



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

August 25, 2004

Ubisense Limited
1, Quayside, Cambridge
Cambridge
CB5 8AB United Kingdom

Reference: Ubitag V1.0
FCC ID: **SEAUBITAG10-F**

Dear Andy Ward,

Enclosed is the EMC test report for compliance testing of the Ubisense Limited, Ubitag V1.0. The Ubisense Limited, Ubitag V1.0 was tested to the requirements of Title 47 of the CFR Part 15 Subpart C Subsection 15.249 for a Transmitter.

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: (\\Ubisense Limited\\ Ubitag V1.0 \\ EMC15813-FCC249)

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DOC-EMC703 2/26/2004



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

Electromagnetic Compatibility Criteria Test Report

For the

**Ubisense Limited
Ubitag V1.0**

Tested under

The FCC Certification Rules contained in
Title 47 of the CFR, Part 15 Subpart C
For a Transmitter

MET Report: 15813-FCC249

August 25, 2004

Prepared For:

**Ubisense Limited
1, Quayside, Cambridge
Cambridge
CB5 8AB United Kingdom**

Prepared By:
MET Laboratories, Inc.
Baltimore, MD 21230



Electromagnetic Compatibility Criteria
Test Report
For the
Ubisense Limited
Ubitag V1.0

Tested Under

The FCC Certification Rules contained in
Title 47 of the CFR, Part 15 Subpart C
For a Transmitter

A handwritten signature in blue ink, appearing to read "K. Mehaffey", is centered on the page.

Kevin Mehaffey, Manager
Electromagnetic Compatibility Lab

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 Subpart C Subsection 15.249, of the FCC Rules under normal use and maintenance.

A handwritten signature in blue ink, appearing to read "Liming Xu", is centered on the page.

Liming Xu
Electromagnetic Compatibility Lab



Report Status Sheet

| Revision | Report Date | Reason for Revision |
|----------|-----------------|-----------------------|
| Ø | August 25, 2004 | Initial Report Issue. |



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List of Terms and Abbreviations

| | |
|------------------------------|---|
| AC | Alternating Current |
| ACF | Antenna Correction Factor |
| Cal | Calibration |
| d | Measurement Distance |
| dB | Deci Bels |
| dBμV | Deci-Bels above one micro Volt |
| dBμV/m | Deci-Bels above one micro Volt per meter |
| DC | Direct Current |
| DCF | Distance Correction Factor |
| E | Electric Field |
| DSL | Digital Subscriber Line |
| ESD | Electrostatic Discharge |
| EUT | Equipment Under Test |
| f | Frequency |
| FCC | Federal Communications Commission |
| H | Magnetic Field |
| GHz | Giga Hertz |
| Hz | Hertz |
| ICES | Interference-Causing Equipment Standard |
| kHz | kilohertz |
| kPa | kilopascal |
| kV | kilo Volt |
| LISN | Line Impedance Stabilization Network |
| MHz | MegaHertz |
| μH | micro Henry |
| μF | micro Farad |
| μs | micro seconds |
| RF | Radio Frequency |
| RMS | Root-Mean-Square |



I. Requirements Summary

| Reference | Description | Compliance |
|---|---|------------|
| Title 47 of the CFR, Part 15, Subpart C, §15.203 | Electromagnetic Compatibility – Antenna Requirements | Complies |
| Title 47 of the CFR, Part 15, Subpart C, §15.207(a) | Electromagnetic Compatibility - Conducted Emissions for an Intentional Radiator | Complies |
| Title 47 of the CFR, Part 15, Subpart C, §15.209(a); §15.249(a) and (b) | Electromagnetic Compatibility - Radiated Emissions for an Intentional Radiator | Complies |
| Title 47 of the CFR, Part 15, Subpart C, §15.249(c) | Electromagnetic Compatibility - Band Edge Requirements | Complies |
| Title 47 of the CFR, Part 15, Subpart C, §15.249(d) | Electromagnetic Compatibility - Peak and Average Measurement | Complies |
| Title 47 of the CFR, Part 15, Subpart C, §15.1046 | Electromagnetic Compatibility – RF Power Output | Complies |
| Title 47 of the CFR, Part 15, Subpart C, §15.1049 | Electromagnetic Compatibility – Occupied Bandwidth | Complies |

Table 1. Requirements Summary of EMC Part 15 Compliance Testing



II. Equipment Configuration

A. Overview

The purpose of this series of tests was to verify compliance of the Ubisense Limited Ubitag V1.0 (referred to as EUT hereafter) with the limits of CFR 47, Section 15.249 for a Part 15 Transmitter.

| | |
|----------------------------|---|
| Model(s) Tested: | Ubitag V1.0 |
| Model(s) Covered: | Ubitag V1.0 |
| EUT Specifications: | Primary Power: Internal Battery |
| | Secondary Power: N/A |
| | FCC ID SEAUBITAG10-F |
| | Equipment Emissions Class: B |
| Analysis: | The results obtained relate only to the item(s) tested. |
| Evaluated by: | Liming Xu |
| Date(s): | August 25, 2004 |



B. 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.

Radiated Emissions measurements were performed in a semi-anechoic chamber. In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories. In accordance with §2.948(d), MET Laboratories has been accredited by the National Voluntary Laboratory Accreditation Program (Lab Code: 100273-0).

C. Description of Test Sample

The Ubitag V1.0, Equipment Under Test (EUT) for the remainder of this document, is powered from an internal battery (dc supply).

The Ubitag is a tag which is attached to equipment and personnel to be tracked in indoor environments. It uses ultrawideband (UWB) signals to allow a surrounding infrastructure to track it to a typical 3D accuracy of 15cm within buildings. The tag also has input and output functionality (buttons, a buzzer and LEDs). The Ubitag has a wide range of applications in a number of different environments, including healthcare, the workplace, exhibitions and museums, and military environments.

The Ubitag uses two radio links – a unidirectional UWB link from the tag to the surrounding infrastructure (compliant with FCC Part 15, Subpart F) and a bidirectional conventional radio link between the tag and the surrounding infrastructure which operates in the 902-928MHz band (compliant with FCC Part 15.249).



D. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

| Ref. ID | Name / Description | Model Number | Part Number | Serial Number | Revision |
|---------|--------------------|--------------|-------------|---------------|-------------|
| 10003 | Ubitag | V1.0 | None Listed | 10003 | None Listed |

Table 2. Equipment Configuration

E. Support Equipment

No support equipment was necessary for the operation and testing of the Ubisense Limited Ubitag V1.0.

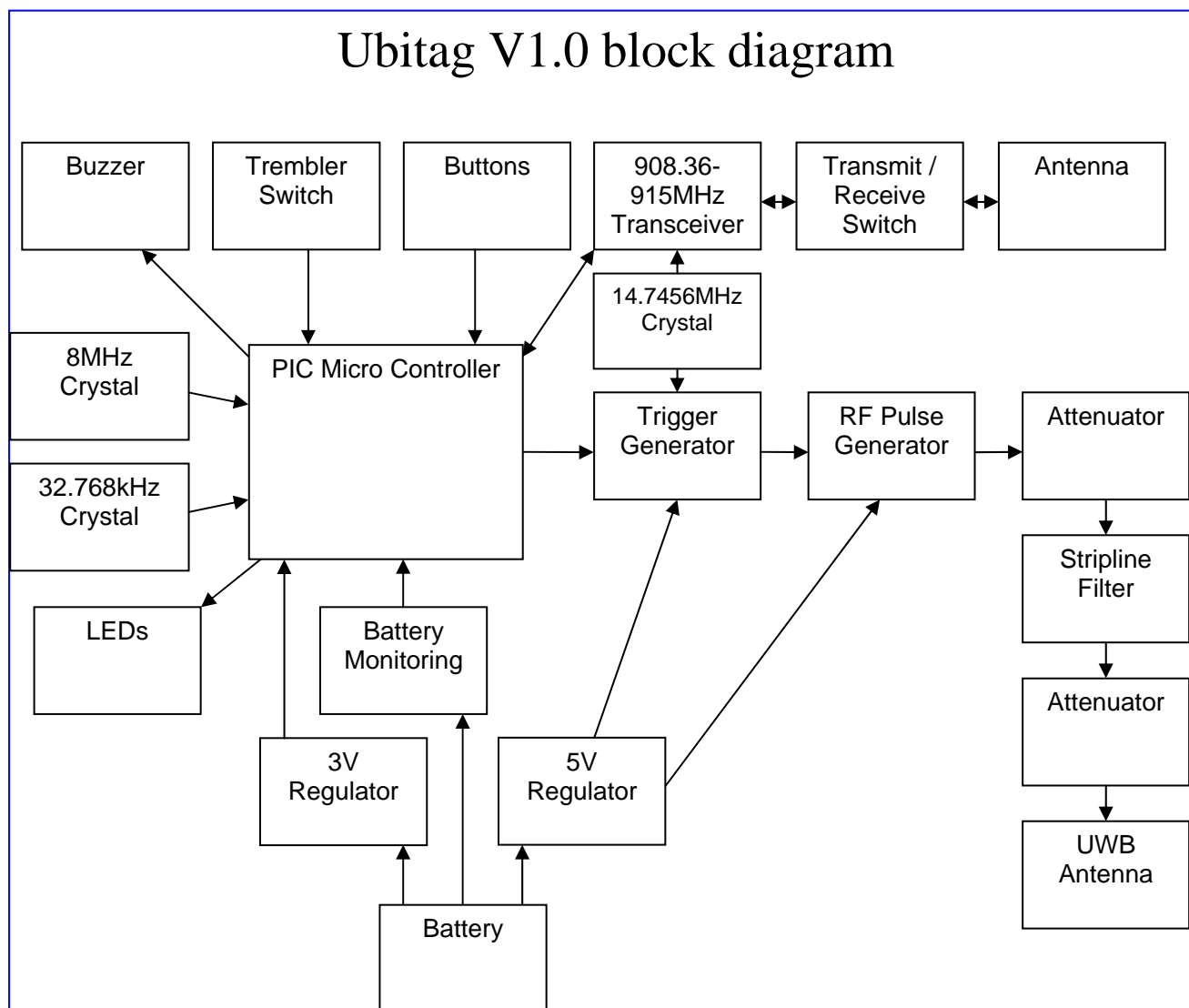


Figure 1. Block Diagram of EUT Operation



Figure 2. Photographs - Front and Back of EUT



F. Mode of Operation

The Ubitag unit supplied to MET Laboratories for testing has two modes which allow the device to emit signals suitable for assessment of compliance with FCC Part 15.517 (the UWB link) and FCC Part 15.249 (the bidirectional conventional radio link).

1. **UWB test mode:** FCC Part 15.517 requires the unit under test to be active in such a way that its UWB pulse train is gated on (15.521(c)). The UWB test mode supplied with the Ubitag behaves in this way – holding down the blue tag button as the Ubitag batteries are inserted will enter this mode.

Within this mode, there are two sub-modes (pressing the blue tag button after start-up will cycle between the modes):

- a. **Fully-active UWB test mode (no LEDs illuminated):** The frequency synthesiser and UWB pulse generator are active, and a continuous train of UWB pulses are generated and emitted through the UWB antenna.
 - b. **Frequency-synthesiser-only UWB test mode (red LED illuminated):** The frequency synthesiser is active, but the UWB pulse generator is not active. The device will internally generate the correct pulse repetition frequency (PRF) for the UWB pulse train, but will not generate or emit any UWB pulses. This mode may be useful for distinguishing between intentional UWB radiation from the device and unintentional spurious emissions from the supporting digital circuitry.
2. **Conventional radio test mode:** The bidirectional radio link is a transceiver – it requires both certification under FCC Part 15.249 (because it is an intentional radiator) and verification as a receiver (under 15.101(b)). The transceiver can operate over a range of 908.37-915MHz, and therefore can tune over a bandwidth of less than 10MHz – the regulations therefore require assessment of the receiver and the transmitter (at maximum power and modulation) at two channels, one near the top of the band and one near the bottom (as per 15.31(m)). The conventional radio test mode supplied with the Ubitag behaves in this way – holding down the orange tag button as the Ubitag batteries are inserted will enter this mode.

Within this mode, there are four sub-modes (pressing the orange tag button after start-up will cycle between the modes):

- a. **Transmitter active, low channel (no LEDs illuminated):** Transmitter is continuously active at maximum power and maximum modulation. Centre frequency of transmission is 908.37MHz.
- b. **Receiver active, low channel (red LED illuminated):** Receiver is continuously active. Centre frequency of receive channel is 908.37MHz.
- c. **Transmitter active, high channel (green LED illuminated):** Transmitter is continuously active at maximum power and maximum modulation. Centre frequency of transmission is 915.00MHz.
- d. **Receiver active, high channel (both LEDs illuminated):** Receiver is continuously active. Centre frequency of receive channel is 915.00MHz.

In normal operation, the Ubitag has a very low duty cycle, and switches the radio links off for the majority of the time to save power. Clearly, the test modes above use continuously active signals to enable compliance measurements to be made – they represent ‘worst-case’ signal emissions which will not be approached by the device in normal operation, and testing using them will therefore be conservative.



G. Method of Monitoring EUT Operation

Each test mode described above has one or more indications that the Ubitag is operating correctly:

1. UWB test mode:
 - a. Fully-active UWB test mode – Low-power signal should be present at 6GHz centre frequency, ~1GHz bandwidth, ~-41dBm/MHz highest average power density.
 - b. Frequency-synthesiser-only UWB test mode – Red LED should be illuminated.
2. Conventional radio test mode:
 - a. Transmitter active, low channel – GFSK-modulated signal should be present at 908.37MHz centre frequency, ~-1dBm EIRP output power.
 - b. Receiver active, low channel – Red LED should be illuminated.
 - c. Transmitter active, high channel – GFSK-modulated signal should be present at 915.00MHz centre frequency, ~-1dBm EIRP output power. Green LED should also be illuminated.
 - d. Receiver active, high channel – Both LEDs should be illuminated.

If the Ubitag periodically flashes the green LED, it is not in a test mode – the likelihood is that the unit's batteries were inserted without pressing down one of the buttons.

H. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

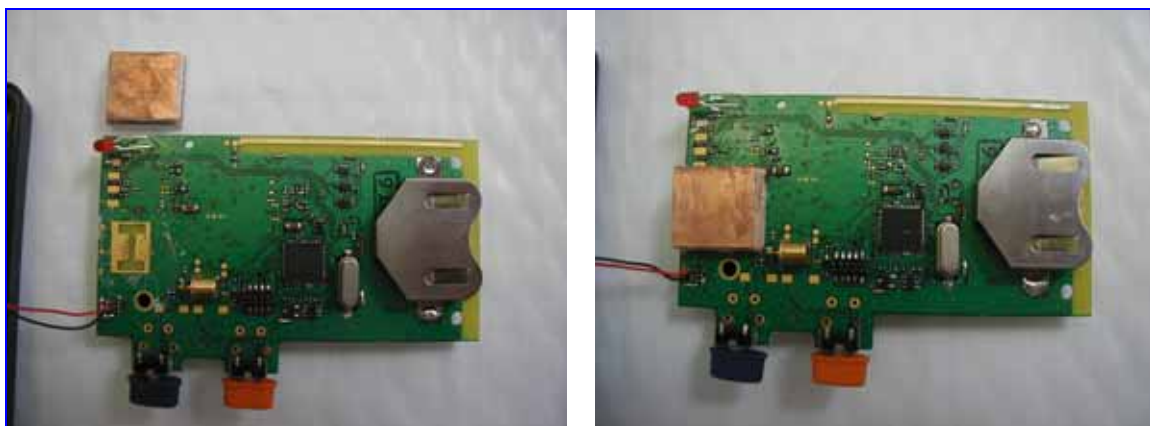
No modifications were made to the test standard.

Antenna Evaluation

Test Requirement(s): The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

- (a) Antenna be 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.

Test Results: The EUT complied with the requirement(s) of this section. The Ubitag V1.0 meets the criteria of this rule by virtue of having a permanently attached internal antenna soldered onto the EUT and is not accessible by the user.



Photograph 1. Antenna Evaluation of the Ubitag V1.0



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 5, 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) | Conducted Limits (dB μ V) | |
|---|-------------------------------|---------|
| | Quasi-Peak | Average |
| * 0.15- 0.45 | 66 - 56 | 56 - 46 |
| 0.45 - 0.5 | 56 | 46 |
| 0.5 - 30 | 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. | | |

Table 3 Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsection 15.207(a)

Test Procedure: Not applicable.

Results: Not applicable. The EUT was powered by a dc source [internal battery].



Radiated Emission Limits

Test Requirement(s): § 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 4.

| Frequency (MHz) | § 15.209(a), Radiated Emission Limits (dB μ V) @ 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 4. Radiated Emissions Limits calculated from FCC Part 15, § 15.209 (a)

§ 15.249 (a): The emissions from an intentional radiator shall not exceed the field strength levels specified in Table 5.

| Fundamental Frequency | Field Strength of Fundamental (mV/m) @ 3m | Field Strength of Fundamental (dB μ V/m) @ 3m | Field Strength of Harmonics (mV/m) @ 3m | Field Strength of Harmonics (dB μ V/m) |
|-----------------------|--|--|---|---|
| 902-928 MHz | 50 (QP) | 94.0 | 500 | 54.0 |
| 2400-2483.5 MHz | 50 (Avg.) | 94.0 | 500 | 54.0 |
| 5725-5875 MHz | 50 (Avg.) | 94.0 | 500 | 54.0 |
| 24.0-24.25 GHz | 250 (Avg.) | 108.0 | 2500 | 68.0 |

Table 5. Limits for Fundamental and Harmonics Radiated Emissions at 3m from Section 15.249(a)

§ 15.249 (d): Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.



Test Procedure: The EUT was installed placed on a 0.8 m high wooden table located in a shielded enclosure (See Photograph 1). Various antennas were placed near the EUT and measurements were taken of the field strengths and frequencies. For final radiated measurements, the EUT was placed in a semi-anechoic chamber, and located 1 m and 3 m from an adjustable antenna mast. For pre-scanning, the spectrum analyzer scanned the frequency range from 30 MHz to 40 GHz to obtain an emission profile of the EUT. For each point of measurement, the turntable was rotated, and the antenna height was varied between 1 m and 4 m, in order to find the maximum radiated emissions. Measurements above 30 MHz were taken using this technique with the antenna in two polarizations: horizontal and vertical. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

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: The EUT complied with the requirement(s) of this section.

Test Engineer(s): Liming Xu

Test Date(s): 08/10/2004



Radiated Emission Limits Test Results

Radiated Emissions Limits Test Results, 15.209 (a)

| Frequency (MHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna Height (m) | Uncorrected Amplitude (dBuv) | Antenna Correction Factor (dB) (+) | Cable Loss (dB) (+) | Distance Correction Factor (dB) (-) | Corrected Amplitude (dBuv) | Limit (dBuv) | Margin (dB) |
|--------------------|-----------------------------|------------------------------|--------------------------|------------------------------------|--|------------------------------|--|----------------------------------|-----------------|----------------|
| 34.000 | 0 | H | 1.00 | 16.50 | 8.42 | 1.36 | 0.00 | 26.28 | 40.00 | -13.72 |
| 34.000 | 0 | V | 1.00 | 16.20 | 7.96 | 1.36 | 0.00 | 25.52 | 40.00 | -14.48 |
| 56.750 | 0 | H | 1.00 | 16.10 | 9.77 | 1.72 | 0.00 | 27.59 | 40.00 | -12.41 |
| 56.750 | 0 | V | 1.00 | 16.20 | 8.04 | 1.72 | 0.00 | 25.95 | 40.00 | -14.05 |
| 100.000 | 0 | H | 1.00 | 16.70 | 7.80 | 2.29 | 0.00 | 26.79 | 43.50 | -16.71 |
| 100.000 | 0 | V | 1.00 | 16.90 | 7.60 | 2.29 | 0.00 | 26.79 | 43.50 | -16.71 |
| 250.000 | 0 | H | 1.00 | 14.20 | 12.20 | 3.33 | 0.00 | 29.73 | 46.00 | -16.27 |
| 250.000 | 0 | V | 1.00 | 14.10 | 12.90 | 3.33 | 0.00 | 30.33 | 46.00 | -15.67 |
| 530.000 | 0 | H | 1.00 | 8.90 | 17.70 | 4.64 | 0.00 | 31.24 | 46.00 | -14.76 |
| 530.000 | 0 | V | 1.00 | 8.40 | 17.80 | 4.64 | 0.00 | 30.84 | 46.00 | -15.16 |
| 820.000 | 0 | H | 1.00 | 6.80 | 21.50 | 5.50 | 0.00 | 33.80 | 46.00 | -12.20 |
| 820.000 | 0 | V | 1.00 | 6.30 | 21.30 | 5.50 | 0.00 | 33.10 | 46.00 | -12.90 |
| 908.365 | 15 | H | 1.00 | 58.07 | 22.37 | 5.63 | 0.00 | 86.07 | 94.00 | -7.93 |
| 908.365 | 263 | V | 1.00 | 59.22 | 21.90 | 5.63 | 0.00 | 86.75 | 94.00 | -7.25 |
| 914.985 | 20 | H | 1.00 | 56.41 | 22.50 | 5.68 | 0.00 | 84.59 | 94.00 | -9.41 |
| 914.985 | 70 | V | 1.00 | 57.77 | 22.00 | 5.68 | 0.00 | 85.45 | 94.00 | -8.55 |



Radiated Emission Limits

Radiated Emissions Limits Test Results, 15.249 (a)

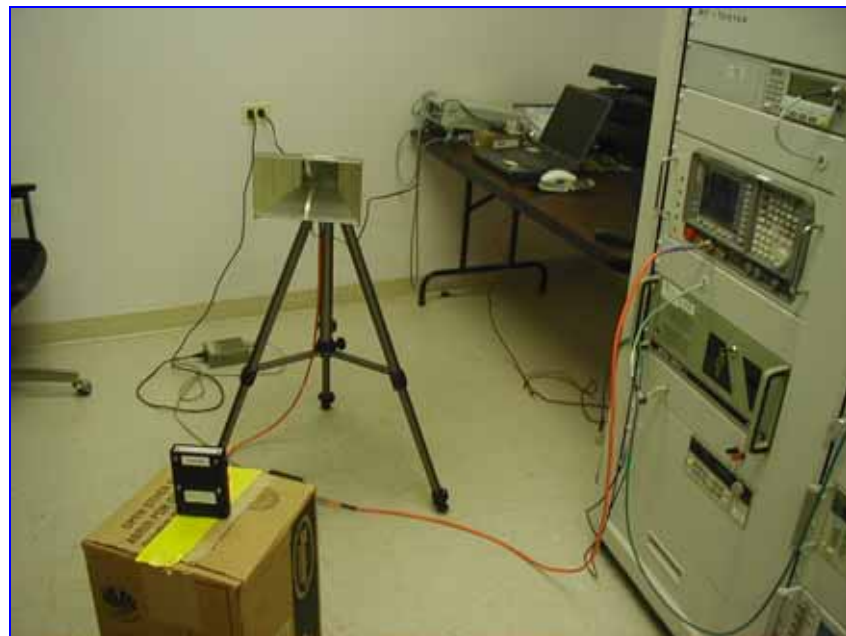
| Frequency (GHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna Height (m) | Uncorrected Amplitude (dBuv) | Antenna Correction Factor (dB) (+) | System Gain (dB) (-) | Distance Correction Factor (dB) (-) | Corrected Amplitude (dBuv) | Limit (dBuv) | Margin (dB) |
|-----------------|-----------------------|------------------------|--------------------|------------------------------|------------------------------------|----------------------|-------------------------------------|----------------------------|--------------|-------------|
| 1.818 | 0 | H | 1 | 25.34 | 26.27 | 0.00 | 9.54 | 42.07 | 54 | -11.93 |
| 1.818 | 0 | V | 1 | 25.88 | 26.25 | 0.00 | 9.54 | 42.59 | 54 | -11.41 |
| 1.83 | 0 | H | 1 | 25.17 | 28.73 | 0.00 | 9.54 | 44.36 | 54 | -9.54 |
| 1.83 | 0 | V | 1 | 25.33 | 28.36 | 0.00 | 9.54 | 44.15 | 54 | -9.85 |

Notes: There are no detectable emissions between 1.818 GHz and 5.000 GHz.

The EUT was tested at 1m. The data has been corrected for comparison with the 3m antenna distance limiting using the formula $20\log(1m/3m)$, as expressed in the "Distance Correction" column.



Radiated Emission Limits



Photograph 1. Radiated Emission Limits Test Setup Photos



III. Occupied Bandwidth and RF Output Power

RF Power Output

Test Requirement(s): **2.1046 (c)** For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

Test Procedures: The EUT was placed on a 0.8 m high wooden table inside a shielded enclosure. As required by 47 CFR 2.1046, *RF power output measurements* were made in a semi-anechoic chamber.

Test Results: The EUT complied with the requirement(s) of this section.

| Frequency (MHz) | EUT Azimuth (Degrees) | Antenna Polarity (H/V) | Antenna Height (m) | Uncorrected Amplitude (dBuv) | Antenna Correction Factor (dB) (+) | Cable Loss (dB) (+) | Distance Correction Factor (dB) (-) | Corrected Amplitude (dBuv) | Limit (dBuv) | Margin (dB) |
|-----------------|-----------------------|------------------------|--------------------|------------------------------|------------------------------------|---------------------|-------------------------------------|----------------------------|--------------|-------------|
| 908.365 | 15 | H | 1.00 | 58.07 | 22.37 | 5.63 | 0.00 | 86.07 | 94.00 | -7.93 |
| 908.365 | 263 | V | 1.00 | 59.22 | 21.90 | 5.63 | 0.00 | 86.75* | 94.00 | -7.25 |
| 914.985 | 20 | H | 1.00 | 56.41 | 22.50 | 5.68 | 0.00 | 84.59 | 94.00 | -9.41 |
| 914.985 | 70 | V | 1.00 | 57.77 | 22.00 | 5.68 | 0.00 | 85.45* | 94.00 | -8.55 |

***Note:** Highest field strengths of fundamental frequency at low and high channels (908.365 MHz and 914.985 MHz, respectively) were measured during testing.

Test Engineer(s): Liming Xu

Test Date(s): 08/13/2004



Occupied Bandwidth

Test Requirement(s): 2.1049

Test Procedures: The EUT was placed on a 0.8 m high wooden table inside a shielded enclosure. As required by 47 CFR 2.1049, *occupied bandwidth measurements* were made on the FM transmitter. Using 9 KHz RBW (FM)), the occupied bandwidth of the emission was determined at the lowest and highest selectable channel range.

Test Results: The EUT complied with the requirement(s) of this section.

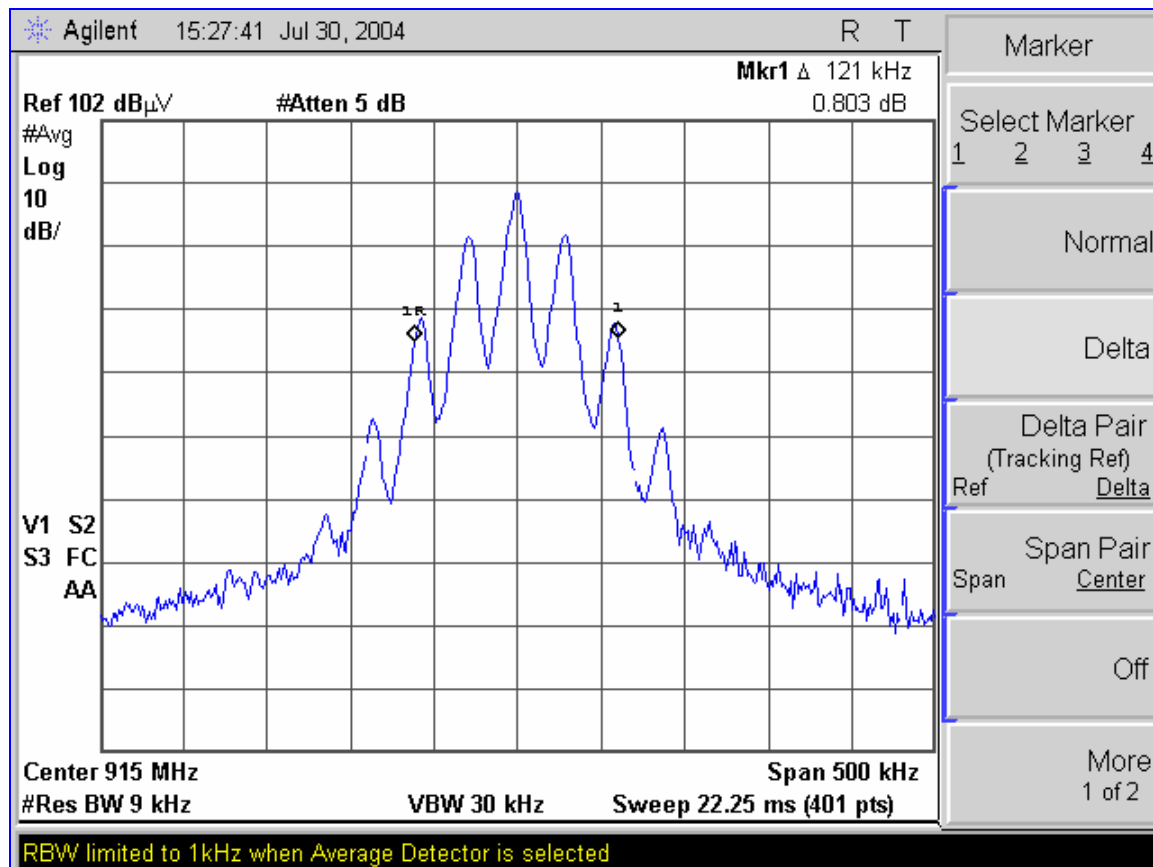
Test Engineer(s): Liming Xu

Test Date(s): 08/02/2004



Occupied Bandwidth

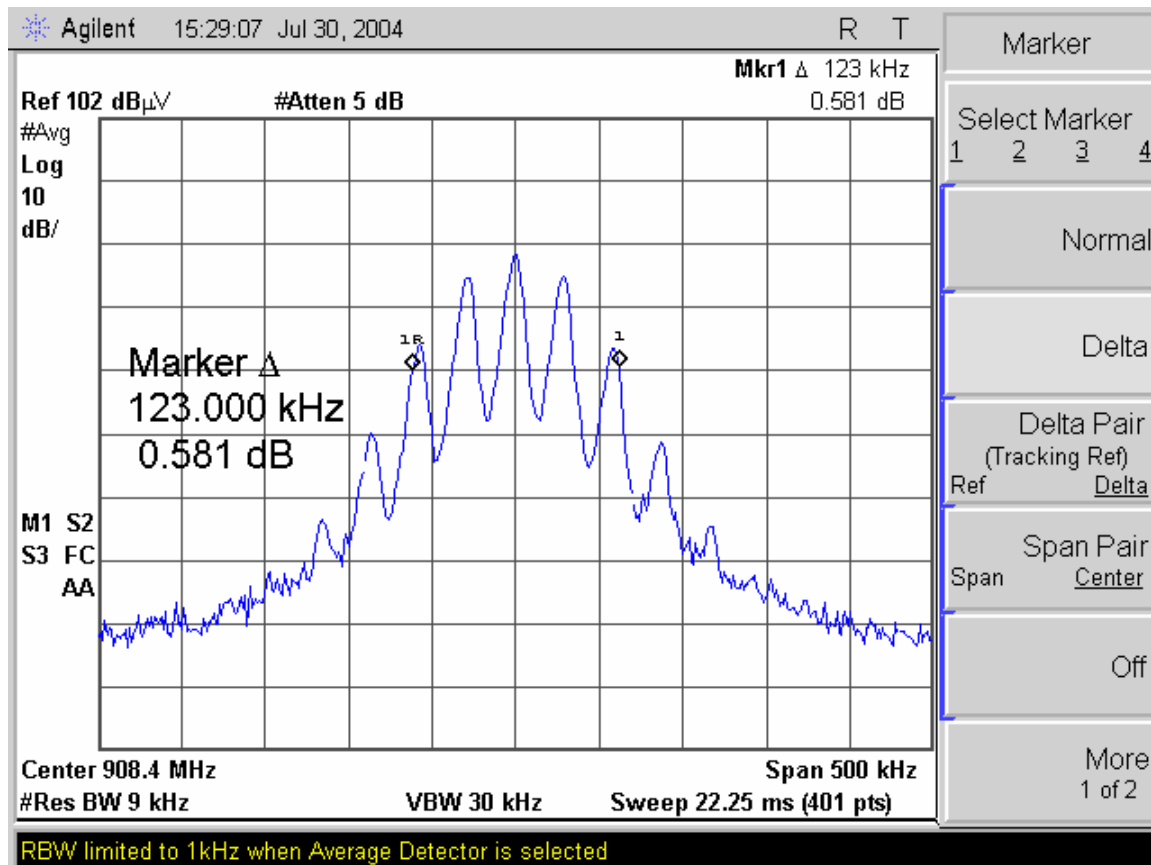
Occupied Bandwidth Test Result Plots



The highest carrier 914.985 MHz,(Center frequency)

Occupied Bandwidth: 121KHz

The highest carrier band edge: $914.985 \text{ MHz} + 0.121/2 \text{ MHz} = 915.045 \text{ MHz}$



The Lowest carrier 908.365 MHz,(Center frequency)

Occupied Bandwidth: 123KHz

The Lowest carrier band edge: $908.365 \text{ MHz} - 0.123/2 \text{ MHz} = 908.304 \text{ MHz}$



IV. 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.

| Test Name: 15.249 Testing | | | Test Date(s): 08/10/2004 | | |
|---------------------------|-------------------|----------------------|--------------------------|---------------|--------------|
| MET Asset # | Nomenclature | Manufacturer | Model | Last Cal Date | Cal Due Date |
| 1T4300 | SHIELD ROOM 1 | EMC TEST SYSTEMS | NONE | 05/03/2004 | 05/03/2005 |
| 1T4303 | ANTENNA; BILOG | SCHAFNER - CHASE EMC | CBL6140A | 04/09/2004 | 04/09/2005 |
| 1T4351 | SPECTRUM ANALYZER | AGILENT | E 7405A | 08/21/2003 | 08/21/2004 |
| 1T2665 | HORN ANTENNA | EMCO | 07/11/1908 | 03/12/2004 | 03/12/2005 |
| 1T4302 | EMI RECEIVER | HEWLETT PACKARD | 8546A | 10/06/2004 | 10/06/2005 |

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



V. Compliance Information

Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

- (a) The various types of radio communication transmitting devices described throughout this chapter.
- (b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.*
- (c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.
- (d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

- (a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:
 - (1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or
 - (2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.
- (d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.



- (e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:
- (i) *Compliance testing;*
 - (ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;
 - (iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;
 - (iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or
 - (v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.
- (e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.
- (f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.



The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

- (a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.¹ *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer,* be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.
- (b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

§ 2.902 Verification.

- (a) *Verification is a procedure where the manufacturer² makes measurements or takes the necessary steps to insure that the equipment complies with the appropriate technical standards.* Submission of a sample unit or representative data to the Commission demonstrating compliance is not required unless specifically requested by the Commission pursuant to § 2.957, of this part.
- (b) Verification attaches to all items subsequently marketed by the manufacturer or importer which are identical as defined in § 2.908 to the sample tested and found acceptable by the manufacturer.

¹ In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

²In this case, MET Laboratories, Inc. is acting as an agent of the manufacturer.



Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

- (a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.
 - (1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.
 - (i) *If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.*
 - (ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.
 - (2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

§ 2.952 Limitation on verification.

- (a) Verification signifies that the manufacturer or importer has determined that the equipment has been shown to be capable of compliance with the applicable technical standards if no unauthorized change is made in the equipment and if the equipment is properly maintained and operated. Compliance with these standards shall not be construed to be a finding by the manufacturer or importer with respect to matters not encompassed by the Commission's rules.
- (b) Verification of the equipment by the manufacturer or importer is effective until a termination date is otherwise established by the Commission.
- (c) No person shall, in any advertising matter, brochure, etc., use or make reference to a verification in a deceptive or misleading manner or convey the impression that such verification reflects more than a determination by the manufacturer or importer that the device or product has been shown to be capable of compliance with the applicable technical standards of the Commission's rules.



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§ 2.953 Responsibility for compliance.

- (a) In verifying compliance, the responsible party, as defined in §2.909 warrants that each unit of equipment marketed under the verification procedure will be identical to the unit tested and found acceptable with the standards and that the records maintained by the responsible party continue to reflect the equipment being produced under such verification within the variation that can be expected due to quantity production and testing on a statistical basis.
- (b) The importer of equipment subject to verification may upon receiving a written statement from the manufacturer that the equipment complies with the appropriate technical standards rely on the manufacturer or independent testing agency to verify compliance. The test records required by §2.955 however should be in the English language and made available to the Commission upon a reasonable request, in accordance with §2.956.
- (c) In the case of transfer of control of equipment, as in the case of sale or merger of the grantee, the new manufacturer or importer shall bear the responsibility of continued compliance of the equipment.
- (d) Verified equipment shall be re-verified if any modification or change adversely affects the emanation characteristics of the modified equipment. The party designated in §2.909 bears responsibility for continued compliance of subsequently produced equipment.

§ 2.954 Identification.

Devices subject only to verification shall be uniquely identified by the person responsible for marketing or importing the equipment within the United States. However, the identification shall not be of a format which could be confused with the FCC Identifier required on certified, notified or type accepted equipment. The importer or manufacturer shall maintain adequate identification records to facilitate positive identification for each verified device.

§ 2.955 Retention of records.

- (a) For each equipment subject to verification, the responsible party, as shown in §2.909 shall maintain the records listed as follows:
 - (1) A record of the original design drawings and specifications and all changes that have been made that may affect compliance with the requirements of §2.953.
 - (2) A record of the procedures used for production inspection and testing (if tests were performed) to insure the conformance required by §2.953. (Statistical production line Emission testing is not required.)
- (b) The records listed in paragraph (a) of this section shall be retained for two years after the manufacture of said equipment item has been permanently discontinued, or until the conclusion of an investigation or a proceeding if the manufacturer or importer is officially notified that an investigation or any other administrative proceeding involving his equipment has been instituted.



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§ 2.956 FCC inspection and submission of equipment for testing.

- (a) Each responsible party shall upon receipt of reasonable request:
 - (1) Submit to the Commission the records required by §2.955.
 - (2) Submit one or more sample units for measurements at the Commission's Laboratory.
 - (i) Shipping costs to the Commission's Laboratory and return shall be borne by the responsible party.
 - (ii) In the event the responsible party believes that shipment of the sample to the Commission's Laboratory is impractical because of the size or weight of the equipment, or the power requirement or for any other reason, the responsible party may submit a written explanation why such shipment is impractical and should not be required.

Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

§ 15.19 Labeling requirements.

- (a) *In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:*
 - (1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.
 - (2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.
 - (3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.



- (4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.
- (5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

§ 15.21 Information to user.

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

§ 15.105 Information to the user.

- (a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.



ICES-003 Procedural & Labeling Requirements

From the Industry Canada Electromagnetic Compatibility Advisory Bulletin entitled, "Implementation and Interpretation of the Interference-Causing Equipment Standard for Digital Apparatus, ICES-003" (EMCAB-3, Issue 2, July 1995):

"At present, FCC and ICES technical requirements are essentially equivalent. Therefore, if you have FCC approval (either by meeting Part 15 of the FCC Rules or CISPR Publication 22), the only additional requirements are: to attach a note to the report of the test results for FCC compliance, indicating that these results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations; to maintain these records on file for the requisite five year period; and to provide the device with a notice of compliance in accordance with ICES-003."

Procedural Requirements: According to Industry Canada's Interference Causing Equipment Standard for Digital Apparatus ICES-003 Issue 3, November 22, 1997:

- Section 6.1: A record of the measurements and results, showing the date that the measurements were completed, shall be retained by the manufacturer or importer for a period of at least five years from the date shown in the record and made available for examination on the request of the Minister.
- Section 6.2: A written notice indicating compliance must accompany each unit of digital apparatus to the end user. The notice shall be in the form of a label that is affixed to the apparatus. Where because of insufficient space or other constraints it is not feasible to affix a label to the apparatus, the notice may be in the form of a statement in the user's manual.

Labeling Requirements: The suggested text for the notice, in English and in French, is provided below, from the ICES-003 Annex:

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe [*] est conforme à la norme NMB-003 du Canada.