Test of Sign Post 433

To FCC 47 CFR Part 15.231 & IC RSS-210

Test Report Serial No; TUVR72-A1 REV C

TEST REPORT

FROM

Test of Sign Post 433

To FCC 47 CFR Part15.231 & IC RSS-210

Test Report Serial No.: TUVR72-A1 Rev C

This report supersedes TUVR72-A1 Rev B

Manufacturer: RF Code Inc.
1250 S. Clearview Ave.
Mesa, Arizona 85208
USA

Product Function: RFID Tag

Copy No: pdf **Issue Date:** 12th April '06

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
3922 Valley Avenue, Suite B
Pleasanton, California 94566, USA
Phone: 925.462.0304
Fax: 925.462.0306
www.micomlabs.com

UKAS TESTING
2106

MiCOM Labs is a UKAS (United Kingdom Accreditation Service)

Accredited Testing Laboratory

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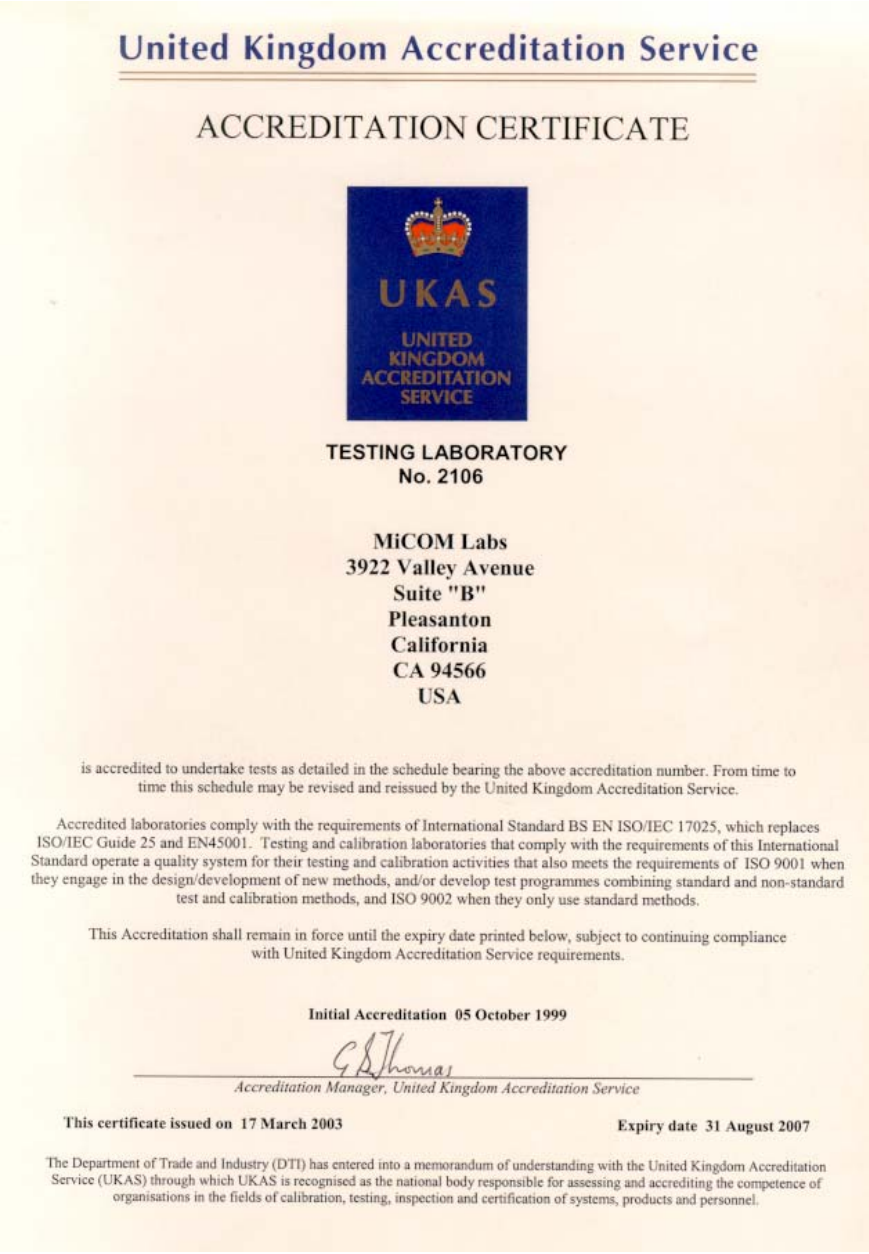
ACCREDITATION & LISTINGS

MiCOM Labs, Inc. an accredited laboratory complies with the international standard BS EN ISO/IEC 17025. The company is accredited by the United Kingdom Accreditation Service (UKAS) www.ukas.org test laboratory number 2106. MiCOM Labs test schedule is available at the following URL;
http://www.ukas.org/testing/lab_detail.asp?lab_id=875&location_id=&vMenuOption=3 .



United Kingdom Accreditation Service

ACCREDITATION CERTIFICATE

UKAS
UNITED KINGDOM ACCREDITATION SERVICE

TESTING LABORATORY
No. 2106

MiCOM Labs
3922 Valley Avenue
Suite "B"
Pleasanton
California
CA 94566
USA

is accredited to undertake tests as detailed in the schedule bearing the above accreditation number. From time to time this schedule may be revised and reissued by the United Kingdom Accreditation Service.

Accredited laboratories comply with the requirements of International Standard BS EN ISO/IEC 17025, which replaces ISO/IEC Guide 25 and EN45001. Testing and calibration laboratories that comply with the requirements of this International Standard operate a quality system for their testing and calibration activities that also meets the requirements of ISO 9001 when they engage in the design/development of new methods, and/or develop test programmes combining standard and non-standard test and calibration methods, and ISO 9002 when they only use standard methods.

This Accreditation shall remain in force until the expiry date printed below, subject to continuing compliance with United Kingdom Accreditation Service requirements.

Initial Accreditation 05 October 1999

G R Thomas
Accreditation Manager, United Kingdom Accreditation Service

This certificate issued on 17 March 2003 Expiry date 31 August 2007

The Department of Trade and Industry (DTI) has entered into a memorandum of understanding with the United Kingdom Accreditation Service (UKAS) through which UKAS is recognised as the national body responsible for assessing and accrediting the competence of organisations in the fields of calibration, testing, inspection and certification of systems, products and personnel.

LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

North America

United States of America
Federal Communications Commission (FCC) Listing #: 102167

Canada
Industry Canada (IC) Listing #: 4143

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	19th May 2005	
Rev A	30th June 2005	
Rev B	24th Jan 2006	Further explanation of test set up added to Section 5.1
Rev C	12th April 2006	Recalculation of field strength measurements ref FCC part 15.35.

1. TEST RESULT CERTIFICATE

Manufacturer:	RF Code Inc. 1250 S. Clearview Ave. Mesa, Arizona 85208 USA	Tested By:	MiCOM Labs, Inc. 3922 Valley Avenue 'B' Pleasanton California, 94566, USA
EUT:	RFID Tag	Telephone:	+1 925 462 0304
Model:	433	Fax:	+1 925 462 0306
S/N:	Not Available		
Test Date(s):	30th April - 4th May '05	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part15.231 & IC RSS-210	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:

UKAS TESTING
2106

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 15.231	2001	Code of Federal Regulations
(ii)	Industry Canada RSS-210	Issue 5 Nov. 2001	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands)
(iii)	ANSI C63.4	2003	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
(iv)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(v)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vi)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(vii)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(viii)	UKAS LAB 1	Edition 4 May 2004	Reference to Accreditation for Laboratories.
(ix)	DTI URN 98/997	2003	Conditions for the use of National Accreditation Marks by UKAS and UKAS Accredited Organizations.

2.2. Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

3. PRODUCT DETAILS AND TEST CONFIGURATIONS

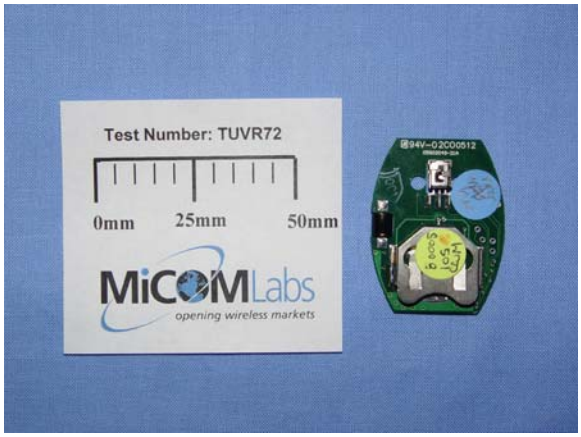
3.1. Technical Details

Details	Description
Purpose:	Test of the Sign Post 433 to FCC and Industry Canada regulations
Applicant:	TUV Rheinland of N. America 1279 Quarry Lane, Suite A Pleasanton, California 94566, USA
Manufacturer:	RF Code Inc. 1250 S. Clearview Ave. Mesa, Arizona 85208, USA
Laboratory performing the tests:	MiCOM Labs, Inc. 3922 Valley Avenue, Suite "B" Pleasanton, California 94566 USA
Test report reference number:	TUVR72-A1 Rev C
Date EUT received:	29th April '05
Standard(s) applied:	FCC 47 CFR Part15.231 & IC RSS-210
Dates of test (from - to):	30th April - 4th May '05
No of Units Tested:	Two
Type of Equipment:	RFID Tag
Manufacturers Trade Name:	Sign Post
Model:	433 MHz
Location for use:	Indoor and Outdoor use
Declared Frequency Range(s):	Single Frequency 433.92 MHz
Type of Modulation:	OOK
Declared Nominal Output Power:	66 dBµV/m
EUT Modes of Operation:	Transmit only (no receive function)
Rated Input Voltage and Current:	3Vdc, 0.003 mA (Lithium Battery)
Operating Temperature Range:	-10ºC to +70 ºC
ITU Emission Designator:	320KA1DEN
Microprocessor(s) Model:	TIMSP430
Clock/Oscillator(s):	32.768 KHz, 50KHz
Frequency Stability:	-120KHz / +100KHz
Equipment Dimensions:	75x45x15mm approximately
Weight:	2.7 oz
Primary function of equipment:	Track and locate assets

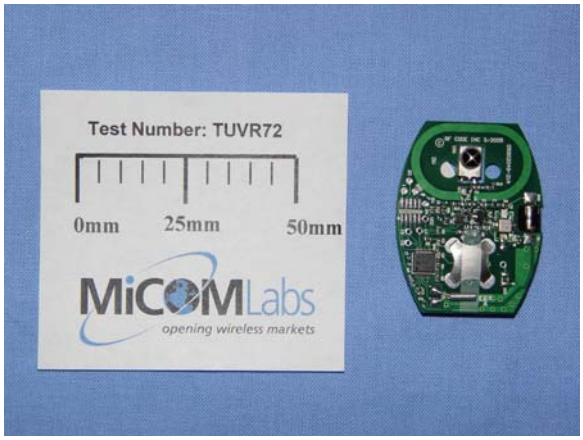
3.2. Scope of Test Program

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules for the radiated emissions of intentional radiators and Industry Canada RSS-210 for Low Power, License-Exempt Radio Communication Devices. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules and Industry Canada Radio Standards Procedure RSP-100.

The scope of the test program was to test the 433 MHz Sign Post against the current FCC and Industry Canada specifications FCC Part 15.231(e) and IC RSS-210, Normative References (i) & (ii).



433 MHz Sign Post – pcb Top



433 MHz Sign Post – pcb underside

3.3. Equipment Model(s) and Serial Number(s)

Name	Manufacturer	Model No.	Serial No.
Sign Post	RF Code	433 MHz (3 sec Duty Cycle)	None Available
Sign Post	RF Code	433 MHz (10 sec Duty Cycle)	None Available

3.4. Antenna Details

Antenna Type	Gain (dBi)	Manufacturer	Model No.	Serial No.
Integral	Not Available	RF Code	433	

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. NONE

3.6. Test Configurations

Matrix of test configurations for a single channel output. All tests were performed in a 3m anechoic chamber as the equipment did not have an external connector for conducted measurements.

Mode	Operation
Test Mode Only	CW
Test Modes Only	Modulated (3 sec Duty Cycle)
Actual Field Operational Mode	Modulated (10 sec Duty Cycle)

Only worst case plots are provided for each test parameter are identified within this report. Plots not included are held on file by the test laboratory and available upon request with client permission.

3.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. NONE

3.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

3.9. Subcontracted Testing or Third Party Data

1. NONE

4. TEST SUMMARY

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.231(e)** and **Industry Canada RSS-210**.

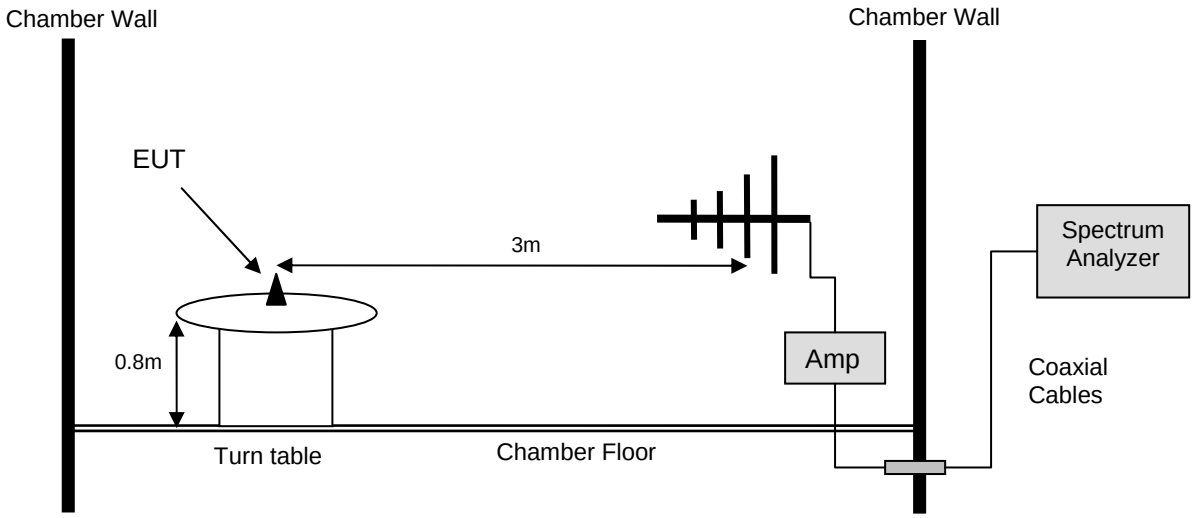
Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.231(c) **6.1.1(c)**	20 dB Bandwidth	≤0.25% of Fundamental Frequency	Radiated	Complies	5.1.1
15.231(e) **15.35(c)** **6.1.1.(e)**	Transmitter and Spurious Emission Field Strength	Fundamental Frequency & Spurious Emissions	Radiated	Complies	5.1.2
	Duty Cycle	Periodic Rate	Radiated	Complies	5.1.3
15.231(b) **6.3**	Restricted Bands	Band Edge Requirements	Radiated	Complies	5.1.4

Note 1: *Test results reported in this document relate only to the items tested*
Note 2: *The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria*
Note 3: *Section 3.7 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix*

5. TEST RESULTS

5.1. Device Characteristics

Test Measurement Set up for all tests



Two tags were provided by the client;

- 10 second periodic tag
- 3 second periodic tag with CW operational mode

Client declared there were no technical differences between the above tags. The 10 second periodic tag was the EUT however in order to fully capture and maximize both the fundamental and harmonics of the transmitter the tag with the 3 second period was utilized for some of the tests. Duty cycle testing was performed on the 10 second period tag.

The client equipment was placed on a 0.8 meter high polystyrene table and positioned consecutively in the X, Y and Z axis and rotated through 360 degrees to determine the orientation of the EUT for maximum emissions.

The photograph in Section 4.1 “Field Strength Measurements” shows the positioning of the EUT where maximum emissions were observed.

5.1.1. 20 dB Bandwidth

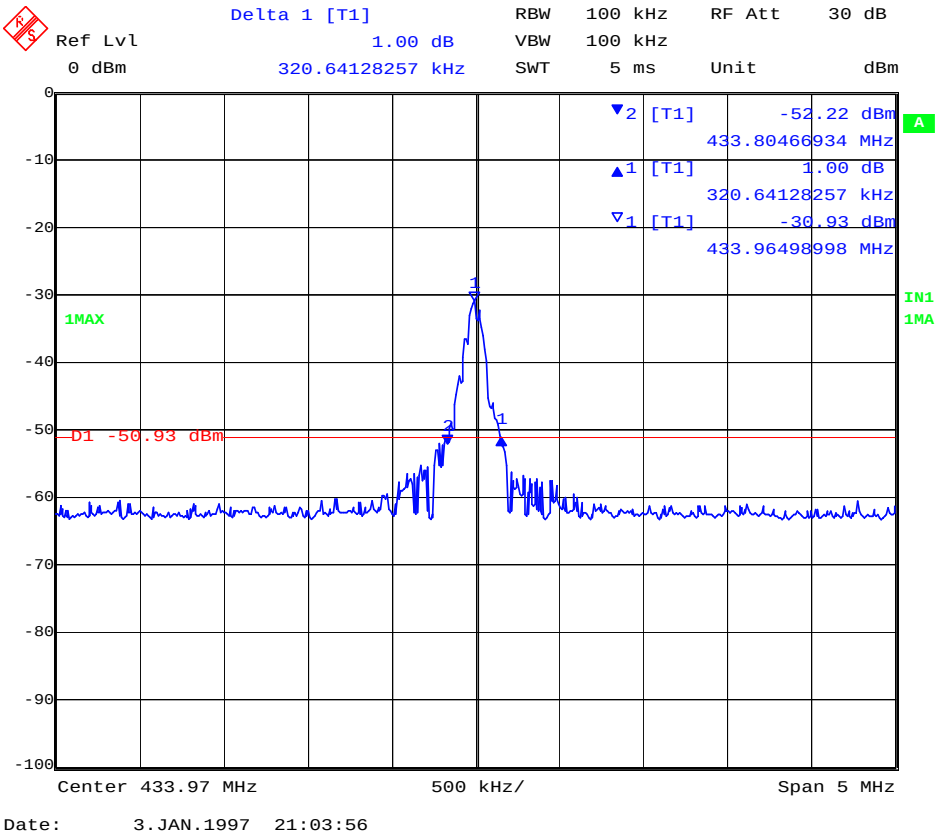
FCC, Part 15 Subpart C §15.247(a)(2)
Industry Canada RSS-210 §5.9.1

Measurement Results for 20 dB Operational Bandwidth(s)

Ambient conditions.
Temperature: 16 to 24 °C Relative humidity: 33 to 58 % Pressure: 1000 to 1010 mbar

TABLE OF RESULTS

Center Frequency (MHz)	20 dB Bandwidth (MHz)	Limit 0.25% of Fundamental Frequency (MHz)
433.92	0.32	1.085



20 dB Bandwidth

Specification

Limits

§**15.231(c) FCC, 6.1.1(c) Industry Canada**
The bandwidth of the emission shall be no wider than 0.25% of the centre frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz the emission shall be no wider than 0.5% of the centre frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Laboratory Measurement Uncertainty for Radiated Measurements

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0078, 0134, 0156, 0184, 0193, 0213, 0310, 0312.

5.1.2. Field Strength Measurements

FCC, Part 15 Subpart C §15.231(e); §15.35
Industry Canada RSS-210 §6.1.1(e)

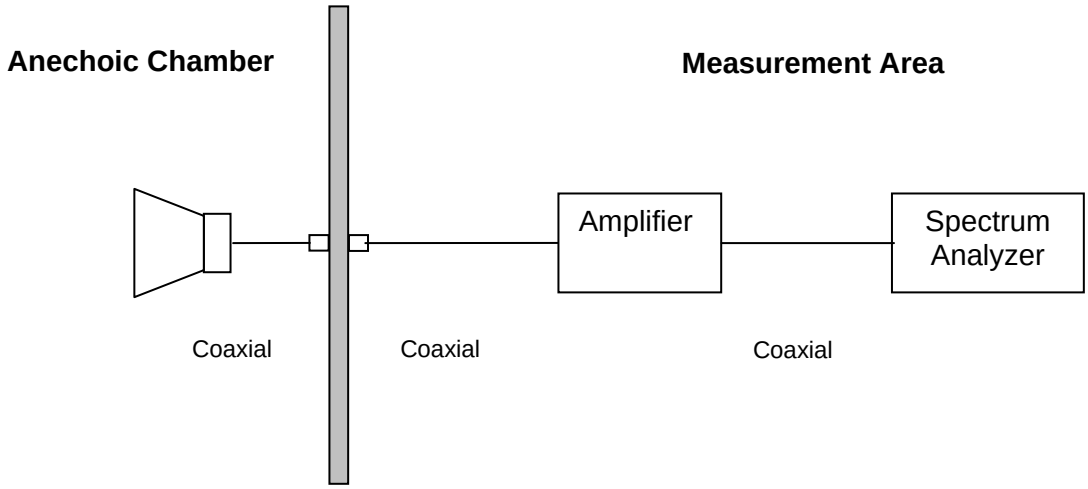
Transmitter & Spurious Field Strength

Test Procedure

Field strength measurements and radiated emissions were measured in an anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities on a modulated carrier. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. The fundamental and highest spurious emissions relative to the limit are listed for each frequency spanned.

Measurements on any frequency or frequencies less than 1 GHz were based on the use of measurement instrumentation employing a peak detector with a 100 KHz bandwidth. Measurements above 1 GHz were performed using a resolution bandwidth of 1 MHz.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

FS = R + AF + CORR - FO

where: FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG
CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor

For example:
Given receiver input reading of 51.5 dBμV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 = 35.3 dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

Measurement Results for Transmitter & Spurious Field Strength

Ambient conditions.
Temperature: 16 to 24 °C Relative humidity: 33 to 58 % Pressure: 1000 to 1010 mbar

TABLE OF RESULTS

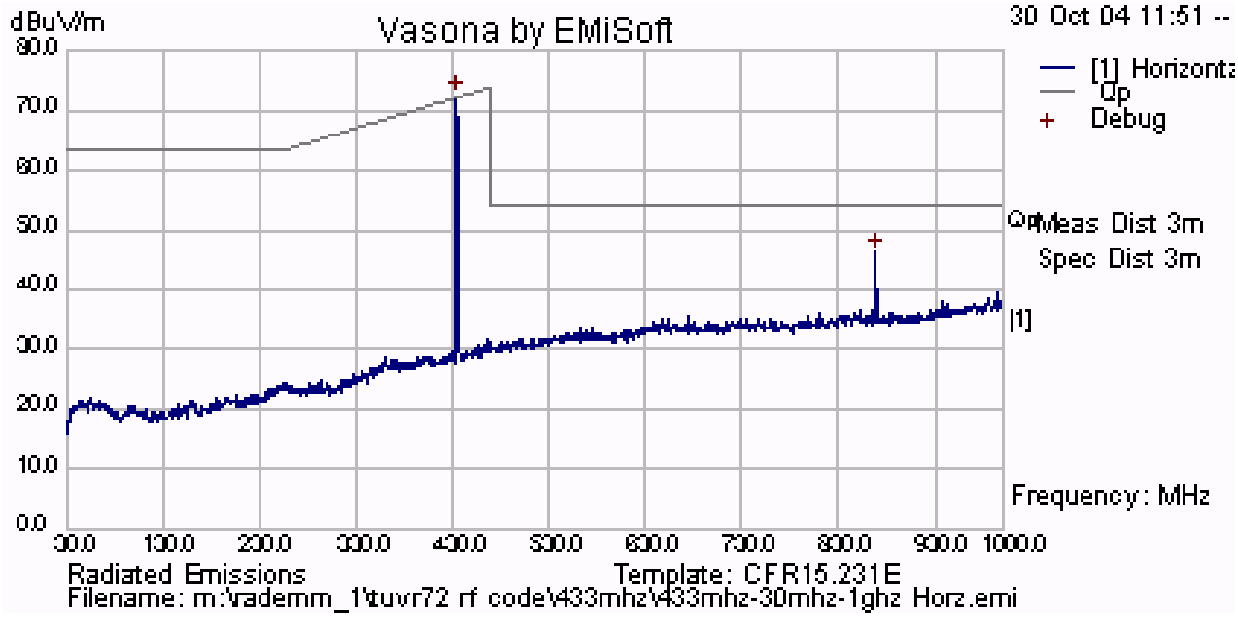
Frequency (MHz)	Peak Value (dBμV/m)	Average Value (dBμV/m)	Ave. Limit (dBμV/m)	Margin (dB)
Fundamental	72.46	36.39	72.59	-36.20
869.071	45.92	9.85	46.00	-36.15

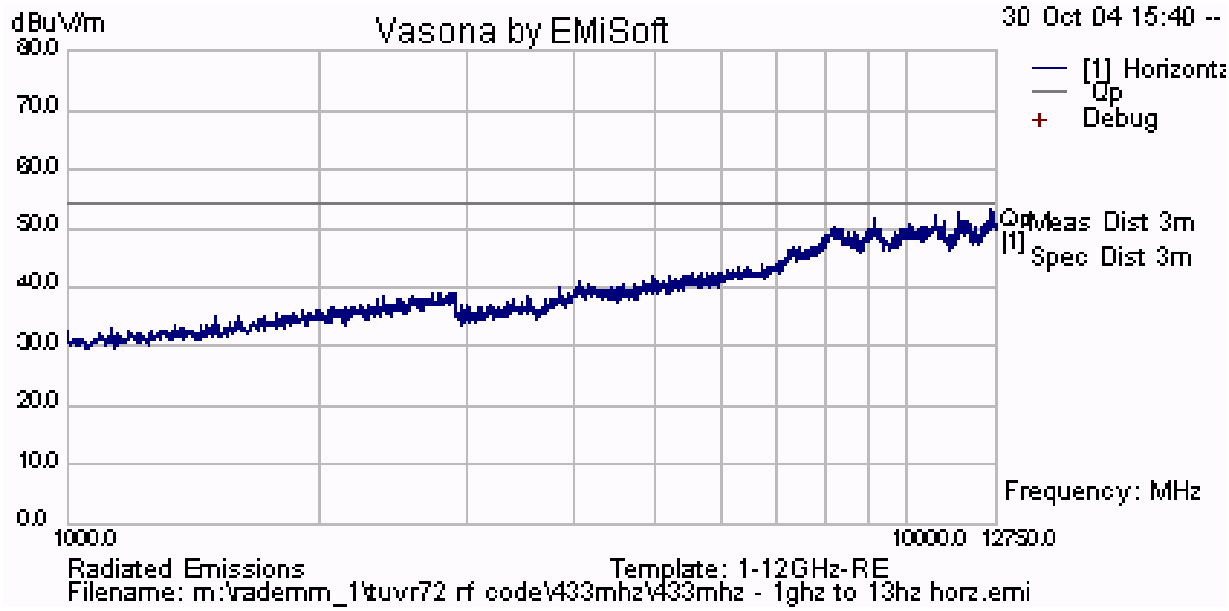
Average value of the fundamental frequency was calculated using **FCC, Part §15.35(c)**

For calculation of duty cycle see Section 5.1.3.

Pulse Train = 89 mSeconds.
Duty Cycle = 1.573 %

Sample Calculation to find Average Value
Peak 72.46dBμV/m = 4,197.6 μV/m
Average Value = 4,197.6 * 1.573 % = 66.03 μV/m = 36.39 dBμV/m





Specification

Limits

Fundamental Frequency (MHz)	Field Strength of Fundamental (µvolts/meter)	Field Strength of Spurious Emissions (µvolts/meter)
40.66 – 40.70	2,250	225
70 - 130	1,250	125
130 - 174	[1]1,250 – 3,750	[1]125 – 375
174 - 260	3,750	375
260 -470	[1]3,750 – 12,500	[1]375 – 1,250
Above 470	12,500	1,250

[1] Linear Interpolation

FCC §15.231 (e), Industry Canada 6.1.1(e) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges. Intentional radiators operating under the provision of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions.

FCC §15.35 (c)
Unless otherwise specified, e.g. Section 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

Laboratory Measurement Uncertainty for Radiated Measurements

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0078, 0104, 0134, 0156, 0184, 0193, 0213, 0310, 0312.

5.1.3. Duty Cycle

FCC, Part 15 Subpart C §15.231(e)
Industry Canada RSS-210 §6.1.1(e)

Test Procedure
System duty cycle was found using the spectrum analyzer in zero span mode on a modulated carrier.

Duty Cycle Calculation

The EUT periodically emits a train of very narrow pulses. The duty cycle is calculated by applying the following formula. All factors are included in the reported data.

DC = (N * PW) / CT

where: DC = Duty Cycle (%)
N = Number of pulses
PW = Pulse Width (secs)
CT = Cycle Time (secs)

For example:-

Given a device that emits 20 pulses of 20 microsecond duration as a pulse train once every two seconds, The Duty Cycle calculation is;-

$DC = (20*20e^{-6})/2$

$= 4e^{-4}/2$

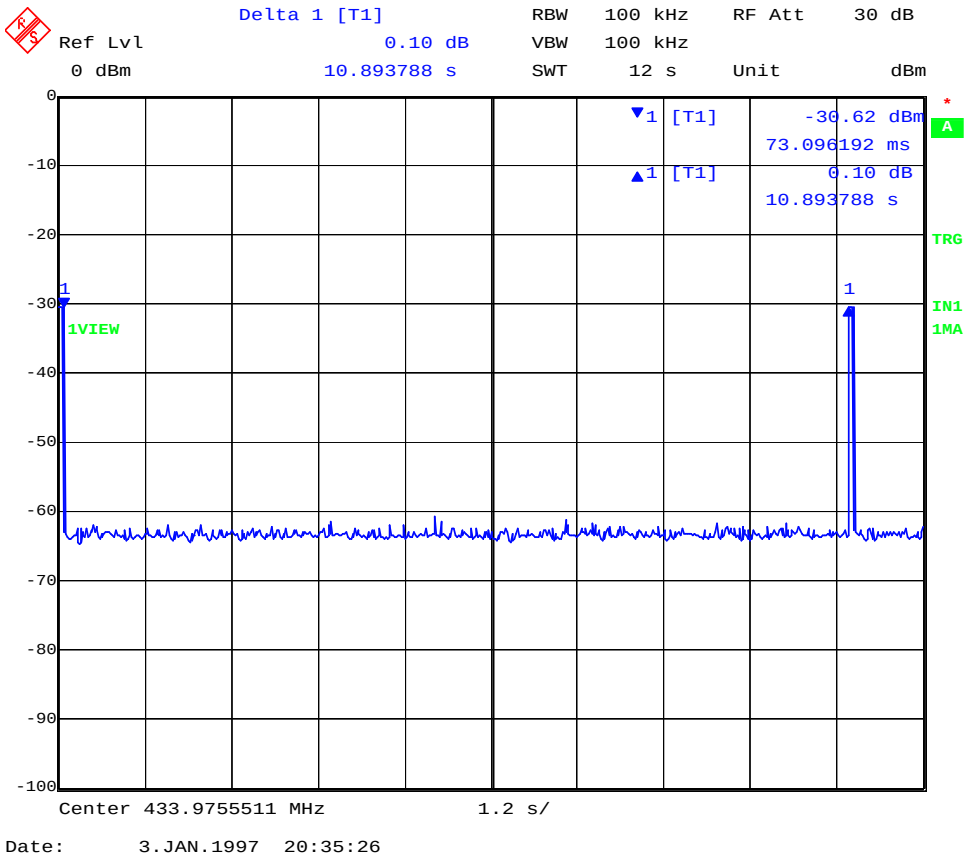
0.02 %

Measurement Results for Duty Cycle

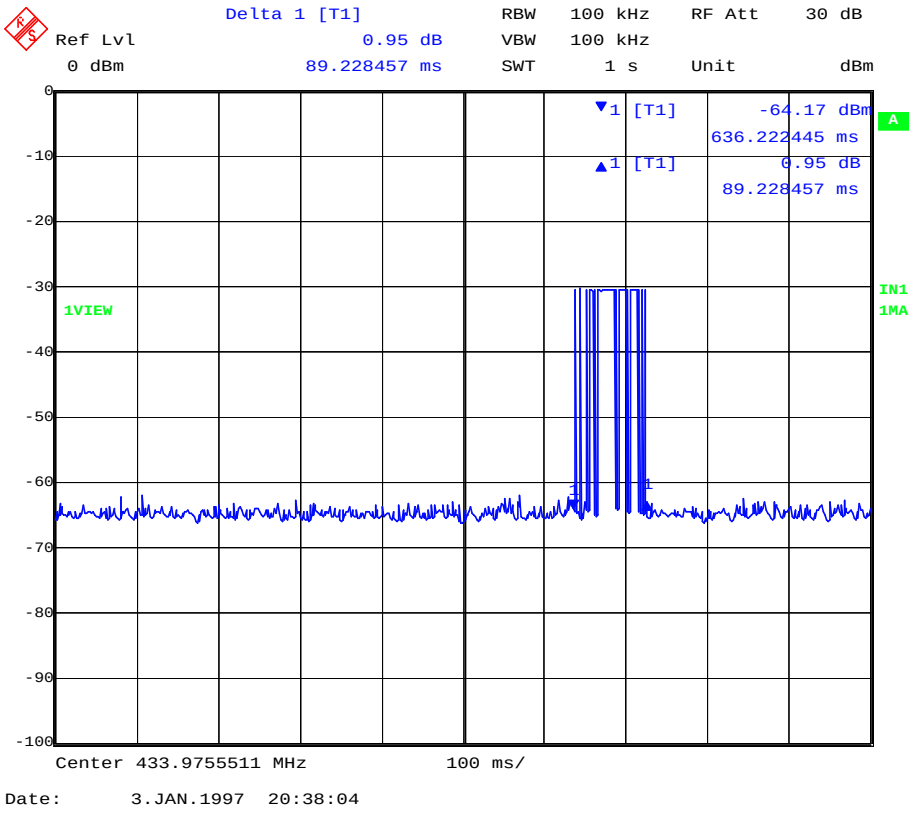
Ambient conditions.
Temperature: 16 to 24 °C Relative humidity: 33 to 58 % Pressure: 1000 to 1010 mbar

TABLE OF RESULTS

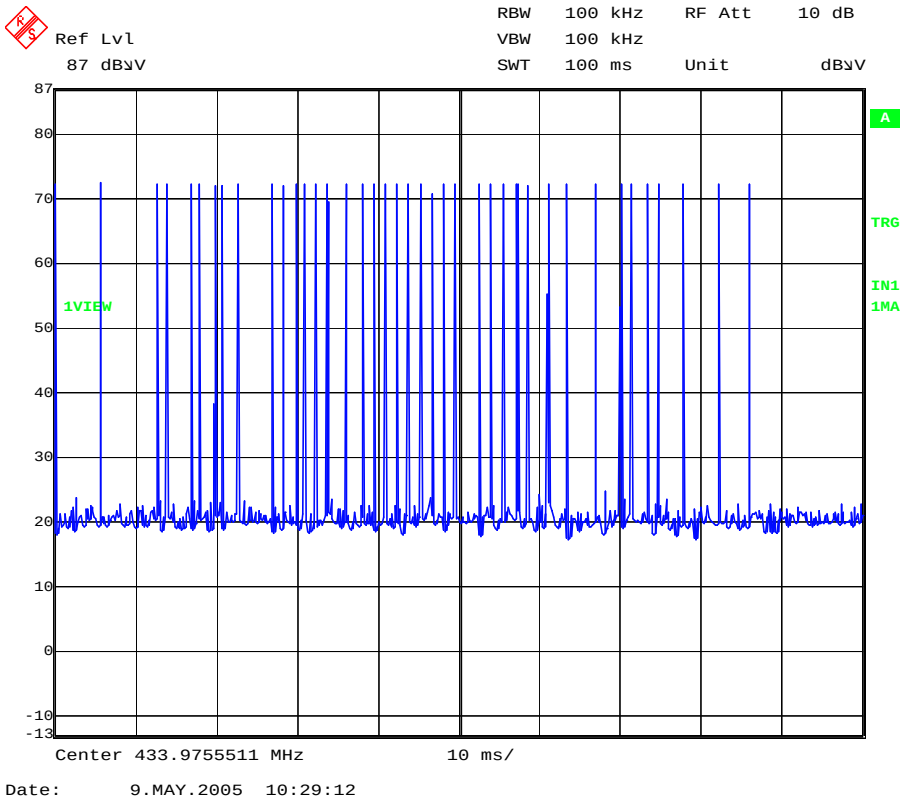
Off Time (Secs)	Pulse Train (mSecs)	On Time (# of Pulses * 35µS per Pulse)	Duty Cycle (%)
10.894	89	1.4mS	1.573



Off Time



On Time



40 Pulses within pulse train

Pulse duration 35µS

Specification

Limit

FCC §15.231(e), Industry Canada RSS-210 §6.1.1(e) Devices operating under the provisions of this Section shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

Laboratory Uncertainty for Frequency Measurements

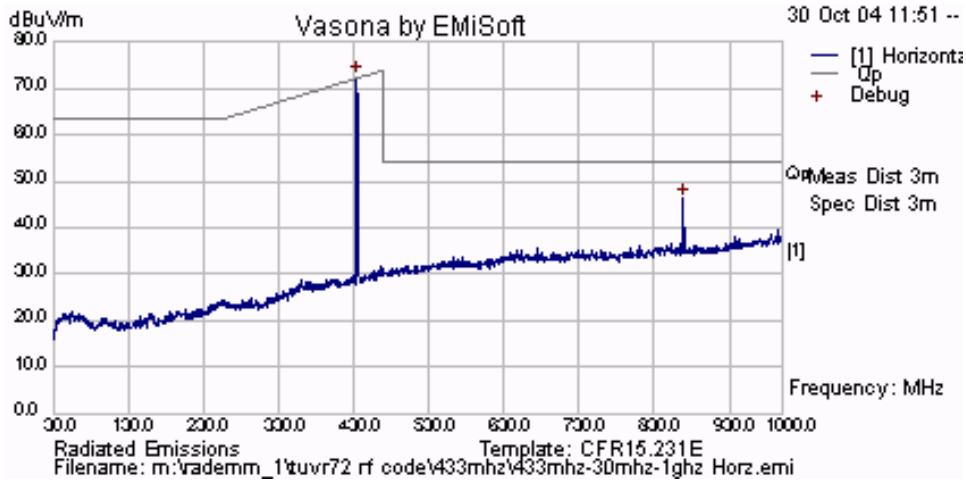
Measurement uncertainty	±0.86ppm

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-02 'Frequency Measurement"	0078, 0134, 0156, 0184, 0193, 0250, 0252 0310, 0312.

5.1.4. Restricted Bands

FCC, Part 15 Subpart C §15.231(b)
Industry Canada RSS-210 §6.3



There are two restricted bands of interest when transmitting at 433.9 MHz. Restricted bands are 410 MHz and 608 MHz.

Freq. (MHz)	Pol. (H/V)	Peak Reading (dBµV/m)	Average Reading (dBµV/m)	Corr'n Factor (dB)	Corr'd Peak Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
410.00	H	31.75	--	-3.25	28.50	46.00	-17.50
606.00	H	34.54	--	-0.34	34.20	46.00	-11.8

Specification

Limits

FCC §15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

FCC §15.205 (a) Except as shown 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 Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

FCC §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 the following table.

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

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0078, 0134, 0156, 0184, 0193, 0250, 0252, 0310, 0312.

6. TEST SET-UP PHOTOGRAPHS

6.1. Field Strength Measurement

7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0078	Antenna (30M-2GHz)	Schaffner and Chase	CBLG140A	1195
0104	1-18GHz Horn Antenna	The Electro-Mechanics Company	3115	9205-3882
0134	Amplifier	Com Power	PA 122	181910
0156	Barometer /Thermometer	Control Co.	4196	E2844
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0193	EMI Receiver	Rhode & Schwartz	ESI 7	838496/007
0213	20-300MHz Antenna	Schwarzbeck	VHBB 9124	9124/0257
0250	230MHz-1GHz Antenna	Schwarzbeck	VUSLP9111	186
0252	SMA Cable	Megaphase	Sucoflex 104	Unknown
0307	BNC Cable	Megaphase	Unknown	Unknown
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	209092-001
0313	Coupler	Hewlett Packard	86205A	1623

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