Test of Tehama Wireless TW101

To: FCC 47 CFR Part15.247 & IC RSS-210

Test Report Serial No.: TEHA01-U2 Rev A

TEST REPORT

FROM

MiCOM Labs

Test of Tehama Wireless TW101

To FCC 47 CFR Part15.247 & IC RSS-210

Test Report Serial No.: TEHA01-U2 Rev A

This report supersedes: None

Manufacturer: Tehama Wireless
423 Tehama Street
San Francisco
California 94103, USA

Product Function: Repeater / Access Point

Copy No: pdf **Issue Date:** 11th January 2011

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
440 Boulder Court, Suite 200
Pleasanton, CA 94566 USA
Phone: +1 (925) 462-0304
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A2LA ACCREDITED
TESTING CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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ACCREDITATION, LISTINGS & RECOGNITION

MiCOM Labs, Inc. an accredited laboratory complies with the international standard EN ISO/IEC 17025. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-01.pdf

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited Laboratory

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 14th day of April 2010.

President & CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2011

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

RECOGNITION

MiCOM Labs, Inc has widely recognized Electrical testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA** countries. Our test reports are widely accepted for global type approvals.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	Listing #: 4143A
Japan	VCCI	-	-	No. 2959
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

**APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.
Phase I - recognition for product testing
Phase II – recognition for both product testing and certification
N/A – Not Applicable

PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard EN ISO/IEC Guide 65. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-02.pdf

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited Product Certification Body

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence as a

Product Certification Body

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC Guide 65:1996 *General requirements for bodies operating product certification systems*. This accreditation demonstrates technical competence for a defined scope and the operation of a quality management system for a Telecommunications Certification Body (TCB) meeting FCC (U.S.), and IC (Canada) requirements.

Presented this 24th day of June 2010.

President & CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2011

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

United States of America – Telecommunication Certification Body

TCB Identifier – US0159

Industry Canada – Certification Body

CAB Identifier – US0159

DOCUMENT HISTORY

Document History		
Revision	**Date**	**Comments**
Draft		
Rev A	11th January 2011	Initial release

1. TEST RESULT CERTIFICATE

Manufacturer:	Tehama Wireless 423 Tehama Street San Francisco California 94103, USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	Wireless Auto Metering (WAM) System	Telephone:	+1 925 462 0304
Model:	TW101	Fax:	+1 925 462 0306
S/N:	E0000116		
Test Date(s):	10th - 15th May 2010	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part15.247 & 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.

ACCREDITED
TESTING CERTIFICATE #2381.01

Approved & Released for MiCOM Labs, Inc. by:

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 15.247	2007	Code of Federal Regulations
(ii)	Industry Canada RSS-210	Issue 7 June 2007	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands)
(iii)	Industry Canada RSS-Gen	Issue 2 June 2007	General Requirements and Information for the Certification of Radiocommunication Equipment.
(iv)	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
(v)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(vi)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vii)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(viii)	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
(ix)	A2LA	14th September 2005	Reference to A2LA Accreditation Status – A2LA Advertising Policy

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

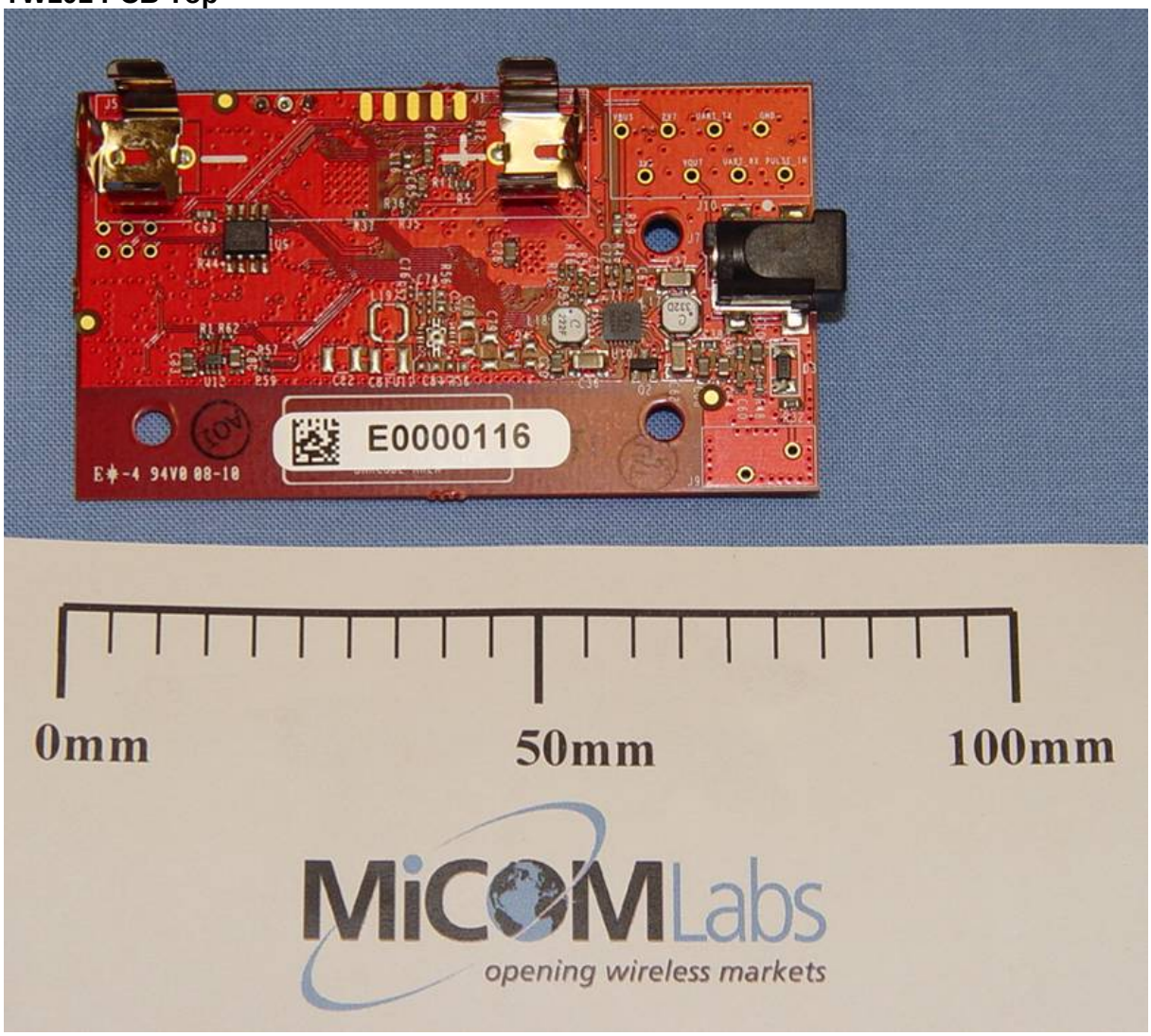
3.1. Technical Details

Details	Description
Purpose:	Test of the Tehama Wireless TW101 to FCC Part 15.247 and Industry Canada RSS-210 regulations
Applicant:	As Manufacturer
Manufacturer:	Tehama Wireless 423 Tehama Street San Francisco California 94103, USA
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	TEHA01-U2 Rev A
Standard(s) applied:	FCC 47 CFR Part15.247 & IC RSS-210
Date EUT received:	10th May 2010
Dates of test (from - to):	10th - 15th May 2010
No of Units Tested:	Two (2): 1 Unit – FCC Test Code 1 Unit – With Hopping enabled
Type of Equipment:	915 MHz RFID Reader
Manufacturers Trade Name:	Tehama Wireless
Model:	TW101
Location for use:	Indoor/Outdoor
Declared Frequency Range(s):	902 - 928 MHz
Type of Modulation:	FSK
Declared Nominal Output Power:	28dBm (+1dB /- 2dB)
EUT Modes of Operation:	FHSS
Transmit/Receive Operation:	Transceiver, Simplex
Rated Input Voltage and Current:	5 VDC w/ Battery
Operating Temperature Range:	0 to +50 C
Microprocessor(s) Model:	Atmel AVR Micro (8MHz internal LC oscillator)
Clock/Oscillator(s):	8 MHz, 2 MHz, 12.8 MHz, 32.768 kHz
Frequency Stability:	±20ppm
EUT Dimensions:	1.8” x 3.2” x 0.8”
EUT Weight :	3 oz
Primary function of equipment:	Repeater / Access Point

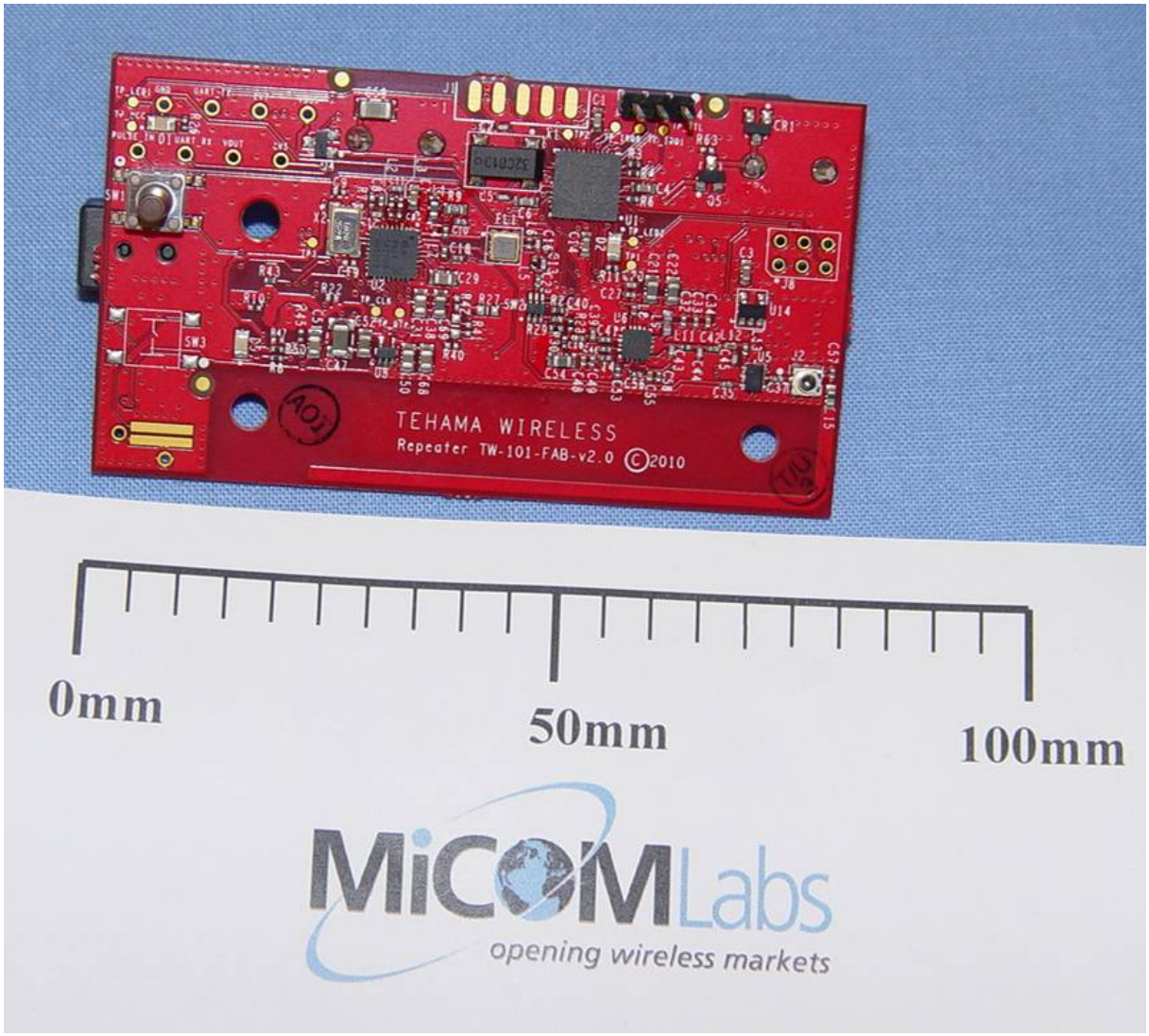
3.2. Scope of Test Program

The scope of the test program was to test the Tehama Wireless TW101 in the frequency ranges 902 - 928 MHz against FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications for radiated and conducted emissions for intentional radiators.

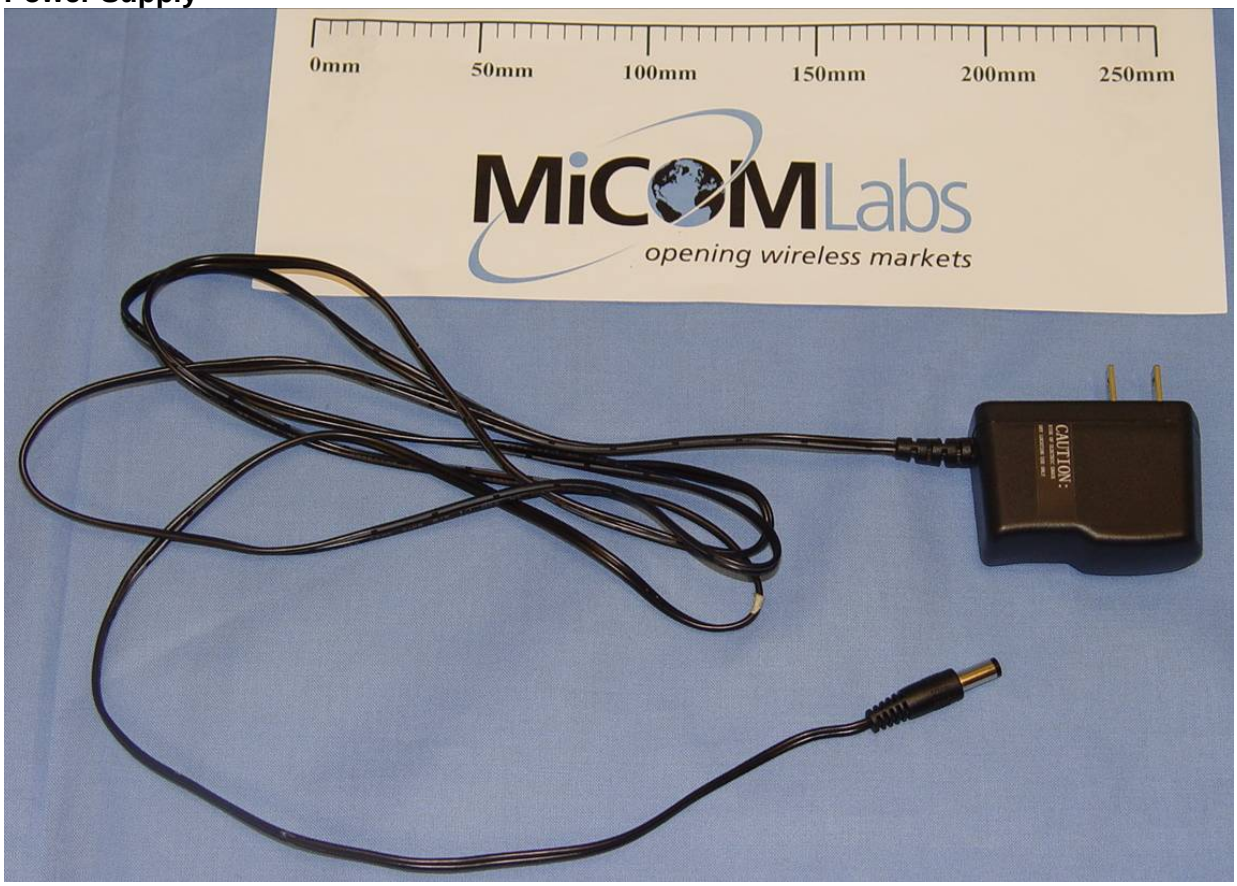
TW101 PCB Top



TW101 PCB Underside



Power Supply



Power Supply Labeling

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

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	TW101 with FCC test code	Tehama Wireless	TW101	E0000116
EUT	5V 1A Class II Power Supply	CUI Inc	EPS050100	n/a
Support	Laboratory DC Power Supply	Hewlett Packard	6274B	2713A-09023
Support	Dell Inspiron 4150 Laptop – Hyperterminal control over EUT (FCC test code)	Dell	PP01L	CN-04P449-48643-2CN-9629 Rev Ao2
Support	USB to serial converter	Tehama Wireless	N/A	N/A

3.4. Antenna Details

- Integral PCB Whip Antenna; Gain = 2.15 dBi

3.5. Cabling and I/O Ports

Number and type of I/O ports

- RF Port (915 MHz)
- Battery Terminals (1 x AA type)
- Serial Port (3 pin) Local Maintenance Terminal
- DC Power Port

3.6. Test Configurations

Test configurations:

EUT was set to 100% duty cycle by FCC Test Code for testing purposes.

Frequency Bands:

Start Freq. (MHz)	Stop Freq. (MHz)	Rated Output Power (Watts)	Frequency Tolerence (p.p.m.)	20dB BW (KHz)	Emission Designator	Microprocessor
903	926	0.689	20	304K	304KF1D	ATMega 644
903	926	0.723	20	133K	127KF1D	ATMega 644
903	913.325	0.723	20	133K	127KF1D	ATMega 644
914.9	926	0.723	20	133K	127KF1D	ATMega 644

Operating Channel	Frequencies (MHz)	Data Rate	Deviation	Channel Spacing
0	903.0	25 Kbits/S	33 kHz	350 kHz
31	914.9	25 Kbits/S	33 kHz	350 kHz
59	926.0	25 Kbits/S	33 kHz	350 kHz
0	903.0	100 Kbits/S	100 kHz	350 kHz
31	914.9	100 Kbits/S	100 kHz	350 kHz
59	926.0	100 Kbits/S	100 kHz	350 kHz
0	903.0	25 Kbits/S	33 kHz	175 kHz
31	908.425	25 Kbits/S	33 kHz	175 kHz
59	913.325	25 Kbits/S	33 kHz	175 kHz
0	914.775	25 Kbits/S	33 kHz	175 kHz
31	921.1	25 Kbits/S	33 kHz	175 kHz
59	926.0	25 Kbits/S	33 kHz	175 kHz

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

The following tests were performed by a MiCOM Labs approved test facility;-

1. NONE

4. TEST SUMMARY

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247**, **Industry Canada RSS-210** and **Industry Canada RSS-Gen.**

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(a)(1) A8.1	20 dB BW	20 dB BW	Conducted	Complies	5.1.1
15.247(a)(1) **A8.1**	Transmitter Channels	Channel Spacing	Conducted	Complies	5.1.2
15.247(a)(1) **A8.1**	Transmitter Channels	Number of Channels	Conducted	Complies	5.1.3.1
		Channel Occupancy	Conducted	Complies	5.1.3.2
15.247(b)(2) **A8.4**	Output Power	Transmit Power	Conducted	Complies	5.1.4
15.247(i) **5.5**	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Conducted	Complies	5.1.5
15.247(d) **A8.5**	Conducted Spurious Emissions	Band Edge	Conducted	Complies	5.1.6
		Spurious Emissions Transmitter (1 to 10 GHz)	Conducted	Complies	
§7.2.3		Standby	Conducted	Complies	5.1.7

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247**, **Industry Canada RSS-210** and **Industry Canada RSS-Gen.**

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(d) **15.205** **15.209** **A8.5** **2.2** **2.6** **4.9**	Radiated Emissions - Transmitter and Receiver	Transmitter Peak Emissions Radiated Spurious Emissions Band Edge Emissions	Radiated	Complies	 *5.1.8.1* *5.1.8.2* *5.1.8.3*
4.10		Receiver	Radiated	Complies	*5.1.8.4*
15.247(d) **15.205** **15.209** **A8.5** **2.2** **2.6**	Radiated Emissions - Digital Emissions		Radiated	Complies	*5.1.9*
15.207 **7.2.2**	Conducted	AC Wireline Conducted Emissions	Conducted	N/A	*5.1.10*

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

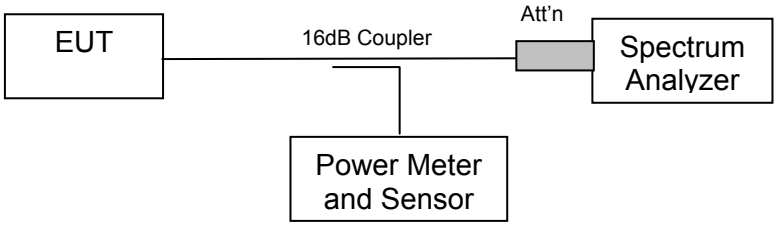
5.1. Device Characteristics

5.1.1. 20 dB Bandwidth

FCC, Part 15 Subpart C §15.247(a)(1)
Industry Canada RSS-210 §A8.1

Test Procedure
The 20 dB bandwidth is measured with a spectrum analyzer connected to the antenna terminal, while the EUT is operating in transmission mode at the appropriate center frequency and modulation.

Test Measurement Set up



Measurement set up for 20 dB bandwidth test

Test Results for 20 dB Bandwidth

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Testing was performed on all data rates available on the EUT.

TABLE OF RESULTS: 33kHz Deviation; 25 Kbits/S

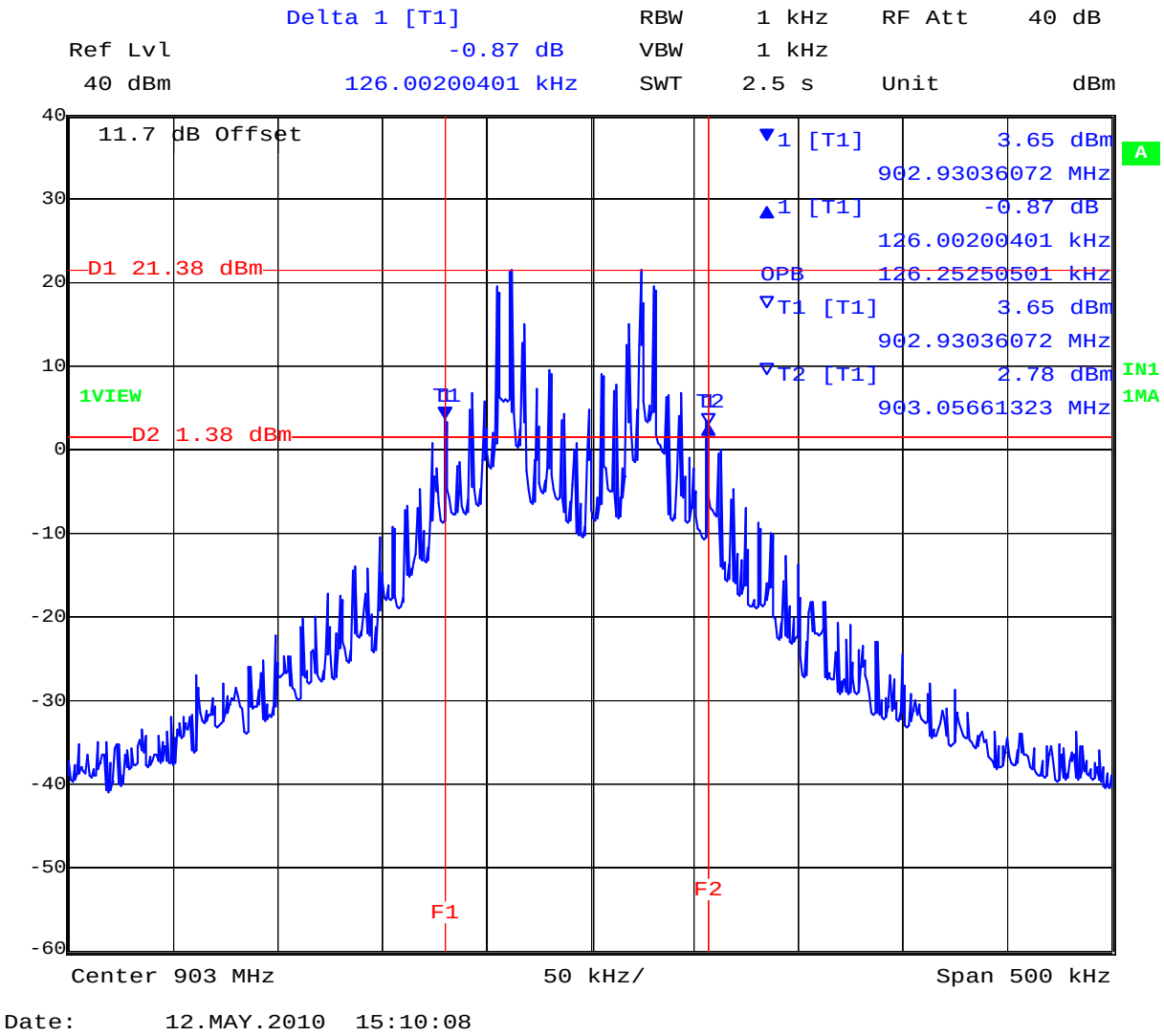
Channel #	Center Frequency (MHz)	20 dB Bandwidth (kHz)	Specification (kHz)
0	903.00	126.002	<500
31	914.90	126.253	
59	926.00	126.503	

TABLE OF RESULTS: 100kHz Deviation; 100 Kbits/S

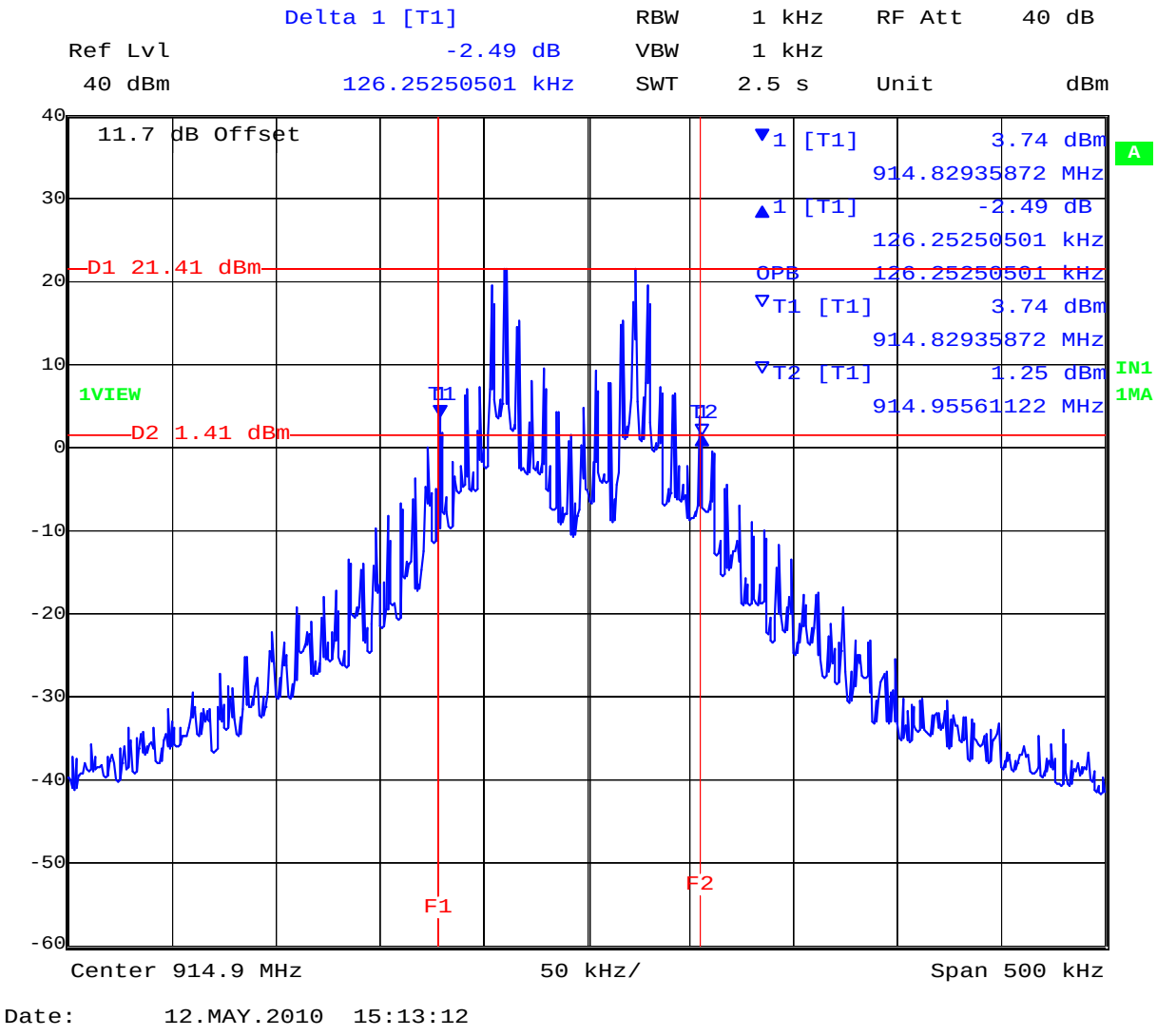
Channel #	Center Frequency (MHz)	20 dB Bandwidth (kHz)	Specification (kHz)
0	903.00	302.104	<500
31	914.90	301.353	
59	926.00	303.607	

5.1.1.1. 33kHz Deviation Test Results:

CH 0 903.00 MHz 20 dB Bandwidth



CH 31 914.90 MHz 20 dB Bandwidth



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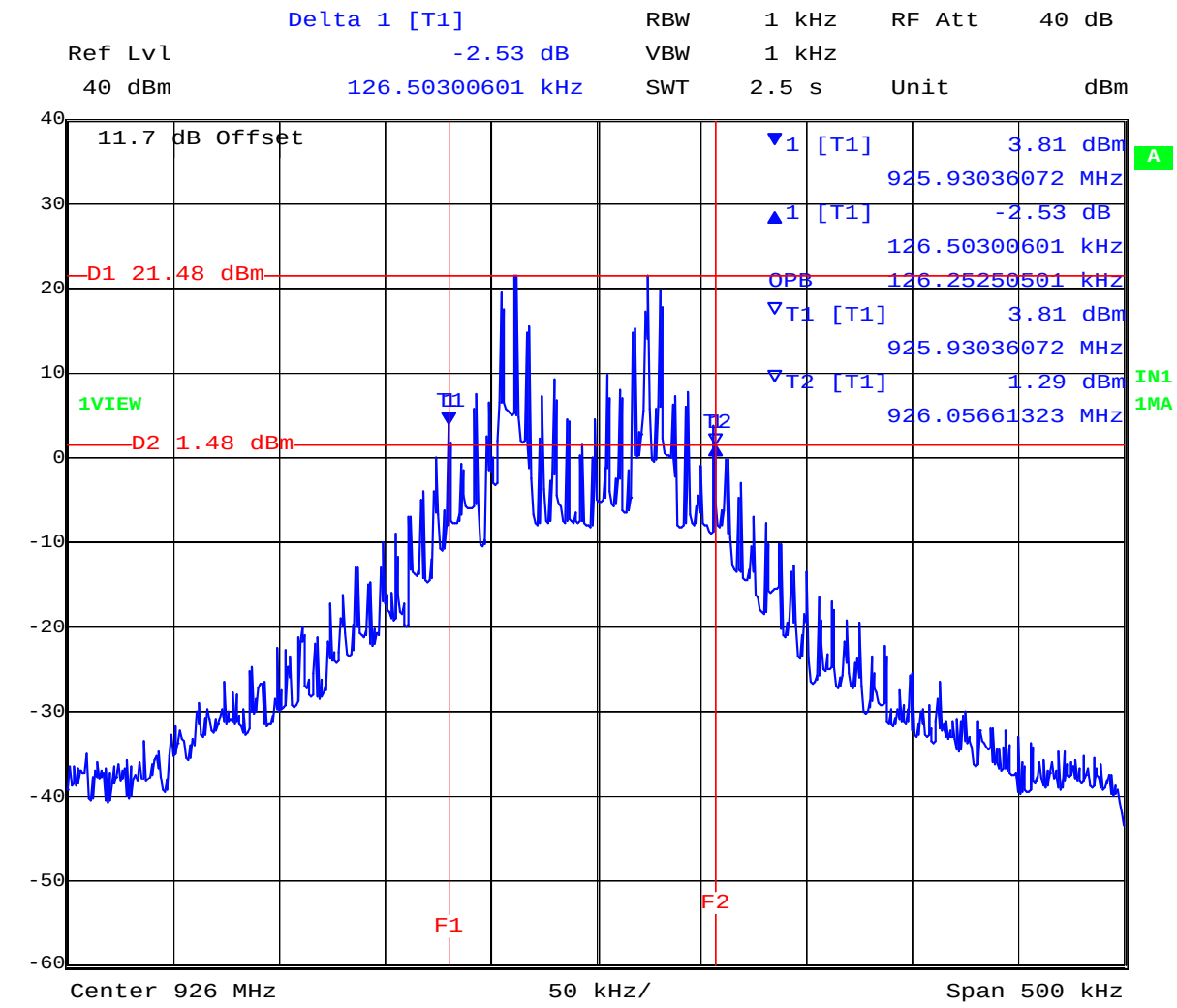
CH 59 926.00 MHz 20 dB Bandwidth



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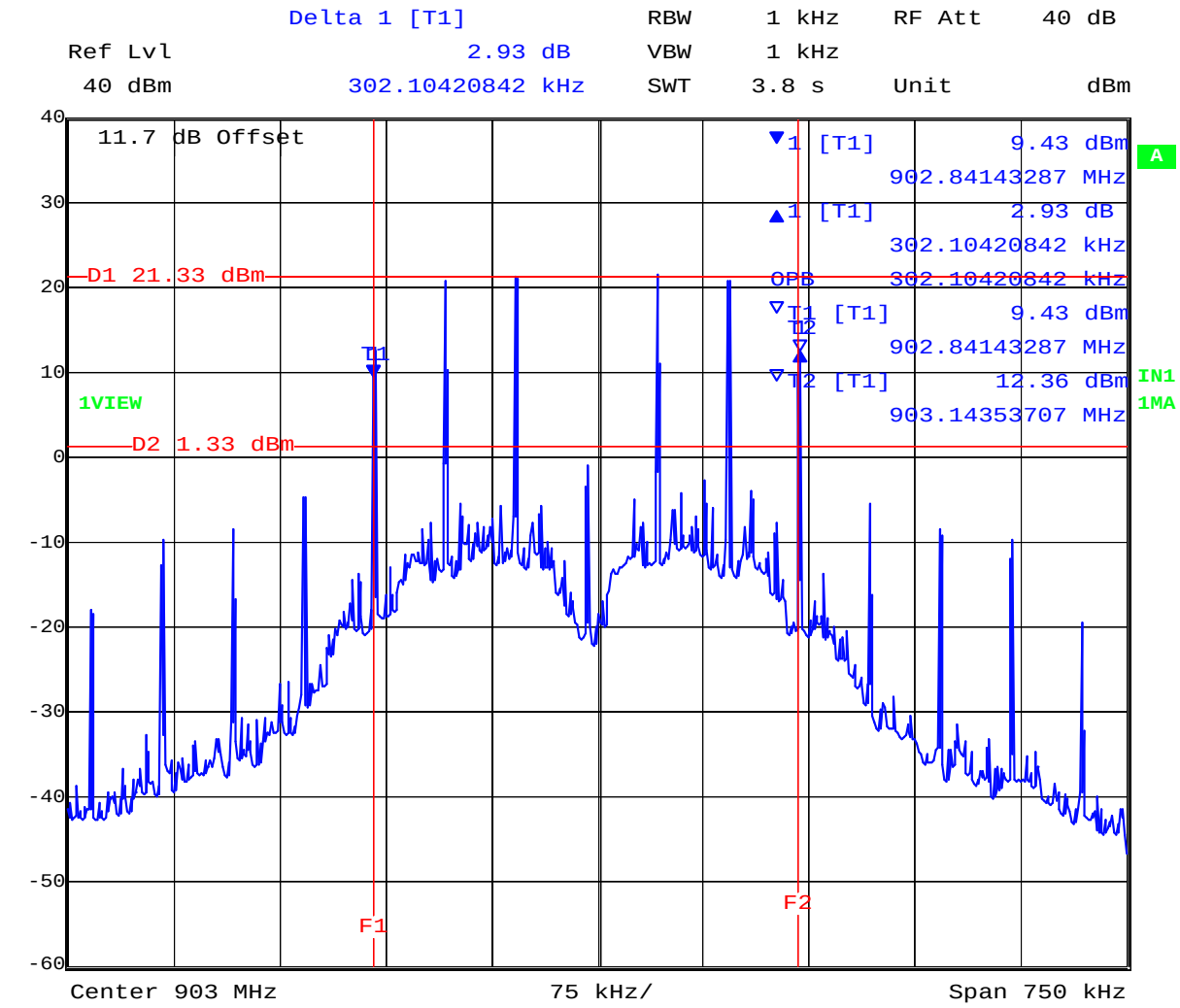
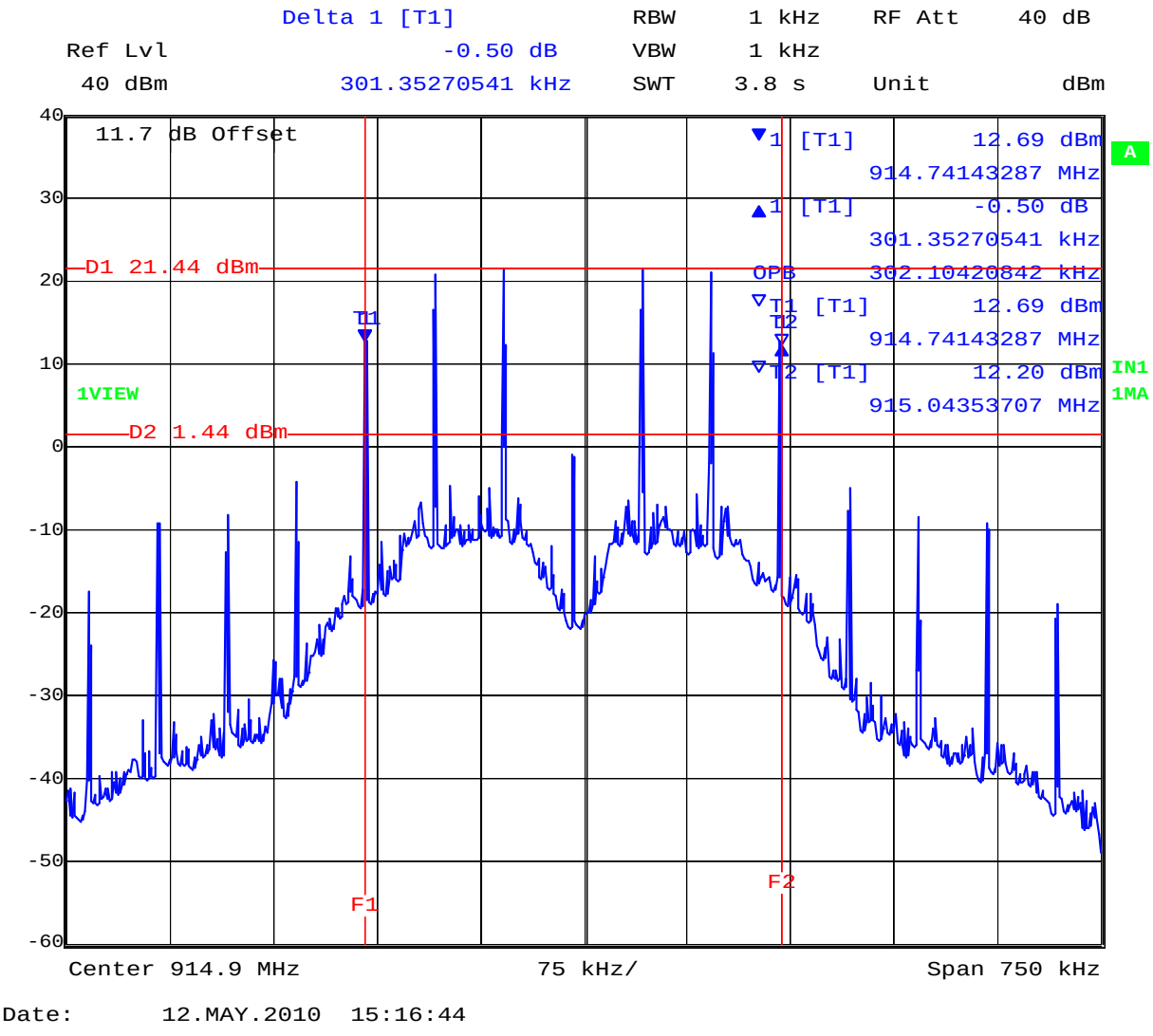
5.1.1.2. 100kHz Deviation Test Results:

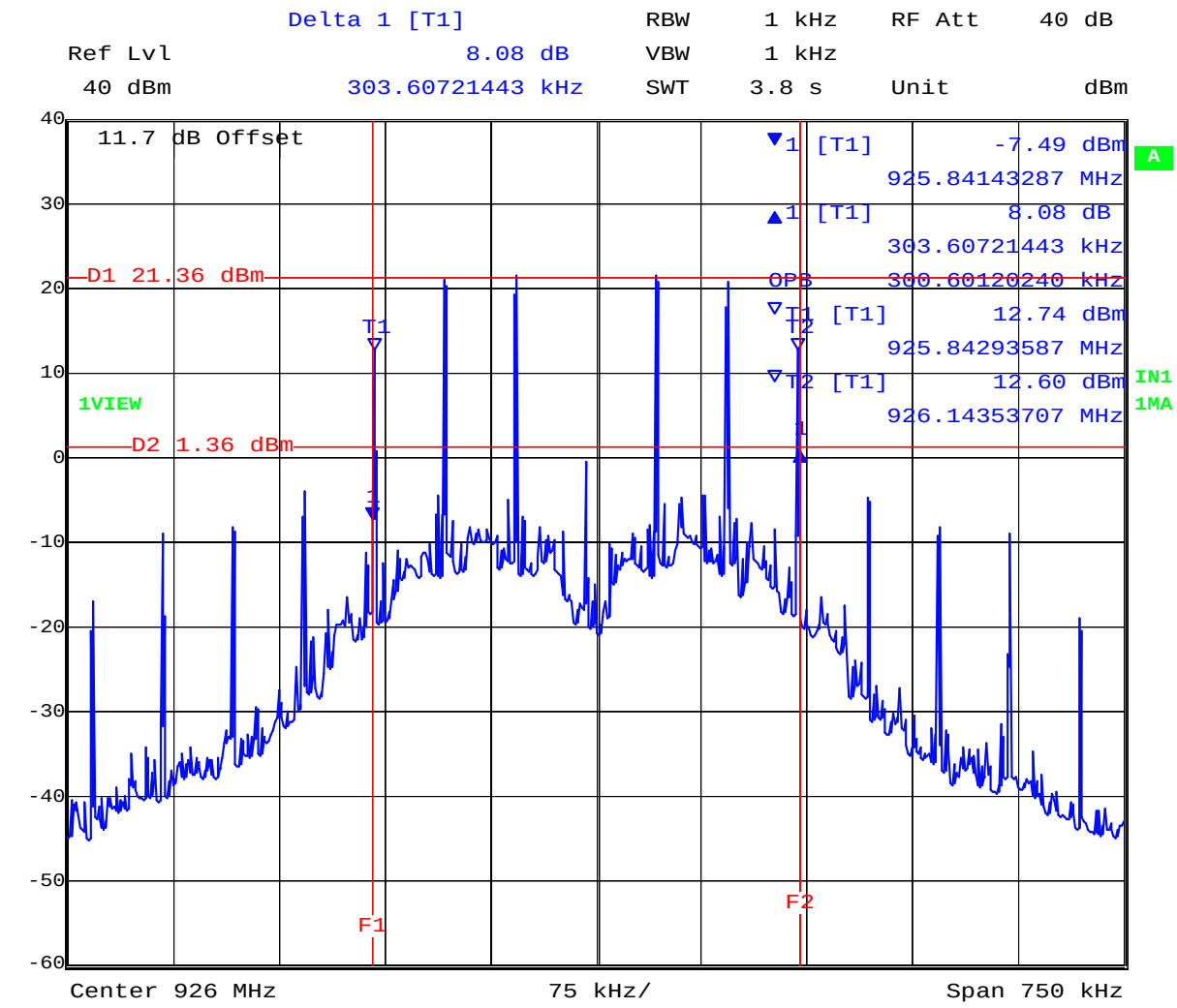
CH 0 903.00 MHz 20 dB Bandwidth



CH 31 914.90 MHz 20 dB Bandwidth



CH 59 926.00 MHz 20 dB Bandwidth



Date: 12.MAY.2010 15:20:26

Specification

Limits

FCC §15.247 (a)(1)
Industry Canada RSS-210 §8.1

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	±2.81 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

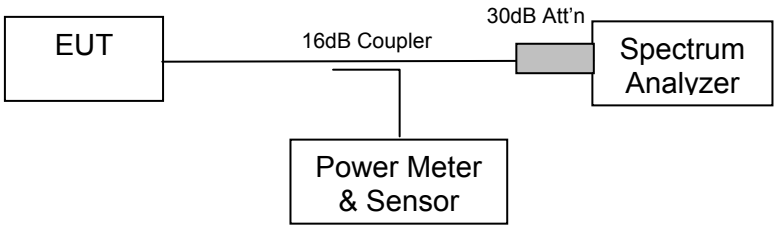
5.1.2. Transmitter Channels - Channel Spacing

FCC, Part 15 Subpart C §15.247(a)(1)
Industry Canada RSS-210 §8.1(2)

Test Procedure

The channel spacing is measured with a spectrum analyzer connected to the antenna terminal, while the EUT is operating in transmission mode at the appropriate center frequency and modulation.

Test Measurement Set up



Measurement set up for Channel Spacing Test

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

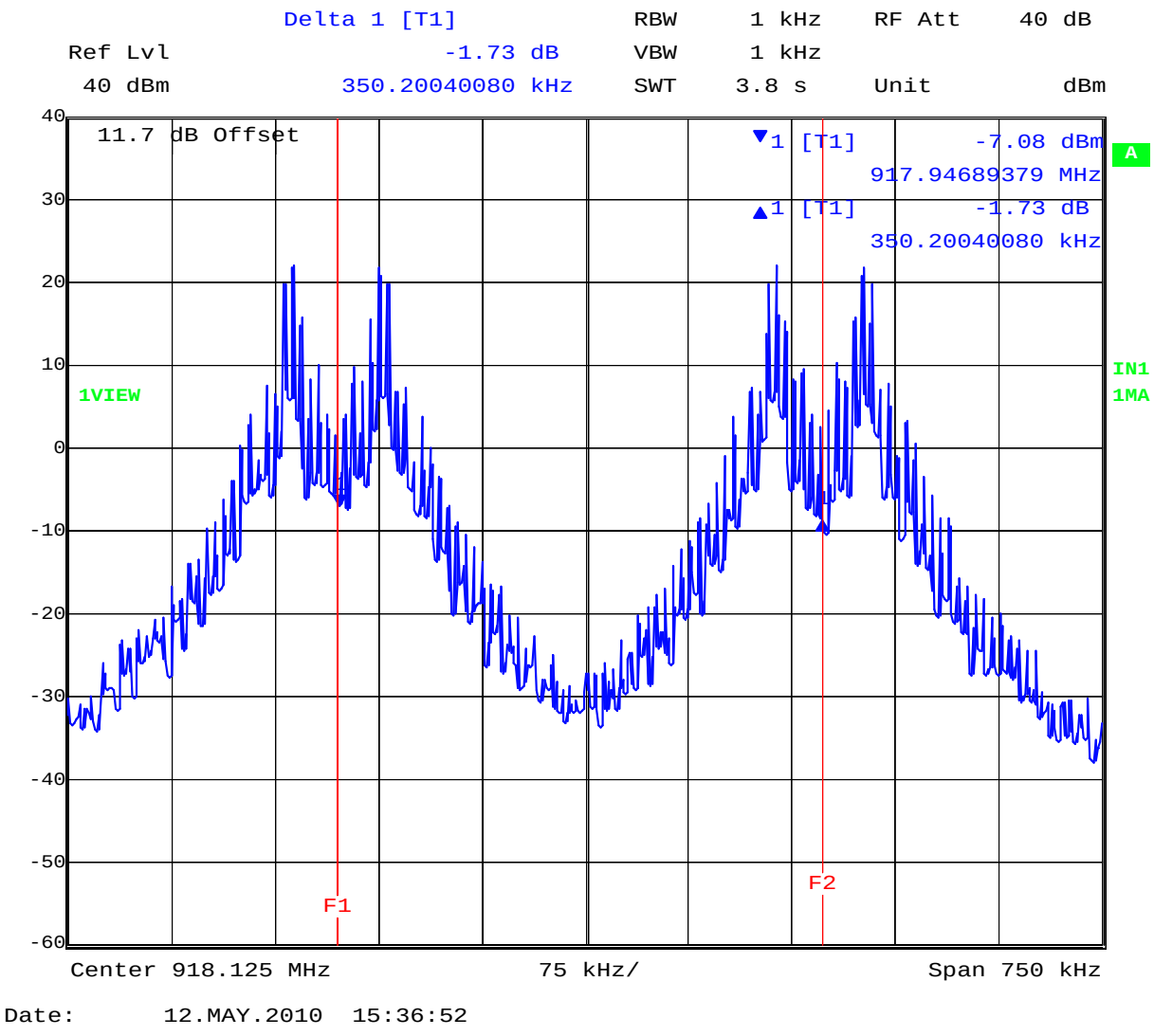
TABLE OF RESULTS

Channel(s)	Channel Spacing (KHz)	Specification
36-37 (33kHz Dev.)	350.2004	Greater than maximum 20 dB Bandwidth
36-37 (100kHz Dev.)	350.2004	Greater than maximum 20 dB Bandwidth
36-37 (33kHz Dev.)	175.51	Greater than maximum 20 dB Bandwidth

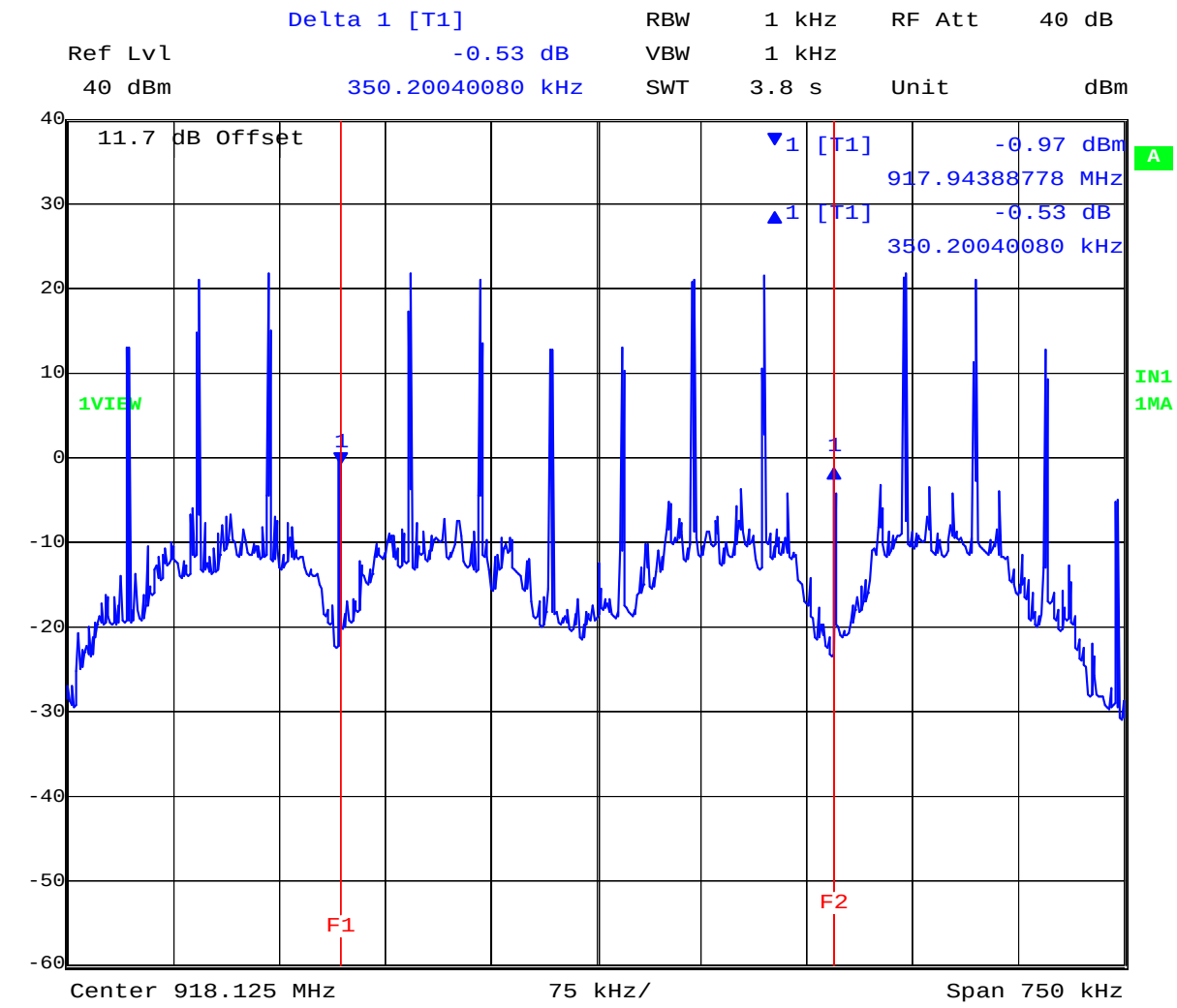
Maximum 20 dB bandwidth (100kHz) = 303.607 kHz

Maximum 20 dB bandwidth (33kHz) = 126.503 kHz

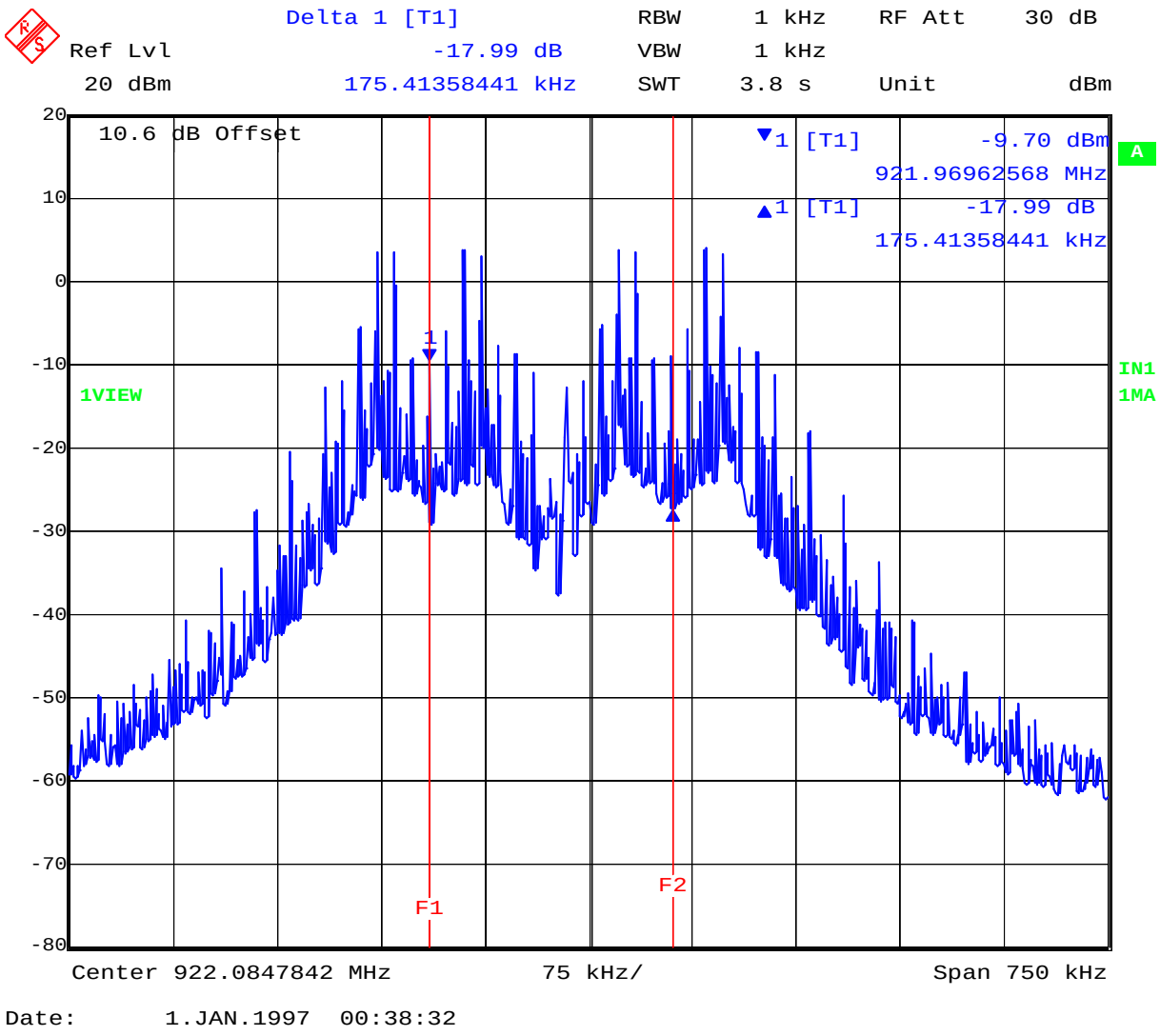
Channel Spacing for CH 36 – CH 37; 30 kHz Deviation



Channel Spacing for CH 36 – CH 37; 100 kHz Deviation



Channel Spacing for CH 36 – CH 37; 30 kHz Deviation; 175kHz Channel Separation



Specification for Channel Spacing

Limits

FCC §15.247 (a)(1)
Industry Canada RSS-210 §A8.1(2)

Frequency hopping systems 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.

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, 0158, 0184, 0193, 0250, 0252 0310, 0312.

5.1.3. Transmitter Channels

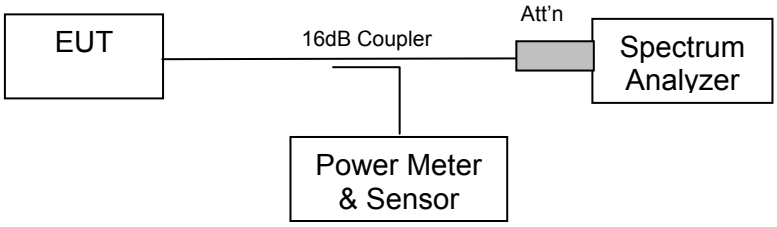
5.1.3.1. Number of Channels

FCC, Part 15 Subpart C §15.247(a)(1)
Industry Canada RSS-210 §A8.1

Test Procedure

The number of channels and channel occupancy is measured with a spectrum analyzer connected to the antenna terminal, while the EUT is operating in transmission mode at the appropriate center frequency and modulation.

Test Measurement Set up



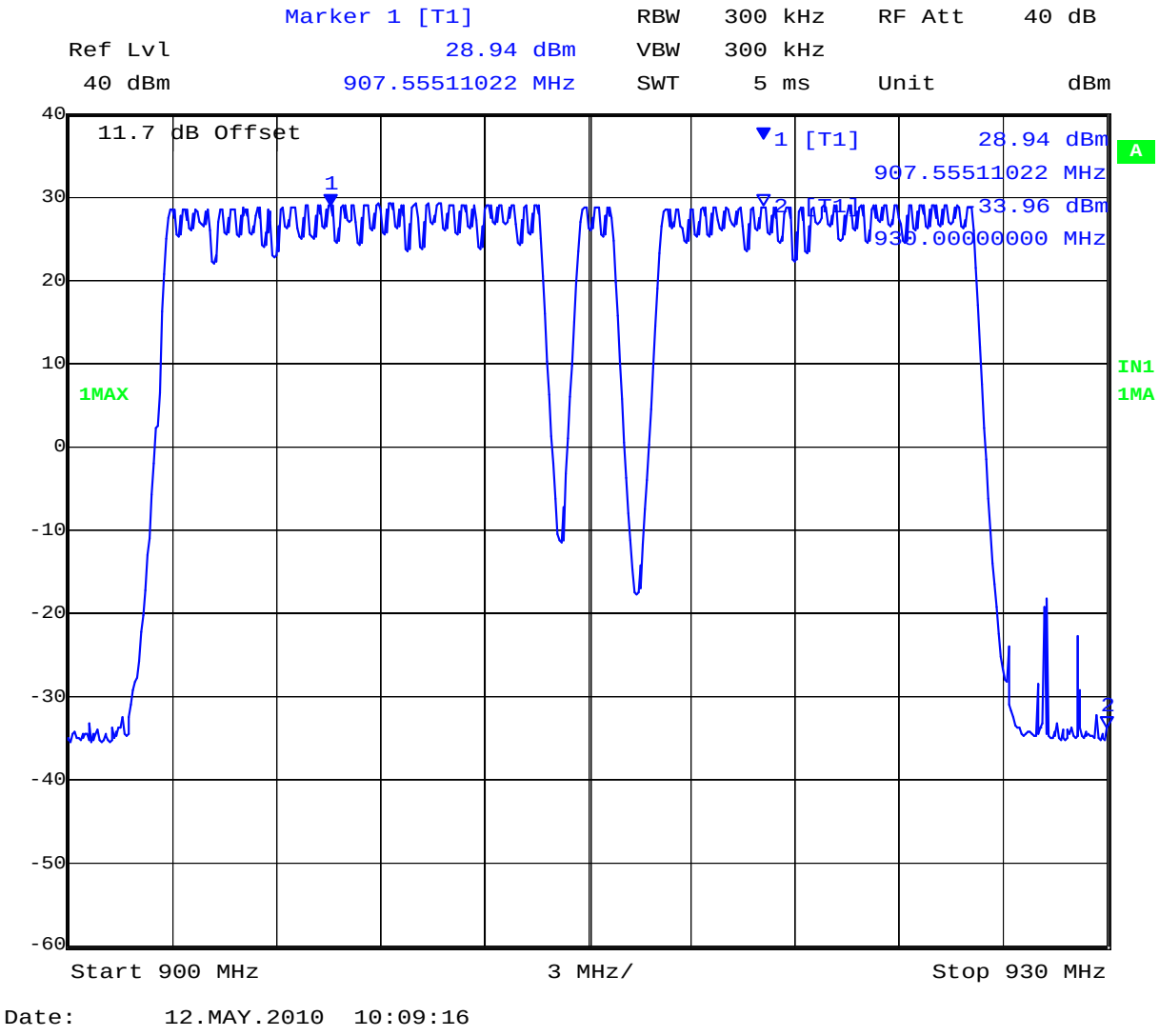
Test set up to measure the number of channels and channel occupancy

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

TABLE OF RESULTS

Number of Channels	20 dB Bandwidth	Specification
60	< 250 kHz	Minimum of 50 hopping channels
60	> 250 kHz	Minimum of 25 hopping channels

NUMBER OF TRANSMISSION CHANNELS



5.1.3.2. Channel Occupancy

FCC, Part 15 Subpart C §15.247(a)(1)
Industry Canada RSS-210 §A8.1

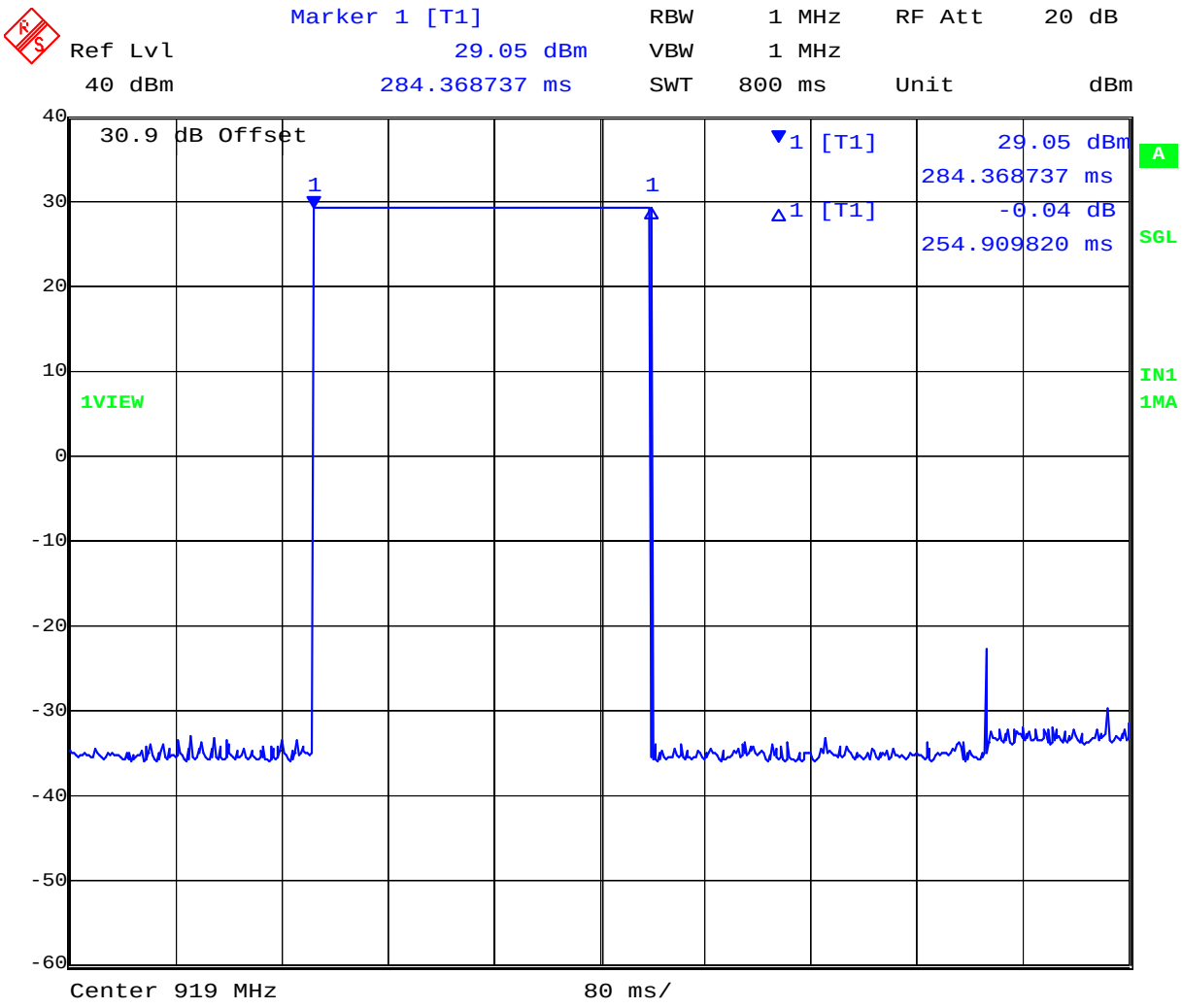
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Channel Dwell Time

TABLE OF RESULTS

Channel #	Center Frequency (MHz)	Channel Dwell Time (single channel) (mSecs)
39	919.0	254.91

CHANNEL DWELL TIME CH 39 919MHZ



Date: 15.MAY.2010 00:54:16

Channel Occupancy

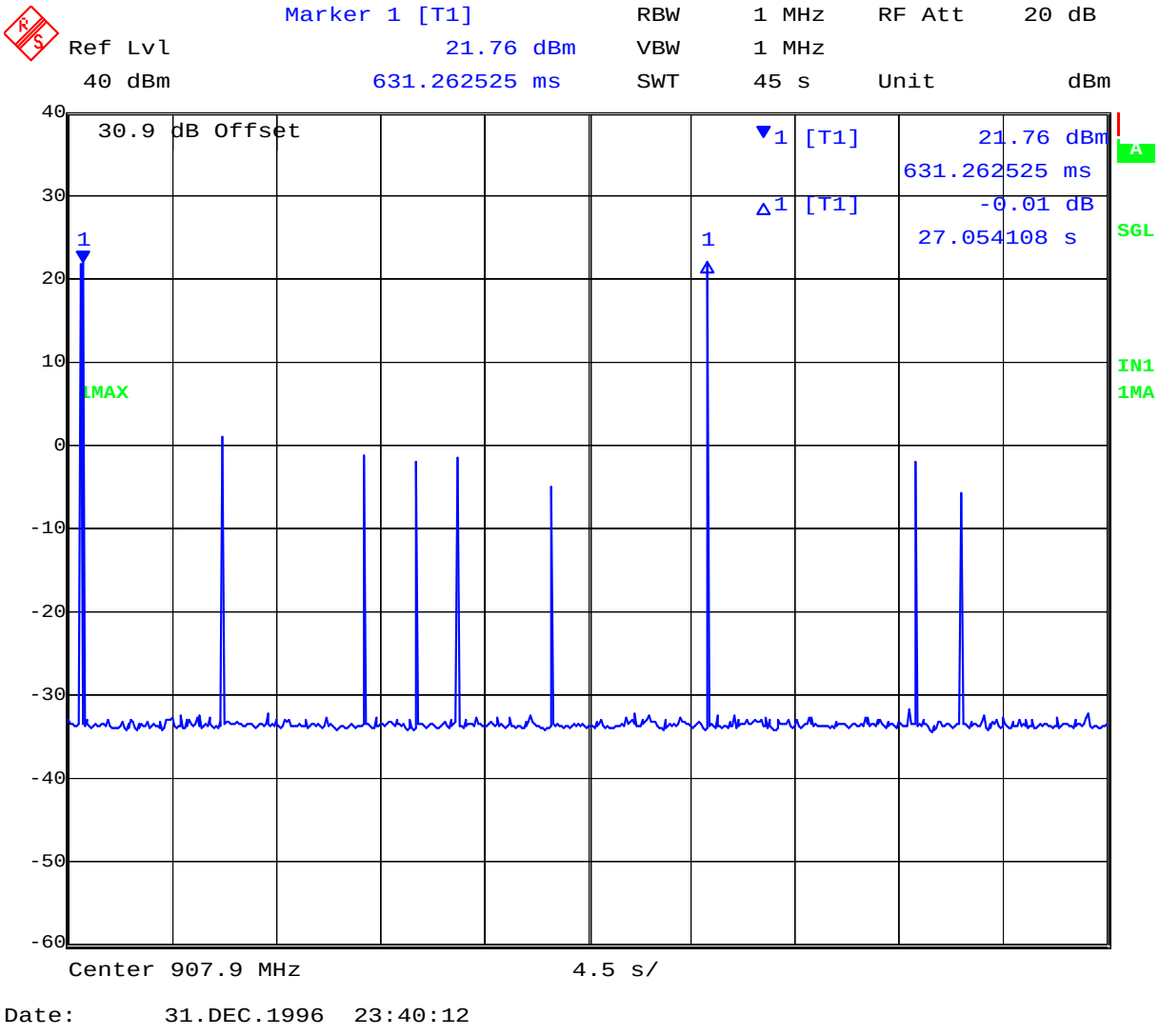
TABLE OF RESULTS

Channel #	Center Frequency (MHz)	20dB Bandwidth (kHz)	Channel Occupancy Limit (mSeconds)	Channel Occupancy Period (Seconds)	Channel Occupancy Limit (mSeconds)
39	919	303.607	400	10	254.91
39	919	126.503	400	20	254.91

Note: Channel repeats after minimum 27.05 seconds

Note: Device test code was set-up to provide the maximum dwell time supported by the EUT hardware. This mode was chosen since EUT only transmits on each channel a maximum of one (1) time during each 10s or 20s period specified in FCC Part 15.247(a)(1)(i). Maximum dwell times will vary by data rate and channel spacing, but all are within compliance based on hardware limitation of the device.

Channel Occupancy 919 MHz



Specification for Number of Channels and Channel Occupancy

Limits

FCC, Part 15 Subpart C §15.247(a)(1)
Industry Canada RSS-210 §A8.1

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Laboratory Uncertainty for Frequency Measurements

Measurement uncertainty	±0.86ppm

Traceability

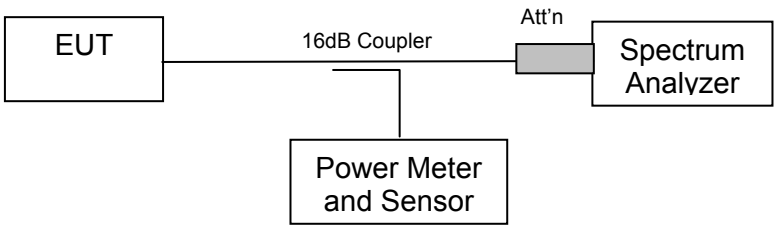
Method	Test Equipment Used
Measurements were made per work instruction WI-02 'Frequency Measurement"	0078, 0134, 0158, 0184, 0193, 0250, 0252 0310, 0312.

5.1.4. Output Power

FCC, Part 15 Subpart C §15.247(b)(2)
Industry Canada RSS-210 §A8.4

Test Procedure
The transmitter terminal of EUT was set for CW (continuous wave) operation and connected to the input of the power meter which was calibrated to measure power. The value of measured power including antenna cable loss was reported.

Test Measurement Set up



Measurement set up for Transmitter Output Power

Measurement Results for Output Power

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

TABLE OF RESULTS: 33 kHz Deviation

Channel #	Center Frequency (MHz)	Power (dBm)
0	903.00	+28.40
31	914.90	+28.55
59	926.00	+28.59

TABLE OF RESULTS: 100 kHz Deviation

Channel #	Center Frequency (MHz)	Power (dBm)
0	903.00	+28.12
31	914.90	+28.32
59	926.00	+28.38

Specification

Limits

FCC, Part 15 Subpart C §15.247 (b)(2) The maximum output power of the intentional radiator shall not exceed the following:
(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

Industry Canada RSS-210 §A8.4
For frequency hopping systems operating in the 902 - 928 MHz band, the maximum peak conducted power output power is not to succeed 1.0 W if the hopset uses 50 or more hopping channels and 0.25 W if the hopset uses less than 50 hopping channels.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

5.1.5. Maximum Permissible Exposure

FCC, Part 15 Subpart C §15.247(i)
Industry Canada RSS-Gen §5.5

Calculations for Maximum Permissible Exposure Levels

Power Density = Pd (mW/cm^2) = EIRP/(4πd^2)
EIRP = P * G
P = Peak output power (mW)
G = Antenna numeric gain (numeric)
d = Separation distance (cm)
Numeric Gain = 10 ^ (G (dBi)/10)

Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is 1.0 mW/cm^2

Freq. Band (MHz)	Antenna Gain (dBi)	Peak Output Power (dBm)	Antenna Gain (numeric)	EIRP (mW)	Distance @ 1mW/cm2 Limit(cm)	Minimum Separation Distance (cm)
2400 - 2483.5	2.15	28.59	1.6405898	1185.77	9.72	20

***Note:** for mobile or fixed location transmitters the minimum separation distance is 20cm, even if calculations indicate the MPE distance to be less.**

Specification

Maximum Permissible Exposure Limits

§15.247(i) 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 levels in excess of the Commission's guidelines.

FCC §1.1310 Limit = 1mW / cm^2 from 1.310 Table 1

RSS-Gen §5.5 Before equipment certification is granted, the applicable requirements of RSS-102 shall be met.

Laboratory Measurement Uncertainty for Power Measurements

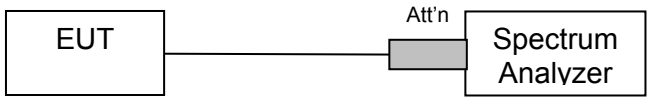
Measurement uncertainty	±1.33 dB

5.1.6. Conducted Spurious Emissions Transmitter

FCC, Part 15 Subpart C §15.247(d)
Industry Canada RSS-210 §A8.5

Test Procedure
Conducted emissions were measured at a limit of 20 dB below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Emissions at the band edge were measured and recorded. Measurements were made while EUT was operating in transmit mode of operation at the appropriate center frequency.

Test Measurement Set up



Band-edge measurement test configuration

Measurement Results of Conducted Spurious Emissions

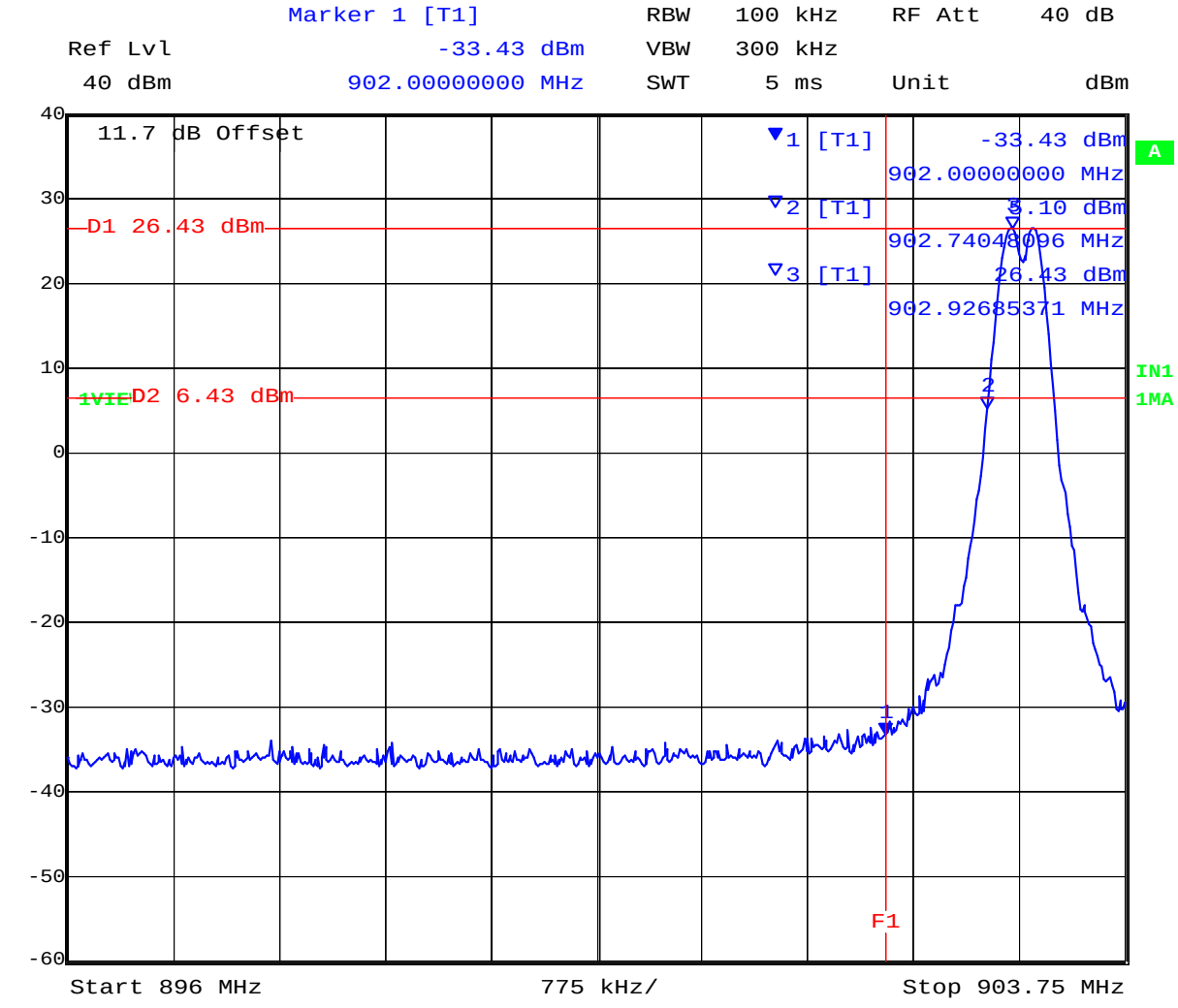
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Conducted Band-Edge Results

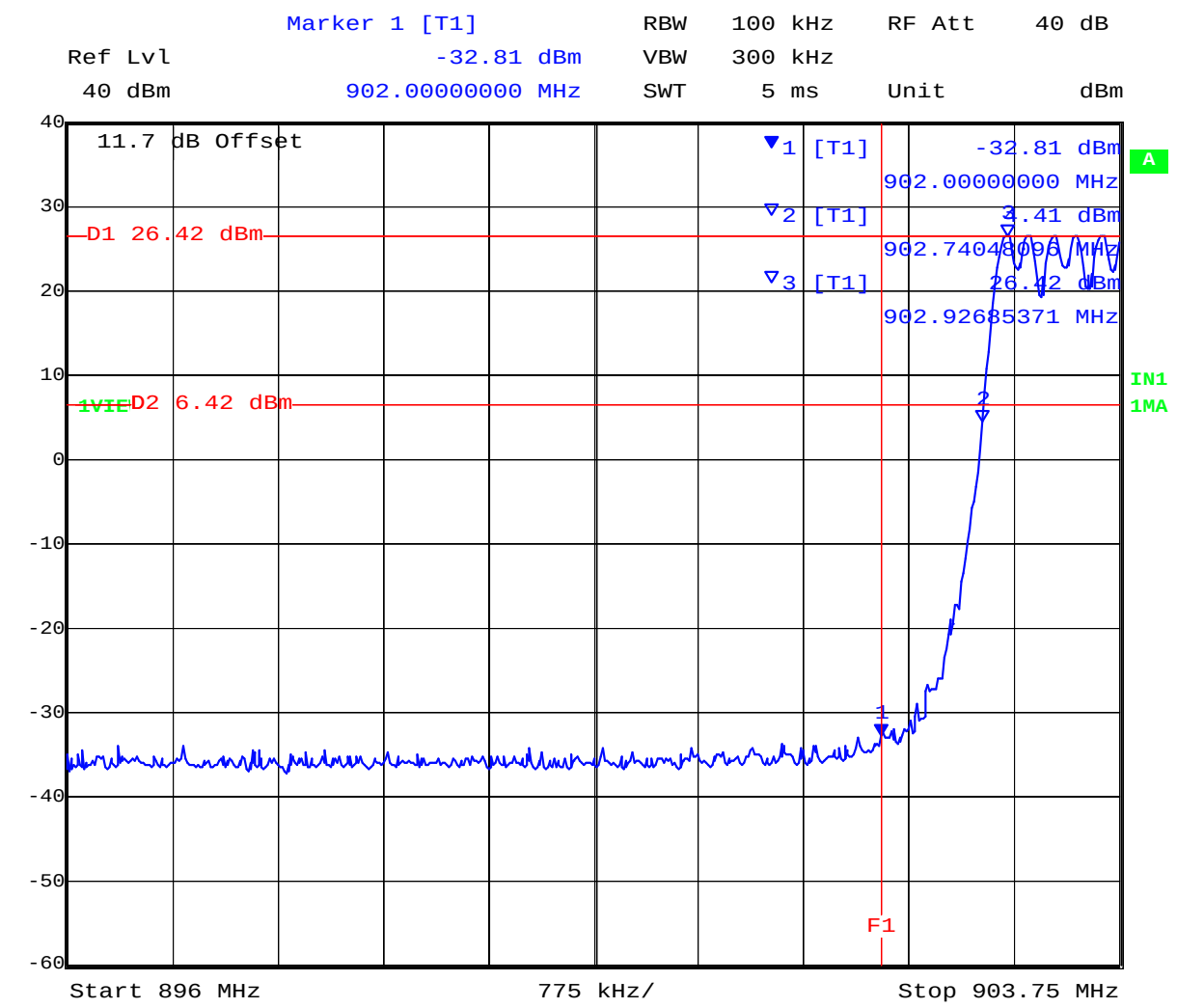
TABLE OF RESULTS

Channel #	Center Frequency (MHz)	Band-edge Frequency (MHz)	Limit (dBm)	Amplitude @ Band-edge (dBm)	Margin (dB)
0	903.00	902.0	6.42	-32.81	-39.23
59	926.00	928.0	5.96	-35.15	-41.11

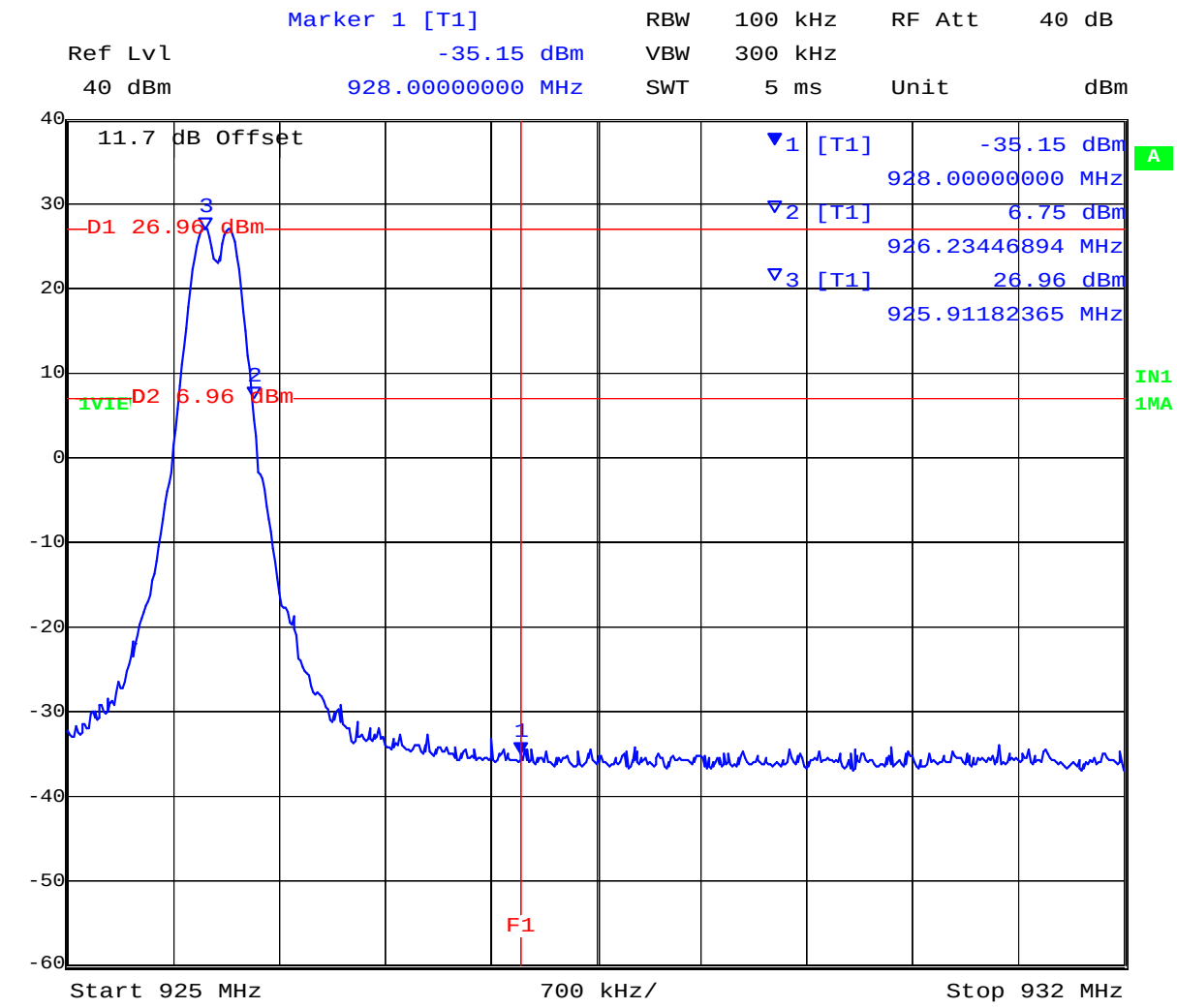
902 MHZ LOWER BAND EDGE – HOPPING OFF



902 MHZ LOWER BAND EDGE – HOPPING ON

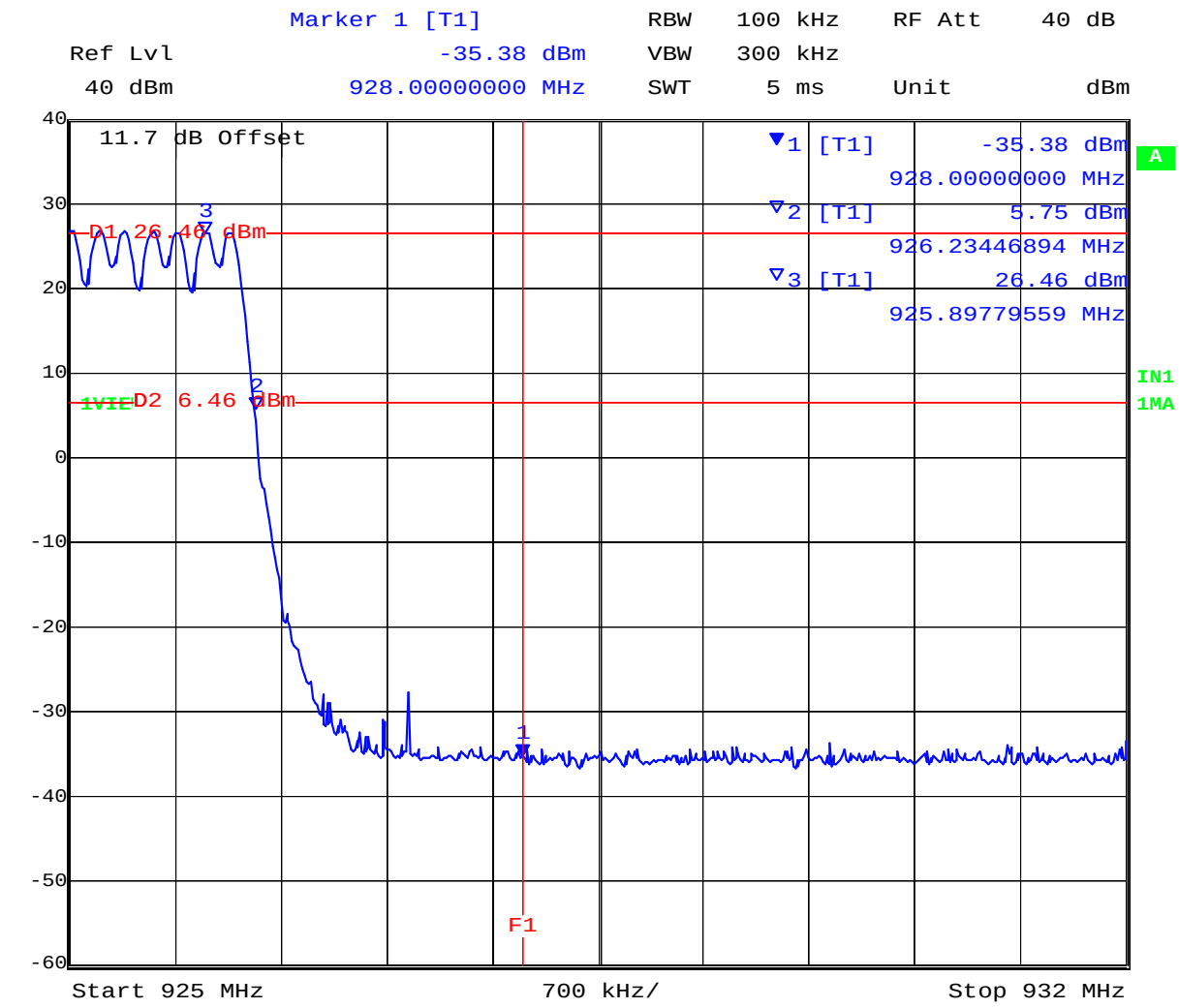


928 MHZ UPPER BAND EDGE – HOPPING OFF



Date: 12.MAY.2010 15:52:57

928 MHZ UPPER BAND EDGE – HOPPING ON



Date: 12.MAY.2010 15:57:19

Spurious Emissions (1-10 GHz)

Conducted spurious emissions (30MHz - 10 GHz) are provided below. The maximum emissions observed are indicated in the results table before each plot.

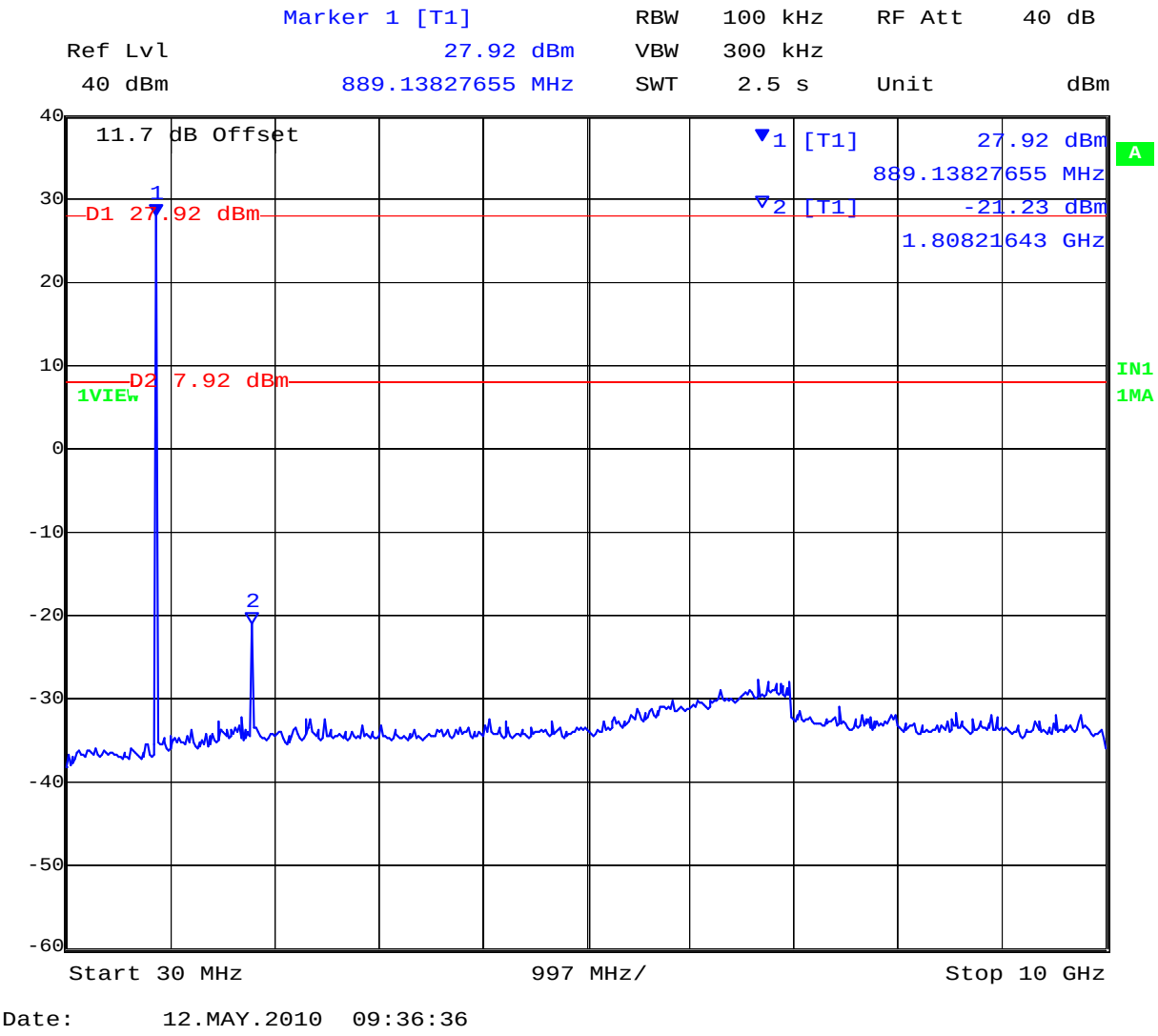
< Plots available beginning next page>

TABLE OF RESULTS

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
903.00	30	10,000	-21.23	7.92	-29.15

The emission breaking the limit line is the carrier.

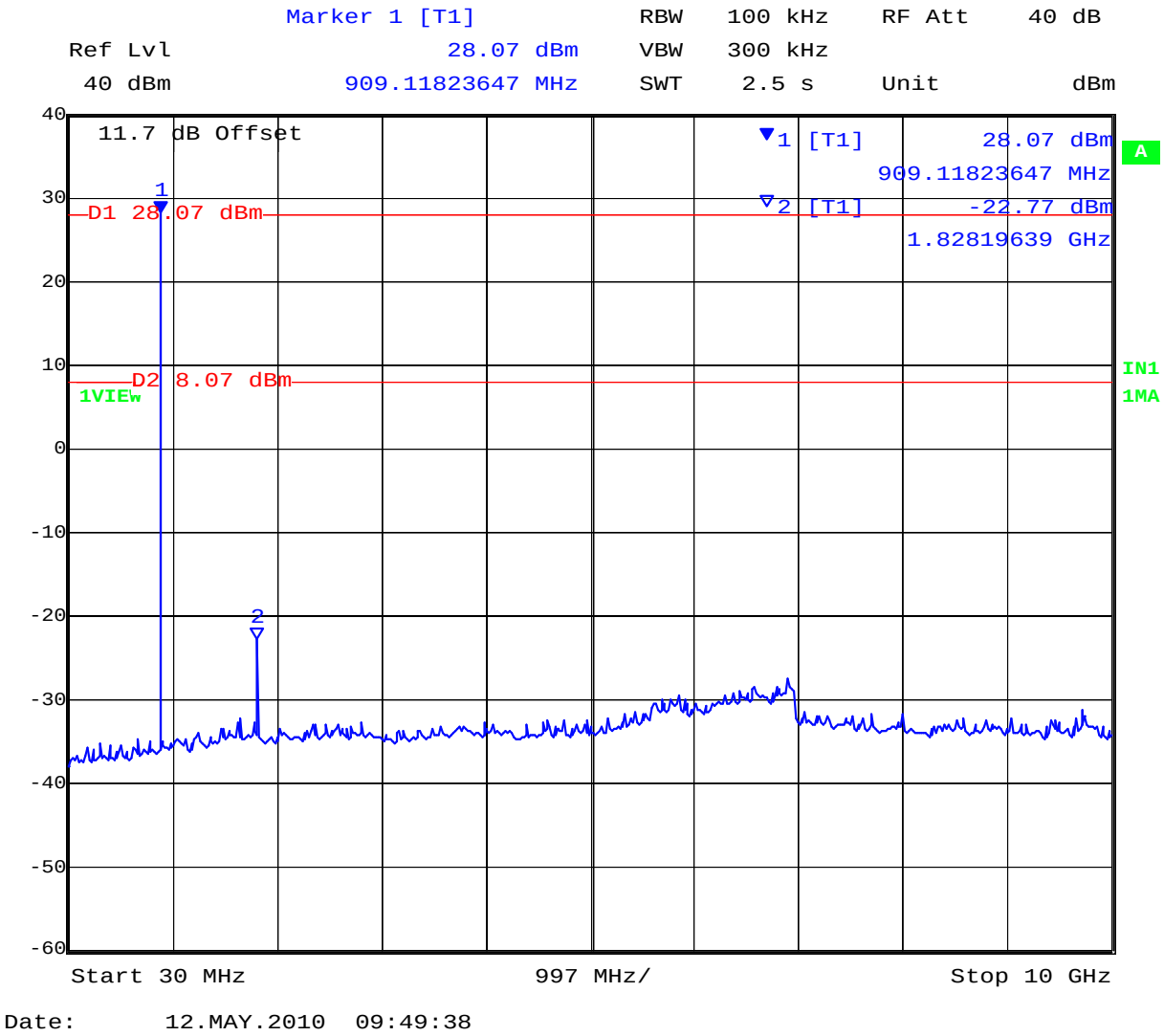
CHANNEL 903.00 MHZ - 30 MHZ TO 10,000 MHZ



Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
914.90	30	10,000	-22.77	8.07	30.84

The emission breaking the limit line is the carrier.

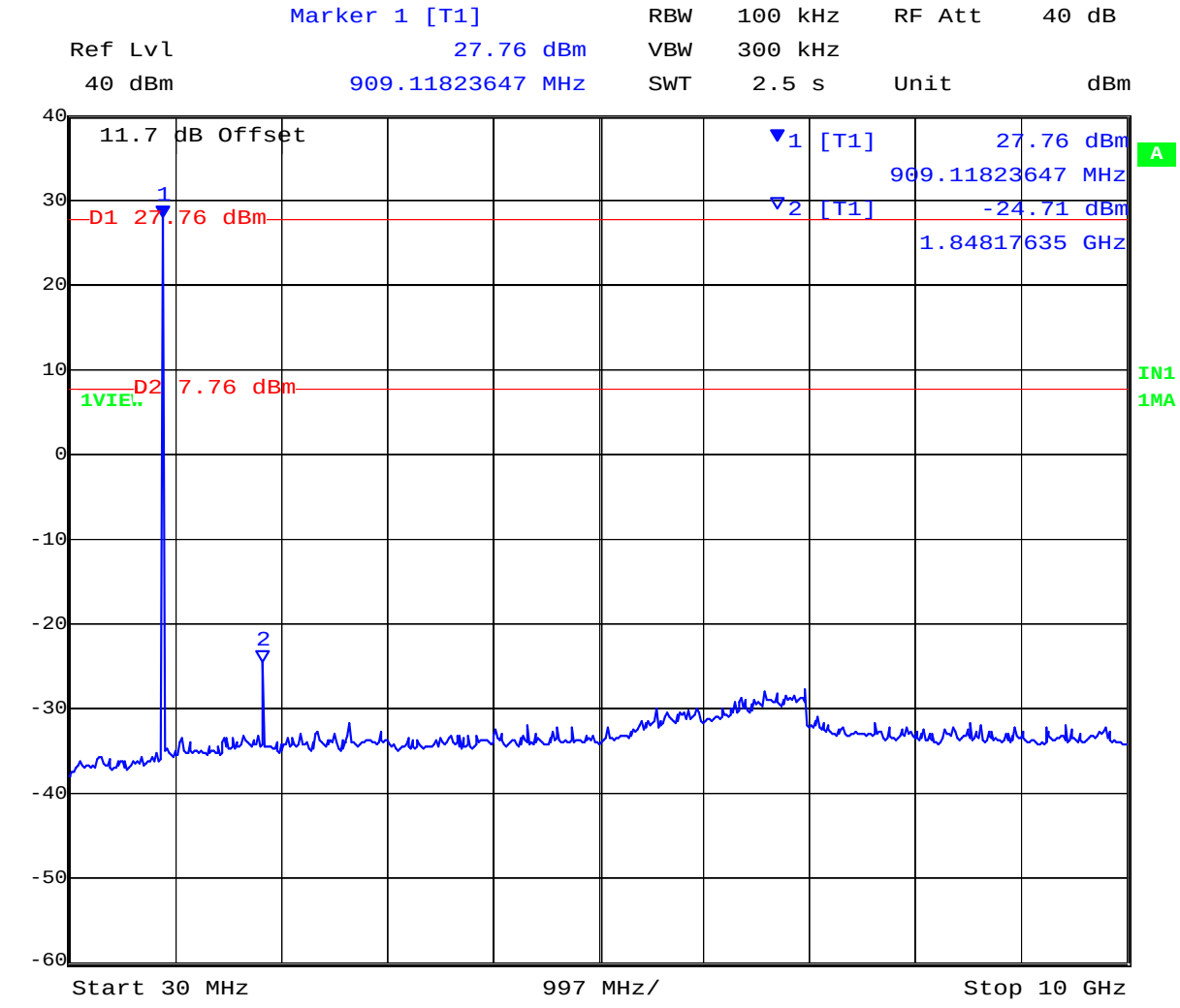
CHANNEL 914.90 MHZ - 30 MHZ TO 10,000 MHZ



Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
926.00	30	10,000	-24.71	7.76	-32.47

The emission breaking the limit line is the carrier.

CHANNEL 926.00 MHZ - 30 MHZ TO 10,000 MHZ



Specification

Limits Band-Edge

Lower Limit Band-edge	Upper Limit Band-edge	Limit below highest level of desired power
902 MHz	928 MHz	≥ 20 dB

FCC, Part 15 Subpart C §15.247(d)

Industry Canada RSS-210 §A.5

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, provided the transmitter demonstrates compliance with the peak conducted power limits.

Laboratory Measurement Uncertainty for Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-05 'Measurement of Spurious Emissions'	0287, 0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117.

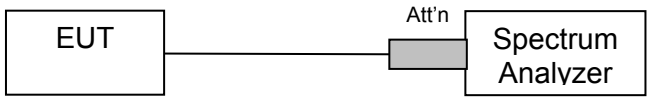
5.1.7. Conducted Spurious Emissions Stand-By

Industry Canada RSS-Gen §7.2.3

Test Procedure

Conducted Stand-By emissions were measured on the device on the mid channel. The EUT was placed in Stand-By mode and emissions were measured 30 MHz – 7 GHz.

Test Measurement Set up



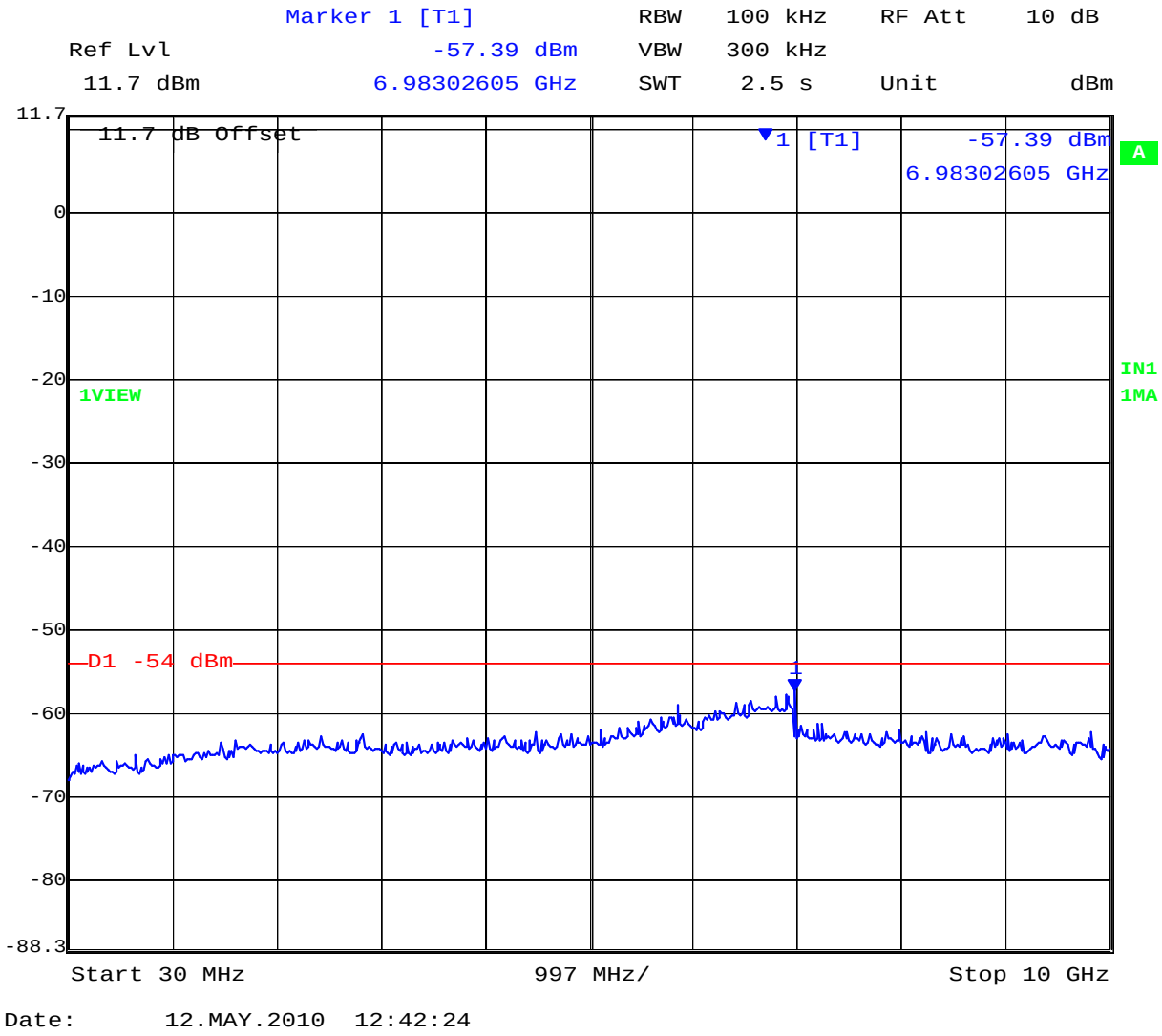
Stand-By spurious emissions test configuration

Measurement Results of Stand –By Spurious Emissions

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

5.1.7.1. Conducted Stand-By Spurious Emissions 30M - 10 GHz

No emissions were observed breaking the limit.



Specification
Antenna Conducted Measurement
Industry Canada RSS-Gen §7.2.3

If the device has a detachable antenna of known antenna impedance, then the antenna conducted method is permitted in lieu of a radiated measurement.
Receiver spurious emissions at any discrete frequency shall not exceed 2 nanowatts (-57 dBm) in the band 30-1000 MHz, or 5 nanowatts (-53 dBm) above 1 GHz.

Laboratory Measurement Uncertainty for Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-05 'Measurement of Spurious Emissions'	0287, 0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117.

5.1.8. Radiated Emissions - Transmitter and Receiver

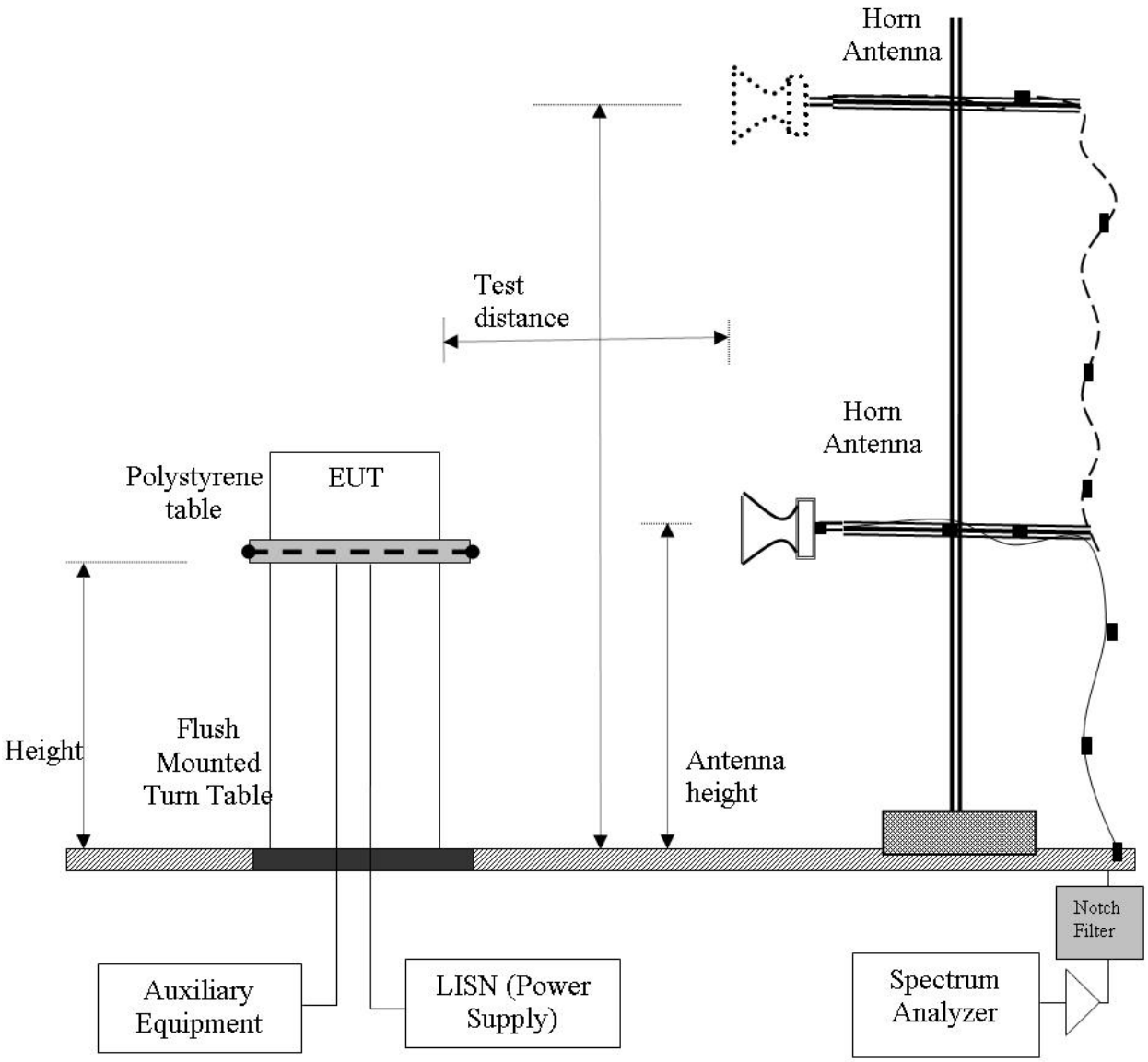
FCC, Part 15 Subpart C §15.247(d)
Industry Canada RSS-210 §A8.5

Test Procedure

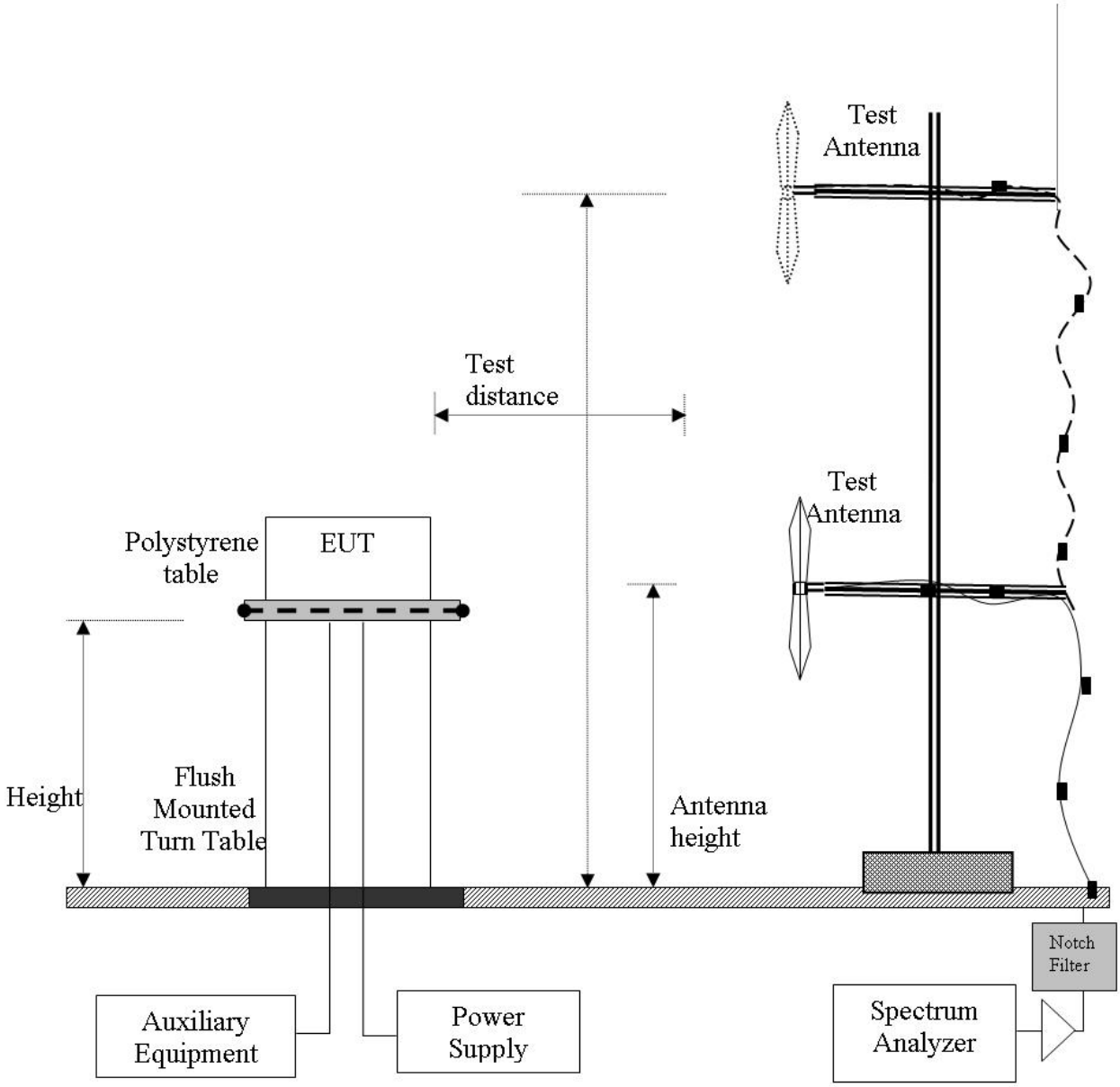
Testing was performed in a 3-meter anechoic chamber. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. Preliminary emissions were recorded with in Spectrum Analyzer mode, using a maximum peak detector while in peak hold mode.

Emissions nearest the limits were chosen for maximization and formal measurement using a CISPR Compliant receiver. Emissions above 1000 MHz are measured utilizing a CISPR compliant average detector with a tuned receiver, using a bandwidth of 1 MHz. Emissions from 30 MHz – 1000 MHz are measured utilizing a CISPR compliant quasi-peak detector with a tuned receiver, using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed.

Test Measurement Set Up



Radiated Emission Measurement Setup – Above 1 GHz



Radiated Emission Measurement Setup – Below 1 GHz

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

FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

Field Strength Calculation 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 and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 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

Specification

Radiated Spurious Emissions

FCC §15.247(d) 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 radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section §15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(a)).

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.

Table 1: FCC 15.209 Spurious Emissions Limits

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 Spectrum Measurement

Measurement Uncertainty	+5.6/ -4.5 dB

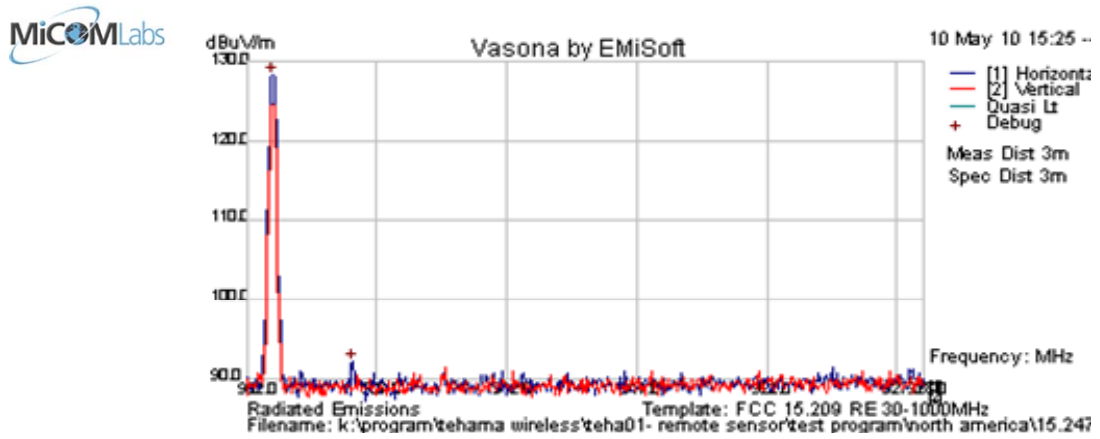
Traceability:

Method	**Test Equipment Used**
Work instruction WI-03	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

5.1.8.1. Transmitter Peak Emissions

Radiated Emissions – Peak Fundamental Emissions

Test Freq.	903.00 MHz	**Engineer**	CSB
Variant	FSK	**Temp (ºC)**	21.5
Freq. Range	902 - 928 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	Peak Emissions		
Test Notes 2	10dB attenuator, no preamp		

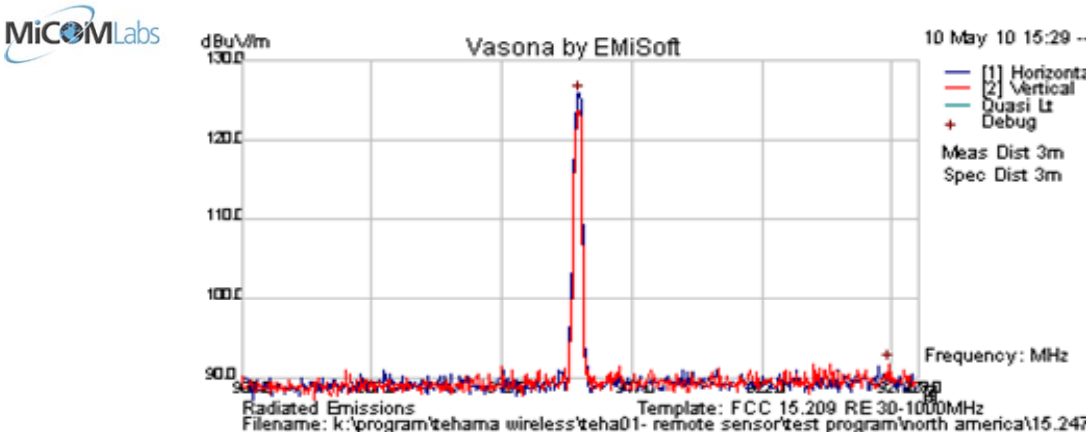


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
902.990	88.3	17.3	22.8	128.3	Peak [Scan]	H						PK

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	PK = Peak Emission of Fundamental

Test Freq.	915.00 MHz	**Engineer**	CSB
Variant	FSK	**Temp (°C)**	21.5
Freq. Range	902 - 928 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	Peak Emissions		
Test Notes 2	10dB attenuator, no preamp		

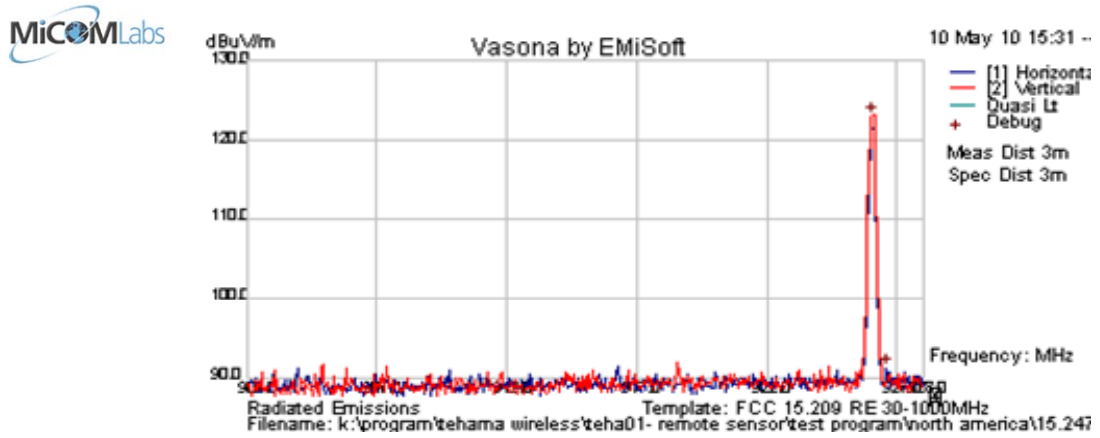


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
914.922	85.5	17.4	22.9	125.8	Peak [Scan]	H						PK

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	PK = Peak Emission of Fundamental

Test Freq.	926.00 MHz	**Engineer**	CSB
Variant	FSK	**Temp (°C)**	21.5
Freq. Range	902 - 928 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	Peak Emissions		
Test Notes 2	10dB attenuator, no preamp		



Formally measured emission peaks

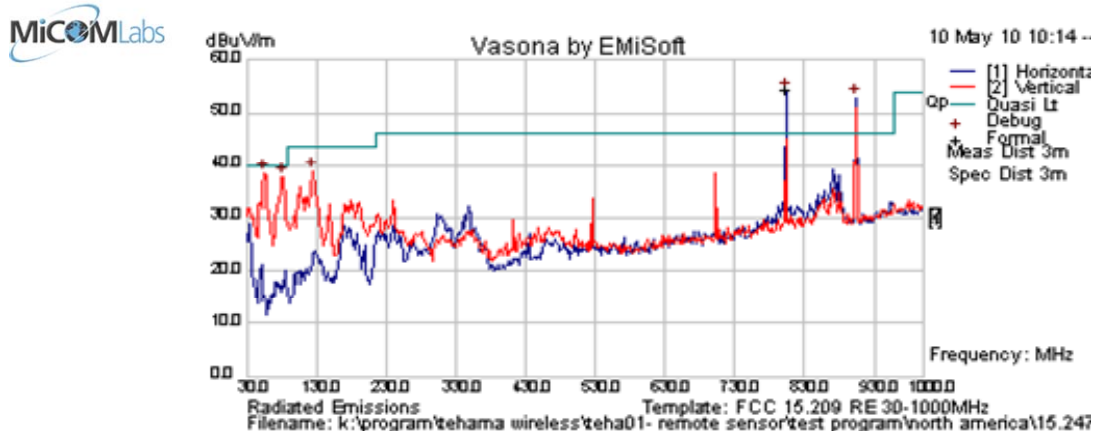
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
926.072	82.9	17.4	22.9	123.2	Peak [Scan]	V						PK

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	PK = Peak Emission of Fundamental

5.1.8.2. Transmitter Radiated Spurious Emissions

Radiated Spurious Emissions – [30-1000MHz]

Test Freq.	903.00 MHz	**Engineer**	CSB
Variant	FSK	**Temp (ºC)**	21.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	EUT Vertical on Test Table		
Test Notes 2	Fundamental attenuated by Band Stop Filter		



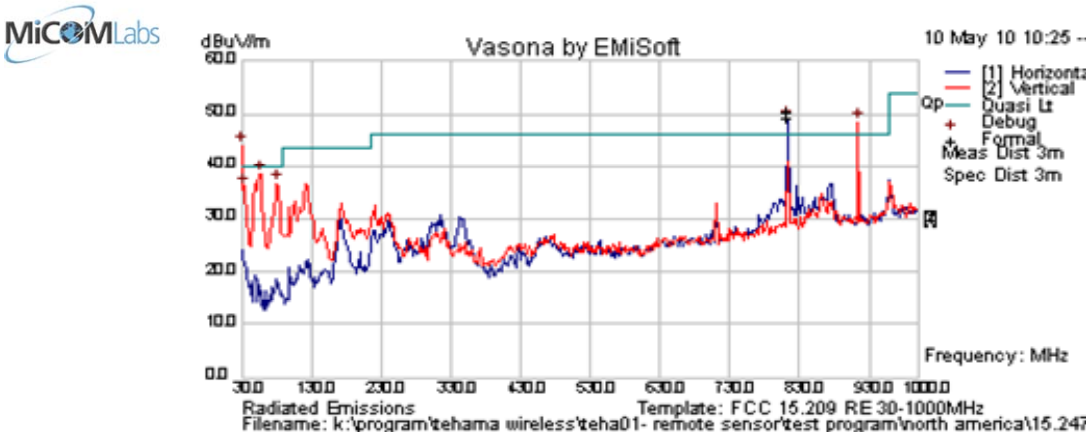
Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
802.651	55.7	7.2	-8.4	54.5	Peak	H	> 20dB below Fundamental				Pass	NRB

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission

Note: Fundamental is visible in plot. Please see Radiated Digital Emissions for emissions results not categorized as radio emissions (TX, NRB = Non Restricted Band, FUND)

Test Freq.	915 MHz	**Engineer**	CSB
Variant	FSK	**Temp (°C)**	21.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	EUT Vertical on Test Table		
Test Notes 2	Fundamental attenuated by Band Stop Filter		



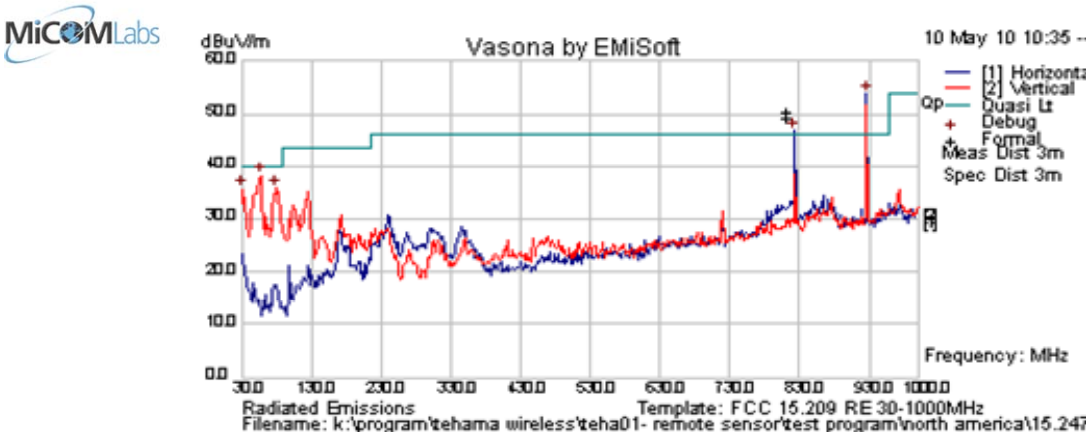
Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
811.984	51.5	7.2	-8.1	50.5	Peak	H	> 20dB below Fundamental				Pass	NRB

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission

Note: Fundamental is visible in plot. Please see Radiated Digital Emissions for emissions results not categorized as radio emissions (TX, NRB = Non Restricted Band, FUND)

Test Freq.	926 MHz	**Engineer**	CSB
Variant	FSK	**Temp (°C)**	21.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	EUT Vertical on Test Table		
Test Notes 2	Fundamental attenuated by Band Stop Filter		



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
823.092	47.7	7.2	-8.0	46.8	Peak [Scan]	H	> 20dB below Fundamental				Pass	NRB

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission

Note: Fundamental is visible in plot. Please see Radiated Digital Emissions for emissions results not categorized as radio emissions (TX, NRB = Non Restricted Band, FUND)

Radiated Spurious Emissions – [1000MHz – 10,000MHz]

EUT was tested at 100% duty cycle. Typical packet lengths are below 15ms, and channel does not repeat over a period of approximately 27 seconds. The slowest baud rate (highest spectral density) and longest operational packet length was used to calculate the duty cycle correction factor displayed below.

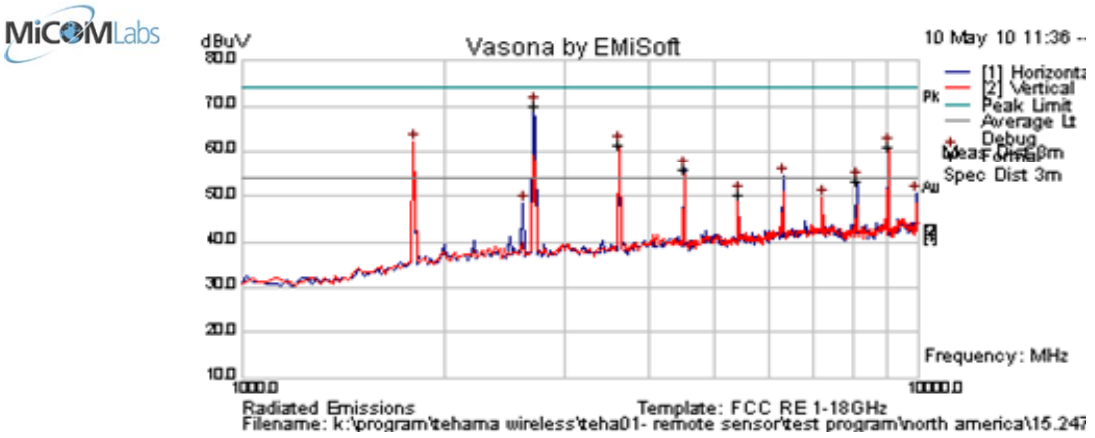
Slowest baud rate = 25Kbit/sec. At 25Kbit/sec, the longest packet will be 23.68mS, and our typical packet under 15mS.

Duty Cycle Correction Factor:

Duty cycle correction factor was applied to spurious emissions in the restricted bands closest to the fundamental transmission.

EUT Operational Duty Cycle: 23.68mS per 100mS window
Correction Factor = 20 * LOG (23.68 / 100)
Correction Factor = -12.51dB
Corrected Value = Measured Value (dB) - 12.51 (dB)

Test Freq.	903.00 MHz	**Engineer**	CSB
Variant	FSK	**Temp (°C)**	21.5
Freq. Range	1000 - 10000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	Duty Cycle correction factor applied as appropriate.		
Test Notes 2			



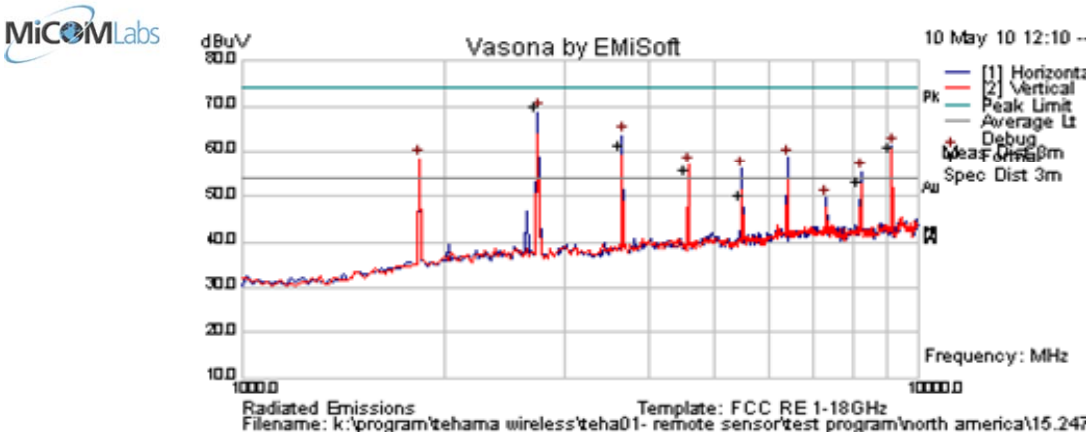
Duty Cycle Correction Factor (dB): 12.51

Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
1805.969	72.1	2.6	-12.7	62.0	Peak [Scan]	V	> 20dB below fundamental				Pass	NRB
2608.642	56.5	3.1	-11.4	48.2	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB
2708.978	78.2	3.2	-11.2	70.2	Peak [Scan]	H	100	0	74	-3.8	Pass	RB
2709.028	67.4	3.2	-11.2	59.4	10Hz VBW	H	101	220	54	-7.1	Pass	RB
3611.943	68.4	3.7	-10.7	61.3	Peak [Scan]	V	100	0	54	-5.2	Pass	RB
4514.976	61.5	4.2	-9.7	56.1	Peak [Scan]	H	100	0	54	-10.5	Pass	RB
5418.006	55.0	4.6	-9.2	50.5	Peak [Scan]	V	100	0	54	-16.1	Pass	RB
6320.892	56.1	5.1	-6.7	54.4	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB
7223.908	49.6	5.4	-5.5	49.5	Peak [Scan]	V	> 20dB below fundamental				Pass	NRB
8126.854	51.6	5.7	-4.0	53.3	Peak [Scan]	H	100	0	54	-13.2	Pass	RB
9029.881	58.4	6.2	-3.7	61.0	Peak [Scan]	H	100	0	54	-5.6	Pass	RB
9932.881	46.6	6.4	-2.7	50.4	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	DCCF = Duty Cycle Correction Factor Applied

Test Freq.	914.9 MHz	**Engineer**	CSB
Variant	FSK	**Temp (°C)**	21.5
Freq. Range	1000 - 10000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	Duty Cycle correction factor applied as appropriate.		
Test Notes 2			



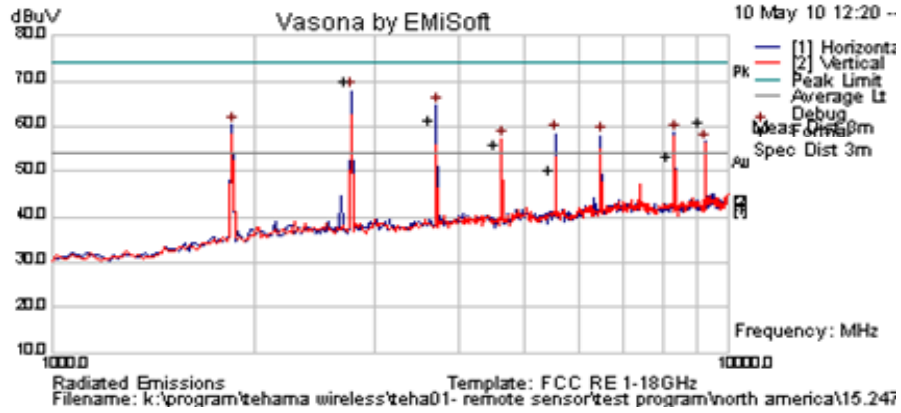
Duty Cycle Correction Factor (dB): 12.51

Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
1829.762	68.5	2.6	-12.8	58.4	Peak [Scan]	V	> 20dB below fundamental				Pass	NRB
2744.689	77.0	3.2	-11.6	68.7	Peak [Scan]	H	100	0	74.0	-5.3	Pass	RB
2744.689	71.3	3.2	-11.6	63.0	10Hz VBW	H	100	0	54	-3.6	Pass	RB
3659.587	70.6	3.7	-10.7	63.6	Peak [Scan]	H	100	0	54	-2.9	Pass	RB
4574.459	62.7	4.2	-10.1	56.9	Peak [Scan]	V	100	0	54	-9.7	Pass	RB
5489.352	60.1	4.6	-8.8	56.0	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB
6404.289	60.2	5.1	-6.6	58.7	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB
7319.238	49.2	5.4	-5.0	49.6	Peak [Scan]	H	100	0	54	-16.9	Pass	RB
8233.955	53.3	5.7	-3.6	55.5	Peak [Scan]	H	100	0	54	-11.0	Pass	RB
9148.957	58.4	6.2	-3.3	61.3	Peak [Scan]	H	100	0	54	-5.3	Pass	RB

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission

Test Freq.	926 MHz	**Engineer**	CSB
Variant	FSK	**Temp (°C)**	21.5
Freq. Range	1000 - 10000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	Duty Cycle correction factor applied as appropriate.		
Test Notes 2			



Duty Cycle Correction Factor (dB): 12.51

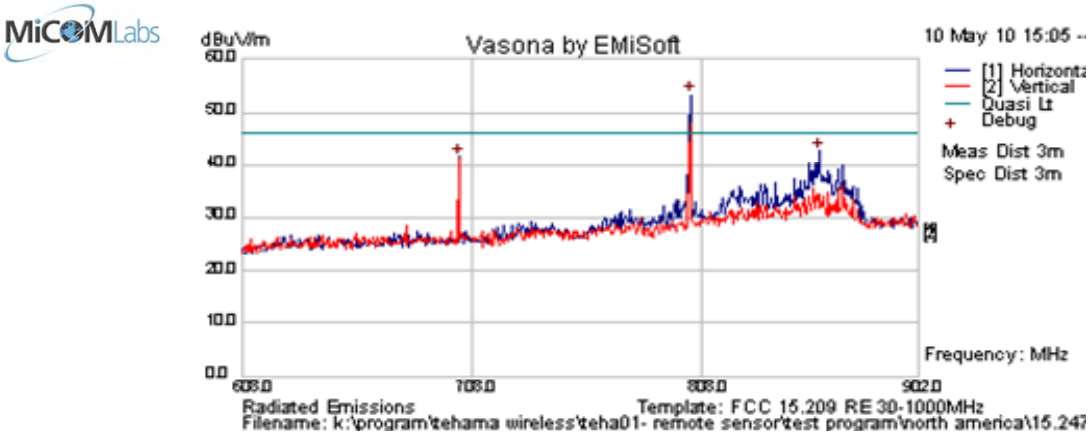
Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
1851.973	70.1	2.7	-12.5	60.2	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB
2777.957	76.3	3.2	-11.6	67.9	Peak [Scan]	H	100	0	74.0	-6.1	Pass	RB
2777.957	73.2	3.2	-11.6	64.8	10Hz VBW	H	100	0	54	-1.7	Pass	RB
3703.937	71.4	3.7	-10.5	64.7	Peak [Scan]	H	100	0	54	-1.8	Pass	RB
4629.961	62.6	4.3	-9.8	57.1	Peak [Scan]	V	100	0	54	-9.4	Pass	RB
5555.932	62.2	4.7	-8.5	58.4	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB
6481.941	59.4	5.1	-6.6	58.0	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB
8333.968	56.4	5.8	-3.6	58.5	Peak [Scan]	H	100	0	54	-8.0	Pass	RB
9259.915	53.0	6.2	-2.8	56.5	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission

5.1.8.3. Band Edge Emissions

Test Freq.	903 MHz	**Engineer**	CSB
Variant	FSK	**Temp (°C)**	21.5
Freq. Range	Band Edge	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	AC Powered		
Test Notes 2			

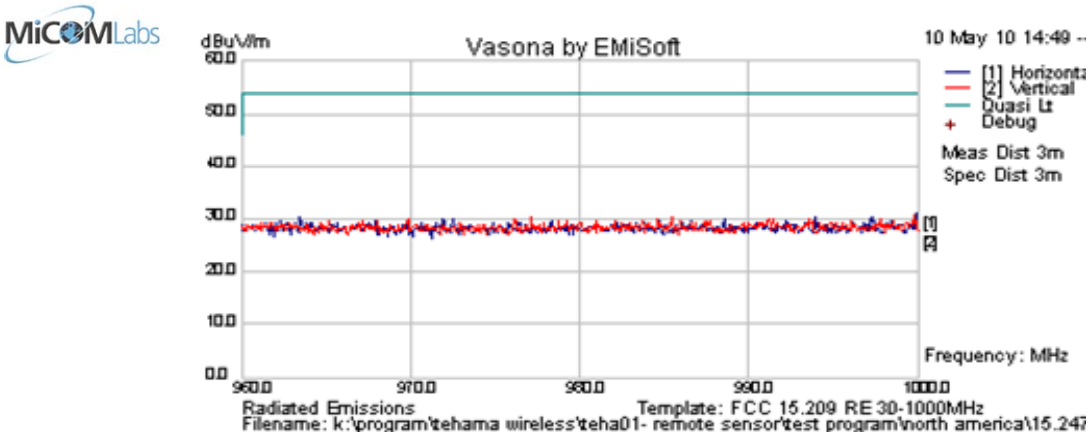


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
Emissions covered under radiated spurious emissions												

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission

Test Freq.	926 MHz	**Engineer**	CSB
Variant	FSK	**Temp (°C)**	21.5
Freq. Range	Band Edge	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	AC Powered		
Test Notes 2			



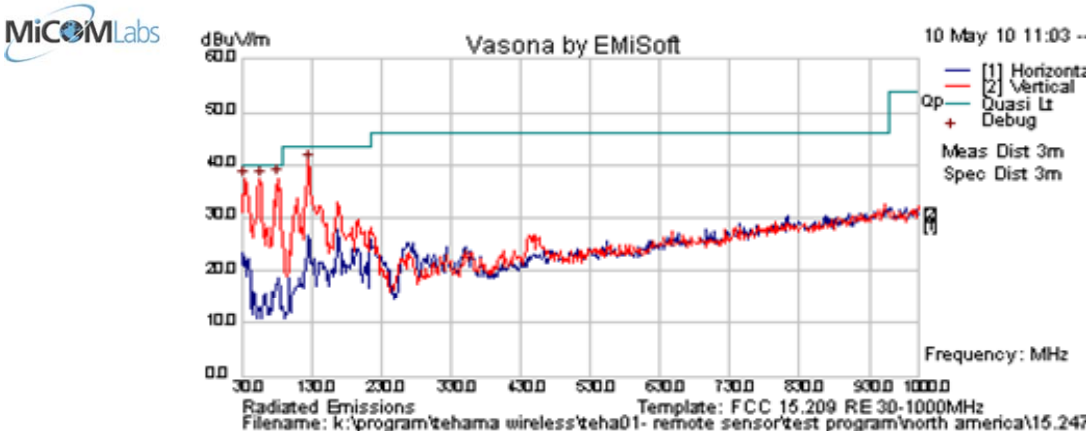
Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No radio emissions within 6dB of limit.												

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission

5.1.8.4. Receiver Radiated Spurious Emissions

Test Freq.	913.5 MHz	**Engineer**	CSB
Variant	FSK	**Temp (°C)**	21.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	AC Powered		
Test Notes 2			



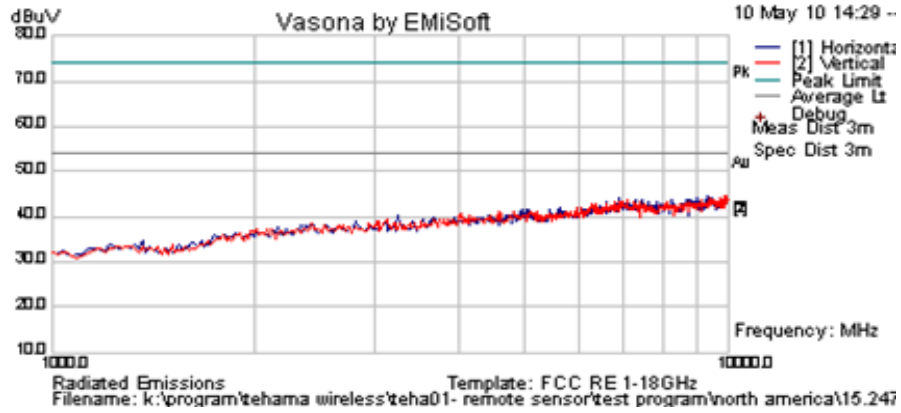
Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No radio emissions within 6dB of limit. 30 - 125 MHz emissions from Power Supply.												

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission

Note: Fundamental is visible in plot. Please see Radiated Digital Emissions for emissions results not categorized as radio emissions (TX, NRB. FUND)

Test Freq.	2437 MHz	**Engineer**	CSB
Variant	FSK	**Temp (°C)**	21.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	AC Powered		
Test Notes 2			



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No radio emissions within 6dB of limit.												

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission

FCC, Part 15 Subpart C §15.247(d)
Industry Canada RSS-210 §A8.5

Specification

FCC Part 15 Subpart C §15.247(d)

Industry Canada §A8.5

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, provided the transmitter demonstrates compliance with the peak conducted power limits.

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'	0287, 0335, 0338, 0158, 0134, 0304, 0311, 0315, 0310, 0312

5.1.9. Radiated Spurious Emissions – Digital Emissions

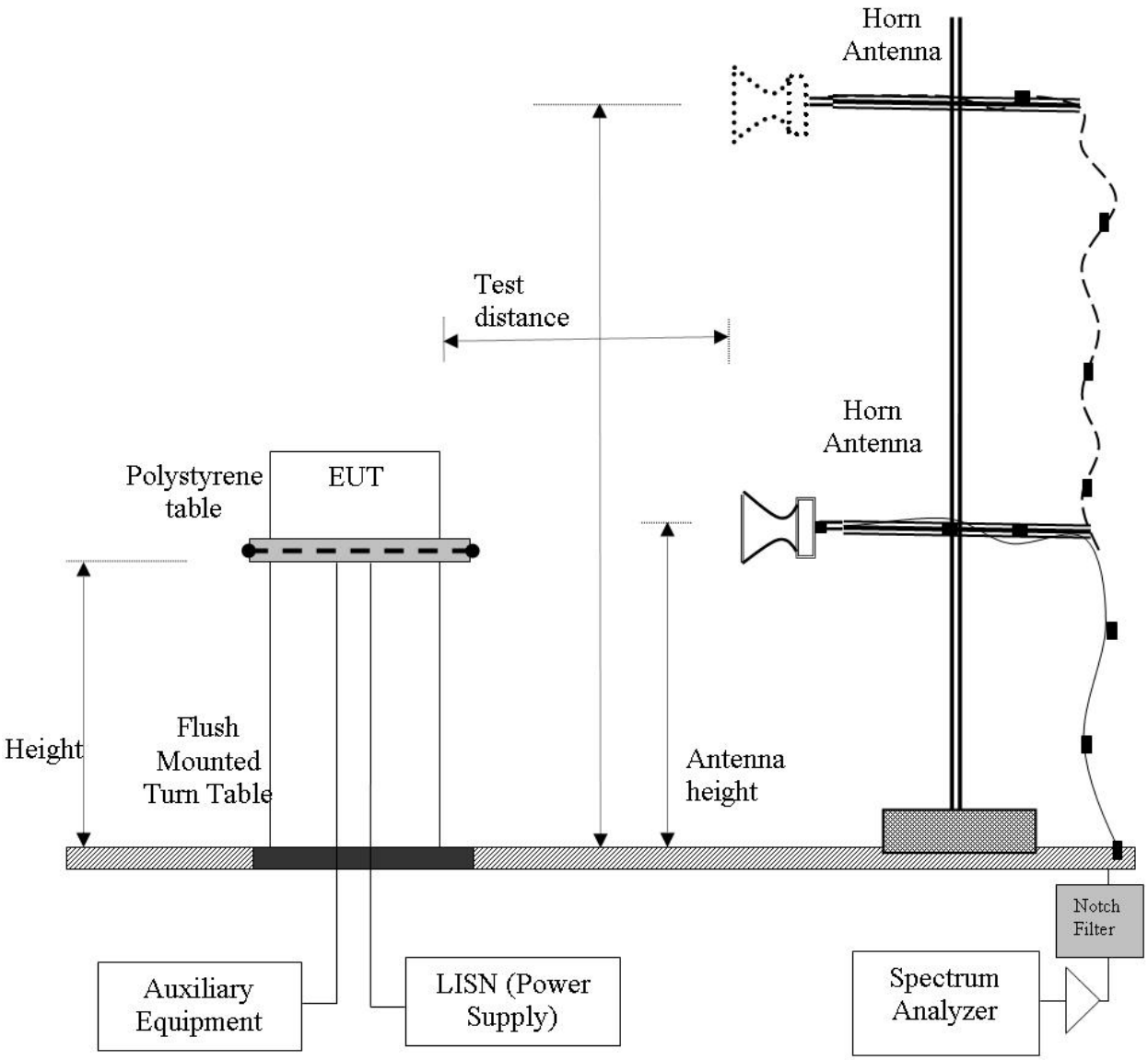
FCC, Part 15 Subpart C §15.247(d), §15.205, 15.109

Test Procedure

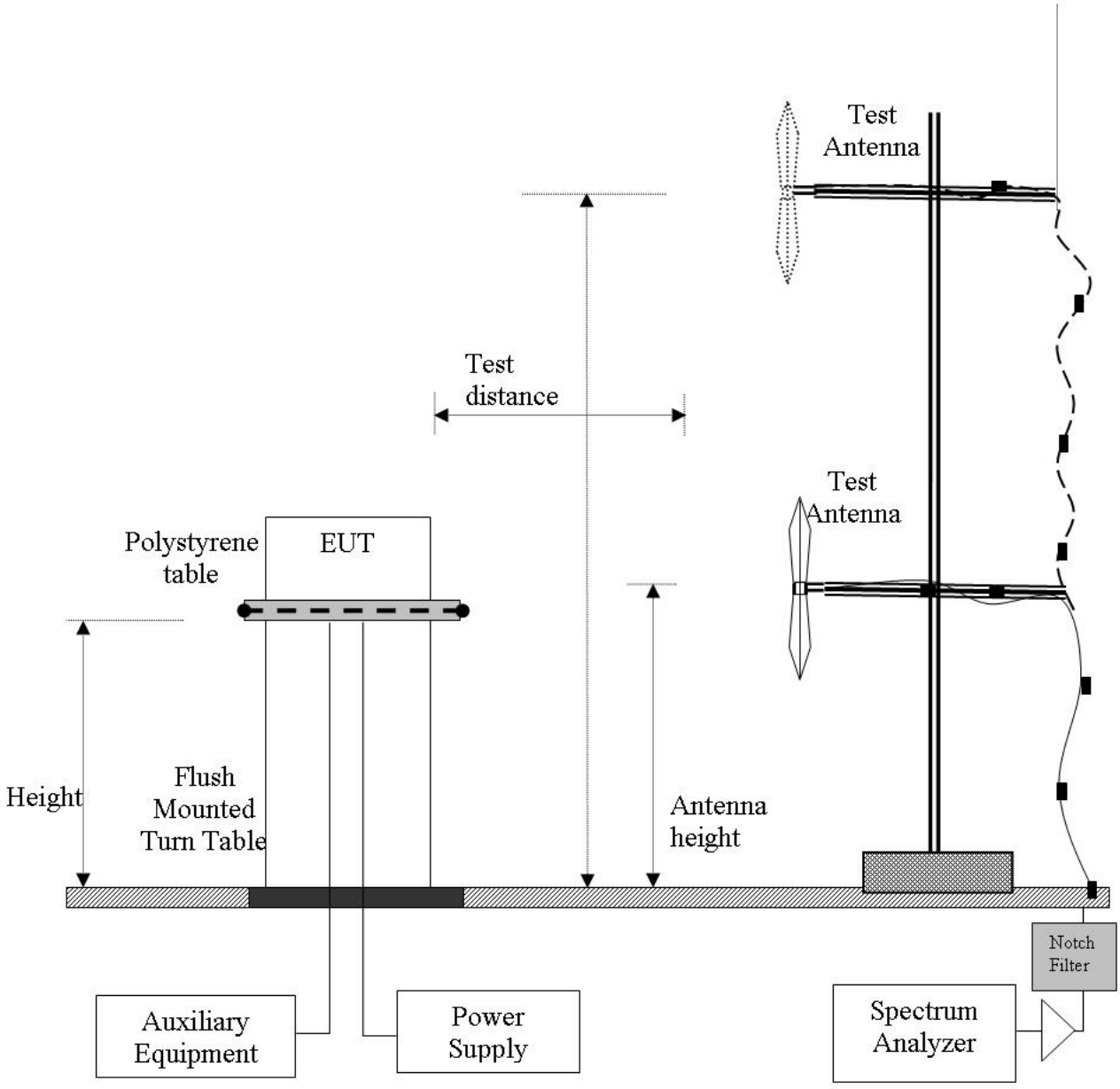
Testing was performed in a 3-meter anechoic chamber. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. Preliminary emissions were recorded with in Spectrum Analyzer mode, using a maximum peak detector while in peak hold mode.

Emissions nearest the limits were chosen for maximization and formal measurement using a CISPR Compliant receiver. Emissions above 1000 MHz are measured utilizing a CISPR compliant average detector with a tuned receiver, using a bandwidth of 1 MHz. Emissions from 30 MHz – 1000 MHz are measured utilizing a CISPR compliant quasi-peak detector with a tuned receiver, using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed.

Test Measurement Set Up



Radiated Emission Measurement Setup – Above 1 GHz



Radiated Emission Measurement Setup – Below 1 GHz

Test Measurement Set Up

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

FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

Field Strength Calculation 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 and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 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

Specification

Radiated Spurious Emissions

FCC §15.247(d) 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 radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section §15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(a)).

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.

Table 1: FCC 15.209 Spurious Emissions Limits

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 Spectrum Measurement

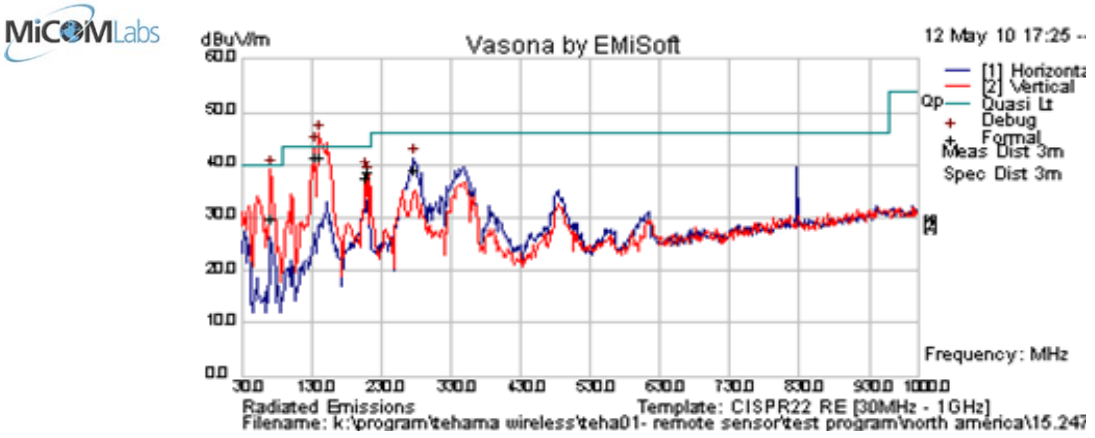
Measurement Uncertainty	+5.6/ -4.5 dB

Traceability:

Method	**Test Equipment Used**
Work instruction WI-03	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

5.1.9.1. Radiated Digital Emissions

Test Freq.	Rx Mode - 914.9 MHz	**Engineer**	CSB
Variant	Digital Emissions	**Temp (°C)**	25
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	38
Power Setting	Receive Mode	**Press. (mBars)**	1005
Antenna	Integral		
Test Notes 1	AC Power supply on table. EUT vertical on table.		
Test Notes 2			

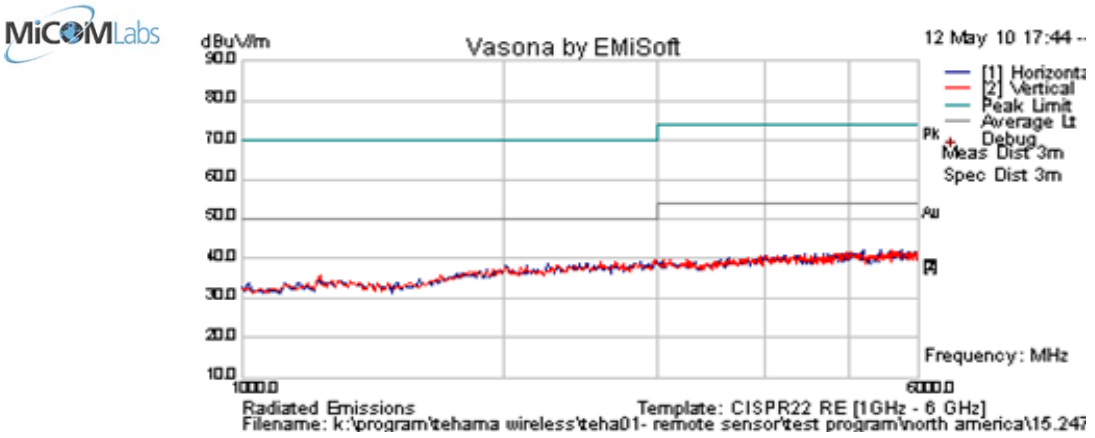


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
71.566	49.1	3.9	-23.1	29.9	Quasi Max	V	158	104	40	-10.1	Pass	DIG
134.483	54.4	4.4	-17.3	41.5	Quasi Max	V	99	118	43.5	-2.0	Pass	DIG
140.979	55.2	4.4	-18.1	41.5	Quasi Max	V	105	100	43.5	-2.0	Pass	DIG
208.240	52.3	4.8	-19.6	37.5	Quasi Max	V	98	249	43.5	-6.0	Pass	DIG
212.572	53.4	4.8	-19.7	38.5	Quasi Max	V	98	27	43.5	-5.0	Pass	DIG
277.628	51.0	5.1	-17.1	39.1	Quasi Max	H	120	53	46	-6.9	Pass	DIG

Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

Test Freq.	Rx Mode - 914.9 MHz	**Engineer**	CSB
Variant	Digital Emissions	**Temp (°C)**	25
Freq. Range	1000 MHz - 6000 MHz	**Rel. Hum.(%)**	38
Power Setting	Receive Mode	**Press. (mBars)**	1005
Antenna	Integral		
Test Notes 1	AC Power supply on table. EUT vertical on table.		
Test Notes 2			



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No emissions w ithing 6dB of the limit.												

Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

Specification

Limits

§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.

§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.

§15.109 (b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 3 meters, shall not exceed the following:

§15.109 (b) Limit Matrix Class A digital device

Frequency(MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance (meters)
30-88	100	49.5	3
88-216	150	54.0	3
216-960	200	57.0	3
Above 960	500	60.0	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'	0287, 0335, 0338, 0158, 0134, 0304, 0311, 0315, 0310, 0312, 0341

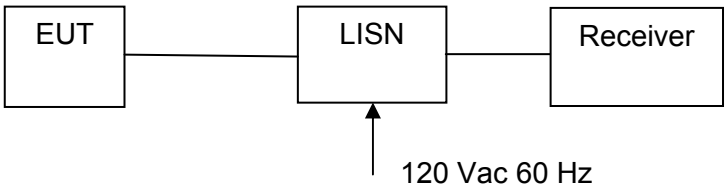
5.1.10. AC Wireline Conducted Emissions (150 kHz – 30 MHz)

FCC, Part 15 Subpart C §15.207
Industry Canada RSS-Gen §7.2.2

Test Procedure

The measurement frequency range extends from 150 kHz to 30 MHz. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

Test Measurement Setup



Measurement set up for Conducted Emissions Test

Specification

§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, 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 following table, as measured using a 50 μΩ line impedance stabilization network (LISN), see §15.207 (a) matrix below. 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.

Limits

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

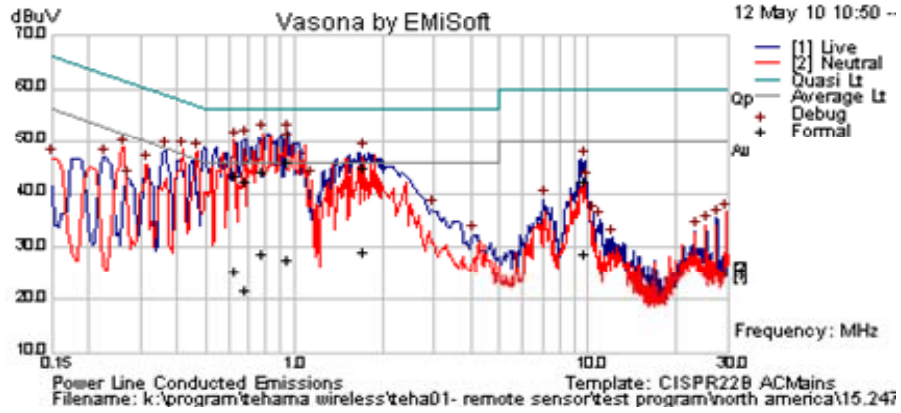
Traceability

All conducted emission measurements are traceable to national standards. The uncertainty of measurement at a confidence level of not less than 95 %, with a coverage factor of k=2, in the range 9 kHz – 30 MHz (Average & Quasi-peak) is ±2.64 dB.

Laboratory Measurement Uncertainty	
Measurement uncertainty	±2.64 dB

Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0193, 0190, 0293, 0307, 156, 193, 190

Test Freq.	N/A	**Engineer**	CSB
Variant	AC Line Emissions	**Temp (ºC)**	25
Freq. Range	0.150 MHz - 30 MHz	**Rel. Hum.(%)**	38
Power Setting	Transmitting at Max Power	**Press. (mBars)**	1005
Antenna	Integral		
Test Notes 1			
Test Notes 2			



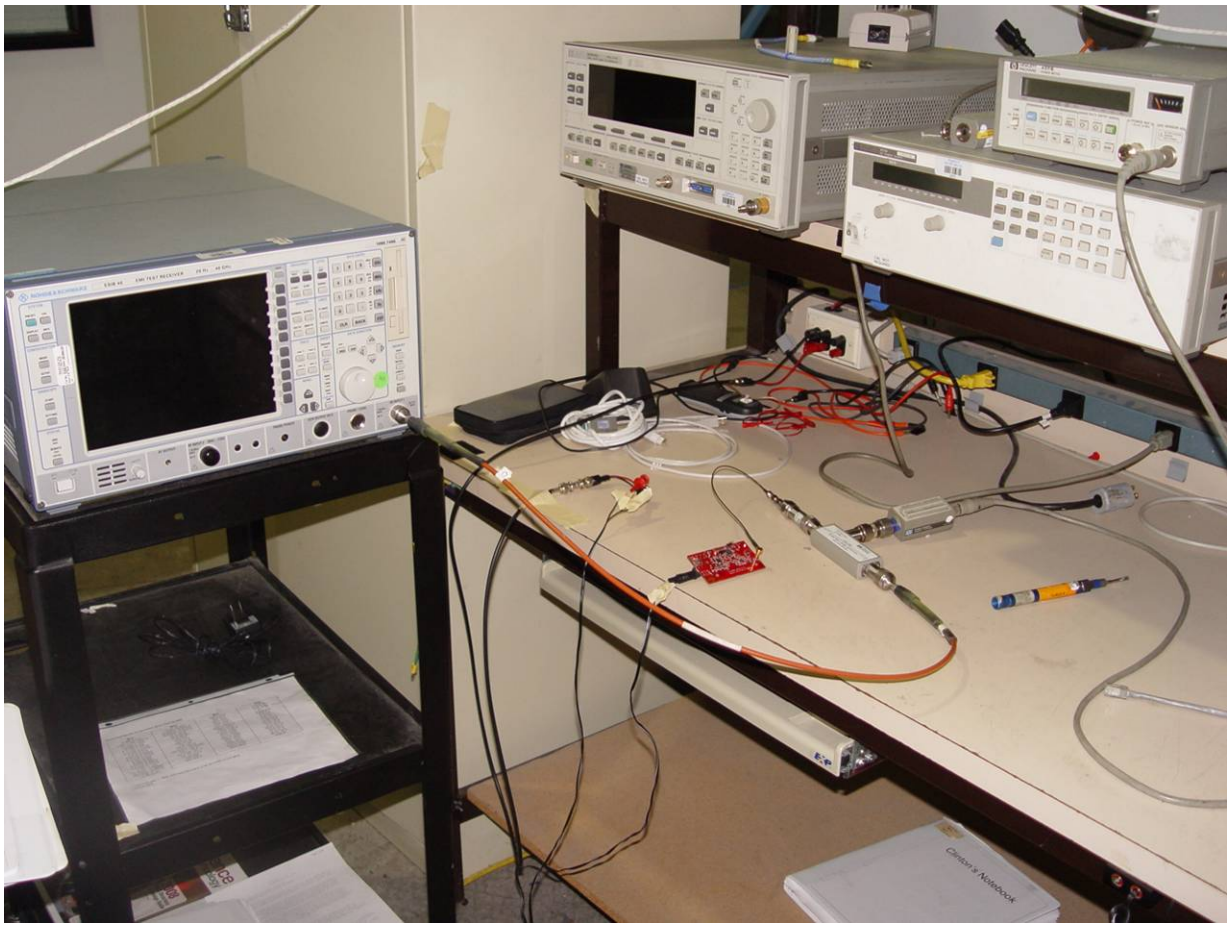
Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.629	15.4	10.0	0.1	25.5	Average	Live	46	-20.6	Pass	
0.629	33.5	10.0	0.1	43.5	Quasi Peak	Live	56	-12.5	Pass	
0.685	11.7	10.0	0.1	21.7	Average	Live	46	-24.3	Pass	
0.685	32.2	10.0	0.1	42.2	Quasi Peak	Live	56	-13.8	Pass	
0.788	34.2	10.0	0.1	44.2	Quasi Peak	Neutral	56	-11.8	Pass	
0.788	18.8	10.0	0.1	28.8	Average	Neutral	46	-17.2	Pass	
0.948	17.5	9.9	0.1	27.6	Average	Neutral	46	-18.5	Pass	
0.948	36.1	9.9	0.1	46.1	Quasi Peak	Neutral	56	-9.9	Pass	
1.740	34.7	10.0	0.1	44.8	Quasi Peak	Live	56	-11.2	Pass	
1.740	18.9	10.0	0.1	29.1	Average	Live	46	-16.9	Pass	
9.736	18.1	10.3	0.4	28.7	Average	Live	50	-21.3	Pass	
9.736	31.9	10.3	0.4	42.5	Quasi Peak	Live	60	-17.5	Pass	

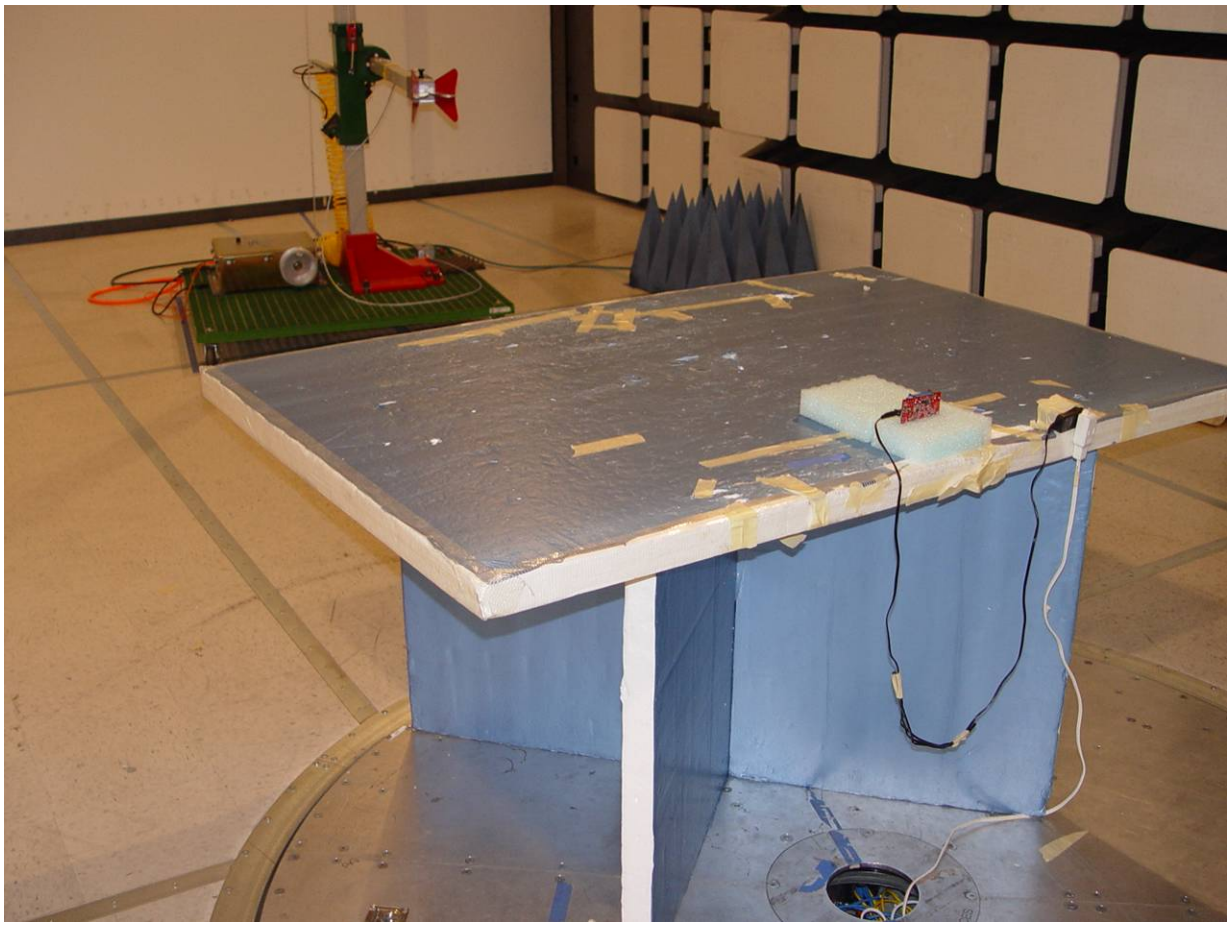
Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

6. PHOTOGRAPHS

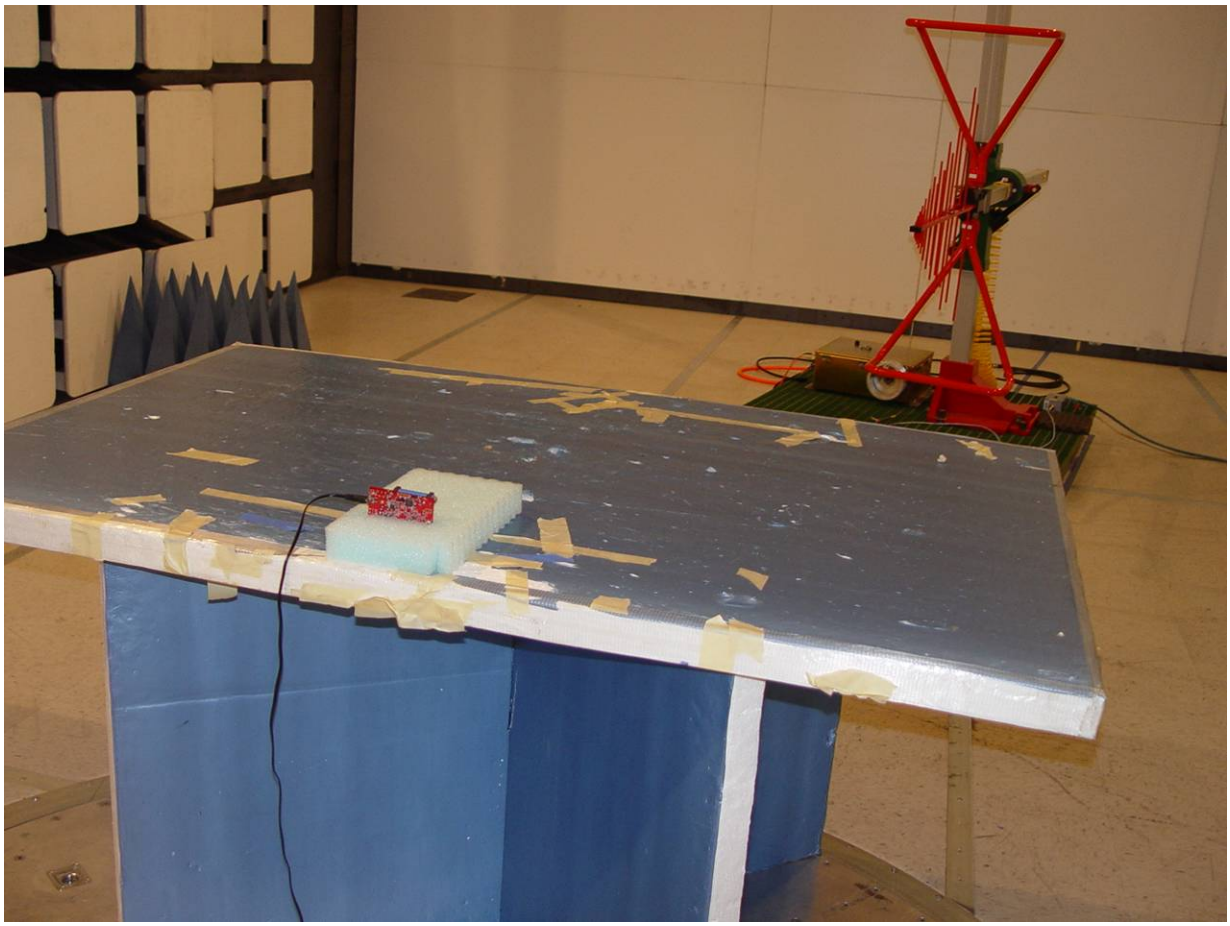
6.1. General Measurement Test Set-Up



6.2. Radiated Emissions >1 GHz



6.3. Radiated Emissions <1 GHz



6.4. AC Mains Conducted Emissions

7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0158	Barometer /Thermometer	Control Co.	4196	E2844
0184	Pulse Limiter	Rhode & Schwarz	ESH3Z2	357.8810.52
0190	LISN	Rhode & Schwarz	ESH3Z5	836679/006
0223	Power Meter	Hewlett Packard	HP EPM-442A	US37480256
0251	K-Cable	Megaphase	Sucoflex 104	Unknown
0252	K-Cable	Megaphase	Sucoflex 104	Unknown
0253	K-Cable	Megaphase	Sucoflex 104	Unknown
0256	K-Cable	Megaphase	Sucoflex 104	Unknown
0271	Amplifier	1 to 26.5 GHz	MiCOM	--
0287	EMI Receiver	Rhode & Schwarz	ESIB 40	100201
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
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	3140A01285
0314	30 dB N-Type Attenuator	ARRA	N944-30	1623
0335	Horn Antenna	The Electro-Mechanics Company	3117	00066580
0337	Amplifier	30 MHz – 3 GHz	MiCOM	--
0338	Antenna (30M-3GHz)	Sunol Sciences	JB3	A052907
0341	902-928 MHz Notch Filter	EWT	EWT-14-0199	H1
0363	Switch	MiCOM Labs	--	--

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