Test of Tehama Wireless TW100

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

Test Report Serial No.: TEHA01-U1 Rev A

TEST REPORT

FROM

MiCOM Labs

Test of Tehama Wireless TW100

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

Test Report Serial No.: TEHA01-U1 Rev A

This report supersedes: None

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

Product Function: Remote Sensor

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
Fax: +1 (925) 462-0306
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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

ilac-MRA

A2LA World Class Accreditation

The American Association for Laboratory 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

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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

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.

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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:	TW100	Fax:	+1 925 462 0306
S/N:	81000102		
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.

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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	2008 2006+A1:2007	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 P101	9th June 2010	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.

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3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Test of the Tehama Wireless TW100 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-U1 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:	TW100
Location for use:	Indoor/Outdoor
Declared Frequency Range(s):	902 - 928 MHz
Type of Modulation:	FSK
Declared Nominal Output Power:	11 dBm (+2 dB /- 2dB)
EUT Modes of Operation:	FHSS
Transmit/Receive Operation:	Transceiver, Simplex
Rated Input Voltage and Current:	3 VDC (Battery Powered)
Operating Temperature Range:	-20 - +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 :	3.5 oz
Primary function of equipment:	Remote Sensor

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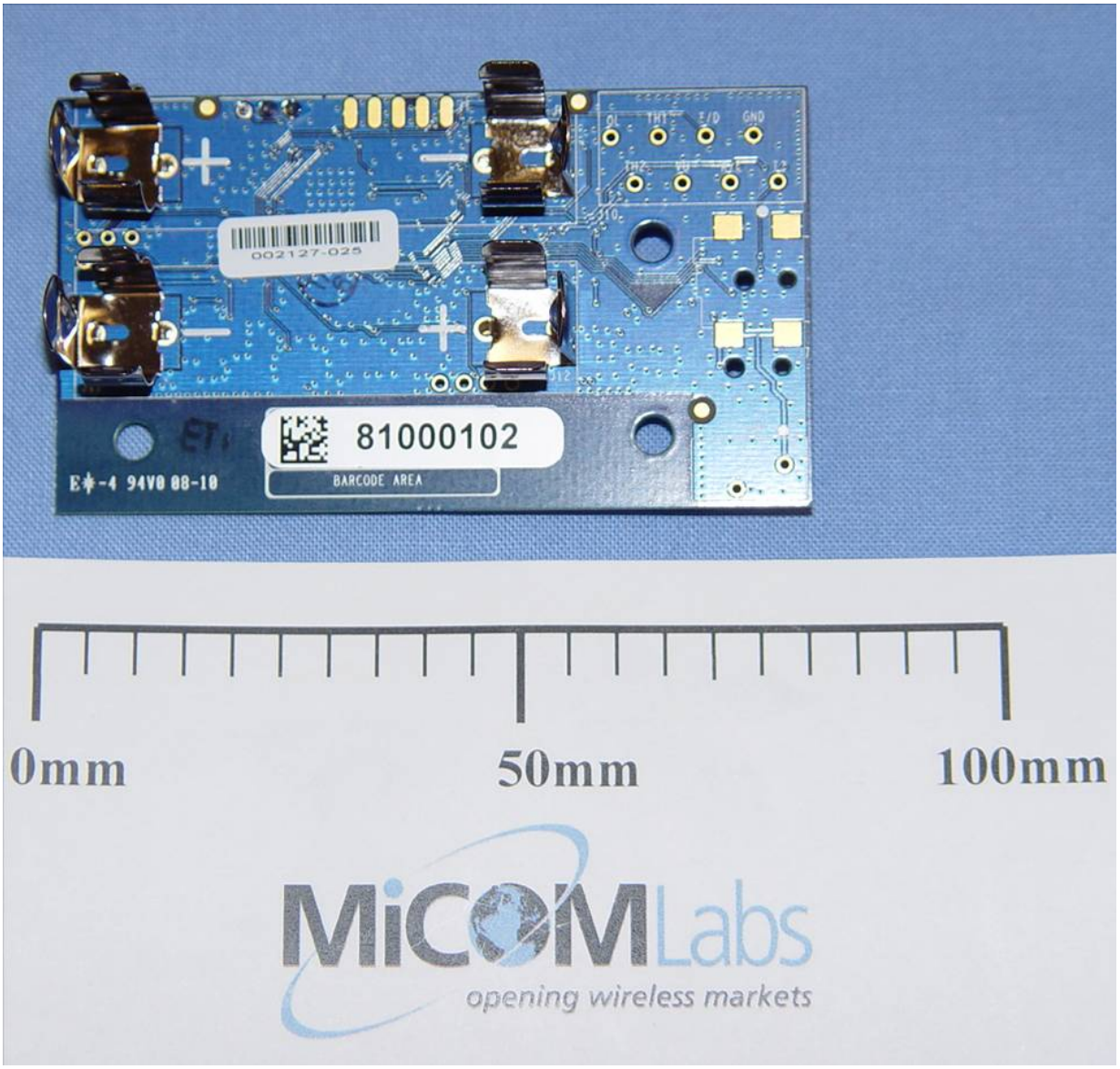
3.2. Scope of Test Program

The scope of the test program was to test the Tehama Wireless TW100 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.

TW100 PCB Top



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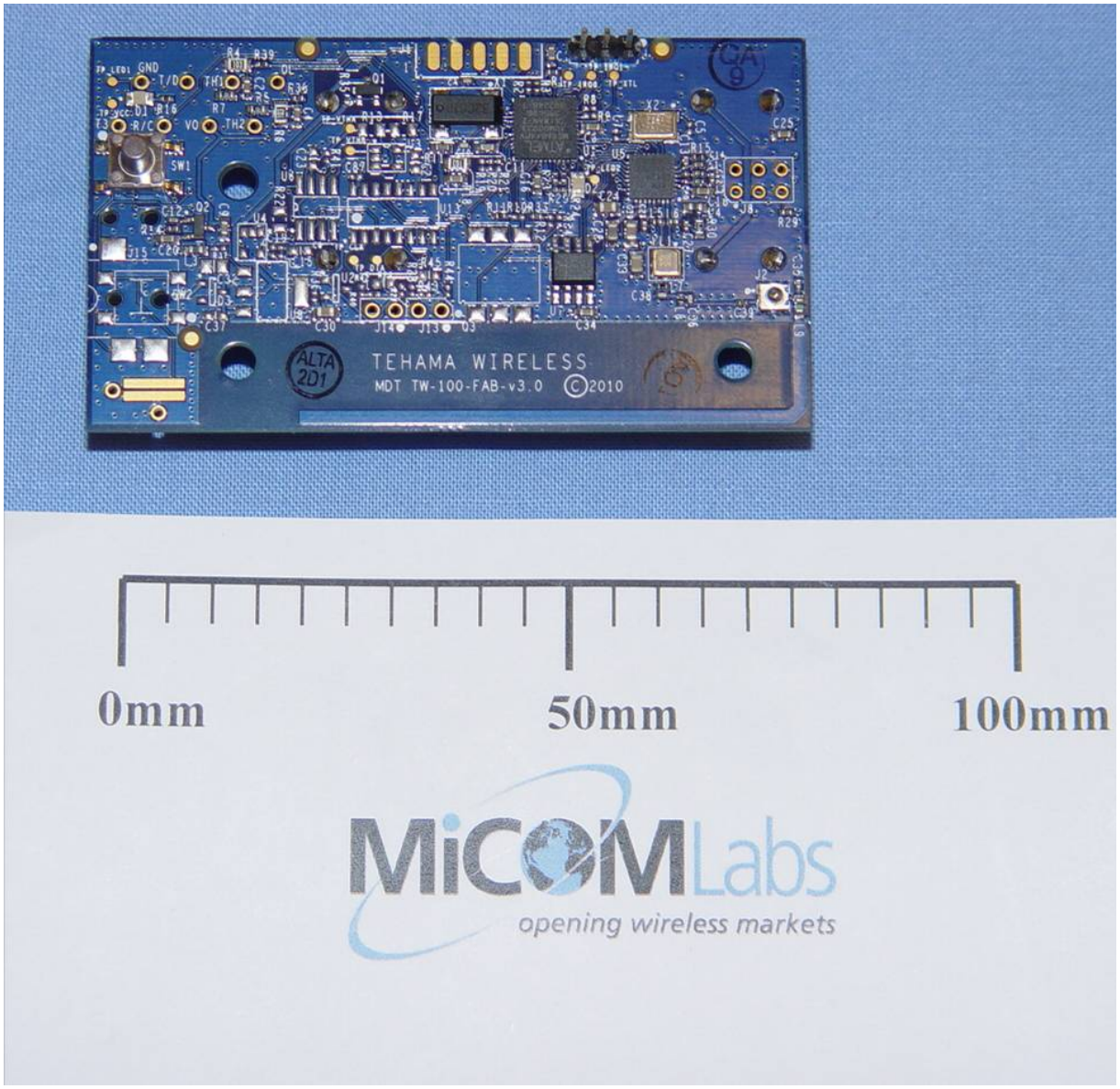
TW100 PCB Underside\



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

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	TW100 with FCC test code	Tehama Wireless	TW100	81000102
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

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3.4. Antenna Details

- Integral PCB Whip Antenna: 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 (2 x AA type)
- Serial Port (3 pin) Local Maintenance Terminal

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3.6. 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	0.013	20	304K	304KF1D	ATMega 644
903	926	0.014	20	133K	133KF1D	ATMega 644
903	913.325	0.014	20	133K	133KF1D	ATMega 644
914.9	926	0.014	20	133K	133KF1D	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

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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

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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

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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 above 1 GHz	Transmitter Peak Emissions Radiated Spurious Emissions	Radiated	Complies	*5.1.8.1* *5.1.8.2*
4.10		Receiver	Radiated	Complies	*5.1.8.3*
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*

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5. TEST RESULTS

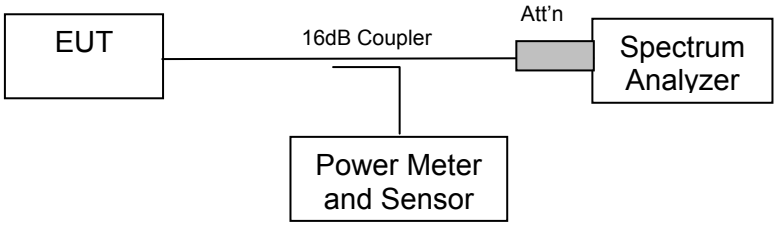
5.1. Device Characteristics

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

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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;

Channel #	Center Frequency (MHz)	20 dB Bandwidth (kHz)	Specification (kHz)
0	903.00	126.2525	<500
31	914.90	132.2645	
59	926.00	126.5030	

TABLE OF RESULTS: 100kHz Deviation;

Channel #	Center Frequency (MHz)	20 dB Bandwidth (kHz)	Specification (kHz)
0	903.00	303.6072	<500
31	914.90	302.1042	
59	926.00	303.6072	

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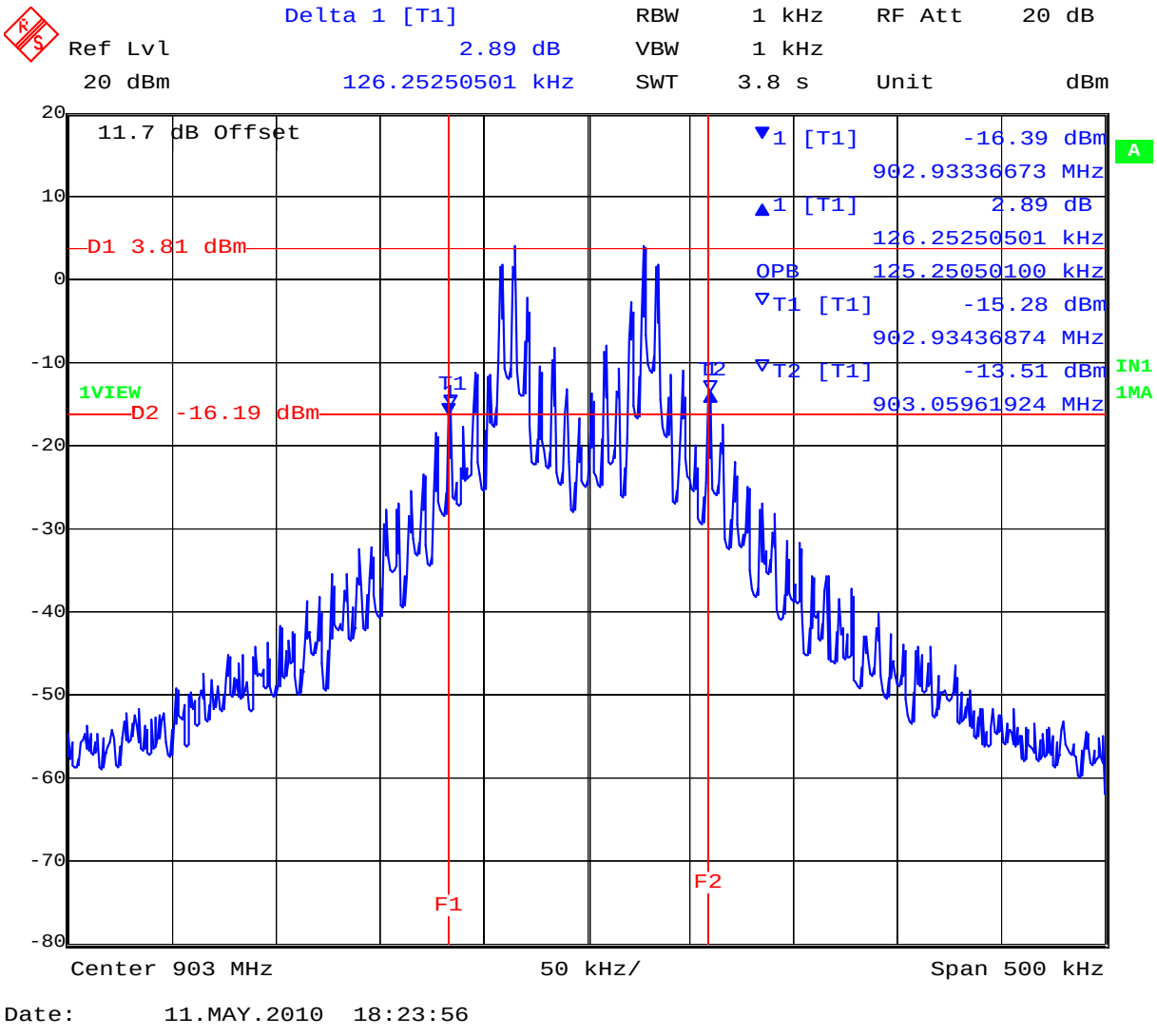
5.1.1.1. 33kHz Deviation Test Results:

CH 0 903.00 MHz 20 dB Bandwidth



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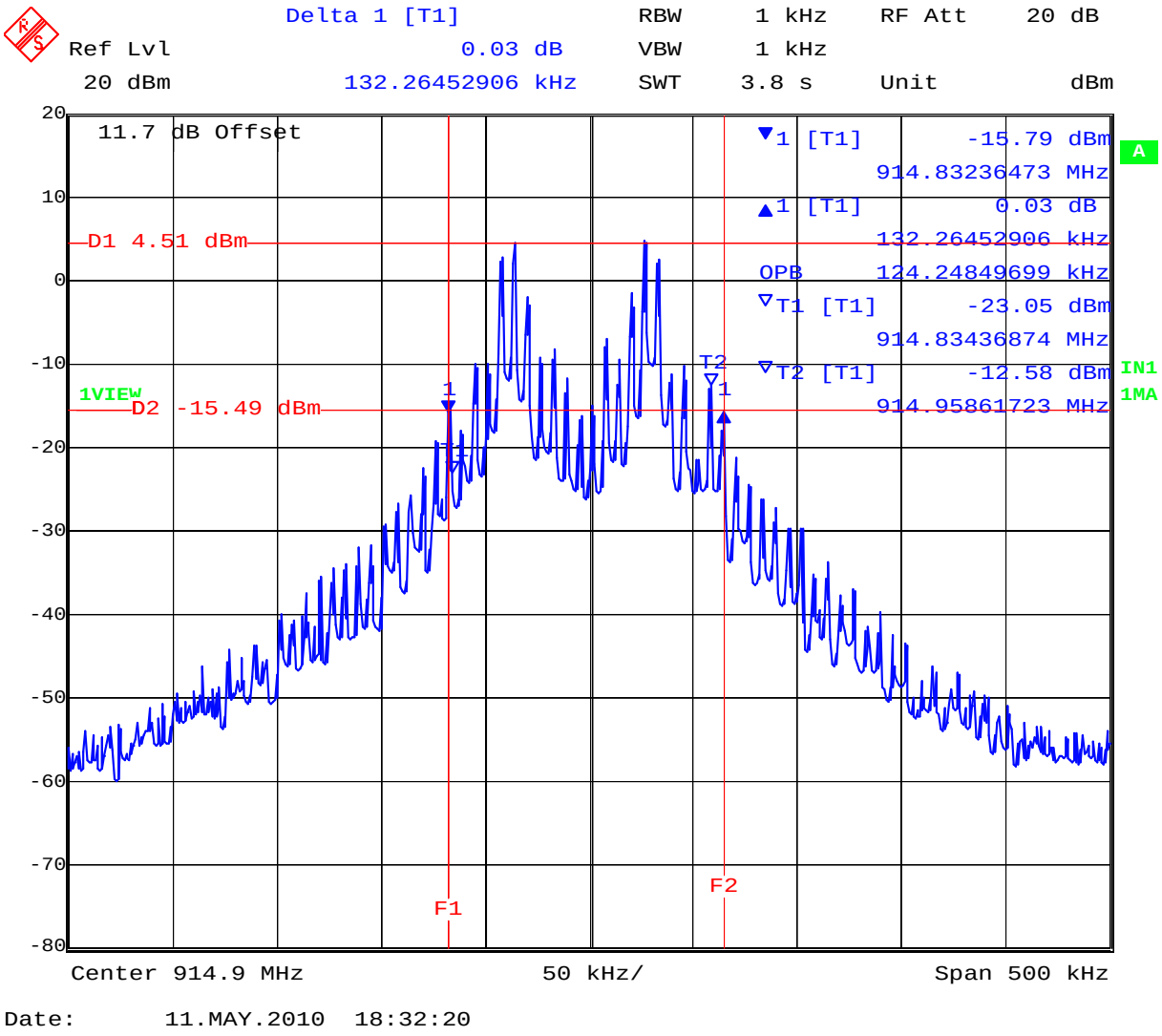
CH 31 914.90 MHz 20 dB Bandwidth



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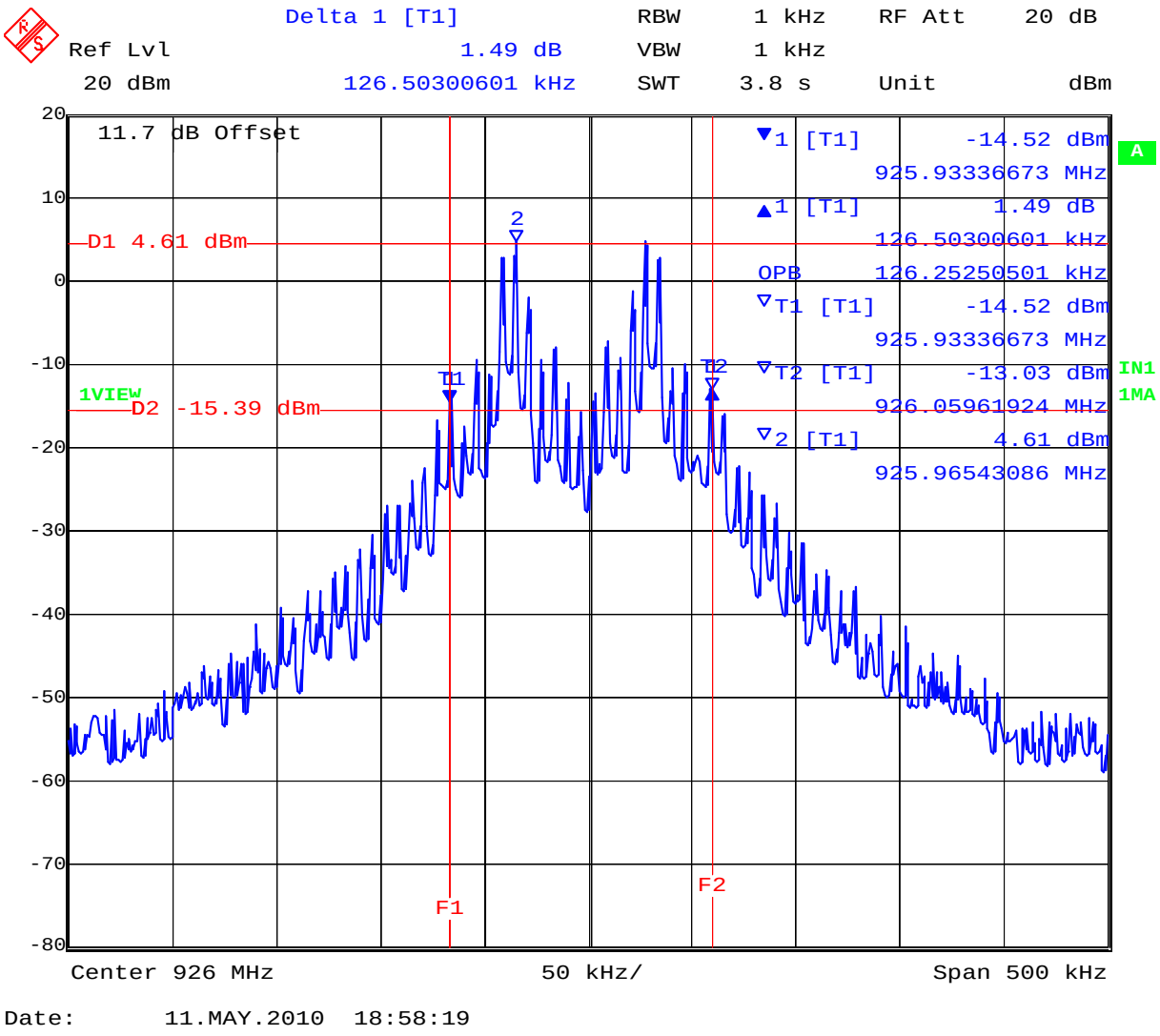
CH 59 926.00 MHz 20 dB Bandwidth



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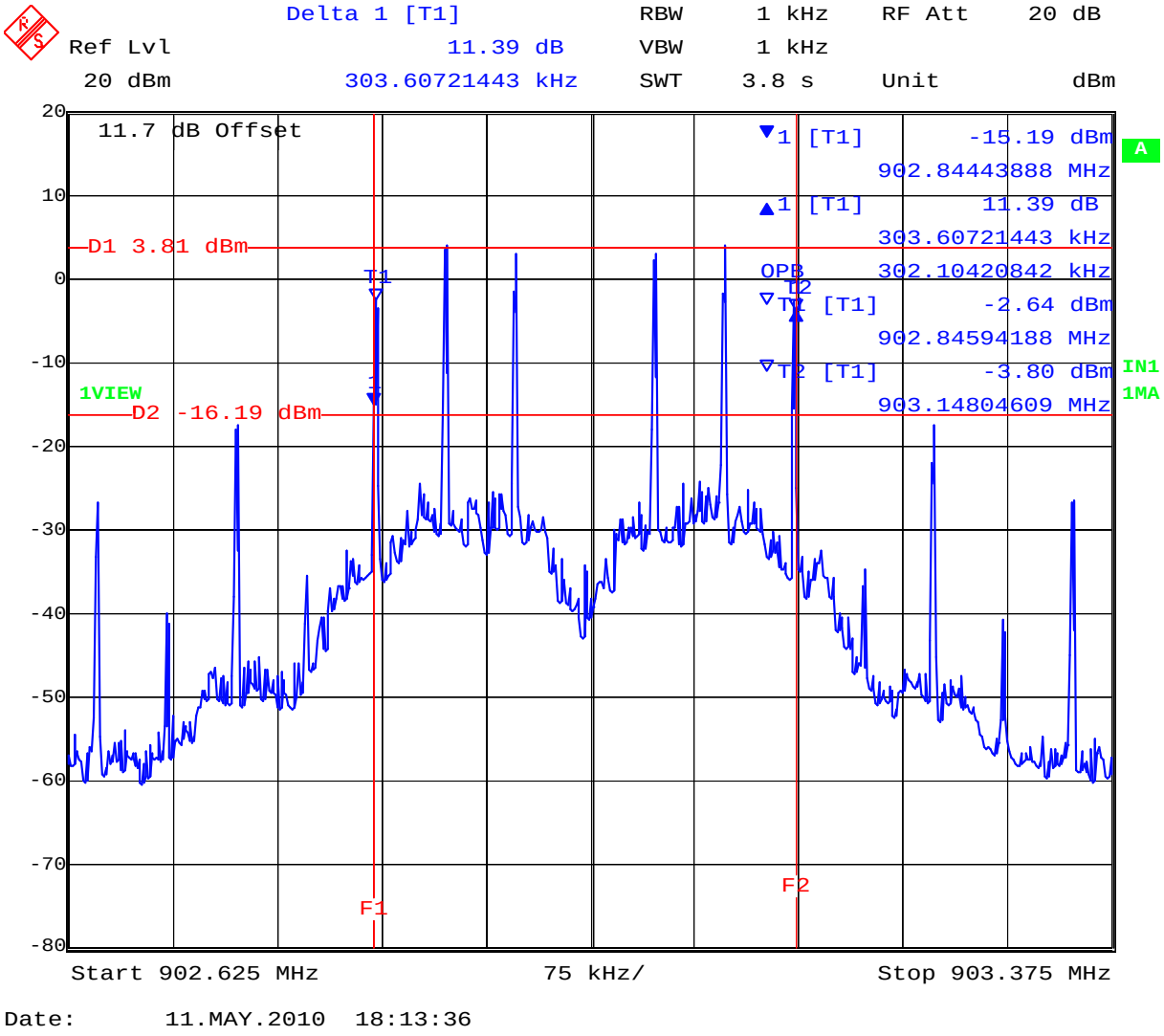
5.1.1.2. 100kHz Deviation Test Results:

CH 0 903.00 MHz 20 dB Bandwidth



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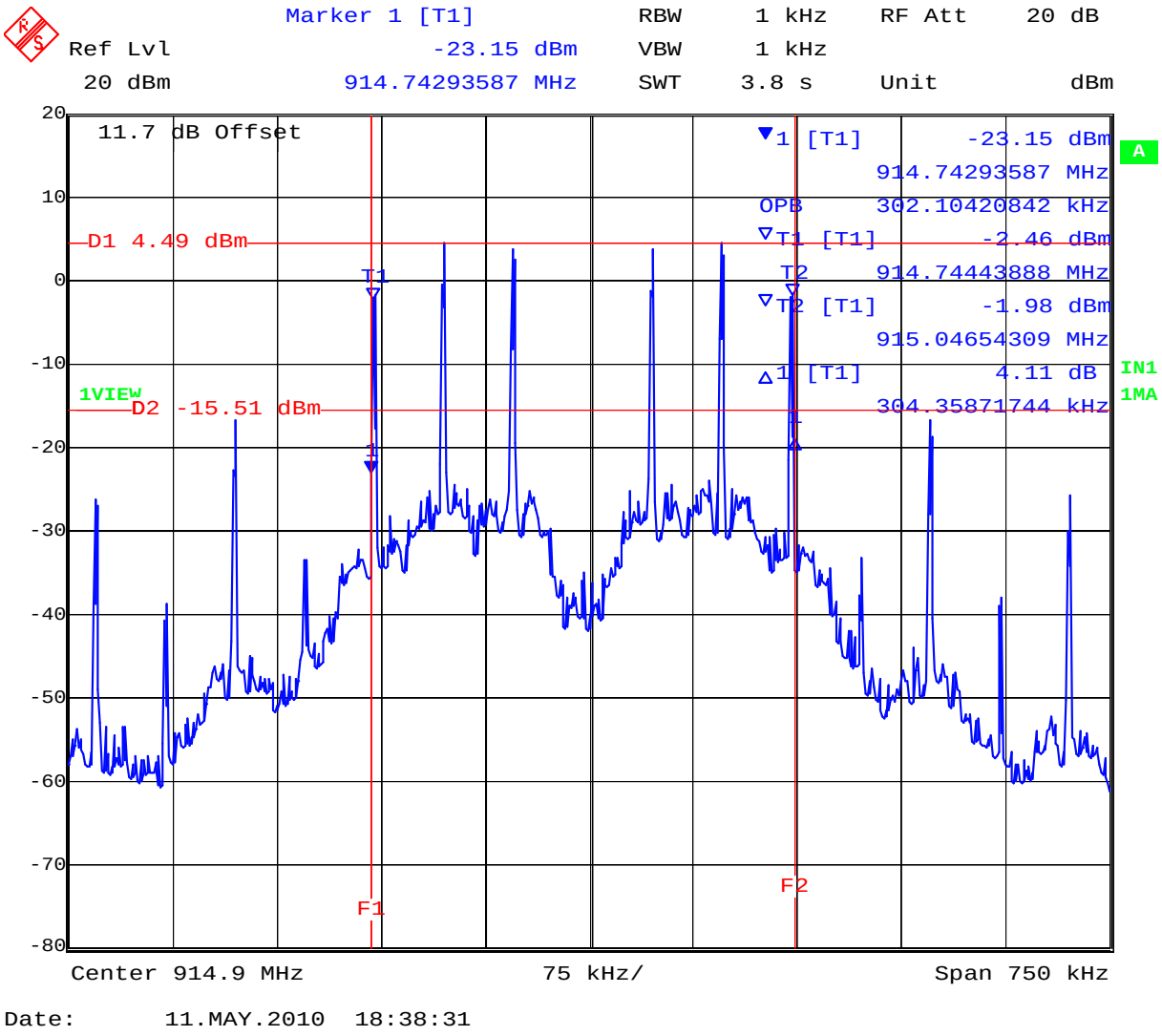
CH 31 914.90 MHz 20 dB Bandwidth



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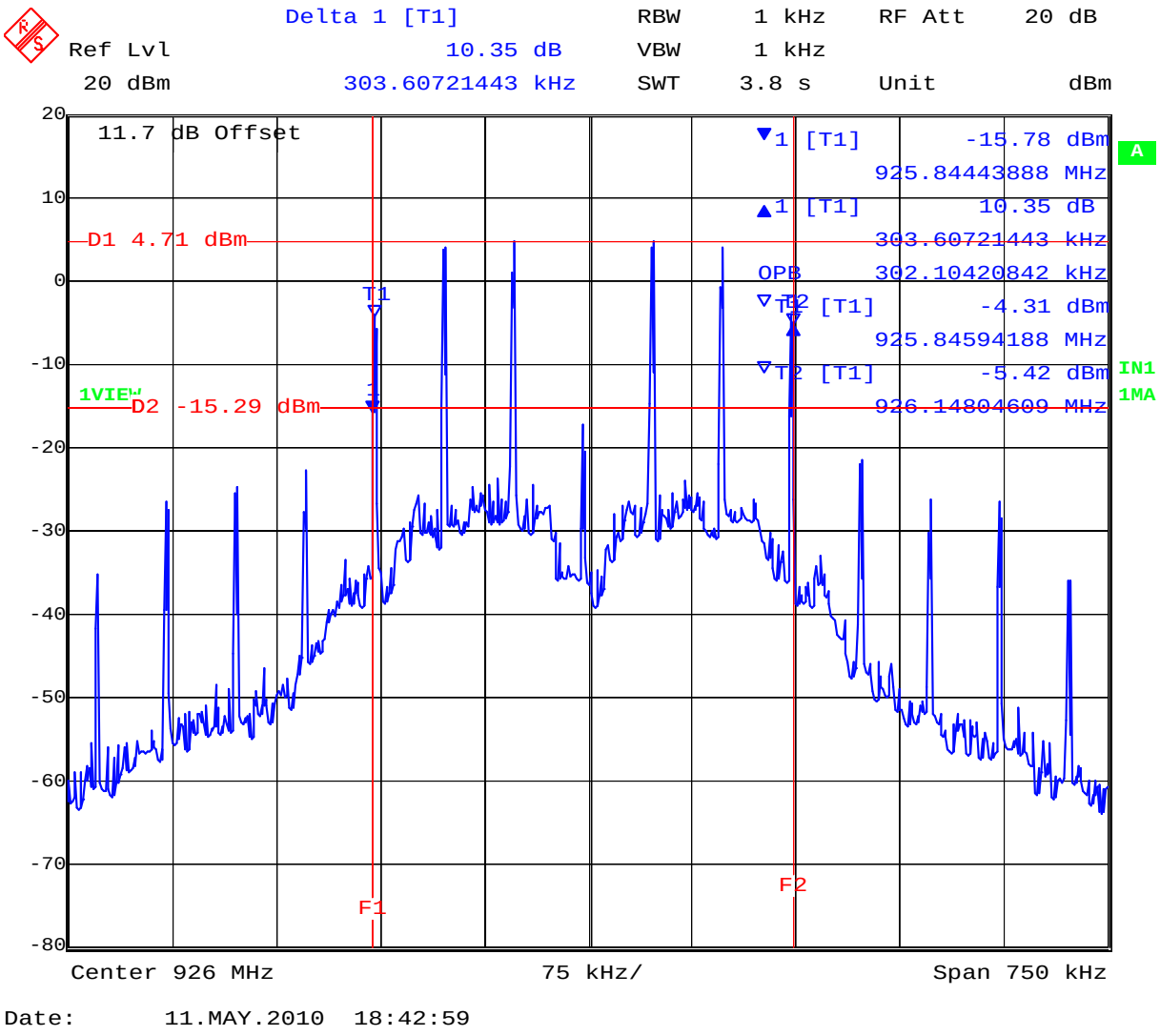
CH 59 926.00 MHz 20 dB Bandwidth



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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

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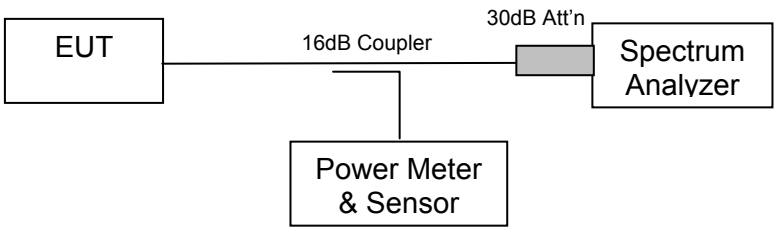
5.1.2. Transmitter Channels - Channel Spacing

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

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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.)	175.51	Greater than maximum 20 dB Bandwidth
36-37 (33kHz Dev.)	350.2004	Greater than maximum 20 dB Bandwidth
36-37 (100kHz Dev.)	351.7034	Greater than maximum 20 dB Bandwidth

Maximum 20 dB bandwidth = 126.50 kHz (33kHz)

Maximum 20 dB bandwidth = 302.6072 kHz (100kHz)

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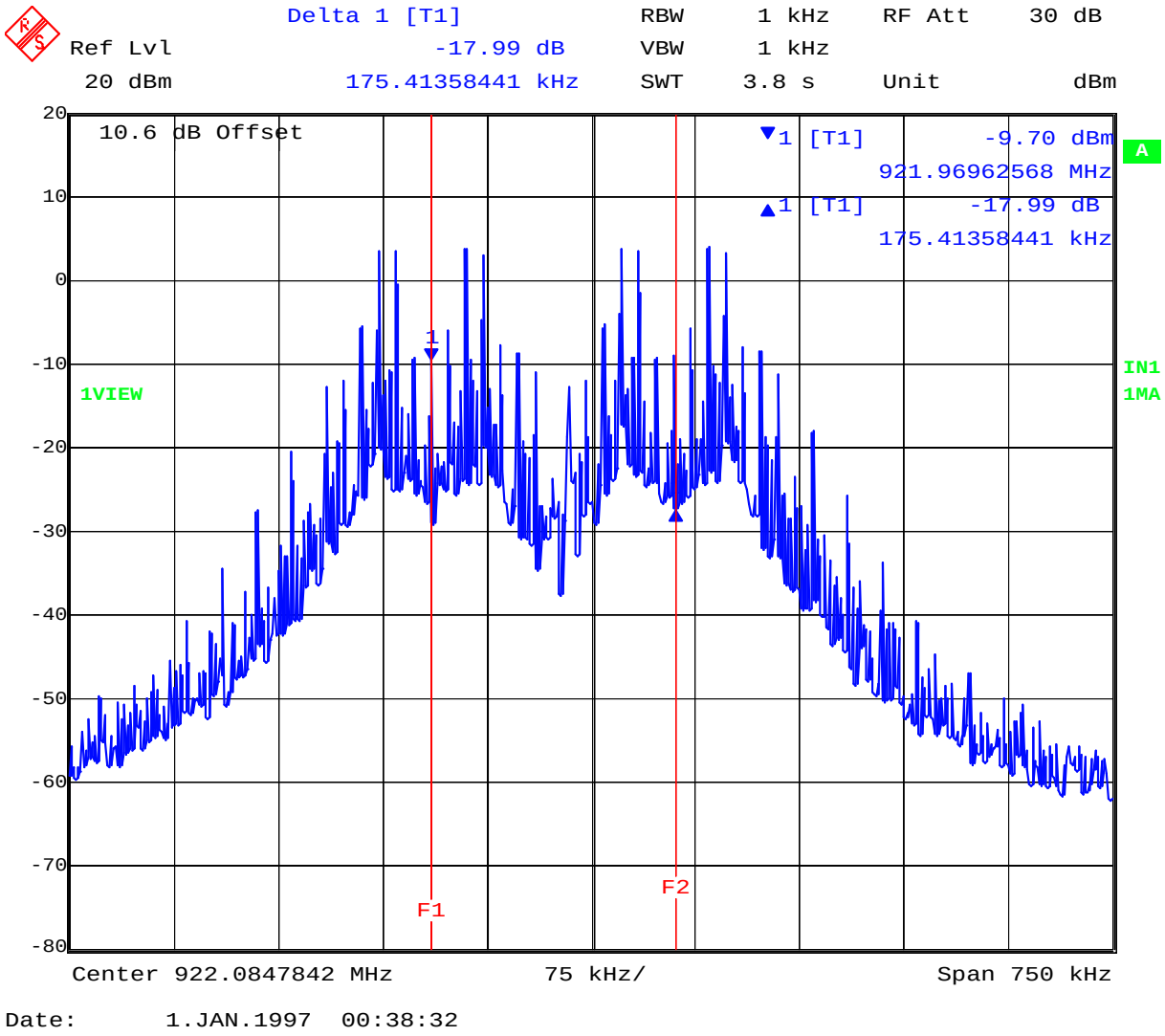
Channel Spacing for CH 36 – CH 37; 30 kHz Deviation; 175kHz Channel Separation



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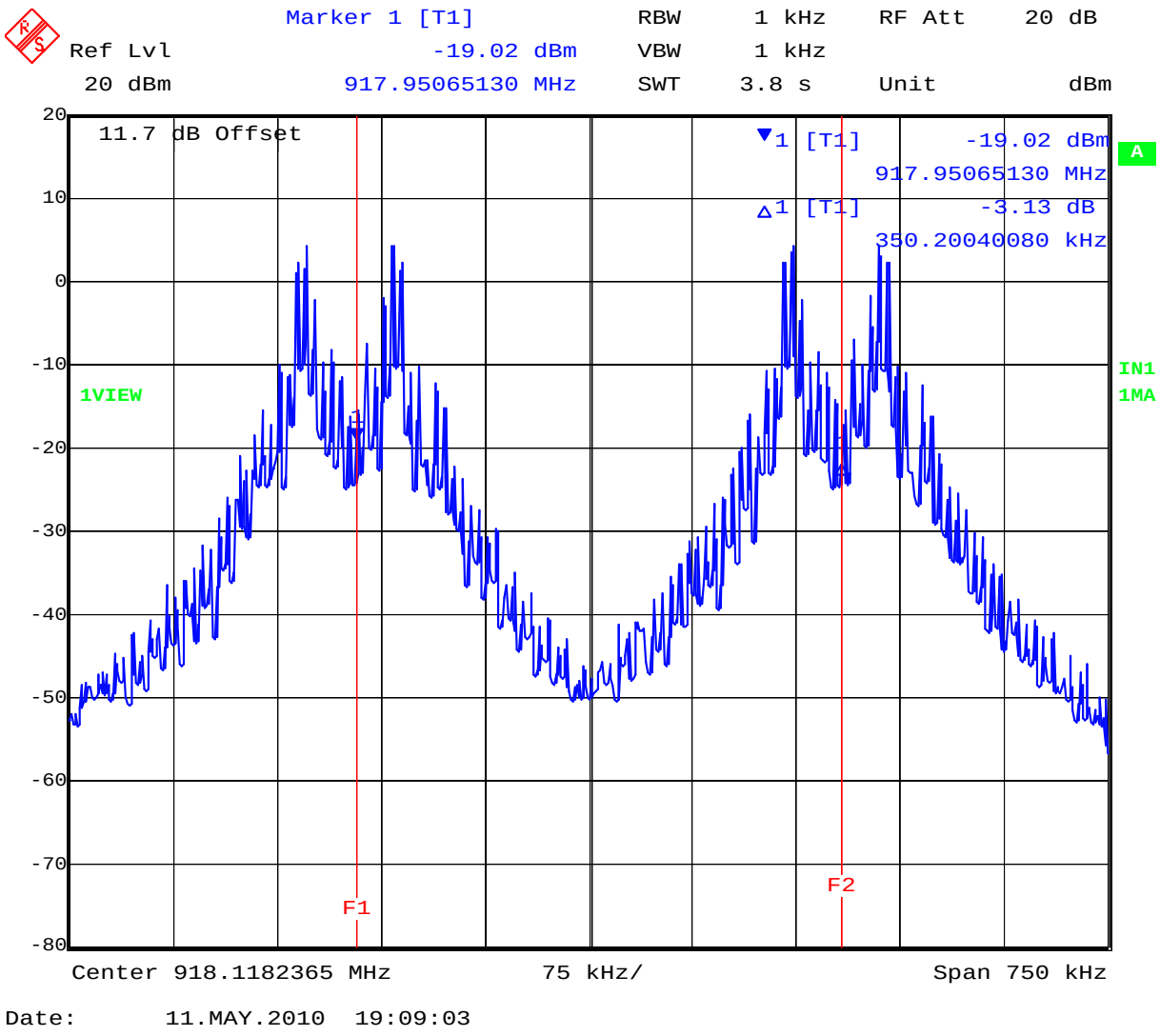
Channel Spacing for CH 36 – CH 37; 30 kHz Deviation; 350kHz Channel Separation



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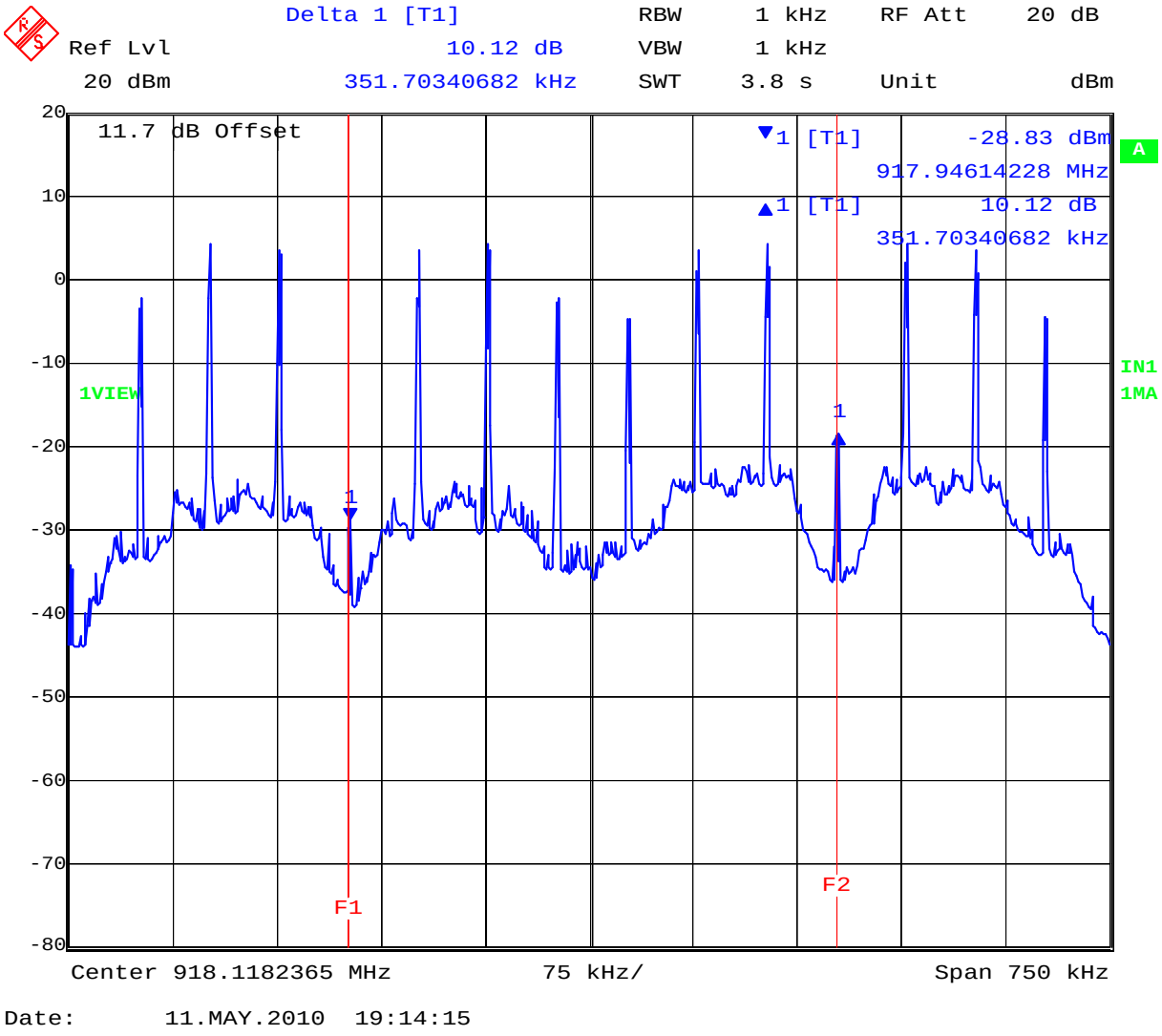
Channel Spacing for CH 36 – CH 37; 100 kHz Deviation; 350kHz Channel Separation



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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.

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5.1.3. Transmitter Channels

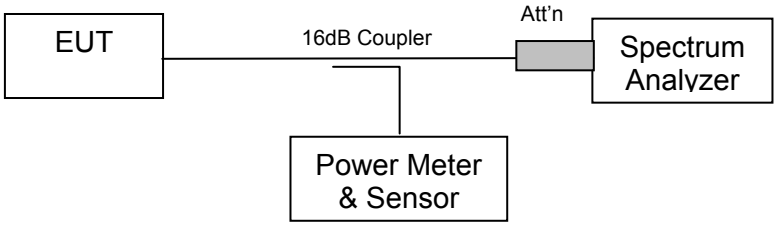
5.1.3.1. Number of Channels

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

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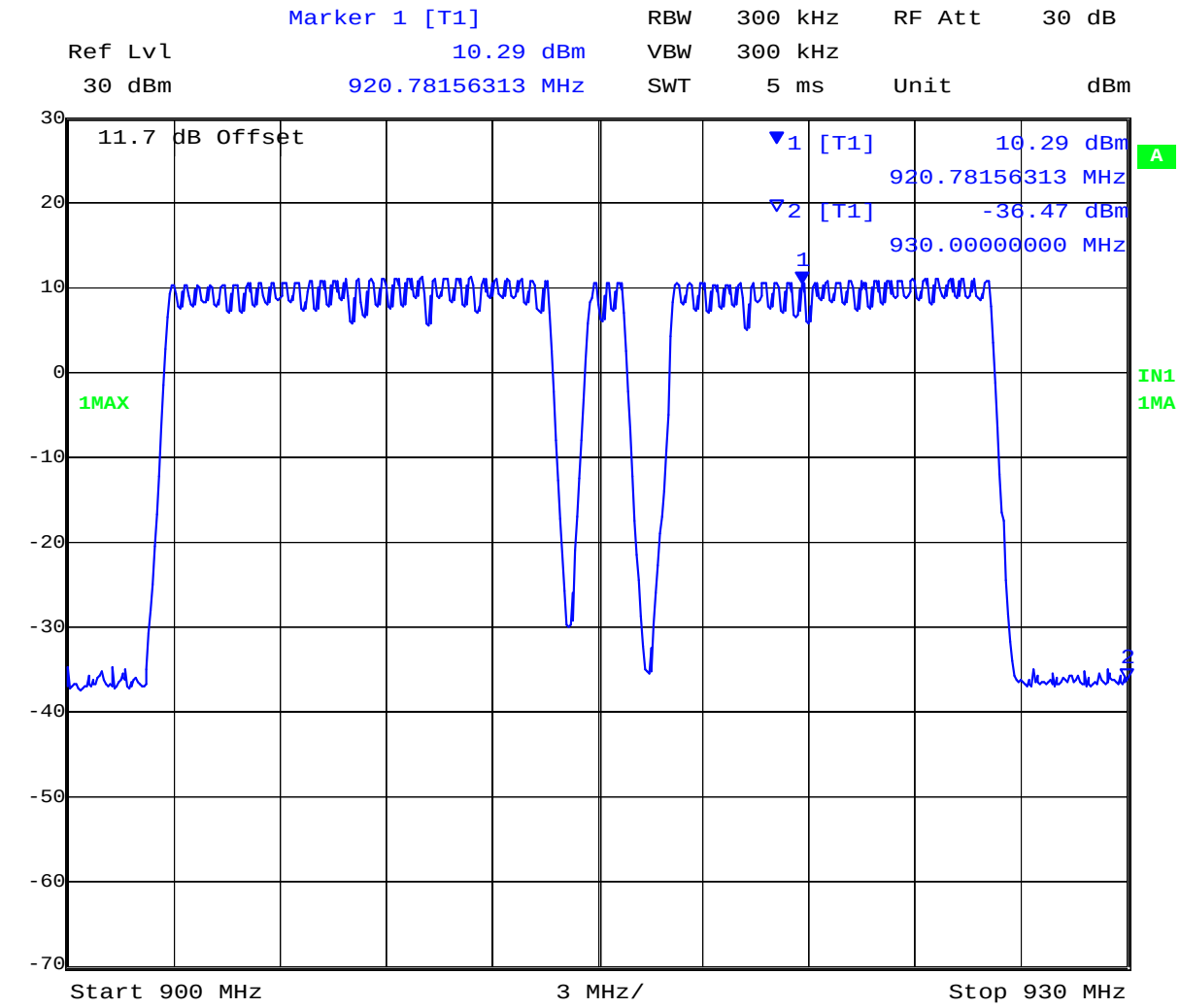
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

TABLE OF RESULTS

Number of Channels	Specification
60	Minimum of 50 hopping channels

NUMBER OF TRANSMISSION CHANNELS



Date: 12.MAY.2010 10:33:44

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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)
31	914.9	253.3066

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.

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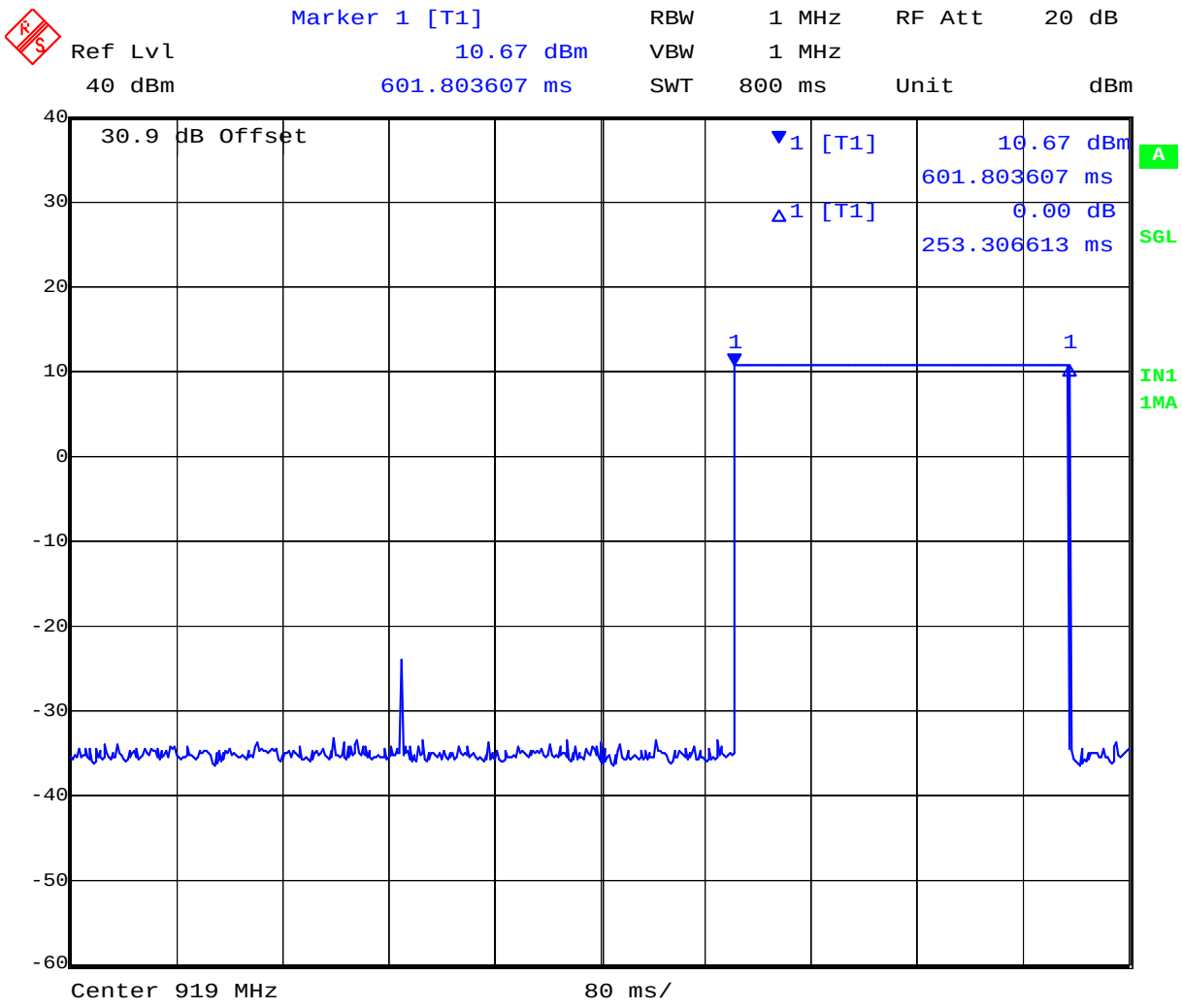
Channel Dwell Time Ch 39 914.90 MHz



Date: 15.MAY.2010 01:00:47

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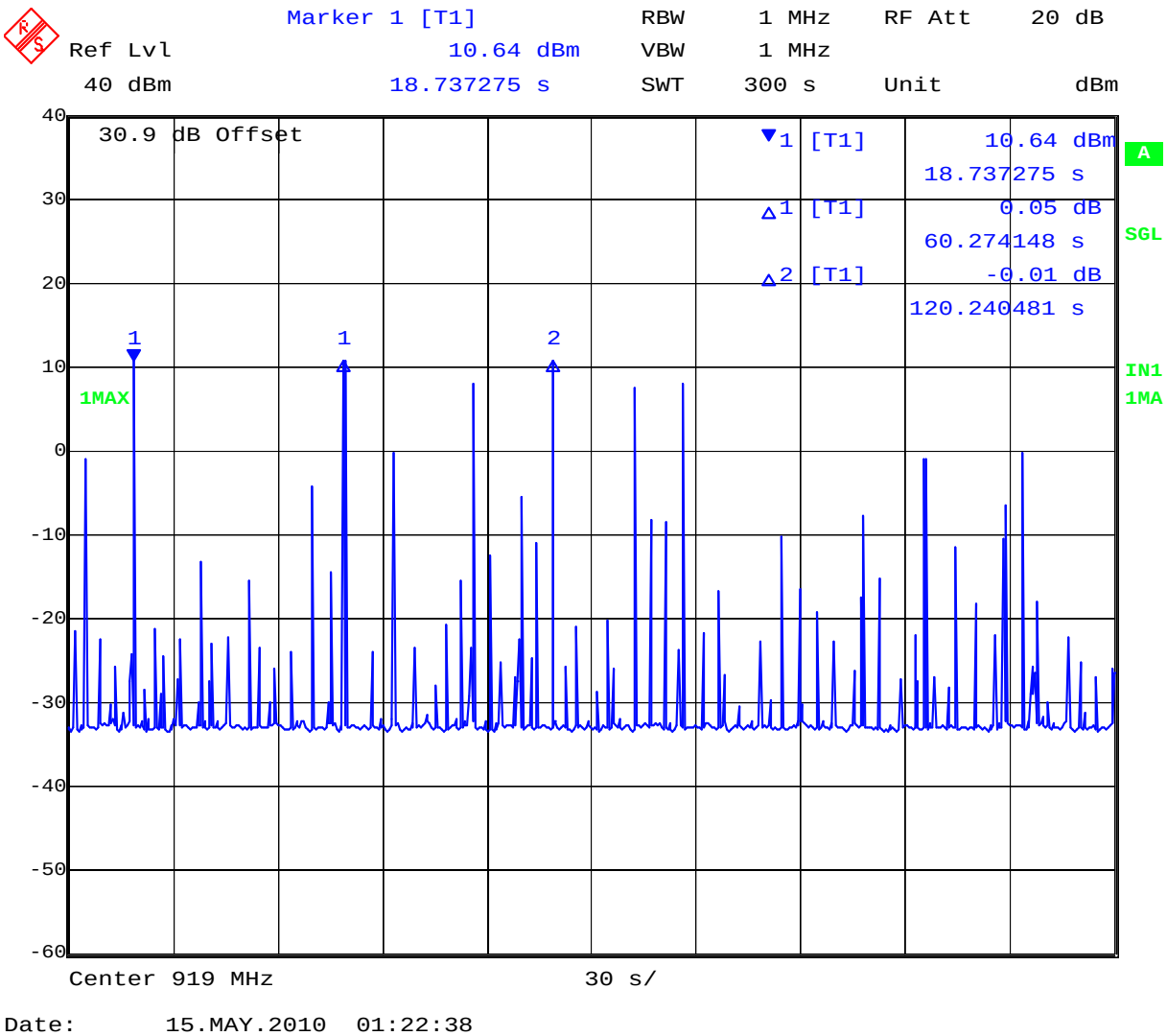
Channel Occupancy

TABLE OF RESULTS

Channel #	Center Frequency (MHz)	Channel Occupancy within 10 Second Period (mSeconds)
39	919.0	253.3066

Note: Channel repeats after 60.27 seconds

Channel Occupancy CH39 919.0 MHz



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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.

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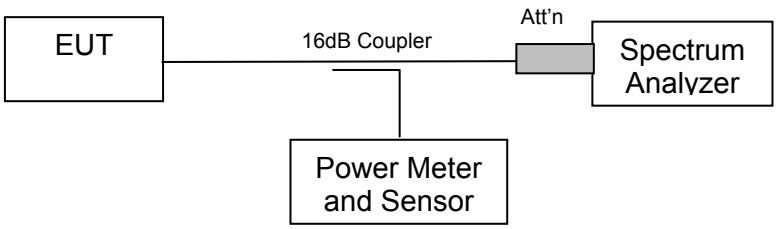
5.1.4. Output Power

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

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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	+10.47
31	914.90	+11.03
59	926.00	+11.22

TABLE OF RESULTS: 100 kHz Deviation

Channel #	Center Frequency (MHz)	Power (dBm)
0	903.00	+10.40
31	914.90	+10.98
59	926.00	+10.99

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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

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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	11.22	1.6405898	21.73	1.32	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

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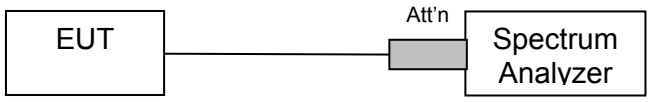
5.1.6. Conducted Spurious Emissions Transmitter

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

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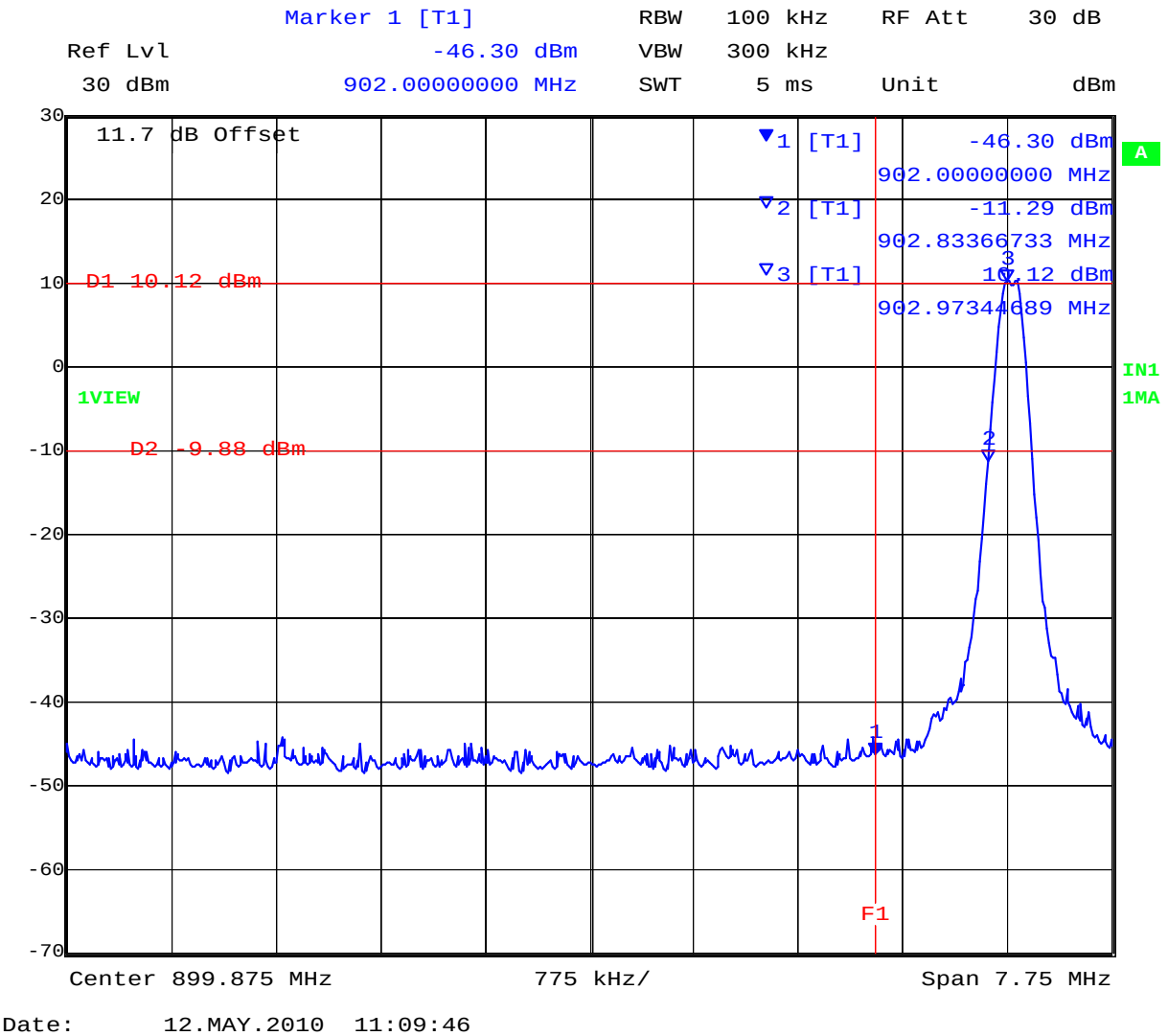
Conducted Band-Edge Results

TABLE OF RESULTS

Channel #	Center Frequency (MHz)	Band-edge Frequency (MHz)	Limit (dBm)	Amplitude @ Band-edge (dBm)	Margin (dB)
0	903.00	902.0	-9.88	-46.22	-36.34
59	926.00	928.0	-9.26	-44.57	-35.31

902 MHZ LOWER BAND EDGE – HOPPING OFF



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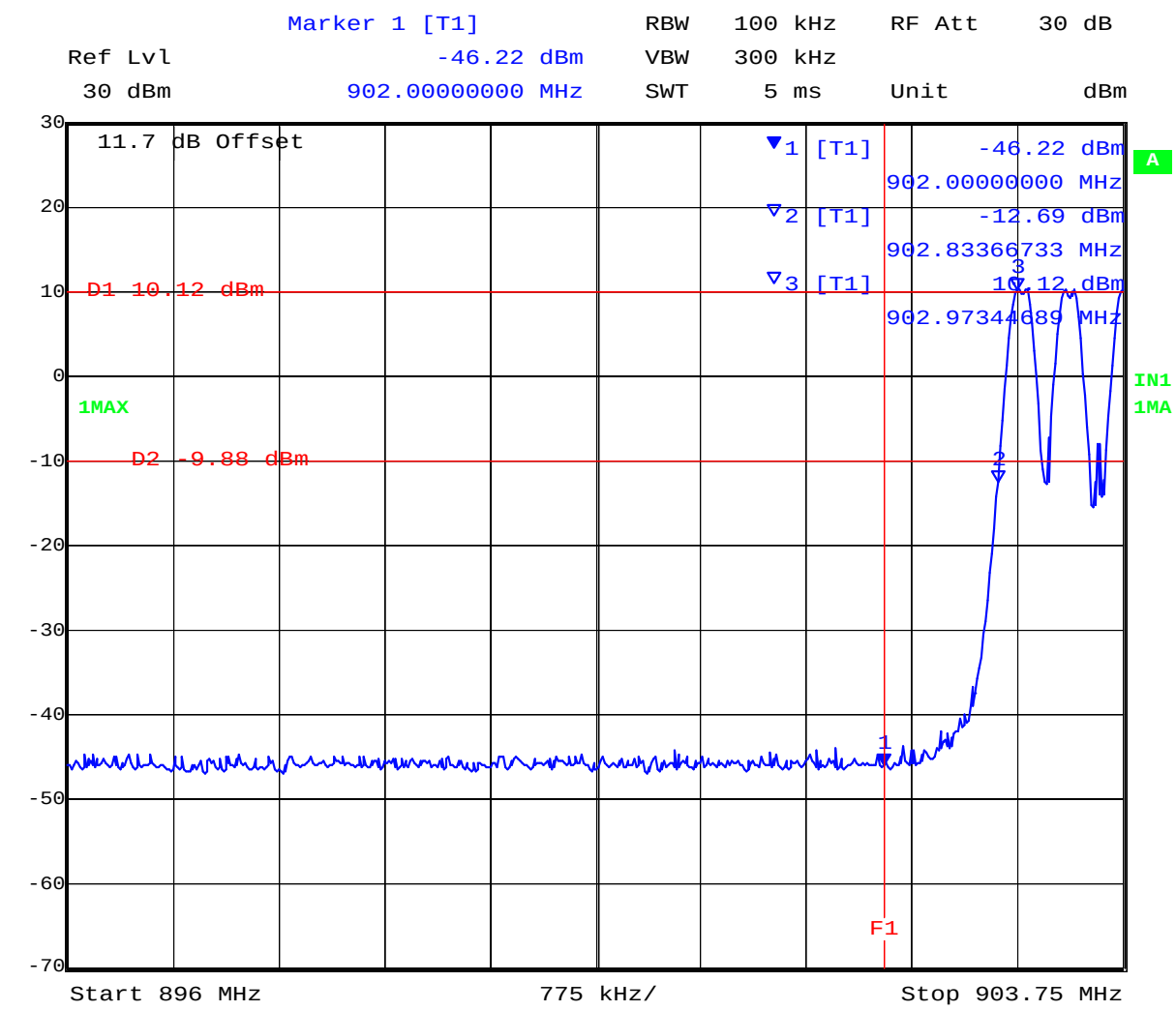
902 MHZ LOWER BAND EDGE – HOPPING ON



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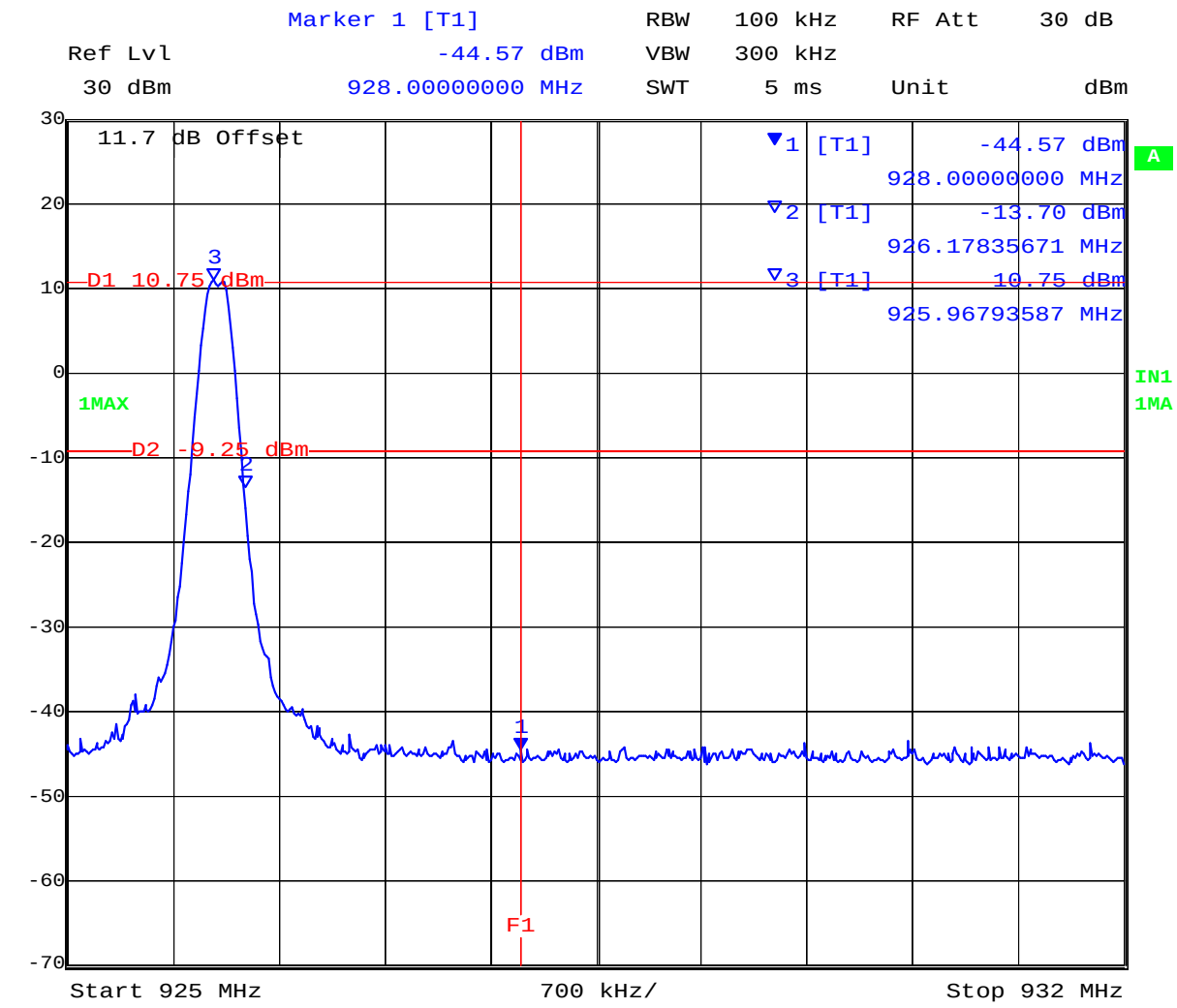
928 MHZ UPPER BAND EDGE – HOPPING OFF



Date: 12.MAY.2010 11:19:31

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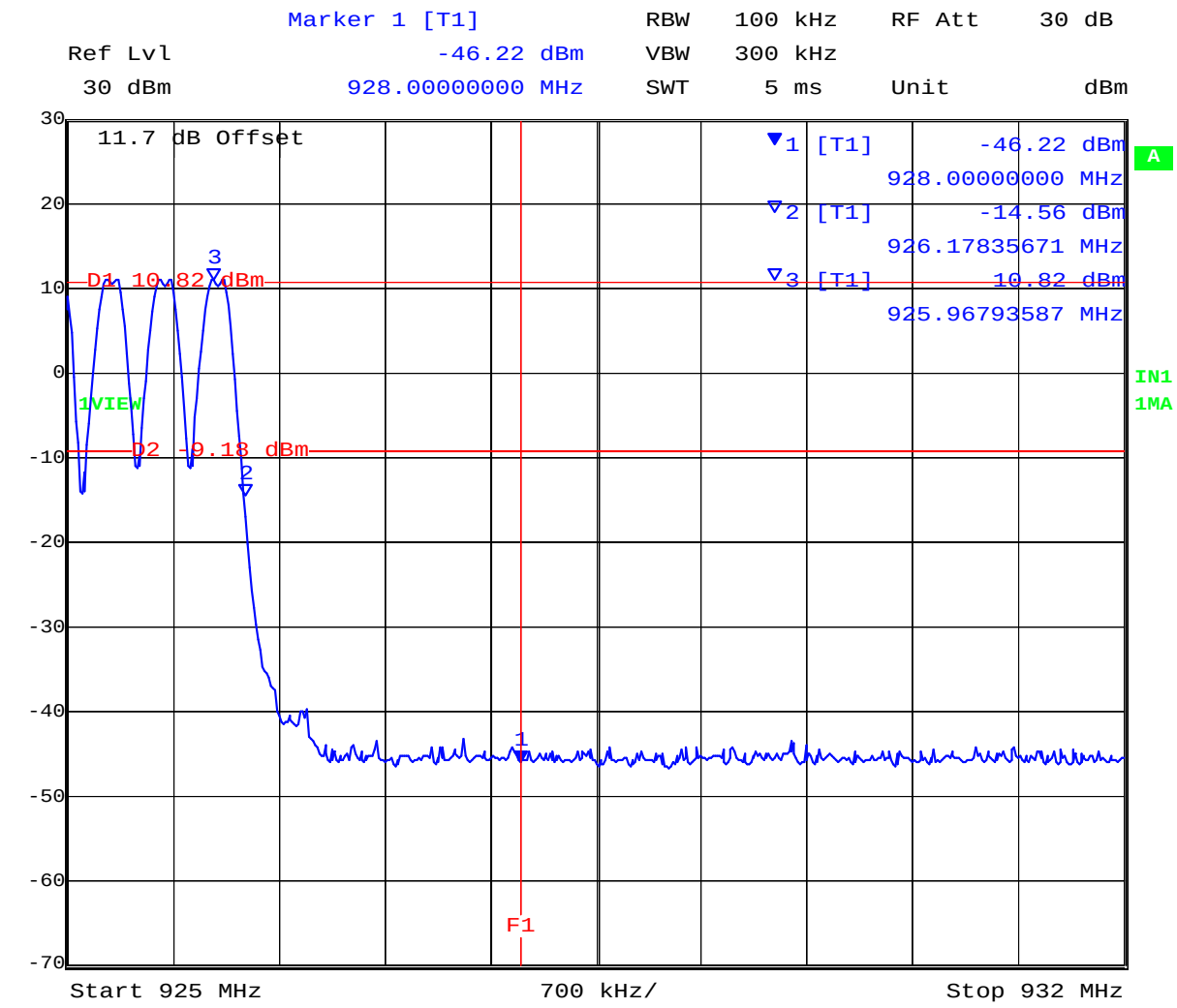
928 MHZ UPPER BAND EDGE – HOPPING ON



Date: 12.MAY.2010 11:23:40

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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>

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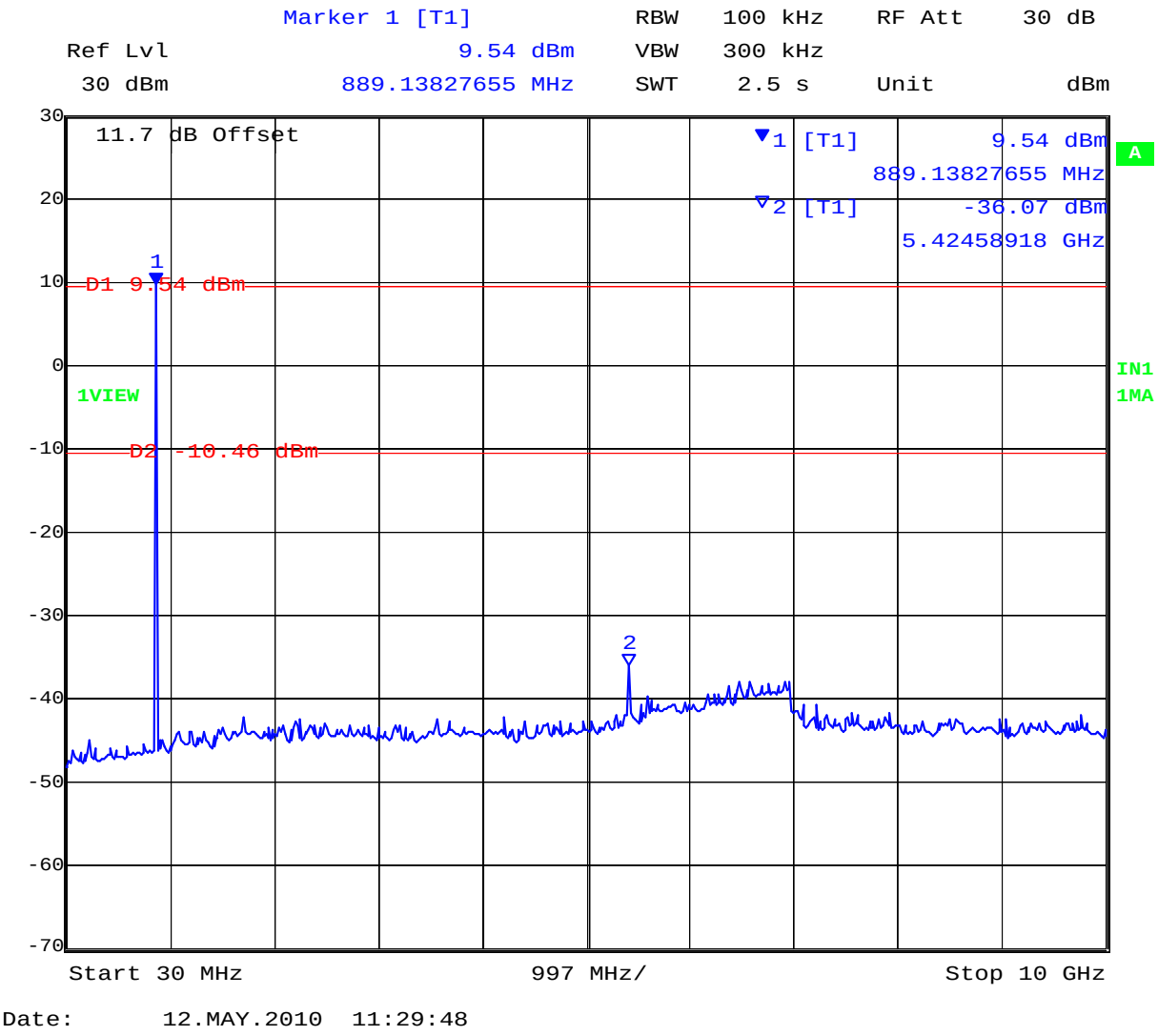
TABLE OF RESULTS

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
903.00	30	10,000	-36.07	-10.46	-25.61

The emission breaking the limit line is the carrier.

CHANNEL 903.00 MHZ - 30 MHZ TO 10,000 MHZ



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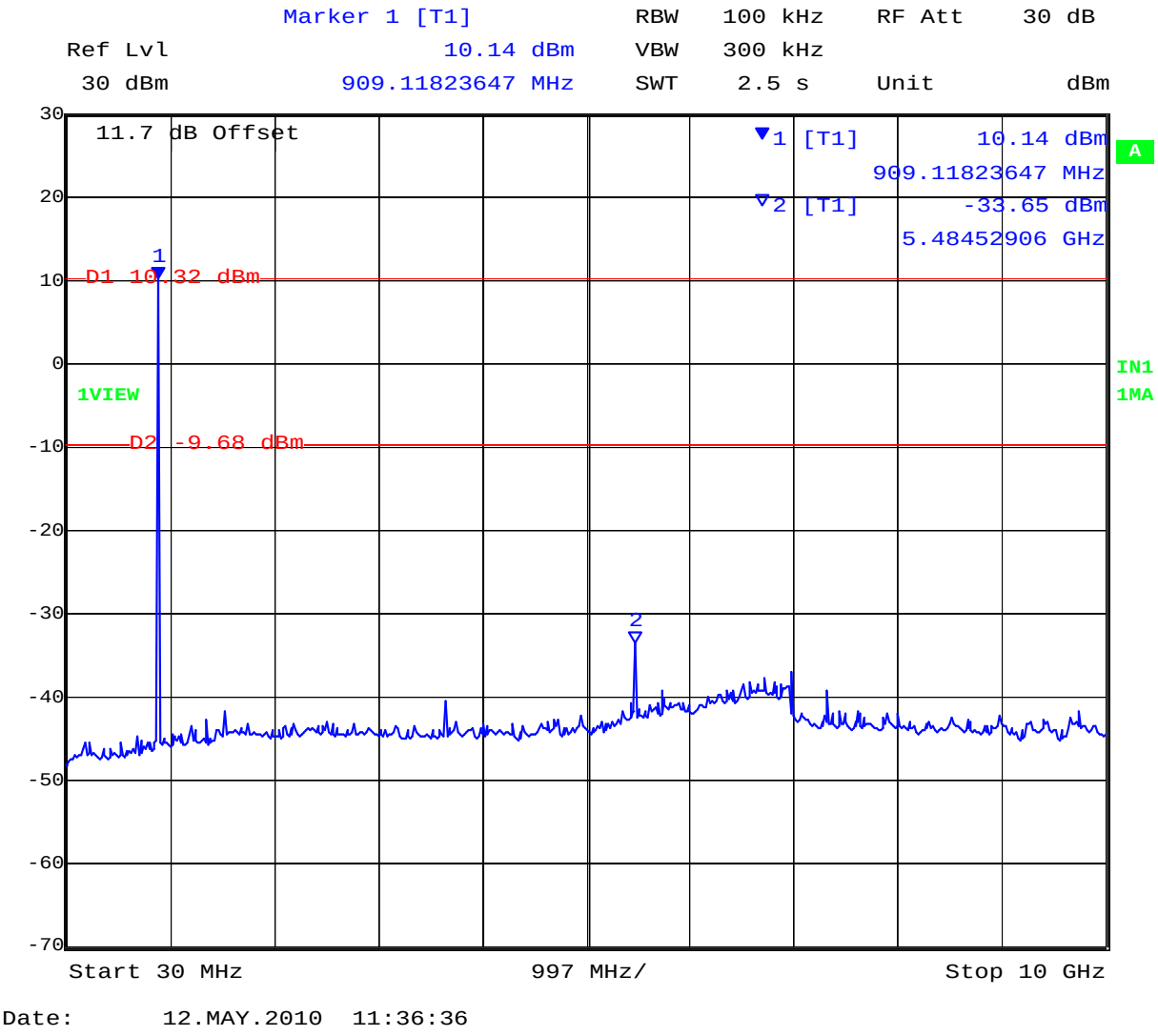
Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
914.90	30	10,000	-33.65	-9.68	-23.97

The emission breaking the limit line is the carrier.

CHANNEL 914.90 MHZ - 30 MHZ TO 10,000 MHZ



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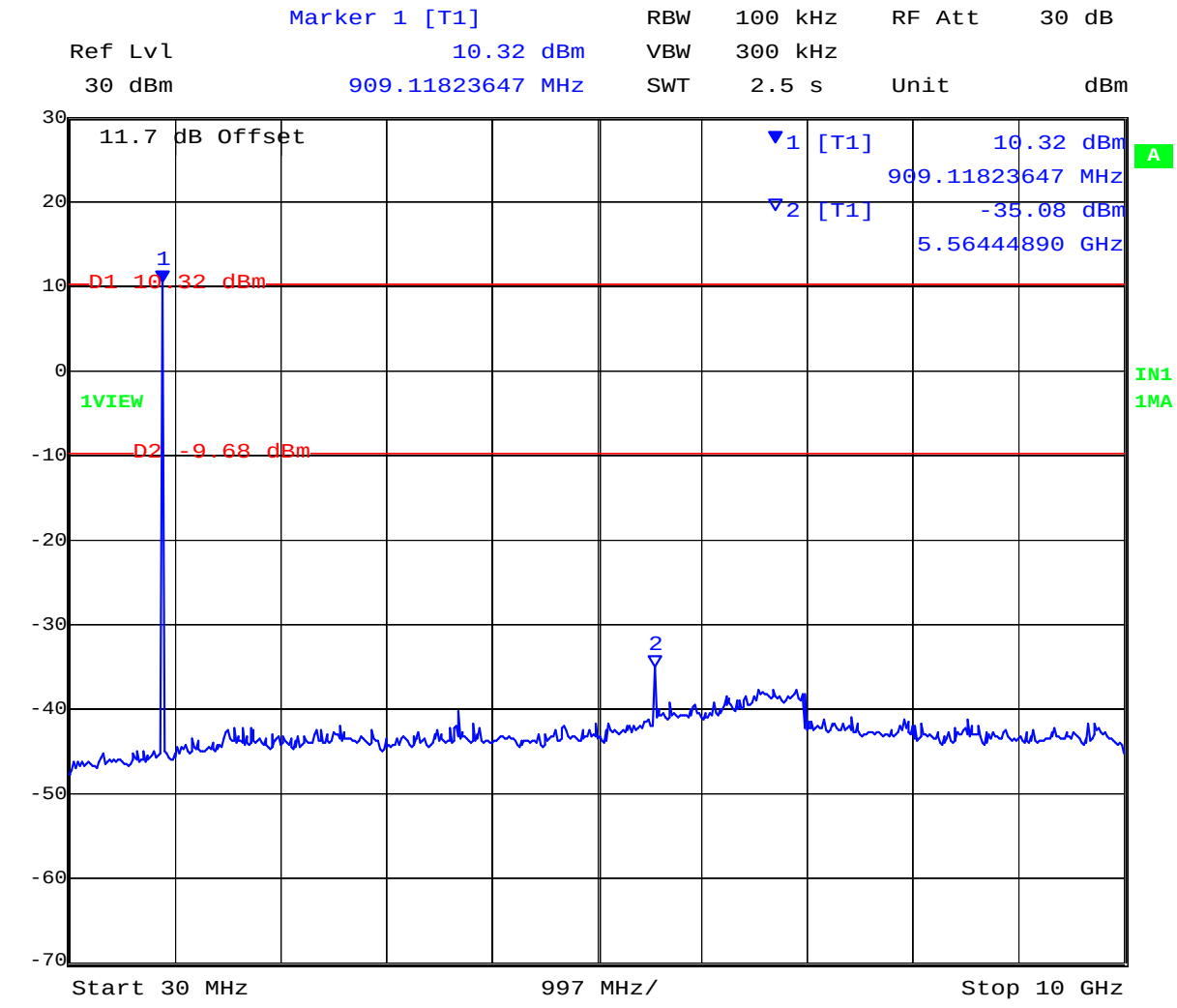
Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
926.00	30	10,000	-35.08	-9.68	-25.40

The emission breaking the limit line is the carrier.

CHANNEL 926.00 MHZ - 30 MHZ TO 10,000 MHZ



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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.

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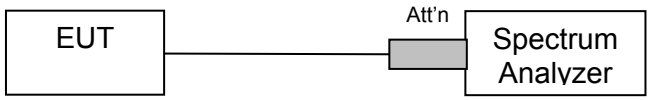
5.1.7. Conducted Spurious Emissions Stand-By

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

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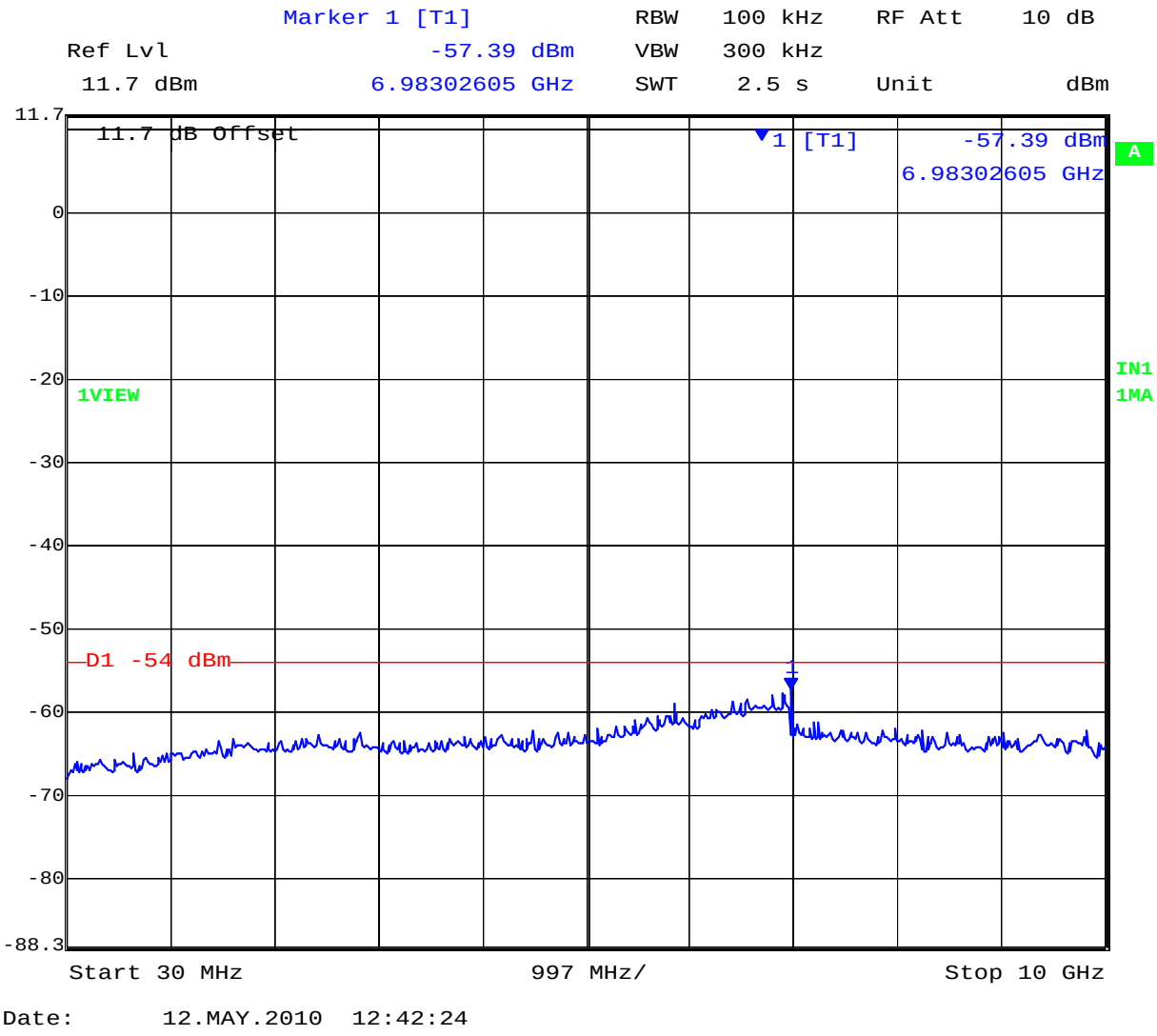
5.1.7.1. Conducted Stand-By Spurious Emissions 30M - 10 GHz



No emissions were observed breaking the limit.

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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.

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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.

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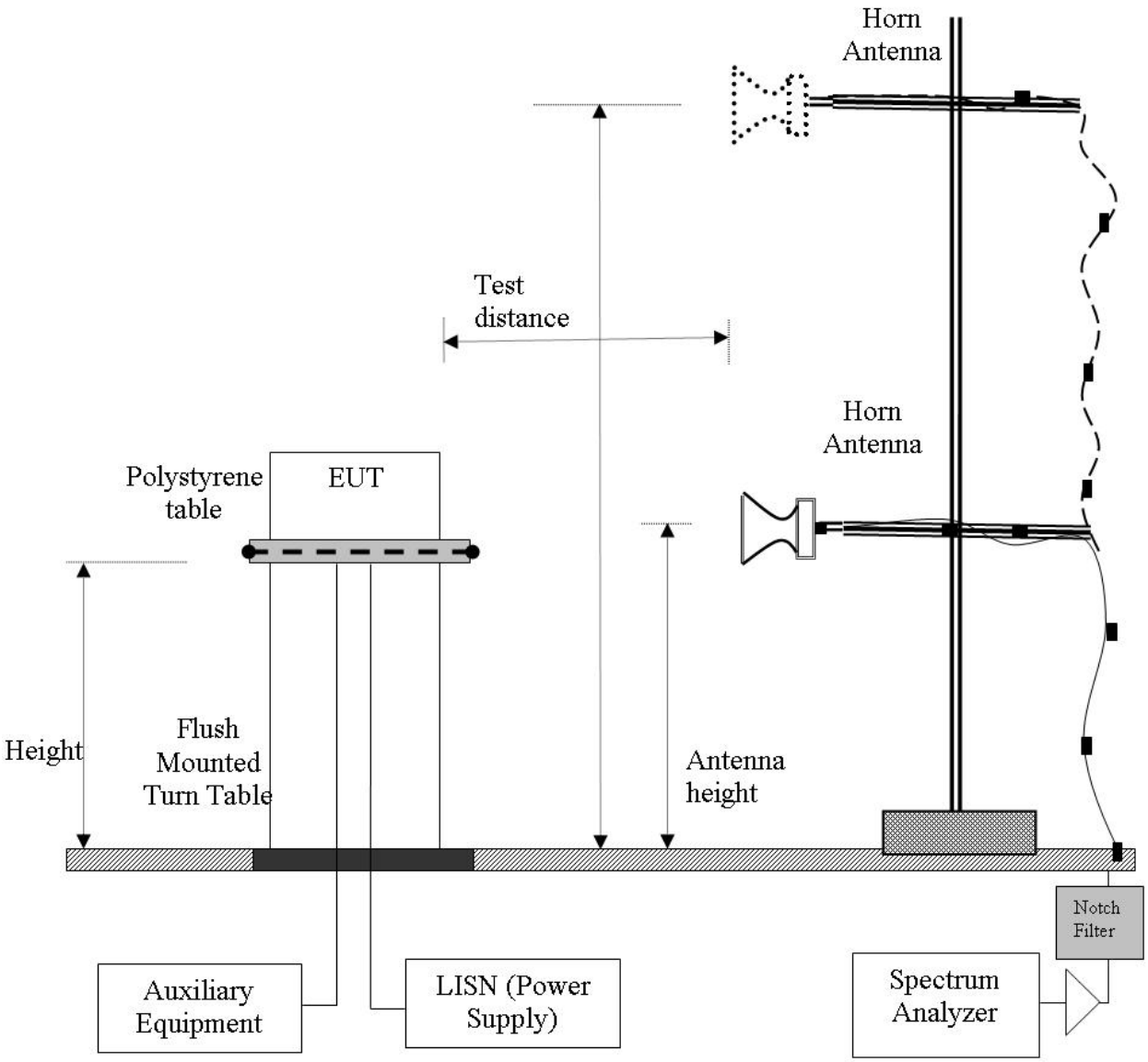
Test Measurement Set Up



Radiated Emission Measurement Setup – Above 1 GHz

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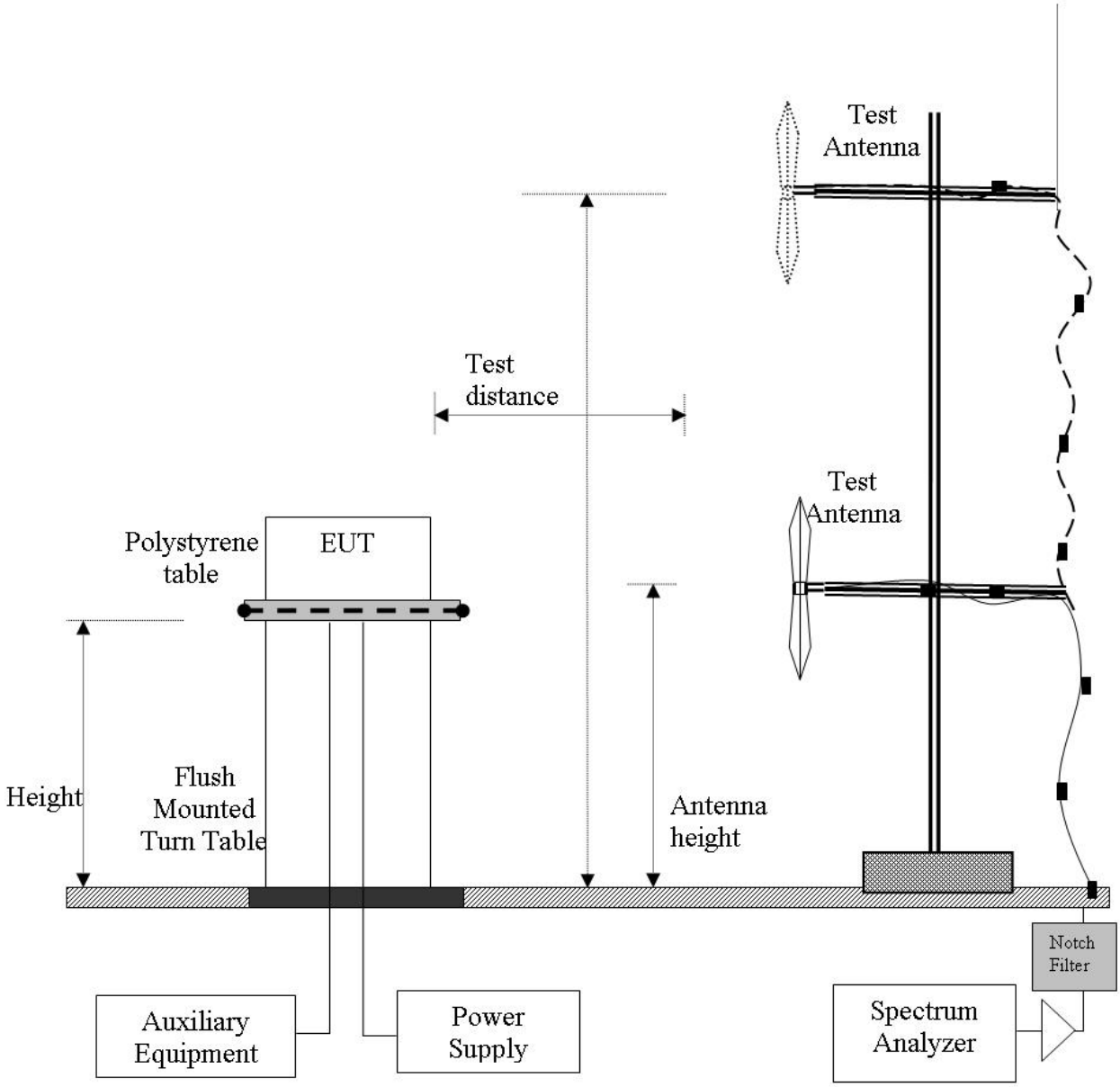

Radiated Emission Measurement Setup – Below 1 GHz

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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

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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

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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

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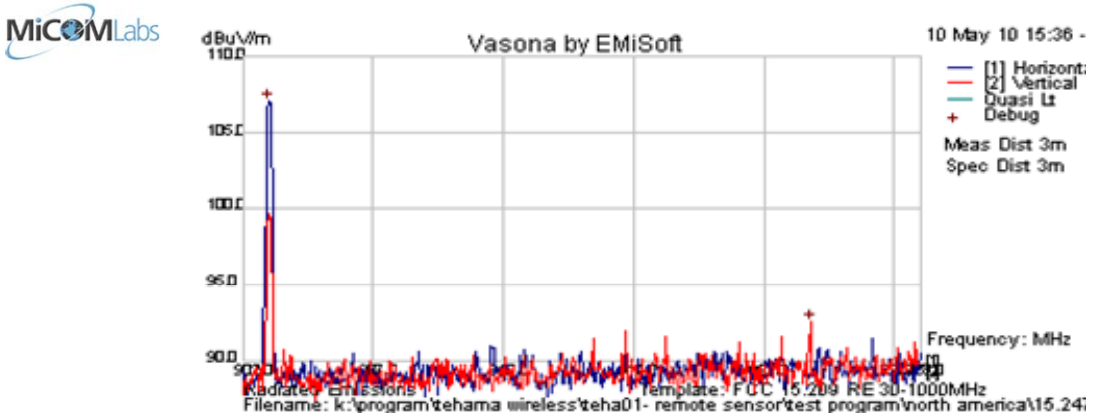
5.1.8.1. Transmitter Peak Emissions

Radiated Emissions – Peak Fundamental Emissions

Test Freq.	903.00 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			



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	67.0	17.3	22.8	107.1	Peak [Scan]	H						PK

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

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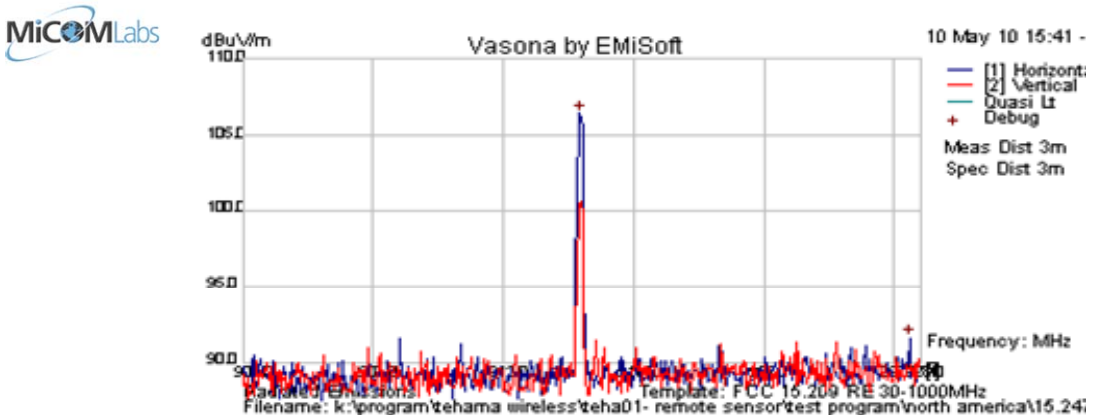
Test Freq.	915.00 MHz	**Engineer**	CSB
Variant	FSK	**Temp (ºC)**	21.5
Freq. Range	902 - 928 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	Peak Emissions		
Test Notes 2			



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	66.2	17.4	22.9	106.4	Peak [Scan]	H						PK

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

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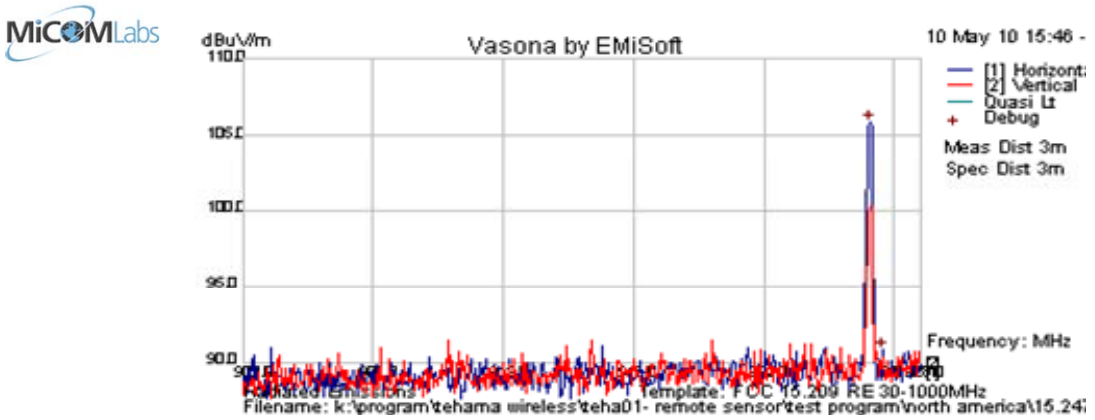
Test Freq.	926.00 MHz	**Engineer**	CSB
Variant	FSK	**Temp (ºC)**	21.5
Freq. Range	902 - 928 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	Peak Emissions		
Test Notes 2			



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	65.5	17.4	22.9	105.8	Peak [Scan]	H						PK

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

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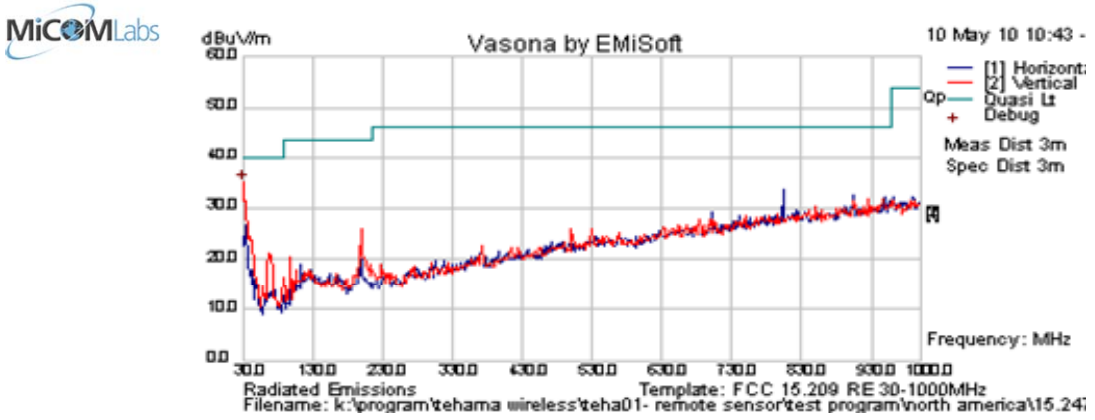
5.1.8.2. Transmitter Radiated Spurious Emissions

Radiated Spurious Emissions – [30-1000MHz]

Test Freq.	903 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
No radio emissions within 6dB of limit												

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

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

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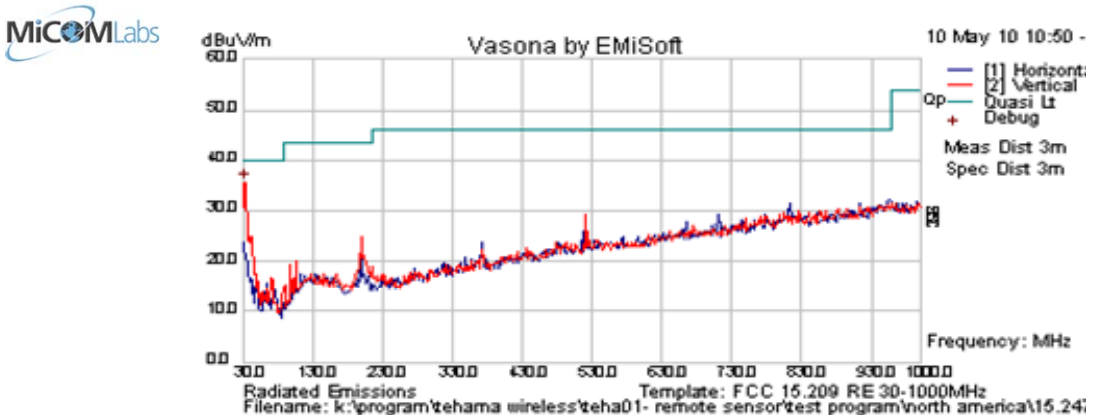
Test Freq.	914.9 MHz	**Engineer**	CSB
Variant	FSK	**Temp (ºC)**	21.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	EUT Vertical on Test Table		
Test Notes 2	Fundamental attenuated by Band Stop 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
No radio emissions within 6dB of limit												

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

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

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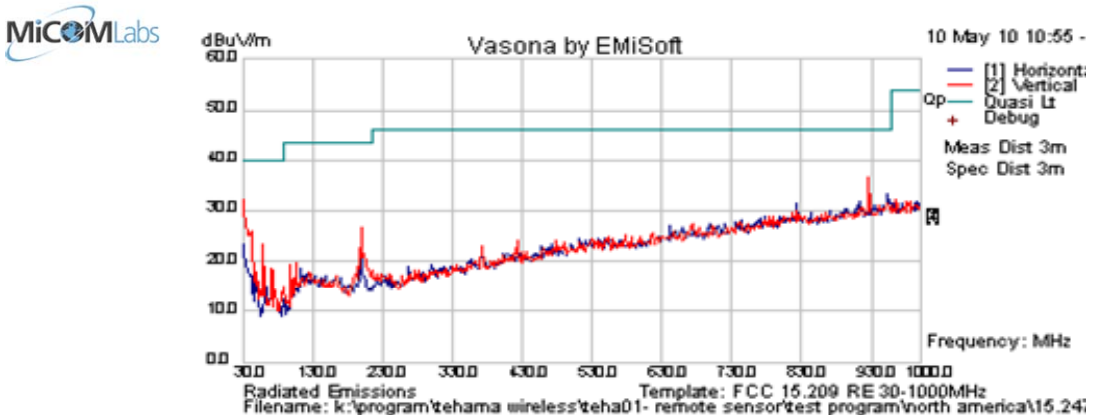
Test Freq.	926 MHz	**Engineer**	CSB
Variant	FSK	**Temp (ºC)**	21.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	EUT Vertical on Test Table		
Test Notes 2	Fundamental attenuated by Band Stop Filter		



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
No radio emissions within 6dB of limit												

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

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

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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 60 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)

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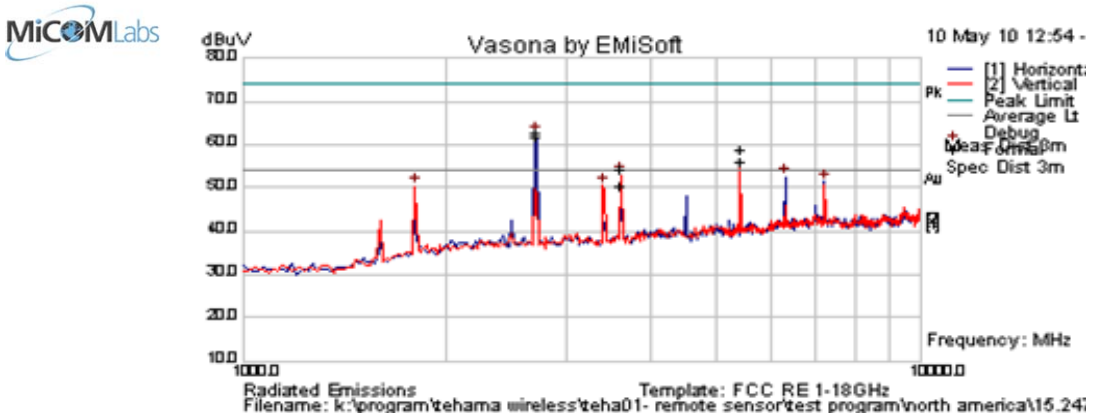
Test Freq.	903 MHz	**Engineer**	CSB
Variant	FSK	**Temp (ºC)**	21.5
Freq. Range	1000 - 10000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	Duty Cycle correction factor to be applied		
Test Notes 2			



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
2708.983	70.3	3.2	-11.2	62.3	Peak [Scan]	H	100	0	54	-4.2	Pass	RB
5417.966	61.3	4.6	-9.2	56.7	Peak [Scan]	V	100	0	54	-9.8	Pass	RB
3611.980	59.9	3.7	-10.7	52.8	Peak [Scan]	V	100	0	54	-13.7	Pass	RB
6321.022	54.1	5.1	-6.7	52.4	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB
7224.078	51.5	5.4	-5.5	51.4	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB
3411.320	58.5	3.6	-11.6	50.5	Peak [Scan]	V	> 20dB below fundamental				Pass	NRB
1805.972	60.4	2.6	-12.7	50.3	Peak [Scan]	V	> 20dB below fundamental				Pass	NRB

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

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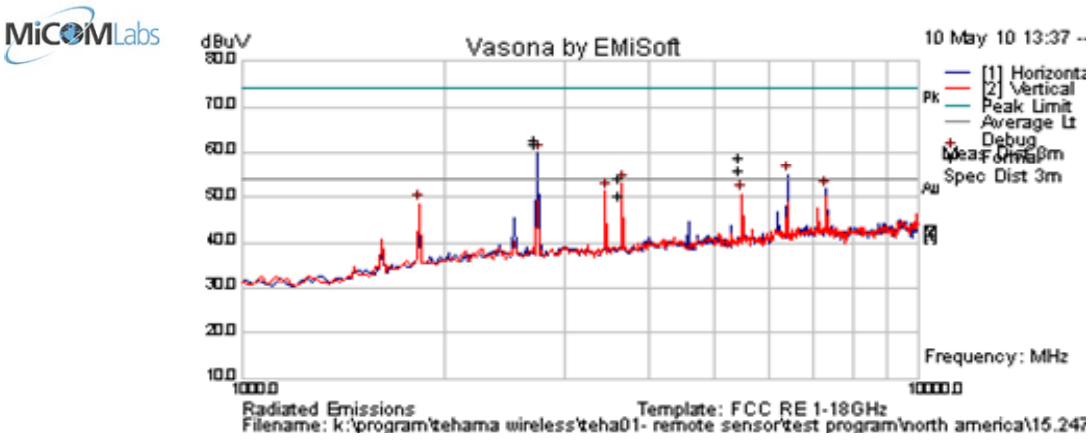
Test Freq.	914.9 MHz	**Engineer**	CSB
Variant	FSK	**Temp (ºC)**	21.5
Freq. Range	1000 - 10000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	Duty Cycle correction factor to be applied		
Test Notes 2			



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
2744.729	68.2	3.2	-11.6	59.8	Peak [Scan]	H	100	0	54	-6.7	Pass	RB
6404.349	56.4	5.1	-6.6	54.9	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB
3659.619	60.0	3.7	-10.7	53.0	Peak [Scan]	V	100	0	54	-13.5	Pass	RB
7319.078	51.4	5.4	-5.0	51.8	Peak [Scan]	H	100	0	54	-14.7	Pass	RB
3456.343	59.3	3.6	-11.6	51.4	Peak [Scan]	V	> 20dB below fundamental				Pass	NRB
5489.389	54.9	4.6	-8.8	50.8	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB
1829.817	58.7	2.6	-12.8	48.5	Peak [Scan]	V	> 20dB below fundamental				Pass	NRB

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

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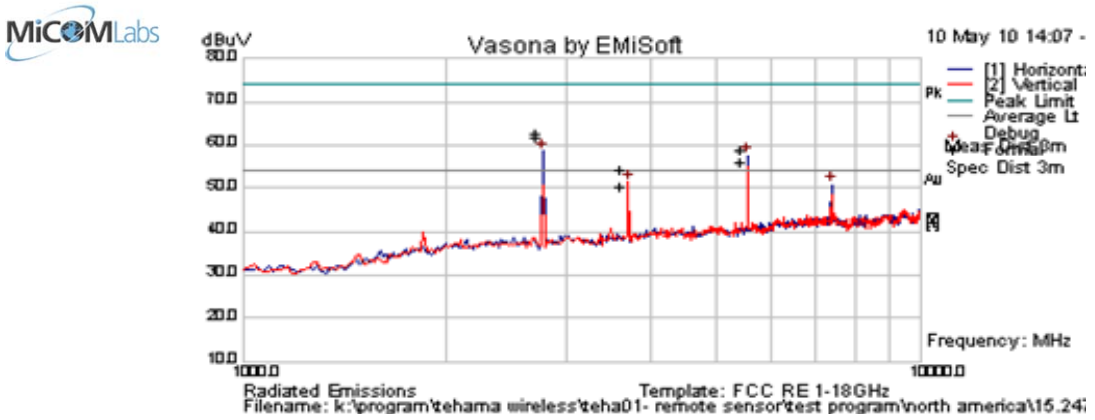
Test Freq.	926 MHz	**Engineer**	CSB
Variant	FSK	**Temp (ºC)**	21.5
Freq. Range	1000 - 10000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	Duty Cycle correction factor to be applied		
Test Notes 2			



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
2777.996	67.0	3.2	-11.6	58.6	Peak [Scan]	H	100	0	54	-7.9	Pass	RB
5556.012	61.4	4.7	-8.5	57.5	Peak [Scan]	H	> 20dB below fundamental				Pass	NRB
3703.977	58.1	3.7	-10.5	51.4	Peak [Scan]	V	100	0	54	-15.1	Pass	RB
7407.943	49.8	5.5	-4.6	50.6	Peak [Scan]	H	100	0	54	-15.9	Pass	RB

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

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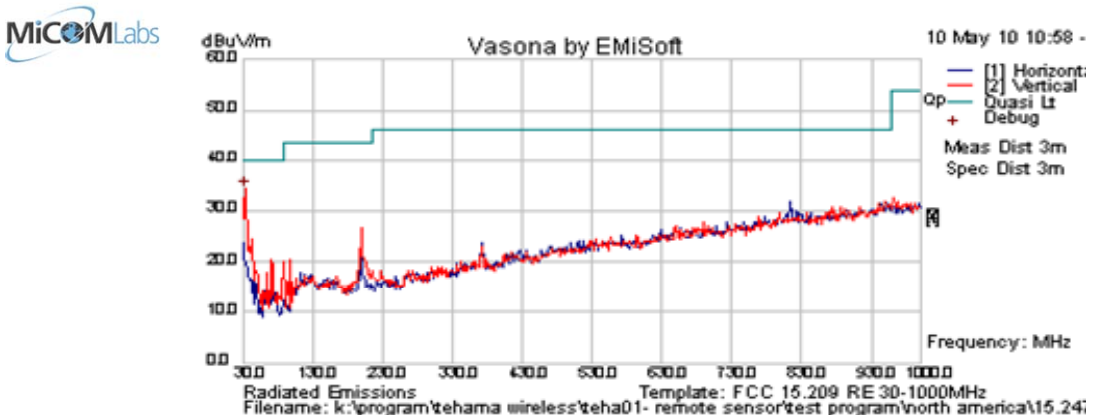
5.1.8.3. Receiver Radiated Spurious Emissions

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	EUT Vertical on Test 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 radio emissions within 6dB of limit												

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

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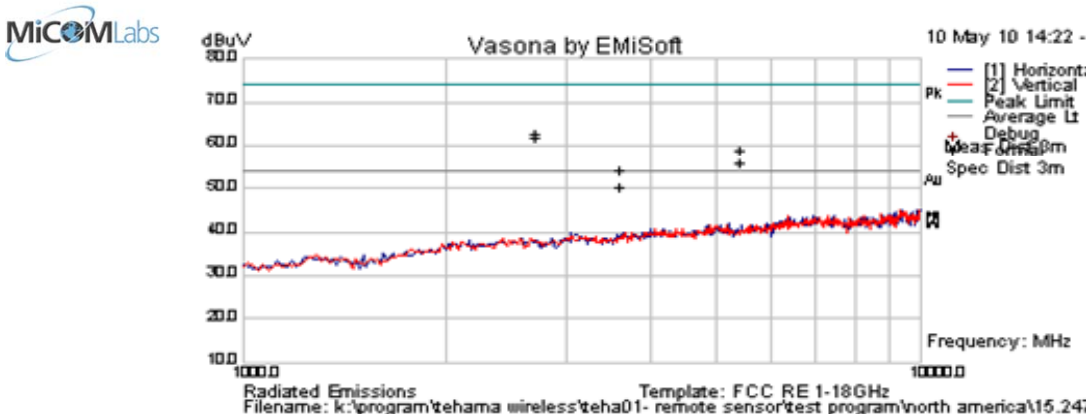
Test Freq.	2437 MHz	**Engineer**	CSB
Variant	FSK	**Temp (ºC)**	21.5
Freq. Range	1 - 10 GHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	EUT Vertical on Test Table		
Test Notes 2	0		



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

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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

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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.

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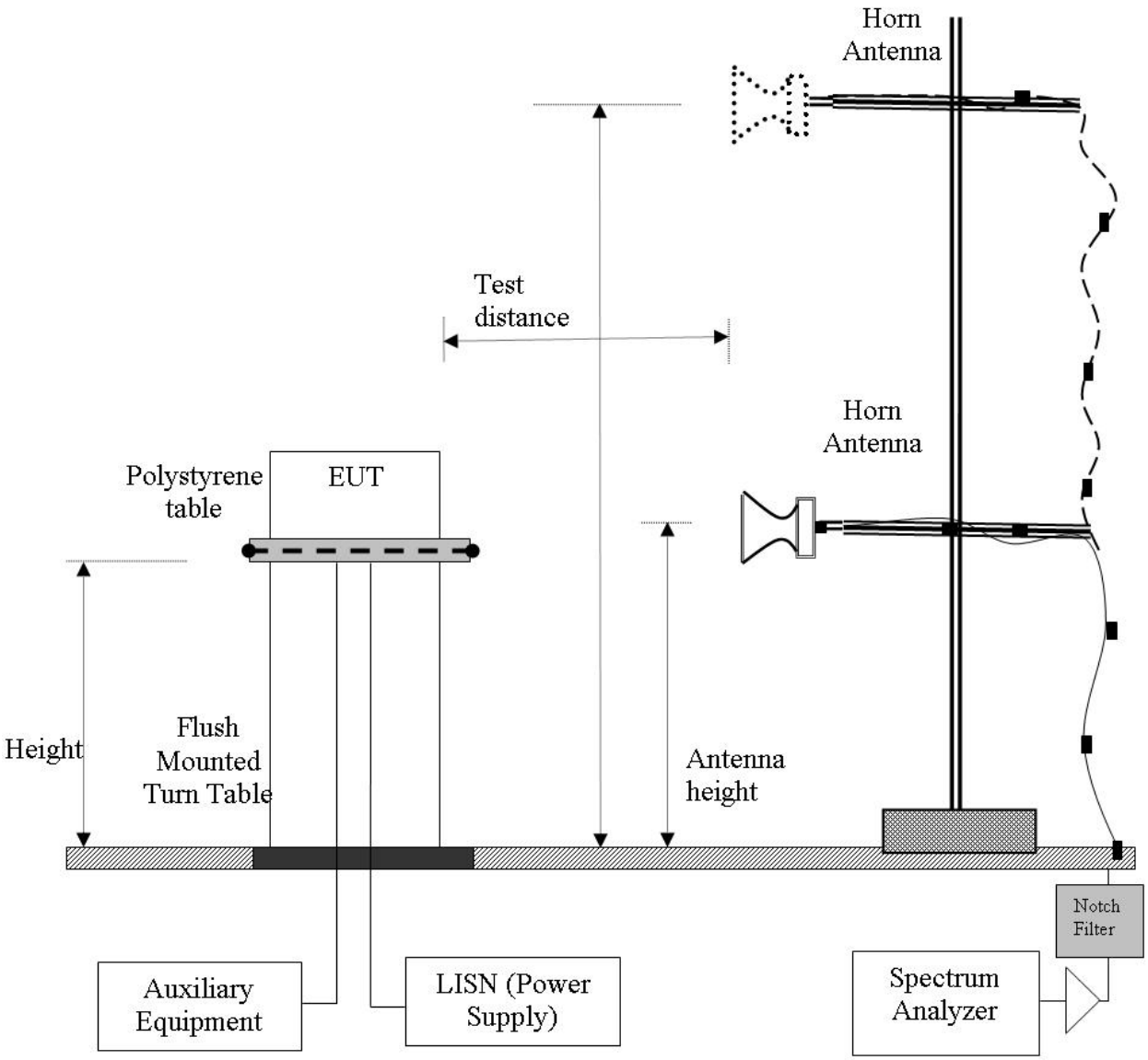
Test Measurement Set Up



Radiated Emission Measurement Setup – Above 1 GHz

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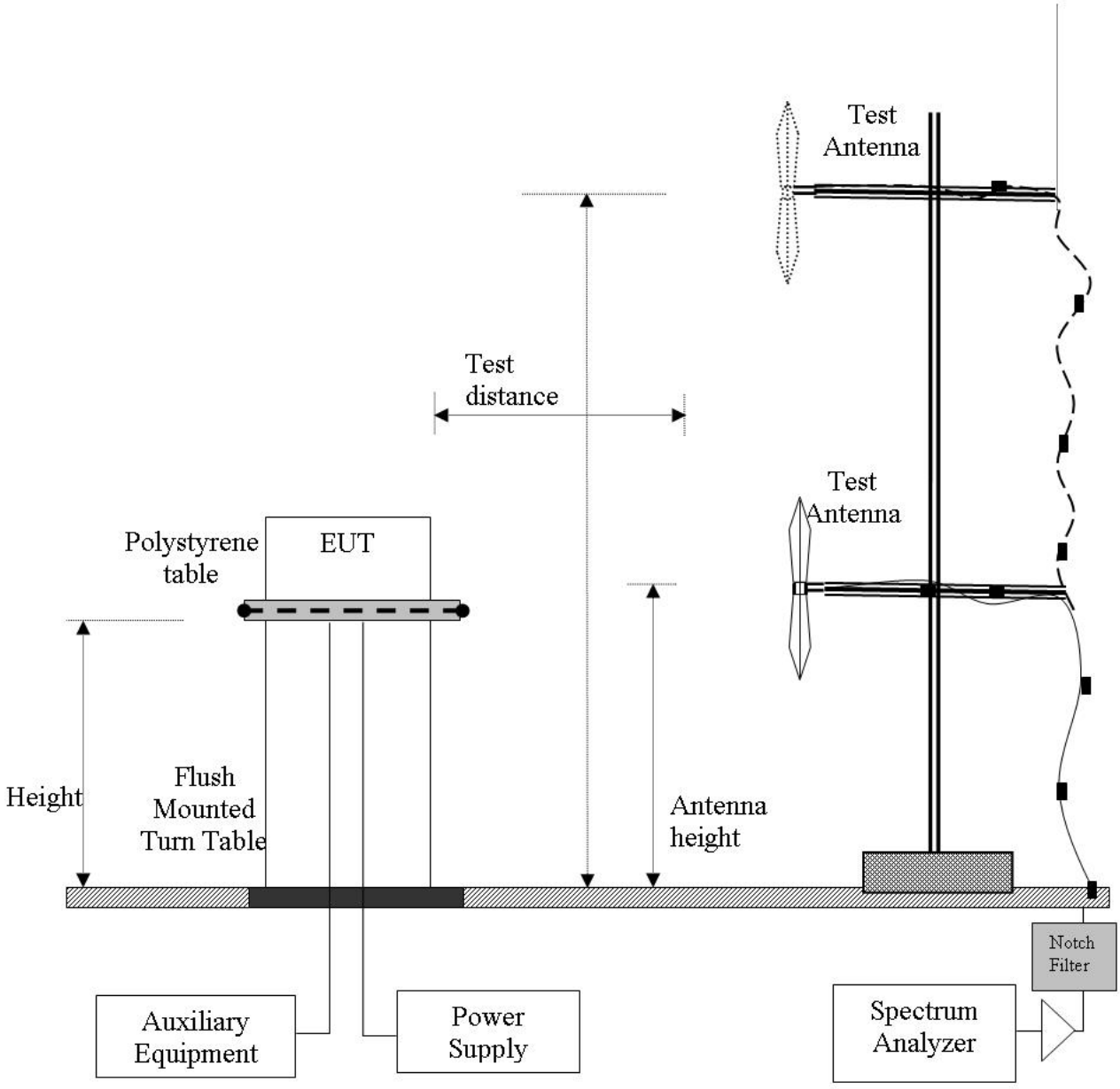

Radiated Emission Measurement Setup – Below 1 GHz

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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

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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

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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

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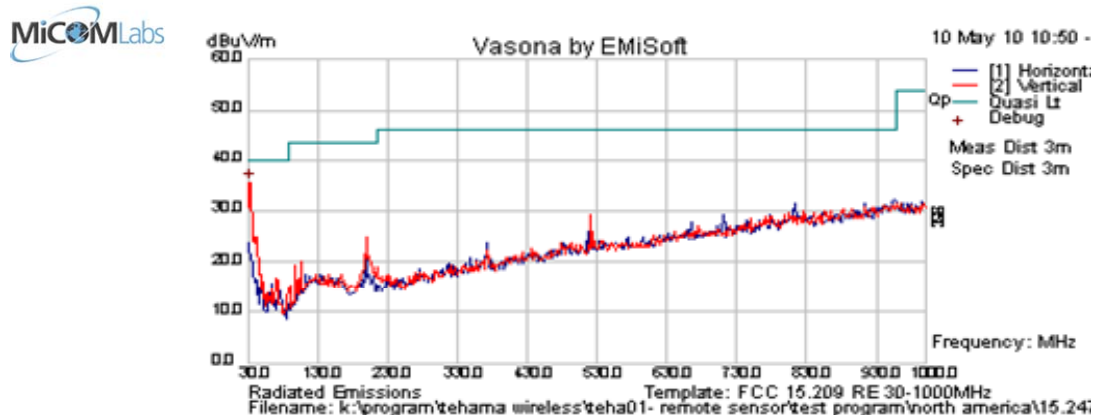
5.1.9.1. Radiated Digital Emissions

Test Freq.	914.9 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
No radio emissions within 6dB of limit												

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

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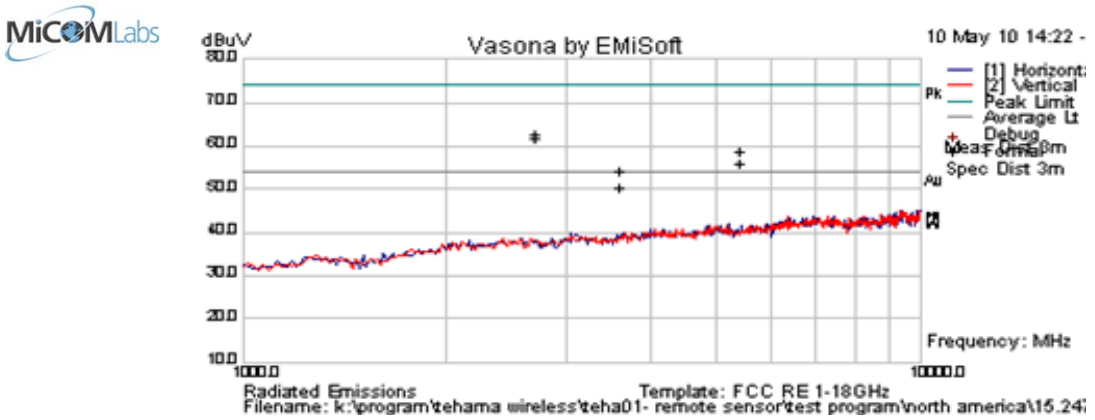
Test Freq.	2437 MHz	**Engineer**	CSB
Variant	FSK	**Temp (ºC)**	21.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	37
Power Setting	Maximum	**Press. (mBars)**	1009
Antenna	Integral Whip	**Duty Cycle (%)**	100
Test Notes 1	EUT Vertical on Test Table		
Test Notes 2			



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

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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

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

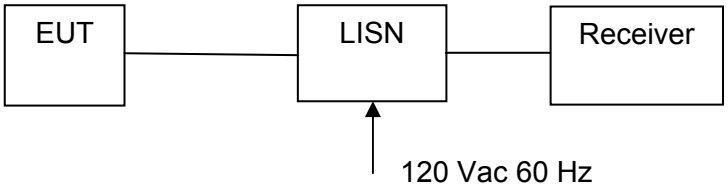
FCC, Part 15 Subpart C §15.207
Industry Canada RSS-Gen §7.2.2

No Measurement Results presented. EUT does not utilize connection to the AC Mains.

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.

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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

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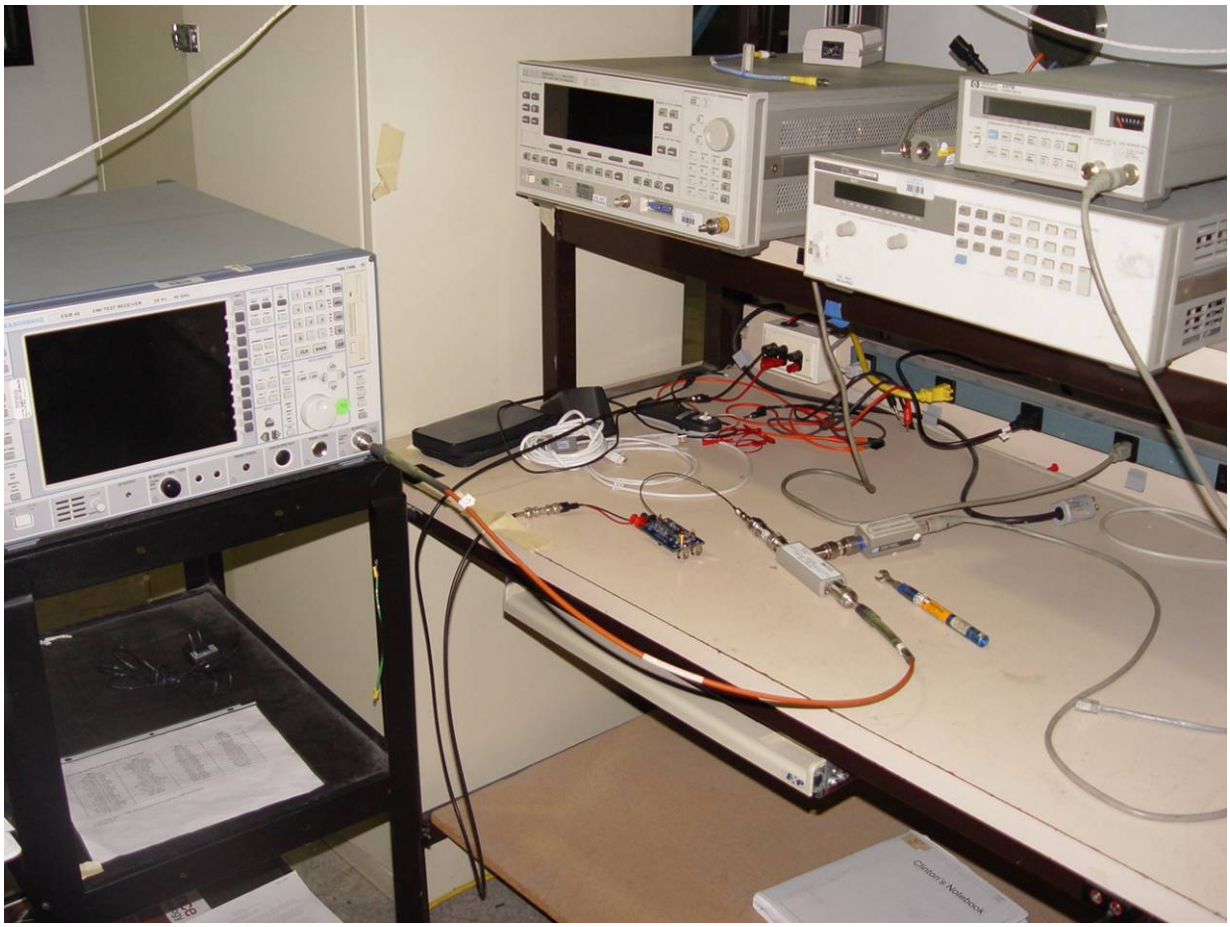
6. PHOTOGRAPHS

6.1. General Measurement Test Set-Up



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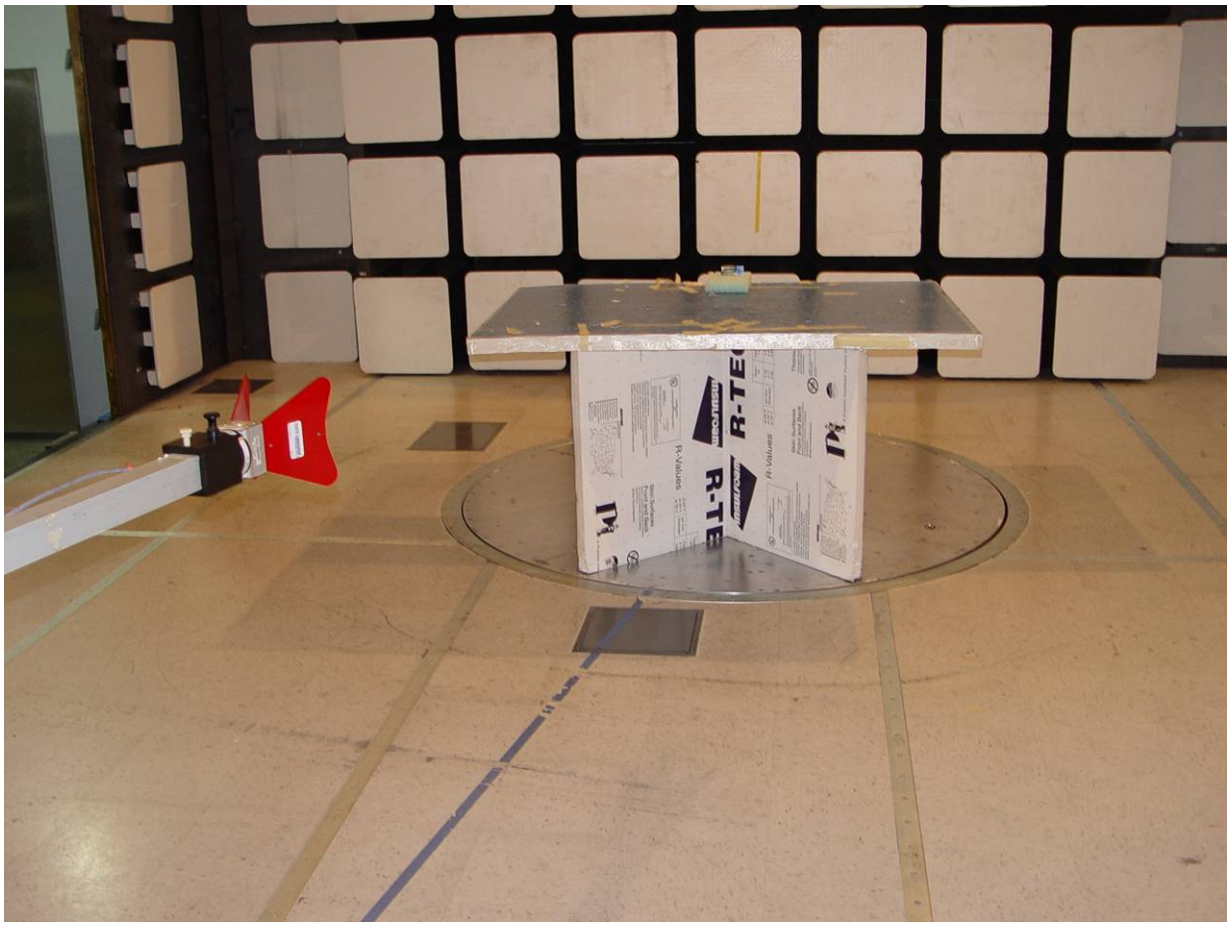
6.2. Radiated Emissions >1 GHz



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6.3. Radiated Emissions <1 GHz

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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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