Test of iControl, miKEY 802.15.4

To: FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: ICON07-A2 Rev A

TEST REPORT

FROM

MiCOM Labs

Test of iControl, miKEY 802.15.4

to

To FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: ICON07-A2 Rev A

This report supersedes: None

Applicant: iControl, Incorporated
3235 Kifer, Suite 260
Santa Clara
California, 95051 USA

Product Function: 802.15.4 Wireless Key Chain for mLOCK

Copy No: pdf **Issue Date:** 16th December 2009

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
440 Boulder Court, Suite 200
Pleasanton, CA 94566 USA
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A2LA ACCREDITED
CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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ACCREDITATION, LISTINGS and RECOGNITION

ACCREDITATION

MiCOM Labs, Inc. an accredited laboratory complies with the international standard BS 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

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 26th day of February 2008.

President & CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to February 28, 2010
Revised November 17, 2009

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

LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

North America

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

Canada
Industry Canada: 4143A

Japan Registration

VCCI Membership Number: 2959

- Radiation 3 meter site; Registration No. R-2881
- Line Conducted, Registration Nos. C-3181 & T-1470
- Emissions; Registration Nos. C-3180 & T-1469

RECOGNITION

APEC MRA (Asia-Pacific Economic Community Mutual Recognition Agreement)

Conformity Assessment Body (CAB) – MiCOM Labs

Test data generated by MiCOM Labs is accepted in the following countries under the APEC MRA.

Country	Recognition Body	Phase	CAB Identification No.
Australia	Australian Communications and Media Authority (ACMA)	I	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	I	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	I	
Singapore	Infocomm Development Authority (IDA)	I	
Taiwan	Directorate General of Telecommunications (DGT) Bureau of Standards, Metrology and Inspection (BSMI)	I I	

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
A	16th December 2009	Initial Release

1. TEST RESULT CERTIFICATE

Manufacturer:	iControl, Incorporated 3235 Kifer, Suite 260 Santa Clara California, 95051 USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	Wireless Key Chain for mLOCK	Telephone:	+1 925 462 0304
Model:	miKEY	Fax:	+1 925 462 0306
S/N:	N/A		
Test Date(s):	21st September to 14th October 2009	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15.247 & 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
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 iControl, miKEY 802.15.4 to FCC Part 15.247 and Industry Canada RSS-210 regulations.
Manufacturer:	As Applicant
Applicant:	iControl, Incorporated 3235 Kifer, Suite 260 Santa Clara California, 95051 USA
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	ICON07-A2 Rev A
Date EUT received:	21st September 2009
Standard(s) applied:	FCC 47 CFR Part 15.247 & IC RSS-210
Dates of test (from - to):	21st September to 14th October 2009
No of Units Tested:	Single unit used for radiated and conducted testing. Conducted testing, RF connector on miKEY pcb Radiated Measurements, integral antenna connected.
Type of Equipment:	802.15.4 Wireless Device
Model:	miKEY
Location for use:	Indoor/Outdoor
Declared Frequency Range(s):	2400 - 2483.5 MHz
Type of Modulation:	Per 802.15.4
Declared Nominal Average Output Power:	-4.0 dBm
EUT Modes of Operation:	802.15.4
Transmit/Receive Operation:	Time Division Duplex
ated Input Voltage and Current:	Battery Operation Nominal: 3.7 Vdc Minimum: 3.3 Vdc Maximum: 4.1 Vdc
Operating Temperature Range:	-40 to +80ºC
ITU Emission Designator:	802.15.4 – 2M5G7DFN
Frequency Stability:	±20 ppm max
Equipment Dimensions:	1.375” W x 2.25” L x 0.5” D
Weight:	2 oz
Primary function of equipment:	Wireless operation of the mLOCK wireless padlock

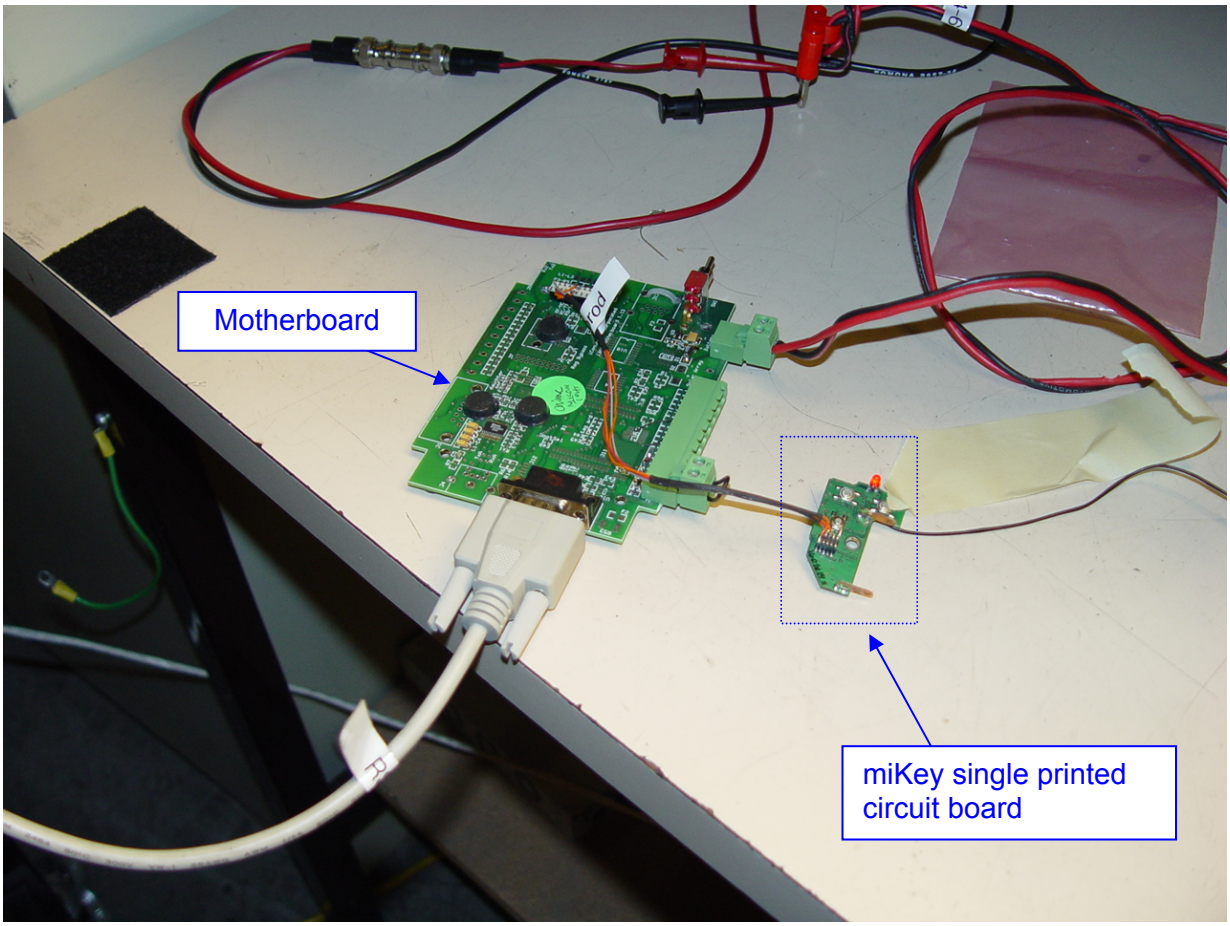
3.2. Scope of Test Program

The scope of the test program was to test the iControl 802.15.4 miKEY in the frequency range 2400 - 2483.5 MHz, FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications. This equipment is intended for periodic reporting of tracking and lock status.

The unit operates via a 3.7 Vdc Lithium battery.

Conducted testing utilized a motherboard to exercise a single printed circuit board. Radiated testing utilized final product packaging however was driven through the motherboard. Photographs of both scenarios have been included.

Conducted Test Configuration



iControl miKEY Product - Front

iControl miKEY Product - Rear

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

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	2.4 GHz ZigBee 802,15.4	iControl, Incorporated	miKEY	N/A
Support	2.4 GHz Wireless Control PCB	iControl, Incorporated	iDAC Motherboard	--
Support	ac Adapter 115Vac 60Hz 9Vdc 1.3A	Unifive	US100913	302-004675
Support	Laptop	IBM	N/A	N/A

3.4. Antenna Details

1. 2400-2483.5 MHz

    - Company Antenna Factor – Integral Antenna

      Model: ANT-2.45-CHP-x

      Antenna Pattern: Omni Directional

      Max Gain: 0.5 dBi

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. NONE

3.6. Test Configurations

Matrix of Channel test configurations.

Channel Operational Mode (802.15.4)	Frequencies (MHz)
11	2405
19	2445
26	2480

3.7. Equipment Modifications

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

1. Power reduced on Channel 26 EUT to meet band edge requirements. Power setting reduced from 95 (nominal) to 70 in test utility (-22.21 dBm)

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

4. TEST SUMMARY

List of Measurements

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

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(a)(2) **A8.2(1)** **4.4**	6 dB and 99 % Bandwidths	≥500 kHz	Conducted	Complies	5.1.1
15.247(b)(3) **15.31(e)** **A8.4(4)**	Peak Output Power Voltage Variation	Shall not exceed 1W Variation of supply voltage 85 % -115 %	Conducted	Complies	5.1.2
15.247(e) **A8.2**	Peak Power Spectral Density	Shall not be greater than +8 dBm in any 3 kHz band	Conducted	Complies	5.1.3
15.247(i) **5.5**	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Conducted	Complies	5.1.4
15.247(d) **15.205 /** **15.209** **A8.5** **2.2** **4.7**	Spurious Emissions (30MHz - 26 GHz b/g and 30 MHz – 40 GHz a)	The radiated emission in any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density	Conducted	Complies	5.1.5

List of Measurements (continued)

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** **4.7**	Radiated Emissions	Restricted Bands	Radiated	Complies	5.1.6
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz		Complies	*5.1.6.1*
	Radiated Band Edge	Band-edge results Peak Emissions		Complies	*5.1.6.2.*
Industry Canada only **RSS-Gen §4.8, §6**	Receiver Radiated Spurious Emissions	Emissions above 1 GHz		N/A	*5.1.6.3*
15.205 / **15.209** **2.2**	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)	Radiated	Complies	*5.1.6.4*
15.207 **7.2.2**	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Not Applicable	*5.1.7*

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 modifications that were required to bring the product into compliance with the above test matrix*

5. TEST RESULTS

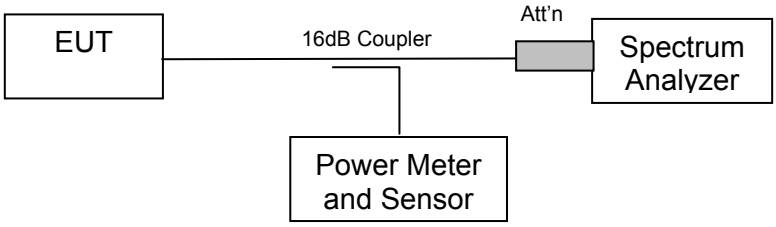
5.1. Device Characteristics

5.1.1. 6 dB and 99 % Bandwidth

FCC, Part 15 Subpart C §15.247(a)(2)
Industry Canada RSS-210 §A8.2
Industry Canada RSS-Gen §4.4

Test Procedure
The bandwidth at 6 dB and 99 % is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

Test Measurement Set up



Measurement set up for 6 dB and 99 % bandwidth test

Measurement Results for 6 dB & 99% Bandwidth

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

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier
Power: Maximum

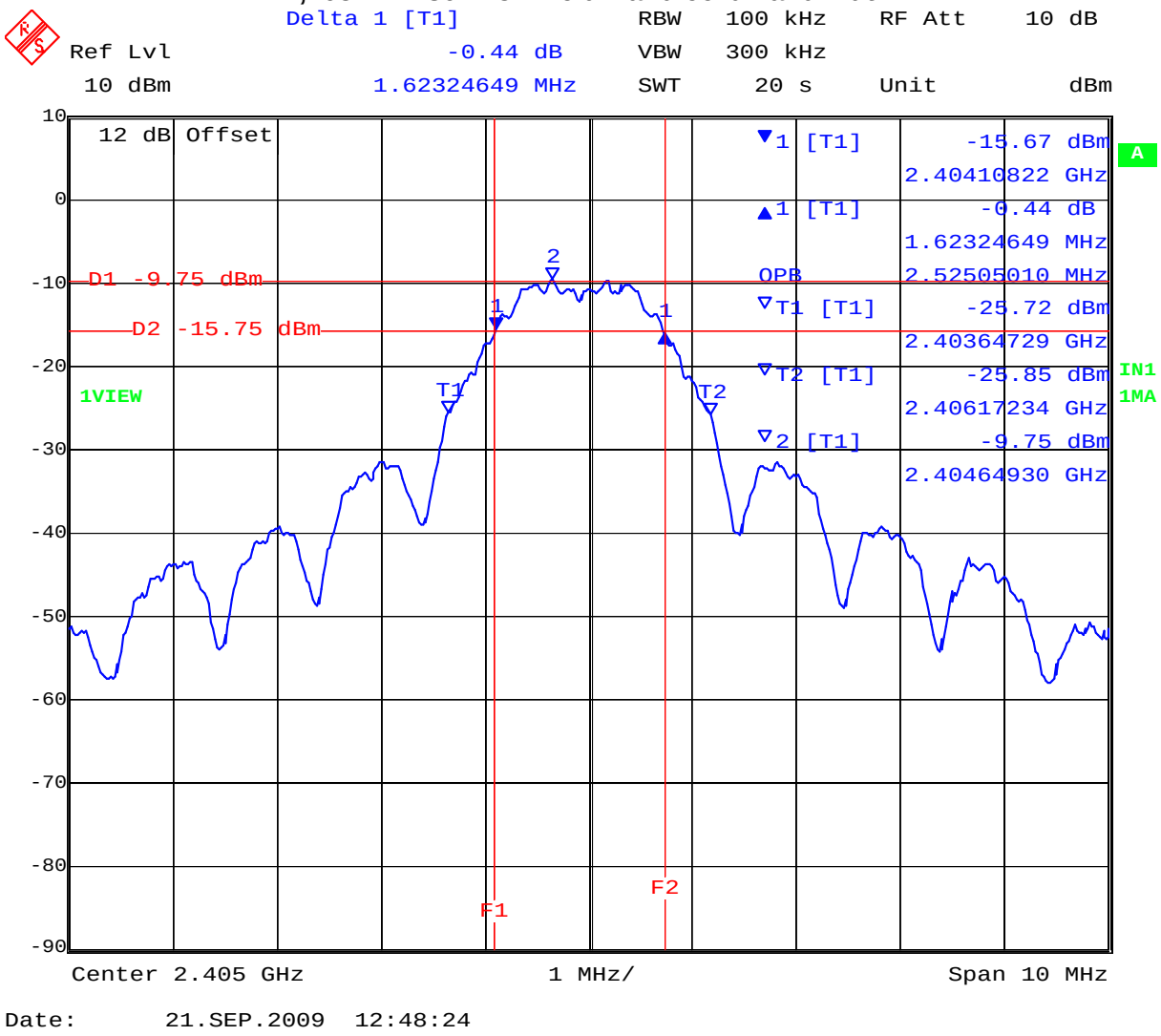
Measurement Results for 6 dB and 99% Operational Bandwidth(s)

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

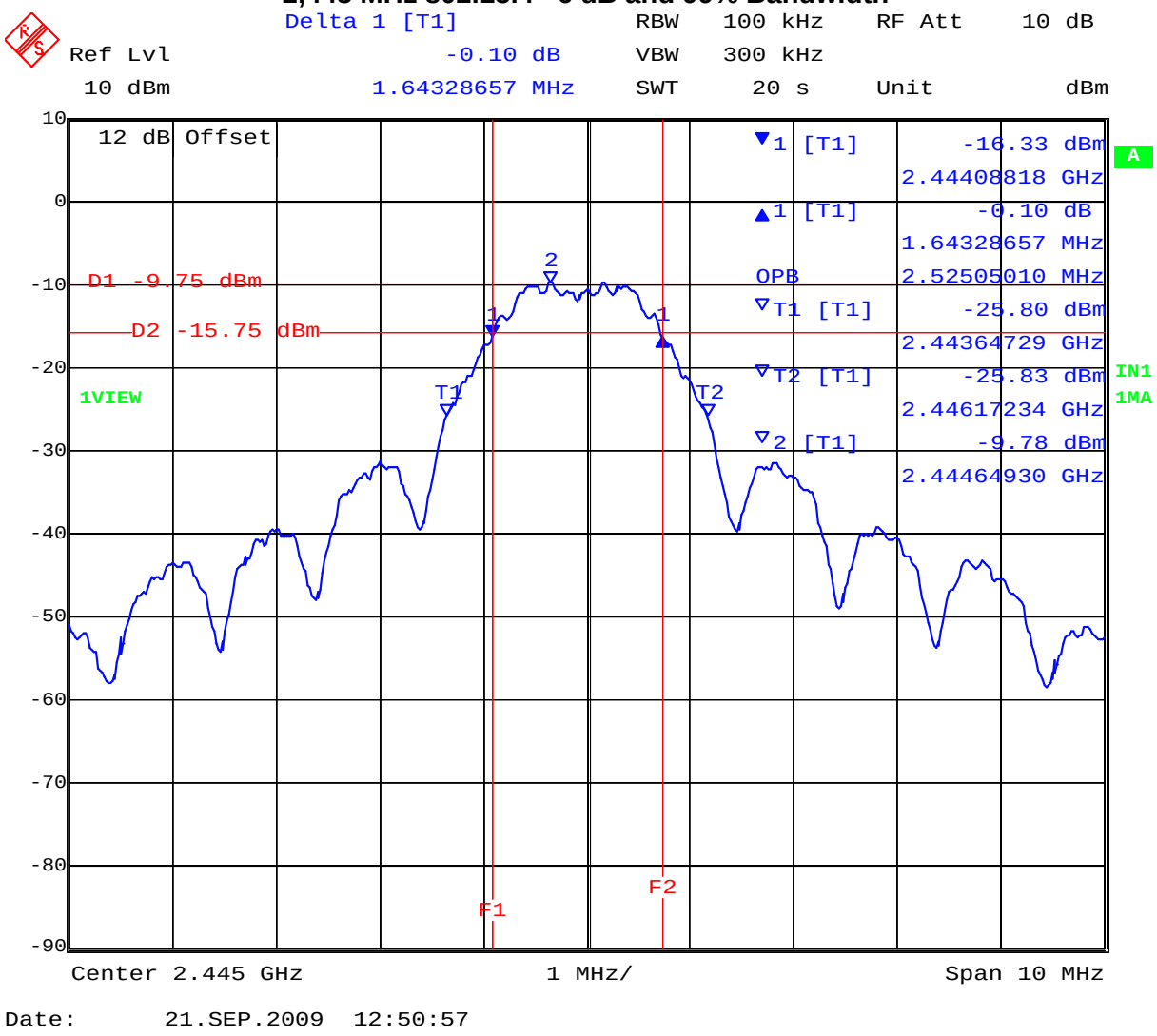
TABLE OF RESULTS

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)
2,405	1.623	2.525
2,445	1.643	2.525
2,480	1.643	2.525

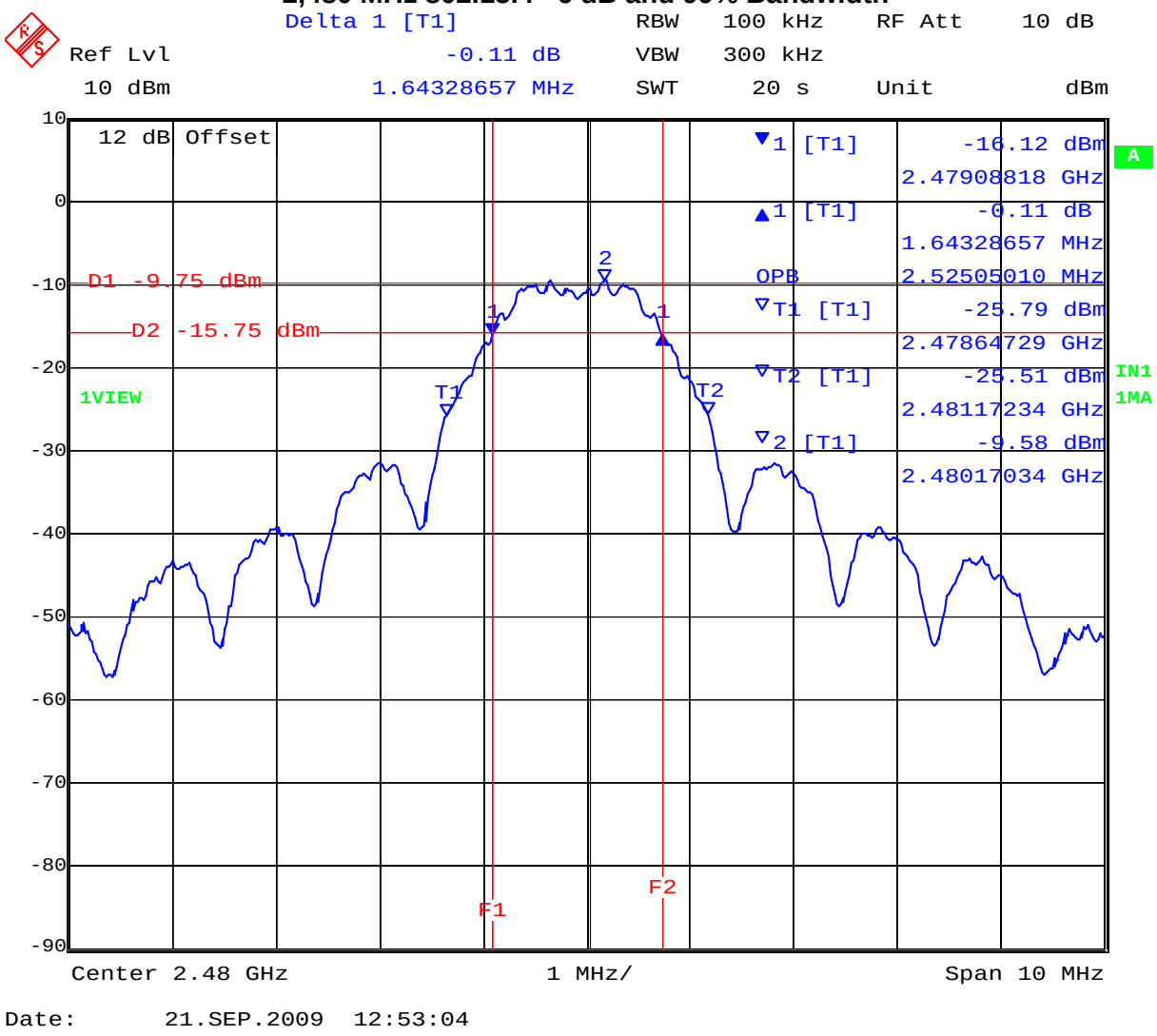
2,405 MHz 802.15.4 6 dB and 99% Bandwidth



2,445 MHz 802.15.4 6 dB and 99% Bandwidth



2,480 MHz 802.15.4 6 dB and 99% Bandwidth



Date: 21.SEP.2009 12:53:04

Specification

Limits

§15.247 (a)(2) & RSS-210 §A8.2(1)
The minimum 6 dB bandwidth shall be at least 500 kHz.

§ IC RSS-Gen 4.4.1 Occupied Bandwidth When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

§ IC RSS-Gen 4.4.2 6 dB Bandwidth Where indicated, the 6 dB bandwidth is measured at the points when the spectral density of the signal is 6 dB down from the in –band spectral density of the modulated signal, with the transmitter modulated by a representative signal.

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	±2.81 dB

Traceability

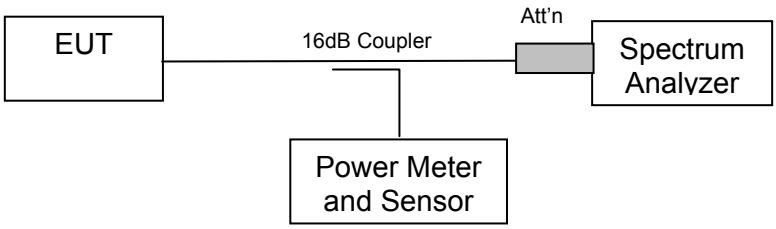
Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

5.1.2. Peak Output Power

FCC, Part 15 Subpart C §15.247(b)(3), §15.31(e)
Industry Canada RSS-210 §A8.4(4)

Test Procedure
The transmitter terminal of EUT was connected to the input of the spectrum analyzer set to measure peak power. The resolution filter bandwidth was set to 6 dB, peak detector selected and the analyzer built-in power function was used to measure peak power over the 99 % bandwidth.

Test Measurement Set up



Measurement set up for Transmitter Peak Output Power

Ambient conditions.

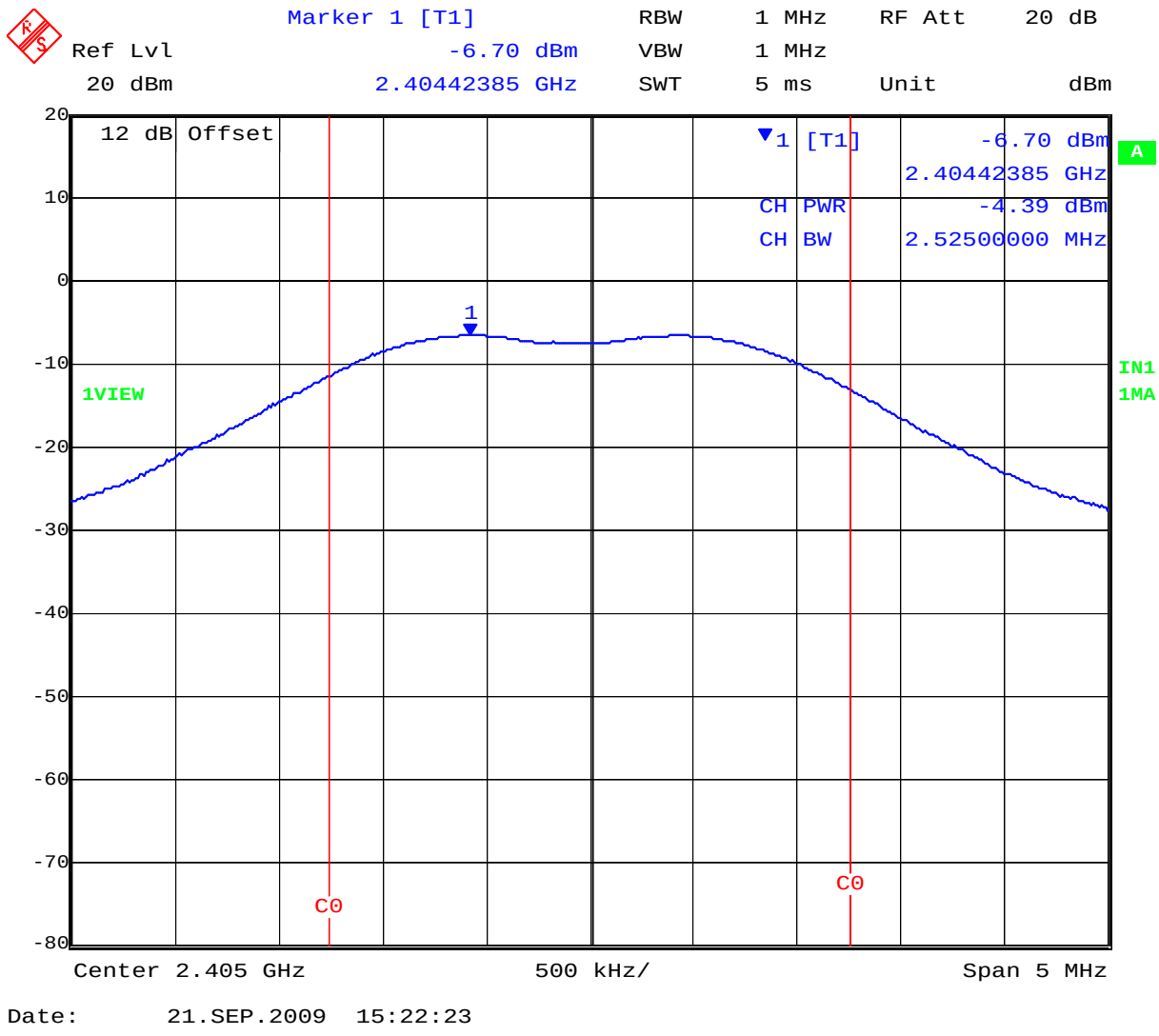
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Maximum Antenna Gain: 0.5 dBi

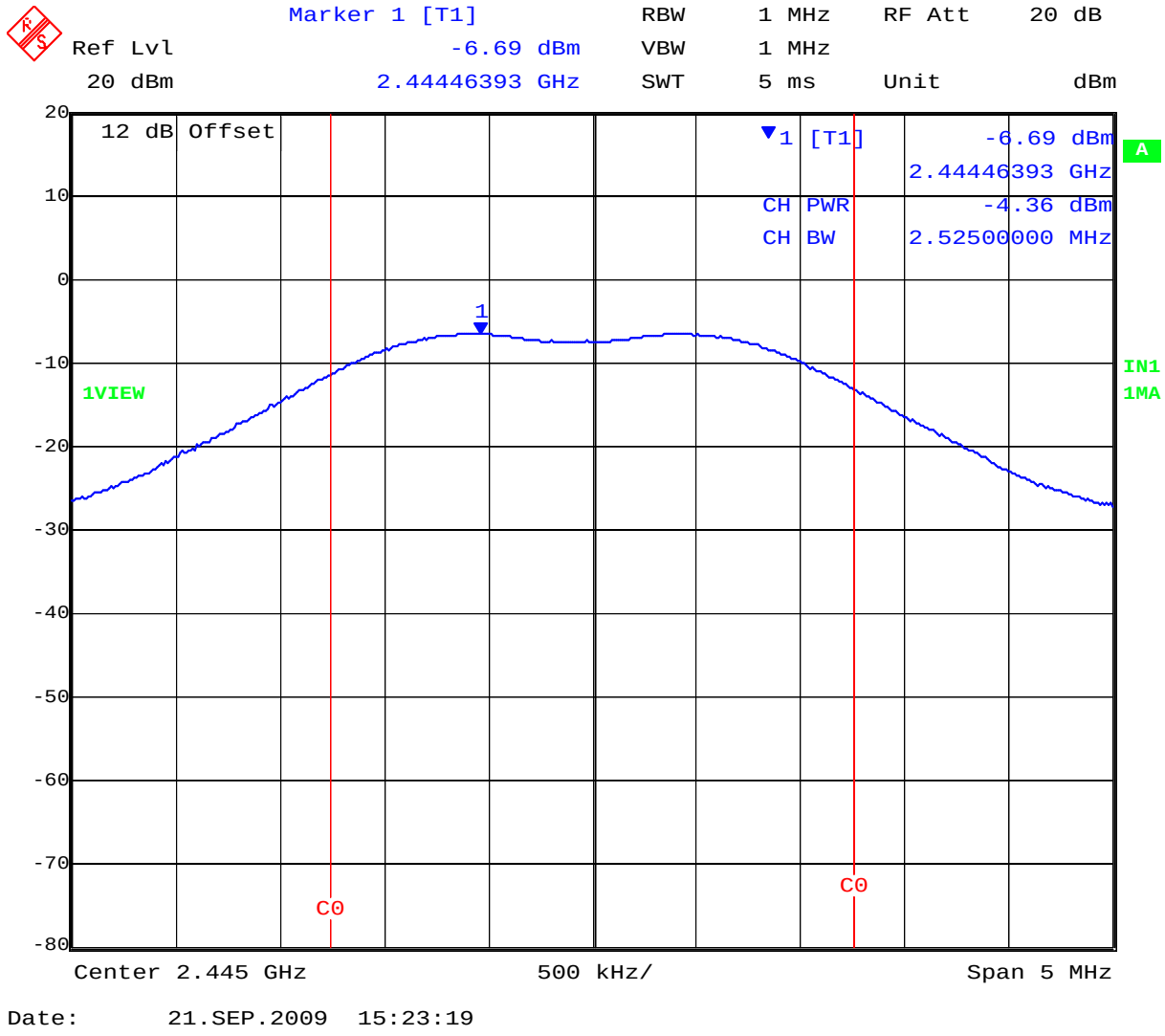
TABLE OF RESULTS
Maximum Conducted Power

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Average Power (dBm)	Peak Power (dBm)	Peak Power EIRP 0.5 dBi Integral Antenna (dBm)
2,405	2.525	-7.37	-4.39	-3.89
2,445	2.525	-7.16	-4.36	-3.86
2,480	2.525	-6.99	-4.06	-3.56

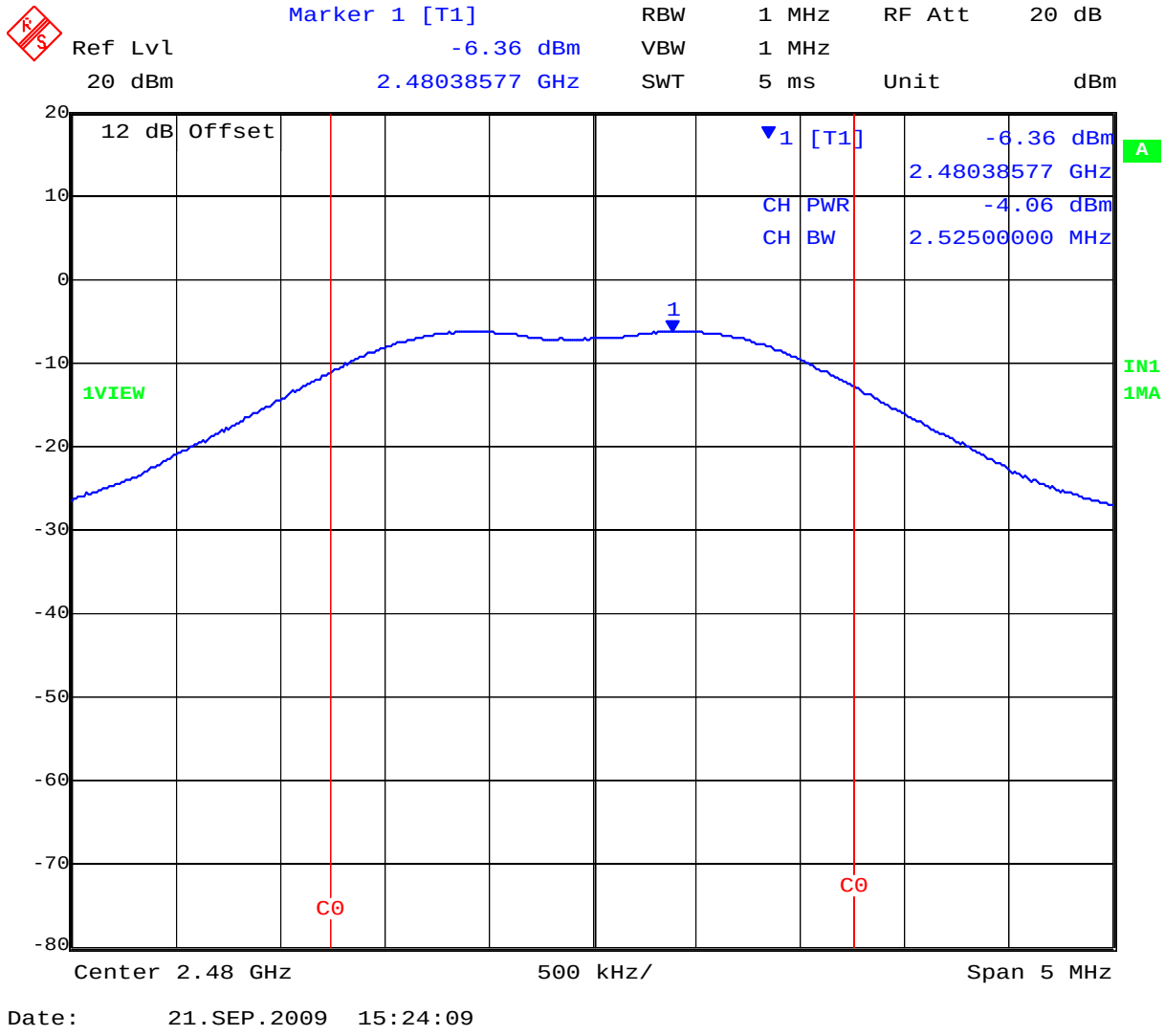
2,405 MHz 802.15.4 Peak Power (dBm)



2,445 MHz 802.15.4 Peak Power (dBm)



2,480 MHz 802.15.4 Peak Power (dBm)



Specification

Limits

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

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands: 1.0 watt.

15.247 (b) (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

15.247 (c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

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

§15.31 (e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

§ RSS-210 A8.4(4) For systems employing digital modulation techniques operating in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands the maximum peak conducted power shall not exceed 1 watt.

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

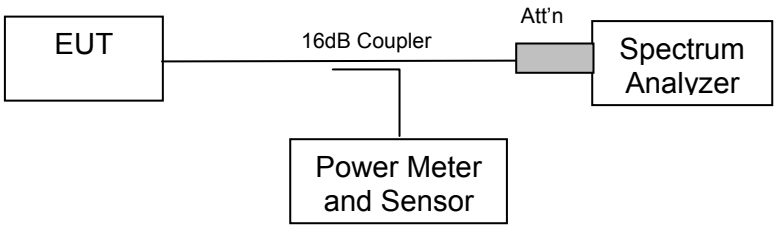
5.1.3. Peak Power Spectral Density

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

Test Procedure

The transmitter output was connected to a spectrum analyzer and the maximum level in a 3 kHz bandwidth was measured. A peak value was found over the full emission bandwidth and the frequency span reduced to obtain enhanced resolution. Sweep time ≥ span / 3 kHz with video averaging turned off. The Peak Power Spectral Density is the highest level found across the emission in a 3 kHz resolution bandwidth.

Test Measurement Set up



Measurement set up for Peak Power Spectral Density

Measurement Results for Peak Power Spectral Density

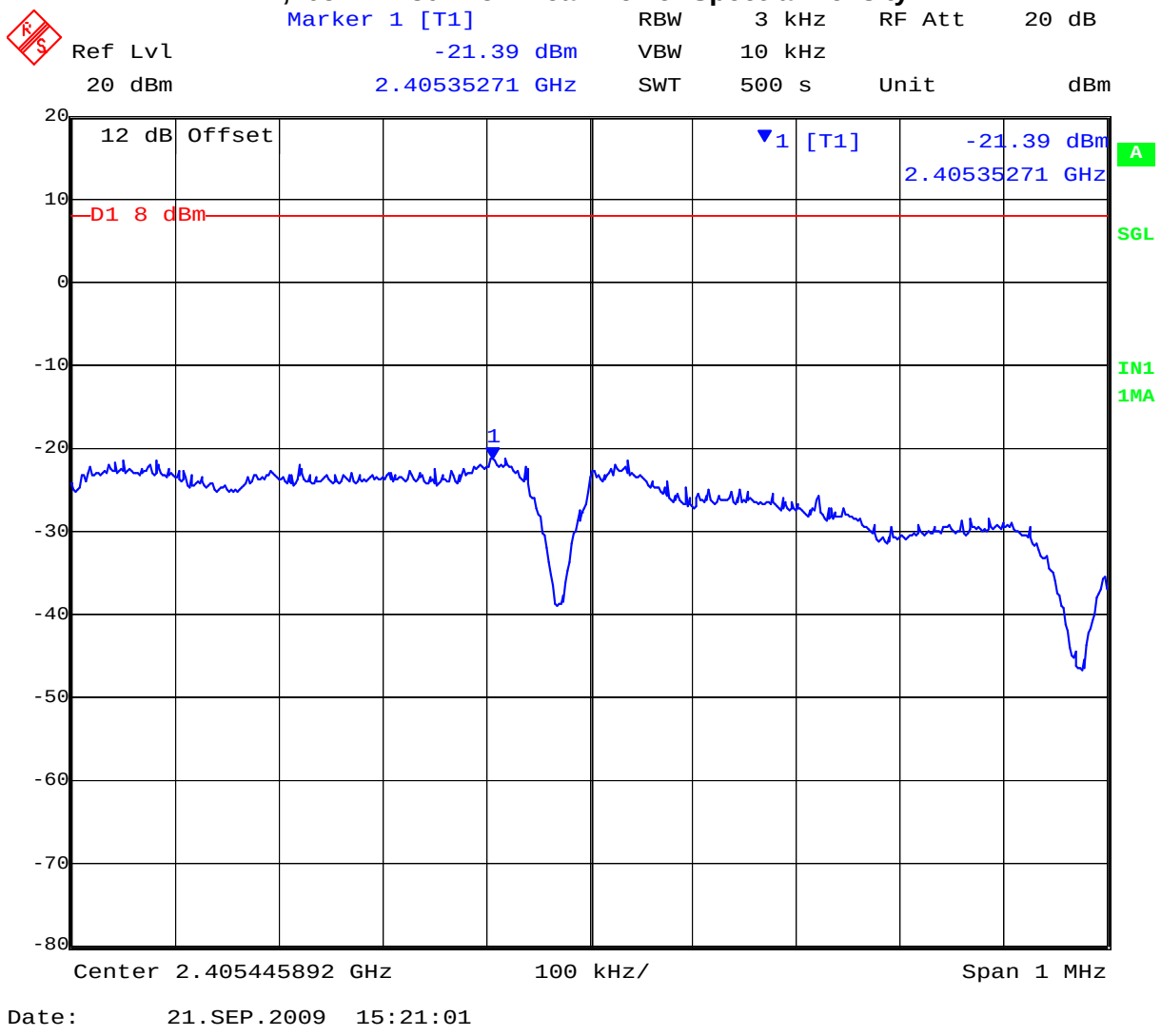
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier

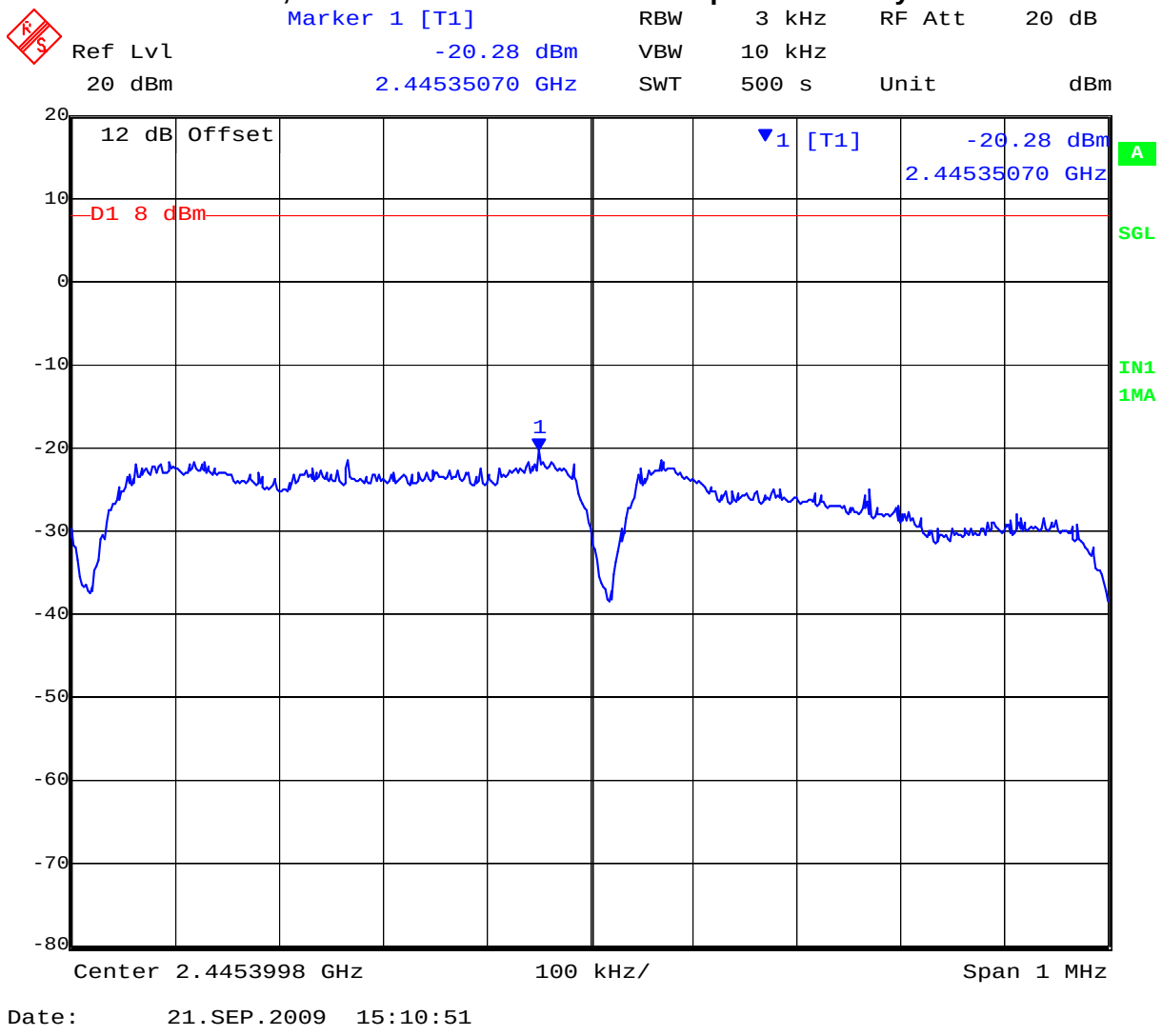
TABLE OF RESULTS

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,405	2405.35271	-21.39	+8.00	-29.39
2,445	2445.35070	-20.28	+8.00	-28.28
2,480	2480.34970	-20.23	+8.00	-28.23

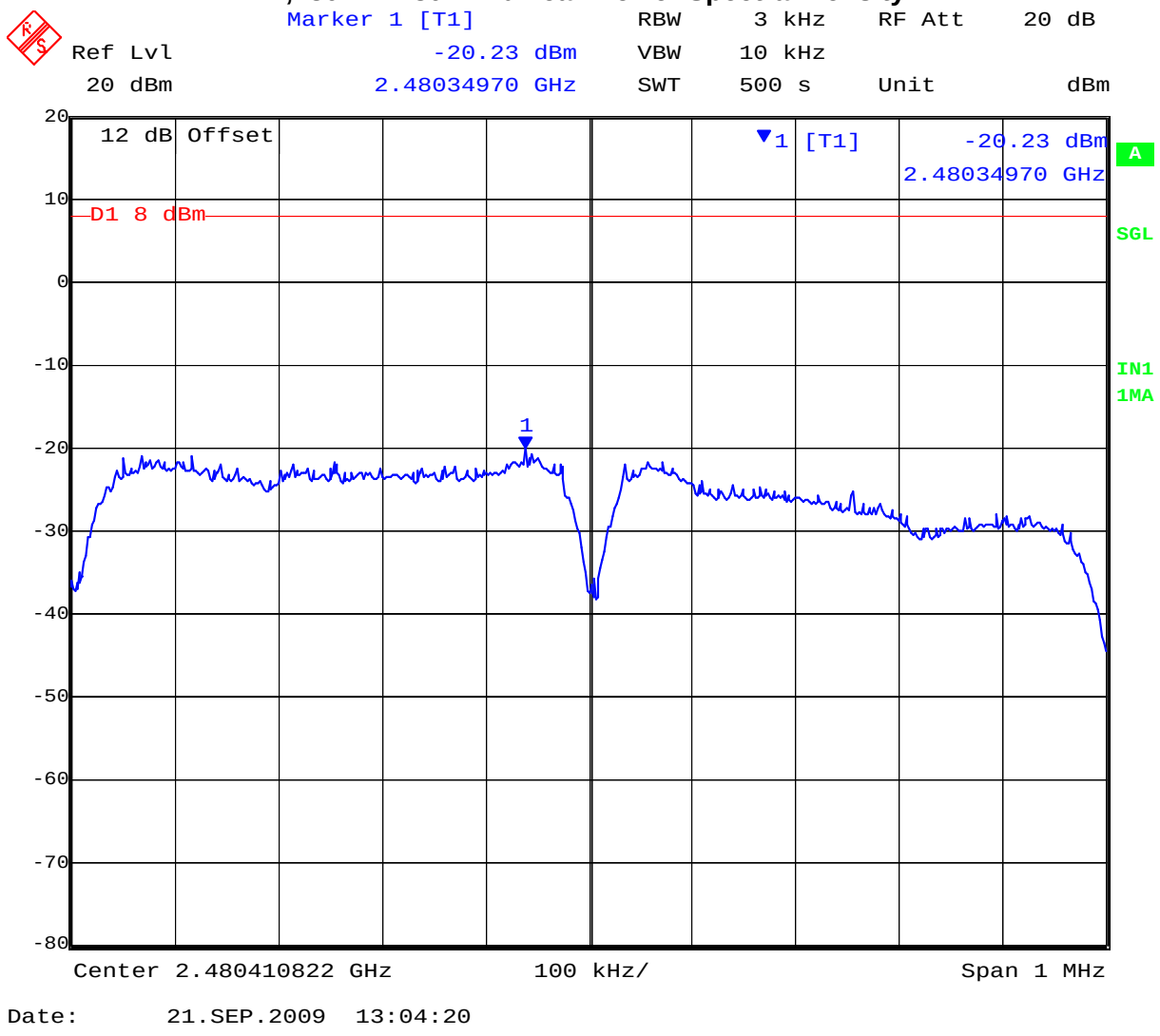
2,405 MHz 802.15.4 Peak Power Spectral Density



2,445 MHz 802.15.4 Peak Power Spectral Density



2,480 MHz 802.11b Peak Power Spectral Density



Specification
Peak Power Spectral Density Limits

§15.247(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission

RSS-210 §**A8.2(2)** The transmitter power spectral density (into the antenna) shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0 second duration.

Laboratory Measurement Uncertainty for Spectral Density

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

5.1.4. 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 (GHz)	Antenna Gain (dBi)	Numeric Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated Safe Distance @ 1mW/cm^2 Limit(cm)	Minimum Separation Distance (cm)
2.4	0.5	1.12	-4.06	0.4	0.19	20.0

***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

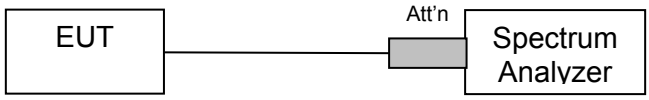
Measurement uncertainty	±1.33 dB

5.1.5. Conducted Spurious Emissions

FCC, Part 15 Subpart C §15.247(d); 15.205; 15.209
Industry Canada RSS-210 §A8.5, §2.2
Industry Canada RSS-Gen 4.7

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

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier

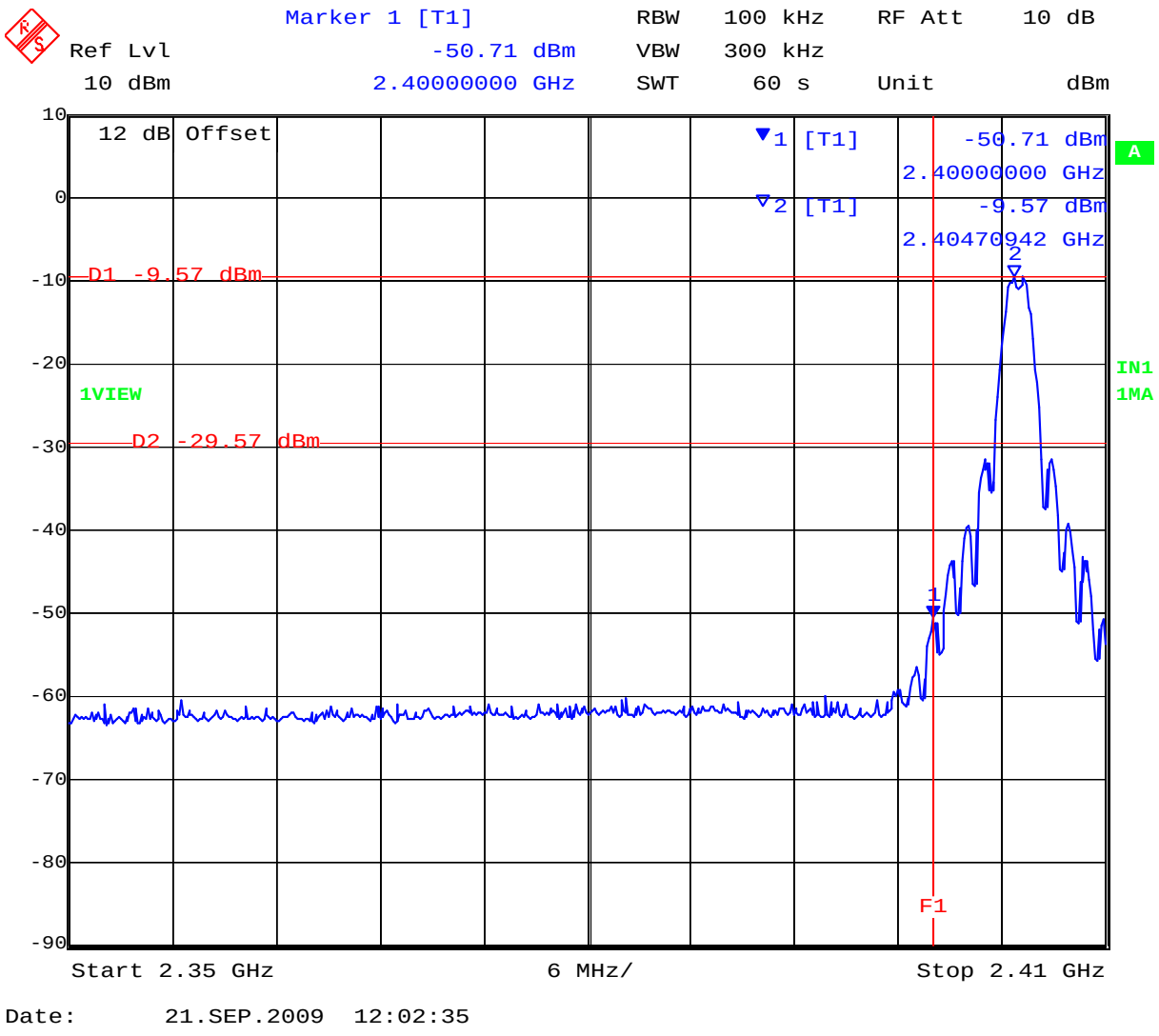
Conducted Band-Edge Results

Measurements were performed with the transmitter tuned to the channel closest to the band-edge being measured. All emissions were maximized during measurement. Limits which were derived from the band-edge measurements provided below are drawn on each plot.

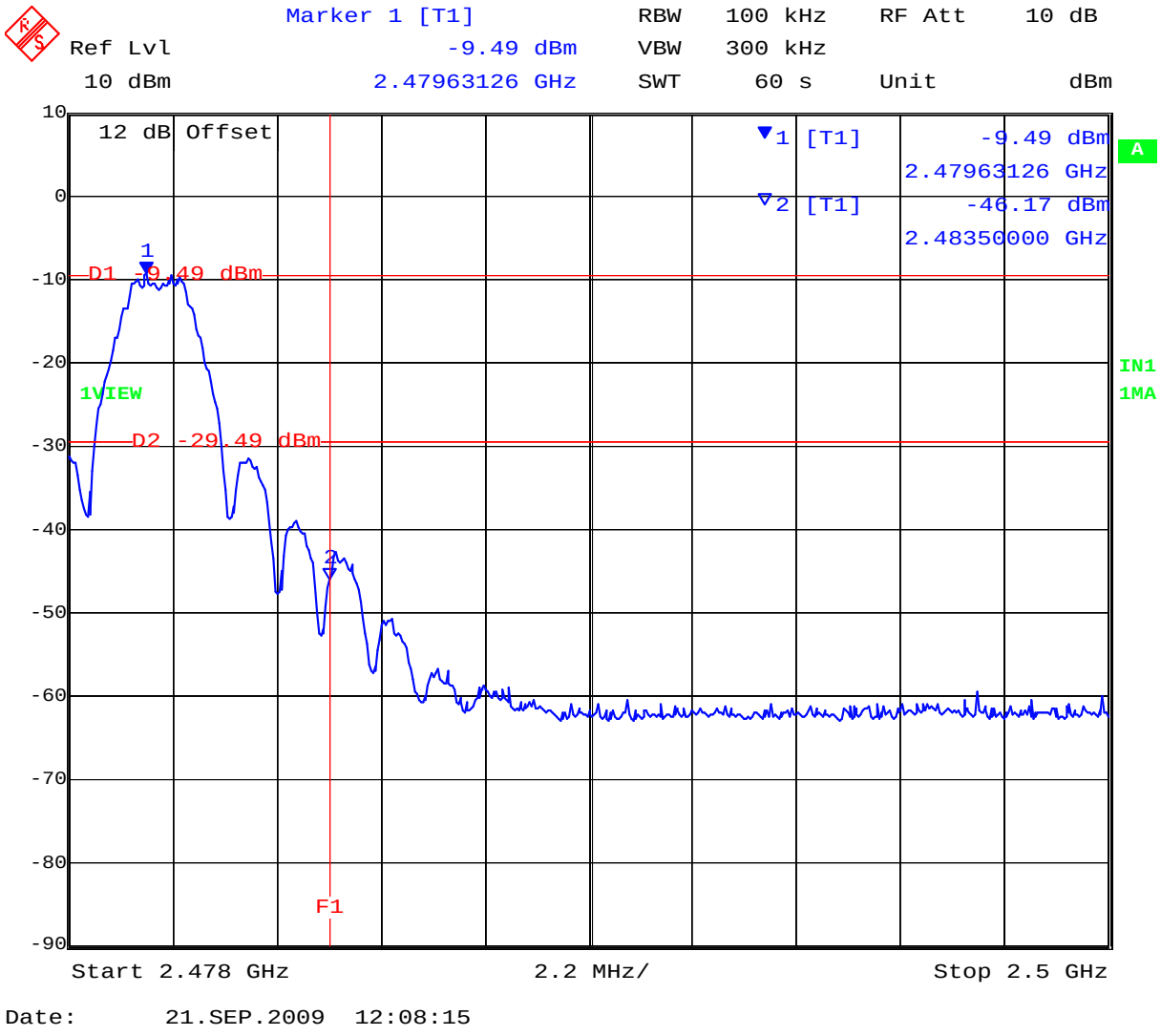
TABLE OF RESULTS

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
2,405	2,400.0	-29.57	-50.71	-21.14
2,480	2,483.5	-29.49	-46.17	-16.68

Conducted Spurious Emissions at the 2,400 MHz Band Edge



Conducted Spurious Emissions at the 2,483.5 MHz Band Edge

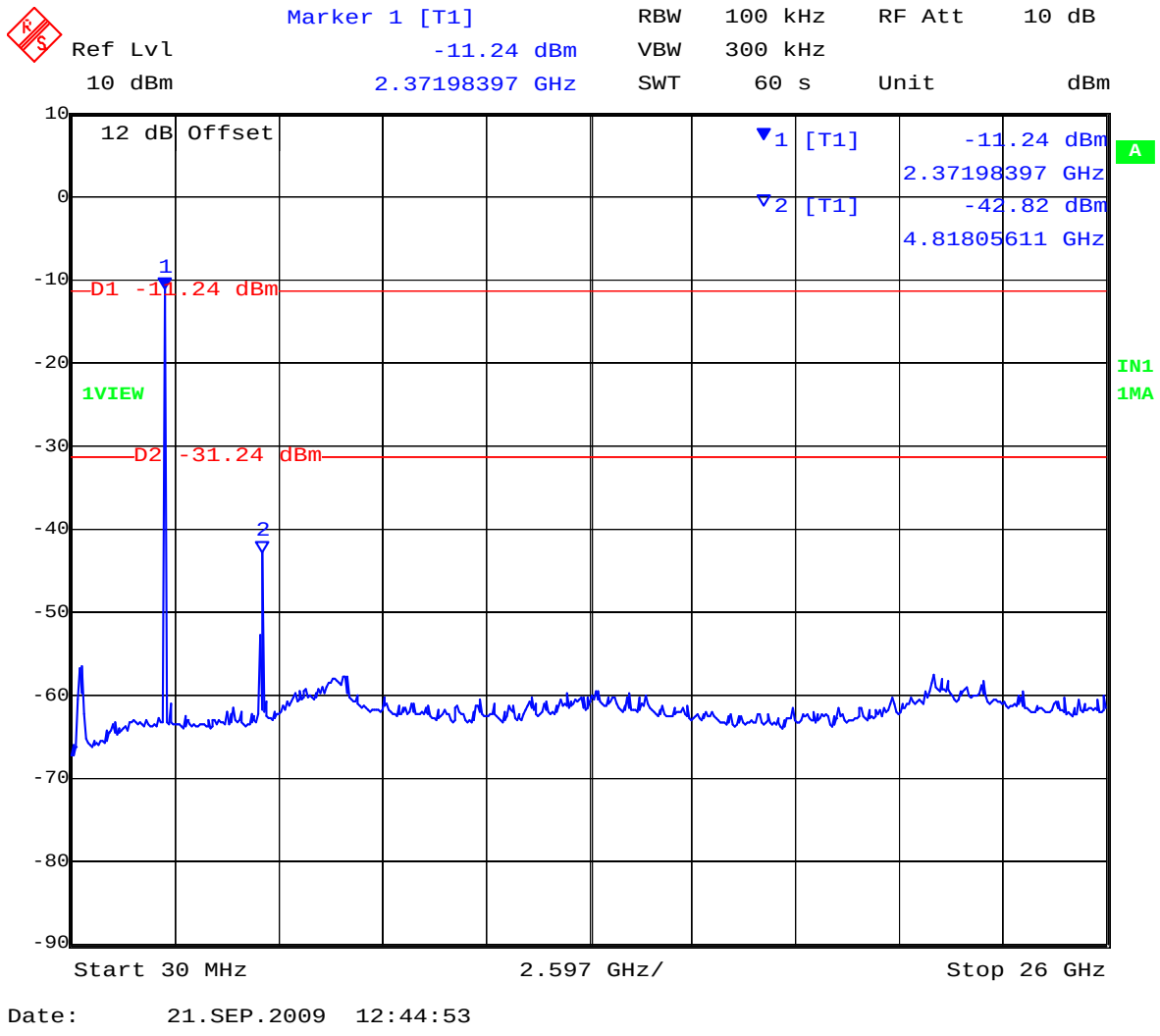


Spurious Emissions (30 - 26,000 MHz)

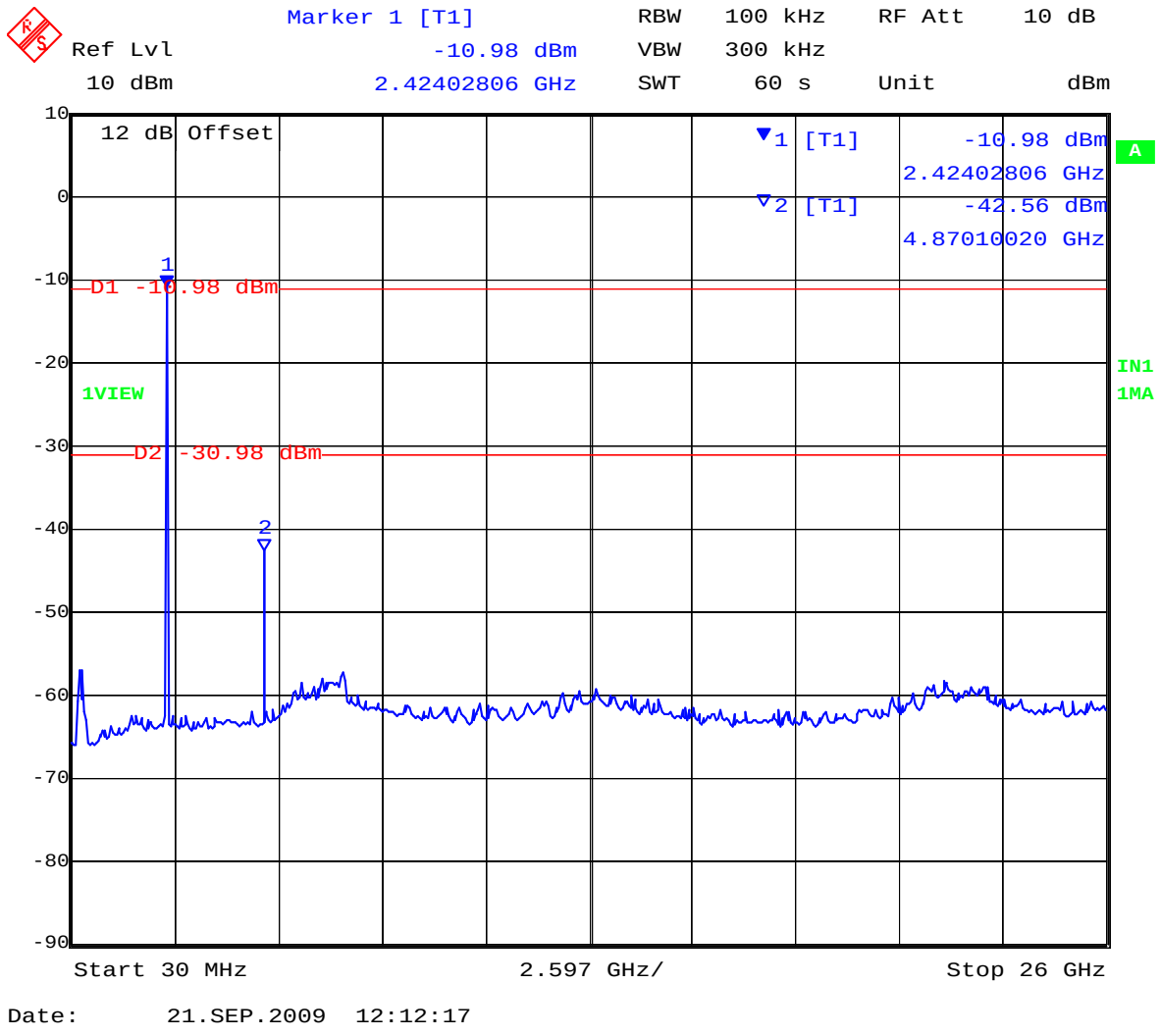
TABLE OF RESULTS

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,405	30	26,000	-31.24	-42.82	-11.58
2,445			-30.98	-42.56	-11.58
2,480			-30.79	-42.33	-11.54

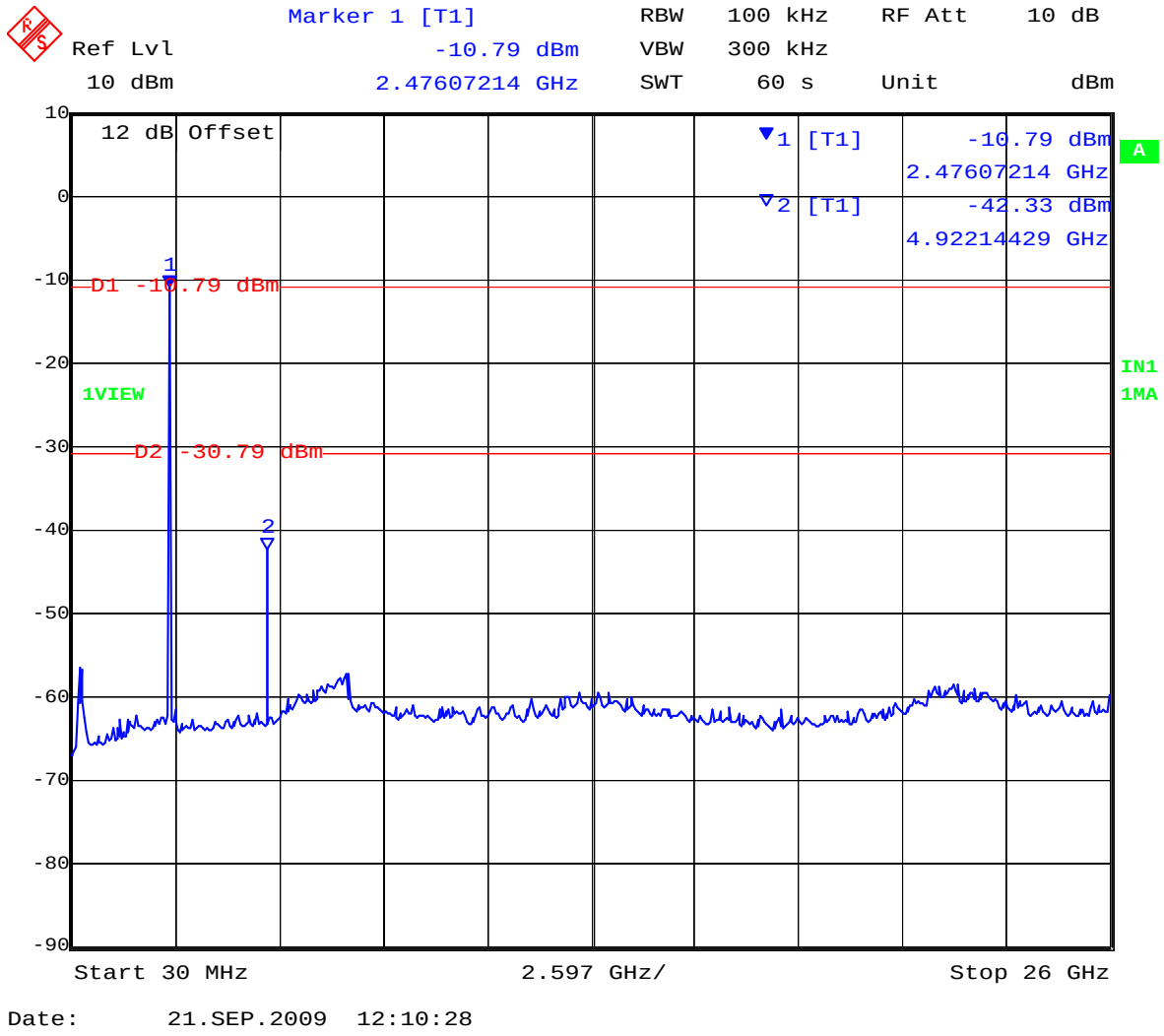
2,405 MHz Conducted Spurious Emissions 30 to 26,000 MHz



2,445 MHz Conducted Spurious Emissions 30 to 26,000 MHz



2,480 MHz Conducted Spurious Emissions 30 to 26,000 MHz



Specification

Limits Band-Edge

Lower Limit Band-edge	Upper Limit Band-edge	Limit below highest level of desired power
2,400 MHz	2,483.5 MHz	≥ 20 dB

§15.247(d) and RSS-210 §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 radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

§15.247(d)
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)).

RSS-210 §A8.5 If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

RSS-Gen §4.7
The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz , whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 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'	0088, 0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117.

5.1.6. Radiated Emissions

5.1.6.1. Transmitter Radiated Spurious Emissions (above 1 GHz)

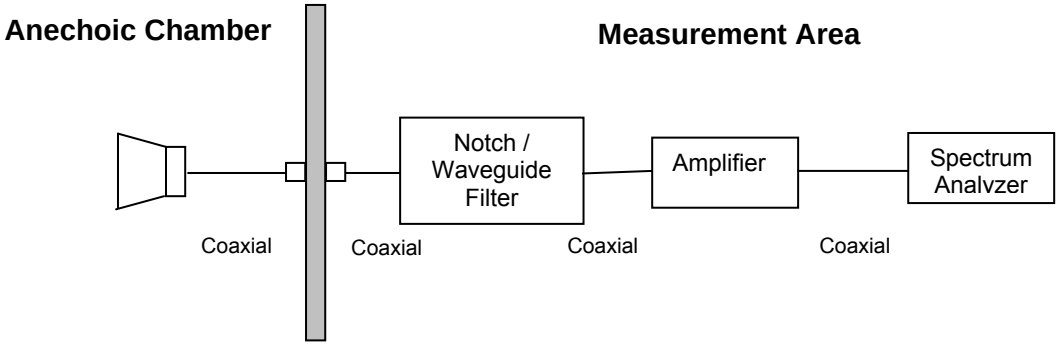
FCC, Part 15 Subpart C §15.247(d) 15.205; 15.209
Industry Canada RSS-210 §A8.5, §2.2, §2.6
Industry Canada RSS-Gen §4.7

Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

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

FS = R + AF + CORR - FO
where: FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

For example:
Given receiver input reading of 51.5 dBμV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB 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))

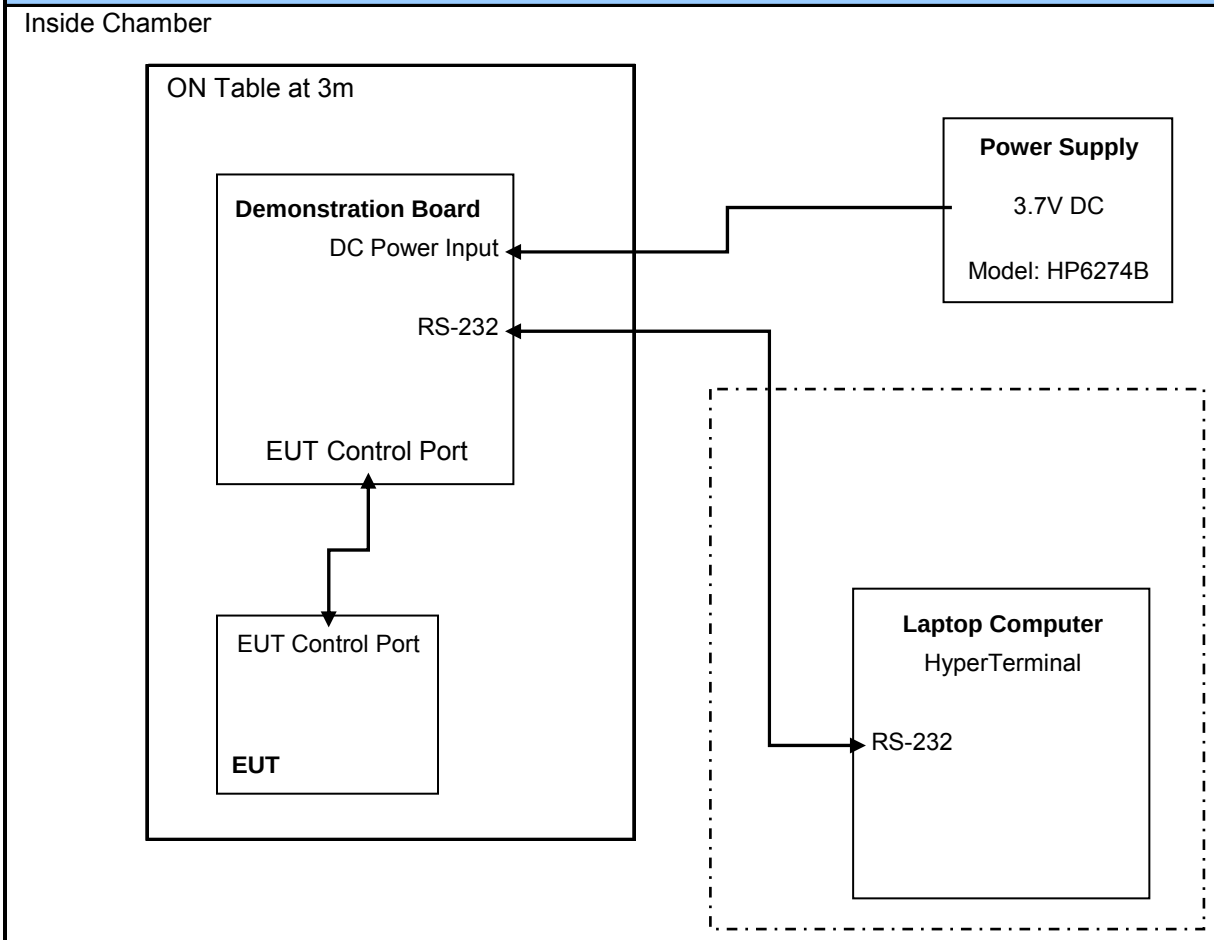
40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

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

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier

Radiated Spurious Emissions above 1 GHz

EUT Setup Diagram



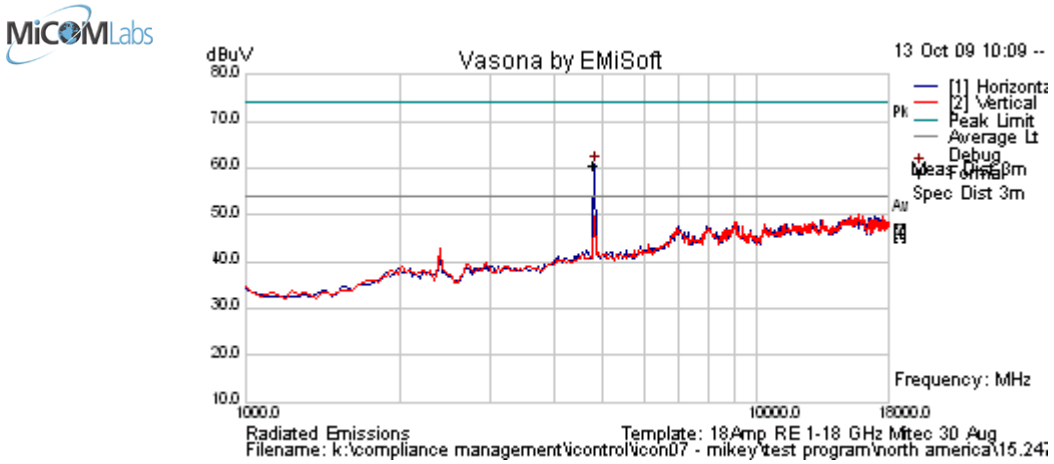
Test Setup Description

Both Vertical and Horizontal EUT positions were investigated during preliminary testing. EUT was setup in the worst case position for final tests (i.e. Horizontal; EUT case laying flat on table)

EUT was connected to demonstration board to provide DC power and control. HP 6274B DC Power Supply was connected during test, and placed on the ground plane next to EUT.

Hyperterminal was used for setup and control of the EUT (i.e.changing the transmit and receive frequencies, changing output power, change Tx/Rx modes) The computer was connected via RS-232 control. The RS-232 cable and computer was removed from chamber before prescans or final measurements were performed.

Test Freq.	2405 MHz (CH11)	**Engineer**	CSB
Variant	Tx in Test Utility	**Temp (ºC)**	23
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	32
Power Setting	95 in test utility	**Press. (mBars)**	999
Antenna	Integral Trace Antenna included on PCB active during testing		
Test Notes 1	EUT board sitting horizontal (i.e. case laying flat) on table		
Test Notes 2	Duty cycle = 100%		

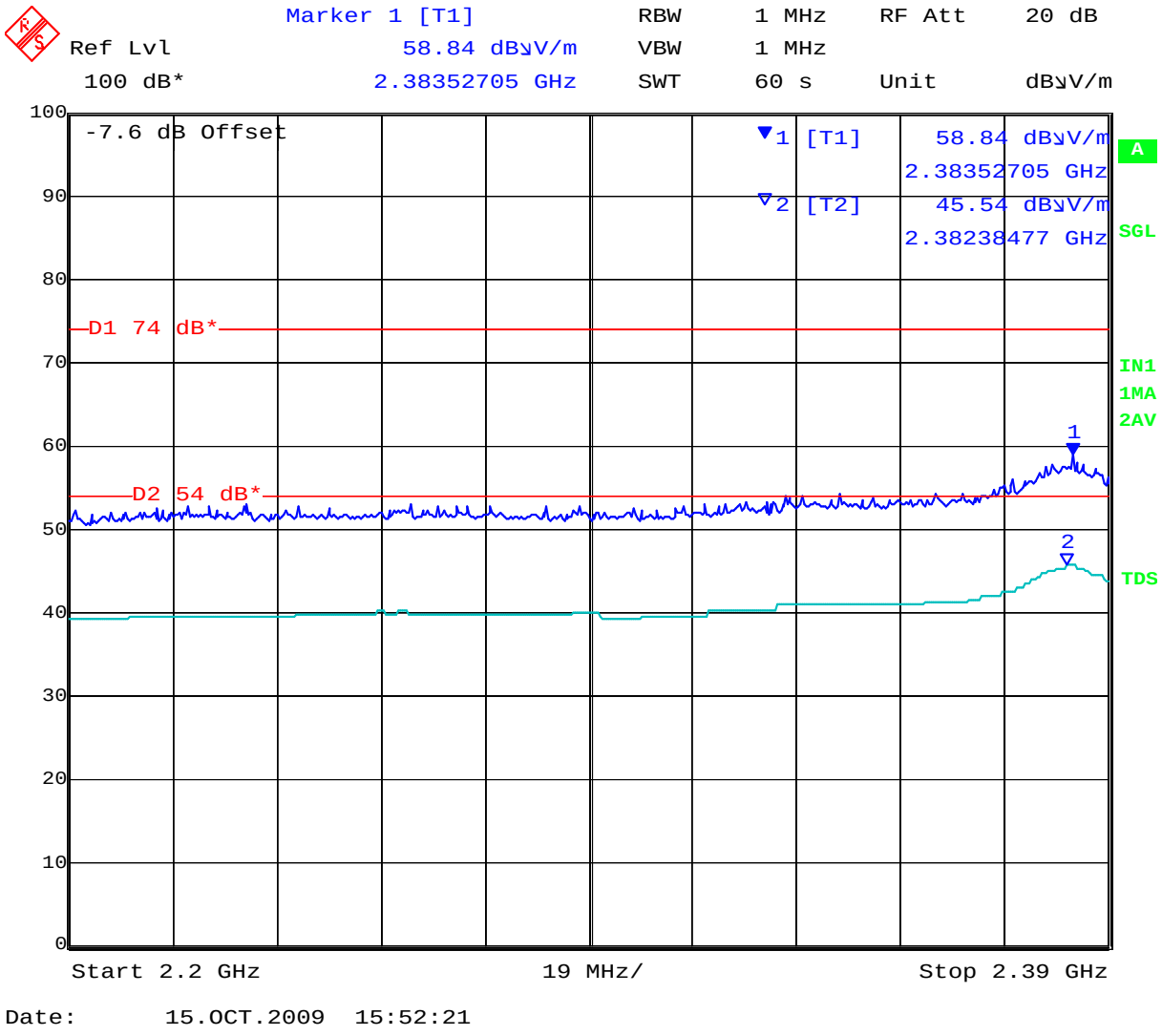


Formally measured emission peaks

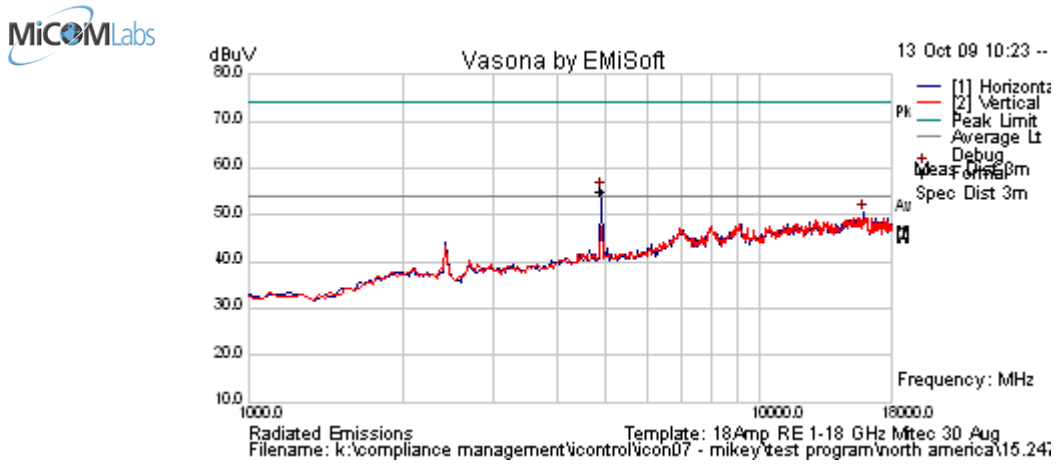
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
4809.858	59.6	4.5	-8.7	55.4	Peak Max	H	98	365	74	-18.6	Pass	RB
4809.858	54.9	4.5	-8.7	50.6	Average Max	H	98	365	54	-3.4	Pass	RB
2383.527	--	--	--	58.8	Peak	H	119	2	74	-15.2	Pass	BE
2382.385	--	--	--	45.5	Average	H	119	2	54	-8.5	Pass	BE

Legend:	RB = Restricted Band; NRB = Non-Restricted Band - Limit is 20dB below carrier - See conducted results
	BE = Emission in Restricted Band Nearest Transmission Band Edge; FUND = Fundamental Freq.

Band-Edge 2405 MHz



Test Freq.	2445 MHz (CH19)	**Engineer**	CSB
Variant	Tx in Test Utility	**Temp (ºC)**	23
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	32
Power Setting	95 in test utility	**Press. (mBars)**	999
Antenna	Integral Trace Antenna included on PCB active during testing		
Test Notes 1	EUT board sitting horizontal (i.e. case laying flat) on table		
Test Notes 2	Duty cycle = 100%		

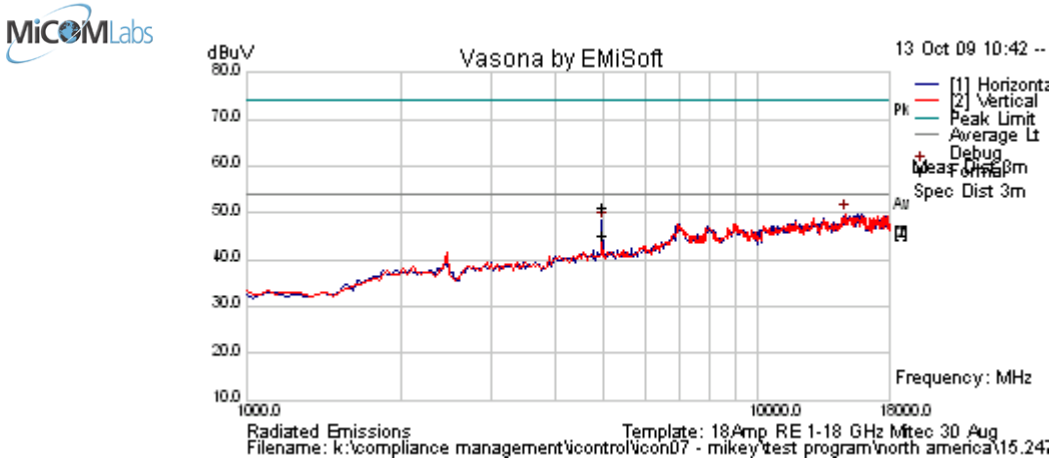


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
4889.856	60.89	4.52	-8.73	56.69	Peak Max	H	98	284	74	-17.31	Pass	RB
4889.856	56.71	4.52	-8.73	52.5	Average Max	H	98	284	54	-1.5	Pass	RB

Legend:	RB = Restricted Band; NRB = Non-Restricted Band - Limit is 20dB below carrier - See conducted results
	BE = Emission in Restricted Band Nearest Transmission Band Edge; FUND = Fundamental Freq.

Test Freq.	2480 MHz (CH 26)	**Engineer**	CSB
Variant	Tx in Test Utility	**Temp (ºC)**	23
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	32
Power Setting	70 in test utility (-22.21 dBm)	**Press. (mBars)**	999
Antenna	Integral Trace Antenna included on PCB active during testing		
Test Notes 1	EUT board sitting horizontal (i.e. case laying flat) on table; Duty cycle = 100%		
Test Notes 2	Power reduced on Channel 26 EUT to meet band edge requirements		

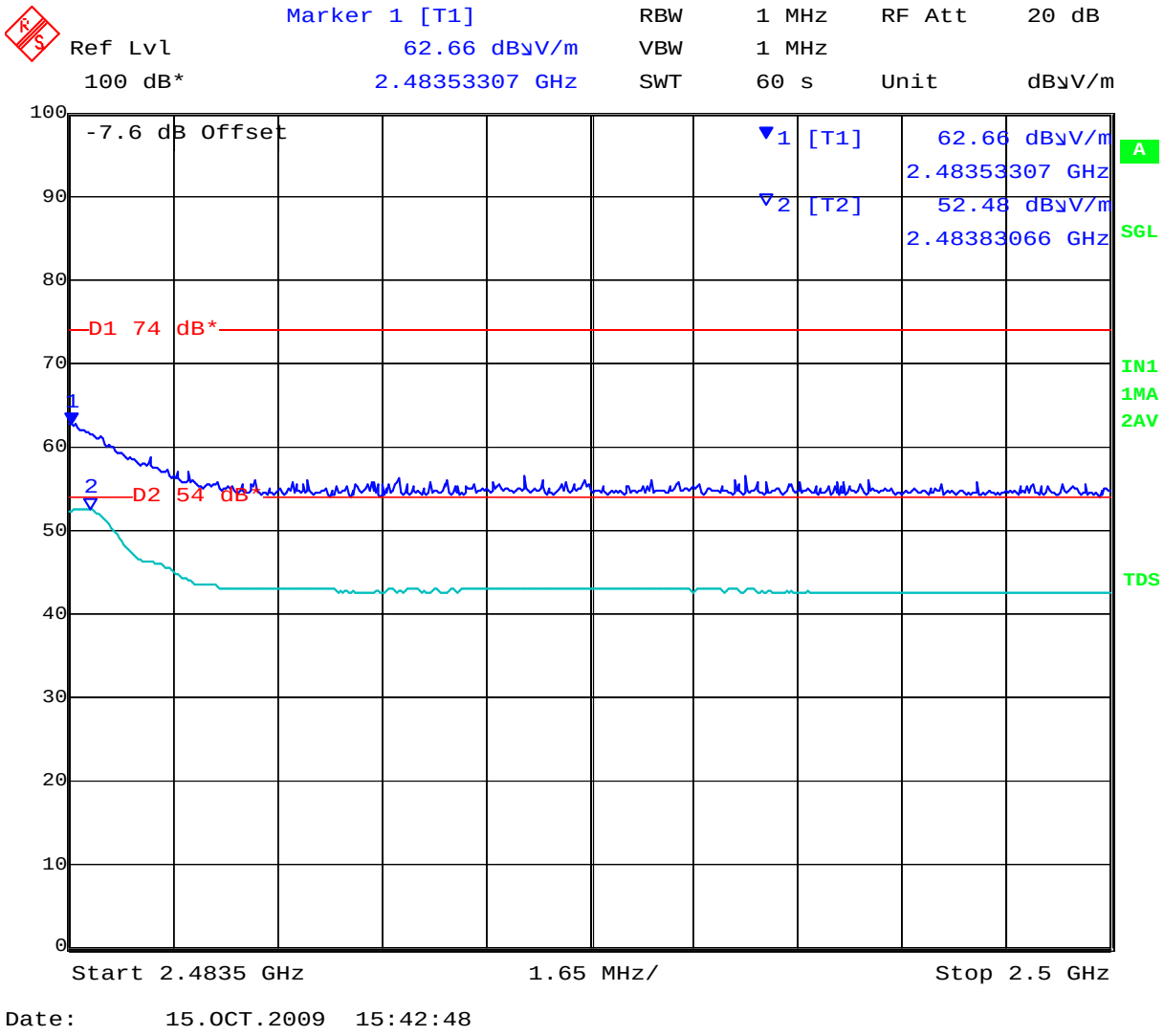


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
4959.813	55.21	4.59	-8.73	51.07	Peak Max	H	98	283	74	-22.93	Pass	RB
4959.813	49.2	4.59	-8.73	45.05	Average Max	H	98	283	54	-8.95	Pass	RB
2483.533	--	--	--	62.7	Peak	H	118	163	74	-11.3	Pass	BE
2483.831	--	--	--	52.5	Average	H	118	163	54	-1.5	Pass	BE

Legend:	RB = Restricted Band; NRB = Non-Restricted Band - Limit is 20dB below carrier - See conducted results
	BE = Emission in Restricted Band Nearest Transmission Band Edge; FUND = Fundamental Freq.

Band-Edge 2480 MHz



Specification Limits

FCC §15.247(d) and RSS-210 §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 radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

FCC §15.247(d)
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)).

IC RSS-210 §A8.5 If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

IC RSS-Gen §4.7
The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz , whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

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.

§15.209 (a) Limit Matrix

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

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

5.1.6.2. Receiver Radiated Spurious Emissions

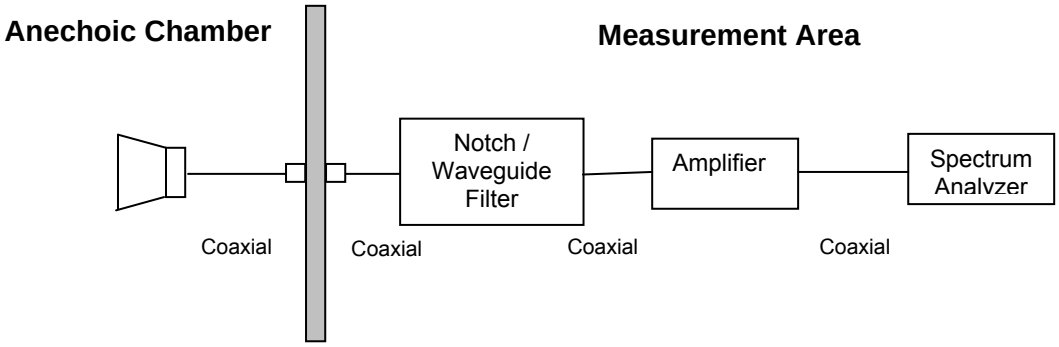
Industry Canada RSS-Gen §4.8, §6

Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

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

FS = R + AF + CORR - FO

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

For example:
Given receiver input reading of 51.5 dBμV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB 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

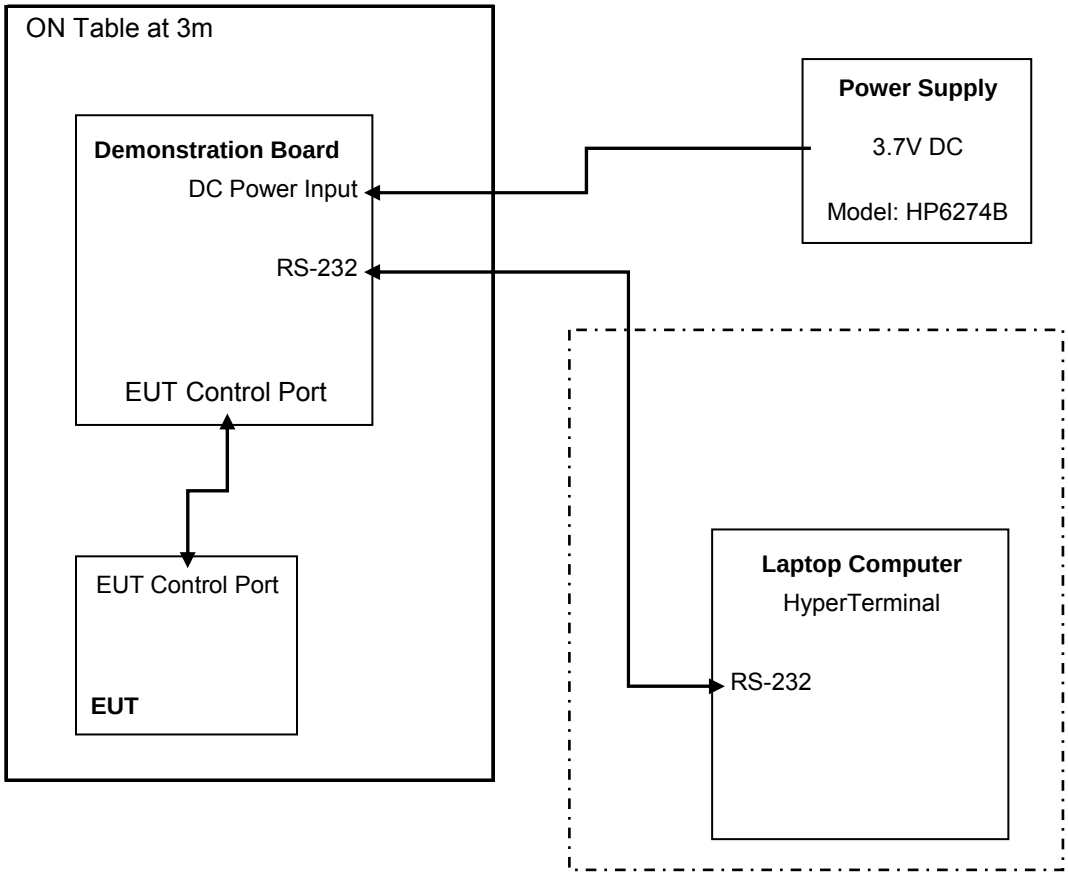
Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

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

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

EUT Setup Diagram

Inside Chamber



Test Setup Description

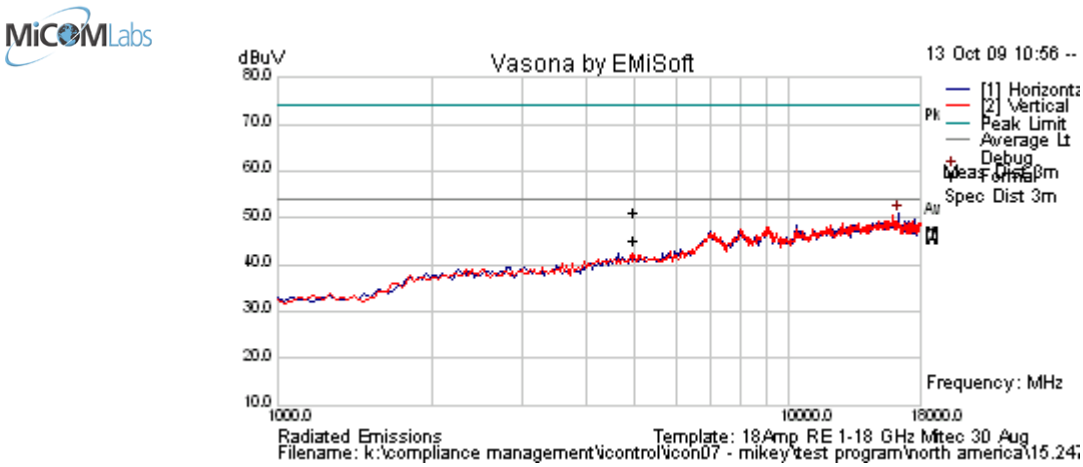
Both Vertical and Horizontal EUT positions were investigated during preliminary testing. EUT was setup in the worst case position for final tests (i.e. Horizontal; EUT case laying flat on table)

EUT was connected to demonstration board to provide DC power and control. HP 6274B DC Power Supply was connected during test, and placed on the ground plane next to EUT.

Hyperterminal was used for setup and control of the EUT (i.e.changing the transmit and receive frequencies, changing output power, change Tx/Rx modes) The computer was connected via RS-232 control. The RS-232 cable and computer was removed from chamber before prescans or final measurements were performed.

Receiver Radiated Spurious Emissions above 1 GHz

Test Freq.	Channel 19	**Engineer**	CSB
Variant	Receive in Test Utility	**Temp (ºC)**	23
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	32
Power Setting	Not Applicable in Receive Mode	**Press. (mBars)**	999
Antenna	Integral Trace Antenna included on PCB active during testing		
Test Notes 1	EUT board sitting horizontal on table		
Test Notes 2			



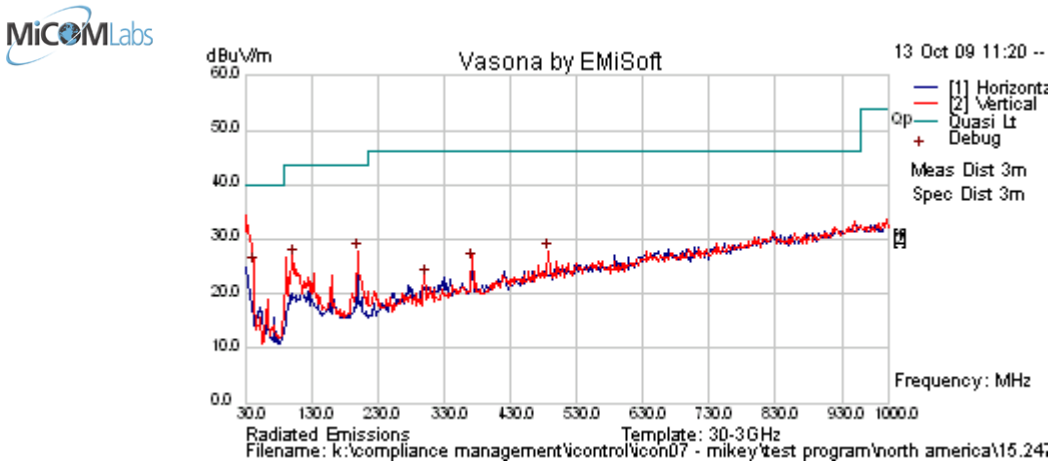
Formally measured emission peaks

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 Receiver Emissions within 6dB of limit.												

Legend:	DIG = Digital Emissions; RX = Receiver Emission

Receiver Radiated Spurious Emissions below 1 GHz

Test Freq.	Channel 19	**Engineer**	CSB
Variant	Receive in Test Utility	**Temp (ºC)**	23
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	32
Power Setting	Not Applicable in Receive Mode	**Press. (mBars)**	999
Antenna	Integral Trace Antenna included on PCB active during testing		
Test Notes 1	EUT board sitting horizontal 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
40.870	39.5	3.6	-18.0	25.1	Quasi Peak	V	104	182	40	-14.9	Pass	DIG
101.708	42.8	4.2	-20.5	26.6	Peak [Scan]	V	98	0	43.5	-16.9	Pass	DIG
200.460	40.4	4.8	-17.7	27.5	Peak [Scan]	V	98	0	43.5	-16.1	Pass	RX
300.658	34.5	5.2	-16.9	22.8	Peak [Scan]	V	98	0	46	-23.2	Pass	DIG
372.265	35.3	5.6	-15.1	25.7	Peak [Scan]	V	98	0	46	-20.3	Pass	DIG
486.812	34.1	6.0	-12.5	27.5	Peak [Scan]	V	98	0	46	-18.5	Pass	DIG

Legend:	DIG = Digital Emissions; RX = Receiver Emission

Specification

Receiver Radiated Spurious Emissions

Industry Canada RSS-Gen §4.8,
The search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tunable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

RSS-Gen §6
The following receiver spurious emission limits shall be complied with;
(a) If a radiated measurement is made, all spurious emissions hall comply with the limits of Table 1.

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

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

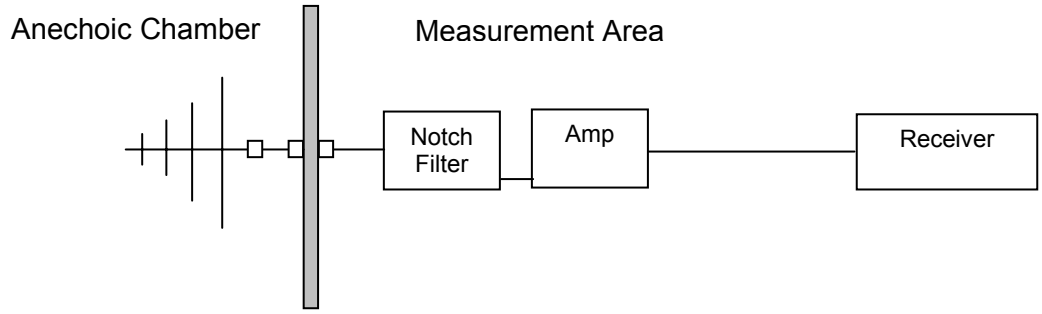
5.1.6.3. Radiated Spurious Emissions (30M-1 GHz)

FCC, Part 15 Subpart C §15.205/ §15.209
Industry Canada RSS-210 §2.2

Test Procedure
Testing 30M-1 GHz was performed in a 3-meter anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

The EUT had two methods of powering on ac/dc converter and Power over Ethernet (POE). Both modes were tested for emissions below 1GHz.

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. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

$$FS = R + AF + CORR$$

where:

FS = Field Strength
R = Measured Receiver Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain

For example:
Given a Receiver input reading of 51.5dBμV; Antenna Factor of 8.5dB; Cable Loss of 1.3dB; Falloff Factor of 0dB, an Amplifier Gain of 26dB and Notch Filter Loss of 1dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3dBμV/m

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

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

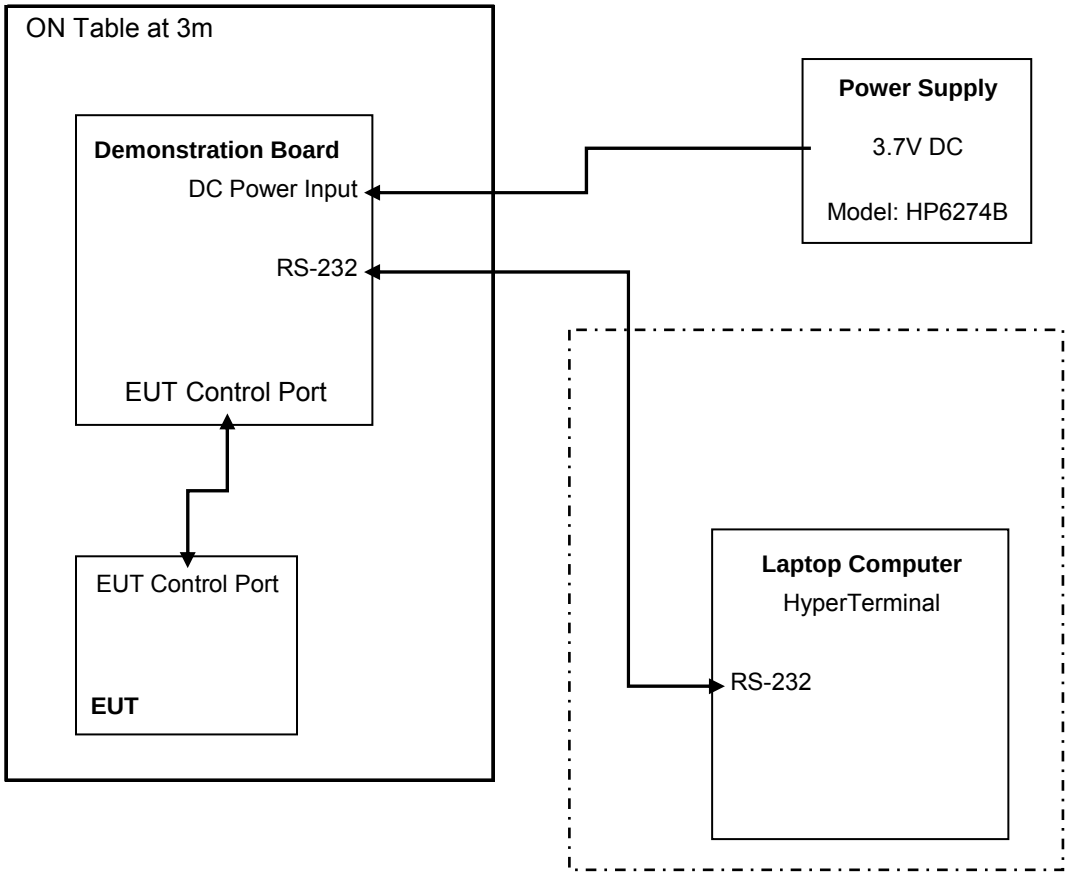
40 dBμV/m = 100μV/m
48 dBμV/m = 250μV/m

Measurement Results for Spurious Emissions (30 MHz – 1 GHz)

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

EUT Setup Diagram

Inside Chamber



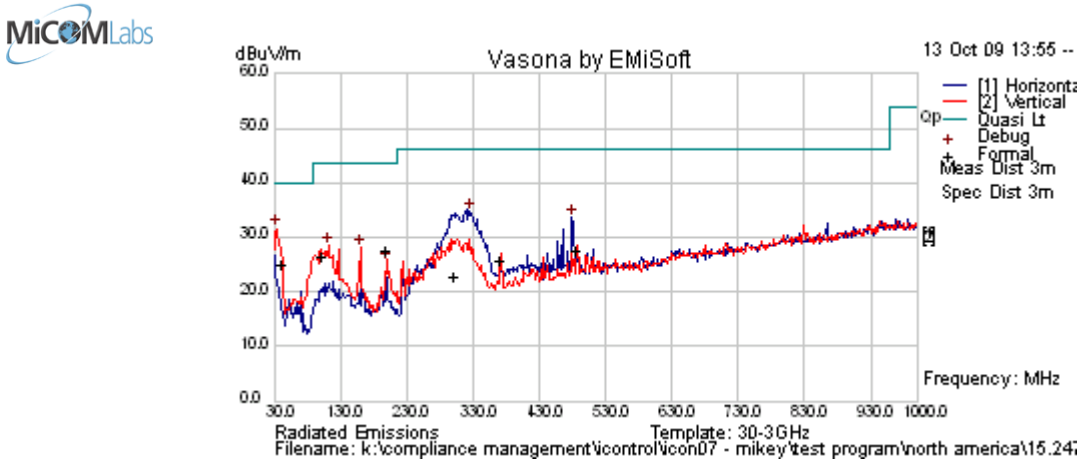
Test Setup Description

Both Vertical and Horizontal EUT positions were investigated during preliminary testing. EUT was setup in the worst case position for final tests (i.e. Horizontal; EUT case laying flat on table)

EUT was connected to demonstration board to provide DC power and control. HP 6274B DC Power Supply was connected during test, and placed on the ground plane next to EUT.

Hyperterminal was used for setup and control of the EUT (i.e.changing the transmit and receive frequencies, changing output power, change Tx/Rx modes) The computer was connected via RS-232 control. The RS-232 cable and computer was removed from chamber before prescans or final measurements were performed.

Test Freq.	2405 MHz (CH11)	**Engineer**	CSB
Variant	Tx in Test Utility	**Temp (ºC)**	23
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	32
Power Setting	95 in test utility	**Press. (mBars)**	999
Antenna	Integral Trace Antenna included on PCB active during testing		
Test Notes 1	EUT board sitting horizontal on table		
Test Notes 2	Duty cycle = 100%		



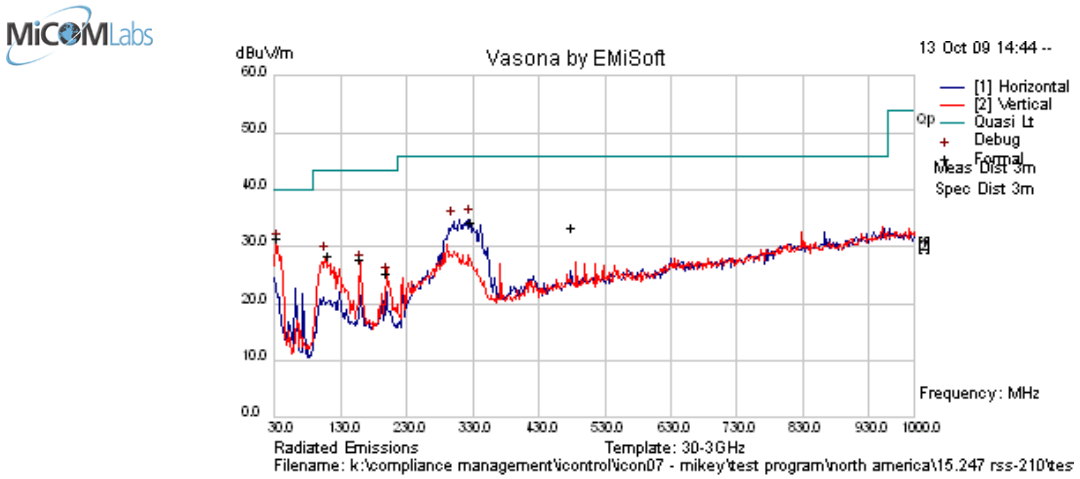
Formally measured emission peaks

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
33.547	40.6	3.5	-12.5	31.6	Peak [Scan]	V	98	360	40	-8.4	Pass	
111.487	42.3	4.3	-18.2	28.3	Peak [Scan]	V	98	360	43.5	-15.2	Pass	
159.991	41.8	4.5	-18.5	27.9	Peak [Scan]	V	98	360	43.5	-15.7	Pass	
200.463	38.3	4.8	-17.7	25.3	Peak [Scan]	V	98	360	43.5	-18.2	Pass	
327.305	45.4	5.3	-16.2	34.4	Peak [Scan]	H	98	360	46	-11.6	Pass	
479.974	40.0	5.9	-12.5	33.4	Peak [Scan]	H	98	360	46	-12.6	Pass	

No Emissions within 6dB of limit.

Legend:	RB = Restricted Band; NRB = Non-Restricted Band; FUND = Fundamental Freq.; WB = Wideband
	BE = Emission in Restricted Band Nearest Transmission Band Edge;

Test Freq.	2445 MHz (CH19)	**Engineer**	CSB
Variant	Tx in Test Utility	**Temp (ºC)**	23
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	32
Power Setting	95 in test utility	**Press. (mBars)**	999
Antenna	Integral Trace Antenna included on PCB active during testing		
Test Notes 1	EUT board sitting horizontal on table		
Test Notes 2	Duty cycle = 100%		



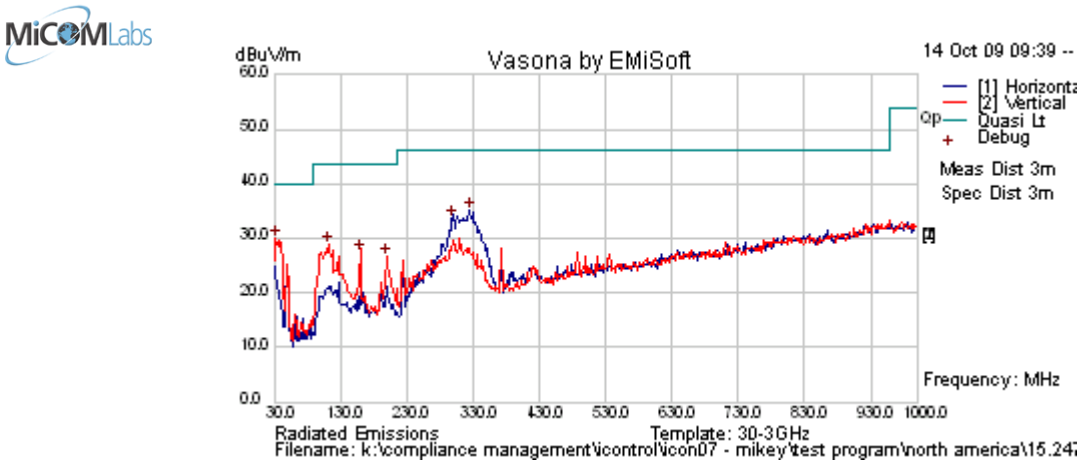
Formally measured emission peaks

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
33.336	38.99	3.45	-12.3	30.12	Peak [Scan]	V	98	360	40	-9.88	Pass	
105.653	43.27	4.21	-19.4	28.1	Peak [Scan]	V	98	360	43.5	-15.4	Pass	
160.497	40.5	4.5	-18.5	26.5	Peak [Scan]	V	98	360	43.5	-17.0	Pass	
200.538	37.5	4.8	-17.7	24.5	Peak [Scan]	V	98	360	43.5	-19.0	Pass	
299.548	45.8	5.2	-16.9	34.1	Peak [Scan]	H	98	360	46	-11.9	Pass	
326.242	45.4	5.3	-16.2	34.5	Peak [Scan]	H	98	360	46	-11.5	Pass	

No Emissions within 6dB of limit.

Legend:	RB = Restricted Band; NRB = Non-Restricted Band; FUND = Fundamental Freq.; WB = Wideband
	BE = Emission in Restricted Band Nearest Transmission Band Edge;

Test Freq.	2480 MHz (CH26)	**Engineer**	CSB
Variant	Tx in Test Utility	**Temp (ºC)**	23
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	32
Power Setting	95 in test utility	**Press. (mBars)**	999
Antenna	Integral Trace Antenna included on PCB active during testing		
Test Notes 1	EUT board sitting horizontal on table		
Test Notes 2	Duty cycle = 100%		



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
32.185	37.94	3.42	-11.4	29.94	Peak [Scan]	V	98	360	40	-10.06	Pass	
111.564	42.85	4.25	-18.2	28.9	Peak [Scan]	V	98	360	43.5	-14.6	Pass	
159.995	41.2	4.5	-18.5	27.2	Peak [Scan]	V	98	360	43.5	-16.3	Pass	
200.466	39.6	4.8	-17.7	26.6	Peak [Scan]	V	98	360	43.5	-16.9	Pass	
299.276	45.38	5.22	-16.9	33.67	Peak [Scan]	H	98	360	46	-12.33	Pass	
325.863	45.8	5.3	-16.2	34.9	Peak [Scan]	H	98	360	46	-11.1	Pass	

No Emissions within 6dB of limit.

Legend:	RB = Restricted Band; NRB = Non-Restricted Band; FUND = Fundamental Freq.; WB = Wideband
	BE = Emission in Restricted Band Nearest Transmission Band Edge;

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.

§15.209 (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.

§15.209 (a) and **RSS-Gen §2.2** Limit Matrix

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

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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

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

Test is not applicable as the device is battery operated

Specification

Limit

§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.

RSS-Gen §7.2.2
The radio frequency voltage that is conducted back into the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table below. The tighter limit applies at the frequency range boundaries.

§15.207 (a) and **RSS-Gen §7.2.2** Limit Matrix
The lower limit applies at the boundary between frequency ranges

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

Laboratory Measurement Uncertainty for Conducted Emissions

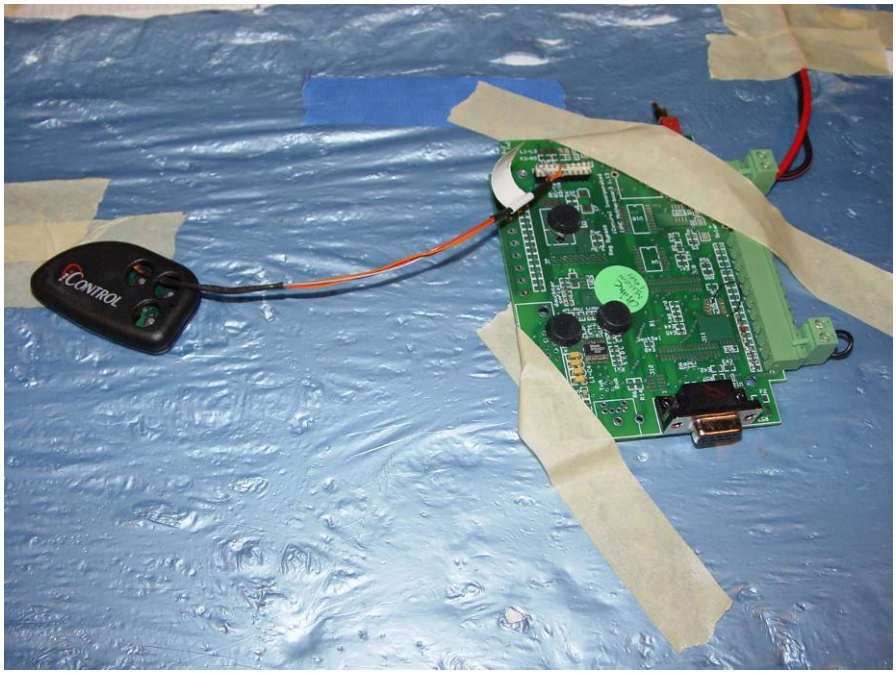
Measurement uncertainty	±2.64 dB

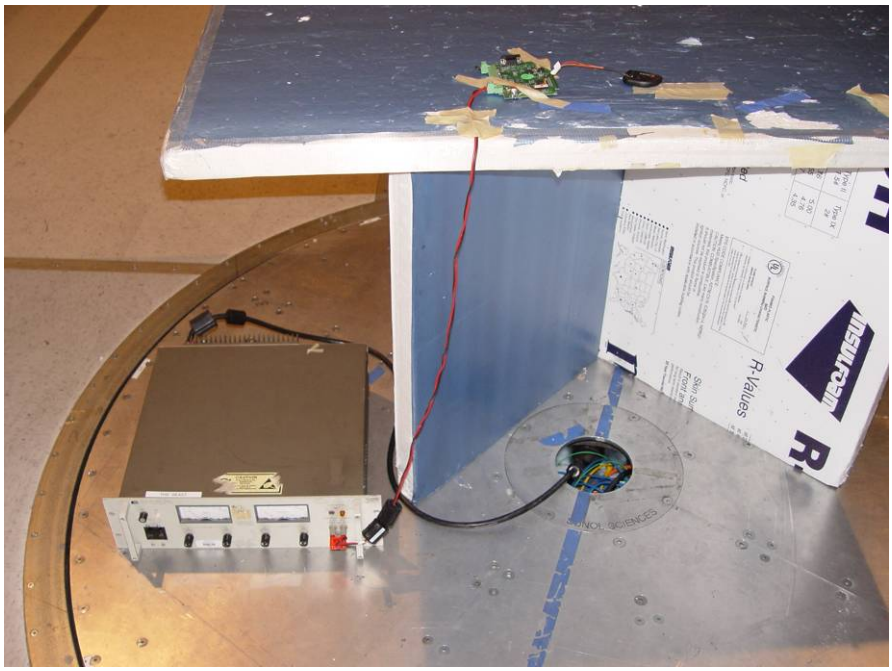
Traceability

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

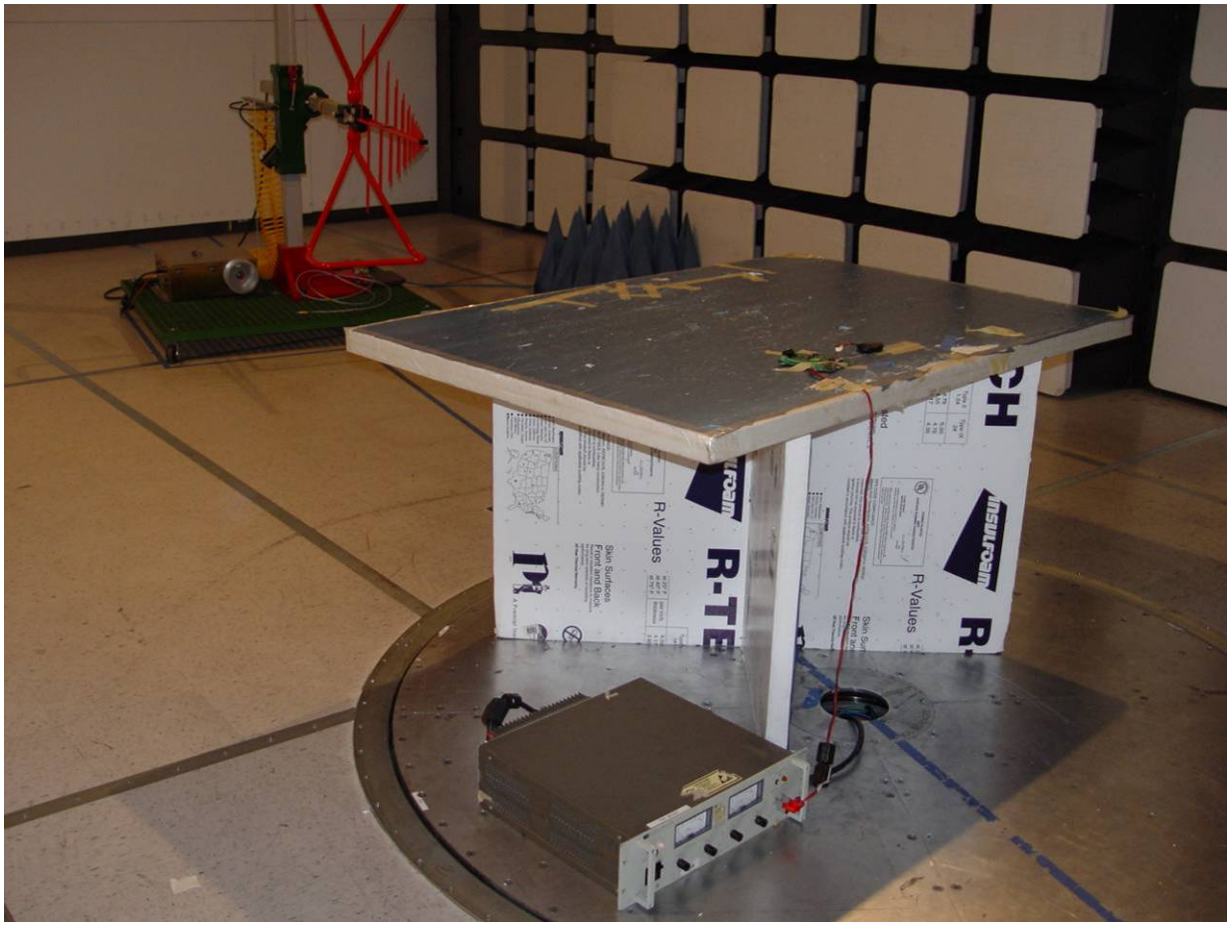
6. PHOTOGRAPHS

6.1. Radiated Spurious Emissions – Test Configuration



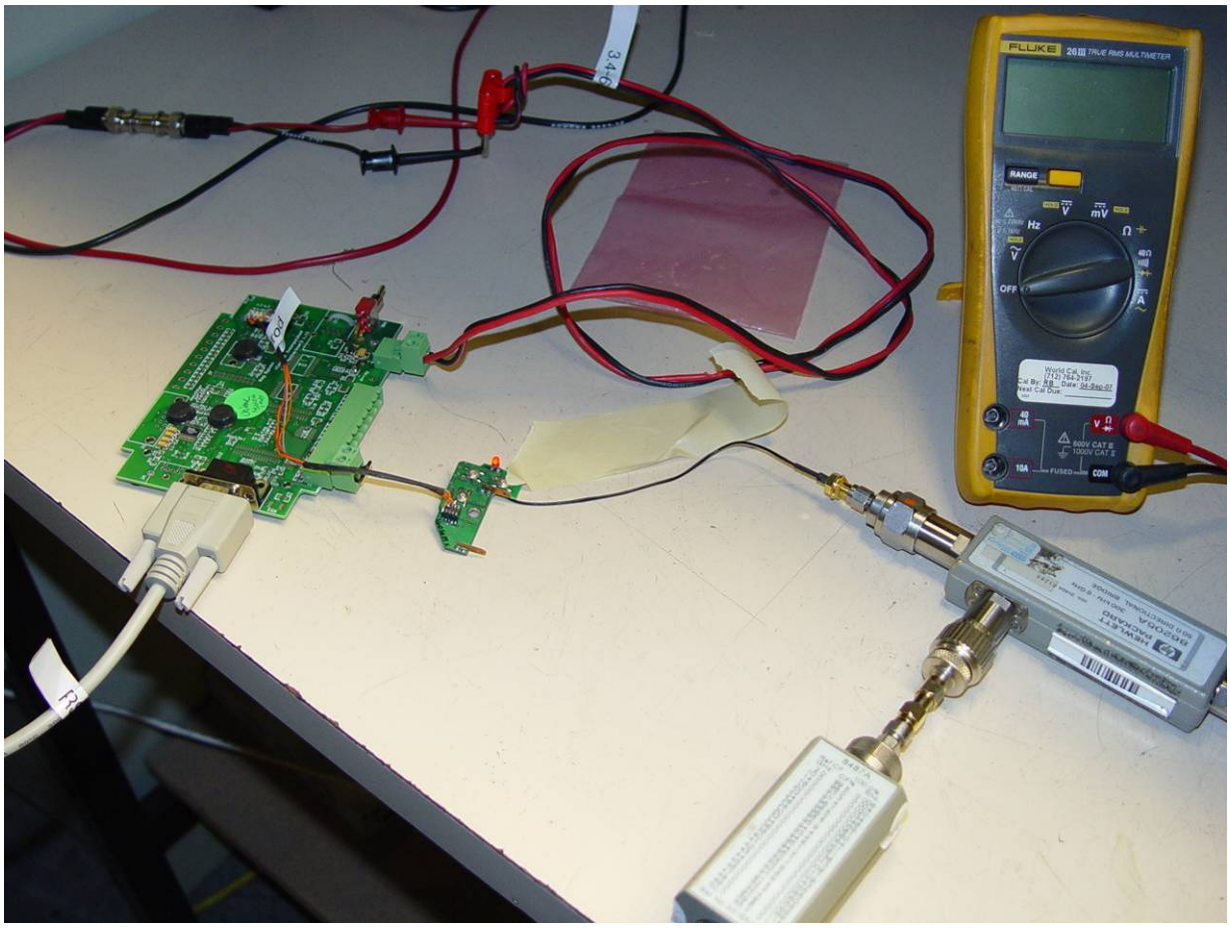


6.2. Radiated Spurious Emissions - below 1 GHz

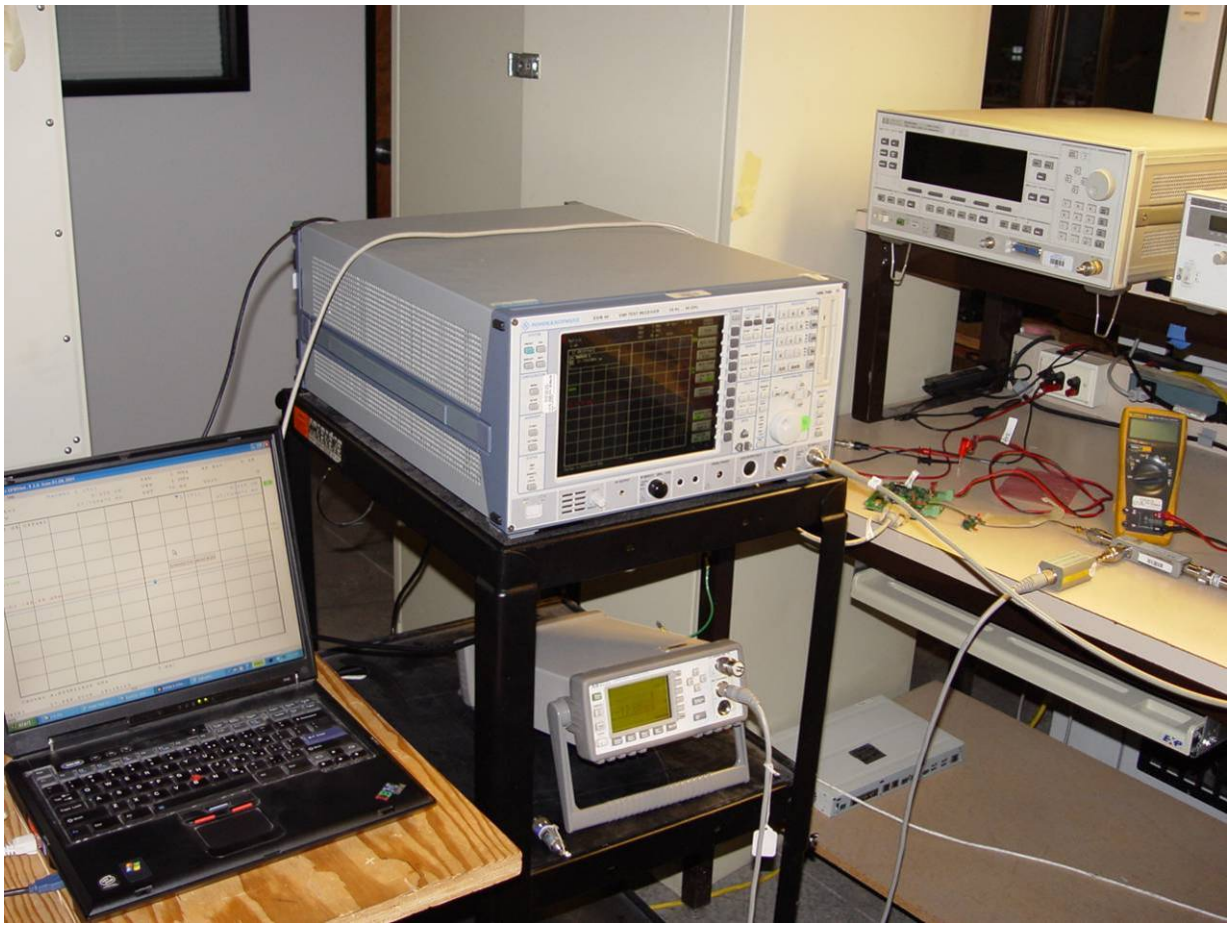


6.3. Radiated Spurious Emissions - above 1 GHz

6.4. Conducted Measurement Test Set-Up



6.5. Conducted Measurement Test Equipment



7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0193	EMI Receiver	Rhode & Schwartz	ESI 7	838496/007
0252	SMA Cable	Megaphase	Sucoflex 104	None
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	30dB N-Type Attenuator	ARRA	N9444-30	1623
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0301	5.6 GHz Notch Filter	Micro-Tronics	RBC50704	001
0302	5.25 GHz Notch Filter	Micro-Tronics	BRC50703	002
0303	5.8 GHz Notch Filter	Micro-Tronics	BRC50705	003
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
0335	1-18GHz Horn Antenna	ETS- Lindgren	3117	00066580
0337	Amplifier	MiCOM Labs	--	--
0338	Antenna	Sunol Sciences	JB-3	A052907

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