Test of Topcon Positioning Systems
GR-3 Global Positioning System (GPS)

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

Test Report Serial No.: TOPC01-A4 Rev B

TEST REPORT

FROM

Test of Topcon Positioning Systems
GR-3 Global Positioning System (GPS)
2.4 GHz Bluetooth Wireless Interface

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

Test Report Serial No.: TOPC01-A4 Rev B

This report supersedes: TOPC01-A4 Rev A

Manufacturer: Topcon Positioning Systems
7400 National Drive
Livermore California 94550
USA

Product Function: GR-3 GPS 2.4 GHz Bluetooth Interface

Copy No: pdf **Issue Date:** 29th May '07

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
www.micomlabs.com

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

THE AMERICAN
ASSOCIATION
FOR LABORATORY
ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

MICOM LABS
Pleasanton, CA

for technical competence in the field of

Electrical Testing

The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified field of testing.

Presented this 14th day of September 2005.

American Association for Laboratory Accreditation
Corporate SEAL 1978 District of Columbia
A2LA

President
For the Accreditation Council
Certificate Number 2381.01
Valid to: November 30, 2007

For 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) Listing #: 102167

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. No additional in-country testing is required to satisfy in-country certification requirements.

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 (MIC)	I	
Singapore	Infocomm Development Authority (IDA)	I	
Taiwan	Directorate General of Telecommunications (DGT)	I	
	Bureau of Standards, Metrology and Inspection (BSMI)	I	

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	21st May 2007	First issue.
Rev B	29th May 2007	Add MPE calculation.

1. TEST RESULT CERTIFICATE

Manufacturer:	Topcon Positioning Systems 7400 National Drive Livermore California 94550 USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	GR-3 Global Positioning System	Telephone:	+1 925 462 0304
Model:	01-050901-21	Fax:	+1 925 462 0306
S/N:	#11 FH915 US GSM		
Test Date(s):	28th Dec 2006 to 14th Jan 2007	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
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	2006	Code of Federal Regulations
(ii)	Industry Canada RSS-210	Issue 6 Sept. 2005	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands)
(iii)	ANSI C63.4	2003	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
(iv)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(v)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vi)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(vii)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(viii)	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 GR-3 Global Positioning System (GPS) to FCC Part 15.247 and Industry Canada RSS-210 regulations for a Bluetooth Wireless Interface
Applicant:	As Manufacturer
Manufacturer:	Topcon Positioning Systems 7400 National Drive Livermore California 94550 USA
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	TOPC01-A4 Rev B
Date EUT received:	20TH December 2006
Standard(s) applied:	FCC 47 CFR Part15.247 & IC RSS-210
Dates of test (from - to):	29th December 2006
No of Units Tested:	1
Type of Equipment:	2.4 GHz Bluetooth Transmitter
Manufacturers Trade Name:	GR-3
Model:	01-050901-21
Location for use:	Outdoor
Declared Frequency Range(s):	2400 – 2483.5 MHz
Type of Modulation:	GFSK, Frequency Hopping Spread Spectrum (FHSS)
Declared Nominal Output Power:	+0 dBm
EUT Modes of Operation:	FHSS
Transmit/Receive Operation:	Time Division Duplex (TDD)
Rated Input Voltage and Current:	7.2 Vdc battery, External dc source 12 Vdc 0.3 -0.6 A
Operating Temperature Range:	Declared range -20 to +50ºC
ITU Emission Designator:	1M0W7D
Microprocessor(s) Model:	ADSP-BF 522
Clock/Oscillator(s):	32.768 kHz; 100-500 kHz (DC-DC convertor); 4 MHz; 20 MHz; 25 MHz; 50 MHz; 56 MHz; 96 MHz; 100 MHz; 188 MHz; 376 MHz; 419 MHz; 1002 MHz; 1401 MHz
Frequency Stability:	Over Temperature Range ±2.5 ppm Aging at 25ºC ±0.8 ppm
Dimensions:	156.6 cm x 156.6 cm x 234 cm
Weight:	1.78 kgs
Primary function of equipment:	Geodesy with Bluetooth for communicating data

3.2. Scope of Test Program

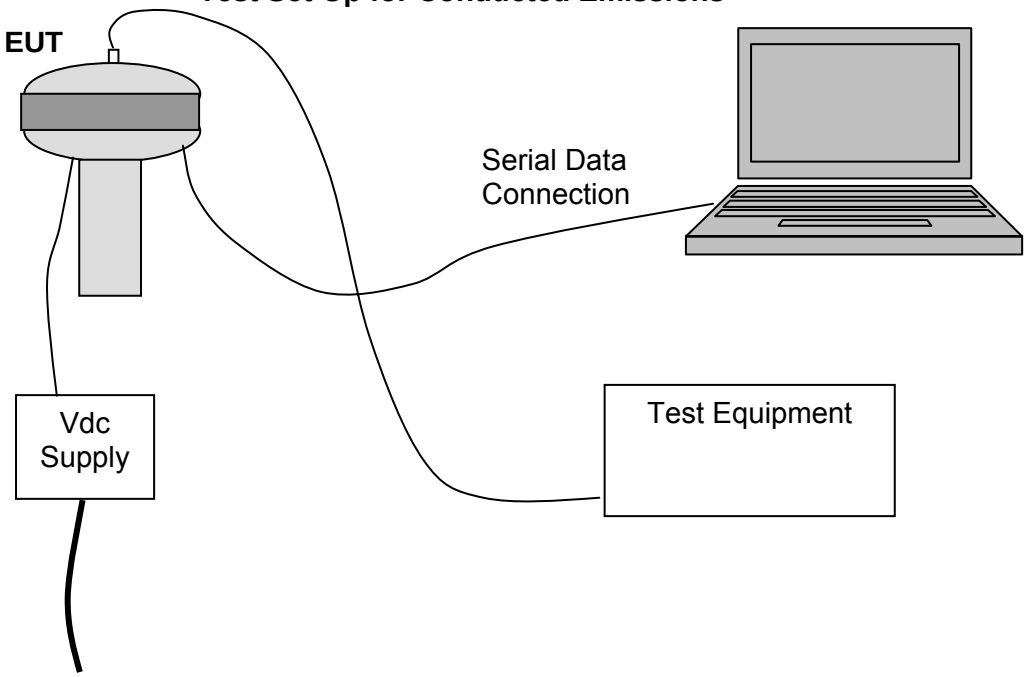
The scope of the test program was to test the Topcon Positioning Systems Inc GR-3 Global Positioning System (GPS) 2.4 GHz Bluetooth Interface in the frequency range 2400 – 2483.5 MHz for compliance against FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications.

Topcon Positioning Systems Inc
GR-3 Global Positioning System (GPS)

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

EUT/ Support	Manufacturer	Equipment Description (Including Brand Name)	Model No.	Serial No.
EUT	Topcon Positioning Systems Inc	GR-3 Global Positioning System (GPS)	01-050901-21	#11 FH915 US GSM
Support	IBM Laptop	Computer	2896-72U	FX-05793 -4/03
Support	IBM AC Adaptor	100-240VAC 50/60Hz	02K6749	ZJ1MN33631NN

Test Set-Up for Conducted Emissions



3.4. Antenna Details

Antenna Type	Gain (dBi)
Integral	0

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. RS 232 Serial data port
2. BNC

3.6. Test Configurations

Test configurations

Test Frequencies		
Low (MHz)	Mid (MHz)	High (MHz)
2402	2441	2480

3.7. Equipment Modifications

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

1. None

3.8. Deviations from the Test Standard

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

1. Duty Cycle

   Duty Cycle measurements were measured using the spectrum analyzer time domain function i.e. zero span mode

3.9. Subcontracted Testing or Third Party Data

Radiated emissions are tested below and verified above 1 GHz at TUV Rheinland of North America's 10m chamber located at the following address;-

2305 Mission College Blvd.
Santa Clara
California 95054
USA

TUV Rheinland of North America IC Registration Number: IC 4453-1

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)(1) **A8.1(1)** **4.4**	20 dB BW	20 dB BW	Conducted	Complies	5.1.1
15.247(a)(1) **A8.1(2)**	Channel Spacing	Channel Spacing	Conducted	Complies	5.1.2
15.247(a)(1) **A8.1(4)**	Transmitter Channels	Number of Channels	Conducted	Complies	5.1.3.1
		Channel Occupancy	Conducted	Complies	5.1.3.2
		Channel Dwell Time	Conducted	Complies	5.1.3.3
15.247(b)(1) **A8.4(2)**	Transmit Power	Transmit Power	Conducted	Complies	5.1.4
15.247(b)(5) **5.5**	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Conducted	Complies	5.1.5
15.247(d) **A8.5** **2.2** **4.7**	Conducted Emissions	Band Edge Spurious Emissions	Conducted Conducted	N/A N/A	5.1.6

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) **A8.5** **2.2** **4.7**	Radiated Emissions above 1 GHz	Transmitter	Radiated	Complies	*5.1.7.1*
		Band Edge – restricted band	Radiated	Complies	*5.1.7.2*
Industry Canada only **RSS-Gen §4.8, §6**	Receiver Radiated Spurious Emissions	Receiver Emissions above 1 GHz	Radiated	Complies	*5.1.7.3*
§15.247(c)/ §15.209 **2.2**	Radiated Emissions below 1 GHz		Radiated	Complies	*5.1.8*
15.207 **7.2.2**	Conducted	AC Wireline Conducted Emissions	No requirement	N/A	*5.1.9*

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*

5. TEST RESULTS

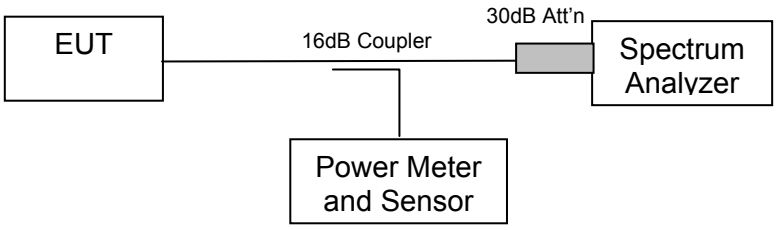
5.1. Device Characteristics

5.1.1. 20 dB Bandwidth

FCC, Part 15 Subpart C §15.247(a)(1)
Industry Canada RSS-210 §A8.1(1)
Industry Canada RSS-Gen §4.4

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. Using a minimum 10 kHz resolution bandwidth filter setting the spectrum analyzer was set to the following;-

Test Measurement Set up



Measurement set up for 20 dB bandwidth test

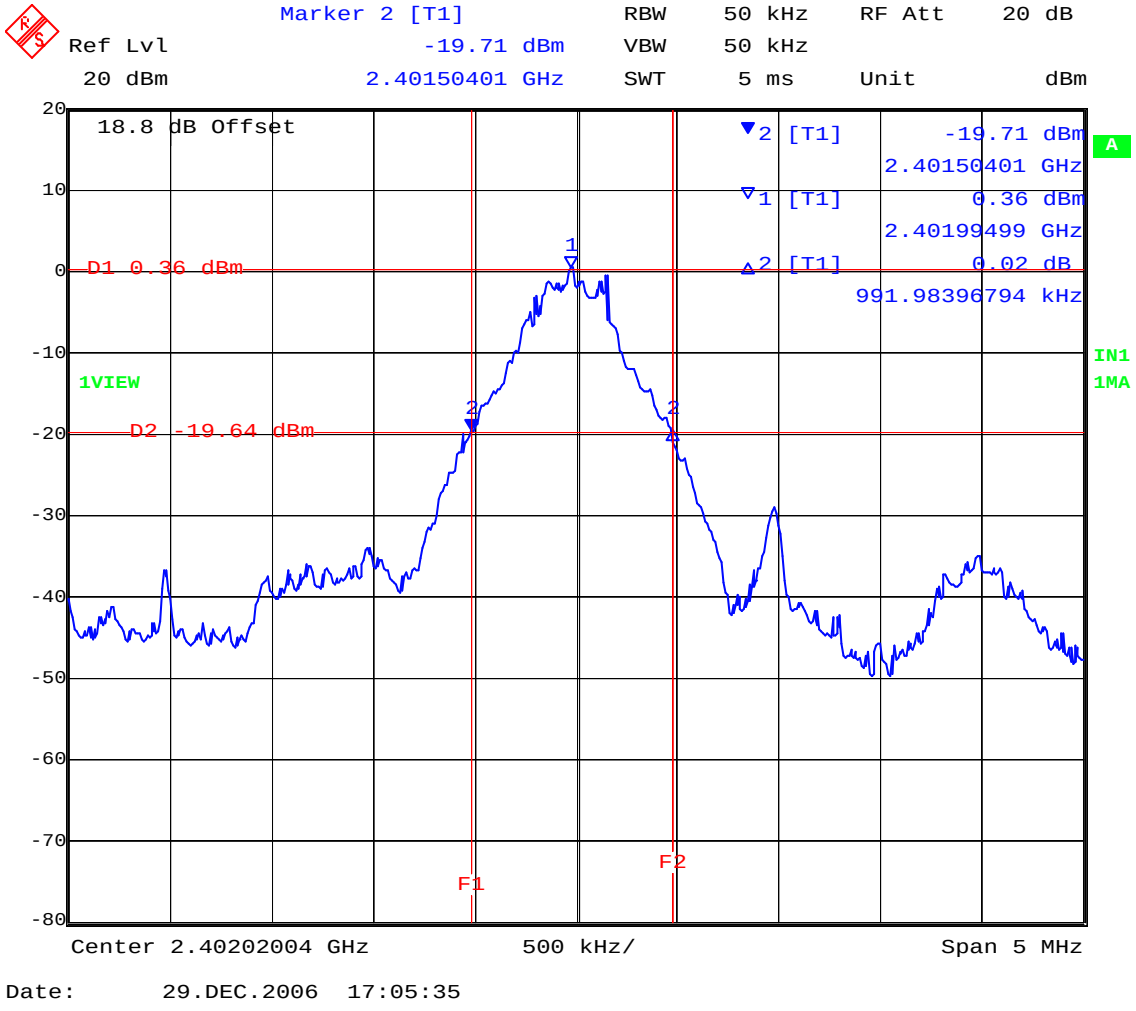
Test Results for 20 dB Bandwidth

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

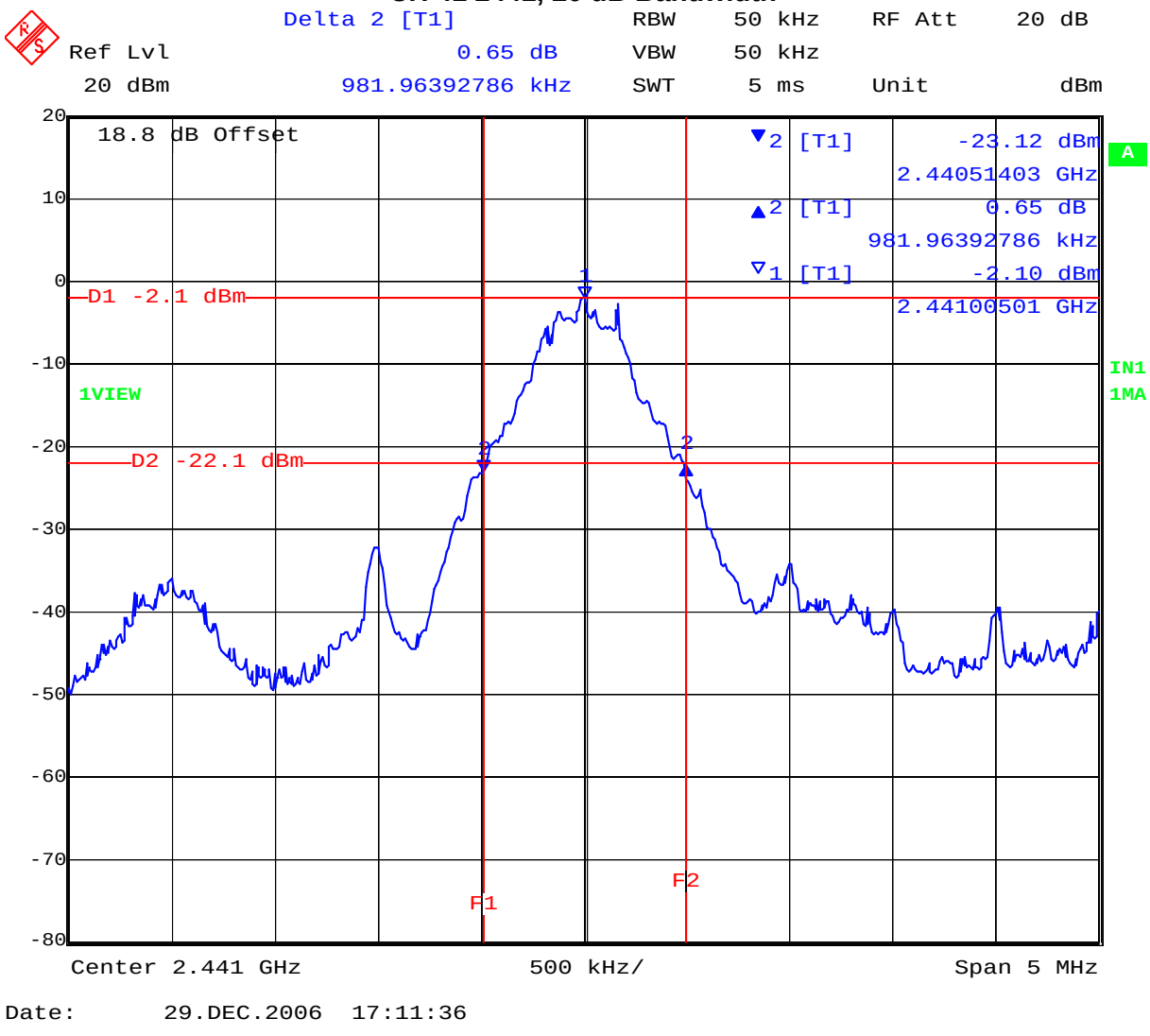
TABLE OF RESULTS –

Channel #	Center Frequency (MHz)	20 dB Bandwidth (MHz)	Specification (kHz)	20 dB Plot #
1	2402	0.991984	<500	01
41	2441	0.981964	<500	02
80	2480	0.971944	<500	03

Plot 01
CH 1 2402, 20 dB Bandwidth

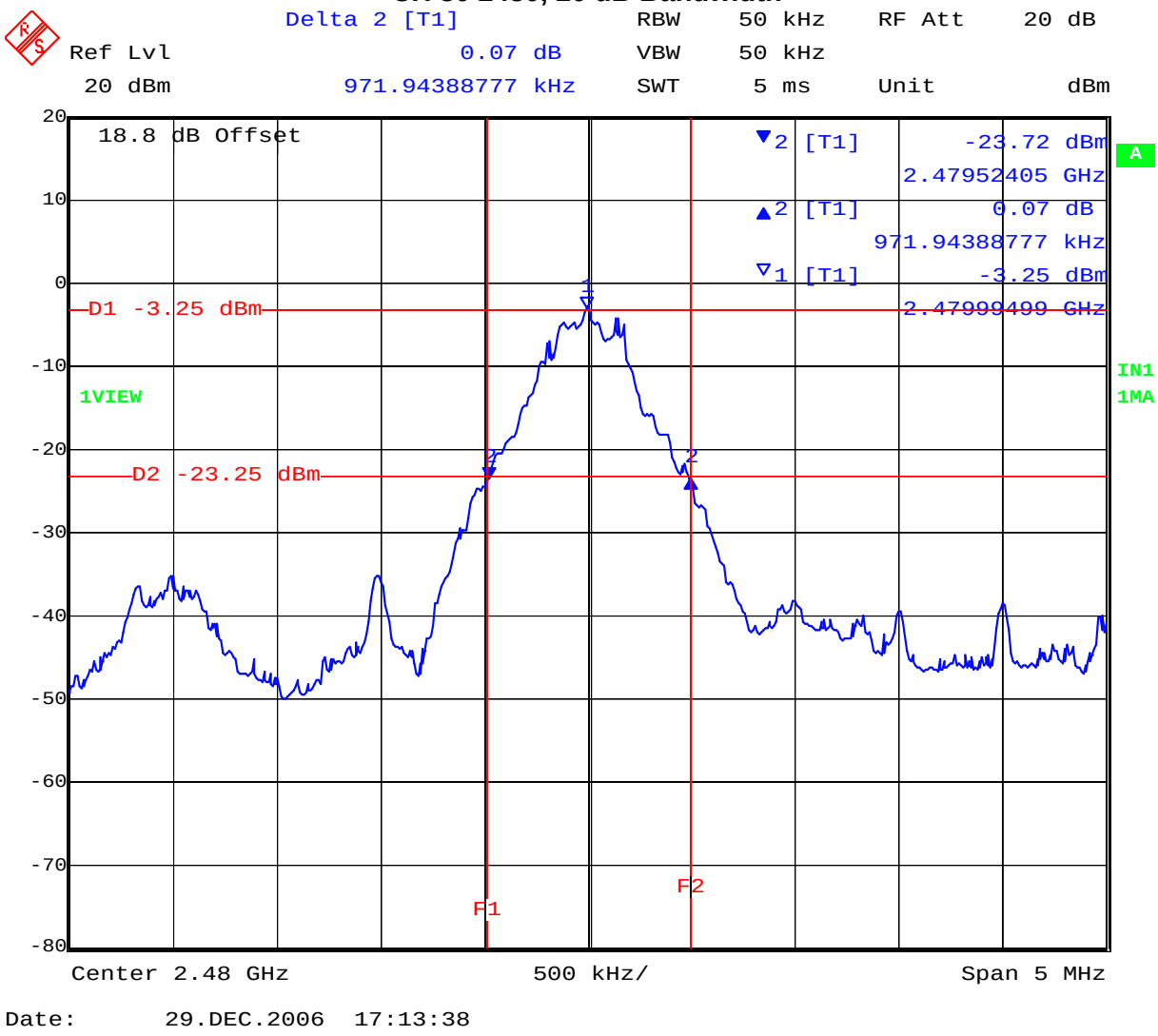


Plot 02
CH 41 2441, 20 dB Bandwidth



Date: 29.DEC.2006 17:11:36

Plot 03
CH 80 2480, 20 dB Bandwidth



Specification

Limits

§15.247 (a)(1)
Industry Canada RSS-210 §**A8.1(1)**
Industry Canada RSS-Gen §**4.4**

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. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

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. Channel Spacing

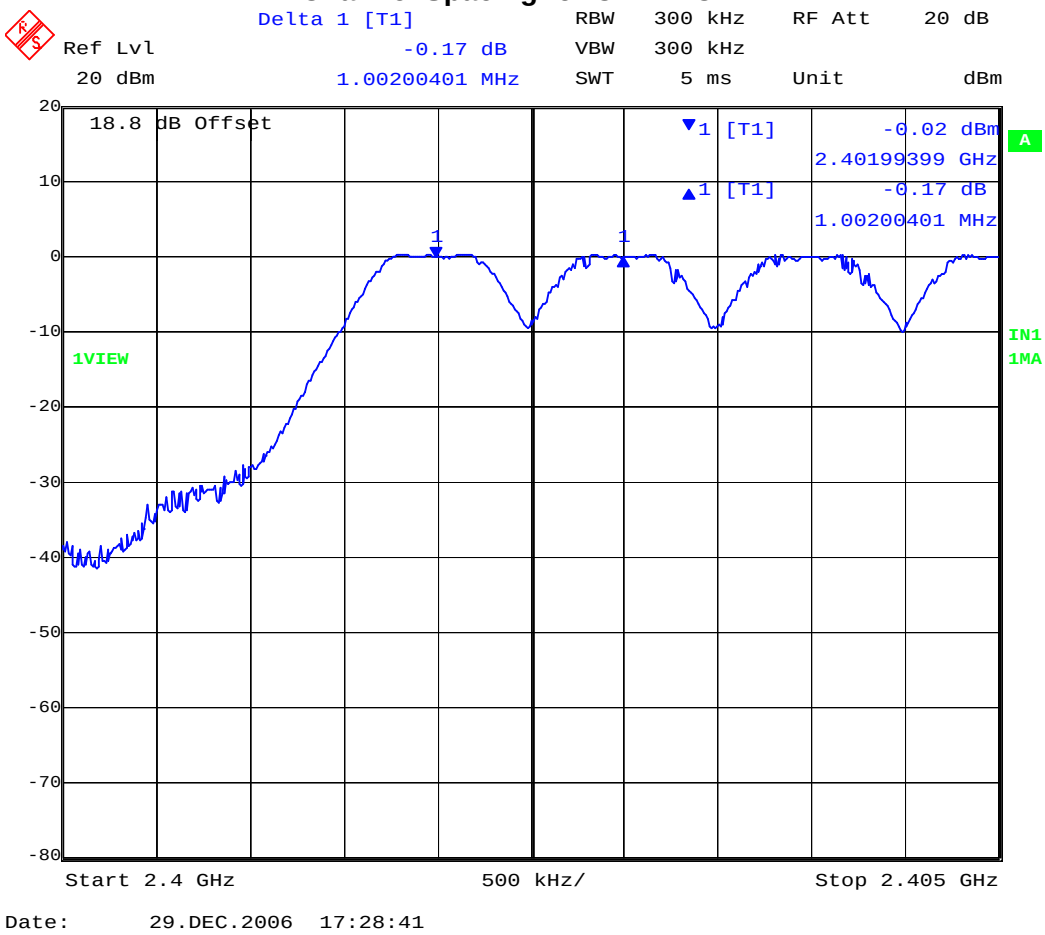
FCC, Part 15 Subpart C §15.247(a)(1)
Industry Canada RSS-210 §A8.1(2)

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

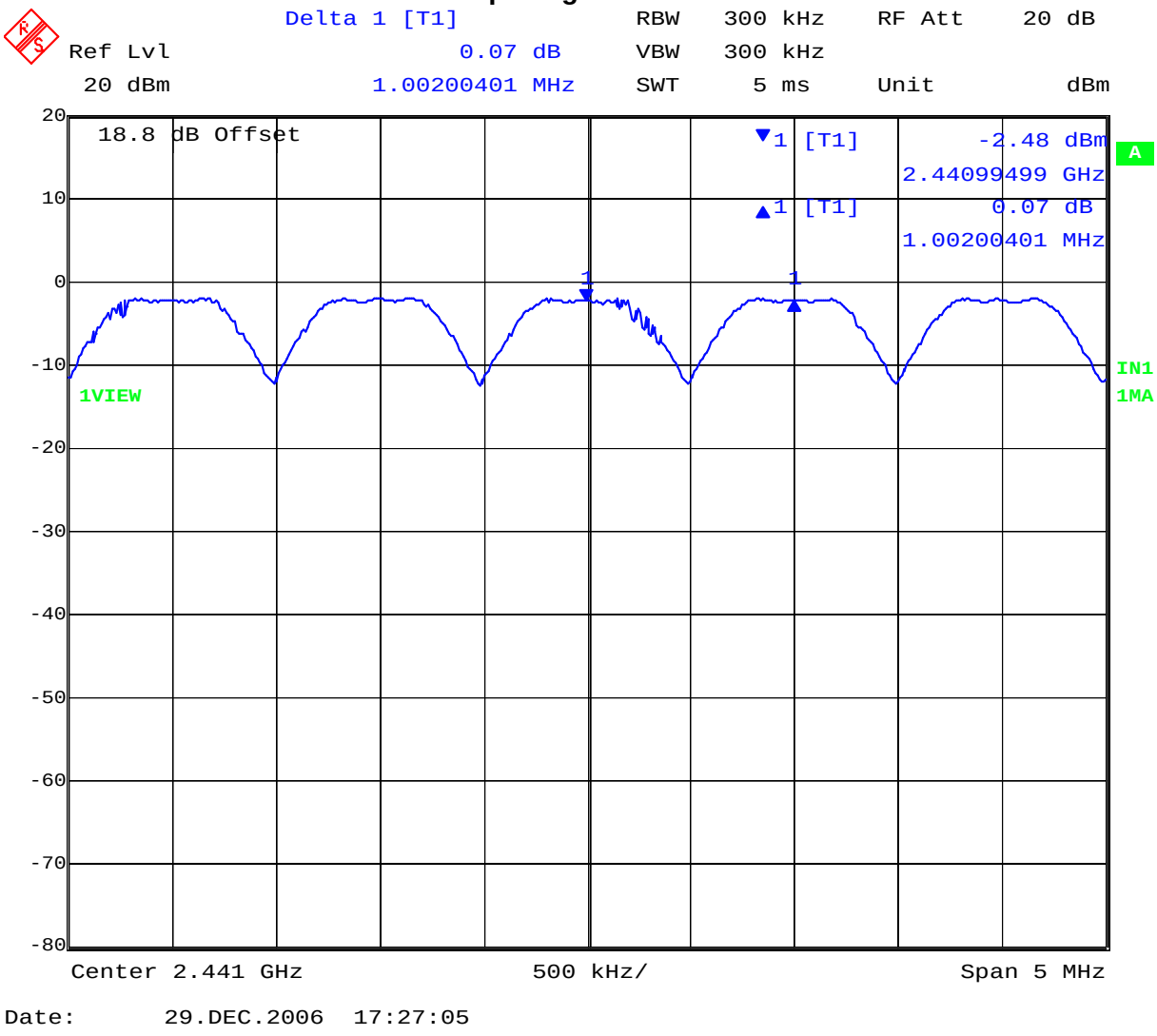
TABLE OF RESULTS

Channel #	Channel Spacing (MHz)	Specification	Plot #
1-2	1.002	20 dB Bandwidth	04
40-41	1.002	20 dB Bandwidth	05
79-80	1.002	20 dB Bandwidth	06

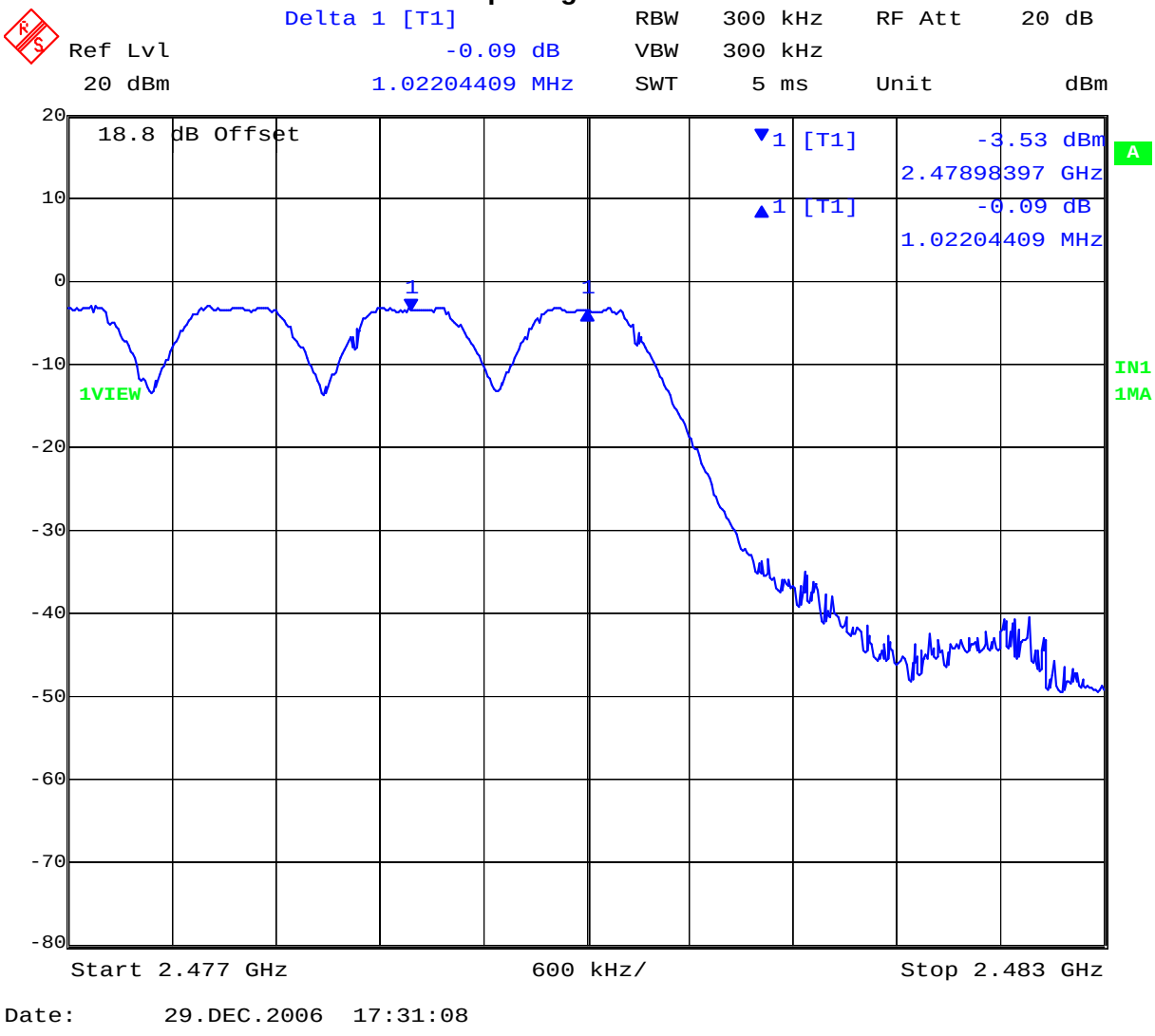
Plot 04
Channel Spacing for CH 1 – CH 2



Plot 05
Channel Spacing for CH 40 – CH 41



Plot 06
Channel Spacing for CH 79 – CH 80



Specification for Channel Spacing

Limits

FCC, Part 15 Subpart C §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, 0156, 0184, 0193, 0250,0252 0310, 0312.

5.1.3. Transmitter Channels

5.1.3.1. Number of Channels

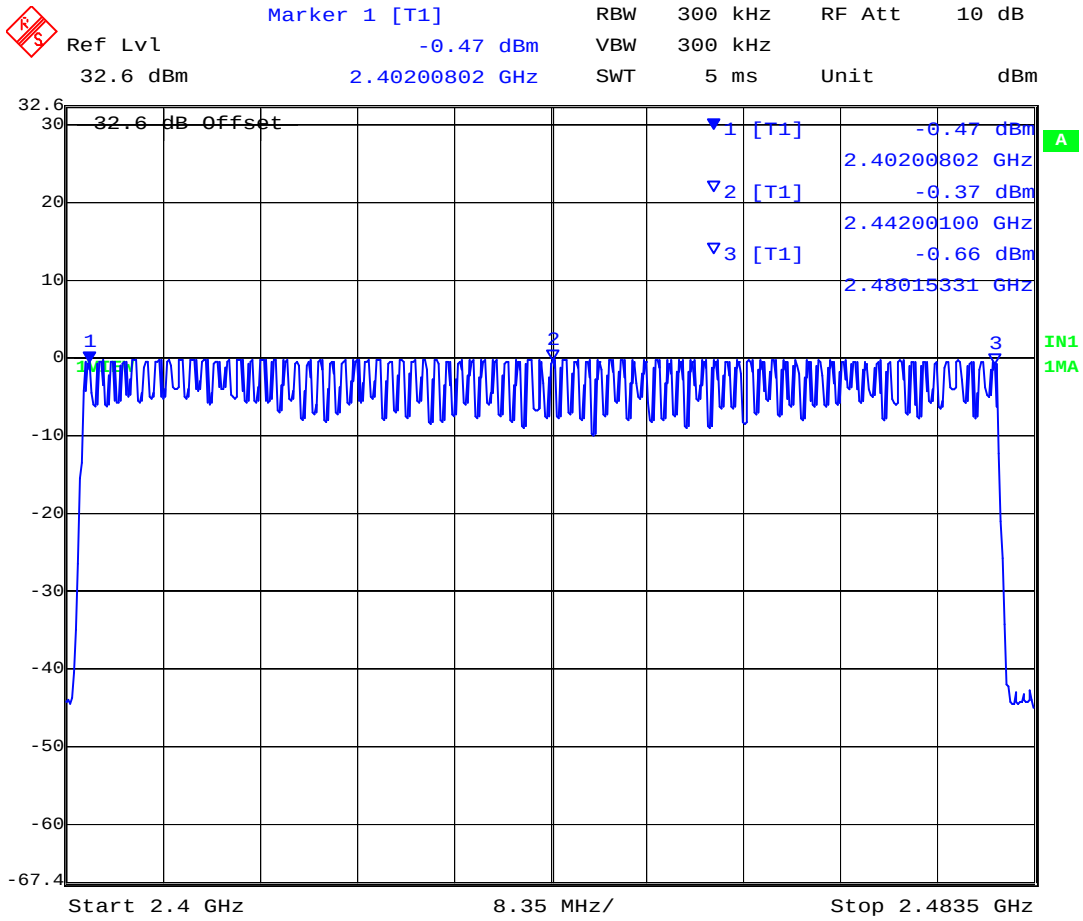
FCC, Part 15 Subpart C §15.247(a)(1)
Industry Canada RSS-210 §A8.1(4)

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

TABLE OF RESULTS –

Number of Channels	Specification	Plot #
79	≥25 Channels for a 20 dB Bandwidth > 250 kHz	07

Plot 07
Number of Channels



5.1.3.2. Channel Occupancy

FCC, Part 15 Subpart C §15.247(a)(1)
Industry Canada RSS-210 §A8.1(4)

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

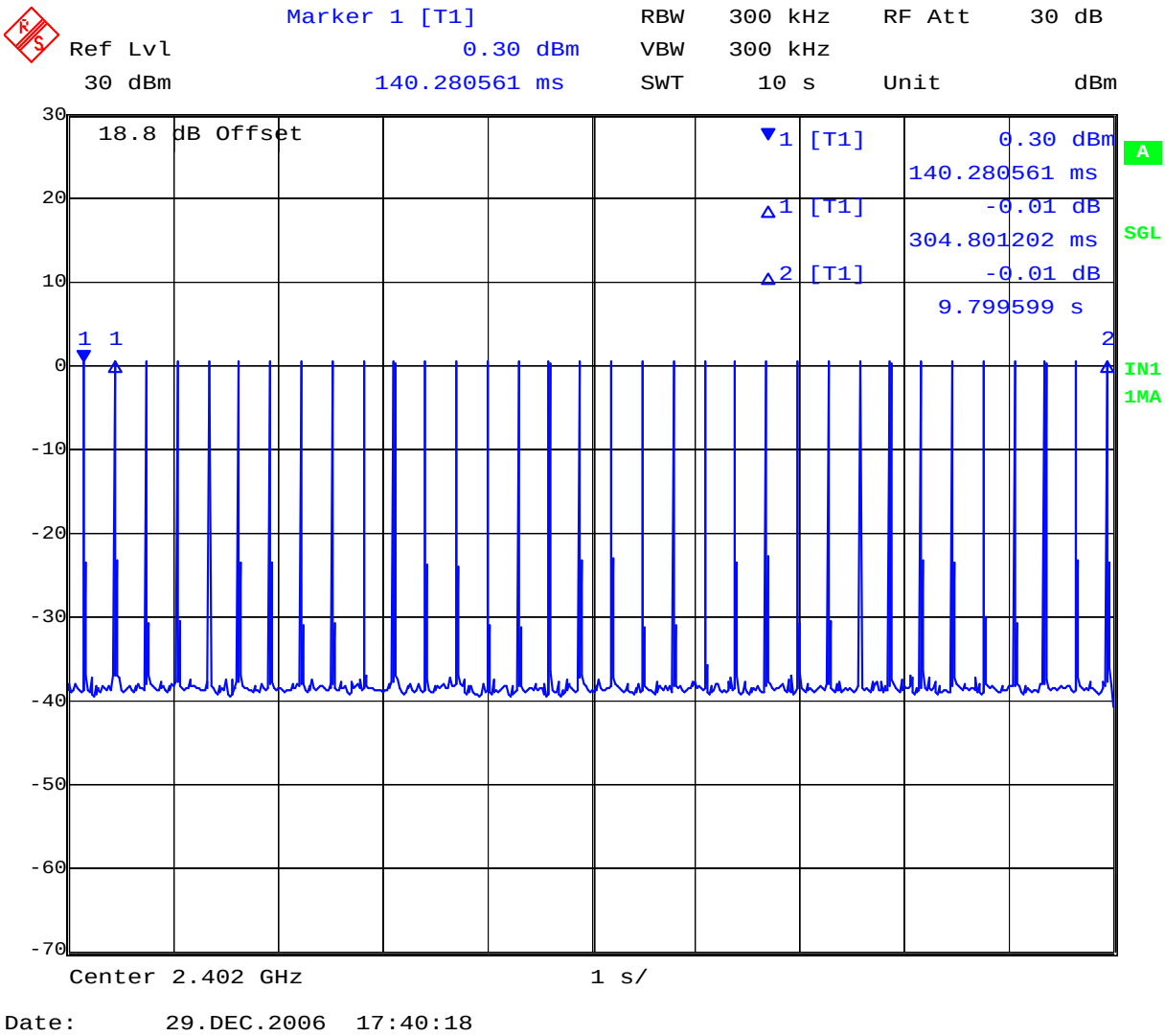
TABLE OF RESULTS – FREQUENCY HOPPING ON

Channel	Center Frequency (MHz)	No. of Times (10 secs)	Dwell Time (mSecs)	Channel Occupancy (mSeconds)	Plot(s) #
1	2402	34	2.935872	99.819648	08/11
41	2441	34	2.935872	99.819648	09/12
80	2480	34	2.935872	99.819648	10/13

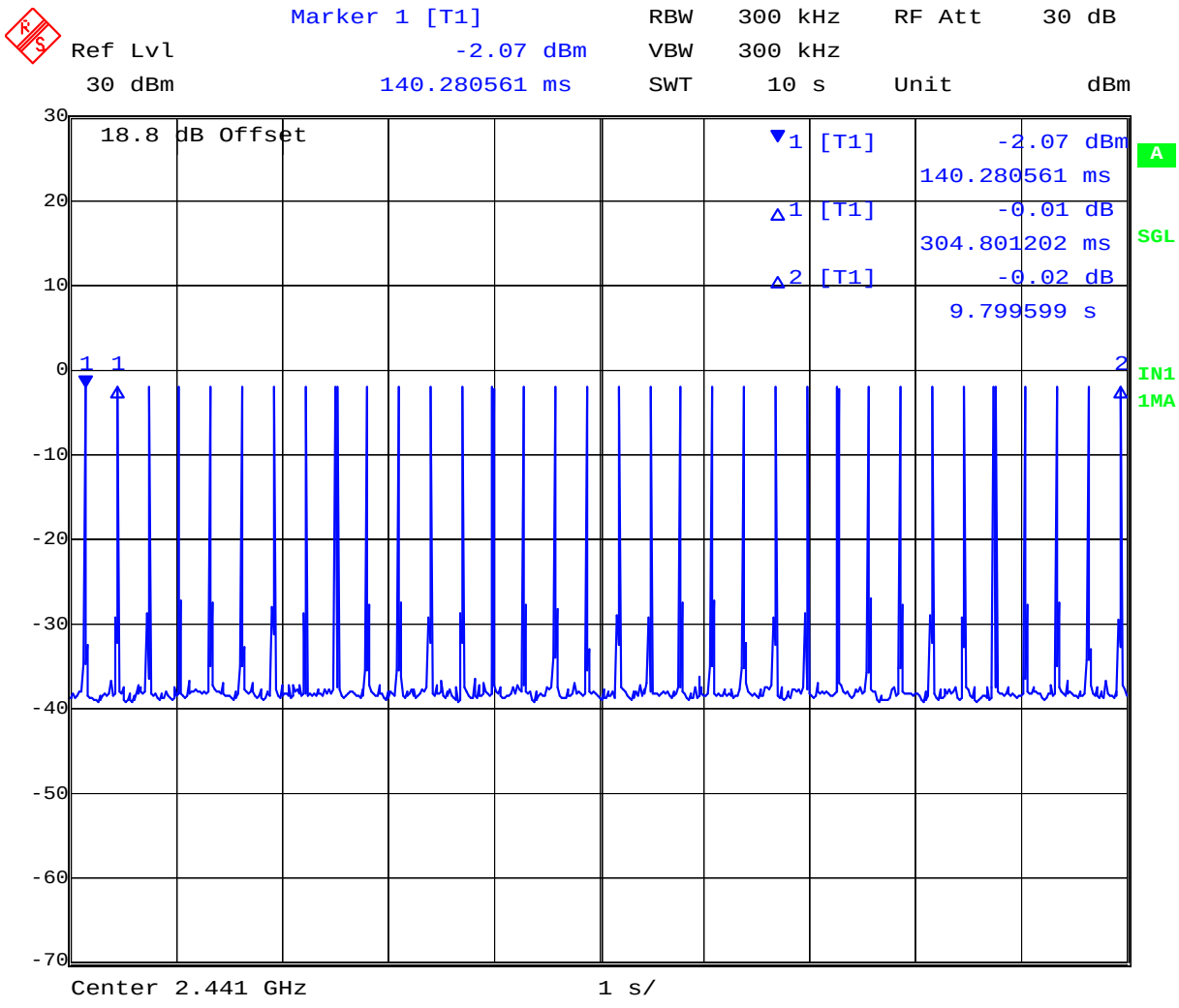
TABLE OF RESULTS – FREQUNCY HOPPING ON

Channel #	Center Frequency (MHz)	Channel Occupancy	Plot #
1	2402	34	11
41	2441	34	12
80	2480	34	13

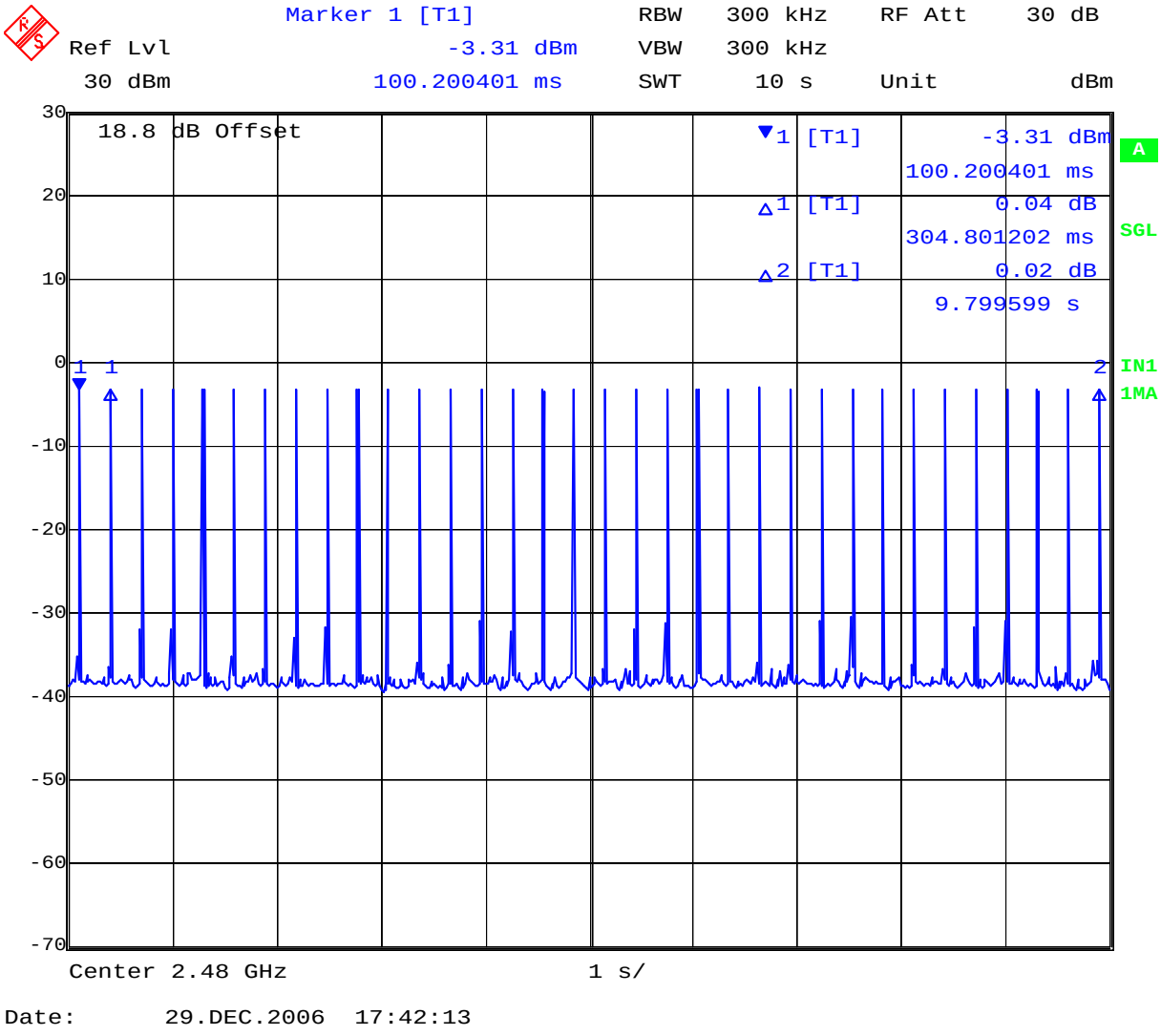
Plot 08
Channel Occupancy Ch 1 2402 MHz



Plot 09
Channel Occupancy Ch 41 2441 MHz



Plot 10
Channel Occupancy Ch 1 2480 MHz

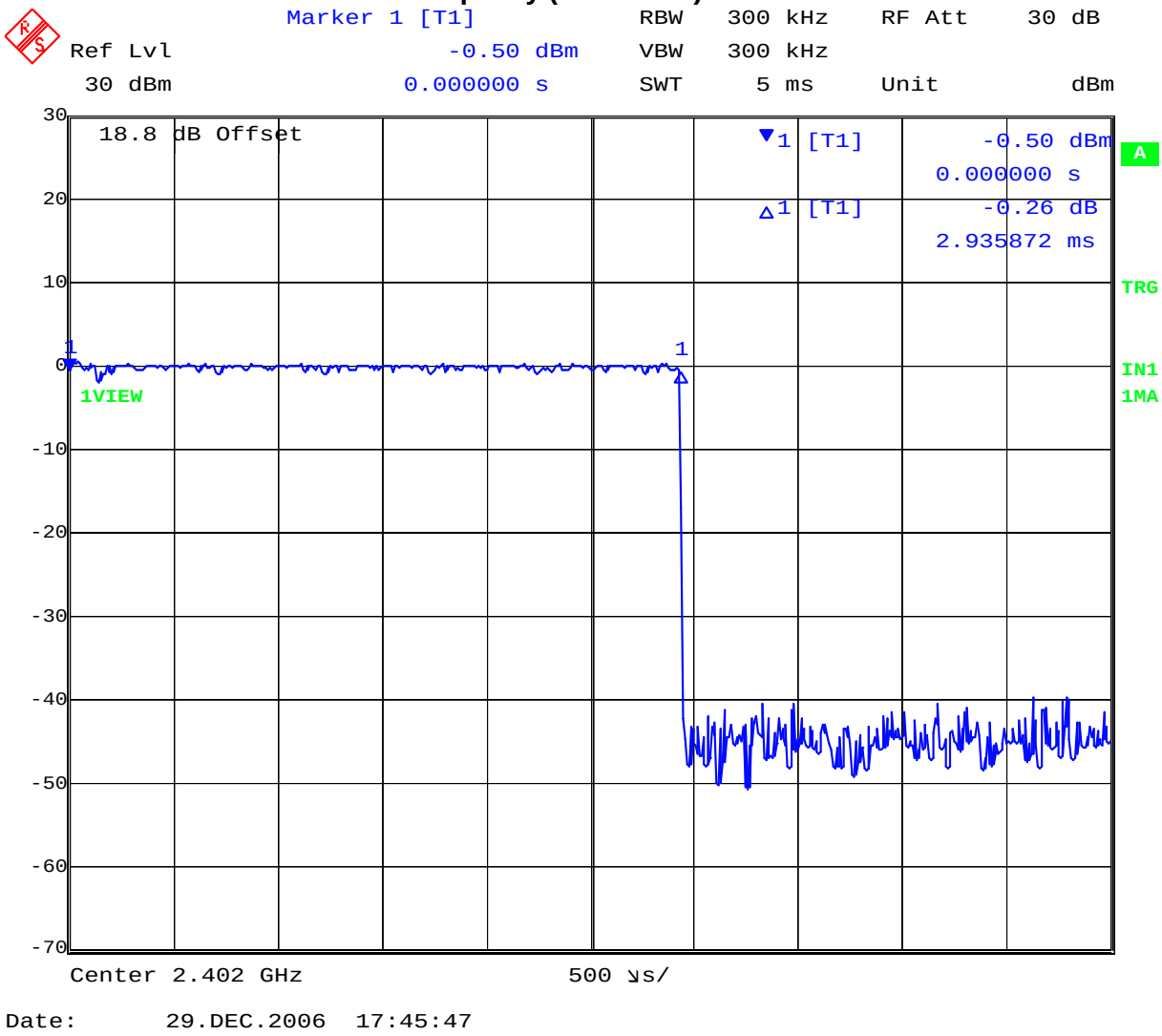


5.1.3.3. Channel Occupancy (dwell time)

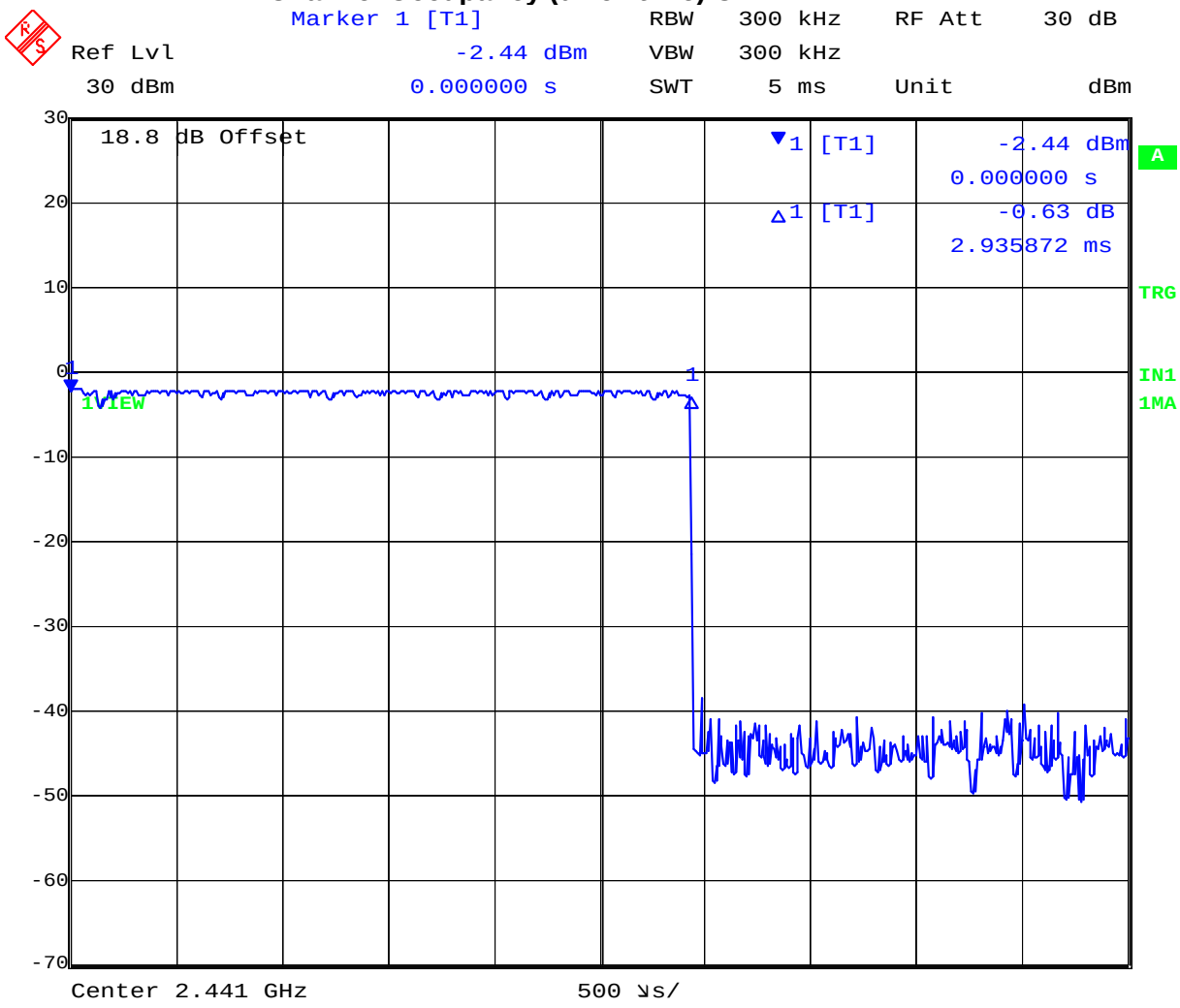
TABLE OF RESULTS – FREQUNCY HOPPING ON

Channel #	Center Frequency (MHz)	Dwell Time (mSeconds)	Plot #
1	2402	2.93587	11
27	2441	2.93587	12
52	2480	2.93587	13

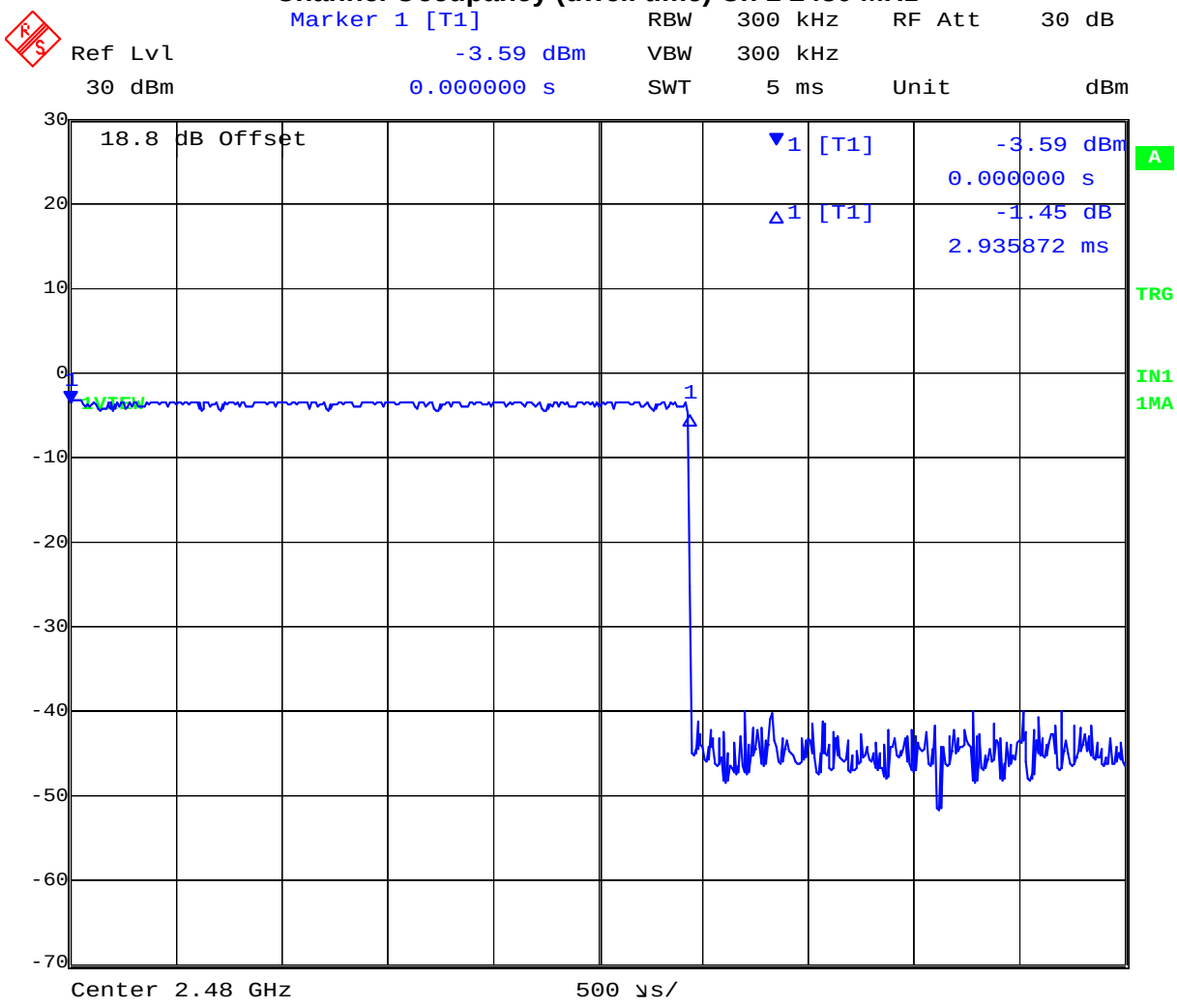
Plot 11
Channel Occupancy (dwell time) Ch 1 2402 MHz



Plot 12
Channel Occupancy (dwell time) Ch 41 2441 MHz



Plot 13
Channel Occupancy (dwell time) Ch 1 2480 MHz



Specification for Number of Channels, Channel Occupancy, and Dwell Time

Limits

FCC, Part 15 Subpart C §15.247(a)(1)
Industry Canada RSS-210 §A8.1(4)

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Laboratory Uncertainty for Frequency Measurements

Measurement uncertainty	±0.86ppm

Traceability

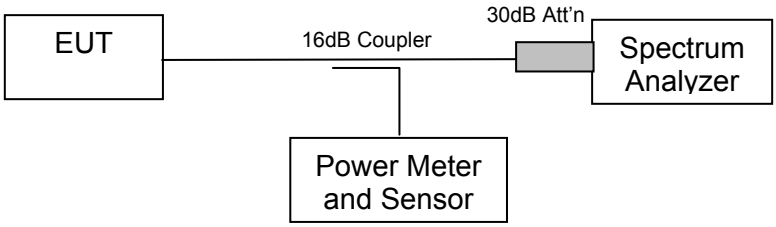
Method	Test Equipment Used
Measurements were made per work instruction WI-02 'Frequency Measurement"	0078, 0134, 0156, 0184, 0193, 0250, 0252 0310, 0312.

5.1.4. Output Power

FCC, Part 15 Subpart C §15.247(b)(1)
Industry Canada RSS-210 §A8.4(2)

Test Procedure
The transmitter terminal of EUT was connected to the input of the spectrum analyzer set to measure power. The resolution filter bandwidth was set to 3 dB, peak detector selected and the analyzer built-in power function was used to measure power over the 99 % bandwidth.

Test Measurement Set up



Measurement set up for Transmitter Output Power

Measurement Results for Output Power

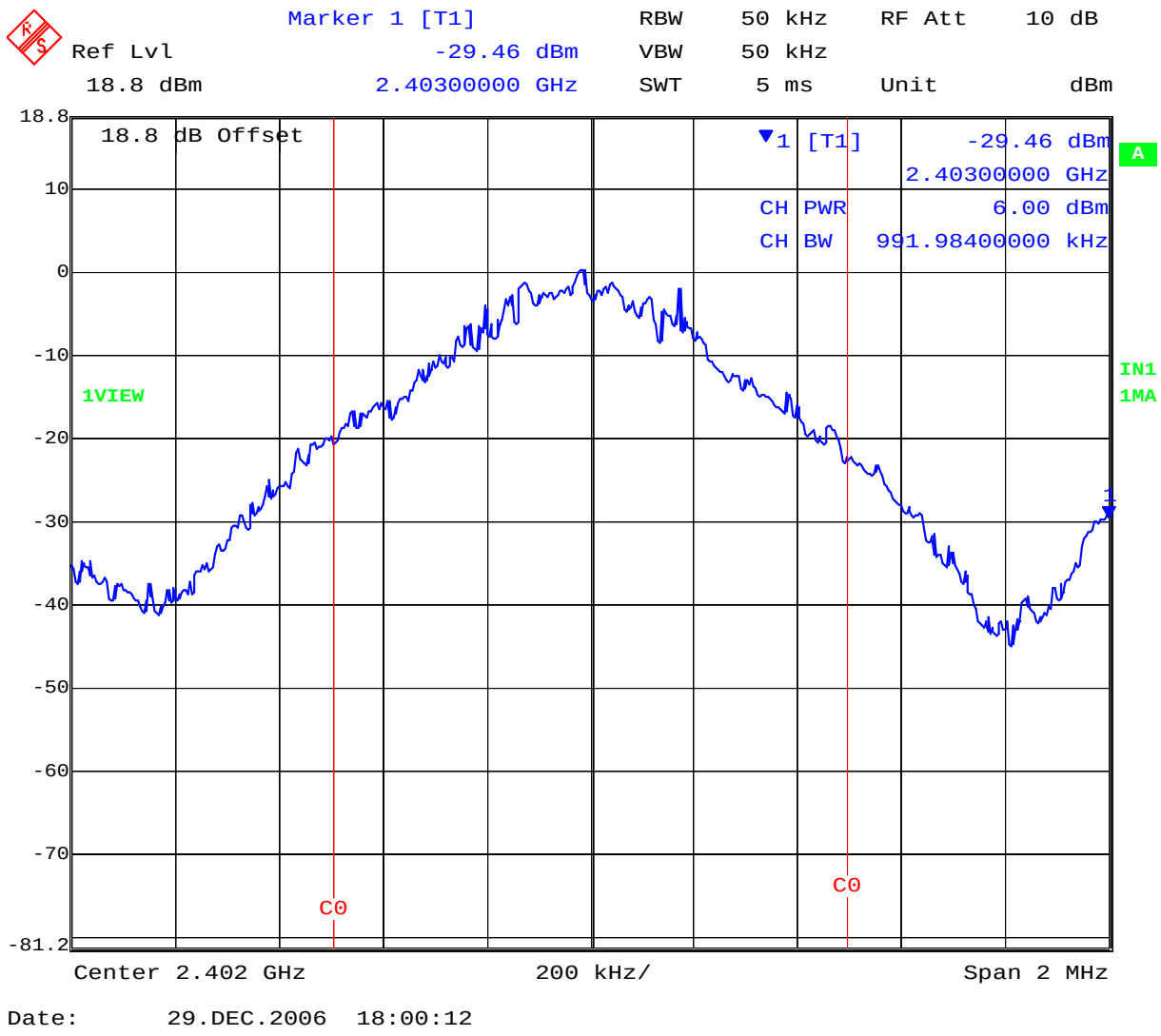
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

TABLE OF RESULTS –

Channel #	Center Frequency (MHz)	Peak Power (dBm)	Plot #
1	2402	+6.00	14
41	2441	+4.30	15
80	2480	+3.30	16

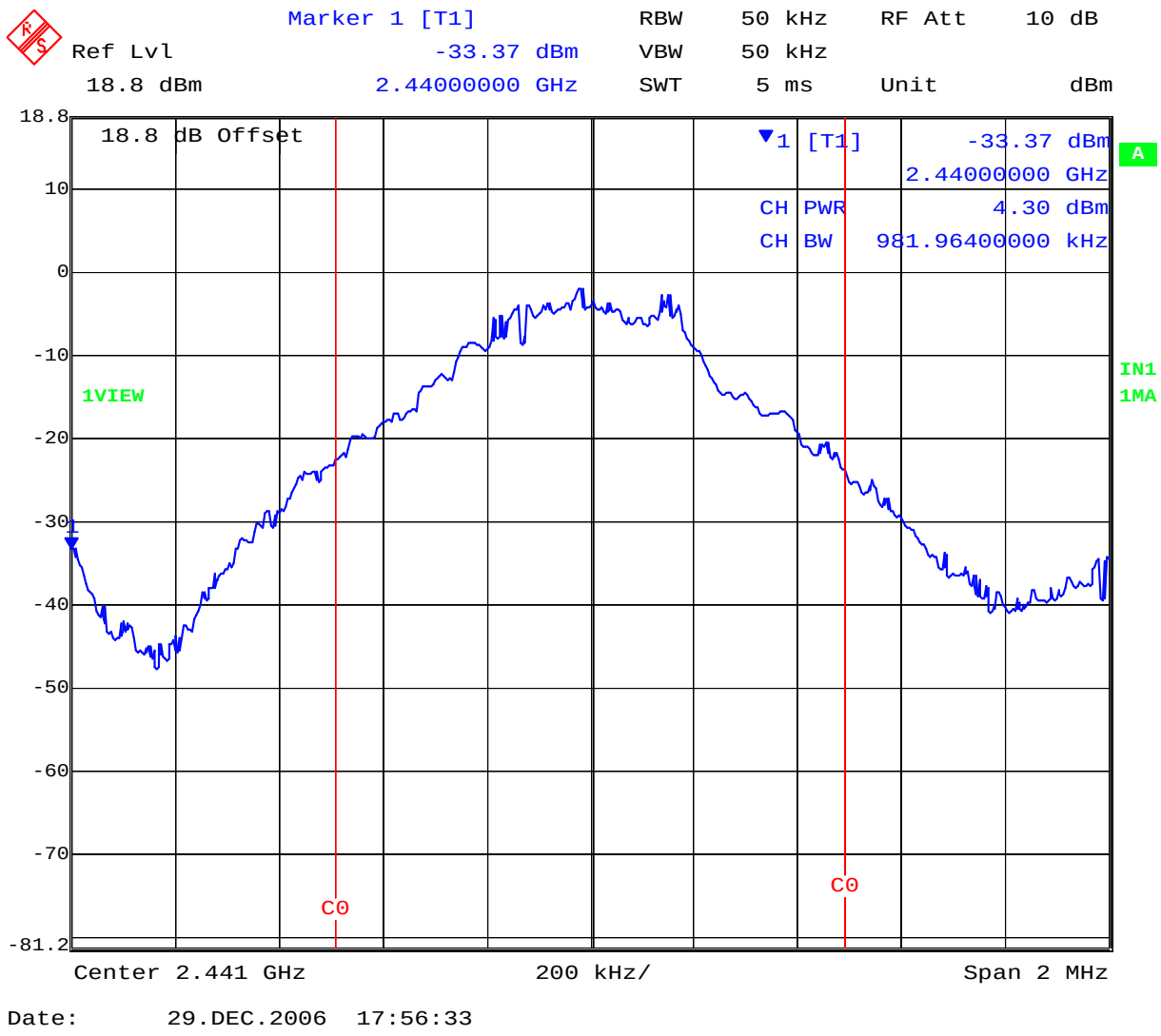
Plot 14

CH 1 2402 MHz Power



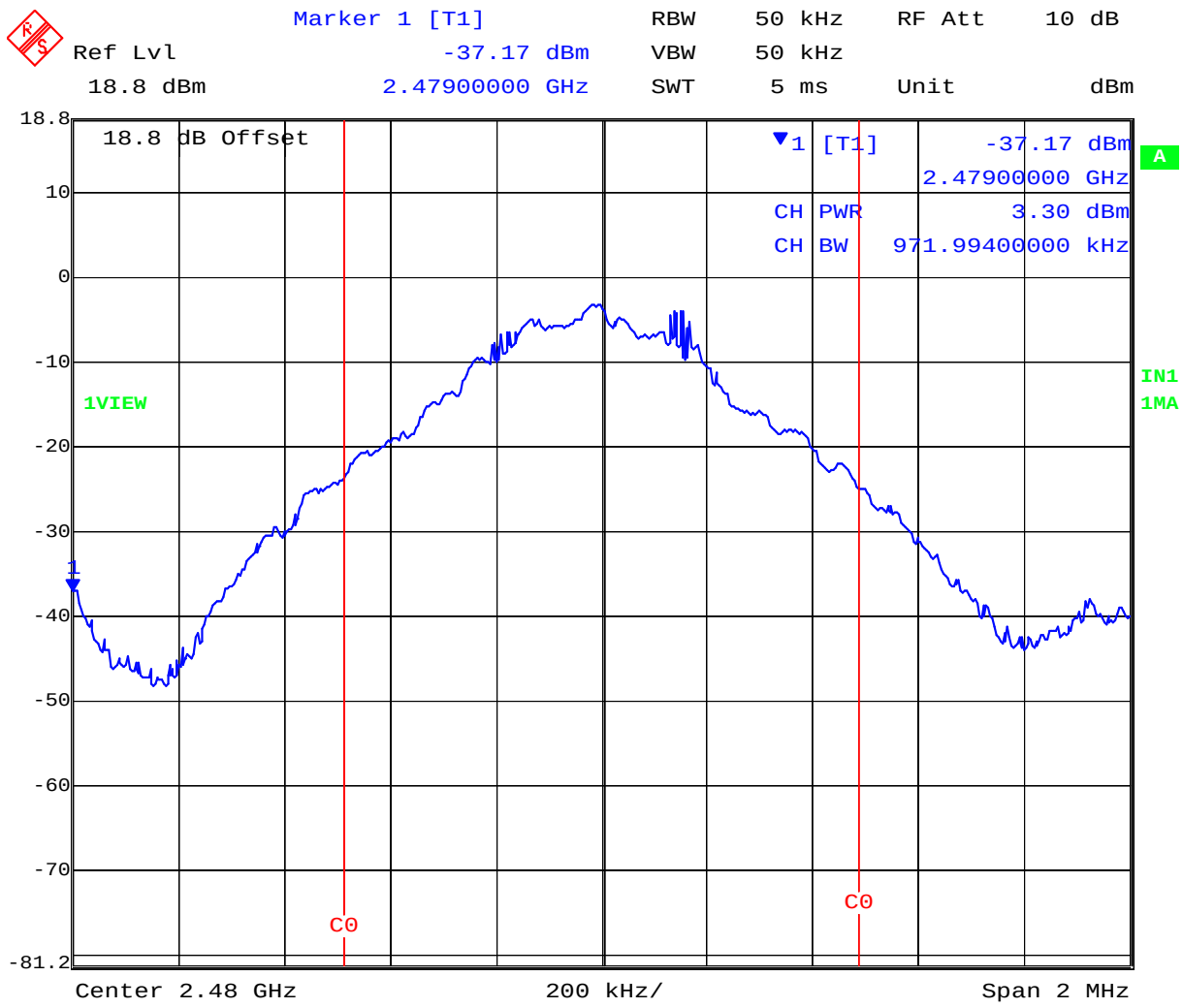
Plot 15

CH 41 2441 MHz Power (+0.33dBm)



Plot 16

CH 80 2480 MHz Power (+0.12dBm)



Specification

Limits

FCC, Part 15 Subpart C §15.247(b)(1)
Industry Canada RSS-210 §A8.4(2)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

Traceability

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

5.1.5. Maximum Permissible Exposure

FCC, Part 15 Subpart C §15.247(b)(5)
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)

For 0 dBi (1 num.) antenna P (worst case) = +6 dBm (3.98 mW)

Because the EUT belongs to the General Population / Uncontrolled Exposure the limit of power density is 1mW/cm^2

Antenna Gain (dBi)	Numeric Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated safe distance @ max limit 1mW/ cm^2 (d=cm)
0	1	+6.0	3.98	0.56

Specification

Maximum Permissible Exposure Limits

§15.247 (b)(5) 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. See §1.1307 (b)(1) of this chapter.

Limit S = 1mW / cm^2 from 1.310 Table 1

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

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

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

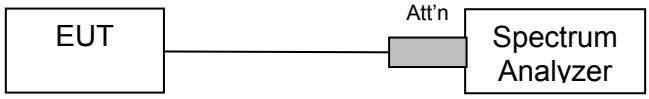
5.1.6. Conducted Spurious Emissions

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



Test configuration

Measurement Results of Conducted Spurious Emissions

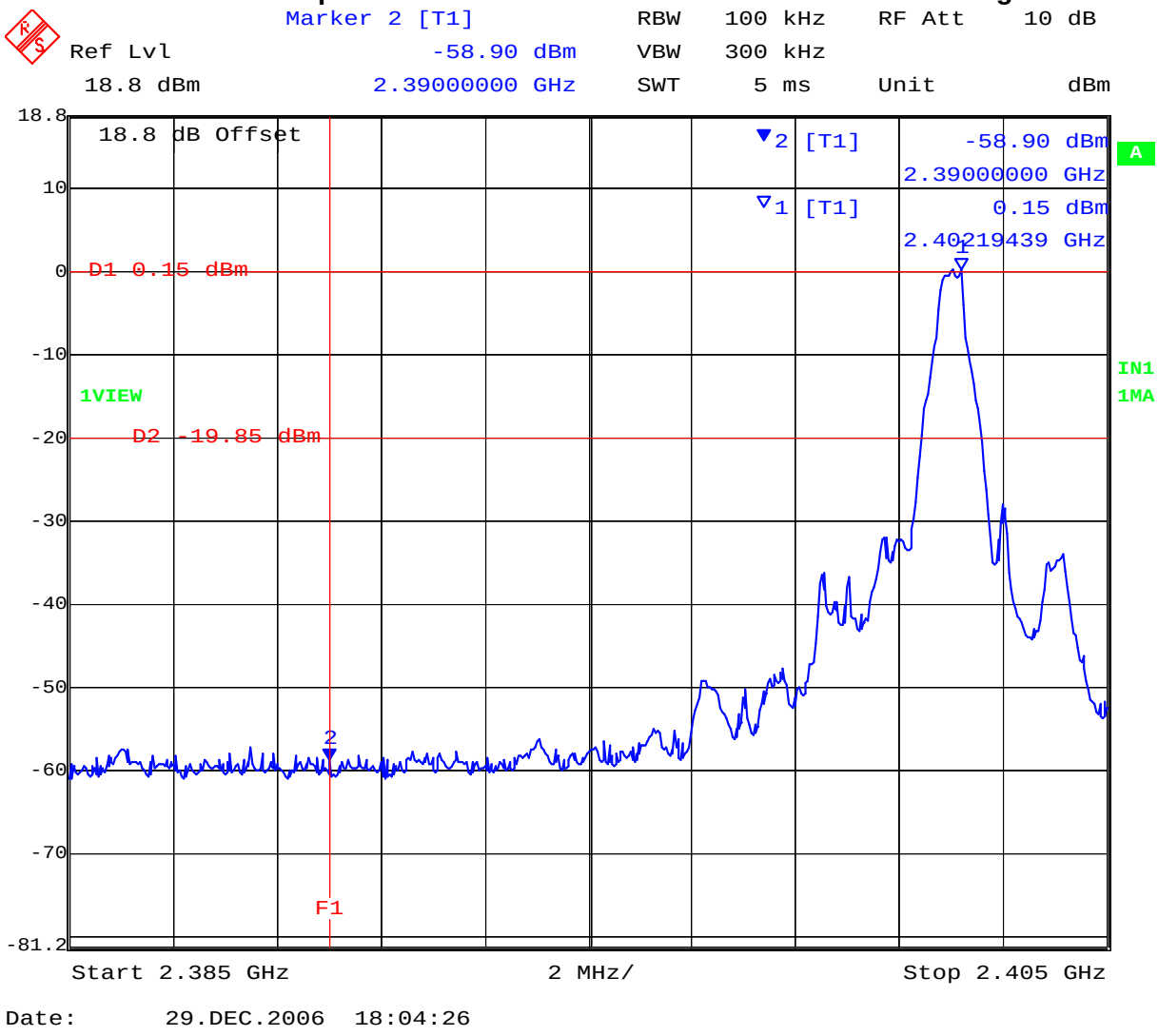
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Conducted Band-Edge Results

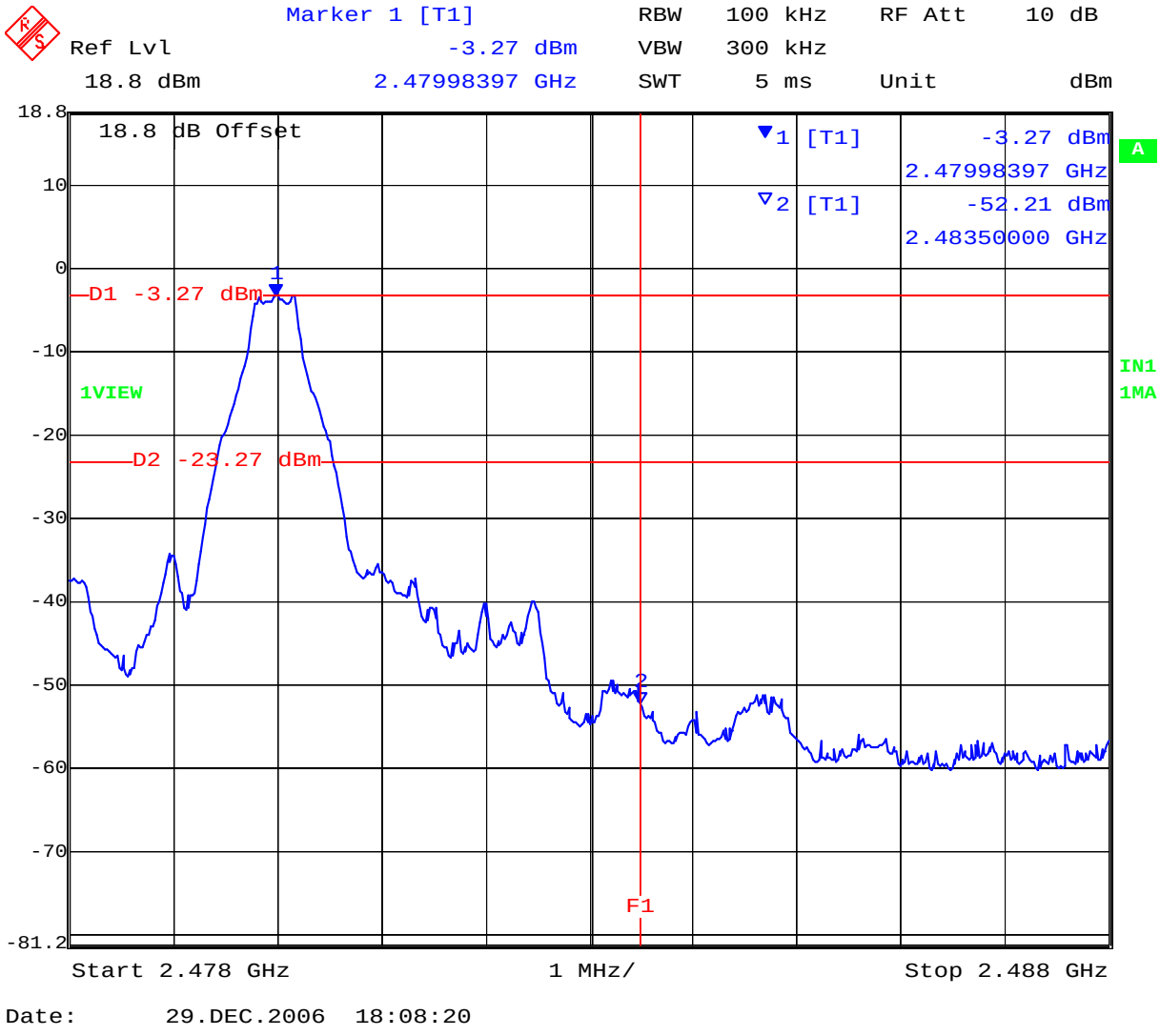
TABLE OF RESULTS

Channel #	Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (dBm)	Amplitude @ Band edge (dBm)	Plot #	Margin (dB)
1	2402	2390	-20.39	-44.20	17	-23.81
80	2480	2483.5	-20.50	-46.33	18	-25.83

Plot 17
Conducted Spurious Emissions at the 2390 MHz Lower Band Edge



Plot 18
Conducted Spurious Emissions at the 2483.5 MHz Upper Band Edge



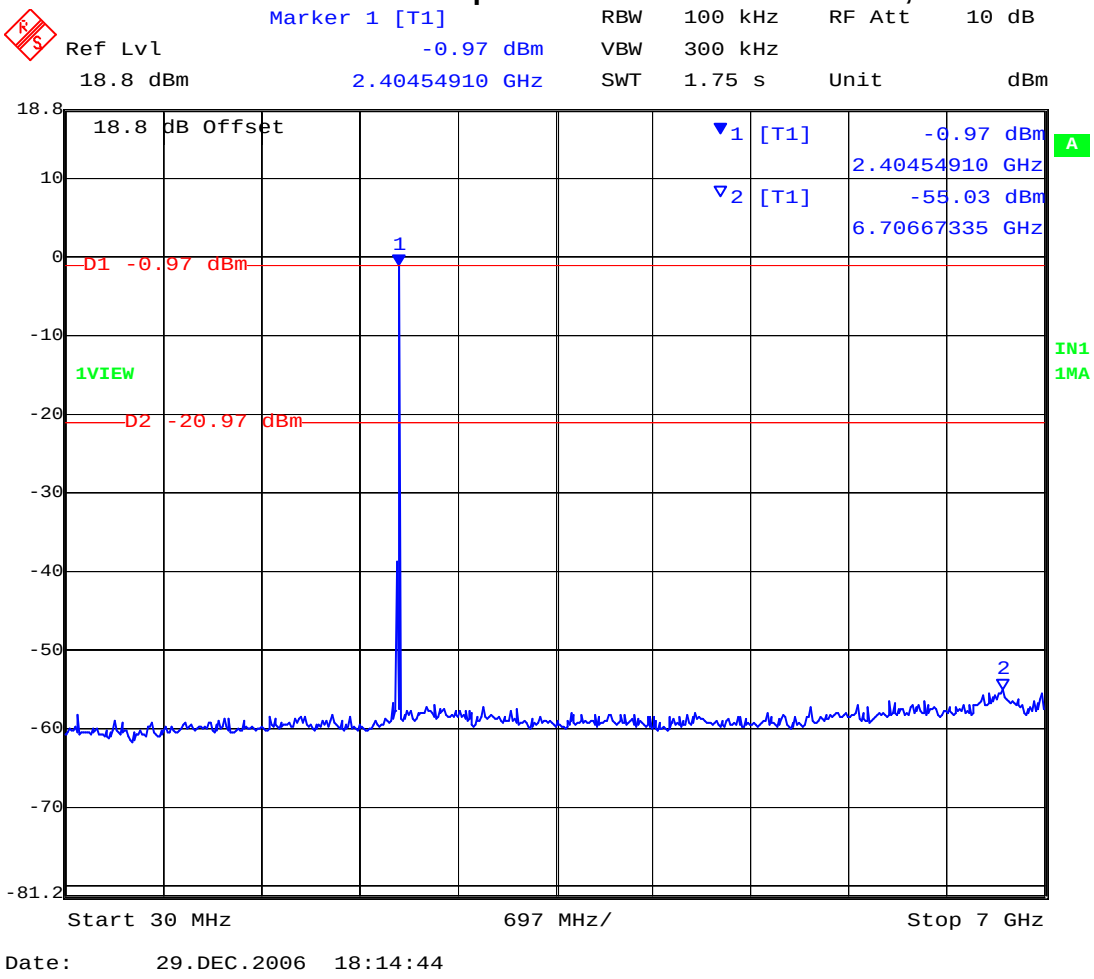
Spurious Emissions (1-25 GHz)

Conducted spurious emissions (1-25 GHz) are provided indicated by the following matrix. 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 –

CH #	Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
1	2402	30	7,000	-55.03	-20.97	19	-34.06
1	2402	7,000	26,000	-35.97		20	-15.00

Plot 19
Ch 1 2402 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



Plot 20
2402 MHz Conducted Spurious Emissions 7,000 MHz to 26,000 MHz

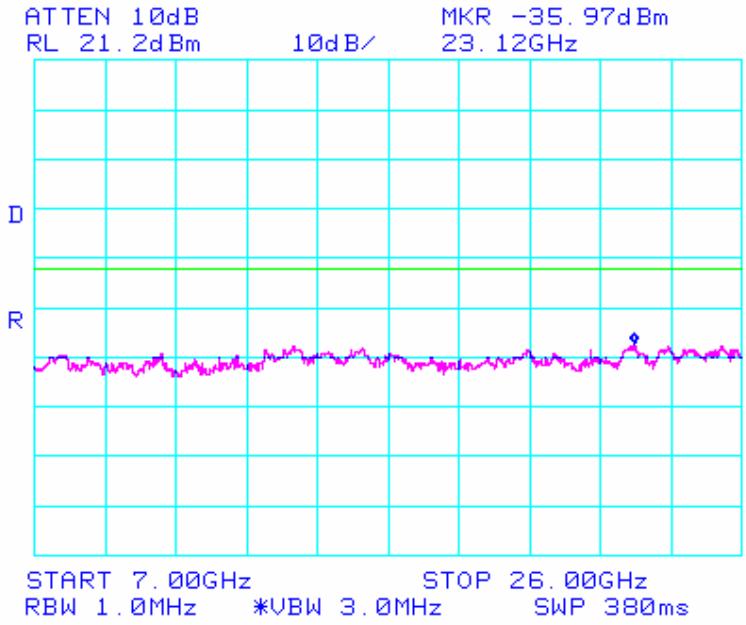
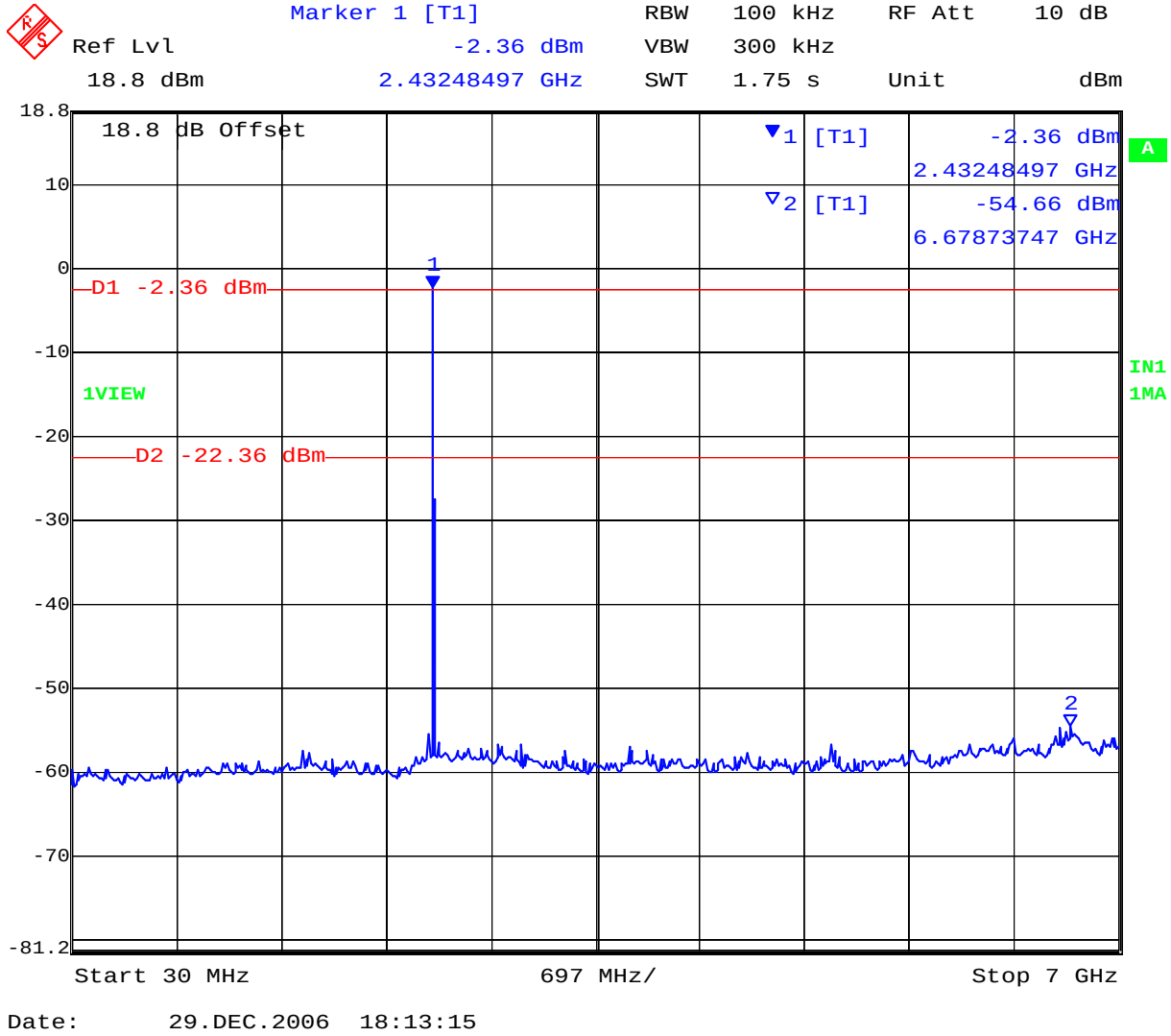


TABLE OF RESULTS –

CH #	Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
41	2441	30	7,000	-54.66	-22.36	21	-32.30
41	2441	7,000	26,000	-35.63		22	-13.27

Plot 21
Ch 41 Conducted Spurious Emissions 30 MHz to 7,000 MHz



Plot 22
Ch 41 Conducted Spurious Emissions 7,000 MHz to 26,000 MHz

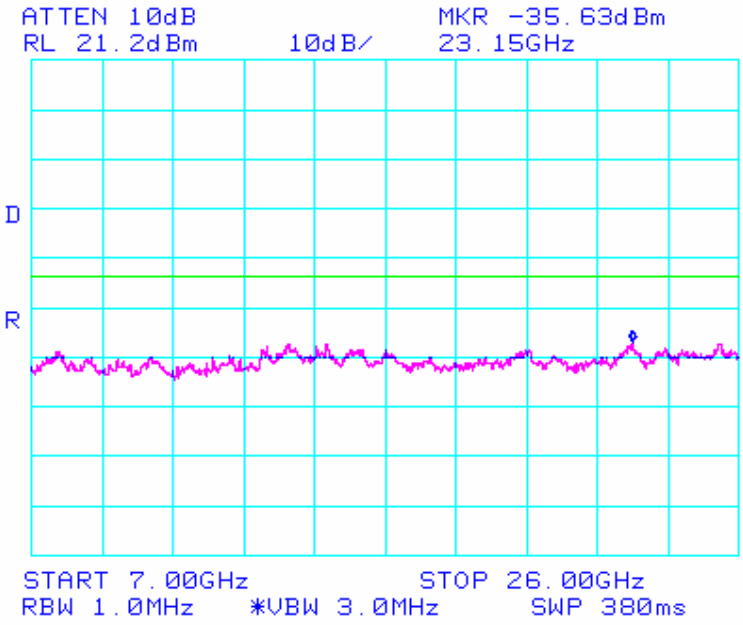
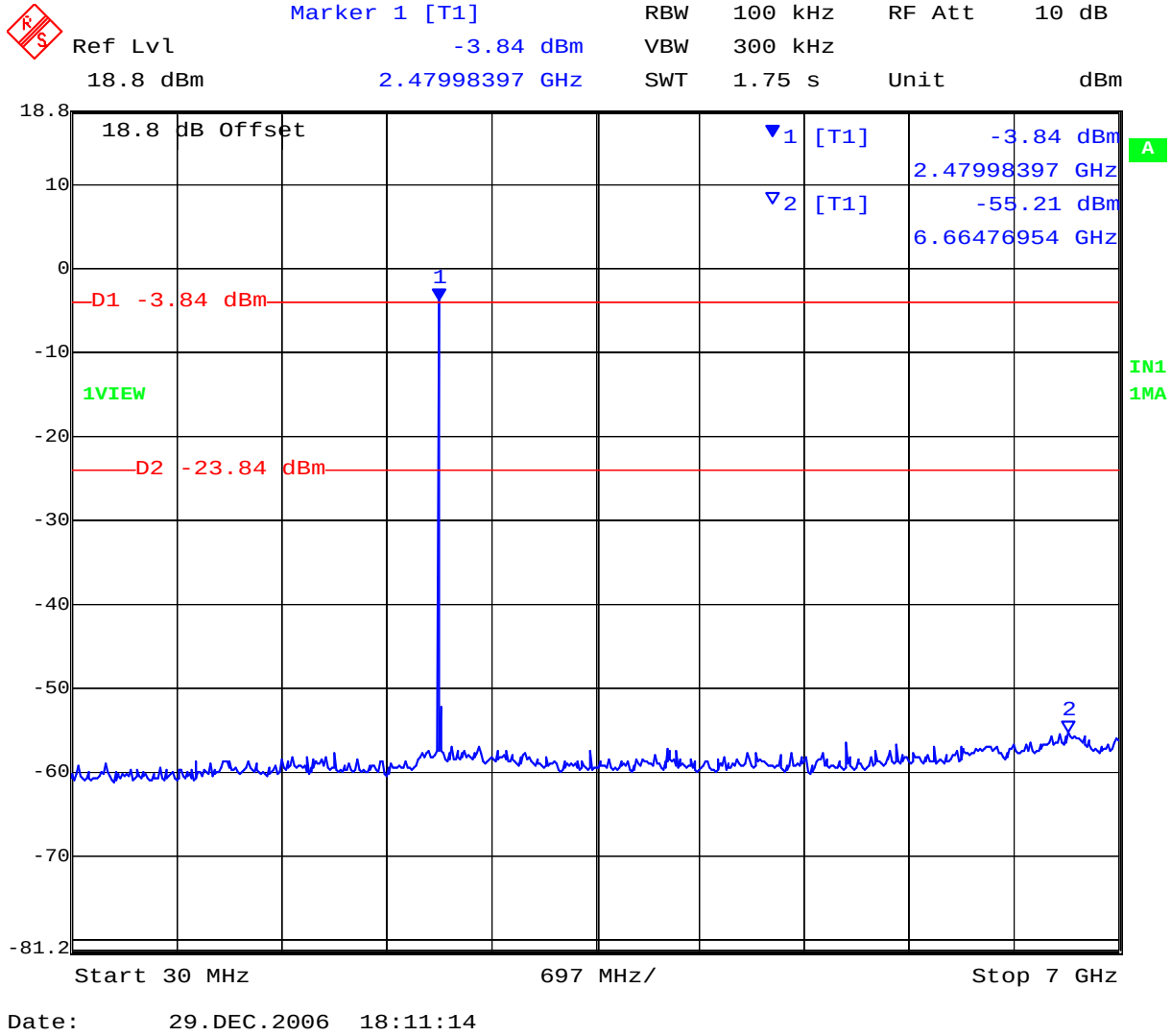


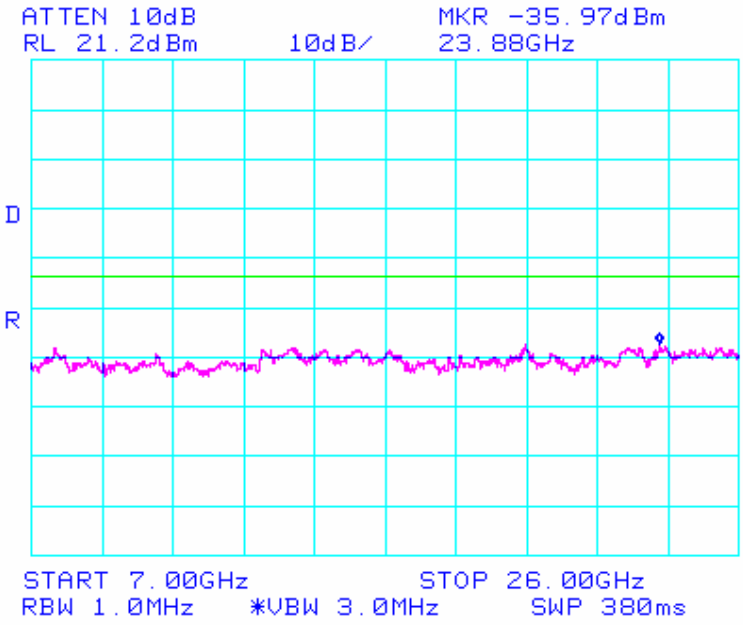
TABLE OF RESULTS –

CH #	Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
80	2480	30	7,000	-55.21	-23.84	23	-31.37
80	2480	7,000	26,000	-35.97		24	-12.13

Plot 23
Ch 80 Conducted Spurious Emissions 30 MHz to 7,000 MHz



Plot 24
Ch 80 Conducted Spurious Emissions 7,000 MHz 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	2483.5 MHz	≥ 20 dB

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

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'	0088, 0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117.

5.1.7. Radiated Emissions

5.1.7.1. Transmitter Radiated Spurious Emissions (above 1 GHz)

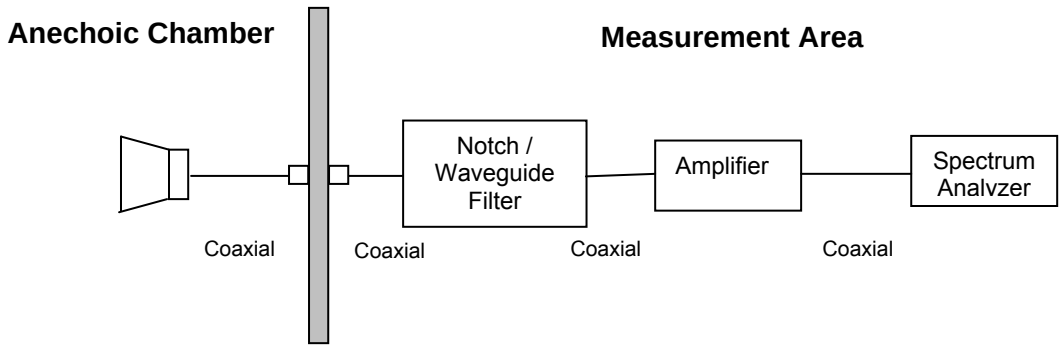
FCC, Part 15 Subpart C §15.247(d)
Industry Canada RSS-210 §2.2; §A8.5
Industry Canada RSS-Gen §4.7

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

Test Configuration

Full Power

Integral Antenna

Radiated Spurious Emissions above 1 GHz

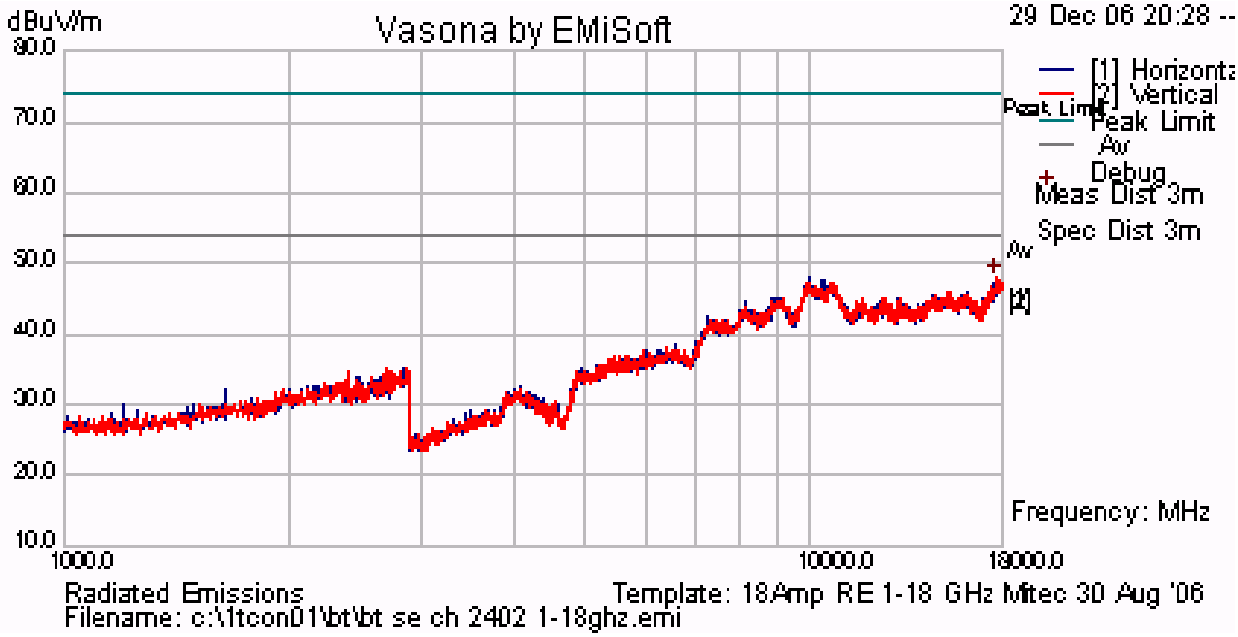
Ambient conditions.
Temperature: 17 to 23°C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

TABLE OF RESULTS – **Channel 2402 MHz**

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
					74 (Peak)	
					54 (Ave)	

No emissions found within 6 dB of the limit

Plot 25
Radiated Emissions for Channel 2402



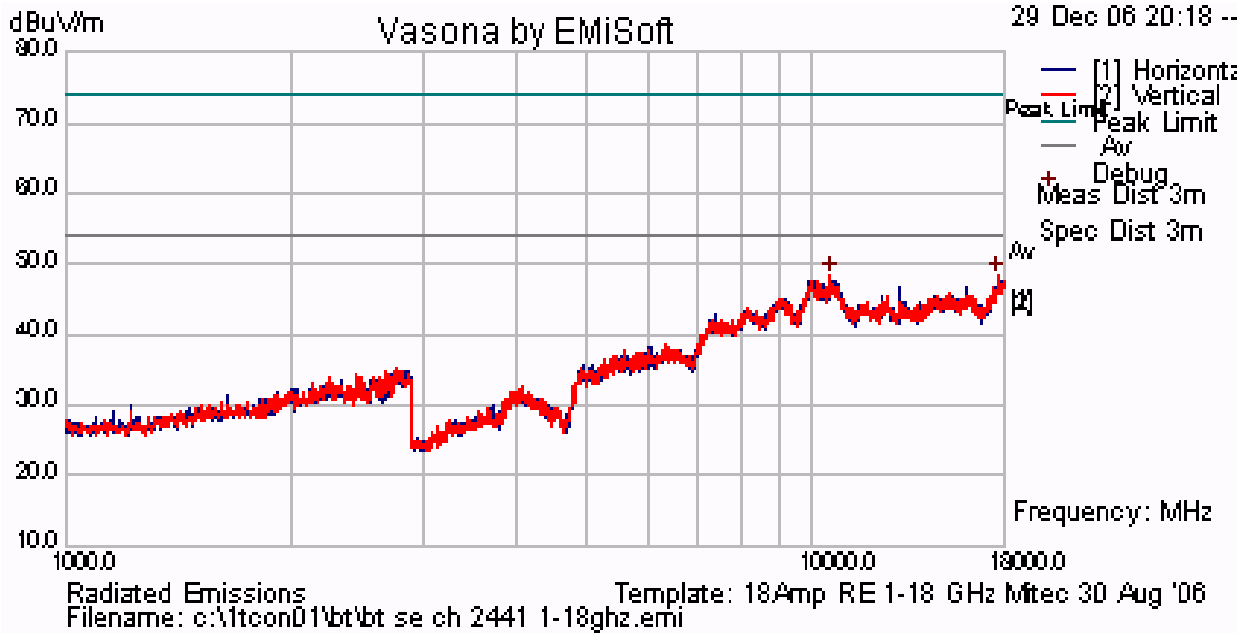
Radiated Spurious Emissions above 1 GHz (continued)

TABLE OF RESULTS – **Channel 2441 MHz**

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
					74 (Peak)	
					54 (Ave)	

No emissions found within 6 dB of the limit

Plot 26
Radiated Emissions for Channel 2441



Radiated Spurious Emissions above 1 GHz (continued)

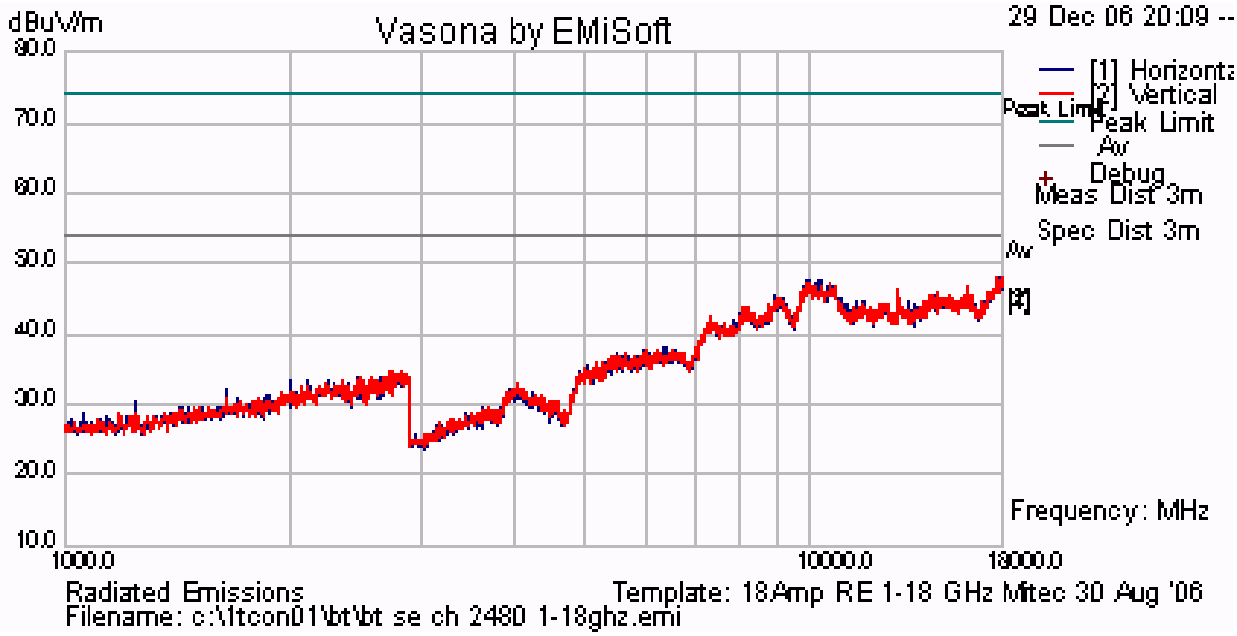
Antenna #1 - 1 dBi Integral Murata

TABLE OF RESULTS – **Channel 2480 MHz**

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
					74 (Peak)	
					54 (Ave)	

No emissions found within 6 dB of the limit

Plot 27
Radiated Emissions for Channel 2480



Specification

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

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'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

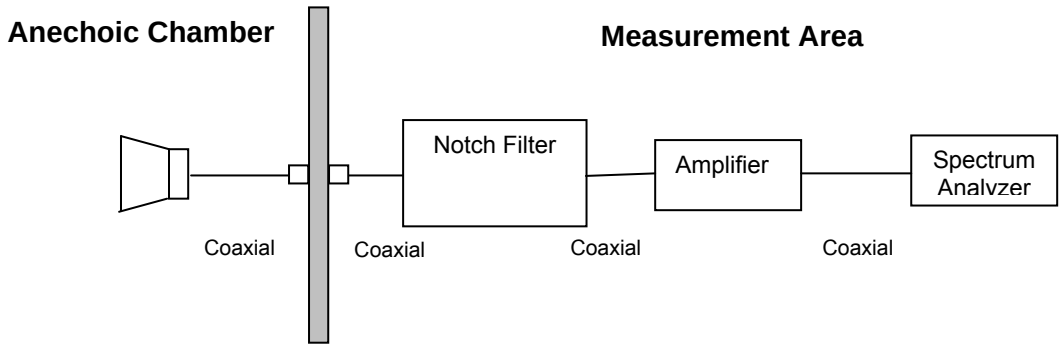
5.1.7.2. Radiated Band Edge - Restricted Band

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. A notch 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 = Band-stop 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

Radiated Band Edge - Test Configurations

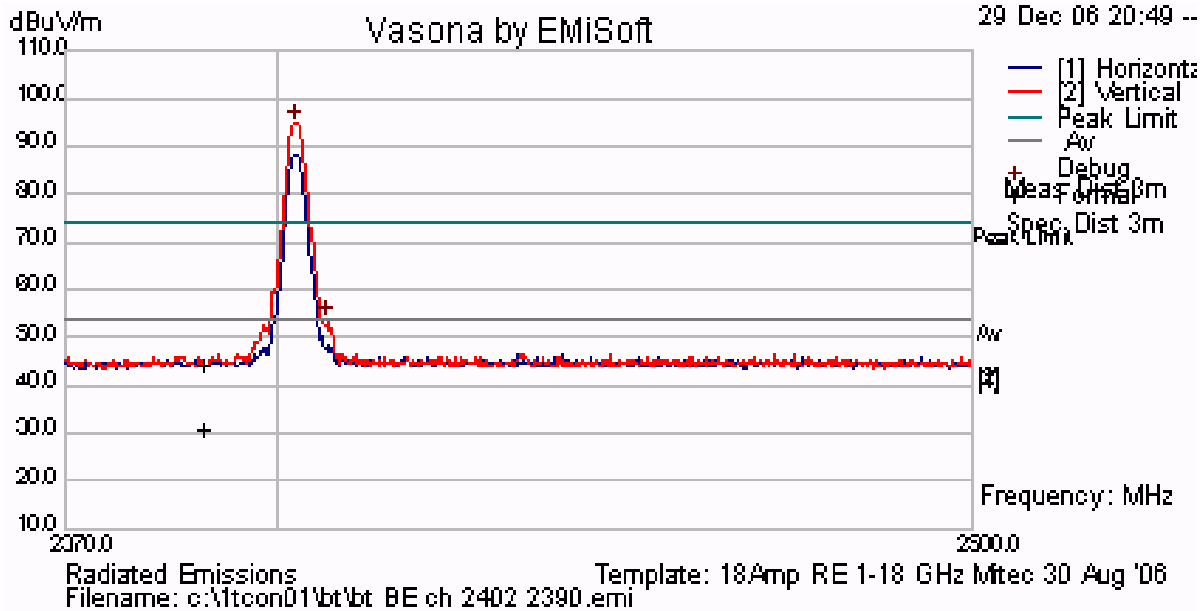
Full Power
Integral Antenna

Results for Antenna #1 - 1 dBi Integral Murata

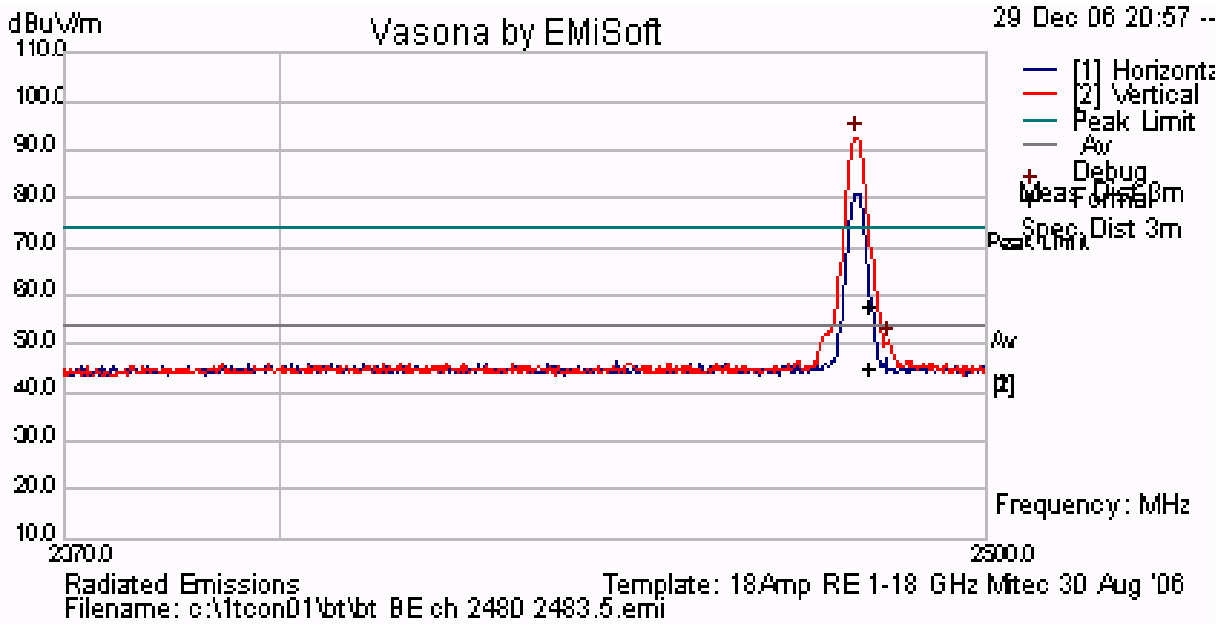
Ch #	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plot #
1	2402_{PEAK}	2,390	41.6	74.0	-32.4	28
	2402_{AVE}	2,390	27.74	54.0	-26.26	
80	2480_{PEAK}	2,483.5	54.56	74.0	-19.44	29
	2480_{AVE}	2,483.5	41.87	54.0	-12.13	

Ch #	Tx Freq. (MHz)	Measured Peak Field Strength (dBuV/m)	Plot #
41	2441_{PEAK}	94.31	28

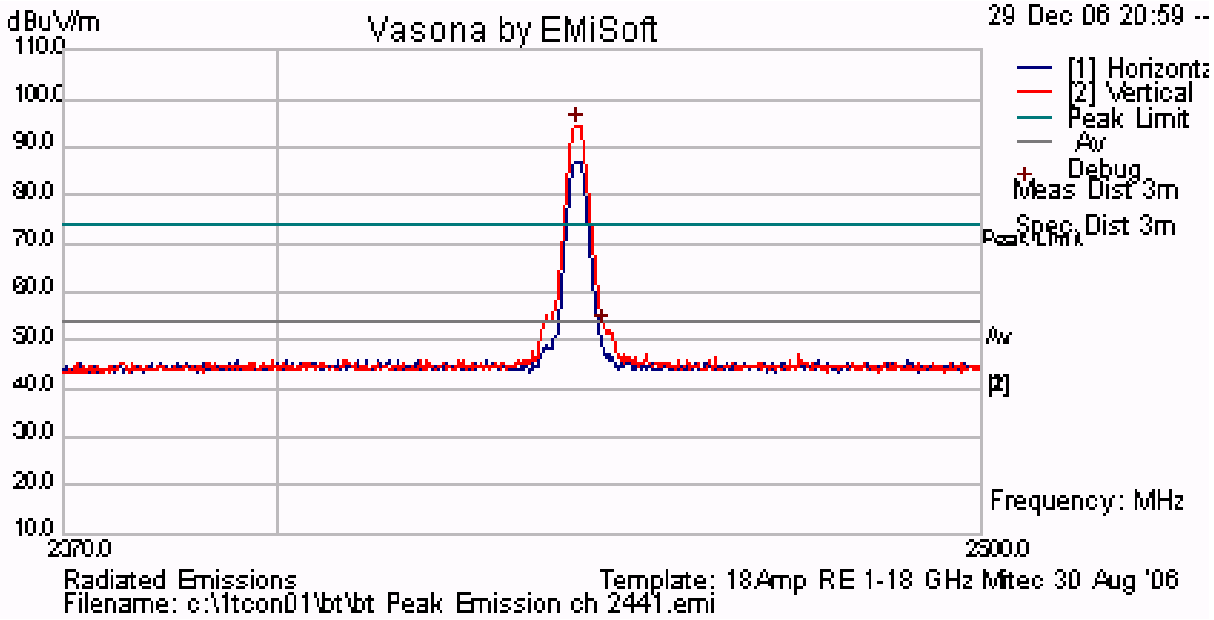
Plot 28 Channel 1 - Lower Band Edge, Peak Emission = 94.6 dBµV/m



Plot 29 Channel 80 – Upper Band Edge, Peak Emission = 92.55 dBµV/m



Plot 30 Channel 41 – Peak Field Strength = 94.31 dBµV/m



Specification 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.

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

FCC §15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

FCC §15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

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

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

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

5.1.7.3. Receiver Radiated Spurious Emissions (above 1 GHz)

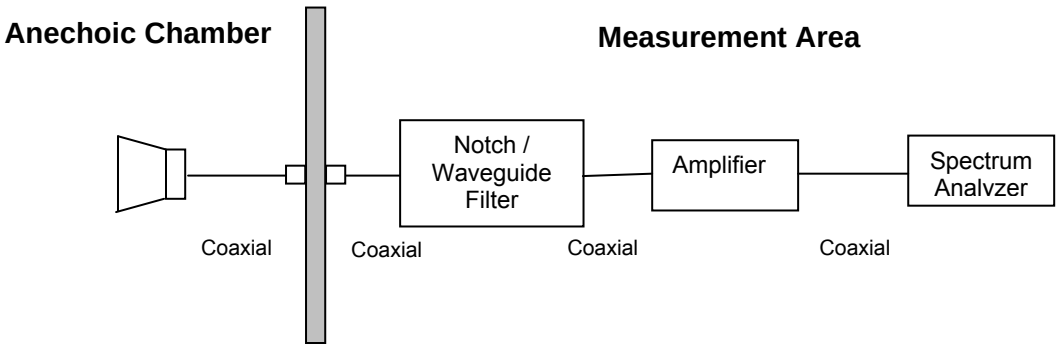
Industry Canada RSS-Gen §4.8, §6

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

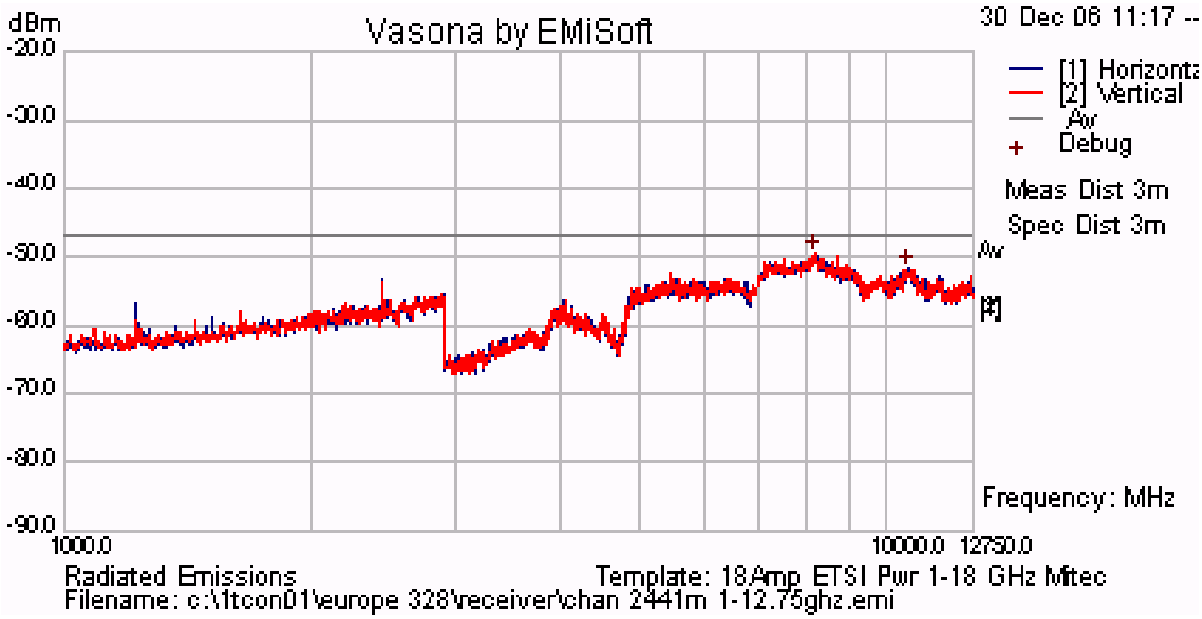
Receiver Radiated Spurious Emissions above 1 GHz

TABLE OF RESULTS – **Channel # 41**

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)

No emissions found

Receiver Radiated Emissions for Ch 41



Receiver Radiated Spurious Emissions (continued)

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

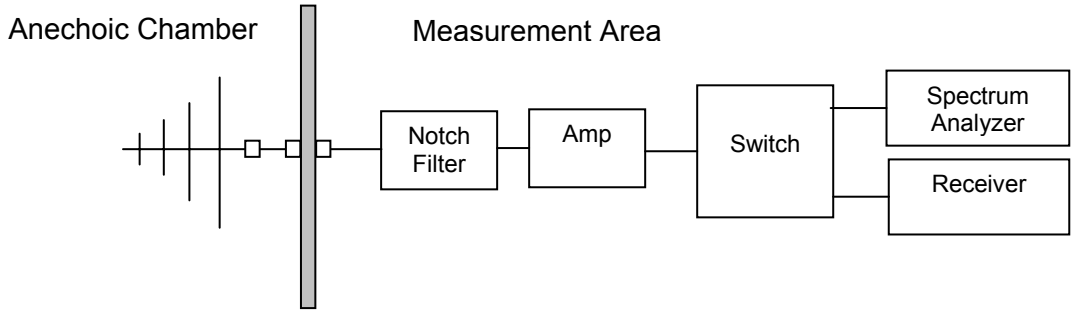
5.1.8. Radiated Spurious Emissions (30M-1 GHz)

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

Test Procedure

Testing 30M-1 GHz was subcontracted to the company identified in Section 3.9 Subcontracted Testing. Preliminary radiated emissions are measured in the anechoic chamber at a 10-meter distance on every azimuth in both horizontal and vertical polarity. The emissions are recorded with a spectrum analyzer 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.

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

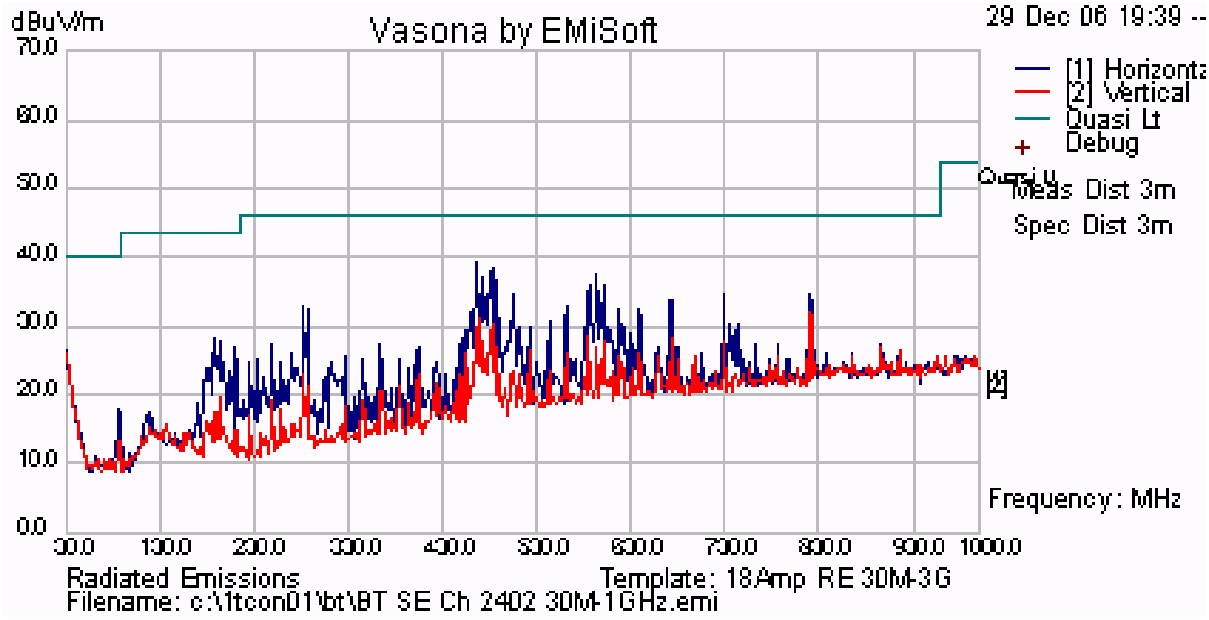
Radiated Emissions Below 1 GHz

TABLE OF RESULTS – Channel 2402 MHz

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)

No emissions were found within 6 dB of the limit

Channel 2402 MHz
Radiated Emissions 30MHz - 1 GHz



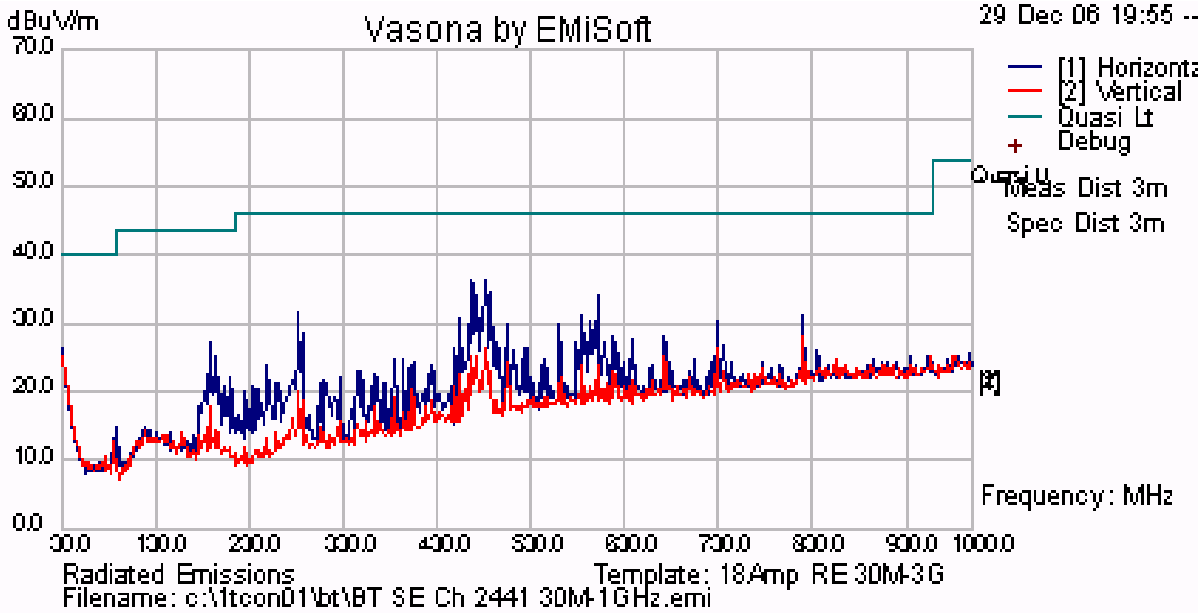
Radiated Emissions Below 1 GHz

TABLE OF RESULTS – Channel 2441 MHz

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)

No emissions were found within 6 dB of the limit

Channel 2441 MHz
Radiated Emissions 30MHz - 1 GHz



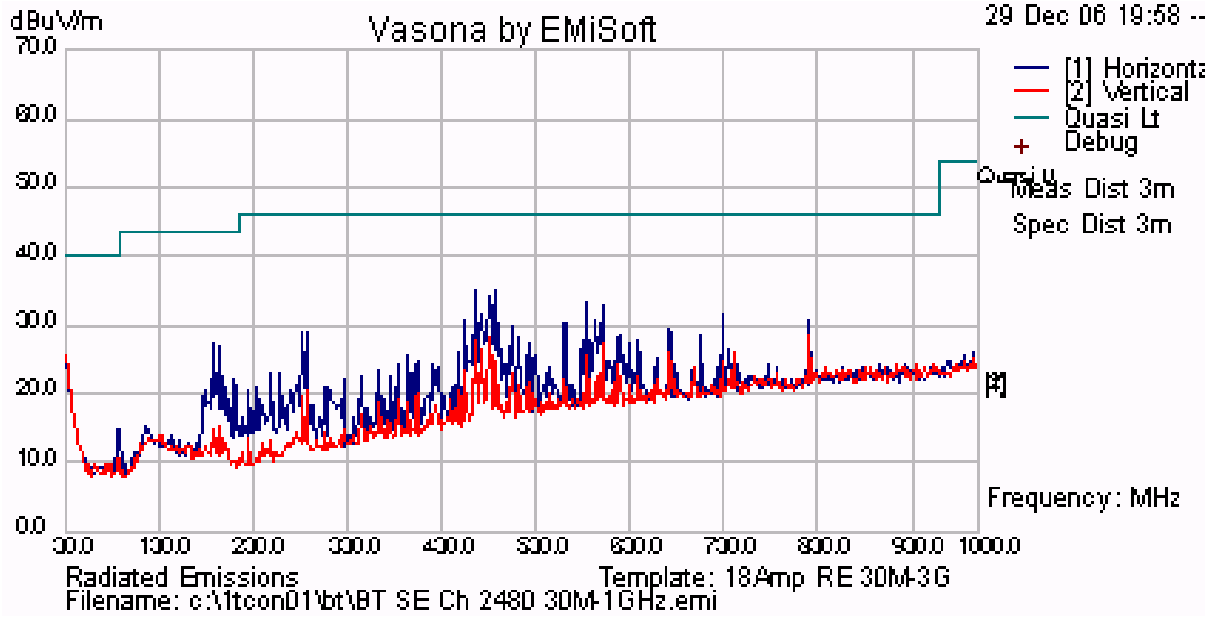
Radiated Emissions Below 1 GHz

TABLE OF RESULTS – Channel 2480 MHz

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)

No emissions were found within 6 dB of the limit

Channel 2480 MHz
Radiated Emissions 30MHz - 1 GHz



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 TUV Rheinland work instruction	8546A HP Receiver and RF Filter, HP Pre-amp, Antenna EMCO Biconilog

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

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

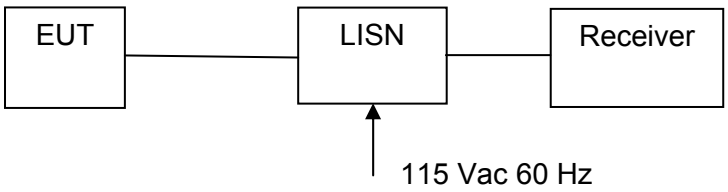
Test not applicable battery powered

Test Procedure

The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a receiver 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.

The dongle was connected to the USB port on the IBM laptop computer. The transmitter was operational during the test.

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

Measurement Results for AC Wireline Conducted Emissions (150 kHz – 30 MHz)

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

TABLE OF RESULTS

Freq (MHz)	Line	Peak (dBµV)	QP (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Ave. (dBµV)	Ave. Limit (dBµV)	Ave. Margin (dB)

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

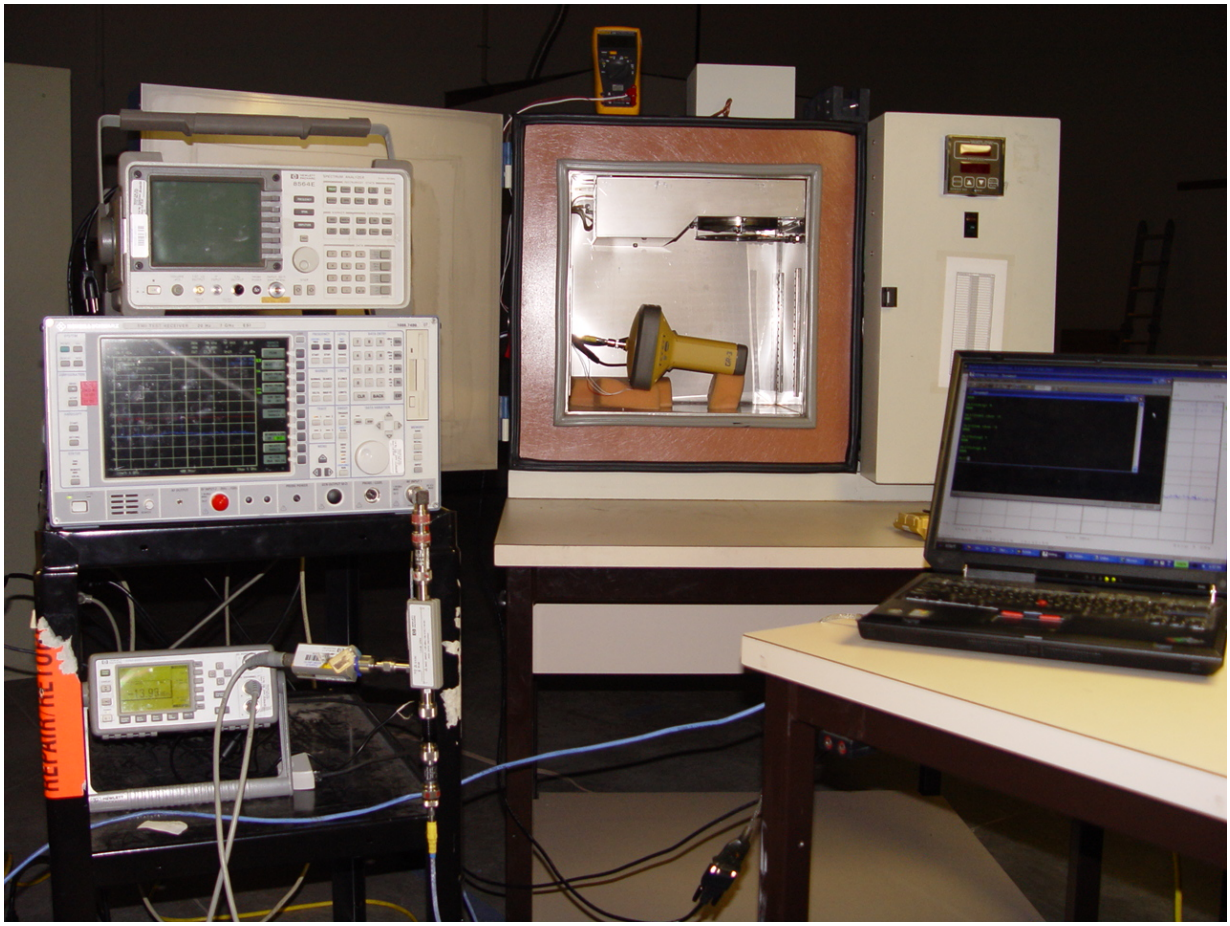
Measurement uncertainty	±2.64 dB

Traceability

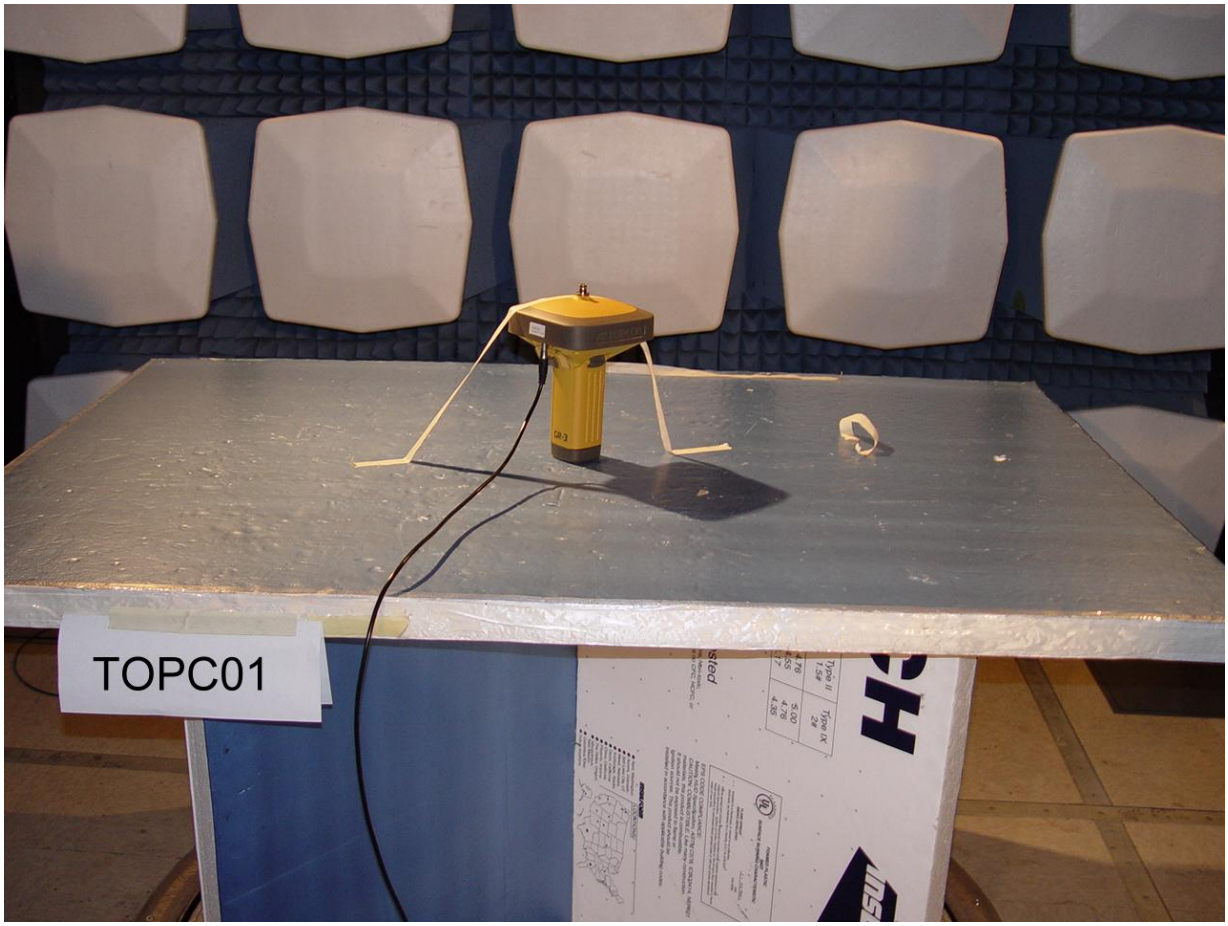
Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0193, 0190, 0293, 0307

6. PHOTOGRAPHS

6.1. General Measurement Test Set-Up



6.2. Radiated Emissions



7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
0104	1-18GHz Horn Antenna	The Electro-Mechanics Company	3115	9205-3882
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
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002

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