Test of PakSense Inc. Ultra Wireless - Reader

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

Test Report Serial No.: PAKS01-A2 Rev A

# TEST REPORT

FROM

Test of PakSense Inc. Ultra Wireless - Reader
to
To FCC 47 CFR Part15.247 & IC RSS-210

Test Report Serial No.: PAKS01-A2 Rev A

This report supersedes: None

**Applicant:** PakSense Inc.
5256 Fairview Ave
Boise
Idaho 83714 USA

**Product Function:** Accumulation of remote Time/Temperature data

**Copy No:** pdf **Issue Date:** 30th November 2008

**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

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**

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 18 June 2005*).

Presented this 26th day of February 2008.

President
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 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) Listing #: 102167

**Canada**
Industry Canada (IC) Listing #: 4143A-2

# 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)<br>Bureau of Standards, Metrology and Inspection (BSMI) | I<br>I | |

# DOCUMENT HISTORY

| Document History | | |
|---|---|---|
| Revision | Date | Comments |
| Draft | | |
| Rev A | 30th Novemebr 2008 | Initial Release |
| | | |
| | | |

# 1. TEST RESULT CERTIFICATE

| | | | |
|---|---|---|---|
| Manufacturer : | PakSense Inc.<br>5256 Fairview Ave<br>Boise Idaho 83714 USA | Tested By: | MiCOM Labs, Inc.<br>440 Boulder Court<br>Suite 200<br>Pleasanton<br>California, 94566, USA |
| EUT: | PakSense Inc. Ultra Wireless - Reader | Telephone: | +1 925 462 0304 |
| Model: | PSUWR01A | Fax: | +1 925 462 0306 |
| S/N: | Not Available | | |
| Test Date(s): | 23rd - 30th September '08 | 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 | 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 PakSense Inc. Ultra Wireless - Reader to FCC Part 15.247 and Industry Canada RSS-210 regulations. |
| Applicant: | PakSense Inc.<br>5256 Fairview Ave<br>Boise Idaho 83714 USA |
| Manufacturer: | As applicant. |
| Laboratory performing the tests: | MiCOM Labs, Inc.<br>440 Boulder Court, Suite 200<br>Pleasanton, California 94566 USA |
| Test report reference number: | PAKS01-A2 Rev A |
| Date EUT received: | 23rd September 2008 |
| Standard(s) applied: | FCC 47 CFR Part15.247 & IC RSS-210 |
| Dates of test (from - to): | 23rd - 30th September '08 |
| No of Units Tested: | 1 |
| Type of Equipment: | 915 MHz Reader |
| Manufacturers Trade Name: | Ultra Wireless |
| Model: | PSUWR01A |
| Location for use: | Indoor and Outdoor |
| Declared Frequency Range(s): | 902 - 928 MHz |
| Type of Modulation: | FSK (Frequency Shift Keying) |
| Declared Nominal Output Power: | +2 dBm |
| EUT Modes of Operation: | Single Mode |
| Transmit/Receive Operation: | Time Division Duplex |
| Rated Input Voltage: | Reader: ac adapter 115Vac 60Hz (3.7Vdc) |
| Operating Temperature Range: | Client declared range -25ºC to +60ºC |
| Software Release | Reader: 1.0 |
| Hardware Release: | 1.0 |
| ITU Emission Designator: | Reader: 745K5F1DCF |
| Frequency Stability: | ±20 ppm max |
| Equipment Dimensions: | Reader: 190h x 108h x 70d mm |
| Weight: | Reader: 350g |
| Primary function of equipment: | Accumulation of remote Time/Temperature data |

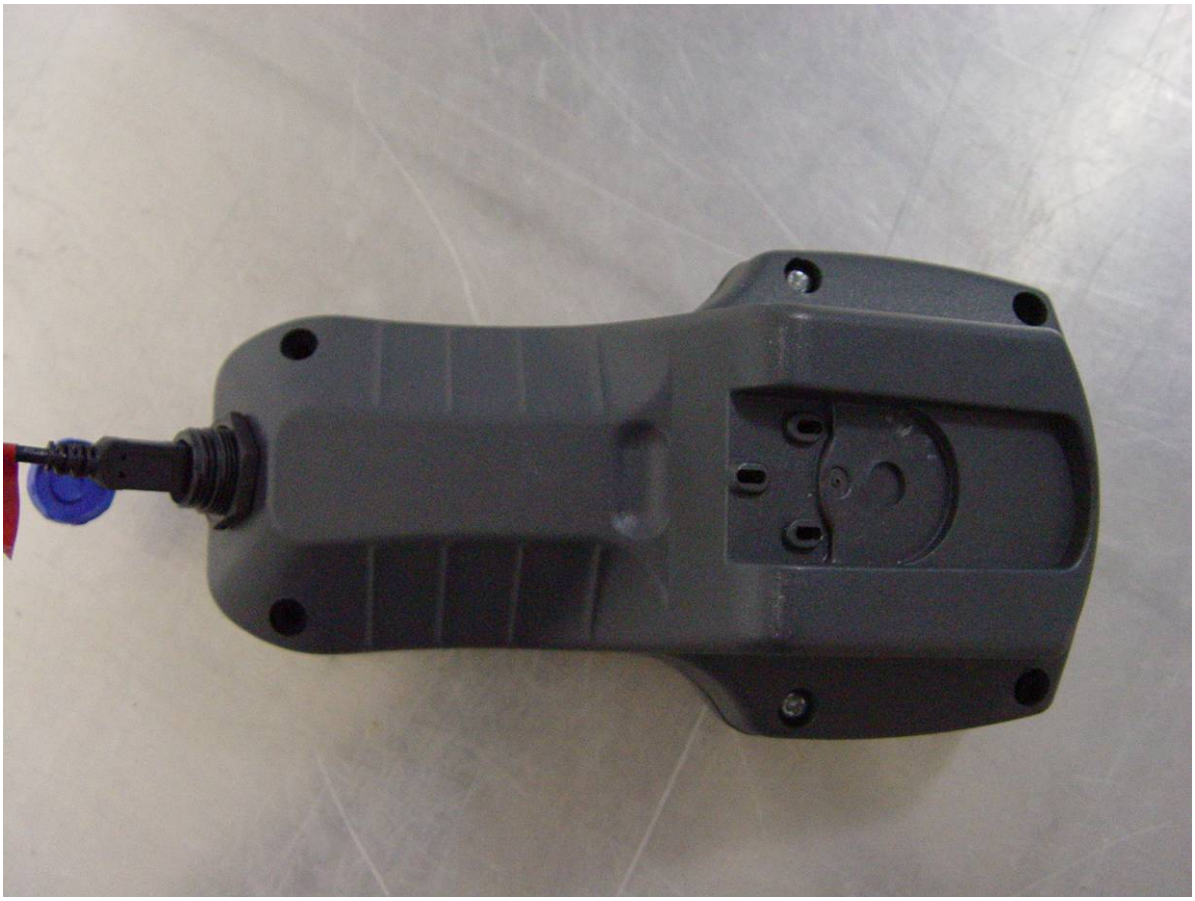
## 3.2. Scope of Test Program

The scope of the test program was to test the PakSense Inc. Ultra Wireless - Reader in the frequency range 902 -928 MHz for compliance against FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications.

The Ultra Wireless consists of a Reader and Label operating at 915 MHz using FSK modulation.

**PakSense Inc.**
**915 MHz UW Reader Model PSUWR01A**

**PakSense Inc.**
**915 MHz UW Reader Model PSUWR01A**



**PakSense Inc.**
**Power Supply for Reader**

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

| Type (EUT/ Support) | Equipment Description (Including Brand Name) | Mfr | Model No. | Serial No. |
|---|---|---|---|---|
| EUT | Ultra Wireless Reader | PakSense Inc. | PSUWR01A | Not Available |
| EUT | Power Supply Unit<br>100-240 V AC, 50/60Hz 0.2A<br>5 V DC, 1,000mA | ITE Power Supply | HK-J105-A05 | N/A |

## 3.4. Antenna Details

Printed circuit board trace antenna Reader and Label

Gain @ 915 MHz: 0dBi

## 3.5. Cabling and I/O Ports

Number and type of I/O ports

1. USB 1.0 Screened (couples as the dc charging port through USB connector)

## 3.6. Test Configurations

Matrix of Channel test configurations.

| Channel | | Frequencies (MHz) |
|---|---|---|
| Low | 0 | 902.75 |
| Mid | 25 | 915.25 |
| High | 49 | 927.25 |

## 3.7. Equipment Modifications

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

1. When the EUT(s) output power was set for +10dBm the emissions above and below 1 GHz were non-compliant. In order to bring the EUT(s) into compliance the output power was reduced to +2 dBm average power.

## 3.8. Deviations from the Test Standard

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

1. NONE

## 3.9. Subcontracted Testing or Third Party Data

1. NONE

# 4. TEST SUMMARY

## List of Measurements

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

| Section(s) | Test Items | Description | Condition | Result | Test Report Section |
|---|---|---|---|---|---|
| **15.247(a)(2)**<br>**A8.2(1)**<br>**4.4** | 6 dB and 99 % Bandwidths | ≥500 kHz | Conducted | Complies | 5.1.1 |
| **15.247(b)(3)**<br>**15.31(e)**<br>**A8.4(4)** | Peak Output Power | Shall not exceed 1W | Conducted | Complies | 5.1.2 |
| **15.247(e)**<br>**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)**<br>**5.5** | Maximum Permissible Exposure | Exposure to radio frequency energy levels | Conducted | Complies | 5.1.4 |
| **15.247(d)**<br>**15.205 /**<br>**15.209**<br>**A8.5**<br>**2.2**<br>**4.7** | Spurious Emissions<br>(30MHz - 26 GHz) | 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)**<br>**15.205 /**<br>**15.209**<br>**A8.5**<br>**2.2**<br>**2.6**<br>**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 | | Complies | |
| **15.205 /**<br>**15.209**<br>**2.2** | Radiated Spurious Emissions | Emissions <1 GHz (30M-1 GHz) | | Complies<br>Class A | |
| Industry Canada only<br>**RSS-Gen §4.8, §6** | Receiver Radiated Spurious Emissions | Emissions above 1 GHz | | Complies | *5.1.6.2* |
| **15.207**<br>**7.2.2** | AC Wireline Conducted<br>Emissions 150 kHz–30 MHz | Conducted Emissions | Conducted | Complies | *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:*** *Appendix A - Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix*

# 5. TEST RESULTS

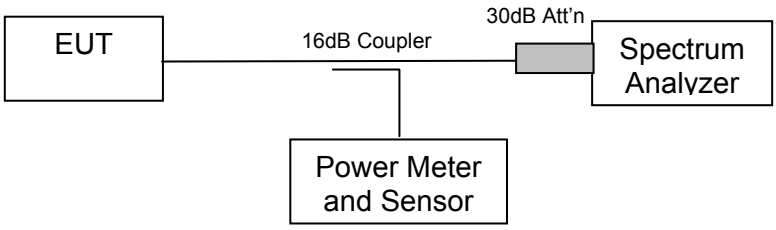
## 5.1. Device Characteristics

### 5.1.1. 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. The analyzer was set for a 6 dB resolution bandwidth filter during this measurement.

**Test Measurement Set up**




Measurement set up for 6 dB and 99 % bandwidth test

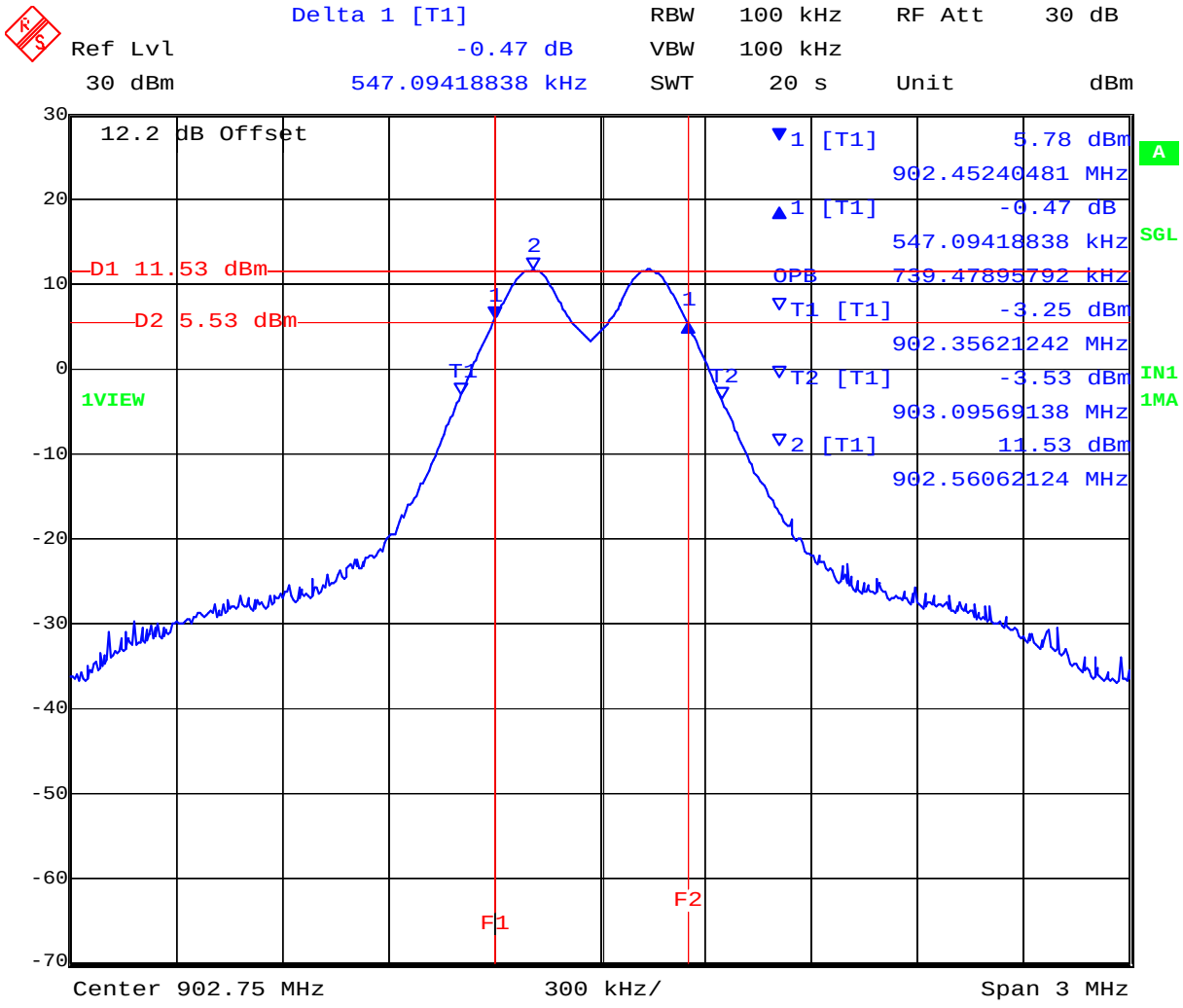
## Measurement Results for 6 dB and 99 % Operational Bandwidth(s)

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

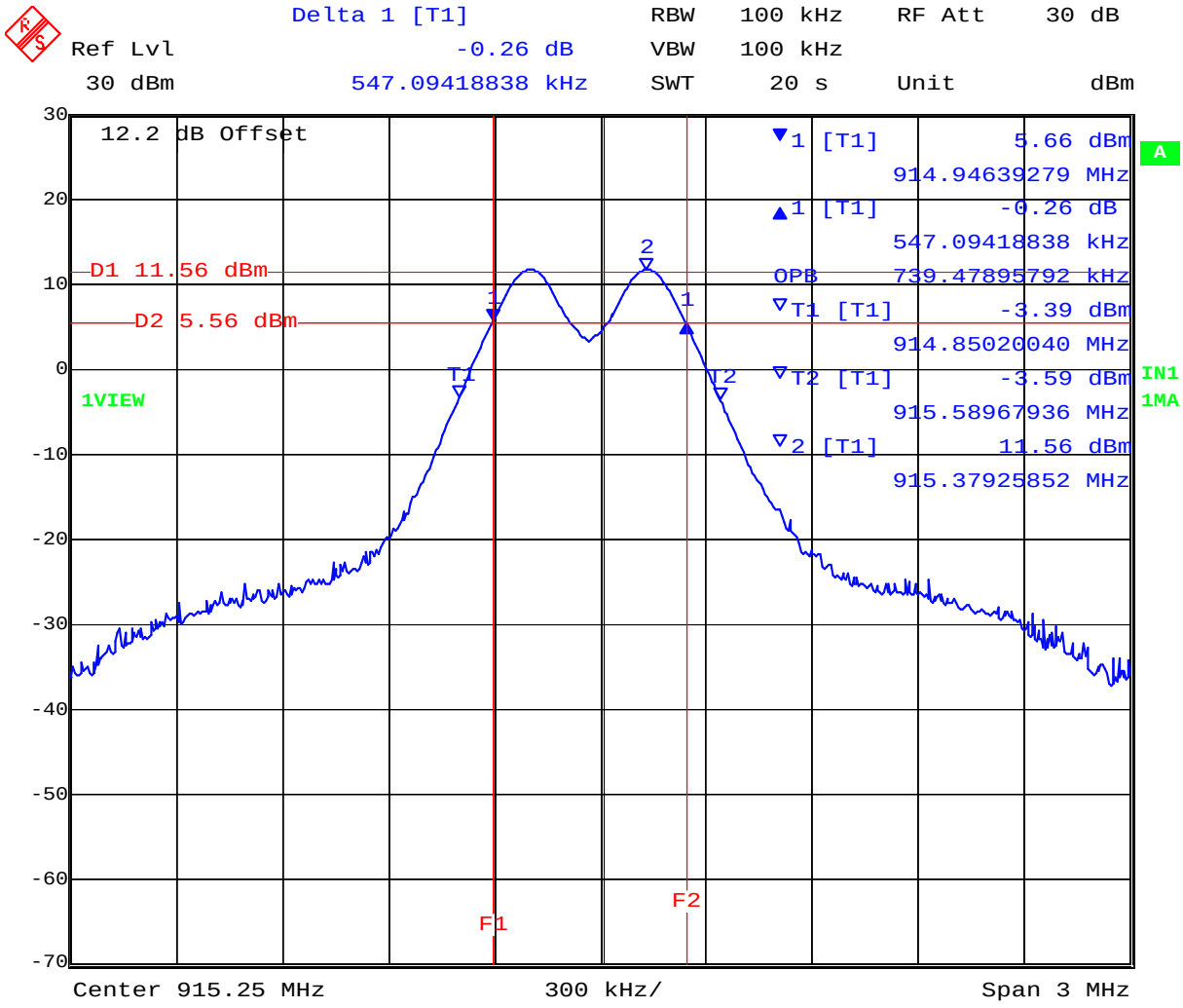
TABLE OF RESULTS – **READER**

| Center Frequency (MHz) | 6 dB Bandwidth (MHz) | 99 % BW (MHz) |
|---|---|---|
| 902.75 | 0.5471 | 0.7395 |
| 915.25 | 0.5471 | 0.7395 |
| 927.25 | 0.5411 | 0.7455 |

**READER 902.75 MHz 6 dB and 99% Bandwidth**



## READER 915.25 MHz 6 dB and 99% Bandwidth



## READER 927.25 MHz 6 dB and 99% Bandwidth

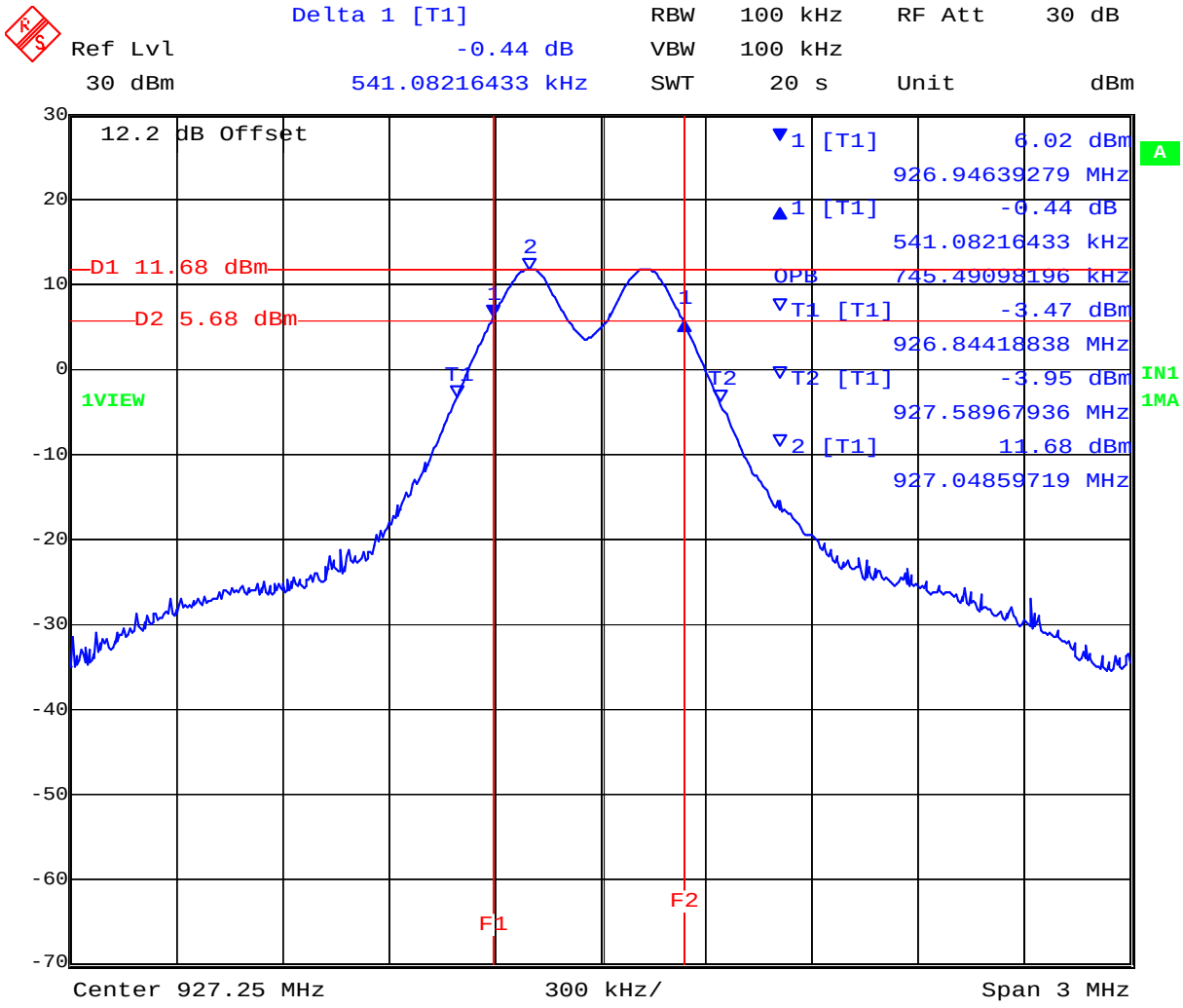
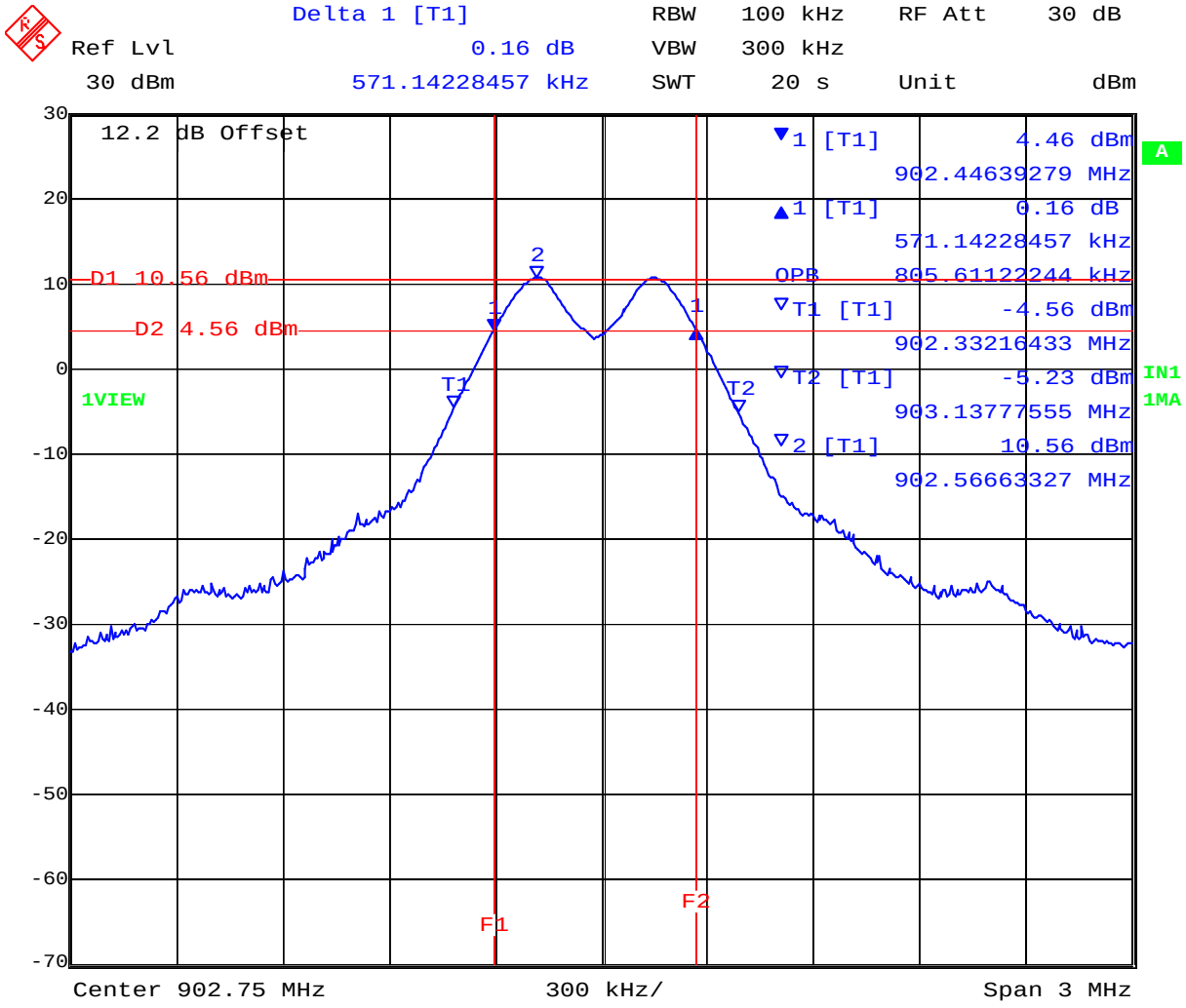


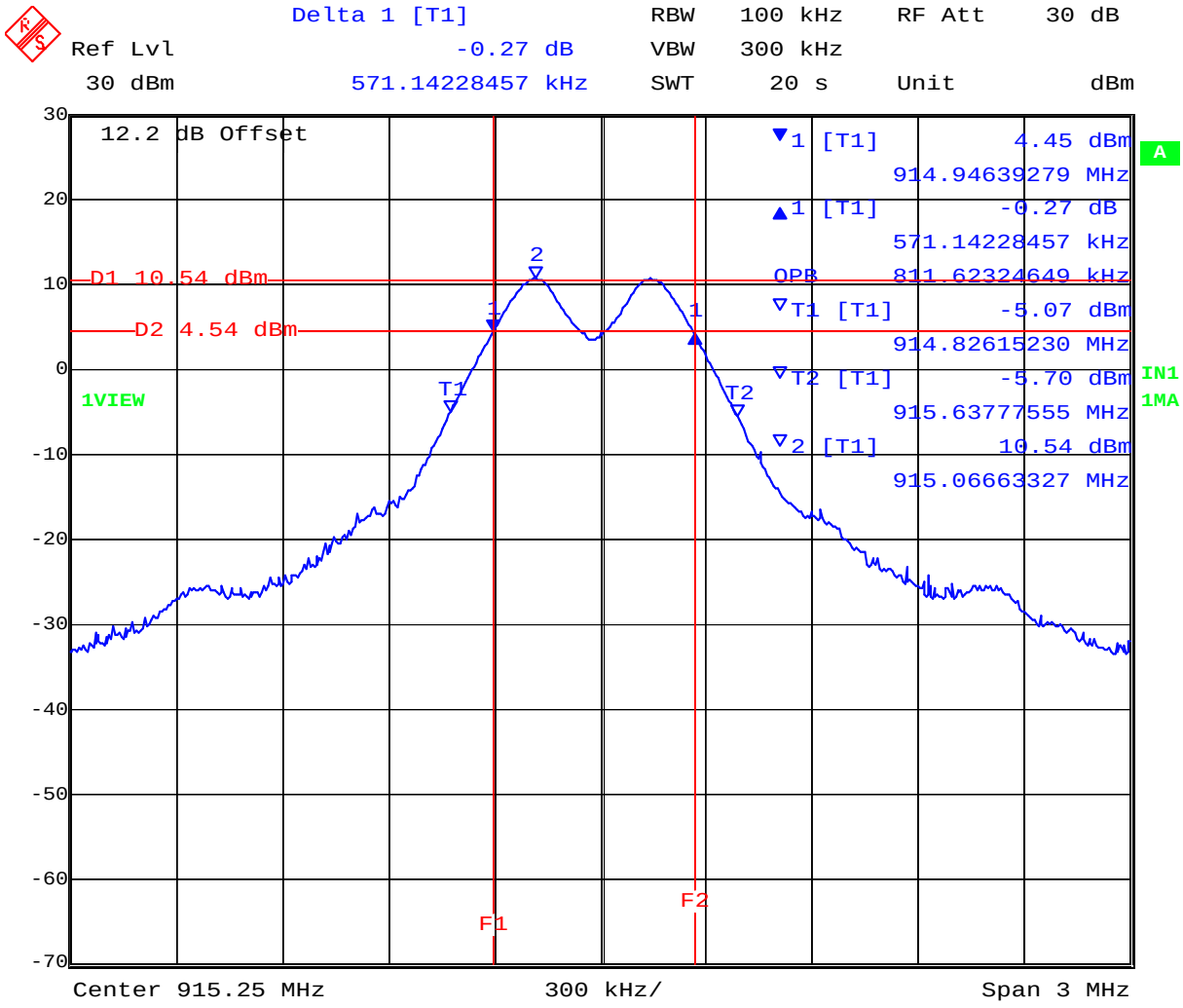
TABLE OF RESULTS – **LABEL**

| Center Frequency (MHz) | 6 dB Bandwidth (MHz) | 99 % BW (MHz) |
|---|---|---|
| 902.75 | 0.5711 | 0.8056 |
| 915.25 | 0.5711 | 0.8116 |
| 927.25 | 0.5771 | 0.8056 |

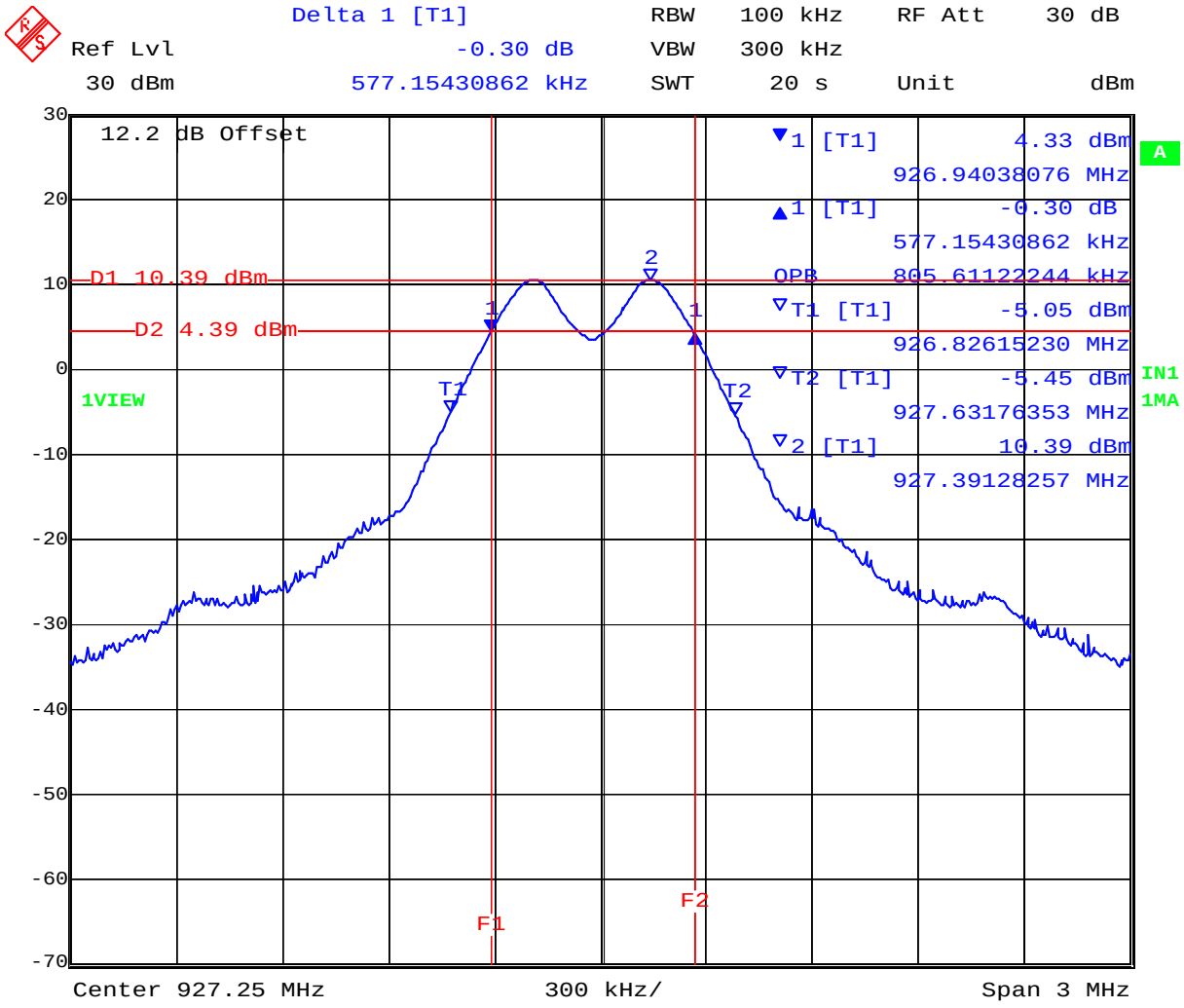
**LABEL 902.75 MHz 6 dB and 99% Bandwidth**



## LABEL 915.25 MHz 6 dB and 99% Bandwidth



## LABEL 927.25 MHz 6 dB and 99% Bandwidth



## 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

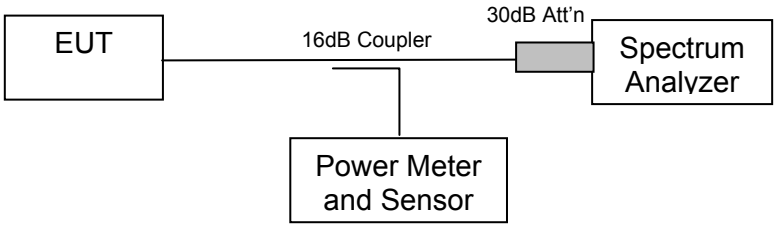
| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask' | 0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117 |

### 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 Peak output power was measured using an average power meter.

**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

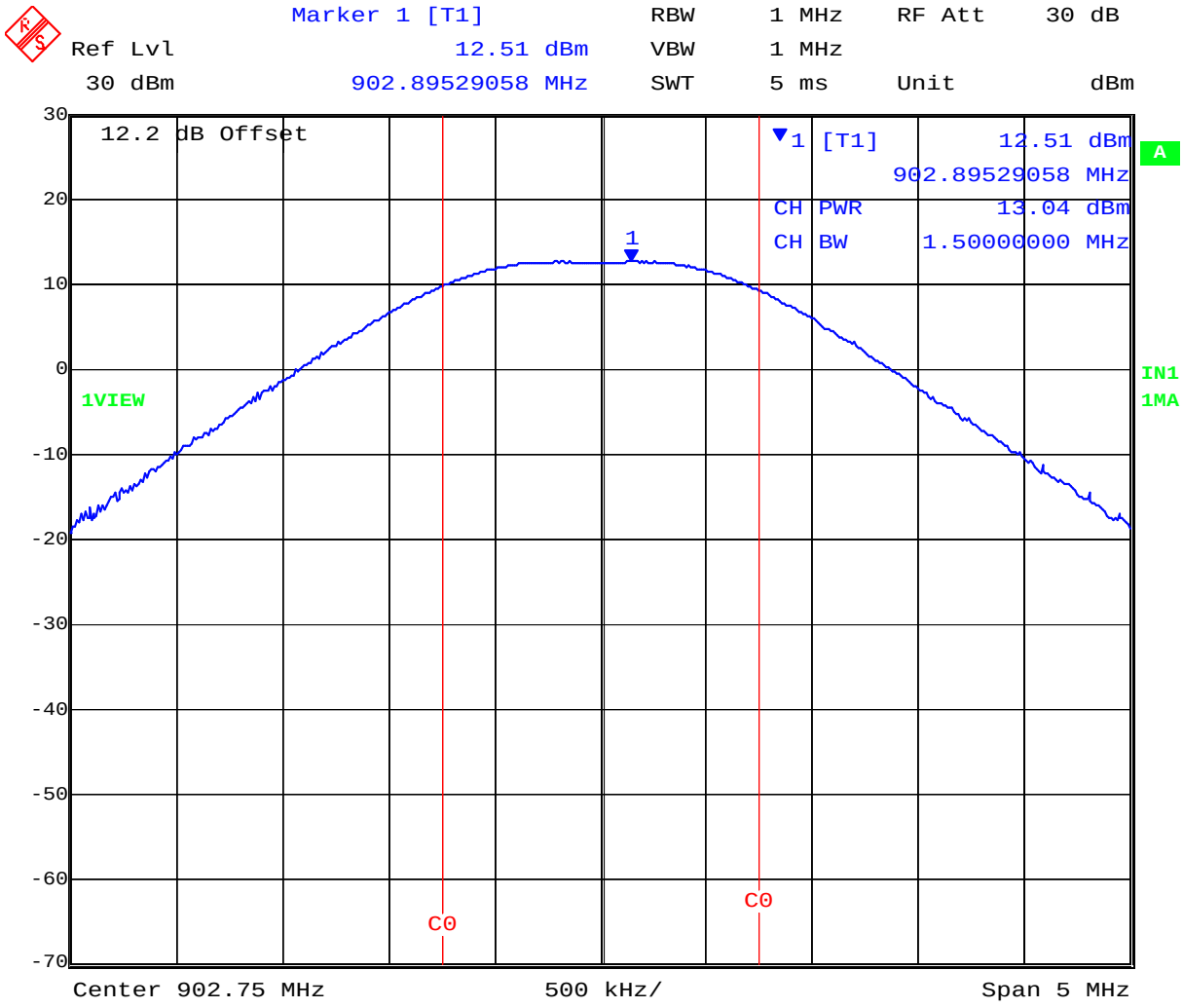
Printed Circuit Antenna Gain = +0 dBi

TABLE OF RESULTS – **Reader**

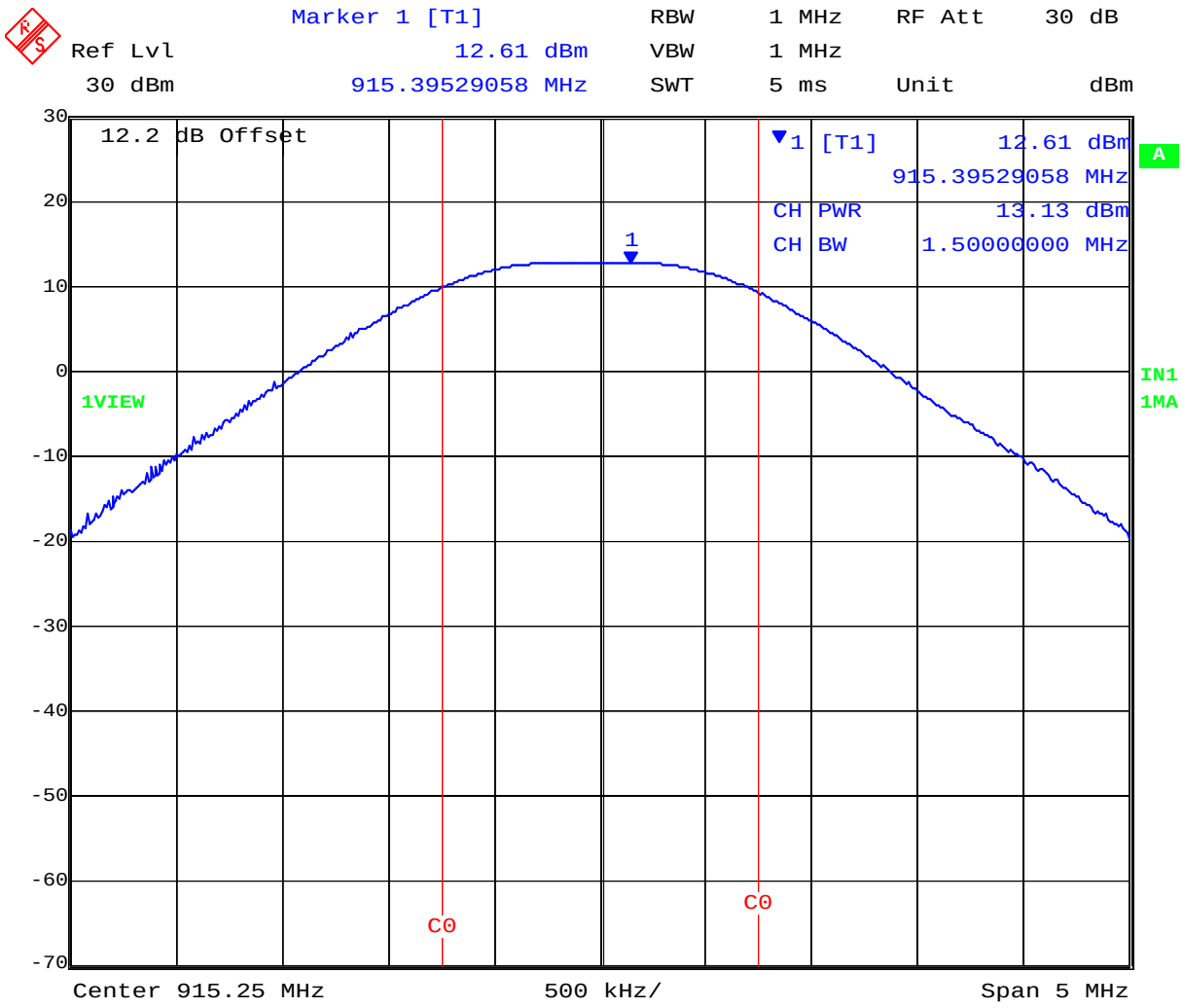
As a result of non-compliance issues, see Section 3.7 Equipment Modifications power was reduced to the following;

| Center Frequency (MHz) | Peak Power (dBm) | Peak Power EIRP (dBm) |
|---|---|---|
| 902.75 | +4.17 | +4.17 |
| 915.25 | +4.29 | +4.29 |
| 927.25 | +4.36 | +4.36 |

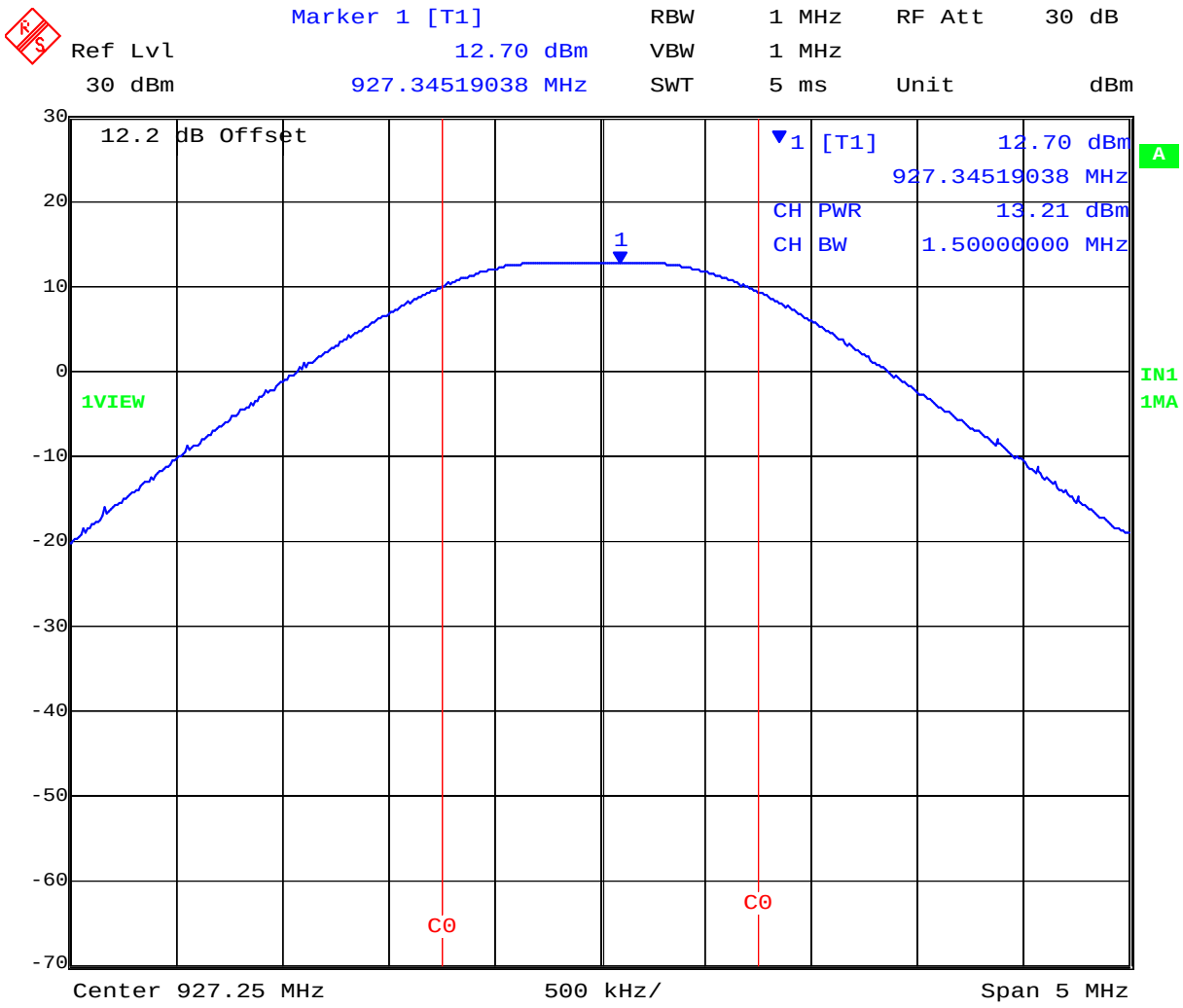
## READER 902.75 MHz Peak Power



## READER 915.25 MHz Peak Power



## READER 927.25 MHz Peak Power



## 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.

**§15.31 (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 |

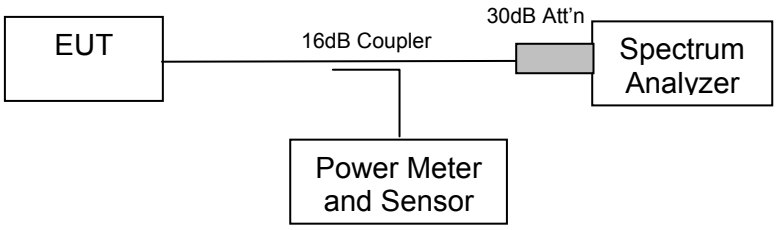
### 5.1.3. Peak Power Spectral Density

**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

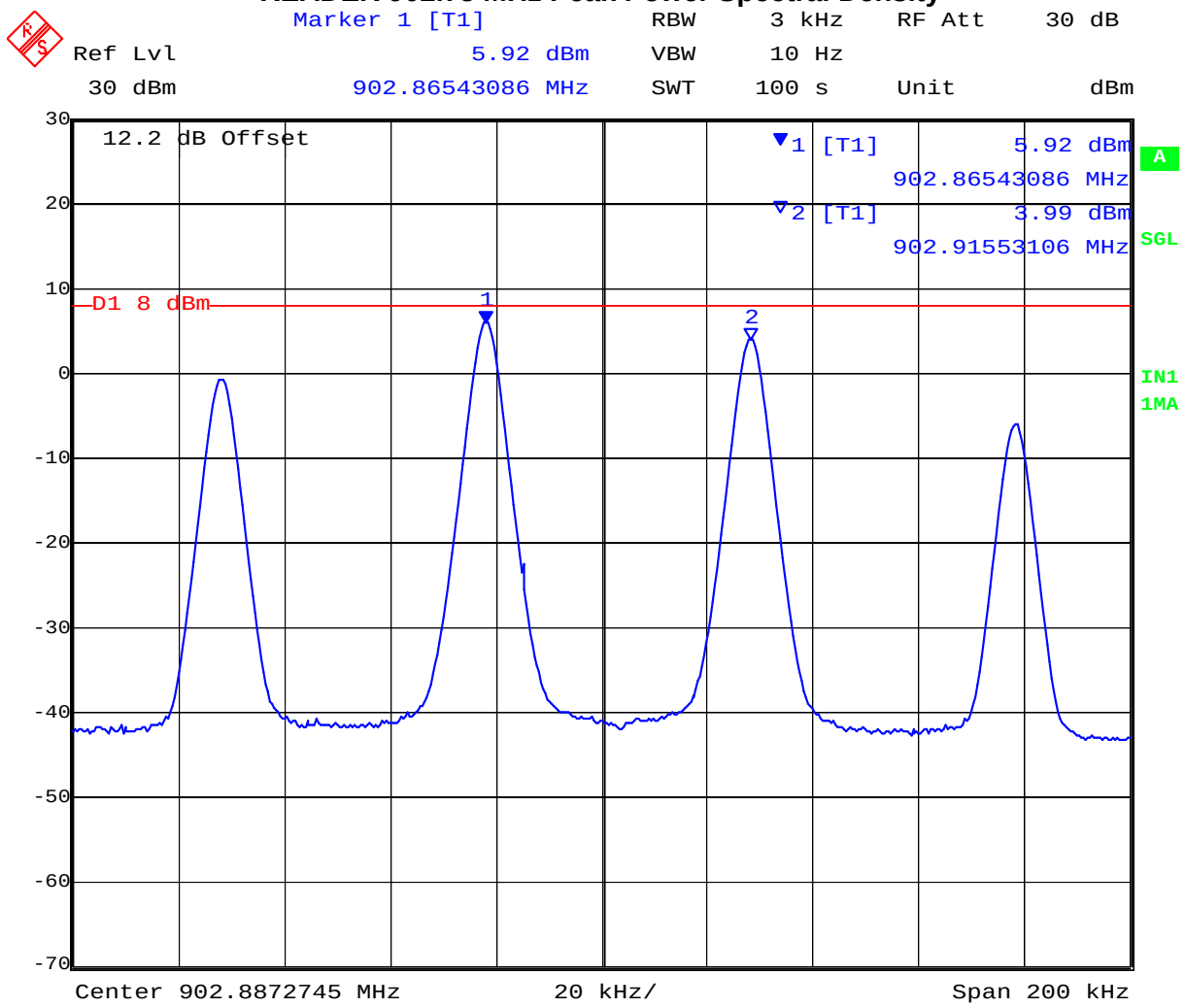
**Measurement Results for Peak Power Spectral Density**

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

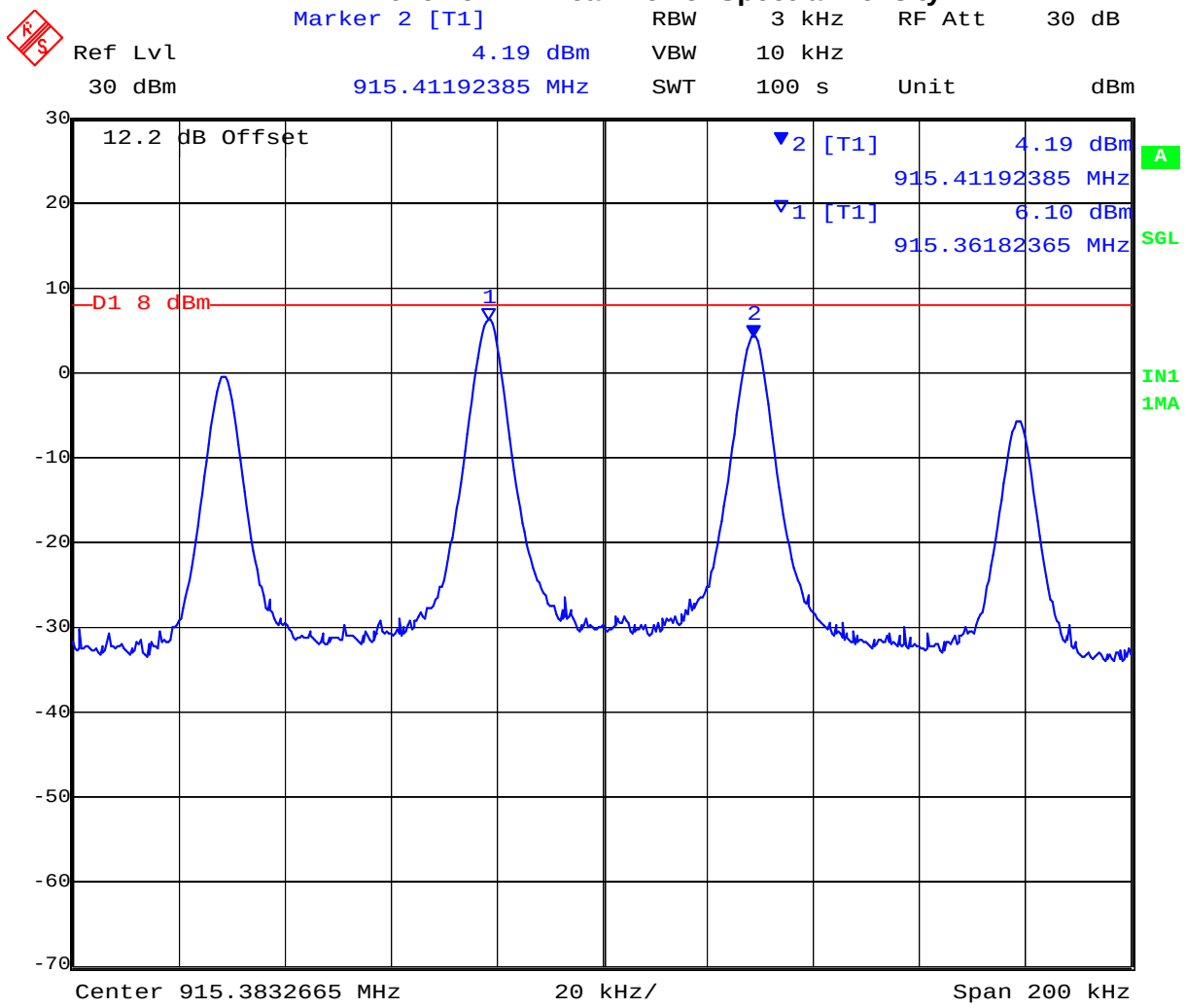
TABLE OF RESULTS – **READER**

| Center Frequency (MHz) | Peak Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Margin (dBm) |
|---|---|---|---|---|
| 902.75 | 902.86543086 | +5.92 | +8 | -2.08 |
| 915.25 | 915.36182365 | +6.10 | +8 | -1.90 |
| 927.25 | 927.05881764 | +6.26 | +8 | -1.74 |

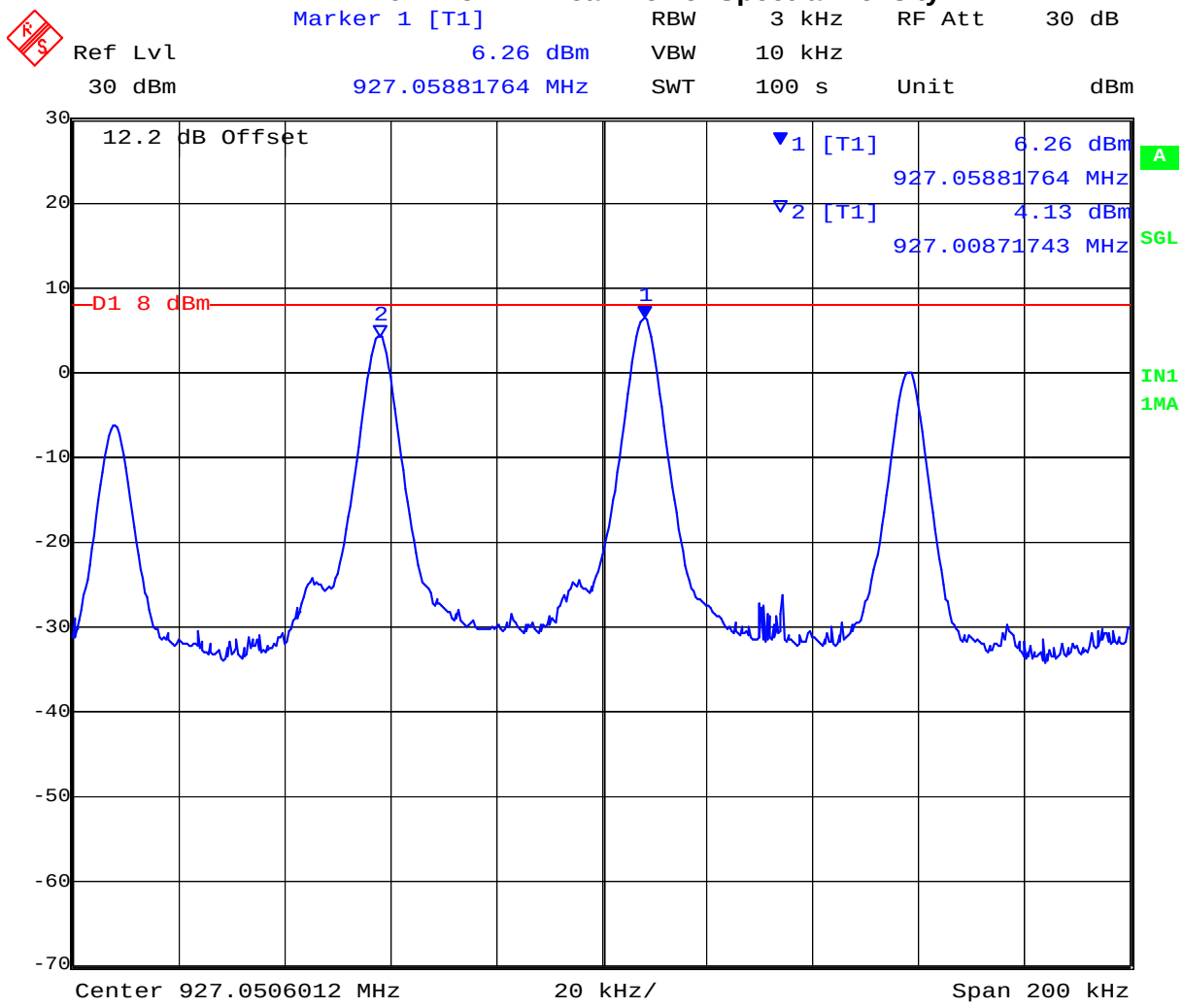
**READER 902.75 MHz Peak Power Spectral Density**



## READER 915.25 MHz Peak Power Spectral Density



## READER 927.25 MHz 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<br><br>**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 ($mW/cm^2$) = $EIRP/(4\pi d^2)$

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/cm² Limit(cm) | Minimum Separation Distance (cm) |
|---|---|---|---|---|---|---|
| 0.915 | 0.0 | 1.0 | +4.36 | 2.73 | 0.47 | 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 |

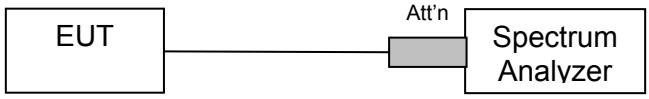
### 5.1.5. Conducted Spurious Emissions

**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

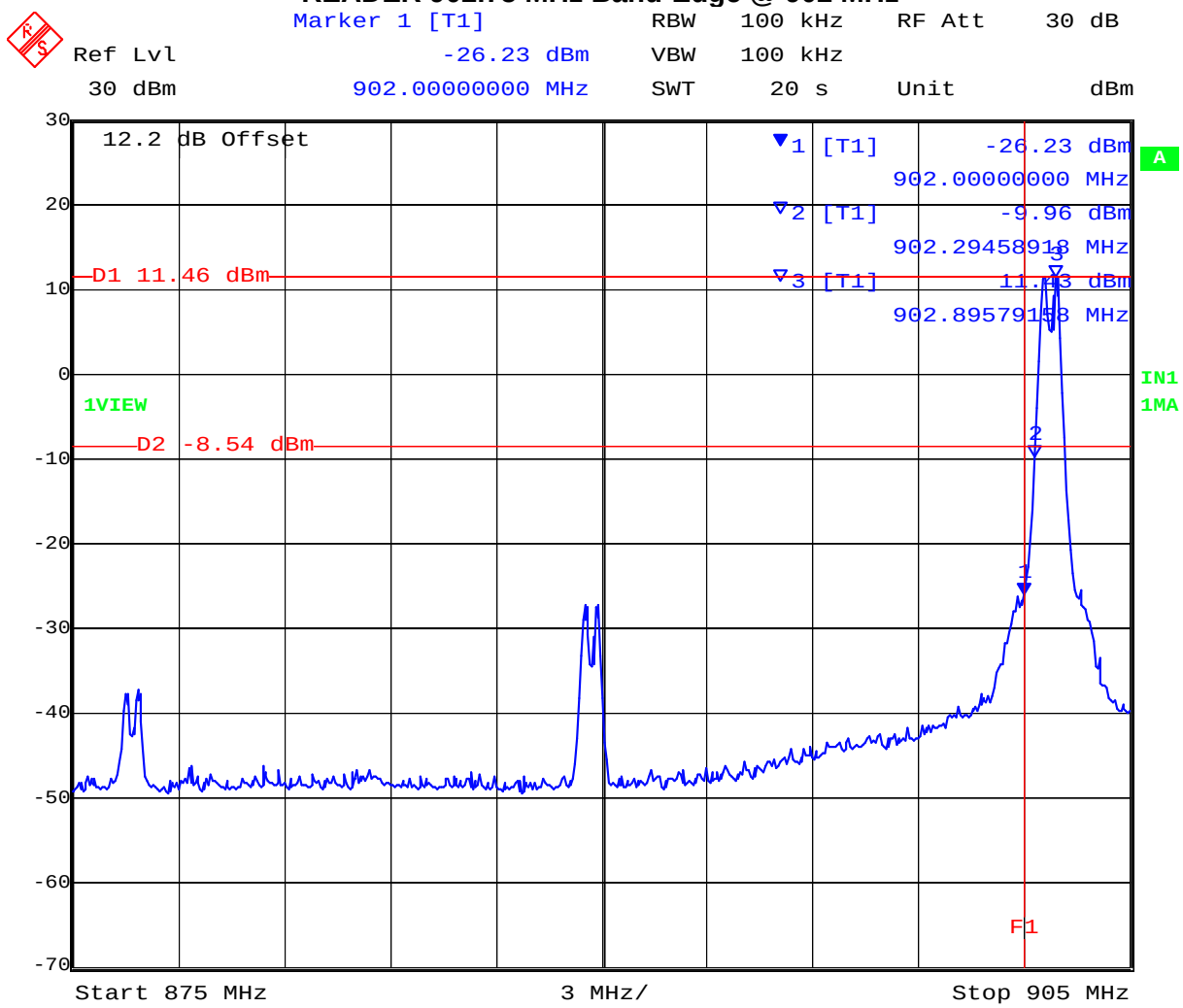
## Conducted Band-Edge Results

Measurements were performed with the transmitter tuned to the channel closest to the band-edge being measured. All emissions were maximized during measurement.

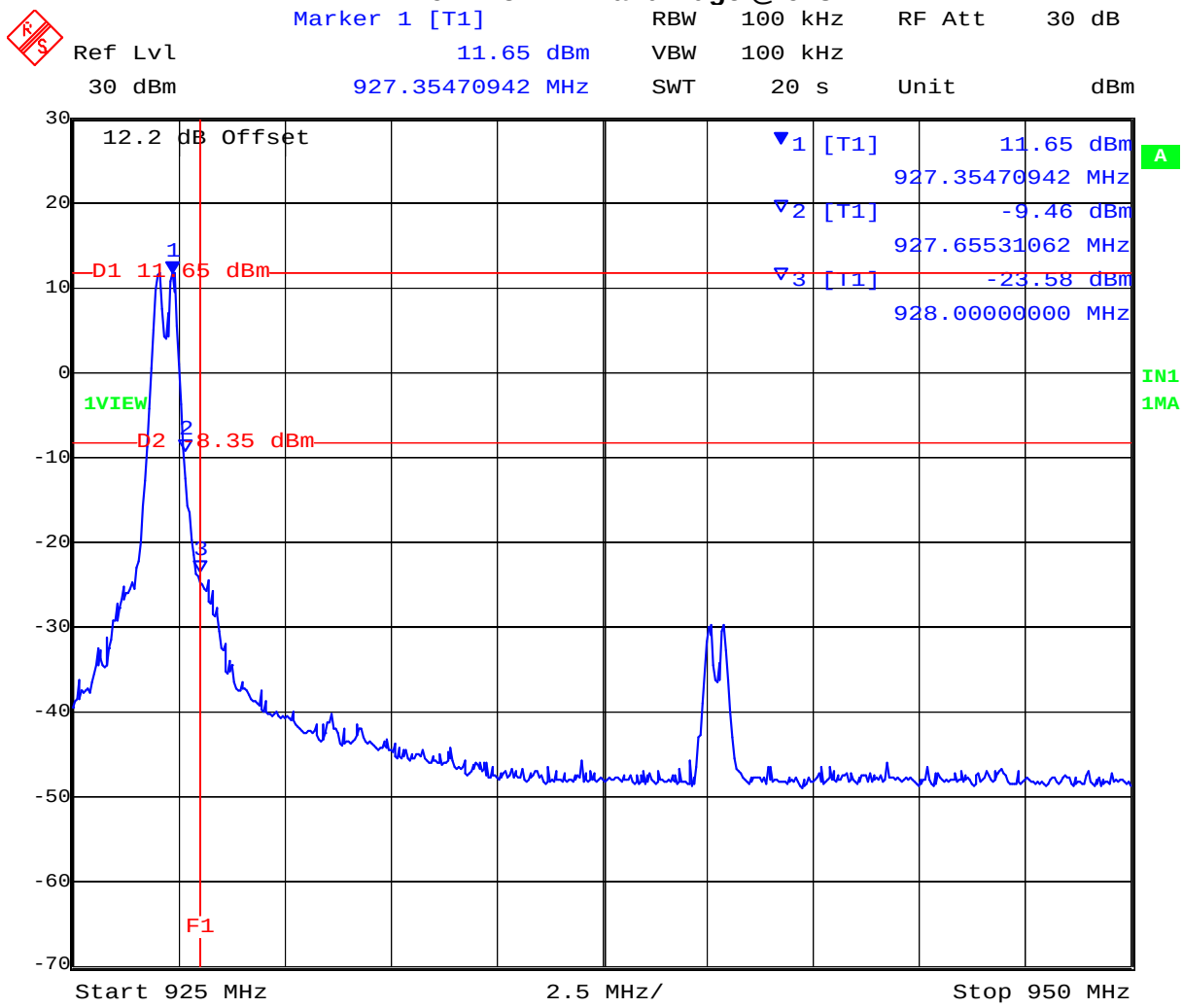
TABLE OF RESULTS – **READER**

| Center Frequency (MHz) | Band edge Frequency (MHz) | Limit (20 dB below peak of fundamental) | Amplitude @ Band edge (dBm) | Margin (dB) |
|---|---|---|---|---|
| 902.75 | 902.0 | -8.54 | -26.23 | -17.69 |
| 927.25 | 928.0 | -8.35 | -23.58 | -15.23 |

**READER 902.75 MHz Band-Edge @ 902 MHz**



## READER 927.25 MHz Band-Edge @ 928 MHz



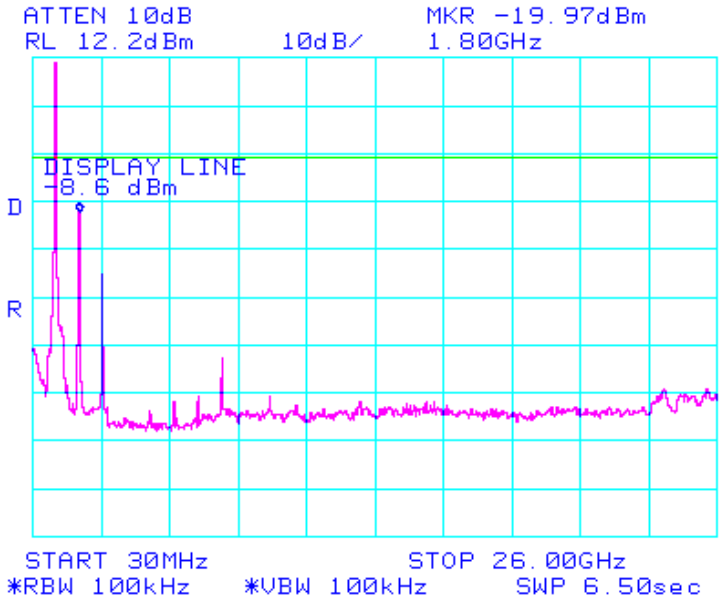
## Spurious Emissions (30 - 26,000 MHz)

TABLE OF RESULTS – **Reader**

| Channel Centre Frequency (MHz) | Start Frequency (MHz) | Stop Frequency (MHz) | Maximum Emission Observed (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| 902.75 | 30 | 26,000 | -19.97 | -8.6 | -11.37 |

**Reader**

**902.75 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz**




The Peak Emission breaking the limit line is the fundamental.

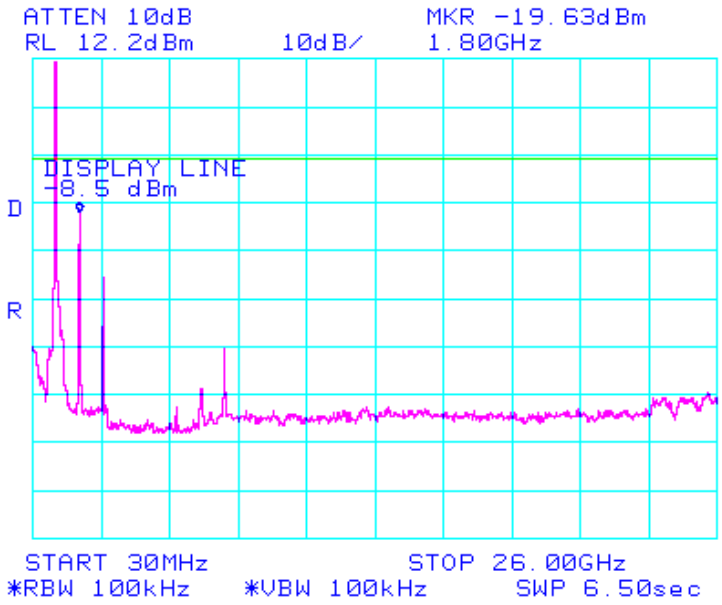
## Spurious Emissions (30 - 26,000 MHz)

TABLE OF RESULTS – **Reader**

| Channel Centre Frequency (MHz) | Start Frequency (MHz) | Stop Frequency (MHz) | Maximum Emission Observed (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| 915.25 | 30 | 26,000 | -19.63 | -8.5 | -11.13 |

**Reader**

**915.25 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz**




The Peak Emission breaking the limit line is the fundamental.

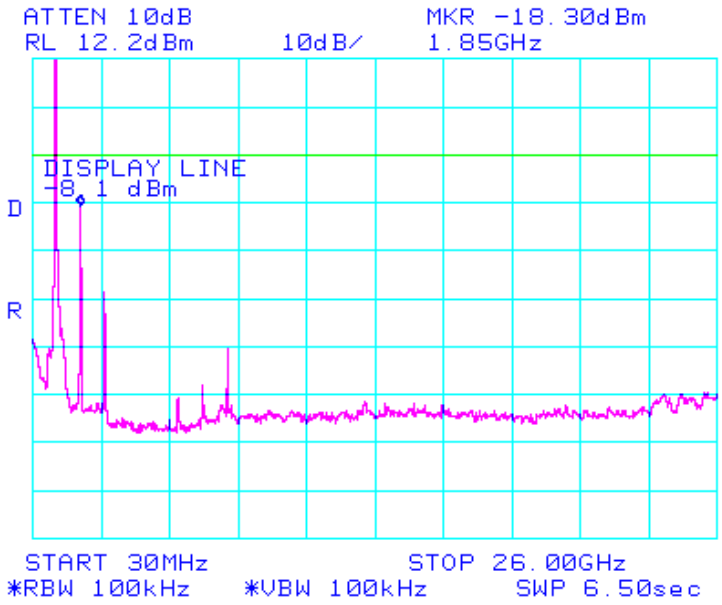
## Spurious Emissions (30 - 26,000 MHz)

TABLE OF RESULTS – **Reader**

| Channel Centre Frequency (MHz) | Start Frequency (MHz) | Stop Frequency (MHz) | Maximum Emission Observed (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| 927.25 | 30 | 26,000 | -18.30 | -8.1 | -10.20 |

**Reader**

**927.25 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz**




The Peak Emission breaking the limit line is the fundamental.

## Specification

### Limits Band-Edge

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

**§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 5$^{th}$ 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' | 0287, 0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117. |

## 5.1.6. Radiated Emissions

### 5.1.6.1. Transmitter Spurious Emissions

**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**

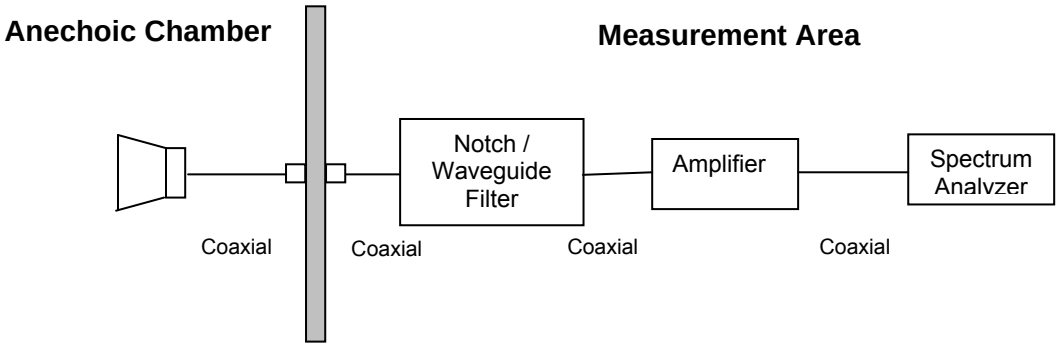
**Test Procedure**

Radiated emissions above and below 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 below 1 GHz are based on the use of measurement instrumentation employing a quasi-peak detector. Peak emissions measurements below 1 GHz were performed using a minimum resolution bandwidth of 100 kHz.

All measurements on any frequency or frequencies over 1 GHz 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

Maximizing Emissions
It was found that the Reader and Label lying flat on the polystyrene table in the Radiated Emissions chamber was the worst case orientation for emissions.

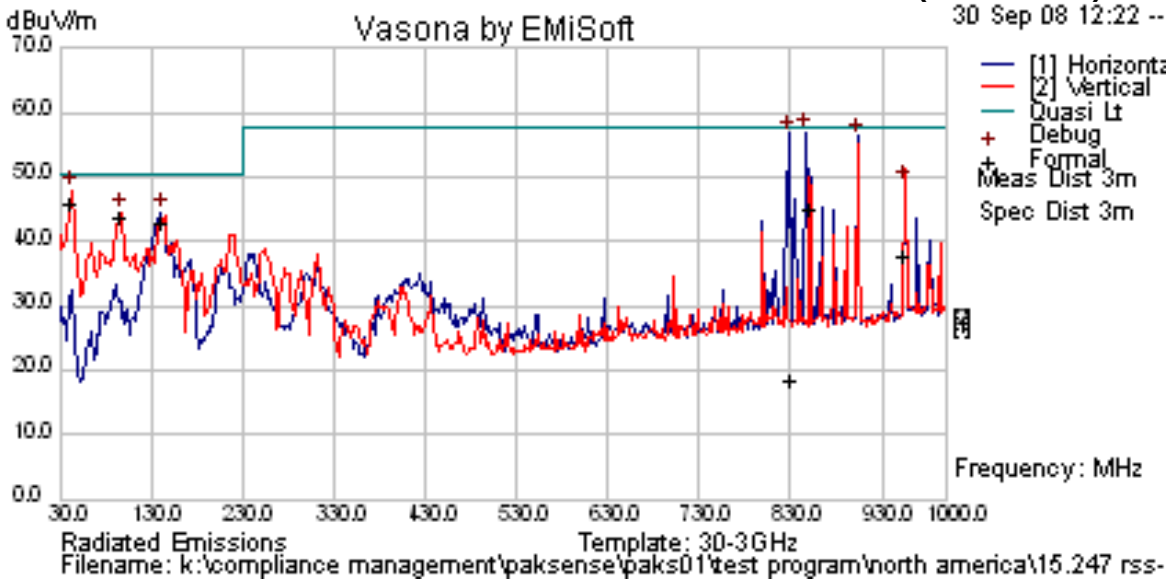
Radio Setting
Power Setting: +2 dBm (Reader + Label)

## Results for Channel 902.75 MHz

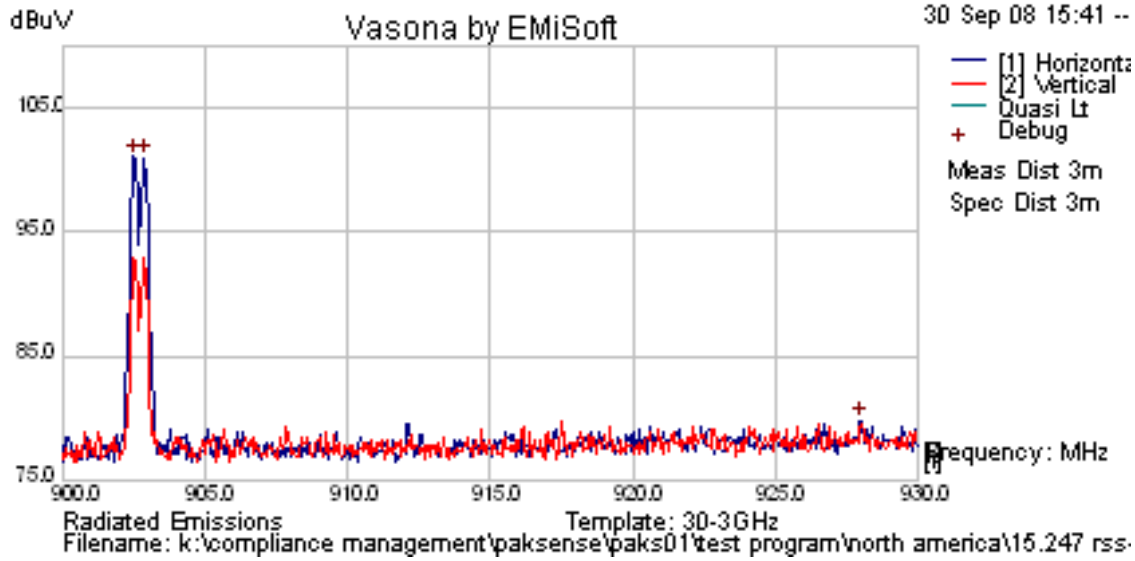
| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 902.525 | 61.16 | 17.32 | 22.7 | 101.18 | Peak Emission | H | | | | | N/A | Peak |
| 850.86 | 58.85 | 7.17 | -20.85 | 45.17 | Quasi Max | H | 101 | 327 | 57.5 | -12.33 | Pass | |
| 829.637 | 32.18 | 7.17 | -20.84 | 18.52 | Quasi Max | H | 182 | 136 | 57.5 | -38.98 | Pass | |
| 42.64 | 67.55 | 3.6 | -25.33 | 45.83 | Quasi Max | V | 152 | 20 | 50.5 | -4.67 | Pass | |
| 141.086 | 67.49 | 4.43 | -29.02 | 42.89 | Quasi Max | V | 234 | 204 | 50.5 | -7.61 | Pass | |
| 96.235 | 71.66 | 4.12 | -32.17 | 43.61 | Quasi Max | V | 124 | 296 | 50.5 | -6.89 | Pass | |
| 954.851 | 50.08 | 7.55 | -19.66 | 37.97 | Quasi Max | H | 287 | 92 | 57.5 | -19.53 | Pass | |
| 1805.611 | 77.36 | 9.74 | -13.65 | 73.44 | Peak [Scan] | H | 100 | 0 | 81.18 | -7.74 | Pass | NRB |
| 5415.304 | 55.76 | 4.62 | -8.43 | 51.95 | Average Max | H | 110 | 282 | 54 | -2.05 | Pass | RB |
| 5415.304 | 71.23 | 4.62 | -8.43 | 67.42 | Peak Max | H | 110 | 282 | 74 | -6.58 | Pass | RB |
| 9025.333 | 30.42 | 6.21 | 0.03 | 36.66 | Average Max | H | 139 | 98 | 54 | -17.34 | Pass | RB |
| 3610.385 | 41.29 | 3.67 | -11.09 | 33.87 | Average Max | H | 120 | 118 | 54 | -20.13 | Pass | RB |
| 9025.333 | 46.42 | 6.21 | 0.03 | 52.66 | Peak Max | H | 139 | 98 | 74 | -21.34 | Pass | RB |
| 2707.63 | 60.43 | 3.17 | -10.94 | 52.65 | Peak Max | H | 117 | 20 | 74 | -21.35 | Pass | RB |

Peak – Peak Emission
RB – Restricted band emission
NRB – Non-restricted band emission

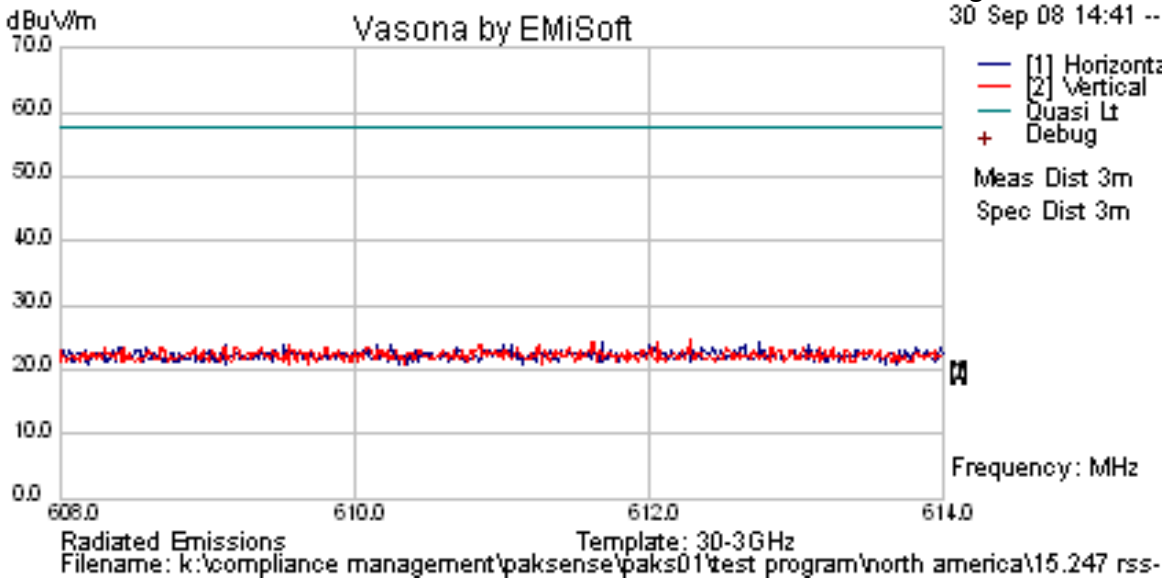
### 902.75 MHz Reader + Label Radiated Emissions below 1 GHz (0.03 - 1 GHz)



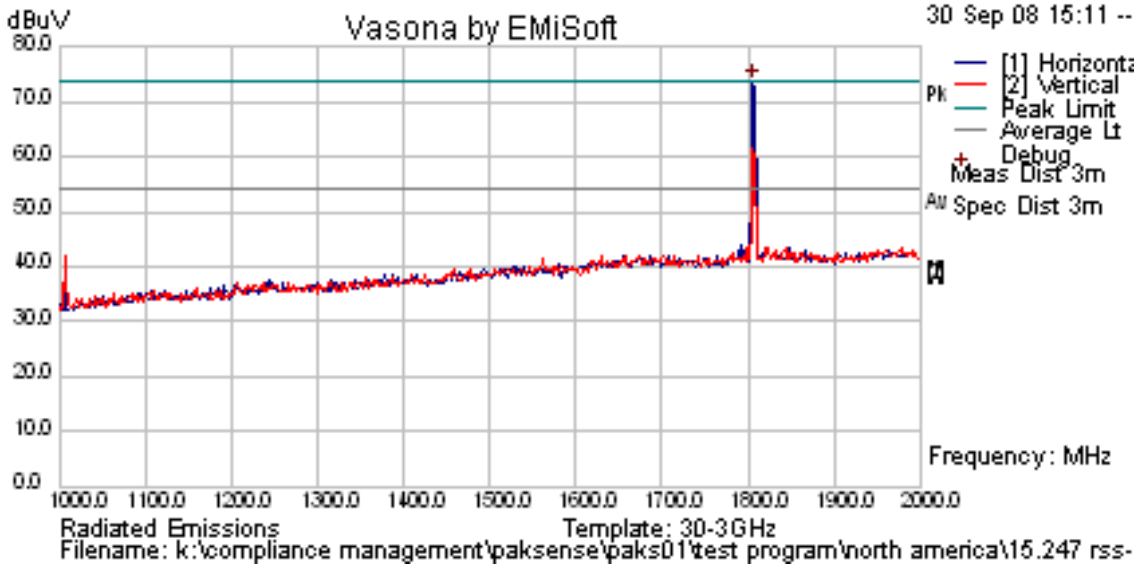
**902.75 MHz Reader + Label Radiated Emissions - Peak Emission**



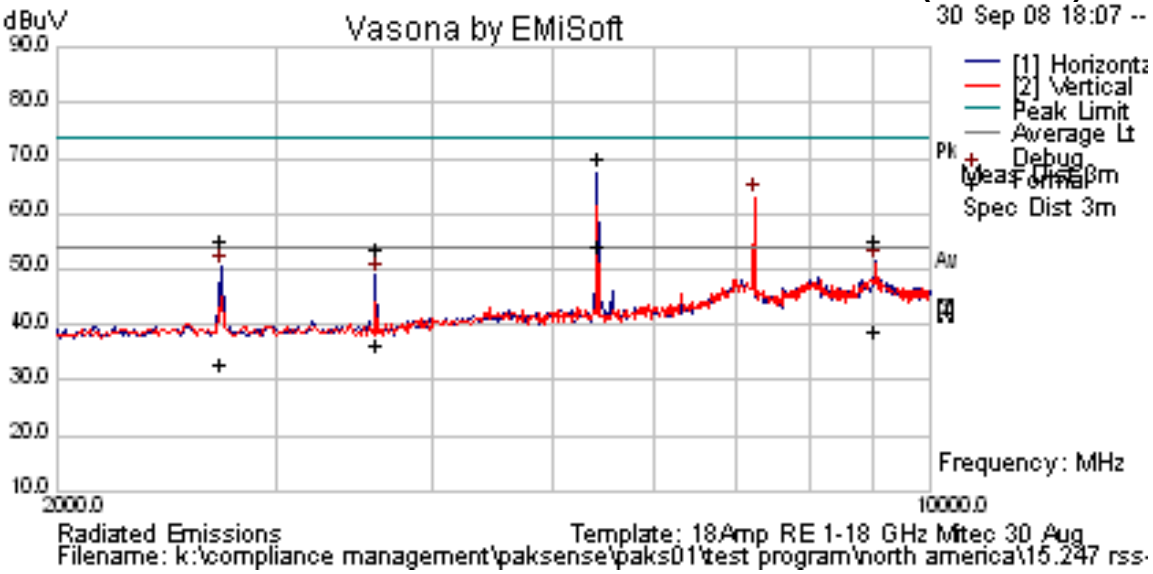

**902.75 MHz Reader + Label Radiated Emissions - Band-Edge**



**902.75 MHz Reader + Label Radiated Emissions Above 1 GHz (1 – 2 GHz)**




**902.75 MHz Reader + Label Radiated Emissions Above 1 GHz (2 - 10 GHz)**

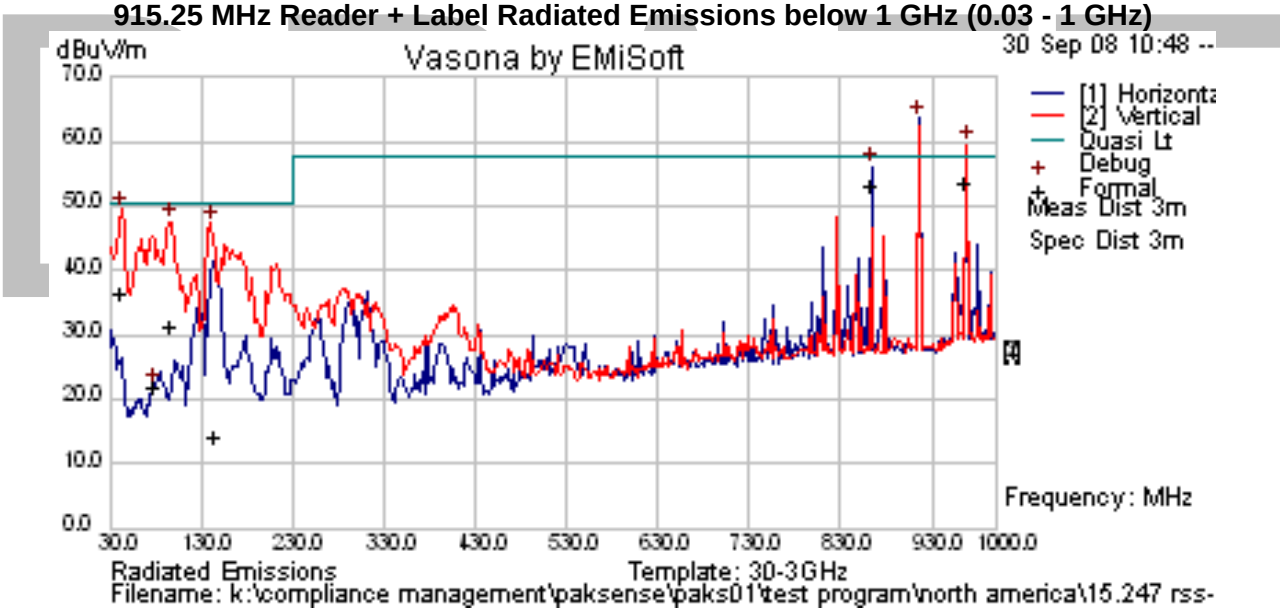


## Results for Channel 915.25 MHz

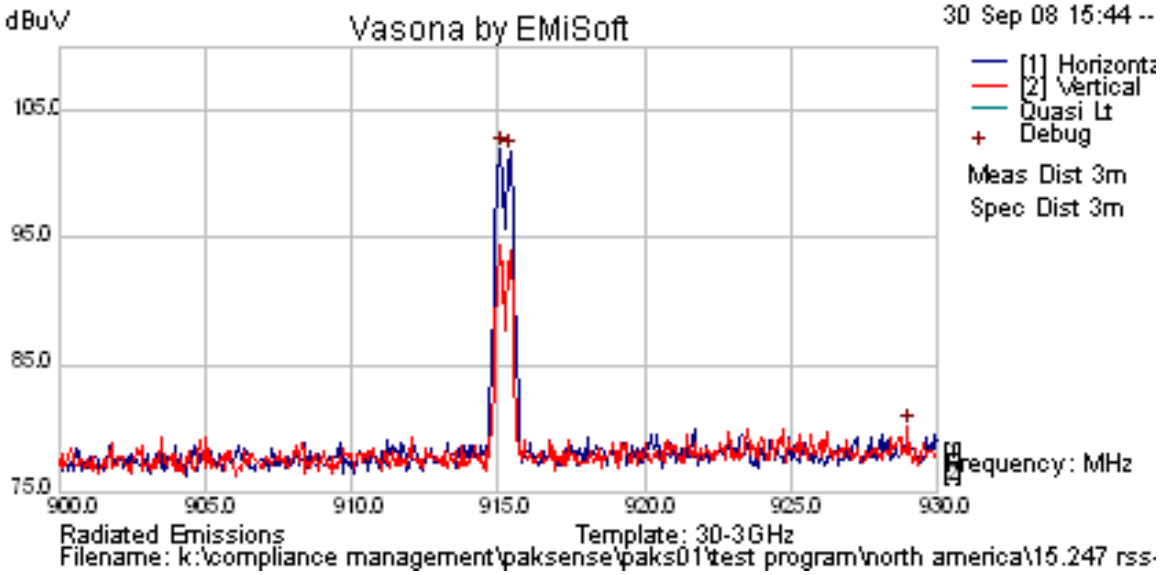
| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 915.09 | 61.74 | 17.38 | 22.9 | 102.02 | Peak [Scan] | H | | | | | N/A | Peak |
| 967.043 | 65.63 | 7.59 | -19.65 | 53.56 | Quasi Max | H | 141 | 166 | 57.5 | -3.94 | Pass | |
| 42.735 | 58.24 | 3.6 | -25.4 | 36.45 | Quasi Max | V | 152 | 230 | 50.5 | -14.05 | Pass | |
| 863.049 | 66.8 | 7.21 | -20.69 | 53.32 | Quasi Max | H | 184 | 167 | 57.5 | -4.18 | Pass | |
| 98.086 | 56.93 | 4.14 | -31.65 | 29.42 | Quasi Max | V | 127 | 229 | 50.5 | -21.08 | Pass | |
| 77.309 | 58.81 | 3.94 | -32.47 | 30.28 | Quasi Max | V | 109 | 221 | 50.5 | -20.22 | Pass | |
| 145.211 | 59.99 | 4.45 | -29.38 | 35.06 | Quasi Max | V | 182 | 186 | 50.5 | -15.44 | Pass | |
| 1831.663 | 76.3 | 9.81 | -13.48 | 72.64 | Peak [Scan] | H | 100 | 0 | 82.02 | -9.38 | Pass | NRB |
| 7320.325 | 62.38 | 5.44 | -2.88 | 64.94 | Peak Max | V | 98 | 198 | 74 | -9.06 | Pass | RB |
| 9150.539 | 51.82 | 6.22 | -0.25 | 57.79 | Peak Max | V | 114 | 252 | 74 | -16.21 | Pass | RB |
| 3661.413 | 60.57 | 3.7 | -10.9 | 53.37 | Peak Max | H | 98 | 178 | 74 | -20.63 | Pass | RB |
| 2745.14 | 61.4 | 3.19 | -11.01 | 53.59 | Peak Max | H | 98 | 29 | 74 | -20.41 | Pass | RB |
| 7320.325 | 27.11 | 5.44 | -2.88 | 29.67 | Average Max | V | 98 | 198 | 54 | -24.33 | Pass | RB |
| 9150.539 | 25.43 | 6.22 | -0.25 | 31.4 | Average Max | V | 114 | 252 | 54 | -22.6 | Pass | RB |

Peak – Peak Emission
RB – Restricted band emission
NRB – Non-restricted band emission

### 915.25 MHz Reader + Label Radiated Emissions below 1 GHz (0.03 - 1 GHz)

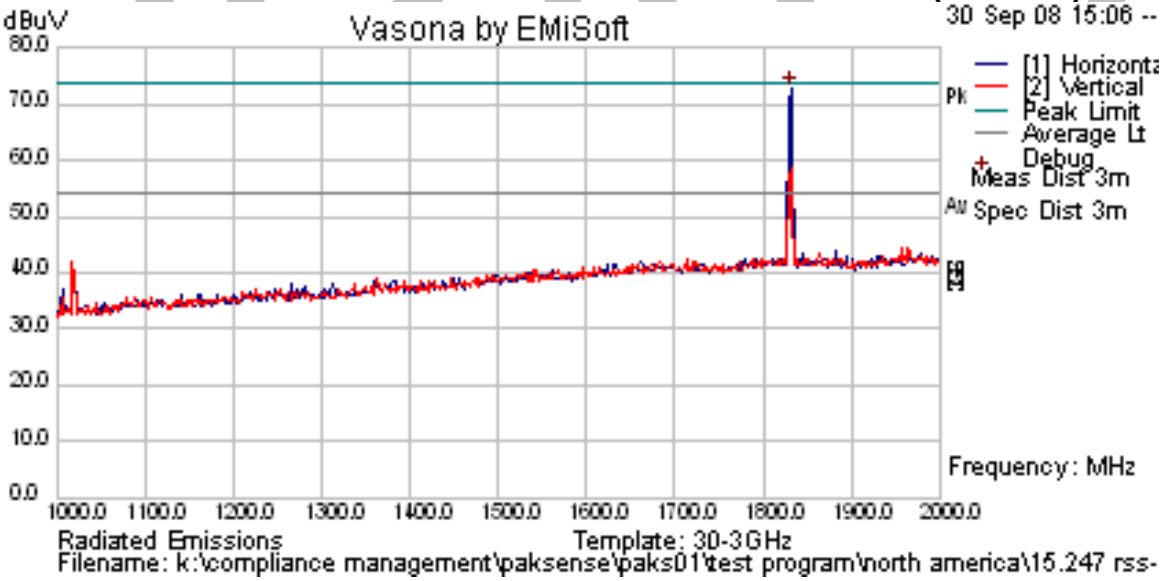


**915.25 MHz Reader + Label Radiated Emissions - Peak Emission**

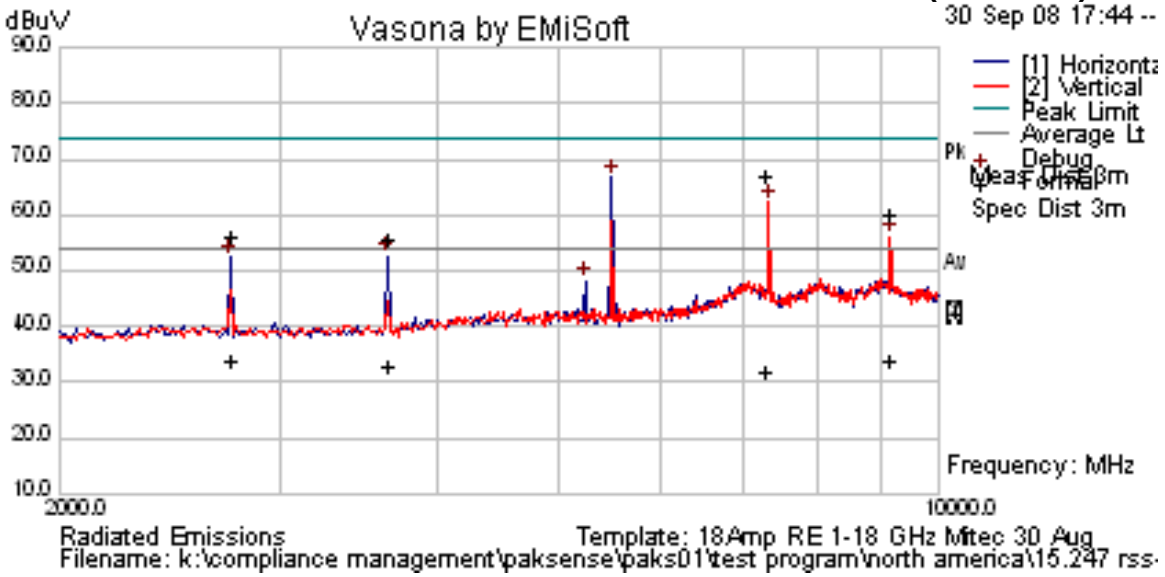





**915.25 MHz Reader + Label Radiated Emissions Above 1 GHz (1 – 2 GHz)**



**915.25 MHz Reader + Label Radiated Emissions Above 1 GHz (2 - 10 GHz)**



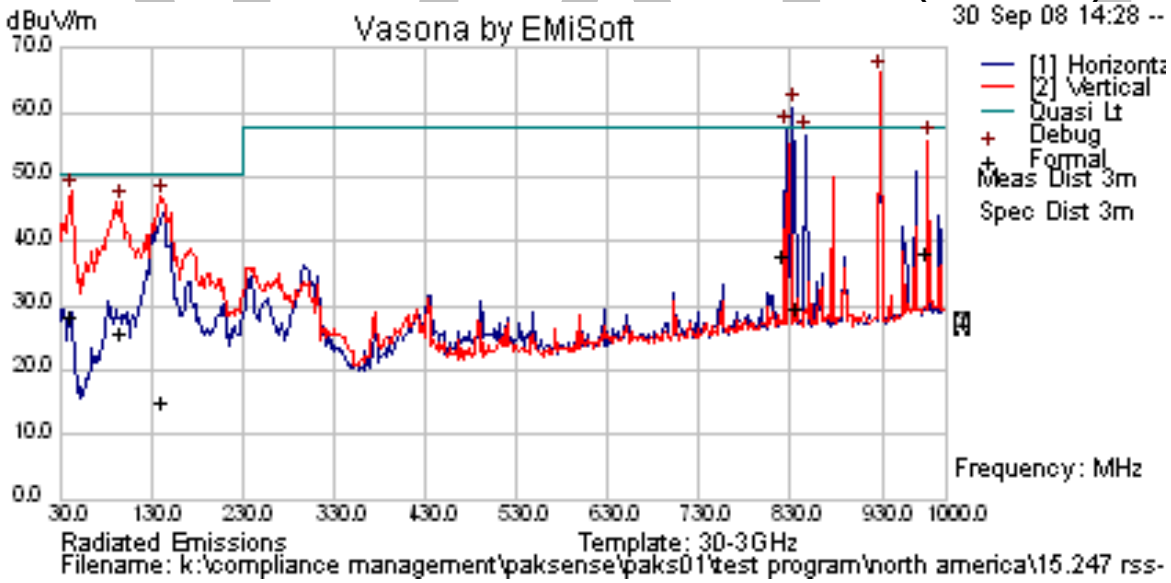
## Results for Channel 927.25 MHz

| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 927.054 | 61.75 | 17.43 | 23.1 | 102.28 | Peak [Scan] | H | | | | | N/A | Peak |
| 967.043 | 65.63 | 7.59 | -19.65 | 53.56 | Quasi Max | H | 141 | 166 | 57.5 | -3.94 | Pass | |
| 42.735 | 58.24 | 3.6 | -25.4 | 36.45 | Quasi Max | V | 152 | 230 | 50.5 | -14.05 | Pass | |
| 863.049 | 66.8 | 7.21 | -20.69 | 53.32 | Quasi Max | H | 184 | 167 | 57.5 | -4.18 | Pass | |
| 98.086 | 56.93 | 4.14 | -31.65 | 29.42 | Quasi Max | V | 127 | 229 | 50.5 | -21.08 | Pass | |
| 77.309 | 58.81 | 3.94 | -32.47 | 30.28 | Quasi Max | V | 109 | 221 | 50.5 | -20.22 | Pass | |
| 145.211 | 59.99 | 4.45 | -29.38 | 35.06 | Quasi Max | V | 182 | 186 | 50.5 | -15.44 | Pass | |
| 979.078 | 65.05 | 7.62 | -19.46 | 53.21 | Peak [Scan] | H | 100 | 0 | 57.5 | -4.29 | Pass | Band-edge |
| 1855.711 | 71.58 | 9.88 | -13.45 | 68.01 | Peak [Scan] | H | 100 | 0 | 82.28 | -14.27 | Pass | NRB |
| 7419.269 | 57.73 | 5.46 | -3.41 | 59.79 | Peak Max | H | 98 | 201 | 74 | -14.21 | Pass | RB |
| 3708.061 | 63.48 | 3.73 | -10.78 | 56.43 | Peak Max | H | 98 | 169 | 74 | -17.57 | Pass | RB |
| 2781.187 | 60.57 | 3.22 | -10.95 | 52.84 | Peak Max | H | 142 | 26 | 74 | -21.16 | Pass | RB |
| 7419.269 | 26.92 | 5.46 | -3.41 | 28.98 | Average Max | H | 98 | 201 | 54 | -25.02 | Pass | RB |
| 3708.061 | 45.02 | 3.73 | -10.78 | 37.97 | Average Max | H | 98 | 169 | 54 | -16.03 | Pass | RB |
| 2781.187 | 38.72 | 3.22 | -10.95 | 30.99 | Average Max | H | 142 | 26 | 54 | -23.01 | Pass | RB |

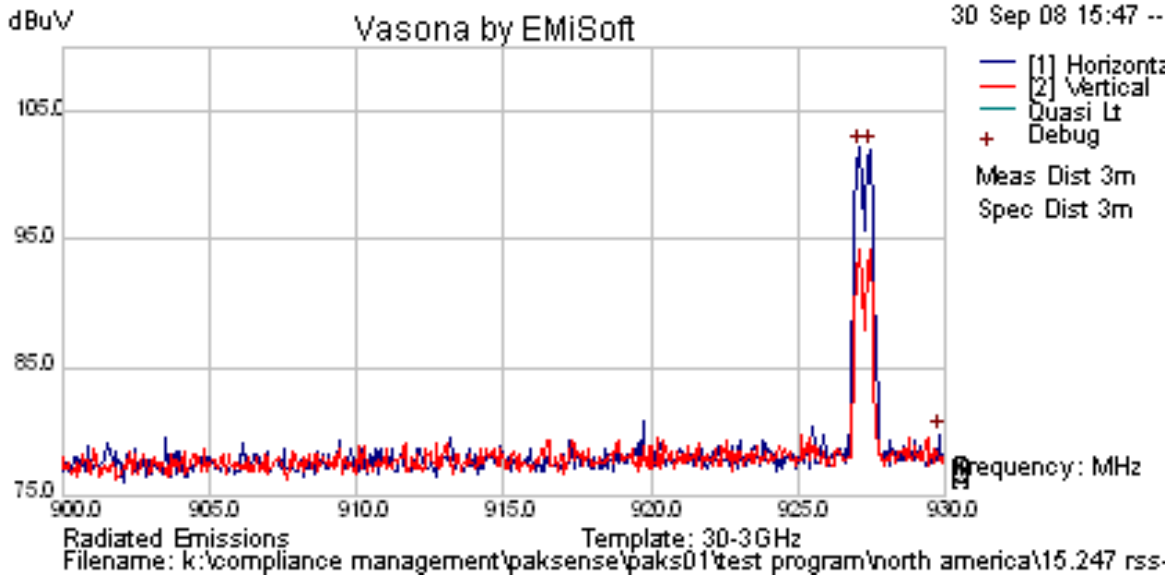
Peak – Peak Emission
RB – Restricted band emission
NRB – Non-restricted band emission
Band-edge – Restricted band-edge



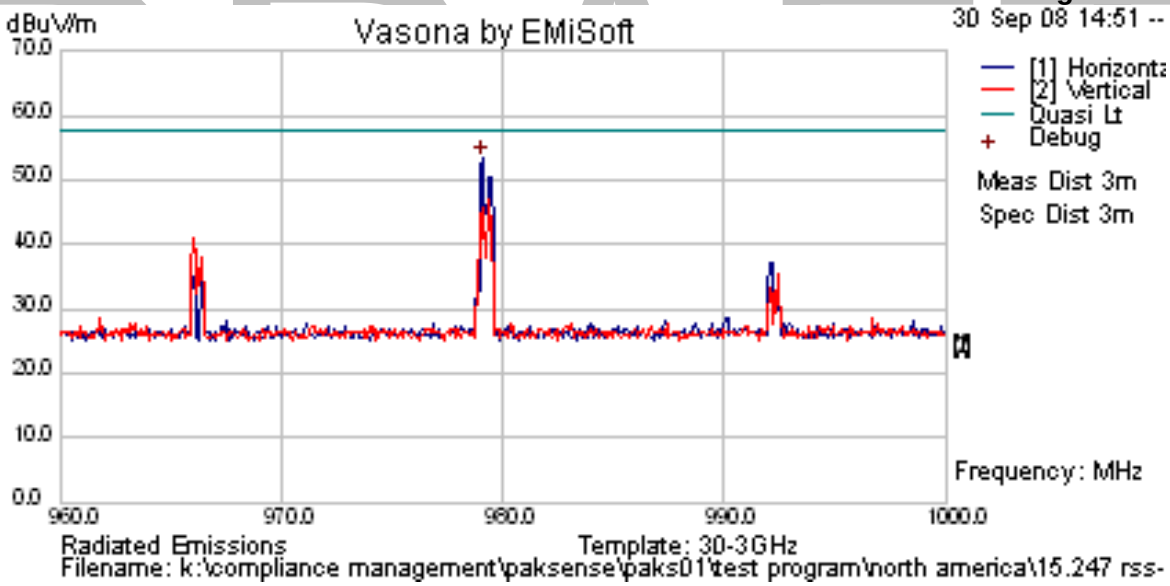
### 927.25 MHz Reader + Label Radiated Emissions below 1 GHz (0.03 - 1 GHz)



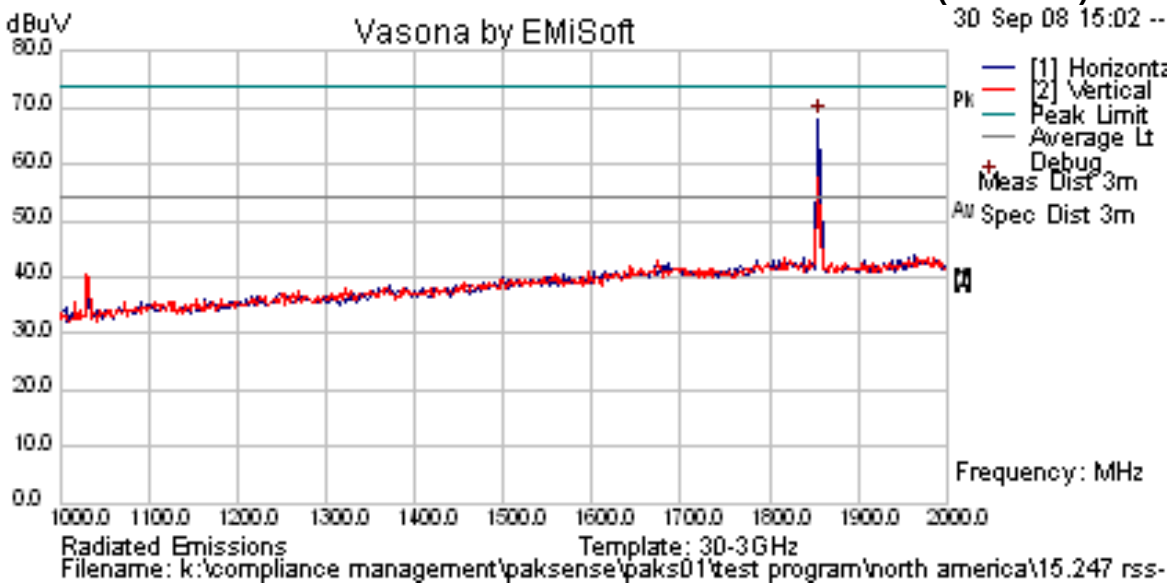
**927.25 MHz Reader + Label Radiated Emissions Above 1 GHz Peak Emission**



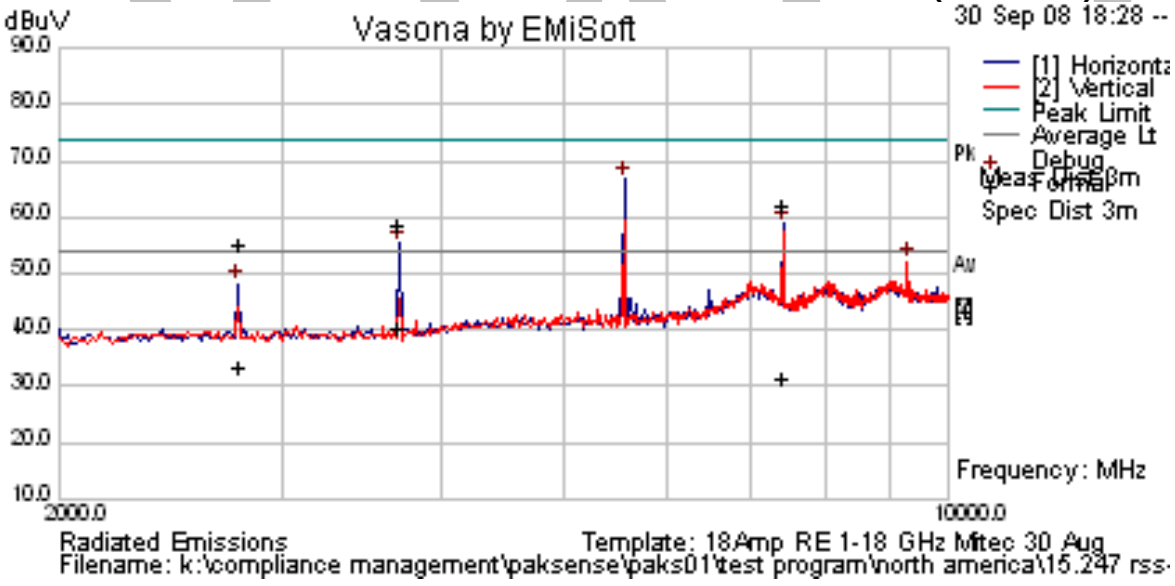

**927.25 MHz Reader + Label Radiated Emissions Above 1 GHz Band-Edge**



**927.25 MHz Reader + Label Radiated Emissions Above 1 GHz (1 – 2 GHz)**




**927.25 MHz Reader + Label Radiated Emissions Above 1 GHz (2 - 10 GHz)**



**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 5$^{th}$ 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.

| 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' | 0287, 0158, 0134, 0304, 0311, 0315, 0310, 0312 |

### 5.1.6.2. Receiver Radiated Spurious Emissions (above 1 GHz)

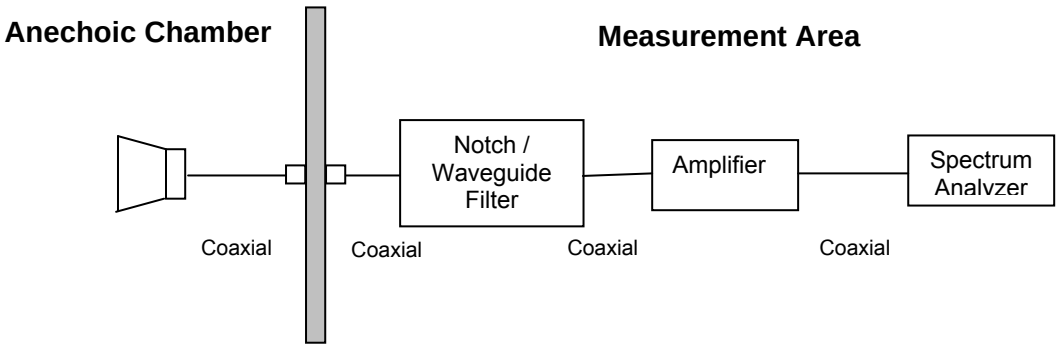
**Industry Canada RSS-Gen §4.8, §6**

**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))

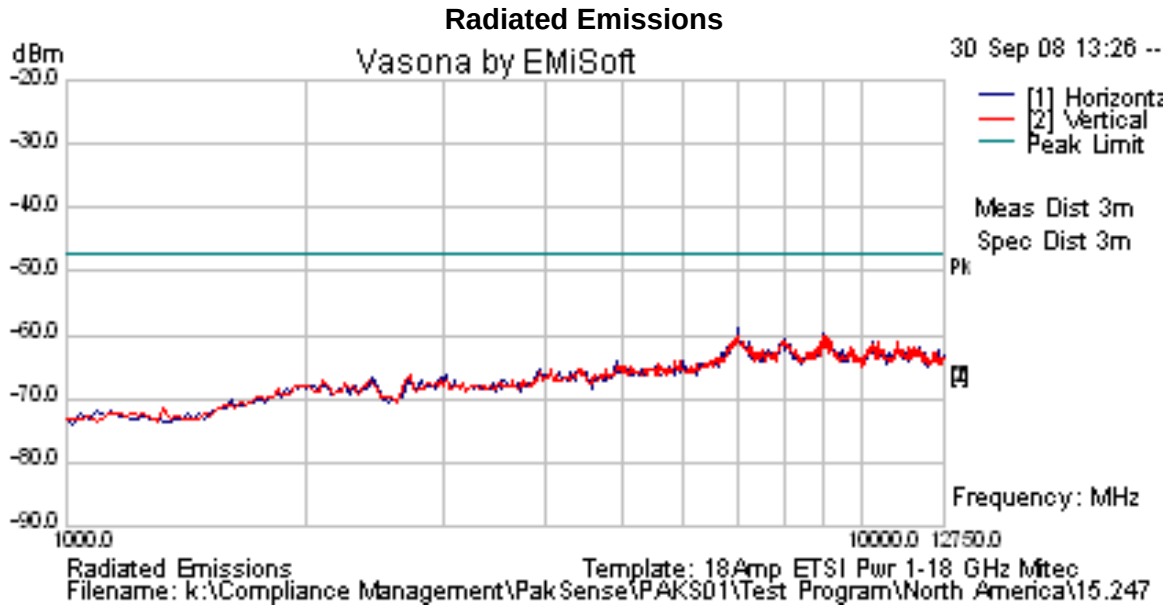
40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

**Test Setup – System communicating between Reader and Label**

TABLE OF RESULTS

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

No emissions within 6 dB of the limit line




The above plot identifies peak emissions

## 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

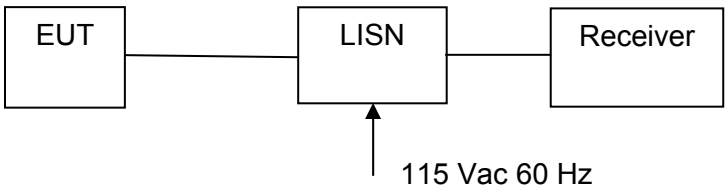
| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions' | 0287, 0158, 0134, 0304, 0311, 0315, 0310, 0312 |

### 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 Procedure**
The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

**Test Measurement Set up**




Measurement set up for AC Wireline Conducted Emissions Test

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

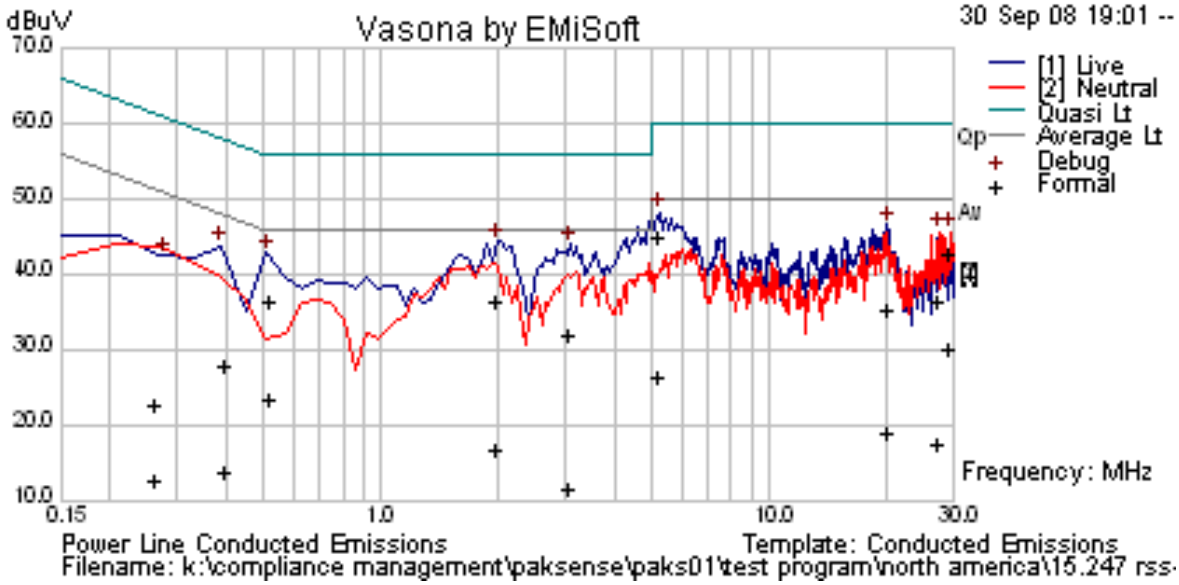
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

EUT parameters.
Reader 115Vac 60 Hz
System communicating between Reader and Label
Frequency of Operation: 927.25 MHz

**TABLE OF RESULTS – Reader**

| Freq (MHz) | LIne | Peak (dBµV) | QP (dBµV) | QP Limit (dBµV) | QP Margin (dB) | Ave. (dBµV) | Ave. Limit (dBµV) | Ave. Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 5.22 | Live | 48.28 | 43.26 | 60 | -16.74 | 24.71 | 50 | -25.29 |
| 29.529 | Neutra | 45.66 | 41.06 | 60 | -18.94 | 28.54 | 50 | -21.46 |
| 2.005 | Live | 44.45 | 34.79 | 56 | -21.21 | 15.21 | 46 | -30.79 |
| 0.523 | Live | 42.93 | 34.77 | 56 | -21.23 | 21.84 | 46 | -24.16 |
| 27.35 | Neutra | 43.79 | 34.65 | 60 | -25.35 | 15.95 | 50 | -34.05 |
| 3.072 | Neutra | 44.07 | 30.18 | 56 | -25.82 | 9.85 | 46 | -36.15 |

**AC Wireline Conducted Emissions 150 kHz – 30 MHz**



## 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

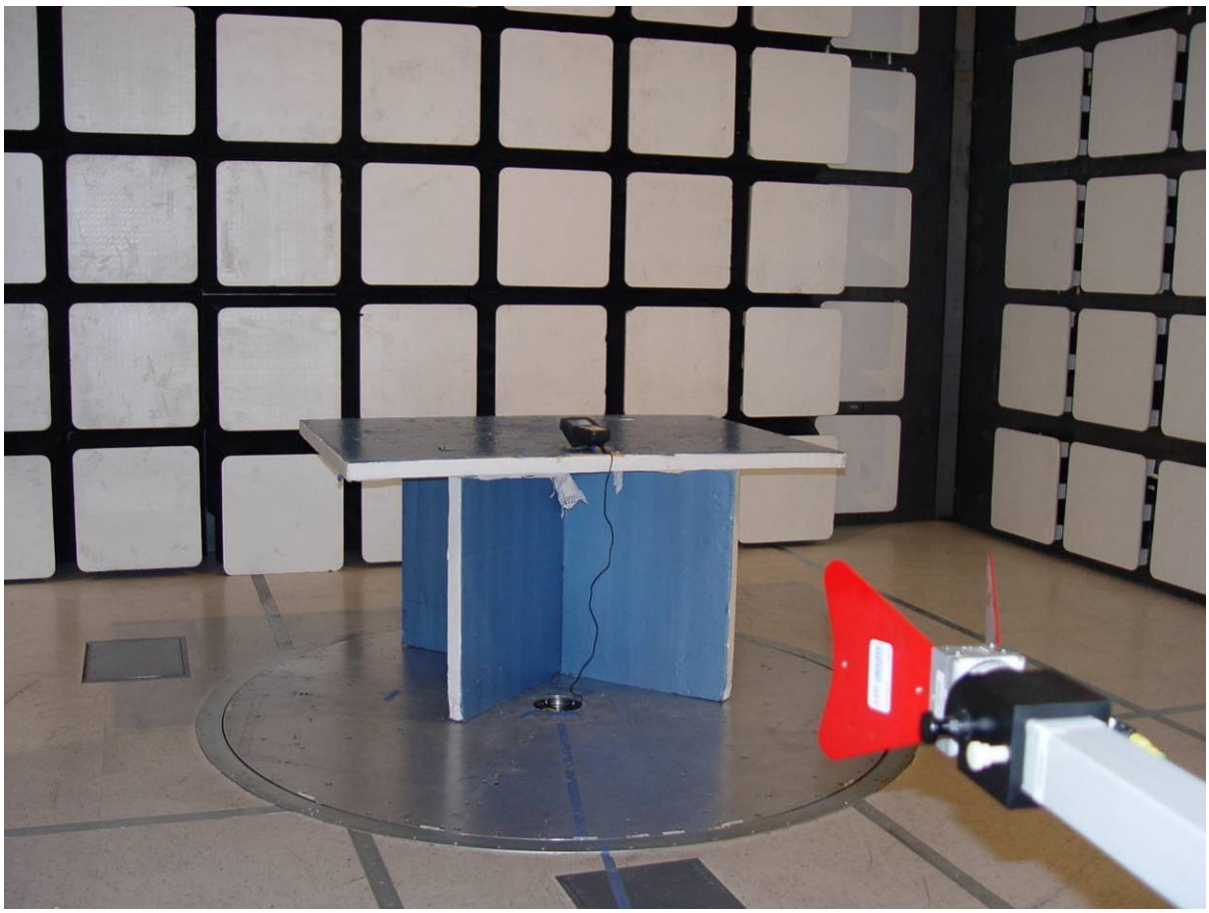
| | |
|---|---|
| Measurement uncertainty | ±2.64 dB |

### Traceability

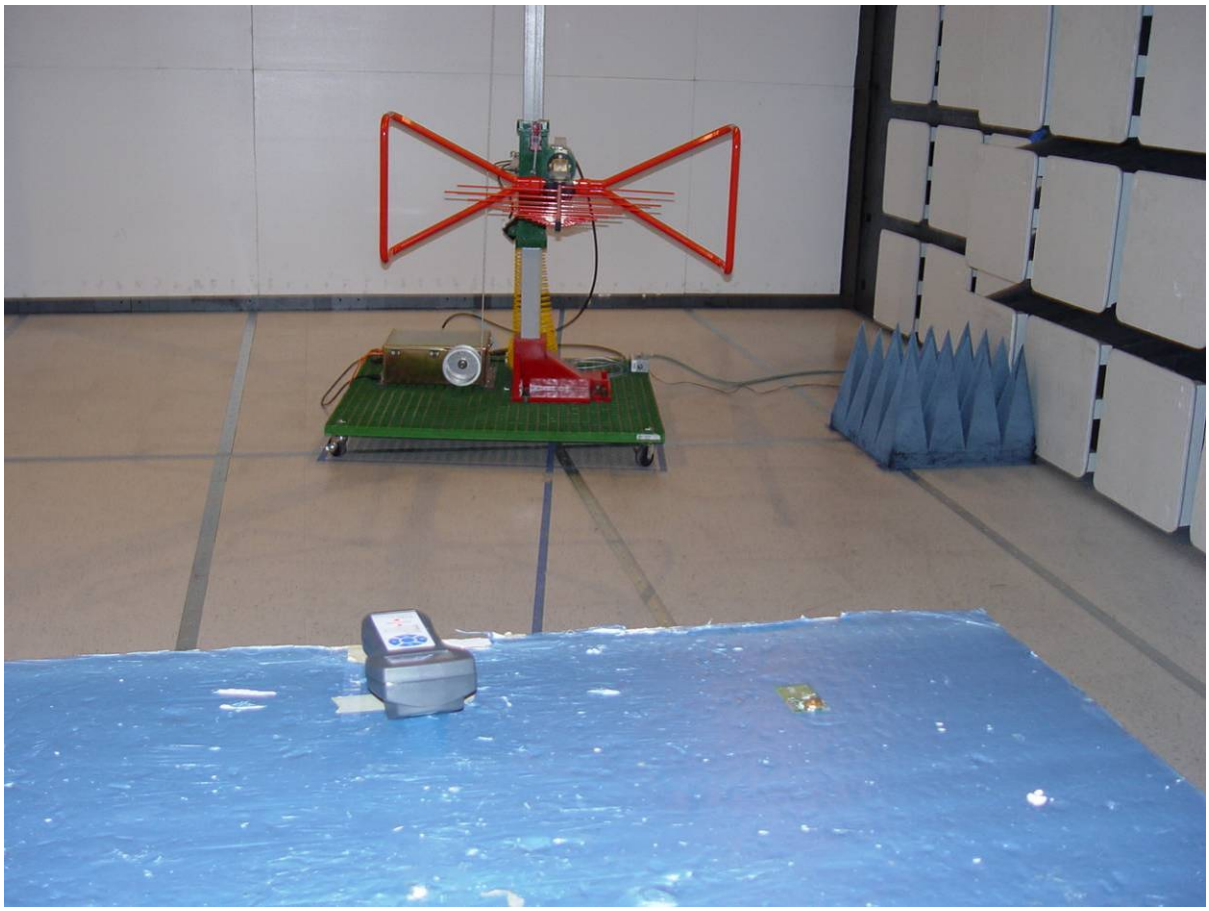
| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions' | 0158, 0184, 0193, 0190, 0293, 0307 |

# 6. PHOTOGRAPHS

## 6.1. Radiated Emissions (>1 GHz)

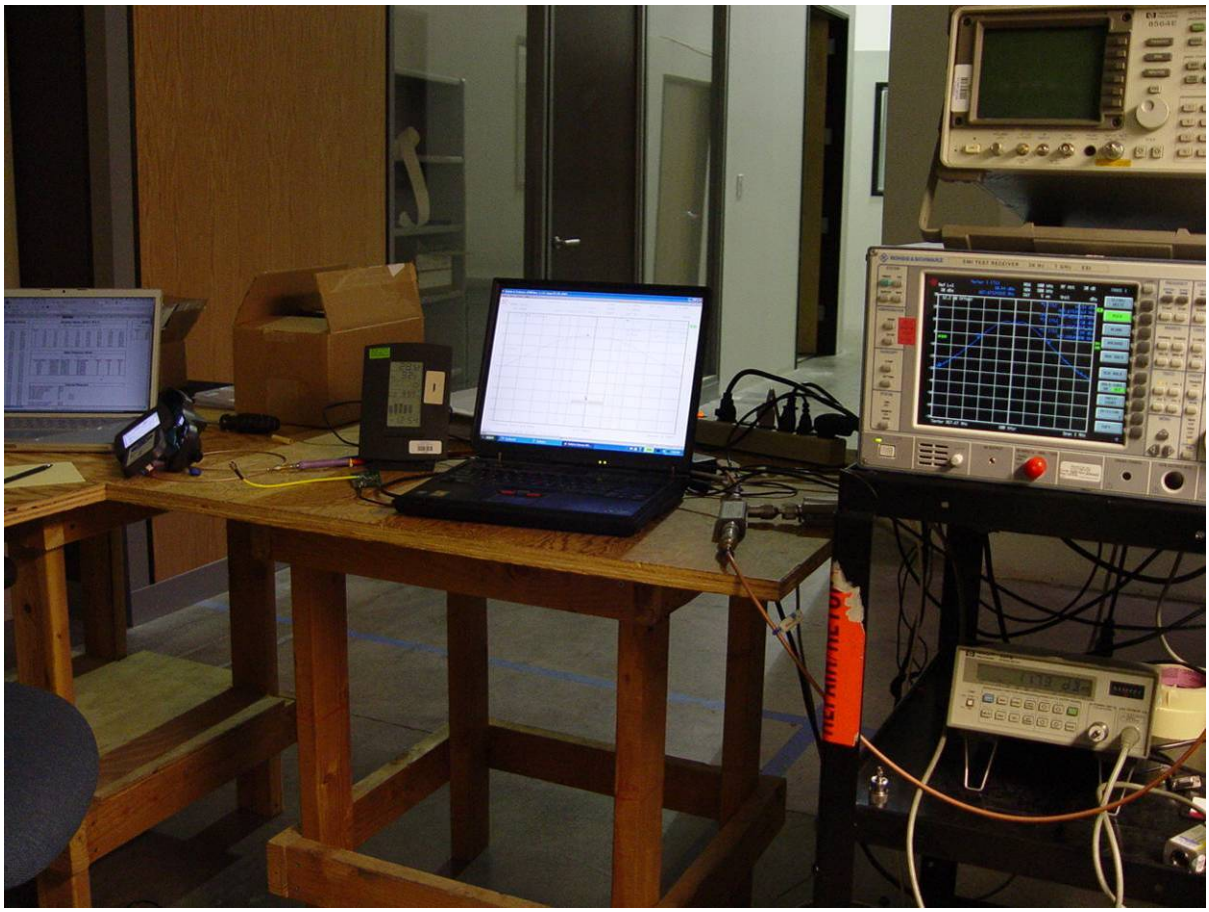


## 6.2. Radiated Emissions (<1 GHz)



## 6.3. AC Wireline Emissions (150 kHz - 30 MHz)

## 6.4. General Measurement Test Set-Up



## 7. TEST EQUIPMENT DETAILS

| Asset # | Instrument | Manufacturer | Part # | Serial # |
|---|---|---|---|---|
| 0287 | EMI Receiver | Rhode & Schwartz | ESIB 40 | 100201 |
| 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 |
| 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 |
| Dipole | 20MHz-1GHz Dipole Antennas | EMCO | 3121C | 9009-505 |
| 0072 | Signal Generator | Hewlett Packard | HP 83640A | 2927A00105 |
| 0075 | Environmental Chamber | Thermatron | SE-300-2-2 | 27946 |
| 0083 | Coupler | Hewlett Packard | HP 87301D | 3116A00389 |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