Engineering and Testing for EMC and Safety Compliance

Accredited under A2LA Testing Certificate # 2653.01

Certification Application Report
FCC Part 15.247 & Industry Canada RSS-210

Test Lab:	Applicant:
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FCC ID/ IC:	MQOWR700-10000/ 2570A-WR700100	**Test Report Date:**	May 20, 2008
Platform:	N/A	**RTL Work Order Number:**	2008098
Model Number:	WR-700-100	**RTL Quote Number:**	QRTL08-205

American National Standard Institute:	ANSI C63.4-2003 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
FCC Classification:	DSS – Part 15 Spread Spectrum Transmitter
FCC Rule Part:	FCC Rules Part 15.247: Operation within the bands 920-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz Direct Sequence System 10-01-07 (Guidance per DA 00-705)
Industry Canada:	RSS-210: Low Power License-Exempt Communications Devices
Digital Interface Information:	N/A

Frequency Range (MHz)	Output Power (W)*	Frequency Tolerance	Emission Designator
902.3 – 927.7	0.339	N/A	153KFXD

*power reported is peak conducted power

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviation from, additions to, or exclusions from, the applicable parts of FCC Part 2, FCC Part 15, ANSI C63.4, and Industry Canada RSS-210.

Signature: _____ Date: May 20, 2008

Typed/Printed Name: Desmond A. Fraser Position: President

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1 General Information

1.1 Scope

Applicable Standards:

- FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.
- Industry Canada RSS-210: Low Power License-Exempt Communications Devices

1.2 Description of EUT

Equipment Under Test	Body Worn Terminal
Model	WR-700-100
Power Supply	Battery operated (powered by T5)
Modulation Type	FHSS
Frequency Range	902.3 – 927.7 MHz
Antenna Connector Type	Internal
Antenna Types	Internal

1.3 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 2003).

1.4 Related Submittal(s)/Grant(s)

This is an original application for certification for Vocollect, Inc. Model # WR-700-100, FCC ID: MQOWR700-10000, IC: 2570A-WR700100.

1.5 Modifications

No modifications were required for compliance.

2 Test Information

2.1 Description of Test Modes

Per FCC 15.31(m), and because the EUT utilizes an operating band greater than 10 MHz, the following frequencies were tested:

Table 2-1: Channels Tested for FHSS – 1 Mbps

Channel	Frequency
Low	902.3
Middle	915.0
High	927.7

2.2 Exercising the EUT

The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. The EUT was provided with software to continuously transmit during testing. The carrier was also checked to verify that information was being transmitted. There were no deviations from the test standard(s) and/or methods. The test results reported relate only to the item tested.

2.3 Antenna

The EUT has an internal antenna and therefore meets the requirements of 15.203.

2.4 Test Result Summary

Table 2-2: Test Result Summary – FCC Part 15, Subpart C (Section 15.247)

Standard	Test	Pass/Fail or N/A
FCC 15.207	AC Power Conducted Emissions	N/A
FCC 15.247(d), 15.209	Radiated Emissions	Pass
FCC 15.247(b)	Maximum Peak Power Output	Pass
FCC 15.247(d)	Antenna Conducted Spurious Emissions	Pass
FCC 15.247(d)	Band Edge Measurement	Pass
FCC 15.247(a)(1)	Carrier Frequency Separation	Pass
FCC 15.247(a)(1)(ii)	20 dB Bandwidth	Pass
FCC 15.247(a)(1)(iii)	Hopping Characteristics	Pass
FCC 15.247(a)(1)(iii)	Average Time of Occupancy	Pass

2.5 Test System Details

The test sample was received on May 5, 2008. The FCC identifiers for all applicable equipment, plus descriptions of all cables used in the tested system, are identified in the following tables.

Table 2-3: Equipment Under Test

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
RFID	Vocollect, Inc.	WR-700-100	P2-0002	MQOWR700-10000	N/A	18420

2.6 Configuration of Tested System

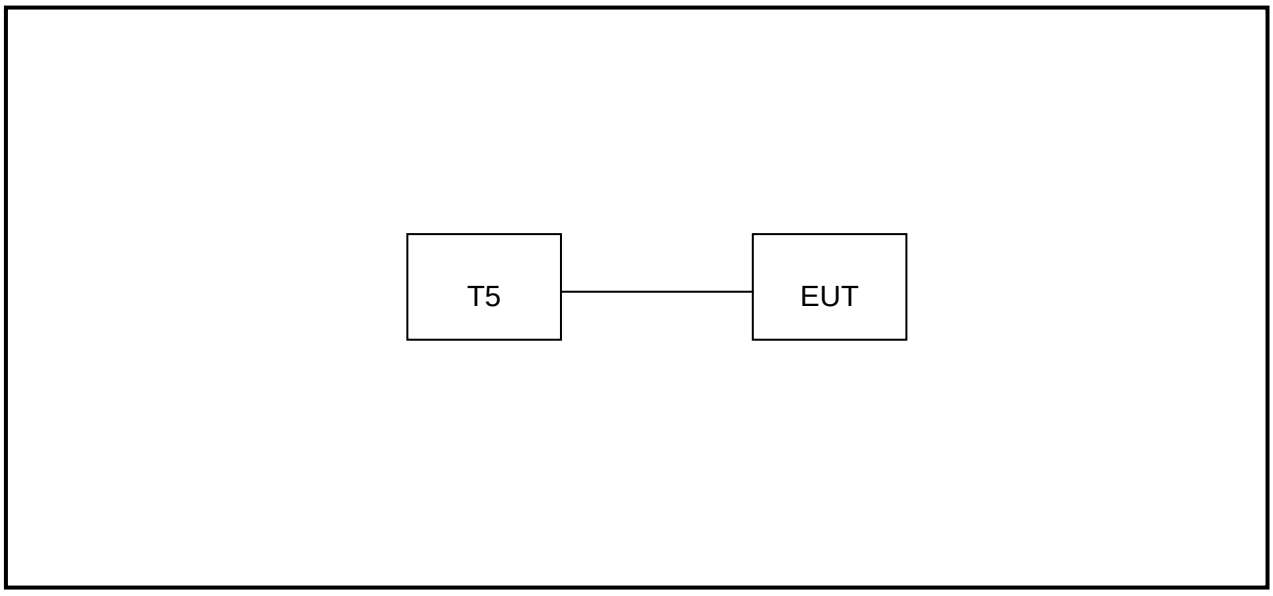


Figure 2-1: Configuration of System Under Test

3 Peak Output Power – FCC §15.247(b)(1); RSS-210 §A8.4(4)

3.1 Power Output Test Procedure

A conducted power measurement of the EUT was taken using an Agilent 4416A EPM-P Series Power Meter with an E9323A Peak and Average Power Sensor.

Table 3-1: Power Output Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901184	Agilent Technologies	E4416A	EPM-P Power Meter, single channel	GB41050573	10/24/08
901356	Agilent Technologies	E9323A	Power Sensor	31764-264	10/24/08

3.2 Power Output Test Data

Table 3-2: Power Output Test Data

Channel	Frequency (MHz)	Peak Power Conducted Output (dBm)	Average Power Conducted Output (dBm)
Low	902.3	24.4	21.0
Middle	915.0	25.3	21.6
High	927.7	24.9	21.5

Note: Maximum peak power is being used to show compliance for EMC. Maximum average power is presented per "FCC OET SAR Measurement Procedures for 802.11a/b/g Transmitters (Oct '06 Rev. 1.1)" for comparison to the SAR report.

Test Personnel:

Richard B. McMurray, P.E.	Richard B. McMurray	May 9, 2008
EMC Test Engineer	Signature	Date of Test

4 Band-Edge Compliance of RF Conducted Emissions – FCC §15.247(d); RSS-210 §2.2

4.1 Band Edge Test Procedure

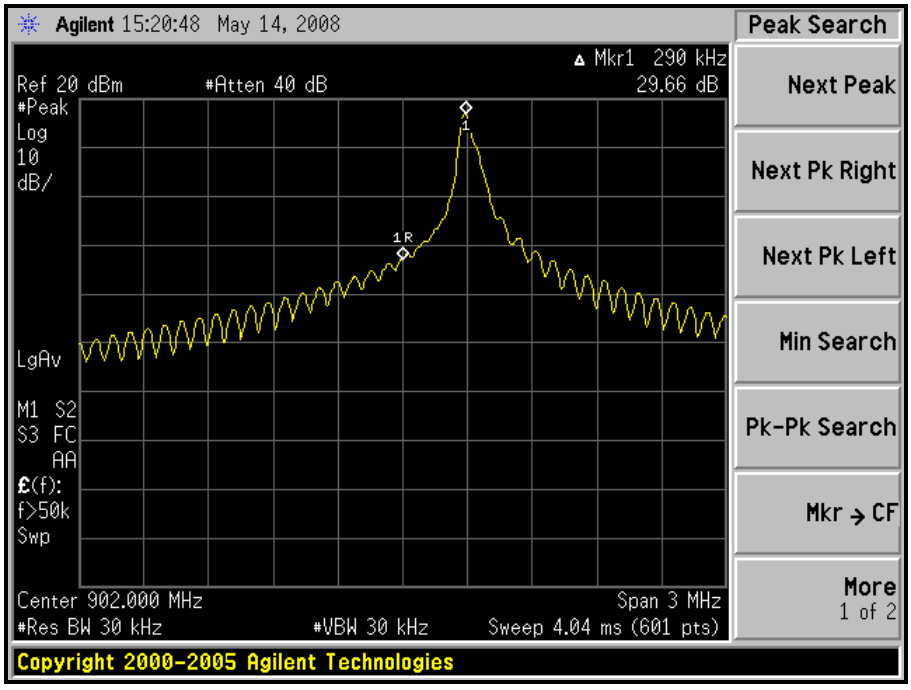
The EUT was connected to the spectrum analyzer through suitable attenuation. The span was set wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The spectrum analyzer was set to the following:

RBW > = 1% of the span
VBW > = RBW
Sweep = auto
Detector function = peak
Trace = max hold

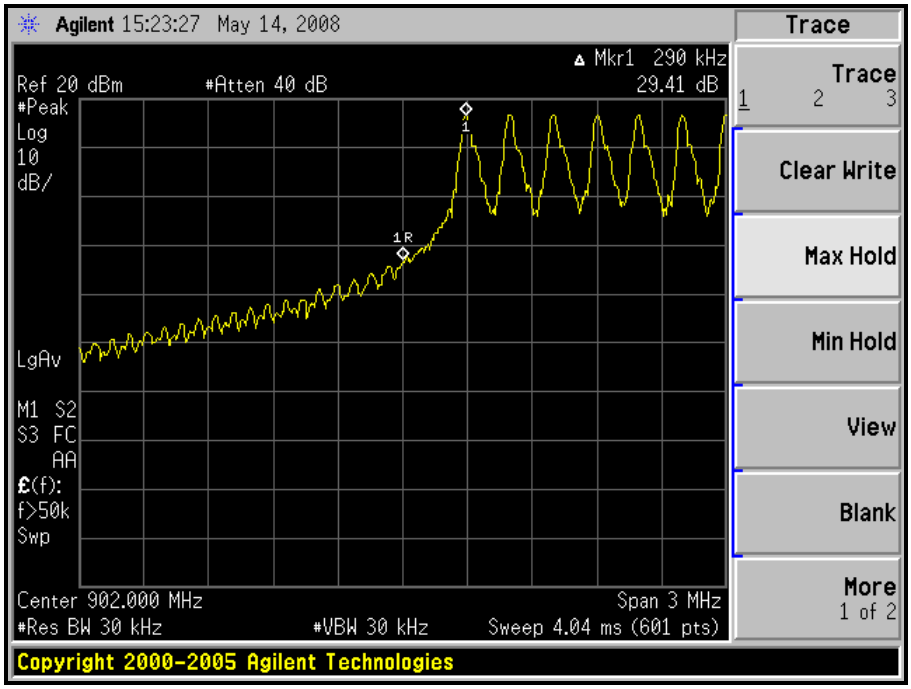
The trace was allowed to stabilize. The marker was set on the emission at the band edge. The marker-delta was used to show the delta between the maximum in-band emission and the emission at the band edge, and was compared to the 20 dBc requirement of 15.247(d) (when using peak emissions). This measurement was taken in both fixed frequency and hopping modes.

4.2 Restricted Band Edge Test Results

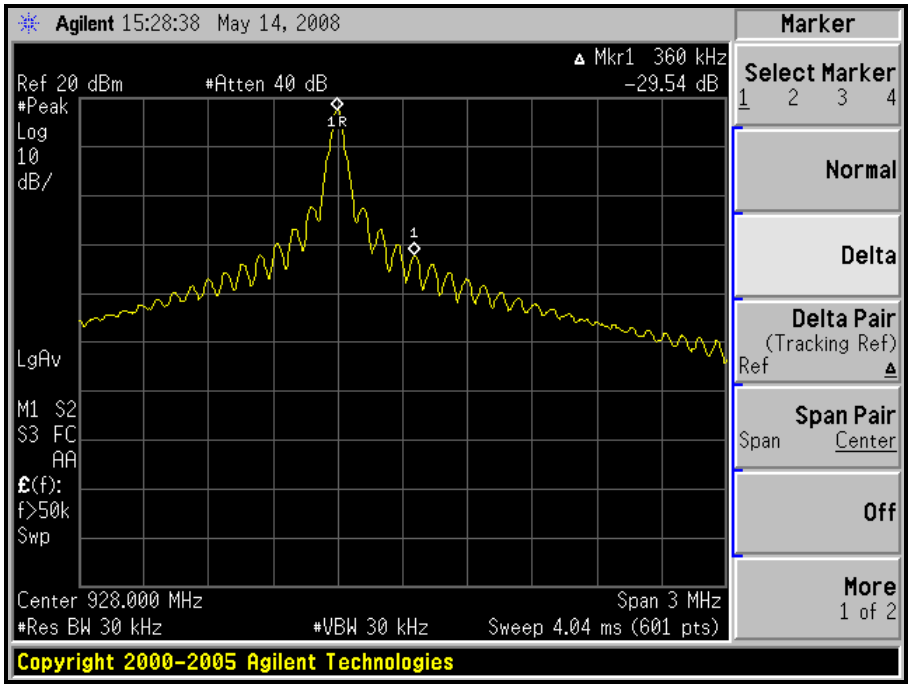
Plot 4-1: Lower Band Edge - TX Frequency 902.3 MHz – Fixed Frequency Mode



Plot 4-2: Lower Band Edge - Hopping Mode



Plot 4-3: Upper Band Edge - TX Frequency 927.7 MHz – Fixed Frequency Mode



Plot 4-4: Upper Band Edge - Hopping Mode

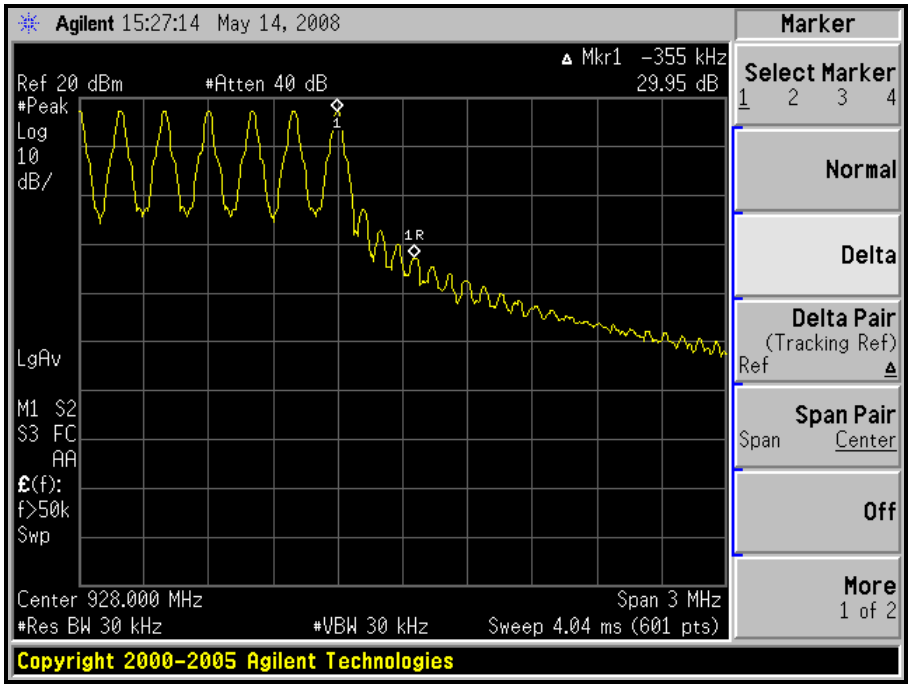


Table 4-1: Band Edge Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	6/14/2008

Test Personnel:

Richard B. McMurray, P.E.	Richard B. McMurray	May 14, 2008
EMC Test Engineer	Signature	Date of Test

5 Antenna Conducted Spurious Emissions – FCC §15.247(d); RSS-Gen

5.1 Antenna Conducted Spurious Emissions Test Procedures

Antenna spurious emissions per FCC 15.247(d) were measured from the EUT antenna port using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 100 kHz. Emissions were investigated with the modulated carrier set to the following frequencies: 902.3, 915.1, and 927.7.

5.2 Antenna Conducted Spurious Emissions Test Results

No harmonics or spurs were found within 20 dB (note that we are reporting power as peak) of the carrier level from the carrier to the 10th harmonic of the carrier frequency. Per FCC 15.31(o), no data is being reported.

Table 5-1: Antenna Conducted Spurious Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	6/14/2008

Test Personnel:

Richard B. McMurray, P.E.	Richard B. McMurray	May 14, 2008
EMC Test Engineer	Signature	Date of Test

6 20 dB Bandwidth – FCC §15.247(a)(1)(ii); IC RSS-210 A8.1(1)

6.1 20 dB Bandwidth Test Procedure

The minimum 20 dB bandwidths were measured using a 50 ohm spectrum analyzer. The carrier was adjusted on the analyzer so that it was displayed entirely on the spectrum analyzer. The sweep time was set to auto and allowed through several sweeps with the max hold function used in peak detector mode. The resolution bandwidth was set to 10 kHz, and the video bandwidth set at 100 kHz. The 20 dB bandwidths were measured using the spectrum analyzer delta marker set 20 dB down from the peak of the modulated carrier. The table below contains the bandwidth measurement results.

The maximum allowed 20 dB bandwidth is 500 kHz. The EUT complies with this requirement.

Table 6-1: 20 dB Bandwidth Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	6/14/2008

6.2 20 dB Modulated Bandwidth Test Data

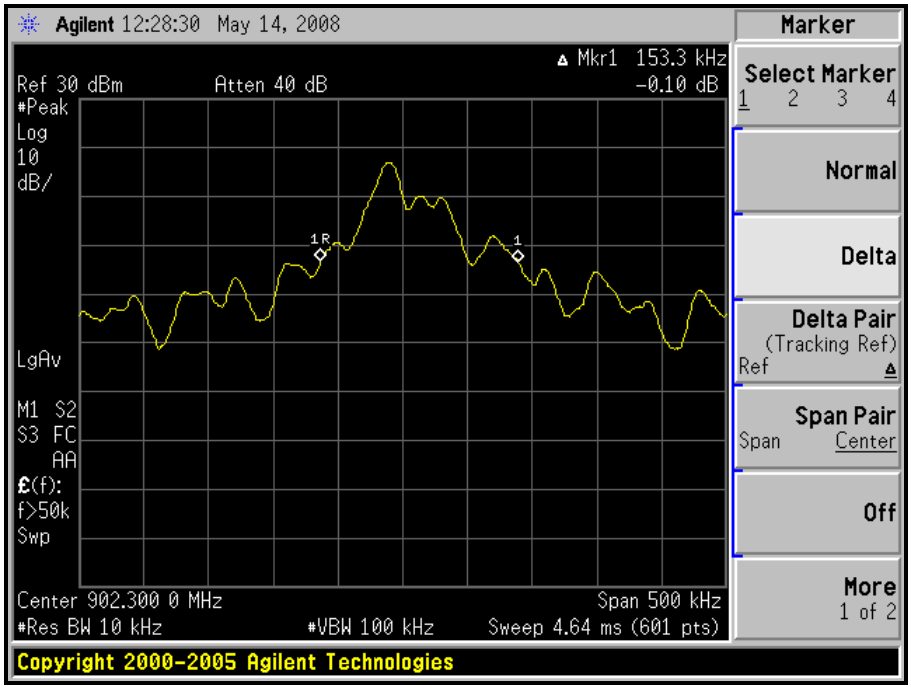
Table 6-2: 20 dB Modulated Bandwidth Test Data

Minimum 20 dB bandwidths

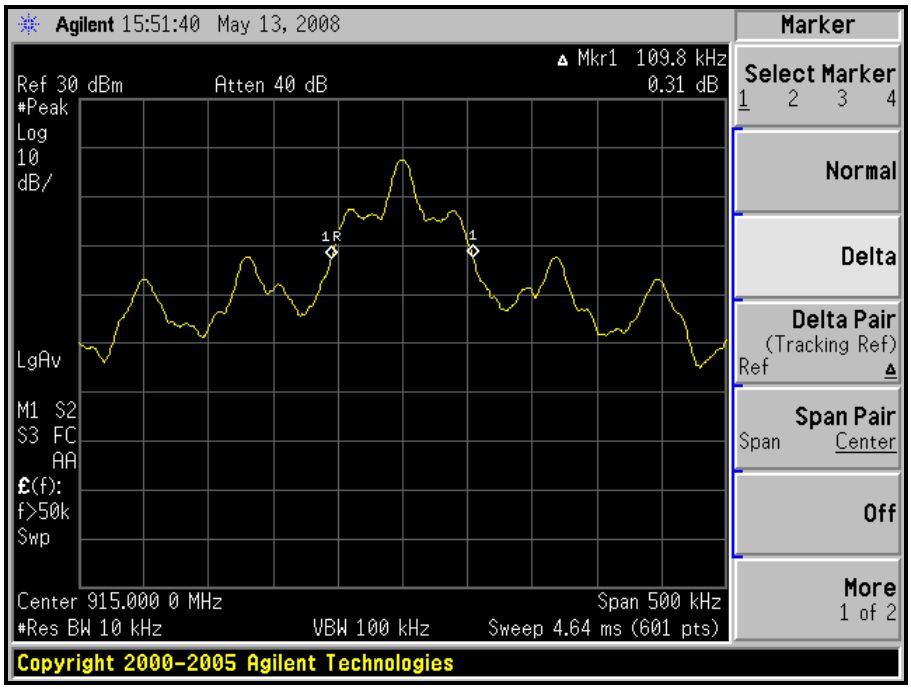
Frequency	20 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)
902.3	153	500	-347
915.0	110	500	-390
927.7	109	500	-391

6.3 20 dB Bandwidth Plots

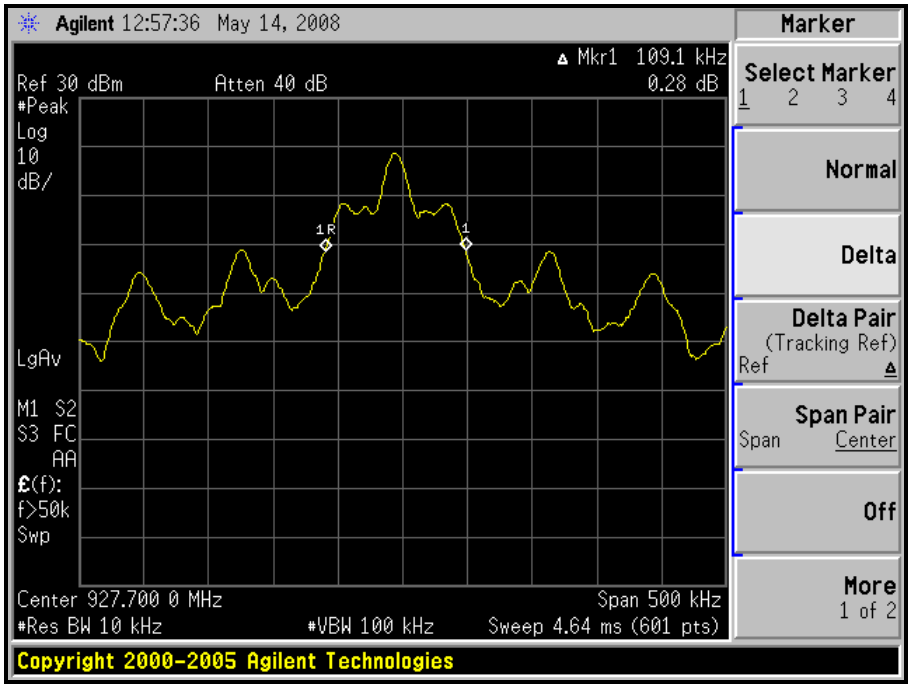
Plot 6-1: 20 dB Bandwidth – Low Channel



Plot 6-2: 20 dB Bandwidth – Middle Channel



Plot 6-3: 20 dB Bandwidth – High Channel



Test Personnel:

Richard B. McMurray, P.E.	Richard B. McMurray	May 13 and 14, 2008
EMC Test Engineer	Signature	Dates of Test

7 Carrier Frequency Separation – FCC §15.247(a)(1); IC RSS-210 A8.1(2)

7.1 Carrier Frequency Separation Test Procedure

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.

Measured frequency separation = 200 kHz

7.2 Carrier Frequency Separation Test Data

Plot 7-1: Carrier Frequency Separation

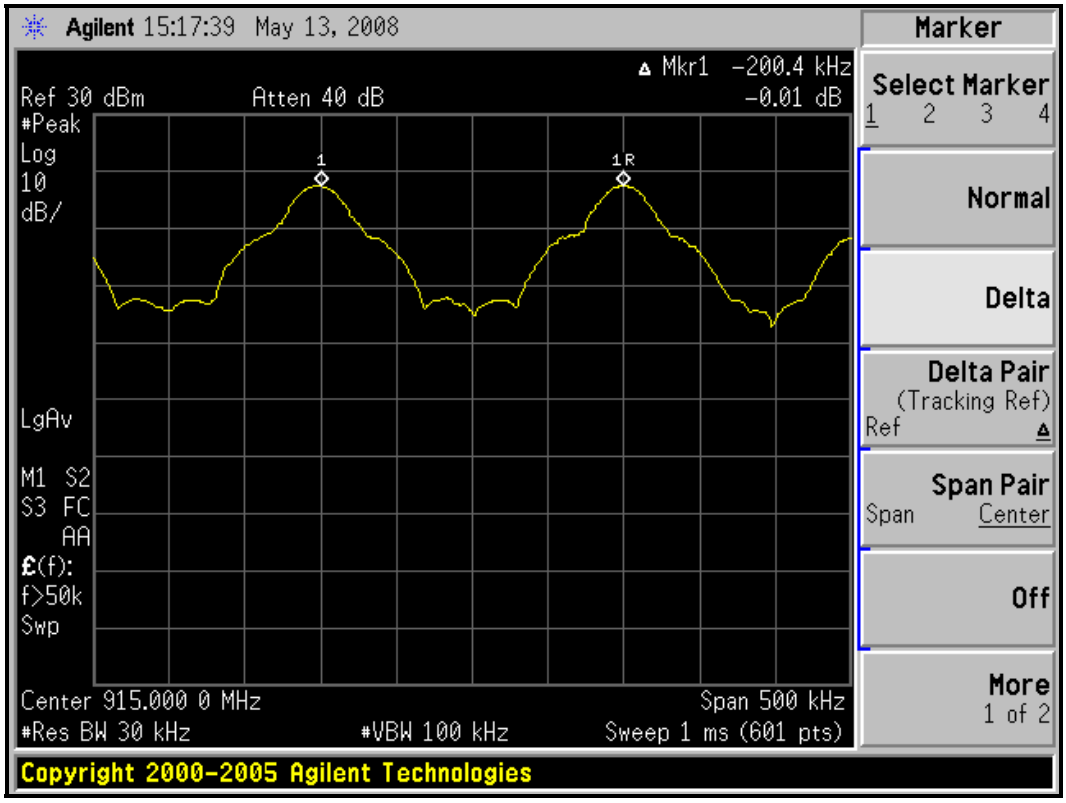


Table 7-1: Carrier Frequency Separation Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	6/14/2008

Test Personnel:

Richard B. McMurray, P.E.	Richard B. McMurray	May 13, 2008
EMC Test Engineer	Signature	Date of Test

8 Hopping Characteristics – FCC §15.247(a)(1)(iii); IC RSS-210 A8.1(4)

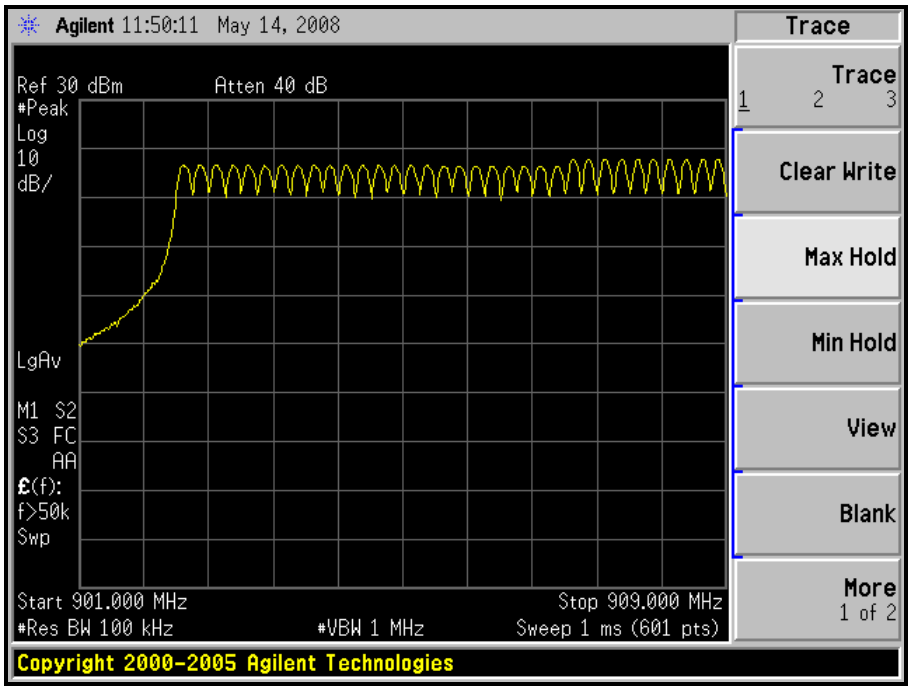
8.1 Hopping Characteristics Test Procedure

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

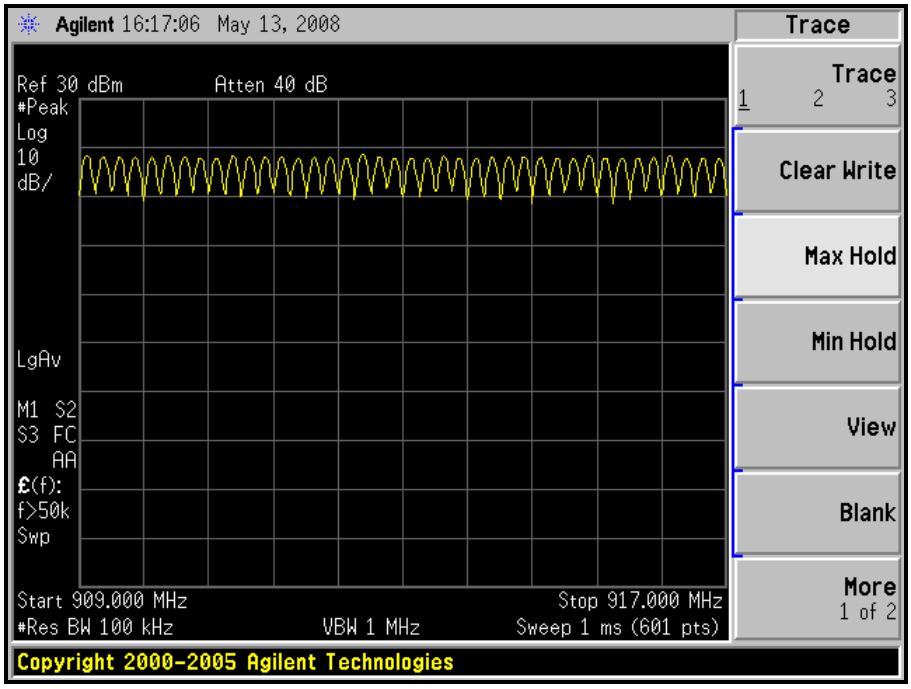
8.2 Number of Hopping Frequencies

Measured number of hopping frequencies = 128 (34 + 40 + 40 + 14)

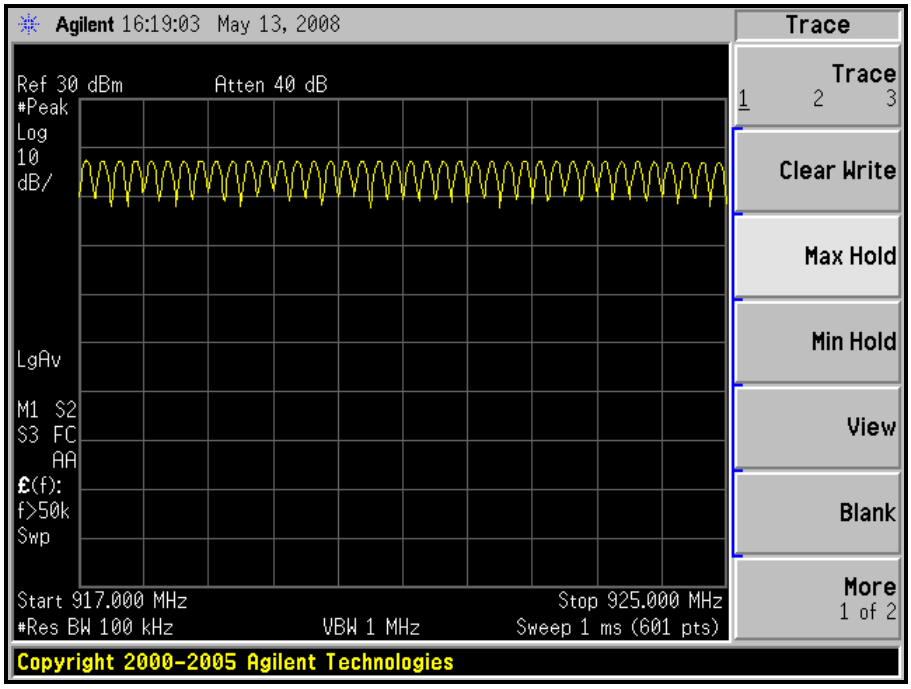
Plot 8-1: Number of Hopping Frequencies; 901 – 909 MHz (34 frequencies)



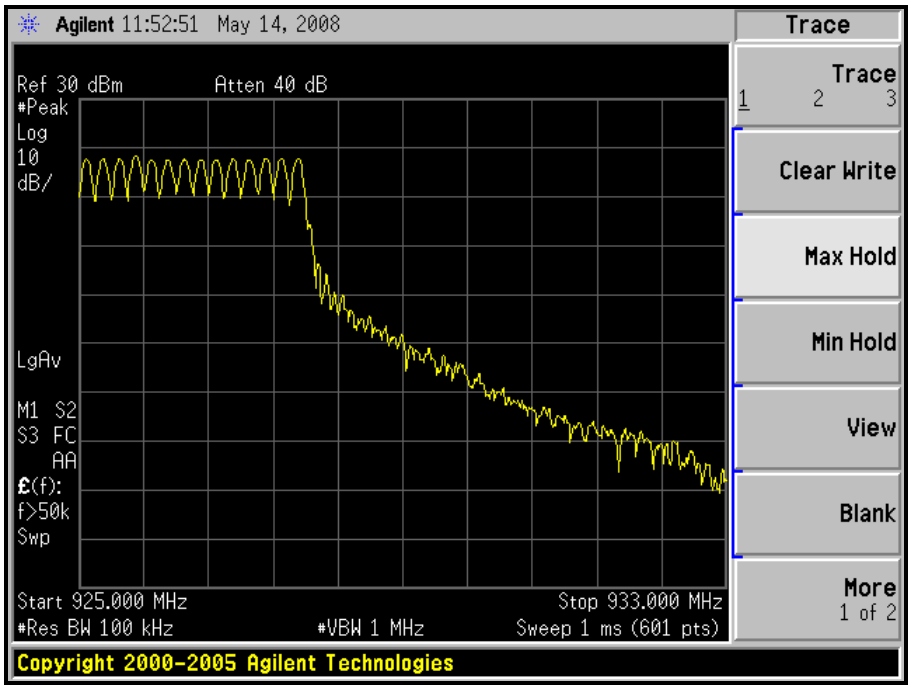
Plot 8-2: Number of Hopping Frequencies; 909 – 917 MHz (40 frequencies)



Plot 8-3: Number of Hopping Frequencies; 917 – 925 MHz (40 frequencies)



Plot 8-4: Number of Hopping Frequencies; 925 – 933 MHz (14 frequencies)



Test Personnel:

Richard B. McMurray, P.E.	Richard B. McMurray	May 13 and 14, 2008
EMC Test Engineer	Signature	Dates of Test

8.3 Average Time of Occupancy

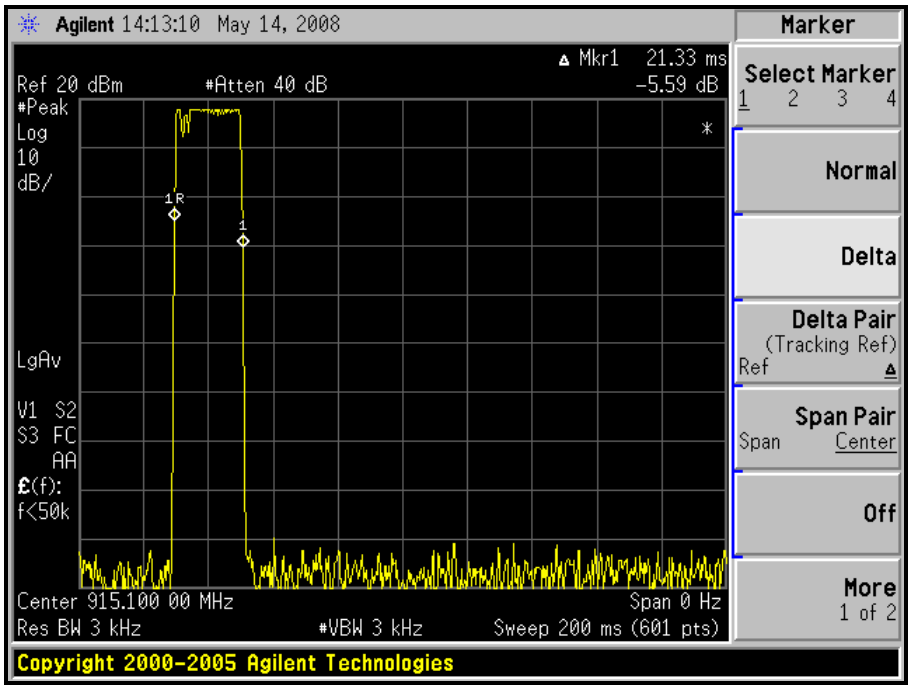
For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

The spectrum analyzer sweep was set to 200 ms with a zero span until a pulse from the device under test was captured. A marker delta was used to measure the dwell time for this pulse. The sweep was then set to single sweep for 20 s.

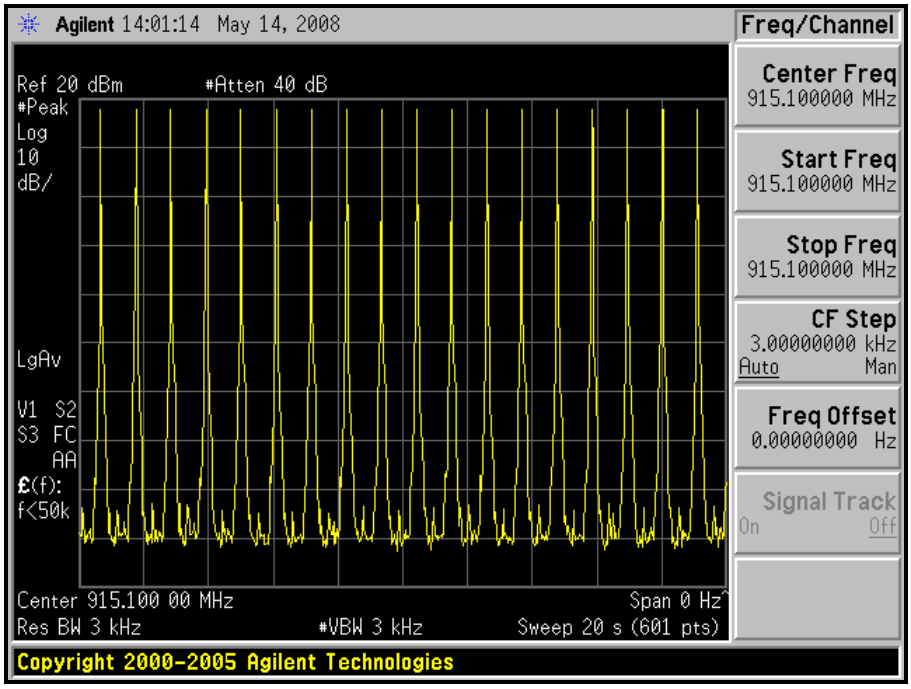
The number of pulses in 20 s was 18.

The average time of occupancy in the 20 s period is equal to 18 pulses x 0.021 ms = 378 ms, which meets the limit of 0.4 seconds.

Plot 8-5: Time of Occupancy (Dwell Time)



Plot 8-6: Time of Occupancy (Dwell Time 5 Second Sweep)



Number of pulses in 20 seconds: 18

Table 8-1: Hopping Characteristics Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	6/14/2008

Test Personnel:

Richard B. McMurray, P.E.	Richard B. McMurray	May 14, 2008
EMC Test Engineer	Signature	Date of Test

9 Conducted Emissions Measurement Limits – FCC §15.207; RSS-Gen

9.1 Limits of Conducted Emissions Measurement

N/A – The EUT is battery operated.

10 Spurious Radiated Emissions – FCC §15.247(d); §15.209; RSS-210 §A8.5 and RSS-Gen

10.1 Limits of Radiated Emissions Measurement

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009-0.490	2400/f (kHz)	300
0.490-1.705	2400/f (kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

This test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b).

Additionally, the average measurement, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit.

As shown in 15.35(b), for frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any circumstances of modulation.

10.2 Radiated Emissions Measurement Test Procedure

Before final measurements of radiated emissions were made on the open-field three/ten meter range, the EUT was scanned indoors at one and three meter distances. This was done in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to ensure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three/ten-meter, open-field test site. The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane. The spectrum was examined from 9 kHz to the 10^{th} harmonic of the highest fundamental transmitter frequency.

At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations. For frequencies between 30 and 1000 MHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1000 MHz, emissions are measured using the average detector function with a minimum resolution bandwidth of 1 MHz. No video filter less than 10 times the resolution bandwidth was used. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

10.2.1 Radiated Emissions Harmonics/Spurious Test Data

Table 10-1: Radiated Emissions Harmonics/Spurious (TX Frequency: 902.3 MHz)

Emission Frequency (MHz)	Analyzer Reading (dBuV)	Detector	Antenna Polarity	Site Correction Factor (dB)	Duty Cycle Correction (dB)	Corrected Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
3609.2	65.6	peak	H	-2.1	N/A	63.5	74.0	-10.5
3609.2	62.6	average	H	-2.1	-13.4	47.1	54.0	-6.9
4511.5	59.0	peak	H	3.9	N/A	62.9	74.0	-11.1
4511.5	53.4	average	H	3.9	-13.4	43.9	54.0	-10.1
5413.8	55.9	peak	V	4.9	N/A	60.8	74.0	-13.2
5413.8	50.4	average	V	4.9	-13.4	41.9	54.0	-12.1

Table 10-2: Radiated Emissions Harmonics/Spurious (TX Frequency: 915.1 MHz)

Emission Frequency (MHz)	Analyzer Reading (dBuV)	Detector	Antenna Polarity	Site Correction Factor (dB)	Duty Cycle Correction (dB)	Corrected Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2745.3	64.4	peak	V	-3.2	N/A	61.2	74.0	-12.8
2745.3	58.9	average	V	-3.2	-13.4	42.3	54.0	-11.7
3660.4	63.8	peak	H	-1.7	N/A	62.1	74.0	-11.9
3660.4	59.8	average	H	-1.7	-13.4	44.7	54.0	-9.3
4575.5	57.6	peak	H	4.0	N/A	61.6	74.0	-12.4
4575.5	51.6	average	H	4.0	-13.4	42.2	54.0	-11.8

Table 10-3: Radiated Emissions Harmonics/Spurious (TX Frequency: 927.7 MHz)

Emission Frequency (MHz)	Analyzer Reading (dBuV)	Detector	Antenna Polarity	Site Correction Factor (dB)	Duty Cycle Correction (dB)	Corrected Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2783.1	67.8	peak	V	-3.7	N/A	64.1	74.0	-9.9
2783.1	61.6	average	V	-3.7	-13.4	44.5	54.0	-9.5
3710.8	67.0	peak	H	-1.5	N/A	65.5	74.0	-8.5
3710.8	63.5	average	H	-1.5	-13.4	48.6	54.0	-5.4
4638.5	60.5	peak	H	3.7	N/A	64.2	74.0	-9.8
4638.5	54.6	average	H	3.7	-13.4	44.9	54.0	-9.1

Notes:

- peak: 1 MHz RBW/VBW
- average: 1 MHz RBW/10 Hz VBW
- measurements taken at 3 m
- Site Correction Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre-amp Gain (dB)
- Per DA 00-705, if the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit. Duty cycle correction factor = 20 log (21.33 ms / 100 ms) = -13.4

Table 10-4: Radiated Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900878	Rhein Tech Labs	AM3-1197-0005	3 meter antenna mast, polarizing	Outdoor Range 1	Not Required
901242	Rhein Tech Labs	WRT-000-0003	Wood rotating table	N/A	Not Required
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	6/13/10
900321	EMCO	3161-03	Horn Antenna (4 – 8.2GHz)	9508-1020	6/13/10
900323	EMCO	3160-7	Horn Antenna (8.2 – 12.4 GHz)	9605-1054	7/31/09
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	5/22/08
900930	Hewlett Packard	85662A	Spectrum Analyzer Display Section	3144A20839	5/22/08
901364	MITEQ	JS4-01002600-36-5P	Amplieir, 15 V, 0.1-26 GHz, 28 dB gain, power 5 dB	849863	10/5/2008
901421	Insulated Wire, Inc	KPS-1503-360-KPS	High Frequency RF cable, 36"	NA	10/5/2008
901425	Insulated Wire, Inc.	KPS-1503-2400-KPS	RF cable, 20'	NA	10/5/2008

Test Personnel:

Richard B. McMurray, P.E.	Richard B. McMurray	May 15, 2008
EMC Test Engineer	Signature	Date of Test

11 Conclusion

The data in this measurement report shows that the EUT as tested, Vocollect, Inc. Model # WR-700-100, FCC ID: MQOWR700-10000, IC: 2570A-WR700100, complies with all the applicable requirements of Parts 2 and 15 of the FCC Rules and Regulations, and Industry Canada RSS-210.