



FCC & Industry Canada Certification Test Report
For the
Symbol Technologies, Inc.
Model MC9090R6

FCC ID: H9PMC9090R6
IC: 1549D-MC9090R6

WLL JOB# 9261
July 18, 2006

Prepared for:

Symbol Technologies, Inc
One Symbol Plaza MS A-13
Holtsville, NY 11742

Prepared By:

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Chief EMC Engineer

Reviewed by: Steven D. Koster
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Abstract

This report has been prepared on behalf of Symbol Technologies, Inc to support the attached Application for Equipment Authorization. The test report and application are submitted for the Symbol Technologies GEMINI Mobile RFID Reader MC9090R6. The device contains a RFID reader operating at 902 – 928MHz band, Bluetooth module, and an 802.11a/b/g WLAN module.

The GEMINI Mobile RFID Reader has already been approved with the 802.11a/b/g WLAN Module and Bluetooth module under FCC ID: H9PMC9090. This application is for a new FCC ID which uses the MC9090 and incorporates a RFID Module.

The RFID Reader has previously been certified (FCC ID: NTTWJMPR7XXX). The original test report covers the testing at the antenna port for this device. As the antenna has changed radiated emissions testing was performed and is reported within.

Collocation testing was also performed to ensure that no intermodulation products were created as a result of the proximity of the radios.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The Symbol Technologies, Inc GEMINI MC9090R6 complies with the limits for a Frequency Hopping Spread Spectrum Transmitter, Bluetooth device, and 802.11a/b/g device under FCC Part 15.247, 15.407 and Industry Canada RSS-210/RSS-GEN.



Table of Contents

Abstract.....	ii
1 Introduction.....	1
1.1 Compliance Statement	1
1.2 Test Scope.....	1
1.3 Contract Information.....	1
1.4 Test Dates	1
1.5 Test and Support Personnel	1
1.6 Test Summary	1
2 Equipment Under Test.....	3
2.1 EUT Identification & Description	3
2.2 Test Configuration	3
2.3 Testing Algorithm.....	3
2.4 Test Location	4
2.5 Measurements	4
2.5.1 References.....	4
2.6 Measurement Uncertainty.....	4
3 Test Equipment.....	5
4 Test Results.....	6
4.1 Radiated Spurious Emissions: (FCC Part §15.247(c) and RSS-210 A8.5)	6
4.1.1 Test Procedure	6
5 Co-Location Measurements	10

List of Tables

Table 1. Device Summary.....	3
Table 2. Test Equipment List.....	5
Table 3. Radiated Emission Test Data, Low Frequency Data (<1GHz).....	7
Table 4. Radiated Emission Test Data, High Frequency Data (>1GHz) (C0 Modulation).....	8
Table 5. Radiated Emission Test Data, High Frequency Data (>1GHz) (C1 Modulation).....	9
Table 6. Co-Location Radio Measurements Test Configuration.....	10

1 Introduction

1.1 Compliance Statement

The Symbol Technologies, Inc GEMINI MC9090R6 complies with the limits for a Frequency Hopping Spread Spectrum Transmitter, Bluetooth device, and 802.11a/b/g device under FCC Part 15.247 and Industry Canada RSS-210/RSS-GEN.

1.2 Test Scope

Tests for radiated emissions were performed. All measurements were performed in accordance with FCC Public Notice DA 00-705, FCC Part 15.247 and 15.407, and the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Symbol Technologies, Inc One Symbol Plaza MS A-13 Holtsville, NY 11742
Purchase Order Number:	4500572768
Quotation Number:	62979

1.4 Test Dates

Testing was performed on the following date(s): 6/22/2006 – 7/13/2006

1.5 Test and Support Personnel

Washington Laboratories, LTD	John Repella
Client Representative	Alan Parrish

1.6 Test Summary

As the GEMINI MC9090R6 has been completely tested with the Bluetooth device and the 802.11a/b/g card (FCC ID: H9PMC9090), no additional testing was performed on these modules with the exception of the collocation testing with all 3 radios operating simultaneously. Radiated emissions testing of the approved RFID card (FCC ID: NTTWJMPPR7XXX) in the MC9090R6 was performed as the antenna has been changed.

The following table is a brief summary of the tests performed on the Symbol Technologies Model MC9090R6.

Section	Requirement	Report Section	Pass/Fail
RFID Device			
15.247(c)	Radiated Spurious Emissions	5.1	Pass
RFID Device, Bluetooth Device, WLAN Module			
Collocation, 15.209	Radiated Spurious Emissions	7	Pass
15.207	AC Powerline Conducted Emissions	7.1	Pass

2 Equipment Under Test

2.1 EUT Identification & Description

The Symbol Technologies, Inc GEMINI 9090R6 is a Mobile RFID Reader system designed for in warehouses and other inventory control stations. The RFID Reader is an already approved EPC Generation 2 reader (FCC ID: NTTWJMPPR7XXX). The GEMINI also contains an 802.11 WLAN module device, also approved (FCC ID: H9P2121160) for communications and a V1.2 Bluetooth module (FCCID: H9PMC9090) for peripheral connectivity.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Symbol Technologies, Inc
FCC ID:	FCC ID: H9PMC9090R6
IC:	IC: 1549D-MC9090R6
Model:	M9090R6
FCC Rule Parts:	§15.247, §15.407
Industry Canada:	RSS210, RSS-GEN
Frequency Range:	Bluetooth: 2402 – 2480M RFID: 902.91 – 927.29M WLAN: 2412-2462, 5180-5240, 5260-5320, 5745-5805, 5825-5830M
RFID Device:	
Maximum Output Power:	0.955W
WLAN Device:	
Maximum Output Power:	2412-2462M: 91.62mW 5825-5830M: 75.16mW 5180-5240M: 48.31mW 5260-5320M: 78.34mW 5745-5805M: 78.52mW
Bluetooth:	
Maximum Output Power:	0.96mW (Bluetooth)
Occupied Bandwidth:	935kHz
Power Source & Voltage:	7.2V Rechargeable Lithium ION

2.2 Test Configuration

The GEMINI was setup with software to allow for continuous transmission of the selected radio. All antennas on the GEMINI are integral and cannot be changed.

2.3 Testing Algorithm

The RFID application software allowed control of the RFID device for setting the channels. A “CeCTxRx” application was used for controlling the WLAN 802.11 device and the BTRegtest was used for controlling the Bluetooth device. During the co-location testing all applications were utilized to get the radios operating simultaneously.

Worst case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

FCC Public Notice DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

FCC Public Notice FCC 97-114, Guidance on Measurements for Direct Sequence Spread Spectrum Systems

FCC UNII Part 15 Subpart E Checklist Document

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ± 2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5 (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2. Test Equipment List

WLL Asset #	Manufacturer Model/Type	Function	Cal. Due
0072	HP 8568B	SPECTRUM ANALYZER	7/03/2007
0068	HP 85650A	QUASI-PEAK ADAPTER	7/03/2007
0070	HP 85685A	RF PRESELECTOR	7/03/2007
0557	SCHAFFNER, CBL6141A	ANTENNA	12/1/2006
0125	SOLAR 8028-50-TS-BNC	LISN	1/21/2007
0126	SOLAR 8028-50-TS-BNC	LISN	1/21/2007
0428	SUNOL JB1	BICONILOG ANTENNA	1/23/2007
0004	ARA DRG118/A	MICROWAVE HORN ANTENNA	2/2/2007
0074	HEWLETT-PACKARD 8593A	SPECTRUM ANALYZER	10/4/2006
0522	HEWLETT-PACKARD 8449B	MICROWAVE PREAMP	5/4/2007
0425	ARA, DRG-118/A	MICROWAVE HORN ANTENNA	1/17/2007
0528	AGILENT 4446A	4446A SPECTRUM ANALYZER	6/27/2006
0280	ITC, 21C-3A1	WAVEGUIDE	2/7/2007
0281	ITC, 21A-3A1	WAVEGUIDE	2/7/2007
209	NARDA, V638	STANDARD GAIN ANTENNA	12/25/2008
210	NARDA, V637	STANDARD GAIN ANTENNA	12/25/2008

4 Test Results

4.1 Radiated Spurious Emissions: (FCC Part §15.247(c) and RSS-210 A8.5)

Radiated emissions that fall in the restricted bands must comply with the general emissions limits in 15.209(a) and RSS-210 Table 2.

The emissions were measured using the following resolution bandwidths:

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>30 kHz
>1000 MHz	1 MHz	<30 Hz (Avg.) 1MHz (Peak)

Harmonic and Spurious emissions that were identified as coming from the EUT were checked in Peak and in Average Mode above 1GHz. It was verified that the peak-to-average ratio did not exceed 20dB.

4.1.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The following is a sample calculation used in the data tables for calculating the final field strength of spurious emissions and comparing these levels to the specified limits.

Sample Calculation:

Spectrum Analyzer Voltage (SA Level): V dBμV
 Antenna Factor (Ant Corr): AFdB/m
 Cable Loss Correction (Cable Corr): CCdB
 Amplifier Gain: GdB
 Electric Field (Corr Level): EdBμV/m = VdBμV + AFdB/m + CCdB - GdB
 To convert to linear units: EμV/m = antilog (EdBμV/m/20)

Data are supplied in the following tables. Testing was performed to 9.3 GHz. No emissions were detected above the 3rd harmonic or approximately 2.8GHz. All detected emissions are reported in the following tables. Both peak and average measurements are listed.

Table 3. Radiated Emission Test Data, Low Frequency Data (<1GHz)

Client:	Symbol Technologies	Date:	6/23/2006
Tester:	John Repella	Job #:	9261
<u>EUT Information:</u>		<u>Test Requirements:</u>	
EUT:	MC9090R6	TEST STANDARD:	FCC Part 15
Configuration:	TX @ 915MHz (C1 Modulation Scheme) (Worst case)	DISTANCE:	3m
		CLASS:	B
<u>Test Equipment (<1GHz):</u>		<u>Test Equipment (>1GHz):</u>	
ANTENNA:	A_00382	ANTENNA:	A_00004
LIMIT:	LFCC_3m_Class_B *Limit <30MHz normalized to 3m (40dB/decade)		
CABLE:	CSITE1_3m	CABLE:	CSITE2_HF
AMPLIFIER:	A_00066		

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Hght (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
108.458	V	73.0	1.0	13.3	12.4	1.9	27.6	24.0	150.0	-15.9
109.549	V	73.0	1.0	12.3	12.6	1.9	26.8	22.0	150.0	-16.7
111.719	V	73.0	1.0	11.8	12.9	2.0	26.7	21.6	150.0	-16.8
138.533	V	160.0	1.0	13.8	13.2	2.2	29.2	29.0	150.0	-14.3
138.751	V	160.0	1.0	11.3	13.2	2.2	26.7	21.7	150.0	-16.8
141.836	V	160.0	1.0	12.9	13.0	2.2	28.1	25.4	150.0	-15.4
142.294	V	160.0	1.0	12.7	13.0	2.2	27.9	24.8	150.0	-15.6
143.174	V	160.0	1.0	11.8	12.9	2.2	26.9	22.2	150.0	-16.6
225.279	V	355.0	1.7	8.5	11.0	2.8	22.3	13.1	200.0	-23.7
225.529	V	355.0	1.7	10.9	11.0	2.8	24.7	17.3	200.0	-21.3
225.786	V	355.0	1.7	18.9	11.0	2.8	32.8	43.4	200.0	-13.3
226.029	V	355.0	1.7	8.3	11.0	2.8	22.2	12.8	200.0	-23.8
338.510	V	76.0	1.7	3.5	14.1	3.6	21.2	11.5	200.0	-24.8
564.285	V	180.0	1.5	17.0	18.6	4.8	40.4	104.8	200.0	-5.6
108.295	H	62.0	2.8	4.6	12.3	1.9	18.9	8.8	150.0	-24.7
109.814	H	62.0	2.8	6.9	12.7	1.9	21.5	11.9	150.0	-22.0
111.623	H	62.0	2.8	4.8	12.9	2.0	19.7	9.7	150.0	-23.8
225.275	H	355.0	2.0	13.1	11.0	2.8	26.9	22.2	200.0	-19.1
225.528	H	355.0	2.0	17.4	11.0	2.8	31.2	36.5	200.0	-14.8
225.775	H	355.0	2.0	25.4	11.0	2.8	39.3	92.1	200.0	-6.7
226.029	H	355.0	2.0	12.7	11.0	2.8	26.6	21.3	200.0	-19.4
338.522	H	252.0	1.1	5.4	14.1	3.6	23.1	14.3	200.0	-22.9
564.276	H	121.0	2.3	12.5	18.6	4.8	35.9	62.4	200.0	-10.1

Table 4. Radiated Emission Test Data, High Frequency Data (>1GHz) (C0 Modulation)

Client:	Symbol Technologies	Date:	6/26/2006
Tester:	John Repella	Job #:	9261
<u>EUT Information:</u>		<u>Test Requirements:</u>	
EUT:	MC9090-G	TEST STANDARD:	FCC Part 15
Configuration:	TX @ 902.91, 915, 927MHz & C0 Modulation Scheme	DISTANCE:	3m
		CLASS:	B
<u>Test Equipment (<1GHz):</u>		<u>Test Equipment (>1GHz):</u>	
ANTENNA:	A_00382	ANTENNA:	A_00425
LIMIT:	LFCC_3m_Class_B *Limit <30MHz normalized to 3m (40dB/decade)		
CABLE:	CSITE1_3m	CABLE:	CSITE1_HF
AMPLIFIER:	A_00066		

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Height (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)	Notes
902.910												
1805.496	V	235.0	1.0	40.1	27.8	2.4	32.0	38.3	82.0	500.0	-15.7	AVG
1805.496	V	235.0	1.0	46.7	27.8	2.4	32.0	44.9	175.5	5000.0	-29.1	PK
2708.242	V	0.0	1.0	34.6	29.7	3.2	32.0	35.4	58.8	500.0	-18.6	AVG
2708.242	V	0.0	1.0	45.3	29.7	3.2	32.0	46.1	202.1	5000.0	-27.9	PK
915.000												
1829.498	V	144.0	1.0	47.0	27.9	2.4	32.0	45.3	184.1	500.0	-8.7	AVG
1829.498	V	144.0	1.0	50.3	27.9	2.4	32.0	48.5	267.6	5000.0	-25.4	PK
2744.247	V	200.0	1.0	32.5	29.7	3.2	32.0	33.4	46.8	500.0	-20.6	AVG
2744.247	V	200.0	1.0	44.7	29.7	3.2	32.0	45.6	190.0	5000.0	-28.4	PK
927.290												
1854.497	V	144.0	1.0	49.4	28.0	2.4	32.0	47.8	244.3	500.0	-6.2	AVG
1854.497	V	144.0	1.0	55.6	28.0	2.4	32.0	53.9	498.2	5000.0	-20.0	PK
2781.748	V	200.0	1.0	36.8	29.8	3.2	32.0	37.8	77.6	500.0	-16.2	AVG
2781.748	V	200.0	1.0	46.2	29.8	3.2	32.0	47.2	229.8	5000.0	-26.8	PK
902.910												
1805.496	H	275.0	1.0	42.2	27.8	2.4	32.0	40.4	104.8	500.0	-13.6	AVG
1805.496	H	275.0	1.0	47.7	27.8	2.4	32.0	45.9	196.5	5000.0	-28.1	PK
2708.238	H	0.0	1.0	34.6	29.7	3.2	32.0	35.4	59.1	500.0	-18.5	AVG
2708.238	H	0.0	1.0	45.3	29.7	3.2	32.0	46.1	201.9	5000.0	-27.9	PK
915.000												
1829.498	H	29.0	1.0	51.7	27.9	2.4	32.0	50.0	316.6	500.0	-4.0	AVG
1829.498	H	29.0	1.0	54.2	27.9	2.4	32.0	52.5	420.7	5000.0	-21.5	PK
2744.245	H	180.0	1.0	39.4	29.7	3.2	32.0	40.3	103.8	500.0	-13.7	AVG
2744.245	H	180.0	1.0	45.1	29.7	3.2	32.0	46.0	198.9	5000.0	-28.0	PK
927.290												
1854.497	H	29.0	1.0	48.9	28.0	2.4	32.0	47.3	232.2	500.0	-6.7	AVG
1854.497	H	29.0	1.0	54.7	28.0	2.4	32.0	53.1	451.7	5000.0	-20.9	PK
2781.750	H	151.0	1.0	36.1	29.8	3.2	32.0	37.1	71.5	500.0	-16.9	AVG
2781.750	H	151.0	1.0	43.9	29.8	3.2	32.0	44.9	175.9	500.0	-9.1	PK

Table 5. Radiated Emission Test Data, High Frequency Data (>1GHz) (C1 Modulation)

Client:	Symbol Technologies	Date:	6/26/2006
Tester:	John Repella	Job #:	9261
EUT Information:		Test Requirements:	
EUT:	MC9090-G	TEST STANDARD:	FCC Part 15
Configuration:	TX @ 902.91, 915, 927MHz & C1 Modulation Scheme	DISTANCE:	3m
		CLASS:	B
Test Equipment (<1GHz):		Test Equipment (>1GHz):	
ANTENNA:	A_00382	ANTENNA:	A_00425
LIMIT:	LFCC_3m_Class_B*Limit <30MHz normalized to 3m (40dB/decade)		
CABLE:	CSITE1_3m	CABLE:	CSITE1_HF
AMPLIFIER:	A_00066		

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Hght (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)	Notes
902.910												
1805.502	V	200.0	1.0	49.7	27.8	2.4	32.0	47.8	246.5	500.0	-6.1	AVG
1805.502	V	200.0	1.0	54.2	27.8	2.4	32.0	52.3	413.9	5000.0	-21.6	PK
2708.252	V	200.0	1.0	34.7	29.7	3.2	32.0	35.5	59.7	500.0	-18.5	AVG
2708.252	V	200.0	1.0	44.3	29.7	3.2	32.0	45.2	181.2	5000.0	-28.8	PK
915.000												
1829.516	V	136.0	1.0	44.1	27.9	2.4	32.0	42.3	130.8	500.0	-11.6	AVG
1829.516	V	136.0	1.0	49.2	27.9	2.4	32.0	47.4	235.2	5000.0	-26.5	PK
2744.256	V	200.0	1.0	33.4	29.7	3.2	32.0	34.3	51.7	500.0	-19.7	AVG
2744.256	V	200.0	1.0	42.9	29.7	3.2	32.0	43.8	154.2	5000.0	-30.2	PK
927.290												
1854.497	V	180.0	1.0	47.9	28.0	2.4	32.0	46.2	205.3	500.0	-7.7	AVG
1854.497	V	180.0	1.0	54.7	28.0	2.4	32.0	53.0	449.1	5000.0	-20.9	PK
2781.748	V	200.0	1.0	37.6	29.8	3.2	32.0	38.6	85.1	500.0	-15.4	AVG
2781.748	V	200.0	1.0	47.4	29.8	3.2	32.0	48.4	263.5	5000.0	-25.6	PK
902.910												
1805.502	H	29.0	1.0	47.2	27.8	2.4	32.0	45.4	186.6	500.0	-8.6	AVG
1805.502	H	29.0	1.0	56.5	27.8	2.4	32.0	54.7	541.8	5000.0	-19.3	PK
2708.238	H	240.0	1.0	35.8	29.7	3.2	32.0	36.6	67.9	500.0	-17.3	AVG
2708.238	H	240.0	1.0	44.6	29.7	3.2	32.0	45.4	186.3	5000.0	-28.6	PK
915.000												
1829.498	H	29.0	1.0	48.0	27.9	2.4	32.0	46.3	206.5	500.0	-7.7	AVG
1829.498	H	29.0	1.0	52.1	27.9	2.4	32.0	50.4	330.4	5000.0	-23.6	PK
2744.250	H	180.0	1.0	33.9	29.7	3.2	32.0	34.8	55.1	500.0	-19.2	AVG
2744.250	H	180.0	1.0	42.9	29.7	3.2	32.0	43.8	155.6	5000.0	-30.1	PK
927.290												
1854.497	H	180.0	1.0	43.3	28.0	2.4	32.0	41.7	121.9	500.0	-12.3	AVG
1854.497	H	180.0	1.0	49.6	28.0	2.4	32.0	48.0	250.3	5000.0	-26.0	PK
2781.750	H	112.0	1.0	41.7	29.8	3.2	32.0	42.6	135.4	500.0	-11.3	AVG
2781.750	H	112.0	1.0	52.1	29.8	3.2	32.0	53.1	452.7	5000.0	-20.9	PK

5 Co-Location Measurements

The Symbol Technologies GEMINI MC9090R6 unit is a device which has collocated transmitters. There are a total of 3 transmitters that will operate simultaneously within 20cm separation distance. As described in Section 2 of this report the unit contains a 902-928MHz FHSS RFID transmitter, Bluetooth transmitter, and a 802.11a/b/g transmitter. To determine if the mixing of signals from one radio to another produces harmonics above specification limits, the device was set up to operate simultaneously with the following configurations:

Table 6. Co-Location Radio Measurements Test Configuration

Configuration	Radio	Frequency (MHz)	Note
1	Bluetooth	2402	Horz./Vert.
	RFID	927.29	Horz./Vert.
	802.11a	5260	Horz./Vert.
2	Bluetooth	2480	Horz./Vert.
	RFID	915	Horz./Vert.
	802.11b	2412	Horz./Vert.

The equipment was configured for a single channel in each band. The device was set up in an anechoic chamber and all transmitters were set to operate normally at maximum power settings. A scan of the spectrum was performed to identify any intermodulation products that may have been produced by mixing action occurring between the different transmitters. Particular attention was paid to the Restricted Bands of operation and measurements were collected as the equipment turntable was rotated through 360 degrees. Measurements were collected up to 18 GHz as it would be expected that any harmonic product would lie at or below the first product.

No additional frequencies or products were detected that exceed the radiated emissions limits of Part 15.209.