Engineering and Testing for EMC and Safety Compliance

CLASS II PERMISSIVE CHANGE REPORT

E. F. Johnson Company
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MODEL: 242-5180

FCC ID: ATH2425180

November 6, 2003

STANDARDS REFERENCED FOR THIS REPORT	
PART 2: 1999	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS
PART 15: 1999	§15.109: RADIATED EMISSIONS LIMITS
PART 90: 1998	PRIVATE LAND MOBILE RADIO SERVICES
PART 22: 1998	PUBLIC MOBILE SERVICES
ANSI C63.4-1992	STANDARD FORMAT MEASUREMENT/TECHNICAL REPORT PERSONAL COMPUTER AND PERIPHERALS
ANSI/TIA/EIA603- 1992	LAND MOBILE FM OR PM COMMUNICATIONS EQUIPMENT MEASUREMENT AND PERFORMANCE STANDARDS
ANSI/TIA/EIA 603-1-1998	ADDENDUM TO ANSI/TIA/EIA 603-1992
ANSI/TIA/EIA –102.CAAA; 1999	DIGITAL C4FM/CQPSK TRANSCEIVER MEASUREMENT METHODS
RSS-119; Issue 6; 2000	LAND MOBILE AND FIXED RADIO TRANSMITTERS AND RECEIVERS 27.41 TO 960.0 MHZ

Frequency Range	Output Power (W) Conducted	Frequency Tolerance (ppm)	Emission Designator
806.0125-823.9875 MHz	3.45	2.5	16K0F3E
806.0125-823.9875 MHz	3.42	2.5	14K0F3E
806.0125-823.9875 MHz	3.43	2.5	8K10F1E
851.0125-868.9875 MHz	3.47	2.5	16K0F3E
851.0125-868.9875 MHz	3.45	2.5	14K0F3E
851.0125-868.9875 MHz	3.43	2.5	8K10F1E

REPORT PREPARED BY:

TEST ENGINEER: DANIEL BALTZELL

Document Number: 2003180 / QRTL03-115

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TABLE OF CONTENTS

INDEX OF TABLES

INDEX OF FIGURES

INDEX OF APPENDIXES

INDEX OF PHOTOGRAPHS

1 GENERAL INFORMATION

The following Report of a Class II Permissive Change is prepared on behalf of **E. F. Johnson Company** in accordance with the Federal Communications Commission and Industry Canada Rules and Regulations. The Equipment Under Test (EUT) was Model **242-5180; FCC ID: ATH2425180**. The test results reported in this document relate only to the item that was tested.

All measurements contained in this application were conducted in accordance with FCC Rules and Regulations CFR 47, Industry Canada RSS-119, and ANSI C63.4 Methods of Measurement of Radio Noise Emissions, 1992. The instrumentation utilized for the measurements conforms to the ANSI C63.4 standard for EMI and Field Strength Instrumentation. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

1.1 TEST FACILITY

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report dated March 3, 1994, submitted to and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 1992).

1.2 RELATED SUBMITTAL(S)/GRANT(S)

The original application for Certification was FCC ID: ATH2425180; this is a Class II Permissive Change per FCC 2.1043(b)(2).

1.3 DESCRIPTION OF CHANGE IN DEVICE

A new stubby antenna is being added which can be used connected directly to the radio body or connected to the external speaker/microphone. A new Alkaline battery pack is also being added. No changes have been made to the radio itself.

1.4 TESTED SYSTEM DETAILS

Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable.

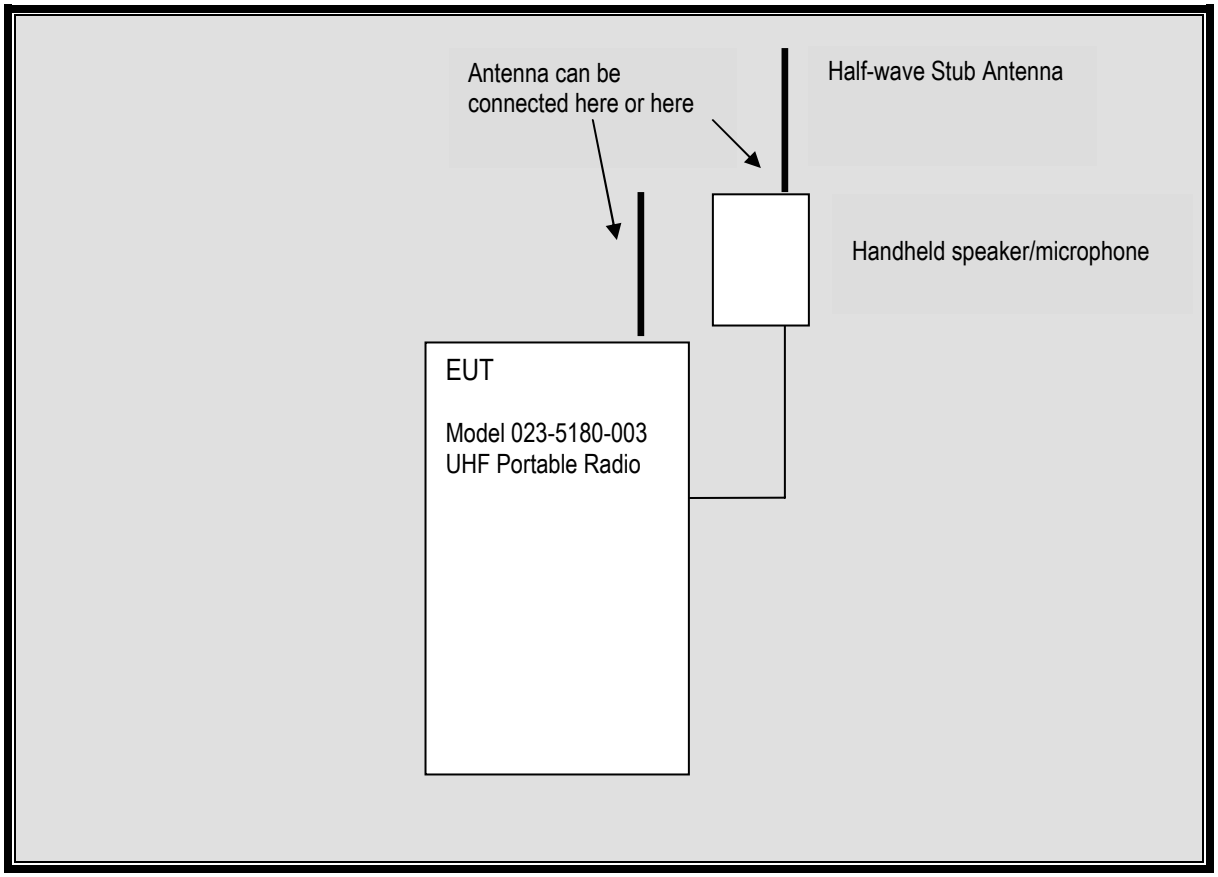
TABLE 1-1: EQUIPMENT UNDER TEST (EUT)

Part	Manufacturer	Model	Serial Number	FCC ID	RTL Bar Code
UHF Portable Radio	EF JOHNSON	023-5180-003	51830A103A 16525	ATH2425180	15066

TABLE 1-2: EXTERNAL COMPONENTS USED IN TEST CONFIGURATION

Part	Manufacturer	Model	Serial Number	FCC ID	RTL Bar Code
Speaker/Microphone	Speaker/Microphone	242-5180	CLI-433-005	N/A	14857
Speaker/Microphone	Speaker/Microphone	242-5180	CLI-433-012	N/A	15068
Stub Antenna	EF JOHNSON	Half-wave	CLI-433-009	N/A	15529
9V AA Alkaline Cell Pack	EF JOHNSON	242-5180	CLI-433-002	N/A	15065

FIGURE 1-1: CONFIGURATION OF TESTED SYSTEM



2 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FI(dBuV/m) = SAR(dBuV) + SCF(dB/m)
FI = Field Intensity
SAR = Spectrum Analyzer Reading
SCF = Site Correction Factor

The Site Correction Factor (SCF) used in the above equation is determined empirically, and is expressed in the following equation:

SCF(dB/m) = - PG(dB) + AF(dB/m) + CL(dB)

SCF = Site Correction Factor
PG = Pre-amplifier Gain
AF = Antenna Factor
CL = Cable Loss

The field intensity in microvolts per meter can then be determined according to the following equation:

$$FI(uV/m) = 10^{FI(dBuV/m)/20}$$

For example, assume a signal at a frequency of 125 MHz has a received level measured as 49.3 dBuV. The total Site Correction Factor (antenna factor plus cable loss minus preamplifier gain) for 125 MHz is -11.5 dB/m. The actual radiated field strength is calculated as follows:

49.3 dBuV - 11.5 dB/m = 37.8 dBuV/m

$$10^{37.8/20} = 10^{1.89} = 77.6 \text{ uV/m}$$

3 RADIATED EMISSIONS

3.1 RADIATED MEASUREMENT

Before final measurements of radiated emissions were made on the open-field three meter range, the EUT was scanned indoors at a three meter distance 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 insure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three-meter, open-field test site. The EUT was placed on a nonconductive turntable at specified level.

At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations.

Note: Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the Rhein Tech Quality Manual, section 6.1. Rhein Tech implements the following procedures to minimize errors that may occur: yearly, as well as daily calibration methods, technician training, and emphasis to employees on avoiding error.

4 FCC RULES AND REGULATIONS PART 2 §2.1046 (A): RF POWER OUTPUT: CONDUCTED

4.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.1

The EUT was connected to a coaxial attenuator having a 50 Ω load impedance.

4.2 TEST DATA

TABLE 4-1: RF POWER OUTPUT (HIGH POWER): CARRIER OUTPUT POWER (UNMODULATED)

Channel	Frequency (MHz)	RF Power measured (Watt)*	Modulation Type
1	806.0125	3.42	25 KHz Analog
2	815.5000	3.45	25 KHz Analog
3	823.9875	3.44	25 KHz Analog
4	806.0125	3.40	NPSPC Analog
5	815.5000	3.42	NPSPC Analog
6	823.9875	3.42	NPSPC Analog
7	806.0125	3.37	P25 Digital
8	815.5000	3.42	P25 Digital
9	823.9875	3.43	P25 Digital
10	851.0125	3.43	25 KHz Analog
11	860.5000	3.45	25 KHz Analog
12	868.9875	3.47	25 KHz Analog
13	851.0125	3.43	NPSPC Analog
14	860.5000	3.45	NPSPC Analog
15	868.9875	3.45	NPSPC Analog
16	815.0125	3.43	P25 Digital

* Measurement accuracy: +/- .02 dB (logarithmic mode)
* Measurement was taken from antenna port on radio

TABLE 4-2: RF POWER OUTPUT (RATED POWER)

Rated Power (W)
3.4 W

TABLE 4-3: TEST EQUIPMENT USED FOR TESTING (RF POWER OUTPUT - CONDUCTED)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901184	Agilent Technologies	E4416A	EPM-P Power Meter, single channel	GB41050573	7/30/04
901186	Agilent Technologies	E9323A (50 MHz – 6 GHz)	Peak & Average Power Sensor	US40410380	7/30/04
901139	Weinschel Corp.	48-20-34 DC-18GHz	Attenuator, 100W 20dB	BK5859	5/13/04

TEST PERSONNEL:

RICHARD B. MCMURRAY	Richard B. McMurray	OCTOBER 6, 2003
TEST ENGINEER	SIGNATURE	DATE OF TEST

5 FCC PART 2 §2.1046 (A): RF POWER OUTPUT: RADIATED

5.1 RF POWER OUTPUT: RADIATED TEST PROCEDURE

Substitution Method:

The EUT was setup at an antenna to EUT distance of 3 meters on an open area test site. The EUT was placed on a nonconductive turntable 1.0 meter above the ground plane. The physical arrangement of the EUT was varied through three orthogonal planes in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations. The worst-case, maximum radiated emission was recorded and used as reference for the measurement. The EUT was then replaced by a ½ wave dipole antenna and polarized in accordance with the EUT's antenna polarization. The ½ wave dipole antenna was connected to a RF signal generator with a coaxial cable. The search antenna height, and search antenna polarity was set to levels that produced the maximum reading obtained. The signal generator was adjusted to a level that produced that maximum radiated emission level. The signal generator level was recorded and corrected by the power loss in the cable between the generator and the antenna and further corrected for the gain of the substitution antenna used relative to an ideal ½ wave dipole antenna. The signal generator corrected level is the ERP level.

5.2 RF POWER OUTPUT: §2.1046 RADIATED TEST DATA

The following channels (in MHz) were tested: 806.0125; 815.0125; 823.9875; 851.0125; 860.0125; and 868.9875 MHz. The worst-case Output Power (highest) levels are shown.

TABLE 5-1: RADIATED CARRIER OUTPUT POWER (STUB ANTENNA ON RADIO)

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)*	Antenna Factor (dBd)	ERP (dBm)	ERP (W)
806.0125	116.5	34.7	0.2	-1.3	33.2	2.1
815.0125	116.0	34.5	0.2	-1.3	33.0	2.0
823.9875	115.3	35.0	0.2	-1.3	33.5	2.2
851.0125	115.2	35.0	0.3	-1.2	33.6	2.2
860.0125	115.5	36.0	0.3	-1.2	34.6	2.8
868.9875	115.5	35.8	0.3	-1.2	34.4	2.7

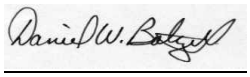
*Cable loss from transmitting antenna to signal generator
*Measurement accuracy is +/- .5 dB

TABLE 5-2: RADIATED CARRIER OUTPUT POWER (STUB ANTENNA ON HANDSET)

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)*	Antenna Factor (dBd)	ERP (dBm)	ERP (W)
806.0125	113.2	31.4	0.4	-1.3	29.7	0.9
815.0125	113.3	31.8	0.4	-1.3	30.1	1.0
823.9875	112.3	32.0	0.4	-1.3	30.3	1.1
851.0125	112.2	32.0	0.4	-1.2	30.5	1.1
860.0125	112.5	33.0	0.4	-1.2	31.5	1.4
868.9875	112.4	32.7	0.4	-1.2	31.2	1.3

*Cable loss from transmitting antenna to signal generator

TEST PERSONNEL:

DANIEL BALTZELL		NOVEMBER 4, 2003
TEST ENGINEER	SIGNATURE	DATE OF TEST

5.3 TEST EQUIPMENT

TABLE 5-3: 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 req'd
900928	Hewlett Packard	83752A	Synthesized Sweeper (0.01 - 20 GHz)	3610A00866	8/5/04
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	7/15/04
901053	Schaffner Chase	CBL6112B	Bi-Log Antenna, (20 MHz - 2 GHz)	2648	7/03/04
901235	IW Microwave Products	KPS-1503-360-KPS	High frequency RF cable, 36"	N/A	1/30/04
901231	IW Microwave Products	KPW-1503-2400-KPS	High Frequency RF Cables	240"	1/30/04
901242	Rhein Tech Labs	WRT-000-0003	Wood rotating table	w/o top for wireless testing	not req'd
900154	Compliance Design Inc,	Roberts Dipole	Adjustable Elements Dipole Antenna (3 0 - 1000 MHz)	900154	10/6/04

6 FCC RULES AND REGULATIONS PART 2 §2.1053 (A): FIELD STRENGTH OF SPURIOUS RADIATION

6.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.12

The spurious emissions levels were measured and the device under test was replaced by a substitution antenna connected to a signal generator. This signal generator level was then corrected by subtracting the cable loss from the substitution antenna to the signal generator and the gain of the antenna was further corrected to a half wave dipole.

6.2 TEST DATA

6.2.1 CFR 47 PART 90.210 REQUIREMENTS

The worst-case emissions test data are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

TABLE 6-1: FIELD STRENGTH OF SPURIOUS RADIATION CHANNEL 2 – 815.0125 MHZ; WIDE BAND (ANTENNA MOUNTED ON RADIO)

Radiated Spurious Emissions
Mid Band Channel 2 (815.0125 MHz, Wideband)
Limit = 43 + 10 Log P = 48.38 dBc
Conducted Power = 35.38 dBm = 3.45 W

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)*	Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
1630.0250	55.8	-21.5	0.5	4.7	52.7	-4.3
2445.0375	72.0	-16.7	8.5	5.1	55.5	-7.1
3260.0500	60.5	-24.7	11.2	6.1	65.2	-16.8
4075.0625	53.0	-34.2	0.9	6.0	64.5	-16.1
4890.0750	48.7	-38.3	1.0	7.0	67.7	-19.3
5705.0875	46.2	-39.5	1.2	6.5	69.6	-21.2
6520.1000	39.7	-38.4	1.5	7.8	67.5	-19.2
7335.1125	38.0	-32.6	1.4	7.6	61.8	-13.4
8150.1250	35.2	-46.0	1.4	8.4	74.4	-26.0

*This insertion loss corresponds to the cable connecting the RF Signal Generator to the ½ wave dipole antenna.

TABLE 6-2: FIELD STRENGTH OF SPURIOUS RADIATION CHANNEL 11 – 860.0125 MHZ; WIDE BAND (ANTENNA MOUNTED ON RADIO)

Radiated Spurious Emissions
Mid Band Channel 11 (860.0125 MHz, Wideband)
Limit = 43 + 10 Log P = 48.38 dBc
Conducted Power = 35.38 dBm = 3.45 W

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)*	Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
1720.0250	57.8	-19.4	0.5	4.7	50.5	-2.2
2580.0375	61.8	-25.7	8.0	5.3	63.8	-15.4
3440.0500	62.8	-21.5	11.8	6.0	62.7	-14.3
4300.0625	44.7	-41.2	0.9	6.6	70.9	-22.5
5160.0750	46.0	-40.8	1.1	6.8	70.5	-22.1
6020.0875	40.3	-42.5	1.4	6.7	72.6	-24.2
6880.1000	37.5	-37.3	1.5	7.7	66.5	-18.1
7740.1125	34.7	-37.7	1.3	8.0	66.4	-18.0
8600.1250	39.5	-40.7	1.4	8.1	69.4	-21.0

*This insertion loss corresponds to the cable connecting the RF Signal Generator to the ½ wave dipole antenna.

TABLE 6-3: FIELD STRENGTH OF SPURIOUS RADIATION CHANNEL 2 – 815.0125 MHZ; WIDE BAND (ANTENNA MOUNTED ON HANDSET)

Radiated Spurious Emissions
Mid Band Channel 2 (815.0125 MHz, Wideband)
Limit = 43 + 10 Log P = 48.38 dBc
Conducted Power = 35.38 dBm = 3.45 W

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)*	Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
1630.0250	46.3	-31.0	0.5	4.7	62.2	-13.8
2445.0375	53.3	-35.4	8.5	5.1	74.2	-25.8
3260.0500	37.0	-48.2	11.2	6.1	88.7	-40.3
4075.0625	28.8	-58.4	0.9	6.0	88.7	-40.3
4890.0750	27.0	-60.0	1.0	7.0	89.4	-41.0
5705.0875	28.2	-57.5	1.2	6.5	87.6	-39.2
6520.1000	23.2	-54.9	1.5	7.8	84.0	-35.7
7335.1125	26.7	-43.9	1.4	7.6	73.1	-24.7
8150.1250	20.8	-60.4	1.4	8.4	88.8	-40.4

*This insertion loss corresponds to the cable connecting the RF Signal Generator to the ½ wave dipole antenna.

TABLE 6-4: FIELD STRENGTH OF SPURIOUS RADIATION CHANNEL 11 – 860.0125 MHZ; WIDE BAND (ANTENNA MOUNTED ON HANDSET)

Radiated Spurious Emissions
Mid Band Channel 11 (860.0125 MHz, Wideband)
Limit = 43 + 10 Log P = 48.38 dBc
Conducted Power = 35.38 dBm = 3.45 W

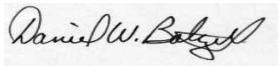
Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)*	Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
1720.0250	45.2	-32.0	0.5	4.7	63.1	-14.8
2580.0375	51.7	-35.8	8.0	5.3	73.9	-25.5
3440.0500	47.5	-36.8	11.8	6.0	78.0	-29.6
4300.0625	30.0	-55.9	0.9	6.6	85.6	-37.2
5160.0750	30.0	-56.8	1.1	6.8	86.5	-38.1
6020.0875	30.5	-52.3	1.4	6.7	82.4	-34.0
6880.1000	29.0	-45.8	1.5	7.7	75.0	-26.6
7740.1125	28.7	-43.7	1.3	8.0	72.4	-24.0
8600.1250	30.8	-49.4	1.4	8.1	78.1	-29.7

*This insertion loss corresponds to the cable connecting the RF Signal Generator to the ½ wave dipole antenna.

TABLE 6-5: TEST EQUIPMENT USED FOR TESTING (FIELD STRENGTH OF SPURIOUS RADIATION)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900814	Electrometrics	EM6961 (RGA-60)	Double Ridge Guide Antenna (1 - 18 GHz)	2310	2/17/04
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1 - 26.5 GHz)	3008A00505	4/22/04
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	7/15/04
901053	Schaffner Chase	CBL6112B	Bi-Log Antenna, (20 MHz - 2 GHz)	2648	7/03/04
901235	IW Microwave Products	KPS-1503-360-KPS	High frequency RF cable, 36”	N/A	1/30/04
901231	IW Microwave Products	KPW-1503-2400-KPS	High Frequency RF Cables	240"	1/30/04
901242	Rhein Tech Labs	WRT-000-0003	Wood rotating table	w/o top for wireless testing	not req’d
900154	Compliance Design Inc,	Roberts Dipole	Adjustable Elements Dipole Antenna (3 0 - 1000 MHz)	900154	10/6/04
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	3/15/04
900321	EMCO	3161-03	Horn Antenna (4.0 - 8.2 GHz)	9508-1020	4/10/04
900323	EMCO	3160-07	Horn Antenna (8.2 - 12.4 GHz)	9605-1054	6/10/04

TEST PERSONNEL:

DANIEL BALTZELL		NOVEMBER 4, 2003
TEST ENGINEER	SIGNATURE	DATE OF TEST

7 FCC RULES AND REGULATIONS PART 15 §15.109: RADIATED EMISSIONS LIMITS

TABLE 7-1: RADIATION EMISSIONS TEST RESULTS – RX/DIGITAL

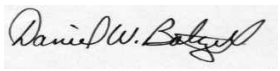
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
188.457	Qp	V	270	1.0	48.4	-11.5	36.9	43.5	-6.6
196.590	Qp	V	300	2.0	44.1	-11.1	33.0	43.5	-10.5
220.100	Qp	V	0	1.0	39.5	-9.9	29.6	46.0	-16.4
364.500	Qp	V	30	1.8	43.3	-4.4	38.9	46.0	-7.1
729.000	Qp	V	270	1.8	35.8	5.3	41.1	46.0	-4.9
777.670	Qp	V	0	1.0	34.9	6.6	41.5	46.0	-4.5
786.660	Qp	V	0	1.0	34.1	6.8	40.9	46.0	-5.1
795.645	Qp	V	0	1.0	33.5	7.1	40.6	46.0	-5.4
822.670	Qp	V	0	1.0	33.5	7.7	41.2	46.0	-4.8
831.670	Qp	V	0	1.0	33.3	7.8	41.1	46.0	-4.9
840.645	Qp	V	0	1.0	33.5	7.9	41.4	46.0	-4.6

Limit/Distance: FCC B/3M

TABLE 7-2: TEST EQUIPMENT USED FOR TESTING (FCC CLASS B RADIATED EMISSIONS)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900724	Antenna Research Associates, Inc.	LPB-2520	LOG Periodic/Biconical Antenna (25 – 1000 MHz)	1037	3/27/04
900811	Rhein Tech Labs	PR-1040	Amplifier	1003	2/13/04
900896	Hewlett Packard	85662A	Display Section	900896	2/07/04
900897	Hewlett Packard	8567A	HP Spectrum Analyzer (10 KHz - 1.5GHz)	900897	2/07/04
900901	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz - 40 GHz)	900901	2/07/04

TEST PERSONNEL:

DANIEL BALTZELL		NOVEMBER 4, 2003
TEST ENGINEER	SIGNATURE	DATE OF TEST