ENGINEERING TEST REPORT

BlackBerry Wireless Handheld
Model No.: R1900G-1-4
FCC ID: L6AR1900G-1-4

Applicant: **Research In Motion Limited**
295 Phillip Street
Waterloo, Ontario
Canada, N2L 3W8

Tested in Accordance With

Federal Communications Commission (FCC)
PERSONAL COMMUNICATIONS SERVICES
CFR 47, PARTS 2 and 24 (Subpart E)

UltraTech's File No.: RIM18-FTX

This Test report is Issued under the Authority of
Tri M. Luu, Professional Engineer,
Vice President of Engineering
UltraTech Group of Labs

Date: Aug. 10, 2001

Report Prepared by: Tri Luu, P.Eng.	Tested by: Mr. Hung Trinh, RFI/EMI Technician
Issued Date: Aug. 10, 2001	Test Dates: Aug. 09, 2001

The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Parts 2 and 24 (Subpart E): 1998
Title	Telecommunication - Code of Federal Regulations, CFR 47, Parts 2 & 24
Purpose of Test:	EIRP Measurements for a PCS radio transmitter operating in the frequency band 1850 - 1910 MHz (Broadband PCS) with with diverse accessories.
Test Procedures	Radiated emissions measurements were conducted in accordance with American National Standards Institute 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.

1.2. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 2 and 24	1998	Code of Federal Regulations – Telecommunication
ANSI C63.4	1992	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
CISPR 22 & EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1		Specification for Radio Disturbance and Immunity measuring apparatus and methods

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Research In Motion Limited
Address:	295 Phillip Street Waterloo, Ontario Canada, N2L 3W8
Contact Person:	Mr. Masud Attayi Phone #: (519) 888-7465 x2442 Fax #: (519) 888-6906 Email Address: mattayi@rim.net

MANUFACTURER	
Name:	Research In Motion Limited
Address:	295 Phillip Street Waterloo, Ontario Canada, N2L 3W8
Contact Person:	Mr. Masud Attayi Phone #: (519) 888-7465 x2442 Fax #: (519) 888-6906 Email Address: mattayi@rim.net

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	BlackBerry
Product Name:	BlackBerry Wireless Handheld
Model Name or Number:	R1900G-1-4
Serial Number:	Pre-production sample
Type of Equipment:	Personal Communications Services
External Power Supply:	AC charging adaptor and synchronization cradle supplied
Transmitting/Receiving Antenna Type:	Integral
Primary User Functions of EUT:	e-mail, personal digital assistant (PDA)

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Portable
Intended Operating Environment:	• Residential • Commercial, light industry & heavy industry
Power Supply Requirement:	Internal rechargeable battery – required accessories supplied for charging
RF Output Power Rating:	1.38 Watts EIRP
Duty Cycle:	PCS network – 1 slot in 8 slot frame – 12.5%
Operating Frequency Range:	1850 - 1910 MHz (Broadband PCS)
RF Output Impedance:	Not applicable – antenna is not removable
Channel Spacing:	200 kHz
Occupied Bandwidth (99%):	250 kHz
Emission Designation:	307KGXW
Digital Oscillator Frequencies:	13 MHz
Radio Oscillator Frequencies:	1048 MHz IF LO, 1719-1779 MHz variable oscillators
Antenna Connector Type:	Integral
Antenna Description:	Manufacturer: RIM Type: Internal modified center fed folded dipole Model: PCB-03092 Frequency Range: 1850 - 1990 MHz In/Out Impedance: Not applicable – antenna in not removable

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	Serial I/O & DC	1	JAE PCB-to-cable connector	None
2	Audio	1	2.5mm audio plug	None

NOTES:

(1) ***Ports of the EUT which in normal operation*** *were connected to ancillary equipment through interconnecting cables via a representative interconnecting cable to simulate the input/output characteristics.*

(2) ***Ports which are not connected to cables during normal intended operation*** *(for factory/technical services uses only)*

None.

2.5. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

2.6. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Cradle
Brand name:	BlackBerry
Model Name or Number:	ASY-02556-111
Serial Number:	Pre-production sample
Cable Length & Type:	2m shielded with RS232 termination to plug into computer and DC receptacle
Connected to EUT's Port:	Serial I/O & DC

Ancillary Equipment # 2	
Description:	AC charging adapter
Brand name:	BlackBerry
Model Name or Number:	PWR-02908-003
Serial Number:	Pre-production sample
Cable Length & Type:	2m unshielded with barrel jack
Connected to EUT's Port:	None – it is plugs into receptacle by RS232 connector on cradle cable

Ancillary Equipment # 3	
Description:	Headset
Model Name or Number:	HDW-03458-001
Serial Number:	N/A
Cable Length & Type:	1.2m
Connected to EUT's Port:	Audio

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21^{o}C
Humidity:	51%
Pressure:	102 kPa
Power input source:	Internal rechargeable battery

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	N/A
Special Hardware Used:	R&S CMU 200

Transmitter Test Signals	
Frequency Band(s): ▪ 1850 – 1910 MHz	Near lowest, near middle & near highest frequencies each frequency bands that the transmitter covers: ▪ 1850.2 MHz, 1880.0 MHz and 1909.8 MHz
Transmitter Wanted Output Test Signals: ▪ RF Power Output (measured maximum output power): ▪ Normal Test Modulation ▪ Modulating signal source:	 ▪ 1.38 Watts (e.i.r.p.) ▪ GXW ▪ Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- Radiated Emissions were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

The above site have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: Aug. 08, 2001.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	APPLICABILITY (YES/NO)
24.229	Frequencies	No request
24.232 & 2.1046	Equivalent Isotropically Radiated Power (e.i.r.p.) Limits	Refer to test report File # RIM-015FTX
24.235 & 2.1055	Frequency Stability	No Request
24.238 & 2.1051	Emission Limits (Conducted)	No Request
24.236 & 24.238, 2.1057 & 2.1053	Emission Limits (Radiated)	Yes

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 7 of this report

5.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 6 for Measurement Uncertainties.

5.3. MEASUREMENT EQUIPMENT USED:

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4:1992 and CISPR 16-1.

5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUACTURER:

The essential function of the EUT is to correctly communicate data to and from radios over RF link.

5.5. EMISSION LIMITS (RADIATED) @ FCC 2.1049, 24.236 & 24.238

5.5.1. Limits

- The predicted or measured field strength at any location on the border of the PCS Service area shall not exceed 47 dBμV/m unless the parties agree to a higher field strength.
- On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43+10lo(P) dB.

5.5.2. Method of Measurements

The spurious/harmonic ERP measurements are using substitution method specified in Exhibit 8, § 8.2 of this report and its value in dBc is calculated as follows:

(1) If the transmitter's antenna is an integral part of the EUT, the ERP is measured using substitution method.
(2) If the transmitter's antenna is non-integral and diverse, the lowest ERP of the carrier with 0 dBi antenna gain is used for calculation of the spurious/harmonic emissions in dBc:
Lowest ERP of the carrier = EIRP – 2.15 dB = Pc + G - 2.15 dB = xxx dBm (conducted) + 0 dBi – 2.15 dB
(3) Spurious /harmonic emissions levels expressed in dBc (dB below carrier) are as follows:

ERP of spurious/harmonic (dBc) = ERP of carrier (dBm) – ERP of spurious/harmonic emission (dBm)

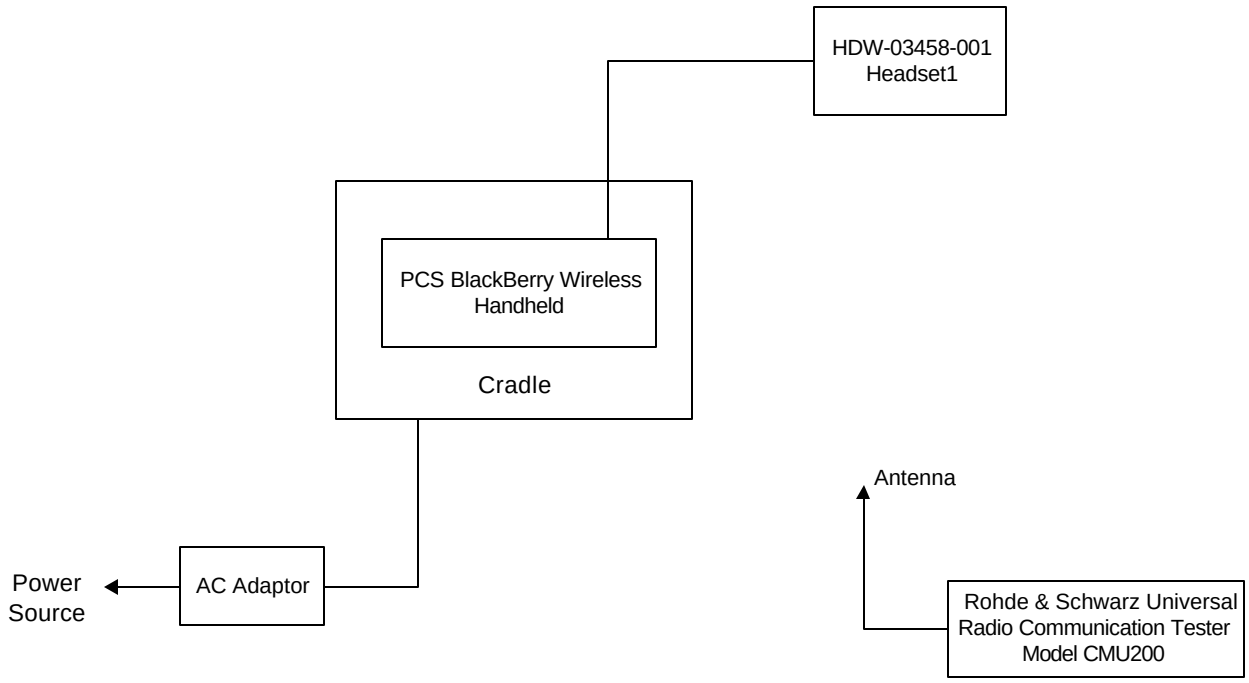
Measuring Bandwidths:

- Outside the permitted band block: RBW = 1 MHz, VBW ≥ RBW
- Inside or on the permitted band block: RBW = 1% of -26dBc Bandwidth, VBW ≥ RBW

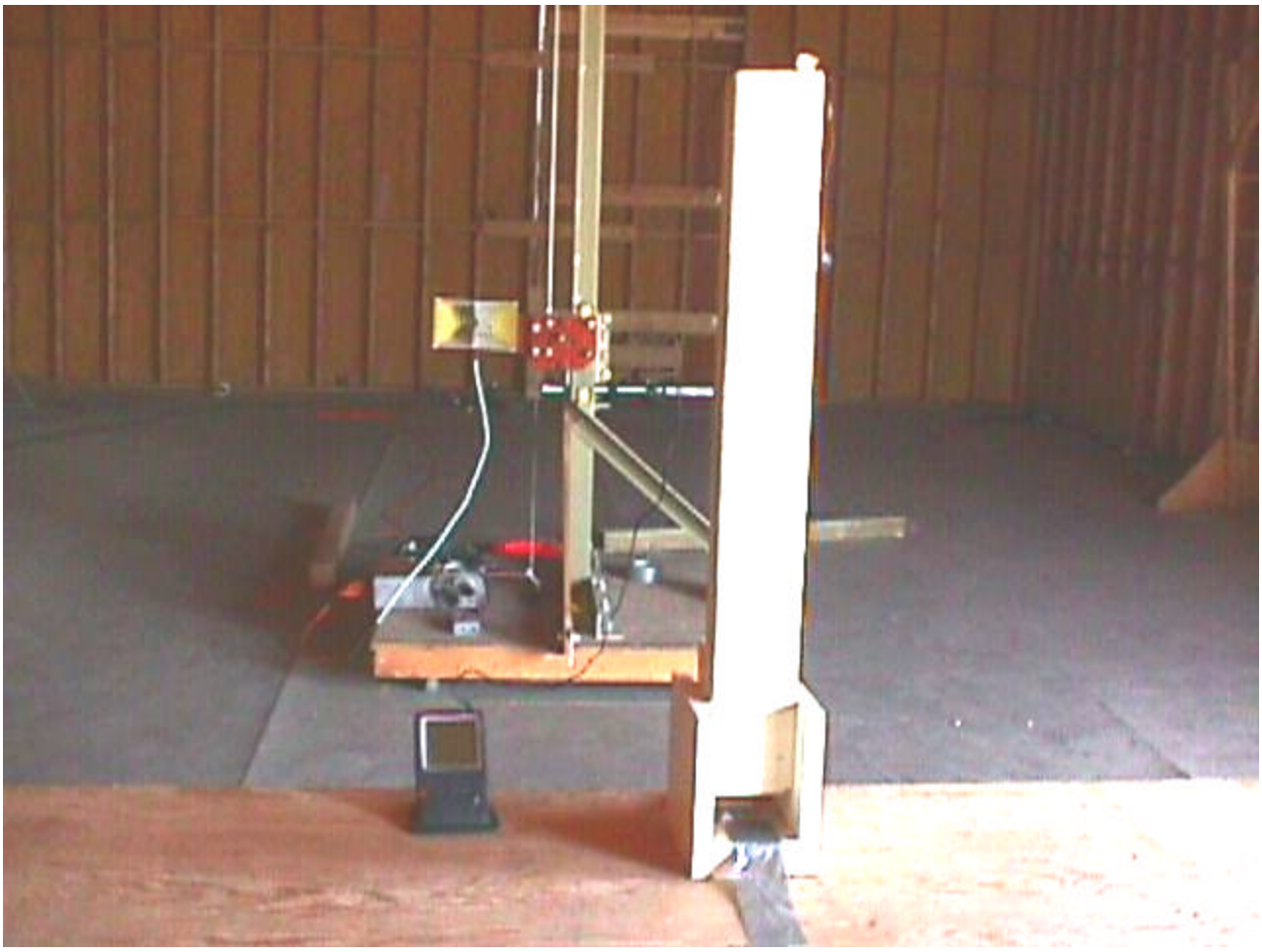
5.5.3. Test Equipment List

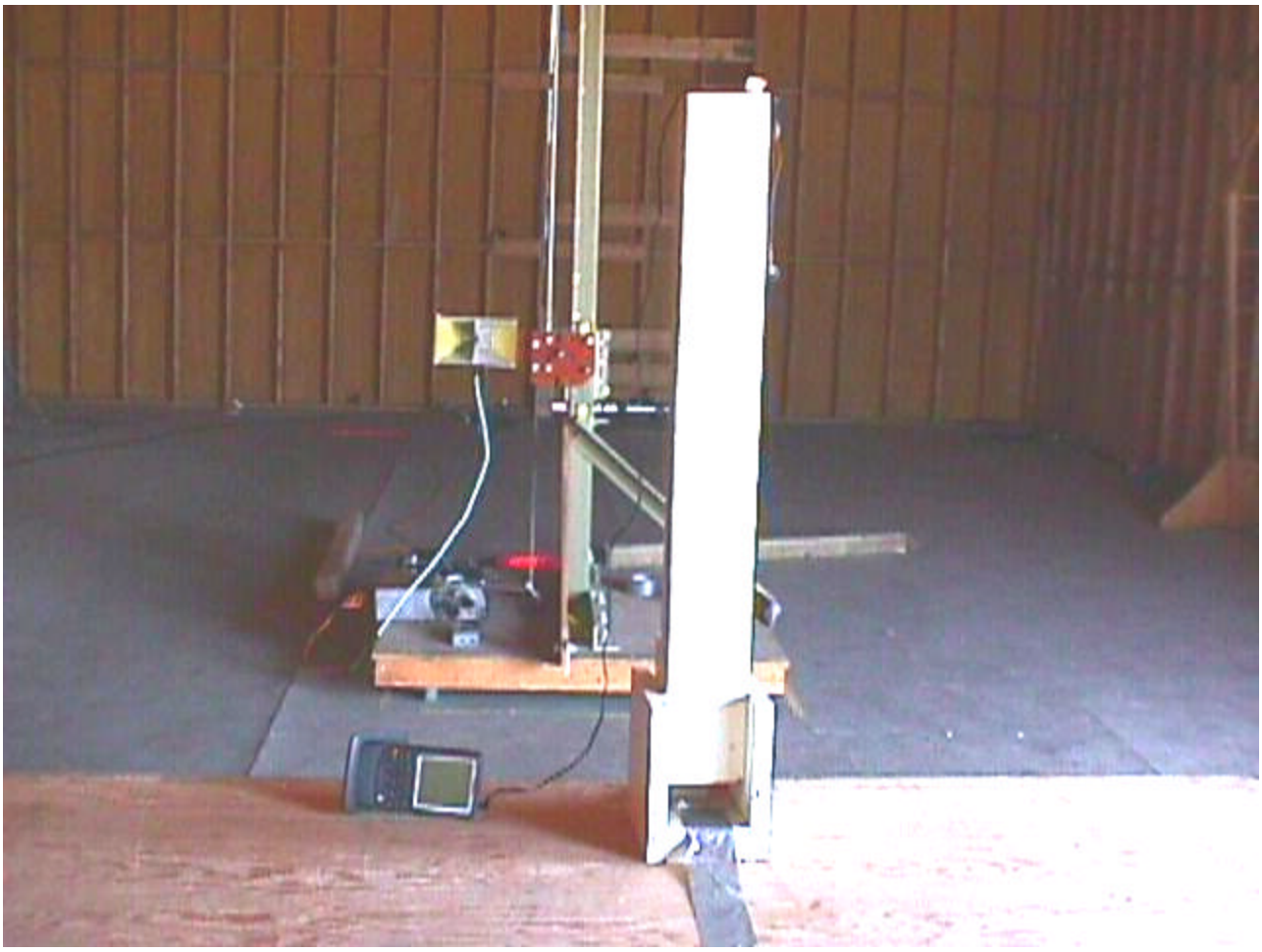
Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Calibration Date
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8546A	…	9 kHz to 5.6 GHz with built-in 30 dB Gain Pre-selector, QP, Average & Peak Detectors.	Sep. 16, 2000
Microwave Amplifier	Hewlett Packard	HP 83017A	3116A00661	1 GHz to 26.5 GHz	Apr. 20, 2001
Biconilog Antenna	EMCO	3142	9901-1347	30 MHz to 2 GHz	Nov. 13, 2000
Dipole Antenna	EMCO	3121C	8907-434	30 GHz – 1 GHz	Mar. 01, 2001
Dipole Antenna	EMCO	3121C	8907-440	30 GHz – 1 GHz	Mar. 01, 2001
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz	Apr. 27, 2001
Horn Antenna	EMCO	3155	9911-5955	1 GHz – 18 GHz	Apr. 27, 2001
Power Meter	Hewlett Packard	436A	1725A02249	10 kHz – 50 GHz, sensor dependent	Sep. 08, 2000
Power Sensor	Hewlett Packard	8481A	2702A68983	10 MHz – 18 GHz	Jan.04, 2001
Synthesize Sweeper	Hewlett Packard	83752B	3610A00457	0.01 – 20 GHz	Jan.30, 2001

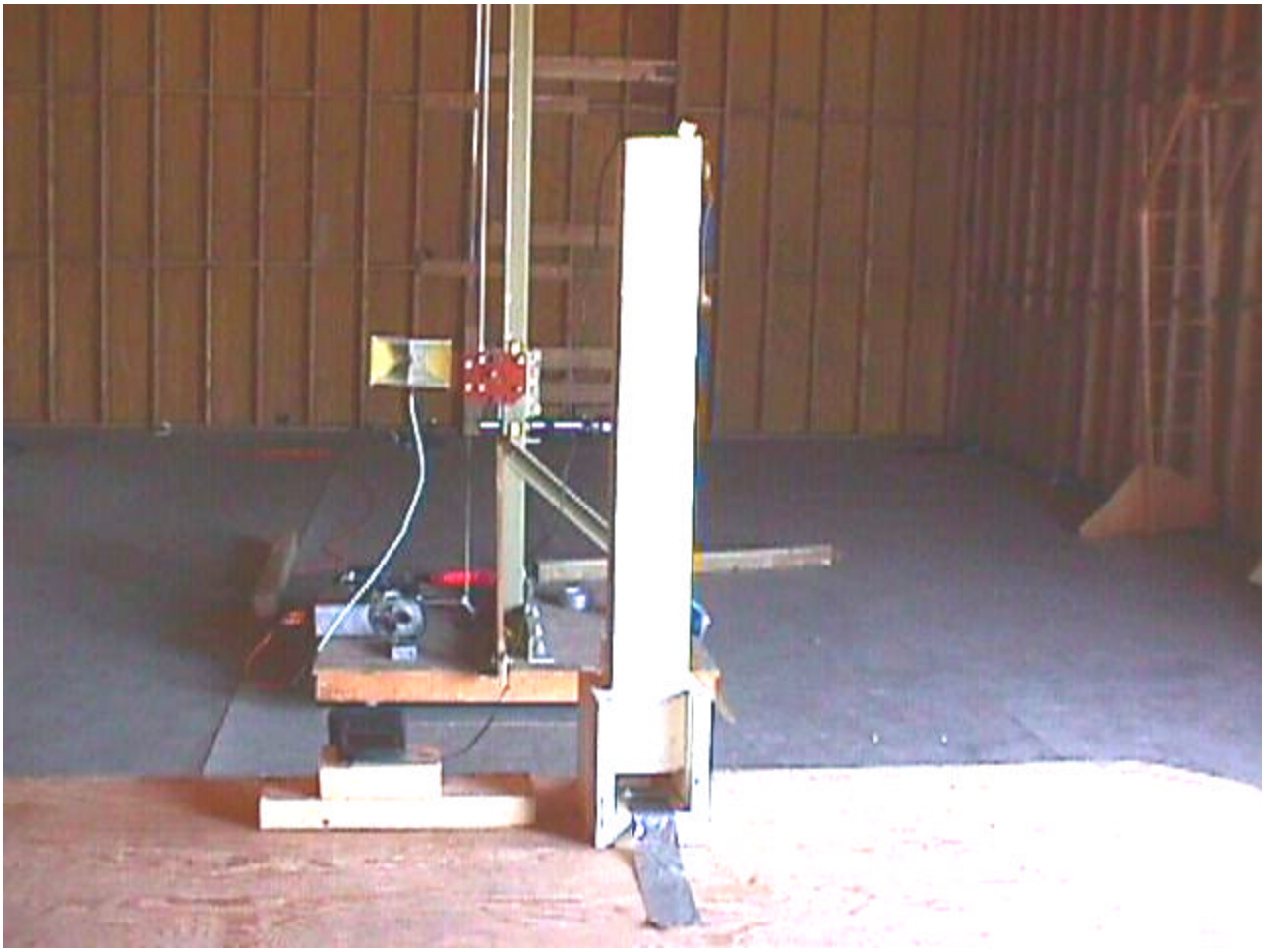
5.5.4. Test Arrangement



5.5.5. Photographs of Test Setup







5.5.6. Test Data

- **Model R1900G-1-4 with Radio S/N: 183, Toshiba battery and Samsung LCD, Cradle and Headset**

Frequency (MHz)	Peak E-Field @ 3m (dBµV/m)	Antenna Polarization (V/H)	Peak Power From Signal Generator (dBm)	Substitution Antenna Gain (dBi)	Measured Peak EIRP (dBm)	Peak EIRP LIMIT (dBm)
1850.2	128.9	V	21.0	9.0	30.0	33.0
	127.7	H	19.6	9.0	28.6	33.0
1880.0	130.5	V	22.4	9.0	31.4	33.0
	127.9	H	19.6	9.0	28.6	33.0
1909.8	128.2	V	21.5	9.0	30.5	33.0
	128.4	H	20.8	9.0	29.8	33.0

This test configuration will be used for transmitter spurious/harmonic emissions with an addition of the headset.

5.5.6.1. Lowest Frequency (1850.2 MHz)

Fundamental Frequency: 1850.2 MHz
RF Output Power: 30 dBm (EIRP)
Modulation: Internal data source

FREQUENCY (MHz)	E-FIELD @3m (dBuV/m)	EIRP measured by Substitution Method (dBm)	(dBc)	EMI DETECTOR (Peak/QP)	ANTENNA POLARIZATION (H/V)	MINIMUM LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
10 – 18800	<<	<<	> 70	PEAK	V & H	43	> 30	PASS

- The emissions were scanned from 10 MHz to 20 GHz, and all emissions were found to be more than 70 dB below the carrier.

5.5.6.2. Middle Frequency (1880 MHz)

Fundamental Frequency: 1880 MHz
RF Output Power: 31.4 dBm (EIRP)
Modulation: Internal data source

FREQUENCY (MHz)	E-FIELD @3m (dBuV/m)	EIRP measured by Substitution Method (dBm)	(dBc)	EMI DETECTOR (Peak/QP)	ANTENNA POLARIZATION (H/V)	MINIMUM LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
10 – 18502	<<	<<	> 70	PEAK	V & H	41.6	> 30	PASS

- The emissions were scanned from 10 MHz to 20 GHz, and all emissions were found to be more than 70 dB below the carrier.

5.5.6.3. Lowest Frequency (1909.8 MHz)

Fundamental Frequency: 1909.8 MHz
RF Output Power: 30.5 dBm (EIRP)
Modulation: Internal data source

FREQUENCY (MHz)	E-FIELD @3m (dBuV/m)	EIRP measured by Substitution Method (dBm)	(dBc)	EMI DETECTOR (Peak/QP)	ANTENNA POLARIZATION (H/V)	MINIMUM LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
10 – 19098	<<	<<	> 70	PEAK	V & H	42.5	> 30	PASS

- The emissions were scanned from 10 MHz to 20 GHz, and all emissions were found to be more than 70 dB below the carrier.

EXHIBIT 6. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

6.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivity	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC Γ_1 = 0.2 Antenna VRC Γ_R = 0.67(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k=2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

EXHIBIT 7. MEASUREMENT METHODS

7.1. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

7.1.1. Maximizing RF Emission Level (E-Field)

(a) The measurements was performed with full rf output power and modulation.
(b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
(e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(f) Set the EMI Receiver #1 and #2 as follows:

Center Frequency:	test frequency
Resolution BW:	100 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(h) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
(k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
(l) Repeat for all different test signal frequencies

7.1.2. Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency:	equal to the signal source
Resolution BW:	10 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
(d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):

- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:

- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

P = P1 - L1 = (P2 + L2) – L1 = P3 + A + L2 - L1
EIRP = P + G1 = P3 + L2 - L1 + A + G1
ERP = EIRP – 2.15 dB
Total Correction factor in EMI Receiver # 2 = L2 – L1 + G1

Where: P: Actual RF Power fed into the substitution antenna port after corrected.
P1: Power output from the signal generator
P2: Power measured at attenuator A input
P3: Power reading on the Average Power Meter
EIRP: EIRP after correction
ERP: ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
(p) Repeat step (d) to (o) for different test frequency
(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.:

Figure 2

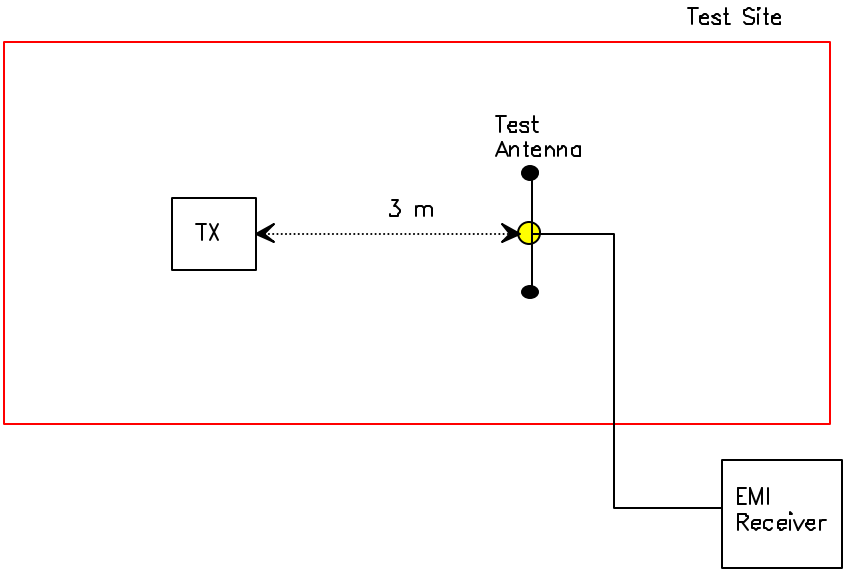


Figure 3