

ELECTROMAGNETIC EMISSIONS TEST REPORT

BY

COM-SERVE CORPORATION

KITCHENER, ONTARIO

CANADA

RADIATED and CONDUCTED EMI TEST REPORT

February 28, 1997

CLIENT:

Research In Motion
295 Phillip Street
Waterloo, Ontario
N2L 3W8

TESTED MODEL:

Model Number:	R800D-15-0
Serial Number:	128/02/000001
Description:	800 MHz PACKET DATA RADIO
Date tested:	February 18, 19 & 21, 1997
Tested with:	Host computer, IBM Thinkpad 760ED Laptop, FCC ID # ANOGCF2704AT, Serial No. 78-VGY28 96/11 with AC/DC power adapter, Part number 85G6704; Printer, Epson, Model FX-80, Serial # 319837, FCC ID BKM9A8P80FA; AC/DC adapter power supply, Mfr. Globtek, Part No. WD1E1000L00, 12 VDC @ 1A; Antenna Company 800 MHz "Cell" antenna, Model Eclipse II/8110-MOD; RIM Radio Monitor Board Model 01585002; Associated cables and cords.

IN ACCORDANCE WITH:

FCC Part 2 and FCC Part 90 Transmitters; Type Acceptance.

Test procedure(s) MP-4 and ANSI C63.4

TESTED BY:

Com-Serve Corporation
17 Old Carriage Court
Kitchener, Ontario
N2P 1V3

TECHNICIAN:

Jim Sims with Mr. Muhammad Dajani (Research in Motion)

FILE NUMBER: RIM 014

RESULTS R800D-15-0

COMPLIANCE

(yes) (no)

RF POWER OUTPUT

Transmitter: 2.985 () ()

OCCUPIED BANDWIDTH

Transmitter: 2.989 (X) ()

SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS

Transmitter: 2.991 (X) ()

FIELD STRENGTH OF SPURIOUS RADIATION

Transmitter: 2.993 (X) ()

FREQUENCY STABILITY

Transmitter: 2.995 () ()

Transmitter: 90.210 g (X) ()

Transmitter: 90.210 g (X) ()

The Research In Motion Limited R800D-15-0 800 MHz packet data radio is intended to facilitate wireless data communication. The R800D-15-0 has a standard TTL level serial asynchronous interface allowing it to communicate directly with imbedded controllers. Radio evaluation and application development is facilitated by the radio monitor board. (RIM Model 01585002) The Radio Monitor Board translates the TTL level serial interface signals to standard RS-232 level signals. The RS-232 level signals can be directly interfaced to a microcomputer serial port. The R800D-15-0 radio is primarily intended for battery powered applications and a standard battery power connector is provided.

To facilitate the required EMI tests, the Radio Monitor Board provided a regulated and filtered 7.8 VDC supply to the R800D-15-0 radio. The Radio Monitor Board was also connected between the serial I/O (COM-1 of the IBM laptop) and the RIM R800D-15-0 radio. The R800D-15-0 radio, Radio Monitor Board, AC adapter, 8110-MOD cellular antenna and all required interface cables will be typically marketed as the "RIM800 Radio Evaluation and Development Kit".

Normal radio operation for live use is called burst packet activity. The radio is normally in receive mode listening to all network activity. When a data packet is received explicitly addressed to a particular radio, it then transmits a short acknowledgement packet. When the radio receives system information from the network to determine when to transmit, it transmits its data in packets.

For testing purposes, an IBM Laptop computer was connected to the R800D-15-0 radio along with the AC/DC power supply adapter. The laptop was also connected to the level shift PCB, or the Radio Monitor Board with an RS-232 DB-9 shielded 1.5 metre cable. A 2.0 metre RF antenna cable was used to connect the Eclipse II/8110-MOD antenna to the R800D-15-0 radio. Several test modes for transmitting continuous carrier with modulation and without modulation generated from scrambler sequence or fixed sequence data were used.

SYSTEM DESCRIPTION; CONTINUED

TEST SETUP FOR:
SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS
AND OCCUPIED BANDWIDTH/BANDWIDTH LIMITATIONS

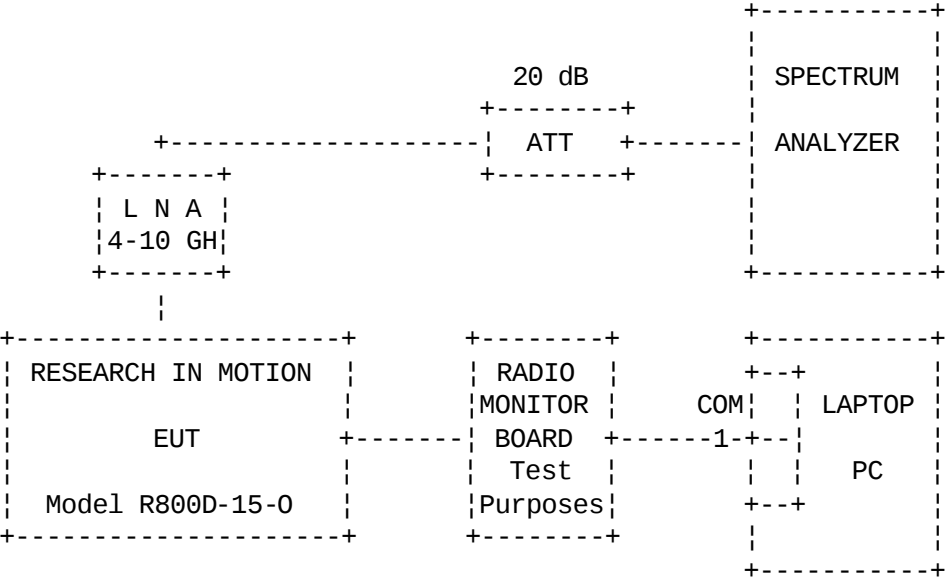


FIGURE # 1

TEST SETUP FOR:
SPURIOUS RADIATED EMISSIONS



FIGURE # 2



TEST PROCEDURE: RADIATED EMISSIONS

All tests were performed in accordance with FCC/MP-4, & ANSI C63.4.

The Research In Motion Ltd. 800 MHz Packet Data Radio model R800D-15-0, was connected together with a host laptop computer, Epson printer, radio monitor board RIM Model 01585002, as described on the "Title and System Description" pages. The system was arranged in a typical configuration of use and placed on top of a one metre non-conducting turntable as per ANSI C63.4. All of the system parts were connected together with cables that are sold with each piece or generic cables purchased for the specific connection involved. Several different equipment placements were tried so as to establish the worst normal case of equipment positioning. In this case the 01585002 Radio Monitor Board, laptop computer, RF radio, Epson printer, and RF antenna were placed on top of the turntable. The power supply was placed at the bottom center of the test table. All of the cables and cords were moved about so as to create the highest level of EMI. The complete system was operating as it would be in normal use. Special software was employed in order that the RIM Radio Monitor Board was processing data in a worst case normal manner. The turntable was rotated through 360 degrees.

A preliminary radio frequency scan was performed on the system to determine the worst case cable and equipment configuration. The attached results represent the system configuration maximized for worst case emissions in each frequency band.

Please refer to the System Description.

The tests were conducted at a distance of ten (10) metres with the receiving antennas in both the horizontal and vertical planes at each emission frequency. It should be noted that a preamplifier (LNA) in conjunction with a notch filter, was used above 1.0 GHz. The test results table entry referred to as "ANT. FAC." include cable loss, antenna correction factor, LNA gain and notch filter insertion loss.

EQUIPMENT:

Setting:	H.P. 8563E Spectrum Analyzer	9.0 KHz - 26.5 GHz
	BW: 300 Hz, 100/120 KHz and 1.0 MHz as required.	
	HP Preamplifier, Model 8449B	1.0 GHz - 26.5 GHz
	SPECTRA 20 dB attenuator, 5.0 W	0.0 Hz - 18.0 GHz
	A.H. Systems log periodic antenna;	1.0 GHz - 12.4 GHz
	Electro Mechanics model 3104C Biconical Antenna	
	Schwarzbeck model UHALP9107 Log Periodic Antenna	
	Electro Mechanics model 3115 Dual Ridge Guide Antenna	
	EATON dipole antennas; T1, T2, T3	25 MHz - 1.0 GHz

NOTE: The ten metre test range has been carefully evaluated to the ANSI C63.4, and will be remeasured for reflections and losses every three years. (ANSI C63.4/FCC OET-55)

RADIATED EMISSION RESULTS

BW: 100/120 KHz
Span: 05 to 50 MHz

PART 2/90 TRANSMITTER RADIATED TESTS TO 10 G HZ

TEST #	FREQ. G Hz	LEVEL μV	ANT. TYPE (PZ)	ANT. FAC.	F.S. μV/M	LIMIT μV/M	DIFF. TO LIMIT; dB
01	0.816	35481.3	ET.3 V	50.1	1.78(V)	---	
02	1.6321	1500.0	L/P V	5.5	8250.0	10,289	-1.92
03	2.4481	130.0	L/P V	9.2	1196.0	10,289	-18.69

NOTE:

A) A preamplifier (LNA) in conjunction with a notch filter was used above 1.0 GHz. The test results table entry referred to as "ANT. FAC." include cable loss, antenna correction factor, LNA gain and notch filter insertion loss.

B) The limit as specified in the above table, is 44.8 dB below the actual measured carrier field strength as specified in test number 01.

OCCUPIED BANDWIDTH/BANDWIDTH LIMITATIONS

TEST PROCEDURE

The Research In Motion Ltd. 800 MHz Packet Data Radio model R800D-15-0, was connected together with a host laptop computer, radio monitor board model RIM Model 01585002 and 20 dB external attenuator as described on the "Title and System Description" pages. The R800D-15-0 antenna output terminal was connected to the input of a 50 Ω spectrum analyzer through a matched 20 dB attenuator. The R800D-15-0 transmitter was operating at full output power with and without internal data modulation.

TEST RESULTS:

UNMODULATED CARRIER LEVEL: **11.0 dBm** with a 20 dB external pad.

- a) Internal Modulation: Please refer to the attached spectrum analyzer plots. 100% of the in-band modulation is below the specified mask per 90.210(g)

NOTE:

The above limits take into account the unmodulated carrier level of +31.0 dBm inclusive of the 20 dB external attenuator. The modulation used was a worst case, random data pattern, causing maximum deviation while still representing a normal modulation pattern.

EQUIPMENT:

	H.P. 8563E Spectrum Analyzer	9.0 KHz - 26.5 GHz
Setting:	BW: 300 Hz, 100 KHz or 120 KHz (Q.P), as required	
	HP PREAMPLIFIER, Model 8449B	1.0 GHz - 26.5 GHz
	SPECTRA 20 dB attenuator, 5.0 W	0.0 Hz - 18.0 GHz
	A.H. Systems biconical antenna;	20 MHz - 330 MHz
	A.H. Systems log periodic antenna;	300 MHz - 1.8 GHz
	A.H. Systems log periodic antenna;	1.0 GHz - 12.4 GHz
	EATON dipole antennas; T1, T2, T3	25 MHz - 1.0 GHz
CDI	ROBERTS dipole antennas T1 T2 T3 T4	25 MHz - 1.0 GHz

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

TEST PROCEDURE:

The Research In Motion Ltd. 800 MHz Packet Data Radio model R800D-15-0, was connected together with a host laptop computer, radio monitor board, RIM Model 01585002, 816 MHz notch filter and 20 dB external attenuator as described on the "Title and System Description" pages. The R800D-15-0 antenna output terminal was connected to the input of a 50 Ω spectrum analyzer through a matched 20 dB attenuator. The R800D-15-0 transmitter was operating at full output power with internal data modulation.

TEST RESULTS:

FREQUENCY MHZ	LEVEL dBm	LIMIT dBm
Ref 815.98	+32.2	(- 44.8)
84.22	-28.8	-12.6
385.15	-52.0	-12.6
1,632.03	-25.3	-12.6
2,448.08	-42.0	-12.6
3,264.40	-58.5	-12.6
4,080.20	-57.0	-12.6
4,896.20	-64.5	-12.6
5,712.10	-65.5	-12.6
7,344.30	-53.3	-12.6

NOTE:

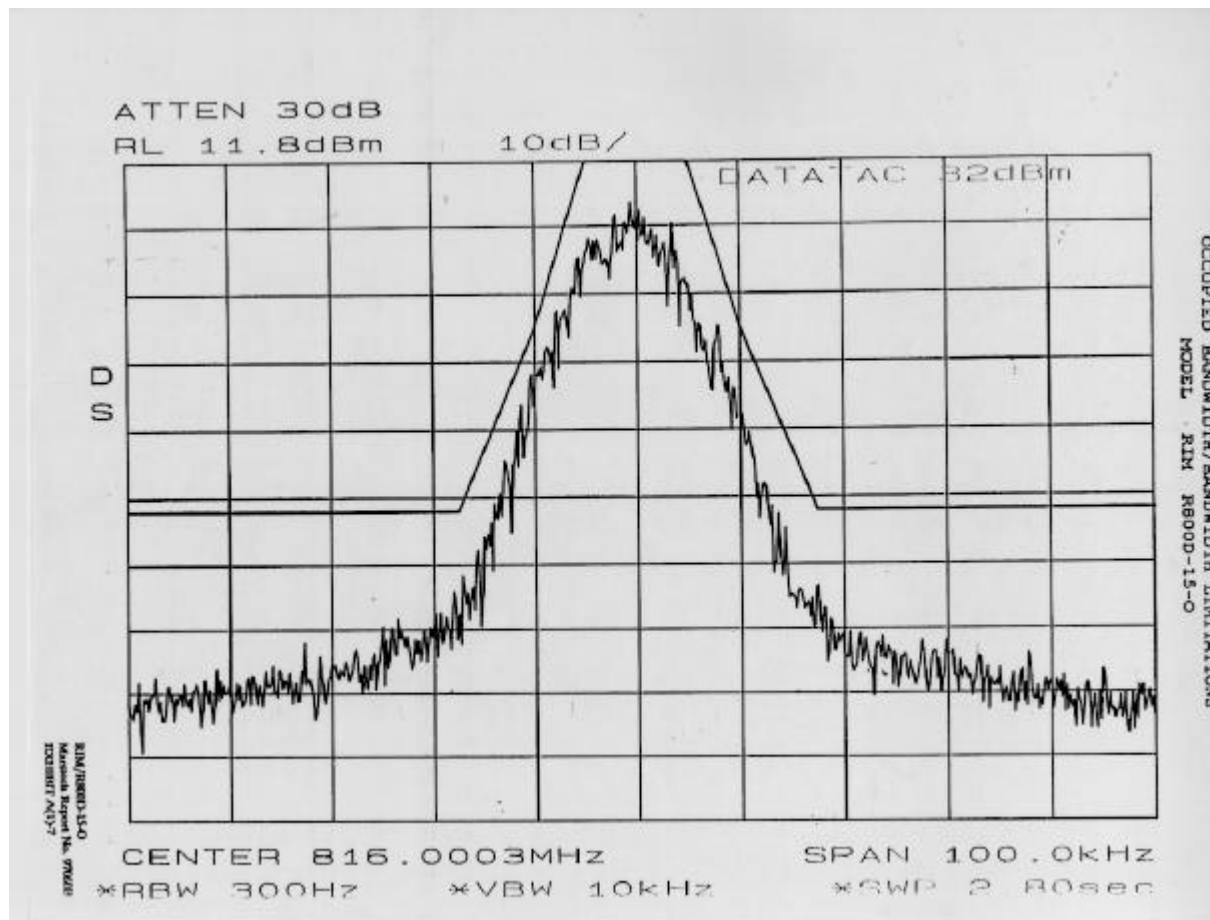
The above limits take into account the unmodulated carrier level of +32.17 dBm inclusive of the 20 dB external attenuator. For emissions beyond 1 GHz, the 20 dB attenuator was removed and replaced with an 816 MHz notch filter having an insertion loss of -8 dB. The modulation used was a worst case, random data pattern while still representing a normal modulation pattern.

EQUIPMENT:

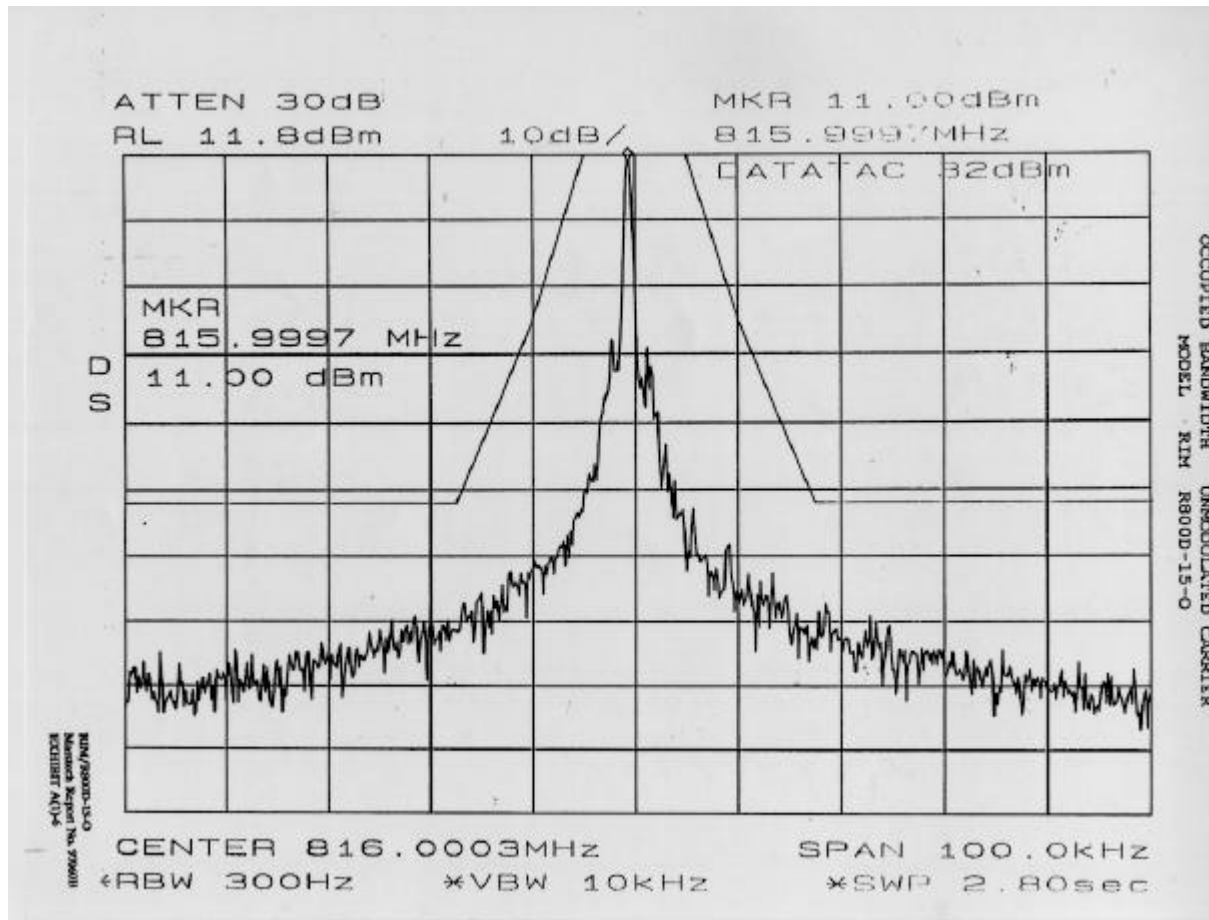
H.P. 8563E Spectrum Analyzer 9.0 KHz - 26.5 GHz

Setting: BW: 100/120 KHz and 1.0 MHz, as required.
 HP PREAMPLIFIER, Model 8449B 1.0 GHz - 26.5 GHz
 SPECTRA 20 dB attenuator, 5.0 W 0.0 Hz - 18.0 GHz

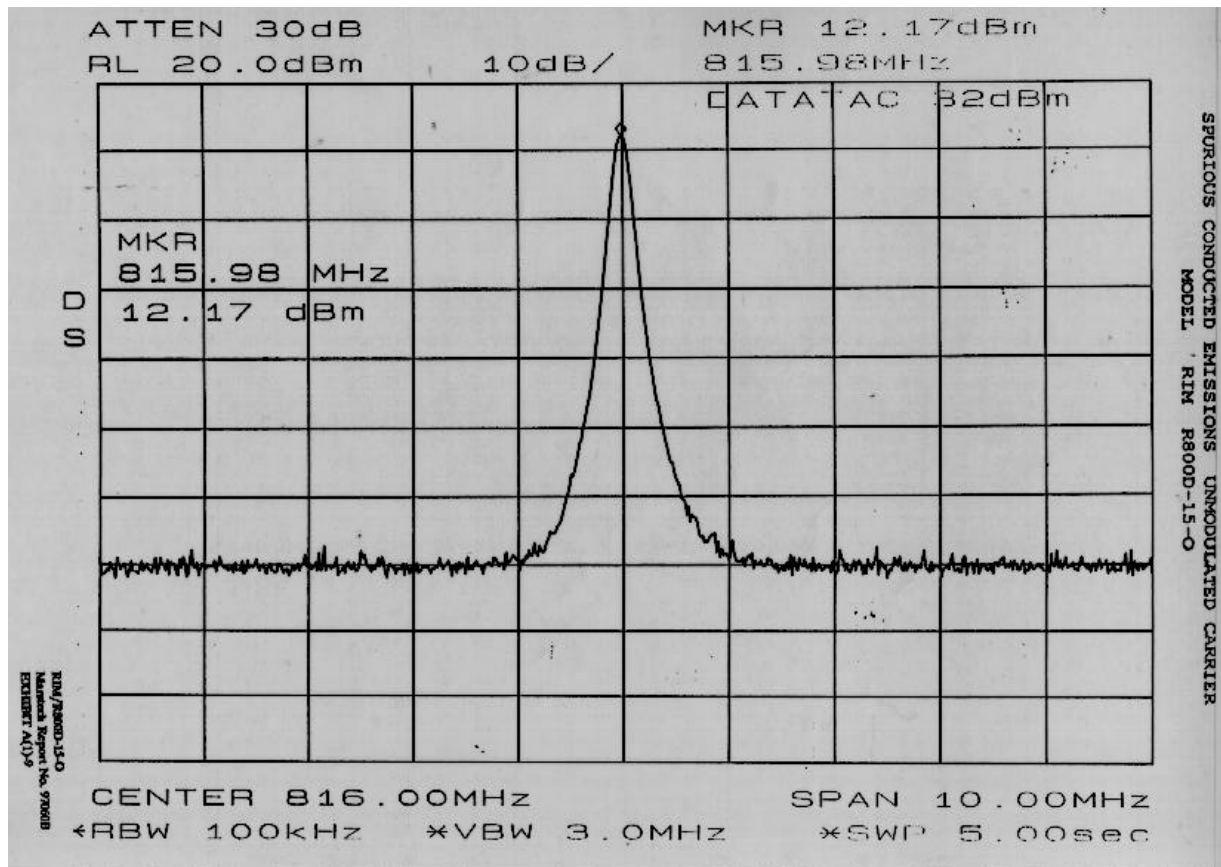
OCCUPIED BANDWIDTH/BANDWIDTH LIMITATIONS
MODEL RIM R800D-15-0



OCCUPIED BANDWIDTH UNMODULATED CARRIER
MODEL RIM R800D-15-0



SPURIOUS CONDUCTED EMISSIONS UNMODULATED CARRIER
MODEL RIM R800D-15-0



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CANADA

RADIATED and CONDUCTED EMI TEST REPORT

February 28, 1997

CLIENT:

Research In Motion
295 Phillip Street
Waterloo, Ontario
N2L 3W8

TESTED MODEL:

Model Number:	01585002
Serial Number:	Not Marked, Production sample
Description:	RADIO MONITOR BOARD
Date tested:	February 18 & 19, 1997
Tested with:	Host computer, IBM Thinkpad 760ED Laptop, FCC ID # AN0GCF2704AT, Serial No. 78-VGY28 96/11 with AC/DC power adapter, Part number 85G6704; Printer, Epson, Model FX-80, Serial # 319837, FCC ID BKM9A8P80FA; AC/DC adapter power supply, Mfr. Globtek, Part No. WD1E1000L00, 12 VDC @ 1A; Antenna Company 800 MHz "Cell" antenna, Model Eclipse II/8110-MOD; RIM Radio Monitor Board Model 01585002; Associated cables and cords.

IN ACCORDANCE WITH:

FCC Part 15, Unintentional Radiator, Class "B" Digital (Computing) Device & the DOC/IC Radio Interference Regulations, C.R.C., c 1374.
Test procedure(s) MP-4 and ANSI C63

TESTED BY:

Com-Serve Corporation
17 Old Carriage Court

Kitchener, Ontario
N2P 1V3

TECHNICIAN:

Jim Sims and Mr. Muhammad Dajani (Research in Motion)

FILE NUMBER: RIM 014

RESULTS

RADIATED:

The Research In Motion Limited Radio Monitor Board model 01585002, **MEETS** the limits for a Class "B" Digital (Computing) Device Peripheral, pursuant to the rules and test procedures of the Federal Communications Commission and INDUSTRY CANADA, formerly the Canadian Department of Communications.

LIMITS:	30 to 88 M Hz		30 μ V/M
	88 to 216 M Hz		45 μ V/M
10	216 to 960 M Hz		60 μ V/M
Metres	Above 960 M Hz		150 μ V/M

CONDUCTED:

The Research In Motion Limited Radio Monitor Board model 01585002, **MEETS** the limits for a Class "B" Digital (Computing) Device Peripheral, pursuant to the rules and test procedures of the Federal Communications Commission and INDUSTRY CANADA, formerly the Canadian Department of Communications.

LIMITS:	450 K Hz to 1.705 M Hz		250 μ V (48 dB μ V)
	1.705 M Hz to 30 M Hz		250 μ V (48 dB μ V)

Jim Sims
Com-Serve Corporation

February 28, 1997

SYSTEM DESCRIPTION

The Research In Motion Limited Radio Monitor Board model 01585002 is intended to facilitate RIM RF radio evaluation and application development. The radio monitor board is an interface between a serial I/O (COM-1 of the IBM laptop) and the RIM R800D-15-0 radio. The board translates the TTL level serial interface signals to standard RS-232 level signals. The RS-232 level signals can be directly interfaced to a personal computer serial port.

The radio monitor board also provides a regulated and filtered 7.8 VDC power supply to the radio. The radio power and the level translation circuit power, are derived from a 12V/1A AC/DC power adapter. The R800D-15-0 radio, radio monitor board, AC adapter, 8110-MOD cellular antenna and all required interface cables will be typically marketed as the "RIM800 Radio Evaluation and Development Kit".

For testing purposes, an IBM Laptop computer was connected to the R800D-15-0 radio via the Radio Monitor Board model 01585002. An AC/DC power supply adapter was used to power the board and the radio. The laptop was connected to the level shift PCB with an RS-232 DB-9 shielded 1.5 metre cable. A 2.0 metre RF antenna cable was used to connect the generic cellular antenna to the RF radio. In order to simulate worst case normal operating conditions, several test modes were used. First the radio monitor PCB was operating while transmitting and receiving data on all I/Os while connected to the laptop computer and the RF radio. Secondly the tests were repeated with the R800D-15-0 radio set in the receive mode of operation.

TEST PROCEDURE

RADIATED:

All tests were performed in accordance with FCC/MP-4, & ANSI C63.4.

The Research In Motion Limited Radio Monitor Board model 01585002, was connected together with a host laptop computer, Epson printer, R800D-15-0 radio, 800 MHz antenna and an AC/DC power supply as described on the "Title and System Description" pages. The system was arranged in a typical configuration of use and placed on top of a one metre non-conducting turntable as per ANSI C63.4. All of the system parts were connected together with cables that are sold with each piece or generic cables purchased for the specific connection involved. Several different equipment placements were tried so as to establish the worst normal case of equipment positioning. In this case the 01585002 Radio Monitor Board, laptop computer, Epson printer, RF radio and RF antenna were placed on top of the turntable. The power supply was placed at the bottom center of the test table. All of the cables and cords were moved about so as to create the highest level of EMI. The complete system was operating as it would be in normal use. Special software was employed in order that the RIM Radio Monitor Board was processing data in a worst case normal manner, and separately the R800D-15-0 radio was operating in the receive mode. The turntable was rotated through 360 degrees.

A preliminary radio frequency scan was performed on the system to determine the worst case cable and equipment configuration. The attached results represent the system configuration maximized for worst case emissions in each frequency band. Please refer to the System Description.

The tests were conducted at a distance of ten (10) metres with the receiving antennas in both the horizontal and vertical planes at each emission frequency.

EQUIPMENT:

Rohde & Schwarz model ESBI-RF Spectrum Analyzer
Rohde & Schwarz model ESAI-D Analyzer Display

Setting: BW: 100 KHz or 120 KHz (Q.P)

H.P. 8563E Spectrum Analyzer 9 KHz - 26.5 GHz
 LNA, HP 8449B Preamplifier (30 dB)... 1 KHz - 26.5 GHz
 A.H. Systems biconical antenna; ... 20 MHz - 330 MHz
 A.H. Systems log periodic antenna; 300 MHz - 1.8 GHz
 Eaton dipole antenna; T3 at 900 MHz
 Electro Mechanics model 3104C Biconical Antenna
 Schwarzbeck model UHALP9107 Log Antenna
 Electro Mechanics model 3115 Dual Ridge Guide Antenna

The radiated emissions from the unit under test were measured while using the methods outlined in ANSI C63.4; 1992 on a 10 metre open area test site. The test sample was placed on a turntable to facilitate rotation.

RADIATED EMISSION RESULTS

BW: 100/120 KHz
 Span: 05 to 50 MHz

TEST #	FREQ. M Hz	LEVEL μ V	ANT. TYPE (PZ)	ANT. FACT.	F.S. μ V/M	LIMIT μ V/M	DIFF. TO LIMIT; dB
01	188.33	04.1	B/C V	7.5	30.8	45.0	-3.31
02	209.44	04.2	B/C H	7.6	31.9	45.0	-2.98
03	219.44	06.8	B/C V	7.0	47.6	60.0	-2.01
04	221.11	07.6	B/C V	6.9	52.4	60.0	-1.17
05	239.44	05.6	B/C V	7.1	39.8	60.0	-3.57
06	263.33	03.0	B/C H	9.1	27.3	60.0	-6.84
07	651.11	01.6	L/P V	16.3	26.1	60.0	-7.24
08	762.22	02.2	L/P V	20.1	44.2	60.0	-2.65
09	957.79	01.9	L/P V	24.4	46.4	60.0	-2.24

TEST PROCEDURE

CONDUCTED:

All tests were performed in accordance with FCC/MP-4, & ANSI C63.4.

The Research In Motion Limited Radio Monitor Board model 01585002, was connected together with a host laptop computer, RF radio, Epson printer, 800 MHz antenna and an AC/DC power supply as described on the "Title and System Description" pages. The system was arranged in a typical configuration of use and placed on top of a non-conducting test table as per ANSI C63.4. All of the system parts were connected together with cables that are sold with each piece or generic cables purchased for the specific connection involved. Several different equipment placements were tried so as to establish the worst normal case of equipment positioning. In this case the 01585002 Radio Monitor Board, laptop computer, Epson printer, RF radio and RF antenna were placed on top of the test table. The power supply was placed at the bottom of the test table. All of the cables and cords were moved about so as to create the highest level of EMI. Special software was employed in order that the RIM Radio Monitor Board was processing data in a worst case normal manner, both while in quiescent or receive mode and also in the transmit mode.

The direct plug-in power supply for the Radio Monitor Board model 01585002, and the power supply for the IBM Thinkpad laptop computer, were connected to a 50 micro-henry line impedance stabilization network. (LISN) The RF voltages on each side of the power line were coupled to the input of a spectrum analyzer and recorded. See the attached results.

The conducted emissions measurements were performed in three (3) different test modes:

- PCB transferring data via the RS-232 serial port on the PC.
- PCB connected to the system while the radio is operating in receive.

- The IBM Thinkpad laptop computer was tested while transferring data to the Radio Monitor PCB.

EQUIPMENT:

Rohde & Schwarz model ESBI-RF Spectrum Analyzer
Rohde & Schwarz model ESAI-D Analyzer Display
Electro-Mechanics model 3816/2 L.I.S. Network

Setting: BW: 10 K Hz or 9 K Hz (Q.P)

The EUT was installed in the semi-anechoic room with the turntable surface used as the reference ground plane. The product was located on a non-metallic test table which represents a 0.8 M ground plane to EUT isolation spacing. A vertical ground plane was positioned 0.4 M from the rear face of the EUT. The EUT conducted emissions were measured within a shielded enclosure (28 x 24 x 10 feet) while using the test procedure outlined in ANSI Publication C63.4; 1992.