APREL
Laboratories

Certification Report on

Maximum Permissible Exposure Evaluation with Respect to FCC Rule Part 47CFR §2.1091

Research in Motion Ltd.

R802D-2-O Radio Modem and 0dBd Larsen NMOQ 800 BSMA Antenna

Date: 26 August, 1999

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APREL Laboratories

CERTIFICATION REPORT

Subject: Maximum Permissible Exposure Evaluation with Respect to FCC Rule Part 47CFR §2.1091

Product: OEM Radio-Modem with 0dBd Larsen Vehicle-Top Mounting Antenna

FCC ID #: L6AR802D-2-O

Model: R802D-2-O Radio-Modem and a NMOQ 800 BSMA Antenna

Client: Research in Motion Limited

Address: 295 Phillip Street
Waterloo, Ontario
Canada, N2L 3W8

Project #: RIMB-R802D2O NMOQ 800 B-3279

Prepared by: APREL Laboratories
51 Spectrum Way
Nepean, Ontario
K2R 1E6

Tested by ____________________ Date: 8 September 1999
Heike Wünschmann, C.E.T.

Submitted by Paul G Cardinal Date: 08 Sep 1999
Dr. Paul G. Cardinal
Director, Laboratories

Approved by ____________________ Date: Sept 8/99
Dr. Jacek J. Wojcik, P. Eng.

REGISTERED PROFESSIONAL ENGINEER
J. J. Wojcik
PROVINCE OF ONTARIO

CERTIFICATION REPORT

Subject:	Maximum Permissible Exposure Evaluation with Respect to FCC Rule Part 47CFR §2.1091
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Director, Laboratories

Approved by ______________________ Date: ______________
Dr. Jacek J. Wojcik, P. Eng.

FCC ID: L6AR802D-2-O
Client : Research in Motion Limited
Equipment : OEM Radio-Modem attached to a Larsen Vehicle-Top Mounting Antenna
Part No. : R802D-2-O Radio-Modem and a Larsen NMOQ 800 BSMA Antenna
Serial No. : Pre-production Model

ENGINEERING SUMMARY

This report contains the results of the maximum permissible exposure (MPE) evaluation performed on the equipment under test (EUT) which was comprised of a Research in Motion R802D-2-O OEM radio-modem, an IBM 760ED ThinkPad laptop, attached to a Larsen Vehicle-Top Mounting Antenna. The tests were carried out in accordance with the applicable requirements of FCC rules found in 47CFR §2.1091 and the standards ANSI/IEEE C95.1-1992 and C95.3-1992. The test frequency was 806 MHz (low channel, 2000_h).

The methodology and results for the test are described in the appropriate section of this report.

The EUT will not exceed the MPE requirements for 806 - 821MHz band. The maximum power exposure level measured at 20 cm was 0.48 mW/cm^2.

TABLE OF CONTENTS

ACRONYMS

EUT	Equipment Under Test
FCC	Federal Communications Commission
MPE	Maximum Permissible Exposure
N/A	Not Applicable
NTS	Not To Scale
OATS	Open Area Test Site
OEM	Original Equipment Manufacturer
QA	Quality Assurance
RIM	Research in Motion

1. INTRODUCTION

1.1. GENERAL

This report describes the Maximum Permissible Exposure (MPE) tests for a Research in Motion R802D-2-O OEM radio-modem, an IBM 760ED ThinkPad laptop, and a Larsen NMOQ 800 BSMA vehicle-top mounting 0dBd antenna, the combination hereinafter called the EUT (Equipment Under Test).

1.2. SCOPE

MPE evaluation was performed on the EUT in accordance with the requirements of the FCC rules for RF compliance found in 47CFR §2.1091 and the standard ANSI/IEEE C95.3-1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave. This Engineering Report contains the following:

- Methodology as to how the tests were performed.
- Test results and analysis.
- Identification of the test equipment used for the testing.
- Test set-up diagram.

1.3. SCHEDULE

The MPE tests were completed on 26th August, 1999.

1.4. APPLICABLE DOCUMENTS

FCC Rule Part 47CFR §2.1091

ANSI/IEEE C95.1-1992, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz.

ANSI/IEEE C95.3-1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.

OET Bulletin 65 (Edition 97-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields.

2. TEST SAMPLE

The MPE test described in this procedure was performed on:

- Research in Motion Model R802D-2-O OEM radio-modem (see specification sheets in Appendix A and figure 3.1)
- IBM ThinkPad Laptop Model 760ED, FCC ID ANOGCF2704AT, Type 9546-U9A, S/N 78-ACPW2 97/02
- Larsen Model NMOQ 800 BSMA 0dBd vehicle top-mounting antenna (see specification sheets in Appendix B)

Figure 3.1 Photograph of R802D-2-O OEM Radio Modem

3. GENERAL REQUIREMENTS

3.1. LOCATION OF TEST FACILITIES

The tests were performed by APREL Laboratories at APREL's test facility located in Nepean, Ontario, Canada. The laboratory operates a 3 and 10 meter Open Area Test Site (OATS) measurement facility. The test site is calibrated to ANSI C63.4-1992.

A description of the measurement facility in accordance with the radiated and AC line conducted test site criteria in ANSI C63.4-1992 is on file with the Federal Communications Commission and is in compliance with the requirements of Section 2.948 of the Commissions rules and regulations. APREL's registration number is 31070/SIT(1300F2).

APREL is accredited by Standard Council of Canada, under the PALCAN program (ISO Guide 25). All equipment used is calibrated or verified in accordance with the intent of AQAP-6/MIL-STD-45662. APREL is also accredited by Industry Canada (formerly DOC) and recognised by the Federal Communications Commission (FCC).

3.2. PERSONNEL

Radiation Hazard technical staff member, Heike Wünschmann, carried out all MPE tests.

3.3. FAILURE CRITERIA

The equipment under test was considered to have failed if any of the following occurred:

When the MPE limits exceeded those permitted by appropriate limits defined by the FCC.

3.4. POWER SOURCE REQUIRED

The following nominal DC Power was maintained during the test:

Voltage: 4.4 VDC (12 VDC cell with a voltage regulator)

3.5. TOLERANCE

The following tolerances on test conditions, exclusive of equipment accuracy, were maintained:

Voltage: ± 1%

4. TEST INSTRUMENTATION & CALIBRATION

4.1. GENERAL

APREL Laboratories, located in Nepean, Ontario is equipped with the necessary instrumentation to ensure accurate measurement of all data recorded during the tests outlined in this document. To ensure continued accuracy, each instrument is re-calibrated at intervals established by APREL and based on standards traceable to the National and International Standards. Accuracy surveillance is a function of APREL Quality Assurance.

4.2. MPE TEST EQUIPMENT REQUIRED

The test equipment required to perform the MPE testing was selected from the equipment available at APREL.

4.3. CALIBRATION REQUIREMENTS

All test equipment instrumentation required for MPE qualification testing was calibrated and controlled.

5. ELECTRICAL/MECHANICAL DESCRIPTION

The MPE Test Program was performed on one OEM radio-modem attached to an IBM ThinkPad laptop computer and a Larsen vehicle-top mounting antenna, the combination hereinafter called the EUT. The test sample consisted of the components supplied by the customer and described below.

5.1. TEST UNIT DESCRIPTION

The two watt R802D-2-O OEM radio-modem transceiver equipped with a Larsen 0dBd vehicle top-mounting antenna and controlled by an IBM ThinkPad laptop computer, consisted of the following components:

Part Number	Description
R802D-2-O	RIM OEM radio-modem
02120-001 Rev B.	RIM interface board (ITB)
SRB01519/9743D59235	RIM execution lock
760ED Think Pad	IBM Laptop computer
NMOQ 800 BSMA	Larsen 0 dBd vehicle-top mounting antenna
0820-0004	6 Gates 2 V 25 AH BC DC cells
VR 4.45	APREL 4.4 VDC voltage regulator

5.2. MPE TEST SETUP

The EUT antenna shall be installed in the centre of a ground plane simulating the rooftop of a vehicle. The other components shall be located underneath this ground plane to simulate operation from inside of the vehicle (see Figures 6.2.1 and 6.2.2).

The vehicle simulator shall be positioned on the turntable in the OATS in such a way that the antenna will be located on the centre of rotation.

The EUT shall be connected to the 4.4 VDC power supply.

For the selection and placement of the measuring probe, the requirements of ANSI/IEEE C95.3-1992 shall be met.

Figure 6.2.1. Photograph of the Setup.

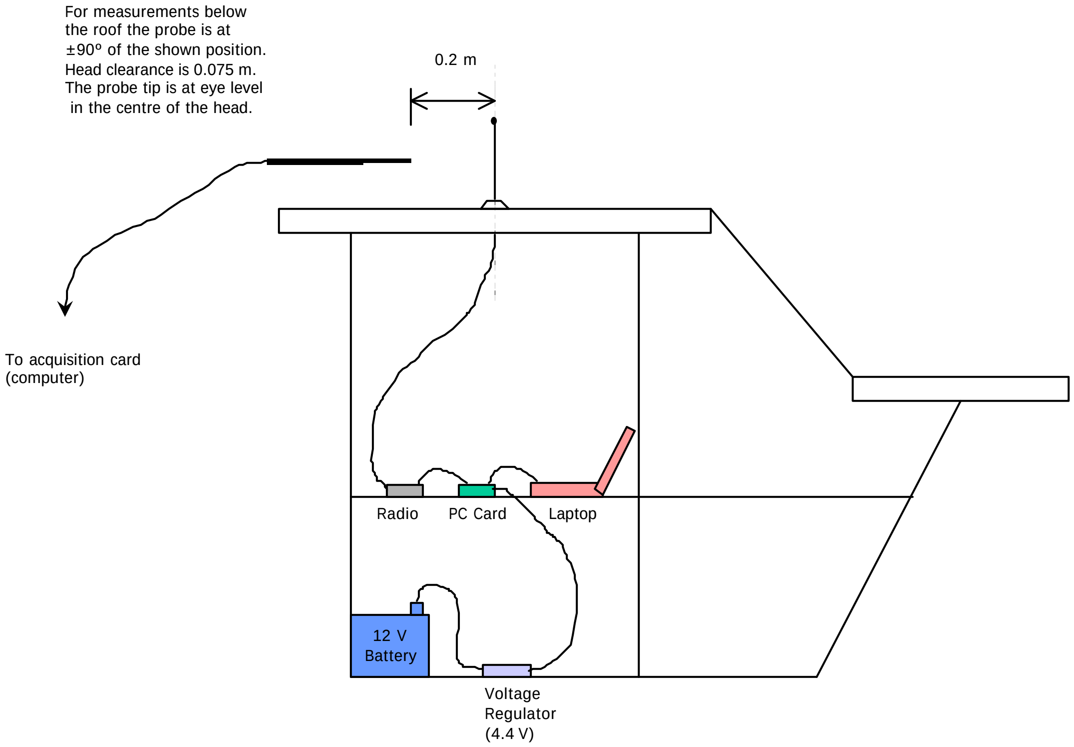

Figure 6.2.2. Elevation View of the Setup.

6. MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

6.1. PURPOSE

This test method is used to verify that the EUT meets the MPE requirements as defined in the criteria for general population/uncontrolled exposure when operating at maximum power levels and in all operating modes.

6.2. TEST EQUIPMENT

Description	**Manufacturer**	**Model No.**
E-Field Probe	APREL Laboratories	E-009 s/n 115

6.3. CRITERIA

Power Density Limits – The EUT shall not generate a power density beyond the limits in the frequency band listed in the left hand column of Table 7.3.1, and the power density given in the right hand column. The power density shall be measured 20 cm from the radiating antenna axis above the vehicle-top simulating ground plane, as well as and in the approximate location of the head of possible vehicle drivers or passengers below the ground plane (see Figure 7.3.1). The measured values shall be recorded.

Table 7.3.1

Power Density Limits
for General Population/Uncontrolled Exposure

Frequency Range	Power Density (mW/cm^2)
300 - 1500 MHz	f/1500

Note: f = frequency in MHz

The measurements shall be performed at one transmitting frequency, the highest of the high, middle or low channels, with the EUT operating at the full rated output power.

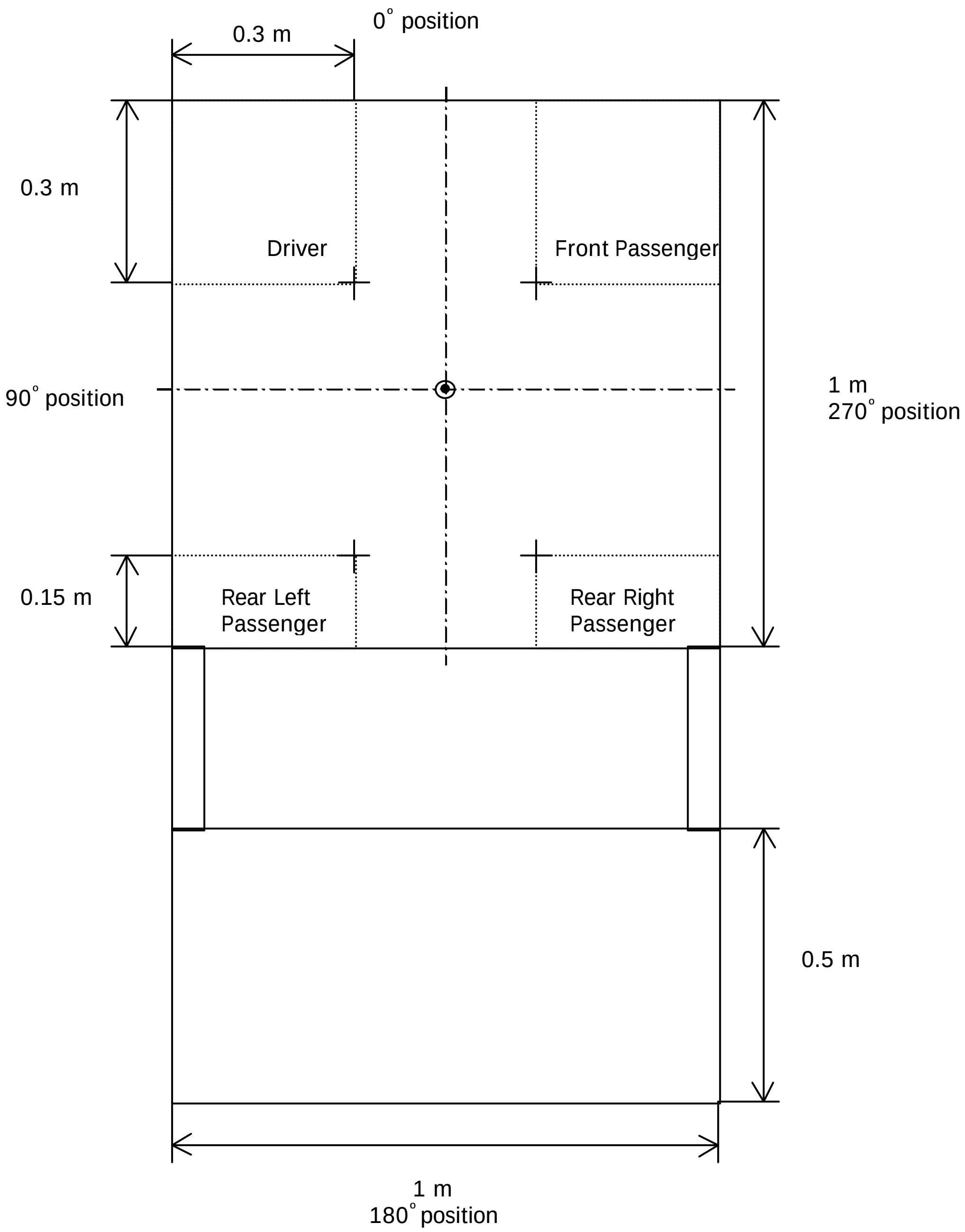

Figure 7.3.1. Plan View of Vehicle Simulator and Setup.

6.4. TEST PROCEDURE

a) The probe shall be positioned close to, and parallel to, the vehicle rooftop simulation with its tip 20 cm from the radiating antenna, and its axis normal to the antenna.

b) Rotate the turntable so that the probe is at the 0° position (see Figure 7.3.1).

c) Turn on the EUT and allow sufficient time for stabilisation. Turn on the transmitter and simulate normal operation conditions. Operate the transmitter at full rated output power.

d) Determine the location of the maximum power density: locate the maximum emissions by scanning vertically along the EUT's antenna. Take and record measurements of the power density at a number of points along the length of the antenna as well as just past its tip.

e) At every 45° of rotation take and record a measurement of the power density at the maximum power density height as for at least the following locations:

- half the maximum power density height
- height halfway between the maximum power density height and the tip of the radiating antenna
- just above the tip of the antenna

f) Turn off the EUT.

g) Position the probe under the vehicle rooftop simulating ground plane in the approximate location of the centre of the head of a potential driver of the simulated vehicle (see Figures 6.2.2 and 7.3.1).

h) Turn on the EUT and allow a sufficient time for stabilisation. Turn on the transmitter and simulate normal operation conditions. Operate the transmitter at full rated output power.

i) Take and record the measurement of the power density at this location.

j) Turn off the EUT.

k) Repeat steps g) through j) for the positions of the other potential occupants of the simulated vehicle as shown in Figure 7.3.1.

6.5. RESULTS

Table 7.5.1 presents the results of the measurements made along the length of the antenna in order to find the location of the maximum power density (the Larsen NMOQ 800 BSMA antenna has a height of 11 cm). Column 1 shows the height at which the measurements were taken and column 2 shows the result ("total" indicates that this is the sum of the power density measured by each of the three orthogonal sensors in the probe). Excess cable loss does not apply here because of its nominal length of 6 feet.

The data in Table 7.5.1 is presented in Figure 7.5.1.

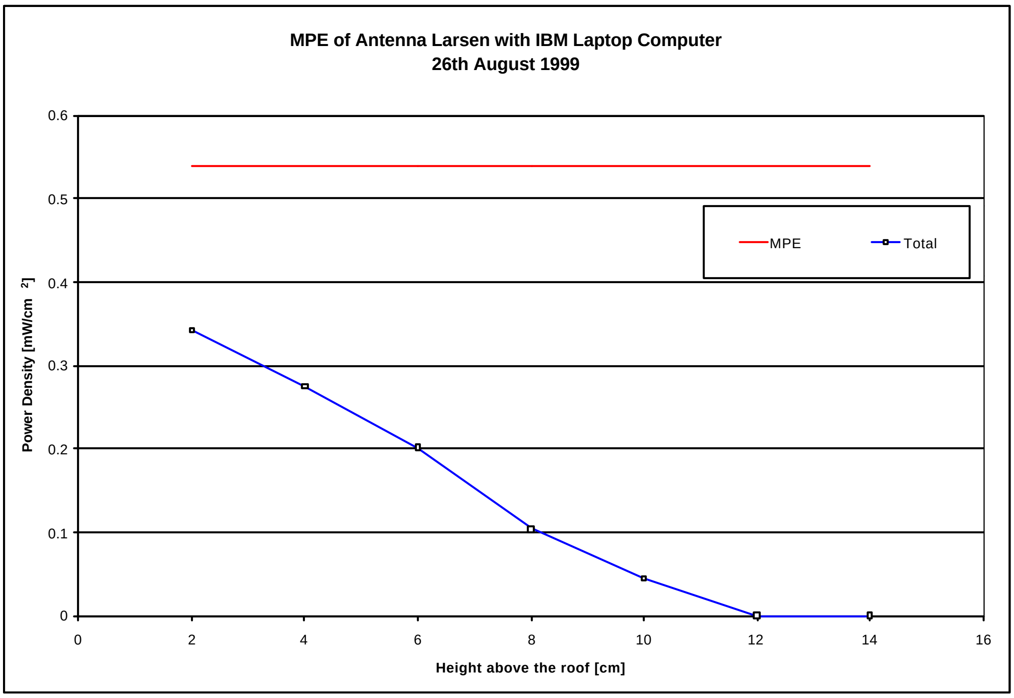

Figure 7.5.1

Table 7.5.1

Power Density Measured at 0° as a Function of Height

Height	Total	Excess cable loss	Adjusted total	Limit
[cm]	[mW/cm^2]	[dB]	[mW/cm^2]	[mW/cm^2]
2	0.34	0	0.34	0.54
4	0.27	0	0.27	0.54
6	0.20	0	0.20	0.54
8	0.10	0	0.10	0.54
10	0.04	0	0.04	0.54
12	0.00	0	0.00	0.54
14	0.00	0	0.00	0.54

Table 7.5.2 presents the results of the measurements made around the antenna at every 45° of rotation. Column 1 shows the angle at which the measurements were taken and columns 2 through 5 show the final adjusted power density at the different measurement heights. The measured exposure level is determined by averaging the adjusted total power density along a vertical line up to the height of a tall typical individual, taken here as 6ft or 180cm. Since the height for the rooftop of the simulated vehicle is 143cm, then the averaging is over those measurements made between 0 and 11cm above the simulated vehicle rooftop. Column 6 shows the results of this averaging.

Table 7.5.2

Power Density Measured
at every 45° as a Function of Height

Angular Position [°]	Adjusted Total Power Density				Averaged Values of 0 to 10 cm [mW/cm^2]	MPE [mW/cm^2]
	H1 [cm]	H2 [cm]	H3 [cm]	H4 [cm]		
	4	6	8	10		
0	0.2745	0.2019	0.1039	0.0443	0.1561	0.54
45	0.2679	0.2139	0.1425	0.0820	0.1766	0.54
90	0.2305	0.1608	0.1077	0.0294	0.1321	0.54
135	0.3429	0.2809	0.1947	0.1068	0.2313	0.54
180	0.4982	0.3589	0.2603	0.1328	0.3125	0.54
225	0.6047	0.5015	0.3783	0.2334	0.4295	0.54
270	0.4846	0.3518	0.2452	0.1172	0.2997	0.54
315	0.3399	0.2552	0.1988	0.1230	0.2292	0.54
360	0.2745	0.2019	0.1039	0.0443	0.1561	0.54

The data in Table 7.5.2 is presented in Figure 7.5.2.

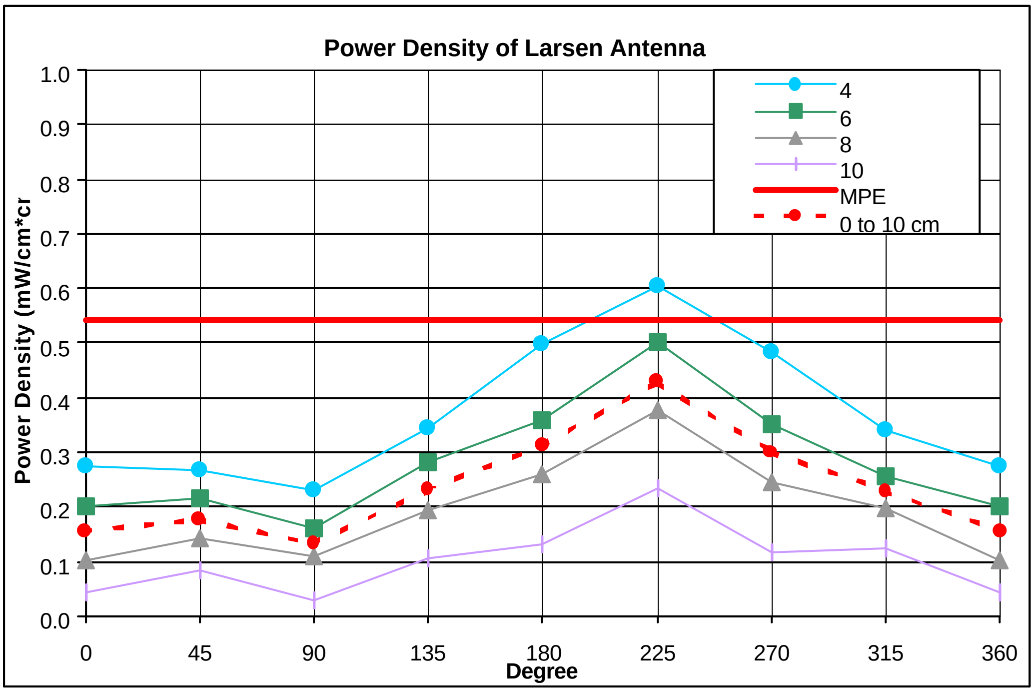

Figure 7.5.2.

Measurements were made below the simulated vehicle rooftop, in the approximate location of the centre of the head of potential occupants. It was assumed that this typical position occurred 17.5cm below the roof of the simulated vehicle (the clearance between the top of an occupant's head and a vehicle's roof is ~3" (7.5cm) and distance between the top of the head and the eyes is ~4" (10cm)). Figure 7.3.1 shows the location of measurements for the four potential occupants. Table 7.5.3 presents the results of the measurements. Column 1 shows the position at which the measurements were taken and column 2 shows the result ("total" indicates that this is the sum of the power density measured by each of the three orthogonal sensors in the probe). Excess cable loss does not apply here because of its nominal length of 6 feet.

Table 7.5.3

Power Density Measured
at Position of Potential Vehicle Occupants

Position	**Total**	**Excess cable loss**	**Adjusted Total**	**MPE Limit**
	[mW/cm^2]	[dB]	[mW/cm^2]	[mW/cm^2]
driver	0.00	0	0.00	0.54
front passenger	0.00	0	0.00	0.54
rear left	0.00	0	0.00	0.54
rear right	0.00	0	0.00	0.54

6.6. DISCUSSION

The maximum exposure determined for this EUT was 0.43mW/cm^2 at a distance of 20 cm from the antenna. These measurements were performed with the maximum duty cycle of 100 % and a maximum power at 2 W (33 dBm).

RIM has found that due to the 0.5 dB tolerance in the calibration tool the radio modem could have an absolute maximum power of 2.25 W (33.5 dBm). It was determined by proportional scaling that the maximum power exposure level at 20 cm would be 0.48 mW/cm^2.

7. CONCLUSION

The EUT consisting of a Research in Motion R802D-2-O OEM radio-modem, an IBM 760ED ThinkPad laptop, and a Larsen NMOQ 800 BSMA antenna will not exceed the MPE requirements for the 806 - 821 MHz band. The maximum power exposure level determined at 20 cm was 0.48 mW/cm^2.

APPENDIX A

Transmitter Specifications

RIM 802D

OEM Radio Modem for DataTAC

INTEGRATOR'S KIT

The RIM 802D Integrator's Kit offers the following tools and accessories to quickly begin using the RIM 802D OEM Radio Modem:

- Software Developer's Kit
- RIM 802D OEM Radio Modem
- Interface and Test Board including:
  - RS232 to 3.0V serial level conversion and FPC cable connector
  - DB-9 serial port for RS-232 connection to the host computer
  - Regulated power for the RIM 802D
  - LED indicators show when the RIM 802D is receiving power, transmitting, message waiting, in coverage, or exchanging data with the host
  - Test points for the 22-pin data cable
- Power supply (AC to DC)
- Required cables (including antenna cable)
- DB-9 to DB-9 straight through serial cable
- Magnetic-mount +3 dBd antenna
- Hardware Integrator's Guide
- Programmer's Guide to RAP (Radio Access Protocol)

SOFTWARE DEVELOPER'S KIT

The RIM 802D Software Developer's Kit includes all the tools required to accelerate application development. The Software Developer's Kit includes:

- Software
- Technical documentation for all APIs
- Source code examples
- Application utilities
- PC-based OS simulator

HARDWARE INTEGRATOR'S GUIDE

The RIM 802D Hardware Integrator's Guide includes valuable information, such as:

- Hardware design recommendations
- Suppliers of cables, connectors, and antennas
- Antenna matching guidelines
- Schematics for power supplies and RS-232 serial port interfaces
- Software development suggestions and tools
- Detailed electrical and serial port specifications

TECHNICAL SPECIFICATIONS

MECHANICAL & ENVIRONMENTAL PROPERTIES

- Weight (incl. case): 35g (1.23oz)
- Footprint: 42.0 x 67.5 mm (1.65" x 2.65")
- Thickness: 8.4 mm (0.33")
- Serial connector: 22-pin FPC connector
- MMCX Antenna cable connector
- Tested to IEC 68-2-6 Part 2 for vibration
- Operating temperature: -30°C to + 70°C
  (at 5-95% relative humidity, non-condensing)
- Storage temperature: -40°C to +85°C

RF PROPERTIES

- Transmit frequency: 806-825 MHz
- Transmit power range: 2.0 W at antenna port
- Receive frequency: 851-870 MHz
- Receive sensitivity: -118 dBm (MDC), -111 dBm (RD-Lap)
- Dual RF Air Protocol (19200 bps RD-Lap and 4800 bps MDC)
- Nation-wide fully automatic roaming
- FCC Parts 15 & 90: Pending
- Industry Canada RSS 119: Pending

POWER SUPPLY & TYPICAL CURRENT USAGE

- Single power supply; operating range: 4.10 to 4.75 VDC
- Battery save stand-by mode: as low as 0.2 mA
- Receive / express stand-by mode: 66 mA
- Transmit mode: 1700 mA
- Average current usage: 4.3 mA
  (based on 94.95% standby, 5.00% receive, 0.05% transmit)

SERIAL COMMUNICATIONS

- 3.0 V asynchronous serial port with flow control
- Second 3-wire serial port (TX, RX, GND)
- Message waiting, coverage, and transmit indicate outputs
- Link level protocols: Radio Access Protocol (RAP) and Native Control Language (NCL)
- Link speed: 1200-15200 bps

OTHER FEATURES

- Intel® 386 processor for onboard applications
- General purpose input/output lines
- I^2C bus capability
- Software can activate radio
- Single line to turn radio on/off
- Radio parameters stored at power down
- Terminal devices may power-down while radio modem remains operational
- Flow control options: Hardware, Xon/Xoff, or None
- Fully shielded metal enclosure
- Network Support: DataTAC 4000

RIM 802D

OEM Radio Modem for DataTAC

THE RIM 802D OEM RADIO MODEM

The RIM 802D OEM Radio Modem is a high-performance digital RF transceiver designed for system integration by original equipment manufacturers. Operating in the 800 MHz frequency range, it is compatible with DataTAC wide-area wireless data communication networks. Typical applications include:

- Handheld Terminals, Laptops, Palmtops
- Electronic Funds Transfer (POS, ATM, etc.)
- Traffic Monitoring, Billboards, Signs, Signals
- Parking Monitoring and Enforcement

The 802D provides an unprecedented wireless development platform with the ability to store and execute an application on the internal Intel® 386 processor. Available memory includes 100KB of RAM, 448KB of file space, and 256KB of application code space. The additional functionality of the 802D is particularly well-suited for applications such as:

- GPS, Asset Tracking, Vehicle Location, Fleet Management
- Telemetry, Meter Reading, Monitoring, Equipment Control
- Vending Machines

RIM 802D FEATURES

Features that compel companies to integrate the 802D OEM Radio Modem into their products include:

EFFICIENT POWER MANAGEMENT

The 802D sets new power consumption standards by reducing stand-by power consumption to as low as 0.2 mA.

SMALL AND LIGHTWEIGHT SINGLE BOARD DESIGN

Significantly smaller than a business card, and uncommonly thin and lightweight, the 802D is ideal for hand-held computers and installation in existing equipment enclosures. The single-board design ensures greater device reliability, particularly in high-vibration environments and in devices that are easily dropped.

POWERFUL AND EFFICIENT TRANSMITTER

The 802D transmitter can supply a full 2 Watts to the antenna, enhancing in-building and fringe-area use. RIM's RF transceiver technology ensures efficient power conservation.

HIGH NOISE IMMUNITY

The 802D has high immunity to RF noise generated by nearby electronics, which significantly extends battery life, increases message exchange reliability, and increases the effective range of operation. As a result of high noise immunity, special shielding and physical separation should not be necessary, allowing the 802D to meet tight space requirements as well as simplifying the integration.

RIM 802D SOFTWARE DEVELOPER'S KIT

The Software Developer's Kit provides an extremely powerful development environment that uses Microsoft Developer Studio 5.0 or later (Visual C++ 5.0 or later), supporting Windows 95 and Windows NT. The 802D platform is well-suited for object-oriented programming as it is managed by an event-driven, multi-tasking operating system that controls applications running on the modem's internal Intel® 386 processor.

The 802D OS simulator allows a standard PC to be used for developing software applications, allowing developers to quickly write applications. When fully tested and debugged, the compiled application is easily downloaded into the 802D OEM Radio Modem without any required modifications.

RIM 802D BENEFITS

Together, these features and the Software Developer's Kit offer developers the following valuable benefits:

REDUCED COSTS

The 802D with its SDK is no longer just a radio modem, but is now also a development platform with an Intel® processor onboard. The SDK essentially eliminates the costs associated with external processing.

EASY DEVELOPMENT AND IMPLEMENTATION

A Microsoft Developer Studio-compatible SDK means that your software engineers can easily develop custom applications for the 802D radio modem.

GET PRODUCTS TO MARKET FASTER

With the entire wireless solution in one package, an easy-to-use SDK and RIM's experience and leadership in the field of wireless communication and technology, your wireless business solutions will be implemented faster.

TECHNICAL SUPPORT

RIM has a team of experienced engineers who are dedicated to support you in the design and implementation of your project.

If you have any questions about radio technology or its integration into your platform, please do not hesitate to contact the RIM team:

Email: rim802d@rim.net
Phone: 519-888-7465
Fax: 519-888-7884
Web: www.rim.net

APPENDIX B

Antenna Specifications

LARSEN’S NMOQ800BSMA

ELECTRICAL

GAIN:	UNITY/0 dBd
COAX:	RG58/U
COAX LENGTH:	6"
COAX LOSS AT 800 MHz PER FOOT:	0.11
CONNECTOR:	SMA MALE CRIMP
CONNECTOR LOSS:	0.05 dB

MECHANICAL

ROD:	17-7 STAINLESS STEEL
FINISHING:	KULROD™ COPPER PLATING WITH BLACK URETHANE
BASE MATERIAL:	MAKROBLEND® PLASTIC (MACROBLEND IS A TRADEMARK OF THE MOBAY COMPANY)
NMO MOUNT MATERIAL:	BRASS THREADS ON A NICKEL PLATED STEEL HOUSING

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Tel: 800 ANTENNA Fax: 360 944-7556
www.larsenantennas.com e-mail:larsen@larsenantennas.com

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Larsen Antenna Technologies

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K2R 1E6

Tested by ____________________________ Date: __________________
Heike Wünschmann, C.E.T.

Submitted by ____________________________ Date: __________________
Dr. Paul G. Cardinal
Director, Laboratories

Approved by ____________________________ Date: __________________
Dr. Jacek J. Wojcik, P. Eng.

FCC ID:	L6AR802D-2-O
Client :	Research in Motion Limited
Equipment :	OEM Radio-Modem attached to an Antenna Company Vehicle-Top Magnet Mounting Antenna
Part No. :	R802D-2-O Radio-Modem and Eclipse II Magnet Mount Antenna
Serial No. :	Pre-production sample

ENGINEERING SUMMARY

This report contains the results of the maximum permissible exposure (MPE) evaluation performed on the equipment under test (EUT) which was comprised of a Research in Motion R802D-2-O OEM radio-modem, an IBM 760ED ThinkPad laptop, attached to an Antenna Company Vehicle-Top Magnet Mounting Antenna. The tests were carried out in accordance with the applicable requirements of FCC rules found in 47CFR §2.1091 and the standards ANSI/IEEE C95.1-1992 and C95.3-1992. The test frequency was 806 MHz (low channel, 2000_h).

The methodology and results for the test are described in the appropriate section of this report.

The EUT will not exceed the MPE requirements for 806 – 821 MHz band. The maximum power exposure level measured at 20 cm was 0.16 mW/cm^2.

TABLE OF CONTENTS

ACRONYMS

EUT	Equipment Under Test
FCC	Federal Communications Commission
MPE	Maximum Permissible Exposure
N/A	Not Applicable
NTS	Not To Scale
OATS	Open Area Test Site
OEM	Original Equipment Manufacturer
QA	Quality Assurance
RIM	Research in Motion

1. INTRODUCTION

1.1. GENERAL

This report describes the Maximum Permissible Exposure (MPE) tests for a Research in Motion R802D-2-O OEM radio-modem, an IBM 760ED ThinkPad laptop, and a 3 dBd Antenna Company Eclipse II Vehicle-Top Magnet Mounting Antenna, the combination hereinafter called the EUT (Equipment Under Test).

1.2. SCOPE

MPE evaluation was performed on the EUT in accordance with the requirements of the FCC rules for RF compliance found in 47CFR §2.1091 and the standard ANSI/IEEE C95.3-1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave. This Engineering Report contains the following:

- Methodology as to how the tests were performed.
- Test results and analysis.
- Identification of the test equipment used for the testing.
- Test set-up diagram.

1.3. SCHEDULE

The MPE tests were completed on 26th August, 1999.

1.4. APPLICABLE DOCUMENTS

FCC Rule Part 47CFR §2.1091

ANSI/IEEE C95.1-1992, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz.

ANSI/IEEE C95.3-1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.

OET Bulletin 65 (Edition 97-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields.

2. TEST SAMPLE

The MPE test described in this procedure was performed on:

- Research in Motion Model R802D-2-O OEM radio-modem (see specification sheets in Appendix A and figure 3.1)
- IBM ThinkPad Laptop Model 760ED, FCC ID ANOGCF2704AT, Type 9546-U9A, S/N 78-ACPW2 97/02
- Eclipse II 3 dBd vehicle-top magnet mounting (see specification sheets in Appendix B)

Figure 3.1 Photograph of R802D-2-O OEM Radio Modem

3. GENERAL REQUIREMENTS

3.1. LOCATION OF TEST FACILITIES

The tests were performed by APREL Laboratories at APREL’s test facility located in Nepean, Ontario, Canada. The laboratory operates a 3 and 10 meter Open Area Test Site (OATS) measurement facility. The test site is calibrated to ANSI C63.4-1992.

A description of the measurement facility in accordance with the radiated and AC line conducted test site criteria in ANSI C63.4-1992 is on file with the Federal Communications Commission and is in compliance with the requirements of Section 2.948 of the Commissions rules and regulations. APREL’s registration number is 31070/SIT(1300F2).

APREL is accredited by Standard Council of Canada, under the PALCAN program (ISO Guide 25). All equipment used is calibrated or verified in accordance with the intent of AQAP-6/MIL-STD-45662. APREL is also accredited by Industry Canada (formerly DOC) and recognised by the Federal Communications Commission (FCC).

3.2. PERSONNEL

Radiation Hazard technical staff member, Heike Wünschmann, carried out all MPE tests.

3.3. FAILURE CRITERIA

The equipment under test was considered to have failed if any of the following occurred:

When the MPE limits exceeded those permitted by appropriate limits defined by the FCC.

3.4. POWER SOURCE REQUIRED

The following nominal DC Power was maintained during the test:

Voltage: 4.4 VDC (12 VDC cell with a voltage regulator)

3.5. TOLERANCE

The following tolerances on test conditions, exclusive of equipment accuracy, were maintained:

Voltage: ± 1%

4. TEST INSTRUMENTATION & CALIBRATION

4.1. GENERAL

APREL Laboratories, located in Nepean, Ontario is equipped with the necessary instrumentation to ensure accurate measurement of all data recorded during the tests outlined in this document. To ensure continued accuracy, each instrument is re-calibrated at intervals established by APREL and based on standards traceable to the National and International Standards. Accuracy surveillance is a function of APREL Quality Assurance.

4.2. MPE TEST EQUIPMENT REQUIRED

The test equipment required to perform the MPE testing was selected from the equipment available at APREL.

4.3. CALIBRATION REQUIREMENTS

All test equipment instrumentation required for MPE qualification testing was calibrated and controlled.

5. ELECTRICAL/MECHANICAL DESCRIPTION

The MPE Test Program was performed on one OEM radio-modem attached to an IBM ThinkPad laptop computer and a Larsen vehicle-top mounting antenna, the combination hereinafter called the EUT. The test sample consisted of the components supplied by the customer and described below.

5.1. TEST UNIT DESCRIPTION

The two watt R802D-2-O OEM radio-modem transceiver equipped with Eclipse II magnet mount antenna and controlled by an IBM ThinkPad laptop computer, consisted of the following components:

Part Number	Description
R802D-2-O	RIM OEM radio-modem
02120-001 Rev B.	RIM interface board (ITB)
SRB01519/9743D59235	RIM execution lock
760ED Think Pad	IBM Laptop computer
8110	Eclipse II 3 dBd vehicle-top magnet mount
0820-0004	6 Gates 2 V 25 AH BC DC cells
VR 4.45	APREL 4.4 VDC voltage regulator

5.2. MPE TEST SETUP

The EUT antenna shall be installed in the centre of a ground plane simulating the rooftop of a vehicle. The other components shall be located underneath this ground plane to simulate operation from inside of the vehicle (see Figures 6.2.1 and 6.2.2).

The vehicle simulator shall be positioned on the turntable in the OATS in such a way that the antenna will be located on the centre of rotation.

The EUT shall be connected to the 4.4 VDC power supply.

For the selection and placement of the measuring probe, the requirements of ANSI/IEEE C95.3-1992 shall be met.

Figure 6.2.1. Photograph of the Setup.

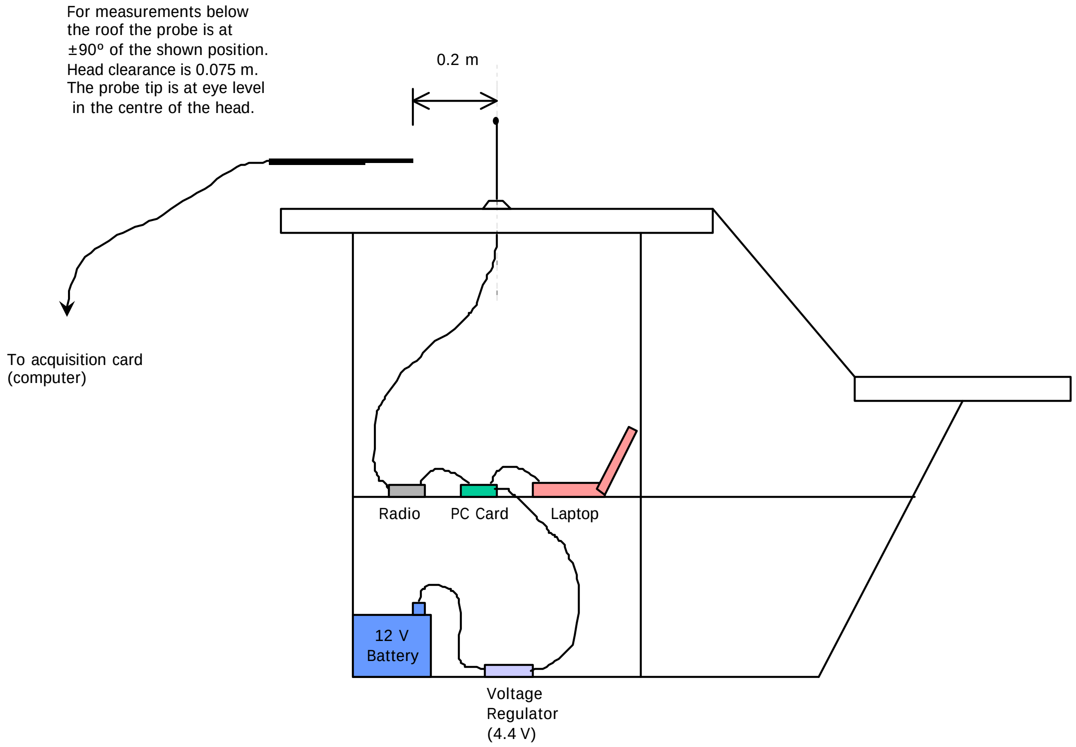


Figure 6.2.2. Elevation View of the Setup.

6. MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

6.1. PURPOSE

This test method is used to verify that the EUT meets the MPE requirements as defined in the criteria for general population/uncontrolled exposure when operating at maximum power levels and in all operating modes.

6.2. TEST EQUIPMENT

Description	**Manufacturer**	**Model No.**
E-Field Probe	APREL Laboratories	E-009 s/n 115

6.3. CRITERIA

Power Density Limits – The EUT shall not generate a power density beyond the limits in the frequency band listed in the left hand column of Table 7.3.1, and the power density given in the right hand column. The power density shall be measured 20 cm from the radiating antenna axis above the vehicle-top simulating ground plane, as well as and in the approximate location of the head of possible vehicle drivers or passengers below the ground plane (see Figure 7.3.1). The measured values shall be recorded.

Table 7.3.1

Power Density Limits
for General Population/Uncontrolled Exposure

Frequency Range	**Power Density (mW/cm^2)**
300 - 1500 MHz	f/1500

Note: f = frequency in MHz

The measurements shall be performed at one transmitting frequency, the highest of the high, middle or low channels, with the EUT operating at the full rated output power.

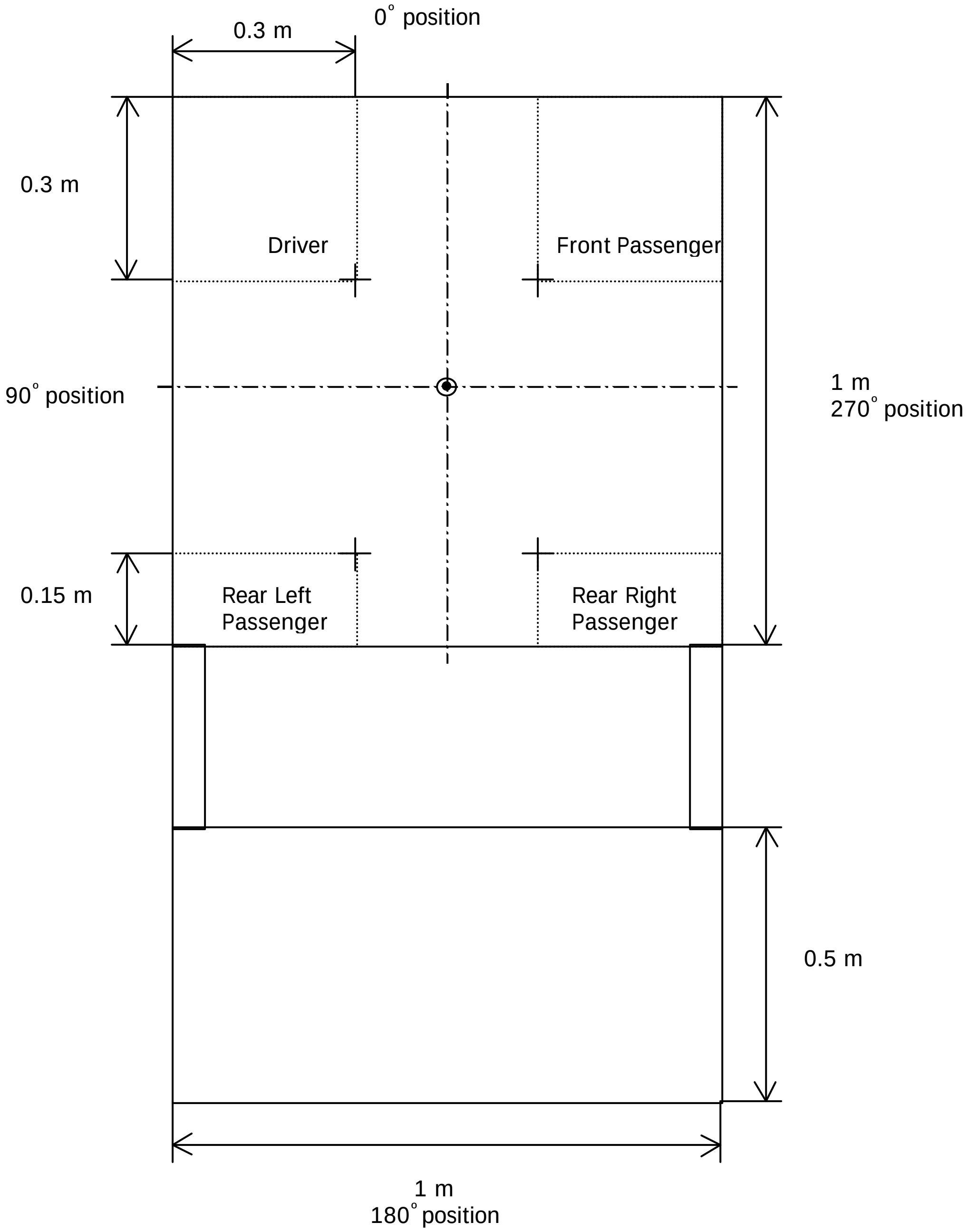


Figure 7.3.1. Plan View of Vehicle Simulator and Setup.

6.4. TEST PROCEDURE

a) The probe shall be positioned close to, and parallel to, the vehicle rooftop simulation with its tip 20 cm from the radiating antenna, and its axis normal to the antenna.

b) Rotate the turntable so that the probe is at the 0° position (see Figure 7.3.1).

c) Turn on the EUT and allow sufficient time for stabilisation. Turn on the transmitter and simulate normal operation conditions. Operate the transmitter at full rated output power.

d) Determine the location of the maximum power density: locate the maximum emissions by scanning vertically along the EUT's antenna. Take and record measurements of the power density at a number of points along the length of the antenna as well as just past its tip.

e) At every 45° of rotation take and record a measurement of the power density at the maximum power density height as for at least the following locations:

- half the maximum power density height
- height halfway between the maximum power density height and the tip of the radiating antenna
- just above the tip of the antenna

f) Turn off the EUT.

g) Position the probe under the vehicle rooftop simulating ground plane in the approximate location of the centre of the head of a potential driver of the simulated vehicle (see Figures 6.2.2 and 7.3.1).

h) Turn on the EUT and allow a sufficient time for stabilisation. Turn on the transmitter and simulate normal operation conditions. Operate the transmitter at full rated output power.

i) Take and record the measurement of the power density at this location.

j) Turn off the EUT.

k) Repeat steps g) through j) for the positions of the other potential occupants of the simulated vehicle as shown in Figure 7.3.1.

6.5. RESULTS

Table 7.5.1 presents the results of the measurements made along the length of the antenna in order to find the location of the maximum power density (Eclipse II antenna has a height of 35.5 cm). Column 1 shows the height at which the measurements were taken and column 2 shows the result ("total" indicates that this is the sum of the power density measured by each of the three orthogonal sensors in the probe). Excess cable loss does not apply here because of its nominal length of 6 feet.

The data in Table 7.5.1 is presented in Figure 7.5.1.

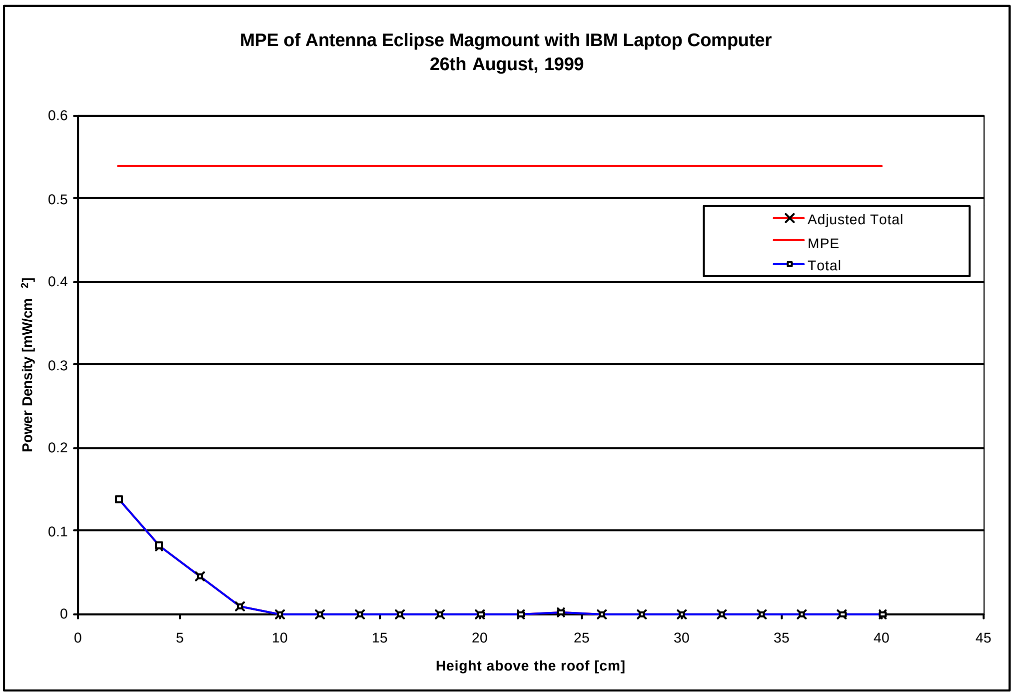


Figure 7.5.1

Table 7.5.1

Height	Total	Excess cable loss	Adjusted total	Limit
[cm]	[mW/cm^2]	[dB]	[mW/cm^2]	[mW/cm^2]
2	0.14	0	0.14	0.54
4	0.08	0	0.08	0.54
6	0.05	0	0.05	0.54
8	0.01	0	0.01	0.54
10	0.00	0	0.00	0.54
12	0.00	0	0.00	0.54
14	0.00	0	0.00	0.54
16	0.00	0	0.00	0.54
18	0.00	0	0.00	0.54
20	0.00	0	0.00	0.54
22	0.00	0	0.00	0.54
24	0.00	0	0.00	0.54
26	0.00	0	0.00	0.54
28	0.00	0	0.00	0.54
30	0.00	0	0.00	0.54
32	0.00	0	0.00	0.54
34	0.00	0	0.00	0.54
36	0.00	0	0.00	0.54
38	0.00	0	0.00	0.54

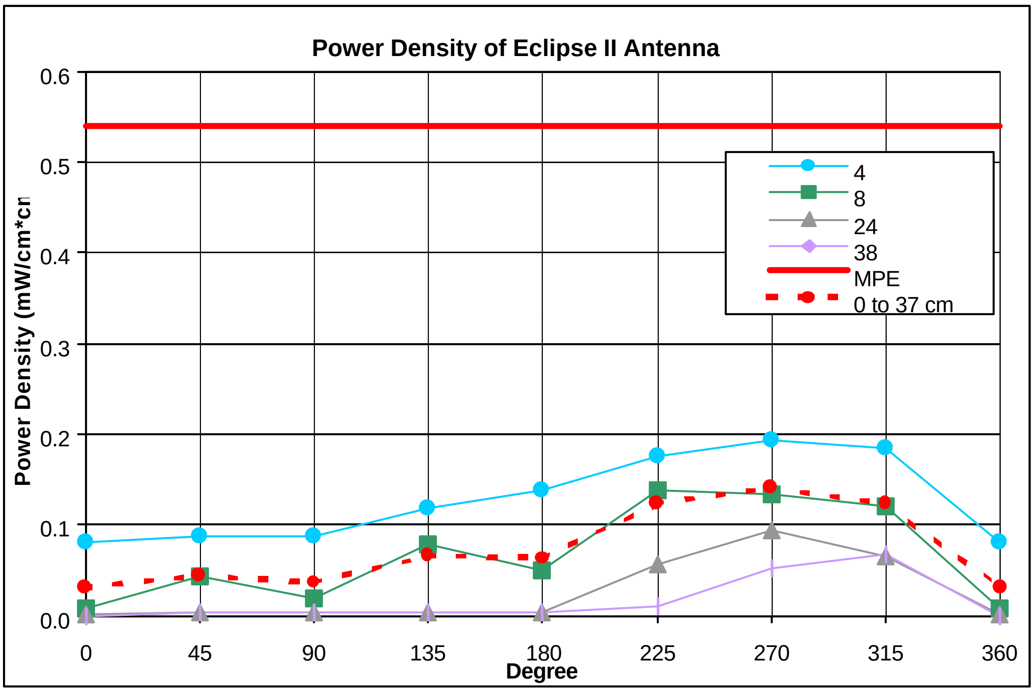
Power Density Measured at 0° as a Function of Height

Table 7.5.2 presents the results of the measurements made around the antenna at every 45° of rotation. Column 1 shows the angle at which the measurements were taken and columns 2 through 5 show the final adjusted power density at the different measurement heights. The measured exposure level is determined by averaging the adjusted total power density along a vertical line up to the height of a tall typical individual, taken here as 6ft or 180cm. Since the height for the rooftop of the simulated vehicle is 143cm, then the averaging is over those measurements made between 0 and 37cm above the simulated vehicle rooftop. Column 6 shows the results of this averaging.

Table 7.5.2

Power Density Measured
at every 45° as a Function of Height

	Adiusted Total Power Densitv				Averaged Values of	
Angular Position [°]	H1 [cm] 4	H2 [cm] 8	H3 [cm] 24	H4 [cm] 38	0 to 37 cm [mW/cm^2]	MPE [mW/cm^2]
0	0.082	0.009	0.002	0.000	0.031	0.54
45	0.087	0.044	0.003	0.003	0.045	0.54
90	0.088	0.020	0.003	0.003	0.037	0.54
135	0.118	0.079	0.003	0.003	0.067	0.54
180	0.138	0.050	0.003	0.003	0.064	0.54
225	0.176	0.138	0.058	0.010	0.124	0.54
270	0.194	0.135	0.094	0.053	0.141	0.54
315	0.185	0.120	0.066	0.068	0.124	0.54
360	0.082	0.009	0.002	0.000	0.031	0.54



The data in Table 7.5.2 is presented in Figure 7.5.2.

Figure 7.5.2.

Measurements were made below the simulated vehicle rooftop, in the approximate location of the centre of the head of potential occupants. It was assumed that this typical position occurred 17.5cm below the roof of the simulated vehicle (the clearance between the top of an occupant's head and a vehicle's roof is ~3" (7.5cm) and distance between the top of the head and the eyes is ~4" (10cm)). Figure 7.3.1 shows the location of measurements for the four potential occupants. Table 7.5.3 presents the results of the measurements. Column 1 shows the position at which the measurements were taken and column 2 shows the result ("total" indicates that this is the sum of the power density measured by each of the three orthogonal sensors in the probe). Excess cable loss does not apply here because of its nominal length of 6 feet.

Table 7.5.3

Power Density Measured
at Position of Potential Vehicle Occupants

Position	Total $[mW/cm^2]$	Excess cable loss [dB]	Adjusted Total $[mW/cm^2]$	MPE Limit $[mW/cm^2]$
driver	0.00	0	0.00	0.54
front passenger	0.00	0	0.00	0.54
rear left	0.00	0	0.00	0.54
rear right	0.00	0	0.00	0.54

6.6. DISCUSSION

The maximum exposure determined for this EUT was 0.14mW/cm^2 at a distance of 20 cm from the antenna. These measurements were performed with the maximum duty cycle of 100 % and a maximum power at 2 W (33 dBm).

RIM has found that due to the 0.5 dB tolerance in the calibration tool the radio modem could have an absolute maximum power of 2.25 W (33.5 dBm). It was determined by proportional scaling that the maximum power exposure level at 20 cm would be 0.16 mW/cm^2.

7. CONCLUSION

The EUT consisting of a Research in Motion R802D-2-O OEM radio-modem, an IBM 760ED ThinkPad laptop, and an Antenna Company Eclipse II Magnet Mount Antenna will not exceed the MPE requirements for the 806 - 821 MHz band. The maximum power exposure level determined at 20 cm was 0.16 mW/cm^2.

APPENDIX A

Transmitter Specifications

RIM 802D
OEM Radio Modem for DataTAC

INTEGRATOR'S KIT

The RIM 802D Integrator's Kit offers the following tools and accessories to quickly begin using the RIM 802D OEM Radio Modem:

- Software Developer's Kit
- RIM 802D OEM Radio Modem
- Interface and Test Board including:
  - RS232 to 3.0V serial level conversion and FPC cable connector
  - DB-9 serial port for RS-232 connection to the host computer
  - Regulated power for the RIM 802D
  - LED indicators show when the RIM 802D is receiving power, transmitting, message waiting, in coverage, or exchanging data with the host
  - Test points for the 22-pin data cable
- Power supply (AC to DC)
- Required cables (including antenna cable)
- DB-9 to DB-9 straight through serial cable
- Magnetic-mount +3 dBd antenna
- Hardware Integrator's Guide
- Programmer's Guide to RAP (Radio Access Protocol)

SOFTWARE DEVELOPER'S KIT

The RIM 802D Software Developer's Kit includes all the tools required to accelerate application development. The Software Developer's Kit includes:

- Software
- Technical documentation for all APIs
- Source code examples
- Application utilities
- PC-based OS simulator

HARDWARE INTEGRATOR'S GUIDE

The RIM 802D Hardware Integrator's Guide includes valuable information, such as:

- Hardware design recommendations
- Suppliers of cables, connectors, and antennas
- Antenna matching guidelines
- Schematics for power supplies and RS-232 serial port interfaces
- Software development suggestions and tools
- Detailed electrical and serial port specifications

TECHNICAL SPECIFICATIONS

MECHANICAL & ENVIRONMENTAL PROPERTIES

- Weight (incl. case): 35g (1.23oz)
- Footprint: 42.0 x 67.5 mm (1.65" x 2.65")
- Thickness: 8.4 mm (0.33")
- Serial connector: 22-pin FPC connector
- MMCX Antenna cable connector
- Tested to IEC 68-2-6 Part 2 for vibration
- Operating temperature: -30°C to + 70°C
  (at 5-95% relative humidity, non-condensing)
- Storage temperature: -40°C to +85°C

RF PROPERTIES

- Transmit frequency: 806-825 MHz
- Transmit power range: 2.0 W at antenna port
- Receive frequency: 851-870 MHz
- Receive sensitivity: -118 dBm (MDC), -111 dBm (RD-Lap)
- Dual RF Air Protocol (19200 bps RD-Lap and 4800 bps MDC)
- Nation-wide fully automatic roaming
- FCC Parts 15 & 90: Pending
- Industry Canada RSS 119: Pending

POWER SUPPLY & TYPICAL CURRENT USAGE

- Single power supply; operating range: 4.10 to 4.75 VDC
- Battery save stand-by mode: as low as 0.2 mA
- Receive / express stand-by mode: 66 mA
- Transmit mode: 1700 mA
- Average current usage: 4.3 mA
  (based on 94.95% standby, 5.00% receive, 0.05% transmit)

SERIAL COMMUNICATIONS

- 3.0 V asynchronous serial port with flow control
- Second 3-wire serial port (TX, RX, GND)
- Message waiting, coverage, and transmit indicate outputs
- Link level protocols: Radio Access Protocol (RAP) and Native Control Language (NCL)
- Link speed: 1200-15200 bps

OTHER FEATURES

- Intel® 386 processor for onboard applications
- General purpose input/output lines
- I^2C bus capability
- Software can activate radio
- Single line to turn radio on/off
- Radio parameters stored at power down
- Terminal devices may power-down while radio modem remains operational
- Flow control options: Hardware, Xon/Xoff, or None
- Fully shielded metal enclosure
- Network Support: DataTAC 4000

RIM 802D

OEM Radio Modem for DataTAC

THE RIM 802D OEM RADIO MODEM

The RIM 802D OEM Radio Modem is a high-performance digital RF transceiver designed for system integration by original equipment manufacturers. Operating in the 800 MHz frequency range, it is compatible with DataTAC wide-area wireless data communication networks. Typical applications include:

- Handheld Terminals, Laptops, Palmtops
- Electronic Funds Transfer (POS, ATM, etc.)
- Traffic Monitoring, Billboards, Signs, Signals
- Parking Monitoring and Enforcement

The 802D provides an unprecedented wireless development platform with the ability to store and execute an application on the internal Intel® 386 processor. Available memory includes 100KB of RAM, 448KB of file space, and 256KB of application code space. The additional functionality of the 802D is particularly well-suited for applications such as:

- GPS, Asset Tracking, Vehicle Location, Fleet Management
- Telemetry, Meter Reading, Monitoring, Equipment Control
- Vending Machines

RIM 802D FEATURES

Features that compel companies to integrate the 802D OEM Radio Modem into their products include:

EFFICIENT POWER MANAGEMENT

The 802D sets new power consumption standards by reducing stand-by power consumption to as low as 0.2 mA.

SMALL AND LIGHTWEIGHT SINGLE BOARD DESIGN

Significantly smaller than a business card, and uncommonly thin and lightweight, the 802D is ideal for hand-held computers and installation in existing equipment enclosures. The single-board design ensures greater device reliability, particularly in high-vibration environments and in devices that are easily dropped.

POWERFUL AND EFFICIENT TRANSMITTER

The 802D transmitter can supply a full 2 Watts to the antenna, enhancing in-building and fringe-area use. RIM's RF transceiver technology ensures efficient power conservation.

HIGH NOISE IMMUNITY

The 802D has high immunity to RF noise generated by nearby electronics, which significantly extends battery life, increases message exchange reliability, and increases the effective range of operation. As a result of high noise immunity, special shielding and physical separation should not be necessary, allowing the 802D to meet tight space requirements as well as simplifying the integration.

RIM 802D SOFTWARE DEVELOPER'S KIT

The Software Developer's Kit provides an extremely powerful development environment that uses Microsoft Developer Studio 5.0 or later (Visual C++ 5.0 or later), supporting Windows 95 and Windows NT. The 802D platform is well-suited for object-oriented programming as it is managed by an event-driven, multi-tasking operating system that controls applications running on the modem's internal Intel® 386 processor.

The 802D OS simulator allows a standard PC to be used for developing software applications, allowing developers to quickly write applications. When fully tested and debugged, the compiled application is easily downloaded into the 802D OEM Radio Modem without any required modifications.

RIM 802D BENEFITS

Together, these features and the Software Developer's Kit offer developers the following valuable benefits:

REDUCED COSTS

The 802D with its SDK is no longer just a radio modem, but is now also a development platform with an Intel® processor onboard. The SDK essentially eliminates the costs associated with external processing.

EASY DEVELOPMENT AND IMPLEMENTATION

A Microsoft Developer Studio-compatible SDK means that your software engineers can easily develop custom applications for the 802D radio modem.

GET PRODUCTS TO MARKET FASTER

With the entire wireless solution in one package, an easy-to-use SDK and RIM's experience and leadership in the field of wireless communication and technology, your wireless business solutions will be implemented faster.

TECHNICAL SUPPORT

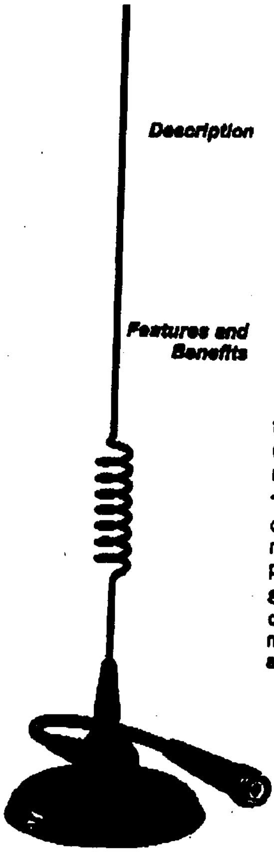
RIM has a team of experienced engineers who are dedicated to support you in the design and implementation of your project.

If you have any questions about radio technology or its integration into your platform, please do not hesitate to contact the RIM team:

Email: rim802d@rim.net
Phone: 519-888-7465
Fax: 519-888-7884
Web: www.rim.net

APPENDIX B

Antenna Specifications



Description

Eclipse II Magnet Mount

The Eclipse II Magnet Mount Antenna is a full 3 dB gain providing dramatically improved performance to portable radio communications in fringe areas or where reception is poor. In addition, the sleek aerodynamic styling and convenient size look great and install easily.

Features and Benefits

Mounts and removes in seconds.

Power balanced magnet delivers maximum magnetic strength.

UV stabilized rubber boot protects vehicle surface.

Connector is protected with extended strain relief.

The Eclipse II is an outstanding performance booster and a proven performer.

Stranded center conductor allows maximum durability and flexibility.

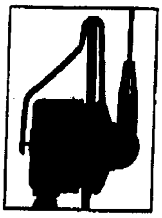
Private Label

Increase your visibility, your prestige, and your sales with this form of low cost advertising.

Call your TAC representative for details.

K2+ Klip™ Window Clip

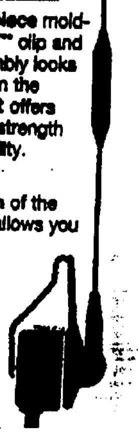
The K2+ Klip™ enclosed coil has all the advantages of the K2+ series in an ideal window clip design. Simply slip the one-piece antenna over your vehicle window and close.



The K2+ Klip™ features our enclosed coil whip to eliminate whistling and to ensure proper clearance over the roof line.

The one piece molded LEXAN™* clip and foot assembly looks fantastic on the vehicle, yet offers maximum strength and durability.

The design of the K2+ Klip™ allows you to seal the window completely without damaging it or the antenna.



Technical Specifications

All antennas include:	
Power Input	60 Watts
Frequency Range	806-866
VSWR	Less than 1.5:1 over specified range
Impedance	50 Ohms

Name	Model numbers	Gain	Whip Height
Eclipse II	#8110/8111/8115/8119	3 dB	14"
MightyMini®	#8120-QR/8121-QR/8126-QR/8129-QR	0 dB	4"
K2+ Klip™	#8620/8621/8625/8629	3 dB	15"

Ordering Information

Model Number	Name
8110	Eclipse II magnet mount w/TNC connector
8111	Eclipse II magnet mount w/N connector
8115	Eclipse II magnet mount w/Mini-UHF connector
8119	Eclipse II magnet mount w/ACC connector
8120-QR	MightyMini® w/TNC connector
8121-QR	MightyMini® w/N connector
8126-QR	MightyMini® w/Mini-UHF connector
8129-QR	MightyMini® w/ACC connector
8620	K2+ Klip™ w/TNC connector
8621	K2+ Klip™ w/N connector
8625	K2+ Klip™ w/Mini-UHF connector
8629	K2+ Klip™ w/ACC connector

To Order Call 1-800-456-2820

Made in the USA

All TAC products are made in the USA, ensuring "America Works."

* LEXAN™ is a trademark of GE