Assessment of Compliance

For

Maximum Permissible Exposure Evaluation with Respect to FCC Rule Part 47CFR §2.1091 and the Standards ANSI/IEEE C95.1-1999 and C95.3-1992

Gemini/PD 900 MHz (GPD9)
Mobile Transceiver with external vehicle-top mounting antenna

Dataradio Incorporated

October 2002

DATB-Gemini/PD 900 MHz Mobile Radio-3955

51 Spectrum Way Nepean ON K2R 1E6
Tel: (613) 820-2730 Fax: (613) 820-4161
email: info@aprel.com

Engineering Report

Subject: **Maximum Permissible Exposure Evaluation with Respect to FCC Rule Part 47CFR §2.1091 and the standards ANSI/IEEE C95.1-1999 and C95.3-1992**

FCC ID: **EOTGPD9**

Equipment: **Mobile Transceiver with external vehicle-top mounting antenna**

Model: **Gemini/PD 900 MHz (GPD9)**

Client: **Dataradio Incorporated**
5500 Royalmount Avenue, Suite 200
Town of Mount Royal
Quebec, Canada
H4P 1H7

Prepared by: **APREL Laboratories,**
Regulatory Compliance Division
51 Spectrum Way
Nepean, Ontario
K2R 1E6

Project #: **DATB – GEMINI/PD 900 MHz Mobile Radio - 3955**

Approved by: _____ Date: Oct 22, 2002
Jay Sarkar: Technical Director, Standards & Certification

Submitted by: _____ Date: Oct 22, 2002
Jay Sarkar: Technical Director, Standards & Certification

Released by: _____ Date: Oct 23/02
Dr. Jack J. Wojcik, P.Eng.

PROFESSIONAL ENGINEER J.J. WOJCIK PROVINCE OF ONTARIO

FCC ID: EOTGPD9
Client : Dataradio Inc.
Equipment : Dataradio Gemini/PD 900 MHz Mobile Transceiver (GPD9) equipped with external vehicle-top mounting monopole antenna

ENGINEERING SUMMARY

This report contains the results of the maximum permissible exposure (MPE) evaluation performed on the Dataradio Gemini/PD 900 MHz Mobile Transceiver equipped with an 5dB external vehicle-top mounting antenna. The output power of the unit was set at 25W-peak value running with 33% maximum source based duty cycle. The antenna was connected to the transmitter via RG-58A/U coaxial cable with 1.66 dB loss. The tests were carried out in accordance with the applicable requirements of FCC rules found in 47CFR §2.1091 and the standards ANSI/IEEE C95.1-1999 and C95.3-1992.

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

The DUI was tested on frequency 900 MHz. The maximum power exposure level measured at 50 cm from the antenna was 0.216 mW/cm^2. Users and installers should be provided with the appropriate operating instructions regarding safe distances and vehicle-mount configurations, for satisfying RF exposure compliance.

FCC SUBMISSION INFORMATION

FCC ID:	**EOTGPD9**
Equipment:	Mobile Transceiver equipped with external vehicle-top mounting antenna
Model:	Gemini/PD 900 MHz (GPD9)
For:	Certification
Applicant:	**Dataradio Inc.** 5500 Royalmount Ave., Suite 200 Town of Mount Royal Quebec, Canada H4P 1H7
Manufacturer:	**Dataradio Inc.** 5500 Royalmount Ave., Suite 200 Town of Mount Royal Quebec, Canada H4P 1H7
Evaluated by:	**APREL Inc.** 51 Spectrum Way Nepean, Ontario Canada, K2R 1E6

ACRONYMS

CBT	Calibration Before Test
CNR	Calibration Not Required
DUI	Device Under Investigation
ERP	Effective Radiated Power
FCC	Federal Communications Commission
MPE	Maximum Permissible Exposure
N/A	Not Applicable
NTS	Not To Scale
OEM	Original Equipment Manufacturer
QA	Quality Assurance

1.0 INTRODUCTION

1.1 General

This report describes the Maximum Permissible Exposure (MPE) tests on an Dataradio Gemini/PD 900MHz Mobile Transceiver (GPD9) equipped with external vehicle-top mounting antenna, the combination hereinafter called the DUI (Device Under Investigation).

1.2 Scope

MPE evaluation was performed on the DUI 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 October 2002.

2.0 APPLICABLE DOCUMENTS

FCC Rule Part 47CFR §2.1091

ANSI/IEEE C95.1-1999, 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) Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields.

3.0 TEST SAMPLE

The MPE test described in this procedure was performed on:

- Dataradio Gemini/PD, 900 MHz Mobile Transceiver (model: GPD9, S/N: LAB) equipped with external vehicle-top mounting monopole antenna

4.0 GENERAL REQUIREMENTS

4.1 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 90416.

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).

4.2 Personnel

EMC/EMI testing staff member, Roman Kuleba, carried out all MPE tests. The report was originated by Jayanta (Jay) Sarkar.

4.3 Failure Criteria

The device under investigation 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.

4.4 Power Source Required

The following nominal DC Power was maintained during the test:

Voltage: 13.8 VDC.

4.5 Tolerance

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

Voltage: ± 10%.

5.0 TEST INSTRUMENTATION & CALIBRATION

5.1 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.

5.2 MPE Test Equipment Required

The test equipment required to perform the MPE testing is listed in paragraph 7.2.

5.3 Calibration Requirements

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

6.0 ELECTRICAL/MECHANICAL DESCRIPTION

The MPE Test Program was performed on an Dataradio Gemini/PD 900 MHz Mobile Transceiver equipped with external vehicle-top mounting antenna, the combination hereinafter called the DUI. The test sample consisted of the components supplied by the customer and described below.

6.1 Test Unit Description

The Dataradio Gemini/PD 900 MHz Mobile Transceiver equipped with external vehicle-top mounting antenna consisted of the following components:

Part Number	Description
-S/N: LAB	Mobile Transceiver (Dataradio Gemini/PD 900 MHz)
-	Antenex A8965CT Vehicle roof-top mounting monopole antenna (gain: 5dB)
-	12 ft Coaxial Cable (RG58A/U) with 1.66 dB cable loss (0.138 dB/ft)

The test frequency and power were set to 900 MHz and 25W. The transmission duty cycle has been monitored using an internal XCVR PTT ("transceiver push to talk") control line and has been found to be 33%. Duty cycle is limited to this maximum value by operating firmware.

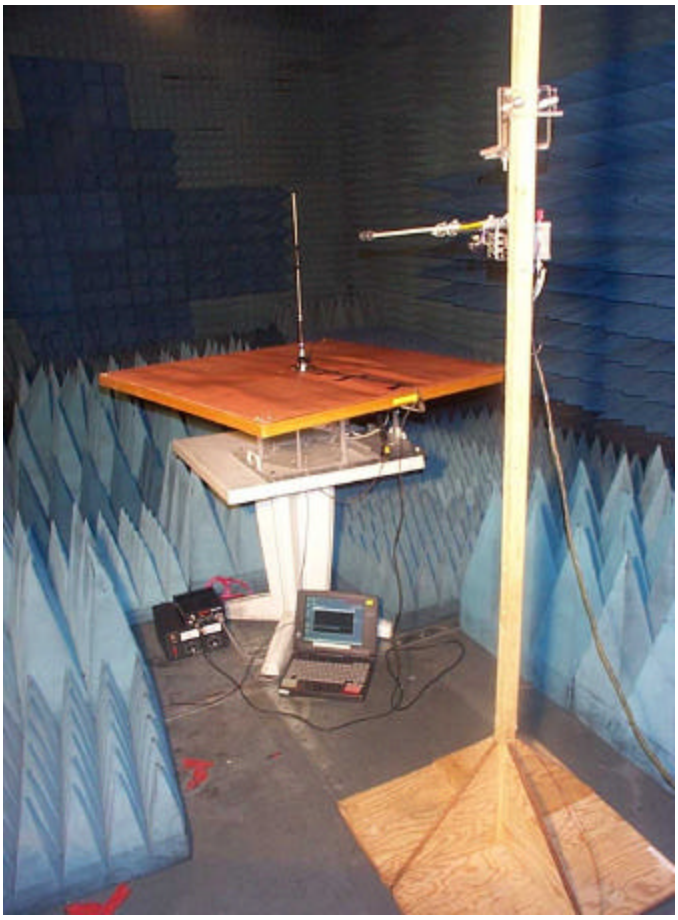
6.2 MPE Test Setup

a) The DUI 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 (see Figures 6.2.1 and 6.2.2).

b) The ground plane shall be positioned on the turntable in the OATS in such a way that the antenna will be located on the centre of rotation.

c) The DUI shall be connected to the 13.8 VDC power supply. DC Power Supply model (Astron VS-20M).

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



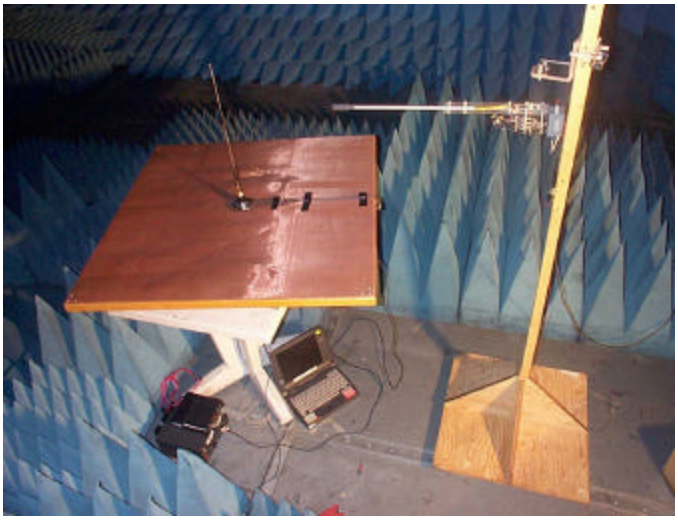


Figure 6.2.1. Photographs of the Setup

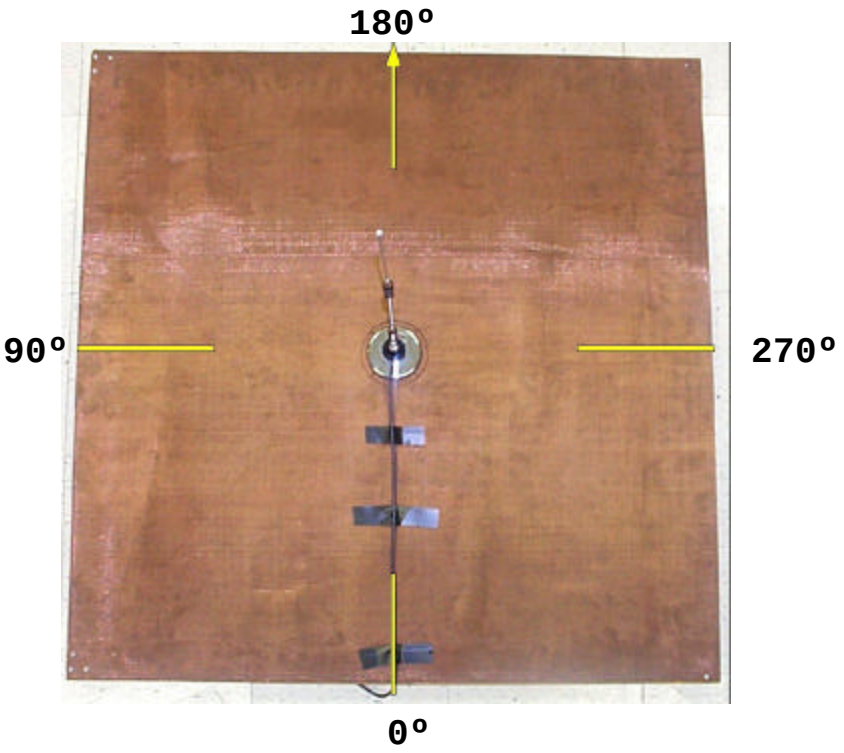


Figure 6.2.2. Plan View of Ground Plane

7.0 MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

7.1 Purpose

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

7.2 Test Equipment

Description	Manufacturer	Model No.	Calibration Due Date
E-Field Probe	APREL Inc.	MPE-APL-2	CBT*
Digital multimeter	Fluke	8505A	Nov. 05, 2002
RF Signal Generator	Hewlett Packard	83640B	Sept. 30, 2003
RF Power Meter	Hewlett Packard	438A	Sept. 05, 2003
TEM Cell	Fisher Custom Comm. Inc.	FCC-TEM-JM1	CNR
20 dB Attenuator	Narda	4779-20	CBT*
RF Amplifier	APREL Inc.	-	CNR
Mast	APREL Inc.	-	N/A
Turntable	APREL Inc.	-	N/A
DC power supply	Astron	VS-20M	N/A
Anechoic Chamber	APREL Inc.	-	N/A

CBT: Calibrate Before Test, in this instance October 4, 2002

7.3 Criteria

Power Density Limits – The DUI 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.

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

7.4 Test Procedure

The power density shall be measured 50 cm from the radiating antenna axis above the vehicle-top simulating ground plane (see Figure 6.2.3). The measurements shall be performed at one transmitting frequency (f_{TX} = 900 MHz) and with the highest power and duty cycle. The measured values shall be recorded.

a) The probe shall be positioned close to, and parallel to, the ground plane (vehicle rooftop simulation) with its tip 50 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 DUI and allow a sufficient time for stabilization. Turn on the transmitter and simulate normal operation conditions. Operate the transmitter at full rated output power. Record the characteristics of the transmit power (duty cycle 33 %).

d) Determine the location of the maximum power density: locate the maximum emissions by scanning vertically along the DUI'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 30° 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 DUI.

7.5 Results

The output power of the device has been set to 25W (rated output power). The measured duty cycle is the same as the source based duty cycle 33%. Antenna gain was 5 dB. The cable loss associated with the supplied 12.0 ft long *Belden RG-58A/U* coaxial cable was 1.66 dB (12.0 ft × 0.138 dB/ft). The resulting ERP is 25W × 33% × (+5dB - 1.66dB) =
25W × 33% × 2.16 = 17.82W.

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 antenna has a height of 48 cm). Column 1 shows the height at which the measurements were taken and column 2 shows the results (power density). Column 3 indicates limit for the MPE in the controlled environment. Margin to the limit is given in column 4.

Table 7.5.1
Power Density Measured at 300° as a Function of Height
Test Frequency: 900 MHz

Height [cm]	Measured Power Density [mW/cm^2]	Limit [mW/cm^2]	Margin [mW/cm^2]
66	0.015	0.60	0.585
60	0.017	0.60	0.583
54	0.020	0.60	0.580
48	0.021	0.60	0.579
42	0.022	0.60	0.578
36	0.024	0.60	0.576
30	0.027	0.60	0.573
24	0.069	0.60	0.531
18	0.180	0.60	0.420
12	0.211	0.60	0.389
6	**0.216**	0.60	0.384
3	0.215	0.60	0.385

The data in the Table 7.5.1 is presented in the Figure 7.5.1.

Test performed by: Kristee Rolan **Date:** October, 2002

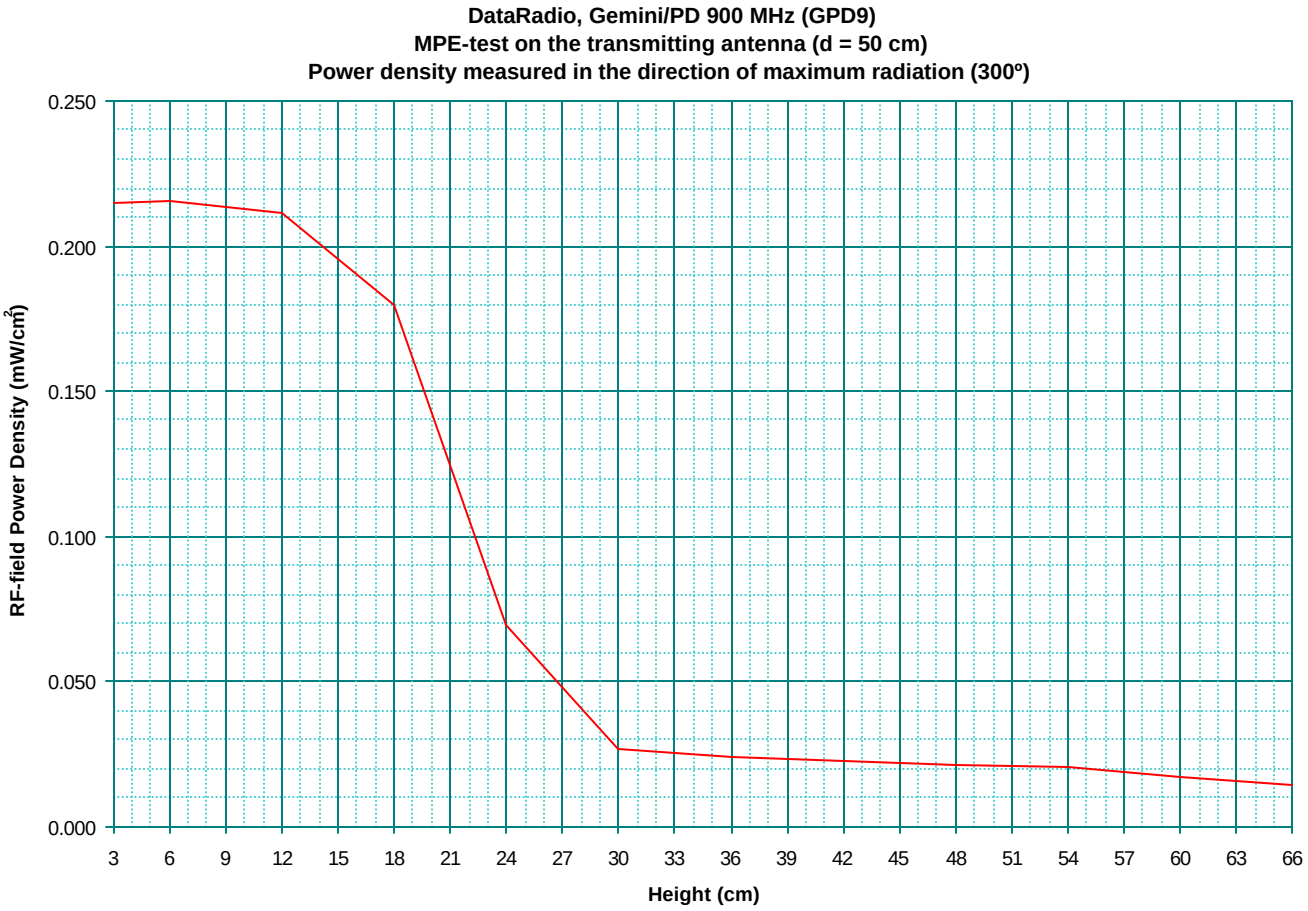


Figure 7.5.1

Table 7.5.2 presents the results of the measurements made around the antenna at every 30° of rotation. Column 1 shows the angle at which the measurements were taken and columns 2 through 14 show the measured power density at the different heights in the range from 3 cm to 66 cm from the roof-top. According to ANSI/IEEE C95.1-1999 the exposure values are those obtained by spatially averaging measured values over an area equivalent to the vertical cross-section (projected area) of the human body. Therefore, the MPE value is determined by averaging the adjusted total power density along a vertical line up to the height of a typically tall individual, taken here as 6 ft or 180 cm. Since the height for the rooftop of the simulated vehicle is 140 cm, then the averaging has to be done over those measurements made between 0 and 39 cm above the simulated vehicle rooftop, which includes first 6 scanned layers. Column 11 shows the results of this averaging.

Table 7.5.2

Power Density Measured
at every 30° as a Function of Height
Test Frequency: 900 MHz

Angular Position (°)	Measured Power Density for Different Heights (mW/cm^2)												Averaged Values (mW/cm^2)	MPE Limit (mW/cm^2)
	3 cm	6 cm	12 cm	18 cm	24 cm	30 cm	36 cm	42 cm	48 cm	54 cm	60 cm	66 cm		
0	0.183	0.163	0.166	0.159	0.072	0.033	0.025	0.019	0.019	0.018	0.015	0.013	0.129	0.60
30	0.182	0.190	0.186	0.165	0.071	0.031	0.024	0.018	0.018	0.019	0.016	0.013	0.138	0.60
60	0.184	0.194	0.188	0.165	0.069	0.029	0.023	0.019	0.019	0.019	0.017	0.014	0.138	0.60
90	0.148	0.148	0.162	0.166	0.076	0.034	0.027	0.021	0.021	0.020	0.017	0.014	0.122	0.60
120	0.168	0.170	0.169	0.156	0.066	0.028	0.025	0.022	0.021	0.021	0.017	0.014	0.126	0.60
150	0.173	0.178	0.173	0.155	0.067	0.029	0.027	0.025	0.024	0.023	0.019	0.016	0.129	0.60
180	0.143	0.142	0.164	0.174	0.075	0.033	0.030	0.028	0.025	0.022	0.018	0.015	0.122	0.60
210	0.188	0.187	0.191	0.176	0.068	0.026	0.026	0.026	0.024	0.022	0.018	0.015	0.139	0.60
240	0.203	0.206	0.203	0.178	0.067	0.025	0.025	0.025	0.023	0.020	0.017	0.015	0.147	0.60
270	0.169	0.166	0.182	0.181	0.074	0.030	0.028	0.027	0.022	0.018	0.016	0.014	0.134	0.60
300	0.215	**0.216**	0.211	0.180	0.069	0.027	0.024	0.022	0.021	0.020	0.017	0.015	0.153	0.60
330	0.201	0.209	0.201	0.172	0.066	0.025	0.023	0.020	0.020	0.019	0.016	0.014	0.146	0.60

Test performed by: Kristine Robinson **Date:** October, 2002

The data in Table 7.5.2 is presented in Figure 7.5.2.

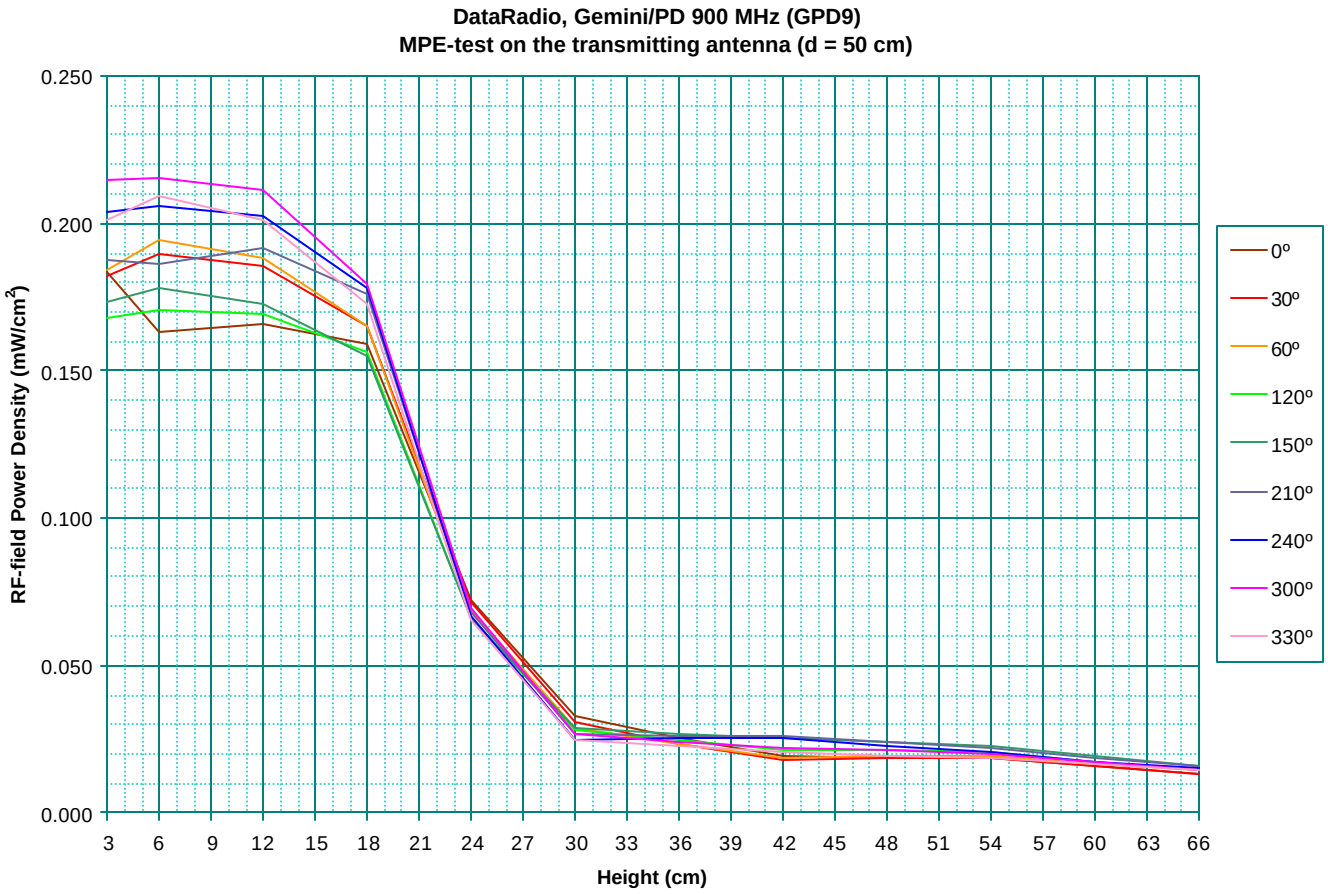


Figure 7.5.2.a

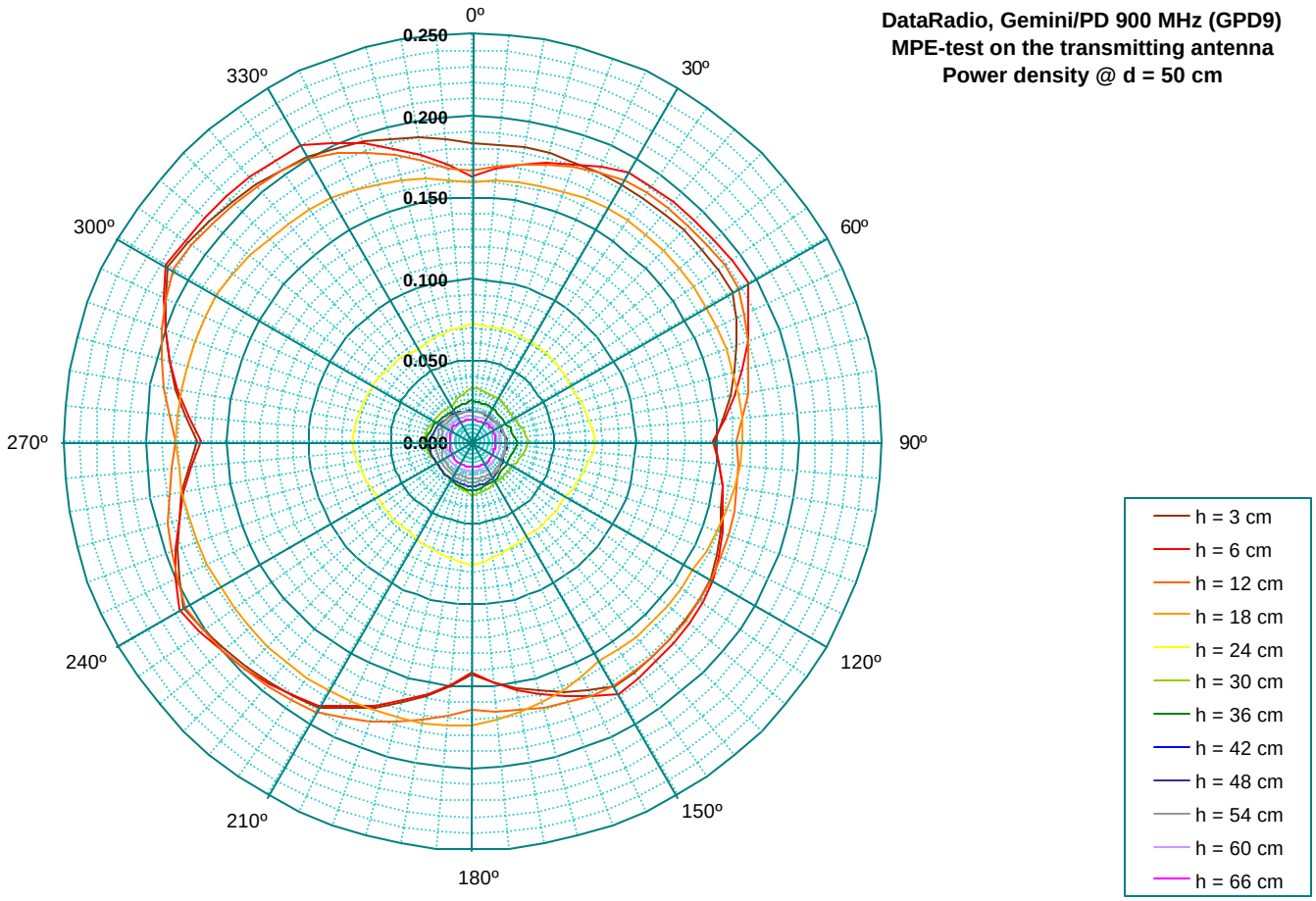


Figure 7.5.2.b

8.0 CONCLUSION

The DUI consisting of a Dataradio Gemini/PD 900 MHz Mobile Transceiver (GPD9) transmitting with an ERP of 17.82W, using an external vehicle-top mounting monopole antenna, will not exceed the MPE requirements at given distances exceeding 50 cm.

The maximum power exposure level measured at 50 cm was 0.216 mW/cm^2, which is 36% of the maximum allowable.