



Product Service

**Choose certainty.
Add value.**

Report On

RF Exposure Assessment of the
Garmin International Inc
VHF 200i Marine VHF with DSC and ATIS

COMMERCIAL-IN-CONFIDENCE

FCC ID: IPH-GARVHF12
IC ID: 1792A-GARVHF12

Document 75904785 Report 01 Issue 3

February 2009



Product Service

TUV Product Service Ltd, Octagon House, Concorde Way, Segensworth North,
Fareham, Hampshire, United Kingdom, PO15 5RL
Tel: +44 (0) 1489 558100. Website: www.tuvps.co.uk

REPORT ON

RF Exposure Assessment of the
Garmin International Inc
VHF 200i Marine VHF with DSC and ATIS

Document 75904785 Report 01 Issue 3

February 2009

PREPARED FOR

Garmin International Inc
1200 East 151st Street
Olathe
Kansas 66062-3426
USA

PREPARED BY

A handwritten signature in black ink, appearing to read 'J Plummer', written over a horizontal line.

J Plummer
Project Engineer

APPROVED BY

A handwritten signature in black ink, appearing to read 'M Jenkins', written over a horizontal line.

M Jenkins
Authorised Signatory

DATED

18 February 2009

This report has been up-issued to Issue 3 to amend the antenna gain, and to add the FCC and Industry Canada ID's.



CONTENTS

Section	Page No
1	REPORT SUMMARY 2
1.1	Introduction 3
1.2	Brief Summary of Results 4
1.3	Product Information 6
1.4	Summary 6
2	TEST DETAILS 7
2.1	Rationale for Assessment of the RF Exposure 8
2.2	Defined Limits 9
2.3	Establishing Wavelength and 1/4 Wavelength 9
2.4	Far Field Calculations 10
3	FIGURES 11
3.1	Field Representations: European – ICNIRP Limits 12
3.2	Field Representations: American – FCC Limits 13
3.3	Field Representations: Canadian – RF Safety Code 6 Limits 15
3.4	Field Representations: Australian – ARPANSA Limits 16
4	DISCLAIMERS AND COPYRIGHT 18
4.1	Disclaimers and Copyright 19



Product Service

SECTION 1

REPORT SUMMARY

RF Exposure Assessment of the
Garmin International Inc
VHF 200i Marine VHF with DSC and ATIS



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the RF Exposure Assessment of the Garmin International Inc VHF 200i Marine VHF with DSC and ATIS to the requirements of the applied test specifications.

Objective	To perform RF Exposure Assessment to determine the Equipment Under Test's (EUT's) compliance of the applied rules..
Applicant	Garmin International Inc
Manufacturer	Kanematsu Corporation
Manufacturing Description	VHF 200i Marine VHF with DSC and ATIS
Model Number(s)	VHF 200i
Declared Model Variants	VHF 100i; VHF 200; VHF 100

Test Specification/Issue/Date

1. EN50385:2002 Product standard to demonstrate the compliances of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110MHz – 40GHz) – General public
2. OET Bulletin 65 Edition 97-01 August 1997 - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
3. RSS-102 Issue 2 November 2005 Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
4. Radiocommunications (Electromagnetic Radiation – Human Exposure) Standard 2003

Related Document(s)

5. Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (Official Journal L 197 of 30 July 1999).
6. FCC Guidelines for Evaluating exposure to RF Emissions - 47 CFR § 1.1310; 47 CFR § 1.1307(b) & 47 CFR § 80.83.
7. Health Canada's Safety Code 6: Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 KHz to 300 GHz.
8. ARPANSA, 'Radiation Protection Standard – Maximum Exposure Levels to Radiofrequency Fields – 3KHz to 300GHz'
9. ICNIRP 1998, 'Guidelines for limiting exposure to time-varying electric magnetic, and electromagnetic fields (up to 300GHz). Guidelines of the International Commission on Non-Ionizing Radiation Protection', Health Physics, vol.74, no.4, pp.494-522.
10. National Council on Radiation Protection and Measurements (NRP) - Report No. 86(1986) "Biological Effects and Exposure Criteria for Radio frequency Electromagnetic



Fields".

11. EN 50383:2002 - Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz - 40 GHz).
12. IEEE Std C95.1-2005: IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3KHz to 300GHz.
13. Australian Standard 2772.2 – 1988, 'Radiofrequency Radiation Part 2 – Principles and Methods of Measurement – 300KHz to 10GHz'

1.2 BRIEF SUMMARY OF RESULTS

1.2.1 General Public Exposure Levels

Antenna Gain (Numeric)	Peak Output Power (mW)	Field	Calculated RF Exposure at 1.410 m (141.0cm)	General Public Exposure Limit	Application
1.000	25000	S	0.050 Wm-2	2.00 Wm-2	ICNIRP
		S	0.0050 mW/cm2	0.20 mW/cm2	FCC 47 CFR § 1.1310
		S	0.050 Wm-2	2.00 Wm-2	Canada's RF Safety Code 6
		S	0.050 Wm-2	2.00 Wm-2	ARPANSA
		E	4.343 V/m	28.00 V/m	ICNIRP
		E	4.343 V/m	27.50 V/m	FCC 47 CFR § 1.1310
		E	4.343 V/m	28.00 V/m	Canada's RF Safety Code 6
		E	4.343 V/m	27.40 V/m	ARPANSA
		H	0.012 A/m	0.073 A/m	ICNIRP
		H	0.012 A/m	0.07 A/m	FCC 47 CFR § 1.1310
		H	0.012 A/m	0.073 A/m	Canada's RF Safety Code 6
		H	0.012 A/m	0.073 A/m	ARPANSA

The calculations have shown that they **meet** the General Public Exposure Levels described in the ICNIRP Guidelines, FCC 47 CFR § 1.1310 Guidelines, Health Canada's RF exposure guideline Safety Code 6 and the Australian ARPANSA limits at **141.0 cm**, the point of investigation.



1.2.2 Occupational Exposure Levels

Antenna Gain (Numeric)	Peak Output Power (mW)	Field	Calculated RF Exposure at 1.410 m (141.0cm)	Occupational Exposure Limit	Application
1.000	25000	S	0.050 Wm-2	10.00 Wm-2	ICNIRP
		S	0.0050 mW/cm2	1.00 mW/cm2	FCC 47 CFR § 1.1310
		S	0.050 Wm-2	10.00 Wm-2	Canada's RF Safety Code 6
		S	0.050 Wm-2	10.00 Wm-2	ARPANSA
		E	4.343 V/m	61.00 V/m	ICNIRP
		E	4.343 V/m	27.50 V/m	FCC 47 CFR § 1.1310
		E	4.343 V/m	60.00 V/m	Canada's RF Safety Code 6
		E	4.343 V/m	61.40 V/m	ARPANSA
		H	0.012 A/m	0.16 A/m	ICNIRP
		H	0.012 A/m	0.16 A/m	FCC 47 CFR § 1.1310
		H	0.012 A/m	0.16 A/m	Canada's RF Safety Code 6
		H	0.012 A/m	0.163 A/m	ARPANSA

The calculations have shown that they **meet** the Occupational Exposure Levels described in the ICNIRP Guidelines, FCC 47 CFR § 1.1310 Guidelines, Health Canada's RF exposure guideline Safety Code 6 and the Australian ARPANSA limits at **141.0 cm**, the point of investigation.



1.3 PRODUCT INFORMATION

1.3.1 Attestation

The wireless device described within this report has been shown to be capable of compliance with the basic restrictions related to human exposure to electromagnetic fields (10 MHz - 300 MHz) - General public. The calculations shown in this report were made in accordance the procedures specified in the applied test specification(s)

1.3.2 Technical Description

The Equipment under test was a Garmin International Inc VHF 200i Marine VHF with DSC and ATIS. A full technical description can be found in the manufacturer's documentation.

The wireless device described within this report has been shown to be capable of compliance with the basic restrictions related to human exposure to electromagnetic fields (10 MHz - 300 MHz) - General public. The calculations shown in this report were made in accordance the procedures specified in the applied test specification(s).

All reported calculations were carried out on the relevant information supplied or measured of a sample of VHF 200i Marine VHF with DSC and ATIS to demonstrate compliance with the applied test specification(s) the sample assessed was found to comply with the requirements of the applied rules.

1.4 SUMMARY

The RF exposure assessment is based upon the following criteria:

The VHF 200i operates in the frequency range of 156.025MHz – 157.425 MHz.

The antenna gain used for the calculation is 0 dBi. However no dedicated antenna is supplied with the product.

The VHF 200i Marine VHF with DSC and ATIS radio power is a maximum 25000 milliwatts.

The point of investigation is 141 cm (1.41m).

A worst case duty cycle of 100% has been used for this assessment, however in practice the applicant declares that the duty cycle should be: 5% Transmit / 5% Receive / 90% Standby.



Product Service

SECTION 2

TEST DETAILS



2.1 RATIONALE FOR ASSESSMENT OF THE RF EXPOSURE

The aim of the assessment report is to evaluate the compliance boundary for a set of given input power(s) according to the basic restrictions (directly or indirectly via compliance with reference levels) related to human exposure to radio frequency electromagnetic fields.

The chosen assessment method to establish the compliance boundary in the far-field region is the reference method as defined in BS EN50383:2002 Clause 5.2; E-field or H-field calculation. The method of calculation used is defined in BS EN50383:2002; Clause 8.2.2, 8.2.3 and 8.2.4. The calculated values have been compared with limits provided in the ICNIRP guidelines. Calculations can be made in three separate regions, based on distance from the antenna. These are called:

- far-field region,
- radiating near-field region,
- reactive near-field region.

The theory that defines these regions is given in EN50383:2002 Annex A.

Far-field region

As shown in EN50383 Annex A, the far-field calculations are accurate when the distance, r , from an antenna of length D to a point of investigation is greater than

$$r = \frac{2D^2}{\lambda}$$

Where, r is the distance from the antenna to the point of investigation.

Radiating near-field region

The radiating near-field region of an antenna of length D as shown in EN50383 Annex A, this region is defined by

$$\frac{\lambda}{4} < r < \frac{2D^2}{\lambda}$$

Reactive near-field region

The reactive near-field region of an antenna as shown in EN50383 Annex A, this region is defined by

$$r \leq \frac{\lambda}{4}$$

Where, r is the distance from the antenna to the point of investigation.

Recommend $\lambda/4$ as the boundary between the radiated near-field and reactive near-field for RF exposure compliance assessment.



Product Service

2.2 DEFINED LIMITS

Normative Reference: ICNIRP Advice on Limiting Exposure to Electromagnetic Fields (0-300GHz). Table A4, Reference Levels for General Public Exposure to Time Varying Electric & Magnetic Fields. Vol 15 No.2. 2004. The defined limits are in accordance with 47 CFR § 1.1310 Radiofrequency radiation exposure limits.

Reference levels for general public exposure to time-varying electric and magnetic fields (unperturbed rms values)

At 156.025 MHz

Power density (Wm-2)	= 2.00	ICNIRP
Power density (mWcm ²)	= 0.20	FCC 47 CFR § 1.1310
Power density (Wm-2)	= 2.00	Canada's RF Safety Code 6
Power density (Wm-2)	= 2.00	Australian Radiation Protection Series Publication No. 3
E-Field (Vm-1)	= 28.00	ICNIRP
E-Field (Vm-1)	= 27.50	FCC 47 CFR § 1.1310
E-Field (Vm-1)	= 28.00	Canada's RF Safety Code 6
E-Field (Vm-1)	= 27.40	Australian Radiation Protection Series Publication No. 3
H-Field (Am-1)	= 0.073	ICNIRP
H-Field (Am-1)	= 0.07	FCC 47 CFR § 1.1310
H-Field (Am-1)	= 0.073	Canada's RF Safety Code 6
H-Field (Am-1)	= 0.073	Australian Radiation Protection Series Publication No. 3

Reference levels for occupational exposure to time-varying electric and magnetic fields (unperturbed rms values)

At 156.025 MHz

Power density (Wm-2)	= 10.00	ICNIRP
Power density (mWcm ²)	= 1.00	FCC 47 CFR § 1.1310
Power density (Wm-2)	= 10.00	Canada's RF Safety Code 6
Power density (Wm-2)	= 10.00	Australian Radiation Protection Series Publication No. 3
E-Field (Vm-1)	= 61.00	ICNIRP
E-Field (Vm-1)	= 27.50	FCC 47 CFR § 1.1310
E-Field (Vm-1)	= 60.00	Canada's RF Safety Code 6
E-Field (Vm-1)	= 61.40	Australian Radiation Protection Series Publication No. 3
H-Field (Am-1)	= 0.16	ICNIRP
H-Field (Am-1)	= 0.16	FCC 47 CFR § 1.1310
H-Field (Am-1)	= 0.16	Canada's RF Safety Code 6
H-Field (Am-1)	= 0.16	Australian Radiation Protection Series Publication No. 3

2.3 ESTABLISHING WAVELENGTH AND 1/4 WAVELENGTH

Frequency (MHz)	$\lambda = \frac{3 \times 10^8}{f}$		$\frac{\lambda}{4}$	
	m	cm	m	cm
156.025	1.9228	192.28	0.4807	48.07
156.800	1.9133	191.33	0.4783	47.83
157.425	1.9057	190.57	0.4764	47.64



2.4 FAR FIELD CALCULATIONS

The following calculations are based on:

Worst case frequency 156.025 MHz

P = 25 (Power (Watts)) or 25000 (Power milliwatts)

G = 1.000 (Numeric Gain) 0 dBi gain antenna

r = 141.0 (Distance (centimetres)) or 1.410 (Distance (meters))

The power flux:

$$S = \frac{PG_{(\theta, \phi)}}{4\pi r^2} \quad S = 0.050 \text{ W/m}^2$$

$$S = 0.005 \text{ mW/cm}^2$$

The electric field strength:

$$E = \frac{\sqrt{30PG_{(\theta, \phi)}}}{r} \quad E = 4.343 \text{ V/m}$$

The magnetic field strength:

$$H = \frac{E}{\eta_0} \quad H = 0.012 \text{ A/m}$$

The calculations meet the General Public Exposure Levels described in the ICNIRP Guidelines.

The calculations meet the General Public Exposure Levels described in the FCC 47CFR§1.1310.

The calculations meet the General Public Exposure Levels described in the Canada's RF Safety Code 6.

The calculations meet the General Public Exposure Levels described in the Australian Radiation Protection Series Publication No. 3

The calculations meet the Occupational Exposure Levels described in the ICNIRP Guidelines.

The calculations meet the Occupational Exposure Levels described in the FCC 47CFR§1.1310

The calculations meet the Occupational Exposure Levels described in the Canada's RF Safety Code 6

The calculations meet the Occupational Exposure Levels described in the Australian Radiation Protection Series Publication No. 3



Product Service

SECTION 3

FIGURES



3.1 FIELD REPRESENTATIONS: EUROPEAN – ICNIRP LIMITS

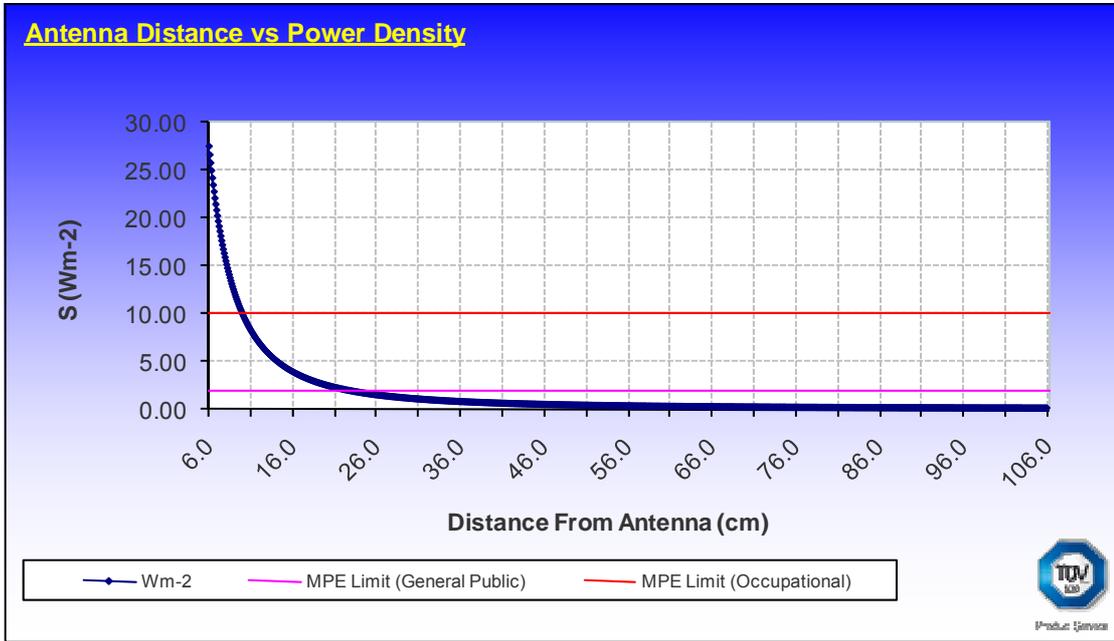


Figure 2 – This graph shows the S field (W/cm²) strength value with regards to distance from the Antenna (cm)

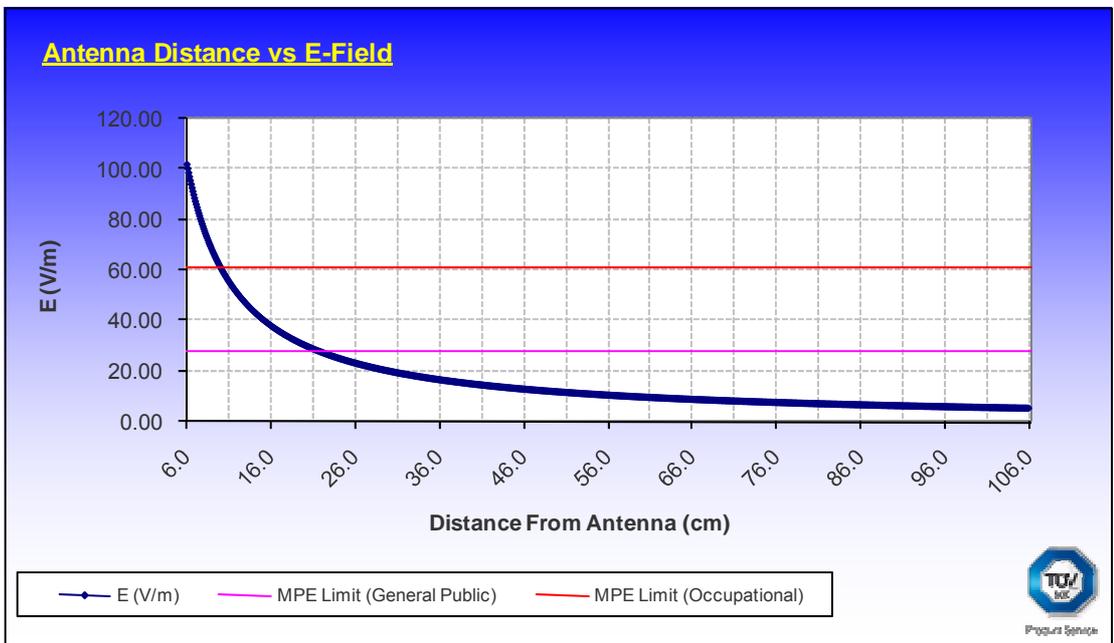


Figure 3 – This graph shows the E field (V/m) strength value with regards to distance from the Antenna (cm).

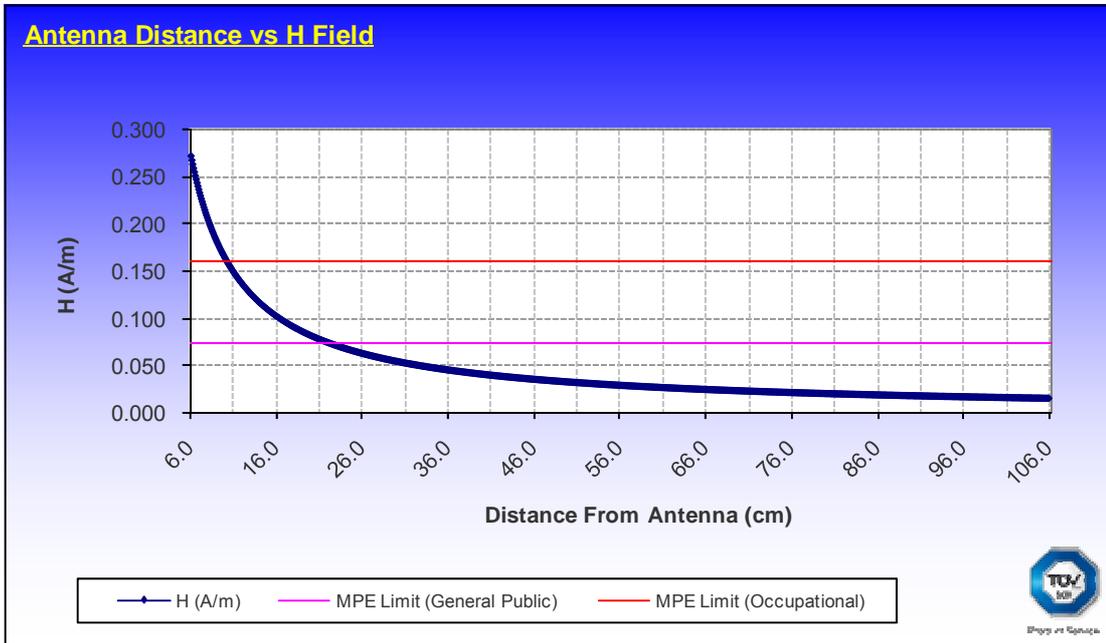


Figure 4 – This graph shows the H field (A/m) strength value with regards to distance from the Antenna (cm).

3.2 FIELD REPRESENTATIONS: AMERICAN – FCC LIMITS

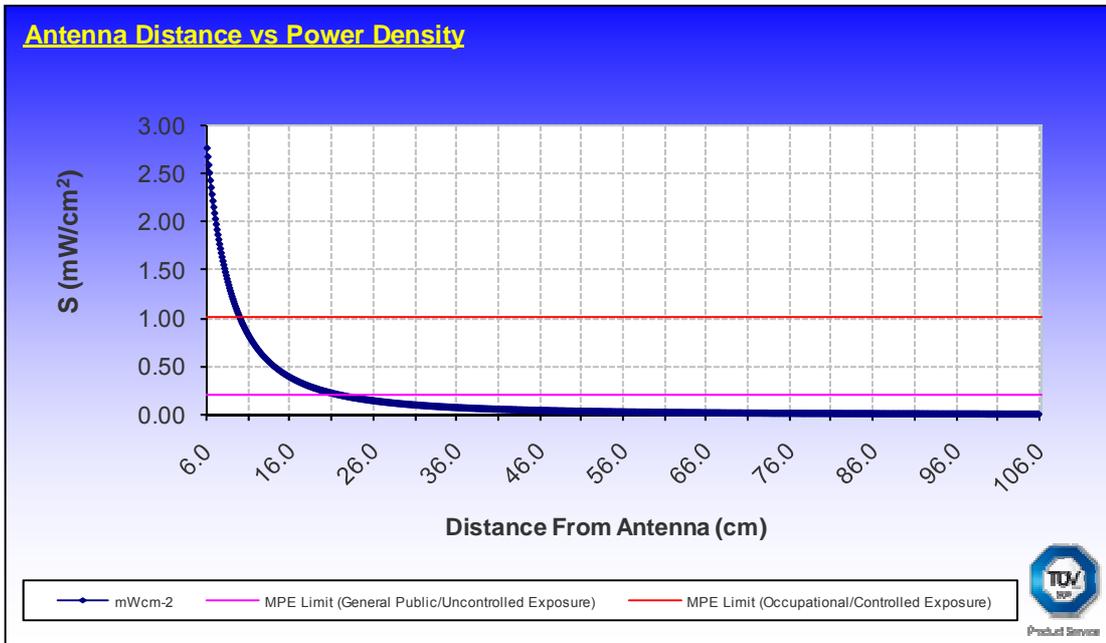


Figure 5 – This graph shows the S field (mW/cm²) strength value with regards to distance from the Antenna (cm).

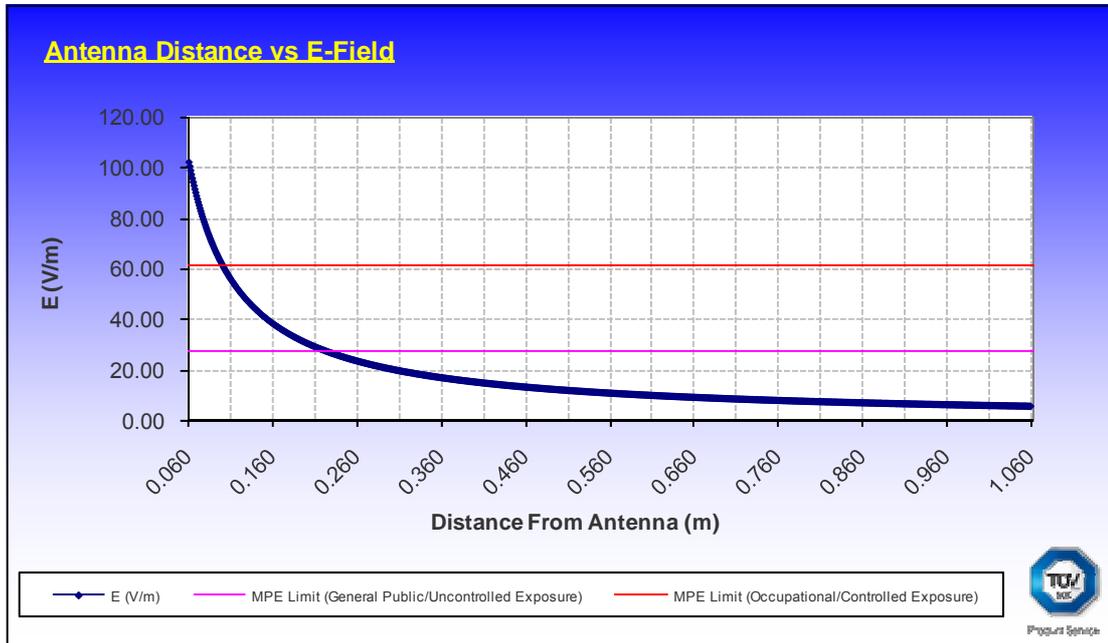


Figure 6 – This graph shows the E field (V/m) strength value with regards to distance from the Antenna (cm).

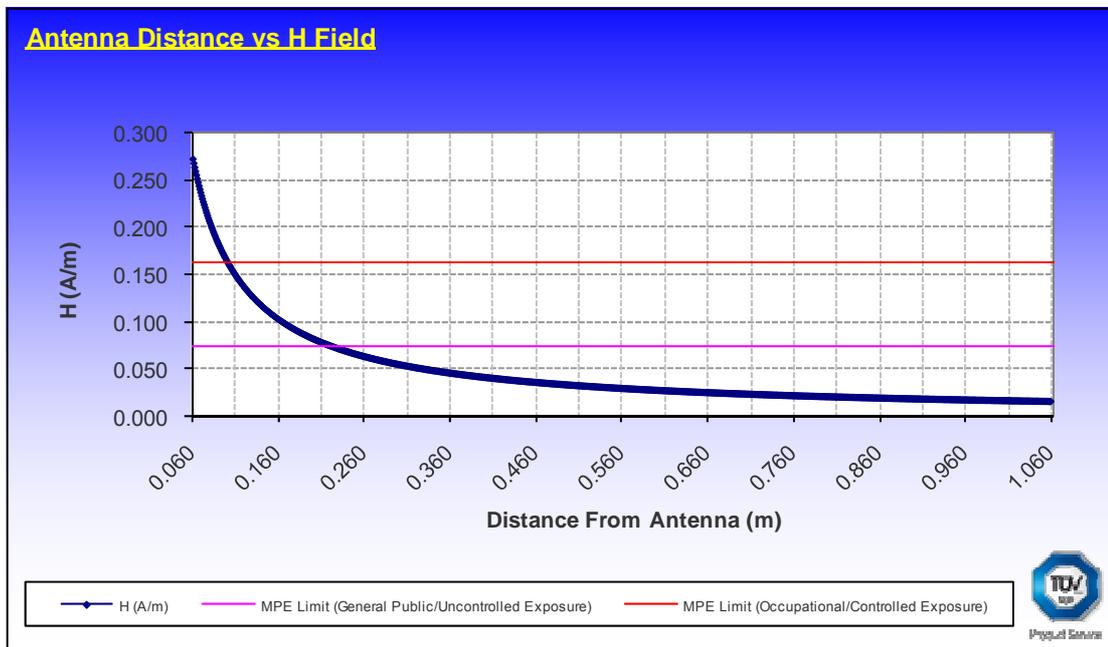


Figure 7 – This graph shows the H field (A/m) strength value with regards to distance from the Antenna (cm).



3.3 FIELD REPRESENTATIONS: CANADIAN – RF SAFETY CODE 6 LIMITS

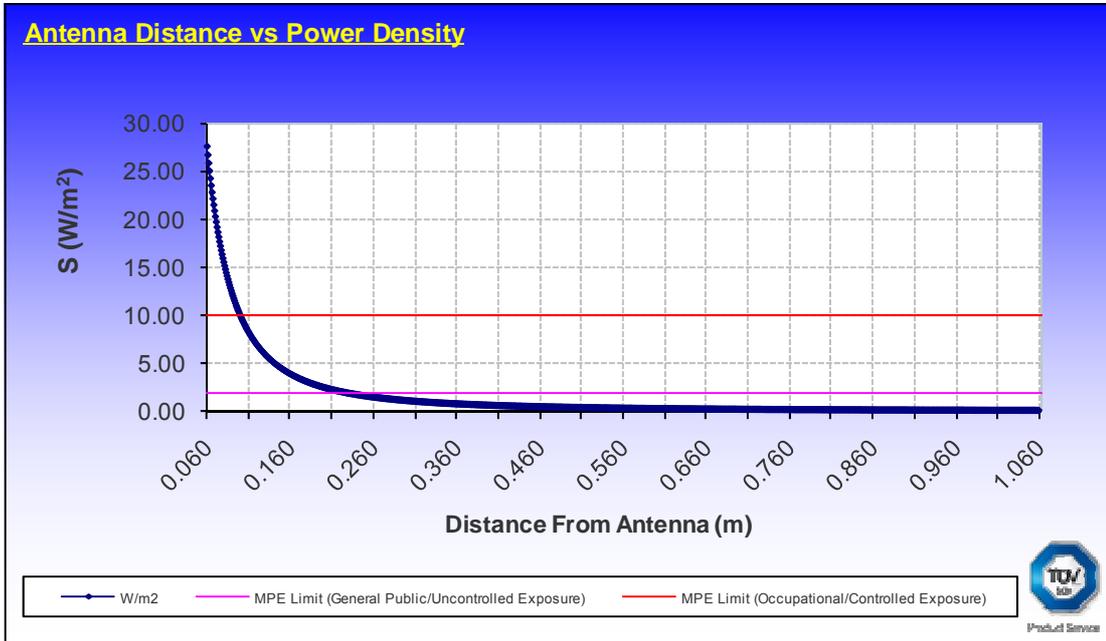


Figure 8 – This graph shows the S field (W/cm²) strength value with regards to distance from the Antenna (cm)

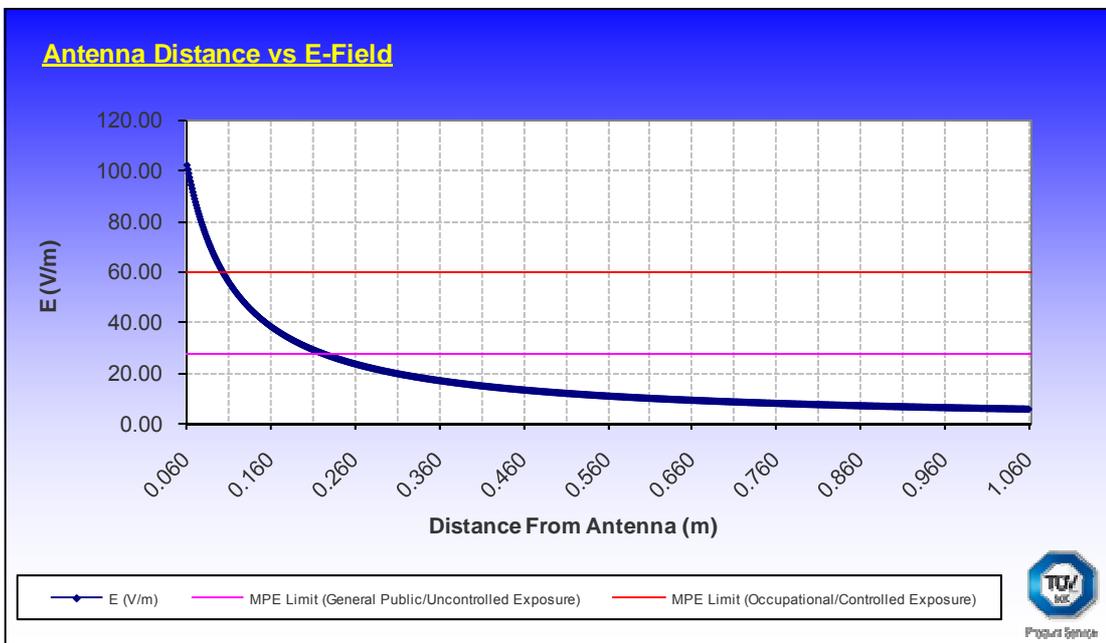


Figure 9 – This graph shows the E field (V/m) strength value with regards to distance from the Antenna (cm).

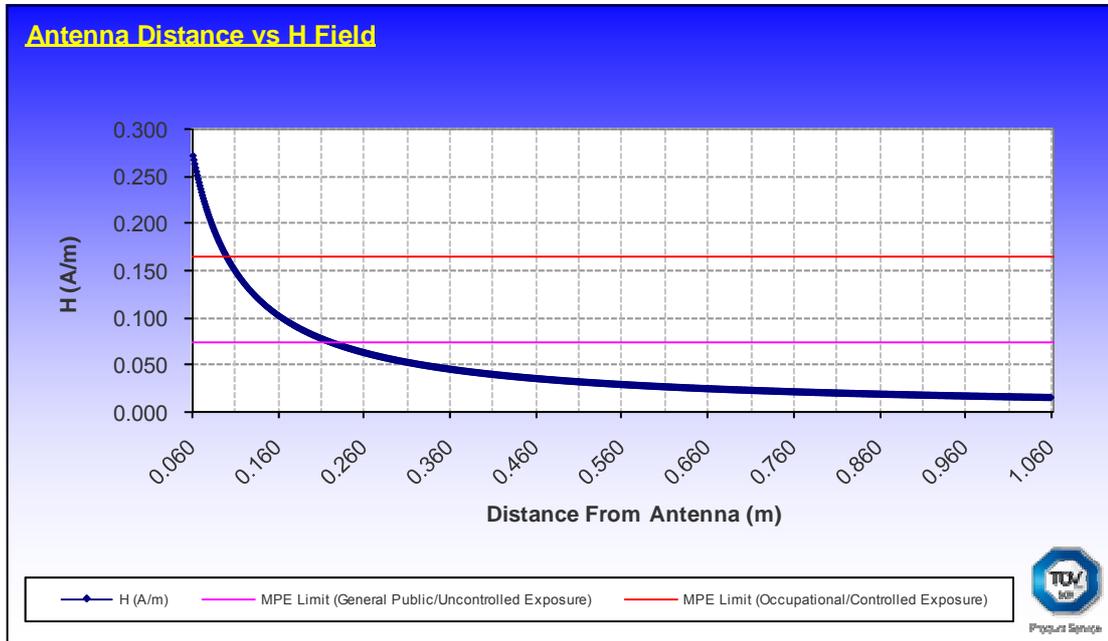


Figure 10 – This graph shows the H field (A/m) strength value with regards to distance from the Antenna (cm).

3.4 FIELD REPRESENTATIONS: AUSTRALIAN – ARPANSA LIMITS

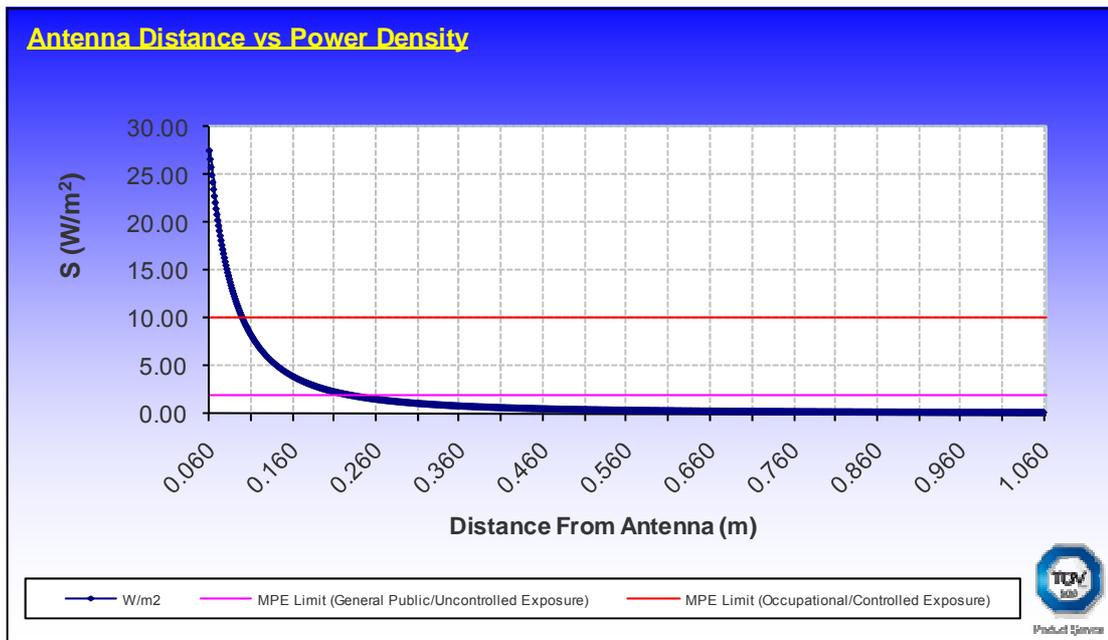


Figure 11 – This graph shows the S field (W/cm²) strength value with regards to distance from the Antenna (cm).

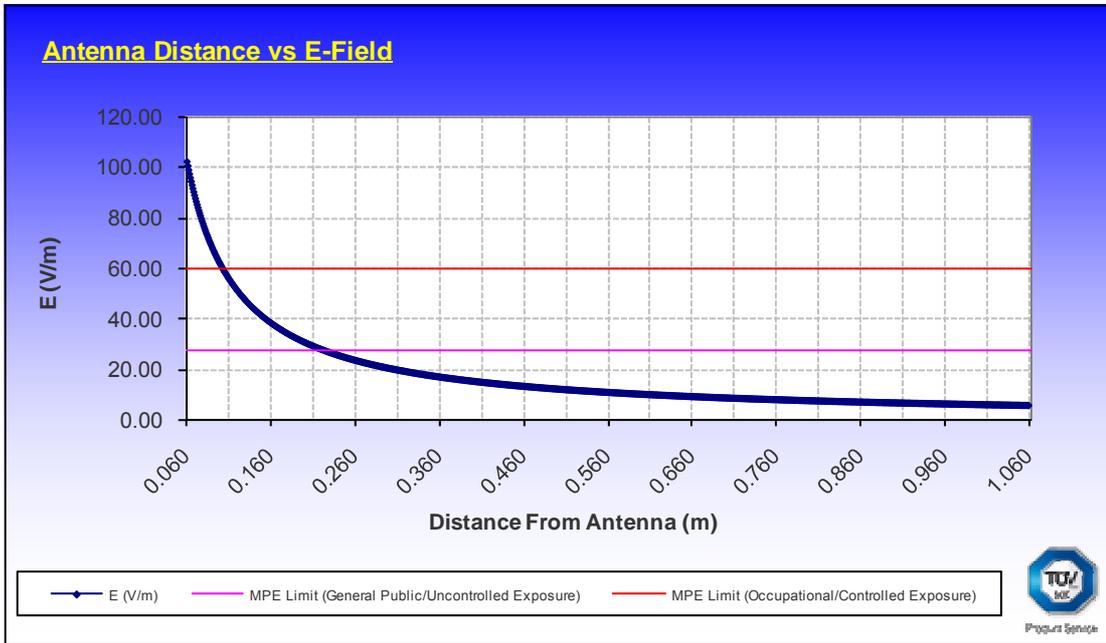


Figure 12 – This graph shows the E field (V/m) strength value with regards to distance from the Antenna (cm).

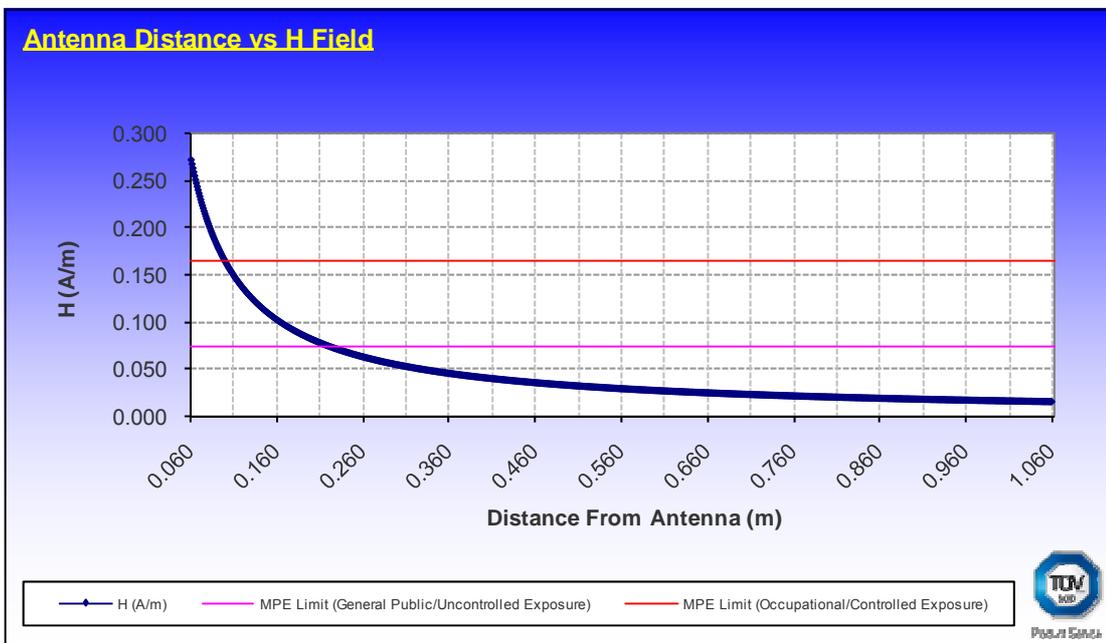


Figure 13 – This graph shows the H field (A/m) strength value with regards to distance from the Antenna (cm).



Product Service

SECTION 4

DISCLAIMERS AND COPYRIGHT



Product Service

4.1 DISCLAIMERS AND COPYRIGHT

This report relates only to the actual item/items tested.

This report must not be reproduced, except in its entirety, without the written permission of
TÜV Product Service Limited

© 2009 TÜV Product Service Limited