TELECOMMUNICATIONS & TELEMATICS FOR TRANSPORTS LABORATORY

IMQ CSQ

Telecommunications & Telematics for Transports Lab.

TEST REPORT

Ref. No. ARSJ00105

Date: 2009-09-30

Measurements performed in accordance with:

FCC Rules : Code of Federal Regulations (CFR) no. 47

PART 15 – RADIO FREQUENCY DEVICES

PRODUCT	: Ground penetrating radar	
TESTED MODEL	: RIS Hi-Mod	
FCC ID	: UFW-Hi-Mod	
APPLICANT	: IDS INGEGNERIA DEI SISTEMI S.p.A. Via Livornese, 1019 – I-56122 PISA	
MANUFACTURER	: IDS INGEGNERIA DEI SISTEMI S.p.A. Via Sterpulino, 20 – I-56121 PISA	
TRADEMARK	: IDS INGEGNERIA DEI SISTEMI S.p.A	
OTHER INFORMATION	Testing dates	: 2009-08-25 ÷ 2009-08-26
	B.E.M. No. (IMQ ref.)	: 50614
	Tested samples No.	: 1
	Testing Laboratory	: IMQ S.p.A. Via Quintiliano, 43 I-20138 MILANO
	Testing site	: Viale Lombardia, 20 – I-20021 Bollate

Tested by :	R. Torri	Signature:	Roberto Torri	Date : 2009-09-30
Checked by:	R. Colombo (EMC and R&TTE Lab. Deputy)	Signature:	Roberto Colombo	Date : 2009/10/01

Revision Sheet

Release No.	Date	Revision Description
Rev. 0	2009-09-30	First edition

TELECOMMUNICATIONS & TELEMATICS FOR TRANSPORTS LABORATORY

CONTENTS

1 INTRODUCTION

1.1 Scope

Obtain FCC Certification Authorization with the requirement of Title 47 of the Code of Federal Regulations Part 15 subpart F.

1.2 Test specifications, methods & procedures

Publication	Year	Title
47 CFR Part 15	2008	Radio Frequency Device
ANSI C63.4	2004	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
FCC Order, ET Docket No. 98-153 (FCC 02-48)	2002	Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems
KDB Publication No. 393764	2007	UWB Compliance Measurements

2 GENERAL DESCRIPTION OF EQUIPMENT UNDER TEST

2.1 Applicant

NAME	IDS INGEGNERIA DEI SISTEMI S.p.A.
ADDRESS	Via Livornese, 1019 – I-56122 PISA
COUNTRY	ITALY

2.2 Manufacturer

NAME	IDS INGEGNERIA DEI SISTEMI S.p.A.
ADDRESS	Via Sterpulino, 20 – I-56121 PISA
COUNTRY	ITALY

2.3 Equipment classification

According to the definition 15.503 EUT is a **Ground penetrating radar (GPR) system** so it shall fulfil provisions of 47 CFR **Part 15 Subpart F – Ultra Wideband Operation– and Section 15.509**.

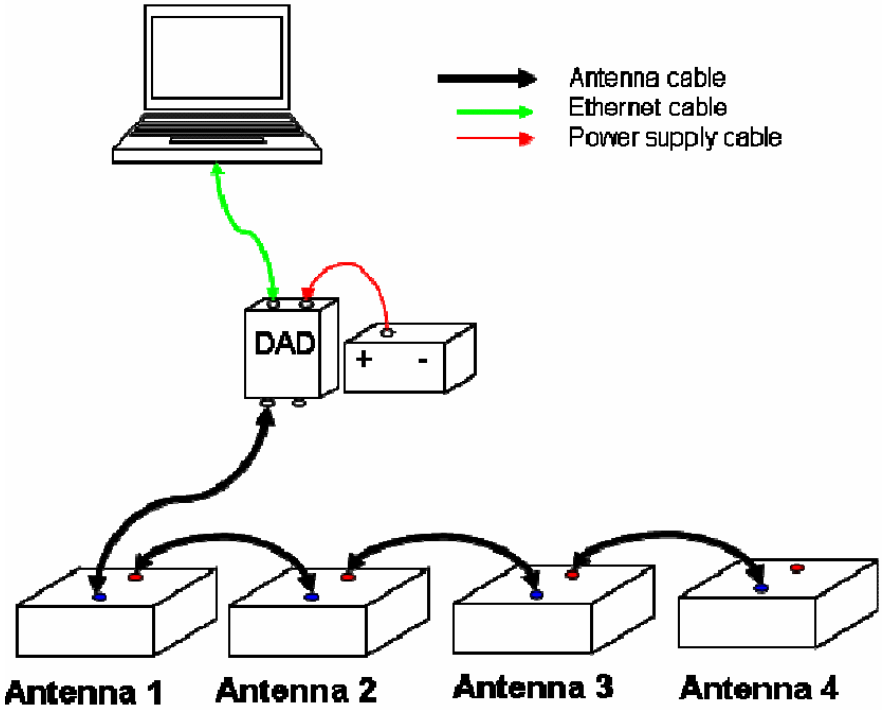
2.4 Basic description of equipment under test

Parameters	Value
Type of equipment	Ground penetrating radar (GPR) system
Model	RIS Hi-Mod
FCC ID	UFW-Hi-Mod
Trade Name	IDS INGEGNERIA DEI SISTEMI S.p.A.
General Overview	The RIS Hi-Mod system is a Ground penetrating radar (GPR) system, i.e., according to the FCC definition, A field disturbance sensor that is designed to operate only when in contact with, or within one meter of, the ground for the purpose of detecting or obtaining the images of buried objects or determining the physical properties within the ground. The energy from the GPR is intentionally directed down into the ground for this purpose. The RIS Hi-Mod product includes: • Up to 4 antennas (each one including two transmitting and two receiving dipoles) • The control unit (hereinafter referred as D.A.D – Digital Antenna Driver) that is linked to a laptop computer for storing the collected data

2.5 Feature of equipment under test

Parameters	Value
Power supply type	DC 12 V battery supplied
Operating frequency	81,5 to 613,5 MHz (10 dB Bandwidth)
Channel Spacing	Not applicable
Pulse Repetition Frequency (PRF)	200 KHz
Antenna description	Integral permanently attached
Antenna Type	Dipole

2.6 Models and Variants

Model	RIS Hi-Mod
Description	The RIS Hi-Mod product includes: Up to 4 antennas (each one including two transmitting and two receiving dipoles) and The control unit (hereinafter referred as D.A.D – Digital Antenna Driver) that is linked to a laptop computer for storing the collected data.
EUT Configuration description	
1) RIS Hi-Mod 1 antennas configuration 2) RIS Hi-Mod 2 antennas configuration 3) RIS Hi-Mod 3 antennas configuration 4) RIS Hi-Mod 4 antennas configuration (full configuration):  	
Tested Model consideration:	
on the above items only tests on 4 antennas configuration model were considered to be carried out, because this is the worst case situation from the emission point of view.	

3 TEST CONFIGURATION OF EQUIPMENT UNDER TEST

3.1 EUT Operating test conditions

Ref.	Description
#1	Continuous transmission with the antenna fitted in a manner typical of normal indented use.

3.2 EUT Configurations

The Equipment under test was powered with a battery and placed directly on the dry sand with no ground plane under it.

3.3 Description of support equipment

Here following the details concerning equipment needed for correct operation or loading of the EUT:

- None.

4 GENERAL TEST SET-UP

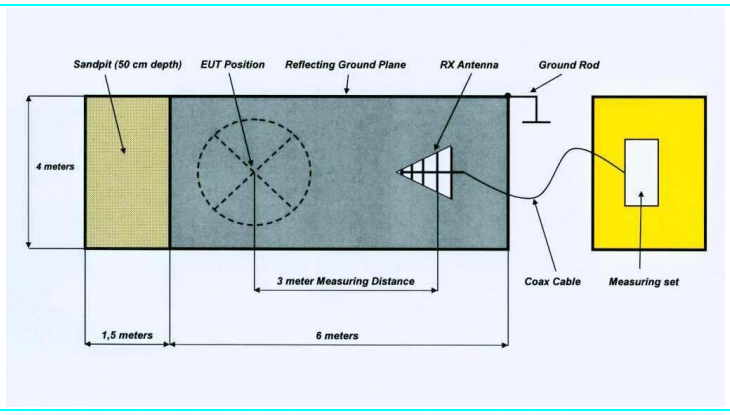
4.1 Environmental conditions

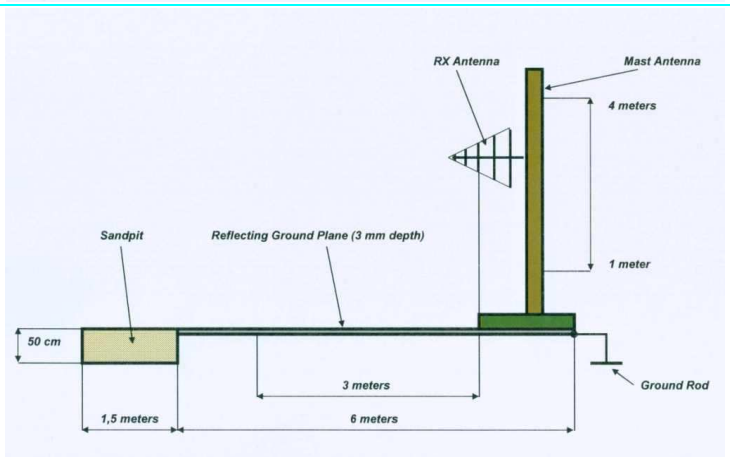
TEST CONDITIONS	MEASURED
Ambient Temperature	25 ÷ 35 °C
Relative Humidity	50 ÷ 60 %
Atmospheric Pressure	900 ÷ 1000 mbar

4.2 Description

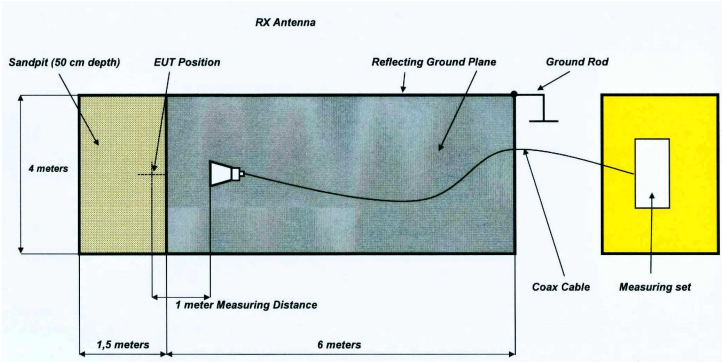
TYPE OF TEST FACILITIES	Open Area Test Site (OATS) The test site is flat and the level area is clear of overhead wires and reflecting structures, it is sufficiently large to permit measuring antenna placement at specified distance. Adequate spacing distance is assured between the EUT and measuring antenna to any adjacent large reflecting structures.
TEST DISTANCE	• 3 meters measuring distance. • 1 meter above 960 MHz for measurement to device not placed on the ground plane with the antenna pointed in the direction of the radiating head.
GROUND PLANE	Galvanized sheet steel soldered panels is installed on the floor, electric contact between the individual plates is provided via continues metallic strips. Dimensions: 6.0m x 4.0m x 3.0mm (LxWxD)
ANTENNA POSITIONER	Semi-Automatic remotely controlled Antenna mast, scan over a range of 1 to 4 meters above the ground plane, Manual antenna polarization change.
SANDPIT	1.5m x 4.0m x 50cm (LxWxD) sandpit area filled with dry sand placed in front of the ground plane (test on UWB Ground penetrating radar).

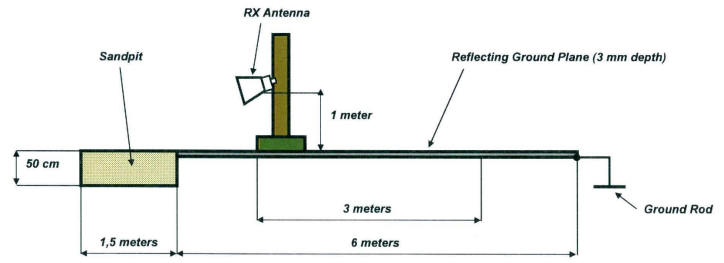
4.3 Drawings





Radiated measurement below 960 MHz





Radiated measurement above 960 MHz

5 SUMMARY OF TEST RESULTS

CFR47 Part 15 Section	Title	Operating condition	Result	Test No.
15.207 (a)	**Conducted Emission**	Not applicable[1]		
15.505	**Cross reference**	/	**PASS**	1
15.507	**Marketing of UWB equipment**	/	**PASS**	2
15.509	**Pulse Repetition Frequency (PRF)**	#1	**PASS**	3
15.509(a)	**UWB Bandwidth**	#1	**PASS**	4
15.509(b)	**General requirements for Low Frequency Imaging System**	/	**PASS**	10
15.509(c)	**Transmission duration**	Not applicable[2]		
15.509(d) 15.209	**Radiated emission ≤ 960 MHz**	#1	**PASS**	5
15.509(d)	**Radiated emission > 960 MHz**	#1	**PASS**	6
15.509(e)	**Radiated emission in GPS bands**	#1	**PASS**	7
15.509(f)	**Highest radiated emission at f_M**	#1	**PASS**	8
15.521	**Technical requirements applicable to all UWB devices**	/	**PASS**	9
15.525	**Coordination requirement**	/	**PASS**	10

[1]Port not present, battery operating device

[2] The EUT is not a handheld device

6 MEASUREMENTS AND TESTS DATA

TEST No. 1	Title: "Cross reference"	47CFR Part 15 Ref. Section: 15.505
TEST REQUIREMENTS	a) Except where specifically stated otherwise within this subpart, the provisions of Subparts A and B and of Sections 15.201 through 15.204 and Section 15.207 of Subpart C of this part apply to unlicensed UWB intentional radiators. The provisions of Sections 15.35(c) and 15.205 do not apply to devices operated under this subpart. The provisions of Footnote US 246 to the Table of Frequency Allocations contained in Section 2.106 of this chapter does not apply to devices operated under this subpart. b) The requirements of Subpart F apply only to the radio transmitter, i.e., the intentional radiator, contained in the UWB device. Other aspects of the operation of a UWB device may be subject to requirements contained elsewhere in this chapter. In particular, a UWB device that contains digital circuitry not directly associated with the operation of the transmitter also is subject to the requirements for unintentional radiators in Subpart B of this chapter. Similarly, an associated receiver that operates (tunes) within the frequency range 30 MHz to 960 MHz is subject to the requirements in Subpart B of this chapter.	

Requirement	Description
15.505(a)	Equipment under test complies with all the relevant and applicable requirements of Subpart A, Subpart B and Section 15.201 through 15.204 and Section 15.207 of Subpart C.
15.505(b)	The Digital circuitry portion of the EUT has been tested and verified to comply with 47 CFR Part 15, subpart B.

Test Result:

The EUT meets the requirements of section 15.505

TEST No. 2	Title "Marketing of UWB equipment"	47CFR Part 15 Ref. Section 15.507
TEST REQUIREMENTS	In some cases, the operation of UWB devices is limited to specific parties, *e.g.*, law enforcement, fire and rescue organizations operating under the auspices of a state or local government. The marketing of UWB devices must be directed solely to parties eligible to operate the equipment. The responsible party, as defined in Section 2.909 of this chapter, is responsible for ensuring that the equipment is marketed only to eligible parties. Marketing of the equipment in any other manner may be considered grounds for revocation of the grant of certification issued for the equipment	

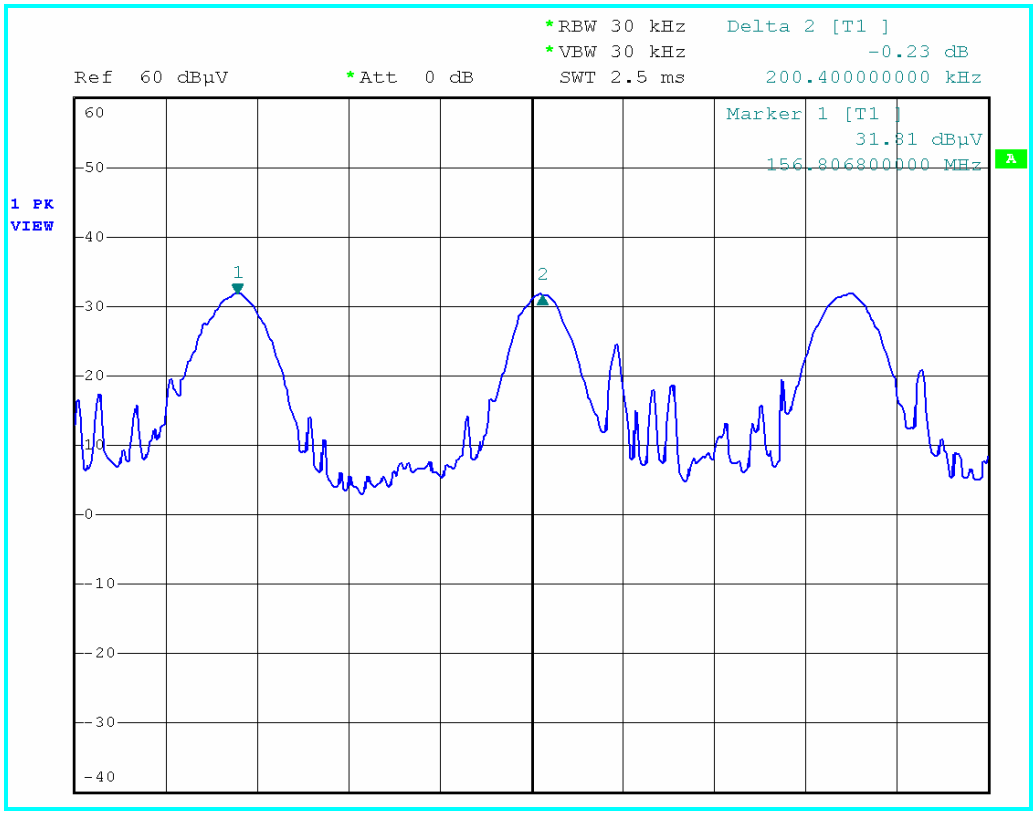
Requirement	Description
15.507 / 2.909	The responsible party is properly informed about the responsible for ensuring that the equipment is marketed only to eligible parties, and provide correct information on the customers and users. (See Important note for the US customers of the Safe Rail System User Guide)

Test Result:

The EUT meets the requirements of section 15.507

TEST No. 3	Title "Pulse Repetition Frequency (PRF)"	47CFR Part 15 Ref. Section
		15.509(d) / 15.209
TEST REQUIREMENTS	Test definition	Pulse Repetition Frequency (PRF) is the trigger repetition frequency
	Test setup	ANSI C63.4
	Test facility	Open Area Test Site (OATS)
	Test distance	3 meters
	RBW bandwidth	30 kHz
	VBW bandwidth	30 kHz
	Detector	Peak
	Remark	None

Test Result Data:



PRF Declared	PRF Measured	Result
200 kHz	200 kHz	Comply

TEST No. 4	Title "UWB bandwidth"	47CFR Part 15 Ref. Section
		15.509(a)
TEST REQUIREMENTS	UWB definition	The bandwidth of a UWB emission is defined by the points on the emission spectrum where the amplitude is 10 dB below the maximum emission amplitude (i.e., the -10 dB points). In cases where the measured emission spectrum contains multiple (more than two) -10 dB points, the outermost points define the bandwidth (i.e., the widest bandwidth is assumed).
	Test setup	ANSI C63.4
	Test facility	Open Area Test Site (OATS)
	Test distance	3 meters
	RBW bandwidth	1 MHz
	VBW bandwidth	3 MHz
	Detector	Peak
	Remark	Frequency span is large enough to display a full spectrum of the RF emission

Limits:

The UWB bandwidth of an imaging system operating under the provisions of this section must be below 10.6 GHz.

Test Procedure:

1) The receiving antenna which varied from 1 to 4 m to find the highest emission is positioned 3 m away from the EUT.
2) Measure the Highest radiated emission at f_M as described in the test No. 8.
3) Recorded the upper and lower frequency that are at the side of the band bounded by the points at 10 dB below the highest radiated UWB emission level.
   Measuring the bandwidth of a UWB device using a radiated test set-up, it is imperative that appropriate adjustments be made to the measured amplitude levels to account for the frequency-dependent components of the measurement system (e.g., antenna gain or factor, pre-amplifier gain, cable loss, etc). Since UWB emissions can have bandwidths several GHz wide, these frequency-dependent characteristics can vary dramatically over the fundamental emission
   According to the nature of the broadband emission characteristics, significant care mast be taken to capture the true spectrum of emission, extremely narrow sweep widths is recommended
4) The UWB bandwidth is the different of the upper and lower frequency recorded.

Test Result Data:

Frequency of Maximum emission level fM	Receiver Antenna polarization	Maximum emission level @ 1 MHz RBW (Peak/QP)	Lower and Upper -10 dB frequencies		10 dB Bandwidth	Result
			Lower fL	Upper fH		
MHz	(V/H)	dBµV/m	MHz	MHz	MHz	
156,80	V	55,23	81,50	613,50	532,00	PASS

Test Result

The EUT meets the requirements of section 15.509(a)

TEST No. 5	Title: "Radiated disturbances ≤ 960 MHz"	47CFR Part 15 Ref. Section: 15.509(d) / 15.209
TEST REQUIREMENTS	Test definition	The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in Section 15.209.
	Test setup	ANSI C63.4
	Test facility	Open Area Test Site (OATS)
	Test distance	3 meters
	RBW bandwidth	120 kHz
	VBW bandwidth	1 MHz
	Detector	Quasi-Peak
	Remark	None

Limits:

Frequency (MHz)	Field Strengths Limits (dBµV/m)	Measuring RBW kHz	Distance (meters)
0.009-0.490	67,6-20*Logf(kHz)	1	300
0.490-1.705	87,6-20*Logf(kHz)	9	30
1.705-30	29,5	9	30
30-88	40,0	120	3
88-216	43,5	120	3
216-960	46,0	120	3

Test Procedure:

1) The EUT was placed on sandpit area filled with dry sand initially placed in front of the ground plane (0° degree position)
2) The receiving antenna which varied from 1 to 4 m to find the highest emission is positioned 3 m away from the EUT.
3) The receiving antenna was positioned in horizontal polarization.
4) The measurements were made with the detector set to peak with a bandwidth of 120 kHz during monitoring the frequency range below 960 MHz.
5) Upon detection of a suspect emission signal, its amplitude and frequency were noted.
6) It is recommended to demodulate the received signals for suitable discrimination of the ambient emission from the EUT emission.
7) At the worst case combination of the EUT operating mode and antenna height , the field strength measure was recorded. At each of the frequencies were a field strength was recorded the final measurement was performed with a Quasi-Peak detector.
8) The receiving antenna was positioned in vertical polarization and the steps 2 to 6 was repeated.
9) The EUT was rotating from 0° to 360° degrees with 45° step increment and the steps 4 to 7 was repeated.
10) All the worst case combination field strength emissions founded of each EUT position and antenna polarization was recorded in the following table and compared with the applicable limits.

Summary of Test Result data:

Frequency (MHz)	EUT Position (angle)	Antenna Polarization (V/H)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
114,41	135	V	40,94	43,50	-2,56	Comply
120,00	45	H	41,93	43,50	-1,57	Comply
156,82	90	V	42,01	43,50	-1,49	Comply
159,82	315	V	40,66	43,50	-2,84	Comply
172,62	180	V	40,98	43,50	-2,52	Comply
183,82	90	V	41,00	43,50	-2,50	Comply
196,21	180	V	40,89	43,50	-2,61	Comply
258,50	315	H	40,04	46,00	-5,96	Comply
393,80	0	H	41,86	46,00	-4,14	Comply
396,50	180	H	39,59	46,00	-6,41	Comply
399,20	0	H	41,73	46,00	-4,27	Comply
399,80	180	H	43,01	46,00	-2,99	Comply
402,00	0	H	40,11	46,00	-5,89	Comply
406,60	0	H	40,58	46,00	-5,42	Comply
408,40	0	H	40,38	46,00	-5,62	Comply
411,40	0	H	40,77	46,00	-5,23	Comply
423,50	0	H	41,38	46,00	-4,62	Comply

Remark: Ambient signal were detected in the different frequency ranges, each of measured signal close or above the limits was examined with relation to the EUT.

Test Data detail:

EUT Position (angle ϑ)			0	Antenna Polarization			H
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	22,70	11,20	0,38	0,00	34,28	43,50	-9,22
120,00	26,56	12,00	0,40	0,00	38,96	43,50	-4,54
156,82	21,07	9,20	0,42	0,00	30,69	43,50	-12,81
159,82	24,38	9,20	0,42	0,00	34,00	43,50	-9,50
172,62	25,69	9,50	0,43	0,00	35,62	43,50	-7,88
183,82	25,33	9,80	0,50	0,00	35,63	43,50	-7,87
196,21	27,57	9,00	0,51	0,00	37,08	43,50	-6,42
258,50	23,90	12,90	0,60	0,00	37,40	46,00	-8,60
393,80	25,92	15,20	0,74	0,00	41,86	46,00	-4,14
396,50	22,47	15,20	0,74	0,00	38,41	46,00	-7,59
399,20	25,79	15,20	0,74	0,00	41,73	46,00	-4,27
399,80	26,34	15,20	0,74	0,00	42,28	46,00	-3,72
402,00	24,17	15,20	0,74	0,00	40,11	46,00	-5,89
406,60	24,54	15,30	0,74	0,00	40,58	46,00	-5,42
408,40	24,24	15,40	0,74	0,00	40,38	46,00	-5,62
411,40	24,52	15,50	0,75	0,00	40,77	46,00	-5,23
423,50	24,82	15,80	0,76	0,00	41,38	46,00	-4,62

EUT Position (angle ϑ)			45	Antenna Polarization			H
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	29,11	11,20	0,38	0,00	40,69	43,50	-2,81
120,00	29,53	12,00	0,40	0,00	41,93	43,50	-1,57
156,82	30,87	9,20	0,42	0,00	40,49	43,50	-3,01
159,82	28,26	9,20	0,42	0,00	37,88	43,50	-5,62
172,62	28,92	9,50	0,43	0,00	38,85	43,50	-4,65
183,82	27,03	9,80	0,50	0,00	37,33	43,50	-6,17
196,21	27,87	9,00	0,51	0,00	37,38	43,50	-6,12
258,50	24,33	12,90	0,60	0,00	37,83	46,00	-8,17
393,80	21,71	15,20	0,74	0,00	37,65	46,00	-8,35
396,50	21,23	15,20	0,74	0,00	37,17	46,00	-8,83
399,20	21,18	15,20	0,74	0,00	37,12	46,00	-8,88
399,80	21,21	15,20	0,74	0,00	37,15	46,00	-8,85
402,00	21,10	15,20	0,74	0,00	37,04	46,00	-8,96
406,60	20,06	15,30	0,74	0,00	36,10	46,00	-9,90
408,40	19,72	15,40	0,74	0,00	35,86	46,00	-10,14
411,40	20,07	15,50	0,75	0,00	36,32	46,00	-9,68
423,50	22,50	15,80	0,76	0,00	39,06	46,00	-6,94

EUT Position (angle ϑ)			90	Antenna Polarization			H
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	25,01	11,20	0,38	0,00	36,59	43,50	-6,91
120,00	29,38	12,00	0,40	0,00	41,78	43,50	-1,72
156,82	29,55	9,20	0,42	0,00	39,17	43,50	-4,33
159,82	28,96	9,20	0,42	0,00	38,58	43,50	-4,92
172,62	26,22	9,50	0,43	0,00	36,15	43,50	-7,35
183,82	24,91	9,80	0,50	0,00	35,21	43,50	-8,29
196,21	23,03	9,00	0,51	0,00	32,54	43,50	-10,96
258,50	25,04	12,90	0,60	0,00	38,54	46,00	-7,46
393,80	22,05	15,20	0,74	0,00	37,99	46,00	-8,01
396,50	22,28	15,20	0,74	0,00	38,22	46,00	-7,78
399,20	22,52	15,20	0,74	0,00	38,46	46,00	-7,54
399,80	22,45	15,20	0,74	0,00	38,39	46,00	-7,61
402,00	21,64	15,20	0,74	0,00	37,58	46,00	-8,42
406,60	20,80	15,30	0,74	0,00	36,84	46,00	-9,16
408,40	20,99	15,40	0,74	0,00	37,13	46,00	-8,87
411,40	20,93	15,50	0,75	0,00	37,18	46,00	-8,82
423,50	21,82	15,80	0,76	0,00	38,38	46,00	-7,62

EUT Position (angle ϑ)			135	Antenna Polarization			H
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	24,41	11,20	0,38	0,00	35,99	43,50	-7,51
120,00	29,51	12,00	0,40	0,00	41,91	43,50	-1,59
156,82	28,05	9,20	0,42	0,00	37,67	43,50	-5,83
159,82	28,96	9,20	0,42	0,00	38,58	43,50	-4,92
172,62	26,64	9,50	0,43	0,00	36,57	43,50	-6,93
183,82	26,07	9,80	0,50	0,00	36,37	43,50	-7,13
196,21	26,93	9,00	0,51	0,00	36,44	43,50	-7,06
258,50	23,95	12,90	0,60	0,00	37,45	46,00	-8,55
393,80	18,47	15,20	0,74	0,00	34,41	46,00	-11,59
396,50	19,20	15,20	0,74	0,00	35,14	46,00	-10,86
399,20	24,83	15,20	0,74	0,00	40,77	46,00	-5,23
399,80	24,86	15,20	0,74	0,00	40,80	46,00	-5,21
402,00	18,99	15,20	0,74	0,00	34,93	46,00	-11,07
406,60	18,71	15,30	0,74	0,00	34,75	46,00	-11,25
408,40	19,31	15,40	0,74	0,00	35,45	46,00	-10,55
411,40	19,09	15,50	0,75	0,00	35,34	46,00	-10,66
423,50	20,87	15,80	0,76	0,00	37,43	46,00	-8,57

EUT Position (angle °)			180	Antenna Polarization			H
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	25,42	11,20	0,38	0,00	37,00	43,50	-6,50
120,00	28,49	12,00	0,40	0,00	40,89	43,50	-2,61
156,82	27,96	9,20	0,42	0,00	37,58	43,50	-5,92
159,82	28,50	9,20	0,42	0,00	38,12	43,50	-5,38
172,62	26,94	9,50	0,43	0,00	36,87	43,50	-6,63
183,82	27,78	9,80	0,50	0,00	38,08	43,50	-5,42
196,21	26,39	9,00	0,51	0,00	35,90	43,50	-7,60
258,50	22,48	12,90	0,60	0,00	35,98	46,00	-10,02
393,80	22,08	15,20	0,74	0,00	38,02	46,00	-7,98
396,50	23,65	15,20	0,74	0,00	39,59	46,00	-6,41
399,20	24,81	15,20	0,74	0,00	40,75	46,00	-5,25
399,80	27,07	15,20	0,74	0,00	43,01	46,00	-2,99
402,00	22,76	15,20	0,74	0,00	38,70	46,00	-7,30
406,60	21,23	15,30	0,74	0,00	37,27	46,00	-8,73
408,40	21,47	15,40	0,74	0,00	37,61	46,00	-8,39
411,40	20,49	15,50	0,75	0,00	36,74	46,00	-9,26
423,50	21,44	15,80	0,76	0,00	38,00	46,00	-8,00

EUT Position (angle °)			225	Antenna Polarization			H
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	21,34	11,20	0,38	0,00	32,92	43,50	-10,58
120,00	29,27	12,00	0,40	0,00	41,67	43,50	-1,83
156,82	27,00	9,20	0,42	0,00	36,62	43,50	-6,88
159,82	27,38	9,20	0,42	0,00	37,00	43,50	-6,50
172,62	27,08	9,50	0,43	0,00	37,01	43,50	-6,49
183,82	28,22	9,80	0,50	0,00	38,52	43,50	-4,98
196,21	29,32	9,00	0,51	0,00	38,83	43,50	-4,67
258,50	22,68	12,90	0,60	0,00	36,18	46,00	-9,82
393,80	17,36	15,20	0,74	0,00	33,30	46,00	-12,70
396,50	18,57	15,20	0,74	0,00	34,51	46,00	-11,49
399,20	20,21	15,20	0,74	0,00	36,15	46,00	-9,85
399,80	19,99	15,20	0,74	0,00	35,93	46,00	-10,07
402,00	16,98	15,20	0,74	0,00	32,92	46,00	-13,08
406,60	17,01	15,30	0,74	0,00	33,05	46,00	-12,95
408,40	17,27	15,40	0,74	0,00	33,41	46,00	-12,59
411,40	17,05	15,50	0,75	0,00	33,30	46,00	-12,70
423,50	19,89	15,80	0,76	0,00	36,45	46,00	-9,55

EUT Position (angle ϑ)			275	Antenna Polarization			H
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	20,91	11,20	0,38	0,00	32,49	43,50	-11,01
120,00	25,77	12,00	0,40	0,00	38,17	43,50	-5,33
156,82	26,60	9,20	0,42	0,00	36,22	43,50	-7,28
159,82	27,03	9,20	0,42	0,00	36,65	43,50	-6,85
172,62	25,73	9,50	0,43	0,00	35,66	43,50	-7,84
183,82	25,60	9,80	0,50	0,00	35,90	43,50	-7,60
196,21	22,83	9,00	0,51	0,00	32,34	43,50	-11,16
258,50	20,97	12,90	0,60	0,00	34,47	46,00	-11,53
393,80	18,12	15,20	0,74	0,00	34,06	46,00	-11,94
396,50	13,35	15,20	0,74	0,00	29,29	46,00	-16,71
399,20	16,51	15,20	0,74	0,00	32,45	46,00	-13,55
399,80	15,60	15,20	0,74	0,00	31,54	46,00	-14,46
402,00	13,25	15,20	0,74	0,00	29,19	46,00	-16,81
406,60	13,37	15,30	0,74	0,00	29,41	46,00	-16,59
408,40	13,08	15,40	0,74	0,00	29,22	46,00	-16,78
411,40	12,63	15,50	0,75	0,00	28,88	46,00	-17,12
423,50	12,59	15,80	0,76	0,00	29,15	46,00	-16,85

EUT Position (angle ϑ)			315	Antenna Polarization			H
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	27,22	11,20	0,38	0,00	38,80	43,50	-4,70
120,00	29,37	12,00	0,40	0,00	41,77	43,50	-1,73
156,82	26,82	9,20	0,42	0,00	36,44	43,50	-7,06
159,82	27,51	9,20	0,42	0,00	37,13	43,50	-6,37
172,62	23,38	9,50	0,43	0,00	33,31	43,50	-10,19
183,82	24,92	9,80	0,50	0,00	35,22	43,50	-8,28
196,21	26,41	9,00	0,51	0,00	35,92	43,50	-7,58
258,50	26,54	12,90	0,60	0,00	40,04	46,00	-5,96
393,80	20,03	15,20	0,74	0,00	35,97	46,00	-10,03
396,50	20,89	15,20	0,74	0,00	36,83	46,00	-9,17
399,20	23,64	15,20	0,74	0,00	39,58	46,00	-6,42
399,80	23,59	15,20	0,74	0,00	39,53	46,00	-6,47
402,00	19,72	15,20	0,74	0,00	35,66	46,00	-10,34
406,60	18,48	15,30	0,74	0,00	34,52	46,00	-11,48
408,40	19,41	15,40	0,74	0,00	35,55	46,00	-10,45
411,40	18,56	15,50	0,75	0,00	34,81	46,00	-11,19
423,50	21,07	15,80	0,76	0,00	37,63	46,00	-8,37

EUT Position (angle ϑ)			0	Antenna Polarization			V
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	29,23	11,20	0,38	0,00	40,81	43,50	-2,69
120,00	28,47	12,00	0,40	0,00	40,87	43,50	-2,63
156,82	29,10	9,20	0,42	0,00	38,72	43,50	-4,78
159,82	30,01	9,20	0,42	0,00	39,63	43,50	-3,87
172,62	30,27	9,50	0,43	0,00	40,20	43,50	-3,30
183,82	29,43	9,80	0,50	0,00	39,73	43,50	-3,77
196,21	25,16	9,00	0,51	0,00	34,67	43,50	-8,83
258,50	24,60	12,90	0,60	0,00	38,10	46,00	-7,90
393,80	20,04	15,20	0,74	0,00	35,98	46,00	-10,02
396,50	18,36	15,20	0,74	0,00	34,30	46,00	-11,70
399,20	18,07	15,20	0,74	0,00	34,01	46,00	-11,99
399,80	20,36	15,20	0,74	0,00	36,30	46,00	-9,70
402,00	17,72	15,20	0,74	0,00	33,66	46,00	-12,34
406,60	17,40	15,30	0,74	0,00	33,44	46,00	-12,56
408,40	18,45	15,40	0,74	0,00	34,59	46,00	-11,41
411,40	19,38	15,50	0,75	0,00	35,63	46,00	-10,37
423,50	25,81	15,80	0,76	0,00	42,37	46,00	-3,63

EUT Position (angle ϑ)			45	Antenna Polarization			V
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	28,70	11,20	0,38	0,00	40,28	43,50	-3,22
120,00	29,16	12,00	0,40	0,00	41,56	43,50	-1,94
156,82	31,50	9,20	0,42	0,00	41,12	43,50	-2,38
159,82	29,05	9,20	0,42	0,00	38,67	43,50	-4,83
172,62	30,86	9,50	0,43	0,00	40,79	43,50	-2,71
183,82	27,31	9,80	0,50	0,00	37,61	43,50	-5,89
196,21	26,33	9,00	0,51	0,00	35,84	43,50	-7,66
258,50	25,73	12,90	0,60	0,00	39,23	46,00	-6,77
393,80	16,84	15,20	0,74	0,00	32,78	46,00	-13,22
396,50	18,60	15,20	0,74	0,00	34,54	46,00	-11,46
399,20	19,90	15,20	0,74	0,00	35,84	46,00	-10,16
399,80	21,12	15,20	0,74	0,00	37,06	46,00	-8,94
402,00	18,83	15,20	0,74	0,00	34,77	46,00	-11,23
406,60	16,49	15,30	0,74	0,00	32,53	46,00	-13,47
408,40	18,38	15,40	0,74	0,00	34,52	46,00	-11,48
411,40	18,23	15,50	0,75	0,00	34,48	46,00	-11,52
423,50	21,76	15,80	0,76	0,00	38,32	46,00	-7,68

EUT Position (angle ϑ)			90	Antenna Polarization			V
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	28,67	11,20	0,38	0,00	40,25	43,50	-3,25
120,00	29,52	12,00	0,40	0,00	41,92	43,50	-1,58
156,82	32,39	9,20	0,42	0,00	42,01	43,50	-1,49
159,82	29,08	9,20	0,42	0,00	38,70	43,50	-4,80
172,62	30,60	9,50	0,43	0,00	40,53	43,50	-2,97
183,82	30,70	9,80	0,50	0,00	41,00	43,50	-2,50
196,21	28,69	9,00	0,51	0,00	38,20	43,50	-5,30
258,50	20,03	12,90	0,60	0,00	33,53	46,00	-12,47
393,80	18,96	15,20	0,74	0,00	34,90	46,00	-11,10
396,50	19,87	15,20	0,74	0,00	35,81	46,00	-10,19
399,20	22,32	15,20	0,74	0,00	38,26	46,00	-7,74
399,80	23,40	15,20	0,74	0,00	39,34	46,00	-6,66
402,00	22,93	15,20	0,74	0,00	38,87	46,00	-7,13
406,60	19,96	15,30	0,74	0,00	36,00	46,00	-10,00
408,40	22,57	15,40	0,74	0,00	38,71	46,00	-7,29
411,40	22,68	15,50	0,75	0,00	38,93	46,00	-7,07
423,50	25,65	15,80	0,76	0,00	42,21	46,00	-3,79

EUT Position (angle ϑ)			135	Antenna Polarization			V
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	29,36	11,20	0,38	0,00	40,94	43,50	-2,56
120,00	28,48	12,00	0,40	0,00	40,88	43,50	-2,62
156,82	27,64	9,20	0,42	0,00	37,26	43,50	-6,24
159,82	28,17	9,20	0,42	0,00	37,79	43,50	-5,71
172,62	30,99	9,50	0,43	0,00	40,92	43,50	-2,58
183,82	29,52	9,80	0,50	0,00	39,82	43,50	-3,68
196,21	29,82	9,00	0,51	0,00	39,33	43,50	-4,17
258,50	22,91	12,90	0,60	0,00	36,41	46,00	-9,59
393,80	19,49	15,20	0,74	0,00	35,43	46,00	-10,57
396,50	20,28	15,20	0,74	0,00	36,22	46,00	-9,78
399,20	21,28	15,20	0,74	0,00	37,22	46,00	-8,78
399,80	23,01	15,20	0,74	0,00	38,95	46,00	-7,05
402,00	18,79	15,20	0,74	0,00	34,73	46,00	-11,27
406,60	18,57	15,30	0,74	0,00	34,61	46,00	-11,39
408,40	18,48	15,40	0,74	0,00	34,62	46,00	-11,38
411,40	18,92	15,50	0,75	0,00	35,17	46,00	-10,83
423,50	25,60	15,80	0,76	0,00	42,16	46,00	-3,84

EUT Position (angle °)			180	Antenna Polarization			V
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	24,19	11,20	0,38	0,00	35,77	43,50	-7,73
120,00	28,65	12,00	0,40	0,00	41,05	43,50	-2,45
156,82	30,28	9,20	0,42	0,00	39,90	43,50	-3,60
159,82	29,24	9,20	0,42	0,00	38,86	43,50	-4,64
172,62	31,05	9,50	0,43	0,00	40,98	43,50	-2,52
183,82	30,25	9,80	0,50	0,00	40,55	43,50	-2,95
196,21	31,38	9,00	0,51	0,00	40,89	43,50	-2,61
258,50	17,12	12,90	0,60	0,00	30,62	46,00	-15,38
393,80	17,61	15,20	0,74	0,00	33,55	46,00	-12,45
396,50	16,63	15,20	0,74	0,00	32,57	46,00	-13,43
399,20	17,02	15,20	0,74	0,00	32,96	46,00	-13,04
399,80	21,82	15,20	0,74	0,00	37,76	46,00	-8,24
402,00	20,26	15,20	0,74	0,00	36,20	46,00	-9,80
406,60	21,72	15,30	0,74	0,00	37,76	46,00	-8,24
408,40	15,76	15,40	0,74	0,00	31,90	46,00	-14,10
411,40	21,12	15,50	0,75	0,00	37,37	46,00	-8,63
423,50	25,93	15,80	0,76	0,00	42,49	46,00	-3,51

EUT Position (angle °)			225	Antenna Polarization			V
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	28,89	11,20	0,38	0,00	40,47	43,50	-3,03
120,00	27,03	12,00	0,40	0,00	39,43	43,50	-4,07
156,82	27,67	9,20	0,42	0,00	37,29	43,50	-6,21
159,82	26,52	9,20	0,42	0,00	36,14	43,50	-7,36
172,62	30,56	9,50	0,43	0,00	40,49	43,50	-3,01
183,82	28,29	9,80	0,50	0,00	38,59	43,50	-4,91
196,21	25,43	9,00	0,51	0,00	34,94	43,50	-8,56
258,50	19,93	12,90	0,60	0,00	33,43	46,00	-12,57
393,80	16,35	15,20	0,74	0,00	32,29	46,00	-13,71
396,50	15,72	15,20	0,74	0,00	31,66	46,00	-14,34
399,20	19,90	15,20	0,74	0,00	35,84	46,00	-10,16
399,80	20,57	15,20	0,74	0,00	36,51	46,00	-9,49
402,00	18,74	15,20	0,74	0,00	34,68	46,00	-11,32
406,60	18,74	15,30	0,74	0,00	34,78	46,00	-11,22
408,40	15,83	15,40	0,74	0,00	31,97	46,00	-14,03
411,40	15,92	15,50	0,75	0,00	32,17	46,00	-13,83
423,50	24,58	15,80	0,76	0,00	41,14	46,00	-4,86

EUT Position (angle ϑ)			275	Antenna Polarization			V
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	27,52	11,20	0,38	0,00	39,10	43,50	-4,40
120,00	24,99	12,00	0,40	0,00	37,39	43,50	-6,11
156,82	14,62	9,20	0,42	0,00	24,24	43,50	-19,26
159,82	19,08	9,20	0,42	0,00	28,70	43,50	-14,80
172,62	25,17	9,50	0,43	0,00	35,10	43,50	-8,40
183,82	29,62	9,80	0,50	0,00	39,92	43,50	-3,58
196,21	25,32	9,00	0,51	0,00	34,83	43,50	-8,67
258,50	13,41	12,90	0,60	0,00	26,91	46,00	-19,09
393,80	12,03	15,20	0,74	0,00	27,97	46,00	-18,03
396,50	13,65	15,20	0,74	0,00	29,59	46,00	-16,42
399,20	13,77	15,20	0,74	0,00	29,71	46,00	-16,29
399,80	14,80	15,20	0,74	0,00	30,74	46,00	-15,26
402,00	13,49	15,20	0,74	0,00	29,43	46,00	-16,57
406,60	14,14	15,30	0,74	0,00	30,18	46,00	-15,82
408,40	13,80	15,40	0,74	0,00	29,94	46,00	-16,06
411,40	12,78	15,50	0,75	0,00	29,03	46,00	-16,97
423,50	22,64	15,80	0,76	0,00	39,20	46,00	-6,80

EUT Position (angle ϑ)			315	Antenna Polarization			V
Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
114,41	28,26	11,20	0,38	0,00	39,84	43,50	-3,66
120,00	28,92	12,00	0,40	0,00	41,32	43,50	-2,18
156,82	30,36	9,20	0,42	0,00	39,98	43,50	-3,52
159,82	31,04	9,20	0,42	0,00	40,66	43,50	-2,84
172,62	29,50	9,50	0,43	0,00	39,43	43,50	-4,07
183,82	29,51	9,80	0,50	0,00	39,81	43,50	-3,69
196,21	25,78	9,00	0,51	0,00	35,29	43,50	-8,21
258,50	24,56	12,90	0,60	0,00	38,06	46,00	-7,94
393,80	18,13	15,20	0,74	0,00	34,07	46,00	-11,93
396,50	19,19	15,20	0,74	0,00	35,13	46,00	-10,87
399,20	19,86	15,20	0,74	0,00	35,80	46,00	-10,20
399,80	20,00	15,20	0,74	0,00	35,94	46,00	-10,06
402,00	16,10	15,20	0,74	0,00	32,04	46,00	-13,96
406,60	16,90	15,30	0,74	0,00	32,94	46,00	-13,06
408,40	19,14	15,40	0,74	0,00	35,28	46,00	-10,72
411,40	18,80	15,50	0,75	0,00	35,05	46,00	-10,95
423,50	22,20	15,80	0,76	0,00	38,76	46,00	-7,24

TEST No. 6	Title: "Radiated disturbances > 960 MHz"	47CFR Part 15 Ref. Section: 15.509(d) / 15.209
TEST REQUIREMENTS	Test definition	The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.
	Test setup	ANSI C63.4
	Test facility	Open Area Test Site (OATS)
	Test distance	1 meter
	RBW bandwidth	1 MHz
	VBW bandwidth	1 MHz
	Detector	RMS
	Remark	/

Limits:

Frequency (MHz)	EIRP @ 3 meters (1 MHz BW) (dBm)	Field strength @ 3 meters (1 MHz BW) (dBµV/m)	Field strength @ 1 meters (1 MHz BW) (dBµV/m)
960-1610	-65.3	29,9	39,4
1610-1990	-53.3	41,9	51,4
1990-3100	-51.3	43,9	53,4
3100-10600	-41.3	53,9	63,4
Above 10600	-51.3	43,9	53,9

Remark: The limits were converted from EIRP to field strength at 3 and 1 meter according to FCC 15.503(k).

Test Procedure:

1) The EUT was placed on sandpit area filled with dry sand initially placed in front of the ground plane (0° degree position)
2) The receiving antenna is placed at 1 meter away from the EUT and it is pointed in the direction of the radiating head with an inclination of -10° to find the highest emission.
3) The receiving antenna was positioned in horizontal polarization.
4) The measurements were made with the detector set to RMS with a bandwidth of 1 MHz during monitoring the frequency range above 960 MHz.
5) Upon detection of a suspect emission signal, its amplitude and frequency were noted.
6) It is recommended to demodulate the received signals for suitable discrimination of the ambient emission from the EUT emission.
7) At the worst case combination of the EUT operating mode and antenna height , the field strength measure was recorded.
8) The receiving antenna was positioned in vertical polarization and the steps 2 to 6 was repeated.
9) The EUT was rotating from 0° to 360° degrees with 45° step increment and the steps 4 to 7 was repeated.
10) All the worst case combination field strength emissions founded of each EUT position and antenna polarization was recorded in the following table and compared with the applicable limits.

Summary of Test Result data:

All maximum Field strength emission are found at the following test set-up conditions:

- EUT Position (angle) : 0 °
- Antenna Polarization : Horizontal

Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1120,00	45,02	24,60	1,50	38,65	32,47	39,40	-6,93
1158,00	31,11	24,70	1,90	38,77	18,94	39,40	-20,46
1265,00	38,16	24,90	1,97	38,79	26,24	39,40	-13,16
1691,40	42,30	26,80	2,30	38,50	32,90	51,40	-18,50
2644,90	34,20	27,50	2,86	37,10	27,46	53,40	-25,94

Remark: Ambient signal were detected in the different frequency ranges, each of measured signal close or above the limits was examined with relation to the EUT.

Test Result:

The EUT meets the requirements of section 15.509(d)

TEST No. 7	Title "Radiated emission in GPS bands"	47CFR Part 15 Ref. Section
		15.509(e)
TEST REQUIREMENTS	Test definition	In addition to the radiated emission limits specified for frequency above 960 MHz, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz in the GPS frequency bands.
	Test setup	ANSI C63.4
	Test facility	Open Area Test Site (OATS)
	Test distance	1 meter
	RBW bandwidth	1 kHz
	VBW bandwidth	3 MHz
	Detector	RMS
	Remark	/

Limits:

Frequency (MHz)	EIRP @ 3 meters (1 MHz BW) (dBm)	Field strength @ 3 meters (1 MHz BW) (dBµV/m)	Field strength @ 1 meters (1 MHz BW) (dBµV/m)
1164-1240	-75.3	19,9	29,4
1559-1610	-75.3	19,9	29,4

Remark: The limits were converted from EIRP to field strength at 3 and 1 meter according to FCC 15.503(k).

Test Procedure:

1) The EUT was placed on sandpit area filled with dry sand initially placed in front of the ground plane (0° degree position)
2) The receiving antenna is placed at 1 meter away from the EUT and it is pointed in the direction of the radiating head with an inclination of -10° to find the highest emission.
3) The receiving antenna was positioned in horizontal polarization.
4) The measurements were made with the detector set to RMS with a bandwidth of 1 kHz during monitoring the GPS frequency ranges.
5) Upon detection of a suspect emission signal, its amplitude and frequency were noted.
6) It is recommended to demodulate the received signals for suitable discrimination of the ambient emission from the EUT emission.
7) At the worst case combination of the EUT operating mode and antenna height , the field strength measure was recorded.
8) The receiving antenna was positioned in vertical polarization and the steps 2 to 6 was repeated.
9) The EUT was rotating from 0° to 360° degrees with 45° step increment and the steps 4 to 7 was repeated.
10) All the worst case combination field strength emissions founded of each EUT position and antenna polarization was recorded in the following table and compared with the applicable limits.

Summary of Test Result data:

Maximum Field strength emission are found at the following test set-up conditions:

- EUT Position (angle) : 0 ° Antenna Polarization : Horizontal

Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1191,36	4,08	24,70	1,92	38,79	-8,09	29,40	-37,49
1208,99	6,47	24,70	1,93	38,79	-5,69	29,40	-35,09
1210,20	3,05	24,70	1,93	38,79	-9,11	29,40	-38,51
1234,52	7,44	24,75	1,94	38,80	-9,06	29,40	-38,46

- EUT Position (angle) : 90 ° Antenna Polarization : Vertical

Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1563,99	15,63	25,30	2,16	37,96	5,13	29,40	-24,27
1566,44	15,42	25,30	2,16	37,96	4,92	29,40	-24,48
1582,56	18,37	25,30	2,18	37,94	7,91	29,40	-21,49
1588,07	15,90	25,30	2,18	37,94	7,91	29,40	-21,49

Test Result:

The EUT meets the requirements of section 15.509(d)

TEST No. 8	Title "Highest radiated emission at f_M"		47CFR Part 15 Ref. Section
			15.509(f)
TEST REQUIREMENTS	Test definition	For UWB devices where the frequency at which the highest radiated emission occurs, fM, is above 960 MHz, there is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on f_M.	
	Test setup	ANSI C63.4	
	Test facility	Open Area Test Site (OATS)	
	Test distance	3 meters	
	RBW bandwidth	1 MHz	
	VBW bandwidth	3 MHz	
	Detector	Peak	
	Remark	/	

Limits:

The peak emission level contained within a 50 MHz bandwidth cantered on f_M mast be limited to a maximum of 0 dBm EIRP.

EIRP limit (dBm)	Field strength limit @ 3 meters (dBµV/m)	Field strength limit @ 3 meters (measured with 1 MHz RBW) (dBµV/m)
0	95,2	75,2

Remark: The limits were converted from EIRP to field strength at 3 meter according to FCC 15.503(k).
As the measurement was employed with a 1 MHz resolution bandwidth the applicable limit is adjusted with a 20log(1/50) dB factor.

Test Procedure:

1) The EUT was placed on sandpit area filled with dry sand initially placed in front of the ground plane (0° degree position)
2) The receiving antenna which varied from 1 to 4 m to find the highest emission is positioned 3 m away from the EUT.
3) The receiving antenna was positioned in horizontal polarization.
4) The measurements were made with the detector set to peak with a bandwidth of 1 MHz during monitoring the frequency range inside the UWB of the EUT..
5) At the worst case combination of the EUT operating mode and antenna height , the field strength measure was recorded.
6) The receiving antenna was positioned in vertical polarization and the steps 4 to 6 was repeated.
7) The EUT was rotating from 0° to 360° degrees with 45° step increment and the steps 4 to 7 was repeated.
8) Record the peak emission from the EUT.

Summary of Test Result data:

Maximum Peak emission contained within 50 MHz is found at the following test set-up conditions:

- EUT Position (angle) : 90 °
- Antenna Polarization : Vertical

Frequency (MHz)	Reading value (dBµV)	Antenna Factor (dB1/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Correcting reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
156,80	45,72	9,00	0,51	0,00	55,23	75,20	-19,97

Test Result:

The EUT meets the requirements of section 15.509(f)

TEST No. 9	Title	47CFR Part 15 Ref. Section
	"Technical requirements applicable to all UWB devices"	**15.521**

Requirement	Description
15.521(a)	The EUT is not employed for the operation of toys, operation onboard an aircraft, ship and satellite.
15.521(b)	Permanent attached antenna, no External radio frequency power amplifiers and antenna modifications are permitted.
15.521(c)	The Digital circuitry portion of the EUT has been tested and verified to comply with 47 CFR Part 15, subpart B.
15.521(d)	Considered
15.521(e)	The f_M, frequency at which the highest radiated emission occurs is contained within the measured UWB bandwidth.
15.521(f)	The EUT is not intended to detection of tags or the transfer or data or voice information.
15.521(g)	Considered
15.521(h)	Considered
15.521(i)	Prohibition in Sections 2.201(f) and 15.5(d) of this chapter against Class B (damped wave) emissions is not applied.
15.521(j)	Battery operating device not connected to AC power lines.

Test Result:

The EUT meets the requirements of section 15.521

TEST No. 10	Title "Coordination requirement"	47CFR Part 15 Ref. Section 15.525
TEST REQUIREMENTS	(a) UWB imaging systems require coordination through the FCC before the equipment may be used. The operator shall comply with any constraints on equipment usage resulting from this coordination. (b) The users of UWB imaging devices shall supply operational areas to the FCC Office of Engineering and Technology, which shall coordinate this information with the Federal Government through the National Telecommunications and Information Administration. (c) The manufacturers, or their authorized sales agents, must inform purchasers and users of their systems of the requirement to undertake detailed coordination of operational areas with the FCC prior to the equipment being operated. (d) Users of authorized, coordinated UWB systems may transfer them to other qualified users. and to different locations upon coordination of change of ownership or location to the FCC and coordination with existing authorized operations. (e) The FCC/NTIA coordination report shall identify those geographical areas within which the operation of an imaging system requires additional coordination or within which the operation of an imaging system is prohibited. (f) The coordination of routine UWB operations shall not take longer than 15 business days from the receipt of the coordination request by NTIA.	

Requirement	Description
15.525	The responsible party is properly informed about the required coordination requirement and provide correct information to the customers and users about their specific care and legislative obligations. (See Important note for the US customers of the Safe Rail System User Guide)

Test Result:

The EUT meets the requirements of section 15.525

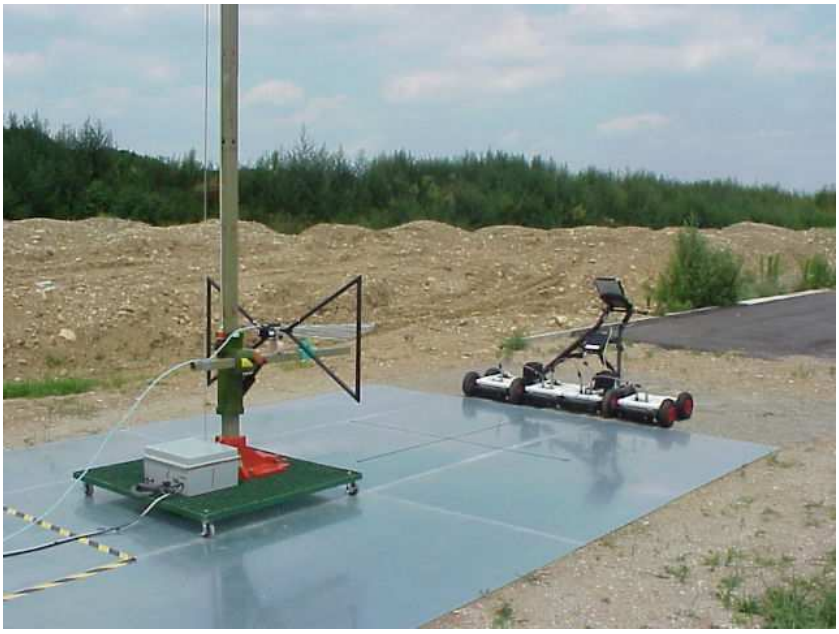
7 TECHNICAL DOCUMENTATION

DOCUMENT	REFERENCE
DAD & antenna block diagrams	/
Installation Guide and User Manual	Protocol: MN/2009/056rev. 1.0
Technical description of the system	technical description of the unit - Hi-Mod

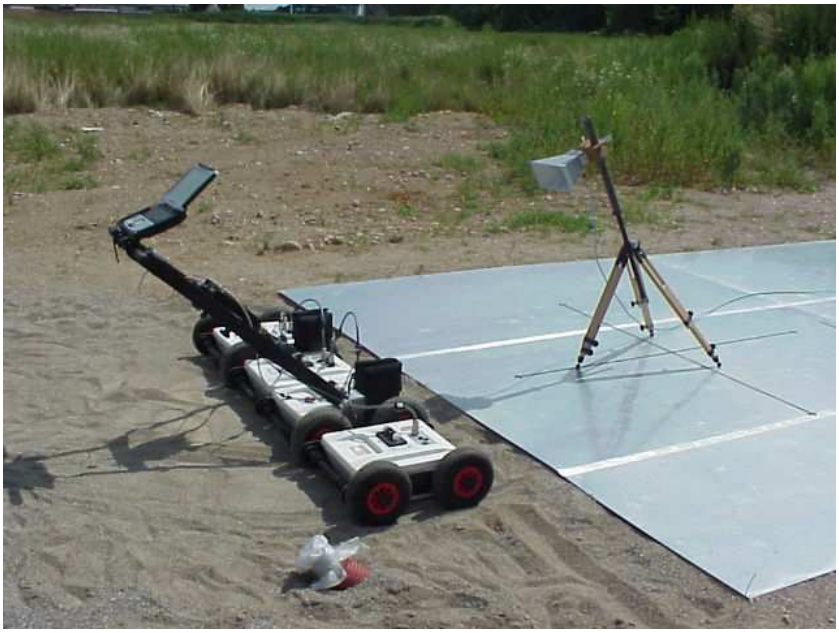
8 PHOTOGRAPHIC DOCUMENTATION

8.1 EUT Identification

8.2 Test set-up



Test set-up below 960 MHz



Test set-up above 960 MHz

9 MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the IMQ procedure No. IO-DT-U01 and requirement of NIST Technical Note 1297 and NIS 81: 1994 “The Treatment of Uncertainty in EMC Measurements”

9.1 Radiated Emission Measurement Uncertainty from 30 to 1000 MHz

Expanded uncertainty:	
Level of confidence	= 95 %
Degree of freedom	= 9
Coverage factor kp	= 2
Combined uncertainty	= 4,77 dB

9.2 Radiated Emission Measurement Uncertainty above 1000 MHz

Expanded uncertainty:	
Level of confidence	= 95 %
Degree of freedom	= 9
Coverage factor kp	= 2
Combined uncertainty	= 3,53 dB

10 LIST OF MEASURING EQUIPMENT AND CALIBRATION INFORMATION

IMQ Serial Number	Instrument	Manufacturer	Type	Last Cal.	Cal. Period.	Calibration Company
S03463	Horn Antenna	Schwarzbeck	BBHA 9120D	06-09	36	NPL
S03511	Log-Per. Antenna	Ara	LPB-2520/1	06-09	36	NPL
S03668	Horn Antenna	Schwarzbeck	BBHA 9170	02-08	36	TESEO
S03724	Horn Antenna	Schwarzbeck	BBHA 9170	02-08	36	TESEO
S02385	Log-Per. Antenna	Ara	LPB-2513	06-09	36	OKD
S03464	Horn Antenna	Schwarzbeck	BBHA 9120D	06-09	36	OKD
S04271	Log-Per. Antenna	Ara	LPB-2513/A	03-09	36	NPL
S04272	Horn Antenna	Schwarzbeck	BBHA 9120D	04-09	36	NPL
S04197	EMI Receiver	Rohde & Schwarz	ESVS-10	12-08	18	I.N.RI.M.
S03629	Spectrum Analyzer	Rohde & Schwarz	FSP40	08-07	24	I.N.RI.M.
S03542	Preamplifier	Hewlett Packard	HP 8449B	07-08	24	AGILENT
S04193	Preamplifier	Bonn Elektronik	BLNA 0110-15C35	12-07	24	DKD
S04322	RF Coax Cable	Rosenberger micro-coax	N 50 Ohm	05-08	24	IMQ
S03745	Oscilloscope	Yokogawa	DL 7200	05-09	12	AVIATRONIK
S04159	Multimenter	Fluke	45	05-09	12	IMQ
S00735	Meter-graph	Salmoiraghi	1656/2B	05-09	12	IMQ
P01723	Antenna Mast	Sunol Sciences	TWR 93-4	/	/	/

The IMQ instruments are tested and calibrated according to UNI EN 45001, the IMQ procedure IP-037 "Calibration test equipment and measurement" and according to plans set on IMQ operating instruction IO-FT-034 “Criteria for the calibration of test equipment and measurement” which are an integral part of the Quality Manual of IMQ.