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Malå Geoscience AB Bernth Johansson Skolgatan 11 93070 Malå, SWEDEN Copy FB/archive, FBM/archive	**Test Report** Date 20 February, 2004 Prepared FBM, Henrik Olsson *EMC Test Engineer*	E014-TR 040018 Supersedes	1 (12)

Title

EMC Test, 1 GHz Shielded antenna. Additional UWB bandwidth measurement

Equipment under test (EUT):

Description:	Ground Penetrating Radar System
Manufacturer:	Malå Geoscience
Model name:	1 GHz Shielded antenna

Summary:

The UWB bandwidth is within the limits stated in FCC Part 15 Subpart F.

Approved:

Petter Gärdin
Laboratory Technical Manager

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1 Introduction

The object of the test is to show compliance with the emission requirements of FCC Part 15 Subpart F.

Date of test:	4 February 2004
Location:	AerotechTelub AB, Östersund
Test performed by:	Henrik Olsson, AerotechTelub / FBM
Client:	Malå Geoscience Skolgatan 11 SE-93070 Malå Sweden
Client's observers:	Lars Mikaelsson, Malå Geoscience

2 Test methods and results

2.1 Results

The test results in this report apply only for the tested specimen.

EMISSION REQUIREMENTS ACCORDING TO FCC Part 15 Subpart F					
Environmental phenomena	Test method	Requirement	Result	Comments	Test order
Radiated emission	ANSI C63.4	FCC 15.209	**PASS**	Prior testing test report E014-TR 0400180140	
UWB definition		FCC 15.503 (a) 15.509(a)	**PASS**	f_L 240 MHz f_C 1020 MHz f_H 1800 MHz at -8dB	1
Peak emission at f_M	FCC 02-42	FCC 15.509 (f)	**PASS**		1
Radiated emission	FCC 02-42	FCC 15.509 (d)	**PASS**	Prior testing test report E014-TR 0400180140	
Radiated emission	FCC 02-42	FCC 15.509 (e)	**PASS**	Prior testing test report E014-TR 0400180140	

3 Applicable documents

Measurements		
ANSI C63.4	1992-07-17	Radio noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz.
FCC Part 15	2003-03-13	Radio Frequency Devices
FCC 02-42	2002-04-22	Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems

4 Equipment under test (EUT)

4.1 Identification of equipment under test

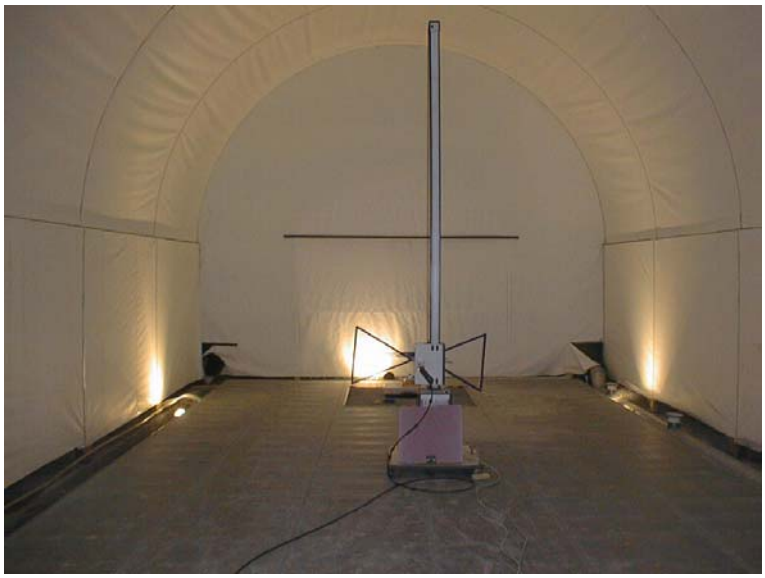
Equipment under test (EUT):

Description:	Ground Penetrating Radar System.
Manufacturer:	Malå Geoscience
Model name:	1 GHz Shielded antenna.
Build state:	Production sample
Serial no:	4771

4.2 Test site

4.2.1 Description

The measurements were all performed on a weather protected open area test site that was modified with a flat sand bed located in the ground plane. The sand bed is about 50 cm deep.



Picture 1: Test Site

The measurement system and related equipment were placed next to the test site.

4.2.2 Ambient signals

A number of ambient signals were detected in the different frequency ranges measurement was made; some of those are listed below.

Mobile telephones:	460 – 470 MHz, 935 – 960 MHz, 1.8 GHz
FM broadcasts:	87 – 108 MHz
Television:	60 – 70 MHz, 650 – 800 MHz
Radar system:	1.3 GHz

In addition many signals of short-term duration were found. Each measurement signal close to or above the limit was examined if ambient or related to the EUT.

4.3 General configuration of EUT

A battery powered the EUT.

The EUT was connected to the control unit with a fibre optical cable.

The EUT was placed directly on the dry sand with no ground plane under it.

Picture 2: EUT set-up on sand bed

4.4 Operation of EUT during tests

The EUT was gathering data like in normal operation.

4.5 Modifications

The results under section *2 Test methods and results* are only valid with the following modifications on the EUT:

- R1 = 22 Ω
- RA1 = 82 Ω

5 Emission

5.1 Measurement of UWB bandwidth and peak emissions

5.1.1 Requirements according to FCC 15

5.1.1.1 Definition according to FCC 15.503 (a)

The UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including antenna.

5.1.1.2 Requirements according to FCC 15.509 (a)

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

5.1.1.3 Requirements according to FCC 15.509 (f)

For UWB devices where the frequency at which the highest radiated emission occurs, f_M, 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. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in Section 15.521.

5.1.2 Procedures

The equipment was placed on the test site described under paragraph 4.2.1 and the radiated emission was measured at 1 meter.

The measurements were made with the EUT in 8 different positions on the sand bed. The antenna was positioned in different polarizations resulting in 16 different sweeps of the frequency range.

A 1 MHz resolution bandwidth was used during the measurement.

Measurement software added antenna factors and cable attenuation and a composite trace of the peak field strength were drawn.

At the peak of emission (f_M), the emission was measured with a resolution bandwidth of 1 MHz.

5.1.3 Results

Given measured values are valid for the described arrangement and operation of the EUT.

The EUT complies with the requirement in FCC 15.509 (a) and (f).

According to 15.509 (a)

From the diagram 200-2000 MHz below the following data was gathered and calculated.

Frequency of highest emission f_M: ~960 MHz

Upper boundary f_H: ~1800 MHz at the -8 dB point

Lower boundary f_L: ~240 MHz

Centre frequency f_C: 1020 MHz

Fractional bandwidth: 1,53

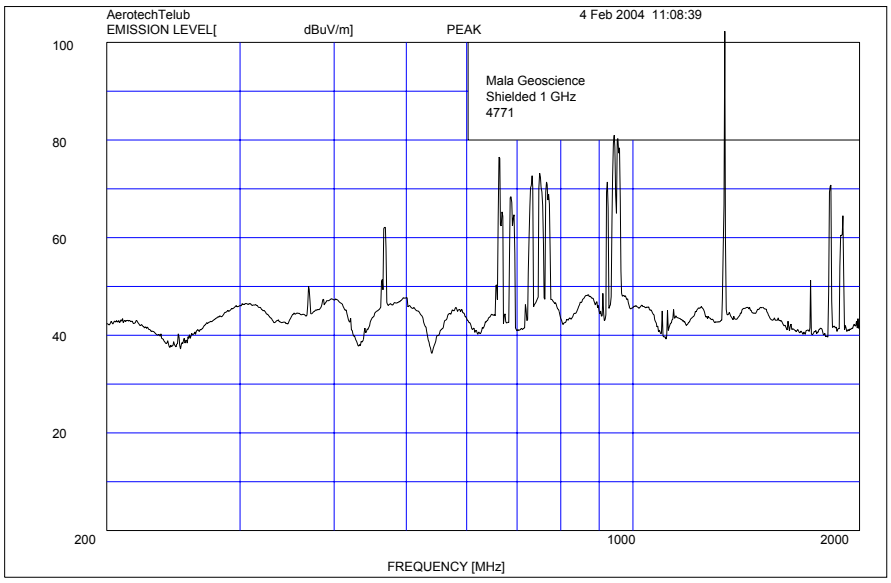
According to 15.509 (f)

Emission at f_M: Radiated emission 48 dBµV/m at a 1 MHz RBw.

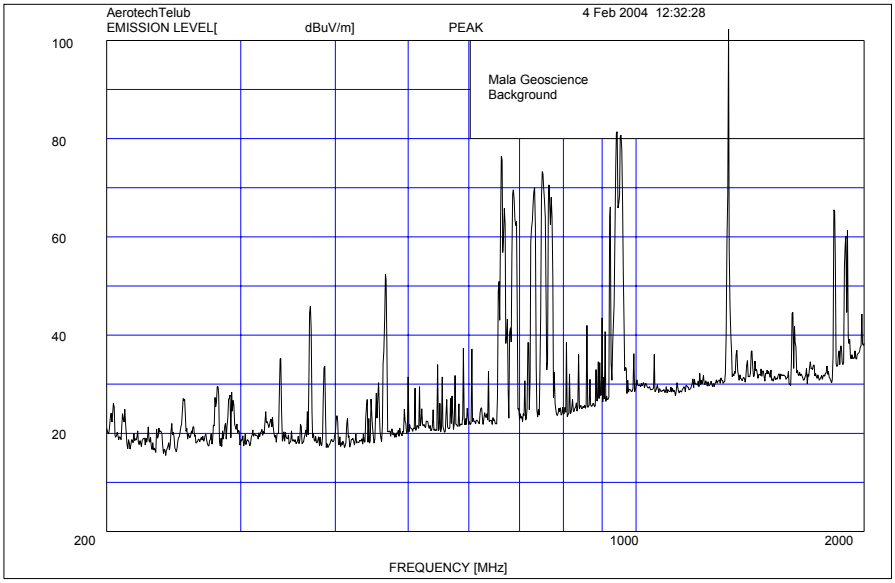
Limit 0 dBm EIRP at 50 MHz RBw
Limit -34 dBm EIRP at 1 MHz RBw
Limit -34 dBm EIRP = 61,2 dBµV/m at 3m
Limit 61,2 dBµV/m + 9,5 = 70,7 dBµV/m at 1m

Margin to limit 70,7 – 48 = 22,7 dB

Composite trace of peak emission



Composite trace of background emission



5.1.4 Instrumentation

Hewlett Packard Spectrum analyser	8566B	100 Hz - 22 GHz	2404A08864 / 2504A01320
Avantek Pre-amplifier	AMG1020M	30 MHz - 1000 MHz	Y987
Hewlett Packard Pre-amplifier	8449B	1 GHz - 26.5 GHz	3008A00103
Emco Double Ridge Waveguide	3106	200 MHz - 2 GHz	9111-2483