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AerotechTelub
ETT FÖRETAG I SAAB-GRUPPEN

Distribution	Document	Ref. No	Page
Malå Geoscience AB Bernth Johansson Skolgatan 11 93070 Malå	**Test Report**	E014-TR 020169	1 (14)
Copy FB/archive, FBM/archive	Date November 18, 2002	Supersedes	
	Prepared FBM, Petter Gärdin *EMC Test Engineer*		

Title

EMC Test 960 MHz – 5 GHz, X3M/Easy Locator MID with 350 MHz Shielded antenna

Equipment under test (EUT):

Description:	Ground Penetrating Radar System
Manufacturer:	Malå Geoscience
Model name:	X3M/Easy Locator MID with 350 MHz Shielded antenna

Summary:

The EUT complied with the requirement of radiated emissions given in FCC 15.509, measured in the frequency range 960 – 5000 MHz.

Approved:

Per Larsson
Ass. Laboratory Technical Manager

Contents

1 Introduction

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

Date of test: October 21,30, 2002

Location: AerotechTelub AB, Östersund

Test performed by: Petter Gärdin, AerotechTelub / FBM

Client: Malå Geoscience
Skolgatan 11
SE-93070 Malå
Sweden

Client's observers: Bernth Johansson, 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
UWB definition		FCC 15.503 (a) 15.509(a)	PASS	f_L 89 f_C 203 f_H 317	1
Peak emission at f_M	FCC 02-42	FCC 15.509 (f)	PASS	Margin 9.1 dB	2
Radiated emission	FCC 02-42	FCC 15.509 (d)	PASS	With peak detector	3
Radiated emission	FCC 02-42	FCC 15.509 (e)	PASS	With peak detector	4

3 Applicable documents

Measurements		
FCC Part 15	2002-07-22	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

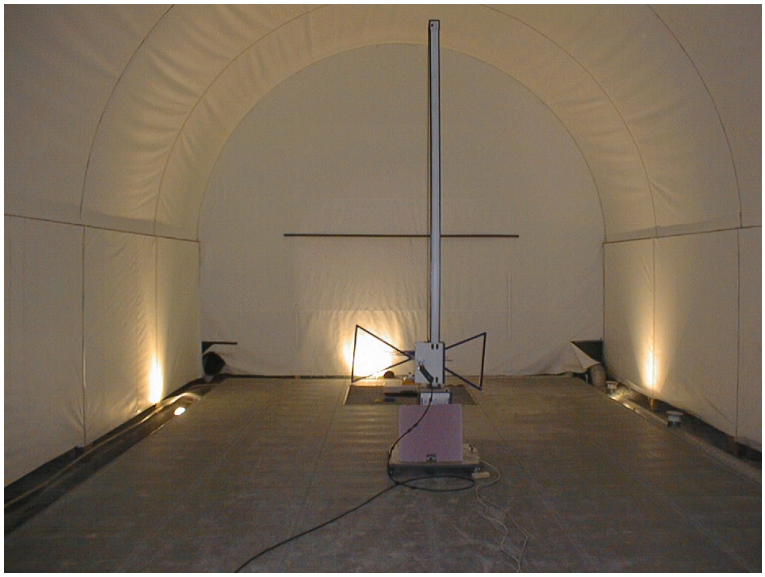
Equipment under test (EUT):

Description:	Ground Penetrating Radar System.
Manufacturer:	Malå Geoscience
Model name:	X3M/Easy Locator MID with 350 MHz Shielded antenna.
Build state:	Production sample
Serial no:	6838

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 distance antenna – EUT was 1 and 3 m. 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, 937 – 945 MHz
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

The EUT was powered by a battery pack intended to be carried as a belt.

An X3M control unit was attached to a 350 MHz shielded antenna unit.

No other cables except to the battery were connected to the EUT.

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

Picture 2: EUT setup on sand bed

4.4 Operation of EUT during tests

The EUT was gathering data like in normal operation.

5 Emission

5.1 Measurement of radiated emission

5.1.1 Requirements according to FCC 15.509 (d) and (e)

Radiated emission from the EUT shall not exceed the limit as specified below.

Frequency range	Limit	Limit*
960 – 1610 MHz	-65.3 dBm EIRP	29.9 dBµV/m
1610 – 1990 MHz	-53.3 dBm EIRP	41.9 dBµV/m
1990 – 10000 MHz	-51.3 dBm EIRP	43.9 dBµV/m

Frequency range	Limit	Limit*
1164 – 1240 MHz	-75.3 dBm EIRP	19.9 dBµV/m
1559 – 1610 MHz	-75.3 dBm EIRP	19.9 dBµV/m

* Converted to field strength level at 3 meters according to FCC 15.521 (g)

5.1.2 Procedures

The radiated emission was measured on an Open Area Test Site (OATS) as described in 4.2.1 with 1 meters measuring distance.

According to the provisions of FCC 15.509 (d) and (e) the emissions should be compared with an average limit measured with a RMS detector.

These measurements were made with a peak detector.

The following resolution bandwidths and video bandwidths were used during the measurement

Frequency range	RBw	VBw
960 – 5000 MHz	1 MHz	3 MHz
1164 – 1240 MHz	1 kHz	1 kHz
1559 – 1610 MHz	1 kHz	1 kHz

Because the measurements were made at 1 meters distance a correction factor (9.5 dB) have been applied to the limits.

The measurements were made with the EUT in 8 different positions on the sand bed and the antenna position was changed as well as its polarization.

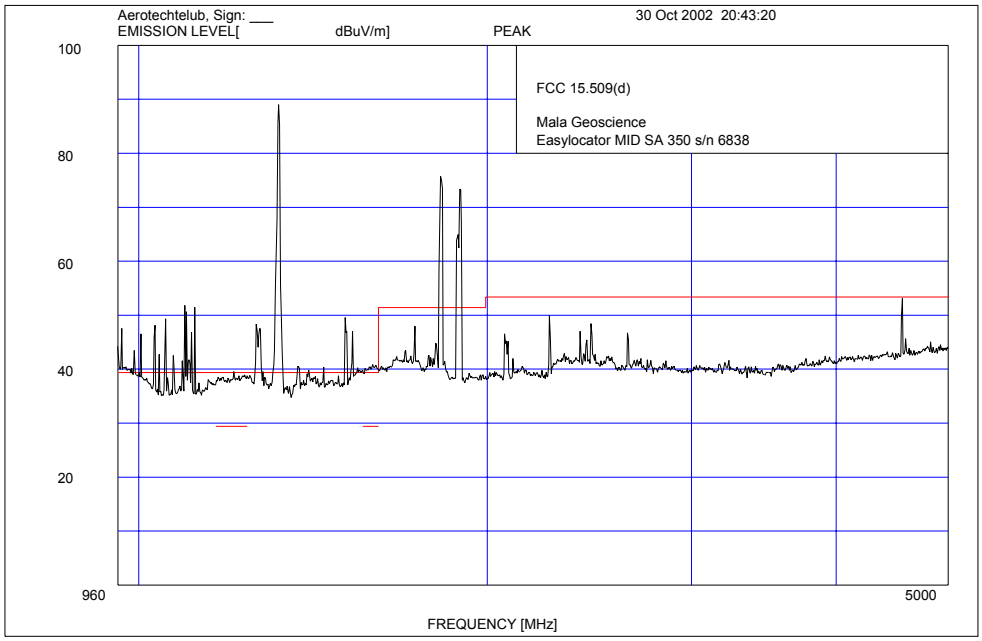
A sweep of the frequency range was made at each position and the resulting max field strength level was plotted.

After the sweeps the max radiated field strength were controlled manually due to the high number of ambients.

5.1.3 Results

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

The EUT complied with the requirement of radiated emission specified in FCC 15.509 (d) and (e) in the frequency range 960 – 5000 MHz when measured with a peak detector.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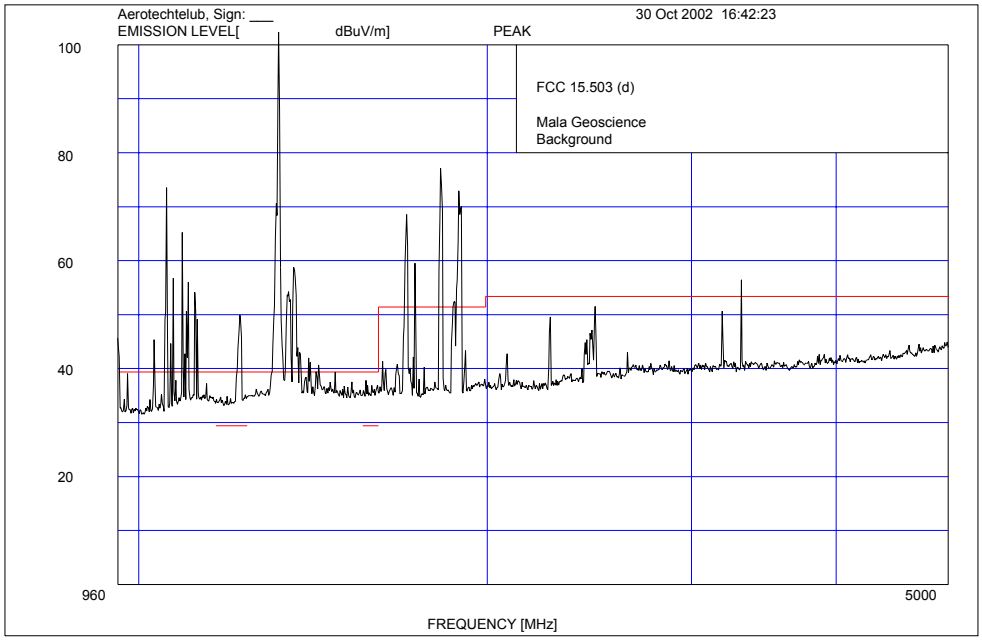
30 Oct 2002 20:43:20
EMISSION LEVEL[dBuV/m] PEAK
100
80
60
40
20
960
5000
FREQUENCY [MHz]
FCC 15.509(d)
Mala Geoscience
Easylocator MID SA 350 s/n 6838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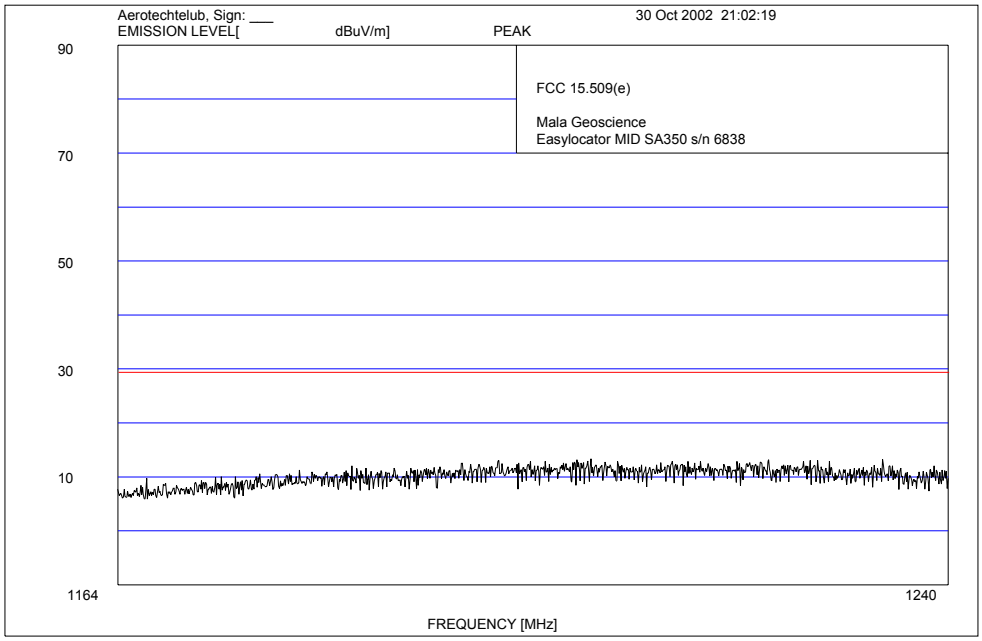
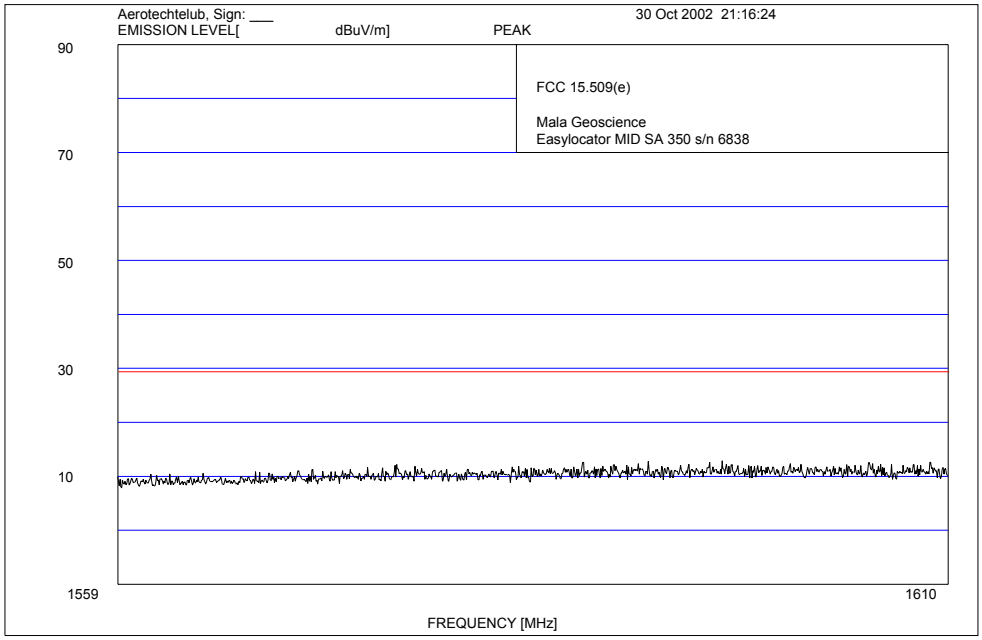
EMISSION LEVEL[dBuV/m] PEAK
100
80
60
40
20
960
5000
FREQUENCY [MHz]
FCC 15.503 (d)
Mala Geoscience
Background


Aerotechtelub, Sign: ___
30 Oct 2002 21:02:19
EMISSION LEVEL[dBuV/m] PEAK
90
70
50
30
10
FCC 15.509(e)
Mala Geoscience
Easylocator MID SA350 s/n 6838
1164
1240
FREQUENCY [MHz]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EMISSION LEVEL[dBuV/m] PEAK
90
70
50
30
10
FCC 15.509(e)
Mala Geoscience
Easylocator MID SA 350 s/n 6838
1559
1610
FREQUENCY [MHz]

5.1.4 Measurement uncertainty

For the test site used no calculations exists.

5.1.5 Instrumentation

Hewlett Packard Spectrum analyzer	8566B	100 Hz - 22 GHz	2404A08864 / 2504A01320
Hewlett Packard Pre-amplifier	8449B	1 GHz - 26.5 GHz	3008A00103
Emco Double Ridge Waveguide	3115	1 GHz - 18 GHz	2800

5.2 Measurement of UWB bandwidth and peak emissions

5.2.1 Requirements according to FCC 15

5.2.1.1 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.

5.2.1.2 Requirements according to FCC 15.509 (a)

The UWB bandwidth of an imaging system operating under the provisions of this section must be below 960 MHz.

5.2.1.3 Requirements according to FCC 15.509 (f)

There is a limit on the peak level of emission contained within a 50 MHz bandwidth centered on f_M. That limit is 0 dBm EIRP. According to the provisions in 15.521 the limit is converted to field strength level in 3 MHz bandwidth.

5.2.2 Procedures

The equipment was placed on the test site described under paragraph 4.2.1 and the radiated emission was measured at 3 meters.

The measurements were made with the EUT in 8 different positions on the sand bed and the antenna position was changed as well as its polarization resulting in 32 different sweeps of the frequency range.

The diagrams show the peak field strength from these sweeps.

At the peak of emission (f_M) the emissions was manually measured with a resolution bandwidth of 3 MHz.

5.2.3 Results

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

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

According to 15.509 (a)

From the diagrams below the following data was gathered and calculated.

Frequency of highest emission f_M: 145 MHz

Upper boundary f_H: 317 MHz

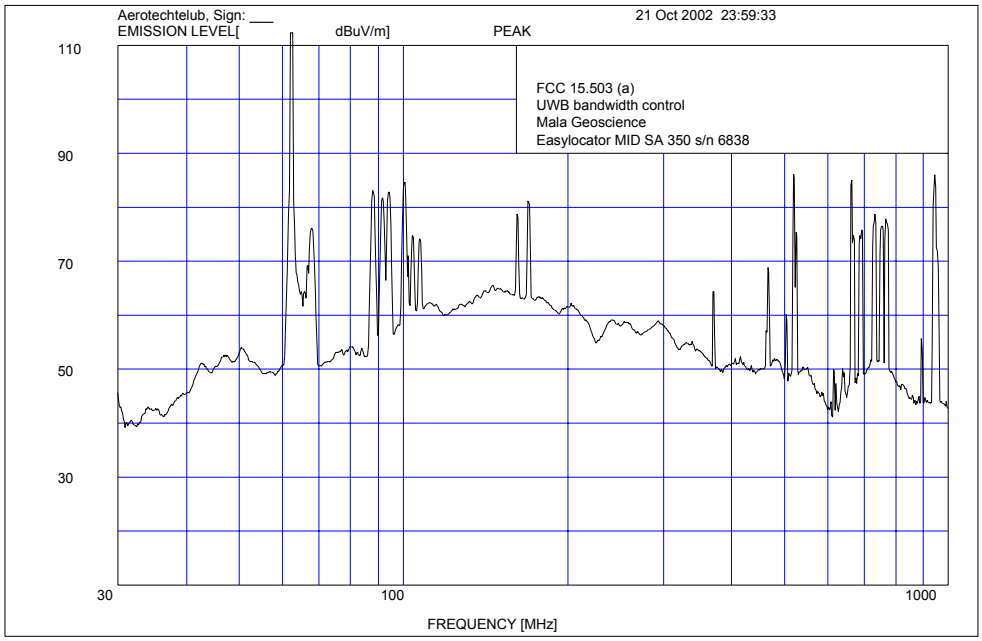
Lower boundary f_L: 89 MHz

Center frequency f_C: 203 MHz

Fractional bandwidth: 1.12

According to 15.509 (f)

Emission at f_M: Radiated emission 61.7 dBµV/m
Limit 70.8 dBµV/m
Margin 9.1 dB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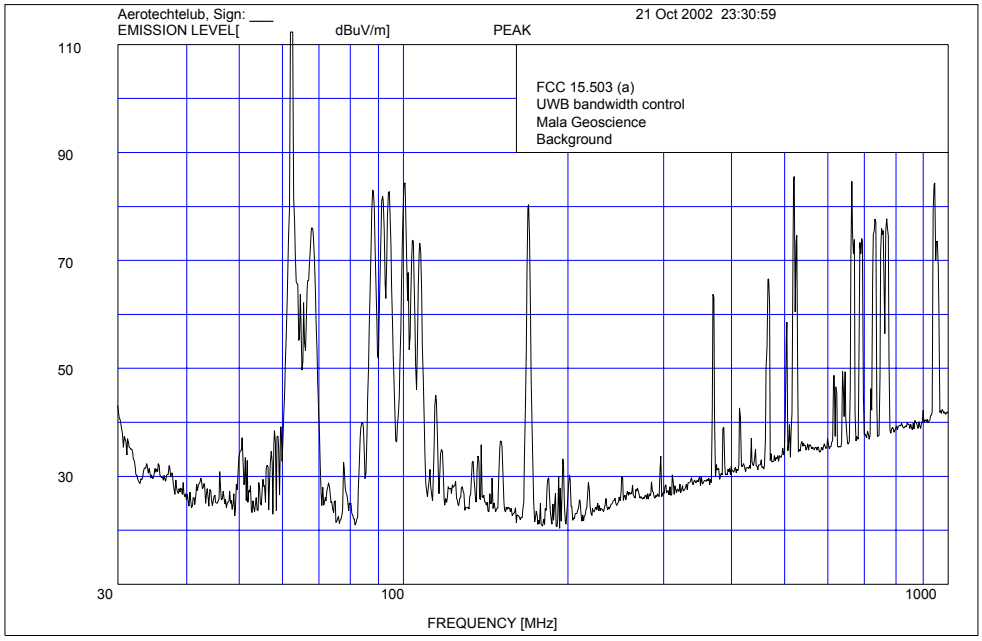
EMISSION LEVEL[dBuV/m] PEAK
110
90
70
50
30
FCC 15.503 (a)
UWB bandwidth control
Mala Geoscience
Easylocator MID SA 350 s/n 6838
30
100
1000
FREQUENCY [MHz]

Background


Aerotechtelub, Sign: ___
21 Oct 2002 23:30:59
EMISSION LEVEL[dBuV/m] PEAK
110
90
70
50
30
FCC 15.503 (a)
UWB bandwidth control
Mala Geoscience
Background
30
100
1000
FREQUENCY [MHz]

5.2.4 Instrumentation

Hewlett Packard Spectrum analyzer	8566B	100 Hz - 22 GHz	2404A08864 / 2504A01320
Chase Bilog antenna	CBL6111A	30 - 1000 MHz	1164