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EMC Test Report

Company:	Research Technologies Inc. 115 Second Ave N, Suite 300 Edmonds, WA 98020
Contact:	Claire Rasmussen
Product:	Eclipse Laser Target
FCC ID Number:	TUR000910
Test Report No:	111105-01-02A
APPROVED BY:	Doug Kramer Senior Test Engineer
DATE:	9 January 2005
Total Pages:	26

ACCREDITED
Certificate Number 1953-01

1.0 Summary of test results

1.1 Test Results

Based on the data collected with the unit as configured.

Test	Test Specification	Results
47 CFR, Part 15.203	Part 15.203	Complies
47 CFR, FCC Part 15.207	Part 15.207, Class B	N/A
47 CFR, FCC Part 15.109/209	Part 15.109, Class B	Complies
47 CFR, FCC Part 15.249	Part 15.249	Complies

1.2 Test Methods

1.2.1 Conducted Emissions

The EUT was powered by an internal rechargeable battery. There was no connection to the AC mains supply network, nor is it an option, therefore conducted emissions measurements are not applicable to this product.

1.2.2 Radiated Emissions

Compliance to 47 CFR Part 15 was tested in accordance with the methods of ANSI/IEEE C63.4, 2003. Several configurations were examined and the results presented represent a worst-case scenario. The EUT was placed on a wooden table approximately 80cm high and centered on a 4m diameter turntable. The table was rotated to find the angles of maximum emissions and the antenna was moved from 1m to 4m in both vertical and horizontal positions. All measurements were taken at a distance of 3m.

2.0 Description

2.1 Equipment under test

The Equipment under test (EUT) was a Research Technologies Eclipse Laser Target for use with a laser alignment system. The target detects the presence of laser light and an infrared sync pulse from the Eclipse Laser Scanner and transmits position data to a PC. The firmware was set to 915MHz transmittion frequency with a BAUD rate of 115,200.

2.1.1 Identification: Eclipse Laser Target

2.1.2 EUT received date: 14 Nov. 2005

2.1.3 EUT tested dates: Nov 22, Dec 1, 2 of 2005

2.1.4 Manufacturer: Research Technologies

2.1.5 Serial number: #63

2.2 Laboratory description

All testing was performed at the NCEE Lincoln facility, which is a FCC registered lab. This site has been fully described in a report submitted to your office, and accepted in a letter dated May 4, 2001. Laboratory environmental conditions varied slightly throughout the tests:

Relative humidity of 46 ± 4%
Temperature of 20 ± 3° Celsius

2.3 Special equipment or setup

The EUT's battery was fully charged prior to testing. The EUT was set to continuously transmit position data. To keep the EUT transmitting, it was required to have the Eclipse laser scanner on the table, so that the target was in the path of the laser. Without the laser presence, the transmitter would not operate.

3.0 Test equipment used

Serial #	*Manufacturer*	*Model*	*Description*	*Last cal.*
1647	EMCO	3142B	Biconilog antenna	10-Mar-05
6416	EMCO	3115	DRG Horn	12-Oct-05
100037	Rohde & Schwarz	ESIB26	EMI Test Receiver	10-Aug-05
082001/003	Rohde & Schwarz	TS-PR18	Preamplifier	N/A
2575	Rohde & Schwarz	ES-K1	Software v1.60	N/A

4.0 Detailed Results

Radiated emissions measurements were made by first using a spectrum analyzer getting a rough signal spectrum, any points were then measured using a CISPR 16 compliant receiver with the following bandwidth setting:

30MHz - 1GHz: 120kHz IF bandwidth, 60kHz steps
1GHz - 10GHz: 1MHz IF bandwidth, 500kHz steps

4.1 FCC Part 15.203 unique connector for antenna

The antenna is inside of the EUT and is permanently attached to the EUT. This is considered sufficient to comply with FCC Part 15.203.

4.2 FCC Part 15.207 Conducted Emissions

Conducted emissions measurements were not applicable to this product, as it has no provisions for connecting to the mains network.

4.3 FCC Part 15.209 Radiated Emissions

The EUT was found to comply with the published limits. The EUT was tested at 3m and the limits were scaled to reflect those for Class 'B' products at 3m. The limits applied were the same as those for FCC Class 'B' products. See figures 3 and 4 for a plot of the data, Table 1 for tabular data and see figures 1 and 2 for EUT setup. As shown in figures 3 and 4, the EUT complies with the limits. Figure 3 shows a plot from the EUT not transmitting, but ready to receive commands, and table 1 contains tabular data from this mode of operation.

4.4 FCC Part 15.249 Operation within the 902-928 MHz Band

The EUT was tested while transmitting at 915MHz. This is the only possible frequency of operation as set in the EUT firmware. All measurements were taken at a 3m distance. The EUT was found to comply with the published limits in accordance with 15.249 in the 902-928MHz band. Below are the measurements of the fundamental frequency and the first two harmonics, which were the two harmonics with the highest emission levels. See figure 4 for a plot of the data, tables 3 and 4 for tabular data, and see figures 1 and 2 for EUT setup. Figure 5 is a plot of the laser scanner without the EUT present. All emissions in excess of the Class 'B' limit are radiating from the laser target.

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Detector
MHz	dBµV/m	dBµV/m	dB	cm	deg		
915.180000	73.26	93.9	20.6	178.0	135	VERT	Quasi-Peak
1830.500000	25.19	53.9	28.7	106.0	79	HORI	Average
2745.500000	25.94	53.9	28.0	99.0	323	VERT	Average
3660.500000	27.78	53.9	26.1	100.0	129	VERT	Average
4574.000000	27.77	53.9	26.1	100.0	162	VERT	Average
1830.500000	54.92	73.9	19.0	141.0	62	VERT	Peak
2745.500000	51.88	73.9	22.0	99.0	323	VERT	Peak
3660.500000	53.10	73.9	20.8	100.0	129	VERT	Peak
4574.000000	49.15	73.9	24.7	100.0	162	VERT	Peak

Appendix A: Test Photos

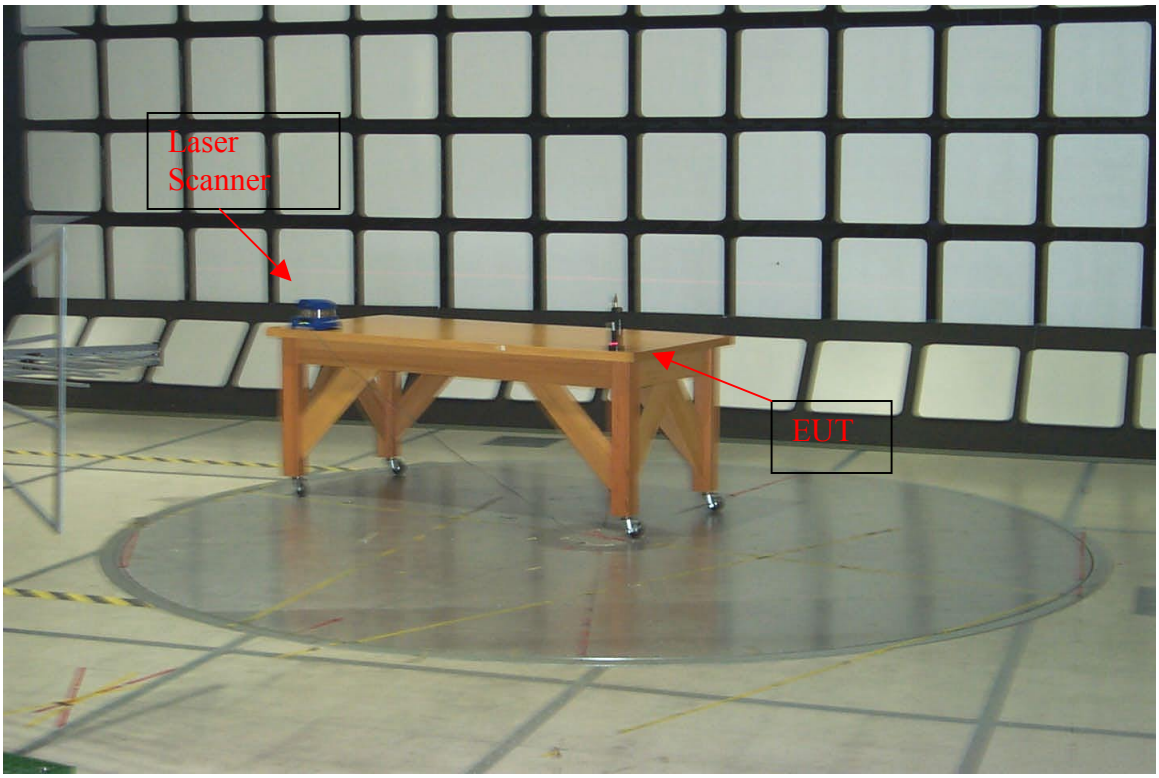

Figure 1 - Radiated Emissions Test Setup

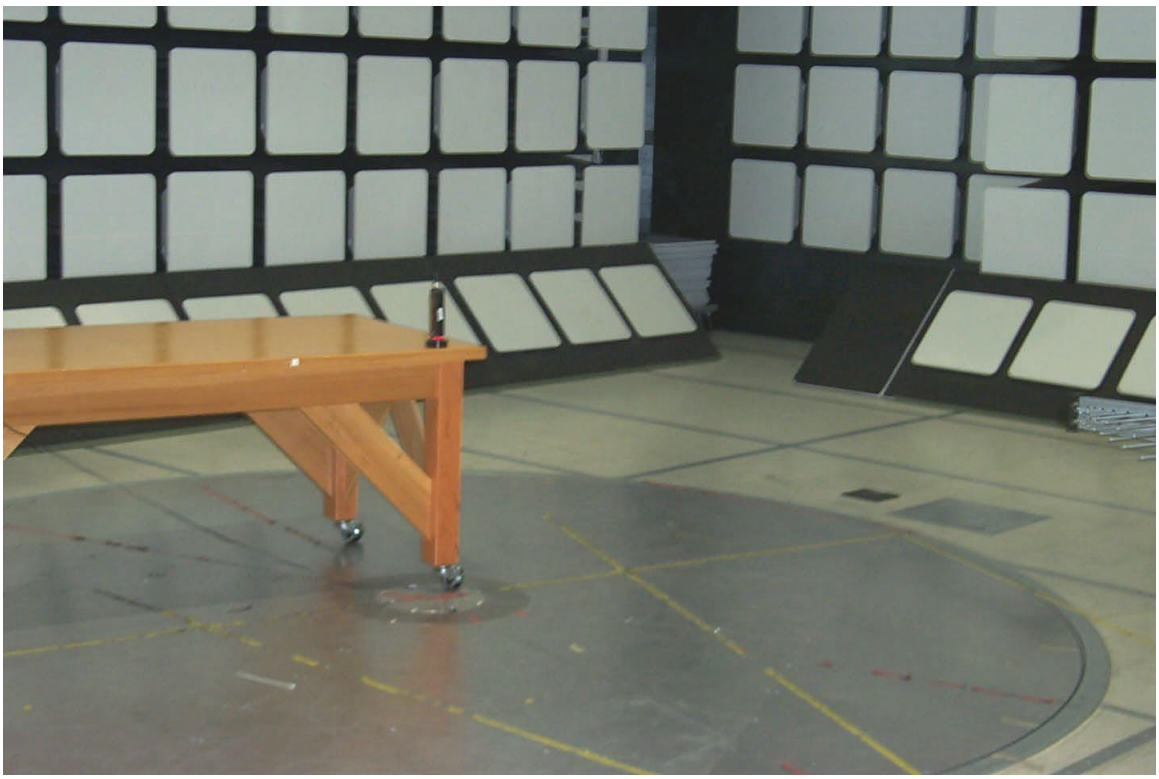

Figure 2 - Radiated Emissions Test Setup

Appendix B: Emissions Plots

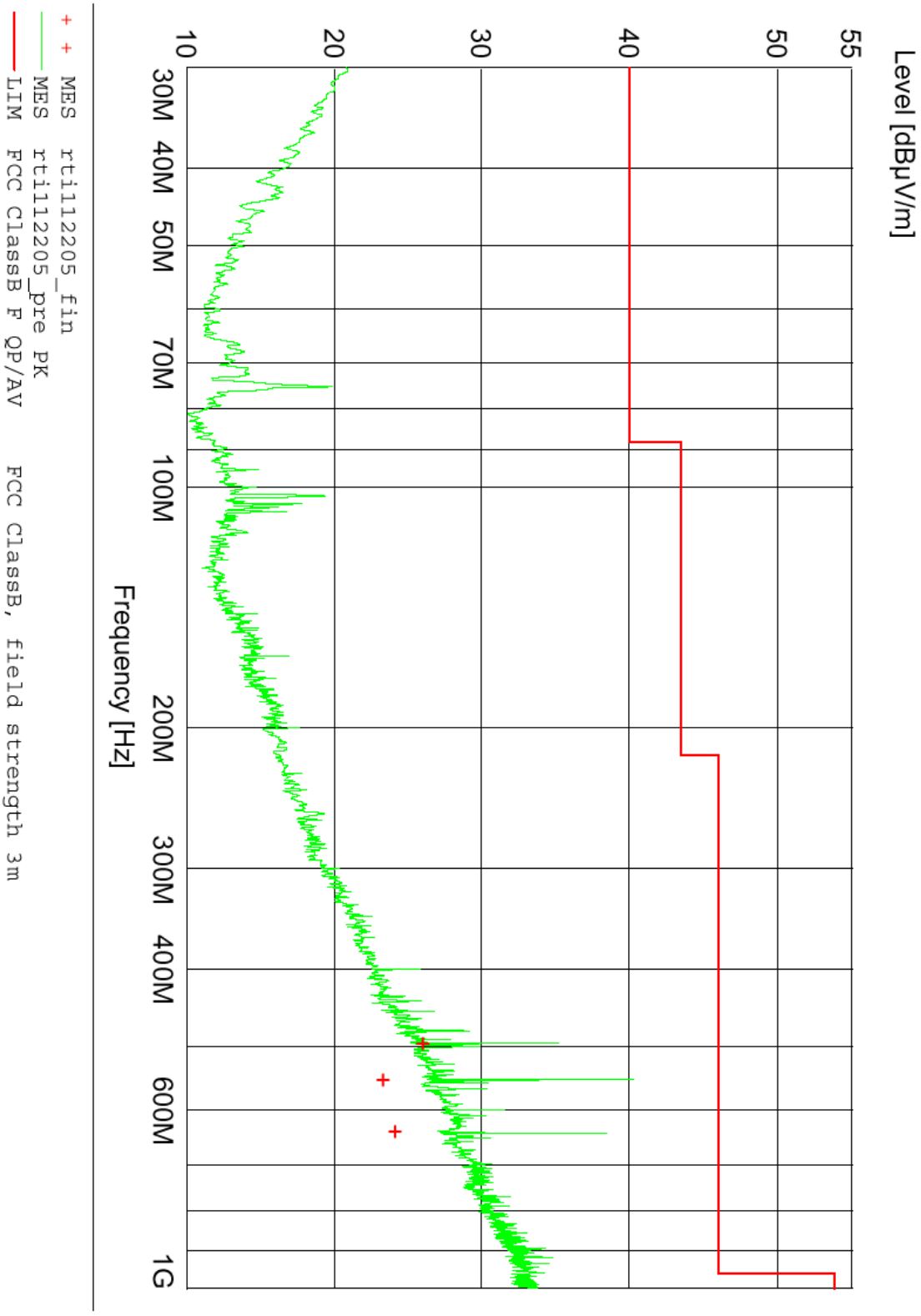

Figure 3 Radiated emissions plot, 3m measurement distance, EUT idle without laser scanner present

Table 1 - Radiated Emissions, Quasi-Peak Data, EUT not transmitting

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
495.180000	26.02	46.0	20.0	250.0	236	HORI
549.240000	23.32	46.0	22.7	400.0	348	VERT
639.240000	24.14	46.0	21.9	371.0	22	VERT

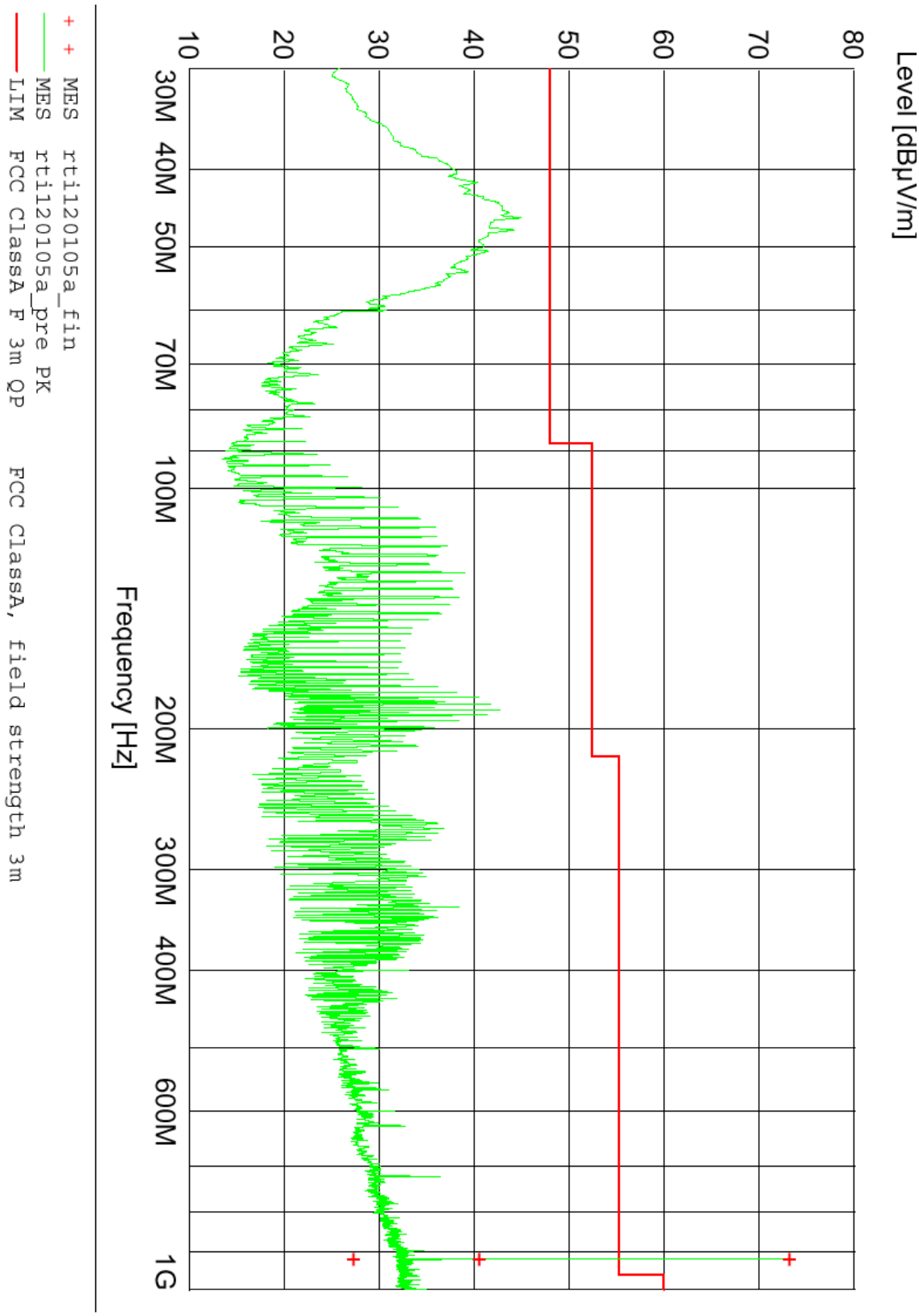

Figure 4 - Radiated Emissions Plot, 3m distance, EUT actively transmitting

Table 2 – Radiated Emissions Quasi-Peak Data, EUT transmitting at 915MHz

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
914.580000	40.52	46.0	5.5	301.0	129	VERT
915.180000	73.26	93.9	20.64	178.0	135	VERT
916.140000	27.30	46.0	18.7	349.0	115	VERT

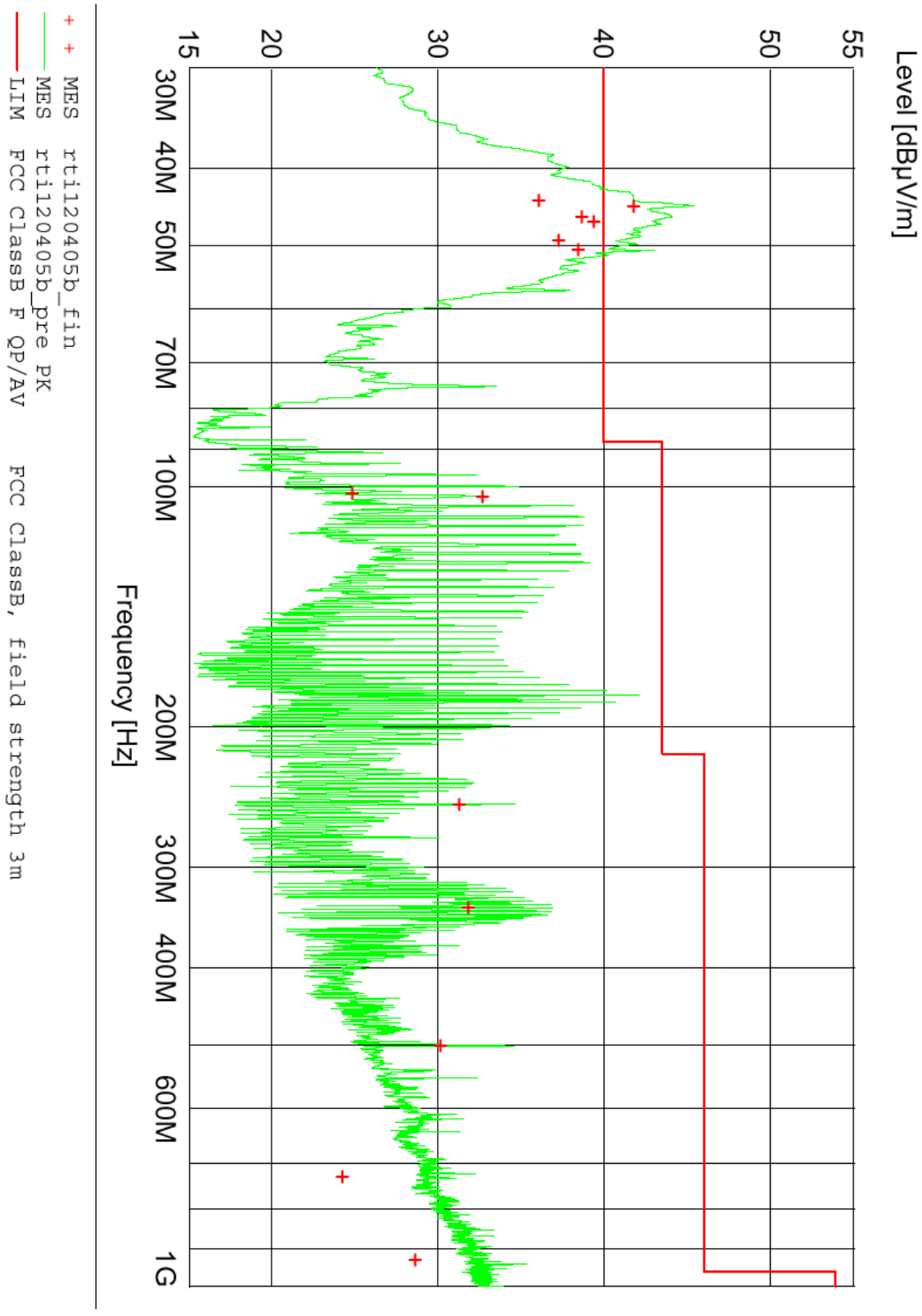

Figure 5 Plot of the laser scanner without the EUT present.

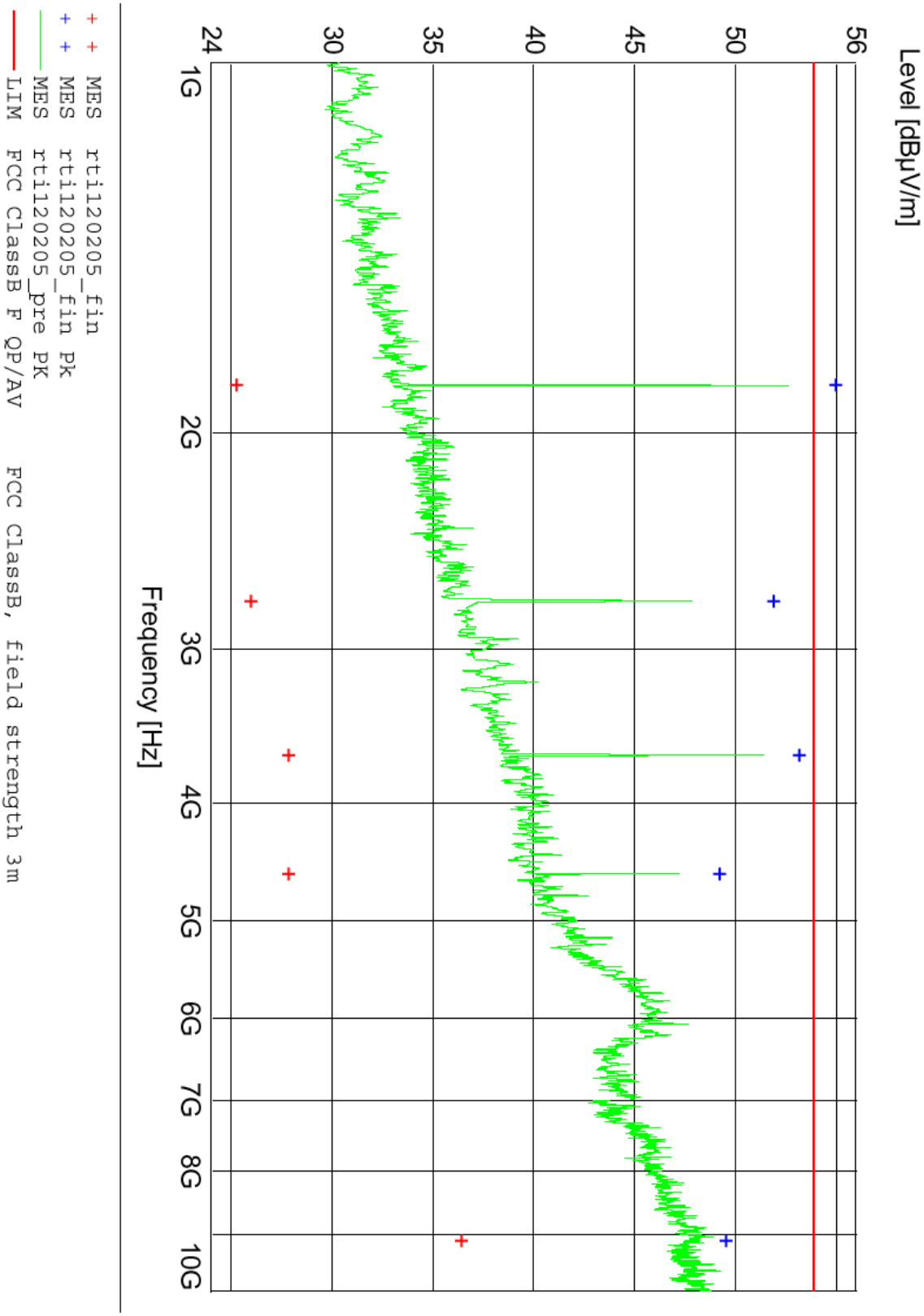

Figure 6 - Radiated Emissions Plot, 3m, 1GHz-10GHz

Table 3 – Radiated Emissions Average Data

Above 1 GHz, EUT transmitting at 915MHz

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
1830.500000	25.19	53.9	28.7	106.0	79	HORI
2745.500000	25.94	53.9	28.0	99.0	323	VERT
3660.500000	27.78	53.9	26.1	100.0	129	VERT
4574.000000	27.77	53.9	26.1	100.0	162	VERT
9079.000000	36.37	53.9	17.5	261.0	199	VERT

Table 4 – Radiated Emissions Peak Data

Above 1 GHz, EUT transmitting at 915MHz

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
1830.500000	54.92	73.9	19.0	141.0	62	VERT
2745.500000	51.88	73.9	22.0	99.0	323	VERT
3660.500000	53.10	73.9	20.8	100.0	129	VERT
4574.000000	49.15	73.9	24.7	100.0	162	VERT
9079.000000	49.46	53.9	4.4	261.0	199	VERT

Appendix C: Bandwidth Data

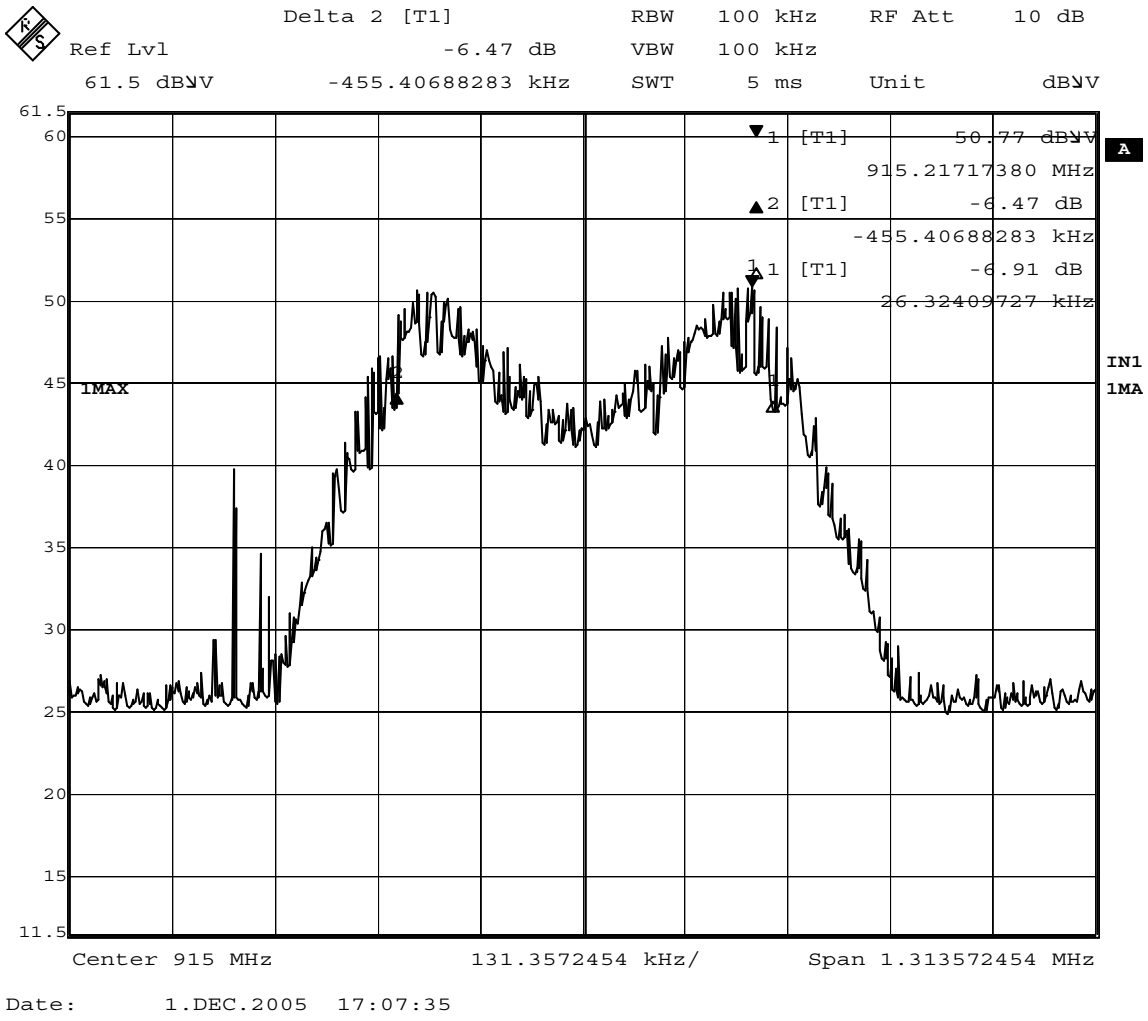

Figure 7 - 6dB Bandwidth, 531.8 kHz (455.4kHz + 76.37kHz)

Appendix D: Sample Calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:
FS = RA + AF – (-CF + AG) + AV

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dBµV is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dBµV/m.

FS = 55 + 12 – (-1.1 + 20) + 0 = 48.1 dBµV/m

The 48.1 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

Level in µV/m = Common Antilogarithm [(48.1 dBµV/m)/20]= 254.1 µV/m

AV is calculated by the taking the 20*log(T_{on}/100) where T_{on} is the maximum transmission time in any 100ms window.

Is this case, T_{on} is less than 50mSec for a 100mSec window. An average correction factor of 6dB was applied where noted.

Appendix E: EUT Photos

Figure 8 - Eclipse Laser Target, Front

Figure 9 - Eclipse Laser Target, Back

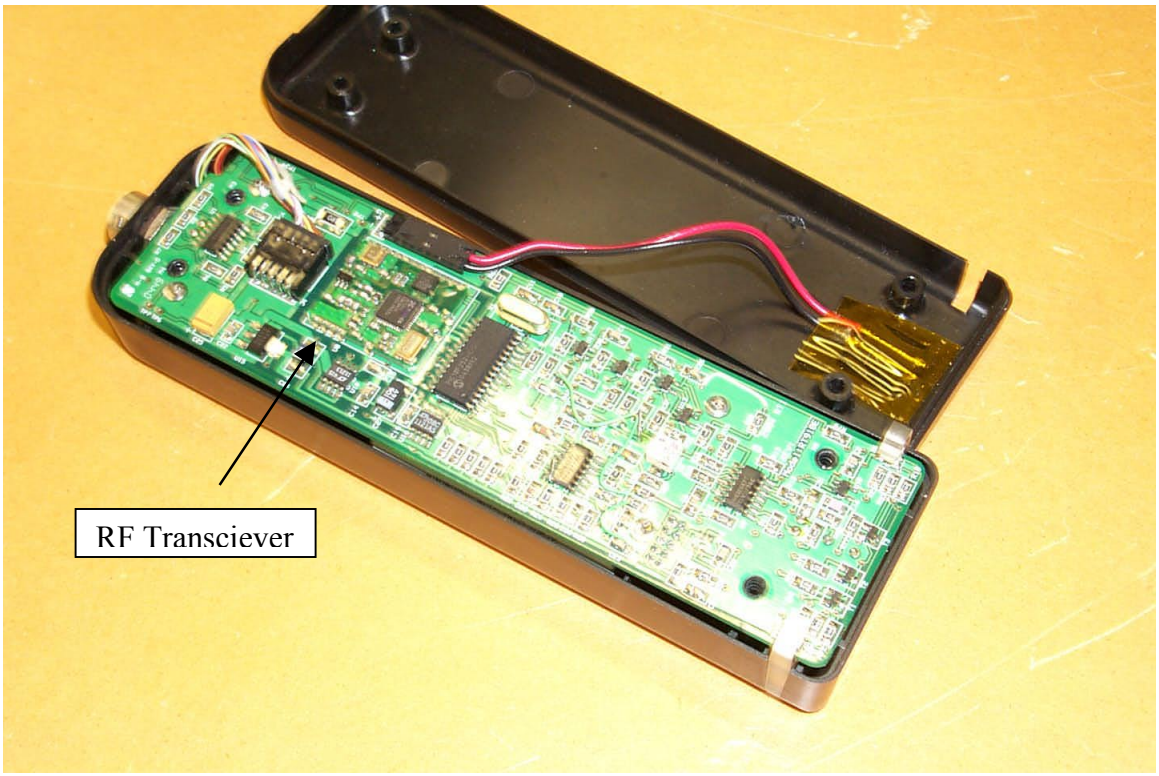

Figure 10 - Eclipse Laser Target

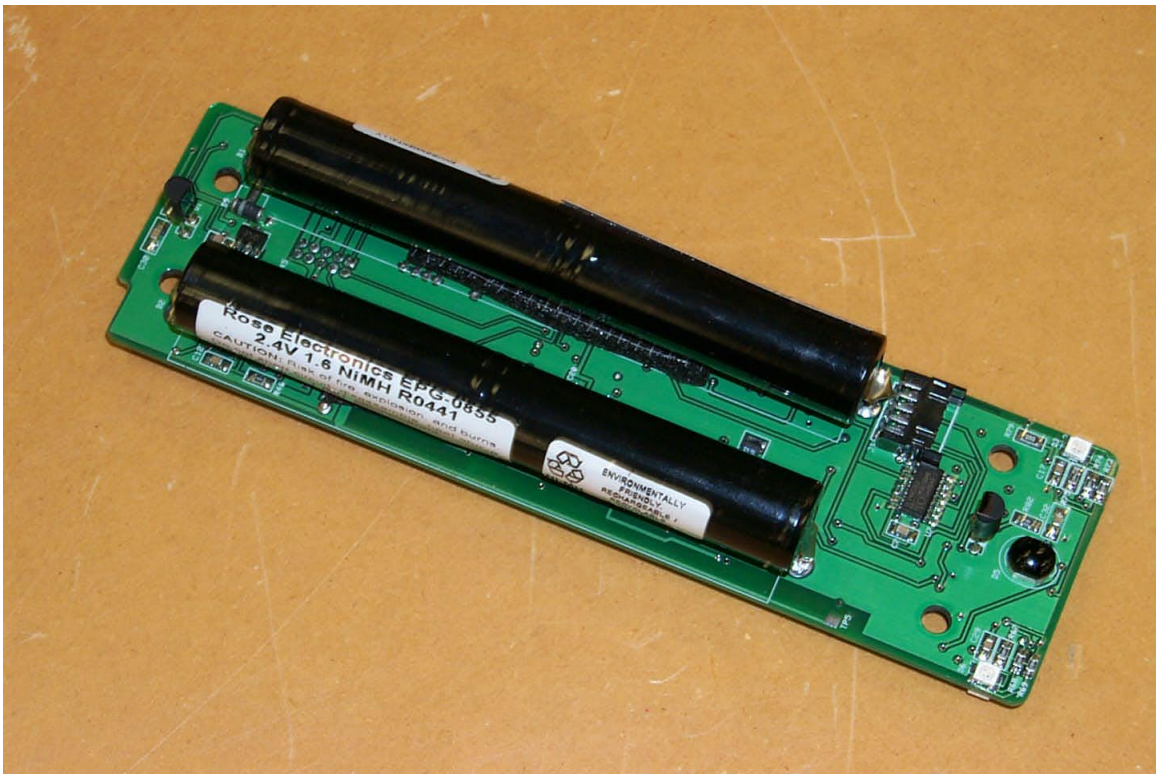

Figure 11 - Eclipse Laser Target, opposite side

Appendix F: RF Block Diagram

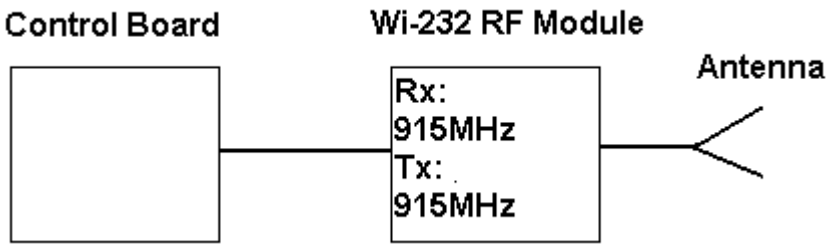

Figure 12 - RF Block Diagram

Appendix G: List of Figures

Figure **Page Number**