EMI Research and Development Laboratory
Department of Electrical Engineering
Florida Atlantic University
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FCC PART 15.249 TEST REPORT

Applicant	ACTIVE WAVE, INC.
Address	902 CLINT MOORE ROAD SUITE 118 BOCA RATON, FL 33487
FCC ID	VJRTAG-141-145
Product Description	CREDIT CARD TAG AND JUMBO TAG READER
Date Sample Received	JULY 18, 2005
Date Tested	AUGUST 24, 2005
Tested By	RAYMOND AINA
Approved By	VICHATE UNGVICHIAN
Test Results	☒ PASS ☐ FAIL

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Technical Report No. 05-041-9

"EMI Evaluation of the Active Wave Credit Card Tag to FCC Part 15 Unintentional Radiators, Class A, Radiated Emission Requirements and Intentional Radiators, Section 15.249

Performed: 18 July – August 24, 2005

Customer: Active Wave, Inc.
Attn: Arnold Banks
902 Clint Moore Road, Suite 118
Boca Raton, FL 33487

Company Official responsible
for product(s) tested:

Arnold Banks, Engineer
561-999-9423

Test Performed and
Reported By:

Raymond Aina, BSEE, BSME
FAU EMI R&D Laboratory

Approved by:

Vichate Ungvichian, Ph.D., P.E.
Director, FAU EMI R&D Laboratory

ACCREDITED
2129.01

1. INTRODUCTION

The Active Wave Credit Card Tag is a transceiver, which is capable to transmit at 916.5 MHz and receive at 433.92 MHz via an internal antenna. The unit was powered by a 3-volt Lithium Battery (Model 2032). Evaluation results reported herein apply only to the specific items of equipment, configurations (including software and unit operation), and procedures supplied to the Florida Atlantic University EMI Research Lab by Active Wave, Inc. under the test conditions listed herein.

2. OBJECTIVE

This evaluation was performed to verify the conformance of the Active Wave Credit Card Tag with reference to the U.S. Federal Communications Commission (FCC) Code of Federal Regulations (CFR), Title 47 - Telecommunication, FCC Part 15 Subpart B- Unintentional Radiators, Section 15.109 (b) and radiated emissions. In addition to FCC Part 15, Subpart C- Intentional Radiators, the unit must comply with Section 15.249, Operating within the band 902-928 MHz.

3. CONCLUSION

The Active Wave Credit Card Tag met the FCC Class A radiated emission requirements and the FCC Part 15, Section 15.249 as described in the following pages.

4. TEST PROCEDURES AND RESULTS

4.1 TEST PROCEDURES

The measurement techniques identified in the measurement procedure of ANSI C63.4-2001 *"American National Standard of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"* were followed as close as practical during this evaluation. Complete details and specific procedures used are discussed in the respective Test Result sections.

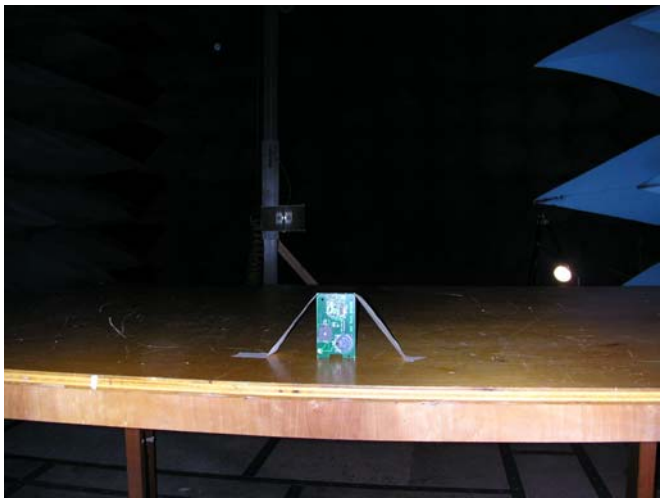
4.2 TEST RESULTS

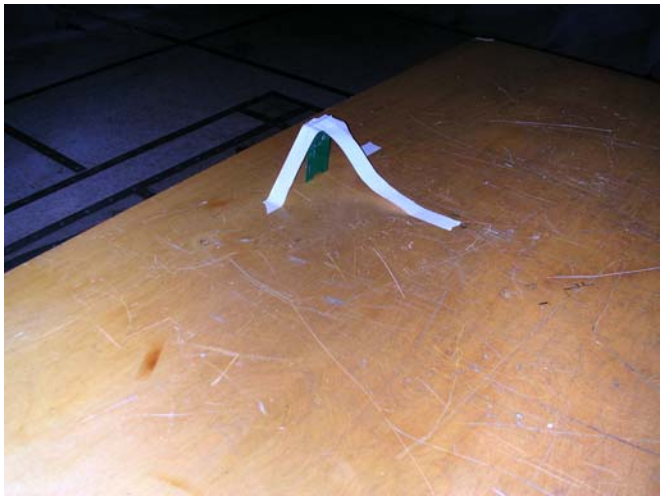
4.2.1 CONDUCTED POWERLINE EMISSIONS

Since the Credit Card Tag is a battery powered device, there was no conducted evaluation required.

4.2.2 RADIATED EMISSIONS

The Active Wave Credit Card Tag was set up on a wooden turntable 80 centimeters above the ground plane of the FAU 3-m Semi-anechoic chamber, which is an FCC listed and A2LA registered site. The unit was programmed to operate in a receiving mode for Section 15.109 (b). For an intentional radiator, Section 15.249, the unit was programmed to transmit at 916.5 MHz. Photographs 1 and 2 show the set up used during the radiated emissions testing.





PHOTOGRAPHS 1 & 2: RADIATED EMISSION TEST SETUP

4.2.2.1 Unintentional Radiator, Radiated Emission Limits, Sections 15.109

An EMCO 3104 Broadband Biconical antenna was installed on an EMCO pneumatically controlled Antenna Mast at a distance of 3 meters from the system. The 30 MHz to 200 MHz frequency range was automatically scanned on the HP 8566B Spectrum Analyzer operated in the peak detector mode with a bandwidth of 120 kHz obtained through the HP 85650A Quasi Peak Adapter. It should be noted that the RES BW and VBW of the spectrum analyzer must be set to 1 MHz for the Quasi Peak Adaptor to provide 120 kHz bandwidth correctly. Hence, in the figures RES BW and VBW are still indicated as 1 MHz.

The Biconical antenna was oriented horizontally polarized to the measured field and was initially set 1-m above the floor. After setting the SA to operate between 30-200 MHz, the max hold switch on the SA was pressed. The turntable was then rotated 360 degrees. After the completion, the turntable was rotated back to the previously noted azimuth angles where the strongest E-field occurred, and the antenna was then scanned in height from 1-4 meters at those angles to obtain the maximum value. The composite field trace was then plotted.

The antenna was then rotated to measure the vertical polarized E-field. The clear write switch was pressed, then the max hold switch was pressed, and the above procedure was repeated. For the 200-1000 MHz band, a Log Periodic antenna (EMCO 3146) was installed and the SA was set to operate between 200-1000 MHz. To collect data, the above measurement procedures were then repeated.

Figures 1-4 show the worse case radiated emissions, independent of azimuth or antenna height, which are below the required Class A limits. The limit lines have been corrected for the appropriate antenna factor, cable loss, amplifier gain, and distance factor based on the following equation:

E (dBμV/m) = SA reading (dBμV) + Antenna Factor (dB/m) + Cable Loss (dB) - Amp Gain (dB) – Corrected Distance Factor (dB).

The correction factor for Class A is 20xlog [10/3] which is equal to 10.45 dB

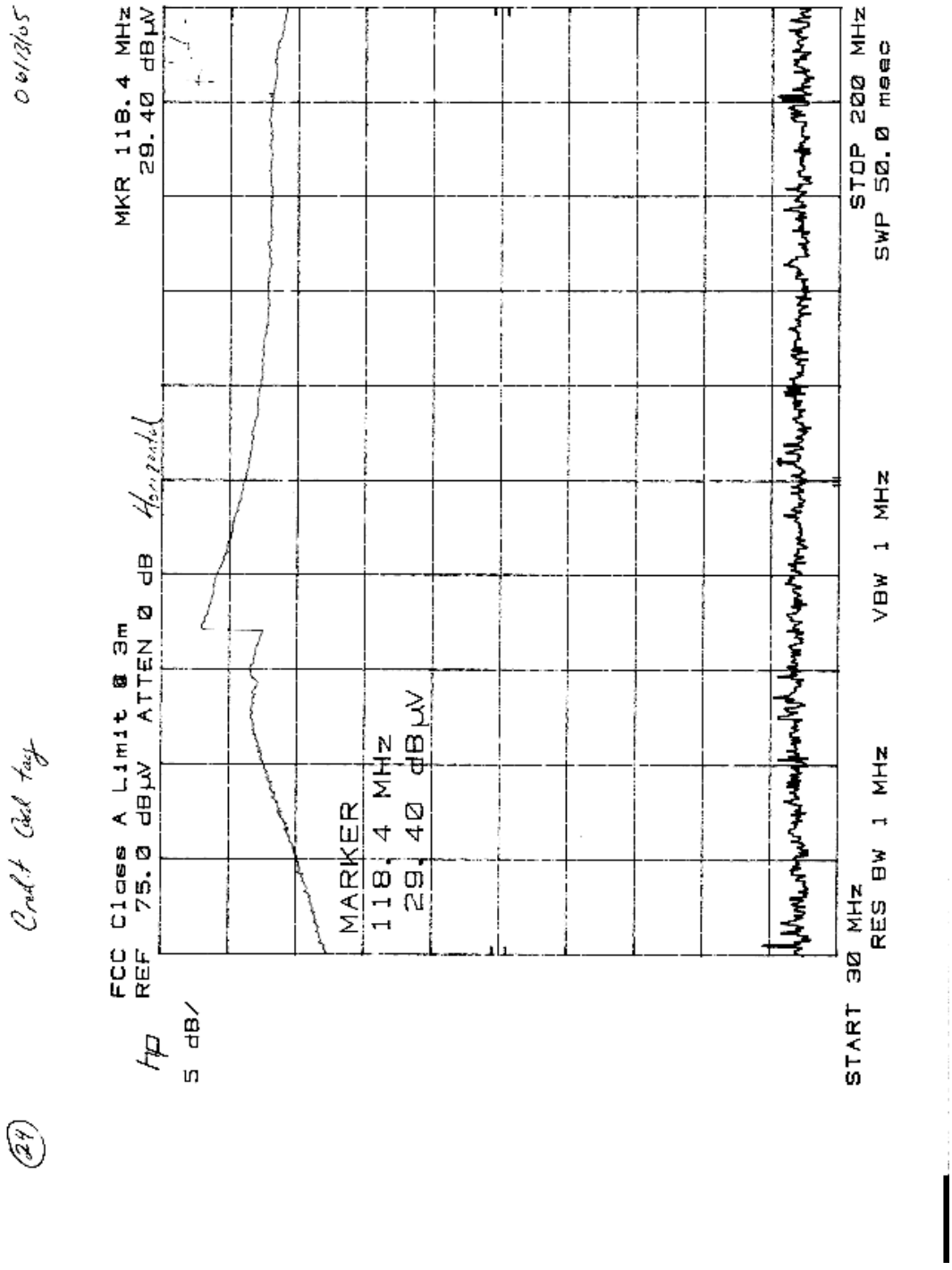


FIGURE 1: RADIATED EMISSIONS (30 - 200 MHz HORIZONTAL)

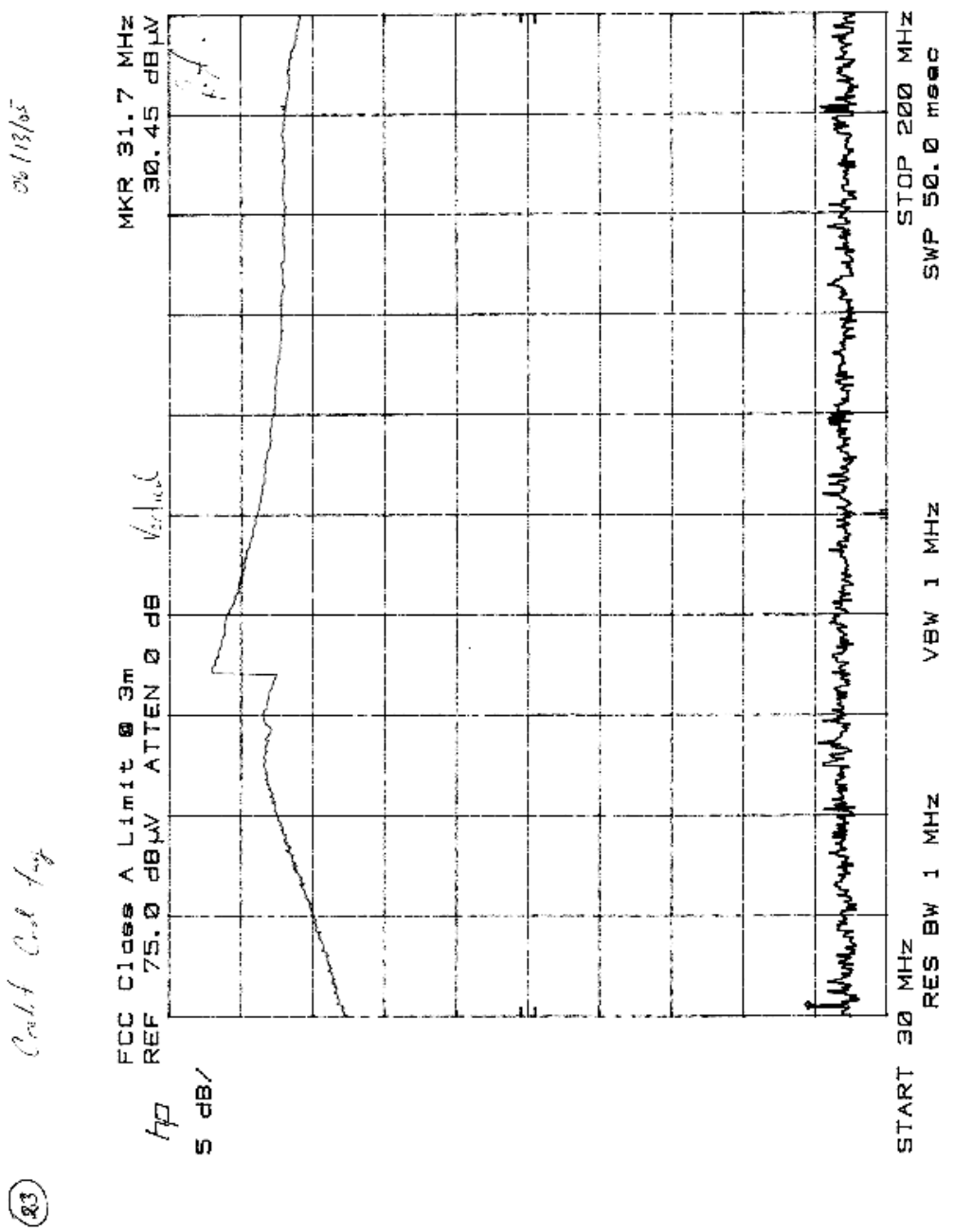


FIGURE 2: RADIATED EMISSIONS (30 - 200 MHz VERTICAL)

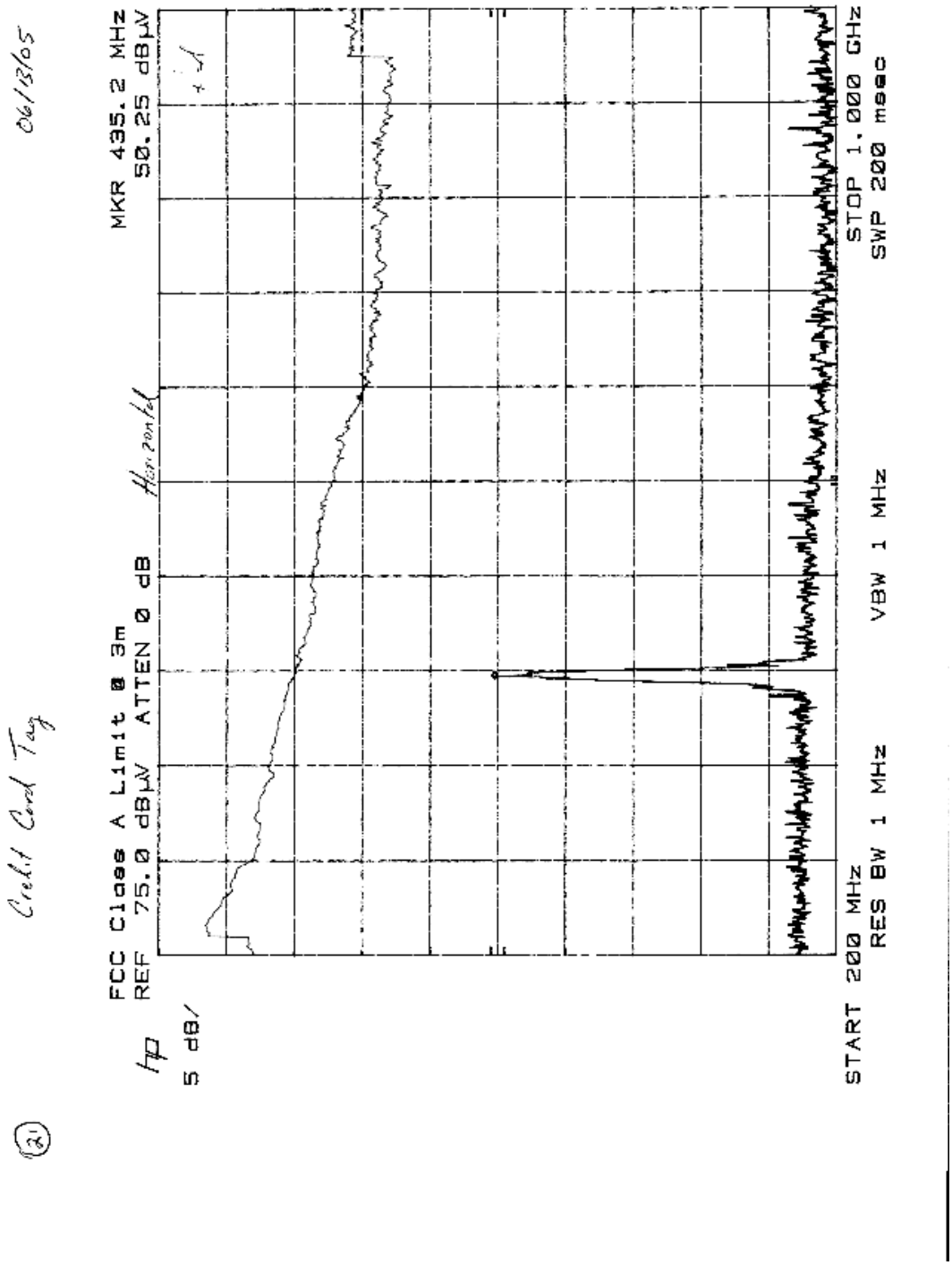


FIGURE 3: RADIATED EMISSIONS (200 MHz - 1 GHz HORIZONTAL)

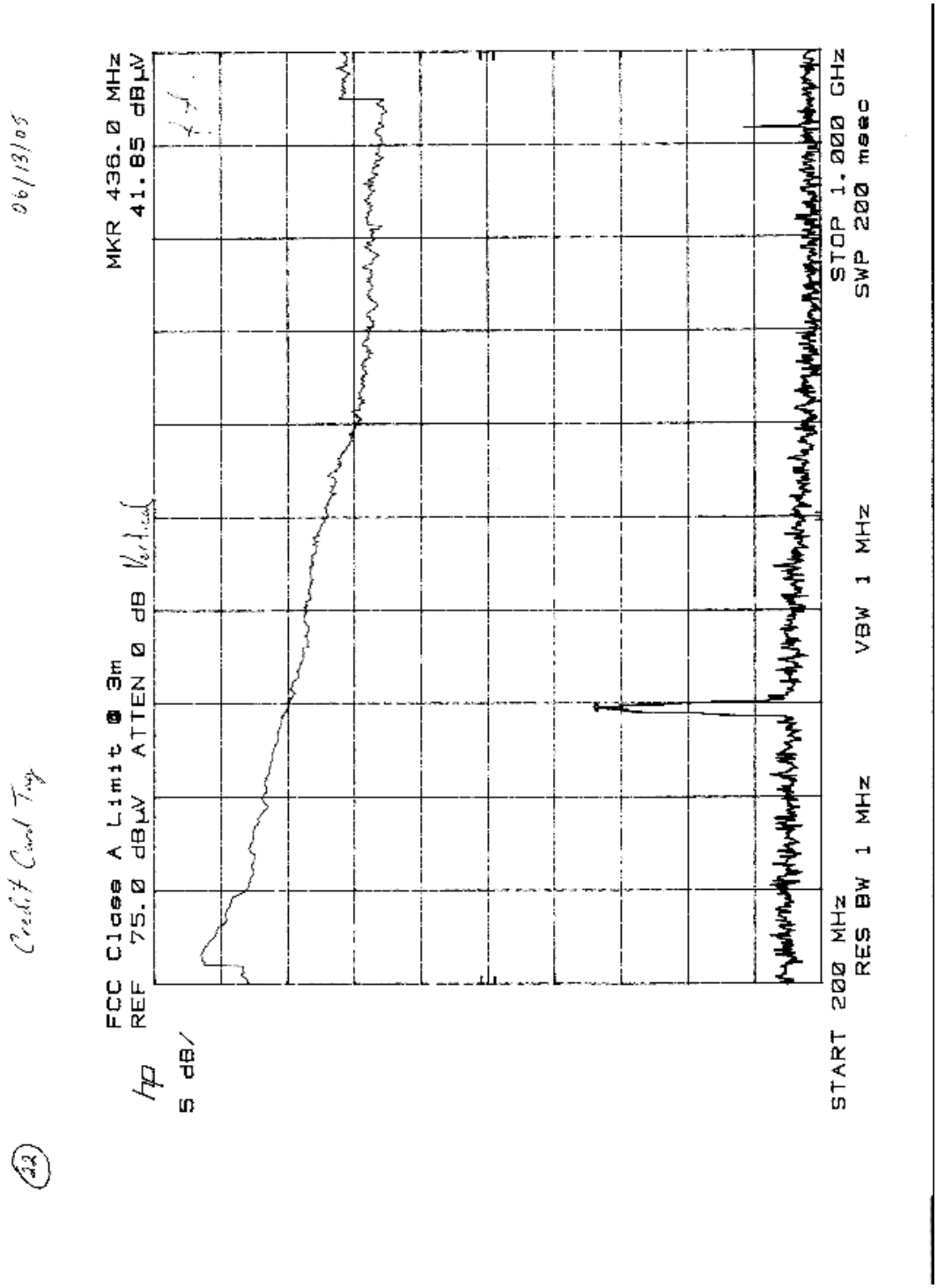


FIGURE 4: RADIATED EMISSIONS (200 MHz - 1 GHz VERTICAL)

4.2.2.2 Intentional Radiators, Operating within the band 902-928 MHz, Section 15.245 (b).

For the frequency 916.5 MHz, as per Section 15.249, the field strength limit for the fundamental frequency is 94 dBμV/m. The spurious emission limit is 54 dBμV/m.

The Log Periodic antenna was used to measure the field at fundamental frequency. To avoid the system overload and non-linear effects generated from an amplifier due to the transmitting power, the amplifier was not used on the receiving system. The data is reported in this report.

For spurious radiated power measurements, a Trilithic high pass filter (Model 23042) was inserted at the amplifier input port. To improve the sensitivity of the receiving system, an appropriated pre-amplifier and antenna were used. An amplifier HP 83017A and an EMCO horn antenna Model 3115 S/N 2419 were used for the 2^{nd} to 10^{th} harmonic evaluations.

To verify if the receiving system including the amplifier and the spectrum analyzer were not overload due to the transmitting power, a 10 dB step attenuator (HP 8495B) was installed at the output of the receiving antenna. This procedure was applied for harmonic frequencies. The attenuator was set to 10 dB and the signal strength observed must reduced by 10 dB as well. Hence, it can be concluded that the receiving system was operating in a linear range.

The spectrum was set to 1833 MHz (2^{nd} harmonics of 916.5 MHz) and the turntable with the device operating in a transmitting mode was rotating 360 degrees. And at the receiving antenna was scanned from 1-4 meters. The maximum reading was recorded and reported in Table 1. The same procedure was repeated for 3^{rd} to 10^{th} harmonics. Due to receiving sensitivity, the field strength was observed up to the 3^{rd} harmonic (2.749 GHz). It can be seen from the margin-below the limit column that all values are positive and hence the unit passes the requirements.

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RADIATED EMISSIONS DATA

INTENTIONAL RADIATED FIELDS @ 916.50 MHz

Frequency	FCC limit	AF	transducer	duty cycle	Yield	SA	Margin	
MHz				CF	Limit	Reading		
	dBuV/m	dB/m	dB	dB	dBuV	dBuV	dB	
916.5	94	24.32	-4.51	11.5	76.67	45	31.67	V
916.5	94	24.32	-4.51	11.5	76.67	42.35	34.32	H
1833	54	33.48	35	11.5	67.02		NF	V
1833	54	33.48	35	11.5	67.02	59.05	7.97	H
2749.5	54	35.58	32.38	11.5	62.3		NF	V
2749.5	54	35.58	32.38	11.5	62.3	43.65	18.65	H
3666	54	37.39	29.02	11.5	57.13		NF	V
3666	54	37.39	29.02	11.5	57.13		NF	H
4582.5	54	38.93	28.41	11.5	54.98		NF	V
4582.5	54	38.93	28.41	11.5	54.98		NF	H
5499	54	41.39	28.73	11.5	52.84		NF	V
5499	54	41.39	28.73	11.5	52.84		NF	H
6415.5	54	40.8	23.94	11.5	48.64		NF	V
6415.5	54	40.8	23.94	11.5	48.64		NF	H
7332	54	41.56	20.45	11.5	44.39		NF	V
7332	54	41.56	20.45	11.5	44.39		NF	H
8248.5	54	43.31	21.11	11.5	43.3		NF	V
8248.5	54	43.31	21.11	11.5	43.3		NF	H
9165	54	43.56	22.82	11.5	44.76		NF	V
9165	54	43.56	22.82	10	43.26		NF	H

FAU generates a yield limit that compensates the FCC limit for ACF, coax loss, and amplifier gain. This value is then compared to the reading on the spectrum analyzer (SA Reading). These are the maximized emissions from the DUT. A margin is calculated from these 2 results.

An example calculation is:

FCC limit – ACF + transducer factor – duty cycle CF = yield limit

TEST EQUIPMENT

FAU EMI R&D LABORATORY TEST EQUIPMENT						
Equipment Type	**Manufacturer**	**Description**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Interval (Years)**
Spectrum Analyzer	Hewlett Packard	RF Section	8566B	2403A06381	Aug-23-04	2
Spectrum Analyzer	Hewlett Packard	Display	85662A	2407A06381	Aug-23-04	2
Spectrum Analyzer	Hewlett Packard	Quasi Peak Adapter	85650A	2430A00559	Aug-23-04	2
RF Amplifier	Hewlett Packard	RF Amplifier	83017A	3123A00324	Aug-02-05	2
Antenna	EMCO	Biconical	3108	2147	Sept-24-03	2
Antenna	EMCO	Log Periodic	3146	3185	Sept-24-03	2
Antenna	EMCO	Double Ridge Horn	3115	2419		2
Receiving Cables (#1,2,3,4-Helix, and 5)					Aug-03-05	2

TEST FACILITY

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A2LA Certificate Number: 2129.01
FCC Registration: 90599
Industry of Canada: IC46405-4076

Description:	The 3-m semi-anechoic chamber and Power Line Conducted Spurious Voltage test setup is constructed and calibrated to meet the FCC requirements of Section 2.948, as well as Industry Canada RSS 212 Issue 1.
Site Filing:	A site description is on file with the Federal Communications Commission, 7435 Oakland Mills Road, Columbia, MD 21046, and with the Industry Canada, Certification and Engineering Bureau, 3701 Carling Ave., Building 94, P.O. Box 11490, Station "H", Ottawa Ontario, K2H 8S2.
Instrument Tolerance:	All measuring equipment is in accordance with ANSI C63.4 and CISPR 22 requirements.

End of Report