FCC CERTIFICATION TEST REPORT

prepared for

MULTIPLEX USA

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Van Nuys, CA 91411

FCC ID: NT9PROFIROYAL

January 19, 2000

WLL PROJECT #: 5229X

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STATEMENT OF QUALIFICATIONS

for

Steven Koster

Washington Laboratories, Ltd.

I am a NARTE-Accredited EMC Test Laboratory Engineer with over nineteen years of electronics experience, the last ten years being directly involved in EMI testing. I am qualified to perform EMC testing to the methods described in this test report. The measurements taken within this report are accurate within my ability to perform the tests and within the tolerance of the measuring instrumentation.

By: _____
Steven Koster
Compliance Engineer

Date: January 19, 2000

FCC CERTIFICATION REPORT

for

MULTIPLEX USA

1.0 Introduction

This report has been prepared on behalf of MULTIPLEX USA in support of their application for FCC Certification under Part 95 of the FCC Rules and Regulations for an R/C transmitter.

The Equipment Under Test was the PROFI mc 4000 Radio model aircraft remote control transmitter.

All measurements were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code 200066-0) as an independent FCC test laboratory.

Measurements were made on the Equipment Under Test in accordance with FCC Rule Part 2 and Part 95, specifically the requirements stipulated in Part 95 Subpart E – Technical Regulations

All results reported herein relate only to the item tested. This report shall not be used to claim product endorsement by NVLAP or any agency of the US Government. The measurement uncertainty of the data contained herein is ±2.3 dB. Refer to Appendix C for Statement of Measurement Uncertainty.

1.1 Summary

The MULTIPLEX USA PROFI mc 4000 Radio complies with the technical requirements of Part 95 of the FCC Rules and Regulations.

2.0 Description of Equipment Under Test (EUT)

The MULTIPLEX USA PROFI mc 4000 Radio is a model aircraft remote control transmitter. The EUT is hand-held battery powered and provides for the remote operation of model aircraft. The unit operates in the 72.01-72.99 MHz band reserved for this purpose and provides control for full aircraft flight. The R/C transmitter uses FM-PPM modulation with a frequency deviation of 1.5 kHz.

3.0 Test Configuration

To complete the test configuration required by the FCC, the R/C Transmitter was tested with the transmitter being set to continuously transmit. For emissions testing the EUT antenna was placed both horizontally and vertically. A power supply was used to power the EUT and to avoid battery drain.

3.1 RF Output Power (FCC Rule Part 95.639)

The EUT was placed on a 0.8m table with the antenna fully extended. A power charging cord was connected to keep the unit at full charge power, however, the unit only runs off batteries.

The output from the transmitter was connected to a 10 dB attenuator and then to the input of an HP 8568B RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the 10 dB attenuator. The RF output power across a 50 ohm load termination was measured directly by the analyzer.

RESULTS: The measured RF output power was 25 dBm, or 0.316 W.

LIMIT: For 72-76 MHz operation: 0.75 W

3.2 Authorized Bandwidth (FCC Rule Part 95.633)

The authorized bandwidth was measured using the same setup that was used for the RF power measurements test except for the spectrum analyzer resolution bandwidth was set to 1000 Hz.

Results of the testing are displayed in Appendix A of this report.

RESULTS: 7.85 kHz
LIMIT: 8 kHz

3.3 Radiated Emissions Testing (FCC Rule Part 95.635)

The EUT was placed on an 80 cm high, 1 X 1.5 meters non-conductive motorized turntable for radiated testing on a 3 meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Broadband antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. Horizontal and vertical field components were measured.

The EUT was setup in a fixed in an upright position with the antenna vertical and laying flat and with the antenna horizontal. The batteries were fully charged during testing. Emissions were measured in both vertical and horizontal polarization.

The output from the antenna was connected, via a preamplifier, to the input of the spectrum analyzer. The detector function was set to peak. The measurement bandwidth of the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth.

3.3.1 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limit, it is necessary to account for various calibration factors that are supplied with the antennas and other measurement accessories. These factors are grouped into a composite antenna factor (AFc) and are supplied in the AFc column of Table 1. The AFc in dB/m is algebraically added to the Spectrum Analyzer Voltage in dBµV to obtain the Radiated Electric Field in dBµV/m. This level is then compared with the FCC limit.

Example:

Spectrum Analyzer Voltage: VdBµV

Composite Antenna Factor: AFcdB/m

Electric Field: EdBuV/m = VdBµV + AFcdB/m

To convert to linear units: EµV/m=antilog (EdBµV/m/20)

RESULTS: The EUT complies with the requirements. Data is recorded in Table 1.
LIMIT: Limit =MAX – (56+10LogP) = 51dB down for spurious emissions.

Table 1

FCC Part 95 Radiated Emissions Data - Site 2

CLIENT: Multiplex USA
MODEL NO: PROFI mc 4000
DATE: 1/6/00
BY: Steve Koster
JOB #: 5229x

Pmeas = 0.316 W; Limit = MAX - (56 + 10logP) = 51 dB Down

Frequency MHz	Polarity H/V	Azimuth Degree	Ant Height m	SA Level (QP) dBuV	AFc dB/m	E-Field dBuV/m	Limit dBuV/m	Margin dB
EUT Antenna in vertical polarity								
72.60	H	112.5	2	106.1	7.3	113.4	122.1	N/A
72.60	V	90.0	1	114.8	7.3	122.1	122.1	N/A
145.20	V	135.0	1	48.2	10.3	58.5	71.1	-12.6
217.80	V	135.0	1	47.4	13.3	60.7	71.1	-10.4
362.96	V	135.0	1	37.7	18.2	55.9	71.1	-15.2
508.14	V	202.5	1	39.5	21.7	61.2	71.1	-9.9
653.32	V	157.5	1	36.7	23.7	60.4	71.1	-10.7
798.47	V	45.0	1	36.7	25.9	62.6	71.1	-8.5
EUT Antenna in horizontal polarity								
72.60	V	292.5	1	97.8	7.3	105.1	122.1	N/A
72.60	H	112.5	3.5	110.9	7.3	118.2	122.1	N/A
145.20	H	90.0	3	45.2	10.3	55.5	71.1	-15.6
217.80	H	247.5	2.5	40.4	13.3	53.7	71.1	-17.4
362.96	H	112.5	2.5	39.9	18.2	58.1	71.1	-13.0
508.14	H	202.5	2.5	39.3	21.7	61.0	71.1	-10.1

3.4 Frequency Stability (FCC Rule Part 95.623)

The requirements of Section 95.623 call for the carrier frequency to be stable under different power supply voltages and over a wide temperature extreme. The requirements for this transmitter is a frequency tolerance of 0.002%. The R/C transmitter was tested for frequency stability for both temperature and voltage variation. The following table lists the test results.

Temperature (C°)	**Frequency (MHz)**	**Difference (Hz)**	**Limit (0.002% of Baseline) (Hz)**
Ambient (24)	72587890 (Baseline)	0	1451.758
-30	72588271	-381	1451.758
-20	72588650	-760	1451.758
-10	72588918	-1028	1451.758
0	72589026	-1136	1451.758
10	72588956	-1066	1451.758
20	72588805	-915	1451.758
30	72588625	-735	1451.758
40	72588463	-573	1451.758
50	72588300	-410	1451.758
Voltage (Vdc)	**Frequency (MHz)**	**Difference (Hz)**	**Limit (0.002% of Baseline) (Hz)**
7.2	72587890 (Baseline)	0	1451.758
6.48	72587600	-290	1451.758

Table 2

Measurement Equipment Used

The following equipment is used to perform measurements:

Hewlett-Packard Spectrum Analyzer: HP 8568B

Hewlett-Packard Quasi-Peak Adapter: HP 85650A

Hewlett-Packard Preselector: HP 85685A

Antenna Research Associates, Inc. Biconical Log Periodic Antenna: LPB-2520A (Site 2)

Solar 50 Ω/50 µH Line Impedance Stabilization Network: 8012-50-R-24-BNC

Solar 50 Ω/50 µH Line Impedance Stabilization Network: 8028-50-TS-24-BNC

AH Systems, Inc. Portable Antenna Mast: AMS-4 (Site 2)

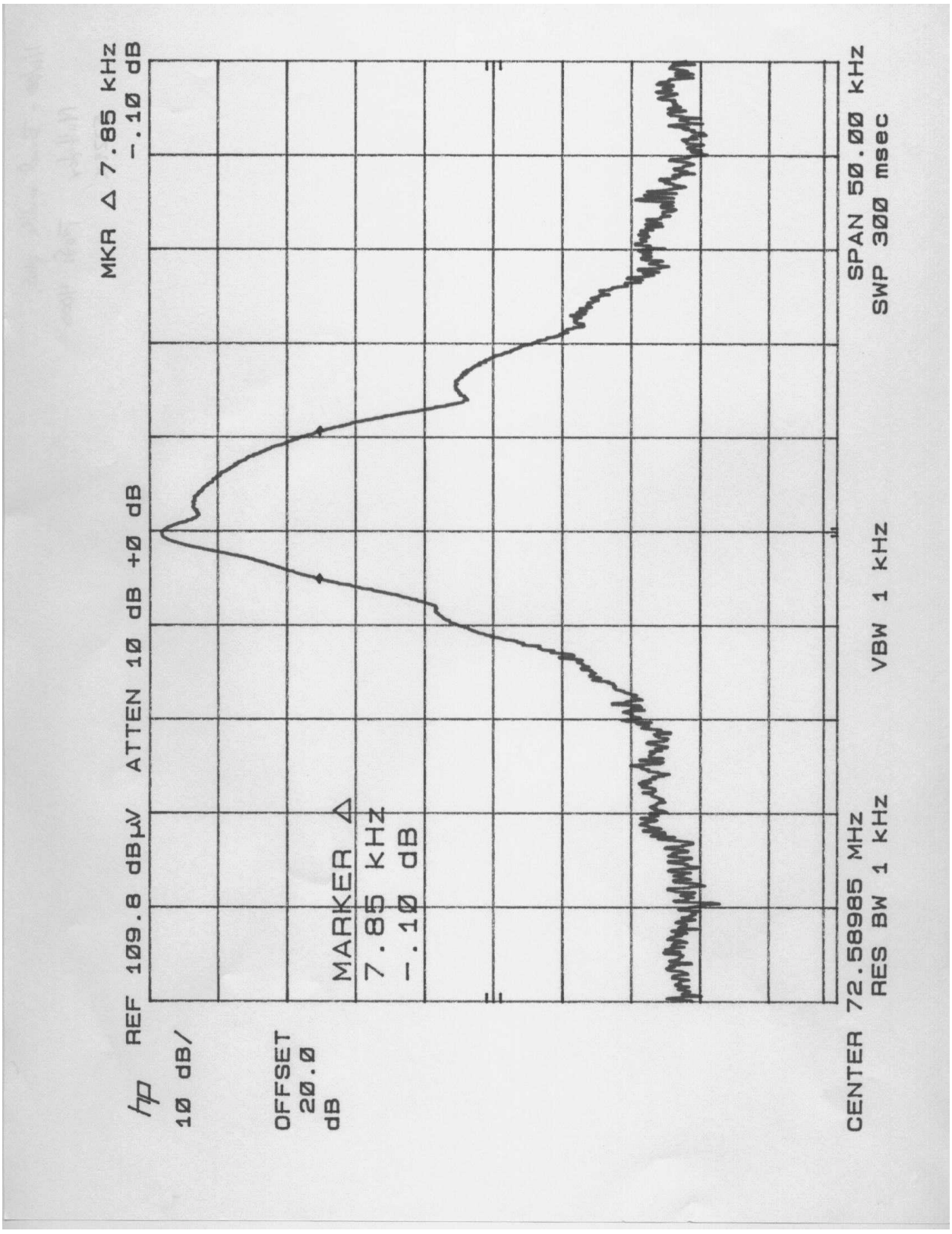
AH Systems, Inc. Motorized Turntable (Site 2)

RG-214 semi-rigid coaxial cable

RG-223 double-shielded coaxial cable

APPENDIX A

OCCUPIED BANDWIDTH PLOT


MKR Δ 7.85 kHz
-.10 dB
REF 109.8 dBµV ATTEN 10 dB +0 dB
10 dB/
OFFSET
20.0
dB
MARKER Δ
7.85 kHz
-.10 dB
CENTER 72.58985 MHz
RES BW 1 kHz
VBW 1 kHz
SPAN 50.00 kHz
SWP 300 msec

APPENDIX B

STATEMENT OF MEASUREMENT UNCERTAINTY

For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:
A = Antenna calibration uncertainty, in dB = 2 dB
B = Spectrum Analyzer uncertainty, in dB = 1 dB
C = Site uncertainty, in dB = 4 dB
n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.