



Engineering and Testing for EMC and Safety Compliance



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FCC Part 87 Certification Report

FreeFlight Systems
3700 Interstate 35 S.
Waco, TX 76706
Contact: Russell Randant

EUT: RA-4000 Model Series
Part # 84560-XX

FCC ID: T7YRA4XXX

January 6, 2009

Standards Referenced for this Report	
Part 2: 2007	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Part 87: 2007	Aviation Services

Frequency Range (MHz)	Rated Transmit Power (W) (Conducted)	Frequency Tolerance (%)	Emission Designator
4,200 – 4,400	0.1	0.32	100MFXN

Report Prepared by Test Engineer: Richard B. McMurray, P.E.

Document Number: 2008223

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Table of Contents

1	General Information.....	4
1.1	Test Facility	4
1.2	Related Submittal(s)/Grant(s)	4
2	Tested System Details	5
3	Summary of Results	7
4	FCC Part 2 Information	7
	2.1033(c)(4) Type of Emissions.....	7
	2.1033(c)(5) Frequency Range	7
	2.1033(c)(6) Rated Power	7
	2.1033(c)(8) Voltages and Currents Through the Final RF Amplifier.....	7
5	FCC Rules and Regulations Part 2.1046(a)/87.131: RF Power Output: Conducted	8
5.1	Test Procedure.....	8
5.2	Test Data.....	8
6	FCC Rules and Regulations Part 2.1055/87.133 Frequency Stability and 2.1049/87.135 Occupied Bandwidth.....	9
6.1	Test Procedure.....	9
6.2	Test Requirements and Results.....	9
7	FCC Rules and Regulations Part 2.1051/87.139: Spurious Emissions – Conducted.....	11
7.1	Test Procedure.....	11
7.2	Test Data.....	11
8	FCC Rules and Regulations Part 2.1053/87.139: Spurious Emissions - Radiated.....	13
8.1	Test Procedure.....	13
8.2	Test Requirements and Results.....	13
9	Conclusion	15

Table of Figures

Figure 2-1:	Configuration of Tested System.....	6
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Table of Tables

Table 2-1:	Equipment under Test (EUT).....	5
Table 2-2:	Support Equipment.....	5
Table 5-1:	RF Power Output.....	8
Table 5-2:	Test Equipment for Testing RF Power Output - Conducted	8
Table 6-1:	Test Equipment for Testing Frequency Stability/Occupied Bandwidth	10
Table 7-1:	Test Equipment for Testing Conducted Spurious Emissions.....	12
Table 8-1:	Test Equipment for Testing Field Strength of Spurious Radiation	14

Table of Appendixes

Appendix A:	TCB Agency Authorization	16
Appendix B:	FCC Confidentiality Request Letter	17
Appendix C:	Operational Description	18
Appendix D:	Schematics	19
Appendix E:	Block Diagram	20
Appendix F:	Alignment/Tune Up Procedure	21
Appendix G:	User Manual	22
Appendix H:	Label & Location.....	23
Appendix I:	Test Configuration Photographs	24
Appendix J:	External Photographs	26
Appendix K:	Internal Photographs	27

Table of Photographs

Photograph 1:	Radiated TX Spurious Emissions – Front View	24
Photograph 2:	Radiated TX Spurious Emissions – Rear View	25

1 General Information

The following Certification Report is prepared on behalf of **FreeFlight Systems** in accordance with Part 87 of the Federal Communications Commission Rules and Regulations. The Equipment Under Test (EUT) was the **RA-4000 model series, part # 84560-XX, Radar Altimeter; FCC ID: T7YRA4XXX**. The test results reported in this document relate only to the item that was tested.

All measurements contained in this application were conducted in accordance with the application portions of the FCC Rules and Regulations. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

1.1 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report submitted to and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing.

1.2 Related Submittal(s)/Grant(s)

This is an original certification application report.

2 Tested System Details

The test sample was received on December 23, 2008. Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this testing, as applicable.

The RA-4000 model series, part # 84560-XX Radar Altimeter (EUT) detects altitude by transmitting a RF signal downward from the aircraft and receiving the reflected signal from ground objects.

The EUT transmits a slowly swept RF carrier while also sampling a portion of the signal from the source of the receiver mixer. The sampled transmit signal is mixed with the received signal using a direct conversion (AKA homodyne) method, and passed through a limiting amplifier. The limiting amplifier produces digital pulses resulting from the beating of the source and delayed-reflected signal; this is then applied to a frequency counter to derive an altitude value. Altitude data is then read via a RS-422/232 port by other instruments.

The EUT is powered by 28 VDC. The transmitter operates continually while powered. A detailed tune up and service procedure sets the sweep start/stop frequencies and width. The procedure also validates calibration at temperature extremes as part of the production process. Thermal frequency stability is assisted by thermistor ovens in the EUT. The sweep speed is a slow 100 Hz, which results in a signal nearly devoid of sidebands.

Table 2-1: Equipment under Test (EUT)

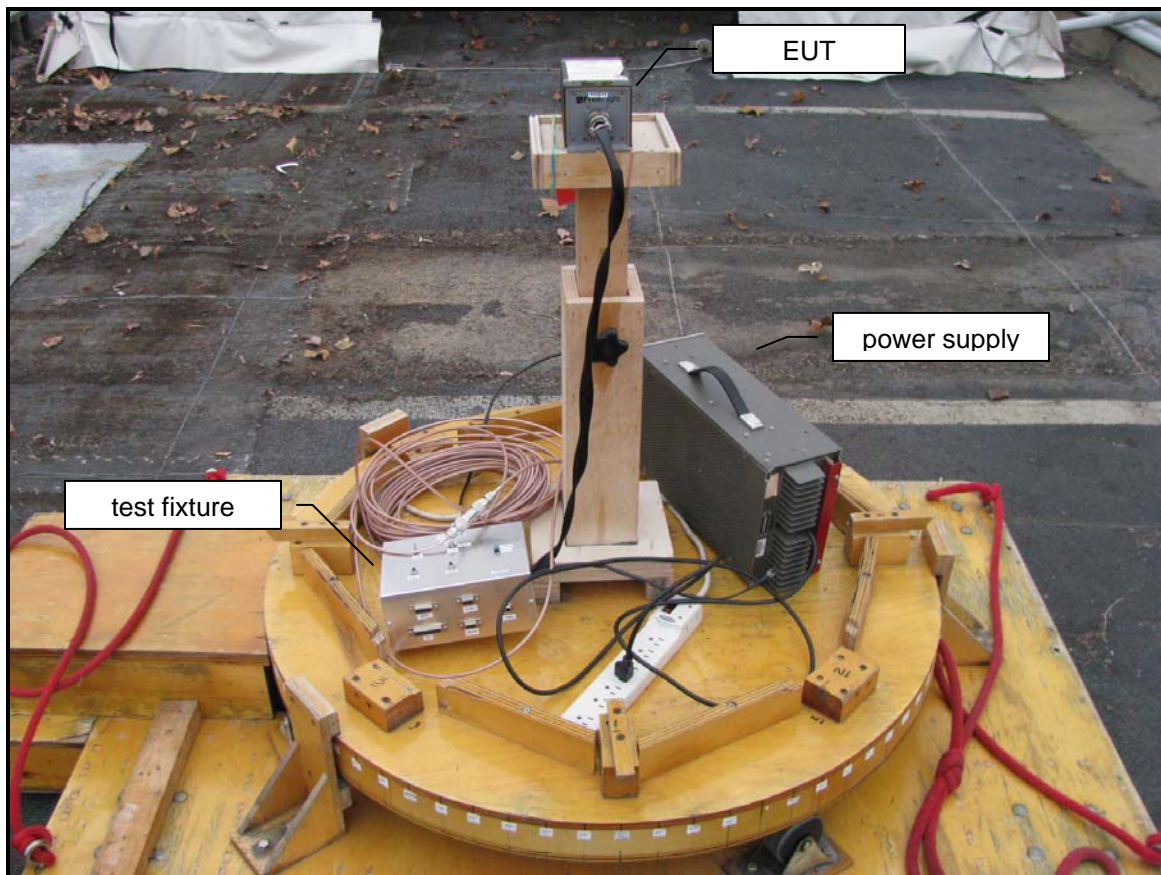
The test system contains the following components:

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Radar Altimeter	FreeFlight Systems	RA-4000 model series, part # 84560-XX	N/A	T7YRA4XXX	18739

Table 2-2: Support Equipment

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Test Fixture	FreeFlight Systems	RA-4000 model series Test Fixture	N/A	N/A	18740

Figure 2-1: Configuration of Tested System



3 Summary of Results

Test	Reference	Result
RF Power Output	2.1046/87.131	Pass
Frequency Stability	2.1055/87.133	Pass
Occupied Bandwidth	2.1049/87.135	Pass
Spurious Emissions – Conducted	2.1051/87.139	Pass
Spurious Emissions – Radiated	2.1053/87.139	Pass

4 FCC Part 2 Information

2.1033(c)(4) Type of Emissions

FXN

2.1033(c)(5) Frequency Range

4,200 – 4,400 MHz

2.1033(c)(6) Rated Power

100 mW

2.1033(c)(8) Voltages and Currents Through the Final RF Amplifier

DC Voltage: +15 V, - 3 V

DC Current: 100 mA

5 FCC Rules and Regulations Part 2.1046(a)/87.131: RF Power Output: Conducted

5.1 Test Procedure

ANSI TIA-603-C-2004, section 2.2.1.

The EUT was connected to a power sensor/meter through an appropriate 50 ohm attenuator. Attenuator loss was accounted for.

5.2 Test Data

Table 5-1: RF Power Output


Frequency (MHz)	RF Power (dBm)*
4200 – 4400	19.9

* Measurement accuracy: +/- .02 dB (logarithmic mode)

Table 5-2: Test Equipment for Testing RF Power Output - Conducted

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901184	Agilent Technologies	E4416A	EPM-P Power Meter, Single Channel	GB41050573	11/05/09
901356	Agilent Technologies	E9323A	Power Sensor	31764-264	11/05/09

Test Personnel:

Daniel Baltzell		December 23, 2008
Test Engineer	Signature	Date Of Test

6 FCC Rules and Regulations Part 2.1055/87.133 Frequency Stability and 2.1049/87.135 Occupied Bandwidth

6.1 Test Procedure

ANSI TIA-603-C-2004, section 2.2.2.

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency or operate within a given authorized band.

The EUT was evaluated over the temperature range -20°C to +50°C, and voltages of 23.8, 28.0 and 32.2 VDC.

The temperature was initially set to -20°C and a 1-hour period was observed for stabilization of the EUT. The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10°C through the range. A ½ hour period was observed to stabilize the EUT at each measurement step, and the frequency stability was measured within one minute after application of primary power to the transmitter.

6.2 Test Requirements and Results

For the type of equipment presented in this report, Part 87.133 states that the bandwidth occupied by the emissions must be maintained within the band allocated to the service (in this case 4,200 – 4,400 MHz) and the indicated tolerances in the 87.133(a) table do not apply.

All emissions were well within the allocated band across the temperature range and voltages mentioned above. A represented plot is shown below. All other plots were similar and compliant, and are not shown for brevity.

The occupied bandwidth is 100 MHz.

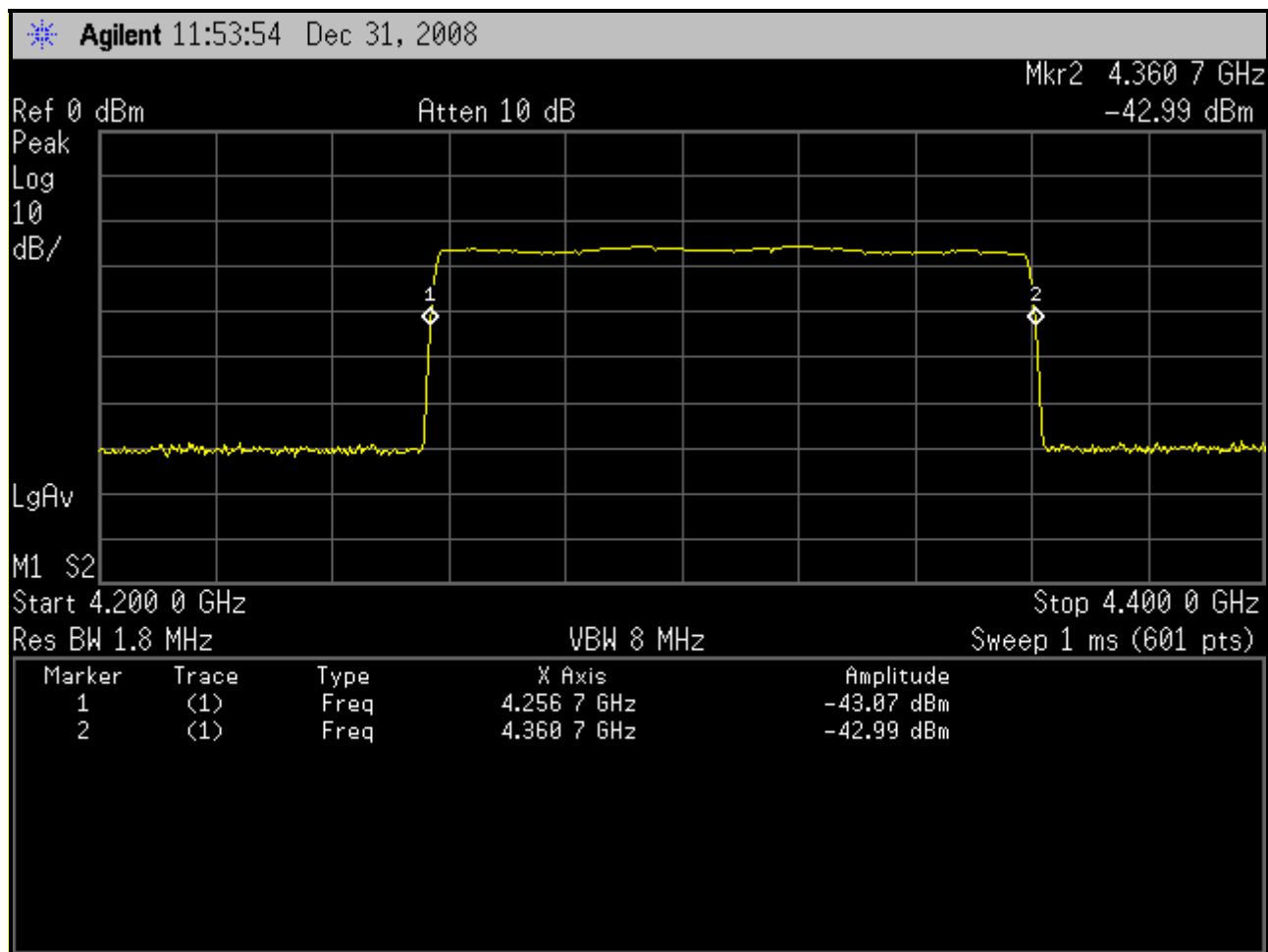


Table 6-1: Test Equipment for Testing Frequency Stability/Occupied Bandwidth

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	5/8/09
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	7/31/09

Test Personnel:

Richard B. McMurray, P.E.
 EMC Test Engineer

Richard B. McMurray
 Signature

December 24, 31, 2008, January 5, 2009
 Dates of Test

7 FCC Rules and Regulations Part 2.1051/87.139: Spurious Emissions – Conducted

7.1 Test Procedure

ANSI TIA-603-C-2004, Section 2.2.13.

The transmitter was interfaced with a spectrum analyzer through an appropriate 50 ohm attenuator. The transmitter was operated at maximum power. Attenuator and cable losses were accounted for.

7.2 Test Data

Frequency range of measurement per Part 2.1057: 9 kHz to 10x F_c .

Limit = 40 dBc

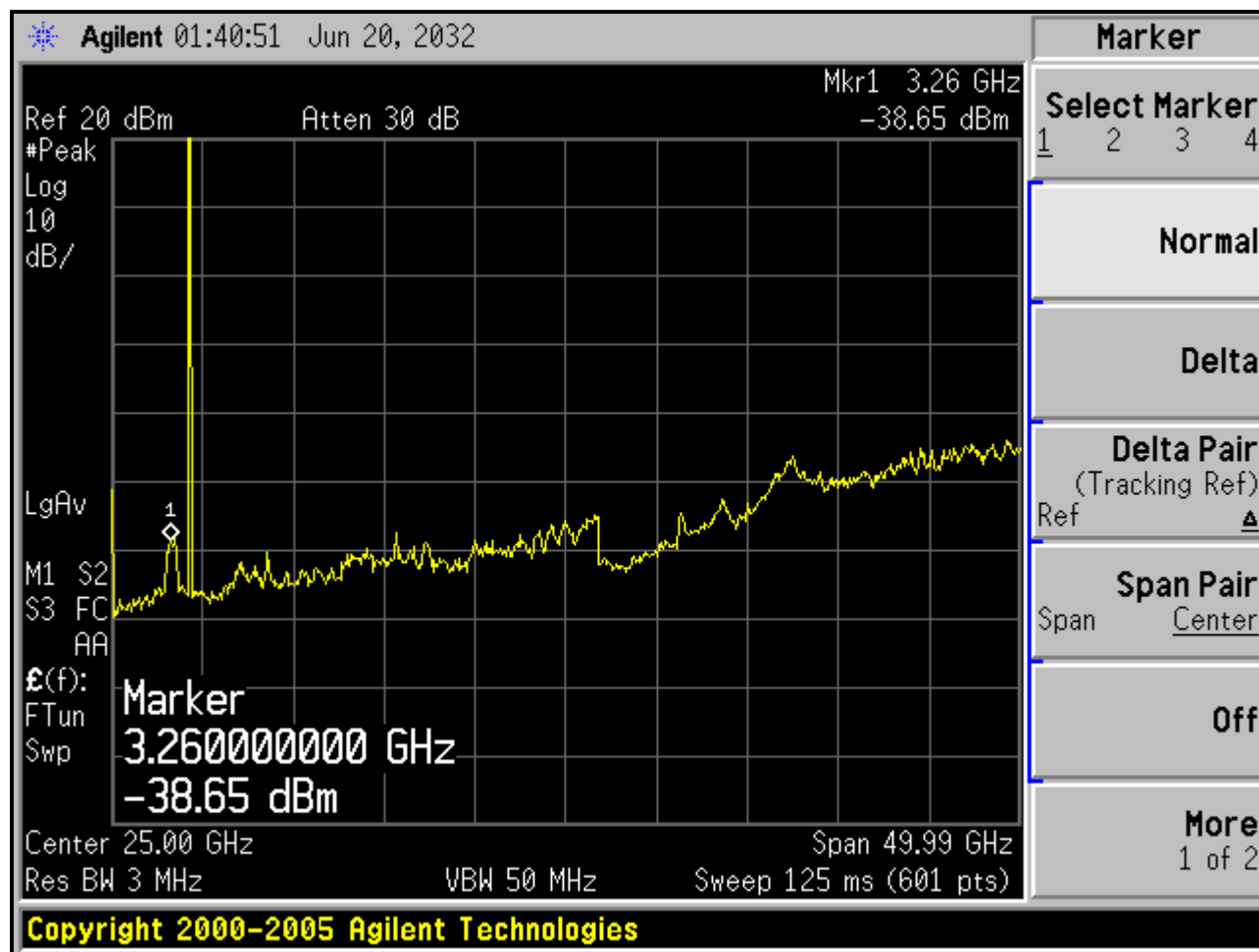



Table 7-1: Test Equipment for Testing Conducted Spurious Emissions

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	7/31/09

Test Personnel:

Daniel Baltzell		December 23, 2008
Test Engineer	Signature	Date Of Test

8 FCC Rules and Regulations Part 2.1053/87.139: Spurious Emissions - Radiated

8.1 Test Procedure

ANSI TIA-603-C-2004, Section 2.2.12.

The spurious emissions levels were measured and the device under test was replaced by a substitution antenna connected to a signal generator. This signal generator level was then corrected by subtracting the cable loss from the substitution antenna to the signal generator, and the gain of the antenna was further corrected to a half wave dipole.

$$P_d(\text{dBm}) = P_g(\text{dBm}) - \text{cable loss (dB)} + \text{antenna gain (dB)}$$

where:

P_d is the dipole equivalent power

P_g is the generator output power into the substitution antenna

8.2 Test Requirements and Results


$$\text{Limit} = 43 + 10 \log (P) \text{ dB} = 40 \text{ dBc}$$

All emissions were found to be greater than 20 dB below the limit, or were at the noise floor. Per 2.1057, no data is being reported.

Table 8-1: Test Equipment for Testing Field Strength of Spurious Radiation

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901365	MITEQ	JS4-00102600-41-5P	Amplifier, 0.1 - 26 GHz, 30dB gain	N/A	2/15/09
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	7/31/09
901516	Insulated Wire, Inc.	KPS-1503-2400-KPS	RF cable, 20'	NA	10/17/09
901517	Insulated Wire Inc.	KPS-1503-360-KPS	RF cable 36"	NA	10/17/09
901053	Schaffner Chase	CBL6112B	Bi-Log Antenna 20 MHz - 2 GHz	2648	12/20/08
900772	EMCO	3161-02	Horn Antenna 2 - 4 GHz	9804-1044	6/14/10
900321	EMCO	3161-03	Horn Antenna 4.0 - 8.2 GHz	9508-1020	6/14/10
900323	EMCO	3160-07	Horn Antenna 8.2 - 12.4 GHz	9605-1054	6/14/10
900356	EMCO	3160-08	Horn Antenna 12.4 - 18 GHz	9607-1044	6/14/10
900325	EMCO	3160-9	Horn Antennas 18 - 26.5 GHz	9605-1051	6/14/10
901303	EMCO	3160-10	Horn Antenna 26.5 - 40.0 GHz	960452-007	6/14/10
900126	Hewlett Packard	11970A	Harmonic Mixer 26.5 - 40 GHz	2332A01199	6/14/10
900717	Hewlett Packard	11970U	Harmonic Mixer 40 - 60 GHz	2332A01110	6/14/10
901256	ATM	19-443-6R	Horn antenna. 40 - 60 GHz, waveguard size WR-19	8041704-01	6/14/10
900933	Hewlett Packard	11975A	2 - 8 GHz Power Amplifier	2304A00348	6/14/10

Test Personnel:

Daniel Baltzell		December 23, 2008
Test Engineer	Signature	Date Of Test

9 Conclusion

The data in this measurement report shows that the FreeFlight Systems RA-4000 model series, part # 84560-XX, Radar Altimeter; FCC ID: T7YRA4XXX, complies with all the applicable requirements of Parts 87 and 2 of the FCC Rules and Regulations.