



Engineering and Testing for EMC and Safety Compliance



Accredited under A2LA testing certificate # 2653.01

FCC Part 87 Certification Report

Dynon Avionics Inc.
19825 141st Place NE
Woodinville, WA 98072
Contact: Ryan Ott
Tel: (425) 402-0433

Model: DX15

FCC ID: WU6-101204-000

June 30, 2009

Standards Referenced for this Report	
Part 2: 2008	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Part 87: 2008	Aviation Services
TIA-EIA-603-C August 2004	Land Mobile FM or PM Communications Equipment – Measurement and Performance Standards

Frequency Range (MHz)	Rated Power (W)	Frequency Tolerance (ppm)	Emission Designator
118–136.975	1.5	0.9	6K00A3E

Report Prepared By: Richard B. McMurray, P.E.

Document Number: 2009191

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360 Herndon Parkway
Suite 1400
Herndon, VA 20170
Tel: 703-689-0368 Fax: 703-689-2056

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1 Test Result Summary

Test	FCC Reference	Result
RF Power Output	2.1046(a), 87.131	Complies
Spurious Emissions at Antenna Terminals	2.1051, 2.1057, 87.139	Complies
Field strength of spurious radiation	2.1053, 2.1057, 87.139	Complies
Occupied Bandwidth/Emission Masks	2.1049(c)(1), 87.135, 87.139	Complies
Frequency Stability vs. Temperature and Voltage	2.1055, 87.133	Complies
Modulation Characteristics – Modulation Limiting	2.1047(a)(b), 87.141	Complies
Modulation Characteristics – Audio Frequency Response of Low Pass Filter	2.1047(a)(b), 87.141(f)	Complies

2 General Information

The following Certification Report is prepared on behalf of **Dynon Avionics Inc.** in accordance with the Federal Communications Commission Rules and Regulations. The Equipment Under Test (EUT) was the **DX15 Aviation Radio, FCC ID: WU6-101204-000**, operating in the 118–136.975 MHz aeronautical band.

The receiver portion of this device is subject to FCC Part 15B emissions requirements, and was tested and found to be compliant. These measurements are contained in a separate report and are available upon request.

All measurements contained in this application were conducted in accordance with FCC Rules and Regulations CFR 47 Parts 2 and 87. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

2.1 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.

2.2 Related Submittal(s)/Grant(s)

N/A

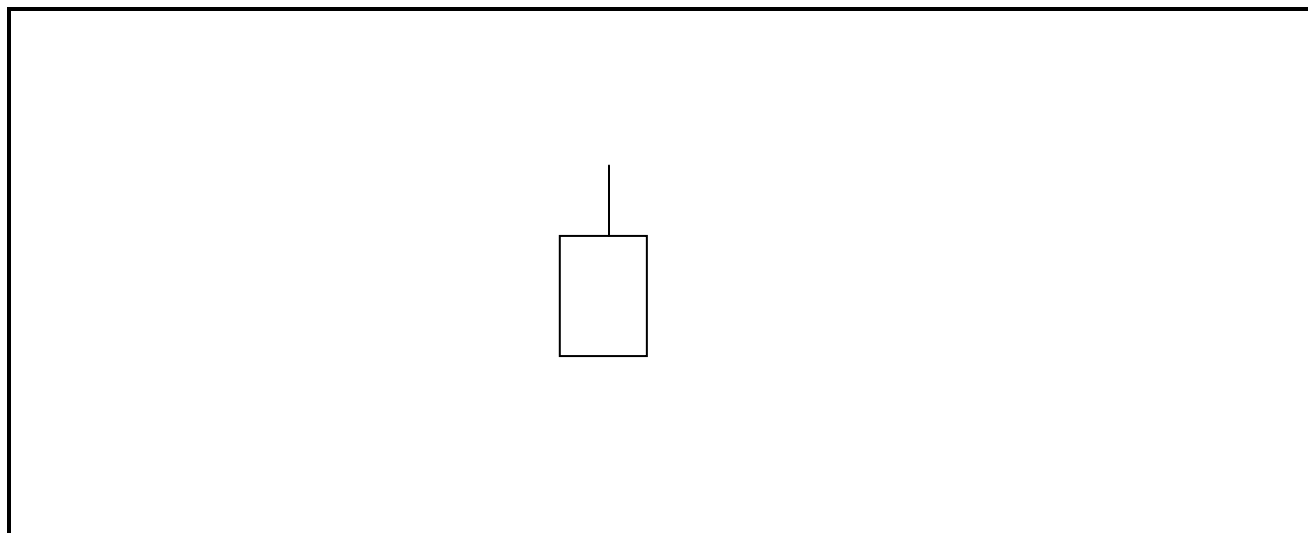
3 Tested System Details

The test sample was received on June 23, 2009. Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable.

Table 3-1: Equipment Under Test (EUT)

Part	Manufacturer	Model	PN	FCC ID	RTL Bar Code
VHF Air Band Transceiver	Dynon Avionics Inc.	DX15	N/A	WU6-101204-000	19024
VHF Air Band Transceiver	Dynon Avionics Inc.	DX15	N/A	WU6-101204-000	19025
Antenna	Dynon Avionics Inc.	N/A	N/A	N/A	19020
Antenna	Dynon Avionics Inc.	N/A	N/A	N/A	19021
Li-Ion Battery Pack	Dynon Avionics Inc.	N/A	100965-000	N/A	19019
Li-Ion Battery Pack	Dynon Avionics Inc.	N/A	100965-000	N/A	19031

Figure 3-1: Configuration of Tested System



4 FCC Rules and Regulations Part 2.1033(C)(8) Voltages and Currents Through The Final Amplifying Stage

2.2 V / 0.8 A

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

5.1 Test Procedure

ANSI/TIA/EIA-603-2002, section 2.2.1

The EUT was connected to a coaxial attenuator having a 50 Ω load impedance.

Manufacturer's rated power: 1.5 W

5.2 Test Data

Table 5-1: RF Conducted Output Power - Measured

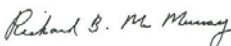
Frequency (MHz)	Power (dBm)	Power (W)	Limit (W)
118.000	31.7	1.48	10
127.475	31.7	1.48	10
136.975	31.8	1.51	10

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

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

Test Personnel:

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


Signature

June 24, 2009
Date Of Test

6 FCC Rules and Regulations Part 2.1051: Spurious Emissions at Antenna Terminals, Part 87.139: Emission Limitations

6.1 Test Procedure

TIA-EIA-603-C August 2004, Section 2.2.13

The transmitter is terminated with a 50 Ω load and interfaced with a spectrum analyzer.

Table 6-1: Test Equipment Used For Testing Spurious Emissions

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

6.2 Test Data

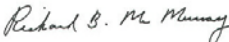
Limit: When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth, the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least $43 + 10 \log_{10} Y$ (dB).

The following frequencies (in MHz) were investigated:

118.000, 127.475 and 136.975

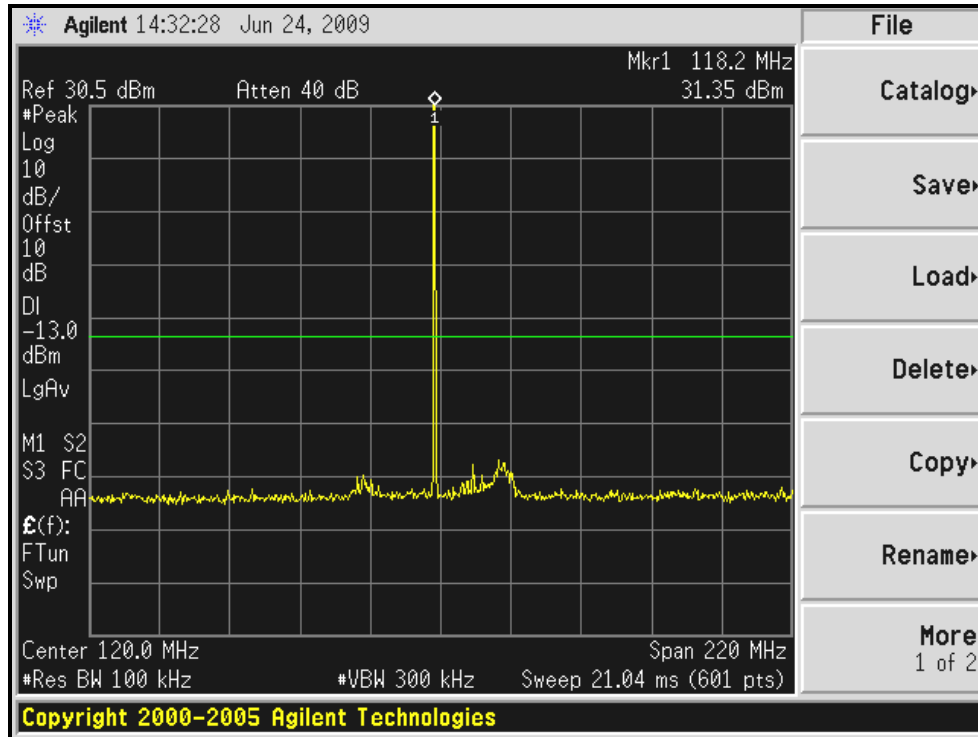
Test Personnel:

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

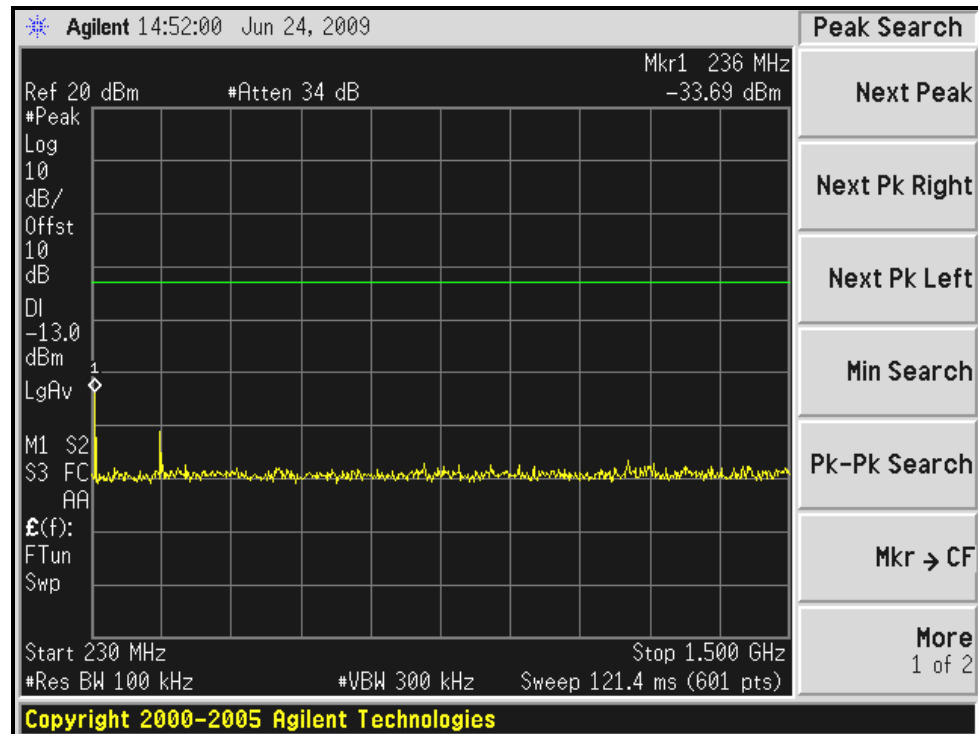

Signature

June 24, 2009
Date Of Test

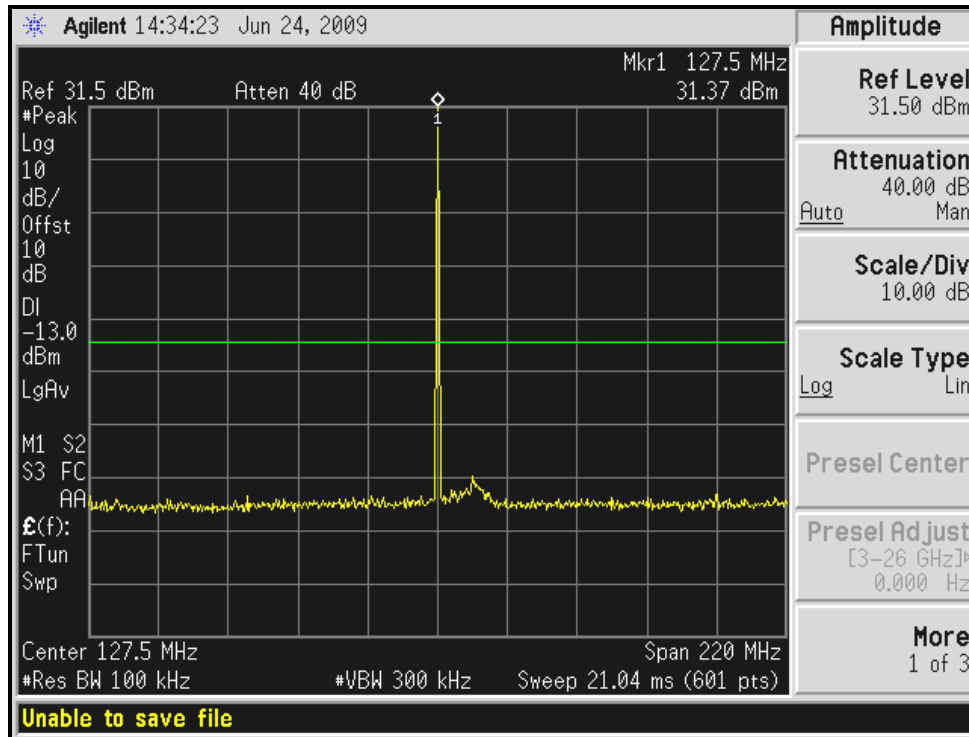
Plot 6-1: **118.000 MHz – Lower Frequency Range**



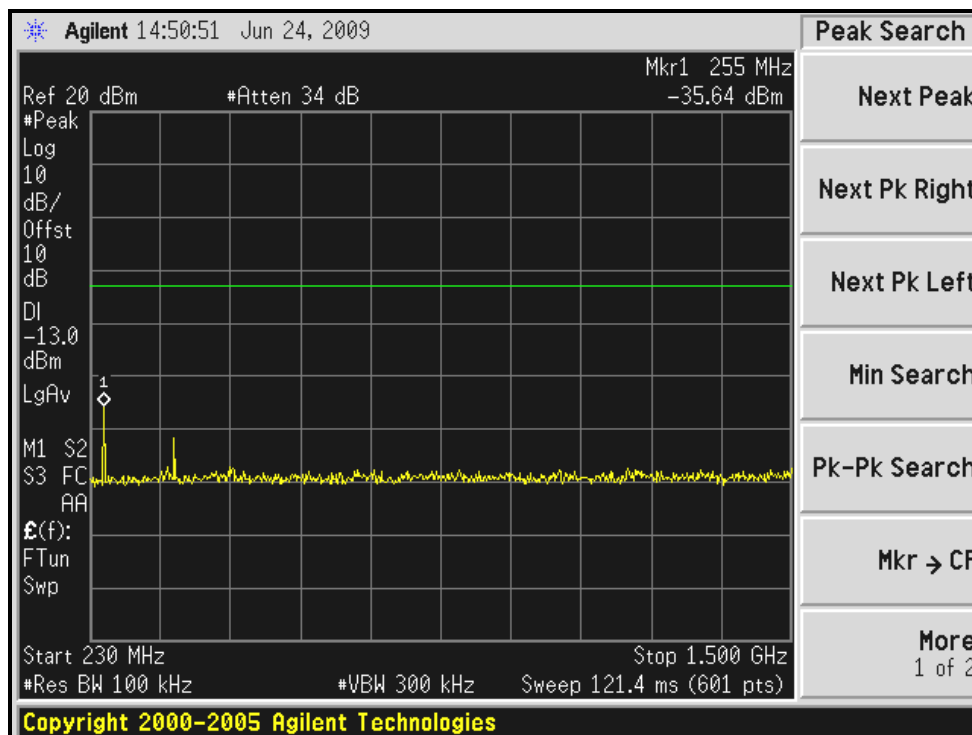
Plot 6-2: **118.000 MHz – Upper Frequency Range**



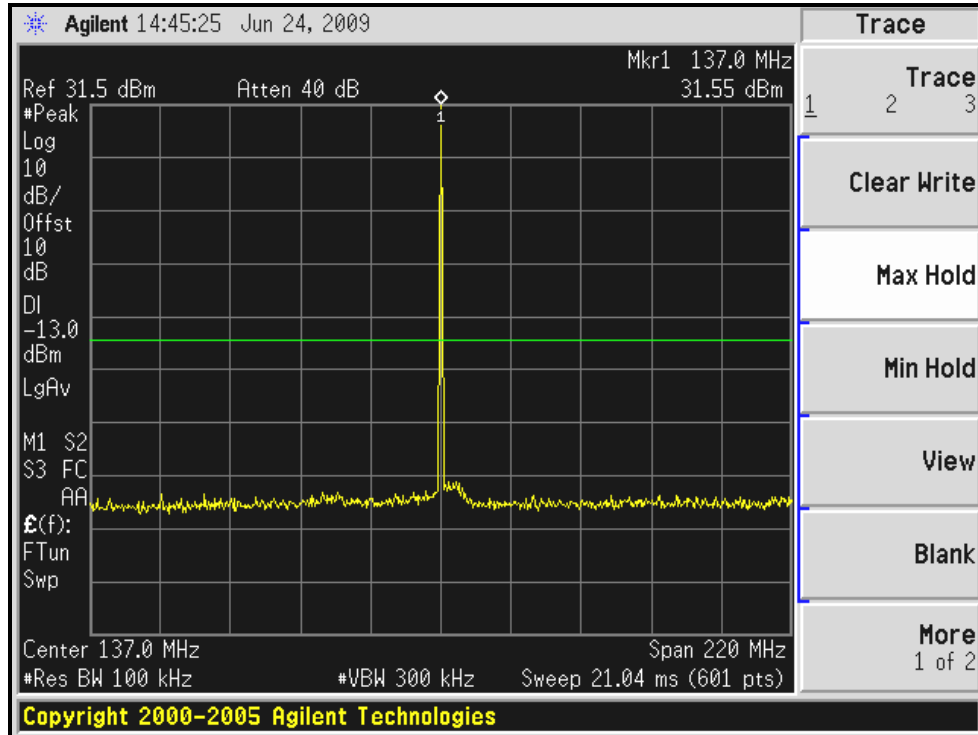
Plot 6-3: **127.475 MHz – Lower Frequency Range**



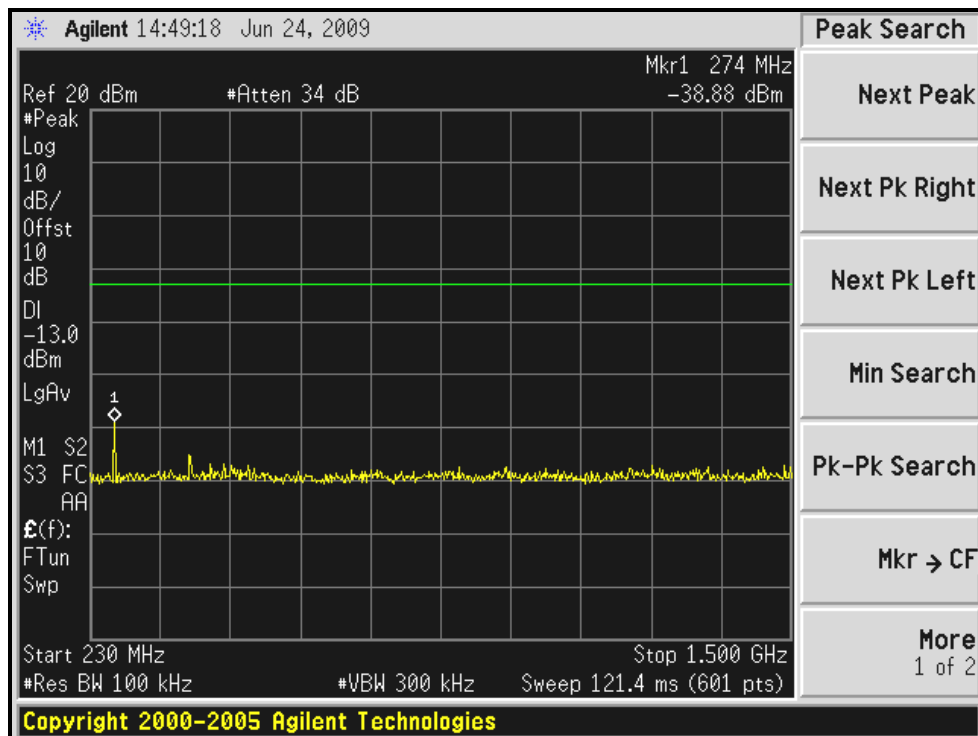
Plot 6-4: **127.475 MHz – Upper Frequency Range**



Plot 6-5: **136.975 MHz – Lower Frequency Range**



Plot 6-6: **136.975 MHz – Upper Frequency Range**



7 FCC Rules and Regulations Part 2.1053: Field Strength of Spurious Radiation, Part 87.139: Emission Limitations

7.1 Test Procedure

TIA-EIA-603-C August 2004, section 2.2.12

Analog Modulation: The transmitter is terminated with a $50\ \Omega$ load and is modulated with a 2,500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of the rated system deviation.

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.

7.2 Test Data

The worst-case emissions test data are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

Table 7-1: Field Strength of Spurious Radiation – 127.475 MHz

Conducted Power = 31.7 dBm = 1.5 W - Limit = $43 + 10 \log P = 44.7$ dBc


Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss* (dB)	Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Limit (dBc)	Margin (dB)
254.95	89.1	-20.4	4.5	1.8	54.5	44.7	-9.8
382.425	86.0	-22.5	5.6	1.5	58.0	44.7	-13.3
509.9	63.8	-40.0	6.8	1.2	77.0	44.7	-32.3
637.375	46.4	-55.1	8.1	1.1	93.5	44.7	-48.8
764.85	48.8	-48.4	9.1	0.9	88.0	44.7	-43.3
892.325	47.4	-43.6	10.0	1.0	84.0	44.7	-39.3
1147.275	22.6	-77.9	10.8	2.9	117.1	44.7	-72.5

*This insertion loss corresponds to the cable connecting the RF Signal Generator to the $\frac{1}{2}$ -wave dipole antenna.

Table 7-2: Test Equipment Used For Testing Field Strength of Spurious Radiation

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901215	Hewlett Packard	8596EM	Spectrum Analyzer (9kHz-12.8GHz)	3826A00144	10/23/09
901365	MITEQ	JS4-00102600-41-5P	Amplifier, 0.1-26 GHz, 30dB gain	N/A	3/4/10
901129	Par Electronics	188-174 (25W)	VHF Notch Filters	N/A	3/10/12
901423	Insulated Wire Inc.	KPS-1503-3600-KPS	RF cable, 30'	N/A	3/13/10
901516	Insulated Wire, Inc.	KPS-1503-2400-KPS-09302008	RF cable, 20'	N/A	10/17/09
901517	Insulated Wire Inc.	KPS-1503-360-KPS-09302008	RF cable 36"	N/A	10/17/09
900791	Chase	CBL6111B	Bilog antenna (30 MHz-2000 MHz)	N/A	12/12/10

Test Personnel:

Daniel Baltzell Test Technician/Engineer	 Signature	June 28, 2009 Date Of Test
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8 FCC Rules and Regulations Part 2.1049(c)(1): Occupied Bandwidth, Part 87.135: Bandwidth of Emission, Part 87.139: Emission Limitations

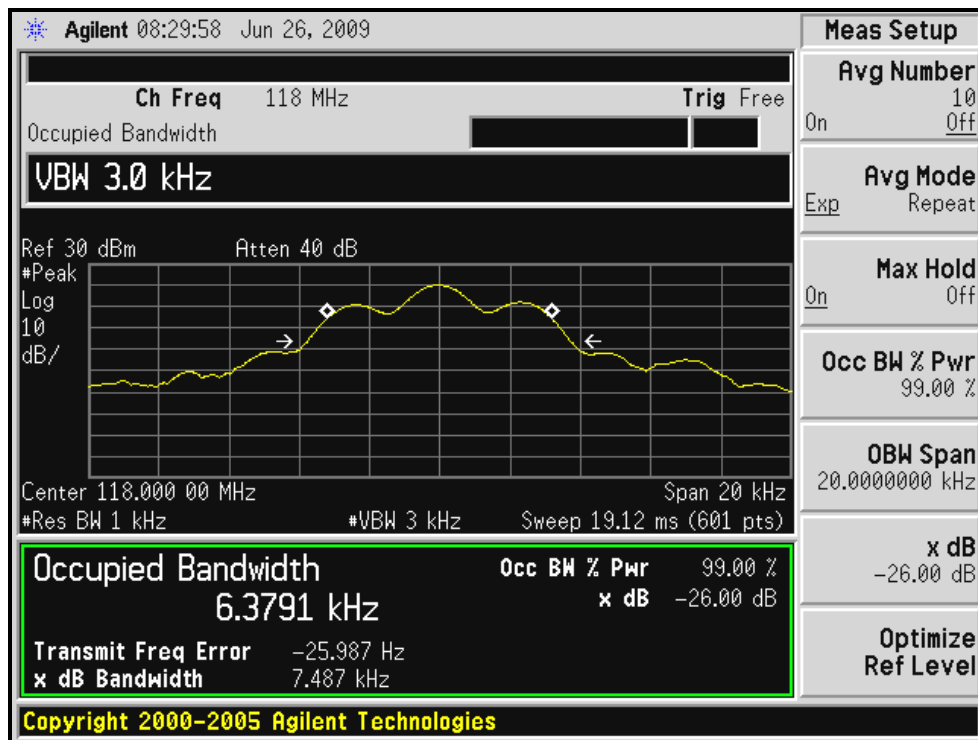
99% Occupied Bandwidth, Compliance with the Emission Masks

8.1 Test Procedure

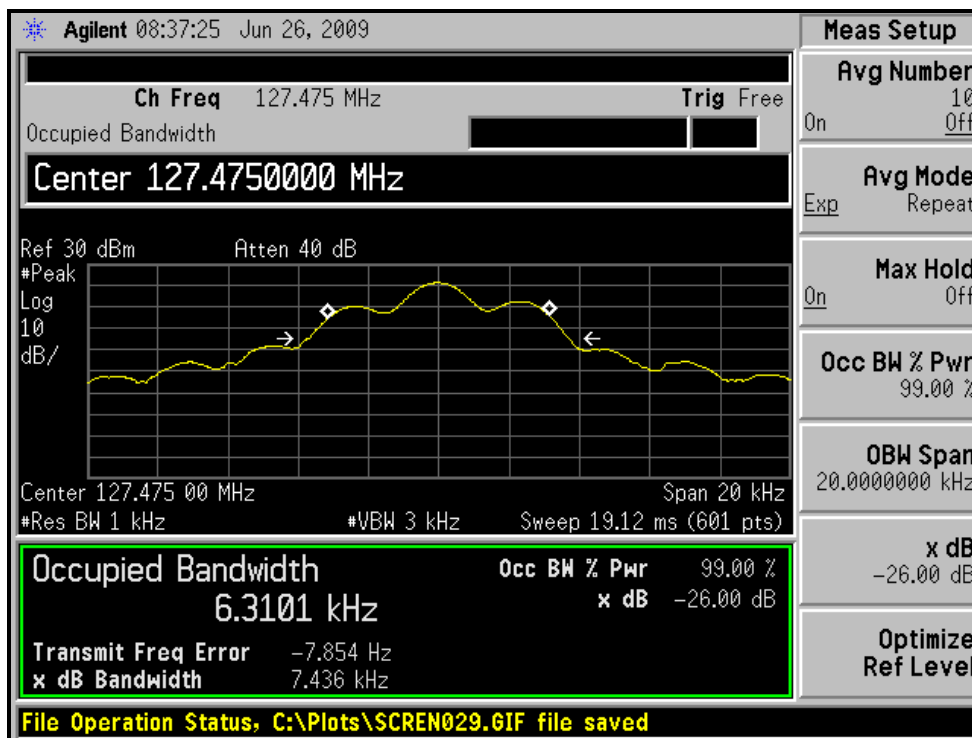
TIA-EIA-603-C August 2004, section 2.2.11

8.2 Test Data

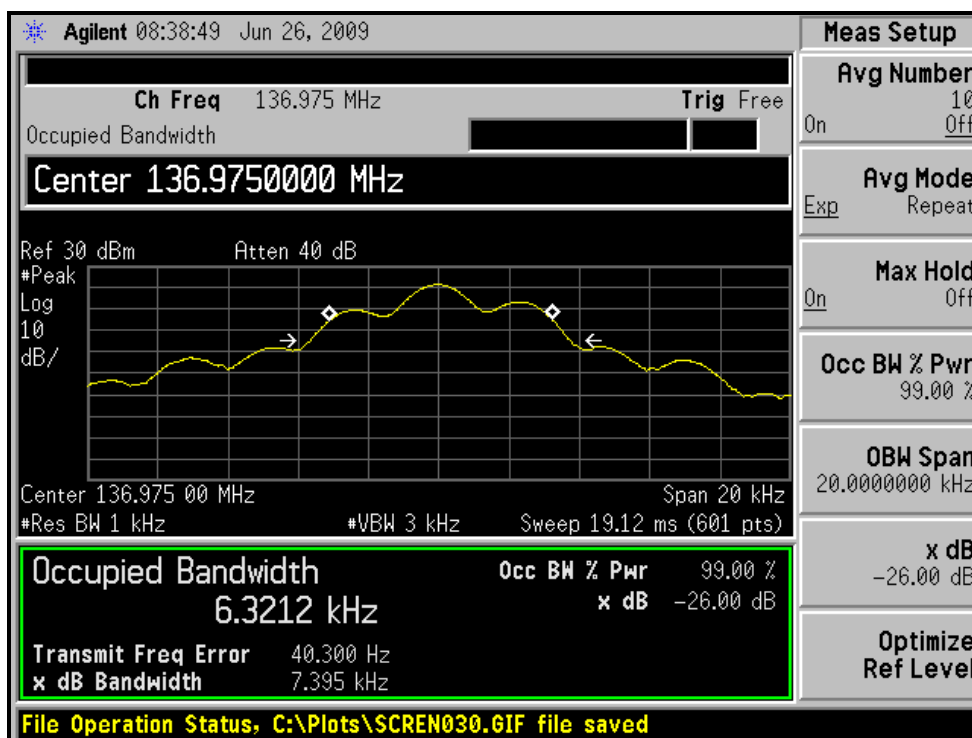
Plot 8-1: Occupied Bandwidth – 118.000 MHz



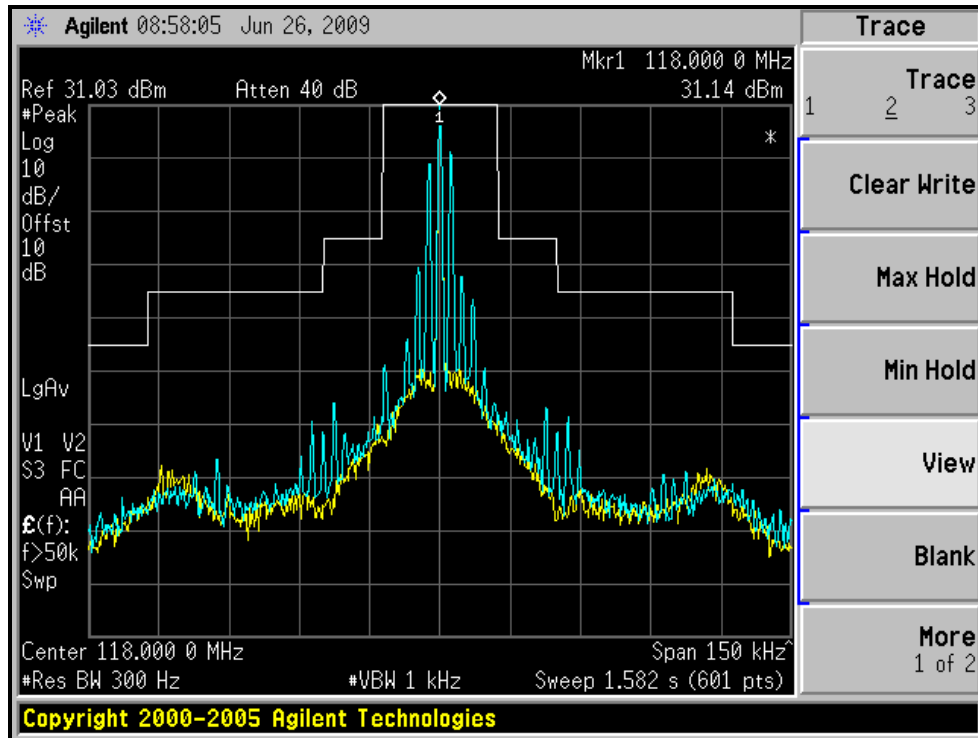
Plot 8-2: Occupied Bandwidth – 127.475 MHz



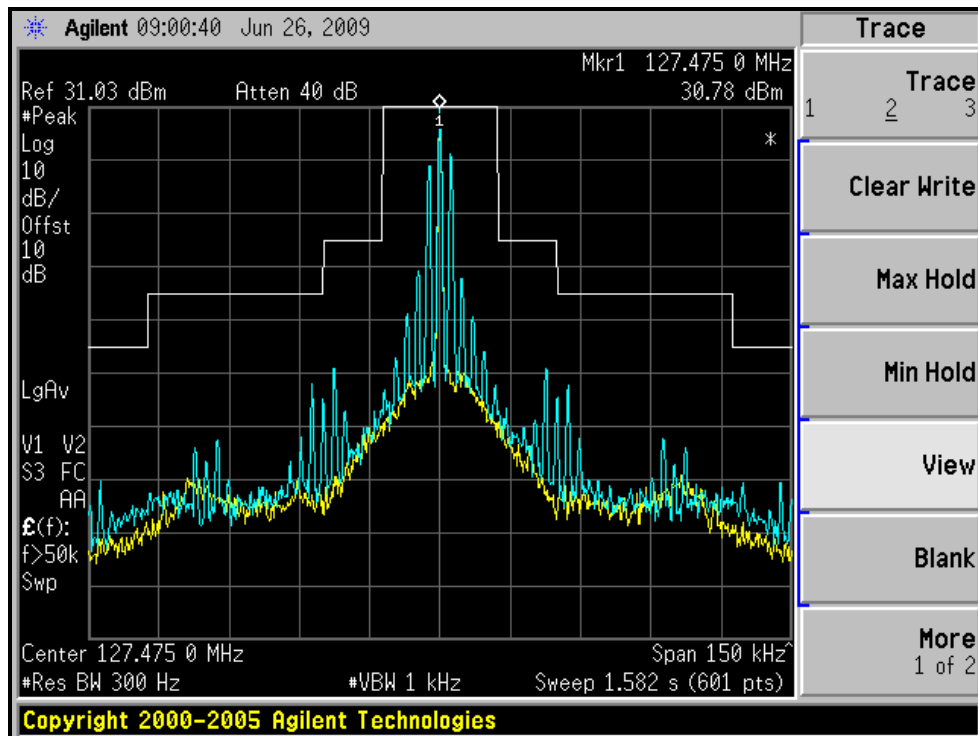
Plot 8-3: Occupied Bandwidth – 136.975 MHz



Plot 8-4: Emission Mask – 118.000 MHz



Plot 8-5: Emission Mask – 127.475 MHz



Plot 8-6: Emission Mask – 136.975 MHz

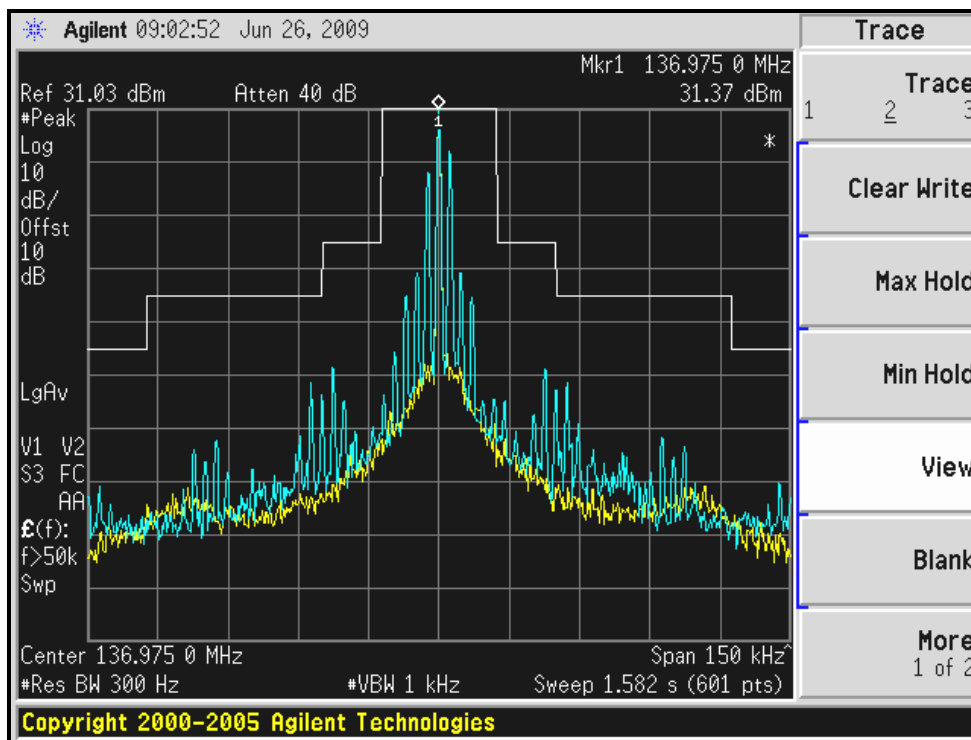


Table 8-1: Test Equipment Used For Testing Occupied Bandwidth

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	7/31/09
901349	Tenma	72-455	Audio Generator	9266283	2/19/10

Test Personnel:

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

Richard B. McMurray
Signature

June 26, 2009
Date Of Test

9 FCC Rules and Regulation Part 2.1055: Frequency Stability, Part 87.133: Frequency Stability

9.1 Test Procedure

TIA-EIA-603-C August 2004, section 2.2.2

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The EUT was evaluated over the temperature range -30°C to +60°C.

The temperature was initially set to -30°C and a 2-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 degrees centigrade 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. Additionally, the power supply voltage of the EUT was varied +/-15% nominal input voltage (note that -15% is lower than the battery endpoint voltage of 6.4 V).

Limit: Band 108–137 MHz: Aircraft and other mobile stations in the aviations services: 30 ppm

9.2 Test Data

Table 9-1: Temperature Frequency Stability – 127.475 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	127,474,880	0.60
-20	127,474,847	0.86
-10	127,474,851	0.82
0	127,474,882	0.58
10	127,474,940	0.13
20 (reference)	127,474,956	0.00
30	127,474,905	0.40
40	127,474,863	0.73
50	127,474,842	0.89
60	127,474,840	0.91

The worst-case deviation was found to be 0.9 ppm.

Result: The EUT is compliant.

9.2.1 Frequency Stability/Voltage Variation

Table 9-2: Frequency Stability/Voltage Variation – 127.475 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
6.12	127, 474, 837	0.93
7.2 (reference)	127, 474, 956	0.00
8.28	127, 474, 841	0.90

Table 9-3: Test Equipment Used For Testing Frequency Stability

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Date
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	5/08/10
901300	Agilent Technologies	53131A	Frequency Counter	MY40001345	6/18/10

Test Personnel:

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

Richard B. McMurray
Signature

June 25, 2009
Date Of Test

10 FCC Part 2.1047(a): Modulation Characteristics, Part 87.141(f): Modulation Requirements

10.1 Requirements

2.1047(a): *Voice modulated communication equipment.* A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted.

87.141(a): (a) When A3E emission is used, the modulation percentage must not exceed 100 percent.

10.2 Test Data

Plot 10-1: Modulation Characteristics - Audio Frequency Response

Note: modulation response normalized to 50% modulation

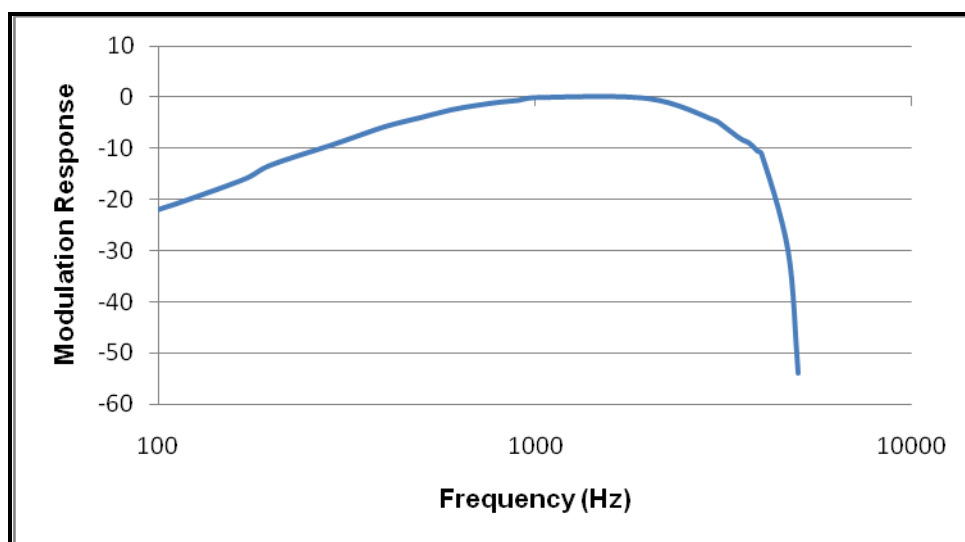


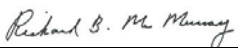
Table 10-1: Modulation Percentage

Audio Frequency (Hz)	Max Modulation Level	Limit	Result
100	43%	100%	Pass
350	84%	100%	Pass
1,000	87%	100%	Pass
2,500	70%	100%	Pass
3,500	44%	100%	Pass
5,000	18%	100%	Pass

Table 10-2: Test Equipment Used For Testing Audio Frequency Response

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901349	Tenma	72-455	Audio Generator	9266283	2/19/10
901118	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2406A00178	9/09/09

Test Personnel:

Richard B. McMurray, P.E.		June 30, 2009
EMC Test Engineer	Signature	Date Of Test

11 FCC Rules and Regulations Part 2.202: Necessary Bandwidth and Emission Bandwidth

Calculation:

$$B_n = 2M$$

Where: B_n = necessary bandwidth in Hz
 M = maximum modulation frequency in HZ

$$M = 3000 \text{ Hz}$$

$$B_n = 2(3000) \text{ Hz} = 6000 \text{ Hz}$$

Emission designator: 6K00A3E

12 Conclusion

The data in this measurement report shows that the **Dynon Avionics Inc.**, Model **DX15**, FCC ID: **WU6-101204-000**, complies with the applicable requirements of Parts 2 and 87 of the FCC Rules and Regulations.