

**FCC TEST REPORT
FOR THE
L3 CORPORATION
MODEL ATN01-311-03
AUTOMATIC IDENTIFICATION SYSTEM
AID TO NAVIGATION**

Prepared for:

L3 Communications Aviation Recorders Corp.
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Submitted by:

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**L3 Communications Aviation Recorders Corporation
FCC Testing
At
Green Mountain Electromagnetics, Inc.**

Unit: Automatic Identification System Aid to Navigation (ATN01-311-03)

Tested: March 13 - 28, 2008

I. Applicable Standards:

The unit described in this report was measured for certification with the Code of Federal Regulations Chapter 47 – "Telecommunication, Part 2 – Frequency Allocations and Radio Treaty Matters: General Rules and Regulations, Subpart J – Equipment Authorization Procedures (2008)." Measurements required were per paragraphs 2.1046 RF Power Output, 2.1047 Modulation Characteristics, 2.1049 Occupied Bandwidth, 2.1051 Spurious Emissions, 2.1053 Field Strength of Spurious Radiation, 2.1055 Frequency Stability, and 2.1091 Radiofrequency Radiation Exposure Evaluation: Mobile Devices.

The AIS Base Station was also measured for verification of compliance with "47 CFR – Telecommunication, Part 80 – Stations in the Maritime Services, Subpart E: General Technical Standards (2008)." Paragraphs used were 80.205 Bandwidths, 80.209 Transmitter Frequency Tolerances, 80.211 Emission Limitations, 80.213 Modulation Requirements, 80.215 Transmitter Power, and 80.217 Suppression of Interference Aboard Ships. Additionally, the AIS Base Station was measured for verification of compliance with "47 CFR, Part 15 – Radio Frequency Devices, Subpart C: Intentional Radiators (2008)," paragraph 15.209, Radiated Emissions.

Measurement procedures were in accordance with ANSI C63.4, "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2003)," IEC 62320-1, "Maritime Navigation and Radiocommunication Equipment and Systems – Automatic Identification Systems (AIS), Part 1: AIS Base Stations – Minimum Operational and Performance Requirements, Methods of Test and Required Test Results (2007)," and FCC OET Bulletin 65, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields (Jan. 2001)."

II. Unit Tested:

The L3 Corporation, Automatic Identification System (AIS) Aid to Navigation (AtoN) Model ATN01-311-03 provides continuous remote signal and data transmission for ship identification. The ATN01-311-03 uses DC power, has a TDMA transmitter and two TDMA/ GPS receivers. It consists of the multi-piece metal enclosure with connector hardware, the transmit/receive circuits, the microprocessor/data-storage electronics, and the antenna interface. The table below describes the unit tested to determine compliance with the standards:

Model/P/N	Manufacturer	Serial Number
AIS AtoN ATN01-311-03	For Tideland Signal Corp. by L3 Communications Corp.	000527787

The following table describes the system physical and electrical properties:

Model	Volts/Amps/Hertz	H/W/D in cm
ATN01-311-03	12 VDC, 2.5 A	15/15/15

The table below describes the support equipment used during testing:

Product	Manufacturer	Model	Serial Number
PC	Antec	Custom by L3	L3ID 9835
Monitor	Dell	CN 0CC280	p/o L3ID 9835
Keyboard	Microsoft	Basic RT 9480	698200139238
Mouse	Logitech	MBT96A	HC6010201177
Antenna	Matsushita	GPS	n/a
Pattern/Modulation Generator (2)	Sine Qua Non	PMG-1	L3ID 5608/9
Power Supply (2)	HP	3634A	L3ID R10150/10321
Attenuator, 30 dB Fixed	Agilent	8489A	L3ID 5121
Band Reject Filter	n/a	n/a	n/a
Serial Hub	Quatech	n/a	L3ID 5636

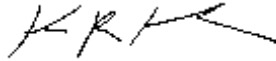
III. Summary of Results:

The L3 Corporation, Model ATN01-311-03 complies with the requirements in FCC 47 CFR, Paragraphs 2, 15, and 80. Section IX contains the results summarized in the table below.

	Test	Mode/Port	CFR 47 Paragraph	Frequency Range/Level	Specified Values	Measured Values
1	Carrier Power	Transmit	2.1046 80.215	<25 W (43.97 dBm)	40.97 dBm LF 40.97 dBm HF	41.03 dBm 40.95 dBm
2	Modulation Characteristics	Transmit	2.1047 80.213	± 1740 Hz TS1 ± 2400 Hz TS2	< ± 5 kHz	All meas. < ± 5 kHz
3	Occupied Bandwidth	Transmit	2.1049 80.205 80.211	± 10 kHz CF ± 10 kHz – 20 kHz ± 20 kHz – 50 kHz > ± 50 kHz	0 dBc -25 dBc -35 dBc -54 dBc	0 dBc -40 dBc -50 dBc -90 dBc
4	Frequency Tolerance	Transmit	2.1055 80.209	± 10 ppm 15.6 V ± 10 ppm 10.8 V	162,025,000 Hz 162,025,000 Hz	162,024,776 Hz 162,024,815 Hz
5	Conducted Spurious	Transmit/ Receive	2.1051 80.217	<30 MHz 30 – 100 MHz 100 – 300 MHz >300 MHz	- 4 dBm 6 dBm 16 dBm 26 dBm	Within All Limits
6	Radiated Emissions	Enclosure	2.1053 15.209	30 – 88 MHz 88 – 216 MHz 216 – 960 MHz 960 – 1630 MHz	40 dBuV/m 43.5 dBuV/m 46 dBuV/m 54 dBuV/m	Within 3m Limits
7	Exposure Evaluation	Enclosure	2.1091	0.3 – 3 MHz 3 – 30 MHz 30 – 300 MHz 300 – 1500 MHz 1500 – 1630 MHz	100 mW/cm ² 900/f ² mW/cm ² 1 mW/cm ² f/300 mW/cm ² 5 mW/cm ²	Within All Limits

Testing was performed by Kyle R. Kowalczyk, president, Green Mountain Electromagnetics and requested by:

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6000 Fruitville Road/(PO Box 3041 34230)
Sarasota, FL 34232
USA



Kyle R. Kowalczyk
5/8/08

IV. Measurement Location:

The GME laboratory and Open Area Test Site (OATS) are located at 219 Blake Roy Road, Middlebury, VT. The OATS is a 3-meter site complete with antenna positioner, ground plane and motorized turntable. The OATS is constructed in accordance with ANSI C63.7-2005 and complies with the requirements for radiated emissions testing in ANSI C63.4-2003 and CISPR standards. The electromagnetic laboratory is constructed in accordance with CE immunity standards and ANSI C63.4-2003 (conducted emissions).

GME is internationally accredited by the American Association for Laboratory Accreditation (A2LA) and meets the quality requirements in ISO/IEC 17025 (2005), "General Requirements for the Competence of Testing and Calibration Laboratories."

V. Equipment and Cable Configuration:

GME witnessed the unit in satisfactory condition for testing, however the manufacturer is responsible for ensuring that the equipment under test (EUT) represents the product line. The manufacturer is also responsible for the EMC test plan and for assuring that this report is consistent with that plan. The EUT configuration was arranged to produce maximum radiated emissions as shown in the block diagram below. The equipment was subjected to complete emissions and susceptibility tests.

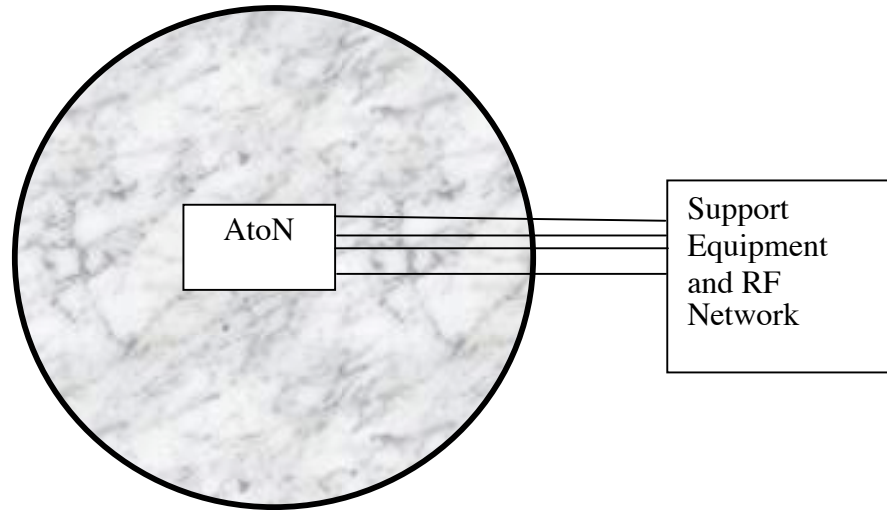


Figure 1 – Block Diagram of EUT on Turntable

VI. Units of Measurement:

Measurements of radiated electric fields were made in units of dB referenced to 1 microvolt per meter (dBuV/m). Limits appearing on the spectrum analyzer data were corrected for the appropriate antenna factor, cable loss, amplifier gain (when used) and measurement distance X. (See Section X.6, Radiated Emissions Measurement Results, for calculations.)

Uncertainty

The uncertainty budgets in GME EMC measurements (using the guidance of NAMAS NIS 81) are identified as follows:

1. Field strength between 30 MHz and 3 GHz on a three-meter OATS using broadband antennas:

Contribution	Probability Distribution	Uncertainty (dB)
antenna factor calibration	normal k=2	0.5
cable loss calibration	normal k=2	0.5
analyzer specification	rectangular	1.5
distance variation	rectangular	0.6
height variation	rectangular	0.5
site imperfection	rectangular	2.0
mismatch	u-shaped	1.5
repeatability	standard deviation	0.5
combined uncertainty u(y)	normal	1.946
expanded uncertainty U	normal k=2	3.892

$$u(y) = \sqrt{\left(\frac{0.5}{2}\right)^2 + \left(\frac{0.5}{2}\right)^2 + \frac{1.5^2 + 0.6^2 + .5^2 + 2.0^2}{3} + \frac{1.5^2}{2} + 0.5^2}$$

$$U = k u(y)$$

VII. Measuring Equipment:

The table below describes the instrumentation used by Green Mountain Electromagnetics to perform this testing:

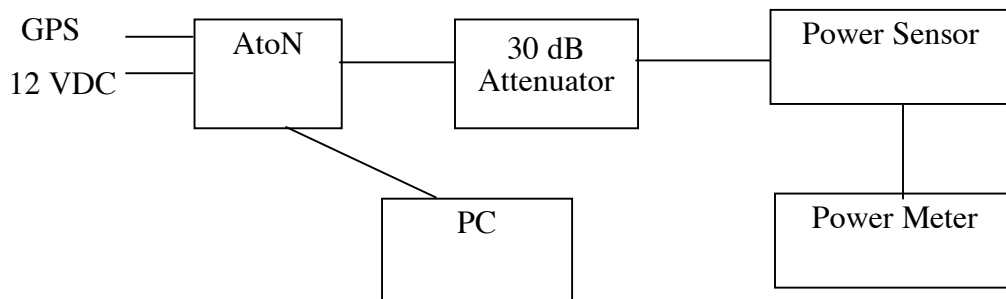
Unit	Manufacturer	Model	Serial #	Last Cal.	Next Cal.
Spectrum Analyzer	Hewlett-Packard	8592 L	3624A00631	3/20/08	3/20/09
Amplifier	MiniCircuits	ZFL-1000G	n/a	2/11/08	2/11/09
Broadband E-field Antenna	Antenna Research Associates	LPB-2513/A	1125	8/9/07	8/9/09
Spectrum Analyzer	Rohde & Schwarz	FSEB 20	L3ID R8004	12/13/07	12/13/08
Signal Generator	Hewlett-Packard	8644B	L3ID 5456	08/28/07	08/28/08
Signal Generator	Hewlett-Packard	E4432B	L3ID R40923	01/22/08	01/22/10
Signal Generator	Marconi	2041	L3ID 501892	06/18/07	06/18/08
Frequency Counter	Agilent	53181A	L3ID R02274	07/05/07	07/05/08
Power Meter	Agilent	E4418B	L3ID 5114	04/23/07	04/23/08
Power Sensor with 30 dB Attenuator	Agilent	E9301B	L3ID 5118	06/08/07	06/08/08
Plotter	Hewlett-Packard	7475A	2517A05281	n/a	n/a

VIII. Measurement Procedures for ATN01-311-03 FCC Tests:

1. Carrier Power.

Specification: 40.97 ± 1.5 dBm (12.5W) Normal Operation

- a. Set up EUT and test instrumentation in laboratory.
 - i. Connect AtoN to 12-VDC power, PC, and GPS antenna; attach power-sensor specific 30-dB attenuator to VHF port. Connect power meter to sensor.
- b. Verify power meter and AtoN operation.
 - i. Power sensor is connected to companion 30-dB attenuator.
 - ii. AtoN channels are selected from PC. Use 162.025 MHz channel.
 - iii. Power meter requires warm-up period, calibration and zeroing.
- c. Operate EUT at high power unmodulated.
- d. Record level displayed on meter.
- e. Repeat for 156.025 MHz channel.



Block Diagram of Carrier Power Test

VIII. Measurement Procedures for ATN01-311-03 FCC Tests Cont'd:

2. Modulation Characteristics.

Test Signal 1 Specification: 24 bit 01 pattern, Start with 0 bit

Bits 0-1 deviation <3400 Hz

Bits 2-3 deviation 1920 Hz to 2880 Hz

Bits 4-31 deviation 2160 Hz to 2640 Hz

Bits 32-199 deviation 1565 Hz to 1915 Hz

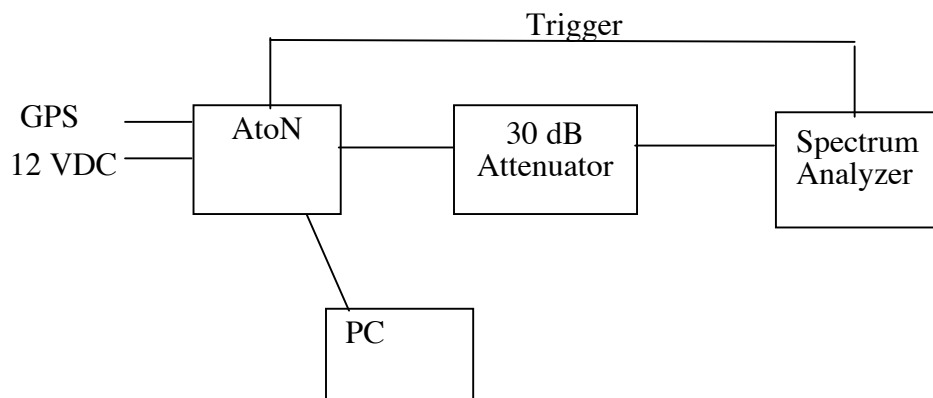
Test Signal 2 Specification: 24 bit 01 pattern, Start with 0 bit

Bits 0-1 deviation <3400 Hz

Bits 2-3 deviation 1920 Hz to 2880 Hz

Bits 4-199 deviation 2160 Hz to 2640 Hz

- a. Set up EUT and test instrumentation in laboratory.
 - i. Connect AtoN to 12-VDC power, PC, and GPS antenna; attach 30-dB attenuator to VHF port. Trigger is direct into analyzer.
- b. Verify analyzer and AtoN operation. Set for 162.025 MHz.
 - i. Spectrum analyzer is connected to 30-dB attenuator.
 - ii. AtoN test signals 1 & 2 per 62320-2, para. 6.2.4.1/2 are selected from PC.
 - iii. Spectrum analyzer requires warm-up period.
- c. Operate EUT at first test signal with standard modulation.
- d. Record deviation displayed on analyzer. Use vector mode, and analog demodulation.
- e. Repeat for second test signal.
- f. Repeat for 156.025 MHz.



Block Diagram of Modulation Characteristics Test

VIII. Measurement Procedures for ATN01-311-03 FCC Tests Cont'd:**3. Occupied Bandwidth.**

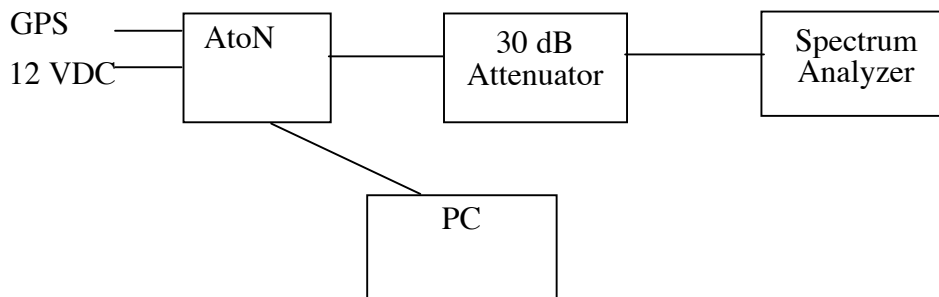
20 kHz Specification: 0 dBc \pm 10 kHz CF

-25 dBc \pm 10 kHz – 20 kHz CF

-35 dBc \pm 20 kHz – 50 kHz CF

-54 dBc $> \pm$ 50 kHz

- a. Set up EUT and test instrumentation in laboratory.
 - i. Connect AtoN to 12-VDC power, PC, and GPS antenna; attach 30-dB attenuator to VHF port.
- b. Verify analyzer and AtoN operation. Set for channel 1060 (156.025 MHz).
 - i. Spectrum analyzer is connected to 30-dB attenuator.
 - ii. AtoN test signal 3 per 62320-2, para. 6.2.4.3 is selected from PC.
 - iii. Spectrum analyzer requires warm-up period. Use 1-kHz RBW and 3-kHz VBW.
- c. Verify AtoN test signal on spectrum analyzer.
- d. Operate EUT at selected test signal with standard modulation.
- e. Record peak frequency spectrum displayed on analyzer.
- f. Repeat for channel 2088 (162.025 MHz).



Block Diagram of Occupied Bandwidth Test

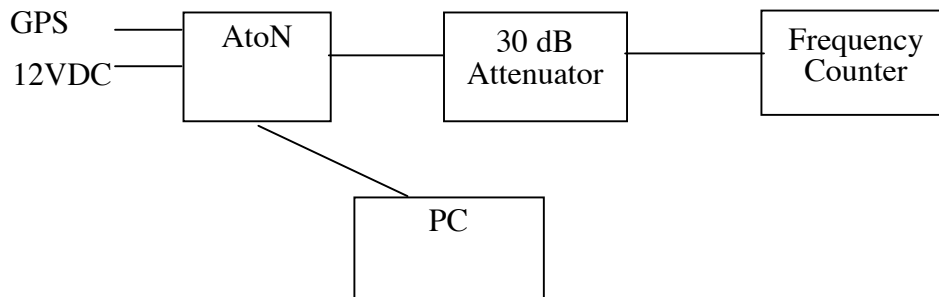
VIII. Measurement Procedures for ATN01-311-03 FCC Tests Cont'd:**4. Frequency Tolerance.**

Frequencies: 162.025 MHz

Specification: ± 10 ppm (1620 Hz)

Voltage Specification: 10.8 VDC to 15.6 VDC Normal Operation

- a. Set up EUT and test instrumentation in laboratory.
 - i. Connect AtoN to 12-VDC power, PC, and GPS antenna; attach 30-dB attenuator to VHF port.
- b. Verify frequency counter and AtoN operation.
 - i. Frequency counter is connected to 30-dB attenuator.
 - ii. AtoN channels are selected from PC, setting is 2088.
 - iii. Frequency counter requires warm-up period.
- c. Operate EUT at low channel with no modulation.
- d. Record frequency displayed on counter.



Block Diagram of Frequency Test

VIII. Measurement Procedures for ATN01-311-03 FCC Tests Cont'd:**5. Conducted Spurious.**

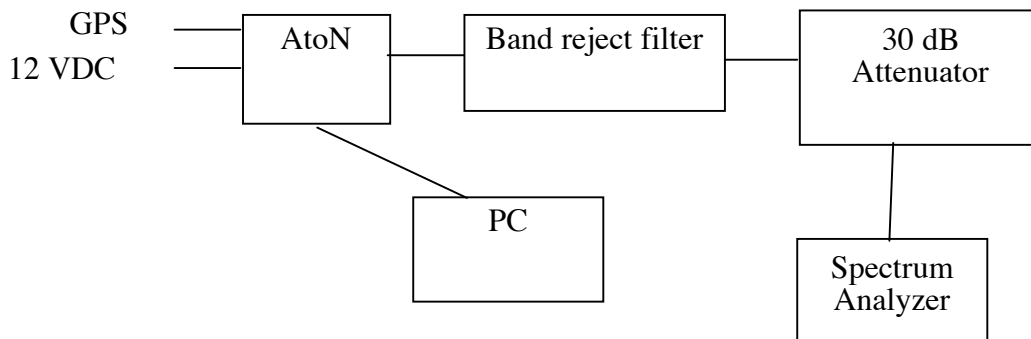
Transmit/Receive Specification: <30 MHz: -4 dBm

30 – 100 MHz: 6 dBm

100 – 300 MHz: 16 dBm

>300 MHz: 26 dBm

- a. Set up EUT and test instrumentation in laboratory.
 - i. Connect AtoN to 12-VDC power and GPS antenna.
- b. Verify analyzer and AtoN operation.
 - i. Spectrum analyzer is connected to attenuator and filter VHF port.
 - ii. Spectrum analyzer requires warm-up period.
 - iii. Connect filter to VHF port.
- c. Operate AtoN transmitter unmodulated.
- d. Tune band reject filter to fundamental frequency of transmitter: Exclude frequencies ± 62.5 kHz from fundamental.
- e. Record required frequency spectrum displayed on analyzer.
- f. Put AtoN in receive only mode. Remove attenuator and filter.
- g. Record required frequency spectrum displayed on analyzer.



Block Diagram of Conducted Spurious Test

VIII. Measurement Procedures for ATN01-311-03 FCC Tests Cont'd:**6. Radiated Emissions.**

Frequency range: 30 MHz to 88 MHz

Limit: 40 dBuV/m @ 3 meters

Frequency range: 88 kHz to 216 MHz

Limit: 43.5 dBuV/m @ 3 meters

Frequency range: 216 MHz to 960 MHz

Limit: 46 dBuV/m @ 3 meters

Frequency range: 960 MHz to 1.63 GHz

Limit: 54 dBuV/m @ 3 meters

- a. Set up instrumentation at open area test site.
 - i. Mount EUT on ground plane and broadband antenna on antenna positioner.
 - ii. Observe temperature, humidity and atmospheric pressure.
 - iii. Measurement distance is 3 meters and antenna scan height is 1 to 4 meters.
- b. Verify spectrum analyzer and antenna operation.
 - i. Spectrum analyzer is connected to antenna.
 - ii. Preamplifier is inserted between antenna and analyzer to ensure analyzer noise threshold is at least 6 dB below specification limit.
- c. Set up, power and operate EUT as described in Section V.
- d. Perform preliminary evaluation of equipment in the near field.
 - i. Vary antenna height, antenna polarization, and antenna orientation to EUT.
 - ii. Repeat step d.i. while evaluating electromagnetic radiation in the 30-MHz to 1.63-GHz spectrum.
- e. Determine frequencies and equipment orientations that produce maximum radiation.
 - i. Identify processor, clock and beat frequencies, and harmonics.
- f. Perform final evaluation of unit by recording spectrum analyzer data on the plotter.
 - i. Ensure the EUT is producing the maximum radiation found in step e.
 - ii. Collect data over the entire frequency range.

VIII. Measurement Procedures for ATN01-311-03 FCC Tests Cont'd:**7. Exposure Evaluation.**

Frequency range: 0.3 MHz - 3 MHz

Limit: 100 mW/cm^2

Frequency range: 3 MHz - 30 MHz

Limit: $900/f^2 \text{ mW/cm}^2$

Frequency range: 30 MHz - 300 MHz

Limit: 1 mW/cm^2

Frequency range: 300 MHz - 1500 MHz

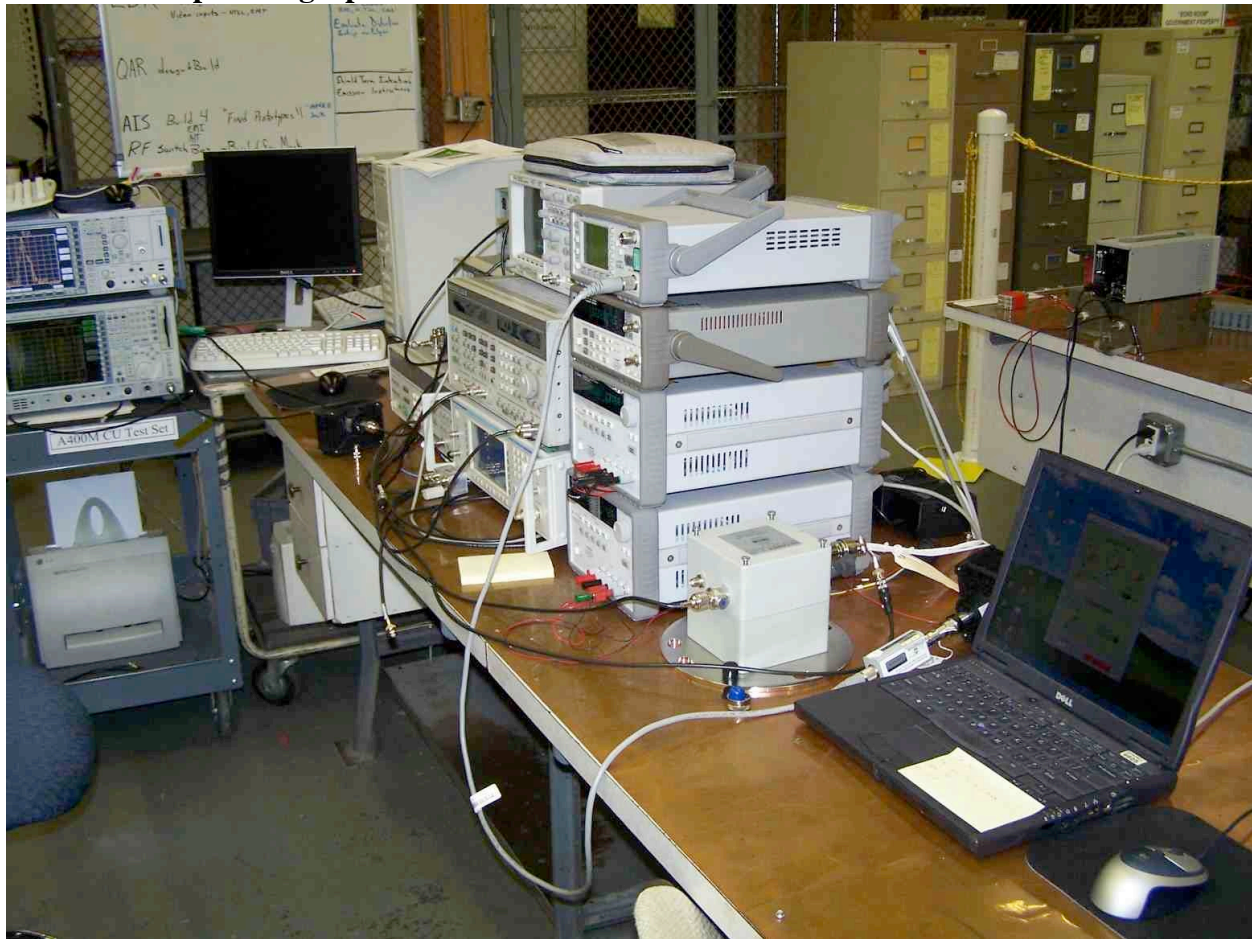
Limit: $f/300 \text{ mW/cm}^2$

Frequency range: 1500 MHz - 1630 MHz

Limit: 5 mW/cm^2

- a. Set up instrumentation at open area test site.
 - i. Mount EUT on table and isotropic probe or loop on antenna positioner.
 - ii. Observe temperature, humidity and atmospheric pressure.
 - iii. Measurement distance is 1 meter and antenna scan height is varied over human body dimensions (0.1 to 2 meters).
- b. Verify spectrum analyzer and antenna operation.
 - i. Spectrum analyzer is connected to antenna.
- c. Set up, power and operate EUT as described in Section V.
- d. Perform preliminary evaluation of equipment in the near field.
 - i. Vary antenna height, antenna polarization, and antenna orientation to EUT.
 - ii. Repeat step d.i. while evaluating electromagnetic radiation in the 0.3-MHz to 1630-MHz spectrum. H and E field are both measured below 300 MHz.
 - iii. Near field measurements of unit emissions are made at ambient frequencies.
- e. Determine frequencies and equipment orientations that produce maximum radiation.
 - i. Set peak hold on analyzer for 6 minutes while slowly varying antenna height.
- f. Perform final evaluation of unit by recording spectrum analyzer data on the plotter.
 - i. Ensure the EUT is producing the maximum radiation found in step e.
 - ii. Collect data over the entire frequency range.
 - iii. Identify all ambient signals.

IX. Test Setup Photographs for ATN01-311-03 FCC Tests:



Photograph 1 – FCC Testing