Serial No. GM28023cr1

EMC TEST REPORT
FOR THE
TIDELAND SIGNAL 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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Accredited
Cert 898.01

L3 Communications Aviation Recorders Corporation
CE EMC Testing
At
Green Mountain Electromagnetics, Inc.

Unit: Automatic Identification System Aid to Navigation (ATN01-311-03)
Received: 3/24/08, 5/8/08 & 9/28/08
Tested: March 24 - 28, April 18, May 9 & September 30 - October 2, 2008
Revision: Repeat radiated emissions, EFT and conducted immunity tests; all results remain compliant.

I. Applicable Standards:

The unit described in this report was evaluated for compliance with International Standard IEC 60945 Ed. 4, "Maritime Navigation and Radiocommunication Equipment and Systems – General Requirements – Methods of Testing and Required Test Results (August 2002)." Paragraph 9, "Electromagnetic Emissions – Methods of Testing and Required Test Results," and paragraph 10, "Immunity to Electromagnetic Environment – Methods of Testing and Required Test Results," were used. All procedures and equipment are in accordance with IEC 60945 and L3 Qualification Test Plan 905-M0998-34.

Immunity measurement equipment and procedures were in accordance with:

EN 61000-4-2, "Electromagnetic Compatibility (EMC) Part 4-2: Testing and Measurement Techniques – Electrostatic Discharge Immunity Test (2001),"

EN 61000-4-3, "EMC Part 4-3: Testing and Measurement Techniques – Radiated, Radio-Frequency, Electromagnetic Field Immunity Test (2002),"

EN 61000-4-4, "EMC Part 4-4: Testing and Measurement Techniques – Electrical Fast Transient/Burst Immunity Test (2004),"

EN 61000-4-6, "EMC Part 4-6: Testing and Measurement Techniques – Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields (2001)."

II. Unit Tested:

The Tideland Signal 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 000487380 (retest)

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
Combiner/Splitter	Mini-Circuits	ZSC-4-1	L3ID 5638
Band Reject Filter	n/a	n/a	n/a
Serial Hub	Quatech	n/a	L3ID 5636

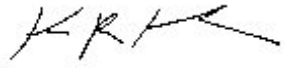
III. Summary of Results:

The Tideland Signal Corporation, Model ATN01-311-03 complies with the requirements in IEC 60945, paragraphs 9 and 10. Section X contains the results summarized in the table below.

	Test	Port	IEC 60945 Paragraph	Frequency Range/Level	Specified Values	Measured Values
1	Conducted Emissions	Power	**9.2**	10 kHz - 150 kHz 150 kHz - 350 kHz 350 kHz - 30 MHz	96 dBuV to 50 dBuV 60 dBuV to 50 dBuV 50 dBuV/m	Transmit, Receiver 1 & Receiver 2 All Within Limits
2	Radiated Emissions	Enclosure	**9.3**	150 kHz - 300 kHz 300 kHz - 30 MHz 30 MHz - 156 MHz 156 MHz - 165 MHz 165 MHz - 2 GHz	80 dBuV/m - to 52 dBuV/m 52 dBuV/m to 34 dBuV/m 54 dBuV/m 24 dBuV/m 54 dBuV/m	Transmit, Receiver 1 & Receiver 2 All Within Limits
3	Conducted Immunity	Power and Signal	**10.3**	150 kHz - 80 MHz @ 3 V Discrete @ 10 V	A	Tx A Rcv1 A Rcv2 A
4	Radiated Immunity	Enclosure	**10.4**	80 MHz - 2 GHz 10 V/m	A	Tx A Rcv1 A Rcv2 A
5	Transient Immunity	Power and Signal	**10.5**	1-kV Common Mode	B	Tx B Rcv1 A Rcv2 A
6	Electrostatic Discharge	Enclosure	**10.9**	6-kV Contact 8-kV Air	B	Tx A Rcv1 A Rcv2 A

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

L3 Communications Aviation Recorders Corp.
6000 Fruitville Road/(PO Box 3041, 34230)
Sarasota, FL 34232 USA



Kyle R. Kowalczyk
10/30/08

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.

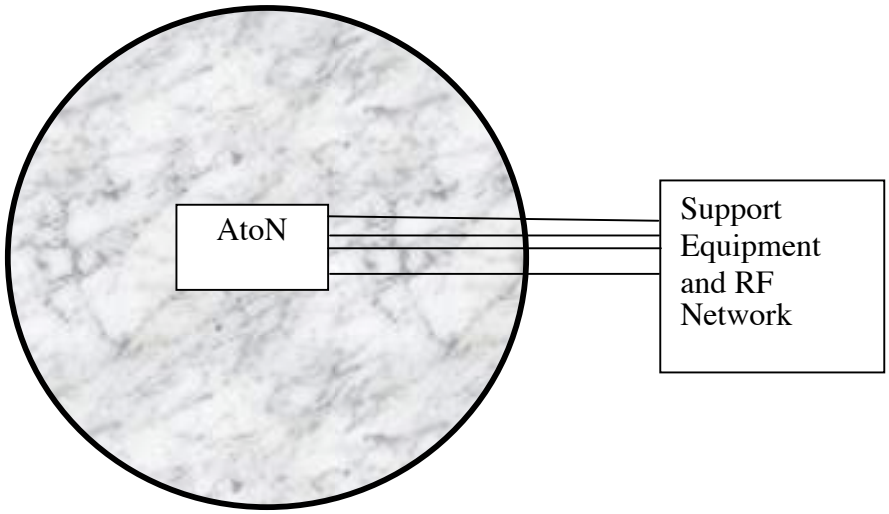


Figure 1 – Block Diagram of EUT on Turntable

The EUT was operating in a continuous mode utilizing and testing its functions. The EUT was also set to self-test upon power up. Susceptibility indications include: performance check error rate, repeatable malfunctions, and erroneous faults.

The performance criteria for the evaluation of the immunity test results are as follows:
Performance Criterion A – during and after testing, normal performance within the specification limits.
Performance Criterion B – during testing, temporary degradation, or loss of function or performance which is self-recovering. No change in actual operating state or stored data is allowed.
Performance Criterion C – during testing, temporary degradation or loss of function which is self-recoverable or can be restored at the end of the test by operation of controls.

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.

The following equations were employed:
Corrected Limit (dBuV/m) = Limit (dBuV/m) + 20 log(X/3 meters) - Antenna Factor (dB) + (Amplifier Gain (dB) - Cable Loss (dB)).

Sample calculation at 30 MHz:
55.6 dBuV corrected limit = 54.0 dBuV/m limit + 20 log(3/3) dB distance – 19.4 dB/m AF + 21 dB cable loss/amp gain.

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

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

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
LISN	Com-Power	LI-115	241031	12/13/07	12/13/08
Signal Generator	Hewlett-Packard	E4421B	US38220195	12/05/07	12/05/08
Broadband E-field Antenna	Antenna Research Associates	LPB-2513/A	1125	8/9/07	8/9/09
Parallel-Plate Antenna	GME	GP1-T	01	12/20/06	12/20/08
ESD Generator	Schaffner	NSG 435	2394	2/28/08	2/28/09
EFT Generator	Haefely-Trench	PEFT 4010	081603-10	6/18/07	6/18/08
CDN	Com-Power	M2-25	511011	4/4/06	4/4/08
Plotter	Hewlett-Packard	7475A	2517A05281	n/a	n/a
Current Probe	EMCO	95236-1	980350213	11/21/07	11/21/08

VIII. Measurement Procedures:

1. Conducted Emissions in accordance with IEC 60945, Para. 9.2.

Frequency range: 10 kHz to 150 kHz
Limit: 96 dBuV decreasing to 50 dBuV
Frequency range: 150 kHz to 350 kHz
Limit: 60 dBuV decreasing to 50 dBuV
Frequency range: 0.35 MHz to 30 MHz
Limit: 50 dBuV

a. Set up instrumentation in laboratory.
   i. Mount EUT on ground plane.
   ii. Observe temperature, humidity and atmospheric pressure.
   iii. Attach EUT power cable to the Artificial Mains V-Network/Line Impedance Stabilization Network (AMN/LISN).
b. Verify spectrum analyzer and AMN/LISN operation.
   i. Spectrum analyzer is connected to AMN/LISN.
   ii. Measurements are made at both phase (L1/+DC) and neutral (L2/-DC) leads.
c. Set up, power and operate EUT as described in Section V.
   i. Use supplied power cable not to exceed 0.8 m in length.
d. Perform preliminary evaluation of equipment.
   i. Vary EUT modes.
   ii. Repeat step d.i. while evaluating conducted emissions from 10 kHz to 30 MHz.
   iii. Ensure resolution bandwidth is set and less than or equal to video bandwidth.
e. Determine frequencies that produce maximum emissions.
   i. Identify 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 emissions found in step e.
   ii. Collect data over the entire frequency range.

2. Radiated Emissions in accordance with IEC 60945, Para. 9.3.

Frequency range: 150 kHz to 300 kHz
Limit: 80 dBuV/m decreasing to 52 dBuV/m @ 3 meters
Frequency range: 300 kHz to 30 MHz
Limit: 52 dBuV/m decreasing to 34 dBuV/m @ 3 meters
Frequency range: 30 MHz to 156 MHz
Limit: 54 dBuV/m @ 3 meters
Frequency range: 156 MHz to 165 MHz
Limit: 24 dBuV/m @ 3 meters
Frequency range: 165 MHz to 2 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. Use CISPR method for measurement at closer distances when reduction of ambient relative to limit is necessary. Record these bandwidths separately.
   iii. For measurements <30 MHz resolution bandwidth is set to 9 kHz and video bandwidth is 30 kHz. These settings also apply to 156-165 MHz.
   iv. For measurements between 30 MHz and 2 GHz resolution bandwidth is set to 120 kHz and video bandwidth is 300 kHz.
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 150 kHz to 2000 MHz 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.

3. Conducted Susceptibility in accordance with IEC 60945, Para. 10.3 & EN 61000-4-6.

Frequency range: 150 kHz to 80 MHz
Voltage: 3 V
Discrete Frequencies: 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22, 25 (all MHz)
Voltage: 10 V

a. Set up instrumentation in laboratory.
   i. Observe temperature, humidity and atmospheric pressure.
   ii. Place EUT over ground plane.
b. Verify spectrum analyzer, signal generator, and power amplifier operation.
   i. Spectrum analyzer is connected to 150-Ω adapter for calibration of coupling/decoupling network (CDN) and verification of applied voltage.
   ii. Signal generator is connected to power amplifier and set for 80% amplitude modulation with a 400 Hz sine wave.
   iii. Power amplifier is connected to CDN.
c. Verify applied voltage at CDN with spectrum analyzer.

d. Attach power cord directly to CDN and operate EUT as described in Section V.
e. Illuminate unit under test with voltage.
f. Sweep frequencies from 150 kHz to 80 MHz.
   i. Frequency scan rates are <.0015 decades/s.
   ii. Dwell time at each frequency is the time necessary for the EUT to respond (1s for transmitter and 0.5 s for receiver).
   iii. Processor frequencies are analyzed separately.
g. Attach current probe to EUT signal lines and power amplifier to current probe.
h. Repeat steps e and f.
i. Perform final evaluation of unit by noting EUT indicators.

4. Radiated Susceptibility in accordance with IEC 60945, Para. 10.4 & EN 61000-4-3.

Frequency range: 80 MHz to 2 GHz
Field Strength: 10 V/m

a. Set up instrumentation in laboratory.
   i. Observe temperature, humidity and atmospheric pressure.
b. Verify spectrum analyzer, signal generator, and power amplifier operation.
   i. Spectrum analyzer is connected to isotropic probe for calibration of radiating antenna and verification of uniform field.
   ii. Signal generator is connected to power amplifier and set for 80% amplitude modulation with a 400 Hz sine wave.
   iii. Power amplifier is connected to broadband antenna.
c. Set up, power and operate EUT as described in Section V.
d. Calibrate broadband antenna for uniform field necessary to enclose EUT.
   A uniform field is defined as 0 to 6 dB above applicable limit over 75% of EUT surface.
   i. Use isotropic probe to determine field strength at 4 to 16 positions.
   ii. At the start frequency, apply forward power necessary to achieve 0 to 6 dB above applicable limit at a minimum of 4 positions on the grid.
   iii. Increase frequency by 10% and repeat steps d.i. and d.ii.
e. Illuminate unit under test with antenna at calibrated distance.
   i. Place isotropic probe near EUT to verify proper antenna operation.
f. Sweep frequencies from 80 to 2000 MHz and rotate EUT to ensure units receive maximum radiation.
   i. Frequency scan rates are <.0015 decades/s.
   ii. Dwell time at each frequency is the time necessary for the EUT to respond (1s for transmitter and 0.5 s for receiver).
   iii. Processor frequencies are analyzed separately.
g. Perform final evaluation of unit by noting EUT indicators.

5. Electrical Fast Transient Immunity IAW with IEC 60945, Para. 10.5 & EN 61000-4-4.

Voltage Peak: 1-kV common mode

a. Set up instrumentation in laboratory.
   i. Observe temperature, humidity and atmospheric pressure.
b. Verify electrical fast transient generator operation.
   i. Perform model self-test.
c. Set up, power and operate EUT as described in Section V.
   i. Place EUT power/signal lines into the capacitive coupling clamp.
   ii. Verify EFT clamp ground bond. Keep non-EUT components away from clamp.
d. Illuminate unit under test with 15-ms, every 300 ms, electrical fast transient/burst.
   i. Duration of at least 3 minutes at each level and each polarity.
   ii. Perform power on self-test before, during, and after application of test voltages.
e. Perform final evaluation of unit by noting EUT indicators.

6. Electrostatic Discharge Immunity IAW with IEC 60945, Para. 10.9 & EN 61000-4-2.

Test Voltage: 6-kV contact /8-kV air

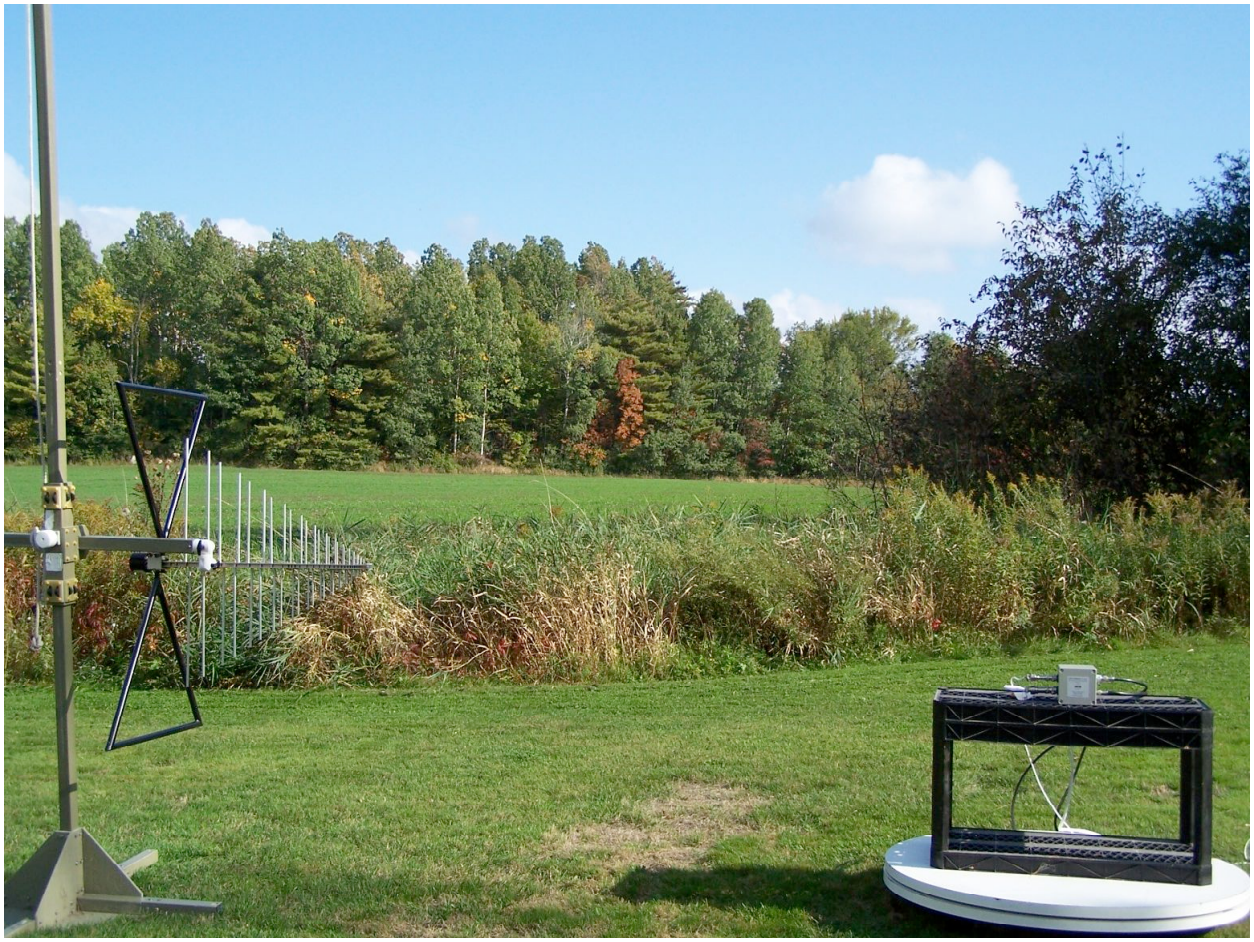
a. Set up instrumentation in laboratory.
   i. Observe temperature, humidity and atmospheric pressure.
b. Verify ESD generator operation.
   i. Perform self-test and verify 150-pF/330-Ω tips are used.
   ii. Connect 2-meter ground cable.
c. Set up, power and operate EUT as described in Section V.
   i. Position EUT over ground plane on insulating mat. Exploratory ESD events are 20/s.
d. Singly discharge contact voltages into unit under test with ESD generator 10 times at intervals of at least 1 s.
   i. Place tip in various operator-accessible positions and vary polarity.
   ii. Slowly increase voltage from minimum to maximum test levels.
e. Singly discharge contact voltages into vertical and horizontal coupling planes with ESD generator.
   i. Position vertical plane .1 m from EUT.
   ii. Illuminate all four sides of the EUT.
f. Repeat d. and e. with air contact tip.
g. Perform final evaluation of unit by noting EUT indicators.

IX. Photographs of Measurement Setup:

The following pages are photographs of the equipment as it was tested.

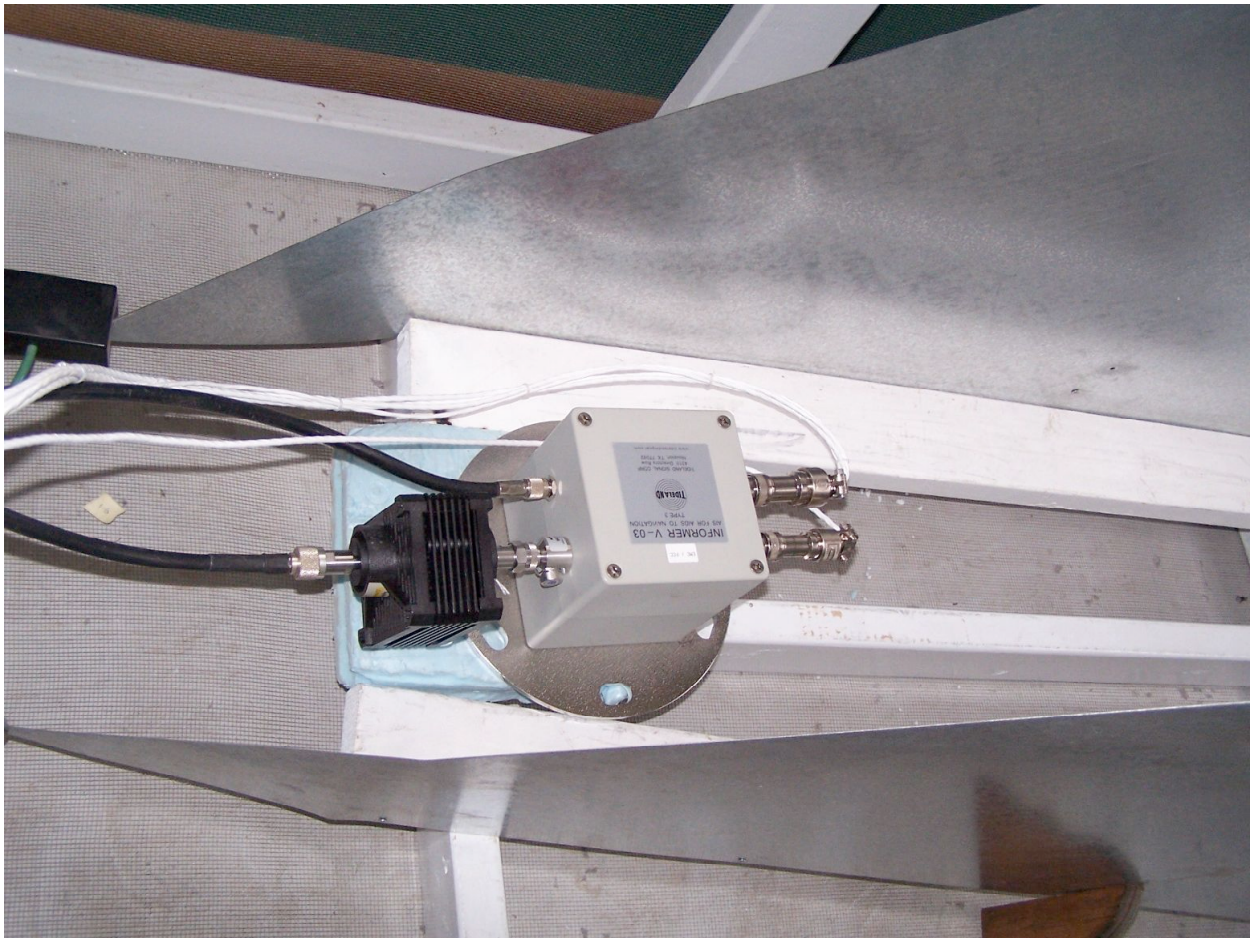
Photograph 1 – Conducted Emissions

Photograph 2 – Radiated Emissions <30 MHz



Photograph 3 – Radiated Emissions >30 MHz

Photograph 4 – ESD



Photograph 5 – Radiated Immunity

Photograph 6 – EFT