EMC TEST REPORT
FOR THE
L3 COMMUNICATIONS
AVIATION RECORDERS CORPORATION
AUTOMATIC IDENTIFICATION SYSTEM
PERFORMANCE TESTS

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
EMC Tests
By
Green Mountain Electromagnetics, Inc.
Middlebury, Vermont

Unit: Automatic Identification System (AIS)
Evaluated: November 3 through 12, 2004

I. Applicable Standards:

The unit described in this report was evaluated for compliance with paragraph 13, "EMC Tests" of IEC 61993-2, "Maritime Navigation and Radiocommunication Equipment and Systems – Automatic Identification Systems (AIS), Part 2: Class A Shipborne Equipment of the Universal AIS – Operational and Performance Requirements, Methods of Test and Required Test Results (December 2001)."

The unit was also measured for compliance with 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" of European Standard EN 60945 Ed. 4, "Maritime Navigation and Radiocommunication Equipment and Systems – General Requirements – Methods of Testing and Required Test Results (August 2002)." All procedures and equipment are in accordance with EN 61993 and EN 60945.

Measurement equipment and procedures were in accordance with CISPR 16-1, "Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods – Part 1: Radio Disturbance and Immunity Measuring Apparatus (1993)" and CISPR 16-2, "Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods – Part 2: Methods of Measurement of Disturbances and Immunity (1999)." Immunity measurement equipment and procedures were in accordance with: EN 61000-4-2, "Testing and Measurement Techniques – Section 2: Electrostatic Discharge Immunity Test (1998);" EN 61000-4-3, "Testing and Measurement Techniques – Section 3: Radiated, Radio-Frequency, Electromagnetic Field Immunity Test (1998);" EN 61000-4-4, "Testing and Measurement Techniques – Section 4: Electrical Fast Transient/Burst Immunity Test (1995);" EN 61000-4-6, "Testing and Measurement Techniques – Section 6: Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields (1996);" and EN 61000-4-11,

"Testing and Measurement Techniques – Section 11: Voltage Dips, Short Interruptions and Voltage Variations Immunity Tests (1994)."

II. Unit Tested:

The L3 Communications Aviation Recorders Corporation, Automatic Identification System provides continuous signal and data transmission for ship identification. The AIS uses 24-VDC power and has TDMA/DSC transmitters and TDMA/GPS/DSC receivers. It consists of the two-piece metal enclosure with connector hardware, the transmit/receive circuits, the micro-processor/data-storage electronics, and the antenna interface. The table below describes the unit tested to determine compliance with the standards:

Model/P/N	Manufacturer	H/W/D in cm	Serial Number
AISD1-000-00	L3 Communications	8/15/20	104

III. 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 C63.7-1992 and complies with the requirements for radiated emissions testing in ANSI C63.4-2000 and CISPR 16-1993. The electromagnetic laboratory is constructed in accordance with CE immunity standards and ANSI C63.4-2000 (conducted emissions).

GME is internationally accredited by the American Association for Laboratory Accreditation (A2LA) and meets the quality requirements in ISO/IEC 17025 (1999), "General Requirements for the Competence of Testing and Calibration Laboratories."

IV. Summary of Results:

The L3 Communications Aviation Recorders Corporation AIS complies with the requirements in IEC 61993-2, paragraph 13 and EN 60945, paragraphs 9 and 10. Section IX contains the results summarized in the table below.

	Test	Port	IEC 60945 Paragraph	Frequency Range/Level	Specified Values	Measured Values
1	Conducted Emissions	Power Lines	**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	Within All 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	Within All Limits *
3	Conducted Immunity	Power, Signal and Control Lines	**10.3**	150 kHz - 80 MHz 10 V	A	A
4	Radiated Immunity	Enclosure	**10.4**	80 MHz - 2 GHz 10 V/m	A	A
5	Transient Immunity	Power, Signal and Control Lines	**10.5**	1 kV Common Mode	B	B
6	Supply Failure	Power Lines	**10.8**	60 Seconds	C	C
7	Electrostatic Discharge	Enclosure	**10.9**	6 kV Contact 8 kV Air	B	B

** Note that the AIS must be properly grounded to achieve these results.*

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

L3 Communications Aviation Recorders Corp.
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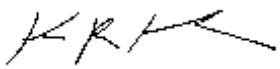


Kyle R. Kowalczyk
11/26/04

V. 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	3624A00631	1/13/04	1/13/05
Amplifier	Hewlett-Packard	8447 D	2944A07313	5/17/04	5/17/05
Signal Generator	Hewlett-Packard	E4421B	US38220195	10/20/04	10/20/05
Plotter	Hewlett-Packard	7475A	2517A05281	n/a	n/a
LISN	GME	4A/50A	n/a	11/02/04	11/02/05
Broadband E-field Antenna	Antenna Research Associates	LPB-2513/A	1125	11/02/04	11/02/05
Broadband Parallel-Plate Antenna	GME	GP1-T	01	11/02/04	11/02/05
ESD Generator	Schaffner	NSG 435	2394	2/27/04	2/27/05
EFT Generator	Haefely-Trench	PEFT 4010	081603-10	5/13/04	5/13/05
CDN	GME	15A	n/a	11/02/04	11/02/05
Interrupt Generator	GME	IG-1	n/a	11/02/04	11/02/05
Injection Probe	EMCO (Tegam)	95236-1	9803-50213	11/02/04	11/02/05
Current Probe	Stoddart	91550	n/a	11/02/04	11/02/05
Frequency Counter	Agilent	53181A	ID5111	4/27/04	4/27/05
Power Sensor	Agilent	E9301B	ID5119AB	6/7/04	6/7/05
Power Meter	Agilent	E4418B	ID5113	4/27/04	4/27/05
Power Supply	Hewlett-Packard	6083	500771	12/10/04	12/10/05

VI. 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, as well as in the photographs in Section VIII. The equipment was subjected to complete emissions and susceptibility tests.

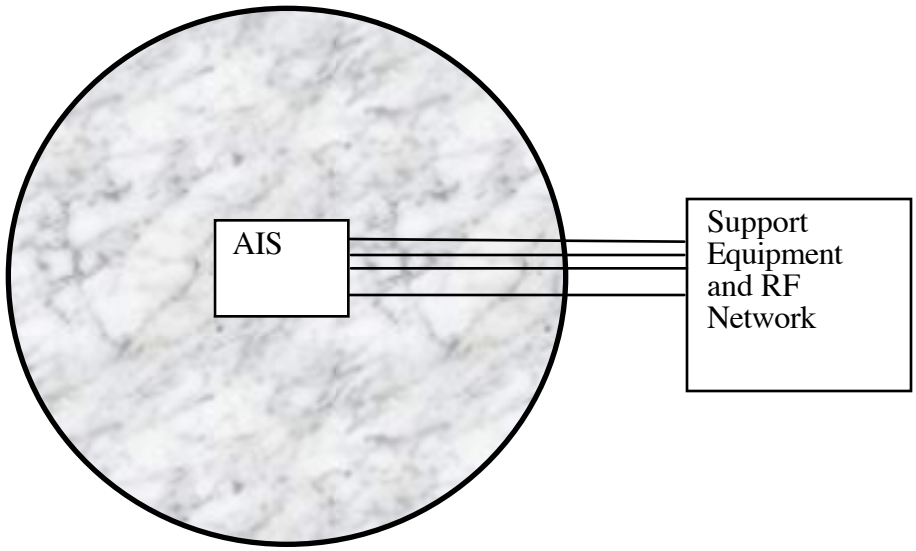


Figure 1 – Block Diagram of EUT on Turntable

The EUT was operating in a continuous mode utilizing and testing its RF signal processing functions. Data with known properties were downloaded from the PC to the AIS, uploaded from the AIS to the PC, and evaluated for errors during testing. The EUT was also set to self-test upon power up. Susceptibility indications include: changes in file parameters, 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. The EUT shall continue to operate as intended after the test.

Performance Criterion C – during testing, temporary degradation or loss of function which requires operator intervention, or system reset occurs.

VII. Measurement Procedures for AIS EMC Tests:

1. Conducted Emissions in accordance with CISPR 16 & EN 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. Record 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 VI.
   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 appropriate 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.

VII. Measurement Procedures for AIS EMC Tests Cont'd:

2. Radiated Emissions in accordance with CISPR 16 & EN 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 table and broadband antenna or loop on antenna positioner.
   ii. Record temperature, humidity and atmospheric pressure.
   iii. Measurement distance is 3 meters and antenna scan height is varied from 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 (not normally necessary below 30 MHz).
c. Set up, power and operate EUT as described in Section VI.
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.
   iii. Ensure appropriate resolution bandwidth is set and less than or equal to video bandwidth.
   iv. Near field measurements of unit emissions are made at ambient frequencies.
e. Determine frequencies and equipment orientations that produce maximum radiation.
   i. Identify any 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.
   iii. Identify all ambient signals.

VII. Measurement Procedures for AIS EMC Tests Cont'd:

3. Conducted Susceptibility in accordance with EN 60945, Para. 10.3 (EN 61000-4-6, Level 3).

Frequency range: 150 kHz to 80 MHz

Voltage: 10 V

a. Set up instrumentation in laboratory.
   i. Record 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 VI.

e. Illuminate unit under test with voltage.

f. Sweep frequencies from 150 kHz to 80 MHz.
   i. Frequency step sizes are 1% of previous frequency (i.e. 5 kHz at 500 kHz).
   ii. Dwell time at each frequency is the time necessary for the EUT to respond (i.e. 1s).
   iii. Processor frequencies are analyzed separately.

g. Attach current probe to amplifier and set signal generator to calibrated sweep.

h. Place current probe on each signal lead (GPS, IEC & RF) and perform steps b(ii) through f.

i. Perform final evaluation of unit by noting EUT indicators.

VII. Measurement Procedures for AIS EMC Tests Cont'd:

4. Radiated Susceptibility in accordance with EN 60945, Para. 10.4 (EN 61000-4-3, Level 3 Annex D).

Frequency range: 80 MHz to 2 GHz

Field Strength: 10 V/m

a. Set up instrumentation and place EUT in broadband parallel plate antenna.
   i. Record 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 VI.

d. Calibrate broadband antenna for uniform field necessary to enclose EUT.
   A uniform field is defined as 0 to 6 dB above 10 V/m over 75% of EUT surface.
   i. Configure broadband antenna to enclose EUT. 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 10 V/m 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 step sizes are 1% of previous frequency (i.e. 5 MHz at 500 MHz).
   ii. Dwell time at each frequency is the time necessary for the EUT to respond (i.e. 1s).
   iii. Processor frequencies are analyzed separately.

g. Perform final evaluation of unit by noting EUT indicators.

VII. Measurement Procedures for AIS EMC Tests Cont'd:

5. Electrical Fast Transient Immunity in accordance with EN 60945, Para. 10.5 (EN 61000-4-4, Level 3).

Voltage Peak: 1kV common-mode

a. Set up instrumentation in laboratory.
   i. Record 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 VI.
   i. Place EUT power lines into the capacitive coupling clamp.
   ii. Verify clamp ground bond.
d. Illuminate unit under test with 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. Set up, power and operate EUT as described in Section VI.
   i. Place EUT signal lines into the capacitive coupling clamp.
   ii. Verify clamp ground bond.
f. Illuminate unit under test with 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.
g. Perform final evaluation of unit by noting EUT indicators.

VII. Measurement Procedures for AIS EMC Tests Cont'd:

6. Supply Failure/Voltage Interrupt in accordance with EN 60945, Para. 10.8 (EN 61000-4-11).

Interrupt Voltages: 100% Interrupt Times: 60s

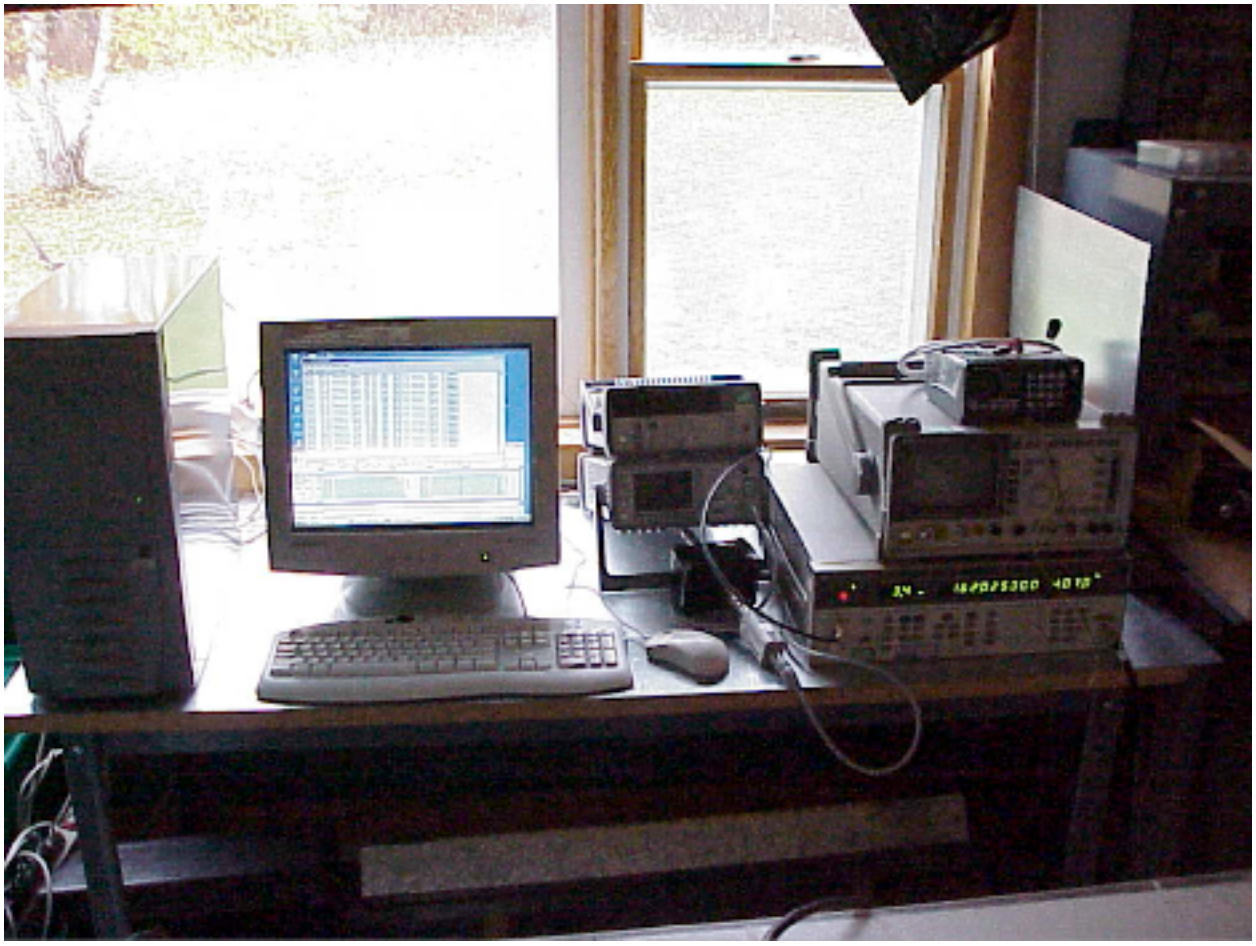
a. Set up instrumentation in laboratory.
   i. Record temperature, humidity and atmospheric pressure.
b. Verify interrupt generator operation.
   i. Perform timer self-test.
   ii. Connect variable transformers.
c. Set up, power and operate EUT as described in Section VI.
d. Break voltage into EUT for duration of interrupt time.
e. Repeat three times at a minimum of 10-s intervals.
f. Perform final evaluation of unit by noting EUT indicators.

7. Electrostatic Discharge Immunity in accordance with & EN 60945, Para. 10.9 (EN 61000-4-2, Level 3).

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

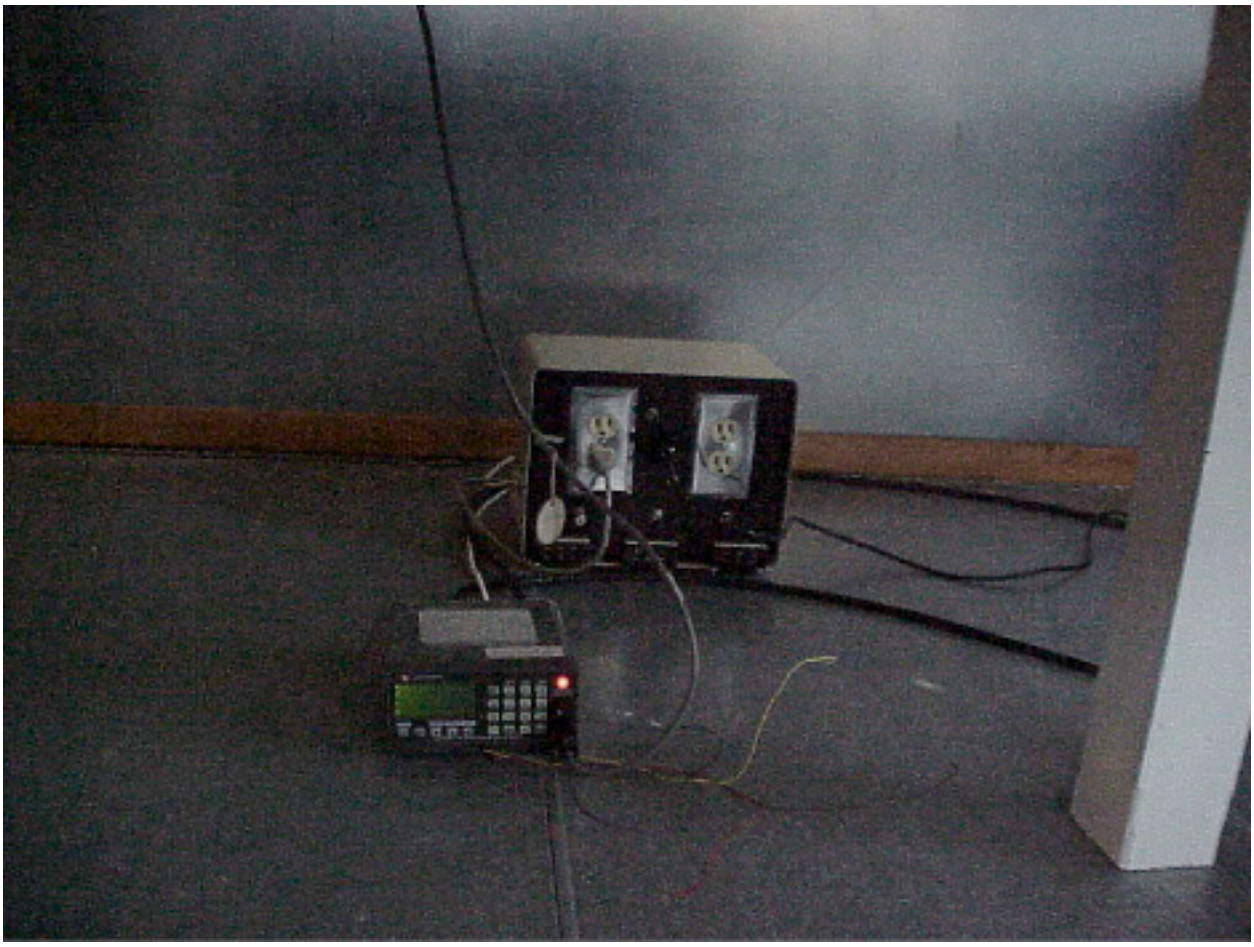
a. Set up instrumentation in laboratory.
   i. Record temperature, humidity and atmospheric pressure.
b. Verify ESD generator operation.
   i. Perform self-test, verify 150-pF/330-Ω tips are used and connect 2-meter ground cable.
c. Set up, power and operate EUT as described in Section VI.
   i. Position EUT over ground plane on insulating mat.
   ii. 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 10 times at minimum 1-s intervals.
   i. Position vertical plane .1 m from EUT.
   ii. Illuminate all four sides of the EUT coupling plane.
f. Repeat d. and e. with air contact tip.
g. Perform final evaluation of unit by noting EUT indicators.

VIII. Test Setup Photographs for AIS EMC Tests:



EUT and Support Equipment

VIII. Test Setup Photographs for AIS EMC Tests Cont'd:

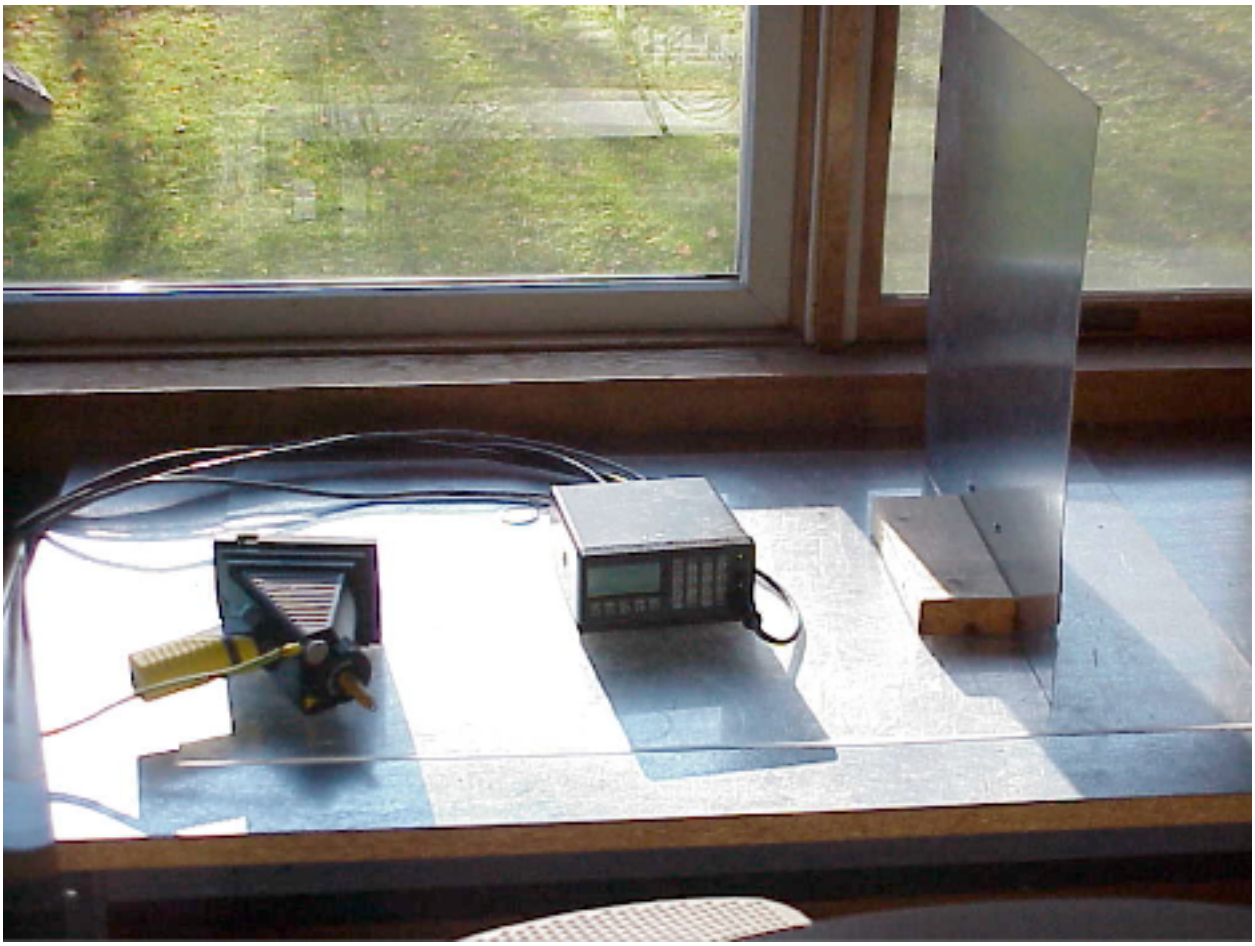


Conducted Emissions Test Setup

VIII. Test Setup Photographs for AIS EMC Tests Cont'd:

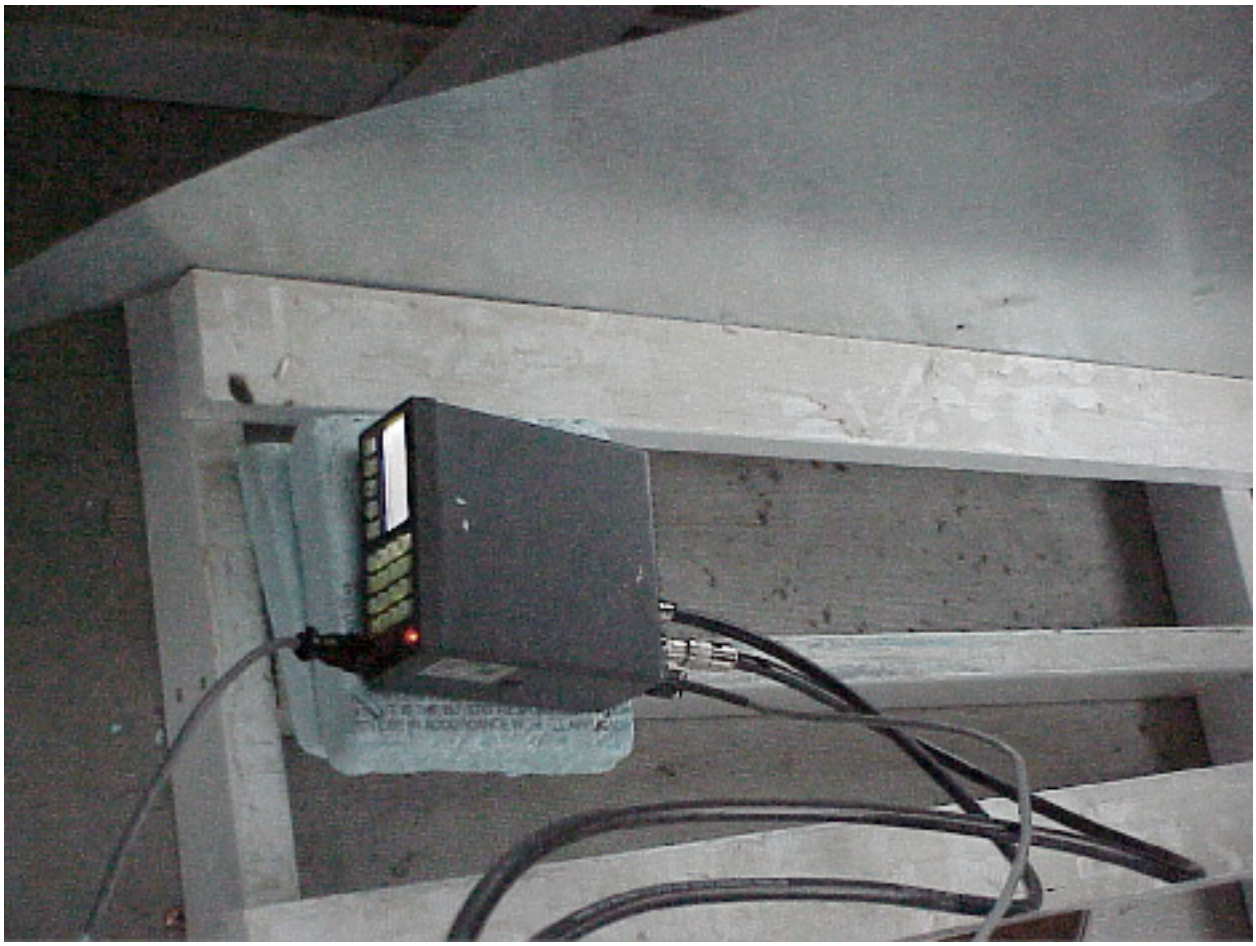
Radiated Emissions Test Setup

VIII. Test Setup Photographs for AIS EMC Tests Cont'd:



Electrostatic Discharge Test Setup

VIII. Test Setup Photographs for AIS EMC Tests Cont'd:

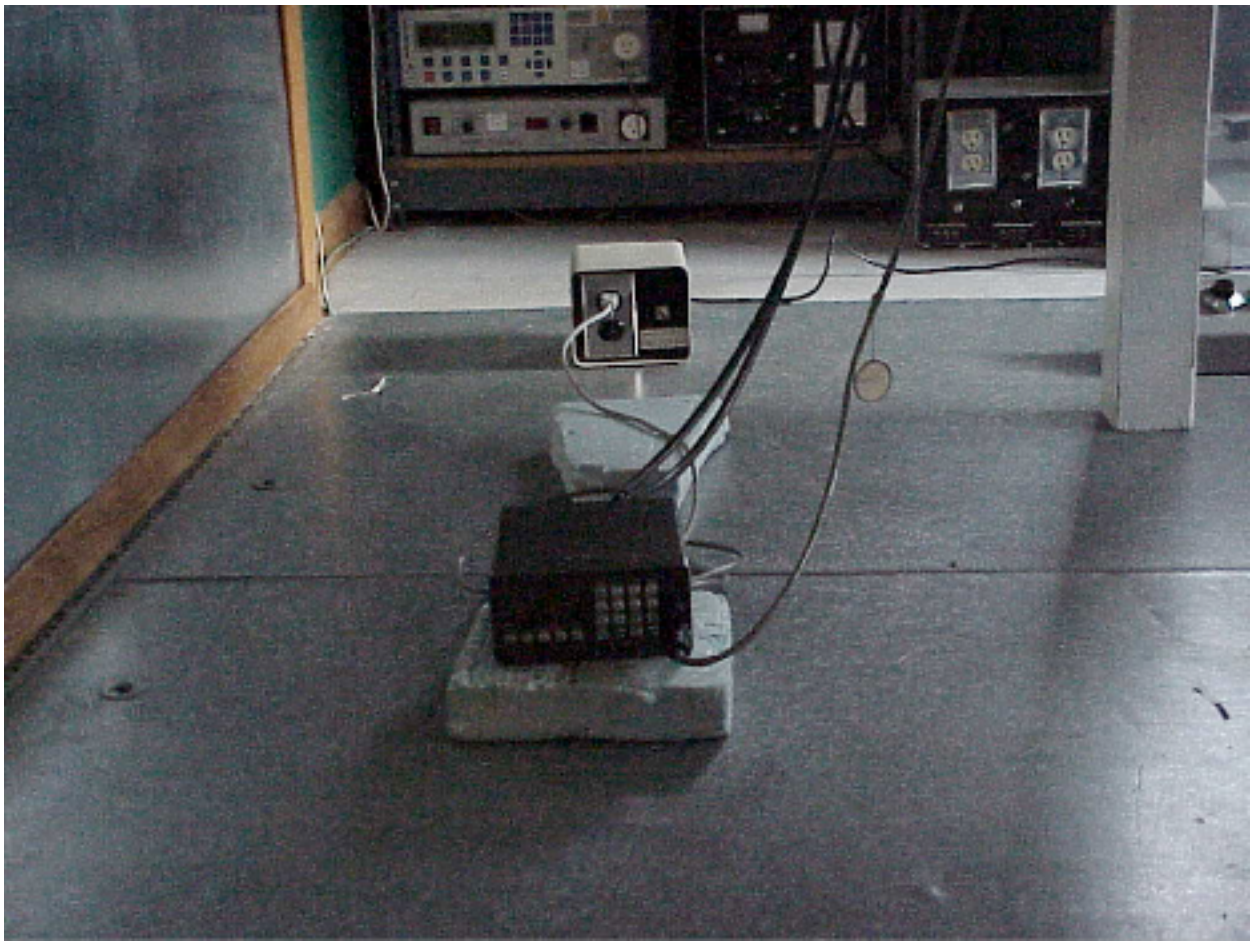


Radiated Immunity Test Setup

VIII. Test Setup Photographs for AIS EMC Tests Cont'd:

Transient Immunity Test Setup

VIII. Test Setup Photographs for AIS EMC Tests Cont'd:



Conducted Immunity & Supply Failure Test Setup