Serial No. GM26069c
Revised

# EMC TEST REPORT
# FOR THE
# L3 COMMUNICATIONS
# AVIATION RECORDERS CORPORATION
# AUTOMATIC IDENTIFICATION SYSTEM (AISA1)
# PERFORMANCE TESTS

**Prepared for:**

L3 Communications Aviation Recorders Corp.
6000 Fruitville Road
Sarasota, FL 34232
USA

**Submitted by:**

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**Accredited**
Cert 898.01

# L3 Communications Aviation Recorders Corporation
# EMC Tests
# At
# Green Mountain Electromagnetics, Inc.
# Middlebury, Vermont

**Unit: Automatic Identification System (AISA1)**
**Evaluated: November 7-10, 2006**

## I. Applicable Standards:

The unit described in this report was evaluated for compliance with European standards:

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)," paragraph 13, "EMC Tests" and paragraph 15.5, "Conducted Spurious Emissions Conveyed to the Antenna."

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." All procedures and equipment are in accordance with IEC 61993 and IEC 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),"

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 (2000),"

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

EN 61000-4-4, "Testing and Measurement Techniques – Section 4: Electrical Fast Transient/Burst Immunity Test (2001),"

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

EN 61000-4-11, "Testing and Measurement Techniques – Section 11: Voltage Dips, Short Interruptions and Voltage Variations Immunity Tests (2000)."

## II. Unit Tested:

The L3 Communications Aviation Recorders Corporation, Automatic Identification System provides continuous signal and data transmission for ship identification. The AISA1 uses DC 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 | Serial Number |
|---|---|---|
| AISA1-000-10 | L3 Communications Corp. | 000383088 |

The following table describes the system physical and electrical properties:

| Model | Volts/Amps/Hertz | H/W/D in cm |
|---|---|---|
| AISA1-000-10 | 12 - 24 VDC, 5 A | 8/16/19 |

The table below describes the support equipment used:

| Product | Manufacturer | Model | Serial Number |
|---|---|---|---|
| AISA1 | L3 | AISA1-000-90 | 000374785 |
| Power Supply | MFJ | MFJ-4035MV | L31D 5144 |
| Power Supply | Tenma | 72-7695 | 0003094 |
| PC | Antec | Custom by L3 | L3ID 9851 |
| Attenuator, Fixed | Bird | 25-A-MFN-30 | 0323 |
| Attenuator, Variable | Agilent | 8496A | MY42140708 |

| | | | |
|---|---|---|---|
| Attenuator, Variable | Agilent | 8494A | MY42140564 |
| Monitor | Princeton | EO700 | KNAA4621773 |
| Mouse | Microsoft | Intellimouse | 3882A611 |
| Keyboard | Microsoft | KWD 203 | 9910249571 |
| Antennas (2) | L3 | GPS | n/a |

The table below describes the cables used:

| Type | Description | Rating |
|---|---|---|
| Power | Twisted Shielded Pair | n/a |
| RF Power/Signal | UHF Coaxial | n/a |
| Digital | Serial Twisted Shielded Pair | n/a |
| Signal | Ethernet Unshielded, Plastic Jack | UL |

**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 (2005), "General Requirements for the Competence of Testing and Calibration Laboratories." For scope of accreditation, contact GME.

## IV. Summary of Results:

The L3 Communications Aviation Recorders Corporation AISA1 complies with the requirements in IEC 61993-2, paragraphs 13 and 15.5 and IEC 60945, paragraphs 9 and 10. Section X contains the results summarized in the table below.

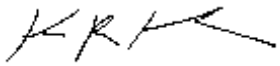
| | Test | Port | IEC 60945 Paragraph | Frequency Range/Level | Specified Values | Measured Values |
|---|---|---|---|---|---|---|
| **1** | Conducted Emissions | Power Lines | **9.2** | 10 kHz - 150 kHz<br>150 kHz - 350 kHz<br>350 kHz - 30 MHz | 96 dBuV to 50 dBuV<br>60 dBuV to 50 dBuV<br>50 dBuV | Within All Limits |
| **2** | Radiated Emissions | Enclosure | **9.3** | 150 kHz - 300 kHz<br>300 kHz - 30 MHz<br>30 MHz - 156 MHz<br>156 MHz - 165 MHz<br>165 MHz - 2 GHz | 80 dBuV/m to 52 dBuV/m<br>52 dBuV/m to 34 dBuV/m<br>54 dBuV/m<br>24 dBuV/m<br>54 dBuV/m | Within All Limits * |
| **3** | Conducted Immunity | Power, Signal and Control Lines | **10.3** | 150 kHz - 80 MHz<br>10 V | A | A |
| **4** | Radiated Immunity | Enclosure | **10.4** | 80 MHz - 2 GHz<br>10 V/m | A | A |
| **5** | Transient Immunity | Power, Signal and Control Lines | **10.5** | 1-kV Common Mode | B | A |
| **6** | Supply Failure | Power Lines | **10.8** | 60 Seconds | C | C |
| **7** | Electrostatic Discharge | Enclosure | **10.9** | 6-kV Contact<br>8-kV Air | B | B<br>* * |
| **8** | Conducted Spurious | TDMA Transmit/ Receive | IEC 61993 **15.5** | 150 kHz to 1 GHz<br>1 GHz to 2 GHz | -57 dBm receive / -36 dBm transmit<br>-47 dBm receive / -30 dBm transmit | Within Limit<br>Within Limit |

** Note 1 - The AISA1 must be properly grounded to achieve these results.*

*** Note 2 - Device communication is disrupted at high ESD levels, but resets automatically. No operator intervention is required.*

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

L3 Communications Aviation Recorders Corp.
6000 Fruitville Road
Sarasota, FL 34232
USA



Kyle R. Kowalczyk
11/21/06

## 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 | 3/8/06 | 3/08/07 |
| Amplifier | Hewlett-Packard | 8447 D | 2944A07313 | 6/1/06 | 6/1/07 |
| Amplifier | Amplifier Research | 1W1000 | 2074 | 11/14/05 | 11/14/06 |
| Signal Generator | Hewlett-Packard | E4421B | US38220195 | 11/14/05 | 11/14/06 |
| Plotter | Hewlett-Packard | 7475A | 2517A05281 | n/a | n/a |
| LISN | Com-Power | LI-115 | 241031 | 8/24/05 | 11/24/06 |
| Broadband E-field Antenna | Antenna Research Associates | LPB-2513/A | 1125 | 11/14/05 | 11/14/06 |
| Broadband Parallel-Plate Antenna | GME | GP1-T | 01 | 11/14/05 | 11/14/06 |
| ESD Generator | Schaffner | NSG 435 | 2394 | 3/6/06 | 3/6/07 |
| EFT Generator | Haefely-Trench | PEFT 4010 | 081603-10 | 7/19/06 | 7/19/07 |

| | | | | | |
|---|---|---|---|---|---|
| CDN | Com-Power | M2-25 | 511011 | 4/4/06 | 4/4/07 |
| Interrupt Generator | GME | IG-1 | n/a | 11/14/05 | 11/14/06 |
| Rod Antenna | Electrometrics | RVR-30 | 135 | 11/14/05 | 11/14/06 |

## 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 IX. The equipment was subjected to complete emissions and susceptibility tests.

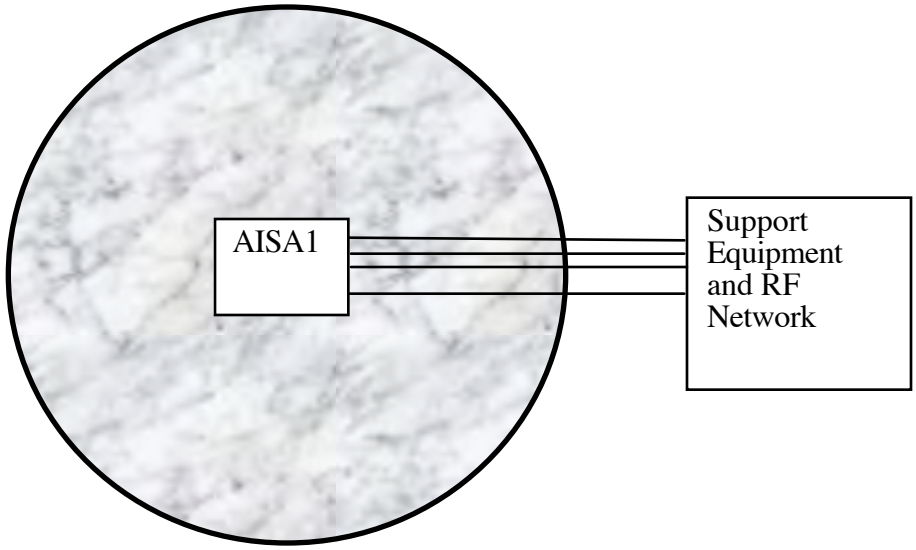



Figure 1 – Block Diagram of EUT on Turntable

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 AISA1, uploaded from the AISA1 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 – Operation as intended during and after testing. No degradation or performance loss within the equipment standard or manufacturer specification limits.
Performance Criterion B – The EUT shall continue to operate as intended after the testing. No degradation or performance loss within the equipment standard or manufacturer specifications. Temporary degradation, or loss of function or performance which is self-recovering, is allowed with no change in state or data storage.
Performance Criterion C – Temporary degradation or loss of function which is self-recoverable or can be restored by control operation.

## VII. 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:
59.4 dBuV corrected limit = 54.0 dBuV/m limit + 20 log(3/3) dB distance – 18.6 dB/m AF + 24 dB cable loss/amp gain.

The GME measurement uncertainty is available upon request.

## VIII. Measurement Procedures for AISA1 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. 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 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.

## VIII. Measurement Procedures for AISA1 EMC Tests Cont'd:

### 2. Radiated Emissions in accordance with CISPR 16 & 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 table and broadband or rod antenna on antenna positioner.
   ii. Observe 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.

**VIII. Measurement Procedures for AISA1 EMC Tests Cont'd:**

**3. Conducted Susceptibility in accordance with IEC 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. 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 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.

**VIII. Measurement Procedures for AISA1 EMC Tests Cont'd:**

**4. Radiated Susceptibility in accordance with IEC 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. 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 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.

**VIII. Measurement Procedures for AISA1 EMC Tests Cont'd:**

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

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 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. Perform final evaluation of unit by noting EUT indicators.

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

Interrupt Voltages: 100% Interrupt Times: 60s

a. Set up instrumentation in laboratory.
   i. Observe 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.

**VIII. Measurement Procedures for AISA1 EMC Tests Cont'd:**

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

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

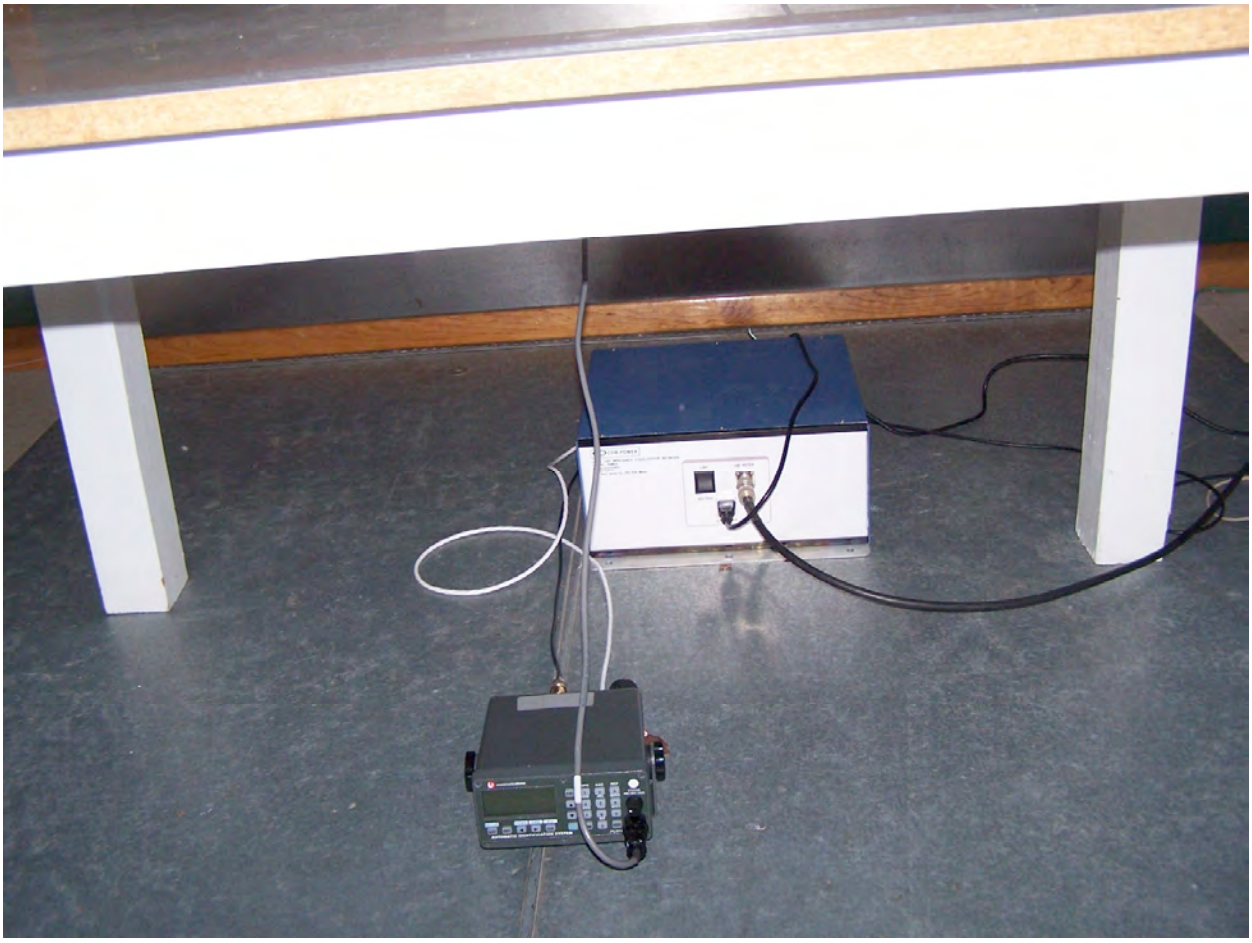
a. Set up instrumentation in laboratory.
   i. Observe temperature, humidity and atmospheric pressure.
b. Verify ESD generator operation.
   i. Perform self-test, verify 150-pF/330-Ω tips are used and connect 2-meter ground cable.
c. Set up, power and operate EUT as described in Section VI.
   i. Position 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.

**8. Conducted Spurious in accordance with IEC 61993-2, Para. 15.5.**

Specification: 150 kHz to 1 GHz: -57 dBm receive / -36 dBm transmit
1 GHz to 2 GHz: -47 dBm receive / -30 dBm transmit

a. Set up EUT and test instrumentation in laboratory.
   i. Connect AISA1 to 120-VAC power and GPS antenna.
b. Verify analyzer and AISA1 operation.
   i. Spectrum analyzer is connected to VHF port.
   ii. AISA1 test signals 1, 2 & 3 are selected from front panel.
   iii. Spectrum analyzer requires warm-up period.
c. Verify AISA1 test signal on spectrum analyzer.
d. Operate EUT at first selected test signal with standard modulation.
e. Record frequency spectrum displayed on analyzer.

## IX. Test Setup Photographs for AISA1 EMC Tests Cont'd:

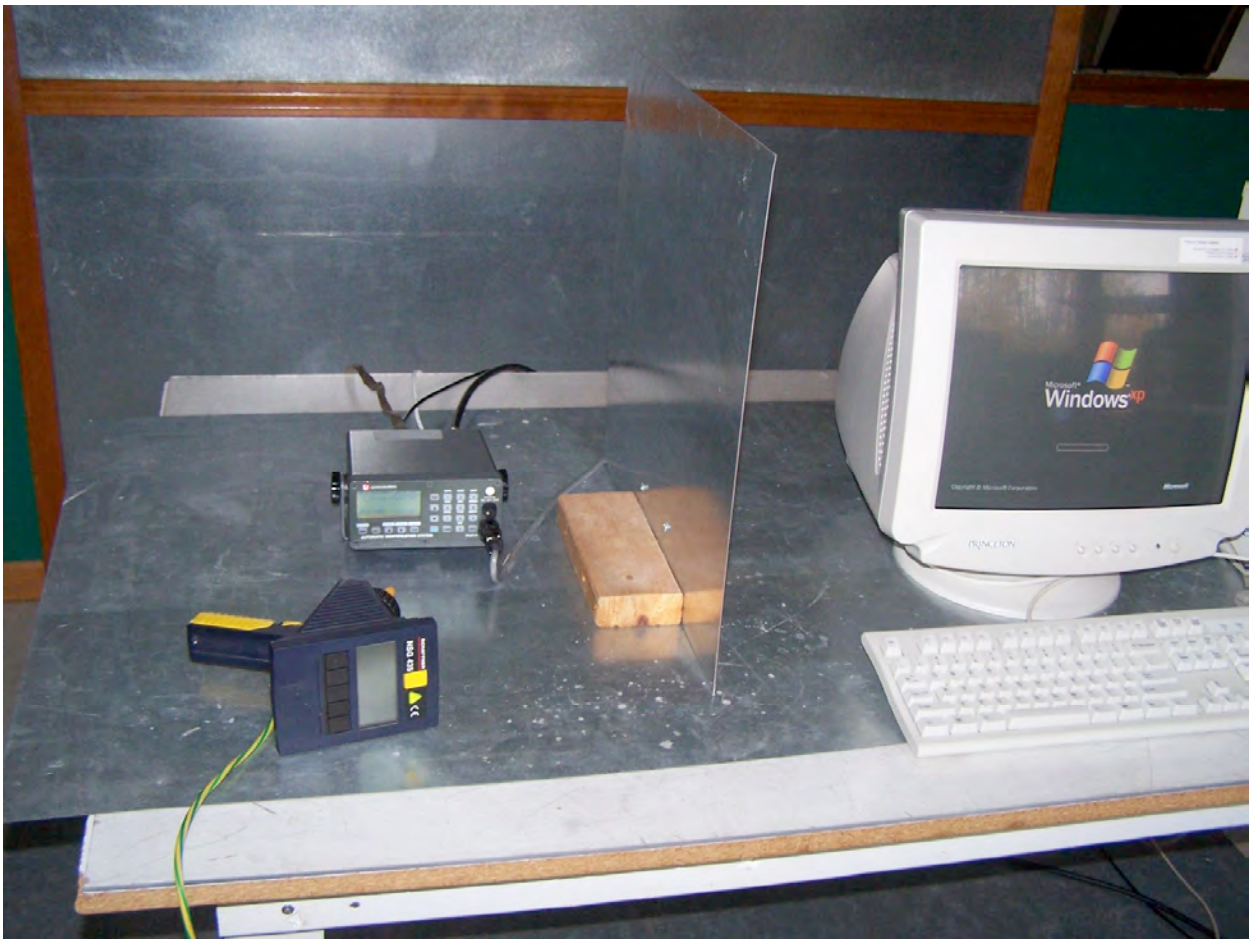


Conducted Emissions Test Setup

## IX. Test Setup Photographs for AISA1 EMC Tests Cont'd:

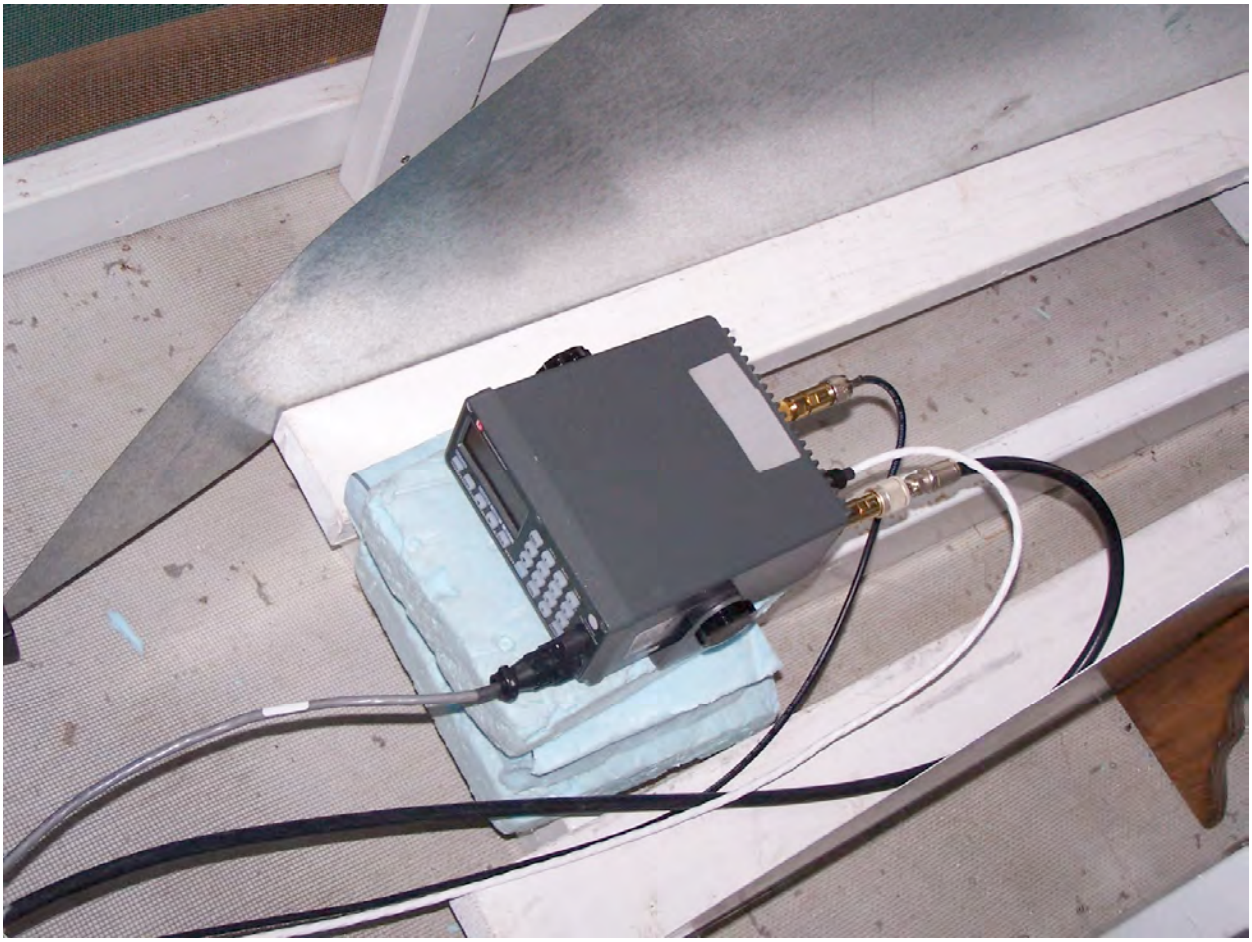
Radiated Emissions Test Setup

## IX. Test Setup Photographs for AISA1 EMC Tests Cont'd:




Electrostatic Discharge Test Setup

## IX. Test Setup Photographs for AISA1 EMC Tests Cont'd:

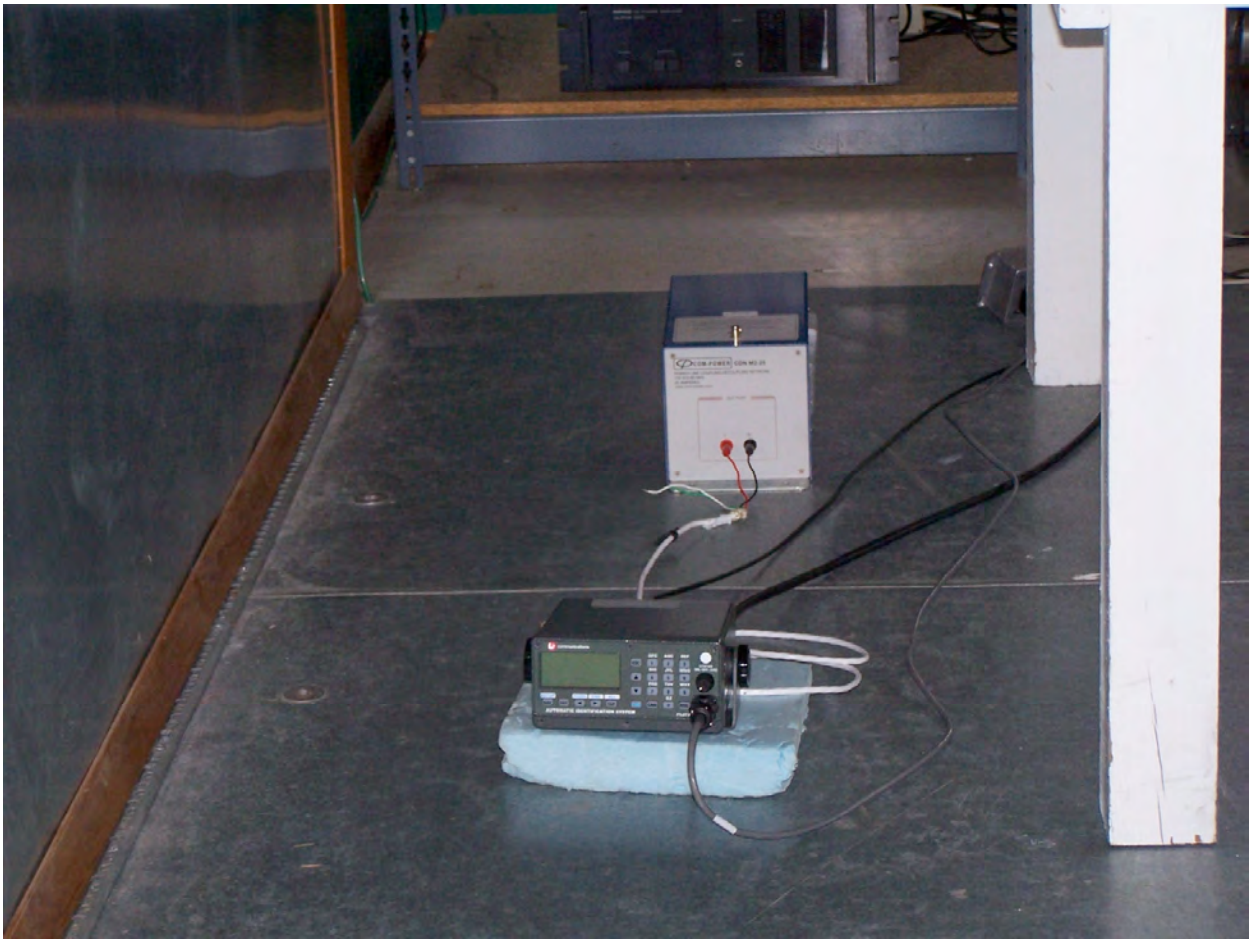


Radiated Immunity Test Setup

## IX. Test Setup Photographs for AISA1 EMC Tests Cont'd:

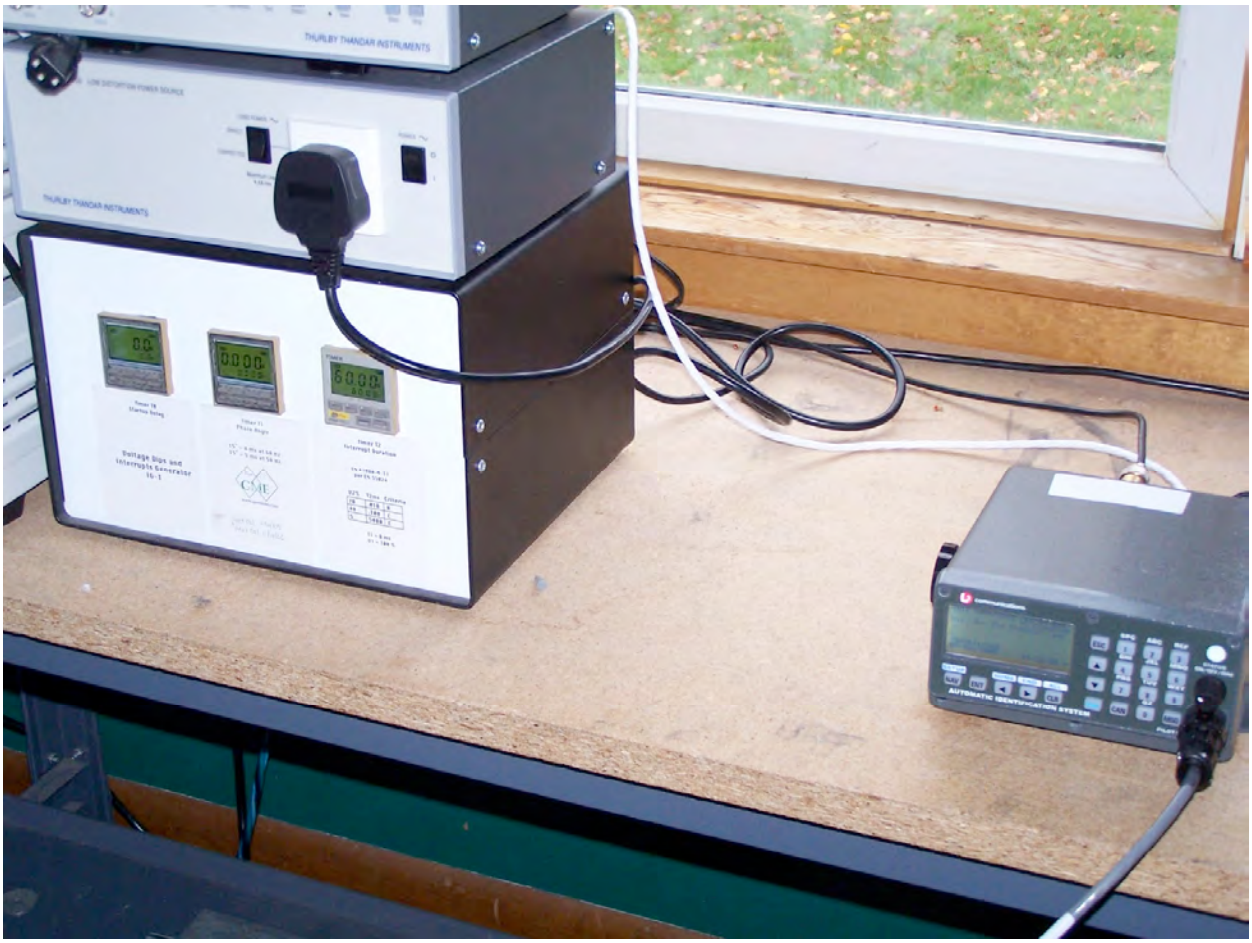
Transient Immunity Test Setup

## IX. Test Setup Photographs for AISA1 EMC Tests Cont'd:



Conducted Immunity Test Setup

## IX. Test Setup Photographs for AISA1 EMC Tests Cont'd:




Supply Failure Test Setup

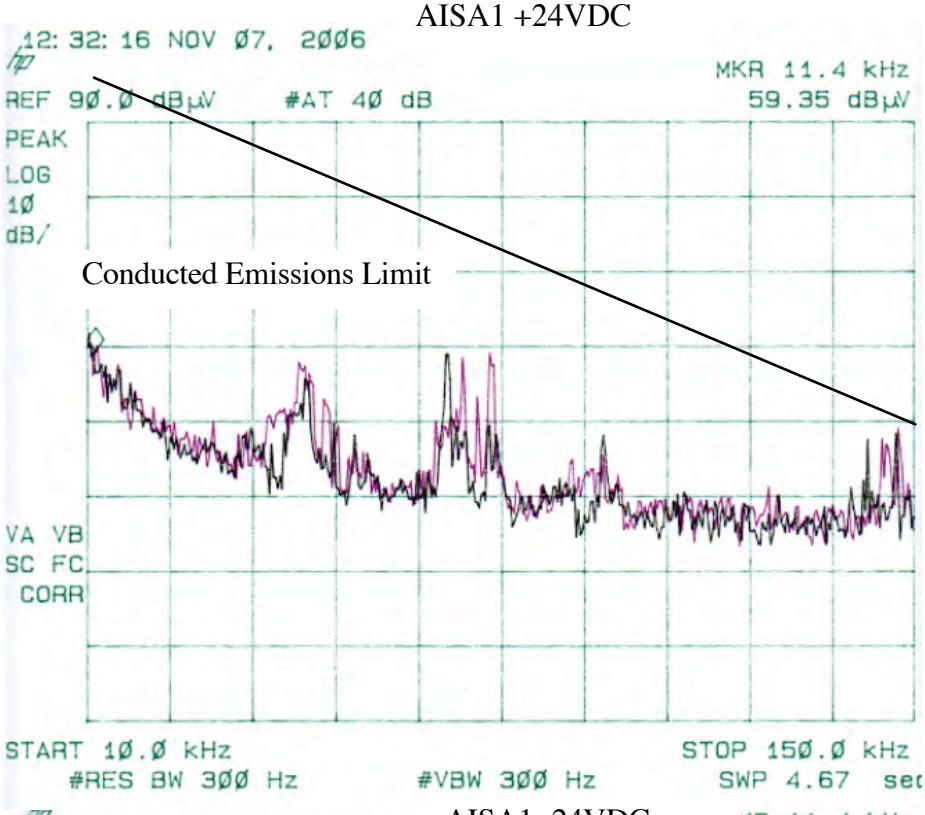
## X. EMC Measurement Results:

### 1. Conducted Emissions – Data.

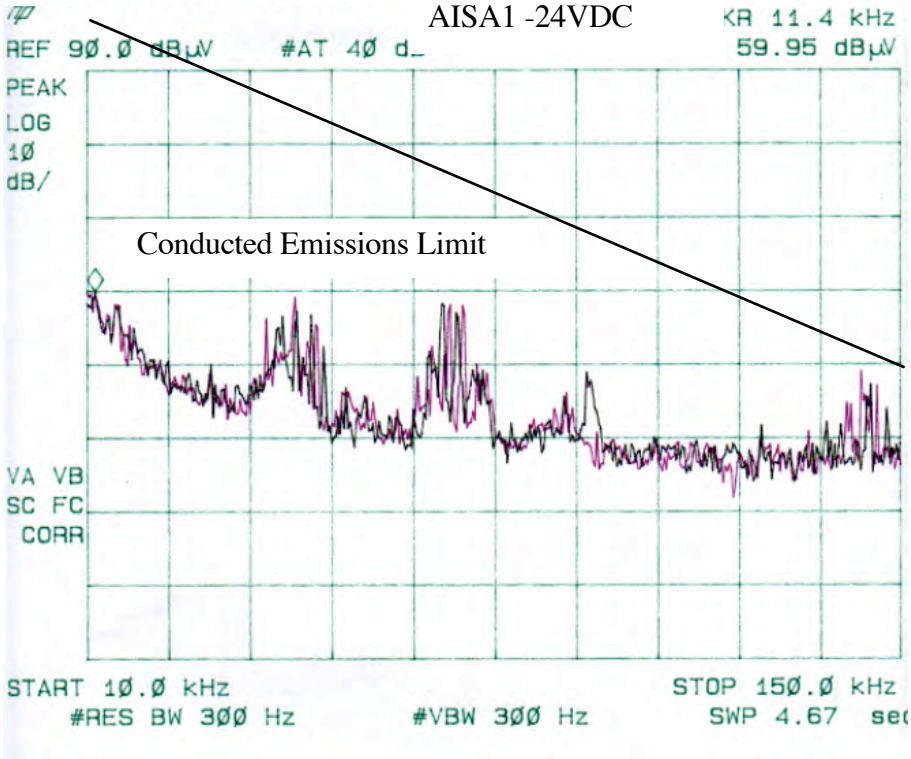
Frequency range: 10 kHz to 150 kHz

Limit: 96 dBuV decreasing to 50 dBuV

AISA1 +24VDC




AISA1 -24VDC



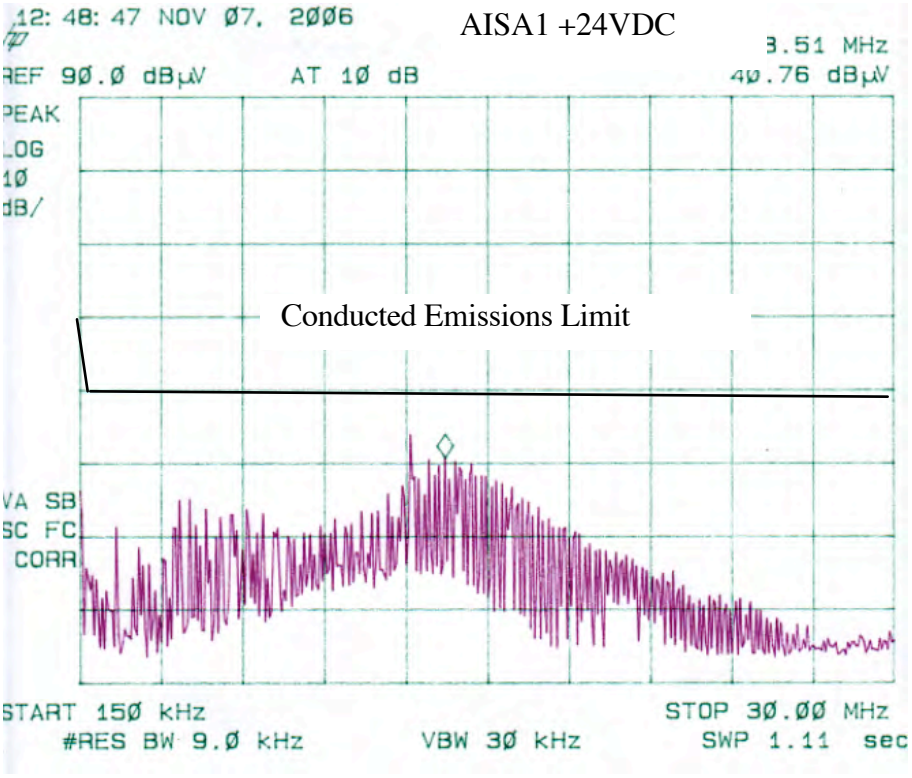
## X. EMC Measurement Results Cont'd:

### 1. Conducted Emissions – Data.

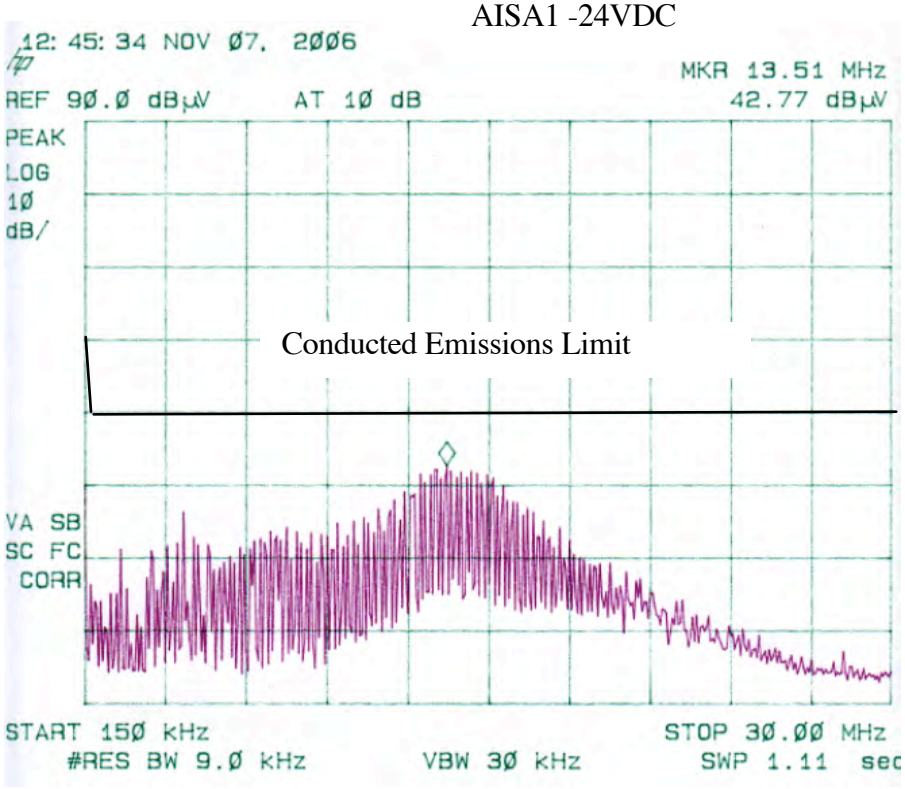
Frequency range: 150 kHz to 350 kHz, Limit: 60 dBuV decreasing to 50 dBuV

Frequency range: 0.35 MHz to 30 MHz, Limit: 50 dBuV

AISA1 +24VDC




AISA1 -24VDC



## X. EMC Measurement Results Cont'd:

### 2. Radiated Emissions – Correction Factors.

The table below describes the correction factors necessary to apply the limit to the spectrum analyzer output. The following pages contain the spectrum analyzer output with the corrected specification limits superimposed. The black pen is the ambient condition, and the other color identifies EUT emissions.

| Frequency kHz | Limit @ 3m dBuV/m | Antenna dB | Correction * dB | Delta dB | Corrected Limit dBuV/m |
|---|---|---|---|---|---|
| 150 | 80 | 41 | 51.5 | 10.5 | 90.5 |
| 300 | 52 | 39 | 51.5 | 12.5 | 64.5 |
| 30000 | 34 | 37 | 51.5 | 14.5 | 48.5 |
| * 51.5 dB, H- to E-field correction in free space -> 20 log (377Ω) | | | | | |

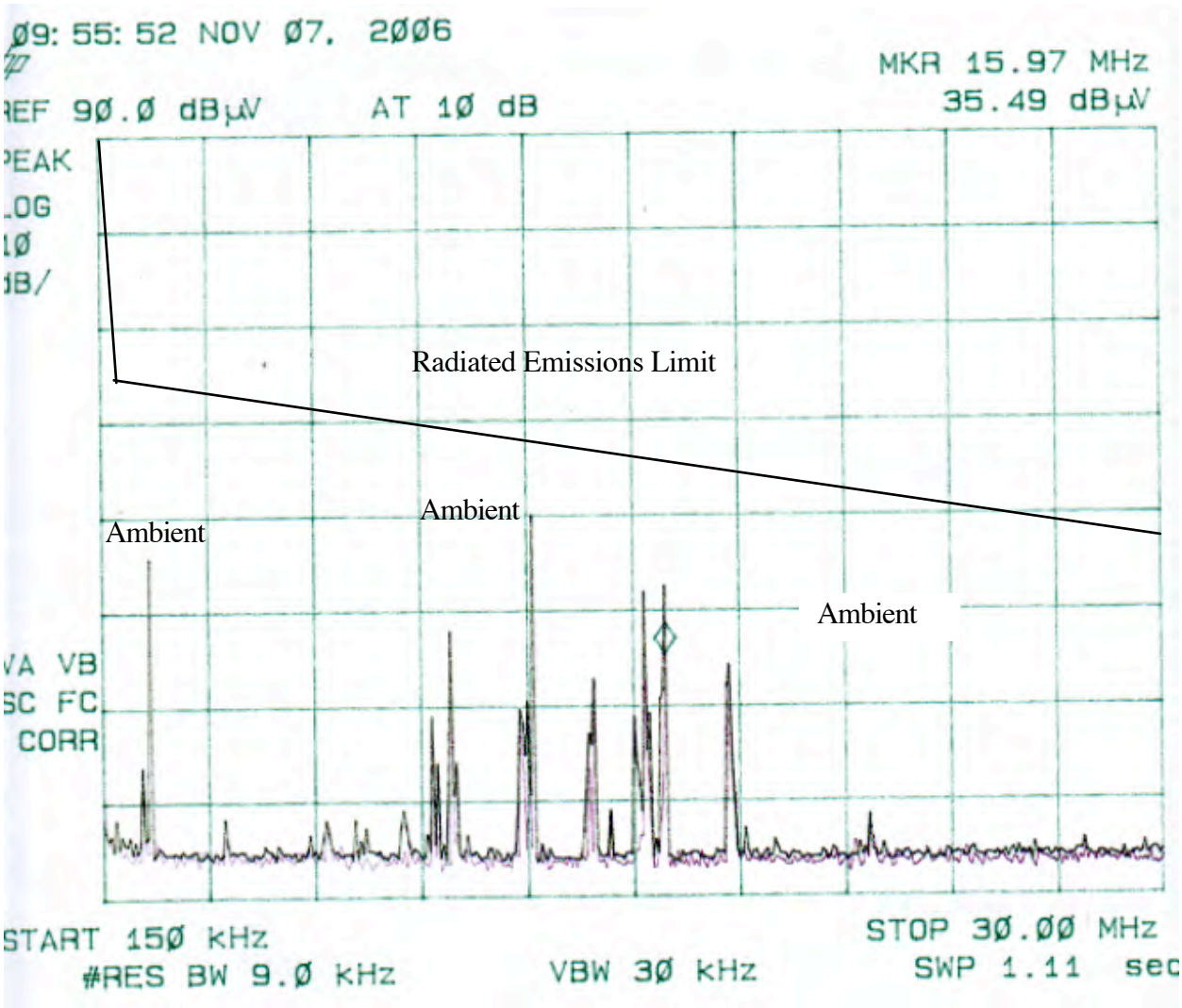
| Frequency MHz | 3m limit dBuV/m | Antenna dB | Amp dB | Cable dB | Delta dB | Corrected Limit dBuV/m |
|---|---|---|---|---|---|---|
| 30 | 54 | 18.6 | 29.0 | 5.0 | 5.4 | 59.4 |
| 50 | 54 | 15.1 | 29.0 | 5.0 | 8.9 | 62.9 |
| 75 | 54 | 8.1 | 29.0 | 5.0 | 15.9 | 69.9 |
| 100 | 54 | 12.2 | 28.0 | 6.0 | 9.8 | 63.8 |
| 125 | 54 | 12.9 | 28.0 | 6.0 | 9.1 | 63.1 |
| 155 | 54 | 11.1 | 28.0 | 6.0 | 10.9 | 64.9 |
| 156 | 24 | 13.2 | 27.0 | 7.0 | 6.8 | 30.8 |
| 165 | 24 | 13.2 | 27.0 | 7.0 | 6.8 | 30.8 |
| 166 | 54 | 13.2 | 27.0 | 7.0 | 6.8 | 60.8 |
| 300 | 54 | 14.9 | 28.0 | 7.0 | 6.1 | 60.1 |
| 500 | 54 | 18.6 | 28.0 | 7.0 | 2.4 | 56.4 |
| 1000 | 54 | 24.2 | 27.0 | 7.0 | -4.2 | 49.8 |
| 1500 | 54 | 26.1 | 27.0 | 8.0 | -7.1 | 46.9 |
| 2000 | 54 | 26.8 | 22.0 | 8.0 | -12.8 | 41.2 |

Tables 1 & 2 – Corrected CE Limit

## X. EMC Measurement Results Cont'd:

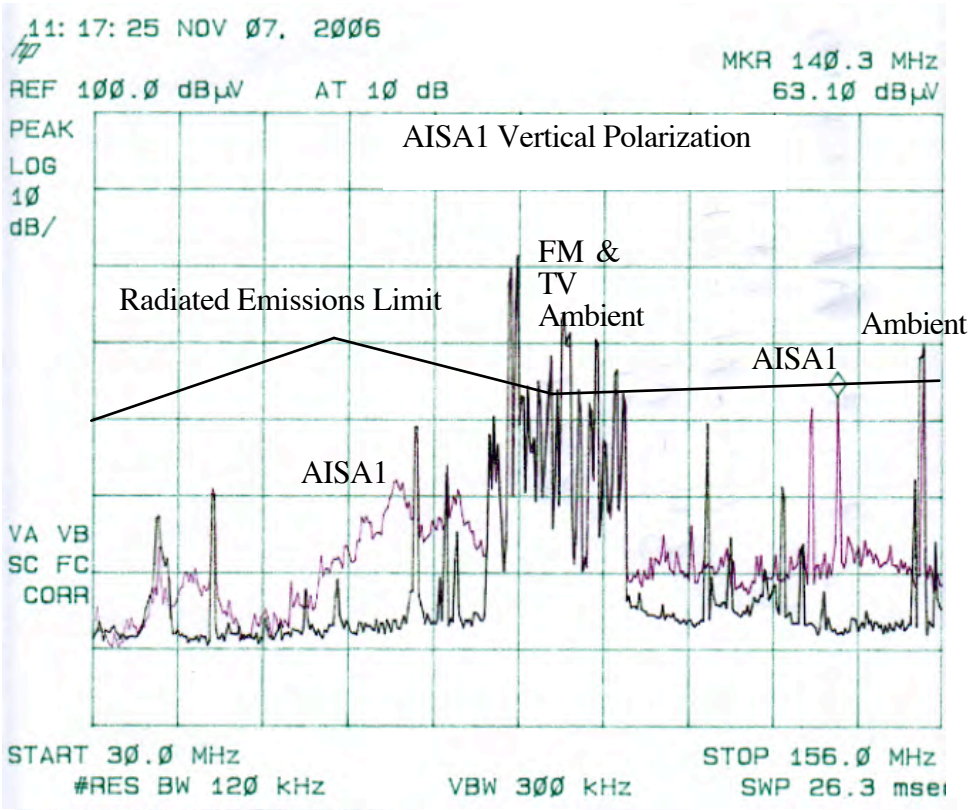
### 2. Radiated Emissions – Data.

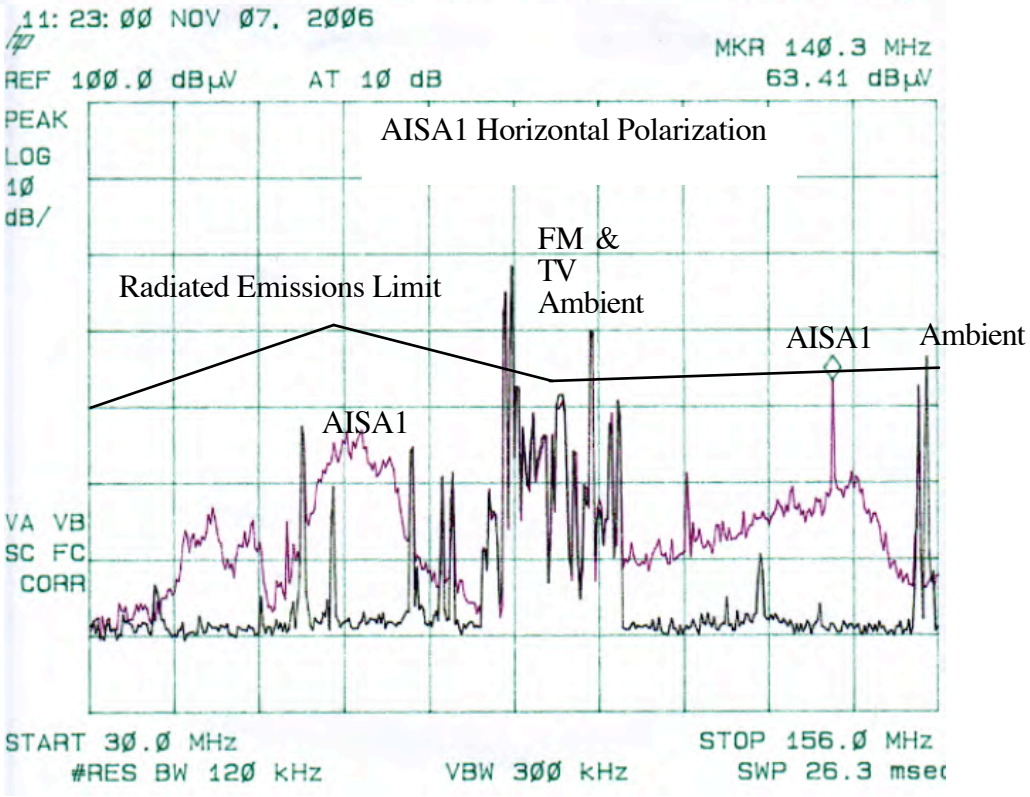
AISA1 Vertical Polarization



## X. EMC Measurement Results Cont'd:

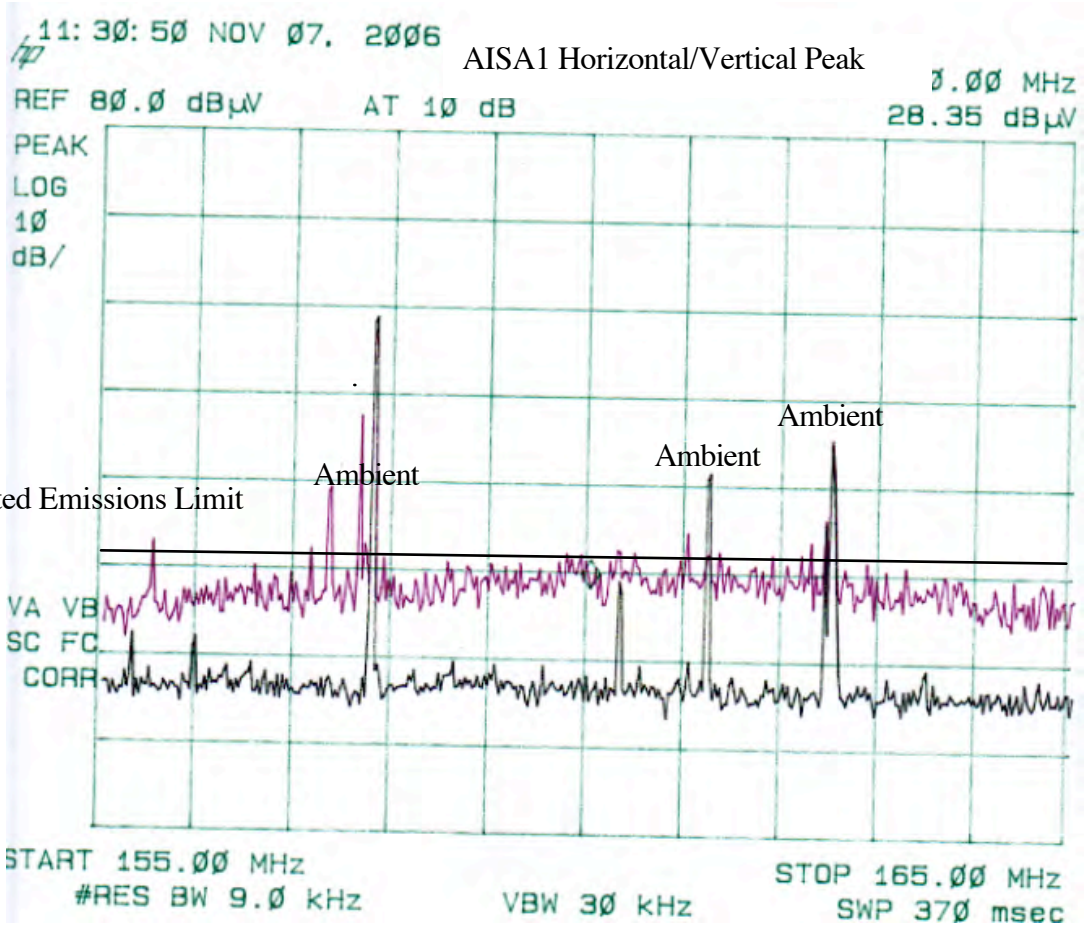
### 2. Radiated Emissions – Data.



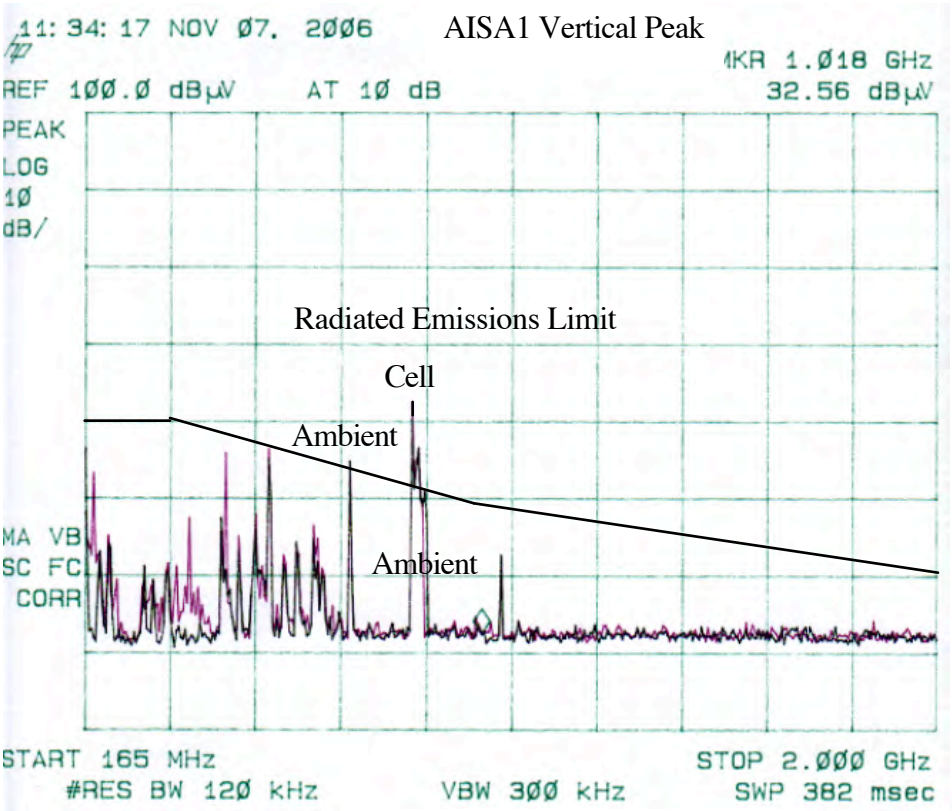
## X. EMC Measurement Results Cont'd:

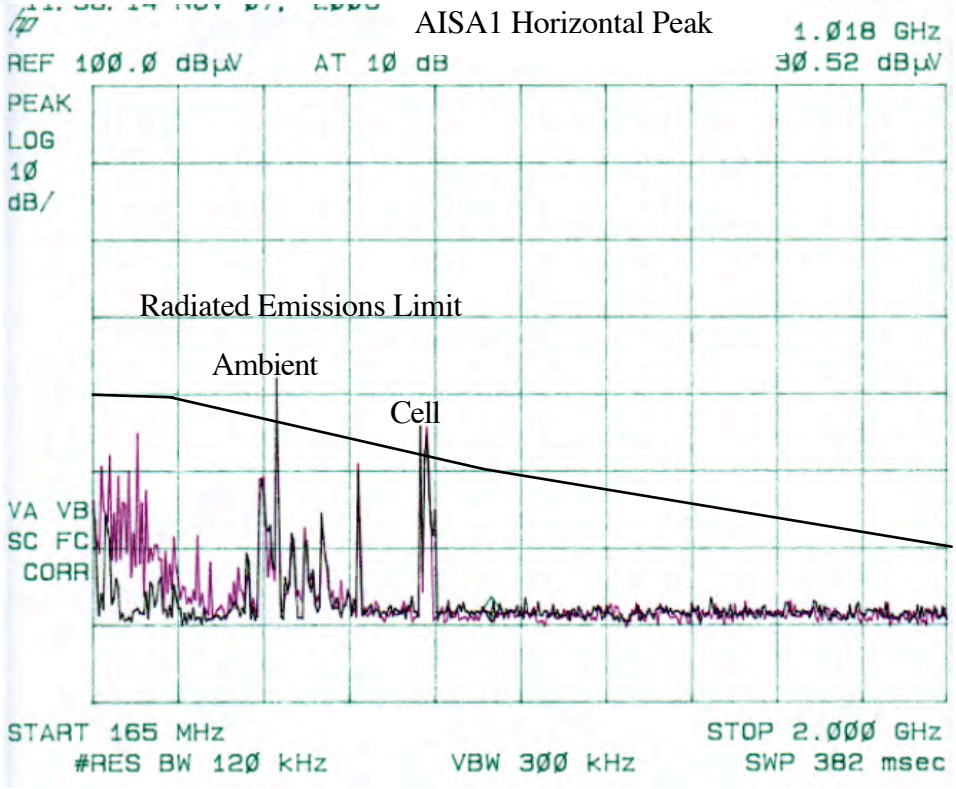
### 2. Radiated Emissions – Data.



## X. EMC Measurement Results Cont'd:

### 2. Radiated Emissions – Data.



## X. EMC Measurement Results Cont'd:

### 3. Conducted Immunity – Data.

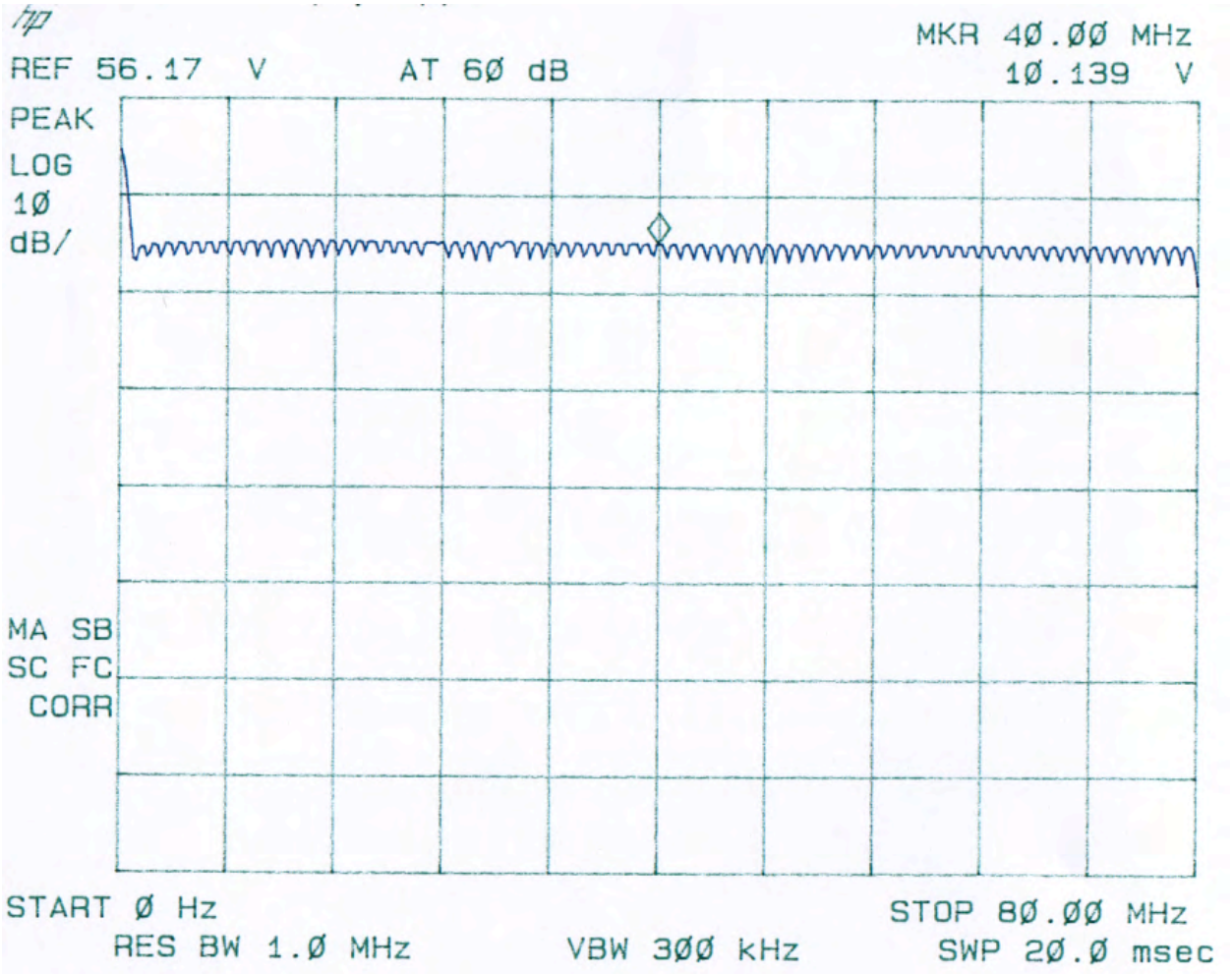
The system exhibits no susceptibility to 10-V conducted signals amplitude modulated at 400 Hz, 80%, applied directly to the power lines from 150 kHz to 80 MHz. Frequencies listed are samples; sweep rate is <1.5 decade/s and dwell > EUT response time. The following page contains the spectrum analyzer output from device calibration.

| Frequency (MHz) | Voltage | Evaluation | Criteria | Criteria Req'd | Criteria Met |
|---|---|---|---|---|---|
| 0.150 | 10 | PC Display | No Degradation | A | A |
| 0.500 | 10 | PC Display | No Degradation | A | A |
| 0.750 | 10 | PC Display | No Degradation | A | A |
| 1 | 10 | PC Display | No Degradation | A | A |
| 2 | 10 | PC Display | No Degradation | A | A |
| 3 | 10 | PC Display | No Degradation | A | A |
| 5 | 10 | PC Display | No Degradation | A | A |
| 10 | 10 | PC Display | No Degradation | A | A |
| 15 | 10 | PC Display | No Degradation | A | A |
| 20 | 10 | PC Display | No Degradation | A | A |
| 25 | 10 | PC Display | No Degradation | A | A |
| 30 | 10 | PC Display | No Degradation | A | A |
| 35 | 10 | PC Display | No Degradation | A | A |
| 40 | 10 | PC Display | No Degradation | A | A |
| 45 | 10 | PC Display | No Degradation | A | A |
| 50 | 10 | PC Display | No Degradation | A | A |
| 55 | 10 | PC Display | No Degradation | A | A |
| 60 | 10 | PC Display | No Degradation | A | A |
| 65 | 10 | PC Display | No Degradation | A | A |
| 70 | 10 | PC Display | No Degradation | A | A |
| 75 | 10 | PC Display | No Degradation | A | A |
| 80 | 10 | PC Display | No Degradation | A | A |

Table 3 – Conducted Immunity Results

## X. EMC Measurement Results Cont'd:

### 3. Conducted Immunity – Calibration.




Applied High-Frequency Conducted Immunity Voltage

## X. EMC Measurement Results Cont'd:

### 4. Radiated Immunity – Data.

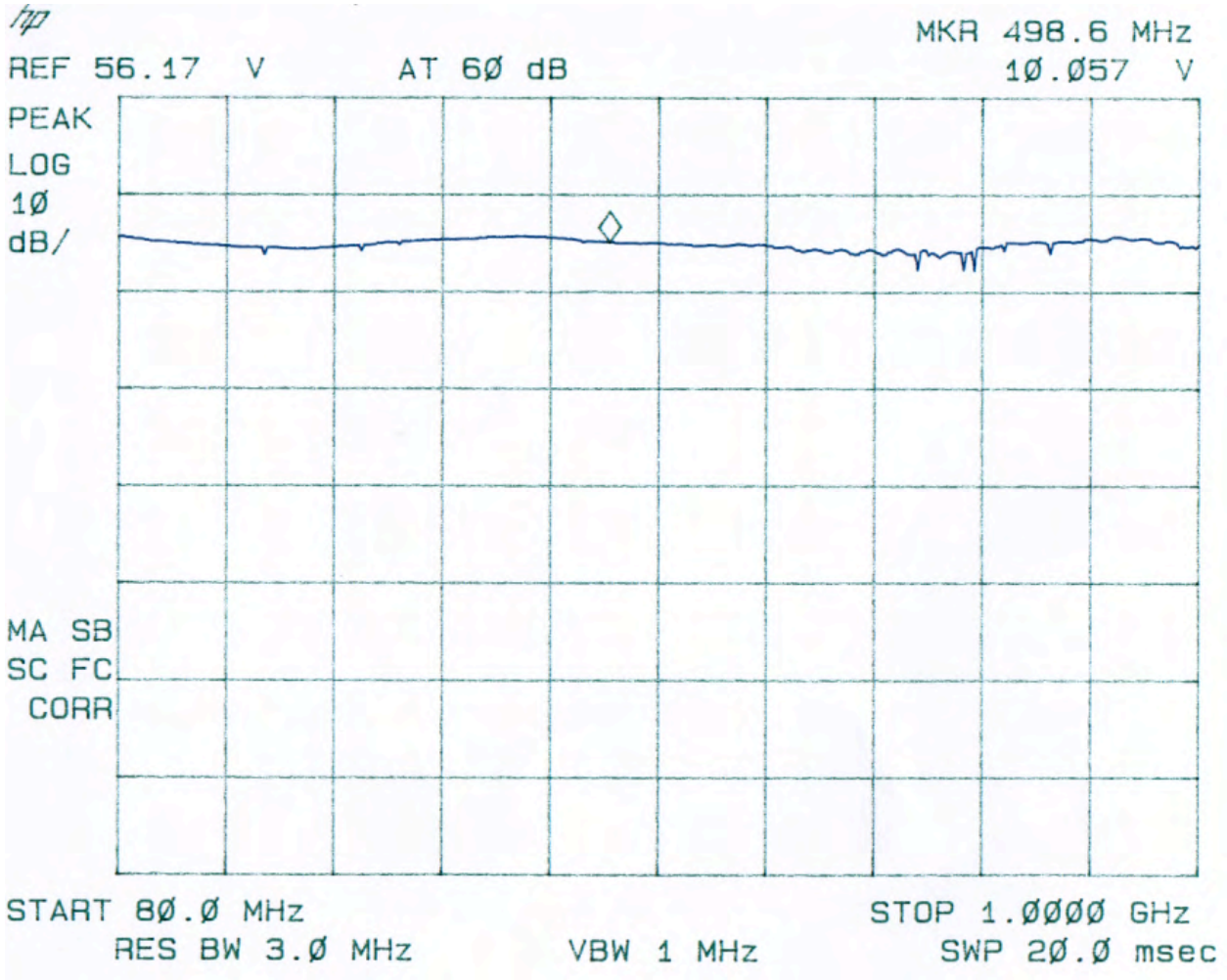
The system exhibits no susceptibility to 10-V/m radiated electric fields, amplitude modulated at 400 Hz, 80%, from 80 MHz to 2 GHz. Frequencies listed are samples; sweep rate is <1.5 decade/s and dwell > EUT response time. The following page contains the spectrum analyzer output from device calibration.

| Frequency (MHz) | Voltage (V) | Evaluation | Criteria | Criteria Req'd | Criteria Met |
|---|---|---|---|---|---|
| 80 | 10 | PC Display | No Degradation | A | A |
| 100 | 10 | PC Display | No Degradation | A | A |
| 120 | 10 | PC Display | No Degradation | A | A |
| 140 | 10 | PC Display | No Degradation | A | A |
| 160 | 10 | PC Display | No Degradation | A | A |
| 180 | 10 | PC Display | No Degradation | A | A |
| 200 | 10 | PC Display | No Degradation | A | A |
| 250 | 10 | PC Display | No Degradation | A | A |
| 300 | 10 | PC Display | No Degradation | A | A |
| 350 | 10 | PC Display | No Degradation | A | A |
| 400 | 10 | PC Display | No Degradation | A | A |
| 450 | 10 | PC Display | No Degradation | A | A |
| 500 | 10 | PC Display | No Degradation | A | A |
| 600 | 10 | PC Display | No Degradation | A | A |
| 700 | 10 | PC Display | No Degradation | A | A |
| 800 | 10 | PC Display | No Degradation | A | A |
| 900 | 10 | PC Display | No Degradation | A | A |
| 1000 | 10 | PC Display | No Degradation | A | A |
| 1200 | 10 | PC Display | No Degradation | A | A |
| 1400 | 10 | PC Display | No Degradation | A | A |
| 1600 | 10 | PC Display | No Degradation | A | A |
| 1800 | 10 | PC Display | No Degradation | A | A |
| 2000 | 10 | PC Display | No Degradation | A | A |

Table 4 – Radiated Immunity Results

## X. EMC Measurement Results Cont'd:

### 4. Radiated Immunity – Calibration.




Applied Radiated Immunity Voltage

## X. EMC Measurement Results Cont'd:

### 5. Transient Immunity – Data.

The system exhibits no susceptibility to 0.5/1-kV transients applied capacitively to the signal, power and control lines. One-kV transients are 15 ms in duration, delivered in 5-kHz bursts every 300 ms.

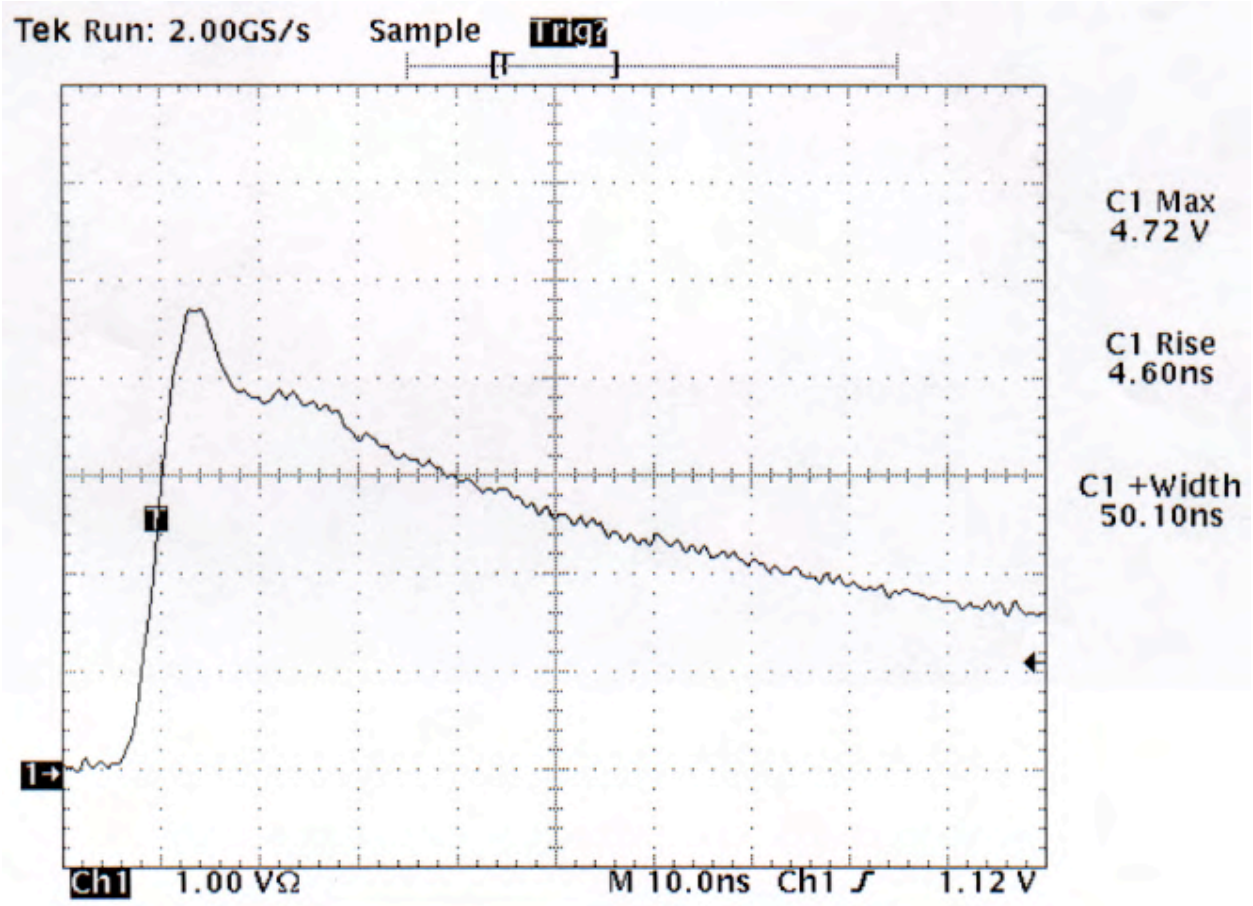
The following page contains the applied waveform output from device calibration.

| Level | Voltage | Application Port | Polarity and Duration | Spec. | Result |
|---|---|---|---|---|---|
| 1 | 500 | Clamp Power Lines | Plus/3 Minutes | B | A |
| 2 | 1000 | Clamp Power Lines | Plus/3 Minutes | B | A |
| 1 | 500 | Clamp Power Lines | Minus/3 Minutes | B | A |
| 2 | 1000 | Clamp Power Lines | Minus/3 Minutes | B | A |
| 1 | 500 | Clamp Data Lines | Plus/3 Minutes | B | A |
| 2 | 1000 | Clamp Data Lines | Plus/3 Minutes | B | A |
| 1 | 500 | Clamp Data Lines | Minus/3 Minutes | B | A |
| 2 | 1000 | Clamp Data Lines | Minus/3 Minutes | B | A |

Table 5 – Transient Immunity Results

## X. EMC Measurement Results Cont'd:

### 5. Transient Immunity – Calibration.




Applied Electrical Fast Transient Waveform

## X. EMC Measurement Results Cont'd:

### 6. Supply Failure – Data.

The system exhibits acceptable susceptibility to voltage interruptions of 60 s for 3 repetitions.

| Interrupt Voltage | Duration (s) | Application Port | Phase Angle | Spec. | Result |
|---|---|---|---|---|---|
| 0 | 60 | Power Entry | 0° | C | C |
| 0 | 60 | Power Entry | 0° | C | C |
| 0 | 60 | Power Entry | 0° | C | C |

Table 6 – Supply Failure Results

## X. EMC Measurement Results Cont'd:

### 7. ESD – Data.

The unit exhibits acceptable susceptibility to 6-kV contact/ 8-kV air discharges, applied singly or repetitively, and directly or indirectly.

Device communication is disrupted at high ESD levels, but resets automatically. No operator intervention is required.

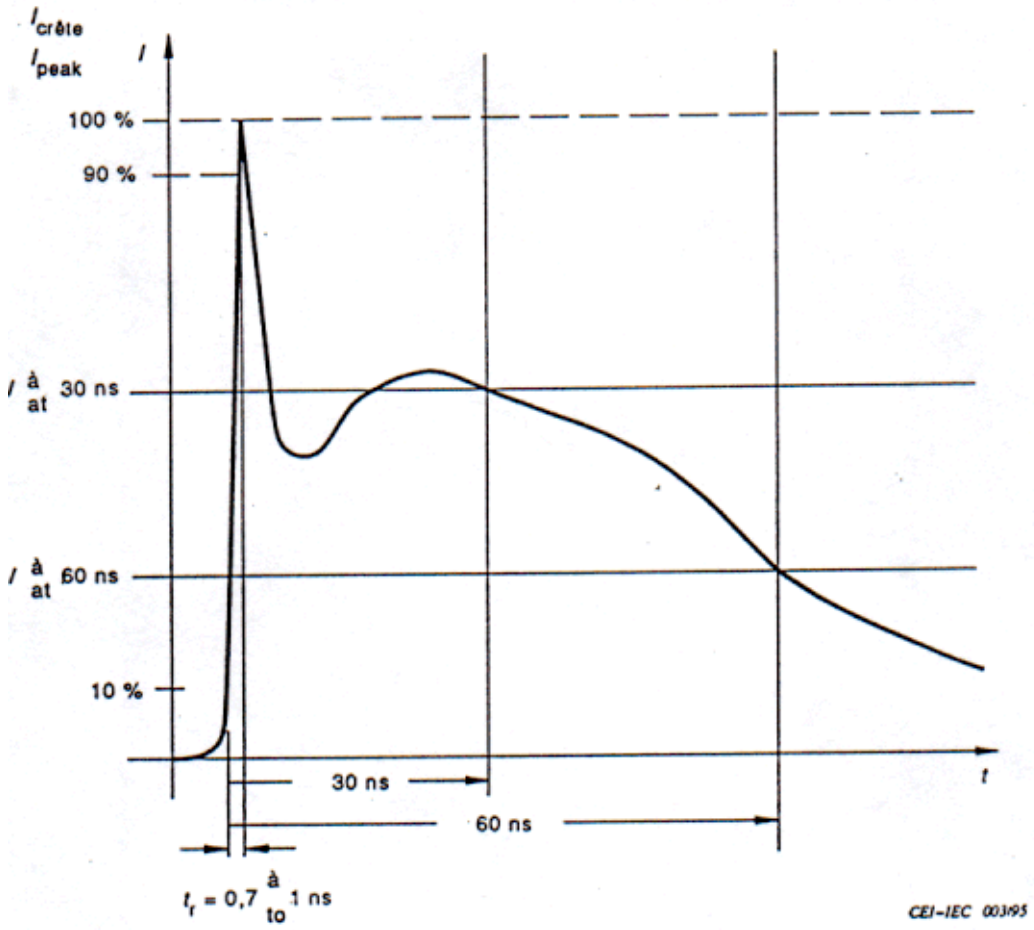
The following page contains the applied waveform output from device calibration.

| Level | Voltage | Application Point | Contact/Air | Spec. | Result |
|---|---|---|---|---|---|
| 1 | 2 | Enclosure | Contact | B | A |
| 2 | 4 | Enclosure | Contact | B | A |
| x | 6 | Enclosure | Contact | B | B |
| 1 | 2 | Enclosure | Air | B | A |
| 2 | 4 | Enclosure | Air | B | A |
| 3 | 8 | Enclosure | Air | B | B |
| 1 | 2 | Coupling Plane | Contact | B | A |
| 2 | 4 | Coupling Plane | Contact | B | A |
| x | 6 | Coupling Plane | Contact | B | B |
| 1 | 2 | Coupling Plane | Air | B | A |
| 2 | 4 | Coupling Plane | Air | B | A |
| 3 | 8 | Coupling Plane | Air | B | B |
| 1 | 2 | Connector | Contact | B | A |
| 2 | 4 | Connector | Contact | B | A |
| x | 6 | Connector | Contact | B | B |
| 1 | 2 | Connector | Air | B | A |
| 2 | 4 | Connector | Air | B | A |
| 3 | 8 | Connector | Air | B | B |

Table 7 – ESD Immunity Results

## X. EMC Measurement Results Cont'd:

### 7. ESD – Waveform.

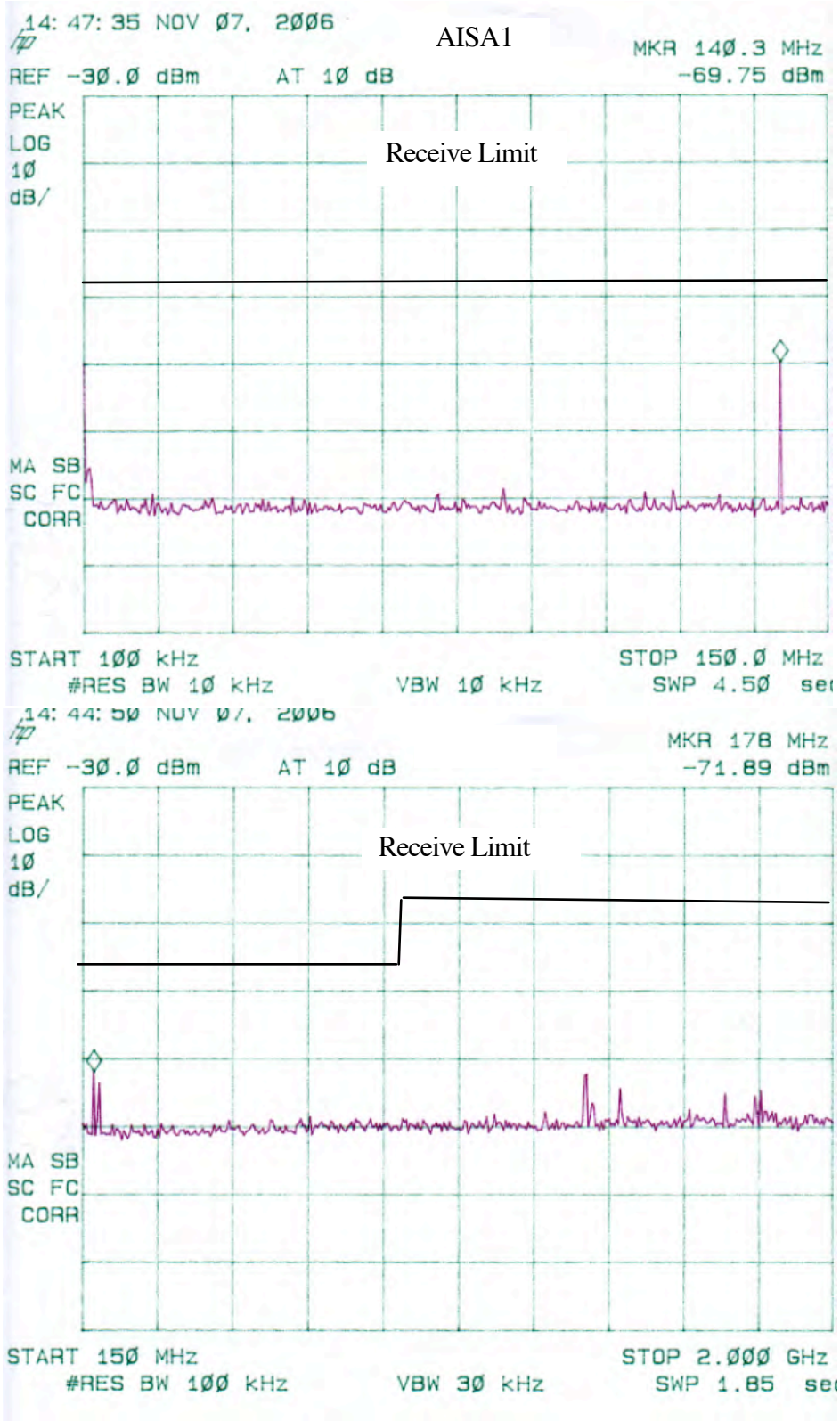



Applied ESD Event

## X. EMC Measurement Results Cont'd:

### 8. Conducted Spurious.

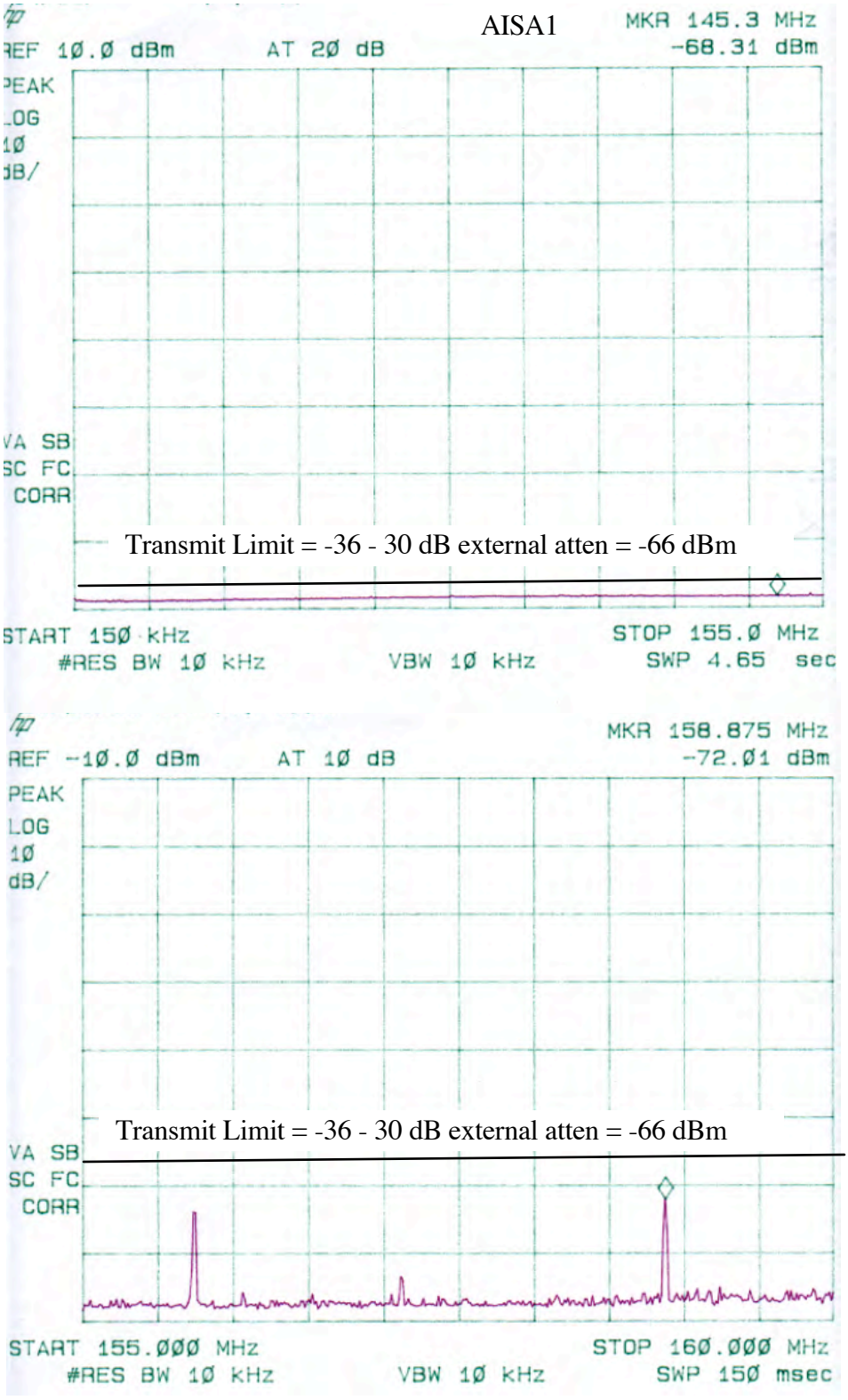
Receive Specification: 150 kHz to 1 GHz: -57 dBm; 1 GHz to 2 GHz: -47 dBm



## X. EMC Measurement Results Cont'd:

### 8. Conducted Spurious.

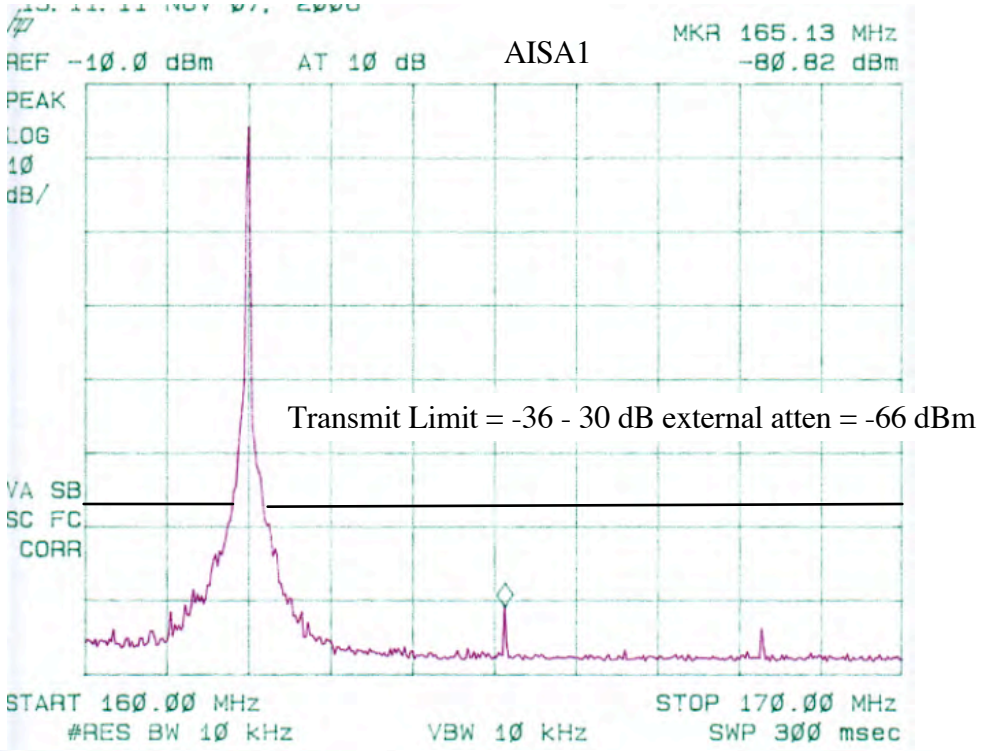
Transmit Specification: 150 kHz to 1 GHz: -36 dBm

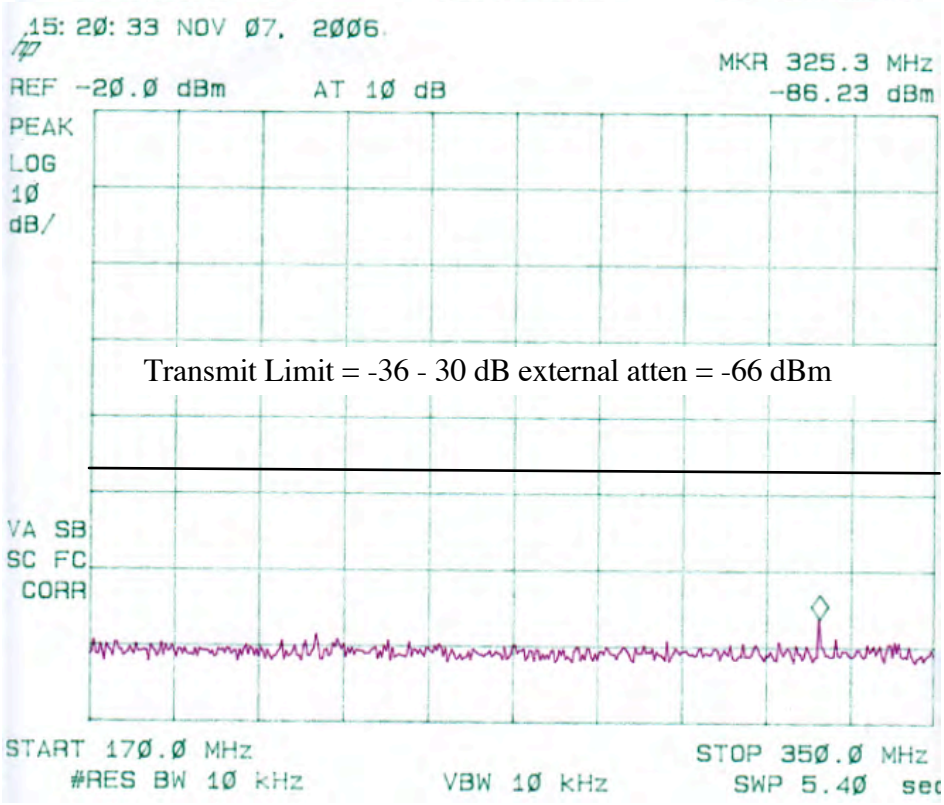


## X. EMC Measurement Results Cont'd:

### 8. Conducted Spurious.

Transmit Specification: 150 kHz to 1 GHz: -36 dBm



## X. EMC Measurement Results Cont'd:

### 8. Conducted Spurious.

Transmit Specification: 150 kHz to 1 GHz: -36 dBm; 1 GHz to 2 GHz: -30 dBm