



**Standard(s):** EN55022:1994 + A1:1995 + A2:1997  
Class B

**Model(s):** Energy Meter (AD7755)

**Prepared for:** Analog Devices, Inc.  
804 Woburn Street  
Wilmington, MA 01887

**Date(s) of Test:** September 8, 1999

**Prepared by:** \_\_\_\_\_ Date \_\_\_\_\_  
Paul A. Ullrich, Compliance Engineer

**Reviewed by:** \_\_\_\_\_ Date \_\_\_\_\_  
Robert D. Goyette, EMI Section Manager

**Report No. 64567.e1**



## Certificate of Compliance

The following product was found to comply with the requirement stated below when tested in accordance with the test procedures described in the accompanying test/measurement report. Reference report number 64567.e1

Manufacturer: Analog Devices, Inc.  
804 Woburn Street  
Wilmington, MA 01887

Model: Energy Meter (AD7755)

Requirement: EN55022:1994 + A1:1995 + A2:1997,  
Class B

Applicable  
Directive: 89/336/EEC

Approved By:

|                                      |  |
|--------------------------------------|--|
| Robert D. Goyette<br>NVLAP Signatory |  |
| Date                                 | 9/13/99  |

Remarks: *Testing is performed using calibrated equipment traceable to the National Institute of Standards and Technology (NIST).*

*This certificate is valid for products tested as described in the accompanying test report. Specific modifications necessary to meet the above requirement, recommended by Integrity Design & Test Services, Inc. are described therein.*

*Integrity Design & Test Services, Inc. is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for Electromagnetic Emissions Testing*

United States Department of Commerce  
National Institute of Standards and Technology

# NVLAP<sup>®</sup>

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Certificate of Accreditation



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LITTLETON, MA

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of NVLAP Guide 25 and the rules and regulations of 16CFR 1201-1202 apply to the accreditation of the laboratory  
concerning test results. All test results issued by the laboratory are subject to the National Voluntary Accreditation of

**ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS  
FIELD**

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Director, NVLAP

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## 1. Executive Summary

### 1.1 Scope

This document describes electromagnetic emissions testing performed on the [Energy Meter \(AD7755\)](#) on [September 8, 1999](#), pursuant to EN55022 requirements. It may be used to demonstrate compliance with the European Union emissions requirements pursuant to the EMC Directive.

### 1.2 Content

Contained herein are the technical descriptions of the equipment under test (EUT) as well as the test methods and results used to verify compliance with the emissions requirements for Information Technology Equipment (ITE), to the above named standards.

### 1.3 Conclusions

The [Energy Meter \(AD7755\)](#) met the EN55022 Class B requirements when tested as described herein.

(Refer to Test Descriptions & Results in section 3 for a detailed description).

## 2. Test Environment

### 2.1 EUT Description

M/N: AD7755          S/N: 99030869

Description: The EUT is an energy meter (watt-hour) based on the AD7755. The meter is used to bill loads 0A to 40A at a line voltage of 220V. The meter is running when 220V is connected.

#### 2.1.1 System Operation

The system was configured to simulate typical operation. During testing, the device was connected to a load and was operating normally.

#### 2.1.2 Support Equipment:

| Description                                | Manufacturer          | Model Number | Serial Number | FCC ID |
|--|-----------------------|--------------|---------------|--------|
| Variable Wirewound Power Resistor (at 30Ω) | Post Glover Resistors | 46949        | N/L           | N/A    |

### Cables

| Quantity | Description                                       |
|----------|---|
| 1        | pair of Stranded 16 gauge wires connected as load |
| 1        | AC power cord, 1 meter, unshielded                |

## **2.2 Test Facility Description**

The test facility is located on the premises of Integrity Design & Test Services, Inc. at 37-7 Ayer Road, Littleton, MA 01460. All testing is performed in an Open Area Test Site conforming to the site attenuation characteristics defined by ANSI C63.4 1992. Test methods and facilities have been audited and accredited by the National Voluntary Lab Accreditation Program (NVLAP).

## **2.3 Test Equipment**

All equipment used in the testing process has up to date calibrations traceable to the National Institute of Standards and Technology (NIST). Refer to Table 2.3-1 for a complete list of equipment used during the testing.

## **2.4 Product Disposition**

All items received for testing undergo an inspection to ensure proper working condition upon reception and before return shipment. The unit under test passed the incoming inspection when received for testing on [September 8, 1999](#). The unit was returned to the client's facility at the completion of testing after passing the final inspection.

Table 2.3-1: Test Equipment

| Description                             | Model Number                  | Serial Number | Last Calibration | Due Calibration | EMI # |
|---|-------------------------------|---------------|------------------|-----------------|-------|
| Spectrum Analyzer<br>(9 KHz to 22 GHz)  | HP8593E                       | 3543A01976    | 7/28/99          | 7/28/00         | 1     |
| Spectrum Analyzer<br>(9 KHz to 26 GHz)  | HP 8593EM                     | 3412A00102    | 2/16/99          | 2/16/00         | 21    |
| Preamplifier<br>(150 KHz to 1.3 GHz)    | HP 8447D                      | 2944A07027    | 4/22/99          | 4/22/00         | 13    |
| Preamplifier<br>(150 KHz to 1.3 GHz)    | HP 8447D                      | 2944A08408    | 1/14/99          | 1/14/00         | 33    |
| Preamplifier<br>(150 KHz to 1.3 GHz)    | HP 8447D                      | 2443A04077    | 4/22/99          | 4/22/00         | 3     |
| Preamplifier<br>(1 GHz to 26.5 GHz)     | HP 8449B                      | 3008A00232    | 6/23/99          | 6/23/00         | 14    |
| Preamplifier<br>(1 GHz to 26.5 GHz)     | HP 8449B                      | 3008A00948    | 8/19/99          | 8/19/00         | 20    |
| BiLog Antenna<br>(30 MHz to 2 GHz)      | Chase<br>CBL6112A             | 2284          | 7/30/99          | 7/30/00         | 6     |
| BiLog Antenna<br>(30 MHz to 2 GHz)      | Chase<br>CBL6112A             | 2173          | 7/30/99          | 7/30/00         | 7     |
| BiLog Antenna<br>(30 MHz to 1GHz)       | Chase<br>CBL6111C             | 2564          | 7/30/99          | 7/30/00         | 34    |
| Guided Ridged Horn<br>(1 GHz to 18 GHz) | A.H. Systems<br>SAS-200/571   | 163           | 9/8/98           | 9/8/99          | 10    |
| Guided Ridged Horn<br>(1 GHz to 18 GHz) | EMCO 3115                     | 9807-5520     | 7/21/98          | 11/21/99        | 29    |
| LISN: 50Ω/50μH                          | Solar<br>9252-50-R-24-<br>BNC | 971601        | 5/25/99          | 5/25/00         | 8     |
| LISN: 50Ω/50μH                          | Solar<br>9252-50-R-24-<br>BNC | 941725        | 5/8/99           | 5/8/00          | 5     |
| LISN: 50Ω/50μH                          | Solar<br>9252-50-R-24-<br>BNC | 971617        | 6/7/99           | 6/7/00          | 15    |
| LISN: 50Ω/50μH                          | Solar<br>9252-50-R-24-<br>BNC | 941724        | 8/5/99           | 8/5/00          | 9     |
| LISN: 50Ω/50μH                          | Solar<br>9233-50-TS-50-N      | 981960        | 10/8/98          | 10/8/99         | 31    |
| Monopole Antenna                        | AM-541                        | 11008         | 1/20/99          | 1/20/00         | 32    |
| LISN: 50Ω/50μH                          | 91221-1                       | 0386          | 2/12/99          | 2/12/00         | 2     |

| <b>Description</b>  | <b>Model Number</b> | <b>Serial Number</b> | <b>Last Calibration</b> | <b>Due Calibration</b> | <b>EMI #</b> |
|---------------------|---------------------|----------------------|-------------------------|------------------------|--------------|
| LISN: 50Ω/50μH      | 91221-1             | 0385                 | 2/12/99                 | 2/12/00                | 18           |
| LISN: 50Ω/50μH      | 91221-1             | 0335-04304           | 2/12/99                 | 2/12/00                | 16           |
| Active Loop Antenna | Emco 6502           | 9902-3267            | 2/26/99                 | 8/26/00                | 19           |

*All equipment used for testing has been calibrated according to methods and procedures defined by the National Institute of Standards and Technology (NIST).*

### **3. Test Description/Results**

#### **3.1 Radiated Emissions**

##### **3.1.1 Object**

The purpose of this test is to measure the radiated electromagnetic emissions generated by the equipment under test (EUT), pursuant to EN55022 Class B requirements. (See Table 3.1.1-1 for the Class B radiated limits).

##### **3.1.2 Procedure**

Testing is performed in an Open Area Test Site. The EUT is placed on a wooden turntable 80 cm in height. The EUT is centered laterally on the turntable and flush with the rear of the table. Peripheral equipment is placed on either side of the EUT with a minimum of 10 cm spacing. (When testing a personal computer system, monitors shall be placed on top of the PC and the keyboard and mouse shall be placed in front of the PC towards the front edge of the turntable.) Excess interface cables are draped over the back edge of the table no closer than 40 cm to the ground plane.

The EUT shall be set into operation such that all parts of the system are exercised. This may require the use of test software designed to exercise the various parts of the system.

With the EUT set into operation, the turntable is rotated over 360 degrees and interface cables are manipulated to maximize the emissions. The peripherals are not moved during the test. The receiving antenna is placed at a test distance of 3 or 10 meters from the closest point on the EUT. The antenna height is varied from 1 to 4 meters, and the polarity of the antenna is switched between vertical and horizontal such that the received signal is maximized.

##### **3.1.3 Deviations from Test Method**

None

##### **3.1.4 Measurement Uncertainty**

A minimum of a 2 dB margin of compliance is recommended for radiated emissions data to verify passing results. This is recommended to compensate for the measurement uncertainties involved.

### 3.1.5 Results

The [Energy Meter \(AD7755\)](#) met the EN55022 Class B radiated emissions requirements when tested as described below. (See Appendix A for a complete listing of data points).

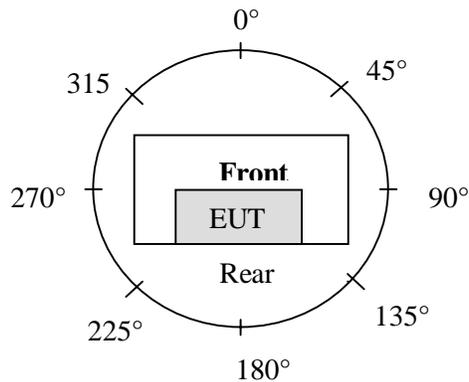
*Worst case emissions measured:*

| Modifications | EN55022 Class B Radiated Emissions   |
|---------------|--|
| See Note (1)  | Passed: - 9.5 dB at 114.5 MHz<br>Line Voltage: 230 VAC, 50 Hz<br>See Table: A1<br>Azimuth Angle (see diagram below): 315°<br>Antenna Height: 1 meter<br>Polarity: Vertical |

#### Notes

- (1) Final scan. No modifications installed.

Azimuth Angle Diagram



*The above results pertain only to the specific item submitted for testing, identified by the product's model and serial numbers.*

### 3.1.6 Radiated Emissions Terms and Calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

**Reading:** This is the reading obtained on the spectrum analyzer in dB $\mu$ V. Any external preamplifiers used are taken into account through internal analyzer settings.

**A.F.:** This is the antenna factor for the receiving antenna. It is a conversion factor which converts electric fields strengths to voltages which can be measured directly on the spectrum analyzer. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

$$\text{Reading on Analyzer (dB}\mu\text{V)} + \text{A.F. (dB)} = \text{Net field strength (dB}\mu\text{V/m)}$$

**Net:** This is the net field strength measurement (as shown above).

**Limit:** This is the EN55022 Class B radiated emission limit (in units of dB $\mu$ V/m). The EN55022 limits are given in units of  $\mu$ V/m. The following formula is used to convert the units of  $\mu$ V/m to dB $\mu$ V/m:

$$\text{Limit (dB}\mu\text{V/m)} = 20 * \log (\mu\text{V/m})$$

**Margin:** This is the margin of compliance below the EN55022 limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example for an emission measuring 20.5 dB $\mu$ V on the spectrum analyzer at 592 MHz:  
(Note: This shows a passing result (i.e. a negative margin))

**Example only:**

| <u>Reading</u> | <u>A.F.</u> | <u>Net Reading</u>  | <u>Net Reading</u>  | <u>EN55022 limit</u> | <u>Margin</u> |
|----------------|-------------|---------------------|---------------------|----------------------|---------------|
| 20.5dB $\mu$ V | + 25 dB     | = 45.5 dB $\mu$ V/m | : 45.5 dB $\mu$ V/m | - 57 dB $\mu$ V/m    | = -11.5 dB    |

## **3.2 Conducted Emissions**

### **3.2.1 Object**

The purpose of this test is to measure the conducted electromagnetic emissions on the AC power lines, pursuant to EN55022 Class B requirements. (See Table 3.2.1-1 for the Class B conducted limits).

### **3.2.2 Procedure**

Testing is performed in an Open Area Test Site. Equipment is arranged on the turntable as described in section 3.1.2. Each individual current-carrying power lead shall be individually connected through a  $50\Omega/50\mu\text{H}$  Line Impedance Stabilization Network (LISN). A 2 meter x 2 meter vertical coupling plane is placed 40 cm to the rear of the EUT. The EUT is set into operation such that all parts of the system are exercised, while the RF voltages across the  $50\Omega$  measuring port of the LISN are recorded. The test is repeated for each current-carrying power line of the EUT.

### **3.2.3 Deviations from Test Method**

None

### **3.2.4 Measurement Uncertainty**

A minimum of a 1 dB margin of compliance is recommended for conducted emissions data to verify passing results. This is recommended to compensate for the measurement uncertainties involved.

### 3.2.5 Results

The [Energy Meter \(AD7755\)](#) met the EN55022 Class B conducted emissions requirements when tested as described below. (See Appendix A for a complete listing of data points).

*Worst case emissions measured:*

| <b>Modifications</b> | <b>EN55022 Class B<br/>Conducted Emissions</b>  |
|----------------------|---|
| See Note (1)         | No significant emissions were detected above the measuring equipment noise floor, which is at least 10 dB below the applicable limit. |

#### Notes

- (1) Final scan. No modifications installed.

*The above results pertain only to the specific item submitted for testing, identified by the product's model and serial numbers.*

### 3.2.6 Conducted Emissions Terms and Calculation

The following is a description of terms and a sample calculation, as appears in the conducted emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

**Reading:** This is the reading obtained on the spectrum analyzer in dB $\mu$ V. Any external attenuators used are taken into account through internal analyzer settings.

**Limit:** This is the EN55022 Class B conducted emission limit ( in units of dB $\mu$ V). The EN55022 limits are given in units of  $\mu$ Volts. The following formula is used to convert the units of  $\mu$ Volts to dB $\mu$ Volts:

$$Limit (dB\mu V) = 20 * \log(\mu V)$$

**Margin:** This is the margin of compliance below the EN55022 limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example for an emission measuring 55 dB $\mu$ V on the spectrum analyzer at 5.4 MHz.  
(Note: This shows a passing result (i.e. a negative margin))

**Example only:**

| <u>Reading</u> |   | <u>EN55022 limit</u> |   | <u>Margin</u> |
|----------------|---|----------------------|---|---------------|
| 55 dB $\mu$ V  | - | 60 dB $\mu$ V        | = | -5 dB         |

**Table 3.1.1-1: EN55022 Class B Radiated Emissions Limit**

| <b>Frequency</b>    | <b>Quasi-Peak Limit @ 3 Meters</b> | <b>Quasi-Peak Limit @ 10 Meters</b> |
|---------------------|------------------------------------|-------------------------------------|
| 30 MHz to 230 MHz   | 40 dB $\mu$ V/m                    | 30 dB $\mu$ V/m                     |
| 230 MHz to 1000 MHz | 47 dB $\mu$ V/m                    | 37 dB $\mu$ V/m                     |

**Table 3.2.1-2: EN55022 Class B Conducted Emissions Limit**

| <b>Frequency</b>  | <b>Average Limit</b>           | <b>Quasi-Peak Limit</b>        |
|-------------------|--------------------------------|--------------------------------|
| .15 MHz to .5 MHz | 56 dB $\mu$ V to 46 dB $\mu$ V | 66 dB $\mu$ V to 56 dB $\mu$ V |
| .5 MHz to 5 MHz   | 46 dB $\mu$ V                  | 56 dB $\mu$ V                  |
| 5 MHz to 30 MHz   | 50 dB $\mu$ V                  | 60 dB $\mu$ V                  |

(Note: For each table shown above, the stricter limit applies at the frequency transition points.)

### **3.3 Labeling Requirements**

#### **3.3.1 EN55022 Labeling Requirements (pursuant to EN55022:1994)**

A specific product label indicating compliance with EN55022 is not required. Conformance with EN55022 does however support the “CE Mark” labeling when used in conjunction with the appropriate immunity standard under the EMC Directive, as well as any additional Directive(s) that applies.

## **Appendix A – Test Data**

**Table A1: EN55022 Class B Radiated Emissions.**

Company: Analog Devices  
 Test Engineer: Paul A. Ullrich  
 M/N: AD7755  
 Test Date: September 8, 1999  
 OATS # 1  
 Test Configuration: Final Scan (230 VAC, 50Hz)

| <b>Polarity<br/>(V or H)</b> | <b>Frequency<br/>(MHz)</b> | <b>Q.P.<br/>Reading<br/>(dBuV)</b> | <b>A.F.<br/>(dB)</b> | <b>Net<br/>(dBuV/m)</b> | <b>EN55022 Class B<br/>Limit @3m<br/>(dBuV/m)</b> | <b>EN55022<br/>Margin<br/>(dB)</b> |
|------------------------------|----------------------------|------------------------------------|----------------------|-------------------------|---|------------------------------------|
| V                            | 64.4                       | 11.5                               | 8                    | 19.5                    | 40  | -20.5                              |
| V                            | 111                        | 15.5                               | 14                   | 29.5                    | 40  | -10.5                              |
| V                            | 114.5                      | 16.5                               | 14                   | 30.5                    | 40  | -9.5                               |
| V                            | 118.2                      | 10                                 | 14                   | 24                      | 40  | -16                                |
| V                            | 121.7                      | 9.5                                | 14.5                 | 24                      | 40  | -16                                |
| V                            | 125.3                      | 11                                 | 13.5                 | 24.5                    | 40  | -15.5                              |
| V                            | 128.9                      | 7                                  | 13.5                 | 20.5                    | 40  | -19.5                              |
| V                            | 133.1                      | 11                                 | 13.5                 | 24.5                    | 40  | -15.5                              |
| H                            | 211.2                      | 11                                 | 12                   | 23                      | 40  | -17                                |

## **Configuration Photographs**

Configuration Photograph

Company: Analog Devices  
Model: Energy Meter (AD7755)



Worst Case Radiated Emissions Test Configuration

Configuration Photograph

Company: Analog Devices  
Model: Energy Meter (AD7755)



Worst Case Radiated Emissions Test Configuration

Configuration Photograph

Company: Analog Devices  
Model: Energy Meter (AD7755)



Worst Case Conducted Emissions Test Configuration

Configuration Photograph

Company: Analog Devices  
Model: Energy Meter (AD7755)



Worst Case Conducted Emissions Test Configuration