Integrity Design & Test Services, Inc.

Standard: **EN 61000-4-2 :1995,**
EN 61000-4-3 :1996,
ENV 50204 :1993, &
EN 61000-4-4 :1995

Model: **Solid State Energy Meter**

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

Date of Issue: **September 13, 1999**

Prepared by: _____

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Report No. 64567.c1

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Integrity
Design & Test
Services, Inc.

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.c1

Manufacturer:	Analog Devices, Inc. 804 Woburn Street Wilmington, MA 01887
Model Number:	Solid State Energy Meter
Requirement:	EN 61000-4-2:1996, EN 61000-4-3:1996, ENV 50204:1993 and EN 61000-4-4:1995 (pursuant to IEC 1036:1996)
Applicable Directive:	89/336/EEC

Approved By:

Christopher P. Burch Immunity Section Manager	Christopher P. Burch
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.

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1. Executive Summary

1.1 Scope

This report describes electromagnetic immunity testing performed on September 9, 1999 through September 10, 1999 on the Solid State Energy Meter, submitted by Analog Devices, Inc. Testing was performed pursuant to IEC 1036:1996, a standard for alternating static watt-hour meters for active energy. Technical descriptions of the equipment under test, support equipment, test equipment, test procedures and results are presented in the following sections.

1.2 Purpose

The purpose of the testing was to determine if the unit was susceptible to electrostatic discharge (ESD), radio frequency interference (RFI), keyed radio frequency interference, and electrical fast transients (EFT) pursuant to IEC 1036:1996 requirements.

1.3 Conclusions

The Solid State Energy Meter met the EN 61000-4-2:1995, EN 61000-4-3:1996, ENV 50204:1993, and EN 61000-4-4:1995 test procedures pursuant to IEC 1036:1996 performance requirements when tested as received. See Table 1.3-1 for a summary of the test results.

Table 1.3-1: Summary of Test Requirements and Results

Requirements	Results
EN 61000-4-2:1995 ± 8 kV through air discharges ± 8 kV direct contact discharges Performance Criterion B	Passed
EN 61000-4-3:1996 10 V/m from 80 MHz to 1000 MHz, 80% AM at 1 kHz Performance Criterion A	Passed
ENV 50204:1993 10 V/m from 895 MHz to 905 MHz, 100% AM at 200 Hz square wave Performance Criterion A	Passed
EN 61000-4-4:1995 ± 4kV coupled to AC power lines ± 4kV coupled to signal lines and I/O lines Performance Criterion B	Passed

1.4 Performance Criteria

Requirements for Performance Criterion A:
The EUT shall continue to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the EUT is used as intended.

Requirements for Performance Criterion B:
The EUT shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the EUT is used as intended. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed.

Requirements for Performance Criterion C:
Temporary loss of function is allowed, provided the function is self recoverable or can be restored by the operation of the controls.

Customer Specified Performance Criteria:
The client has specified that failures are considered to include if the frequency, as indicated on the oscilloscope, deviates more than 5% or if the EUT loses power.

2. Test Environment

2.1 EUT Description

M/N: AD7755 S/N: Not Labeled

The Equipment Under Test (EUT) is a meter, designated as the Solid State Energy Meter. During testing, the EUT was powered with 220V AC with a load on the output; where applicable in testing the load was removed. The EUT had an inferred LED that flashed at a rate proportional to the current. An inferred receiver converted the pulses allowing one to monitor the frequency and waveform on an oscilloscope.

2.1.1 Support Equipment:

Description	Manufacturer	Model Number	Serial Number
Oscilloscope	Tektronix (ASSET # 004088)	TD5754A	B010440
Power Supply	Hewlett Packard	6215A	1139A10817
Inferred Receiver	Analog Devices	Not Labeled	Not Labeled
Universal Counter (Used for reference only)	Hewlett Packard (ASSET # 005319)	5335A	2510A07680

Cables:

Quantity	Description
1	AC input line, DB 2, Unshielded, 1 meter in length
1	AC input line, DB 2, Unshielded, 3 meter in length
1	Coax (From inferred receiver to oscilloscope), DB 2, Shielded, 3 meters in length

2.2 Test Facility Description

The test facility is located on the premises of Integrity Design & Test Services, Inc. at 37 Ayer Road, #7, Littleton, MA, 01460. Testing is performed in one or more of the following chambers:

(A) anechoic chamber 10 feet high x 17 feet wide x 22 feet long
(B) anechoic chamber 16 feet high x 18 feet wide x 28 feet long
(C) shielded room 9 feet high x 8 feet wide x 12 feet long
(D) workstation ground plane 7 feet wide x 8 feet long with a copper ground reference table 32" x 64"
(E) workstation ground plane 7 ½ feet wide x 8 feet long with a copper ground reference table 32" x 64"

2.3 Test Equipment

See 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 receipt and before return shipment. The Solid State Energy Meter passed the incoming inspection when received for testing on September 9, 1999. The Solid State Energy Meter was returned to the customer after completion of testing.

Table 2.3-1: Test Equipment

Item	Description	Model #	Serial #	Last Calibr.	Calibr. Due
1	Monitor	ZEC ZEN1492-1	051RE0024 ROA	N/A	N/A
2	Computer	Trademark	149E369314	N/A	N/A
3	Keyboard	Trademark	700089679	N/A	N/A
4	Amplifier (75W)	Amplifier Research 75A250	19281	N/A	N/A
5	Signal Generator	Fluke 6071A	3625035	12-07-98	12-07-99
6	Amplifier (10W)	Amplifier Research 10W1000A	14885	N/A	N/A
7	Audio Generator	Leader LAG-27	2032144	N/A	N/A
8	Signal Generator	Fluke 6071A	2850014	7-02-99	7-02-00
9	Leveling Pre-amp	Amplifier Research 888	15607	N/A	N/A
10	Isotropic Field Monitor	Amplifier Research FM2000	14932	N/A	N/A
10A	Field Probe	Amplifier Research FP2000	14055	N/A	N/A
11	Amplifier (50W)	Amplifier Research 50W1000A	18991	N/A	N/A
12	Fast Transient Burst Generator	Schaffner NSG 1025	3360	9-14-98	9-14-99
13	Fast Transient Burst Generator	Schaffner NSG 1025	3289	6-18-99	6-18-00
14	ESD Simulator	Schaffner 402-579/D	228	9-08-98	9-08-99
15	Monitor	Epson E1181A	02P5000414	N/A	N/A
16	Transmitting Horn Antenna	Com-Power AH-118	10077	N/A	N/A

Item	Description	Model #	Serial #	Last Calibr.	Calibr. Due
17	Antenna High Power Transmitting Log Periodic	Allied Instruments, LOG-1	00138	N/A	N/A
18	High Energy Pulse Generator	Schaffner NSG650	1089044	3-30-99	3-30-00
19	Surge Pulse Coupling Network	Schaffner CDN 110	2389347	3-30-99	3-30-00
20	Monitor	IBM 2113-001	23-97469	N/A	N/A
21	Printer	Hewlett Packard C4565A	US69L14076	N/A	N/A
22	Keyboard	IBM	P73G4614	N/A	N/A
23	IBM Laptop Thinkpad	Laptop	78-A2038	N/A	N/A
24	Computer	Packard Bell Force (1)	90275176	N/A	N/A
25	Impedance Network	Voltech	1B079034	N/A	N/A
26	Power Analyzer	VoltecPM 3000A	AI099349	1-12-99	1-12-00
27	E Field Generator	Amplifier Research AT3000	25919	N/A	N/A
28	Coupling/Decoupling Network	FCC FCC-801-M3-25	97-03	1-05-99	1-03-00
29	Coupling/Decoupling Network	FCC FCC-801-M3-25	97-02	12-31-98	12-31-99
30	Coupling/Decoupling Network	FCC FCC-801-M2-25	97-01	1-05-99	1-05-00
31	Current Injection Clamp	Solar Electronics 9144-1N	956610	1-05-99	1-05-00
32	EM Injection Clamp	FCC F-2031	264	1-06-99	1-06-00
33	Loop Antenna	Solar Electronics 7334-1	945207	1-12-99	1-12-00

Item	Description	Model #	Serial #	Last Calibr.	Calibr. Due
34	Oscilloscope	Tektronix TDS350	B040735	9-01-98	9-01-99
35A	Helmholtz Coil	Loop One IDTS PT202	00415	N/A	N/A
35B	Helmholtz Coil	Loop Two IDTS PT202	00415	N/A	N/A
36	Variable Autotransformer	Staco Energy 3PN1520	N/L	N/A	N/A
37A	Antenna, Log Periodic (A)	IDTS LG1000	00125	N/A	N/A
37B	Antenna, Log Periodic (B)	IDTS LG1000	0014	N/A	N/A
38	AC Power Source	Hewlett Packard 6813A	3524A-00302	12-07-98	12-07-99
39	I/O and Signal Line Clamp	Amplifier Research	20343	N/A	N/A
40	I/O and Signal Line Clamp	IDTS	00414	N/A	N/A
41	Computer	IBM 433DX/D	23-5T10L	N/A	N/A
42A	10.0 MFD R.F Capacitor	Solar Electronics 6512-106R	N/L	N/A	N/A
42B	10.0 MFD R.F Capacitor	Solar Electronics 6512-106R	N/L	N/A	N/A
43	Keyboard	IBM M	P52G9700	N/A	N/A
44	Mouse	IBM 13H6690	23-743652	N/A	N/A
45	CE Master	Keytek	9802223	2-23-99	2-23-00
46	3ϕ CDN, Coupling Decoupling Network	IDTS	Not Labeled	N/A	N/A
47	Function Generator	LG Precision FG-8002	8071121	N/A	N/A
48	Monitor	Gateway 2000 PMV1448NI	TB9EO8756	N/A	N/A

Item	Description	Model #	Serial #	Last Calibr.	Calibr. Due
49	Computer	Total Peripherals Mini Tower	476065040	N/A	N/A
50	Laptop	IBM Think Pad	78-TV260	N/A	N/A
51	Mouse	13H6690	23-743652	N/A	N/A
52	Signal Generator	Fluke 6060B	5830205	1-12-99	1-12-00
53	CM-ESD Gun	Keytek Simulator Probe	9802329	2-23-99	2-23-00
54	Helmholtz Coil	Keytek	Not Labeled	N/A	NA
55	True RMS AC/DC Clamp Meter	Extech Instruments 380920	9800181	N/A	N/A
56A	Surge Control Center	Keytek E-Class Series 100	9907197	7-20-99	7-20-00
56B	Surge Network	Keytek E509A	9907200	7-20-99	7-20-00
57	EM Radiation Meter	Wandel & Goltermann EMR-200	L-0016	6-10-99	6-10-01
58	Signal Generator	Hewlett Packard 83260B	3722A00552	2-11-99	2-11-00
59	Amplifier (10 W)	Hughes 1177H06F000	314	N/A	N/A

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 Descriptions and Results

3.1 Electrostatic Discharge Pursuant to EN 61000-4-2:1995

3.1.1 Object

The purpose of this test is to evaluate the performance of the EUT when subjected to electrostatic discharges of ± 4 kV using the direct contact method, and/or ± 8 kV using the through air method.

3.1.2 Procedure

Testing is performed on a reference ground plane. The EUT and its interface cables are isolated from the ground plane by a distance of 0.5 millimeters (see Figure 3.1-1). Positive and negative discharges are made to all surfaces of the EUT which are normally accessible to the operator. At least four test points are selected for every side. The voltage level is set initially at 2 kV, and increased to a maximum level of 4 kV for contact discharges and 8 kV for air discharges. Fifty discharges for each polarity are made to each test point with a minimum time interval of 1 second between discharges.

Direct contact injection is the preferred method of discharge. This method is performed on all metallic surfaces. If an electrostatic discharge event is unattainable by using the direct contact method, then the though air method of discharge is employed.

Additional discharges are made in close proximity to the EUT to simulate charged objects near the EUT. These discharges are made to a vertical coupling plate around all sides of the EUT and its interface cables. Approximately 200 single discharges are made to the ground plane, with a minimum time interval of 1 second between discharges.

Testing of the EUT was performed in room B (see Section 2.2). Support equipment was located outside the testing room.

3.1.3 Test Equipment

The following test equipment was used for this test (refer to Table 2.3-1); Item No: 14.

3.1.4 Climatic Conditions

The climatic conditions must comply with certain requirements during testing and were measured as follows:

	Requirement	Measured
Ambient temperature	15° C to 35° C	23° C
Humidity	30% to 60%	54 %
Pressure	86 kPa to 106 kPa	100.4 kPa

3.1.5 Confidence of Results and Deviations from Test Method

Confidence of results is obtained by exceeding the requirement for minimum number of discharge locations and by increasing the test voltage level to 105% of specification.

3.1.6 Results

The Solid State Energy Meter met the Performance Criterion B requirements of IEC 1036:1996, at test level three, when tested as received. Test level three stipulates ESD events of up to and including ± 8 kV using the through air discharge method and up to and including ± 8 kV using the direct contact discharge method.

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

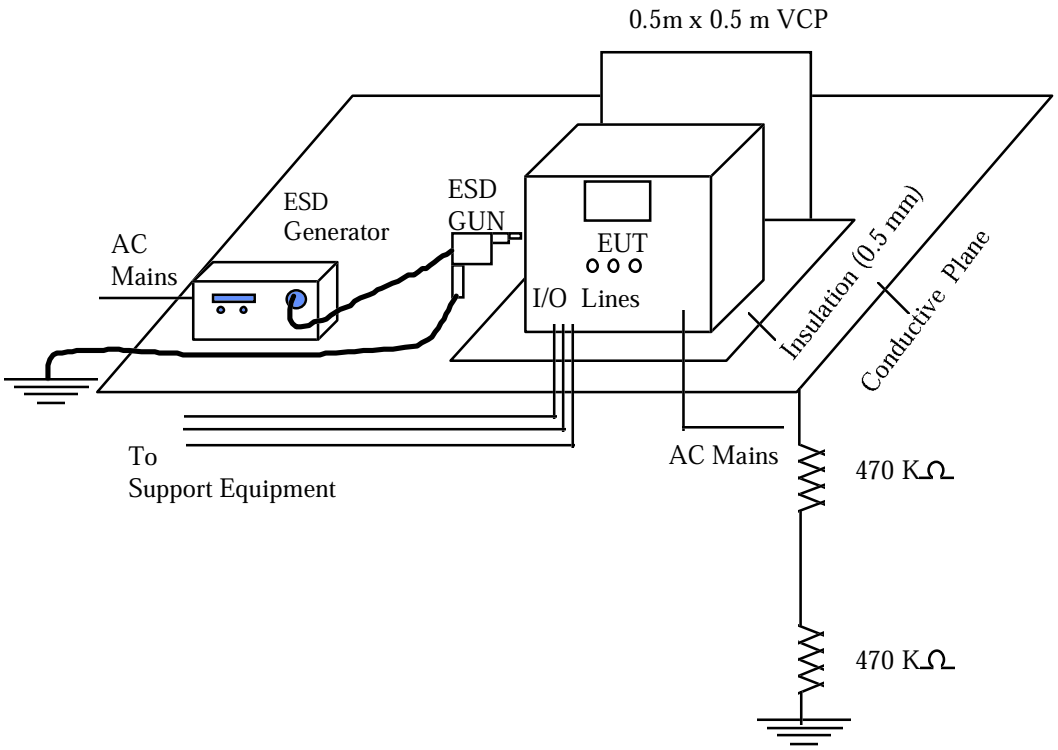


Figure 3.1-1: EN 61000-4-2:1995 Test Setup

3.2 Radiated Susceptibility Pursuant to EN 61000-4-3:1996

3.2.1 Object

The purpose of this test is to evaluate the performance of the EUT when subjected to an electric field of 10 V/m from 80 MHz to 1000 MHz with 80% amplitude modulation at 1 kHz.

3.2.2 Procedure

Testing is performed in a shielded anechoic enclosure. A calibration of the field is preformed to validate the uniform test area. The "uniform area" is a vertical plane in which e-field variations are acceptably small. This uniform area size is 1.5m x 1.5m. An isotropic field strength probe is placed within the empty room connected to the field strength monitor over a fiber optic cable. The signal level to the radiating system is adjusted until the required field intensity is indicated. The frequency range is swept from 80 MHz to 1000 MHz. The voltage or power required at the output terminals of the amplifier to establish the specified field is monitored and recorded. The number of points to be tested to demonstrate uniformity is 16, at 0.5 steps. A field is then verified uniform when its magnitude does not vary over the defined area by greater than -0 dB, + 6 dB of nominal value, over 75%.

The EUT is placed in the center of the enclosure (on a wooden table if tabletop equipment), while a broadband transmitting antenna is placed 3 meters away (see Figure 3.2-1). The EUT support equipment is placed outside of the shielded enclosure. Cable connections from inside to outside of the enclosure are made through feed through connectors. EUT connections to its support equipment are made through an access hole in the shielded enclosure.

The frequency is then swept across the entire range of interest at the required field strength while monitoring the EUT for performance. The sweep is repeated for both horizontal and vertical polarizations of the antenna and again, for all sides of the EUT in succession.

Testing of the EUT was performed in room B (see Section 2.2). Support equipment was located outside the testing room.

3.2.3 Test Equipment

The following test equipment was used for this test (refer to Table 2.3-1); Items No: 8, 9, 10, 10A, 11, and 37B.

3.2.4 Climatic Conditions

The climatic conditions were measured as follows:

	Requirement	Measured
Ambient temperature	none specified in standard	23° C
Humidity	none specified in standard	53 %
Pressure	none specified in standard	100.6 kPa

3.2.5 Confidence of Results and Deviations from Test Method

Confidence of results is obtained by ensuring the frequency sweep rate is slow/fast enough to detect a product failure and by increasing the test voltage level to 105% of specification. Per customer request, dwell frequencies at 450 MHz and 900 MHz was tested at 20 V/m. Also, the left side of the EUT was scanned at 20 V/m for both horizontal and vertical polarity.

3.2.6 Results

The Solid State Energy Meter met the Performance Criterion A requirements of IEC 1036:1996 when subjected to an electric field of 10 V/m from 80 MHz to 1000 MHz with 80% AM at 1 kHz, and dwell frequencies at 450 MHz and 900 MHz passed at 20 V/m, and last the left side of the EUT was scanned at 20 V/m passing both horizontal and vertical polarity.

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

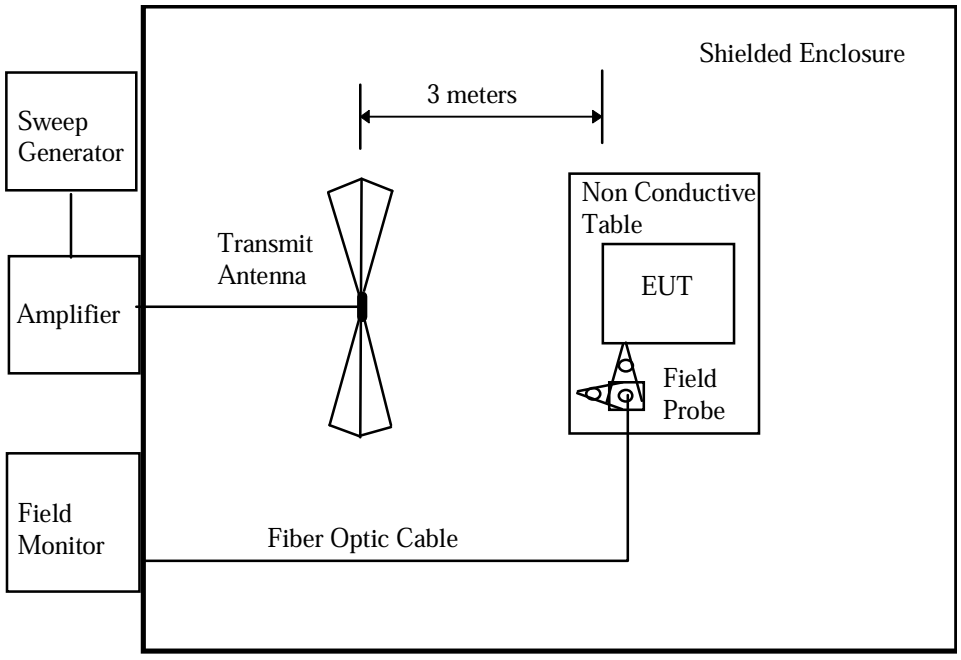


Figure 3.2-1: EN 61000-4-3:1996 Test Setup

3.3 Radiated Susceptibility Pursuant to ENV 50204:1993

3.3.1 Object

The purpose of this test is to evaluate the performance of the EUT when subjected to an electric field of 10 V/m from 895 MHz to 905 MHz with 100% amplitude modulation at 200 Hz (square wave).

3.3.2 Procedure

Testing is performed in a shielded anechoic enclosure. A calibration of the field is preformed to validate the uniform test area. The "uniform area" is a vertical plane in which e-field variations are acceptably small. This uniform area size is 1.5m x 1.5m. An isotropic field strength probe is placed within the empty room connected to the field strength monitor over a fiber optic cable. The signal level to the radiating system is adjusted until the required field intensity is indicated. The frequency range is swept from 80 MHz to 1000 MHz. The voltage or power required at the output terminals of the amplifier to establish the specified field is monitored and recorded. The number of points to be tested to demonstrate uniformity is 16, at 0.5 steps. A field is then verified uniform when its magnitude does not vary over the defined area by greater than -0 dB, + 6 dB of nominal value, over 75%.

The EUT is placed in the center of the enclosure (on a wooden table if tabletop equipment), while a broadband transmitting antenna is placed 3 meters away (see Figure 3.3-1). The EUT support equipment is placed outside of the shielded enclosure. Cable connections from inside to outside of the enclosure are made through feed through connectors. EUT connections to its support equipment are made through an access hole in the shielded enclosure.

The frequency is then swept across the entire range of interest at the required field strength while monitoring the EUT for performance. The sweep is repeated for both horizontal and vertical polarizations of the antenna and again, for all sides of the EUT in succession.

Testing of the EUT was performed in room B (see Section 2.2). Support equipment was located outside the testing room.

3.3.3 Test Equipment

The following test equipment was used for this test (refer to Table 2.3-1); Items No: 7, 8, 10, 10A, 11, and 37B.

3.3.4 Climatic Conditions

The climatic conditions were measured as follows:

	Requirement	Measured
Ambient temperature	none specified in standard	23° C
Humidity	none specified in standard	53 %
Pressure	none specified in standard	100.6 kPa

3.3.5 Confidence of Results and Deviations from Test Method

Confidence of results is obtained by increasing the test voltage level to 105% of specification.

3.3.6 Results

The Solid State Energy Meter met the Performance Criterion A requirements of IEC 1036:1996 when subjected to a 10 V/m keyed electric field from 895 MHz to 905 MHz with 100% AM at 200 Hz (50% duty cycle).

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

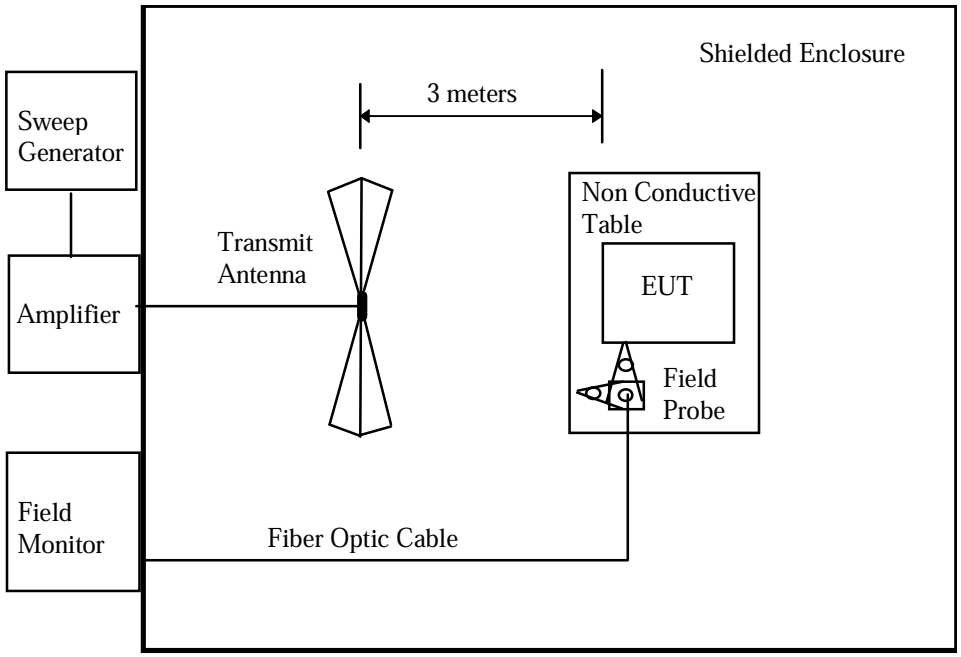


Figure 3.3-1: ENV 50204:1993 Test Setup

3.4 Electrical Fast Transient Pursuant to EN 61000-4-4:1995

3.4.1 Object

The purpose of this test is to evaluate the performance of the EUT when subjected to electrical fast transients of ± 1.0 kV on the power lines and ± 0.5 kV on the signal lines and I/O lines.

3.4.2 Procedure

Testing is performed on a reference ground plane. The EUT and its interface cables are isolated from the ground plane by a distance of 0.8 meters (see Figure 3.4-1). The interference signal is coupled to the power lines through an internal capacitive coupling network in the interference generator. The transients are applied to the power lines at ± 1.0 kV in several coupling configurations including L1 to Ground, L2 to Ground and L1/L2 to Ground, while monitoring the EUT for performance. Transients are applied for a minimum of one minute for each test configuration.

In addition to the power lines, the signal is also applied to all signal lines greater than 3 meters in length. This is done with the use of a capacitive coupling clamp (see Figure 3.4-1). The interference signal is applied directly to the clamp while the signal cables under test are placed in the clamp. This provides a means of capacitively coupling the interference signal to the cables without a direct electrical connection. The interference level is set at ± 0.5 kV, while monitoring the EUT for performance.

Testing of the EUT was performed in room B (see Section 2.2). Support equipment was located outside the testing room.

3.4.3 Test Equipment

The following test equipment was used for this test (refer to Table 2.3-1); Items No: 13 and 39.

3.4.4 Climatic Conditions

The climatic conditions must comply with certain requirements during testing and were measured as follows:

	Requirement	Measured
Ambient temperature	15° C to 35° C	23° C
Humidity	25% to 75%	54 %
Pressure	86 kPa to 106 kPa	100.5 kPa

3.4.5 Confidence of Results and Deviations from Test Method

Confidence of results is obtained by extending test duration from one (1) minute per configuration to a minimum of three (3) minutes per configuration. Per customer request, the test level was increased to ± 4 kV for all configurations in this procedure.

3.4.6 Results

The Solid State Energy Meter met the Performance Criterion B requirement of IEC 1036:1996 at ± 4 kV applied to the AC power lines and ± 4 kV capacitively coupled to the signal and I/O lines.

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

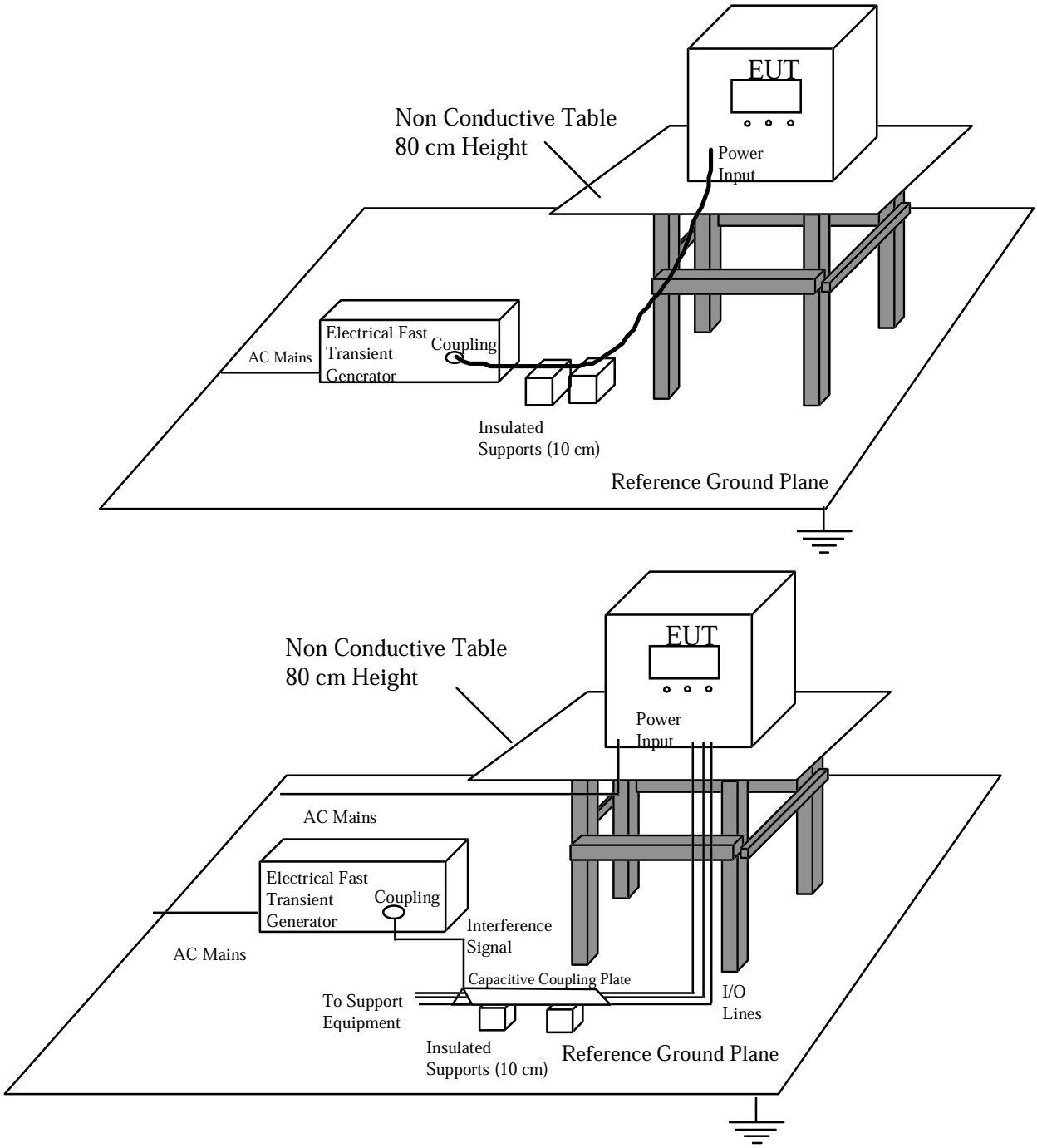
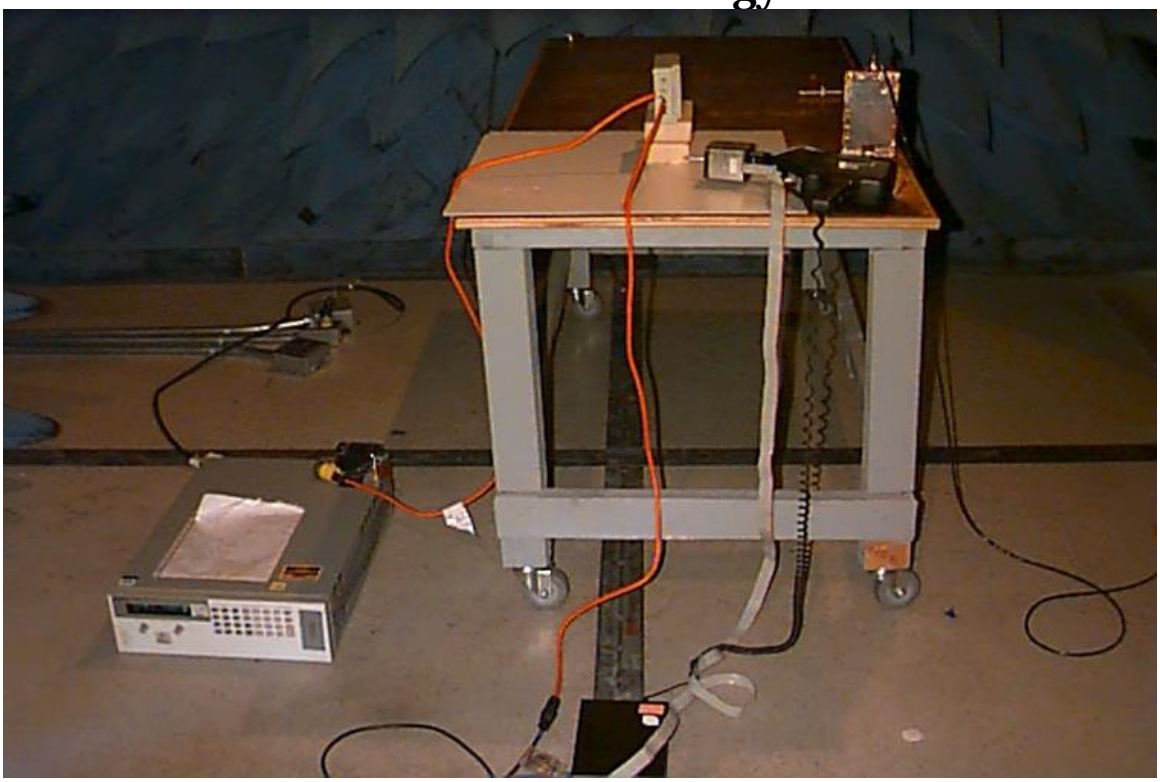


Figure 3.4-1: EN 61000-4-4:1995 Test Setup

APPENDIX A

CONFIGURATION PHOTOGRAPHS

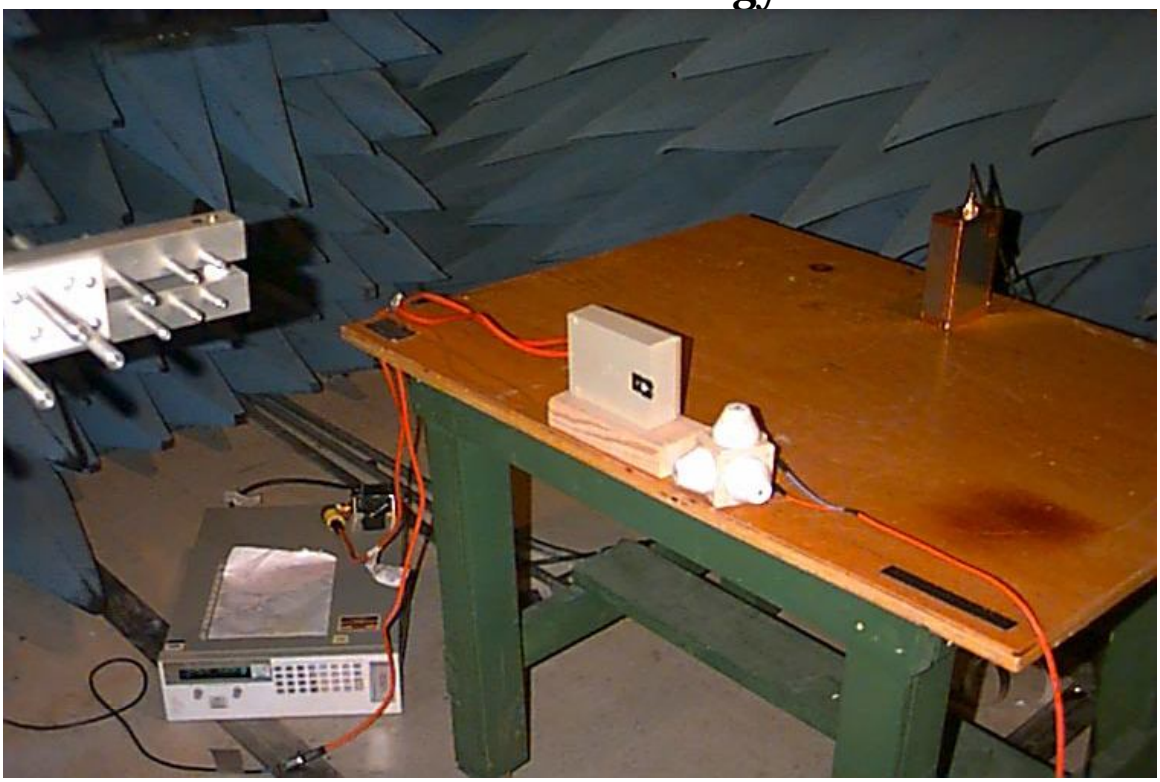
Analog Devices, Inc.
Model: Solid State Energy Meter



EN 61000-4-2:1995 Test Configuration

Test Engineer: ERR

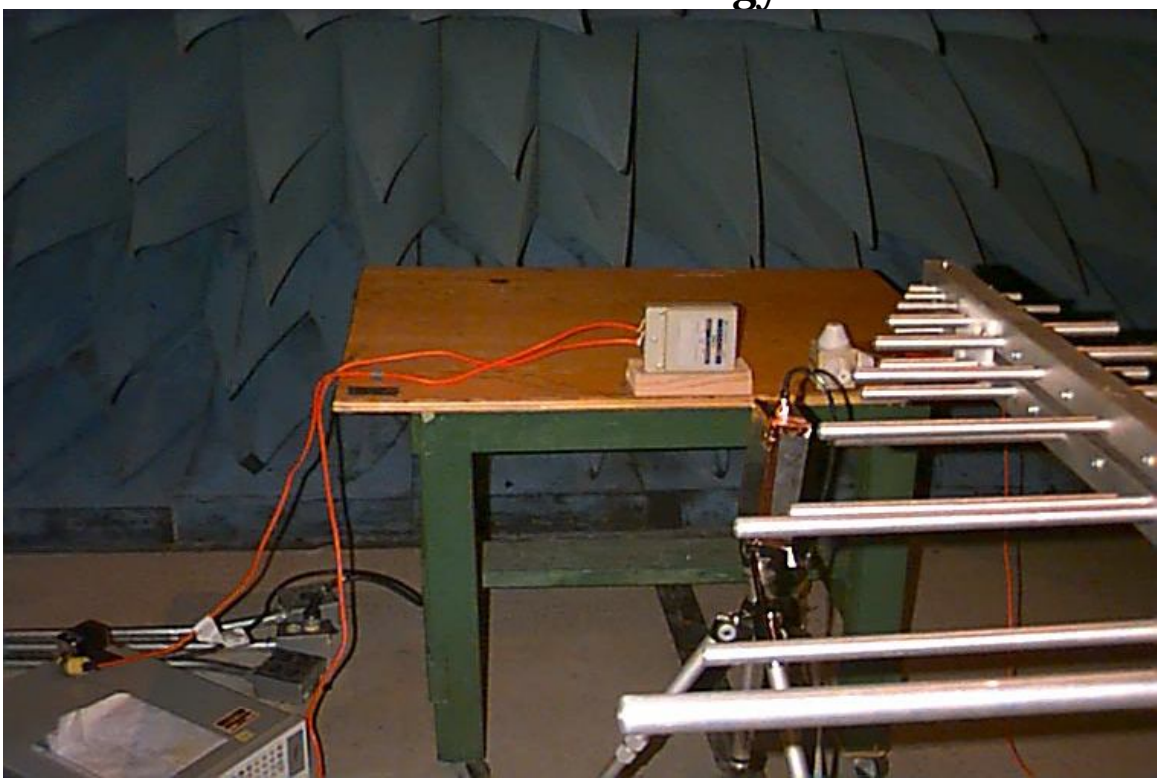
Analog Devices, Inc.
Model: Solid State Energy Meter



EN 61000-4-3:1996 & ENV 50204:1993

Test Configuration
Test Engineer: ERR

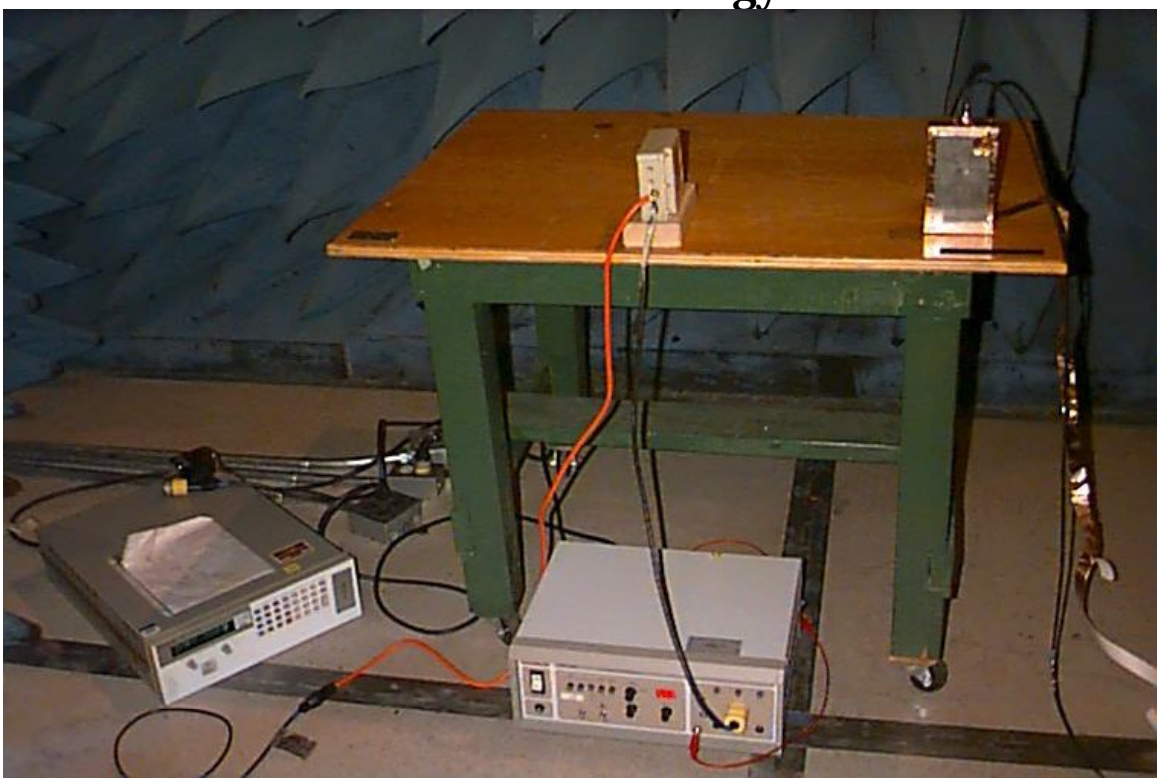
Analog Devices, Inc.
Model: Solid State Energy Meter



EN 61000-4-3:1996 & ENV 50204:1993

Test Configuration
Test Engineer: ERR

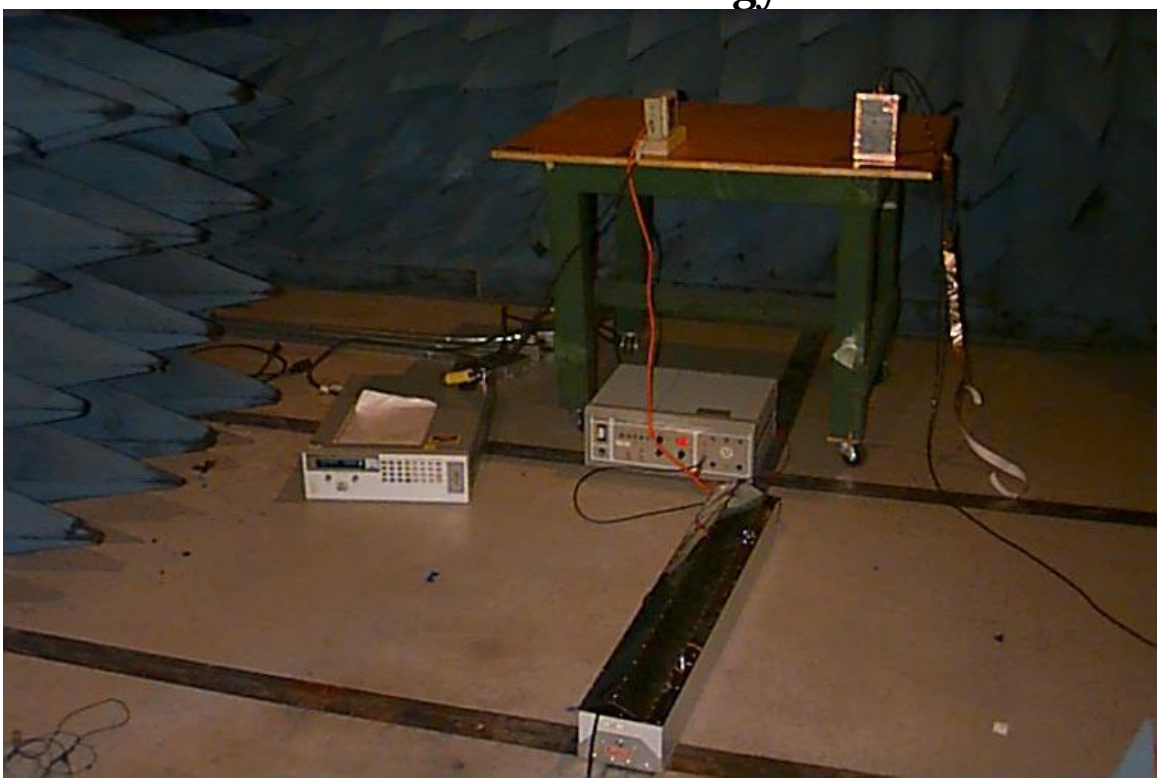
Analog Devices, Inc.
Model: Solid State Energy Meter



EN 61000-4-4:1995 Power Line Test

Test Engineer: ERR

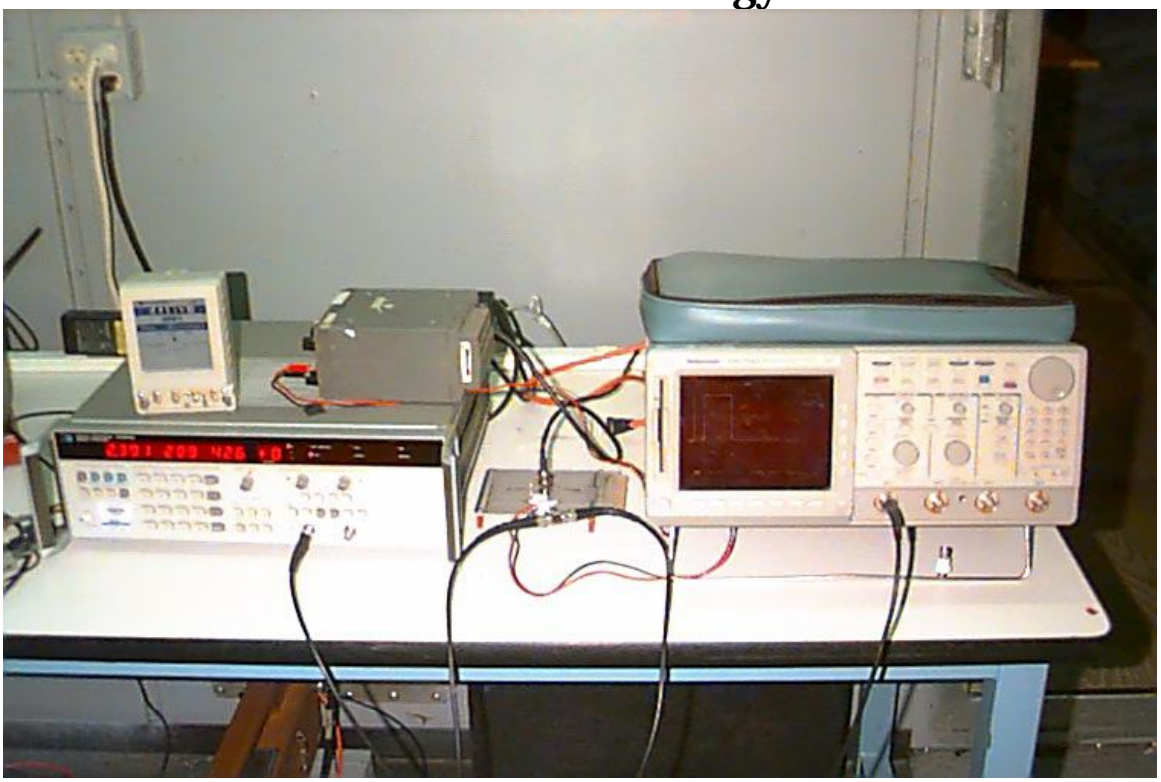
Analog Devices, Inc.
Model: Solid State Energy Meter



EN 61000-4-4:1995 I/O and Signal Line Test

Test Engineer: ERR

Analog Devices, Inc.
Model: Solid State Energy Meter



EUT Support Equipment
Test Engineer: ERR