



FCC 47 CFR PART 15 SUBPART B

TEST REPORT

For

Wide-Temperature Isolated RS-422/485 Repeater

Model: ADAM-4510I

Trade Name: ADVANTECH

Issued to

Advantech Co., Ltd.

**No. 1, Alley 20, Lane 26, Rueiguang Road,
Neihu District, Taipei 114, R.O.C.**

Issued by



**Compliance Certification Services Inc.
Hsintien Lab.**

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1. TEST RESULT CERTIFICATION

Applicant: **Advantech Co., Ltd.**
 No. 1, Alley 20, Lane 26, Rueiguang Road,
 Neihu District, Taipei 114, R.O.C.

Manufacturer: **Advantech Co., Ltd.**
 No. 1, Alley 20, Lane 26, Rueiguang Road,
 Neihu District, Taipei 114, R.O.C.

Equipment Under Test: Wide-Temperature Isolated RS-422/485 Repeater

Trade Name: ADVANTECH

Model: ADAM-4510I

Detailed EUT Description: See Item 2 of this report

Date of Test: June 1, 2006

| Applicable Standard | Class / Limit | Test Result |
|---|---------------|-------------------------|
| FCC Part 15 Subpart B IC ICES-003 | Class A | No non-compliance noted |
| Deviation from Applicable Standard | | |
| None | | |

The above equipment was tested by Compliance Certification Services Inc. for compliance with the requirements set forth in the FCC Rules and Regulations Part 15, Subpart B and the measurement procedures were according to ANSI C63.4. This said equipment in the configuration described in this report shows the maximum emission levels emanating from equipment are within the compliance requirements.

Approved by:

David Wang
 Manager of Hsintien Laboratory
 Compliance Certification Services Inc.

Reviewed by:

Vince Chiang
 Assistant Manager of Hsintien Laboratory
 Compliance Certification Services Inc.

**2. EUT DESCRIPTION**

| | |
|------------------------------|---|
| Product | Wide-Temperature Isolated RS-422/485 Repeater |
| Trade Name | ADVANTECH |
| Model | ADAM-4510I |
| Housing Type | Plastic |
| EUT Power Rating | 10-48VDC |
| OSC/Clock Frequencies | 14.7MHz |

Model Differences

| Model Name | Report No. | Difference | Tested (Checked) |
|-------------------|-------------------|-----------------------------|-------------------------------------|
| ADAM-4520I | 60530204 | Original | <input checked="" type="checkbox"/> |
| ADAM-4510I | 60616204 | For marketing purpose only. | |

I/O PORT OF EUT

| I/O PORT TYPE | Q'TY | TESTED WITH |
|----------------------|-------------|--------------------|
| 1). SIO Port | 1 | 1 |

Note: None.



3. TEST METHODOLOGY

3.1 EUT SYSTEM OPERATION

1. All peripherals connect EUT to test.

Note: Test program is self-repeating throughout the test.

3.2 DECISION OF FINAL TEST MODE

1. The following test mode were scanned during the preliminary test:

Mode:

| | |
|---|-------------|
| 1 | NORMAL MODE |
|---|-------------|

2. After the preliminary scan, the following test mode was found to produce the highest emission level.

Conduction: N/A *(The subject equipment is not intended to be connected to AC mains supply. Therefore, this test is not applicable.)*

Radiation: Mode 1

Then, the EUT configuration and cable configuration of the above highest emission mode was recorded for all final test items.



4. SETUP OF EQUIPMENT UNDER TEST

Setup Diagram

See test photographs attached in Appendix I for the actual connections between EUT and support equipment.

Support Equipment

Peripherals Devices:

| No | Equipment | Model | Serial No. | FCC ID / BSMI ID | Trade Name | Data Cable | Power Cord |
|----|---|------------|------------|------------------|------------|---|---------------------|
| 1 | DC Power Supply | S-201-12 | N/A | N/A | MEAN | GND: Unshielded, 0.5m DC: Unshielded, 0.3mx2 | Unshielded, 1.8m |
| 2 | Wide-Temperature Isolated RS-422/485 Repeater | ADAM-4520I | N/A | N/A | ADVANTECH | Unshielded, 0.1mx6 | N/A |
| 3 | COM Load | N/A | N/A | N/A | N/A | Shielded, 1.0m | N/A |

Note: All the above equipment/cables were placed in worse case positions to maximize emission signals during emission test.

Grounding: Grounding was in accordance with the manufacturer's requirements and conditions for the intended use.



5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at CCS Taiwan Hsintien Lab at No. 165&199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan.

The measurement facilities are constructed in conformance with the requirements of CISPR 16-1, ANSI C63.4 and other equivalent standards.

5.2 LABORATORY ACCREDITATIONS AND LISTINGS

The test facilities used to perform Electromagnetic compatibility tests are registered or accredited by the organizations listed in the following table which includes the recognized scope specifically.

This accredited organization maintains A2LA accreditation to ISO/IEC 17025 for the specific test listed in A2LA Certificate # 0824-01. The test results included in this report, however, are not covered by this accreditation.

| Country | Agency | Scope of Accreditation | Logo |
|---------|-----------------|--|------|
| USA | A2LA | CFR 47, FCC Part 15/18; AS/NZS 3548; VCCI V3; CNS 13438; CNS 13439; CNS 13783; CNS 14115; CISPR 11/EN 55011; CISPR 14 1/EN 55014 1; CISPR 15/EN 55015; CISPR 22/EN 55022; EN 50081-1/EN 61000-6-3; EN 50082-1/EN 61000-6-4; IEC/EN 61000-4-2, IEC/EN 61000-4-3, IEC/EN 61000-4-4, IEC/EN 61000-4-5, IEC/EN 61000-4-6, IEC/EN 61000-4-8, IEC/EN 61000-4-11, IEC/EN 61000-3-2, IEC/EN 61000-3-3; CISPR 24/EN 55024; CISPR 14-2/EN 55014-2; EN 50081-2/EN 61000-6-1; EN 50082-2/EN 61000-6-2. | |
| USA | FCC | 3/10 meter Open Area Test Sites to perform FCC Part 15/18 measurements | |
| Japan | VCCI | 3/10 meter Open Area Test Sites and Line Conducted Test Room to perform conducted/radiated measurements | |
| Norway | NEMKO | EN 50081-1/2, EN 50082-1/2, IEC 61000-6-1/2/3/4, EN 50091-2, EN 50130-4, EN 55011, EN 55013, EN 55014-1/2, EN 55015, EN 55022, EN 55024, EN 61000-3-2/3, EN 61326-1, IEC 61000-4-2/3/4/5/6/8/11, Cisp 16-1/2/3/4 | |
| Taiwan | CNLA | 47 CFR FCC Part 15 Subpart B, EN 61000-3-2, EN 61000-3-3, CNS 13439, CNS 13783-1, CNS 13438, AS/NZS 3548, VCCI, CNS 13022-1/2/3, EN 55022, EN 55013, EN 55014-1, EN 61000-4-2/3/4/5/6/8/11, ENV 50204, ENV 50141, ENV 50142 | |
| Taiwan | BSMI | CNS 13438, CNS 13783-1, CNS 13439 | |
| Canada | Industry Canada | RSS212, Issue 1 | |

Note: No part of this report may be used to claim or imply product endorsement by CNLA, A2LA or other government agency.



6. INSTRUMENT AND CALIBRATION

6.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

6.2 TEST AND MEASUREMENT EQUIPMENT

The following list contains measurement equipment used for testing. The equipment conforms to the requirement of CISPR 16-1, ANSI C63.2 and other equivalent standards.

Calibration of all test and measurement, including any accessories that may effect such calibration, is checked frequently to ensure the accuracy. Adjustments are made and correction factors are applied in accordance with the instructions contained in the respective manual.

Equipment Used for Emission Measurement

| Open Area Test Site # K | | | | |
|----------------------------|---------------|--------------|---------------|-------------------------|
| EQUIPMENT | MFR | MODEL | SERIAL NUMBER | CAL. DUE |
| SITE NSA | CCS | K Site | N/A | 10/01/2006 |
| MEASURE RECEIVER | SCHAFFNER | SCR3501 | 412 | 05/18/2007 |
| SPECTRUM ANALYZER | ADVANTEST | R3132 | 120900029 | No Calibration Required |
| ANTENNA | SCHAFFNER | CBL 6112B | 2846 | 05/26/2007 |
| PRE-AMPLIFIER | SCHAFFNER | CPA9231A | 3639 | 10/08/2006 |
| CABLE | SUHNER | RG 214 | N-TYPE #K2 | 02/17/2007 |
| Above 1GHz Used | | | | |
| EMC ANALYZER (100Hz-22GHz) | HP | 8566B | 2937A06102 | 06/30/2006 |
| ANTENNA (1-18GHz) | EMCO | 3115 | 00022256 | 01/12/2007 |
| AMPLIFIER (1-18GHz) | HP | 8449B | 3008A01266 | 02/06/2007 |
| CABLE (1-18GHz) | JYEBAO | LL142 | SMA#RS1 | 02/06/2007 |
| CABLE (1-18GHz) | HUBER +SUHNER | SUCOFLEX 104 | SMA#RS3 | 02/06/2007 |
| CABLE (1-18GHz) | JYEBAO | LL142 | SMA#C1 | 02/06/2007 |

Note: The measurement uncertainty is less than +/- 3.36dB, which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.



| Conducted Emission Test Site # A | | | | |
|----------------------------------|-------------|------------------|---------------|------------|
| EQUIPMENT | MFR | MODEL | SERIAL NUMBER | CAL. DUE |
| TEST RECEIVER | R&S | ESHS20 | 840455/006 | 02/06/2007 |
| LISN (EUT) | SCHWARZBECK | NSLK 8127 | 8127382 | 01/02/2007 |
| LISN | SOLAR | 8012-50-R-24-BNC | 8305114 | 01/02/2007 |
| BNC CABLE | JYE BAO | RG-223/U | BNC A 2 | 10/08/2006 |
| THERMO-HYGRO METER | TOP | HA-202 | 9303-1 | 02/22/2007 |

Note: The measurement uncertainty is less than +/- 2.83dB, which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.

7. LINE CONDUCTED & RADIATED EMISSION TEST

7.1 LIMIT

Maximum permissible level of Line Conducted Emission

| FREQUENCY (MHz) | Class A (dBuV) | | Class B (dBuV) | |
|-----------------|----------------|---------|----------------|---------|
| | Quasi-peak | Average | Quasi-peak | Average |
| 0.15 - 0.5 | 79 | 66 | 66 - 56 | 56 - 46 |
| 0.50 - 5.0 | 73 | 60 | 56 | 46 |
| 5.0 - 30.0 | 73 | 60 | 60 | 50 |

Note: The lower limit shall apply at the transition frequency.

Maximum permissible level of Radiated Emission measured at 10 meter

| FREQUENCY (MHz) | Class A (dBuV/m) | Class B (dBuV/m) |
|-----------------|------------------|------------------|
| | Quasi-peak | Quasi-peak |
| 30 - 230 | 40 | 30 |
| 230 - 1000 | 47 | 37 |

Note: The lower limit shall apply at the transition frequency.

Maximum permissible level of Radiated Emission measured at 3 meter

| FREQUENCY (MHz) | Class A (dBuV/m) | | Class B (dBuV/m) | |
|-----------------|------------------|------|------------------|------|
| | Average | Peak | Average | Peak |
| Above 1000 | 59.3 | 79.3 | 53.9 | 73.9 |

Note: The lower limit shall apply at the transition frequency.



7.2 TEST PROCEDURE OF LINE CONDUCTED EMISSION

Procedure of Preliminary Test

- The EUT was set up as per the test configuration to simulate typical usage per the user's manual. When the EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.4 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.
- Support equipment, if needed, was placed as per ANSI C63.4.
- All I/O cables were positioned to simulate typical actual usage as per ANSI C63.4.
- The test system with EUT received AC power, 120V/60Hz, through a Line Impedance Stabilization Network (LISN), which supplied power source and was grounded to the ground plane.
- All support equipment received power from a second LISN.
- The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a EMI Test Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to the Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Receiver.
- The Receiver scanned from 150kHz to 30MHz for emissions in each of the test modes.
- During the above scans, the emissions were maximized by cable manipulation.
- The test mode(s) described in Item 3.2 were scanned during the preliminary test.
- After the preliminary scan, we found the test mode described in Item 3.2 producing the highest emission level.
- The EUT configuration and cable configuration of the above highest emission level were recorded for reference of the final test.

**Procedure of Final Test**

- EUT and support equipment were set up on the test bench as per step 10 of the preliminary test.
- A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. If EUT emission level was less -2dB to the AV. limit in Q.P. mode, then the emission signal was re-checked using an AV. detector.
- The test data of the worst-case condition(s) was recorded.

Data Sample:

| Freq. MHz | Read Level dBuV | Factor dB | Level dBuV | Limit dBuV | Over Limit dB | Reading Type (P/Q/A) | Line (L1/L2) |
|-----------|-----------------|-----------|------------|------------|---------------|----------------------|--------------|
| x.xx | 42.95 | 0.55 | 43.50 | 73 | -29.50 | Q | L1 |

- Freq. = Emission frequency in MHz
 Read Level = Uncorrected Analyzer/Receiver reading
 Factor = Insertion loss of LISN + Cable Loss
 Level = Read Level + Factor
 Limit = Limit stated in standard
 Over Limit = Reading in reference to limit
 P = Peak Reading
 Q = Quasi-peak Reading
 A = Average Reading
 L1 = Hot side
 L2 = Neutral side

Calculation Formula

$$\text{Over Limit (dB)} = \text{Level (dBuV)} - \text{Limit (dBuV)}$$



7.3 TEST PROCEDURE OF RADIATED EMISSION

Procedure of Preliminary Test

- The equipment was set up as per the test configuration to simulate typical usage per the user's manual. When the EUT is a tabletop system, a wooden turntable with a height of 0.8 meters is used which is placed on the ground plane. When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.
- Support equipment, if needed, was placed as per ANSI C63.4.
- All I/O cables were positioned to simulate typical usage as per ANSI C63.4.
- The EUT received AC power source, 120V/60Hz, from the outlet socket under the turntable. All support equipment received power from another socket under the turntable.
- The antenna was placed at 10 meter away from the EUT as stated in ANSI C63.4. The antenna connected to the Spectrum Analyzer via a cable and at times a pre-amplifier would be used.
- The Analyzer / Receiver quickly scanned from 30MHz to 1000MHz. The EUT test program was started. Emissions were scanned and measured rotating the EUT to 360 degrees and positioning the antenna 1 to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level.
- The test mode(s) described in Item 3.2 were scanned during the preliminary test:
- After the preliminary scan, we found the test mode described in Item 3.2 producing the highest emission level.
- The EUT and cable configuration, antenna position, polarization and turntable position of the above highest emission level were recorded for the final test.

**Procedure of Final Test**

- EUT and support equipment were set up on the turntable as per step 8 of the preliminary test.
- The Analyzer / Receiver scanned from 30MHz to 1000MHz. Emissions were scanned and measured rotating the EUT to 360 degrees, varying cable placement and positioning the antenna 1 to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level.
- Recorded at least the six highest emissions. Emission frequency, amplitude, antenna position, polarization and turntable position were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit and only Q.P. reading is presented.
- The test data of the worst case condition(s) was recorded.

Data Sample:

| Freq. MHz | Amptd dBuV/m | Margin dB | Limit dBuV/m | Reading dBuV | Factor dB/m | Reading Type (P/Q/A) | Pol. (H/V) |
|-----------|--------------|-----------|--------------|--------------|-------------|----------------------|------------|
| x.xx | 26.2 | -13.8 | 40 | 14 | 12.2 | Q | H |

- Freq. = Emission frequency in MHz
 Reading = Uncorrected Analyzer/Receiver reading
 Factor = Antenna Factor + Cable Loss + Attenuator (3/6/10dB) – Amplifier Gain
 Amptd = Uncorrected Analyzer/Receiver reading + Factor
 Limit = Limit stated in standard
 Margin = Reading in reference to limit
 P = Peak Reading
 Q = Quasi-peak Reading
 A = Average Reading
 H = Antenna Polarization: Horizontal
 V = Antenna Polarization: Vertical

Calculation Formula

$$\text{Margin (dB)} = \text{Amptd (dBuV/m)} - \text{Limit (dBuV/m)}$$



7.4 TEST RESULTS

Line Conducted Emission

Model: N/A

Test Mode: N/A

Temperature: N/A

Humidity: N/A

Test Results: N/A

Tested by: N/A

| Six Highest Conducted Emission Readings | | | | | | | |
|---|-------------------|-------------|--------------|-------------------|-----------------|----------------------|--------------|
| Frequency Range Investigated | | | | 150 kHz to 30 MHz | | | |
| Freq (MHz) | Read Level (dBuV) | Factor (dB) | Level (dBuV) | Limit Line (dBuV) | Over Limit (dB) | Reading Type (P/Q/A) | Line (L1/L2) |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

NOTE: The subject equipment is not intended to be connected to AC mains supply. Therefore, this test is not applicable.

**Radiated Emission****Model:** ADAM-4510I**Test Mode:** Mode 1**Temperature:** 28°C**Humidity:** 75% RH**Test Results:** Passed**Tested by:** Benson Yang

(The chart below shows the highest readings taken from the final data.)

| Six Highest Radiated Emission Readings | | | | | | | |
|---|---------------------------|------------------------|---------------------------|----------------------------------|--------------------------|-------------------------------------|-----------------------|
| Frequency Range Investigated | | | | 30 MHz to 1000 MHz at 10m | | | |
| Freq (MHz) | Amptd (dBuV/m) | Margin (dB) | Limit (dBuV/m) | Reading (dBuV) | Factor (dB/m) | Reading Type (P/Q/A) | Pol. (H/V) |
| 79.8200 | 32.36 | -7.64 | 40.00 | 52.00 | -19.64 | Q | V |
| 172.5600 | 32.01 | -7.99 | 40.00 | 47.90 | -15.89 | Q | V |
| 66.4100 | 31.94 | -8.06 | 40.00 | 52.70 | -20.76 | Q | H |
| 79.3300 | 33.42 | -6.58 | 40.00 | 53.10 | -19.68 | Q | H |
| 128.9100 | 32.93 | -7.07 | 40.00 | 46.80 | -13.87 | Q | H |
| 183.7900 | 32.62 | -7.38 | 40.00 | 48.70 | -16.08 | Q | H |

NOTE: 30MHz to 1000MHz test is Applicable CISPR 22 / EN 55022 standard.



APPENDIX I - PHOTOGRAPHS OF TEST SETUP

RADIATED EMISSION TEST

