FCC PART 15 SUBPART C

EMI MEASUREMENT AND TEST REPORT

For

Actiontec Electronics, Inc.

760 North Mary Avenue
Sunnyvale, CA 94086

FCC ID: LNQR3010UW

January 6, 2001

This Report Concerns:	**Equipment Type:**
☒ Class II Permissive Change	Ethernet Router

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Test Date:	December 5, 2001
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1 - GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

The *Actiontec Electronics, Inc'*s product, model no.: *R3010UW (AP)* or the "EUT" as referred to in this report is an Ethernet Router which measures approximately 8.0"L x 6.0"Wx 2.0"H.

The EUT is based on Virata Network processor. Realtek Ethernet PHY and Intersil 802.11b technology. The EUT has one Ethernet port connected to WAN, one Ethernet LAN port, build in 802.11b wireless LAN port and one USB slave port, also has PCMCIA slot for custom flexible configuration.

The EUT utilized Hitron Electronics Corp. AC/DC adapter, Model: HES10-06520-0-1.

**The test data in this test report was good for the test sample only. It may have deviation to other test samples.*

1.2 Objective

This Class II Permissive Change report is prepared on behalf of *Actiontec Electronics, Inc.* in accordance with Part 2, Subpart J, Part 15, Subpart A, B and C of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules for Conducted and Spurious Radiated Emission.

1.3 Related Submittal(s)/Grant(s)

Refer to BACL R0112051. Some components are removed from the original EUT, which had model name as R3010UW:

- The WAN port connector and the components that associate with WAN port including U13 chip, T3 Transformer, RJ45 connector and C76/C77 caps; and
- The PCMCIA slot and the components that associate with PCMCIA slot including J4 PCMCIA connector and U8 analog switch.

1.4 Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-1992, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory Corporation. The radiated testing was performed at an antenna-to-EUT distance of 3 Meters.

1.5 Test Facility

The Open Area Test site used by Bay Area Compliance Laboratory Corporation to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Sunnyvale, California, USA.

Test site at Bay Area Compliance Laboratory Corporation has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI).

The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-1992.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, Bay Area Compliance Laboratory Corporation is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (NVLAP). The scope of the accreditation covers the FCC Method - 47 CFR Part 15 - Digital Devices, IEC/CISPR 22: 1998, and AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods under NVLAP Lab Code 200167-0.

1.6 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Due Date
HP	Spectrum Analyzer	8568B	2610A02165	12/6/02
HP	Spectrum Analyzer	8593B	2919A00242	12/20/02
HP	Amplifier	8349B	2644A02662	12/20/02
HP	Quasi-Peak Adapter	85650A	917059	12/6/02
HP	Amplifier	8447E	1937A01046	12/6/02
A.H. System	Horn Antenna	SAS0200/571	261	12/27/02
Com-Power	Log Periodic Antenna	AL-100	16005	11/2/02
Com-Power	Biconical Antenna	AB-100	14012	11/2/02
Solar Electronics	LISN	8012-50-R-24-BNC	968447	12/28/02
Com-Power	LISN	LI-200	12208	12/20/02
Com-Power	LISN	LI-200	12005	12/20/02
BACL	Data Entry Software	DES1	0001	12/20/02

*** Statement of Traceability: Bay Area Compliance Laboratory Corp.** certifies that all calibration has been performed using suitable standards traceable to the NATIONAL INSTITUTE of STANDARDS and TECHNOLOGY (NIST).

1.7 Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
DELL	Motherboard	370SDW	MA010112	None
DELL	Power Supply	FSP235-60GT	6LL0005707	DOC
NEC	3.5”Floppy Drive	F3927	JU257A586P	DOC
MAXTOR	Hard Drive	3.5 Series	3759072751	DOC
SONY	CD-ROM	BCD40SB	M92926149	DOC
Dell	Chassis	4720	4720089906890	None
RMC	ETHERNET CARD	D1-11	NA	DOC

1.8 Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
Microsoft	KB	E03601QUS201-C	J930025707	DOC
Compaq	Mouse	M-S34	141189-401	DZL211029
KDS	Monitor	KD-1731	0891265478	Euokd-1731
Citizen	Printer	LSP-10	5047999-82	DLK66TLSP-10
EVEREX	Modem	EV-945	None	E3E5UEVE-945
DELL	Desktop	DCB	ULGBT	DOC

1.9 External I/O Cabling List and Details

Cable Description	Length (M)	Port/From	To
Shielded KB Cable	1.6	KB Port/Host	Keyboard
Shielded Mouse Cable	1.8	Mouse Port/Host	Mouse
Shielded Serial Cable	1.5	Serial Port/Host	Modem
Shielded Printer Cable	2.0	Parallel Port/Host	Printer
Unshielded RJ45 Cable	1.2	Ethernet Port/EUT	Ethernet Card
Shielded Video Cable	1.8	Build-in VGA/Host	Monitor

2 - SYSTEM TEST CONFIGURATION

2.1 Justification

The host system was configured for testing in a typical fashion (as a normally used by a typical user).

The EUT was tested in the normal (native) operating mode to represent *worst*-case results during the final qualification test.

2.2 EUT Exercise Software

The EUT exercising program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. The test software, terminal.exe, provided by the customer, is started the Windows 98 terminal program under the Windows 98 operating system. Once loaded, the program sequentially exercises each system component.

The sequence used is as follows:

1. Lines of Hs scroll across the notebook monitor.
2. The modem(s) receives Hs.
3. The printer output Hs.

This process is continuous throughout all tests.

2.3 Special Accessories

As shown in section 2.5, all interface cables used for compliance testing are shielded as normally supplied by INMAC and their respective support equipment manufacturers. The host pc and other peripherals featured shielded metal connectors.

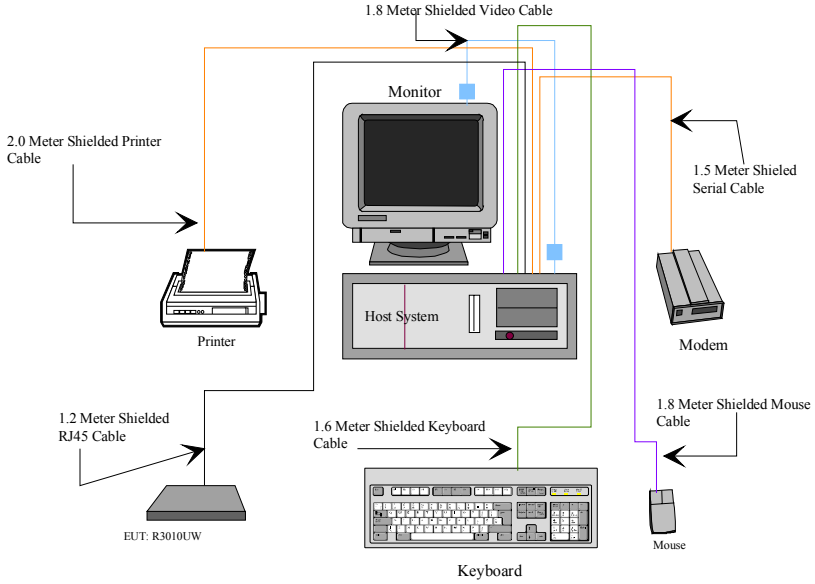
2.4 Schematics / Block Diagram

Appendix A contains a copy of the EUT's schematics diagram as reference.

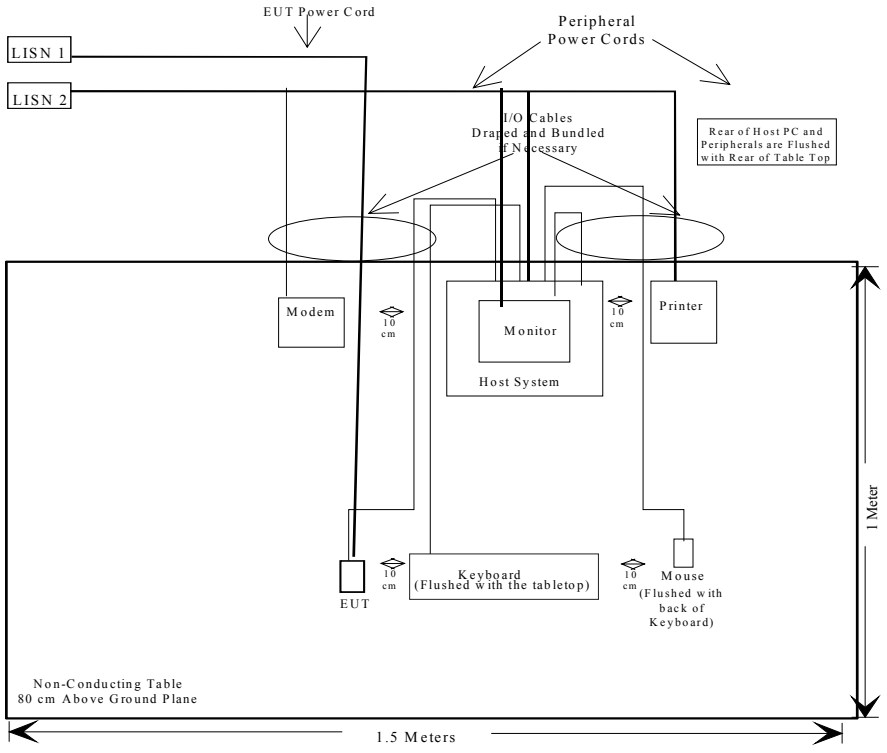
2.5 Equipment Modifications

No modifications were made by BACL Corporation to ensure the EUT to comply with the applicable limits and requirements.

2.6 Configuration of Test System



2.7 Test Setup Block Diagram



3 - SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
§ 15.205	Restricted Bands	Compliant
§ 2.1091	RF Safety Requirements	Compliant
§15.203	Antenna Requirement	Compliant
§15.209 (a)	Radiated Emission	Compliant

4 - CONDUCTED OUTPUT POWER MEASUREMENT

4.1 Standard Applicable

According to §15.247(b) (2), the maximum peak output power of the intentional radiator shall not exceed 1 Watt.

4.2 Measurement Procedure

1. Place the EUT on the turntable and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.

4.3 Measurement Result

Channel	Test Data	Test Result
Low Channel	17.54 dBm	Pass
Middle Channel	17.61 dBm	Pass
High Channel	17.32 dBm	Pass

4.4 Test Equipment

Manufacturer	Model No.	Serial No.	Calibration Due Date
Agilent	E4419b	GB40202891	4/8/03
Agilent	E4412a	US38486529	4/8/03


17.54


17.61


17.32

5 - ANTENNA REQUIREMENT

5.1 Standard Applicable

For intentional device, according to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to § 15.247 (1), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.2 Antenna Connected Construction

The directional gain of antenna used for transmitting is 2 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

6 - RF EXPOSURE

According to 15.247(b)(4), RF exposure is calculated.

MPE Prediction

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S = PG/4\pi R^2$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal: 17.61dBm
Maximum peak output power at antenna input terminal: 57.68mW
Antenna Gain (typical): 2.0dBi
Maximum antenna gain: 1.58numeric
Prediction distance: 3cm
Predication frequency: 2400(MHz)
MPE limit for uncontrolled exposure at prediction frequency: 1mW/cm^2
Power density at predication frequency: 0.806mW/cm^2
Maximum Allowable Antenna Gain: 2.9dBi

Test Result

The predicted power density level at 3 cm is 0.806mW/cm². This is below the uncontrolled exposure limit of 1mW/cm² at 2400 MHz.

7 - SPURIOUS RADIATED EMISSION DATA

7.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at BACL is $\pm$4.0 dB.

7.2 EUT Setup

The radiated emission tests were performed in the open area 3-meter test site, using the setup in accordance with the ANSI C63.4 - 1992. The specification used was the FCC 15 Subpart C limits.

The EUT was put in the front of the test table. The host PC system was placed on the center of the back edge on the test table. The modem was placed on the left side of the host PC system, and the printer was placed on the right side of the host PC system. The monitor was place directly above the host PC system. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.

The keyboard was placed directly in front of the monitor, flushed with the front of tabletop. The mouse was placed next to the keyboard, flushed with the back of keyboard.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The host PC system was connected with 110Vac/60Hz power source.

7.3 Spectrum Analyzer Setup

According to FCC Rules, 47 CFR §15.33 (a) (1), the system was tested to 26GHz.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

Start Frequency	30 MHz
Stop Frequency	26GHz
Sweep Speed	Auto
IF Bandwidth	1 MHz
Video Bandwidth	1 MHz
Quasi-Peak Adapter Bandwidth	120 kHz
Quasi-Peak Adapter Mode	Normal
Resolution Bandwidth	1MHz

7.4 Test Procedure

For the radiated emissions test, the EUT and support equipment power cords were connected to the AC floor outlet.

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations. All data was recorded in the peak detection mode. Quasi-peak readings was performed only when an emission was found to be marginal (within -4 dBμV of specification limits), and are distinguished with a "**Qp**" in the data table.

7.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dBμV means the emission is 7dBμV below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – Subpart C Limit

7.6 Summary of Test Results

According to the data in section 11.7, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.207 and 15.247, and had the worst margin of:

Intentional Emission, 30MHz to 26GHz, 3 meters

-2.0 (Avg.) dBμV at 4823.10 MHz in the Vertical polarization, Low Channel

-1.7 (Avg.) dBμV at 4873.94 MHz in the horizontal polarization, Middle Channel

-2.9 (Avg.) dBμV at 4921.92 MHz in the Vertical polarization, High Channel

Unintentional Emission, 30 to 1000MHz, 3 meters

-1.7 dBμV at 361.00 MHz in the Horizontal polarization

Intentional Emission, 30 MHz – 26GHz, 3 Meters

INDICATED			TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 Subpart C	
Frequency MHz	Ampl. dBμV/m	Comments	Angle Degree	Height Meter	Polar H/ V	Antenna dBμV/m	Cable DB	Amp. DB	Corr. Ampl. dBμV/m	Limit dBμV/m	Margin dB
Low Channel											
4823.10	44.6	*	210	1.2	V	32.5	4.9	30.0	52.0	54	-2.0
7239.15	39.4	*	60	1.2	V	35.1	5.6	30.0	50.1	54	-3.9
4823.10	40.5	*	330	1.5	H	32.5	4.9	30.0	47.9	54	-9.3
4076.00	35.1	*	270	1.2	H	31.4	4.7	30.0	41.2	54	-12.8
Middle Channel											
4873.94	44.90	*	60	1.20	H	32.5	4.9	30.0	52.3	54	-1.7
4873.94	40.3	*	90	1.5	V	32.5	4.9	30.0	47.7	54	-6.3
7314.49	39.2	*	0	1.5	V	35.1	5.6	30.0	49.9	54	-12.7
7314.49	36.4	*	330	1.2	H	35.1	5.6	30.0	47.1	54	-13.2
High Channel											
4921.92	43.7	*	210	1.2	V	32.5	4.9	30.0	51.1	54	-2.9
4921.92	40.6	*	60	1.0	H	32.5	4.9	30.0	48.0	54	-6.0
7383.38	30.8	*	310	1.2	V	35.1	5.6	30.0	41.5	54	-12.8
7383.38	35.2	*	60	1.0	H	35.1	5.6	30.0	45.9	54	-13.5

* Restricted Band and Average

Unintentional Emission, 30MHz to 1000MHz, 3 meters

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC15 SUBPART C	
Frequency MHz	Ampl. dBμV/m	Angle Degree	Height Meter	Polar H/ V	Antenna dBμV/m	Cable dB	Amp. dB	Corr. Ampl. dBμV/m	Limit dBμV/m	Margin dB
361.00	48.6	0	1.2	H	15.5	5.2	25.0	44.3	46	-1.7
375.06	47.6	30	1.5	H	15.8	5.3	25.0	43.7	46	-2.3
160.10	51.2	15	1.5	V	13.2	1.6	25.0	41.0	43.5	-2.5
80.10	50.9	60	1.2	V	9.6	1.4	25.0	36.9	40	-3.1
124.90	50.7	160	1.2	V	12.1	2.2	25.0	40.0	43.5	-3.5
40.30	48.5	110	1.2	V	12.1	0.7	25.0	36.3	40	-3.7
242.00	51.7	330	1.5	H	12.6	2.3	25.0	41.6	46	-4.4
220.40	49.8	330	1.5	H	12.1	3.9	25.0	40.8	46	-5.2
425.00	44.6	45	2.0	H	17.2	3.0	25.0	39.8	46	-6.2