

**Before the  
STATE OF NEW YORK PUBLIC SERVICE COMMISSION  
Albany, New York**

**In the Matter of** )  
 )  
**Proceeding on Motion of the Commission to** ) **CASE 06-M-0043**  
**Examine Issues Related to the Deployment of** )  
**Broadband Over Power Line Technologies** )

**To: The Commission, c/o  
Jaclyn A. Brillling, Secretary  
Three Empire State Plaza  
Albany, New York 12223-1350**

**COMMENTS OF ARRL, THE NATIONAL  
ASSOCIATION FOR AMATEUR RADIO**

ARRL, the National Association for Amateur Radio, also known as the American Radio Relay League, Incorporated (ARRL), by its General Counsel and pursuant to the *Order Initiating Proceeding and Inviting Comments* (the Order) in the above-captioned proceeding, hereby respectfully submits its comments in response thereto. The Order was issued and effective January 25, 2006, and called for comments to be filed not later than 45 days after the date of issuance. Therefore, these comments are timely filed. In response to the issues raised in the Order, ARRL states as follows:

1. ARRL is a Connecticut non-profit association, and is the principal representative throughout the United States of individuals who are Amateur Radio operators. ARRL has a nationwide membership of more than 140,000 licensees of the Federal Communications Commission (FCC) in the Amateur Radio Service. Amateur Radio is an avocation which is intended to promote and encourage technical self-training in telecommunications; foster international goodwill; and to provide disaster relief and emergency communications on a noncommercial, non-pecuniary basis. It is

comprehensively regulated by the Federal Communications Commission. Licensees have demonstrated skill in telecommunications theory and practice through examinations. In times of natural or other disasters or emergencies, whether local or regional, Amateur Radio operators respond reliably and provide trained interoperability and other communications for public safety and disaster relief agencies, and assist in restoring communications systems that are damaged or overloaded.

2. The Commission in this proceeding notes that Broadband over Power Line (BPL) systems have been deployed commercially at various locations in the United States, including Cincinnati, Ohio; Briarcliff Manor, New York; and Manassas, Virginia. As the result, it is examining the options for increasing competition for consumers in the area of broadband delivery in the State of New York, and the State's proper regulatory response to BPL deployment.

3. BPL, as the Commission notes, raises "unique" issues. These issues include the fact that BPL is premised on the transmission of broadband signals in the High Frequency (HF) part of the radio spectrum (i.e. between 3 and 30 MHz) and in the low VHF range (i.e. 30 to 80 MHz), via overhead, medium-voltage power lines which are unshielded.<sup>1</sup> These overhead power lines were never intended, nor designed, to carry HF radio signals. As the result of the portion of the radio spectrum in which BPL operates, typically between 3 and 80 MHz (or some portion thereof), and given the unshielded nature of the power lines, the lines act as very efficient and effective antennas, and radiate the signals into the air, as well as conducting them through the power line. There are numerous frequency allocations, international and domestic, for the Amateur Radio Service within

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<sup>1</sup> Overhead power lines are not shielded, and do not restrict the radiation of radio frequency signals. This is distinct from, for example, cable television cables, which are shielded, so that radio frequency energy is not radiated from them.

the HF and low VHF spectrum.<sup>2</sup> Because of this, and because Amateur Radio stations are located in both residences of licensees and in their vehicles, the Amateur stations are in very close geographic proximity to the medium-voltage power lines on which BPL signals are conducted and unintentionally radiated. Amateur Radio stations, therefore, are subject to, and in trial and limited commercial deployments of BPL (with very few exceptions to date) have experienced harmful interference from the wideband BPL signals. In the cases of the Manassas, Virginia and Briarcliff Manor, New York BPL deployments, the BPL operators have proven unable, over a long period of time, to resolve the interference. On March 7, 2006, the FCC has commenced its investigation of the harmful interference from the Manassas, Virginia BPL system. Attached hereto as **Exhibit A** are the FCC's correspondence with both the Manassas BPL operator and the Amateur Radio operators who are victims of the interference. In Briarcliff Manor, the BPL operator has been unable to resolve the harmful interference for a long period of time. Attached hereto as **Exhibit B** is the most recent interference complaint filed by ARRL with the FCC relative to the Briarcliff Manor, NY deployment. Most recent measurements and interference investigation of that BPL system in January of this year reveal that the interference remains unabated in Briarcliff Manor. ARRL has repeatedly requested that the FCC shut that system down. A member of the FCC's Enforcement Bureau visited Briarcliff Manor recently and confirmed the existence of overwhelmingly high BPL noise levels that would preclude Amateur Radio communications.

4. ARRL's concern with BPL is due exclusively to its substantial, and empirically demonstrated severe interference potential to Amateur Radio communications. ARRL is

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<sup>2</sup> The Amateur Radio Service is, in the United States, allocated the bands 3.5 to 4 MHz; some channels near 5 MHz; 7.0 to 7.3 MHz; 10.100 to 10.150 MHz; 14.0 to 14.35 MHz, 18.068 to 18.168 MHz; 21.00 to 21.45 MHz; 24.890 to 24.990 MHz; and 28.0 to 29.7 MHz, as well as 50.0 to 54.0 MHz.

not concerned with BPL *per se*, however, and in general is supportive of improving broadband deployment. Amateur Radio stations utilize broadband and themselves experiment with advanced high speed multimedia technology.

5. Radio interference phenomena are beyond the scope of this Commission's jurisdiction. It is instead the exclusive province of the FCC, pursuant to the Communications Act of 1934 (47 U.S.C. § 151 *et seq.*).<sup>3</sup> The FCC has adopted rules recently in ET Docket No. 04-37 governing BPL, including some rules addressing the interference potential of BPL to licensed radio services. These rules are, in ARRL's view, clearly inadequate and insufficient to prevent or lead to a resolution of the inevitable interference that would result from wide scale deployment of BPL systems. The FCC BPL rules are currently subject to administrative appeal. Regardless of the nature of that ongoing FCC proceeding, however, it is clear that BPL systems are regulated as unlicensed, unintentional radiating devices under the FCC's rules (47 C.F.R. § 15.601 *et seq.*). The so-called "Part 15" rules include two absolute requirements for such unlicensed devices: First, they may not cause interference to licensed radio service stations. Second, unlicensed devices and systems must accept any interference received from licensed radio services. 47 C.F.R. § 15.5.<sup>4</sup> Therefore, should BPL systems cause

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<sup>3</sup> See, e.g. *960 Radio, Inc.*, FCC 85-578, 1985 Lexis 2342 (released October 29, 1985). ("federal power in the area of radio frequency interference is exclusive; to the extent that any state or local government attempts to regulate in this area, [its] regulations are preempted."); *Broyde v. Gotham Tower, Inc.*, 13 F. 3d 994, 998 (6<sup>th</sup> Cir. 1994); *Blackburn v. Doubleday Broadcasting Co.*, 353 N.W. 2d 550 (Minn. 1984) and in *Smith v. Calvary Educational Broadcasting Network*, 783 S.W. 2d 533 (Mo. App. 1990); *Southwestern Bell Wireless v. Johnson County Board of Commissioners*, 199 F. 3d 1185 (10<sup>th</sup> Cir. 1999);

<sup>4</sup> That rule provides, in relevant part, that "(p)ersons operating intentional or unintentional radiators shall not be deemed to have any vested or recognizable right to continued use of any given frequency by virtue of prior registration or notification of equipment... Operation of an intentional, unintentional or incidental radiator is subject to the conditions that no harmful interference is caused and that interference must be accepted that may be caused by the operation of an authorized radio station, by another intentional or unintentional radiator, by industrial, scientific and medical (ISM) equipment, or by an incidental radiator... The operator of a radio frequency device shall be required to cease operating the device upon notification

harmful interference, they must cease operating until the interference is corrected. Conversely, interference from licensed radio services which harm or preclude BPL operation must be tolerated, even if that interference precludes operation of the system.

6. This Commission, while it does not have jurisdiction over radio interference issues, is properly concerned with the reliability of BPL deployments. At page 6 of the Order, the Commission states as follows:

BPL may create interference for or be affected by interference from electrical equipment, including vacuum cleaner motors, light dimmers, electric heater thermostats or power line communication systems such as baby monitors, intercoms or private computer networks located inside or outside of a customer's premises. Commenters should address the extent of such interference and its effects, including the creation of harmonics that could impair electric utility power quality. The parties should address the extent to which a BPL provider, the utility, and the electrical equipment user should be required to mitigate such interference. Similarly, what is the obligation, if any, of any party who operates a conducted power line communications system within their premises to remedy interference with BPL services being provided to another customer on the same general electric utility circuit... Who should ultimately be responsible for any unknown problems or issues that arise on an electric utility customer's premises due (to) the new BPL system (e.g. interference with existing customer owned systems such (as) security or fire alarms)? What is the appropriate forum for resolution of disputes concerning interference or power quality issues arising from operation of BPL systems?

7. Some of these issues are outside the jurisdiction of this Commission. As noted above, however, this Commission is directly concerned with the quality of utility service provided to customers. BPL is inferior to other broadband delivery mechanisms specifically because of its substantial interference potential, and because of its interference susceptibility. Both of those inherent factors cause BPL to be an unreliable broadband transmission method. It is subject to interruption or termination of service.

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by a(n FCC) representative that the device is causing harmful interference. Operation shall not resume until the condition causing the interference has been corrected."

There is no question that BPL systems that cause harmful interference to licensed radio services must cease operation pending interference resolution. It is impossible to determine when, and for how long, a BPL system will be unable to provide service in a given location. Neither is BPL service immune from interruptions due to interference from nearby radio stations. Some preliminary tests conducted by ARRL technical representatives and amateur radio groups <sup>5</sup> have concluded that, at only four watts of transmitter power at normal separation distances from a BPL modem mounted on overhead power lines, BPL data packets are interrupted. At power levels of approximately 100 watts, some modems have exhibited damage. At normal Amateur Radio power levels, the BPL transmissions are interrupted by over-the-air radio signals at distances of up to a third of a mile from the power line. This makes BPL a distinctly inferior broadband delivery mechanism relative to DSL, fiber, satellite or cable delivery.

8. It should be noted that not all BPL architectures have exhibited similar interference potential to Amateur Radio Service stations. For example, the system designed by Current Technologies (the BPL system in use in Cincinnati, Ohio) has in ARRL's experience exhibited significantly less interference potential to Amateur Radio than do the systems deployed in Manassas, Virginia (the Main.net system) and that in Briarcliff Manor, NY (designed by Ambient). The reason for this is that the Current Technologies system utilizes frequencies between 30 and 50 MHz, rather than the HF radio spectrum, on medium voltage power lines. While this raises potential issues with

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<sup>5</sup> The Amateur Radio Research and Development Corporation (AMRAD) conducted extensive interference susceptibility tests of the BPL system at Potomac, Maryland in November of 2003. These tests revealed that, at typical Amateur Radio power levels between 4 and 500 watts of transmitter power output (Amateur Radio operators are entitled to utilize up to 1500 watts of transmitter power output) BPL transmissions were interrupted at distances up to 0.3 of a mile from the power line BPL modem. The complete results can be viewed at the FCC Web Site in the *Additional Reply Comments of the Amateur Radio Research and Development Corporation (AMRAD)* in ET Docket 03-104.

public safety and other land mobile services that used this range of spectrum, there are no Amateur Radio allocations in the frequency range utilized by Current. The Current Technologies system also utilizes the “HomePlug” standard for connections between the medium voltage power line and the customer’s residence. ARRL worked with HomePlug in developing this standard, and generally it makes no use of Amateur frequency allocations.<sup>6</sup> Motorola has developed, cooperatively with ARRL, a BPL architecture that makes no use of medium-voltage power lines at all. In extensive testing cooperatively with Motorola, the system does not exhibit either significant interference potential to Amateur Radio nor significant interference susceptibility. The Motorola BPL system was specifically designed to avoid interaction with Amateur Radio or other users of the HF spectrum.

9. Though this Commission does not have jurisdiction over radio frequency interference phenomena, it would appear that it does have the ability to require utilities to respond promptly to complaints of interference from FCC licensees, so as to promote, if possible, resolution of interference complaints that might result in interruption of BPL service to customers. Though the FCC’s skeletal BPL regulations (which ARRL has demonstrated to be inadequate to address the substantial interference potential of BPL) require prompt responses to interference complaints, ARRLs’ extensive experience with BPL test sites and initial deployments reveals that BPL operators routinely either deny that interference is occurring or deny that the interference is “harmful interference” within the standard, international definition thereof.<sup>7</sup> A Commission requirement that a

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<sup>6</sup> There was recently created in the United States a small Amateur Radio allocation in the vicinity of 5 MHz, which is utilized in the HomePlug standard, but that is the only exception.

<sup>7</sup> The FCC’s regulations use the same definition of harmful interference as do the International Telecommunication Union (ITU) Radio Regulations, which have treaty status in the United States: Harmful

BPL operator respond within 24 hours to an interference complaint from an FCC-licensed radio station might potentially forestall a confrontation that would result ultimately in the BPL system having to cease operation and interrupt service to customers.

10. Ultimately, the determining factor here in terms of quality of BPL service is the choice of BPL architecture by a particular utility. Those BPL systems using the DS2 Chipsets, typified by the Ambient, Mitsubishi or Amperion BPL systems, and the Main.net BPL architecture, have exhibited severe interference potential, resulting in multiple complaints that, regardless of the level of good faith exhibited by the BPL operator, have proven virtually impossible to remedy other than by shutting the BPL system down. While BPL is an unreliable broadband delivery method, some systems are notably better than others in terms of interference potential. ARRL suggests, therefore, that, in the interests of served customers, this Commission should not approve BPL on a blanket basis. It should, instead, permit only those BPL systems that have exhibited a substantially reduced interference potential and interference susceptibility. Those systems will then have a substantially attenuated likelihood of service interruption. Alternatively, it should adopt requirements that, prior to and as a condition of commencing operation, the BPL provider should demonstrate, via a proof of performance, that (1) its system is capable of operating without causing interference to Amateur Radio stations, and (2) that it is not susceptible to signal ingress by nearby licensed radio stations. ARRL would be pleased to assist in the development of proof of performance criteria.

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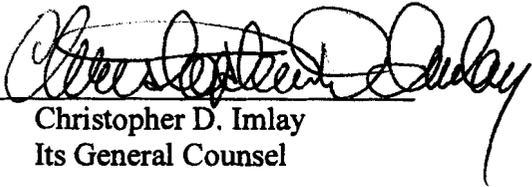
Interference for a non-safety of life radio service is that which "seriously degrades, obstructs or repeatedly interrupts a radiocommunication service operating in accordance with these (International) Radio Regulations." 47 C.F.R. § 2.1(c); Radio Regulations, Resolution 68 (Geneva, 1982).

Therefore, the foregoing considered, ARRL, the National Association for Amateur Radio, respectfully requests that the Commission permit BPL deployment in New York State only in accordance with the foregoing recommendations.

Respectfully submitted,

**ARRL, the National Association  
for Amateur Radio**

225 Main Street  
Newington, CT 06111

By:   
Christopher D. Imlay  
Its General Counsel

Booth, Freret, Imlay & Tepper, P.C.  
14356 Cape May Road  
Silver Spring, MD 20904-6011  
(301) 384-5525 telephone  
(301) 384-6384 facsimile  
W3KD@arrl.org

March 9, 2006

**EXHIBIT A**



FEDERAL COMMUNICATIONS COMMISSION  
Enforcement Bureau  
Spectrum Enforcement Division  
445 12<sup>th</sup> Street, S.W.  
Washington D.C. 20554

March 7, 2006

James N. Horwood, Esq.  
Attorney for the City of Manassas  
Spiegel & McDiarmid  
1333 New Hampshire Avenue, N.W.  
Washington, DC 20036

Chris Imlay, Esq.  
General Counsel, ARRL  
Booth, Freret, Imlay & Tepper, P.C.  
14356 Cape May Road  
Silver Spring, MD 20904

Mr. Walter P. Adams  
Vice President, New Technology  
COMTek  
14151 Newbrook Drive, Suite 400  
Chantilly VA 20151

Mr. George V. Tarnovsky  
8314 Morningside Drive  
Manassas VA 20112

Mr. Dwight Agnew  
9335 King George Drive  
Manassas, VA 20109

Mr. Donald Blasdel  
9727 Loudon Avenue  
Manassas VA 20109

Mr. William South  
6074 River Forest Drive  
Manassas VA 20112-3042

Mr. Jack B. Cochran  
11053 Camfield Court, # 002  
Manassas VA 20109

Gentlemen:

We have received responses from all parties to our letter of November 30, 2005, in which we requested additional information regarding complaints of interference caused to amateur radio licensees by the City of Manassas' broadband over power line (BPL) system. Additionally, subsequent to our letter, we have received a complaint from Mr. Dwight Agnew which contained specific allegations of interference. Based on correspondence provided by the amateur radio licensees and the ARRL, we understand that, as of January 17, 2006, the ongoing discussions between the complainants, COMTek, and the City of Manassas regarding the interference have ended without a satisfactory resolution, and we continue to receive complaints of harmful interference from the complainants. Accordingly, to enable us to make a determination in this matter, we are now requesting further information from the complainants concerning their complaints of harmful interference.

Section 15.5 (b) of the Commission's Rules (47 C.F.R. Section 15.5(b)) prohibits access BPL providers from causing harmful interference.<sup>1</sup> In order for us to proceed, the complainants should provide us with the following supplementary information:

- a description of the interference, including (1) the device receiving interference, (2) the frequency(ies) on which interference occurred; and (3) and what effect the interference has on the licensee's use of the spectrum (e.g., prevents or degrades reception, ongoing communications interrupted. etc.);
- a statement of when the interference started, how often it occurs, when it was last experienced;
- the specific geographic location where the interference occurs and the circumstances that result in the complainant's "routine" presence in that area;
- complainant's license information, if any (type of license, call sign, expiration date, etc.); and
- any other information deemed pertinent by the complainant relating to the provider's overall compliance with the Commission's Rules.

We have reviewed Mr. Agnew's correspondence of January 19, 2006 and find that it contains sufficient information for us to investigate whether harmful interference exists. It will not be necessary for Mr. Agnew to file supplementary information concerning his complaint. By separate letter of this date, we have forwarded Mr. Agnew's complaint to the City of Manassas and COMTek with a request for a resolution in accordance with the Commission's Rules. (Copy enclosed.)

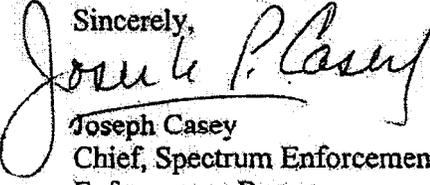
With the exception of Mr. Agnew, any amateur licensee addressed in this letter who wishes to continue pursuing this matter, should provide the Commission with the information described above. If a complainant fails to respond with the requested information within 30 days of the date of this letter, we will take no further action regarding his complaint.

Correspondence concerning this matter should be sent by first class mail to: Katherine Power, Esq., Spectrum Enforcement Division, Enforcement Bureau, Room 7B-555, Federal Communications Commission, Washington DC 20554.

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<sup>1</sup> For these purposes, the Commission defines "harmful interference" as "[a]ny emission, radiation or induction that endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunications service operating in accordance with this chapter." See 47 C.F.R. § 15.3(m).

The FCC's *ex parte* rules require that parties also serve copies of their submissions on all parties in the proceeding, as listed above.

Sincerely,  
  
Joseph Casey  
Chief, Spectrum Enforcement Division  
Enforcement Bureau

Enclosure



FEDERAL COMMUNICATIONS COMMISSION  
Enforcement Bureau  
Spectrum Enforcement Division  
445 12<sup>th</sup> Street, S.W.  
Washington D.C. 20554

March 07, 2006

James N. Horwood, Esq.  
Attorney for the City of Manassas  
Spiegel & McDiarmid  
1333 New Hampshire Avenue, N.W.  
Washington, DC 20036

Mr. Walter P. Adams  
Vice President, New Technology  
COMTek  
14151 Newbrook Drive, Suite 400  
Chantilly VA 20151

Via Certified Mail  
Return Receipt Requested

Dear Mr. Horwood and Mr. Adams:

On January 19, 2006, we received a complaint from amateur radio licensee Mr. Dwight Agnew (Call sign AI4II), alleging that the City of Manassas' broadband over power line (BPL) operation causes harmful interference to his authorized transmissions while traveling along Virginia Business Route 234 in Manassas. (Copy enclosed.) Mr. Agnew states that he has been unable to engage in radio communications during his daily travels on this main road between his home and place of work. In light of this complaint, and the apparent inability of the City of Manassas and various Amateur Radio Service licensees to reach a mutually satisfactory resolution to other interference complaints,<sup>1</sup> we are directing the City of Manassas to take several steps to investigate this allegation and take appropriate remedial steps to eliminate any instances of harmful interference.

***System Compliance.*** Access BPL systems are required to meet the pertinent radiated emissions requirements specified in Section 15.611(b) of the Commission's Rules (47 C.F.R. § 15.611(b)). Accordingly, in order to demonstrate compliance with 47 C.F.R. § 15.611(b), we direct the City of Manassas to make measurements at the locations described in Mr. Agnew's complaint, during the hours of peak usage of the system by BPL customers. These measurements must be made in accordance with the

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<sup>1</sup> We have received complaints regarding the City of Manassas BPL system from amateur licensees other than Mr. Agnew. In that context, we have been informed that, as of January 17, 2006, the ongoing discussions between the complainants, COMTek, and the City of Manassas regarding the interference have ended without a satisfactory resolution.

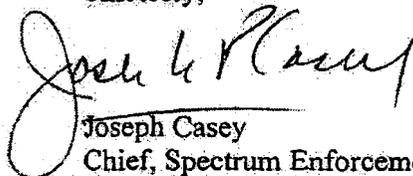
guidelines of Section 15.613 of the Commission's Rules (47 C.F.R. § 15.613).<sup>2</sup> Documentation of these measurements must be submitted to the Commission. If the measurements reveal any portion of the system to be non-compliant with the pertinent Commission requirements, it must be noted. In this event, the report must also include a description of remedial steps taken to bring the system into compliance with the Rules, along with post-remediation measurements confirming compliance. In addition, in your report, please advise what plans you have, if any, for upgrading the present "grandfathered" equipment in your system with FCC certified equipment.

**Interference Complaint.** Section 15.5 (b) of the Commission's Rules (47 C.F.R. § 15.5(b)) prohibits access BPL providers from causing harmful interference.<sup>3</sup> Accordingly, once compliance is confirmed, the City of Manassas is directed to take action to resolve any continuing harmful interference.

The Commission has stated that at frequencies below 30 MHz, reducing emissions to 20 dB below the Part 15 limits generally will be considered to be sufficient to resolve instances of interference to mobile operations.<sup>4</sup> Accordingly, the City of Manassas must either eliminate any continuing harmful interference to Mr. Agnew's operations in the Business Route 234 area, or reduce the emissions in that area to 20 dB below the Part 15 limit.<sup>5</sup> The City of Manassas must submit a report to the Commission detailing its investigation of Mr. Agnew's complaint. This report must include any steps taken to mitigate interference, and give the status of the interference situation subsequent to these actions.

**Response Required.** Your report of system compliance and your report of actions taken to address the alleged harmful interference must be submitted to us within thirty days of the date of this letter. Correspondence concerning this matter should be sent by first class mail to: Katherine Power, Esq., Spectrum Enforcement Division, Enforcement Bureau, Room 7B-555, Federal Communications Commission, Washington DC 20554. The City of Manassas shall serve Mr. Agnew with copies of any Commission filings made in response to this letter.

Sincerely,



Joseph Casey  
Chief, Spectrum Enforcement Division  
Enforcement Bureau

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<sup>2</sup> See *Amendment of Part 15 regarding new requirements and measurement guidelines for Access Broadband over Power Line Systems ("BPL Report and Order")*, 19 FCC Rcd 21265, 21339, Appendix C (2004).

<sup>3</sup> For these purposes, the Commission defines "harmful interference" as "[a]ny emission, radiation or induction that endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunications service operating in accordance with this chapter." See 47 C.F.R. § 15.3(m).

<sup>4</sup> See *BPL Report and Order* at 21294.

<sup>5</sup> See 47 C.F.R. § 15.611(c)(1).

cc: Mr. Dwight Agnew  
9335 King George Drive  
Manassas, VA 20109

-----Original Message-----

**From:** Dwight AI4II [mailto:da@agnew.us]

**Sent:** Thursday, January 19, 2006 4:14 PM

**To:** Joseph Casey

**Subject:** at a loss with noise

Hello,

You know I am starting to feel all this interference is hindering my ability to communicate, it is but I was thinking in letters to the fcc. I am a mobile and portable ham radio operator. I drive through Manassas Virginia several times a day. Not that I am just going to Manassas to look for interference from the power companies internet service, as some have suggested. I live and work in the Manassas area. As for having to "look" for area's to complain about, its harder to find area's that are quiet to interference.

In this email I will complain about the Sudley Rd to Grant Ave to Dumfries Rd. also know as Route 234 Business. Its a main road. The BPL ish interference is noticable on the whole drive with one are on Grant thats fairly quiet. I had been talking to a friend in Ohio while on my way home from work. I could no longer hear him over the interference on 40 meters (7.2 MHz) while driving through the city. Was able to hear him after I left the city, its like a giant fuzzy mute.

I think I mentioned before that I had gotten into ham radio after 9/11, as my part to be ready to help out with portible long range communication gear. My cell would not work on 9/11 and had learned to have a back up plan. Manassas City and Comtek's BPL service effectively ends this, unless the lights go dark in Manassas. I also have solar backup on my gear.

I am hopeful you can help me.

Dwight Agnew - AI4II  
9335 King George Dr.  
Manassas, VA 20109  
703-335-7726

1/23/2006

**EXHIBIT B**



**STAMP & RETURN**

- JIM HAYNIE  
W5JBP, PRESIDENT
- JOEL M. HARRISON  
W6ZN, FIRST VICE PRESIDENT
- KAY C. CRAIGIE  
N3KN, VICE PRESIDENT
- RODNEY J. STAFFORD  
WBROD, VICE PRESIDENT  
INTERNATIONAL AFFAIRS
- JAMES E. McCOBB  
W1LLU, TREASURER
- DAVID SUMNER  
K1ZZ, CHIEF EXECUTIVE OFFICER  
SECRETARY
- BARRY J. SHELLEY  
N1VXY, CHIEF FINANCIAL OFFICER
- MARK J. WILSON  
K1RO, CHIEF OPERATING OFFICER
- MARY M. HOBART  
K1MMH, CHIEF DEVELOPMENT OFFICER
- PAUL RINALDO  
W4RI, CHIEF TECHNOLOGY OFFICER

**Office of the General Counsel**  
**14356 Cape May Road**  
**Silver Spring, Maryland 20904-6011**  
**(301) 384-5525 telephone**  
**(301) 384-6384 facsimile**  
**W3KD@ARRL.ORG**

January 5, 2006

Via U.S. Mail and E-mail  
 Joseph.Casey@fcc.gov  
 Bruce.Franca@fcc.gov  
 James.Burtle@fcc.gov

**RECEIVED - FCC**



JAN - 6 2006

Joseph Casey, Esquire  
 Chief, Spectrum Enforcement Division  
 Enforcement Bureau  
 Federal Communications Commission  
 445 Twelfth Street, S.W.  
 Washington, D.C. 20554

Federal Communication Commission  
 Bureau / Office

Bruce Franca, Acting Chief  
 Office of Engineering and Technology  
 Federal Communications Commission  
 445 Twelfth Street, S.W.  
 Washington, D.C. 20554

James Burtle, Chief  
 Experimental Licensing Division  
 Office of Engineering and Technology  
 Federal Communications Commission  
 445 Twelfth Street, S.W.  
 Washington, D.C. 20554

**RE: Pending Interference Complaints, Ambient  
 Corporation Broadband Over Power Line System at  
 Briarcliff Manor, New York; Continued Request for  
 Immediate Cessation of Operation Pursuant to  
 Experimental Authorization WD2XEQ, File No. 0118-  
 EX-RR-2005.**

Gentlemen:

ARRL, the National Association for Amateur Radio, also known as the American Radio Relay League, Incorporated (ARRL), filed on October 12, 2004; December 17,

**AMERICAN RADIO RELAY LEAGUE**

ADMINISTRATIVE HEADQUARTERS • 225 MAIN STREET • NEWINGTON, CONNECTICUT, USA 06111-1494  
 TELEPHONE 860-594-0200 • FAX 860-594-0259 • INTERNET: [hq@arrl.org](mailto:hq@arrl.org) • WWW: <http://www.arrl.org/>

2004; and on January 7, 2005, complaints of ongoing harmful interference regarding, and requests for an instruction by the Commission to Ambient Corporation to cease the unlawful operation of, a Broadband over Power Line (BPL) system located in Briarcliff Manor, Westchester County, New York. The BPL system operates on power lines owned and used by Consolidated Edison. The complaints included technical reports on the result of tests conducted by ARRL. The conclusion reached in each complaint, which ARRL now reiterates, is that this facility was, and now still is, causing harmful interference to Amateur Radio stations and must be required to cease operation immediately.

The ARRL complaints followed multiple earlier complaints about the same system by an individual Amateur Radio licensee resident in the area, Mr. Alan Crosswell.

In December of 2004, Mr. Riley Hollingsworth of the Commission's Enforcement Bureau visited the Briarcliff Manor site; personally witnessed the interference complained of by ARRL; and can verify it. However, according to a letter to undersigned counsel from Mr. Franca dated February 10, 2005, Commission staff inspected the Briarcliff Manor installation on January 18, 2005 and allegedly found no harmful interference. Mr. Franca's letter was responded to by ARRL on March 17, 2005. That ARRL response noted that the Commission's staff did not contact the complainant in Briarcliff Manor when they allegedly conducted their investigation; they conducted only a truncated investigation on only one single frequency; and they never visited the site of substantial interference along Dalmeny Road. ARRL staff conducted more comprehensive measurements on February 18, 2005, and found that, along Dalmeny Road, there remained emissions which would preclude Amateur communications throughout the Amateur 20-meter band.

No further Commission action has been taken with respect to these multiple complaints, and the experimental license pursuant to which this system has been authorized by the Commission was renewed without any apparent concern on the Commission's part for an additional term, from August 1, 2005 to August 1, 2007. The Briarcliff Manor BPL system currently (still) causes harmful interference to Amateur Radio communications and it is not compliant with applicable FCC part 15 regulations, including Section 15.5 thereof. Neither is it compliant with the terms of the experimental authorization granted by the Commission, most recently on August 1, 2005. Finally, it is not listed in the BPL publicly accessible database that is maintained by UTC. ARRL reiterates its request, now more than a year old, that the BPL facility at Briarcliff Manor, New York be instructed to shut down immediately; and that it not resume operation unless the facility is shown to be in full compliance with Commission rules regarding radiated emissions and with the non-interference requirement of both Section 15.5 of the Commission's Rules and the terms of the experimental authorization. Finally, information about it must be listed in the BPL publicly accessible database.

As per the attached Engineering Study prepared by ARRL Laboratory Manager Ed Hare, ARRL visited the Briarcliff Manor BPL site on December 5, 2005. ARRL has repeatedly found in past measurements at the site that the system operates with radiated emission levels strong enough to cause widespread harmful interference to the Amateur

Radio Service. It has also found on several occasions that parts of the system were operating at levels exceeding the emission limits for BPL systems operating under Part 15 of the Commission's rules. On December 5, 2005, ARRL found that the "notching" previously reported by Ambient to have been done on Amateur bands was not in place, and that at several locations, the BPL system was operating at or near the FCC emission limits in the Amateur bands, causing strong interference. The levels of BPL noise in the Amateur bands were at or near S9, or well above that level in some cases, on the signal strength meter of the good-quality communications receiver being used. That signal level is clearly sufficient to produce inevitable harmful interference to stations operating in the Amateur Radio Service.

In addition, as was found in previous tests done at Briarcliff Manor, in a number of locations, the "notching" used was insufficient in one or more Amateur bands, typically leaving about a +15 dB interference-to-noise ratio, completely covering up many of the signals typically used in the Amateur Radio Service.

At one location near the injector for the substation, ARRL's Laboratory Manager measured emissions at a level of 70.6 dBuV/m at frequencies near 37 MHz, extrapolated to 10 meters distance. In this frequency range, the measured levels exceed the FCC emission limits (Section 15.109 of the Commission's Rules) by approximately 31 dB.

Ambient has previously, in its 6-month reports filed with the Commission which it is obligated to file according to the terms of the Experimental Construction Permit and License, repeatedly represented to the Commission that it is not making use of Amateur allocations, as all Amateur bands were "notched out." That is not true. ARRL discovered that the notching is not in place at all locations at which its system operates.

Condition #1 of the Experimental Authorization requires that if any interference occurs, the licensee of this authorization will be subject to immediate shut down. Interference has repeatedly occurred, and it has been witnessed and verified by a member of the Commission's Enforcement Bureau staff.

Condition #5 of the authorization includes a requirement that the progress report filed by Ambient "should include a description of measurements and results demonstrating compliance with Part 15.109." The radiated emissions from the Briarcliff Manor BPL system, between 30 and 40 MHz, were approximately 31 dB above that limit. The requisite showing cannot, therefore, be made by Ambient.

Because this experimental authorization, apparently uniquely and inappropriately, permits station locations on a "US; mobile; nationwide" basis, it is impossible for radio amateurs to know where the Ambient systems are deployed. The Commission wants such information, according to Condition #7 of the Experimental Authorization, but there is no requirement that Ambient report deployments anywhere in the United States to any licensees of the Commission which might be subject to interference from an Ambient BPL system. The BPL system at Briarcliff Manor, having been operating for more than two years, and causing interference for that same period of time, is not, to date, listed in

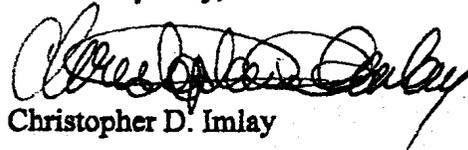
the BPL database, notwithstanding the obligation to provide this information. In its Public Notice released October 13, 2005 (DA 05-2701) the Commission advised that "Access BPL systems will be required to comply with the requirements of Section 15.615 by November 19, 2005." The Public Notice goes on to state, "All information on Access BPL systems as required by 47 C.F.R. Section 15.615(a) must be entered into the database and be available to the public by November 19, 2005." That deadline has now passed. There is no exception for BPL systems operating pursuant to an Experimental Authorization. Section 15.615(a) requires that "Entities operating Access BPL systems shall supply to an industry-recognized entity, information on all existing Access BPL systems and all proposed Access BPL systems for inclusion in a publicly available data base, within 30 days prior to initiation of service."

Accordingly, ARRL now requests that the Commission immediately advise Ambient that it must cease operation of the Briarcliff Manor, NY BPL system until 30 days after the information is available as required by §15.615(a). Furthermore, in light of the record of long-standing interference to licensed stations in Briarcliff Manor and the apparent inability and/or unwillingness of Ambient to resolve interference complaints timely or in good faith, the Commission should require that the BPL system immediately cease, not resume operation until the facility is shown to be in full compliance with Commission rules regarding radiated emissions, § 15.109, and with the non-interference requirement of §15.5 of the Commission's Rules and the terms of the Experimental Authorization.

Alternatively, the Commission should rescind the experimental authorization, and determine other appropriate sanctions against Ambient Corporation.

Kindly address all communications on this subject to the undersigned counsel.

Yours very truly,



Christopher D. Imlay

cc: George Y. Wheeler, Esq.  
Holland & Knight  
2099 Pennsylvania Avenue, N.W.  
Washington, D.C. 20006  
*Counsel for Ambient Corporation*  
(via U.S. Mail, w/attachment)

# Additional Testing of the BPL System in Briarcliff Manor, NY

Testing Date: December 5, 2005  
Test engineer: Ed Hare, ARRL Laboratory Manager<sup>1</sup>  
Report Date: December 28, 2005

## 1. History and Summary:

- 1.1 The Broadband over Power Line (BPL) system in Briarcliff Manor, NY is operated by the local electric utility, Con Ed. The Ambient Corporation is the manufacturer of the BPL system. This system uses Orthogonal Frequency-Division Multiplexing (OFDM) technology, using multiple carriers in groups of three spaced approximately 1.1 kHz. It occupies multiple segments of HF and low VHF. At the present time, it is being operated under an Experimental license, WB9XQT.
- 1.2 Over the past two years, several interference complaints have resulted from the operation of this system. In several instances, the BPL manufacturer, the Ambient Corporation, attempted what it characterized as "adjustments" to the system to mitigate interference<sup>2</sup>. These adjustments have not generally corrected interference, and although ARRL has sometimes found interference to be partially mitigated after Ambient makes adjustments, follow-up measurements have shown such remedies to be temporary.
- 1.3 ARRL has previously done testing of the interference from this BPL system<sup>3</sup>. Throughout the course of that testing, ARRL has repeatedly found that the system operates with radiated emission levels strong enough to cause widespread harmful interference to the Amateur Radio Service. It has also found on several occasions that parts of the system were operating at levels exceeding the emission limits for BPL systems operating under Part 15 of the FCC rules<sup>4</sup>.

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<sup>1</sup> ARRL, 225 Main Street, Newington, CT 06111, Tel: 860-594-0318, Email: [W1RFL@arrl.org](mailto:W1RFL@arrl.org), Web: <http://www.arrl.org/bpl>.

<sup>2</sup> These "adjustments" have come to be called "notching" by the BPL industry, although in general, these techniques do not create notches in their spectrum use, but either move blocks of spectrum around or attempt to turn off blocks of carriers.

<sup>3</sup> This testing was performed on September 21, 2004; December 6, 2004; December 16, 2004; February 18, 2005 and March 11, 2005.

<sup>4</sup> Although this system is operating under an Experimental license, one of the conditions of its operation is that it must not exceed the Part 15 emissions limits that apply to BPL and intentional emitters.

1.4 In earlier testing, on September 21, 2004, ARRL measured as much as 40 dB of degradation of the ambient noise levels along Dalmeny Road. It also measured emissions on the 3.5 MHz band at a level of 71.9 dBuV/m, extrapolated using 20 dB/decade on Park Road, behind the police station<sup>5</sup>. On March 11, 2005, ARRL measured emissions on Woodside Avenue at a level of 68 dBuV/m<sup>6</sup>. On the additional test dates listed in Footnote 3, ARRL observed and measured interference to the Amateur bands and degradation of the noise floor along overhead power lines.

## **2. Present Status of the BPL System in Briarcliff Manor:**

- 2.1 On December 5, 2005, ARRL's Laboratory Manager drove to Briarcliff Manor to assess the present status of the system and to make additional measurements. At this time, he found that the notching previously reported by Ambient to have been done on Amateur bands was not in place, and that at several locations, the BPL system was operating at or near the FCC emissions limits in the Amateur bands, causing strong interference. He did not measure the field strength of the BPL emissions at all of these locations using calibrated test equipment, but in these site surveys, he found that the levels of BPL noise in the Amateur bands were at or near S9, or well above that level in some cases, as read on the signal strength meter on the communications receiver being used. These signal levels are clearly sufficient to produce harmful interference to stations operating in the Amateur Radio Service.
- 2.2 In addition, as was found in previous tests done in Briarcliff Manor, in a number of locations, the "notching" used was insufficient in one or more Amateur bands, typically leaving about a +15 dB I/N ratio, completely covering up many of the signals typically used in the Amateur Radio Service.
- 2.3 At one location near the injector for the substation, ARRL's Laboratory Manager measured emissions at a level of 70.6 dBuV/m at frequencies near 37 MHz, extrapolated to 10 meters distance<sup>7</sup>. These levels were measured using a calibrated biconical antenna and Rohde and Schwarz EMC spectrum analyzer, using a quasi peak detector and 120 kHz bandwidth. In this frequency range, the measured levels exceed the FCC emissions limits by approximately 31 dB. The signals were demodulated and determined by ear and experience to be BPL from the DS2 chipset that Ambient uses in this system.

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<sup>5</sup> This rule violation was corrected by the BPL operator at some point after this report. If this were extrapolated at 40 dB/decade, the measured level would be 59.3 dBuV/m at 30 meters. This was still well above the emissions limit of 29.5 dBuV/m at 30 meters.

<sup>6</sup> Extrapolated at 20 dB/distance decade, this is a field strength of 58.4 dBuV/m at 30 meters Extrapolated at 40 dB/distance decade, this is a field strength of 48.7 dBuV/m.

<sup>7</sup> Using 20 dB/decade, as specified in the rules for measurements made above 30 MHz.

### **3. Ongoing Interference:**

- 3.1 The results of this recent testing demonstrate that despite over two years' time of Ambient's alleged experimenting with notching as a mitigation technique, strong interference levels continue in several amateur bands in various parts of this system. The frequencies and locations involved are described later in this document. As found in previous assessments of this system, the lack of overall success shown in these test results indicate that it is not practically possible to effectively apply notching to a complex system with multiple BPL segments. This insufficient mitigation will result in systems that create strong interference to mobile and fixed operation in the Amateur Radio Service in most areas of that installation.

### **4. General Discussion and Notes:**

- 4.1 Although there is a relatively small number of users on this system, it is complex, with multiple "legs" and repeaters used to extend the BPL signal across the entire geographical range of the system. Some portions of the system appear to operate with continuous carriers, while at other locations, these carriers are modulated and are present only when customers are using the system. For this reason, it is possible that additional segments and spectrum use may not have been discovered during this single day of testing.

#### **4.2 Test Conditions:**

- 4.2.1 The testing for this report was done with the FSH3 quasi-peak mode with a 9000 Hz measurement bandwidth between 1.7 and 30 MHz and a 120 kHz bandwidth for measurements made on 30-50 MHz. To the extent possible and practical, ARRL followed the test methods outlined by the FCC in the BPL Report and Order, at fixed locations, with the calibrated antennas mounted on a non-conductive tripod at a height of 1 meter. Listening tests were done using the ICOM IC-756 receiver and inductively loaded mobile whip, in motion or at unspecified locations near BPL equipment.

### 4.3 Test Equipment Used:

Description	Manufacturer	Model	Serial number	Date Calibrated	Notes
EMC Spectrum Analyzer, 0.1 MHz to 3 GHz	Rohde and Schwarz	FSH3	102393	1/19/2005	Peak, quasi-peak or average measurements
Biconical antenna, 20-200 MHz	ETS-Lindgren	3104C	00052201	8/26/2005	New, placed in service 11/1/2005
24-inch loop antenna	EMCO	6502	00051644	11/9/2005	New, placed in service 11/1/2005
Non-metallic tripod	Mil. surplus	N/A	N/A	N/A	
Optical range finder	Ben Meadows	100	100	N/A	Used to measure slant-range distance
25-foot BNC coaxial cable	Pomona	25-foot	N/A	Measured 12/5/2006 in ARRL Lab	Retest before each use
Signal generator	Marconi	2041	119333017	11/18/2005	Used to measure 25-foot cable loss
Signal generator	IFR	2041	203001/752	12/07/2004	
Power meter	HP	HP437B	3125U20786	11/16/2005	
Measuring wheel	Lufkin	None	N/A	N/A	1-meter diameter
Measuring tape	Lufkin	None	100 ft	N/A	Non-conductive
General coverage Amateur Radio transceiver	ICOM	IC-756 FCC ID AFJIC-756	02071	Not calibrated	Communication receiver used for monitoring only
Loaded mobile whip antenna, adjustable coil	MFJ	MFJ-1668	None	Not calibrated	Communication antenna used for monitoring only

## 5. Test Results:

### 5.1 Spectrum Survey:

- 5.1.1 Ambient has been operating this BPL system under an experimental license<sup>8</sup> since June 21, 2002<sup>9</sup>. Among other requirements, the Experimental license requires that Ambient operate the system without causing harmful interference to licensed operation or be subject to immediate shutdown and that it submit 6-month progress reports<sup>10</sup> that show compliance with Part 15.109 of the FCC rules.
- 5.1.2 Among the documents that are filed as part of the records of this Experimental license are a number of reports of harmful interference to a mobile station operating in the Amateur Radio Service<sup>11</sup>.
- 5.1.3 Ambient addressed these interference reports in its 6-month reports and other correspondence with the Commission. Here is an excerpt from its latest report:

As previously reported to the Commission, the Company has notched out its signals on Amateur bands, demonstrating significant advancements in our technology over the relatively short time period of its test program. These bands include the following Amateur Radio bands: 80, 40, 30, 20, 15 and 10 meters: 3.5-4 MHz, 7-7.3 MHz, 10.1-10.15 MHz, 14.0-14.35 MHz, 21-21.45 MHz and 28.0-29.7 MHz.

Figure 1 -- This shows the claims that Ambient made in its previous 6-month reports to the FCC.

<sup>8</sup> Search for "Ambient" at the FCC URL <https://gullfoss2.fcc.gov/prod/oet/cf/els/reports/GenericSearch.cfm>.

<sup>9</sup> Ambient was originally licensed as WB9XQT for specific locations and frequencies in Westchester County, NY. On July 28, 2003 Ambient was granted an Experimental license under the call sign WD2XEQ. On September 3, 2003, this license was issued to permit Ambient to operate BPL systems nationwide, from 1.7-88 MHz.

<sup>10</sup> Some of these reports are not available on the FCC web page because Ambient asked that they be treated as confidential. However, others are available at:

[https://gullfoss2.fcc.gov/prod/oet/els/forms/blobs/65107.0.02522345616.pdf\\_stripped.pdf](https://gullfoss2.fcc.gov/prod/oet/els/forms/blobs/65107.0.02522345616.pdf_stripped.pdf)

[https://gullfoss2.fcc.gov/prod/oet/els/forms/blobs/67258.0.95293196344.pdf\\_stripped.pdf](https://gullfoss2.fcc.gov/prod/oet/els/forms/blobs/67258.0.95293196344.pdf_stripped.pdf)

[https://gullfoss2.fcc.gov/prod/oet/els/forms/blobs/69555.0.74399685913.pdf\\_stripped.pdf](https://gullfoss2.fcc.gov/prod/oet/els/forms/blobs/69555.0.74399685913.pdf_stripped.pdf)

<sup>11</sup> These reports were filed by Alan Crosswell, <Call> and by ARRL. They are available on the FCC web site:

[http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native\\_or\\_pdf=pdf&id\\_document=6516182610](http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6516182610)

[https://gullfoss2.fcc.gov/prod/oet/els/forms/blobs/68798.0.35033256311.pdf\\_stripped.pdf](https://gullfoss2.fcc.gov/prod/oet/els/forms/blobs/68798.0.35033256311.pdf_stripped.pdf)

[https://gullfoss2.fcc.gov/prod/oet/els/forms/blobs/69871.0.55463268964.pdf\\_stripped.pdf](https://gullfoss2.fcc.gov/prod/oet/els/forms/blobs/69871.0.55463268964.pdf_stripped.pdf)

A comprehensive report on ARRL's findings at this location was filed with the FCC as part of ARRL's complaints. It is available at <http://www.arrl.org/~ehare/bpl/bcm/bcm-3-17-2005.doc>. Other complaints or reports of strong interference levels filed by other Amateurs in the area are available at:

[http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native\\_or\\_pdf=pdf&id\\_document=6514682097](http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6514682097)

[http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native\\_or\\_pdf=pdf&id\\_document=6514683874](http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6514683874)

[http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native\\_or\\_pdf=pdf&id\\_document=6515284064](http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6515284064)

5.1.4 Although ARRL cannot determine whether this notching was ever put in place completely as described, in this most recent testing done in Briarcliff Manor, it is clear that the notching is not in place now at all locations in their system. In each series of measurements ARRL has made in this system, it has found different locations notched, or not notched at different locations and times. At this time, some notching was evident, incompletely along Dalmeny Road and Pleasantville Road and apparently adequately (at the time of this measurement) along North State Road<sup>12</sup>.

5.1.5 The following represents a spectrum-use assessment made at 4 locations in the BPL test area.

**Location #1 - At "turnaround" area on Pleasantville Rd**

5.5 - 6.7 MHz  
7.4 - 9.1 MHz  
19.15 - 20.9 MHz  
21.6 - 22.9 MHz  
27.3 - 27.9 MHz

Note: No intentional use of the Amateur bands was observed at this location at the time of the most recent inspection, but the notching on part of the 21 MHz band was inadequate to prevent harmful interference and was observed to be approximately 15 dB greater than the ambient noise levels<sup>13</sup>.

**Location #2, Dalmeny Road**

4.9 - 5.5 MHz  
8.1 - 12.1 MHz  
14.5 - 16.9 MHz  
19.1 - 20.6 MHz  
21.7 - 22.9 MHz

Note: Intentional use of the Amateur bands was observed at this location.<sup>14</sup>

**Location #3 - Fuller Road**

5.4 - 6.7 MHz  
7.7 - 7.9 MHz  
10.4 - 12.2 MHz  
16.3 - 16.6 MHz  
18.1 - 18.8 MHz - Overlaps 18.068 MHz Amateur band  
22.6 - 25.3 MHz - Completely overlaps 24.890 MHz Amateur band  
26.2 - 27.8 MHz

Note: Intentional use of the Amateur bands was observed at this location. The notching on the 10.1 MHz Amateur allocation was inadequate to prevent harmful interference and was observed to be approximately 15 dB greater than the ambient noise levels.

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<sup>12</sup> In this ever-changing EMC environment, the lack of coordination with local spectrum users makes continuing interference reports inevitable.

<sup>13</sup> This has been observed and measured by ARRL staff in previous measurements made in Briarcliff Manor, notably along Dalmeny Road.

<sup>14</sup> In most cases, the degree to which these systems occupy spectrum depends on whether there are active BPL users at the time a measurement or test is made. It is possible that other spectrum could be in use at some times if some of the BPL users were not active at the time these measurements were made.

#### **Location #4 - Substation injector on Woodside Ave**

8.5 - 9.6 MHz

10.6 - 12.3 MHz

14.5 - 16.9 MHz

22.0 - 25.2 MHz Note: Completely utilizes the 24.890 MHz Amateur band.

25.2 - 27.9 MHz<sup>15</sup>

33.7 - 37.7 MHz

Note: Intentional use of the Amateur bands was observed at this location.

### **6. Field Strength Measurements:**

6.1 Although the primary purpose of this site visit was to assess the use of spectrum by this BPL system, measurements of the field strength at two locations were made.

#### **6.2 Location #1 - Dalmeny Road**

6.2.1 The first measurements were made along Dalmeny Road, at one of the injectors near the eastern end of the street. At this location, ARRL found a maximum measurement of 54.5 dBuV/m quasi peak in 9 kHz at a slant-range distance of 9.2 meters. When this is extrapolated to 30 meters using a 40 dB/decade extrapolation factor<sup>16</sup>, a value of 34 dBuV/m is obtained<sup>17</sup>. Other spot measurements made along Dalmeny road showed emissions below the limits if a 40 dB/decade extrapolation were used.

#### **6.3 Location #2 - Woodside Ave**

6.3.1 Location #4 is located on Woodside Avenue, near the Con Ed substation on Park Road at the coordinates shown.

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<sup>15</sup> From 25.2 MHz to 27.9 MHz, BPL observed at varying levels. Some notching may have been used in this frequency range.

<sup>16</sup> ARRL continues to maintain that a 40 dB/decade distance extrapolation is inappropriate for measurements made at the slant-range distances used for BPL testing. However, because this is the method specified in the present rules, ARRL is using it here to determine whether these systems are compliant with the present rules.

<sup>17</sup> This is 5.5 dB above the permitted level of 29.5 dBuV/m. However, this falls right on the edge of ARRL's estimate of the measurement uncertainty of its measurements. ARRL does note, however, that good EMC engineering practice would have required Ambient to add its measurement uncertainty to its measurements if it were to be able to claim that its system is operating below the permitted limits.

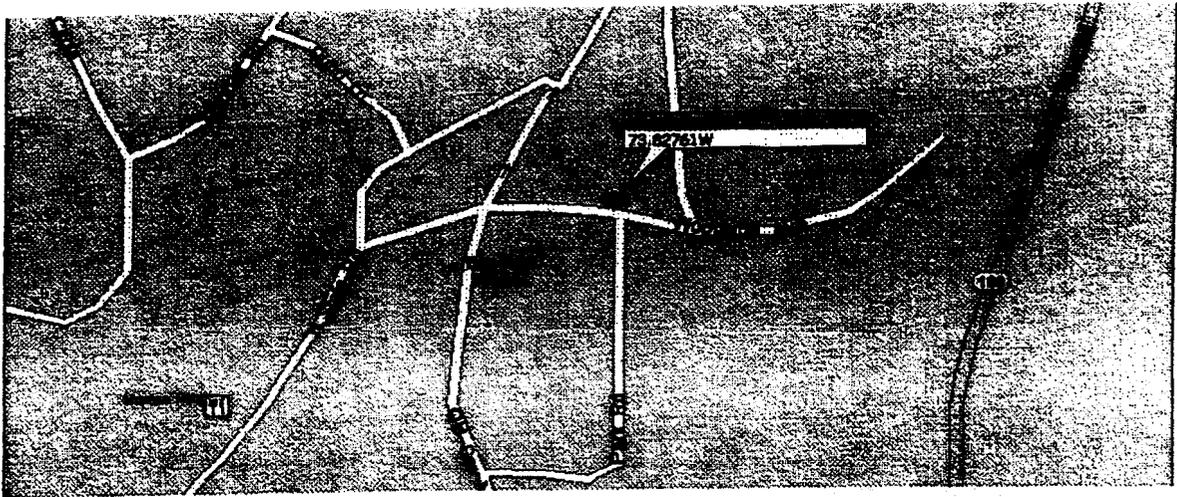


Figure 2 -- On Woodside Avenue, ARRL's test engineer estimated that the BPL emissions below 30 MHz were within the FCC limits (again only using a 40 dB/decade extrapolation), so no specific measurements were made below 30 MHz. However, when checking the effectiveness of the notching or out-of-band-emission suppression on the nearby 28- and 50-MHz Amateur allocations, strong radiated BPL signals were observed on the receiver between approximately 34 and 38 MHz. ARRL made a measurement of the VHF spectrum at this location and found that the VHF emissions at this location were well above the emission limits.

## **7. Measurements of Field Strength Between 30 and 40 MHz:**

7.1 The measurement was made between 30 and 40 MHz at the injector located at GPS coordinates 41.15300N and 73.82761W, located on Woodside Avenue as shown in Figure 2. The test location was across the street from the injector, at a horizontal distance of approximately 8.9 meters. The slant-range distance to the injector being measured was 8.7 meters. Figure 3 below shows the spectrum analyzer data. The spectrum analyzer data have been corrected for antenna factor and cable loss, but not for slant-range distance or height for measurements made above 30 MHz. The biconical antenna was positioned 1-meter above ground, oriented horizontally and positioned parallel to the overhead transmission line.

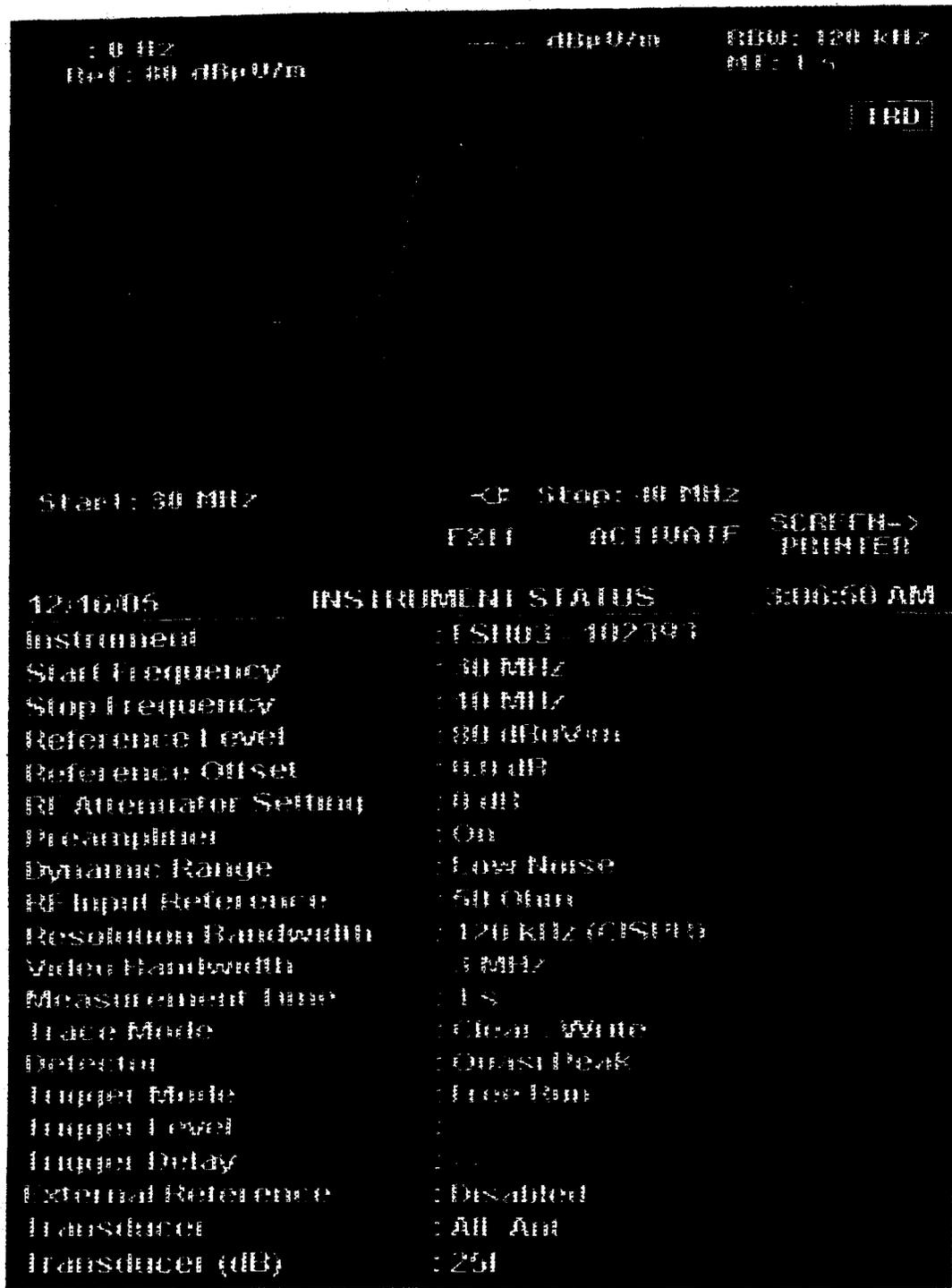


Figure 3: Levels measured on 30-40 MHz at the biconical antenna near one of the BPL injectors.

## 8. Summary of Test Results at the Substation Injector on Woodside Avenue:

Field Strengths 30 MHz - 40 MHz						
Frequencies of six highest readings: (MHz)	36.67	36.73	37.33	37.37	37.43	37.50
Cable loss at the measurement frequency: (dB) (Programmed into spectrum analyzer)	N/A	N/A	N/A	N/A	N/A	N/A
Received signal level dBuV corrected for cable loss	N/A	N/A	N/A	N/A	N/A	N/A
Antenna Factor at the measurement frequency: (dB) (Programmed into spectrum analyzer)	N/A	N/A	N/A	N/A	N/A	N/A
Received signal level corrected for Antenna factor and previous corrections	66.8	66.8	66.6	66.6	66.6	65.8
Height conversion of E-Field readings (+5 dB)	+5.0	+5.0	+5.0	+5.0	+5.0	+5.0
Received signal level corrected for cable loss, antenna factor and height	71.8	71.8	71.6	71.6	71.6	70.8
Slant range distance to the wires (X meters) (Measured)	8.7 m					
Slant range distance correction (20log 10/X) in dB	-1.2 dB	-1.2 dB	-1.2 dB	-1.2 dB	-1.2 dB	-1.2 dB
Signal level corrected for all factors, dBuV/m at 10 meters distance	70.6	70.6	70.4	70.4	70.4	69.6
FCC limit at 10 meters distance (90 uV)	39.1	39.1	39.1	39.1	39.1	39.1
Measurement relative to limit	31.5 dB	31.5 dB	31.3 dB	31.3 dB	31.3 dB	30.5 dB
Pass/Fail	Fail	Fail	Fail	Fail	Fail	Fail

8.1 Note that is the same location for which ARRL had made measurements on March 11, 2005, showing that the BPL system in Briarcliff Manor was operating above the FCC emissions limits between 14 and 18 MHz. The only apparent change at this location between then and now is that the operation of that part of the system has been moved above 30 MHz, at essentially the same levels.

## Calibration Certificates:



An EMC Technologies Company

EMC Test Systems, L.P.  
1701 Arroyo Pkwy  
Cedar Park, Texas 78613

Phone: (512) 331-6400  
Fax: (512) 331-6800  
Info@ets-lindgren.com  
http://www.ets-lindgren.com

Dear ETS-Lindgren Customer,

The Certificate of Calibration accompanying this product states the date this unit was calibrated according to EMC Test Systems procedures. According to ISO 17025, para 8.10.4.4 we are advised not to identify an instrument recommended calibration due/next date on a certificate or label. Therefore, the recalibration recall of this unit should be based on when the product is placed into service by the user, plus the user's internal calibration interval. We have determined that the calibration of this product is not affected by storage prior to its initial receipt by the customer.

ANSI Z39.9 series recommends a calibration interval of 12 months. To determine the date for recalibration, the customer should use the appropriate start date, and apply either the recommended ANSI calibration interval on the calibration label, or an interval that satisfies their own organization's internal quality system requirements. This label should then be applied to the instrument.

The recalibration due date should be annotated on the calibration label provided.

For information regarding the establishment of calibration intervals, please log on to our web page at [www.ets-lindgren.com](http://www.ets-lindgren.com). For more information or questions, call your local ETS Sales Representative or our home office in Cedar Park, TX at (512) 631-6400.

Sincerely,

Charles E. Garrison,  
ETS-Lindgren Quality Assurance

Retail Recommendation Notice (10/92)



**ETS-LINDGREN**  
An EMC Technologies Company

1301 Arrow Point Drive  
Cedar Park, Texas 78613  
(512) 631-8488

**EMC CALIBRATION**  
Traceable to NIST  
By: SL Date: 28-Aug-05  
Next Cal Due:

Cert ID: 51718  
Lab Code: 115844/1207.01

**Certificate of Calibration Conformance**

Page 1 of 4

The instrument identified below has been individually calibrated in compliance with the following standards:

SAE ARP-958-1207, Electromagnetic Interference Measurement Antennas; Standard Calibration Method, Society of Automotive Engineers, Aerospace Recommended Practice; Antenna factors determined using 3 antenna method.

ANSI C63.5-1998, American National Standard for Electromagnetic Compatibility, Radiated Emission Measurements in Electromagnetic Interference (EMI) Control; Calibration of Antennas, American National Standards Institute, Inc. Antenna factors determined using 3 antenna method.

Environment: Laboratory MPE is maintained in a temperature controlled environment with ambient conditions from 18 to 25°C, relative humidity less than 50%. The instrument under test has been calibrated on an open air test site (OATS) with environment temperature conditions ranging from 0 to 40°C which has no known influences on measurement quality.

Manufacturer:	EMCO	Operating Range:	20 - 200 MHz	
Model Number:	3704C	Instrument Type:	Biconical (Type 1)	
Serial Number / ID:	0902201			
Tracking Number:	1001308			
Date of Calibration:	28-Aug-05			
Test Type:	1, 2 and 10 Meter, Horizontal			
Calibration Uncertainty:	31m	20 - 200 MHz:	±1.2 dB	
EMC Conversion Loss:	33m	20 - 200 MHz:	±0.9 dB	
	50m	20 - 30 MHz:	±1.0 dB; 30 - 200 MHz:	±0.9 dB

Test Results: Pass

Calibration Traceability: All measuring and Test Equipment (MTE) identified below are traceable to the National Institute for Standards and Technology (NIST). Calibration Laboratory and Quality System controls are complete and in accordance with ISO 9001:2000.

**Standards and Equipment Used:**

Make / Model / Serial / S/N / Revision Data	Calibration of Instrument
Anritsu MS4622A Network Analyzer 002201 10-Apr-05	In Tolerance to Internal Quality Standards

Calibration Completed By  
Slav Lipek, Cal Lab Technician

Approved and Issued On: 28-Aug-05  
Ronald W. Byring, Calibration Lab Supervisor

This document provides traceability of measurements to recognized national standards using calibrated procedures of the ETS-Lindgren Calibration Laboratory. Uncertainties listed are defined from the methods described by NIST Tech Note 1297. This certificate and report may not be reproduced, stored in a retrieval system, or transmitted in any form or by any means, without the written approval of ETS-Lindgren Calibration Laboratory in accordance with ISO/IEC 17025:1999, QAF 3107-01/04.



Gain and Antenna Factors for Electrical Antennas  
 Manufactured by EMC Test Systems  
 Model Number: 3104C Serial Number: 00062201  
 1.0 Meter Calibration Polarization: Horizontal

Frequency (MHz)	Antenna Factor (dB/m)	Gain Numeric	Gain dBi
20	14.6	0.01	-18.4
25	11.2	0.05	-13.1
30	10.1	0.09	-10.3
35	10.5	0.11	-9.7
40	11.6	0.12	-9.4
45	12.0	0.13	-9.7
50	12.3	0.16	-9.1
55	12.0	0.20	-7.0
60	11.6	0.26	-5.8
65	10.4	0.41	-2.8
70	8.8	0.68	-1.7
75	7.8	1.02	0.1
80	8.0	1.07	0.3
85	8.9	0.97	-0.1
90	9.8	0.88	-0.6
95	10.6	0.82	-0.9
100	11.5	0.75	-1.2
105	12.2	0.89	-1.6
110	13.3	0.60	-3.2
115	14.1	0.58	-2.7
120	14.7	0.51	-2.9
125	14.8	0.55	-2.8
130	14.2	0.67	-1.7
135	13.0	0.84	-0.8
140	13.0	1.04	0.2
145	12.7	1.19	0.8
150	12.6	1.30	1.1
155	12.0	1.31	1.1
160	13.6	1.17	0.7
165	14.8	0.94	-0.3
170	16.3	0.71	-1.5
175	17.7	0.64	-2.7
180	18.5	0.48	-3.2
185	18.8	0.47	-3.3
190	18.8	0.52	-2.9
195	18.2	0.61	-2.1
200	17.7	0.72	-1.4

Specification compliance testing factor (1.0 meter spacing) to be added to receiver meter reading in dBV to convert to field intensity in dBV/meter. Calibrated 26 Aug 08 (DDMMYYYY). Calibration per ARP 968.



Gain and Antenna Factors for Biconical Antennas  
 Manufactured by EMC Test Systems  
 Model Number: 3184C Serial Number: 00052201  
 3.0 Meter Calibration Polarization: Horizontal

Frequency (MHz)	Antenna Factor (dB/m)	Gain Numeric	Gain dBi
20	21.6	0.00	-25.4
25	15.3	0.02	-17.1
30	12.1	0.06	-12.9
35	11.6	0.08	-10.8
40	11.8	0.11	-9.6
45	11.7	0.14	-8.4
50	11.3	0.18	-7.1
55	10.4	0.29	-5.4
60	9.4	0.44	-3.8
65	8.0	0.71	-1.6
70	6.8	1.07	0.3
75	6.2	1.41	1.5
80	6.8	1.41	1.5
85	8.1	1.18	0.7
90	9.4	0.87	-0.1
95	10.8	0.83	-0.8
100	11.5	0.74	-1.3
105	12.1	0.71	-1.5
110	12.6	0.71	-1.5
115	12.7	0.74	-1.3
120	12.8	0.79	-1.0
125	12.8	0.87	-0.6
130	12.5	0.89	-0.1
135	12.3	1.12	0.5
140	12.1	1.28	1.1
145	12.0	1.38	1.4
150	12.1	1.44	1.6
155	12.6	1.36	1.4
160	13.1	1.30	1.1
165	13.8	1.18	0.7
170	14.6	1.07	0.3
175	15.4	0.94	-0.3
180	16.0	0.86	-0.6
185	16.5	0.80	-0.9
190	17.0	0.78	-1.2
195	17.1	0.78	-1.1
200	17.1	0.82	-0.9

Specification compliance testing factor (3.0 meter spacing) to be added to receiver meter reading in dBV to convert to field intensity in dBV/meter. Calibrated 25 Aug 05 (DDMM/YYYY). Calibration per ANSI C63.5.

# ETS-LINDGREN™

Gain and Antenna Factors for Biocentral Antenna  
 Manufactured by EMC Test Systems  
 Model Number: 31040 Serial Number: 0002201  
 10.0 Meter Calibration Polarization: Horizontal

Frequency (MHz)	Antenna Factor (dB/m)	Gain Numeric	Gain dBi
20	19.8	0.00	-23.5
25	14.1	0.03	-15.9
30	11.8	0.07	-11.5
35	11.0	0.10	-9.9
40	11.4	0.12	-9.1
45	11.4	0.16	-8.1
50	11.1	0.20	-7.0
55	10.5	0.29	-5.4
60	9.7	0.41	-3.8
65	8.8	0.61	-2.2
70	7.5	0.92	-0.3
75	6.4	1.35	1.3
80	6.1	1.67	2.2
85	6.0	1.84	2.9
90	6.3	1.25	1.8
95	6.6	1.08	1.0
100	10.9	0.85	-0.7
105	11.7	0.78	-1.1
110	12.3	0.74	-1.3
115	12.6	0.78	-1.2
120	12.7	0.81	-0.9
125	12.6	0.88	-0.5
130	12.5	1.01	0.0
135	12.2	1.15	0.6
140	12.0	1.30	1.1
145	12.0	1.41	1.5
150	12.1	1.46	1.8
155	12.5	1.41	1.5
160	13.2	1.30	1.1
165	13.9	1.16	0.6
170	14.8	1.04	0.2
175	15.4	0.92	-0.4
180	16.0	0.86	-0.7
185	16.6	0.80	-1.0
190	17.0	0.76	-1.2
195	17.0	0.79	-1.0
200	16.8	0.85	-0.7

Specification compliance testing factor (10.0 meter spacing) to be added to receiver meter reading in dBV to convert to field intensity in dBV/meter. Calibrated 25 Aug 95 (DDMMYY). Calibration per ANSI C63.5.

# ETS-LINDGREN

AN ISO 9001:2008 Certified Company

ETS-LINDGREN, L.P.  
2011 Lindgren Drive  
Cedar Park, TX 78613

Phone: (512) 531-6100  
Fax: (512) 531-6000  
E-Mail: [info@ets-lindgren.com](mailto:info@ets-lindgren.com)  
www.ets-lindgren.com

Dear ETS-Lindgren Customer,

The Certificate of Calibration accompanying this product states the date this unit was calibrated according to EMC Test Systems procedures. According to ISO 17025, para 6.10.4.4 we are advised not to identify an instrument recommended calibration due/next date on a certificate or label. Therefore, the recalibration recall of this unit should be based on when the product is placed into service by the user, plus the user's internal calibration interval. We have determined that the calibration of this product is not affected by storage prior to its initial receipt by the customer.

ANSI Z39.92 recommends a calibration interval of 12 months. To determine the date for recalibration, the customer should use the appropriate start date, and apply either the recommended ANSI calibration interval on the calibration label, or an IATF 16949 site utilizes their own organization's internal quality system requirements. This label should then be applied to the instrument.

The recalibration due date should be annotated on the calibration label provided.

For information regarding the establishment of calibration intervals, please log on to our web page at [www.ets-lindgren.com](http://www.ets-lindgren.com). For more information or questions, call your local ETS Sales Representative or our home office in Cedar Park, TX at (512) 531-6100.

Sincerely,



Charles E. Garrison  
ETS-Lindgren Quality Assurance

Recall Recommendation Notice (10/02)



# ETS-LINDGREN

an ETSI Technologies Company  
1301 Arrow Point Drive  
Cedar Park, Texas 78613  
(512) 631-8488

IEEE CALIBRATION	
Form 1001	Lot # <input type="checkbox"/>
By JT	Date 08-11-06
New Order # _____	

Cert. I.D.: 52943  
Lab Code: 115544/1207.01

## Certificate of Calibration Conformance

Page 1 of 2

The instrument identified below has been individually calibrated in compliance with the following identification:

IEEE Std 291 - 1996 IEEE Standard Methods for Measuring Electromagnetic Field Strength of Electrodipole Coaxial Waves, 30 Hz to 30 GHz, Institute of Electrical and Electronics Engineers, Inc.

Environment: Laboratory MTE is maintained in a temperature controlled environment with ambient conditions from 18 to 22°C, relative humidity less than 90%. The instrument under test has been calibrated in an open air test site (OATS) with environment temperature conditions ranging from 0 to 40°C which has no known influences on measurement quality.

Manufacturer:	EMCO	Operating Range:	10 kHz - 30 MHz
Model Number:	4502	Instrument Type:	Loop (Active)
Serial Number / ID:	80891844		
Tracking Number:	J097071		
Date Completed:	08-Nov-06		
Test Type:	Standard Loop, H-Field Gain/F, 1 meter Separation		
Calibration Uncertainty:	±0.1 dB		±0.2 dB
95% Confidence Level			
Test Remarks:	None		

Calibration Traceability: All Measuring and Test Equipment (MTE) identified below are traceable to the National Institute for Standards and Technology (NIST). Calibration Laboratory and Quality System controls are compliant with ISO/IEC 17025:1999.

Standards and Reference Data	Condition of Instrument
Model / Manufacturer / Name / Date	On / Off / In-Tolerance / Internal Quality Standards
Model / Manufacturer / Name / Date	On / Off / In-Tolerance / Internal Quality Standards
Model / Manufacturer / Name / Date	On / Off / In-Tolerance / Internal Quality Standards
Model / Manufacturer / Name / Date	On / Off / In-Tolerance / Internal Quality Standards

Calibration Completed by  
Justin Tate, Cal Lab Technician

Approved and Issued on 08-Nov-06  
Patrick W. Gentry, Calibration Lab Supervisor

This document provides traceability of measurements to international standards using controlled processes at the ETS-Lindgren Calibration Laboratory. Uncertainty level and coverage for methods described by NIST Tech Note 1997. This method and facility may not be replicated, unless in full, without the written approval of ETS-Lindgren Calibration Laboratory in accordance with ISO/IEC 17025:1999, CNF 1109 07/05.



Antenna Factors for Loop Antenna  
Manufactured by EMC Test Systems  
Model Number: 8582 Serial Number: 00951944

Frequency (MHz)	Magnetic Antenna Factor (dB/m)	Electric Antenna Factor (dB)
0.009	-31.8	19.6
0.010	-32.8	18.7
0.020	-37.4	14.1
0.050	-40.3	11.2
0.075	-40.6	10.9
0.100	-40.6	11.0
0.150	-40.6	10.9
0.250	-40.6	10.9
0.500	-40.6	10.9
0.750	-40.6	10.9
1.000	-40.6	11.0
2.000	-40.6	10.9
3.000	-41.0	10.6
4.000	-41.1	10.4
5.000	-41.2	10.4
10.000	-41.7	9.8
15.000	-42.2	9.4
20.000	-42.6	9.0
25.000	-43.6	8.1
30.000	-44.7	6.8

For EMC compliance testing factor to be added to receiver meter reading in dBV to convert to magnetic field intensity in dB/meter or to equivalent electric field intensity in dBV/meter. Calibrated on Nov. 05 (00 MW YC).  
Calibrated per IEEE 294, Induction-Field Method.

**Kalibrierschein  
Calibration Certificate**

Nummer 1940102393  
Number

**Gegenstand  
Item** Handheld Spectrum Analyzer with Pre-amplifier

**Hersteller  
Manufacturer** RÖHDE & SCHWARZ

**Typ  
Type** FSH3

**Sech.-Nr.  
Stock No.** 1145.5800.00

**Serien-Nr.  
Serial No.** 102393

Dieser Kalibrierschein bescheinigt, daß der genannte Gegenstand nach folgenden Vorgaben geprüft und gemessen wurde. Die Messung liegt im Regelfall mit einer Wahrscheinlichkeit von mindestens 95% im angegebenen Messintervall (Standardabweichung  $\leq 1,5 \cdot \sigma$ ).

Die Kalibrierung erfolgte mit akkreditierten Normalein, die direkt oder mittel durch Ableitung (Werte spezifizierter Kalibrierscheine) rückgeführt sind auf Normale der PTB/DLR oder andere international anerkannte Standards zur Realisierung der jeweiligen Einheiten in Zusammenarbeit mit dem internationalen Einheitensystem (SI). Wenn seine Normale verloren, erfolgt die Rückführung über Messergebnisse der PEMSTAR Laboratorien.

Gründlagen und Verfahren der Kalibrierung entsprechen ISO / IEC 17025. Das Beschriftungssystem ist die verwendete Normale entspricht DIN ISO 10131-1. Das angewandte Qualitätsmanagementsystem ist zertifiziert nach DIN EN ISO 9001.

Dieser Kalibrierschein darf nur während und unverändert weiterverwendet werden. Kalibrierscheine ohne Unterschriften sind ungültig.

Für die Erhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

**Auftraggeber  
Customer**

**Bestellung Nr.  
Order No.**

This certificate certifies documents, that the named item is tested and measured against defined specifications. Measurement results are issued usually in the corresponding interval with a probability of approx. 95% (coverage factor  $k=1,5$ ).

Calibration is performed with test equipment and standards directly or indirectly accessible by means of approved calibration certificates in the PTB/DLR or other internationally recognized standards, which derive the physical units of measurement according to the international system of units (SI). In case of loss of original standards or certificates, measurement are transferred to standards of the PEMSTAR laboratories.

Reference and methods of calibration correspond with ISO / IEC 17025. The used calibration certificates system is the used standard corresponds to DIN ISO 10131-1. The applied quality management system is certified according to DIN EN ISO 9001.

This calibration certificate may not be reproduced after than it is. Certificates without signature are invalid.

The user is obliged to have the object recalibrated at appropriate intervals.

**Ort u. Datum d. Kalibrierung  
Place and date of calibration** PEMSTAR Almelo, 2005-01-19

**Umfang der Kalibrierung  
Scope of calibration** Standard Calibration

**Leistungseignung  
Performance on receipt**

**Kalibrierergebnis  
Result of calibration** Measurement Results in Specifications

**Umfang des Kalibrierscheins  
Extent of the certificate** 2 Pages

**Ausstellungsdatum  
Date of issue**

**Labortleitung  
Head of laboratory**

**Bearbeiter  
Person responsible**

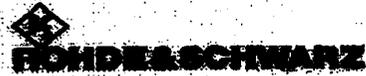
2005-01-19

Ton van Hattensveld

Johan Korink

Type: FSH3  
 Item: Handheld Spectrum Analyzer with Pre-amplifier

Serial No. 102303  
 Stock No. 1146.3460.03  
 Cal. Date 2005-01-19



Page: 2 of 2  
 Calibration Certificate No. 1349102303

Kalibrierung: Calibration  
 Certificate: Certificate  
 Umgebungsbedingungen: Ambient temperature

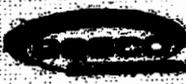
Service Manual FSH3  
 1146.5973.82-03  
 (23-3) °C

Eingangsdatum: Date of receipt  
 Relative Luftfeuchtigkeit: Relative humidity <20 %

Variante: Gebrauchsnormale  
 Working Standard used

Gegenstand Item	Typ Type	Seiten-Nr. Ser./No.	Kalibrierchein. Nr. Certificate No.	Kalibr. bis Cal. due
Signal Generator	SMT06	100568	17-126678	2007-02-01
Power Meter	NRY5	100210	10-300048713	2005-08-07
Diode Power Sensor	NRY-22	100017	10-300050371	2005-10-08

Anmerkungen:  
 Notes:



# ESSCO CALIBRATION LABORATORY

DIVISION OF WALLEN ENGINEERING SERVICES, INC.  
CALIBRATION / REPAIR OF ALL TYPES OF ELECTRONIC / MECHANICAL TEST EQUIPMENT  
14 ALPHA ROAD, CHELSEA, MA 01924-1102  
TEL: (908) 825-2201 (978) 250-0800 www.esccolab.com

## CERTIFICATE OF CALIBRATION

PG: 1

CERT. NO: 1000392346

ISSUE DATE: 11/16/2005

<b>CUSTOMER LOCATION:</b> AMER. RADIO RELAY LEAGUE 225 MAIN STREET  NEWINGTON . CT 06111  PURCHASE ORDER: E29COR1111	<b>EQUIPMENT:</b> DESCRIPTION: POWER METER INSTRUMENT: HP 437B MANUFACTURER: HP MODEL NO: 437B SERIAL NO: 3195020765 CONTROL NO: 4476294 BARCODE: 0476294
--	--

**CONDITION RECEIVED**  
RECEIVED IN TOLERANCE

**CONDITION RETURNED**  
RETURNED IN TOLERANCE

**METHOD / ENVIRONMENT**  
PERFORMED: In Lab  
TEMPERATURE (deg C): 22.0  
RELATIVE HUMIDITY (% RH): 30.0  
METHOD: HP 437B

**CALIBRATION**  
CALIBRATION DATE: 11/16/2005  
CALIBRATION DATE: 11/18/2005  
METROLOGIST: P. JERRY

**CALIBRATION STANDARDS USED**

ID NO.	DESCRIPTION	REPORT NO.	CAL. DATE	EXPI. DATE	COMMENTS
11491	HP 13463A POWER CALCULATOR	1000380140	08/21/2005	08/21/2005	N/A
11492	HP 5052A FREQUENCY COUNTER	1000382744	01/21/2005	01/21/2005	N/A
11551	HP 432A POWER METER	1000582512	01/21/2005	01/21/2005	N/A
11552	HP 8470B THERMISTOR MOUNT	1-100754831-1	08/26/2005	08/26/2005	N/A

The Escco Quality System is certified to ISO 9001:2000

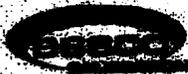
ESSCO CALIBRATION LABORATORY is a division of WALLEN ENGINEERING SERVICES, INC. 14 ALPHA ROAD, CHELSEA, MA 01924-1102. TEL: (908) 825-2201 (978) 250-0800. WWW.ESCCOLAB.COM. ISO 9001:2000 CERTIFICATION NO. 1111111111. DATE OF CERTIFICATION: 08/26/2005. EXPIRES: 08/26/2008.

Quality Assurance Manager

Internal Use Only: 11/11/2005 ~ 11/18/2005 ~ Data

10295

ESSCO Y



# ESSCO CALIBRATION LABORATORY

DIVISION OF WALSH ENGINEERING SERVICES, INC.  
 CALIBRATION / REPAIR OF ALL TYPES OF ELECTRONIC / MECHANICAL TEST EQUIPMENT  
 14 ALPHA ROAD, ONELENDEN, MA 01834-4182  
 TEL: (508) 225-2201 (978) 282-0820 www.essco.com

## CERTIFICATE OF CALIBRATION

PG 1

TEST NO: 1000392344

ISSUE DATE: 11/15/2005

<b>EQUIPMENT:</b> IDENTIFICATION: LOW NOISE SIGNAL GENERATOR INSTRUMENT: MARCONI 2051 MANUFACTURER: MARCONI MODEL NO: 2041 SERIAL NO: 11835217 CONTROL NO: 02/0921 BARCODE: 0210891	<b>CONDITION RECEIVED:</b> RECEIVED IN TOLERANCE
--	---

<b>CONDITION RECEIVED</b> RECEIVED IN TOLERANCE	<b>CONDITION RETURNED</b> RETURNED IN TOLERANCE
--	--

<b>METHOD / ENVIRONMENT</b> In Lab Humidity (40% C): 23.2 Humidity (50% RH): 23.9 MANUFACTURER: MARCONI 2041	<b>CALIBRATION</b> CALIBRATION DATE: 11/10/2005 CALIBRATION DUE: 11/15/2007 METROLOGIST: CRRZK
--	---

CALIBRATION STANDARDS USED					
ID NO.	DESCRIPTION	INSTRUMENT NO.	ISSUE DATE	EXPIRE DATE	COMMENTS
1000392344-1	1000392344-1	1-1000392344-1	09/23/2005	09/23/2007	N/A
1000392344-2	1000392344-2	2-1000392344-2	09/23/2005	09/23/2007	N/A
1000392344-3	1000392344-3	3-1000392344-3	09/23/2005	09/23/2007	N/A
1000392344-4	1000392344-4	4-1000392344-4	09/23/2005	09/23/2007	N/A
1000392344-5	1000392344-5	5-1000392344-5	09/23/2005	09/23/2007	N/A

The Essco Quality System is certified to ISO 9001:2000

ESSCO CALIBRATION LABORATORY is a division of Walsh Engineering Services, Inc. (WES) and is certified to ISO 9001:2000 by DNV GL Certification AS. The certification is valid for the scope of work defined in the certificate of registration. The certification is subject to annual surveillance audits and a full recertification audit every three years. For more information, please contact DNV GL Certification AS, P.O. Box 130, Sandnessveien 130, NO-1703 Sandness, Norway. Tel: +47 91 15 15 15. Fax: +47 91 15 15 16. Email: essco@essco.com

*[Signature]*

Quality Assurance Manager



**Antenna factor data:**  
**Description, combines data for EMCO 6502 and ETS-Lindgren 3104C.**

Frequency Hz	Gain dBS/m
9000	19.5
10000	18.7
20000	14.1
50000	11.2
75000	10.9
100000	11
150000	10.9
250000	10.9
500000	10.9
750000	10.9
1000000	11
2000000	10.8
3000000	10.5
4000000	10.4
5000000	10.4
10000000	9.8
15000000	9.4
20000000	8.9
25000000	8.1
30000000	6.8
30000000	11.3
35000000	11
40000000	11.4
45000000	11.4
50000000	11.1
55000000	10.5
60000000	9.7
65000000	8.6
70000000	7.5
75000000	6.4
80000000	6.1
85000000	6.9
90000000	8.3
100000000	9.6
105000000	10.9
110000000	11.7
115000000	12.3
120000000	12.6
125000000	12.7
130000000	12.6
135000000	12.5
140000000	12.2
145000000	12
150000000	12
155000000	12.1
160000000	12.5
165000000	13.2
170000000	13.9
175000000	14.6
180000000	15.4
185000000	16
190000000	16.5
195000000	17
200000000	16.9

**Cable loss data (25 foot RG-58 - measured in ARRL Lab)**  
**Description, 25-foot RG-58**

1000000	.1
2000000	.1
5000000	.2
10000000	.4
15000000	.4
20000000	.5
30000000	.5
50000000	.65
100000000	1.1
200000000	1.6
300000000	2
500000000	2.6