

The Growing Impact of Ambient Noise on Broadcasting

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Introduction

Radio hobbyists –

Ham radio operators, shortwave listeners, broadcast DXers, and other enthusiasts are usually quite aware of the growing radio noise issues we face...

But most people are unaware of this “noise pollution” problem.



Observations

Broadcasters receive many complaints from listeners, staff, or management regarding reception problems...



Did you try moving the antenna?

Observations

An increasing number of listeners report deteriorating reception:

Over the last 5 years, WPR Audience Services “Listener Logs” showed a 40% increase in complaints related to reception.

“I used to get good reception, but not anymore...”



Did they reduce their power?

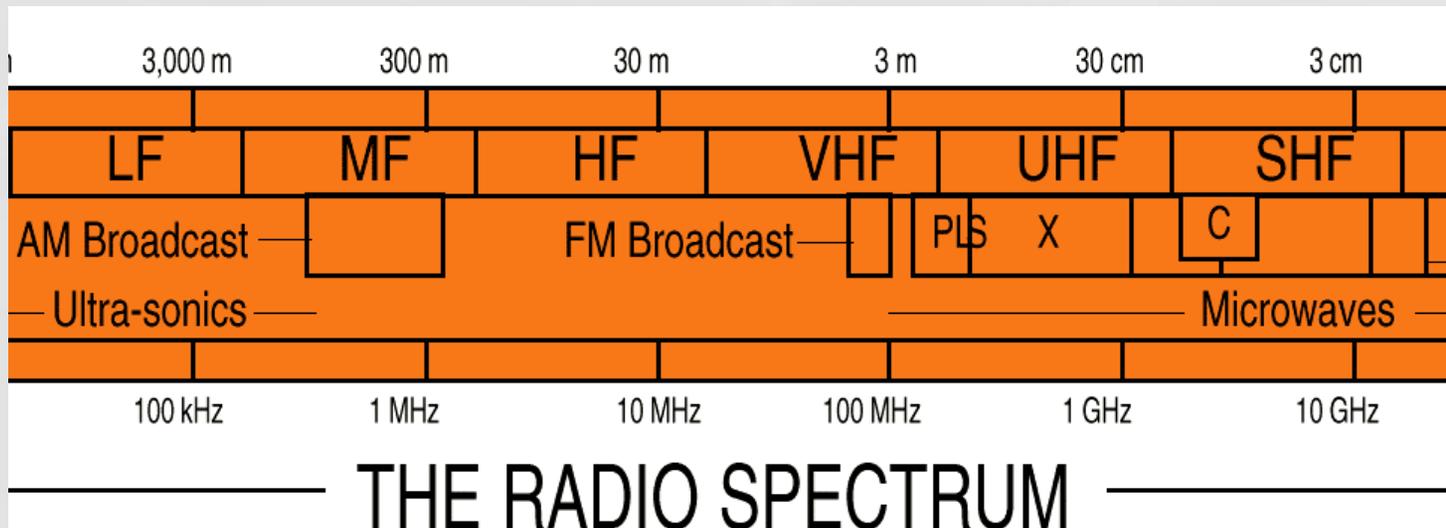


I just can't tune them in!

Observations

Awareness of the ambient noise problem seems limited among broadcasters.

Some recognize that AM radio is susceptible to noise interference (an issue raised in the recent “AM Improvement” movement), but most seem unaware of the impact of environmental noise on FM, TV, and other services.





The Society of Broadcast Engineers



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News & Headlines

[SBE Files FCC Comments on AM Improvement](#) *March 21, 2016*

The Society of Broadcast Engineers filed comments in response to the Federal Communications Commission's further notice of proposed rulemaking and the combined notice of inquiry in the AM Improvement Docket, 13-249. Its comments focused on a single issue first raised in the SBE's comments filed in the proceeding in 2014, but not addressed by the FCC in its October 21, 2015, first report and order: that of ambient noise in the AM broadcast band specifically, and in the Medium Frequency bands generally. The SBE's comments note that the Commission has made, and is currently examining additional short-term improvements in AM broadcasting in this proceeding. Although those short-term initiatives may be necessary to help the serious economic conditions for AM broadcasters, they are not going to lead to any meaningful, long-term improvement in MF AM broadcasting. To do that, the SBE asserts, the Commission is going to have to be willing to implement some difficult regulatory reforms that it has not addressed to date. It must develop and commit to a regulatory plan that, over time, will reduce the levels of man-made noise in the MF bands, and more broadly in the bands below 30MHz.

The FCC noted earlier in the docket that "AM radio is particularly susceptible to interference from electronic devices of all types, including such ubiquitous items as TV sets, vehicle engines, fluorescent lighting, computers, and power lines. The noise on the AM band that is caused by those sources is only expected to increase as electronic devices continue to proliferate." The SBE suggested that this increase in noise is not inevitable. However, it is a serious and worsening problem. Citing the aggregate effects of Part 15 and Part 18 unlicensed devices, the SBE notes that the FCC does not have any practical ability to address the interference potential of unlicensed devices past the point of sale. Reductions in field staff available to conduct spectrum enforcement have made enforcement in interference cases involving unlicensed devices unavailable in the future. The only source of regulatory reform that has a meaningful chance to positively affect the noise floor over time are the regulations that create obligations on manufacturers and importers and dealers, prior to the point that the consumer deploys it.

Citing a study by the LBA Group, AM reception is dependent on the desired signal being typically some 26dB above the ambient noise level. The AM band is subject to AM coverage distortion, increasing noise threats, and interference from the proliferation of wireless systems, electronic devices and low-frequency radiators that distort AM signals more now than as recently as 10 years ago. The electric power grid has expanded, bringing noise contributions from corona, arcing, and other modes. AM stations have increased power to raise their signal-to-noise ratio in an attempt to preserve their coverage areas, often interfering with other stations. But there is a limit to power increases, both economically and technically, and those limits are now reached in many cases.

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LEGAL PERSPECTIVE

By Chris Imlay, CBT
SBE General Counsel
cimlay@sbe.org

Ambient RF Noise: It Isn't Just an AM Problem

Relative to my recent article about the FCC's lack of focus on the increasing levels of ambient RF noise in the AM Broadcast band (a problem for MF and HF users generally), I received an eye-opener from Steve Johnston, the director of engineering and operations at Wisconsin Public Radio. Steve has studied ambient noise in detail and presented a paper on the impact of ambient noise on FM reception at the NAB Show a few years ago (see link).

Steve noted that the ambient noise problem extends to FM and TV as well as to AM. The nature of FM analog and TV digital reception experience tends to hide the noise, making it more difficult to attribute interference to man-made (typically Part 15 and Part 18 device) sources. However, Steve has noted that the higher noise floor has made the range of FM stations effectively shrink. As an example, Steve noted that a listener to a Wisconsin FM station (in an reception area of quite strong desired signal strength) said that after many years of solid reception, she could no longer pick up the station in her kitchen. When asked if she had any new electronics or appliances, she said she had added a new microwave oven. An on/off test with the oven resulted in suddenly clear reception, all back to normal, with the oven unplugged. She acquired a replacement oven of the same make and model, and experienced the same problem. When she replaced the microwave with a different

several urban apartments, suburban houses, and urban offices. All were found to have higher noise levels inside than outdoors on the same property.

Growing interference

Surely, most broadcast engineers have heard and responded to reception complaints. Steve, however, has noticed a new trend: that long-time listeners report deteriorating reception over time. In the past five years, Steve found that WPR Audience Services Listener Logs show a 37 percent increase in email and telephone complaints related to reception. Doubtless, this is due to a deteriorating ambient RF environment.

Steve's study of some WPR listener and staff homes used a battery-powered spectrum analyzer and a loop of stiff wire about one-quarter wavelength in circumference on a short length of coaxial cable as a pickup antenna. His goal was to get a better sense of the noise encountered at 88-108MHz in a variety of indoor situations.

The strongest noise sources Steve found inside residences were recently manufactured switch-mode power supplies used for charging batteries in cellphones and digital cameras. Some made a loud beeping while others produced a series of rapid beeps

In June 2016 a working group of the TAC was formed to study radio noise...



PUBLIC NOTICE

Federal Communications Commission
445 12th St., S.W.
Washington, D.C. 20554

News Media Information 202 / 418-0500
Internet: <https://www.fcc.gov>
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DA 16-676

Released: June 15, 2016

OFFICE OF ENGINEERING AND TECHNOLOGY ANNOUNCES TECHNOLOGICAL ADVISORY COUNCIL (TAC) NOISE FLOOR TECHNICAL INQUIRY

ET Docket No. 16-191

Comment Deadline: August 11, 2016

The FCC's Technological Advisory Council (TAC), an advisory group to the FCC operating under the Federal Advisory Committee Act, is investigating changes and trends to the radio spectrum noise floor to determine if there is an increasing noise problem, and if so, the scope and quantitative evidence of such problem(s), and how a noise study should be performed. In this public notice, the Office of Engineering and Technology (OET) announces the TAC's public inquiry, seeking comments and answers to questions below for the TAC about radio spectrum noise.¹

TAC Noise Floor Technical Inquiry

The TAC is requesting input to help answer questions about the study of changes to the spectrum noise floor over the past 20 years. Noise in this context denotes unwanted radio frequency (RF) energy from man-made sources. Like many spectrum users, TAC members expect that the noise floor in the radio spectrum is rising as the number of devices in use that emit radio energy grows. However, in search for concrete evidence of increased noise floors, we have found limited available quantitative data to support this presumption. We are looking to find ways to add to the available data in order to answer important questions for the FCC regarding this topic.

Radio spectrum noise is generated by many different types of devices. Devices that are not designed to generate or emit RF energy but do so as a result of their operation are called *Incidental Radiators*. Most

In December 2016, a report was presented by the TAC...

Technical Inquiry Responses

- Responses were received from 83 different people/entities.
 - 100 submissions to ECFS, including some duplicates
 - 8 direct submissions to the committee by email are not in ECFS
- The breakdown on responders (with some overlap between groups):
 - 24 Companies/Industry Organizations.
 - 39 RF Professionals.
 - 31 Licensed Radio Amateurs.
 - 2 University Researchers
 - *9 Responders did not reply to the questions asked.*



Responding Entities

- NAB (Broadcast)
- SBE (Broadcast)
- DTS Inc (Broadcast)
- Wisconsin Public Radio (Broadcast)
- V-Soft (Broadcast)
- Cohen, Dippell & Everest (Broadcast)
- LHW Consulting (Broadcast)
- Kintronic Labs (Broadcast)
- NPSTC (Public Safety)
- Calif Office Emerg Serv (Public Safety)
- Society of Amateur Radio Astronomers
- Radio Jove Spectrograph (Astronomy)
- ARRL (Amateur Radio)
- GPSIA (GPS)
- Deere and Company (GPS)
- Exacter, Inc (Power Lines)
- Shure Inc (Wireless Microphones)
- Pericle Comm (Noise Hunter)
- CTIA (Cellular)
- AT&T Services (Cellular)
- Verizon (Cellular)
- American Lighting Assoc (Lighting)
- Philips Lighting (Lighting)
- NEMA (Lighting)



After summarizing the comments of the respondents...

Performing a Noise Study

- Virtually unanimous agreement that a noise study is needed
 - 1 respondent thinks problems are obvious, no study needed
- 20 respondents had suggestions for studying the noise floor
 - Most thought uncalibrated data could be used to show trends
 - Several respondents mentioned existing data taken over years that is available for analysis
 - 2 respondents believe only calibrated data can be used

What's Next?

- NOI / NPRM should be issued to resolve unanswered questions and take corrective action, if necessary.
 - Is observed noise due to noncompliant devices on the market?
 - Should radiated emissions testing be made below 30 MHz?
 - How should aggregation of emissions from arrays of individually compliant devices be regulated?
 - Should the distinction between Class A & Class B devices remain?
 - Should differences between Part 15 & Part 18 emissions limits remain?
 - Are current regulatory emissions limits sufficiently low?
 - Should some classes of devices continue to be excluded from mandatory emissions testing?
 - Should an FCC label confirming emissions testing be required on every device?



A presentation to the FCC Chairman was made by the professional group for consulting engineers...



AFCGE – The Radio Frequency Environment

The Radio Frequency Environment: FCC's Role in Preserving and Maximizing a National Resource

April 11, 2017

Thomas King
Jonathan Edwards
Donald Everist
Robert Weller

Among the many good points made, this really struck me – 1993!

The screenshot shows the FCC website interface. At the top left is the FCC logo and the text 'Federal Communications Commission'. To the right are navigation options: 'Browse by CATEGORY' and 'Browse by BUREAUS & OFFICES'. A search bar is located on the right side of the top navigation bar. Below the navigation bar is a secondary menu with links: 'About the FCC', 'Proceedings & Actions', 'Licensing & Databases', 'Reports & Research', 'News & Events', and 'For Consumers'. The main content area has a breadcrumb trail: 'Home / Commission Documents /'. The title of the document is 'FCC Interference Handbook, 1993 Edition'. Below the title are sections for 'Full Title', 'Description', 'Document Type', 'Bureau(s)', and 'Files'. A 'Document Dates' box highlights the release and issue dates as 'Released On: Jan 1, 1993' and 'Issued On: Jan 1, 1993'. The 'Files' section shows a list item: 'Consumer Advisory: Pdf Txt'.

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FCC Interference Handbook, 1993 Edition

Full Title

FCC Interference Handbook, 1993 Edition

Description

Interference Handbook, 1993 edition. Contact information contained therein is now out of date

Document Type: Consumer Advisory

Bureau(s): Media

Files

- Consumer Advisory: Pdf Txt

Document Dates

Released On: Jan 1, 1993

Issued On: Jan 1, 1993

My Observations

On AM radios, noise interference is easily heard as pops, clicks, buzzes, and hiss.

Analog TV allowed the viewer to see “snow”, wavy lines in the picture, and other picture defects which provided clues to the nature of the interference.

On the other hand...

FM receivers tend to mask the sound of interference – the listener often just has an inability to get a clear reproduction of the desired station. The signal is perceived as “weak”.

Digital TV has the “cliff effect” – reception is perfect as long as the signal-to-noise ratio is above a threshold, then you “fall off the cliff” and lose reception. This all-or-nothing experience hides the interference from the viewer.

The problem as I see it...

- Growing levels of radio noise are hurting otherwise-receivable AM, FM, and TV signals, driving listeners and viewers to competitors.
- Awareness of the problem needs to be raised.
- Devices are being made and sold without adequate concern for their incidental noise radiation, raising interference levels indoors.
- Outdoor systems that are not meant to radiate (power lines, cable TV systems, traffic control equipment, etc) are not properly designed and maintained.
- Regulatory agencies have lost control of the situation.

FM Field Measurements

Not absolute measurements – instead a comparison of outdoor to indoor FM reception conditions.

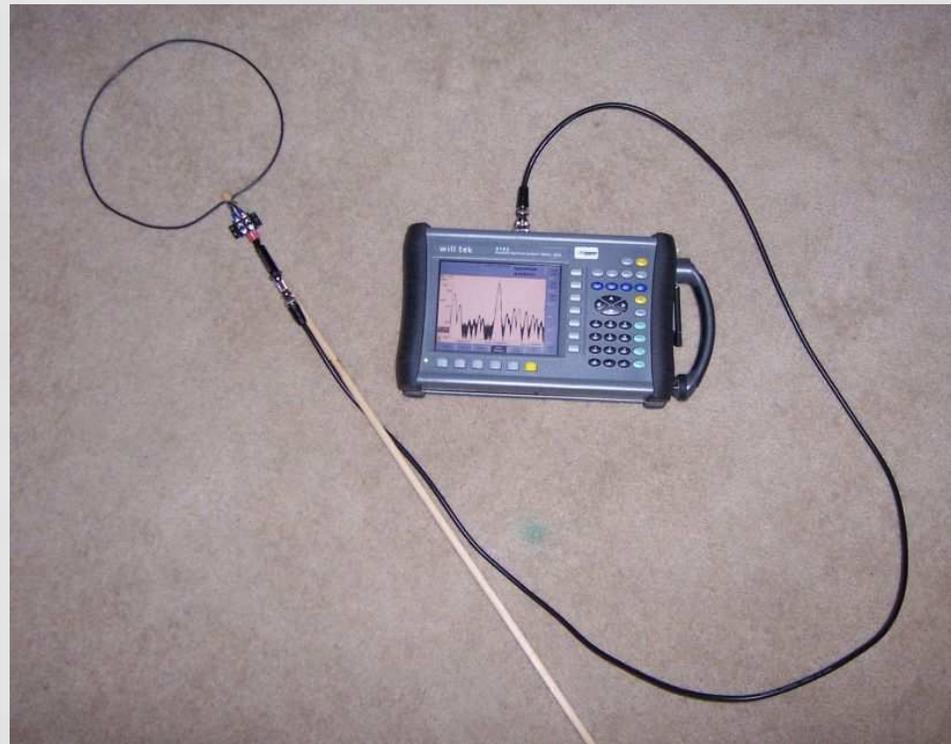
These results would apply to TV reception as well.

Study locations

- Suburban houses
- Urban apartments
- Urban offices

FM Field Measurements

Portable spectrum analyzer with
home-made loop antenna.



FM Field Measurements

- Balun-fed loop antenna
- $1/4$ -wavelength in circumference



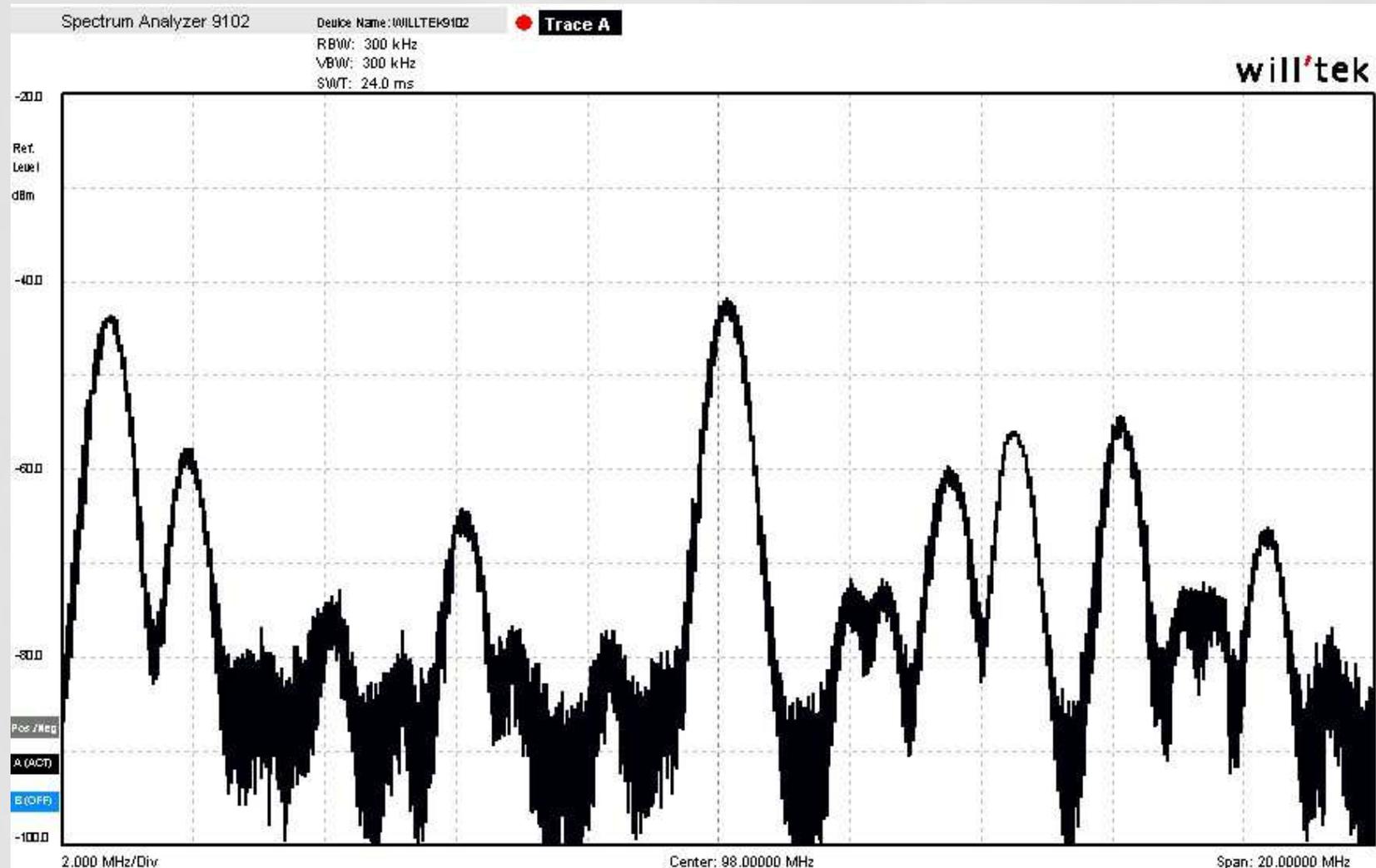
Field Tests

- Suburban homes

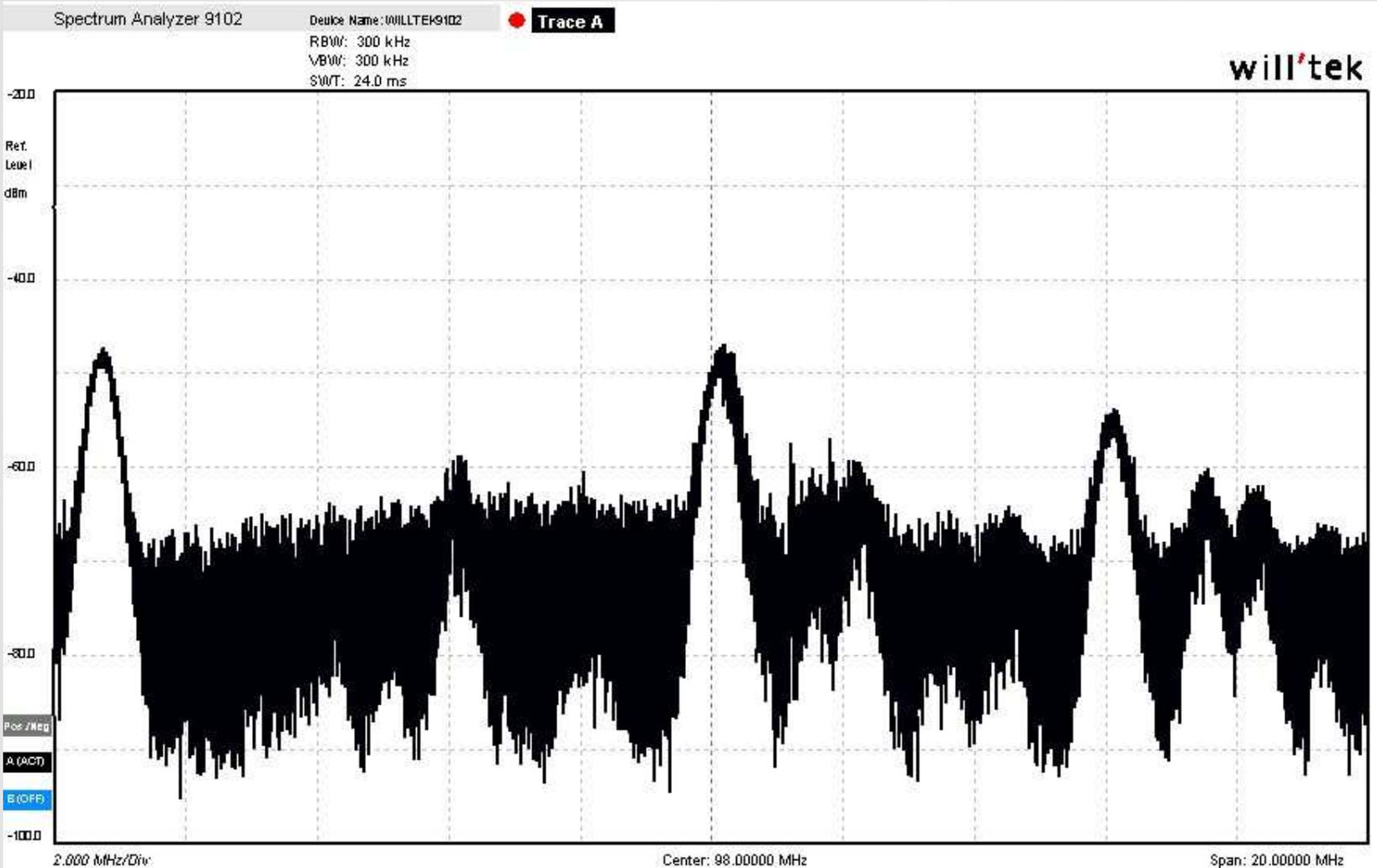


Fitchburg, Wisconsin

Outside Suburban Home



Inside Suburban Home



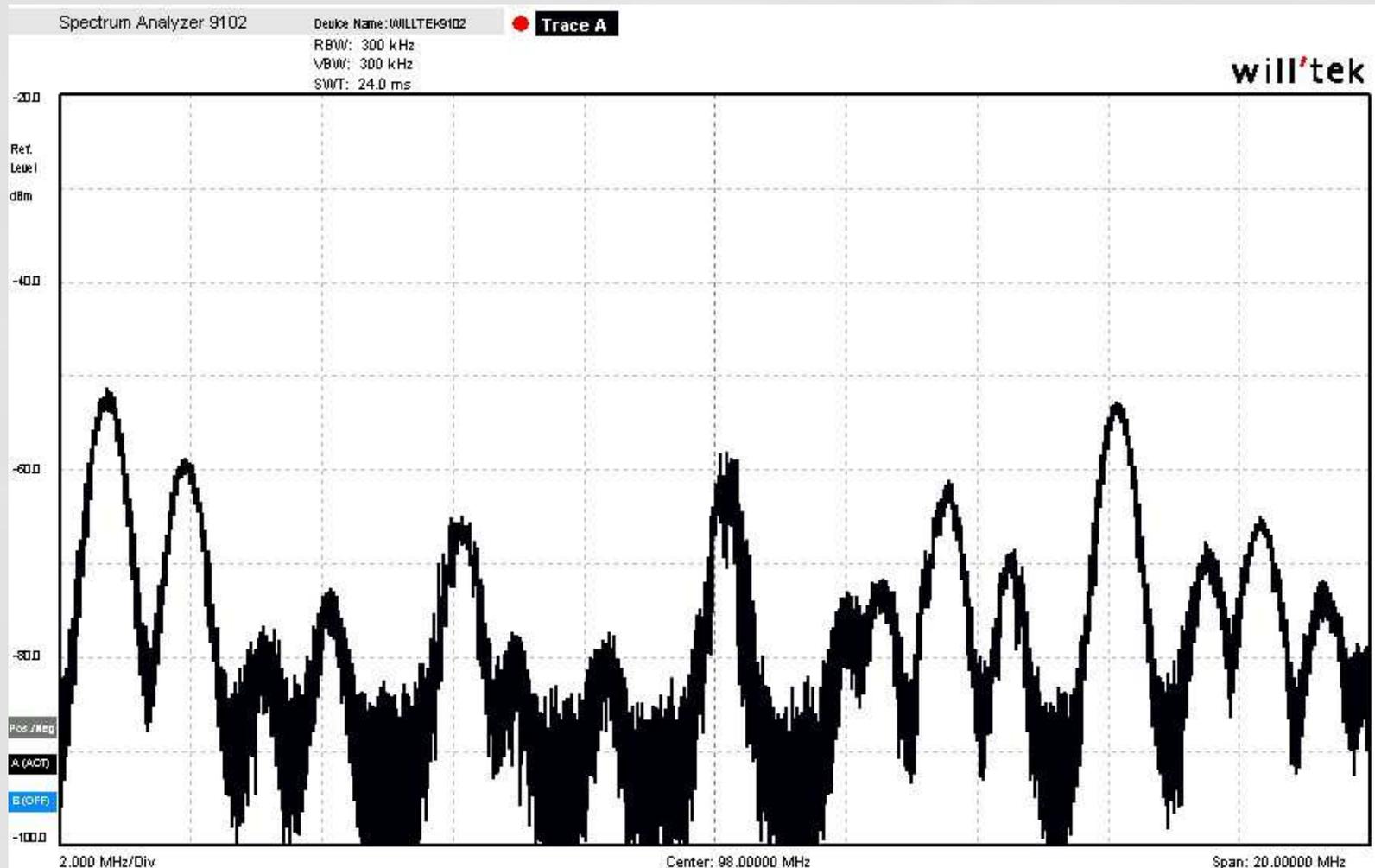
Field Tests

- Urban Apartments

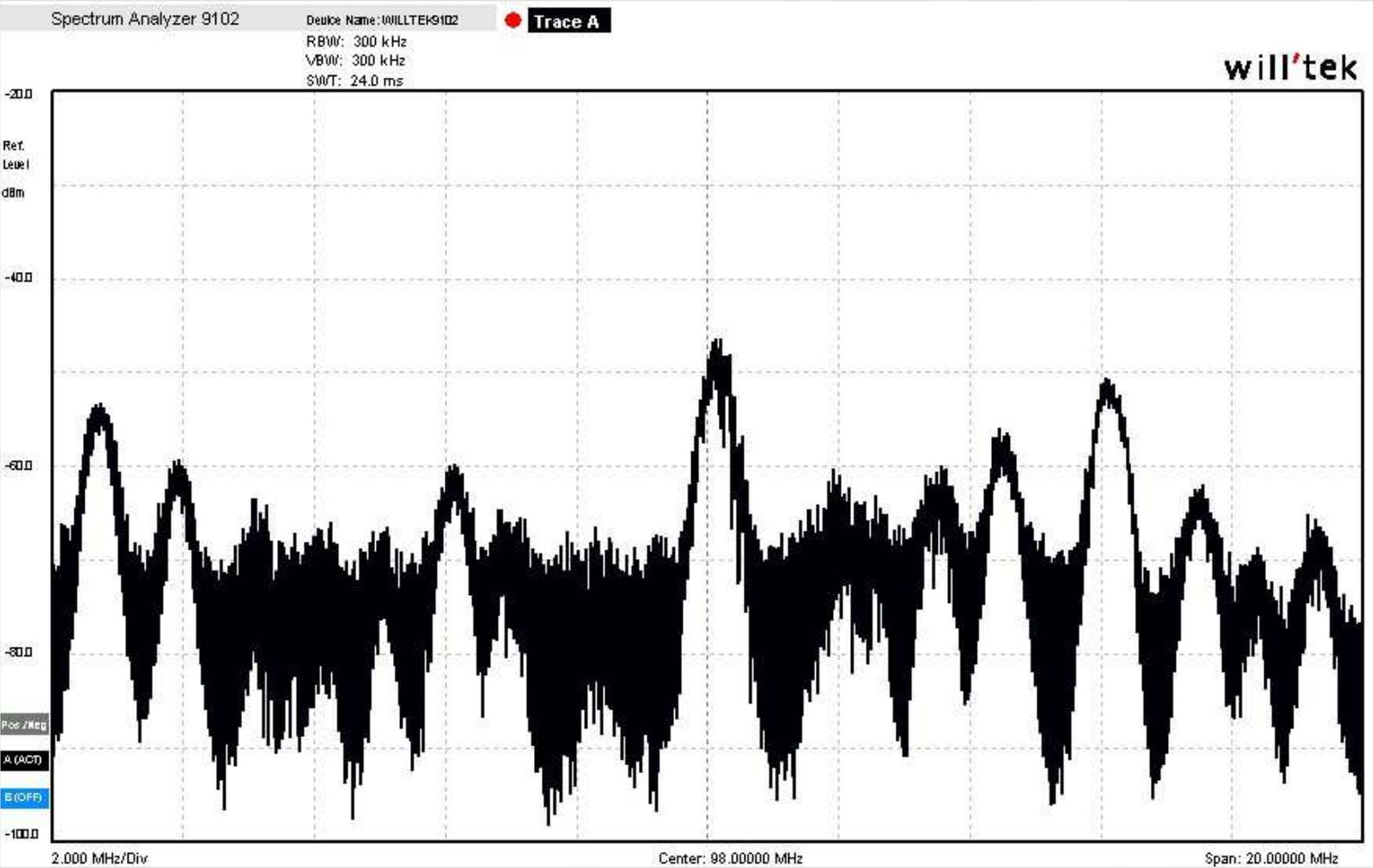


Quisling Apartments - Madison, Wisconsin.

Outside Apartment Building



Inside Apartment



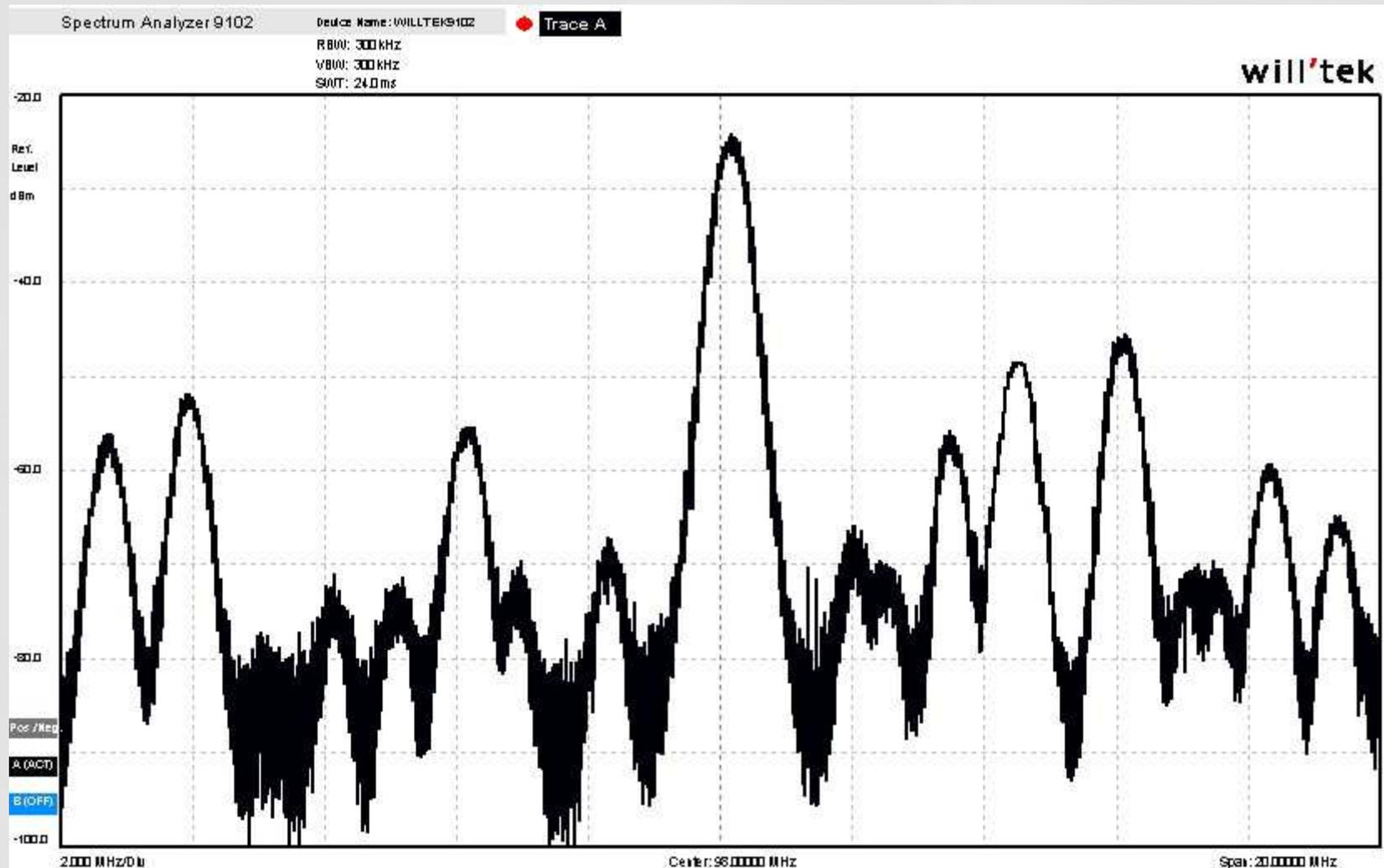
Field Tests

- Urban Offices

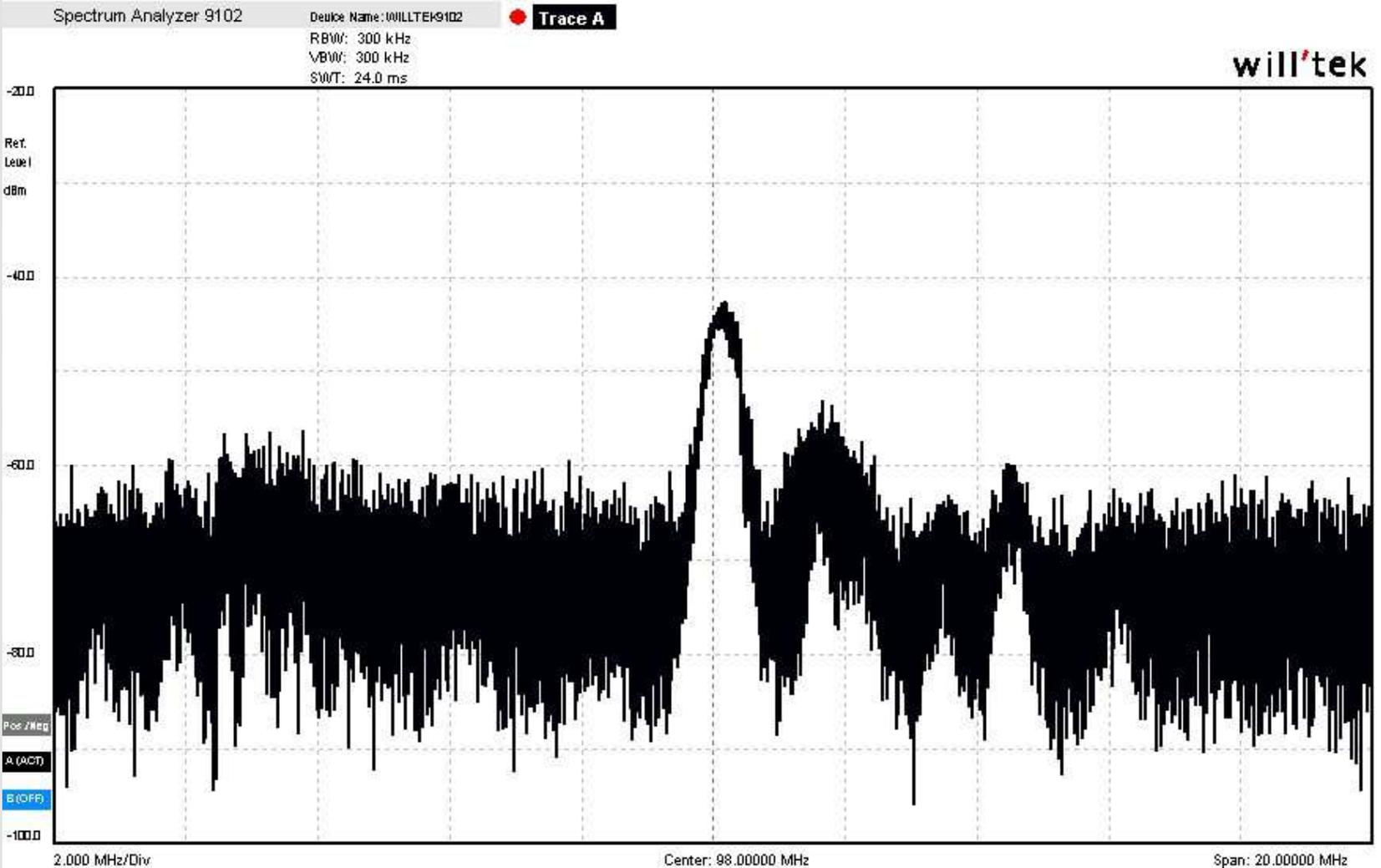


UW Vilas Hall - Madison, Wisconsin

Outside Office Building



Inside Office Building



Summary of Results

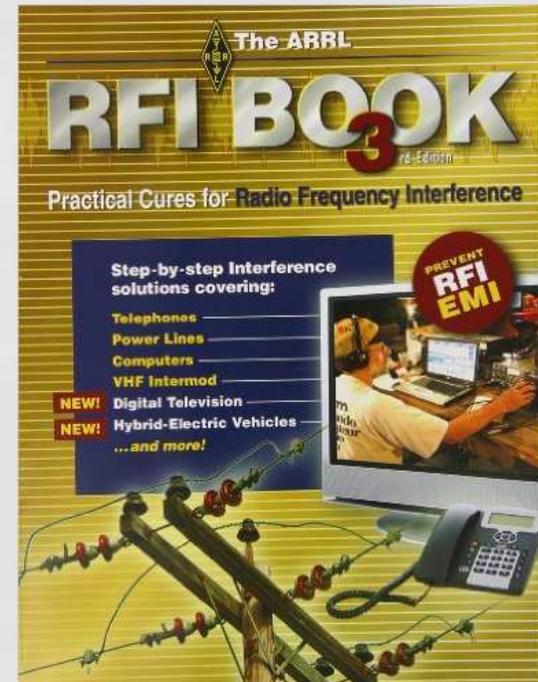
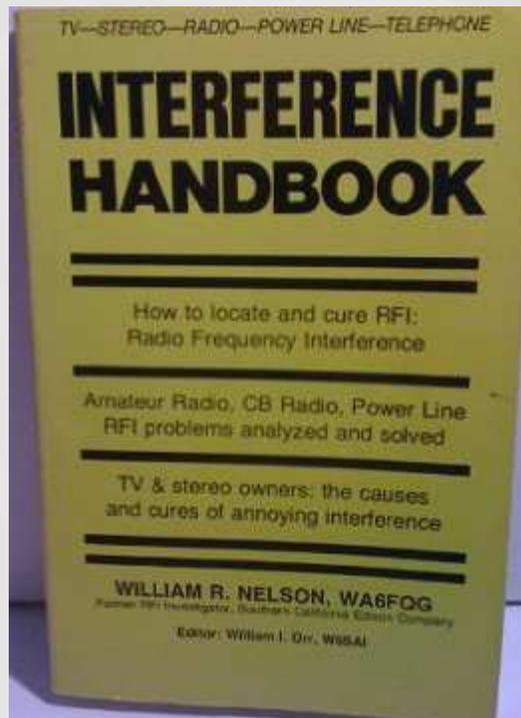
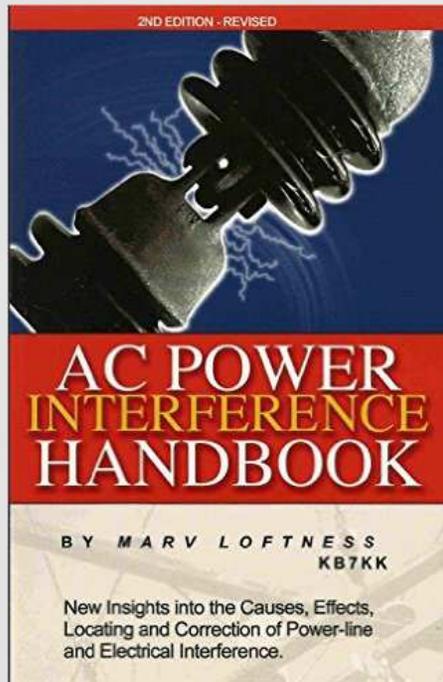
The increase in noise from outdoor to indoor was dramatic in all cases, sometimes as much as 20 to 30 dB.

Why is this happening?

I contacted several engineers involved in the manufacturer of consumer electronics. They confirm that devices are often being made without adequate concern for their incidental RF radiation.

- Anecdotal reports: prototypes are RFI tested, but actual products are built cheaper and not to tested specs.
- Switching power supplies from third-parties not tested

Educational Resources



Educational Resources



Typical Noise Sources

Indoors

- Switching power supplies
- Consumer electronics
- Lighting systems

Outdoors

- Power lines
- Cable TV systems
- DSL services
- Traffic lights and other roadway systems

Examples of Noise Sources

RCA (Thomson) model DRC200N DVD/CD player



Plugged the player into switched outlet strip so owner can completely turn it off.

Examples of Noise Sources

- Jishisheng Wanji “Electric Appliance” Model SP80

Battery charger for
electric scooter



Replaced with a linear (non-switching) power supply

Examples of Noise Sources

- Voltek (Volgen) model EXU-15010
Office equipment power supply



Added bypass capacitors to AC input and DC outputs.

Examples of Noise Sources

- Viewsonic Model LSE9901B1250 Power supply for monitor



Examples of Noise Sources

- Motorola model DCH4-050MV-0301 Cellphone charger



Examples of Noise Sources

- No-Name USB device charger



Examples of Noise Sources

- Delta Electronics WiFi router power supply



Replaced with a linear (non-switching) power supply

Examples of Noise Sources

- Lite-On Technology model PA-1650-01 Toshiba notebook PC power supply (Toshiba p/n PA3396U-1ACA)



Replaced with a linear (non-switching) power supply

Examples of Noise Sources

- Broksonic Corporation model CTGV-5463TCT Television set



“Broke-sonic” - a perfect name for this noisy product!

Examples of Noise Sources

- Microwave Oven



Listener switched to a different make/model to restore reception

Examples of Noise Sources

- Lumatek LK1000 lighting ballast



Used by “indoor gardening” enthusiasts.

Examples of Noise Sources

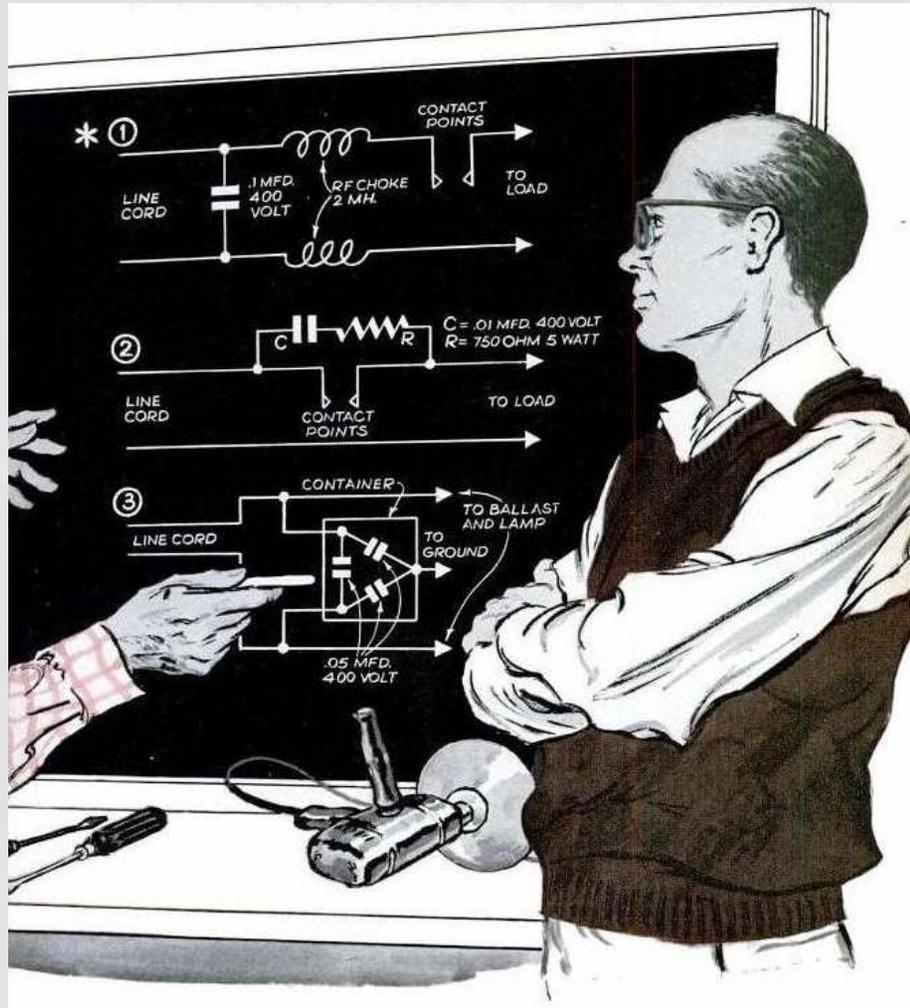
- Failed power line connector



Power companies often only fix dramatic situations like this.

The problem as I see it...

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- Outdoor systems that are not meant to radiate (power lines, cable TV systems, traffic control equipment, etc) are not being properly designed and maintained.
- Regulatory agencies have lost control of the situation.



Questions?

Your observations?

Thank you...

Steve Johnston

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