

ARRL EMC Committee Report – Rev A – Doc. #16

for the ARRL Board of Directors Meeting
January 20-21, 2023

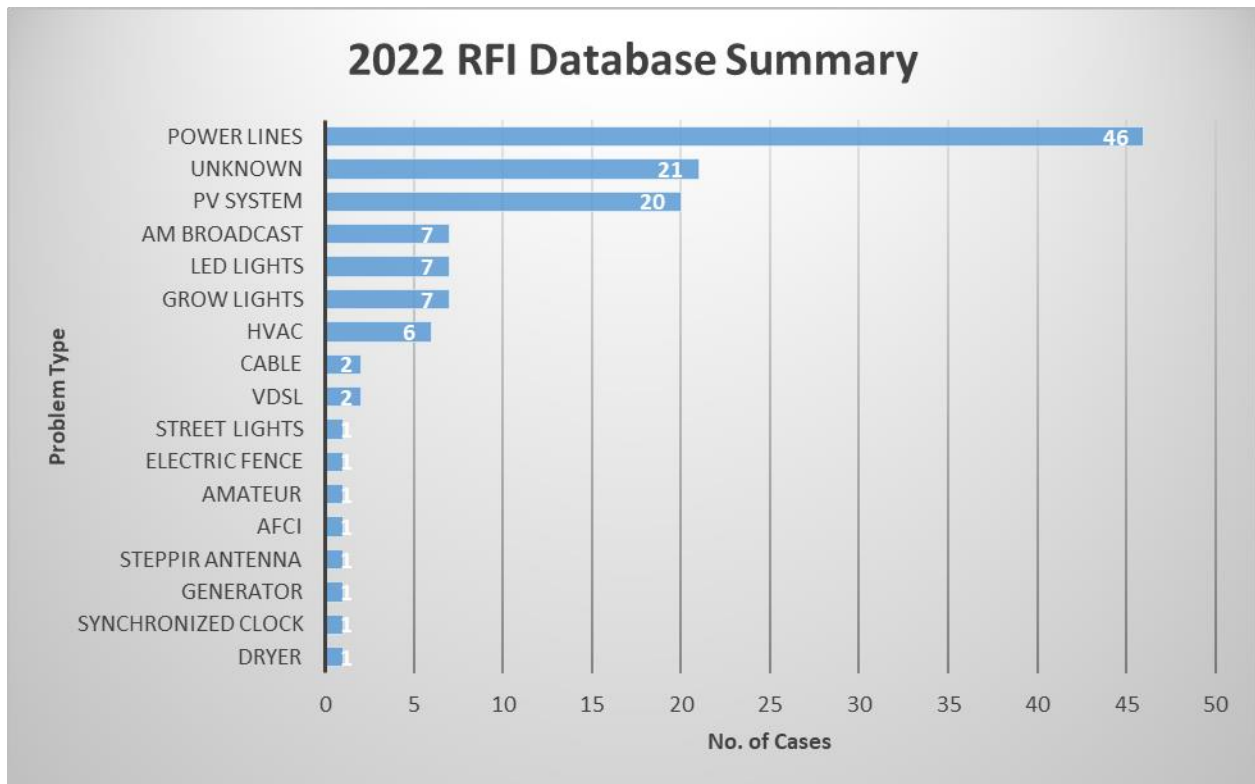
Submitted by
Carl Luetzelschwab K9LA
Director, Central Division
Chair, ARRL EMC Committee



for the period July 2022 through December 2022

HQ Activity (by W1EMI)

Steve Anderson, W1EMI, is responsible for communications (e-mail and phone) to/from amateur radio operators experiencing RFI problems. He is also responsible for following up on RFI cases, maintaining our RFI Database, issuing ARRL letters to those identified to be a source of RFI, working with FCC to issue letters to RFI sources, and for performing conducted and radiated emissions testing on products which may be the subject of RFI complaints. Steve reports the following in the way of 2022 RFI activity:



Comparison to Previous Years

Case Type	Calendar Year									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	
Unknown Unintentional Radiators	81	49	70	73	56	47	60	42	21	
Power Line Noise	51	43	47	44	47	28	32	24	46	
PV Systems	1	3	10	24	10	12	24	20	20	
Confirmed & Suspect Grow Lights	16	6	12	11	10	6	9	9	7	
Broadcast Transmitters	2	5	1	3	3	1	2	7	6	
Computing Devices and Modems	6	8	3	12	5	0	4	3	0	
Lighting Devices	15	7	19	6	8	6	4	2	7	
Water Pump Systems	2	0	0	1	1	3	6	2	1	
HVAC Systems	6	5	12	6	3	4	1	1	6	
Other	16	15	30	16	12	10	10	1	5	
Cable TV	4	4	2	2	3	2	4	0	4	
Satellite TV	3	1	0	2	0	1	1	0	0	
Plasma TV Receivers	5	1	3	1	1	1	1	0	0	
Other Broadcast Receivers	4	0	1	1	1	0	0	0	0	
Other Receivers	4	1	6	5	0	0	1	0	0	
Other Transmitters	4	3	3	2	13	5	5	0	0	
Fence Systems	3	0	2	0	2	0	1	0	1	
Battery Chargers / Power Supplies	5	7	9	6	1	3	4	0	0	
Alarm Systems including detectors	4	2	3	4	2	0	1	0	0	
Other Appliances	4	3	10	7	5	3	3	0	2	
GFCI / AFCI	25	6	5	6	6	7	10	0	1	
Automobile Systems	1	1	3	5	1	1	1	0	0	
Manufacturing Generated Noise	2	0	0	0	0	1	1	0	0	
AT&T U-Verse Systems	4	6	1	2	0	0	1	0	0	
Doorbell Transformers	3	0	2	2	1	1	1	0	0	

The following table shows the overall activity related to RFI cases handled by the ARRL lab:

Overall Case Activity (year to date)		Explanation
Active cases in database	134	No. of cases opened
ARRL letters/notices	51	Letters/notices may be a letter or e-mail to a suspected RFI source from ARRL
FCC letters	12	Letter sent from FCC is case is unresolved or not being resolved, generally 45 days after ARRL notice
FCC second letters	3	Letter sent from FCC, generally a stronger warning, sometimes followed by FCC investigation, if there is not adequate resolution
Resolved cases	25	Ham has confirmed the case has been resolved or resolution is known some other way
Inactive	17	No response from ham, no activity on the case for an extended period of time

Beginning in 2022, we started tracking ARRL and FCC letters, and case status in our database to help facilitate resolution of ongoing cases. Unfortunately, due to the volume of RFI cases and inquiries, it's not possible to follow up on every case once they are on a path to resolution. Many cases get resolved and ARRL is not informed. Also, some cases can take many months to resolve, especially if they require letters from ARRL and/or FCC, work with device manufacturers, etc.

It should also be noted that, while it follows similar trends, ARRL handles more RFI work than we track in our database. The database is used primarily for cases that require tracking to facilitate resolution, while we get numerous inquiries that are handled quickly and directly by our RFI desk. If it's a call or an e-mail to provide some advice, an intake form, a filtering solution or similar, we may opt to hold off on creating a database record unless and until the need arises. To illustrate just how much RFI traffic comes through ARRL, we sent out over 2500 e-mails this year, both managing cases and providing assistance to radio amateurs.

We also participated in the following activities this year:

Power-Line Interference Workshop

We attended the RFI Services Power-Line Interference workshop in Pigeon Forge, Tennessee, conducted by Mike Martin of RFI Services. This workshop, attended mostly by power company RFI investigators, was an excellent opportunity to learn the proper techniques for investigating and finding RFI. With decades of experience investigating RFI, specializing in power-line noise investigation, Mike Martin provided invaluable training from both a theoretical and practical perspective during this workshop.

AM Improvement Workgroup

The ARRL continues its role in helping the National Association of Broadcaster's AM Improvement Workgroup (AIWG) with its work in characterizing the challenges facing AM radio, including but not limited to ambient noise from myriad devices in homes, vehicles and elsewhere that have made AM listening less attractive in many areas of our country. To this end, our RFI Engineer has been actively participating in the development of an RF Noise Study paper which is meant to clearly illustrate the noise sources and their impact on AM radio, along with suggestions for improvement.

WPT-EV (by K9LA)

WPT-EV is short for Wireless Power Transfer – Electric Vehicles.

As far as I'm aware, the demo of a WPT-EV system in Detroit has not yet occurred. The latest news (September 2022) indicates Electreon (a company headquartered in Israel) will be providing the charging system. But there is much infrastructure needed for the entire system to function.

Electreon is also working on a charging system for the Autobahn in Germany. This system may come on line prior to the demo in Detroit. The IARU Region 1 EMC Committee may have an update on this German system. I will ask at the next IARU Region 1 EMC Committee meeting.

Of note, many entities are concerned about the noise generated by these charging systems. Here is a typical article that was published in late 2022.

Wireless EV Charging Could Pose Threat to AM Reception

New medium-frequency interference concerns are raised by Xperi

By Randy J. Stine

Published: November 18, 2022

Consumers are eager to cut the cord on their electronics charging devices, a trend that could soon benefit drivers of electric vehicles (EVs).

HD Radio developer and licensing company Xperi is seeking to raise awareness about a potential new threat to AM radio broadcast reception: the proposed introduction of wireless power transfer systems for electric vehicle charging (WPT-EV) that use switching frequencies that generate harmonics in the lower AM band.

Xperi recently filed comments about this concern in response to a notice of inquiry at the FCC about radio receiver performance. It hopes to raise awareness and also believes its HD Radio technology can be of help.

Interference to AM from unintentional radiators including low-cost switching power supplies in EVs is a concern, even before the question of wireless charging comes into the discussion.

EV sales are rising across the globe, and the United States has set a lofty goal that half of new vehicles sold are to be electric by 2030, according to the National Association of Broadcasters. With that comes growing concern over noise on the AM band in EVs. The electromagnetic interference from EV motors to AM radio signals is well established, and some carmakers have pared AM radio from dashboards because of concerns over audio quality.

Seemingly inexorable

Now wireless EV charging systems are being proposed by several developers and being considered by international standard setting organizations.

“This topic has been heavily discussed within ITU [the International Telecommunication Union]. As WPT-EV engineers design more efficient ways to transmit power, the seemingly inexorable increase in AM-band noise floors can be expected to continue,” Xperi told the FCC.

The ITU is the United Nations specialized agency for information and communication technologies. In 2019 it reported on various wireless power transmission applications in use around the world.

The group noted the frequencies expected to be used for WPT for electric vehicle charging could affect a large number of radio services.

“The impact can be on the same frequency, adjacent frequencies or frequencies with larger separations,” ITU said.

The frequency range for those WPT systems are often around 85 kHz, according to ITU, which “does not overlap with any broadcasting band, and so it is only harmonic emissions from such systems that would have any impact. It may also be that harmonics are used in the power transfer process.”

But ITU wrote that WPT-EV is expected to produce harmonics in the bands 148.5-283.5 kHz, 525-1705 kHz and 2300–26100 kHz and can interfere with the reception of LF, MF and HF sound broadcasting.

Xperi in the past has been among those calling for better control overall of manmade electromagnetic interference. It has also expressed concerns about LED lighting interfering with lower-level FM signals.

The proposed wireless EV chargers provide no shielding from EMI, according to Xperi. EMI can be suppressed in EVs using mitigation techniques such as shielding cables and electric motors and installing filters, but that might not work in the case of wireless EV charging pads, according to Xperi officials.

Wireless charging uses the principle of electromagnetic induction to transmit electrical power through the air as a magnetic field, which allows car owners to cut the cord, according to Plugless Power, a developer of autonomous charging. The process is sometimes referred to as wireless inductive charging.

Nearly every electric car maker has plans for hands-free EV charging, according to observers familiar with developments in this area. EV buyers are already being given the option for built-in wireless charging.

Just how commonplace wireless EV charging might become is only limited by the imagination, according to some vehicle developers. One has described a future in which specific lanes on the freeway contain charging pads, over which EV vehicles drive to charge while in motion.

ITU interest

Ashruf El-Dinary, senior VP for radio technology solutions at Xperi, said the potential impact of noise from wireless charging has fallen under the radar in the United States.

“However, it’s being actively discussed within ITU and on a number of different fronts, from small chargers for phone and electronics but also on these larger concepts with wireless charging pads for the home or office and even the wireless charging networks built into streets for EV buses and other vehicles,” El-Dinary said.

“This is still a new industry that is growing. And with the Biden administration infrastructure plans to build out EV charging networks in place, the companies behind wireless charging are feeling empowered to put forward these new concepts looking for some regulatory help.”

El-Dinary and others believe FCC rules covering unintentional radiators should be given a role here. “Then ultimately any future technology would have to follow regulations under the FCC. They are in charge of protecting the AM band,” he said.

There are a number of the wireless charging technologies being proposed, El-Dinary said, any of which will affect AM broadcasters by potentially adding to the noise floor.

“Some of these are pretty high power, and in order to do that they need a higher modulation frequency for coupling. And it’s not so much the fundamental frequency, but the harmonics generated by the wireless charging systems that is a concern to many. Some of the reports are showing that noise is being generated up within 500, 600 and 700 kHz, which will have a direct impact on the lower end of the AM band.”

El-Dinary believes this isn’t so much an issue with shielding of the receiver in EVs but rather the radiation from the wireless charging systems being picked up by the antenna of the car, which is then directly coupled into the tuner.

He said the National Radio Systems Committee has started some paper studies and NAB is keeping abreast of the situation. “The radio broadcast industry needs to be aware of the wireless charging issue and watching developments closely,” El-Dinary said.

RFI Teams (by K1UI)

As mentioned in the EMC Committee report to the July 2022 Board Meeting, a major goal of the EMC Committee is to eventually have an RFI Team in every section (maybe more than one team, depending on the population density and the physical expanse of the section). An RFI Team has been formed in all seven sections in the New England Division, and the following discussion is about those teams. As a side note, there are other RFI Teams scattered throughout the continental USA (WA6MEM and AI4GK, for example), and a secondary goal is to identify others and get them involved with the ARRL EMC Committee.

Funds from ARDC were received a month later than anticipated. This also caused some of the quotes for equipment to expire. The revised quotes were slightly more than the originals. This will not impact the team equipment but may delay procurement of the Radar Engineers equipment kept at the Division level for temporary use in challenging cases.

ARDC has said that additional funds may be available for unplanned price escalation and we will pursue this once we fully understand the shortfall.

Since the team equipment is unaffected, we will schedule training and deployment once delivery dates are confirmed. Orders have been placed for the team equipment. Some antennas are out of stock and will be delayed about 60 days. Team Training and deployment will reflect this.

The net result is projected to be about a calendar quarter delay to the original schedule but winter weather may further impact this.

Case work on a limited basis continues with on-hand equipment and web site maintenance and minor improvements continue.

12/7/2022 update

We have about 75% of the grant material at the K1UI QTH. 5 of 7 hf loop kits should be here later this month (on back order). The 2M/440 Yagis are constructed and are being powder coated. The Radar Engineering (RE) equipment will ship in January 2023. I'm holding back on one piece of (non-critical) RE equipment until I see if our contingency funding is sufficient.

Here's the original schedule for the seven RFI Teams in the New England Division. As mentioned previously, there is about a one-quarter delay in the schedule.

New England Division RFI Team Project	
<u>Timing</u>	<u>Action</u>
June	Teams formed in all 7 sections.
July	ARDC equipment grant submitted.
September	ARDC grant (\$23.6K) approved.
October	Training and deployment for teams in progress. Funds not yet received.
Dec/Jan	Goal to meet with teams, train and deploy equipment.
1 st /2 nd Qtr 2023	Implement pilot, adjust process after 10 and 25 cases
3 rd Qtr 2023	Full process implementation and follow-up. Stage for additional grants as required

1/3/2023 update

January 21 is scheduled for training and equipment distribution at NE Sci Tech for WMA, RI, EMA. The February 25 session at ARRL HQ for CT, with other sections invited.

VHF/UHF Yagis are on their way to complete equipment sets for teams. Developing training document for use of IC705 and other equipment.

Additional session planned for Nearfest in April.

I have delivered an equipment set to the EMA team lead (less the Yagi, which is on its way) to enable W1DAN to help me develop the training document.

The Radar Engineers order for the (NE Division-held) 243 and 245 RFI Locators should be placed thus month.

Illegal Transmitters (by W1RFI)

In 2021, the ARRL Lab had prepared a report outlining problems with a number of manufacturers and models of VHF and UHF transceivers. Many of these have problems with illegal spurious emissions and their being marketed wide-open over a wide frequency range, well outside any FCC certification obtained to use these radios in other services, such as Part 90. These devices are being marketed to and purchased by the general public, which uses them on the ham band and on other frequencies, with “amateur radio” taking the blame for some of the

problems. The report the Lab prepared included testing of spurious emissions, frequency ranges and a marketing survey. In 2022, the Lab updated the marketing survey and now has a fresh report that ARRL can use to file a formal complaint to the FCC.

Devices that Exceed the FCC Emission Limits (by W1EMI)

The ARRL laboratory also has a conducted and radiated emissions testing facility where pre-compliance Part 15B testing can be performed as necessary. This year, conducted emissions testing was completed on the following products:

- 1) LED lighting (e.g., recessed lights, grow lights and garage lights): completed testing of several LED lights and drivers this year, generally found by hams to have harmful interference affecting HF bands, and to be coming from neighbor's homes. The drivers and lights, which rely on Switch Mode Power Supplies (SMPSs) to power low voltage LED lights, were either provided to the ARRL lab or the lab purchased them. Overall, testing of these devices confirmed they exceed Part 15B limits, some by as much as 30 – 40 dB. We also provided help by testing devices with various filters and/or by testing more RF quiet replacement devices hams had proposed to their neighbors.
- 2) Charger unit: the lab tested a marine charger which failed to meet Part 15B limits during all phases of charging.
- 3) Circuit breakers: we received a couple reports concerning issues with some newer Eaton circuit breakers tripping when transmitting, so we purchased two breakers to test over at W1AW. We were unable to get the breakers we purchased to trip under any of the conditions we tested under, which included transmitting at 800+ watts simultaneously on several bands at W1AW. However, when the ham sent his circuit breaker into the lab, we were able to find at least one point where it did trip, at about 500 watts – this would seem to indicate a faulty breaker, albeit at a high level of RF and simultaneous transmission on several bands at W1AW. This is likely an isolated incident.
- 4) Dimmers: we received reports of dimmers that were noisy. We purchased two different dimmers and tested them in the lab. We found that both dimmers were noisy on the low end (0-5 MHz). We will be purchasing a couple more brands to see how well those do as well.

The information on this testing has been compiled, and we are considering approaching the FCC to develop a reporting process (similar to the process with Laura Smith at the FCC for radio frequency interference) for known noisy devices which create harmful interference to amateur radio operators.

Harmful interference from these devices falls under Laura Smith's bailiwick, but emission-limit violations belong to FCC's Office of Engineering and Technology (OET). Thus this new program would be with OET, where we could send reports directly to OET. OET would then contact manufacturers, informing them that the FCC has a report of emissions violation,

informing manufacturers of the applicable rules and asking for a copy of the test data the manufacturer is required to provide to the FCC upon request.

Mr. Hare advised that he could arrange a visit to the FCC Lab to see what can be done to move the ARRL in that direction.

Standards (by W1RFI)

Ed Hare has been ARRL's point of contact with respect to industry standards being developed by the IEEE, the American C63® committee on EMC and others. C63 develops standards that are often incorporated into regulations by reference by the FCC. For the past 10 years, Mr. Hare has served as a member of the IEEE EMC Society Board of Directors, as a Director-at-Large and then as the EMC Society Vice President of Standards. He is term limited as of the end of 2022, but will continue to serve as an active member of the EMC Society Standards Development and Education Committee, as its appointed Standards Representative and as a member of the EMC Society Standards Activity and Coordination Committee, maintaining contact with non-IEEE standards development organizations. Mr. Hare will continue that work in 2023, as an employee and then as a volunteer, representing ARRL and ensuring that amateur radio has a seat at the table, and at the head of the table, in these major industry organizations.

This is used to good effect to help raise awareness of the value and importance of amateur radio within industry and with regulators that work closely with industry. In 2022, amateur radio was featured prominently at the EMC Society Symposium held in August in Spokane, WA. One entire track of presentations was devoted to amateur radio and booth space in the exhibitor area was donated to ARRL to allow W1AW/remote to be operated by local amateurs and attendees remotely. In 2023, this will be repeated, with an even more-visible presence for amateur radio in the Symposium to be held in Grand Rapids, MI.

Ed Hare W1RFI and Steve Anderson W1EMI attended both the IEEE EMC Society and ANSC C63 meetings held in New Brunswick, NJ and Santa Rosa, CA, respectively. These meetings provided an introduction to the important work of both of these organizations, how each organization impacts the EMC standards we use for measuring conducted and radiated emissions, and ARRL's role in both organizations as well.

In 2022, this work culminated in the completion of an IEEE Recommended Practice that outlines procedures that electric power companies can use to appropriately and effectively respond to complaints about radio (and television) interference. This standard was initiated at a request by ARRL, chaired by ARRL consultant and EMC Committee member Mike Gruber, W1MG, with Jerry Ramie, KI6LGY, also an EMC Committee member, as Secretary. ARRL provided a significant amount of text for the initial draft, but the electric-utility members of the Working Group that developed the standard ensured that the standard is written in a way that should have the support of the utility industry. The standard was submitted for ballot, a balloting group has been formed and the ballot is just getting underway. The standard is expected to be published by the middle of 2023.

Update of the ARRL RFI Book (by W1RFI)

The ARRL *RFI Book* has been out of print for a while. Now that Steve Anderson has a year of experience as the ARRL RFI Engineer under his belt, he and Ed Hare were able to evaluate which chapters needed update and revision, which new chapters should be written and which chapters (VCRs, for example) can be eliminated. Mr. Anderson is in the process of contacting potential authors for the book and determining which chapters can be authored by ARRL Lab staff.

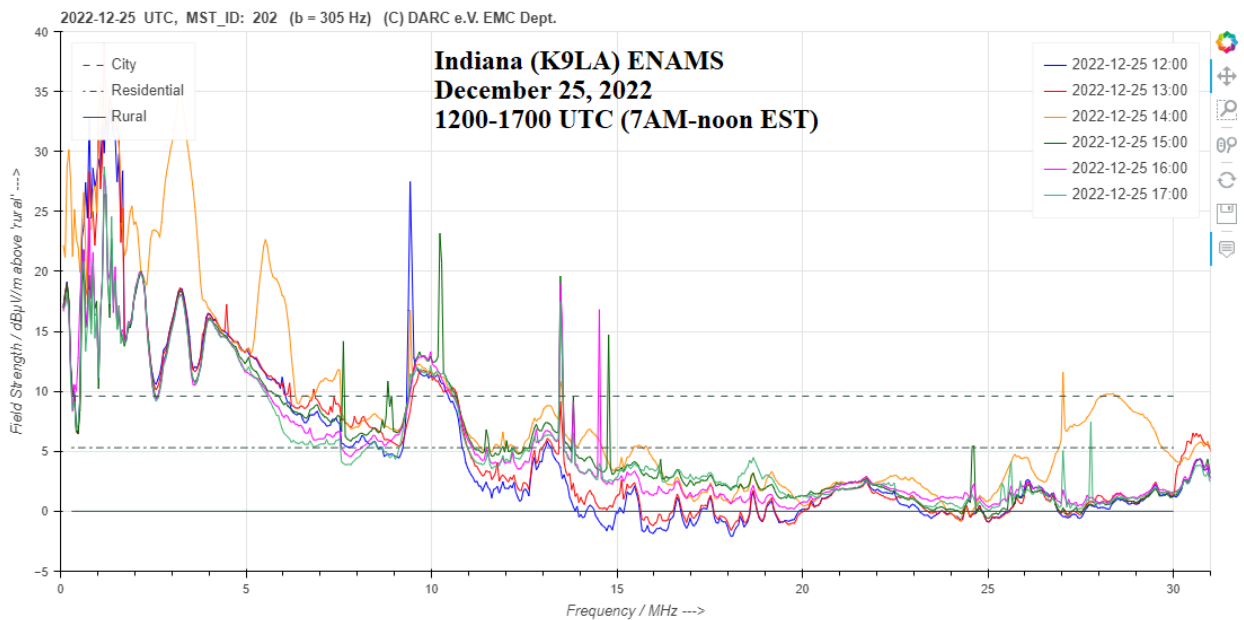
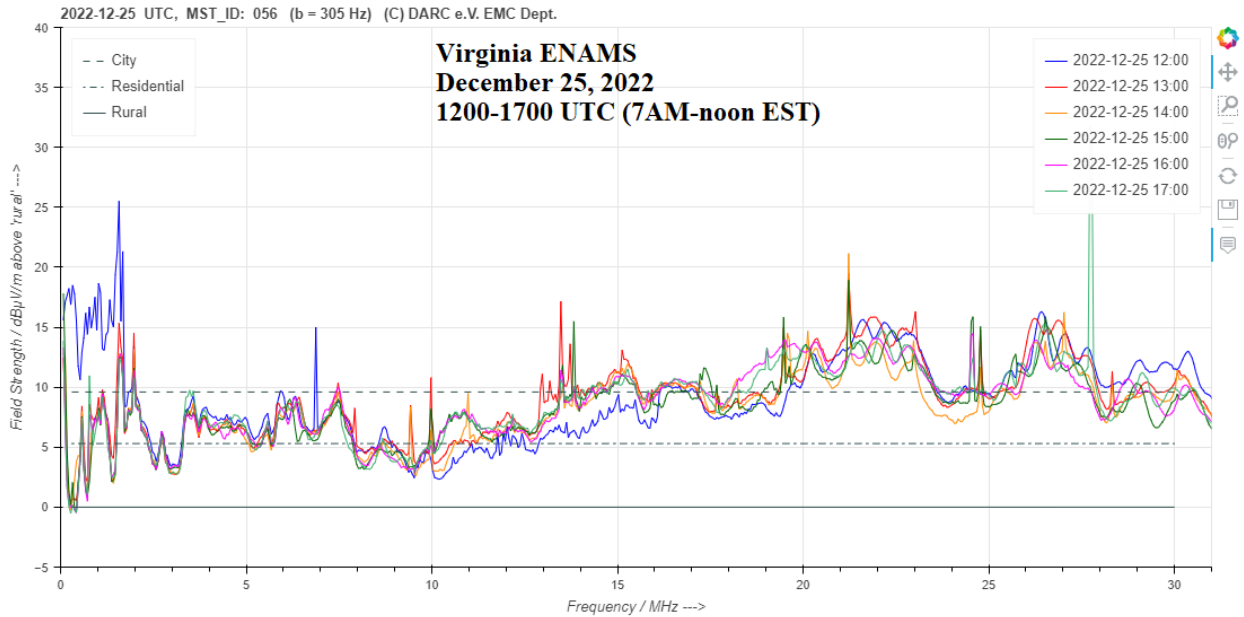
ENAMS (by K9LA)

ENAMS is short for Electrical Noise Area Measurement System.

ARRL EMC Committee Chair K9LA participates in the monthly IARU Region 1 EMC Committee meetings. Ed Hare W1RFI has also attended some of these meetings when his ARRL work schedule allowed. Members of the IARU Region 1 EMC Committee are experiencing the same issues as the ARRL EMC Committee members.

The Region 1 EMC Committee has a Noise Measurement Campaign (NMC) sub-working group. They have installed more than 50 ENAMS, mostly in Europe. The ENAMS consists of an SDR receiver that automatically scans the entire frequency range from longwave (66 kHz) to shortwave (31 MHz) every hour of the day. At present, there are three ENAMS in the USA. One is in Virginia (by Raymond Reis, who is the owner of Alltec in Germany), and the other one is in Indiana at K9LA's QTH. A third ENAMS was placed on-line at W1RFI in Burlington, CT, pending the permanent installation of the antenna at a location more distant from his house.

The following two images show results of the Virginia ENAMS and the Indiana ENAMS on December 25 for every hour from 1200 UTC to 1700 UTC.



What's obvious is the noise environment on the lower frequencies at the Virginia ENAMS is quieter than the noise environment at the Indiana ENAMS. But the noise environment on the higher frequencies at the Indiana ENAMS is quieter than the noise environment at the Virginia ENAMS.

With respect to the noise environment on the lower frequencies at the Indiana ENAMS, it is believed that the cause is tied to switching power supplies and other noisy devices at the K9LA QTH. Work is in process to resolve these issues.

ARRL EMC Committee members:

There are 16 members on the EMC Committee. These individuals are on the EMC Committee reflector:

Carl Luetzelschwab, K9LA, Central Division Director (Chair)
Kristen McIntyre, K6WX, Pacific Division Director
Ed Hudgens, WB4RHQ, Delta Division Vice Director
Ned Stearns, AA7A, Southwestern Division Vice Director
Ed Hare, W1RFI, ARRL Lab Manager (Staff Liaison)
Steve Anderson, W1EMI, ARRL Lab
Mike Gruber, W1MG, (ARRL Volunteer)
Kermit Carlson, W9XA
Brian Cramer, W9RFI
Richard Dubroff, W9XW
Ron Hranac, N0IVN
Riley Hollingsworth, K4ZDH
Greg Lapin, N9GL
Ghery Pettit, N6TPT
Jerry Ramie, KI6LGY
James Roop, K9SE

There are 8 other participants with an interest in and/or with technical expertise that are also invited to attend the meetings:

Fred Kemmerer, AB1OC, New England Division Director
Mickey Baker, N4MB, Southeastern Division Director
Rob Leiden, K1UI
Dan Fisher, AI4GK
Gary Lopes, WA6MEM
Steve Jackson, KZ1X
Phil Barsky, K3EW
Gordon Beattie, W2TTT

Mission Statement:

- Advise and make recommendations to the ARRL Board and HQ staff

- Maintain contact with other organizations involved in EMC matters through established liaison individuals
- Aid HQ staff in resolving issues reported by members
- Develop RFI Teams in each ARRL section
- Work in concert with the ARRL RF Safety Committee

Next Six Months:

- 1) Continue helping hams and non-hams with noise issues
- 2) Keep abreast of Detroit and Germany WPT-EV demos/tests. When the Detroit demo goes live, Mr. Hare is planning on doing a site visit to measure and assess the interference potential of an actual device.
- 3) Continue implementation of New England Division RFI Teams and interface with other RFI Teams around the US
- 4) Work with Laura Smith at the FCC to curtail illegal transmitters
- 5) Work with the OET of the FCC to interface with manufacturers whose devices are not within FCC limits
- 6) Continue working with other groups to define appropriate standards
- 7) Update the ARRL RFI Book to the 4th Edition
- 8) Put the third US ENAMS on line and resolve noise issues seen at K9LA's ENAMS