

ARRL EMC Committee Annual Report Doc. #16

**ARRL Board of Directors Meeting
January 21-22, 2022**

**Submitted by
Kermit Carlson, W9XA
Chairman, ARRL EMC Committee**

EXECUTIVE SUMMARY:

Five significant EMC issues continue to be major challenges to continuation of interference-free access to the amateur radio spectrum: WPT-EV (Wireless Power Transfer-Electric Vehicles); residential solar installations; powerline sources of harmful EMI (electro-magnetic interference); residential and commercial grow lights; and the illegal marketing of transmitters that either transmit well outside the amateur bands or have illegal spurious emissions. A digest of some of these sources which have recently been measured, researched, and documented by the EMC Committee of the ARRL are presented in this report.

The issue of WPT-EV, Wireless Power Transfer – Electric Vehicles, presents the potential for harmful interference from what could become a ubiquitous presence of wireless vehicle charging systems. WPT-EV is notable because FCC and international rulemaking is underway. In the US, this is covered by FCC Docket 19-226. The ARRL has filed Comments and Reply Comments in the Docket 19-226 proceedings which are now part of the record. The League is also working with the IARU on the international rulemaking proceedings. Ed Hare, W1RFL, as the IARU Region-2 EMC Coordinator and ARRL Laboratory Manager is involved in the effort to consolidate the International response to the challenges that WPT-EV presents to the entire global amateur radio community. Two main concerns are that first, no amateur bands be used for the fundamental frequency for power transfer and that second, that any impact to amateur operations by spurious and harmonic emissions cause less than a 1-dB increase to the background noise floor within the amateur bands.

With regards to the potential for harmful interference arising from WPT-EV charging systems for transportation, the ARRL has been working with our sister EMC organizations, within industry standards groups and directly with manufacturers at some of the first deployments of WPT-EV systems in test range environments. This almost invisible and highly technical involvement in the establishment and refinement of standards produces a great impact on reducing the potential for harmful interference. The standards being proposed presently are for a field strength that combined with a typical reduction of un-necessary emission still creates a signal far above the noise background found at most amateur stations.

In the case of what was seen at one test installation of a WPT-EV, the charging system covered the 40-meter band with noise that registered S7 at a distance of 32 feet from a typical mobile

amateur radio installation. WPT-EV continues to be of great concern since most designs have not been installed and deployed in large numbers.

Another use of WPT is for those systems which power or charge consumer electronics and portable cellphone devices. At present there is no allowance for systems that convey power over one meter in distance, however documentation recently filed with the FCC by the law firm of Minz reports that during an ex-parte meeting with one of the FCC Commissioners that several WPT manufacturers are seeking new rulemaking for WPT which would operate across distances over one meter. At present FCC Part 18 devices that work at a distance of more than one meter are not covered in the regulations. While there were no substantive details in the filing it does give rise for concern about the possibility that interference could arise from such devices.

The second issue, that of harmful interference to amateur operations from the installation of residential solar power systems, is the other main potential source of great concern. For installation into a residential setting such devices are regulated by the FCC under Title 47 of the Code of Federal Regulations, Part 15, in order to protect licensed users of the spectrum within this residential setting. However, the only standards that apply in Part 15 below 30 MHz are for conducted emissions from the power converter into the AC Mains. There are no applicable limits that apply for radiated emissions below 30 MHz, and there is no regulation of conducted RF between the solar panels, power optimizers and the power converter.

The ARRL Laboratory and the EMC Committee have been working with industry, manufacturers and standards committees for solar-panel issues. In the case of the solar panel industry the work by the ARRL Laboratory with the manufacturers has proven quite effective. This began with ARRL's cooperation with Solar Edge in the design improvements of that manufacturer's roof-top mounted optimizers. This work is ongoing. Due to the publicity that ARRL and others have generated regarding noise from solar systems, other solar companies have also contacted ARRL to discuss EMC issues and to discuss solutions and improvements they are making. This includes Generac, LG, Delta and EnPhase. Working with the manufacturers has been extremely productive in solving many cases of harmful interference to amateur radio installations and continues to be the best hope for developing consistent solutions of this type of interference.

Mr. Hare has visited four different local "solar farms" with acres of solar panels and found that in all four cases, no significant noise was heard on HF outside the perimeter of the solar farm. This preliminary news is reassuring. Ongoing testing as new installations are identified will continue.

Powerline gap noise continues to provide a significant problem for many amateur installations. Several members of the EMC Committee have been working on the IEEE P1897 Working Group which has been developing best recommended practices for the remediation of Powerline Gap Noise. A more thorough discussion can be found later in this report.

Another significant “growing” problem is found in the high-powered lighting controllers being used for various forms of indoor gardening. ARRL continues to receive reports of interference from grow lights, notably in states where the growing of cannabis has been made legal. One recent report involved noise heard 15 miles from the source and a very “aggressive” neighbor.

The EMC Committee and the ARRL Laboratory staff have for several years been investigating the problems that arise from the importation and marketing of non-compliant and illegal FM transceivers. Contained in this EMC Committee as an appendix to this report are the findings of several years’ effort documenting the technical aspects of this growing problem.

MISSION STATEMENT:

The EMC Committee monitors developments in the Electromagnetic Compatibility (EMC) field and assesses their impact on the Amateur Radio Service. The Committee informs the ARRL Board of Directors about these activities and makes policy recommendations for further action, if appropriate.

The overall goals of the committee are:

- Advise the ARRL Board about issues related to radio-frequency interference
- Advise the ARRL HQ staff on the content of its publications
- Make recommendations to the ARRL Board and HQ staff
- Maintain contact with other organizations involved in EMC matters through established liaison individuals

MEMBERS OF THE COMMITTEE:

- Mr. Kermit Carlson, W9XA, EMC Committee Chairman
- Mr. Carl Luetzelschwab, K9LA, Central Division Director, EMC Committee Board Liaison
- Mr. Stephen Anderson, W1EMI, ARRL Lab RFI Engineer
- Mr. Ed Hare, W1RFI, ARRL Laboratory Manager, Staff liaison
- Mr. Mike Gruber, W1MG, Past ARRL Lab EMC Engineer, IEEE P1897 WG Chair
- Ms. Kristen McIntyre, K6WX, ARRL Pacific Division Director
- Mr. Ned Sterns, AA7A, ARRL Southwest Division Vice Director
- Mr. Ed B. Hudgens, WB4RHQ, ARRL Delta Division Vice Director
- Mr. Riley Hollingsworth, K4ZDH, ARRL Volunteer Monitor Program Coordinator
- Dr. Gregory Lapin, N9GL, Chair ARRL RF Safety Committee
- Mr. James Roop, K9SE, Supervisory Electronics Engineer, FCC, retired
- Mr. Ghery Pettit, N6TPT, Pettit EMC Consulting
- Mr. Jerry Ramie, KI6LGY, ARC Technical Resources
- Mr. Phil Barsky, K3EW, Engineering/Management Consultant, retired

- Mr. Gordon Beattie, W2TTT, AT&T
- Mr. Brian Cramer, PE, W9RFI, Commonwealth Edison
- Dr. Richard E. DuBroff, W9XW, Professor Emeritus at Missouri University of Science & Technology
- Mr. Ron Hranac, NØIVN, Society of Cable Telecommunications Engineers liaison

HQ STAFF:

The role of the ARRL HQ staff consists of the following:

- Answer individual inquiries from hams (and sometimes their neighbors) about RFI problems
- Write, review and publish articles about RFI
- Write and publish the ARRL *RFI Book*
- Design and update ARRL's RFI web pages
- Produce video content pertaining to RFI
- Maintain a database at ARRL to facilitate EMC case tracking and reporting
- Work with ARRL's D.C. office on various spectrum and RFI-related filings
- Maintain contact with industry
- Participate in standards and industry groups, as a voting member or as a liaison. This includes but is not limited to the ANSI accredited C63[®] and the IEEE EMC Society Board of Directors.
- Work with the FCC Enforcement Bureau on RFI cases that require FCC intervention and to help resolve RFI cases sent to ARRL by the FCC.

Over the course of 2021, EMC matters were handled by Mr. Cianciolo and Mr. Hare. A new Lab RFI Engineer, Stephen Anderson, was hired in the Lab, starting on January 3, 2022.

The duties of the RFI engineer are:

- Responding to member inquiries about RFI issues and problems
- Adding updates and revisions to the ARRL RFI Web pages.
- Facilitating and providing assistance on resolving long standing power line noise and other RFI cases with the FCC.
- Testing the conducted emissions of suspect consumer electronic and electrical devices. Devices that exceed FCC specified absolute limits can be identified and reported to the FCC. Of particular concern are lighting devices, including LED and grow lights. Issues concerning grow lights have been discussed in previous EMC Committee reports.
- Working with SolarEdge, Generac, Enphase, LG and Delta to resolve RFI from both PV panel optimizers, microinverters, and line tie inverters
- Reviewing proposed EMC related material for ARRL publications.

EMC COMMITTEE PARTICIPATION IN INDUSTRY STANDARDS

The EMC Committee Members work on several Industry and Standards group such as IEEE and ANSI. This work maintains seats for amateur radio and radiocommunications technology at many industry and regulator tables. This enhances the perceived value of amateur radio with industry, FCC and other entities. Of note, ARRL staff and volunteers do not just have seats at the table. In recognition of the value of amateur radio, they are generally elected to various leadership positions, holding seats at the head of these important industry tables.

C63®

The C63® Committee is mentioned several times in this report. As an answer to the question, “What is the C63® Committee?”, the following section is included in this report.

Scope of C63®

C63® is an accredited standards committee that develops North American EMC standards. It included the following Subcommittees. Each Subcommittee has one or more working groups maintaining or developing various standards in its areas of expertise.

The Subcommittees and Chairs that report to the Main Committee include:

- SC-1 – Measurement and Instrumentation, Zhong Chen, ETS Lindgren
- SC-2 – Definitions, Marcus Shellman, US Dept. of Defense
- SC-3 – International Standardization, Ross Carlton, ETS Lindgren
- SC-4 – Wireless and ISM Equip. and Msrmnts, Bob DeLisi, Underwriters Lab
- SC-5 – Immunity Testing, Ed Hare, ARRL
- SC-6 – Laboratory Accreditation, Randy Long, ANSI Nat. Accreditation Board
- SC-7 – Spectrum Etiquette, Jason Coder, National Inst. Stds and Technology
- SC-8 – Medical Equipment Testing, Stephen Berger, independent consultant

Several of the standards developed by C63® are adopted by the FCC and FDA by reference in their rules.

The C63® membership is diverse, including manufacturers, industry groups, regulators, independent consultants. In this venue, ARRL is a representative of both a radiocommunications service and a user of standards and products affected and controlled by them. More information on C63® and the scope of its work can be found on its web page¹.

¹ <http://www.c63.org>

Origin of C63®

The origin of the C63® Committee is still being researched, but its existence goes back at least as far as 1936. It may have existed earlier. Some of its earliest work was not only oriented toward American standards, but also focused on international standardization, through entities such as CISPR. Over the years, its stature has steadily increased, and although its focus is North American, its work is often harmonized internationally.

A good article describing more of the history of C63® is available at the link in Footnote 2².

Importance of C63® to amateur radio

A quick review of the list of C63® Subcommittees and membership shows a wide range of interests. ARRL's participation in this arena broadens ARRL's contact with key players in industry and with regulators. ARRL also brings the value of amateur radio to this professional table. Based on appreciation expressed by many participants and their desire to elevate ARRL participants to positions of leadership are yet another example of the value of ARRL's work with standards in general.

Although all industry standards are of importance to amateur radio, C63® may be one of the most important. C63® develops American standards that are often incorporated by reference into the rules by the FCC. At this time, this includes the standards in the table below. Other C63® standards, such as the one on WPT device measurement, are under consideration by the FCC.

Standard	Brief description
C63.4	Measurement methods
C63.10	Measurements of intentional unlicensed emitters
C63.26	Measurement of licensed transmitters
C63.19	Hearing aid compatibility with transmitting devices

The C63.10 standard on unlicensed emitters is of particular import because its section on distance extrapolation measurement methods is scientifically accurate. This was a major contention between ARRL and the FCC during the BPL proceeding. What was not won in that proceeding was ultimately won in the standards arena, as industry and regulators alike recognized the importance of scientifically accurate test methods. Achieving this in the C63.10 standard was a major step forward that is being adopted and refined into other standards. The task group that wrote this section of the standard was chaired by Mr. Hare.

² <https://incompliancemag.com/article/the-ansi-asc-c63-committee-on-electromagnetic-compatibility/>

ARRL Participation in C63®

ARRL's participating in C63® became especially important when Public Law PL-97.259 was adopted in 1982. This law gave the FCC the authority, but not the mandate, to regulate the immunity of consumer devices to strong RF signals. The FCC chose to implement that law by allowing the industry to create and adopt industry standards to regulate the immunity of devices. C63® undertook this work, forming a subcommittee on immunity that monitored progress in the industry to that end. ARRL became an active voting member of both C63 and the subcommittee on immunity, represented by then Atlantic Division Director Hugh Turnbull, W3ABC (SK).

ARRL has been a voting member of C63® ever since, with strong participation in the Main Committee activities, and participation in most subcommittees and a number of its working groups. As is often the case, as ARRL brings information and the value of amateur radio to industry standards groups, not only is the importance of amateur radio elevated in the perception of industry and regulators, ARRL staff are elevated to positions of leadership within these committees. ARRL is current represented by Mr. Hare as the primary representative and Mr. Carlson as the alternate. Mr. Hare is the Chairman of Subcommittee 5, Immunity and a voting member of the C63® Steering Committee (its ExCom).

SUMMARY OF RECENT AND ONGOING ARRL LAB EMC ACTIVITIES:

Power-Line Noise:

Power line noise remains a significant problem facing hams today. Cases can drag on for years without meaningful FCC enforcement, often leading to frustration on the part of the ham. Much of the time ARRL spends on a case involves helping the amateur understand the issues and how-to best work with his or her local power company and, most important, how the Amateur can correctly identify noise as being caused by electric- utility equipment and how to correctly identify the source. Although in theory, if power-company equipment causes interference, it is the responsibility of the power company to fix it, they can generally do so much faster if the complainant is able to identify the pole from which the noise is coming. The ARRL EMC desk has noticed a trend for amateurs to locate several possible RFI sources (poles) and report them all to the utility, who will then address them only to find this has not resolved the amateurs line noise problem. The cost involved makes them hesitant to work further with that amateur. This an issue that HQ staff has been trying to resolve through education when speaking with the amateur, emphasizing the importance of signature analysis. Signature analysis is the correct manner to determine which noise source is the cause of the harmful interference experienced by that amateur's station.

P1897 Recommended Practice for handling Sparking Gap Noise complaints:

This IEEE Working Group continues developing an IEEE standard on the best practices for electric utilities to use to resolve power-line radio and television noise complaints. The group, chaired by Mr. Gruber, formerly an ARRL staffer, now an ARRL consultant, has been working

cooperatively for over four years on this document. The standard is now in final edit, being prepared for an IEEE ballot.

The EMC Committee recognizes the staff and volunteer efforts of Mr. Gruber, the Chair of the WG. It also appreciates the work done on this standard by Mr. Ramie, the WG Secretary. He is primarily responsible for the successful creation of this important industry standard. The standard is expected to be in ballot early in 2021 and should be published by the end of the year.

Mr. Cramer is the Vice Chair of the P1897 Working Group Additional EMC Committee members in the Group also include Mr. Carlson; Mr. Ramie, who serves as its secretary; Mr. Hare; Mr. Gordon Beattie; Mr. Hranac and Mr. Hollingsworth. The electric-utility industry is also heavily represented in this working group, helping to ensure acceptance and adoption of the standard when adopted. An important goal in developing this standard is to achieve the consensus with the utility industry, to ensure adoption and use of the standard.

Photo-Voltaic (PV) Systems (Solar Panels)

The California mandate:

It is extremely important to note that California has a mandate for new homes to include solar power PV as a power source. The California solar mandate is a relatively new building code that requires new construction homes to have a solar photovoltaic (PV) system as an electricity source. This code, which went into effect on January 1, 2020, applies to both single-family homes and multi-family homes that are up to three stories high. This appears to be only the beginning of a trend, that has the potential to become a problem nationwide.

Complaints involving residential solar PV systems continue to be on the rise and are, in fact, the dominant RFI issue ARRL staff has dealt with in recent months. ARRL has received multiple complaints involving several new manufacturers of solar equipment. SolarEdge, Generac, LG, Enphase, and Delta have been identified as major RFI contributors. Although all these manufacturers have Part15B certification, the problem of RFI continues. FCC Part 15B addresses conducted emission's concerning the AC line but does nothing to address the emissions from the DC side wiring to the PV panels and optimizers. There are two sources of RFI that have been identified ARRL concerning PV panel installations. The line inverter that converts the DC output of the PV panels, typically 400 Volts to synchronous 220-volts AC, and the optimizers which are essentially a DC to DC converter that extracts maximum power from the PV panel while providing NEC rapid shutdown capabilities. Even with the PV system is shut down, the optimizers still generate RFI whenever sunlight is impinging on the PV panels. The severity of RFI is case dependent.

The ARRL is working with several of the manufacturers to resolve these issues. SolarEdge, LG, Delta, Enphase and Generac have been responsive in discussions on methods of RFI mitigation. SolarEdge has retrofitted in excess of 250 systems to the satisfaction of the amateurs

afflicted. The resolution consists of replacing the AC inverter, the optimizers, rewiring the panels using twisted-pair wiring and adding ferrite common-mode chokes.

There is at least one case that appears to be difficult to resolve, though, with some residual noise present even after the retrofit has been completed. Resolving these RFI cases becomes challenging when several homes in a given area have implemented solar power near an Amateur operator. In many areas, homes are closely-spaced and Amateur antennas may be only 15 to 30 feet away from a neighbor's solar array. These retrofits are very time-consuming and expensive. ARRL has reports from Solar Edge that indicate that as many as 9 systems needed to be retrofitted in the vicinity of a single Amateur operator in order to mitigate harmful interference.

Here again COVID has hampered efforts to retrofit systems, this was due to limited parts availability and travel restrictions. These delays are obviously not a welcome news for the affected parties.

Grow Lights:

Grow lights cases continue to increase as a source of RFI being second only to solar power. Many states have adopted various degrees of marijuana legality for both medicinal and adult recreational use. The typical grow light installations vary, but most grow lights operate between the 600-watt and 1000-watt level. The largest home grow light system Mr. Cianciolo has dealt with is comprised of six 1000-watt ballasts. Most grow light ballasts are imported and have no EMC filtering between the device and the AC mains. RFI varies on a case-by-case basis but S-9 noise levels within a one-mile radius have been noted in extreme situations.

In addition to RFI issues, once a source has been identified, the neighbor interaction can be difficult due to the stigma attached to this issue. It is not uncommon to hear stories of guard dogs and firearms when speaking with amateurs who have confronted neighbors on the issue of grow light RFI.

Other Lighting Devices:

Interference from other lighting devices continues to be a problem. Most of the problems are caused by switching mode power supplies in low-voltage lighting products. Some states mandate efficient lighting in new construction, leading to wholesale installation of LED bulbs. Another issue has been dimmers for LED bulbs. The solid-state drivers/ballasts are the chief causes. Commercial establishments wishing to lower energy costs are moving toward utility-subsidized LED lighting fixtures. Some of which are causing RFI. These are being handled by ARRL staff, but the EMC Committee is continuing to monitor this as a potential threat to Amateur Radio. As reports of specific noisy devices are received, the ARRL Lab will purchase samples on the open market and test them to ensure that devices being marketed meet the FCC emissions limits for lighting devices.

An additional problem involves the sale and marketing of non-consumer rated ballasts to consumers in hardware and big box stores. These ballasts are still being sold to unsuspecting consumers and have been the subject of interference complaints to the ARRL Lab.

HVAC Equipment:

ARRL has received complaints involving several different types of HVAC equipment. One of these companies is Mitsubishi, the manufacturer of the HVAC system used at ARRL HQ. Resolution of these problems is still in progress. The ARRL Lab has devised filtering that can be added to the wiring of the system in operation at ARRL. This will be completed in the summer of 2022.

Other Appliances:

Residential devices are experiencing RFI from amateur radio operators as well. One such case involved a Samsung gas oven/stove which would mysteriously turn on the oven in the middle of the night. The cause was found to be a local amateur operator working 20 meters CW getting into the microprocessor control circuitry. Samsung replaced the oven with another unit and returned the problem unit to the factory for study.

Update on Samsung gas range. Since the January 2020 EMC report, 5 more cases have been reported. RF immunity in these appliances appear to be severely lacking. Reported faults with these appliances range from erratic displays to stove turning on without input by the owner. Contact has been made with the Samsung engineering staff and several emails have been passed. Samsung did finally respond to ARRL's emails and phone calls but would not work with the ARRL. Samsung company policy dictates that communications will only be conducted with the customer. So far only one of the five afflicted amateurs has been contacted.

Wireless Power Transfer Systems:

Wireless Power Transfer (WPT) systems. WPT is used in two ways. The first is already widely deployed, through low-powered wireless chargers used to charge cell phone and similar devices. While there haven't been any reported cases of interference from low-powered WPT chargers so far, this emerging technology in the use of WPT for high-powered chargers for electric vehicles (WPT-EV) could have the potential to cause significant interference problems. This may be particularly true in cases involving high power, such as in a system used to charge an electric vehicle. We continue to monitor WPT development using industry contacts.

The most recent challenge to Amateur Radio spectrum is from potential interference from WPT-EV (Wireless Power Transmission – Electric Vehicles) systems. Appendix #1 shows the block diagram of one such system under development. This rapidly developing threat has been understood to be a large potential issue that must be addressed at national and international levels. ARRL staff is working the IARU on an ongoing basis. In 2020 and again in early 2021, Mr. Hare worked with Don Beattie, G3BJ and other IARU representatives, and ARRL's Jon

Siverling, WB3ERA, to refute findings that WiTricity, a WPT-EV manufacturer, has been presenting into various international standards and regulatory proceedings (ITU, CISPR, CENELEC, etc.)

The largest concern is that of harmonics and noise related to a high-power system where those emissions fall onto Amateur Radio spectrum. There is no doubt that there will be harmonics and noise arising from the use of such devices. In earlier testing, Mr. Hare and Mr. Don Beattie measured a WPT-EV system and found that it did meet FCC limits, but were at a level significantly above the median values of man-made noise described in the ITU-R Recommendation P.372-14. It was the conclusion of both representatives that this high level would cause significant harmful interference to amateur radio. The test site at this commercial EMC facility was located in a light industrial and commercial area. It had a noise level significantly higher than the median levels in P.372-14.

Since the coupling between the charging power source primary coil and the vehicle's receiving secondary coil will form an imperfect coupling system, the radiative leakage from this type of system has the potential to create harmful interference to nearby receivers. A misalignment between the two coils could also provide for the potential of power coupling to material other than the target of intended coil on the vehicle. The amount of stray field is particularly important since the estimated power transfer for a typical residential WPT charger system is expected to be in range of 10-15 kW.

The report that resulted from these measurements was ultimately compiled by the WPTEV manufacturer into a report that is has been using in various international regulatory and standardization efforts.

RFI Database:

The ARRL HQ staff maintains a database of RFI reports and cases. This is used primarily as a case-management tool for the several hundred RFI cases ARRL handles every year, but the information the Lab staff are gathering about types of interference cases, involved equipment and frequencies will provide a wide range of reporting capability. In addition, over 150 phone calls were taken from members concerning RFI issues, that do not rise to the level of cases to be added to the data base. Table 1 contains statistics from the database for entire year 2021 compared to the previous seven years, sorted to show the most predominant cases in calendar year 2021.

Table 1 – RFI Database Statistics – New Cases Each Year

Case Type	Calendar Year							
	2014	2015	2016	2017	2018	2019	2020	2021
Unknown Unintentional Radiators	81	49	70	73	56	47	60	49
Power Line Noise	51	43	47	44	47	28	32	33
PV Systems	1	3	10	24	10	12	24	23
Confirmed & Suspect Grow Lights	16	6	12	11	10	6	9	11
Broadcast Transmitters	2	5	1	3	3	1	2	7
Computing Devices and Modems	6	8	3	12	5	0	4	3
Lighting Devices	15	7	19	6	8	6	4	2
Water Pump Systems	2	0	0	1	1	3	6	2
HVAC Systems	6	5	12	6	3	4	1	1
Other	16	15	30	16	12	10	10	1
Cable TV	4	4	2	2	3	2	4	1
Satellite TV	3	1	0	2	0	1	1	0
Plasma TV Receivers	5	1	3	1	1	1	1	0
Other Broadcast Receivers	4	0	1	1	1	0	0	0
Other Receivers	4	1	6	5	0	0	1	0
Other Transmitters	4	3	3	2	13	5	5	0
Fence Systems	3	0	2	0	2	0	1	0
Battery Chargers / Power Supplies	5	7	9	6	1	3	4	0
Alarm Systems including detectors	4	2	3	4	2	0	1	0
Other Appliances	4	3	10	7	5	3	3	0
GFCI / AFCI	25	6	5	6	6	7	10	0
Automobile Systems	1	1	3	5	1	1	1	0
Manufacturing Generated Noise	2	0	0	0	0	1	1	0
AT&T U-Verse Systems	4	6	1	2	0	0	1	0
Doorbell Transformers	3	0	2	2	1	1	1	0

ARRL RFI Forums:

The two RFI forums remain ongoing in the ARRL forums pages. These forums provide self-help and discussion for members. They are monitored and moderated by HQ Lab staff and other volunteers. The pages are:

- RFI - Questions and Answers: RFI questions and are answered by other members and RFI experts. Members can post questions and read answers about solutions to an RFI problem they are having. The link is: www.arrl.org/forum/categories/view/20
- RFI - General Discussion: his forum is a place to discuss technical issues associated with RFI and Amateur Radio. The link is: www.arrl.org/forum/categories/view/21

Messrs. Hare and Anderson are also regular participants in the RFI email list hosted by contesting.com.

FCC ENFORCEMENT CONCERNS:

While a lack of meaningful enforcement in cases involving operators of interfering Part 15 devices has been the norm for a considerable period of time, the issues described in the previous EMC Committee reports remain ongoing. A brief summary includes but not limited to:

- Grow lights and other devices being marketed and sold that exceed the FCC limits, in some cases by a considerable margin.
- Illegal marketing of Part 18 non-consumer lighting devices. Non-consumer devices are being marketed to consumers for residential environments. These devices are only intended for commercial and industrial environments.
- Field investigations are almost non-existent with abnormally long waiting times. FCC is generally under a COVID-mandated policy of not having its staff interact in person with the public, so very few field investigations will be taking place in the immediate future.
- Field investigations being conducted in such a way that the outcome will not be favorable to the Amateur. Examples include cases in which the investigation took place at times when the source was known to be off, checking for noise at random (unaffected) frequencies, etc.
- There is a growing proliferation of imported handheld VHF transceivers that are presenting problems for amateur radio. Some of these devices are not FCC certificated. Others are sold “wide open,” to all comers, operating on the full VHF and/or UHF range. A separate internal report of the findings of the ARRL Lab and recommendations is appended.

It must be emphasized that any FCC enforcement effort in any of these matters will have the maximum impact if it takes place in a timely fashion. Some cases have been ongoing for a considerable period with no known formal FCC action. Even if there was to be an FCC action at this point, it would not be timely enough to achieve maximum impact as a future deterrent.

With the proliferation of new types of electronic devices and technology, some of which have the potential to cause a considerable interference problem, some meaningful FCC enforcement is badly needed. A lack of enforcement in RFI matters would no doubt be disastrous for both hams and other services as well. If the FCC does nothing about something as egregious as grow lights, or proper follow-up to a Citation & Order, or illegal marketing of industrial devices, it would fundamentally call into question the FCC’s credibility as an enforcement body. It would also seem unlikely that meaningful enforcement could be expected in other interference matters as well.

Status of the Cable Television Industry:

Mr. Hranac reports that the cable industry continues to do a good job adhering to the FCC’s regulations about signal leakage and interference. During 2021, ARRL received only one

report of a cable-related interference problem that was resolved with assistance from Mr. Hranac. Since only one report of interference has been received by the ARRL Laboratory during this latest period that would seem to indicate that most cable systems are either clean or are addressing complaints effectively.

Smart Grid EMC Standardization Participation and Monitoring:

The EMC Committee is also closely monitoring the development and proliferation of the Smart Grid. Mr. Ramie is involved in developing and promoting EMC Standards for the Smart Grid as the liaison between the IEEE-EMC Society and the Power & Energy Society of the IEEE. In that role, Mr. Ramie reports to Mr. Hare, the VP of Standards for the EMC Society. Here's a summary of recent activity:

P1613 - EMC Immunity testing of Communicating Devices - This is becoming the controlling EMC immunity document for any smart grid device in a substation blockhouse or out on a pole that has a communications port, including an antenna. Almost all smart grid controllers will communicate, so the COM port was used as a hook to attach immunity requirements to these products. (It calls out the three C37.90.x Standards below, all of which are under revision) The standard is being finished by the working group and being forwarded to the IEEE sponsoring committee to approve it to be sent to ballot.

PC37.90.1 - SWC & EFT Testing of Protective Devices (controllers for protective relays) – The Surge Withstand Capability (tolerance of switching transients) in this document is already harmonized with Europe under IEC 61850-3 and IEC 60255-26 draft. The Electrical Fast Transients (EFT) section will have the 100kHz rep rate added to address this frequency region that is filled with switch-mode power supply noise. Mr. Ramie reports that he is not expecting problems with moving this document forward. He expects to have a draft in 2 years or less.

PC37.90.2 - Radiated RF Immunity testing of Protective Devices: Changes made to this document, in response to Mr. Ramie's presentation to this working group, used Mr. Hare's ARRL modeling software to develop four Use Cases to justify the highest test level in the industry, at 35V/m peak (20V/m before modulation is applied). Mr. Ramie donated custom photography to make this section more compelling. This is a realistic level that was widely supported and not any higher than the previous version of this document. This document is very near completion and should go to MEC editing and formal balloting later this year.

PC37.90.3 - Electrostatic Discharge (ESD) testing of Protective Devices – This document is undergoing significant revision in response to Mr. Ramie's input. Controversy over the suggested edits seems to have died down and the working group is in the process of implementing Mr. Ramie's suggested text changes into the first working draft, which should be ready before the end of 2022.

It is expected to take 2-3 years to complete this work. Mr. Ramie reports that cooperation is much improved now that TVA supports our efforts.

INDUSTRY CONTACT AND COMMITTEES:

ARRL continues to be represented on professional EMC committees. Messrs. Hare and Carlson continue to represent the interests of Amateur Radio on the ANSI ASC C63® EMC committee. The C63® committee is working on developing industry standards for immunity, emissions and testing of electronic devices. ARRL serves as a resource to the committee to protect the interests of Amateur Radio.

Mr. Hare is the Primary ARRL C63® representative; Mr. Carlson is the Alternate. Mr. Hare serves as the Chair of Subcommittee 5, Immunity. Mr. Hare also serves on Working Groups developing standards for the measurement of LF and HF wireless power-transfer devices, lighting devices and a Working Group writing recommended procedures to test various forms of Industrial, Scientific and Medical devices.

Mr. Ramie serves as the C63® Secretary and as a member of Subcommittee 5. Subcommittee 1 continues to work on a variety of EMC projects, primarily related to test site standardization. Subcommittee 5 deals with immunity and immunity measurement issues.

Subcommittee 8 deals with various types of medical equipment. The multiple ARRL EMC Committee representation on C63 watches immunity and testing developments.

Mr. Hare also serves on the IEEE EMC Society Standards Development and Education Committee (SDECom). SDECom serves as the EMC Society standards board, overseeing the development of all IEEE EMC Standards. He is in his final term as the IEEE EMC Society Vice President for Standards. As the Vice President for Standards, he will be using an IEEE WebEx account to host the virtual meetings of about a dozen of the Working Groups at IEEE virtual symposium that will be held in August.

Related to committee work, Mr. Hare also maintains informal contact with a number of industry groups, including HomePlug, Society of Cable Telecommunications Engineers, Society of Automotive Engineers and the Electric Power Research Institute, as a few examples.

HF NOISE FLOOR MEASUREMENT

During the World Radio Conference in the fall of 2019, there were several comments made by participants from other delegations that opined that the noise floor in rural areas was the same as that found in suburban and urban areas. This has immediate implications should this inference be accepted as fact, absent any quantitative measurements since it has the possibility of allowing regulators to provide lower level of protection to sources from EMI sources in low-noise areas. Should the level of protection afforded to spectrum users be established at the level of the higher urban noise level environment, it would be at the detriment to the noise floor in suburban and rural areas. With the future now presenting the possibility of many high-power potential noise

sources being introduced into common usage, there is a very real need to protect users of the amateur spectrum from a detrimental increase in “background noise”.

Sources of the man-made portion of the radio background noise have been made as far back as the 1920’s when there was noted to be a significantly higher background in urban and suburban areas attendant with the-then new modern use of electrical devices. There have been few measurements in the modern era since the mid-1970’s. While most amateur stations have experienced some increase in the noise background experienced during normal operation, the evidence is extremely anecdotal. There is a serious need to replicate as best as possible the methodology used in the mid-70’s to benchmark the noise background with qualified and calibrated receivers and antennas in an effort to determine the amount of increase over the past 50 years. Further, the methodology of any noise measurement effort should be established for an on-going long-term gathering and analysis of collected data.

For the past two years a sub-group of EMC Committee has been studying the various methods and technical issues that arise when making qualified noise measurements with calibrated antennas. The immediate goal has been to measure the noise floor of one remote site with defensible and technically correct methods of analysis, and to use the results of that analysis to refute the assertion that noise in rural areas is at the same level as urban locations. It is the hope to be able to eventually establish a network of noise measurement sites to measure long-term changes to the radio noise floor.

DARC has been undertaking a measurement campaign called the Electrical Noise Area Monitoring System (ENAMS). ARRL has ordered two ENAMS receivers and antennas, but supply-chain problems have delayed the delivery of the receivers. The calibrated antennas are in shipping and tracked to NY customs as of the time this report was drafted. These calibrated antennas can be used with existing ARRL Lab test equipment to make accurate measurements of radiated HF noise.

Mr. Hare has also outfitted his personal mobile van with a loop antenna located on a trailer, a spectrum analyzer, computer and test receiver to make measurements of noise in the field. Initial tests indicate that this set-up can be used to measure noise in the field, at specific locations and in motion.

THE FUTURE OF EMC AND AMATEUR RADIO:

Interference to hams appears to be the present major work of the committee. Although immunity problems still do occur, this is being addressed at the national and international standards level. RFI from unlicensed devices poses a major real threat to Amateur Radio at this time. This will continue to require significant Committee and ARRL staff attention. To the extent possible with existing staff, or with additional resources, the ARRL should increase its contact with standards organization, industry groups and individual companies, and continue to work on all aspects of RFI problems and solutions. ARRL's information about RFI can be read at: www.arrl.org/radio-frequency-interference-rfi.

As a note of personal thanks, I would like to recognize Mr. Hare, W1RFI; Mr. Ramie, KI6LGY; Mr. Cianciolo, W1VLF; Mr. Gruber, W1MG and Mr. Anderson, W1EMI, for their contribution of material for this report. I would also like to thank the EMC Committee members for their ongoing service to the ARRL and the Amateur Radio community.

Respectfully Submitted,

**Kermit A Carlson W9XA
ARRL EMC Committee Chairman**