

ARRL EMC Committee Semi-Annual Report

Doc. # 16

**For The
American Radio
Relay League**

**Board of Directors Meeting
July 19th and 20th**

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

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, ARRL Central Division Director, EMC Committee Chairman
- Mr. Phil Barsky, K3EW, Engineering/Management Consultant, retired
- Mr. Gordon Beattie, W2TTT, Principal Technical Architect, AT&T Enterprise IT Service Assurance
- Mr. Jody Boucher, WA1ZBL, RFI troubleshooter, Eversource, retired
- Mr. Brian Cramer, PE, W9RFI, Electrical Interference Solutions, Inc.
- Mr. Paul A. Cianciolo W1VLF, ARRL Lab RFI Engineer, HQ Staff Liaison
- Mr. Ed Hare, W1RFI, ARRL Laboratory Manager
- Mr. Ron Hranac, N0IVN, Technical Leader, Cisco Systems; past member of the Board of Directors, Society of Cable Telecommunications Engineers
- Mr. Jerry Ramie, KI6LGY, ARC Technical Resources, Inc.
- Mr. James Roop, K9SE, past FCC District Director
- Dr. Steve Strauss, NY3B, Home Phone Networking Alliance Technical Committee
- Dr. Richard E. Dubroff, W9XW, Professor Emeritus at Missouri University of Science & Technology
- Mr. Bob Allison, WB1GCM, Assistant ARRL Laboratory Manager
- Mr. Ed B. Hudgens, WB4RHQ, ARRL Delta Division Vice Director
- Mr. Carl Luetzelschwab, K9LA, ARRL Central Division Vice Director
- Mr. Riley Hollingsworth, K4ZDH, ARRL Atlantic Division Vice Director

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 ANSI accredited C63[®], Society of Automotive Engineers EMC and EMR committees, Home Phone Networking Alliance, VDSL, HomePlug, FCC and individual companies.

Paul Cianciolo W1VLF has taking over the responsibilities of ARRL Lab's EMC engineer. Paul handles the majority of the staff work on EMC matters. In the 2nd half of 2019, he will continue working in the following key areas:

Summary of Recent and Ongoing Lab Activities

- 1) 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. On November 21, 2018, the FCC issued a press release that indicated that it had reached 21 settlement agreements with LED-device manufacturers, netting total forfeitures of \$850,000. Although settled primarily on the basis of labeling violations, in the agreements, all of the companies indicated that they will comply with all FCC rules that apply to the devices that they manufacture.
- 2) Residential and commercial LED Lighting continues to be a growing issue. Some states are mandating efficient lighting on new construction which means LED lighting. The solid-state drivers/ballast are the chief causes of interference. 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.
- 3) Variable speed pulsed DC motors now appearing in such things as washing machines, dryers, dishwashers, HVAC systems and pool pumps. Furnaces and air conditioners seem to be particularly problematic and difficult to resolve. The mentioned appliances, depending on the case can be either the source or victim of the interference. Many such devices are hard wired to the AC line making it difficult to affix common mode chokes or other filter remedies.

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. Paul Cianciolo has established a contact within Mitsubishi technical resources. Alex Stephens, one of the Mitsubishi engineers, is bringing the issue of ECM RFI up at the Mitsubishi HVAC technical staff meetings for review. No engineering takes place in the USA, so the issues will be forwarded to the engineering in Japan. Specific model numbers of Mitsubishi equipment generating RFI have been given to Mr. Stephens. This is a new contact into Mitsubishi, as of January 7, 2019 so the resolution of these problems is still in progress. ARRL is pleased that Mitsubishi is looking into the problems, but as of this date no remedy has been implemented.

- 4) Complaints involving solar PV systems continue to be on the rise, and are in fact in dominant RFI issue we have dealt with in recent months. Many cases have been forwarded to Solar Edge, the major manufacturer of the RFI generating equipment, and have been retrofitted to the amateur radio operators satisfaction. SolarEdge US technical staff have been quite cordial and accommodating during

phone conversations. Field engineers report that over 100 systems have been retrofitted with improved wiring techniques as well as ferrite core common mode chokes.

Resolving this RFI source becomes challenging where several home in a given area have implemented solar power in close proximity to the amateur radio operator. In many cases homes are very closely spaced, and the antennas are located only 15 to 30 away from a neighbor's solar array.

- 5) 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. However more time is being spent to educate amateurs with a PLN problem, on how to locate the interference sources more precisely. This has led in many cases, to the resolution, of the interference by the power company. Power companies are far more likely to respond to complaints if they know the precise location of the noise.
- 6) Working with AT&T engineering staff to help resolve RFI issues with U-Verse and other broad band systems.
- 7) Reviewing proposed EMC related material for ARRL publications.

Working Group for Recommended Practice of Locating Power Line Noise

The IEEE has created a standards working group (WG) to develop an IEEE Recommended Practice that describes to power companies what procedures they can use to respond to customer complaints about electrical noise. Although he has retired from ARRL, Mike Gruber will continue to Chair this Working Group. p a Recommended Practice for Location of Power Line Gap Noise. See **Committees** section for additional details. EMC Committee member Jerry Ramie, also serves as the Working Group's secretary.

Grow Lights

Grow light continue to be an issue. At the present time, Paul Cianciolo refers a suspected grow light case to Laura Smith for follow-up. Ms. Smith then sends a suspect grower a letter without mentioning the ham or Amateur Radio. In cases where the FCC letter is ignored, however, specific FCC enforcement action has not been occurring. Grow light activity continues to rise as more states legalize the growing of marijuana.

Other Lighting Devices

Paul Cianciolo reports that interference from lighting devices seems to be on the rise. Much of the problem to be 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.

It should also be noted that LED bulbs can be legally marketed and sold if their emissions are close to the FCC limits. The emissions in this case could be high enough to create interference issues even from nearby residences in a typical suburban neighborhood. If and when such interference occurs, the burden then falls on the device *operator* to correct problem. While this rule may work on a case-by-case basis involving a small or limited number of sources, it is not practical should many bulbs in several houses be contributing to a wide spread problem. This issue has been demonstrated in an actual case in California.

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. LED panel displays, and signs have been a minor issue to date. RFI from these devices typically appear in the VHF range, and some weak signal operators have been affected.

Status on FCC Enforcement and Outstanding EMC Cases

Paul Cianciolo reports that the FCC continues sending letters to utilities (and consumers) with some regularity. Specific enforcement beyond that, however, continues to be lacking. To the best of his knowledge, no previously reported longstanding power line noise case has been resolved during the 1st half of 2019 due to enforcement. While some cases have been closed, many cases can drag on indefinitely. .

So far, most cases involving Amateur radio have been argued on the basis of harmful interference as opposed to exceeding the FCC emissions limits. The FCC rules place the burden to correct harmful interference on the *operator* of the offending device – not the distributor or manufacturer. Device operators in a typical RFI case include a power company or neighbor.

It appears that FCC field agents do not always have the proper training or equipment to correctly identify and locate power line and other noise sources. Their equipment seems better suited for locating such things as transmitters. Even if the source is known, or if the source is a consumer device in a nearby home, we've yet to see one in which the FCC Finally, from what we've seen so far, the FCC Field Office reduction continues to have a significant and negative impact on FCC field resources. Despite the Commission's

enthusiastic claims for a centralized “Tiger Team” approach, it has only made matters worse. To the best of Paul Cianciolo’s knowledge, it has yet to be even one Amateur case investigated by a Tiger Team. It also appears that FCC enforcement issues have become problematic for other radio services as well.

FCC Enforcement Concerns

While a lack of meaningful enforcement in cases involving device operators 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:

1. Grow lights and other devices being marketed and sold that exceed the FCC limits, in some cases by a considerable margin.
2. 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.
3. Field investigations are almost non-existent with abnormally long waiting times.
4. 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.

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 it 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.

First Half 2019 Year Total RFI - Case Statistics:

New RFI Cases – 73

New electrical power-line cases – 22

- ARRL Letters sent – 4
- FCC 1st Letters submitted – 3 (Note: Laura Smith may have issued FCC letters based on need and input from the ARRL. These letters were not formally submitted by ARRL and therefore not included in this total. Many of these letters could possibly be follow-up in nature and therefore require custom legal language. The effectiveness of these letters has yet to be determined.)
- FCC 2nd Letters submitted – 2

RFI-Case 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.

Here are some statistics from the database for the first half of 2019 and compared to the previous six years:

Category of Case Reported to ARRL Lab/EMC Engineer	2013	2014	2015	2016	2017	2018	2019
BPL	0	0	0	0	0	0	0
Unknown Unintentional Radiators	68	81	49	70	73	56	23
CABLE TV	4	4	4	2	2	3	2
Satellite TV	2	3	1	0	2	0	1
Computing Devices and Modems	5	6	8	3	12	5	0
Power Line Noise	52	51	43	47	44	47	10
Plasma TV Receivers	3	5	1	3	1	1	1
Other Broadcast Receivers	4	4	0	1	1	1	0
Other Receivers	1	4	1	6	5	0	0
Other Transmitters	2	4	3	3	2	13	0
Broadcast Transmitters	6	2	5	1	3	3	1
Lighting Devices	10	15	7	19	6	8	4
Confirmed & Suspect Grow Lights ¹	2	16	6	12	11	10	3
Fence Systems	3	3	0	2	0	2	0
Battery Chargers / Power Supplies	4	5	7	9	6	1	2
Wheelchair	0	0	0	0	0	0	0
Water Pump Systems	2	2	0	0	1	1	1
HVAC Systems	10	6	5	12	6	3	2
Alarm Systems including detectors	2	4	2	3	4	2	0
Other Appliances	7	4	3	10	7	5	3
GFIC / AFCI	7	25	6	5	6	6	5
AUTOMOBILE Systems	7	1	1	3	5	1	1
Manufacturing and Retail					0		
Generated Noise	1	2	0	0		0	0

¹ It can be difficult to confirm a Grow Light. As a result, a number of other grow lights may appear as Unknown Sources. Based on their signatures, a number of Unknown Sources are most likely Grow Lights but remain unconfirmed.

AT&T U-Verse Systems	3	4	6	1	2	0	0
PV Systems	2	1	3	10	24	10	0
Doorbell Transformers	2	3	0	2	2	1	1
Other	16	16	15	30	16	12	6

The WPT-EV Wireless Power Transmission – Electric Vehicle:

The most recent challenge to Amateur Radio spectrum is from potential interference from WPT-EV (Wireless Power Transmission – Electric Vehicles). This rapidly developing threat had been understood to be a large potential issue for the 2019 World Radiocommunications Conference (“WRC-19”). Planning within the IARU Committees had started work on gathering background information about WPT-EV and the potential for harmful interference to the Amateur Radio Service starting approximately at the beginning of 2018. The IARU is extremely concerned that the international movement for world standards for WPT-EV at the WRC will not provide sufficient protection to the amateur radio allocations, this is a viewpoint shared with the EMC Committee.

On September 2, 2018 the FCC released a Notice, Report Number 3103 with a call for comments to a Petition for Rulemaking that had been filed jointly by BMW of North America LLC, Ford Motor Company, Nissan North America Inc. and Toyota Motor North America Inc. The ARRL has filed Comments with the FCC about the proposed field strength limits that would allow high-power wireless charging technologies for electric vehicles that would operate in the 79-90 kHz band.

What remains quite disconcerting is that the major vehicle manufacturers have begun to lay the regulatory ground-work for WPT-EV prior to WRC-19, and it is being done prior to the publication of the results of any field strength measurements. A very good pdf online describing the details of certain WPT-EV systems under development by Momentum Dynamics Corporation are available for viewing <https://www.pdma.com/sites/default/files/uploads/tech-forums-transportation-power-electronics/presentations/is112-wireless-power-transfer-developers-guide.pdf> .

While the subject band of frequencies (79-90 kHz) is not directly used by the Amateur Radio Service, the potential for harmful interference remains significant. The ARRL Laboratory and the ARRL EMC Committee has not been able to gain access to any prototype or experimental WPT-EV system for actual field strength measurements, although the Laboratory continues to try to obtain access to an operational system.

The limit stated in the NPRM for WPT-EV emissions in the band 79-90 kHz is stated as 74.4 dBuA (dB microAmp) per meter at a distance of 10 meters. An equivalent term for this level of field strength (disregarding the near-field effects) for such a system could be

stated as an equivalent 2 Volt per meter. The recent filings with the Commission for WPT systems indicate that they are being classified as intentional emitters, under current regulation the harmonic power must be below -40dB from the fundamental which translates into the equivalent electrical field strength of 20 mV/Meter at a distance of 10 meters. This level would be a potential source of considerable harmful interference to a neighboring amateur radio station. Paul Cianciolo has prepared the table on the next page which indicates the harmonic relationship to Amateur and Broadcast LF/MF allocations that could potentially be affected by WPT operating in the 79-90 kHz band. A full Excel version of Mr. Cianciolo's spreadsheet that covers most of the HF spectrum is available upon request.

WPT Harmonic computations Where do they fall?

KHz	AM Broadcast			160 Meters			80 Meters			60 Meters																																							
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
70	140	210	280	350	420	490	560	630	700	770	840	910	980	1050	1120	1190	1260	1330	1400	1470	1540	1610	1680	1750	1820	1890	1960	2030	2100	2170	2240	2310	2380	2450	2520	2590	2660	2730	2800	2870	2940	3010	3080	3150	3220	3290	3360	3430	3500
71	142	213	284	355	426	497	568	639	710	781	852	923	994	1065	1136	1207	1278	1349	1420	1491	1562	1633	1704	1775	1846	1917	1988	2059	2130	2201	2272	2343	2414	2485	2556	2627	2698	2769	2840	2911	2982	3053	3124	3195	3266	3337	3408	3479	3550
72	144	216	288	360	432	504	576	648	720	792	864	936	1008	1080	1152	1224	1296	1368	1440	1512	1584	1656	1728	1800	1872	1944	2016	2088	2160	2232	2304	2376	2448	2520	2592	2664	2736	2808	2880	2952	3024	3096	3168	3240	3312	3384	3456	3528	3600
73	146	219	292	365	438	511	584	657	730	803	876	949	1022	1095	1168	1241	1314	1387	1460	1533	1606	1679	1752	1825	1898	1971	2044	2117	2190	2263	2336	2409	2482	2555	2628	2701	2774	2847	2920	2993	3066	3139	3212	3285	3358	3431	3504	3577	3650
74	148	222	296	370	444	518	592	666	740	814	888	962	1036	1110	1184	1258	1332	1406	1480	1554	1628	1702	1776	1850	1924	1998	2072	2146	2220	2294	2368	2442	2516	2590	2664	2738	2812	2886	2960	3034	3108	3182	3256	3330	3404	3478	3552	3626	3700
75	150	225	300	375	450	525	600	675	750	825	900	975	1050	1125	1200	1275	1350	1425	1500	1575	1650	1725	1800	1875	1950	2025	2100	2175	2250	2325	2400	2475	2550	2625	2700	2775	2850	2925	3000	3075	3150	3225	3300	3375	3450	3525	3600	3675	3750
76	152	228	304	380	456	532	608	684	760	836	912	988	1064	1140	1216	1292	1368	1444	1520	1596	1672	1748	1824	1900	1976	2052	2128	2204	2280	2356	2432	2508	2584	2660	2736	2812	2888	2964	3040	3116	3192	3268	3344	3420	3496	3572	3648	3724	3800
77	154	231	308	385	462	539	616	693	770	847	924	1001	1078	1155	1232	1309	1386	1463	1540	1617	1694	1771	1848	1925	2002	2079	2156	2233	2310	2387	2464	2541	2618	2695	2772	2849	2926	3003	3080	3157	3234	3311	3388	3465	3542	3619	3696	3773	3850
78	156	234	312	390	468	546	624	702	780	858	936	1014	1092	1170	1248	1326	1404	1482	1560	1638	1716	1794	1872	1950	2028	2106	2184	2262	2340	2418	2496	2574	2652	2730	2808	2886	2964	3042	3120	3198	3276	3354	3432	3510	3588	3666	3744	3822	3900
79	158	237	316	395	473	553	632	711	790	869	948	1027	1106	1185	1264	1343	1422	1501	1580	1659	1738	1817	1896	1975	2054	2133	2212	2291	2370	2449	2528	2607	2686	2765	2844	2923	3002	3081	3160	3239	3318	3397	3476	3555	3634	3713	3792	3871	3950
80	160	240	320	400	480	560	640	720	800	880	960	1040	1120	1200	1280	1360	1440	1520	1600	1680	1760	1840	1920	2000	2080	2160	2240	2320	2400	2480	2560	2640	2720	2800	2880	2960	3040	3120	3200	3280	3360	3440	3520	3600	3680	3760	3840	3920	4000
81	162	243	324	405	486	567	648	729	810	891	972	1053	1134	1215	1296	1377	1458	1539	1620	1701	1782	1863	1944	2025	2106	2187	2268	2349	2430	2511	2592	2673	2754	2835	2916	2997	3078	3159	3240	3321	3402	3483	3564	3645	3726	3807	3888	3969	4050
82	164	246	328	410	492	574	656	738	820	902	984	1066	1148	1230	1312	1394	1476	1558	1640	1722	1804	1886	1968	2050	2132	2214	2296	2378	2460	2542	2624	2706	2788	2870	2952	3034	3116	3198	3280	3362	3444	3526	3608	3690	3772	3854	3936	4018	4100
83	166	249	332	415	498	581	664	747	830	913	996	1079	1162	1245	1328	1411	1494	1577	1660	1743	1826	1909	1992	2075	2158	2241	2324	2407	2490	2573	2656	2739	2822	2905	2988	3071	3154	3237	3320	3403	3486	3569	3652	3735	3818	3901	3984	4067	4150
84	168	252	336	420	504	588	672	756	840	924	1008	1092	1176	1260	1344	1428	1512	1596	1680	1764	1848	1932	2016	2100	2184	2268	2352	2436	2520	2604	2688	2772	2856	2940	3024	3108	3192	3276	3360	3444	3528	3612	3696	3780	3864	3948	4032	4116	4200
85	170	255	340	425	510	595	680	765	850	935	1020	1105	1190	1275	1360	1445	1530	1615	1700	1785	1870	1955	2040	2125	2210	2295	2380	2465	2550	2635	2720	2805	2890	2975	3060	3145	3230	3315	3400	3485	3570	3655	3740	3825	3910	3995	4080	4165	4250
86	172	258	344	430	516	602	688	774	860	946	1032	1118	1204	1290	1376	1462	1548	1634	1720	1806	1892	1978	2064	2150	2236	2322	2408	2494	2580	2666	2752	2838	2924	3010	3096	3182	3268	3354	3440	3526	3612	3698	3784	3870	3956	4042	4128	4214	4300
87	174	261	348	435	522	609	696	783	870	957	1044	1131	1218	1305	1392	1479	1566	1653	1740	1827	1914	2001	2088	2175	2262	2349	2436	2523	2610	2697	2784	2871	2958	3045	3132	3219	3306	3393	3480	3567	3654	3741	3828	3915	4002	4089	4176	4263	4350
88	176	264	352	440	528	616	704	792	880	968	1056	1144	1232	1320	1408	1496	1584	1672	1760	1848	1936	2024	2112	2200	2288	2376	2464	2552	2640	2728	2816	2904	2992	3080	3168	3256	3344	3432	3520	3608	3696	3784	3872	3960	4048	4136	4224	4312	4400
89	178	267	356	445	534	623	712	801	890	979	1068	1157	1246	1335	1424	1513	1602	1691	1780	1869	1958	2047	2136	2225	2314	2403	2492	2581	2670	2759	2848	2937	3026	3115	3204	3293	3382	3471	3560	3649	3738	3827	3916	4005	4094	4183	4272	4361	4450
90	180	270	360	450	540	630	720	810	900	990	1080	1170	1260	1350	1440	1530	1620	1710	1800	1890	1980	2070	2160	2250	2340	2430	2520	2610	2700	2790	2880	2970	3060	3150	3240	3330	3420	3510	3600	3690	3780	3870	3960	4050	4140	4230	4320	4410	4500
91	182	273	364	455	546	637	728	819	910	1001	1092	1183	1274	1365	1456	1547	1638	1729	1820	1911	2002	2093	2184	2275	2366	2457	2548	2639	2730	2821	2912	3003	3094	3185	3276	3367	3458	3549	3640	3731	3822	3913	4004	4095	4186	4277	4368	4459	4550
92	184	276	368	460	552	644	736	828	920	1012	1104	1196	1288	1380	1472	1564	1656	1748	1840	1932	2024	2116	2208	2300	2392	2484	2576	2668	2760	2852	2944	3036	3128	3220	3312	3404	3496	3588	3680	3772	3864	3956	4048	4140	4232	4324	4416	4508	4600
93	186	279	372	465	558	651	744	837	930	1023	1116	1209	1302	1395	1488	1581	1674	1767	1860	1953	2046	2139	2232	2325	2418	2511	2604	2697	2790	2883	2976	3069	3162	3255	3348	3441	3534	3627	3720	3813	3906	3999	4092	4185	4278	4371	4464	4557	4650
94	188	282	376	470	564	658	752	846	940	1034	1128	1222	1316	1410	1504	1598	1692	1786	1880	1974	2068	2162	2256	2350	2444	2538	2632	2726	2820	2914	3008	3102	3196	3290	3384	3478	3572	3666	3760	3854	3948	4042	4136	4230	4324	4418	4512	4606	4700
95	190	285	380	475	570	665	760	855	950	1045	1140	1235	1330	1425	1520	1615	1710	1805	1900	1995	2090	2185	2280	2375	2470	2565	2660	2755	2850	2945	3040	3135	3230	3325	3420	3515	3610	3705	3800	3895	3990	4085	4180	4275	4370	4465	4560	4655	4750
96	192	288	384	480	576	672	768	864	960	1056	1152	1248	1344	1440	1536	1632	1728	1824	1920	2016	2112	2208	2304	2400	2496	2592	2688	2784	2880	2976	3072	3168	3264	3360															

There is no doubt that there will be harmonics and noise associated with the use of such devices but the ARRL Lab has not been able to make field strength measurements. Of great concern is the fact that WPT-EV has a great potential for harm given that coupling between the charging power source primary and the vehicle's receiving secondary will form an imperfect coupling system, and that mis-alignment between the two could provide for the potential for saturated inductors and power coupling to material other than the target of intended coil on the vehicle.

One of the systems that has been described to Mr. Carlson performs an interface between the charging base and vehicle by a separate wireless communications link but that the frequency of the power transmission is swept within the power transfer frequency band to identify the frequency of best power transfer. The potential is strong that each of these systems might continue to sweep the 70 to 90 kHz band along with the attendant harmonic and vestigial switching noise at higher frequencies.

Smart Grid & EMC Standardization Efforts

Mr. Ramie, KI6LGY, updates our efforts in these areas:

1) IEEE-P1613 Standard for Environmental and Testing Requirements for Devices Installed in Transmission and Distribution Facilities

The draft document is very near completion. The IEEE EMC Society joined in a co-sponsor of this standard. Issues with the scope of this standard being made more narrow to exclude equipment that needed to be covered were quickly resolved and Mr. Ramie and the ARRL EMC Committee believe that this standard should offer reasonable immunity to nearby Amateur and other signals.

2) IEEE-C37.90.1 Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

This document covers both Electrical Fast Transient (EFT) and Surge Withstand Capability (SWC) for protective relays. These are products that open output circuits to prevent damage to equipment in the event of faults. (shorted outputs) The EFT section needs updating to the higher repetition rates in the more recent IEC 61000-4-4 and the SWC section need additional ringing frequencies to cover Gas Insulated Substations as in IEC 61000-4-18, which are small with short lines that ring-down at higher frequencies from switching operations. (like the shorter strings of a piano). The EMC Society is also seeking to become a co-sponsor of this standard, so any hanging issues should be resolved as a result.

3) IEEE-C37.90.2 Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers

This radiated RF immunity document has been reviewed and I have submitted text to address its shortcomings. The test setup diagram is incorrect, the frequency range has been increased but the levels are same/similar.

4) IEEE-C37.90.3 IEEE Standard Electrostatic Discharge Tests for Protective Relays

This document needs to harmonize with IEC 61000-4-2, it's self-contradictory and needs to have an informative annex for optional pin testing if the I/O ports are being damaged in use. (USE CASE: a laptop is pushed on a cart and it's I/O cord is plugged into various relay controllers to program them) The use case is supported by the new IEEE-C63.16 Recommended Practice on ESD testing.

5) SEPA-EMI Issues Working Group

The League is continuing to support Mr. Ramie's work with the former Smart Grid Interoperability Panel (SGIP) originally under NIST, now a working group within SEPA. (Smart Electric Power Alliance) The EMI Issues Working Group did the original work defining the missing tests for utility equipment that became IEEE-1613.1(2013). (when compared to IEC 61850-3) That Standard was the vehicle that brought American utilities into harmonization with the Europeans on specifying reliable communications networking equipment that could resist interference by demonstrating "immunity" to simulated interference during required type-testing. (harmonized with IEC 61850-3).

6) IEEE-P1897 Recommended Practice for Powerline Noise Mitigation

Mike Gruber is the Chair of this Working Group that's discussing the best practices for utilities to employ for resolving powerline noise complaints. The Vice Chair, Brian Cramer, W9RFI, of Exelon, is also a member of the EMC Committee. Additional EMC Committee members in the Group also include Mr. Ramie, KI6LGY, who serves as its secretary, Mr. Hare, W1RFI, Mr. Beattie, W2TTT, Mr. Boucher, WA1ZBL, Mr. Hranac, NOIVN, and Mr. Carlson, W9XA. Although not a member of the EMC Committee, it should be noted that Atlantic Division Vice Director Riley Hollingsworth, K4ZDH, is also a Working Group member.

We want consensus with the utility industry and I feel it is attainable. Progress has been slow, as the Working Group insists on reading the document together at each meeting. Relationships are cordial, however. This has been going on for almost three years! I'm assuming we can have text ready to ballot and push out of this Working Group up to our Sponsoring EMC Society Standards Development & Education Committee by the end of 2019.

Mr. Gruber reports that progress continues with p1897, a recommended practice for the resolution of power line gap noise complaints. Although he has now retired as the ARRL EMC Engineer, he is continuing as the Working Group's chairman. Additional EMC Committee members in this group include Messrs. Cramer as Co-chairman, Ramie, Carlson, Hare and Boucher.

This P1897 Working Group is sponsored by the EMC Society. The first formal meeting was held on December 10, 2015 and development on a set of best practices continues with monthly meetings. Mr. Gruber reports that progress has been slower than expected but he hopes that it will be ready for ballot by the end of this year.

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
 - This forum is a place to discuss technical issues associated with RFI and Amateur Radio. The link is:
www.arrl.org/forum/categories/view/21ssion

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 also serves on the EMC Society Board of Directors as the Vice President for Standards.

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.

A list of the planned, recent and ongoing EMC activities at the ARRL Laboratory includes:

- Continue to identify and test devices that operate above the FCC limits, including lighting devices.
- Develop standardized methods of locating RFI sources of harmful interference to Amateur Radio stations. Work with other Industry Groups to develop methods of best practices for location sources such as lighting controls, motor controls and power line noise.
- Test several devices that belong to staff and/or local hams that have caused instances of harmful interference.

Mr. Gruber continues as Chairman of a Working Group to develop a Recommended Practice for Location of Power Line Gap Noise. Additional EMC Committee members in this group include Messrs. Cramer as Co-chairman, Ramie, Carlson, Hare and Boucher. This P1897 Working Group is sponsored by the EMC Society. The first formal meeting was held on December 10, 2015 and development on a set of best practices continues with monthly meetings.

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. Gruber, W1MG and Mr. Paul Cianciolo, W1VLF, for their contribution of material for this report. I would also like to thank all of the EMC Committee members for their ongoing service to the ARRL and the Amateur Radio community.

Respectfully Submitted,

**Kermit A Carlson W9XA
EMC Committee Chairman
Director Central Division**