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2022-05-10 amateur hour

So we've talked about radio spectrum regulation in some detail, including the topic of equipment authorization (EA)--the requirement, under 47 CFR, that almost all electronics receive authorization from the FCC prior to sale. We've also talked about the amateur radio service (ARS, 47 CFR 97), and I've hinted that these two topics collide in an unusual way. So this of course raises the question: does amateur radio equipment require authorization? Or, more fun to type, does EA apply to ARS?

The answer is... it's complicated.

In fact, it's sort of surprisingly difficult to get a straight answer on this question. 47 CFR itself is not very clear on this point, because of course the authors of regulations are a lot more willing to throw in special cases to resolve special circumstances than to provide a convenient general rule. While amateur radio is mentioned in various places in Parts 2 and 15, and equipment authorization is touched on in Part 97, there's no general requirement or exception to be found in 47 CFR.

Further contributing to confusion, there is a lot of "armchair lawyering"[1] in the amateur radio community. You will get different answers from different people on even very basic questions about EA. Part of the reason is that the rules have changed over time, less due to 47 CFR itself than due to enforcement actions and regulatory guidance coming from the FCC Enforcement Burea. Part of the reason is because people are repeating things they heard eighth hand from somewhere in the 1950s. And, well, part of the reason is that amateur radio operators enjoy a rather unusual privilege: generally speaking, there are no EA [2] requirements for amateur radio.

In a way this is intuitive: amateur radio has a substantial tradition of home-built or home-modified equipment. "Vintage" HF equipment are sometimes colloquially referred to as "boat anchors" in reference to both weight and typical market value while sitting on a hamfest vendor's table. But, as a matter of fact, if you manage to construct a boat anchor into an RF transmitter you are welcome to use it in the amateur radio service, subject to the technical requirements of Part 97. A common way to explain this (common enough that the FCC itself says it in a number of places, even though it is not quite a literal part of the regulations) is to say that amateur radio privilege rests entirely with the person holding the license. As a licensed operator, you alone are responsible for the operation of your station... not the device manufacturers. You can make use of anything, subject to good engineering and amateur practice.

But I said it was complicated, didn't I?

The first reason is related to requirements on the sale of *scanning receivers*. As a convenience and because it is fairly easy to implement with modern electronics, almost all amateur transceivers on the market today offer wide-band reception. Any device capable of monitoring two or more frequencies between 30 and 960 MHz and switching to one on which a signal is received is considered a scanning receiver (47 CFR 15.3(v)). As of 1999, all scanning receivers require certification by the FCC (47 CFR 15.101(a)). Certification is used here in its current sense in the regulations, meaning that the FCC must actually review and approve the results of testing. A mere declaration of conformity from the manufacturer is not acceptable.

In other words, the majority of amateur radio transceivers sold today are actually subject to equipment authorization under *Part 15,* Part 97 be damned. If you remember our talking about the verboten band, this might be familiar: the certification requirement for scanning receivers was created specifically to prevent the sale of devices which would be used to eavesdrop on analog mobile calls. This ruling somewhat inadvertently introduced a de facto EA requirement for the amateur radio industry, and it is typical today for amateur radio devices to somewhat incongruously bear a Part 15 Device label.

Amateur radio transceivers can be marketed and sold without certification under Part 15 if, and only if, they do not meet the definition of a scanning receiver... not particularly likely since wideband reception and dual VFO with “dual watch” have become standard features on even the cheapest HTs. A more likely type of device to not fall under this requirement are HF transceivers, which are more likely to omit wideband reception and not have receive capabilities above 30MHz. Still, this is not especially common.

Given that the first complication boils down to reaction to mobile phone eavesdropping, it will perhaps be unsurprising (at least if you’ve read enough of my radio rambling) that the second complication boils down to citizens band.

For primarily cultural reasons that are hard for anyone under 40 to really comprehend, citizens band (CB) enjoyed a brief period of mass popularity, during which it was the primary thorn in the FCC’s side. Like other services which are licensed-by-rule (e.g. FRS and GMRS), CB is available to individuals without training or registration. To prevent the band becoming unusable, there are strict limitations on CB equipment in terms of output power: 4 watts. That doesn’t sound like a lot, but remember that unlike the consumer radios we’re used to today, CB is HF. 4 watts travels surprisingly far below 30MHz, conditions allowing.

What makes CB very different, from a regulatory perspective, from FRS and GMRS was the absolutely huge extent of rule-breaking. While illegal operations at e.g. higher than permitted power is not unheard of in FRS and GMRS, it is not very common. At the height of the CB craze, illegal operation at 100W or more became practically the norm. While there were higher-than-limit CB radios available for purchase through various grey market channels, high CB output powers were most commonly achieved by adding an external power amplifier.

Power amplifiers would probably be unfamiliar to most radio users today, because we now use mostly VHF and UHF where power levels are relatively low and linear amplifiers are troublesome for technical reasons. But in the HF bands, still today in amateur radio, it’s fairly normal to use a transmitter with an output power of, say, 4 watts, and direct that power to an external linear amplifier which uses it as the gate input for a very big power tube.

Power amplifiers were not legal to sell for CB use, but the CB band is close to the popular 10 meter amateur band. Close enough, in fact, that a power amplifier intended for 10M use will typically work acceptably when driven by a CB radio. The inevitable result: truck stops suddenly diversified into the lucrative amateur radio power amplifier market. Who amongst us has not stopped into a Pilot Travel Center to upgrade our 10M rig to 300W output?

The FCC addressed this runaround of the rules by creating 47 CFR 97.315. This exception to the general lack of EA rules in Part 97 states specifically that any power amplifier capable of operation below 144 MHz is subject to equipment authorization. The same section then provides broad exceptions for any such amplifier that is built, modified, or purchased used, but only when the user holds an amateur radio license.

What rules must such amplifiers meet to receive EA? 47 CFR 97.317 tells us that the amplifier must exhibit zero gain between 26 and 28 MHz, not be easily modified to demonstrate gain on those frequencies, and more broadly not be usable for services other than amateur radio. 26 to 28 MHz is, of course, the citizen's band. Just to reinforce this, along with some brief boilerplate amateur radio is mentioned in Part 2 (which, remember, states the general requirement for equipment authorization subject to whatever other part applies to the device) only once... 47 CFR 2.1060(c), which says that "Certification of external radio frequency power amplifiers may be denied when denial would prevent the use of these amplifiers in services other than the Amateur Radio Service." Here, the FCC protects "can be used for CB" as a reason to refuse authorization under Part 97--in the one case where it's required.

Why the 144 MHz cutoff? I'm not sure exactly but there is an obvious direction for speculation. 144 MHz is the start of the 2-meter band, which is for most purposes the lowest amateur band that is not HF. Power amplifiers designed for VHF and UHF use are fairly substantially different from those designed for HF and would be unlikely to produce usable output when driven by any HF transmitter, including a CB radio. The "below 144 MHz" rule seems to just give a pass for those power amplifiers that are unlikely to be part of the problem.

Now, if an amateur radio power amplifier can be modified for use in CB radio, what about a whole amateur transceiver? Yes, that's where the off-label CB market went next. Remember Pilot truck stops? Agents of the FCC Enforcement Bureau visited eleven of them in 2004--well into the decline of CB radio. They are not famous for their quick reaction to new trends. Still, the FCC found that these Pilot locations had oddly diversified again into amateur radio retail.

It's part of the American tradition to dream big, and it ought to inspire us all that Pilot aspired to best such barons of industry as Ham Radio Outlet and.... no, that's it, HRO is actually the only brick and mortar amateur radio retailer I have ever laid eyes on. The fact that their Portland location is still open can only be explained by miracle.

Of course this was not really the case, what Pilot was selling as amateur HF transceivers were just CB radios without equipment authorization. Or more accurately, they were 10M transceivers that had been intentionally designed to allow trivial modification to CB. For this bit of not-so-clever deception Pilot was ordered to pay $125,000 to the FCC. That includes an extra bonus forfeiture for continuing to sell them after the first set of violation notices was issued.

This notice of apparent liability for forfeiture[3], FCC docket 04-272 or better cited

as 19 FCC Rcd 23113, is notable mostly because it is now the primary citation given for the fact that amateur radio equipment does not generally require equipment authorization. It states explicitly in paragraph 3 that "radio transmitting equipment that transmits solely on Amateur Radio Service frequencies is not subject to equipment authorization requirements prior to manufacture or marketing." Had the Enforcement Bureau not provided that plain statement in this particular NALF, the lack of EA requirements for amateur radio would remain a largely non-obvious consequence of the lack of any particular EA requirements in Part 97 (other than the one about sub-144 MHz power amplifiers).

Note though that, fortunately, the FCC didn't decide to address this problem by adding an EA requirement for amateur radio transceivers that could transmit anywhere near 30 MHz. Instead, the Enforcement Bureau finds that the existing rules are quite clear enough. Any transmitter intended for use in CB must be type certified for CB, and it was well established earlier in the CB craze that "easy modifiability" does not work as a loophole. A device which is sold on the premise that it can be easily modified for CB use is still, in the FCC's view, a CB radio.

Nonetheless, illegal CB equipment remains pretty easy to obtain. A trivial Google search found a 100W power amplifier for sale at just $88, apparently from an Italian manufacturer. The internet has made regulation of the radio market very challenging, as it has for most markets. Equipment is made for legal applications in other countries and then imported, or just starts out as a design for the US gray market.

This problem has become particularly large with the rise of the Chinese radio manufacturing industry. There is a substantial global market for inexpensive land-mobile radio equipment for business use, and many countries have rather lax regulations on radio services and devices. LMR radios in the United States are generally prohibited from being face-programmable, for example, but many other countries have no such prohibition. A set of Chinese radio manufacturers have emerged that sell products into this market. One of the cheaper ones has become less of a brand and more of a category in the amateur radio market: Baofeng.

Baofeng, more properly Fujian Baofeng Electronics Co., Ltd, was founded in 2001 by one Wang Jinding. With around 1000 employees, Baofeng produces a large line of VHF/UHF handheld radios, or Handie-Talkies as amateurs charmingly still like to call them (a term that dates back to WWII). For several years now, Baofeng seems to be represented in the United States by Baofeng Tech or BTech. Baofeng Tech conspicuously promotes themselves as based in the sub-1000 population town of Arlington, SD, and indeed the Secretary of State has the filings for B-Tech Distribution Inc, incorporated by one Andrew Brown. The same Andrew Brown at the same address has formed a variety of LLCs with names like "Three B Developments" and "Three B Investments," but I can find little else about them. The About page on the Baofeng Tech website ends in "if you have accepted Christ as your personal Savior - contact us today here to let us know and we will send you a one time package of literature."

BTech has also sent a one-time package of literature to the FCC, as they obtained equipment authorization on a number of Baofeng models based on test results commissioned from Bay Area Compliance Laboratories of Dongguan. These equipment authorizations are, in fact, type certifications for Part 90 land-mobile radio operation. As a result, for these models, it is perfectly legal to market and sell Baofeng radios in the United States. It is, though, still completely possible to purchase Baofeng models with no such equipment authorization, often shipping direct from China. This would constitute a violation of the FCC regulations on the part of the retailer.

But what of amateur radio? Type certifications are done against specific parts of the FCC rules. The Part 90 certificate for the Baofeng models list specific bands and modes (emission designators) for which they are authorized. Part 90 (private land-mobile radio) is not Part 97 (amateur radio), and so the radio is not really authorized per se.

But the trouble here is, amateur radio is largely exempt from equipment authorization in this way too. Much like Part 97 lacks equipment authorization requirements (except power amplifiers) on manufacturers, it also lacks any prohibition on the use of unauthorized equipment. In fact, both Part 2 and Part 97 contain exceptions to equipment authorization requirements that explicitly preserve the ability of amateur radio operators to use any equipment they choose. For example, Part 2 provides an exception to general requirements that modifications be authorized by the FCC: Amateur license holders can freely modify equipment for use in the amateur radio service. No approvals required.

It has for some time been a generally accepted practice to repurpose Part 90 equipment for amateur use. This was particularly true in the days of crystal-based mobile radios, when many ex-police HF radios were modified for amateur operation. I know of club repeaters today running on lobotomized Motorola P25 (trunking system typically used by law enforcement) equipment. And an active group of amateurs operates WiFi equipment in amateur bands, based on their overlap with foreign WiFi allocations.

As a result of this exceptional latitude, amateur radio operators are, as far as I can tell, completely permitted to use Part 90 authorized radios. Further, amateur radio operators can use radios that are not authorized at all. This actually shouldn't be that surprising: most amateur radios today only need equipment authorization under the 1999 anti-eavesdropping rule. Prior to '99 most all amateurs were operating unauthorized equipment!

Nonetheless, the organizations marketing and selling these unauthorized models are violating FCC rules. The FCC seems to have taken a light touch on the issue of selling unauthorized equipment for amateur use, not just a bit because doing so would only really violate normal Part 15 rules and not nominally harm any licensed service. But the FCC has increasingly taken an aggressive position on retailers selling unauthorized radios to non-licensed users. In a prominent case, hobby vendor Rugged Radios received a threat of a forfeiture notice if they did not cease sale of the RH5R (apparently a custom case version of the Baofeng UV-5R) and other models. The target market was primarily offroad and powersports users, who don't generally hold any radio license [4].

Offroad and powersports users might better be advised to use the licensed-by-rule services MURS or CB [5], or even apply for an industrial/business pool license as an organization (although the logistics of distributing Part 90 radios are somewhat complex, since they must be programmed externally). But Rugged Radios was selling unauthorized radios along with materials that included lists of Part 90 and Part 95 frequencies. This clearly constituted marketing of an unauthorized device to a use for which authorization is required.

The importation of radios not built to US regulations will continue to be a challenge in spectrum coordination. Incidents of drone FPV transmitters directly interfering with aviation radar show the practical effects. I tend to think, though, that the impact will always be limited: Today, consumer radio use not controlled by a licensed entity is largely limited to the microwave oven bands.

[1] This is as opposed to what I'm doing here, which is more like jailhouse lawyering.

[2] or device certification, type acceptance, or type certification. The FCC itself is not entirely consistent about how it uses these terms and they have changed over time, including a find-replace amendment to 47 CFR to swap out words.

[3] This has sort of come up a couple of times now. The FCC is not properly a part of the government (it's an independent agency) and so it does not issue fines. Instead, it issues Notices of Apparent Liability for Forfeiture, which tell the target how much they are expected to pay as a civil matter. NALFs are often attached to a Memorandum of Opinion and Order, which give an interpretation of how the regulations apply to the present situation. Those memoranda are sort of like court opinions in that they set precedent the Enforcement Bureau will rely on later.

[4] Unless they happen to also be amateur radio operators. While there are restrictions on the use of amateur radio for any commercial purpose, it's well accepted to use amateur radio in the course of other hobbies. That is, an amateur radio operator who also e.g. participates in off-road racing would be permitted to use amateur radio equipment and spectrum for that purpose so long as it is not a commercial activity (in which case the Part 90 industrial/business pool would be applicable). There is a particularly strong tradition of amateur radio in the RC world, where many amateur radio operators use amateur equipment and spectrum for telecontrol of RC aircraft and etc.

[5] MURS, the Multi-Use Radio Service, is a licensed-by-rule service similar to GMRS but in low band where propagation in the open tends to be better. MURS radios are more commonly mobile (i.e. automotive) than handheld, but ther are both handheld MURS radios and mobile GMRS radios on offer. GMRS is a slightly odd situation for that matter and there actually is such thing as a "GMRS license," which confers privileges beyond those of licensed-by-rule users such as repeater operation. This might also be attractive to off-road users. If you chuckle at the common pronunciation "murrs" you are probably going to hell but I am right there with you. Consult Baofeng Tech for advice on salvation.