Interference from In-House PLT

1. Purpose of this Leaflet

This Leaflet is for RSGB members and provides a background to PLT technology and the associated EMC issues.

PLT (or PLC) stands for Powerline Telecommunications. In the USA it is usually called BPL (Broadband over Powerlines). There are two types of PLT. *Access PLT* which delivers internet services to a customer via signals injected at the electricity sub-station or other convenient point, and *In-House PLT* which uses the domestic electricity wiring for networking home computers and similar devices.

There are technical and commercial problems with the use of Access PLT to distribute the internet. At present Access PLT is not a deployed technology in the UK although recently there have been trials of lower data rate Access PLT systems in Continental Europe and in the UK for *Smart Metering* and similar applications. See note 1.

2. In-House PLT

In-house PLT is technically and commercially a more practical proposition and Powerline LAN Adaptors (PLAs) have been on sale in UK High Street shops under various brand names for a number of years. PLAs use the HF band between about 4 and 27MHz. Some years ago, most of the powerline LAN devices available in the UK were produced to an early-generation industry standard and were mainly used in home computer networks. They caused few problems to amateur radio for several reasons:

1. They were notched in the amateur bands.
2. They only generated significant interference when actually exchanging data.
3. The method of encoding and the lower data rate meant that the interference generated was not particularly intrusive.
4. When the use was simply for interconnecting domestic computers, the periods when data was being passed, and interference was being generated, was fairly short.

A few years ago a much more serious problem arose, when BT Vision started using PLT devices to distribute TV signals as part of their IPTV (Internet Protocol Television) package. The type of PLA used at that time was manufactured by “Comtrend”. While these were notched for the amateur bands, outside the amateur bands the interference was severe. The encoding system caused interference which was very disruptive to AM short-wave broadcast services. Moreover the interference was present even when no

data was being exchanged. In effect there was interference twenty-four hours a day seven days a week!

The PLA now being used by BT vision is to a different industry standard. This is notched for the amateur bands but still causes interference to short-wave broadcasting. Because of the different encoding system the interference is less obtrusive than with the Comtrend units previously used, though the actual levels are similar. When not passing data these units generate short pulses of interference at about 40ms intervals. It sounds similar to ignition interference but more regular.

3. How Serious is the Problem

BT Vision's deployment of PLA devices on a large scale focussed the attention of the radio world on interference generated by In-House PLT. Measurements made by the RSGB on antennas 17 metres from a house where a pair of units were operating, showed significant interference, except where the spectrum was notched for the amateur bands. (See Section 5 below.) Since many listeners to short-wave broadcasting use antennas which are indoors or close to the house, interference to broadcast services was a problem. This is borne out by the many reports posted on web sites. Inside the amateur bands the situation was different. The notching seems to be quite effective but there is the question of the extent to which intermodulation products (intermods) will cause the notches to fill.

At frequencies below 30MHz interference getting out into the mains is not measured directly, as a radiated emission, but is inferred by measuring the current which cause the interference. This is known as "conducted emission current". In the case of PLAs the *launch power*, that is the RF power deliberately injected into the mains for communications purposes, is effectively a conducted emission current, so Standards can be compared on this basis. How much radio interference these currents actually cause depends on how much of the power is radiated and how much is lost in other ways. Fortunately in domestic mains installations much of the power seems to be dissipated in losses and is not radiated. If it were not so, things would be considerably worse than they are.

It is interesting to note that the level of interference - measured as conducted current – at the bottom of the amateur band notches is in the same order as the levels permitted by CISPR22 (EN55022). Outside the amateur bands they are about 30dB higher.

4. In-house PLT Standard EN50561

In November 2012 the EMC Standard EN50561, which covers Interference from In-house PLT devices, was accepted by CENELEC. This does not, in itself, make it a Harmonised Standard. Before this can happen it must be published in the Official Journal of the EU. When this will happen is not clear and there is a possibility that it may not happen at all.

The RSGB had opposed the adoption of this standard mainly on the grounds that it does not meet the Essential Requirements of the EU EMC Directive. (see note 2). On the plus side, although EN50561 can be said to go outside the normally accepted EMC criteria, it does include measures to mitigate interference to radio services:

1. The launch spectrum is notched for the international amateur bands and for certain safety-of-life frequencies
2. There is a degree of protection to the HF broadcast bands (See section 7).
3. In includes Dynamic Power Control. This is intended to reduce the launch power except when the link path loss is high.
4. There are limits on emissions when not passing data. The launch power must not exceed CISPR22 (EN55022) limits when no data is being passed.

If EN50561becomes a Harmonised Standard the Society's position will be to monitor the situation to see that these mitigation measures are being fully implemented and to press for amendments – such as an overall reduction of launch power. Apart from directly reducing interference, reducing the launch power will also reduce the risk of intermods causing interference in the notches.

5. Practical Experience of In-house PLT

There have been a large number of complaints of interference to Short-Wave broadcasting caused by PLAs. Most of these were probably from BT Vision Comtrend PLAs. Other types of PLA devices also cause interference, but the widespread use of PLAs by BT Vision means that there are a lot of them about – and they generate interference 24/7.

Most of the trials carried out by the RSGB EMC Committee were with Comtrend PLAs and used inverted V dipoles sited 17m away from the house in a similar set-up to that used to observe the ambient noise floor as described in *Notes on the RSGB Observations of the HF Ambient Noise Floor* [1]. Levels of interference varied widely across the spectrum but typically interference was up to 30dB above the ambient noise level outside the amateur bands; inside the amateur bands interference was not discernible. In this particular set-up, filling of the amateur band notches by intermods was minimal. It is not known how typical this is. Trials with the new digital short-wave broadcasting technique Digital Radio Mondiale (DRM) showed that the presence of PLT interference significantly lowered the signal-to-noise margin. The audio output maintains the usual good audio quality until the S/N ratio falls to a critical level at which point the audio disappears completely.

Trials of the new BT Vision PLA have been limited to subjective observations on antennas 17metres from the house. The brand name on the device obtained by the RSGB was *SIMPLER NETWORKS.* Interference outside the amateur bands is comparable in level to the Comtrend units, but the audible effect on AM reception is less obtrusive. In practice

this may lead to a smaller number of complaints. No interference was observed inside the amateur bands. The “ignition” type interference emitted when no data is being passed is very noticeable, though it probably would not degrade readability as much as the Comtrend interference did.

6. Notching for the Amateur Bands

This is achieved by processing the spectrum of the outgoing signal to minimise power in the appropriate bands. The effect is to produce notches about 30dB deep. Intermods will cause some reduction of notch depth, but it is not known how significant this will be. Trials are being conducted to find out which types of loads generate intermods and how much the notch depth is reduced.

7. Mitigation of Broadcast Interference

Standard EN50561-1 requires protection of the HF Broadcast bands either by notching the whole band or by dynamic notching, where the spectrum is notched for individual broadcast signals. The latter approach is likely to be favoured by manufacturers because it makes more of the spectrum available to the PLT operators. To implement the dynamic notching the PLA has a built in receiver chip which detects broadcast signals and notches the spectrum of the PLA accordingly. The criterion for notching is that the signal must be of a level which the ITU defines as a usable broadcast signal strength. On the whole radio, users are sceptical as to how such a system would work in practice. Also many listeners dislike the idea that it restricts their ability to listen to the radio stations as they wish, without any third party making decisions for them.

8. Identifying PLT/PLA Interference

So far as is known all PLAs on sale in the UK are notched for the amateur bands, so the key feature for identifying PLA interference is that it is low or not discernable inside the amateur bands but is much stronger outside the band. The edges of the interference are quite sharp. The trend should be evident over a few tens of kHz. If possible the receiver should be set to AM and the AGC switched off. This is a fairly decisive test but can sometimes be less clear cut than expected, due to the large fluctuation of interference levels across the spectrum. Comtrend PLAs sound very distinctive, exhibiting a 1.2kHz tone – particularly noticeable when no data is being passed [SB2].
The new PLAs used by BT Vision cause a rough “whitish” sounding interference signal when passing data at full speed. When not passing data they cause the “ignition” interference noted above. When viewing a video file the device is not working at full speed and the effect is a mixture of the two. [SB4]..
The older types of PLA, used mainly for home networking (see Section 2 above) are not so obvious and are more difficult to track down because they only generate interference while passing data.

Before making a specific complaint of PLA interference, be as sure as you can that the interference really is from a PLA device. It is not essential to know where the device is located but it is important to be sure that the source is a PLA. The sound bites below (available on the RSGB website) give an idea of what PLAs sound like.

- SB1. Single Comtrend PLA
- SB2 Pair of Comtrends. No data being passed
- SB3. Pair of SIMPLER NETWORKS PLAs passing no data for 25 seconds then full speed download for 54 seconds then no data for 32 seconds
- SB4. Pair of SIMPLER NETWORKS PLAs passing no data for 20 seconds then viewing a video file for 50 seconds then no data for 30 second

9. What To Do If You Are Suffering PLT/PLA Interference

It is most important that all cases of interference from PLAs are reported to Ofcom so that any problems are officially recognised. Make sure you get a reference number so that the case can be followed up. Generally speaking Ofcom will investigate reports of PLA interference, but they have no powers of enforcement should the householder refuse to co-operate. (The RSGB has been pressing for this to be changed for a number of years). Thus Ofcom can only "advise" – though on the plus side it can be said that the moral authority of such an organisation is considerable. Usually Ofcom works with BT and the common solution is to install a wired system or a wireless system. By such means it is claimed that the majority of cases are solved. While it is good news that Ofcom and BT accept that interference is being caused and accept responsibility for dealing with individual cases, it does not solve the underlying emission issues.
In addition to reporting PLA interference to Ofcom**, it should also be reported to the RSGB.** You don't have to be a member to report PLA interference to the RSGB EMC Committee [2].

10. New Powerline Devices.

New types of PLA are being developed which are claimed to have a data rate in the gigabit region. These devices uses not only the HF band but also extends up into the VHF region. Emissions at VHF will pose different problems from those at HF. Above 30MHz the natural noise which constitutes the ultimate noise floor at HF, starts to die away and as the frequency rises towards 100MHz receiver noise becomes the dominant factor. This makes it possible to receive very small signals, but it also means that interference is more of a problem. Current Standards permit fairly high radiated emissions on VHF, presumably on the assumption that interference will be infrequent and on discrete frequencies. Broadband interference at the maximum level permitted by CISPR22 would be a very serious problem to the amateur VHF bands.

Notes and links.

Note 1.

Access PLT was strongly encouraged by the EU Commission around 2000 to 2005. It was seen as a way of providing competition to the "old" telecommunications organisations providing internet access via telephone lines. This was supported by the UK government of the time on the mistaken assumption that it would somehow assist their "Broadband Britain" plans. Access PLT has severe technical problems and has been eclipsed by simpler, low cost systems using telephone lines and cable systems.
Access PLT proposals in the UK involved injecting an RF signal, carrying the data, into the electricity cables at a convenient electricity sub-station. The idea was that customers could simply plug a modem into a 13Amp socket anywhere in the house and get an internet signal. The obvious disadvantage, apart from interference, was that the injected data stream was shared by a relatively large number of customers, so that the data speeds we have now come to expect were not practical. The whole proposal to promote Access PLT was vigorously opposed by the RSGB and the IARU, and in reality few trials of Access PLT took place. Those that did have been closed. Access PLT as a mean of providing broadband internet access to the home is not currently considered a viable technology, nor a commercial proposition.
However, Access PLT is now being supported by the EU Commission because it provides a means of access for Smart Metering schemes as envisaged by the Energy Directive. We can expect renewed activity in the field of Access PLT, though fortunately the high data rates required for video streaming will probably not be required. On the other hand the prospect of every home transmitting usage data every few minutes means that a huge amount of data will be exchanged which could have other EMC implications.

Note 2

The Essential Requirement states that:
"*Equipment shall be so designed and manufactured, having regard to the state of the art, as to ensure that:*
"(a) the electromagnetic disturbance generated does not exceed the level above which radio and telecommunications equipment or other equipment cannot operate as intended".

Links

[1] Link to "*Notes on the RSGB Observations…"*
http://www.rsgb.org/emc/docs/pdf/archive/rsgbmeasurements_1b.pdf

[2] Link to report PLA interference to RSGB.
http://rsgb.org/main/technical/emc/are-you-getting-interference/

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