Radiocommunication Study Groups

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North American Broadcasters Association (NABA)

PRELIMINARY DRAFT NEW RECOMMENDATION ITU-R BS.[PLT]

Protection requirements for broadcasting systems operating in the LF, MF, HF and VHF bands below 80 MHz against the impact of power line telecommunication (PLT) systems

The North American Broadcasters Association (NABA, *www.nabanet.com*) is an association of broadcasters in Canada, Mexico, and the United States, and the NABA Technical Committee is its standing technical body. NABA is thus in a position to present the technical viewpoints of the most authoritative association of professional North American Broadcasters in television and sound programme production, post-production, and distribution for terrestrial, satellite, and cable broadcasting.

NABA is a Sector Member of ITU-R and a long-time participant in ITU-R Study Groups, Working Parties, Task Groups, Rapporteur groups, etc. NABA numbers among its members Chairmen, Vice-Chairmen and members of the above groups. NABA also participates widely in the ITU work on radio, television and multimedia services and has a strong interest in spectrum management studies including spectrum engineering techniques, spectrum management fundamentals, spectrum monitoring, and inter-service sharing, interference and compatibility.

In this context, NABA takes note of the Working Party 6A Chairman's Report (Document 6A/56) for the June 2008 meeting. The Chairman reports that extensive discussions on Document 6/229 (Rev. 1) took place and that Working Party 6A decided to send the matter back to Study Group 6 for further consideration (Document 6/47). The Chairman also references numerous ITU-R documents and contributions related to the issue. The Study Group 6 Chairman reports (Annex 2 of Document 6/79) that the Study Group "discussed the issue and decided to attach the Preliminary draft new Recommendation (Document 6/229 (Rev. 1)) to the Summary Record of the meeting to serve as a point of reference for future contributions".

NABA returns to Document 6/229 (Rev. 1) and attempts in the Annex 1 below to add further justification for an ITU-R Recommendation that provides satisfactory protection to the Broadcasting Service. NABA notes the increasing number of devices, including PLT, having radio frequency emissions in the broadcasting frequency bands without a corresponding allocation in the Radio Regulations. The effect of these emissions might seriously jeopardize, as demonstrated also by extensive measurements, the broadcasting service below 80 MHz often resulting in a complete

service disruption. This would prejudicially damage, in particular, small private broadcasters operating a single affected transmitter at MF as well as emergency and distress communications addressed on LF, MF, and HF to the nation-wide population.

The effect of these emissions may seriously affect those broadcasters, which have already made huge investments to introduce digital services, carefully planned and agreed to at the international level, to ensure satisfactory reception in the absence of any additional and unforeseen source of interference as it may result from the operation of the above mentioned devices. It should also be noted that at least in some countries, the introduction of digital broadcasting services in the VHF Band and the achievement of given quality targets, has been the consequence of decisions involving not only the broadcasters but also the relevant Administration. As a consequence, adequate protection of such investments made by broadcasters in response to such decisions should be expected at both the national and international level.

Despite the opinion expressed by some parties that such a situation should be controlled at national level only, without involving the ITU, the present trade globalization (e.g. e-commerce, etc.) may lead to a situation where the PLT devices might be introduced in a country without any effective control. Therefore, the problem assumes an international connotation directly involving the ITU according to its Constitution.

It is the goal of NABA to seek a protection criterion that is acceptable to all concerned. To this end, NABA is pleased to inform Working Party 6A that it has initiated an investigation of the emissions from actual PLT devices. NABA has engaged the world-recognized Communications Research Centre (CRC, Canada) to perform the investigation. A copy of the test proposal is attached in Annex 2. NABA anticipates by the next Working Party 6A meeting to have sufficient test results to help in the definition of an appropriate and acceptable protection criterion.

Annex

Working Party 6A

PRELIMINARY DRAFT NEW RECOMMENDATION ITU-R BS.[PLT]

Protection requirements for broadcasting systems operating in the LF, MF, HF and VHF bands below 80 MHz against the impact of power line telecommunication (PLT) Systems

(Question ITU-R 32/6)

Scope

This Recommendation is intended to protect broadcasting systems in the LF, MF, HF and VHF bands below 80 MHz from the impact of power line telecommunication (PLT) Systems.

Deleted: Its principal focus is on the impact of PLT Systems installed and used inside buildings

Summary

This Recommendation provides the protection requirements for the terrestrial broadcasting service operating in the LF, MF, HF, and VHF bands below 80 MHz. Since the terrestrial broadcasting service is often planned on a noise-limited basis, the requirements are based upon a criterion afforded to devices that do not have a corresponding frequency allocation in the Radio Regulations and have emissions that occur in the frequency bands allocated to the broadcasting service.

The ITU Radiocommunication Assembly,

considering

a) that new telecommunication systems are being developed which utilize Electrical Infrastructure Wiring for the transmission of signals;

b) that those telecommunication systems radiate and occupy a broad bandwidth that may affect the use of LF, MF, HF and VHF bands below 80 MHz;

c) that the Electrical Infrastructure Wiring is not designed or installed for wideband signal transmission, and radiation from the conductors will inevitably occur;

d) that any unwanted radiation from such PLT Systems may cause interference to the reception of broadcasting services;

e) that broadcasting systems are often planned on a noise-limited basis;

Deleted: e

f) that broadcasting systems are designed and services are planned, taking into account intrinsic receiver noise and external radio noise, including atmospheric, man-made and galactic noise;

Deleted: f

g) that radiation from such PLT Systems increases the level of man-made radio noise, causing an increase in the external radio noise;

Deleted: g

h) that the increase in external radio noise results in an increase in the minimum usable field strength and degradation of the reception quality of the broadcasting services;

j) that Recommendation ITU-R P.372 describes levels of some types of radio noise;

k) that broadcasting is the most economical and widespread telecommunication service accessible by the majority of the World's population;

l) that the broadcasting service is considered by the ITU as one of the preferred media to ensure communications in cases of disaster prevention, mitigation and relief as provided in Resolutions 644 (WRC-07), 646 (WRC-03), 647 (WRC-07), 53 (RA-07), and 55 (RA-07);

m) that the reception environment of broadcasting services should be protected from interference,

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noting

a) that Article No. 15.12 of the Radio Regulations states that: administrations shall take all practicable and necessary steps to ensure that the operation of electrical apparatus or installations of any kind, including power and telecommunication distribution networks, but excluding equipment used for industrial, scientific and medical applications, does not cause harmful interference to a radiocommunication service and, in particular, to a radionavigation or any other safety service operating in accordance with the provisions of these Regulations (in this matter, administrations should be guided by the latest relevant ITU-R Recommendations);

b) that the signal peak factor of such PLT Systems may be higher than the ordinary broadcasting receiver noise, accordingly, the acceptable r.m.s. level of PLT radiation should be lower than that for white noise;

c) that the broadcasting service in a low SNR environment, which is marginally available with analogue modulation (AM) transmission, may be completely lost by radiation from such PLT Systems, with digital modulation operated with the transmitting power reduced by several dB for compatibility with AM;

d) that external radio noise and the broadcasting received signal may be attenuated when entering inside the building;

e) that branch lines and spurs which are parts of the Electrical Infrastructure Wiring – such as for ceiling lights – may generate additional PLT radiation;

f) that electric equipment connected to an AC power socket may also generate additional radiation;

g) that a broadcasting receiver connected to an AC power socket may receive noise coming from such PLT Systems directly through its own power cable, in particular, when an external long wire antenna is used for better reception (the power line itself acts as part of the antenna, since RF frequencies present on it are capacitively coupled to the receiver ground plane), or when the power line is itself intentionally used as an antenna by grounding the external antenna terminal (this is often done in buildings where broadcasting radio wave is shielded);

h) that a broadcasting receiver with an AC power supply (or even without) is usually located close to a wall where an AC power socket is provided and/or AC power wiring is installed,

recommends

1 that the total radiated noise from PLT Systems operating over the Electrical Infrastructure Wiring and from electric equipment connected to a power socket should not be higher than the value given in Section 5 and Fig. 3 of Annex 1 at any place where a receiver might be located;

2 that interference through a receiver power cable to a broadcasting receiver connected to an AC power socket should not be higher than the equivalent value given in Section 5 and Fig. 3 of Annex 1, including the case when an external long wire antenna is used.

NOTE – The limits in *recommends* 1 and 2, and in Section 5 and Fig. 3 of Annex 1, assume that interference (disturbance) from PLT Systems is the same as that from white noise when the r.m.s. levels are equal. When different waveforms in the PLT System cause the interference (disturbance) effect to differ from that of white noise, an equivalent adjusted level must be used.

Glossary

Different terms are used in different parts of the world to describe the various elements of the electrical distribution chain from the power station through to individual appliances, lighting, etc. connected to it. For the purpose of this document the following terms are taken to have the attached meanings and are "capitalized" throughout the document:

Electrical Infrastructure Wiring – This means the whole of the electrical distribution wiring from the generating station through to power sockets, light fittings, switches, etc., and the individual appliances, lamps, etc. connected directly to it. Importantly, since the primary focus of this document is the effects found inside buildings, the Electrical Infrastructure Wiring includes household and/or office and other building wiring systems, AC outlets and all spurs or branches to light fittings, ceiling outlets, etc.

PLT System – The communications system which uses the Electrical Infrastructure Wiring, or parts of it, to transfer high-frequency data signals from place to place. The PLT System is typically superimposed on existing Electrical Infrastructure Wiring.

Annex 1

1 Receiver sensitivity

Using the AM bands as an example, the sensitivity of AM sound broadcast receivers is defined in Recommendation ITU-R BS.703 (Reference receivers for planning purposes). It is defined as the minimum usable field strength, using a built-in antenna (even if a terminal for an external antenna is provided), and for a receiving quality of: 26 dB *AF S*/*N*, with 30% modulation, in the absence of external noise. The values are as follows:

LF: 66 dB(μV/m),

MF: 60 dB(μV/m),

HF: 40 dB(μV/m).

2 Receiver noise level and acceptable interference level

To estimate deterioration in receiver sensitivity from co-channel interference, or to estimate the acceptable co-channel interference level, it is essential to know the receiver noise level, which consists of internal and external noise, rather than the receiver sensitivity. If the co-channel interference power is the same level as the original receiver noise, the resultant noise power increases twofold (3 dB) and the sensitivity is deteriorated by 3 dB (neglecting the difference of noise waveforms). The effective sensitivity is essentially determined by the total noise.

2.1 Receiver internal (intrinsic) noise

The receiver external noise and interference level are usually expressed as a field strength. Accordingly, for ease of comparison, it is convenient also to express the receiver internal noise as an equivalent field strength (as if it were being received by a noiseless receiver through a specified antenna).

Receiver internal noise level, corresponding to receivers, whose sensitivities are specified in the previous paragraph 1, can be assumed to be:

$$AF\ S/N\ (\text{dB}) = RF\ C/N\ (\text{dB}) + \text{modulation degree}\ (\text{dB})$$

Substituting the conditions: *AF S*/*N* = 26 dB, and modulation degree = 30% (−10.5 dB), *RF C*/*N* which corresponds to the minimum usable field strength is 36.5 dB. Accordingly, the field strength equivalent to the receiver internal noise is 36.5 dB below the minimum usable field strength. That is:

LF: 29.5 dB(μV/m),

MF: 23.5 dB(μV/m),

HF: 3.5 dB(μV/m).

Although this receiver internal noise is calculated using analogue receiver sensitivity, these results also apply to digital receivers when the bandwidth differences are taken into account.

2.2 Receiver external noise and overall noise

Receiver noise usually includes external noise that is received through the receiving antenna besides receiver internal noise generated in the receiver. The external noise for receivers operating below 80 MHz includes man-made, cosmic noise and below 30 MHz atmospheric noise.

Recommendation ITU-R P.372 expresses the average strength of each kind of external noise when received through a lossless short vertical monopole antenna with a perfect ground plane by comparing it with the thermal noise level (kT_o). Their field strengths can be calculated as shown in Section 2.3. Therefore, it is convenient to convert the receiver internal noise level into equivalent field strength (*Eri*), as mentioned above, based on the identical antenna.

Equivalent field strength of the receiver (overall) noise (*Ert*) is expressed by the field strength corresponding to the power sum of the above *Eri* and average field strength of the external noise (*Ere*). That is:

$$Ert^2 = Eri^2 + Ere^2 \quad (1)$$

When co-channel interference of field strength, *Eu*, is superposed on this *Ert*, the equivalent field strength of the receiver noise power increases to *Ertu*; corresponding to the power sum of *Ert* and *Eu.* That is:

$$Ertu^2 = Ert^2 + Eu^2 \quad (2)$$

As examples:

Ratio of additional noise to receiver noise expressed in dB	Sensitivity reduction (dB)
0 dB	3 dB
–6 dB	1 dB
–10 dB	0.5 dB
–20 dB	0.05 dB

When *Eu* is 20 dB lower than *Ert*, receiver sensitivity deteriorates by 0.05 dB.

That is, in order to limit the receiver sensitivity deterioration due to co-channel interference (*Eu*) within 0.05 dB, *Eu* should be 20 dB lower than equivalent field strength of the receiver (overall) noise (*Ert*).

Receiver internal noise in Section 2.1 is calculated using the receiver sensitivity with a built-in antenna. However, the sensitivity figures in Section 2.1 are significantly improved by using an external antenna, such as a short wire extended in the room. Taking this improvement and low loss performance in the antenna matching of VHF receivers into account, external noise, whose minimum value is determined by the man-made noise, is considered the major component of receiver noise in receivers operating below 80 MHz.

2.3 Equivalent field strength of receiver noise

With the above antenna condition defined in Recommendation ITU-R P.372, a lossless short vertical monopole antenna with perfect ground plane, the received power (P_r) from a field strength E is expressed by:

$$P_r = E^2\lambda^2/(640\pi^2) \quad (3)$$

where:

P_r: maximum available received power (W)

E: field strength (V/m)

λ: wavelength (m) = $3 \times 10^2/f$

f: frequency (MHz).

Substituting kT_ob (–164.5 dBW) into the above P_r, equivalent field strength of the thermal noise; $E(kT_ob)$ for (b = 9 000 Hz) is given by:

$$E(kT_ob) = 20 \log f - 56 \text{ dB } (\mu\text{V/m}) \quad (4)$$

where:

$E(kT_ob)$: equivalent field strength of the thermal noise: kT_ob dB(μV/m)

k: Boltzmann's constant = 1.38×10^{-23} J/K

T_o: reference temperature = 288 K

b: receiver effective noise bandwidth (Hz)

kT_ob: –164.5 dBW (for b = 9 000 Hz (the bandwidth b is to be adjusted in accordance with the necessary bandwidth of the transmitter system)).

The value of $E(kT_ob)$ is shown in Fig. 2. Recommendation ITU-R P.372 expresses the average strength of each kind of external noise by comparing it with the thermal noise level (F_{am} dB relative to kT_o). That is, each field strength is obtained as F_{am} dB above $E(kT_ob)$ dB(μV/m).

3 External noise

Recommendation ITU-R P.372 expresses each of average strength of atmospheric noise, man-made noise, and cosmic noise comparing with the thermal noise level (F_{am} dB relative to kT_o) when they are received through a lossless short vertical monopole with a perfectly grounded plane.

3.1 Man-made noise

Figure 1 shows a summary of man-made noise in various environments. Equivalent field strengths are shown in Fig. 2 (for b = 9 000 Hz).

3.2 Comparison between man-made noise and atmospheric noise

The minimum level of external noise is determined by the man-made noise as this is the dominant factor when the atmospheric noise fades.

4 Permissible interference field strength

From the above, it is concluded that:

– When an external antenna is used, external noise is the major receiver noise.

– With a built-in-antenna, external noise is the major factor in business and residential areas. Even in rural areas the external noise is significant.

– Since the minimum value of external noise is determined by the man-made noise, the permissible interference field strength is also determined by man-made noise.

– It is suggested that the figure for man-made noise in quiet rural areas be used as a reference because in future man-made noise in other environments should be suppressed as much as possible.

– In order to limit receiver sensitivity deterioration due to a co-channel interference (*Eu*) to within 0.05 dB, *Eu* should be 20 dB lower than equivalent field strength of the man-made noise for quiet rural area, shown as limit F in Fig. 3. If 10 dB attenuation of man-made noise is assumed when entering inside the building, the interfering PLT signal level (*Eu*) in the building on the limit F is 10 dB lower than field strength of the man-made noise for quiet rural area and sensitivity deterioration is 0.5 dB.

5 Interference limits for PLT Systems

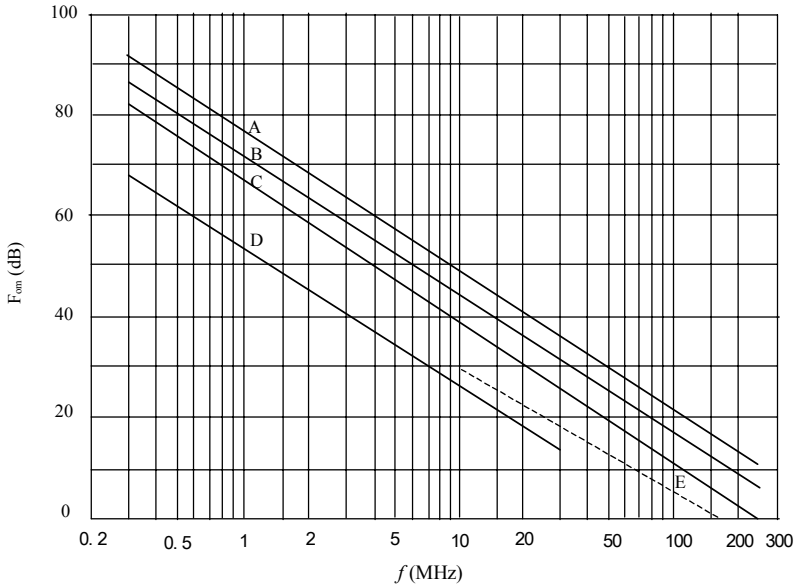
1) The total radiated noise, from PLT Systems operating over the Electrical Infrastructure Wiring and from electrical equipment connected to a power socket, should not be higher than the value shown as line F in Fig. 3 (r.m.s. value) and should not be higher than the value shown as line G in Fig. 3 (peak value) at any place where a receiver might be located.

2) Interference through a receiver power cable to a broadcasting receiver using an AC power supply should not be higher than the equivalent value given in Fig. 3, including the case when an external long wire antenna is used or when a power line is used as an antenna by grounding the external antenna terminal.

NOTE – The limits in Sections 4 and 5 and in Fig. 3 assume that interference (disturbance) from PLT Systems is the same as that from white noise when the r.m.s. levels are equal. When different waveforms in the PLT System cause the interference (disturbance) effect to differ from that of white noise, an equivalent adjusted level must be used.

FIGURE 1

Relative medium man-made noise level comparing with the thermal noise level (F_{am} dB relative to kT_o) when they are received through a lossless short vertical monopole with perfectly grounded plane



Environmental categories: A: Business B: Residential C: Rural D: Quiet rural E: Cosmic noise

Median values of man-made noise power for a number of environments are shown in Fig. 1. The Figure also includes a curve for galactic noise.

In all cases results are consistent with a linear variation of the median value, F_{am}, with frequency f of the form:

$$F_{am} = c - d \log f \qquad \text{(dB)} \qquad (5)$$

With f expressed in MHz, c and d take the values given in Table 1. Note that equation (5) is valid in the range 0.3 to 250 MHz for all the environmental categories except those of curves D and E as indicated on the Figure.

TABLE 1

Values of the constants *c* and *d*

Environmental category	*c*	*d*
Business (curve A)	76.8	27.7
Residential (curve B)	72.5	27.7
Rural (curve C)	67.2	27.7
Quiet rural (curve D)	53.6	28.6
Galactic noise (curve E)	52.0	23.0

Since the above are received values with lossless short vertical monopole above a perfect ground plane, the vertical component of the r.m.s. field strength is obtained as F_{am} dB above $E(kT_o b)$ dB given by equation (4).

For b = 9 000 Hz,

$$E_n = F_{am} + 20 \log f - 56 \quad \text{dB}(\mu\text{V/m}) \tag{6}$$

where:

E_n: field strength in bandwidth b, and

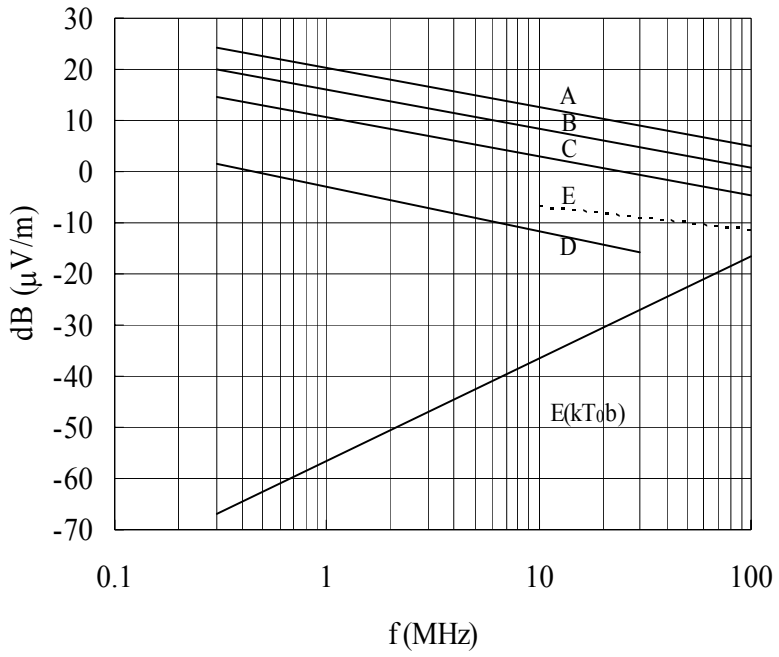
f: centre frequency (MHz)

b: receiver effective noise bandwidth (Hz).

Median values of man-made noise field strength for a number of environments obtained from equation (6) are shown in Fig. 2.

FIGURE 2

Equivalent field strength of man-made noise (*b*: 9 000 Hz)



By substituting F_{am} expressed by equation (5) into equation (6),

$$E_n = c - d \log f + 20 \log f_{\text{MHz}} - 56 \quad \text{dB}(\mu\text{V/m}) \tag{7}$$

$$= c' + d' \log f \quad \text{dB}(\mu\text{V/m}) \tag{8}$$

where:

$c' = c - 56$

$d' = 20 - d$

c' and d' take the values given in Table 2.

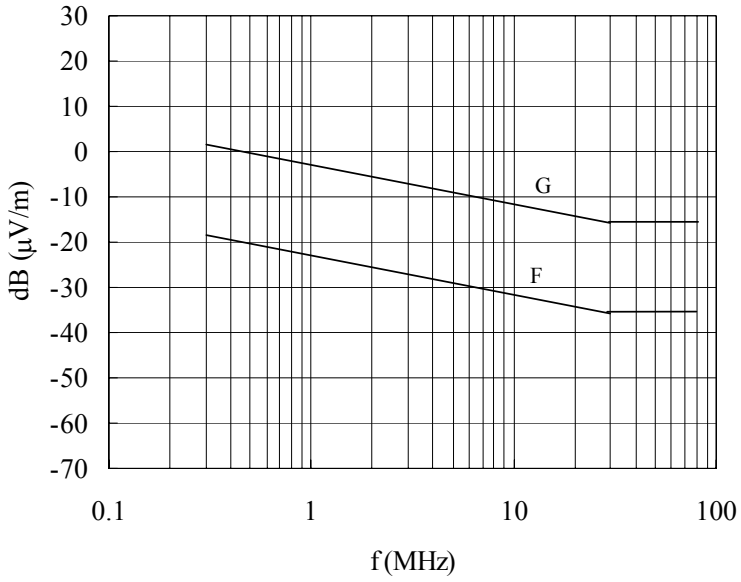
TABLE 2

Values of the constants *c′* and *d′*

Environmental category	*c′*	*d′*
Business (curve A)	20.8	–7.7
Residential (curve B)	16.5	–7.7
Rural (curve C)	11.2	–7.7
Quiet rural (curve D)	–2.4	–8.6
Galactic noise (curve E)	–4	–3.0

FIGURE 3

Required limits for interference field strength (*b*: 9 000 Hz)



F: limit for r.m.s value of interference field strength (20 dB below curve D in Fig. 2 at below 30 MHz)

G: limit for peak value of interference field strength (20 dB above F).

c′ and *d′* for curves F and G take the values given in Table 3.

TABLE 3

Values of the constants *c′* and *d′* at below 30 MHz

Environmental category	*c′*	*d′*
Curve F	–22.4	–8.6
Curve G	–2.4	–8.6

Annex 2

The proposal from the Communications Research Centre (Canada) entitled "Technical Support for the Measurement of Electrical Field from Power Line Telecommunication (PLT) Devices operating in the Residential Environment" is attached below:

CRC PLT Test Proposal.doc