**Technical Guidance Note TGN 17**

# Technical Guidance Note TGN on Assessment of Powerline Telecommunications (PLT) Equipment

## *1. Introduction*

The definition of the measurement methods and of the emission limits for power line telecommunications (PLT) systems has been a pending issue for many years.

Up to now assessment of PLT-modems by Notified Bodies (when they were requested for an assessment) was based on the document CISPR/I/89CD. Its method is based on an analogy to the test of the telecommunication ports defined in CISPR 22. The major difference is the value of the longitudinal conversion loss (LCL) of the ISN, which is reduced to 30 dB compared to CISPR22:1997.

Following the decision 10a made in 2004 at the Shanghai meeting of CISPR/I, the project team CISPR/I/PT-PLT was established. Its main goal is to issue an amendment to CISPR 22 for broadband telecommunication equipment over power lines. CISPR/I/PT-PLT issued the document CISPR/I/257CD “CISPR 22 Limits and method of measurement of broadband telecommunication equipment over power lines” in February 2008 for national committee voting. Compared to CISPR/I/89CD the voltage limits correspond to those for the mains port (Tables 1 and 2). Furthermore the common mode impedance is reduced to 25 Ω which is consistent with the AMN. Finally the LCL is reduced to 24 dB.

CISPR/I/PT-PLT also issued in February 2008 the document CISPR/I/258DC “Report on Mitigation Factors and Methods for Power Line Telecommunications”. Its purpose is to show the potential of state of the art technology and methods to eliminate radio interference in case of need, e.g. methods such as notching: static or dynamically adaptive.

Further adaptive power management techniques reduce the interference potential from PLT at all frequencies.

## *2. Assessment of PLT modems*

The following topics have to be considered as the basis for assessment by Notified Bodies until an amended CISPR 22 comes into force.

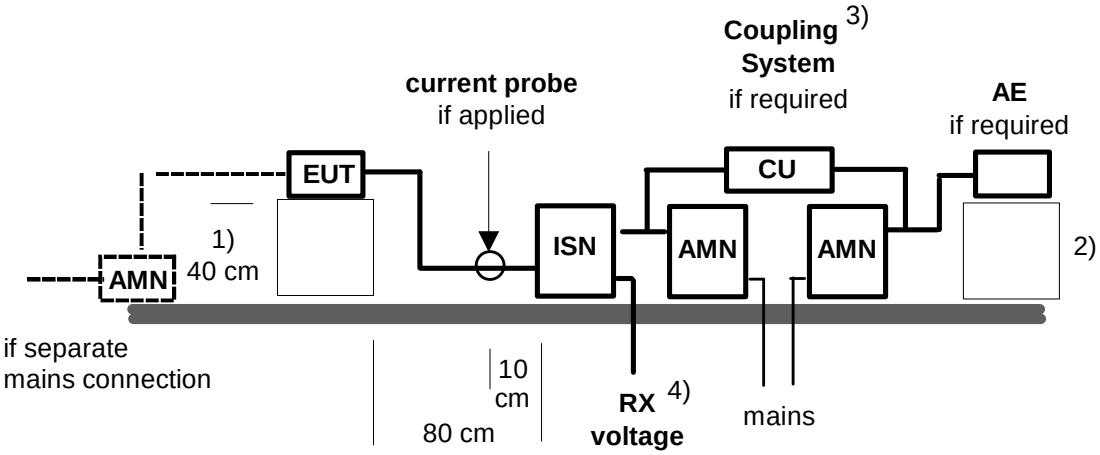
**Table 1 – Limits of conducted common mode (asymmetric mode) disturbance at PLT ports in the frequency range 1605 kHz to 30 MHz with the telecommunication function active for Class A equipment**

| **Frequency range** MHz | **Voltage limits** dB(µV) | | **Current limits** dB(µA) | |
|---|---|---|---|---|
| | **Quasi-peak** | **Average** | **Quasi-peak** | **Average** |
| 1,605 to 30 | 73 | 60 | 45 | 32 |
| NOTE 1 The lower limit shall apply at the transition frequencies.<br>NOTE 2 The current and voltage disturbance limits are derived for use with an impedance stabilization network (ISN) which presents a common mode (asymmetric mode) impedance of 25 Ω to the PLT port under test. (conversion factor is 20 $\log_{10}$ 25 Ω = 28 dB) | | | | |

**Table 2 – Limits of conducted common mode (asymmetric mode) disturbance at PLT ports in the frequency range 1605 kHz to 30 MHz with the telecommunication function active for Class B equipment**

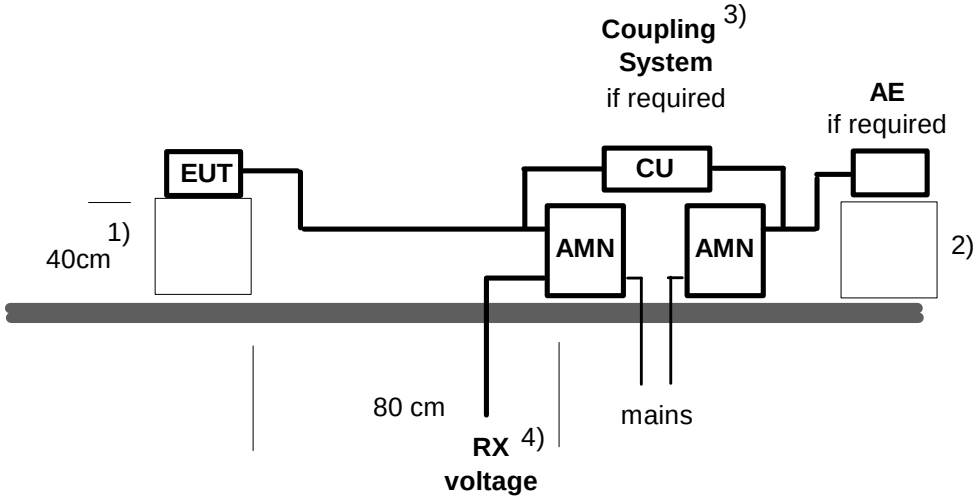
| **Frequency range** MHz | **Voltage limits** dB(µV) | | **Current limits** dB(µA) | |
|---|---|---|---|---|
| | **Quasi-peak** | **Average** | **Quasi-peak** | **Average** |
| 1,605 to 5 | 56 | 46 | 28 | 18 |
| 5 to 30 | 60 | 50 | 32 | 22 |
| NOTE 1 The lower limit shall apply at the transition frequencies.<br>NOTE 2 The current and voltage disturbance limits are derived for use with an impedance stabilization network (ISN) which presents a common mode (asymmetric mode) impedance of 25 Ω to the PLT port under test. (conversion factor is 20 $\log_{10}$ 25 Ω = 28 dB) | | | | |

**Test setups:**




Description of ISN (CM- and DM-Impedance, LCL) with current as well as voltage measurement, with mains limits (no internal schematic of ISN)

**Figure 1: Compliance test set-up for 1605 kHz to 30 MHz when the telecommunication function is active**




1) Distance to the reference ground plane (vertical or horizontal)
2) Distance to the reference ground plane is not critical
3) Functions of the Coupling set-up:
- stabilization of the differential mode impedance
- isolation of the differential- and common mode signal of the AE
- filtering of the differential- and common mode signal from the mains

4) AMN voltage

**Figure 2: Compliance test set-up for PLT for 1605 kHz to 30 MHz when the telecommunication function is inactive**

**Detailed specification of the impedance stabilization network (ISN):**

a) The common mode termination impedance shall be 25 Ω +/- 3 Ω, phase angle 0o +/- 25o,

b) The differential mode termination impedance shall be 100 Ω +/- 10 Ω, phase angle $0^o$ +/- $25^o$,

c) The insertion loss (symmetric) of the ISN (excluding the Coupling System) shall be $a_{DISN} = 20 \log (E_D / (2 * V_{DISN})) \geq 15$ dB (the measurement set-up is shown in Figure A.1 of annex A of this TGN)

d) The decoupling attenuation (common mode isolation) of the ISN (excluding the Coupling System) between the AE port and the voltage port shall be $a_{CISN} = 20 \log (E_{CISN} / (2 * V_{CISN})) > 14$ dB (the measurement set-up is shown in Figure A.2 of annex A of this TGN)

e) The longitudinal conversion loss (LCL) of the ISN input (EUT side) shall be 24 dB +/- 1 dB

f) The attenuation distortion or other deterioration of the signal quality in the wanted signal frequency band caused by the presence of the ISN shall not affect the normal operation of the EUT.

g) If a voltage port on the ISN is available then the accuracy of the voltage division factor shall be within ±1,0 dB of the nominal value. The voltage division factor is the difference between the voltage appearing across the common mode impedance presented to the EUT by the ISN and the resulting voltage appearing across a receiver input attached to the measuring port of the ISN, expressed in decibels.

h) The attenuation of the Coupling System in conjunction with the ISN, for common mode current or voltage disturbances originating from the AE or from the mains, shall be such that the measured level of these disturbances at the measuring receiver input shall be at least 10 dB below the relevant disturbance limit. The following attenuations are recommended:

   The differential mode transmission loss of the Coupling System should be $a_{DCS} = 20 \log (E_{DCS} / (2 * V_{DCS}))$ 40 dB +/- 6 dB;
   (The measurement set-up is shown in Figure A.3)

   The common mode transmission loss of the coupling System should be $a_{CCS} = 20 \log (E_C / (2 * V_{CCS})) > 40$ dB;
   (The measurement set-up is shown in Figure A.4)

## *3. State of the art protection of radio services*

Certain radio services, such as broadcast services, amateur radio, public safety etc., may warrant special protection from PLT emissions. Their functions require additional protection against possible interference from PLT operations. This section contains a summary of the state of the art means of protection.

For excluded frequency bands the transmit signal shall be suppressed by at least 30 dB with respect to the transmit level outside the excluded frequency band.

**Frequency band exclusions (Static Mitigation Techniques)**
PLT systems could be required to exclude on a permanent basis ("place no carrier frequencies in") certain designated bands. This technique is sometimes called "static notching" or simply "notching".

It is required to permanently exclude the frequency bands of Table 3 since these frequencies are allocated by radio amateur or CB-Band services.

**Table 3 - Frequency bands requiring permanent frequency band exclusions**

| MHz | Service | | MHz | Service |
|---|---|---|---|---|
| 1,80 - 2,00 | Radio amateur | | 18,068 - 18,168 | Radio amateur |
| 3,50 – 4,00 | Radio amateur | | 21,000 - 21,450 | Radio amateur |
| 7,00 – 7,30 | Radio amateur | | 24,890 - 24,990 | Radio amateur |
| 10,10 -10,15 | Radio amateur | | 26,175 – 28 | On-site paging, CB |
| 14,00 – 14,35 | Radio amateur | | 28,000 - 29,700 | Radio amateur |

**Dynamic mitigation techniques for PLT access systems (last mile systems)**
Access PLT operators are required to employ equipment with interference mitigation techniques under the control of the operator. This would permit PLT operators to exclude frequencies in order to mitigate interference at particular locations in particular bands when it is reported. If the access PLT system is not capable of dynamic mitigation technique, e.g if connection was lost or if there is no connection to the operator the system has to exclude permanent all frequencies allocated to radio broadcast bands as a fall back solution. Alternatively access systems could use the adaptive notching described below.
*Note: Access systems shall provide identical protection to radio-broadcast as in-house systems.*

**Adaptive notching for PLT (in-house systems)**
Adaptive Notching is a technique used to protect radio broadcast services against PLT interferences. This technique has been adopted by ETSI and is specified in detail in ETSI TS 102 578. It aims to protect in-house short wave broadcast reception and avoids static notching of all broadcast bands at all times, which would result in substantial permanent performance loss. Laboratory and field tests jointly with the EBU (ETSI TR 102 616) have successfully demonstrated this technique. Adaptive notching is a powerful mitigation technique for PLT devices.

Adaptive notching operates autonomously. The modems sense the radio frequency spectrum, detect the broadcast channels received with usable quality at the site and at the time and notch out these channels in the transmitted signal. The loss of throughput of a PLT system due to adaptive notching is very low. Only the few broadcast channels which offer useful indoor reception at a given time are notched.

**Adaptive feeding power management**
The transmission loss of In-House PLT communication channels between two outlets may vary by 60dB or more. Today, most PLT modems adapt the setting of the automatic gain control at the PLT receiver accordingly. An alternative solution would be to adapt the PLT transmitter feeding power to the channel characteristics (loss and noise floor). This can be done without any throughput loss compared to the traditional method. By means of adaptive feeding power management the probability of interference caused by in-house PLT modems can be reduced to a great extent.

## *4. Guidelines*

Notified Bodies when being consulted to provide an opinion on PLT conformity assessment are strongly encouraged to base their opinion on the following:

a) Measurement of PLT emissions have to be done according to what it is described in clause 2 of this TGN.

b) Additional mitigation measures have to be implemented according to what it is described in clause 3 of this TGN

## General Notes:

Notified Bodies - when consulted on this matter- are strongly encouraged to follow this Technical Guidance Note accordingly.

Manufacturers or test labs, when applying this TGN shall clearly note the PLT assessment setup conditions in their test reports.

Notified Bodies and Manufacturers should be aware that where PLT equipment provides internet access technology the R&TTE Directive may be applicable.

## Annex A
## (informative)

## Measurement set-ups for the characterization of ISN and Coupling System to be used for compliance testing of PLT devices when the communication function is active

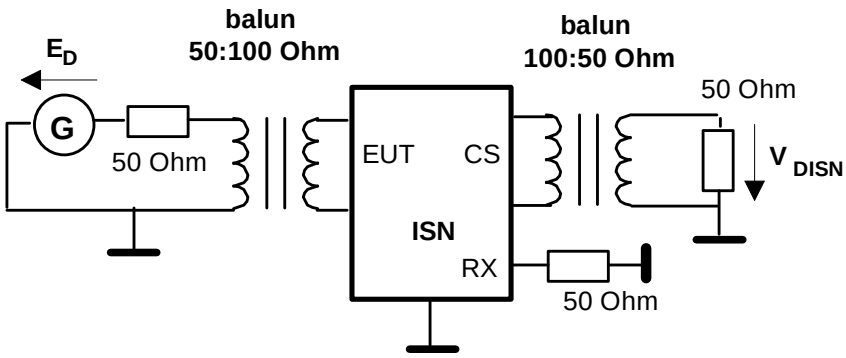
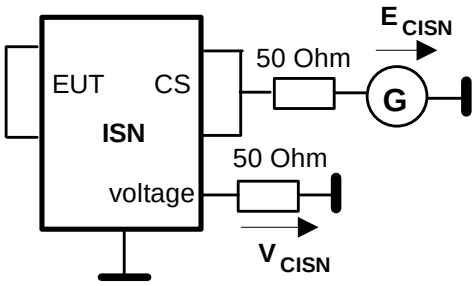
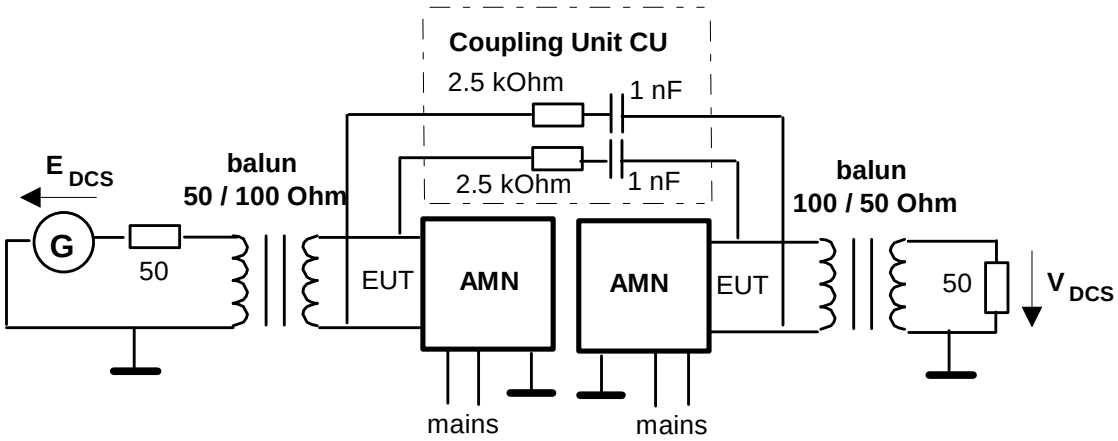



**Figure A.1 Measurement set-up for the Insertion loss (symmetric) of the ISN (excluding the Coupling System)**




CS: Coupling System port

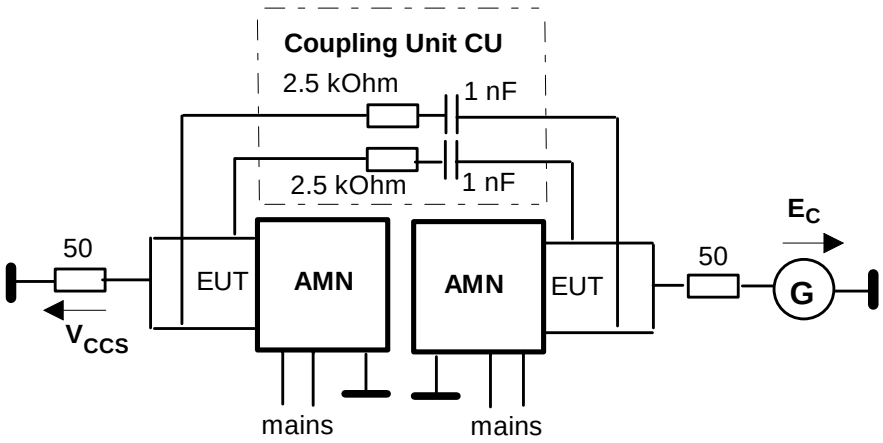
**Figure A.2 Measurement set-up for the common mode decoupling attenuation (isolation) of the ISN (excluding the Coupling System)**




**do not connect to the mains for this test !**

$a_{DCS} = 20 \log (E_{DCS} / (2 * V_{DCS}))$

**Figure A.3 Measurement set-up for the insertion loss (symmetric) of the Coupling Unit**




**do not connect to the mains for this test !**

$a_{CCS} = 20 \log (E_C / (2 * V_{CCS}))$

**Figure A.4 Measurement set-up for the common mode decoupling attenuation (isolation) of the Coupling Unit**