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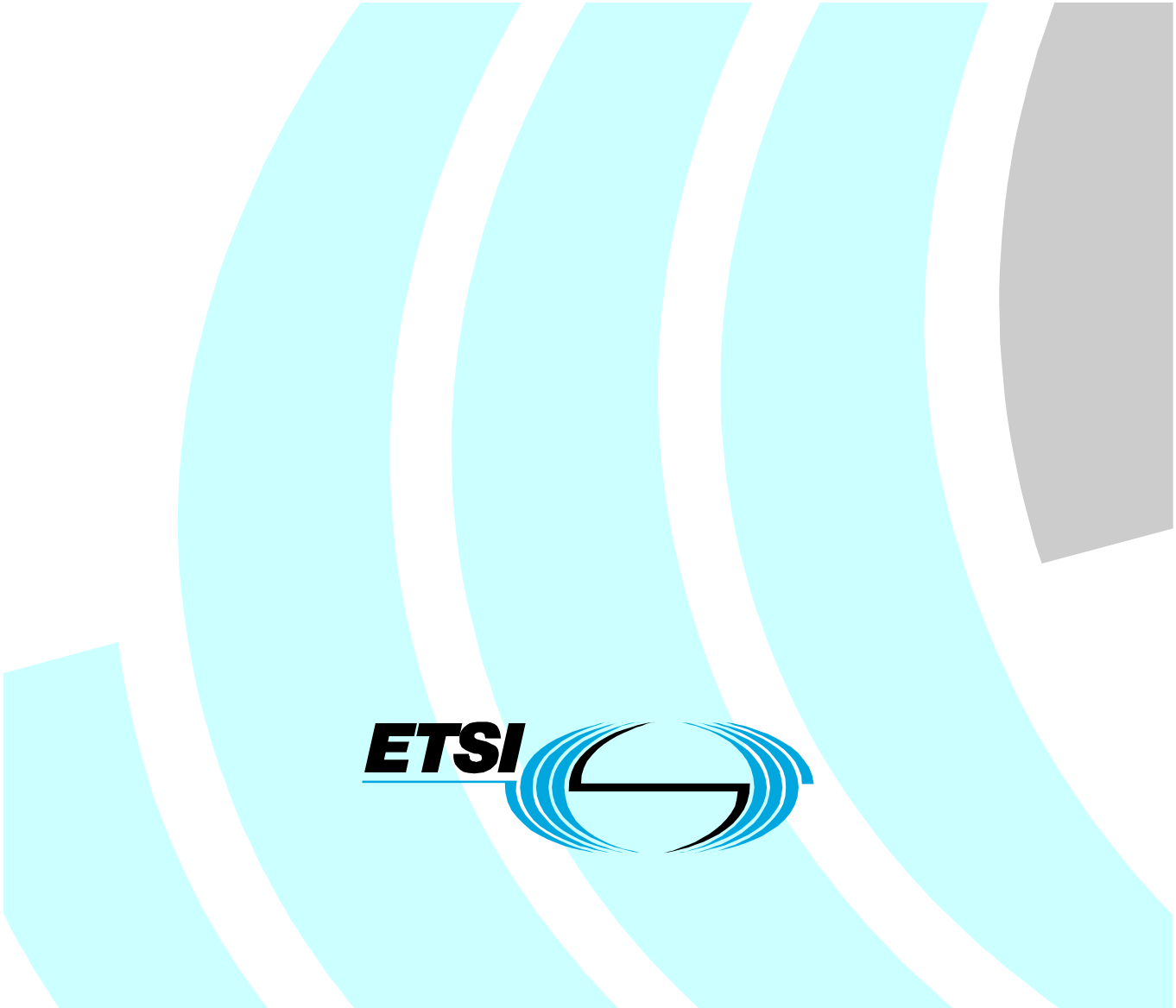
Technical Report

PowerLine Telecommunications (PLT);
Radiated emissions' characteristics
and measurement method of state of the art
powerline communication networks



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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Powerline Telecommunications (PLT).

The present document has been developed following the letter from the European Commission.

Ref. (ENTR/G3/TB/mm/D(2003)835713).

Introduction

The present document provides the radiated emissions' characteristics of state of the art powerline communication networks and specifies the measurement method.

The present document has been developed based on the field experience and measurement campaigns performed by PLC experts. The present document also specifies the measurement method used to characterize the radiated emissions, so that future measurements can be performed using the same method.

1 Scope

The present document describes the radiated emissions' characteristics, and associated method of measurements, of state of the art powerline communication networks as defined in clause 3.

The present document reports the radiated emissions' characteristics of powerline communication networks in the frequency range 1,605 MHz to 30 MHz.

The radiated emissions' characteristics presented in the present document cover both access and in-home powerline communication networks.

2 References

For the purposes of this Technical Report (TR) the following references apply:

[1] IEC 60050-161: "International Electrotechnical Vocabulary. Chapter 161: Electromagnetic compatibility".

[2] CISPR 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

electronic communications network: means transmission systems and, where applicable, switching or routing equipment and other resources which permit the conveyance of signals by wire, by radio, by optical or by other electromagnetic means, including satellite networks, fixed (circuit- and packet-switched, including Internet) and mobile terrestrial networks, electricity cable systems to the extent that they are used for the for the purpose of transmitting signals, networks used for radio and television broadcasting and cable TV networks, irrespective of the type of information conveyed

NOTE: In the context of the present document the definition is limited to only the combination of equipment and passive devices (network cables, connectors) directly connected together to constitute the wire-line part the network.

emission: phenomenon by which electromagnetic energy emanates from a source

NOTE: See IEC 60050-161 [1].

measurement distance: The measurement distance is taken as a straight line rectangular from the telecommunication cable tract (or its projection to the floor level), from the boundary of the premises, office, or flat, or from the exterior wall of the building hosting the network concerned, to the measuring antenna reference point. This reference point can be:

- the centre of the coil of a loop antenna used for measurements of the magnetic component of electromagnetic fields; or
- the balun, in case of a broadband dipole, or the reference point of a logarithmic-periodical or horn antenna referred to for calibration purposes.

powerline communication network: electronic communication network using the mains distribution network infrastructure for communication

3.2 Symbols

For the purposes of the present document, the following symbols apply:

H_{eff}	effective magnetic field strength
$H_{x,y,z}$	magnetic field strength components of each orthogonal orientation

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

CISPR	International Special Committee on Radio Interference
IEC	International Electrotechnical Committee
IEV	International Electrotechnical Vocabulary
RF	Radio Frequency
TV	TeleVision

4 Measurement method

4.1 General arrangements

In order to get the highest readings of emissions it shall be ensured that the part of the electronic communication network or installation being assessed operates at maximum wanted signal levels typical for this site and in the mode that results in maximum RF emission field strength levels consistent with normal operation. If the system is interactive, measurements shall also be performed in the presence of both the upstream and downstream signals.

4.2 Radiated emissions measurements below 30 MHz

In the frequency range 1,605 MHz to 30 MHz the magnetic component of the radiated emission shall be measured.

In the frequency range below 30 MHz, measurements of the electric field strength should be avoided. The readings obtained are not suitable for determination of mitigation measures to the network concerned since they depend in a high degree from random environmental conditions found at the site of operation of the part of the network to be assessed.

For radiated emission measurements in the frequency range 1,605 MHz to 30 MHz, a calibrated measuring system in accordance with CISPR 16-1 [2] consisting of a radio disturbance measuring receiver, an associated loop antenna for the measurement of magnetic field components, and a tripod is required.

Other specialized equipment such as resonant loop antennas can also be used, if necessary.

In the frequency range 1,605 MHz to 30 MHz, a measuring bandwidth of 9 kHz and a Quasi-peak detector shall be used.

It is recommended that both the measuring receiver and the loop antenna have an independent power source with no ground connection (e.g. battery power), particularly in case of indoor measurements, in order to minimize the possibility of current loops via earth that could affect the measurement.

Mount the loop antenna on a tripod and place it at the measurement location(s) so that it is at the reference measurement distance. The middle of the loop should be at least 1 m above the ground.

Set the measuring receiver to the measuring frequency and type of detector required, position the loop antenna subsequently in each of the orthogonal directions X, Y and Z, record the maximum readings obtained, and calculate the effective field strength using equation (1).

$$H_{eff} = \sqrt{H_x^2 + H_y^2 + H_z^2} \quad (1)$$

NOTE: All field strength values in equation (1) are in units of A/m.

The measurement of magnetic fields radiated from electronic communication networks in the frequency range up to 30 MHz may become complicated due to the presence of a variety of high-level wanted RF emissions from radio services.

In view of this it may be necessary to restrict the measurements to the frequency ranges (called quiet frequencies) where the measured signal should be at least 6 dB greater than the background noise. This should be done without altering the antenna position and ideally with the electronic communication network switched off.

The quiet frequencies or frequency ranges identified will be used to measure the emission. The background noise levels on each of these frequencies shall be assessed subjectively. Using the measuring bandwidth and detector specified, the highest emission field strength level (in dB(µA/m)) observed over a period of 15 s shall be recorded. Any short duration isolated peaks shall be ignored.

If local restrictions require a reduction of the measurement distance to less than the reference measurement distance, the actual measurement distance can be reduced provided it is not less than 1 m to the network to be assessed. In case of outdoor measurements, it can also be necessary to use a measurement distance which is larger than the reference distance. If the actual measurement distance deviates from the reference distance, then the obtained measurement results need to be normalized to the reference distance. For that normalization, the method specified in clause 5.1 shall be used.

5 Processing of obtained results

5.1 Graphical method for normalizing the measured field strengths to the reference measurement distance

During measurements of disturbance field strengths local restrictions in space (appearing e.g. during indoor measurements) may require a reduction of the measuring distance to less than the reference measurement distance. The actual measurement distance may be smaller than the reference distance, but not closer than 1 m to the cable to be assessed. In the case of outdoor measurements, it may also be necessary to use a measurement distance which is larger than the reference distance.

If a measurement distance greater or smaller than the reference measurement distance needs to be used, then three different and accessible measuring points located along the measuring axis shall be chosen. The distance between these points should be as large as possible. At each point, the level of the disturbing field strength shall be measured. The local conditions and measurability of the disturbance field strength will be the determining factors.

The measurement results shall then be plotted in a diagram showing the field strength levels in dB(µA/m) or dB(µV/m) versus the logarithm of the measurement distance. The line interconnecting the measurement results represents the slope in field strength along the measuring axis. If this slope cannot be determined, then additional measuring points shall be chosen. The field strength level at the reference measurement distance can be read from the diagram using the straight prolongation of the interconnecting line.

5.2 Correction of measurement results due to near field conditions

Measurement results for the magnetic or electric disturbance field strength obtained by means of the measuring system described in clause 4.2 do not need any related subsequent correction, even if measured under near field conditions.

6 Radiated emissions' characteristics

100 % of the measurements of radiated emissions from state of the art powerline communication networks are below the value given in table 1.

Table 1: Radiated emissions from powerline communication networks below 30 MHz

Frequency range (MHz)	Field strength (dB(µA/m) quasi-peak)	Reference measurement distance (m)	Measurement bandwidth (kHz)
1,605 to 30	14	3	9

80 % of the measurements of radiated emissions from state of the art powerline communication networks are below the value given in table 2.

Table 2: Radiated emissions from powerline communication networks below 30 MHz

Frequency range (MHz)	Field strength (dB(µA/m) quasi-peak)	Reference measurement distance (m)	Measurement bandwidth (kHz)
1,605 to 30	4	3	9

History

Document history		
V1.1.1	May 2004	Publication