

# EU Regulation of high-speed Powerline Communication in the spectrum 150-500 kHz

## Abstract

There is a widespread misconception that the usage of Powerline Communications (PLC) within the frequency range 150-500 kHz would be forbidden in Europe. Within this rumor the terms “regulation”, “standardization” and “market access” get mixed up in various ways, as well as the distinction between the competences of regulatory authorities, both on EC or national level, and standardization organizations such as “CENELEC”. Therefore this paper first provides general information on the regulatory regime in Europe.

Then the specific technical assessment for PLC in 150-500 kHz is provided, so that products can gain the CE certification. Yes – devolo delivers PLC products in the spectrum 150-500 kHz with CE certification!

## Table of Content

1. Introduction .....	2
2. The applicable regulation .....	2
3. Market access regulation.....	3
4. devolo’s EMC assessment on PLC products between 150-500 kHz.....	4
5. Regulation in the case of interference complaints.....	5
6. Risk assessment of interference complaints.....	6
7. Comparison with PLC above 1,6 MHz .....	9
References.....	9

## **1. Introduction**

This paper focuses on EMC aspects in the EU. Please note that for a CE sign also other aspects such as e.g. electrical safety are important that are not considered by this paper.

Directives from the European Commission (EC) define the EU regulatory structure, while official (“de jure”) standardization organizations such as ETSI and/or CENELEC describe the specific limits.

The EC is of the belief that the same regulation principles should be applied to all telecommunication devices irrespective of the underlying technology. Consequently PLC systems cannot exceed the radiation levels of other telecommunication technologies such as, e.g. digital subscriber lines. Furthermore comparable measurement processes are applied, considering that mains and telecommunication port are the same for PLC devices.

## **2. The applicable regulation**

As a rule PLC equipment is classed as telecommunication equipment and is controlled in the EU under the framework of the EMC Directive 2014/30/EU [2]. The former EMC Directive 2004/108/EC [1] is repealed by April 20<sup>th</sup> 2016. The legal structure and the relevant rules are laid out in the EMC Directive, where it differentiates between installations and consumer products. However it does not describe technical aspects such as measurement setups and/or boundaries. Both market access and interference complaint handling are covered by the EMC Directive.

The Radio Equipment Directive (RED) 2014/53/EU [4] becomes relevant for PLC products that link to wireless systems such as WiFi or ZigBee. The EMC rules of the EMC Directive are valid for all types of PLC because the RED refers to the EMC Directive for EMC aspects. RED replaces the former Radio and Telecommunications Terminal Equipment (R&TTE) Directive 1999/5/EC [3] which is repealed with effect from 13 June 2016. Both, the EMC and the RED have to be converted into national law by the EU member states. So, the regulation applies in all EU member countries.

The manufacturers need to certify with a Declaration of Conformity (DoC) whether their product complies with these directives. As the old EMC as well as the R&TTE Directives will be repealed in Q2'2016, devolo has to recertify the DoC of all its products as the DoC gives exact reference to the applied directive and needs to be changed to the new applicable directive.

The perception, that CENELEC would regulate Europe, is totally wrong. CENELEC produces standards that can but do not need to be referred to by a manufacturer (please see further explanations section 3).

### **3. Market access regulation**

The above mentioned EMC [2] or RED [4] Directive regulates market access, and the EMC relevant part is ruled by the EMC Directive. The goals of the EMC Directive are to ensure the unrestricted movement of apparatus, installations and networks within the EU, and to preserve a suitable EMC environment. The second goal is aimed firstly by guaranteeing that electromagnetic disturbances emitted by an apparatus do not interfere with the functioning of another apparatus as well as radio and telecommunication networks, related equipment and electricity distribution networks, but also by ensuring that the apparatus has a sufficient level of inherent immunity to permit it to operate as envisioned in the presence of electromagnetic disturbances.

Therefore, emission and immunity requirements are an essential part of the protection requirements.

When products comply with the EMC regulation market access is approved. For this purpose, product specific compliant tests are necessary. Directive 2014/30/EU is a so-called “New Approach Directive” requiring manufacturers’ self-declaration. According to this directive a manufacturer is permitted to evaluate the EMC of its products

- a) either by compliance with a European Harmonized Standard, which is EN 50065 for narrowband PLC in the spectrum 3-148,5 kHz,
- b) or by carrying out an EMC assessment centered on manufacturers’ own procedures and approaches.

The certification of these procedures and methods by an independent Notified Body (as defined by the EMC Directive) are normally included in option b). These procedures and methods are usually the result of discussions in the relevant standardization platforms. In the case of PLC in 150-500 kHz, devolo refers to the present IEEE P1901.2 draft.

Irrespective of which option has been selected, the manufacturer is compelled to provide a statement of conformity declaring the compliance of its products with the protection requirements based on the EMC Directive. The “Conformité Européenne” (CE) marking is proof of product compliance with all appropriate directives (e.g. safety etc.).

Option b) still remains a valid option, although one day a European Harmonized Standard should be available for 150-500 kHz PLC. Should a European Harmonized standard come into existence, the manufacturer will only have to explain why he prefers to maintain his own procedures and methods. A potential argumentation line could be based on the installed embedded base without interference problems at that time. The argumentation is also only needed for new products – already certified products do not need to be recertified.

In the meaning of the EMC Directive 2014/30/EU, access PLC networks and equipment are considered as installations. Variations in their applications such as usage as part of the public telecommunication set-up or in Smart Grids (as part of a corporate utility network) have an effect on the overall regulatory structure but not with regards to the EMC position. The guidelines for market access for installed access PLC devices, such as head-ends or repeaters, differ from those that apply to access PLC end-user modems (CPEs). As laid out in the EMC Directive, the CE mark is not required on installed access PLC devices. However

as the CE mark indicates conformance to all applicable directives for a particular product, therefore including compliance with EMC requirements, most PLC operators (e.g. power utilities) nevertheless require the CE mark in their procurement regulations and will only use CE marked products for installation in their power grid. When on sale to consumers, access PLC CPEs require CE marking. As CPEs are network terminals, they could come under the regulation of the RED [4]. However as the RED refers to the EMC Directive for EMC aspects, this is immaterial to the extent that EMC is affected.

In April 2005 [6] the EC announced a Commission Recommendation on broadband electronic communications through power lines. The crucial element regarding market access in the above mentioned recommendation is that ex-ante conformity assessment is not a requirement. In other words, the basic theory is that PLC products are legal and do not require specific ex-ante regulation. Ex-post regulation is applicable only in the interference complaint case. As the recommendation does not define the applicable frequency range, it is assumed that it is applicable to any PLC system that is in the spectrum above “CENELEC” PLC [5] and in consequence “broader”, that means it is applicable for 150-500 kHz as well.

#### **4. devolo’s EMC assessment on PLC products between 150-500 kHz**

There is no European Harmonized Standard for PLC above 148,5 kHz<sup>1</sup>. This statement is sometimes challenged by the anti-PLC lobby with reference to EN55022 resp. CISPR22. The EC made it completely clear in several references, latest in a letter from EC to CENELEC [8] with “...*The Commission services responsible invite CENELEC ... to prepare a modified version of EN55022:2006 for PLT. Modifications should cover all PLT technologies and should cover both network and home apparatus...*” CENELEC reacted to this letter by forming a new working group (TC210 WG11) with the core statement “*Specify limits and methods of measurement of radio disturbance characteristics above 150 kHz for telecommunication equipment using low-voltage power lines as a transmission medium.*” in the working group’s Terms of Reference [9]. WG11 organized its work within several steps. First inhouse PLC from 1,6 MHz to 30 MHz was addressed. There is at present a draft prEN50561-1 under the approval process. There is no draft available for the spectrum between 150-500 kHz, yet, as the working group wants to approve the first standard before proceeding with other aspects.

As there is no European Harmonized Standard for PLC above 148,5 kHz available, option b) in section 3 is the only option. As already described, devolo is free to choose its own procedures and methods for assessment. So devolo developed together with University of Duisburg-Essen a proposal for 150-500 kHz which is derived from the present discussions in CENELEC concerning inhouse PLC between 1,6-30 MHz. The development of this proposal was based on sound research within the background of more than 10 years’ experience with EMC assessment of PLC above 1,6 MHz which is exactly in the same situation. In order to make tests easier reproducible in labs, a conducted measurement approach was chosen. Therefore, the relation between conducted and radiated signals needed to be carefully

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<sup>1</sup> below 148,5 kHz: EN50065 [5]

examined and verified in theory, by simulation, with radiated measurements in the lab (Figure 1) and during devolo's field trials in Vattenfall's power grid (Figure 2, Figure 3, Figure 4).



**Figure 1 Evaluation of resulting radiation at University of Duisburg-Essen**

devolo introduced this proposal into IEEE P1901.2 for review. This EMC assessment is now part of the draft IEEE P1901.2 standard and following the IEEE approval process. devolo is using the specified procedure and method for its G3 based product developments. The tests are done by independent test houses, the evaluation and certification are done by a Notified Body. Hence, devolo's G3 based products will have CE sign.

## **5. Regulation in the case of interference complaints**

All broadband systems (DSL, CaTV, Ethernet, etc.) produce radiation. This radiation can theoretically interfere with radio services. In 2001, the EC issued mandate 313 to ETSI/CENELEC/CEN to outline a harmonized standard for radiation restrictions which should apply to all telecommunications technologies including PLC. Thus, the radiation boundaries shall be technology-neutral for all broadband telecommunications technologies. Network radiation is not to be regulated by individual countries. The ETSI/CENELEC Joint Working Group accepted Mandate 313. The Joint Working Group decided to split up the work into 3 standards, from which one is dedicated to PLC (50529-3). 50529-3 is pending. The mandate has not been returned to the EC as long as the standard remains pending/undecided. Therefore, separate national actions are illegal.

The document Recommendation (05)04 by the Electronic Communication Committee (ECC) [7] is often taken as reference in the context of EMC regulation. This recommendation doesn't have any normative regulatory impact and is intended for information purposes solely.

The initial fact to be assessed when approaching an interference complaint is whether interference is damaging or not. The EC Recommendation on PLC [6] declares in Article 4:

*Where it is found that a powerline communications system is causing harmful interference that cannot be resolved by the parties concerned, the competent authorities of the Member State should request evidence of compliance of the system and, where appropriate, initiate an assessment.*

Consequently, it is not deemed damaging interference, if, for example, a radio receiver has been positioned intentionally directly next to a street-cabinet with PLC equipment. If the radio user does not use up-to-date modern equipment, it is also inappropriate to ask the PLC operator for interference mitigation. If interference is considered damaging, the mitigation procedures should be proportionate.

The EC Recommendation on PLC declares in Article 5:

*If the assessment leads to an identification of non-compliance of the powerline communications system, the competent authorities should impose proportionate, non-discriminatory and transparent enforcement measures to ensure compliance.*

For example, it is proportionate to ask for mitigation only at the very site and frequency at which interference actually happened. So, a PLC installation cannot be stopped by single complaints.

The control function of the EC reduces errors by EU member states when applying the EC recommendation. The EC Recommendation on PLC declares in Article 7:

*Member States should report to the Communications Committee on a regular basis on the deployment and operations of powerline communications systems in their territory. Such reports should include any relevant data about disturbance levels (including measurement data, related injected signal levels and other data useful for the drafting of a harmonised European standard), interference problems and any enforcement measures related to powerline communications systems.*

## **6. Risk assessment of interference complaints**

If an interference complaint is filed, it does not matter whether the manufacturer of the suspected equipment has chosen option a) or b) out of section 3. The National Regulatory Authority has to assess the interference complaint and eventually mitigate it after examination anyway.

In order to assess the risk of interference complaints, devolo together with University of Duisburg-Essen measured the radiation during its field trial at Vattenfall Hamburg (Figure 2, Figure 3, Figure 4) and will measure it as well during upcoming field trials in other countries and power grids.



**Figure 2 EMC measurements beside an installation**



**Figure 3 EMC measurements in the cellar beside the meter**



Figure 4 EMC measurements in a substation

In most of the measured installations, the PLC signal was not even visible in the EMC noise floor. In some cases, it was visible when measured in 1m distance, but not anymore in 3m distance. Figure 5 shows one of highest radiation measured.

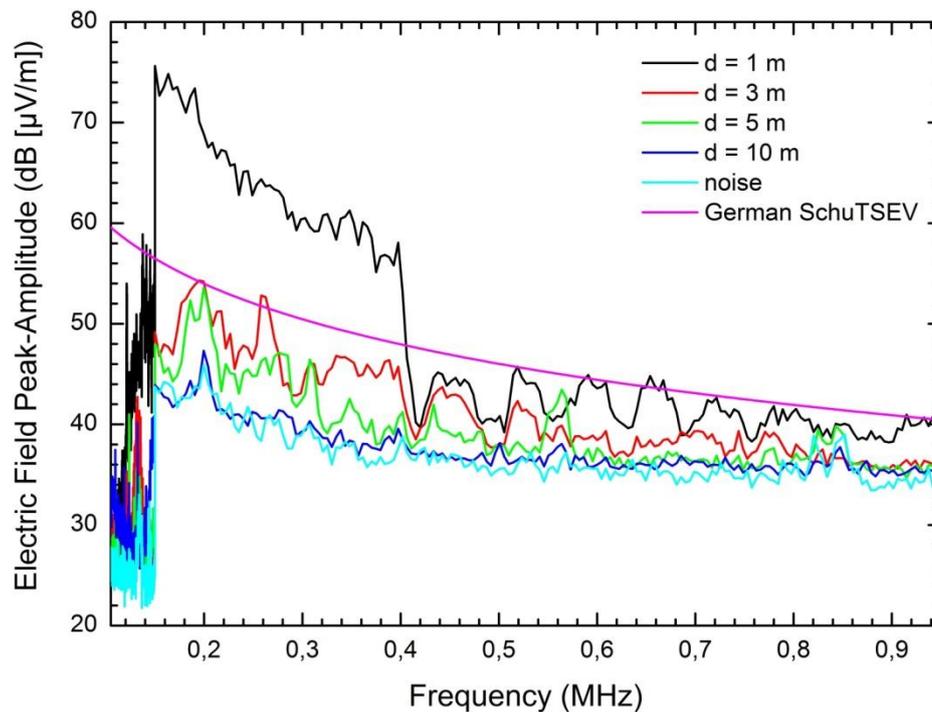


Figure 5 EMC Test Results

The results are compared with the radiated limits proposed for any system (not PLC specific) by the German SchuTSEV [10]. The intention of the SchuTSEV is to guarantee higher protection of safety relevant frequencies on a national level. The SchuTSEV is sometimes discussed contentiously as it is an individual national measurement. devolo compared its

measurement results with the SchuTSEV limits as exactly the same measurement method was used and the limits are the most stringent ones from the PLC perspective. SchuTSEV defines the limits for a measurement distance of 3m. Hence, in Figure 5 only the 3m result (red curve) can be compared to the SchuTSEV limits. As one can see, the PLC radiation is pretty within the limits.

The potentially interfered radio services within the spectrum 150-500 kHz are long-wave radio broadcasters and beacon frequencies of airports. The SchuTSEV does not apply for either, that means that the German BNetzA foresees less protection for this band than the stringent SchuTSEV limits. Therefore, based on devolo's radiation measurements, the probability of interferences is firstly very, very low and secondly the probability that the regulator will act in an interference case is very low, too. However, if an interference case should occur, the mitigation will happen on specific measures exactly on this case (mitigation at the very location and in the very frequency) – it will never result in a complete switch-off the PLC system.

As interference mitigation is within the competence of a National Regulatory Authority, the situation in the case of an interference complaint is open within the limits given by the EMC Directive. As the EC Recommendation [6] attempts for a coordinated approach within the EU, the risk that interference complaint might be dealt with differently by different national regulatory authorities is low.

## **7. Comparison with PLC above 1,6 MHz**

For many years, there was only an European Harmonized Standard available on EMC for 3-148,5 kHz. None of the other PLC applications had back-up by an European Harmonized Standard. For inhouse PLC between 1,6-30 MHz, the CENELEC standard EN50561-1 is now available. For access PLC or inhouse PLC ranging also above 30 MHz (as e.g. IEEE 1901 or ITU G.hn compliant PLC systems) there is exactly the same situation as for 150-500 kHz.

Since mass deployment of PLC above 1,6 MHz during the last 12 years, in particular HAM radio guys filed interference complaints and sent it to different National Regulatory Authorities. Within the frequency range of 150-500 kHz, there are no HAM frequencies. Therefore, the waves of complaints fostered by HAM organizations will not happen here.

Only very few of these complaints on broadband PLC have been approved as harmful interferences. These cases were mitigated by e.g. notching. The statistics on these harmful interferences compared to the total number of deployed broadband PLC devices in Europe (estimated with more than 30 Mio) is such that they are not statistically relevant. There was never a risk that broadband PLC will be stopped Europe-wide, although some National Regulators were trying to tackle broadband PLC. With a few court law decisions supporting the PLC approach, this tackling has stopped.

## **References**

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