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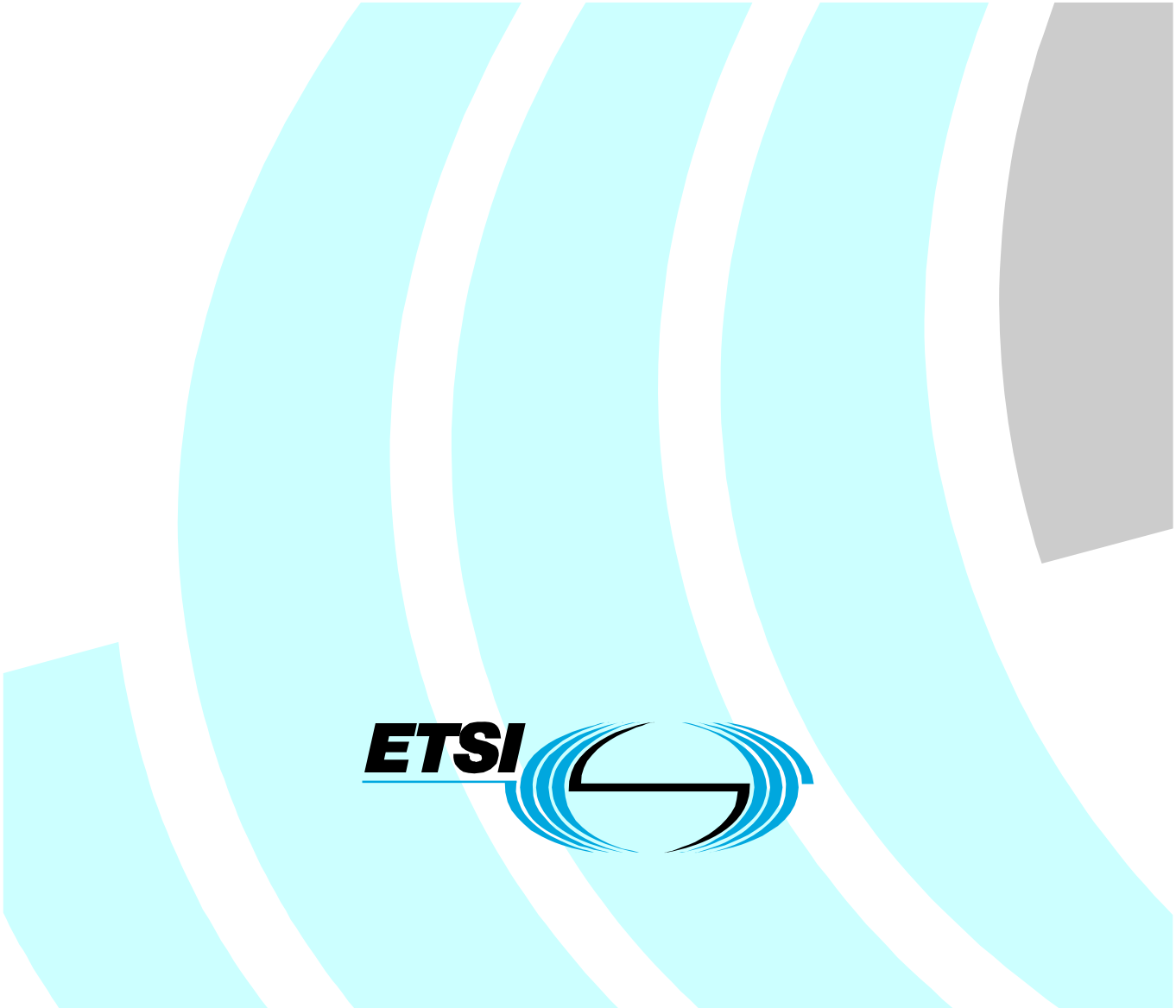
Technical Specification

Powerline Telecommunications (PLT); Programmable PSD Mask; Specifications for Access and Indoor Systems



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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Powerline Telecommunications (PLT).

The present document describes the requirements for the programmable PSD mask for PLT Access Network systems and PLT Indoor systems.

Introduction

The PLT equipment integration involves the development of technology within two main layer architectures: the physical layer and network layer. The Physical layer deals with the electrical systems while the network layer deals with the transmission technology.

The integration of the physical and network layer technologies allows high-speed data to be transmitted over existing utility power lines to customers' premise.

In order to modulate the EMC behaviour of PLT transceivers, the PSD mask can be reshaped by introducing notches corresponding to sensitive frequency bands in specific locations, as it is for instance performed in VDSL [2].

The mechanisms for defining notches over the PSD mask of a PLT device specified in the present document are very useful in the very specific areas where interferences might be encountered. For these reasons it is useful to have the PSD mask of the PLT devices to be programmable in order to better coexist with other users of the spectrum.

PSD programmability can be applied to provide spectral compatibility between PLT applications and non-PLT applications.

Narrow band radio signals may couple onto the electrical lines. This effect may interfere with the PLT operation. The programmable PSD specifications defined in the present document will enhance the performance of the PLT network by avoiding the frequencies of the interference.

The present document specifies the programmability of the PSD mask and the activation of notches for PLT modems to ensure coexistence with radio services locally used in the specific neighbourhood where a PLT system is deployed.

1 Scope

The present document specifies PSD characteristics for high frequency PLT transceivers providing digital transmission on power cables. The present document is applicable to a modem in a PLT access transmission systems or PLT Indoor LAN systems designed to provide communications over electrical wires. It is concerned with the key functional and electrical requirements for PLT.

The present document gives the definition of common parameters characterizing the PSD mask, the methods for initiating them in the context of PLT modems and finally a measurement method in order to verify the compliance of the PSD of a PLT modem with the present document.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
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For online referenced documents, information sufficient to identify and locate the source shall be provided. Preferably, the primary source of the referenced document should be cited, in order to ensure traceability. Furthermore, the reference should, as far as possible, remain valid for the expected life of the document. The reference shall include the method of access to the referenced document and the full network address, with the same punctuation and use of upper case and lower case letters.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] ITU-R Radio Regulations(2004).

[2] ETSI TS 101 270-2: "Transmission and Multiplexing (TM); Access transmission systems on metallic access cables; Very High Speed Digital Subscriber Line (VDSL); Part 2: Transceiver specification".

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area**.** For non-specific references, the latest version of the referenced document (including any amendments) applies.

Not applicable.

3 Definitions and abbreviations

3.1 Definitions

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

depth: reduction of the Power Spectral Density (PSD) in the notch: amount of the reduction of transmission power in the notch

NOTE: The depth of notch is measured at that frequency showing the weakest attenuation in the frequency band of the notch. It can be given either in dB representing the additional attenuation or in dBm/Hz already taking the non-reduced PSD into account.

notch: significant reduction of transmission power in a given frequency band

NOTE: The notch is characterized by the features defined in figure 1.

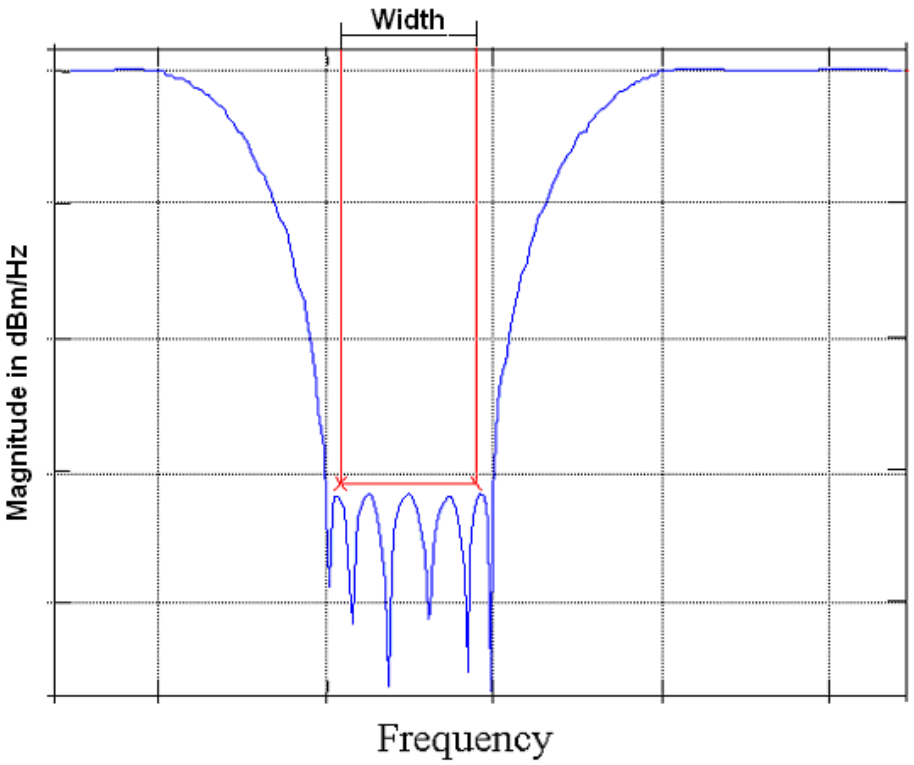

Figure 1: Illustration of a notch

PLT modem: functional unit that modulates and demodulates signals in order to enable digital transmission over the electricity lines and that can be functionally and physically integrated within an equipment with other functionality

scalability of the width: ability to change the width of a notch

NOTE: The scalability can be either adjustable continuously or in steps. Steps are given in kHz.

slopes: transmission power frequency profile between the frequencies at which the PSD is at its nominal level and those at the depth of the notch

NOTE: There are two slopes: One slope coming from the lower frequencies and the other towards the higher frequencies. Each slope is defined uniquely by its start and stop frequencies as well as their start and stop attenuation accordingly. From these numbers the mean slopes are calculated and provided in degrees (°).

width of the notch: frequency band inside which the PSD shall always be equal or lower than the specified depth

NOTE: The width is measured in kHz.

3.2 Abbreviations

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

AE	Auxiliary Equipment
EMC	Electro-Magnetic Compatibility
EUT	Equipment Under Test
LAN	Local Area Network
MIB	Management Information Base
MN	Measurement Network
OMC	Operation Maintenance Centre
PLT	Power Line Telecommunications
PSD	Power Spectral Density
QoS	Quality of Service
SNMP	Simple Network Management Protocol
SNR	Signal to Noise Ratio

4 Transmitter power back off

The equipment shall implement transmit power control in order to improve its EMC behaviour.

The PLT transmitter implementing this technique shall have the ability to reduce its transmit PSD whenever the required SNR margins to achieve the service level or maximum throughput at the corresponding receiver is exceeded significantly. The adjustment is realized by attenuating the amplitude of the transmit signal. In case the system cannot obtain the specified SNR margin then the corresponding transmitter will transmit at its maximum allowed power spectral density. The power back off adaptation of the PSD should take into account the time and frequency characteristics of the received SNR.

The manufacturer shall determine both the transmit signal attenuation step size and number of steps.

The level of transmitter power backoff technique shall not prevent the applications using PLT to operate as required.

5 Notching

5.1 Notches frequency locations

The modem shall be able to notch out any frequency within the operating frequency band of the modem.

5.2 Notch activation mechanisms

The manufacturer shall implement at least one of the four notch activation mechanisms specified in this clause. The following clauses show the possibilities and define the criteria so that different systems are comparable for the user in a standardized way.

5.2.1 Automatic Modem Initiative

5.2.1.1 Inquiry to the Outside

This mechanism is based on a "Pull it" technique. The PLT equipment automatically initiates the retrieval of the notching information from an external source.

For this type of activation method a data connection from the PLT device to an equipment located remotely is required.

This activation method shall be activated at the first initialization of the PLT device at the end customer's site, and at least every **month**.

For instance a web client implemented on the modem downloads the list of notches and characteristics from the Internet or Intranet.

The information of the notches can be "pulled" for example from a proxy server (dealing with PLT information) or from the manufacturer's home page.

5.2.1.2 Autonomous configuration

Within this mechanism, the PLT equipment senses the electricity line or uses a wireless interface to detect whether relevant radio carriers are in operation at the specific location. If the PLT equipment detects radio carriers, the PLT system will notch out these frequencies.

In this mechanism there is no communication from the PLT equipment to any external device to retrieve the notching information.

A PLT equipment with a wireless interface is a combined example of "pull" and "push" methods. For example a radio set with an embedded PLT modem in which the radio set instructs the PLT modem to notch out frequencies to which the radio is currently tuned (by any interface).

5.2.2 External initiative

This mechanism is based on a "Push it" technique. An external source, local or remote to the PLT equipment, initiates the communication with the PLT equipment to send the notching information.

For instance an SNMP client with which a service provider or operator configures the notches on the PLT equipment.

5.2.2.1 Local Initiative

A PLT system shall have a local interface (human user interface or serial port, etc.) to enter the notches information.

Within this option, the manufacturer provides the end-user with tools so that the end-user can activate the notch on his modem.

For example the end-user can download the notch-activation software through the Internet. After executing the software, the notch will be permanently activated until another download of the notch-activation software. A second example can be that the PLT system offers a human interface where a list of notches can be programmed on to the PLT modem.

5.2.2.2 Remote, OMC (Operations Maintenance Centre), Initiative

Within this mechanism, the activation of a notch in the PLT modem is done remotely from an operations and maintenance centre.

For example this can be performed using SNMP and an appropriate MIB defined in the PLT equipment.

5.3 Notch activation characteristics

The notches shall be activated minimizing the impact on the payload traffic being communicated by the PLT devices affected. For instance the PLT devices could look for the appropriate moment to activate the notches, when there is no payload traffic being communicated or with low QoS requirements.

Once the new information of notches has been received the PLT device shall start the PSD change at most 5 minutes later.

The PSD change itself shall not take longer than 1 s.

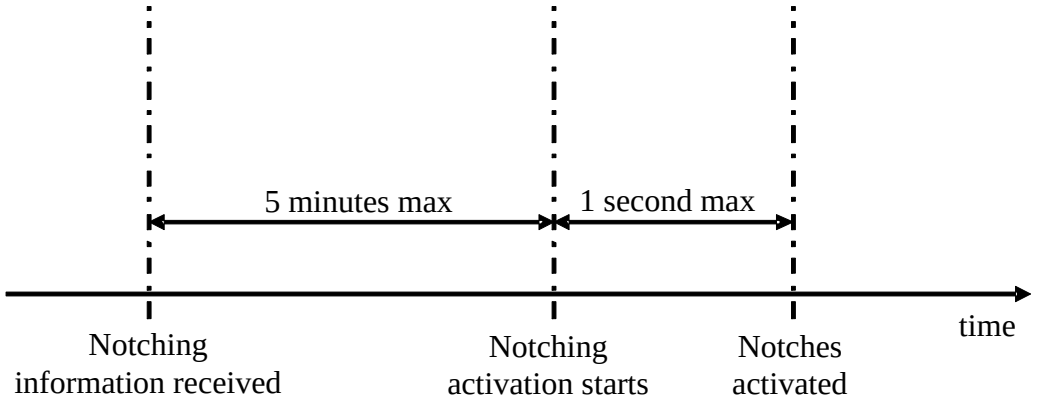

Figure 2: Notch activation timing

5.4 Specification of PSD Notch characteristics

5.4.1 Depth: Level of the Power Spectral Density (PSD) in the notch

The depth requirement for a PSD notch may vary depending on the interference scenario. At a minimum the PLT modem shall have the ability to create notch such that the PSD in the notch frequency band is at least 23 dB below the PSD in the un-notched frequency band.

5.4.2 Width of the notch

The minimum width of the notch shall be at least 10 kHz covering the narrowest ingress signals.

5.4.2.1 Scalability of bandwidth

The width of the notches shall be scalable in step sizes of at least 10 kHz in order to adapt to the bandwidth of the frequency allocation to the services defined in ITU-R Radio Regulations [1].

5.4.3 Number of programmable notches

The minimum number of notches that shall be possible to activate at the same time is 15, regarded as a good trade off between the PLT performance and the EMC behaviour of PLT transceivers.

5.4.4 Minimum Total Notched Bandwidth

The PLT modem shall be capable of activating a Total Notched Bandwidth.

The Total Notched Bandwidth is defined to be the sum of the width of all implementable notches.

The minimum Total Notched Bandwidth shall be 5 % of the HF band (from 3 MHz to 30 MHz).

6 Verification of the PSD

The purpose of this clause is to measure the PSD of the modem transmitting data over electrical wires and verify the active notches and check their depth.

The PLT modem under test shall be transmitting at its maximum signal level and at its maximum traffic capacity.

The following figure shows the test set up that shall be used to verify compliance of the PSD with the provisions of the present document.

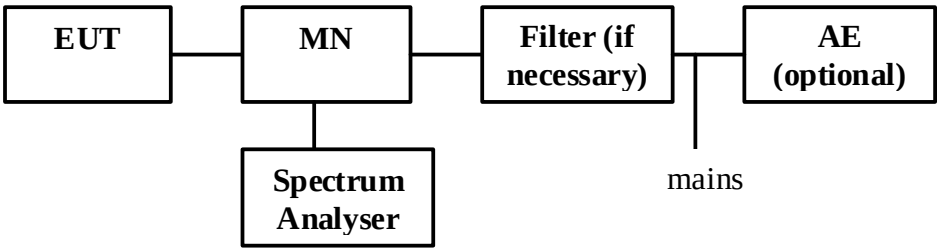

Figure 3

The PLT port of the Equipment Under Test (EUT) shall be connected to the PLT port of the Measurement Network (MN). The MN shall also have a measurement port to which a spectrum analyser is connected to record the measurement results. Additionally the MN shall have a mains port that shall be connected to the electricity network for providing electrical supply on the PLT port. Auxiliary Equipment (AE) may be connected also to the mains port of the MN if required for the EUT to perform correctly. In order to avoid that noise coming from the electricity network disturbs the measurement results it may be needed to include a filter between the mains port of the MN and the electricity network.

The electrical characteristics of the different circuits of the test setup, in the frequency range from 1 MHz to 30 MHz shall be:

- The PLT and the mains ports of the MN shall have a differential input impedance of 100 Ω.
- The measurement port of the MN shall have a differential input impedance of 50 Ω.
- The measurement port of the MN shall be isolated from the PLT and mains ports with a transformer.
- The attenuation of the differential signal between the PLT and the mains ports of the MN shall not be more than 3 dB.
- The attenuation of the common-mode signal between the PLT port and the mains port and between the PLT port and the measurement port of the MN shall be at least 60 dB.
- The attenuation of the differential signal between the ports of the optional Filter shall be of 30 dB ± 3 dB.
- The ports of the optional Filter shall have a differential input impedance of 100 Ω.

The measured values shall be corrected taking into account the attenuation of the differential signal between the PLT and the measurement ports of the MN.

For the purposes of compliance with this requirement, the amplitude of the PSD is plotted on a spectrum analyser as a function of frequency, scanned from 1 MHz to 30 MHz using a resolution bandwidth of 10 kHz.

Annex A (informative): Examples of measurement circuits

This annex is not normative, it is for information, the purpose of this clause being to give some diagrams of electrical circuits allowing the measurement of a PSD of PLT modem in order to verify the implementation of notches and their characteristics given above.

Figures A.1 and A.2 show examples of circuits that can be used as Measurement Networks (MN), for measuring the PSD.

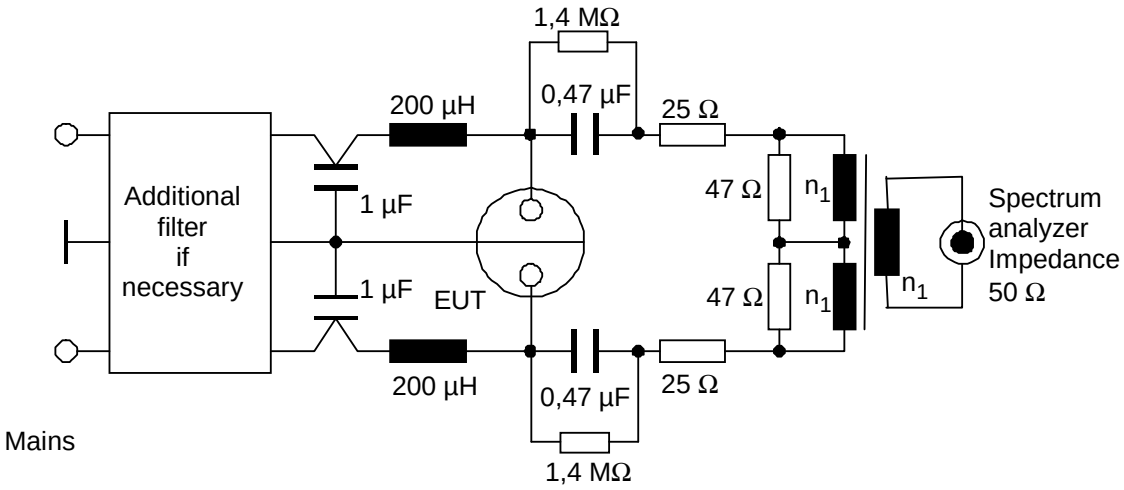

Figure A.1: Measurement of the PSD

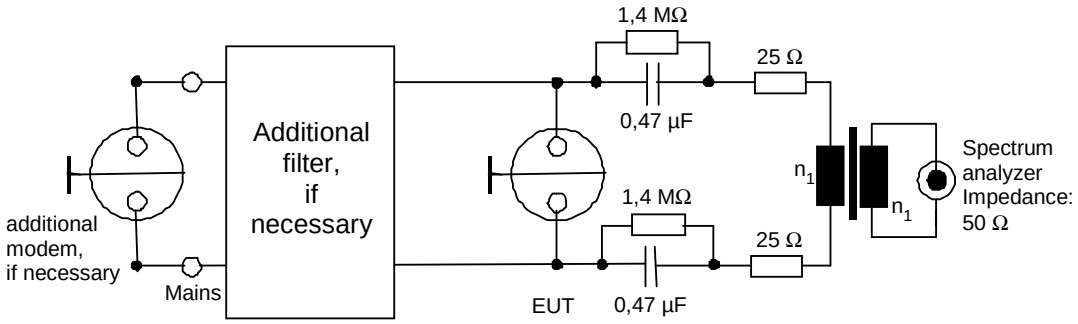

Figure A.2: Measurement of the PSD

The value read on the spectrum analyzer must be corrected by +6 dB due to the serial impedance matching resistors (2 × 25 Ω) when using the second example shown above.

The additional filter, if required, can be implemented as shown in figure A.3.

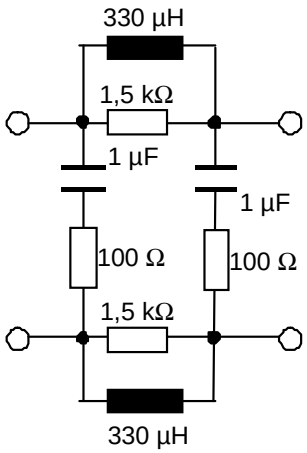

Figure A.3: Additional filter electrical diagram

History

Document history		
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