ETSI TS 101 952-2-2 V1.1.1 (2003-03)

Technical Specification

Access network xDSL transmission filters;
Part 2: VDSL splitters for European deployment;
Sub-part 2: Specification of the high pass part of VDSL/POTS splitters for use at the Local Exchange (LE) and the user side near the Network Termination Point (NTP)

Reference

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Keywords

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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM).

- AT Analogue of Technical Committee Access and Terminals (AT);
- and TM6 of Technical Committee Transmission and Multiplexing (TM).

The present document is part 2 sub-part 2 of a multi-part deliverable covering different aspects of European specific DSL splitters, as identified below:

Part 1: "ADSL splitters for European deployment";

Part 2: "VDSL splitters for European deployment";

Sub-part 1: "Specification of the low pass part of VDSL/POTS splitters";

Sub-part 2: "Specification of the high pass part of VDSL/POTS splitters for use at the Local Exchange (LE) and the user side near the Network Termination Point (NTP)";

Sub-part 3: "Specification of VDSL/ISDN splitters for use at the Local Exchange (LE) and the user side near the Network Termination Point (NTP)";

NOTE: The choice of a multi-part format for this deliverable is to facilitate maintenance and future enhancements.

The present document is fully in line with initiative "eEurope 2002 - An Information Society For All", under "The contribution of European standardization to the eEurope Initiative, A rolling Action Plan" especially under the key objective of a cheaper, faster and secure Internet.

1 Scope

The present document describes requirements and test methods for DSL splitters. The present document specifies requirements and test methods for the high pass part of VDSL over POTS splitters to be used at the Local Exchange and at the user side near the NTP. The present document is derived from TS 101 952-1-2 [4], describing requirements for ADSL over POTS splitters. A consequence of this is that the filter described in this document can only be applied to VDSL over POTS in an environment where the VDSL pass band starts around 25 kHz, i.e. the upstream band US0 TS 101 270-1 [3] is used.

The high pass filter described in this document is intended to be used in conjunction with a low pass part defined in TS 101 952-2-1 [5], and with a practical VDSL transceiver impedance defined in [3]. If VDSL splitter parts and VDSL transceivers, which are not intended to inter-operate, are combined then severe problems of incompatibility might arise.

There are at least two more variants under study for the high pass filter, and for the related low pass in conjunction with the relevant VDSL impedance:

- Where the VDSL passband starts at around 138 kHz and the VDSL transceiver impedance is close to the nominal design impedance above 138 kHz, for application in which the US0 band is not used.
- Where the VDSL passband starts at a frequency higher than around 900 kHz and the VDSL transceiver impedance is close to the nominal design impedance above this frequency, for instance in a cabinet deployment where the band below around 900 kHz is not used in order to be spectrally compatible with ADSL from the Central Office.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- 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.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

[1] ETSI EN 300 001: "Attachments to the Public Switched Telephone Network (PSTN); General technical requirements for equipment connected to an analogue subscriber interface in the PSTN".

[2] ITU-T Recommendation O.9: "Measuring arrangements to assess the degree of unbalance about earth".

[3] ETSI TS 101 270-1 : "Transmission and Multiplexing (TM); Access transmission systems on metallic access cables; Very high speed Digital Subscriber Line (VDSL); Part 1: Functional requirements".

[4] ETSI TS 101 952-1-2: "Access network xDSL transmission filters; Part 1: ADSL splitters for European deployment; Sub-part 2: Specification of the high pass part of ADSL/POTS splitters".

[5] ETSI TS 101 952-2-1: "Access network xDSL transmission filters; Part 2: VDSL splitters for European deployment; Sub-part 1: Specification of the low pass part of VDSL/POTS splitters".

3 Abbreviations

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

CPE	Customer Premise Equipment
DSL	Digital Subscriber Line
ITU	International Telecommunication Union
LE	Local Exchange (Central Office)
NTP	Network Termination Point
POTS	Plain Old Telephone Service
TE	Terminal Equipment (e.g. Telephone, Fax, voice band modem, etc.)
VDSL	Very high speed Digital Subscriber Line

4 General functional description of VDSL over POTS splitters

The main purpose of the VDSL over POTS splitter filter is to separate the transmission of POTS signals, and VDSL band signals, enabling the simultaneous transmission of both services on the same twisted pair. The splitter also serves to protect POTS from interference due to egress (and ingress) from VDSL signals. Equally it protects the VDSL transmission from transients generated primarily during POTS signalling (dialling, ringing, ring trip, etc.), and it must also prevent interference to the VDSL service due to fluctuations in impedance and linearity that occur when telephones change operational state (e.g. from off-hook to on-hook).

The splitter filter may be implemented as an independent unit, separately from the VDSL transceiver, or may be integrated with the VDSL termination unit.

4.1 Functional diagram

The functional diagram for the splitter combination is given in figure 1.

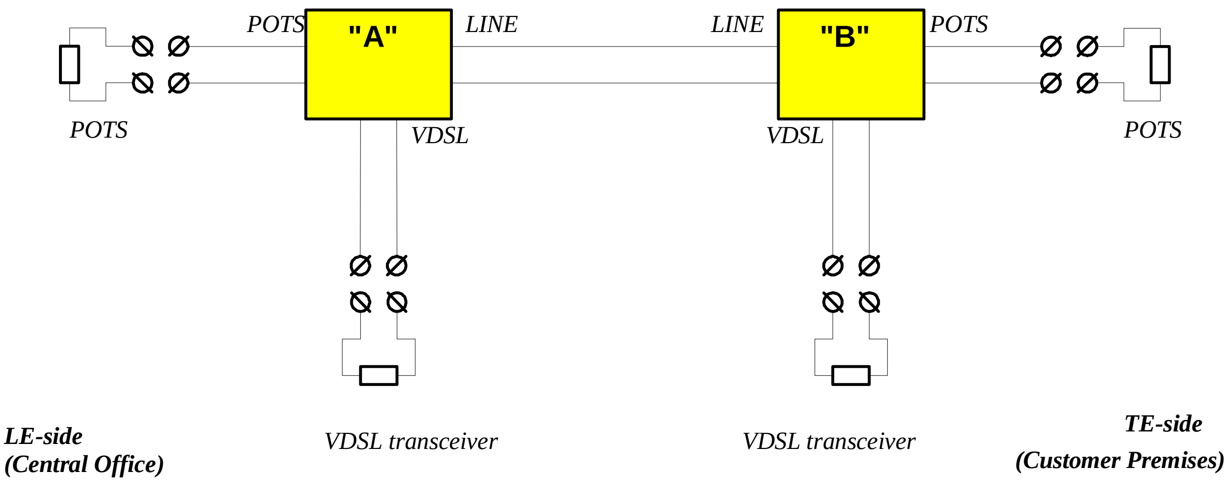


Figure 1: Functional diagram of the DSL splitter configuration

The transfer functions between the different ports of the splitter can be understood as follows:

- The transfer function from the POTS port to the LINE port and vice-versa is that of a low-pass filter.
- A very high level isolation is required from the VDSL port to the POTS port and vice-versa to prevent undesirable interaction between VDSL and any existing narrowband services.
- The transfer function from the VDSL port to the LINE port and vice-versa is either that of a high-pass filter, or it may be all pass in nature, in the case where the full high pass filter function is implemented in the DSL transceiver (see TS 101 952-1-2 [4] and the present document).

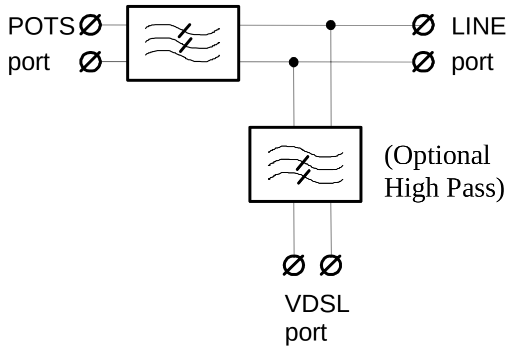


Figure 2: Structure of the VDSL splitter filter

5 High pass filter options

The high pass filter, as referred to in the present document, is the series high pass filter that is located in the splitter unit. It is distinct from the input high pass filter of the VDSL modem, which is located in the VDSL transceiver.

Reasons for including a series high pass filter in the LE splitter unit include the following:

- safety to uncouple the POTS line from damage due to the VDSL service;
- DC decoupling, to avoid "stealing" POTS service from the premises of an alternative operator;
- POTS privacy, when VDSL is supplied by an alternative operator, to avoid "listening".

In the case of a CPE filter, the role of the series high pass filter is less important. It provides DC de-coupling between the POTS and VDSL, and presents a more controlled impedance to the low pass filter at the VDSL port (e.g. it potentially enables the POTS service to continue functioning in the case of a user short circuiting the VDSL port of the splitter).

The high pass filter shall be one of the following options:

- Option A: 0^{th} order filter, i.e. no series high pass filter in the splitter unit;
- Option B: 1^{st} order filter made up of two blocking capacitors;
- Option C: Higher order filter.

Implementation requirements for options B and C are given in clause 6.

Electrical requirements for each option are given in clause 7.

6 High Pass filter implementation

6.1 Option B: 1st order filter

Blocking capacitors C_B = 120 nF, with C_B as defined by figure 3, shall make up the 1st order high pass filter.

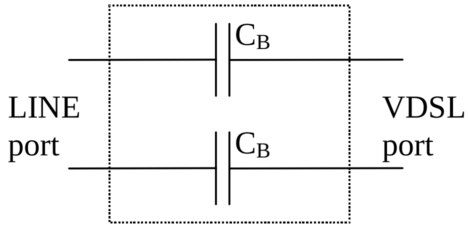


Figure 3: Implementation of 1st order high pass filter

A tolerance of 5 % shall be allowed for the practical implementation of these capacitors. Each of these capacitors shall retain their nominal value for DC voltages up to those present in the telephony network as defined in EN 300 001 [1].

6.2 Option C: higher order filter

The third order high pass filter as defined by figure 4 shall make up the option C high pass filter.

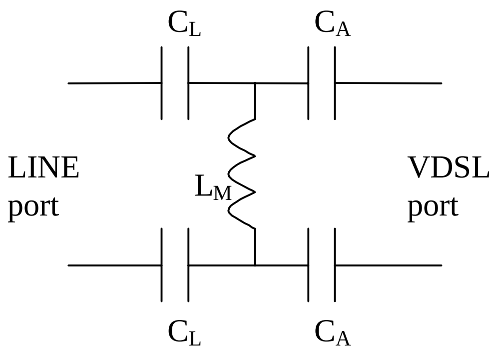


Figure 4: Implementation of 3rd order high pass filter

The following values for the electrical representation could be used: C_L = 54 nF, C_A = 90 nF, L_M = 0,38 mH.

A tolerance of 5 % shall be allowed for the practical implementation of the capacitors. A tolerance of 7 % shall be allowed for the inductor.

The impedance network presented in figure 4 is an electrical representation, rather than a circuit diagram. The implementation shall present an equivalent impedance to that shown in figure 4, however derived.

NOTE: The electrical representation given in figure 4 is considered to be a satisfactory implementation of the higher order filter. Alternative implementation methods are for further study.

7 High Pass filter requirements

In the case where either option B or option C, as described in clause 6, is present in the splitter unit, the requirements of clause 7 shall be met. The impedances networks shown in figures 5 and 6 are used in some of the test setups for these requirements.

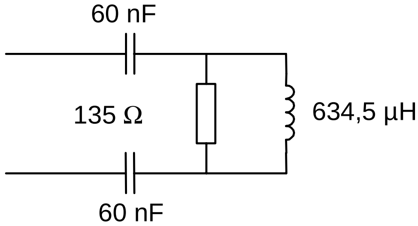


Figure 5: Schematic diagram of the Z_{VDSL-M}

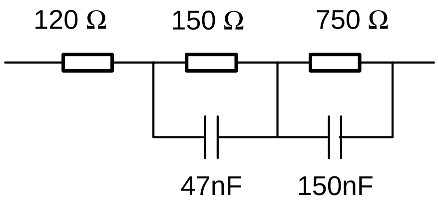


Figure 6: Impedance Z_{RHF}

7.1 Insertion loss requirements

7.1.1 Insertion loss requirements for options A and B

The insertion loss due to the insertion of the splitter (i.e. both the blocking capacitors and low pass filter in the case of option B) between the LINE port and the VDSL port shall be as specified in table 1. Examples of valid test setups are given in figures 7 and 8.

The insertion loss requirements of table 1 are to be met in the case where Z_{POTS} of figure 7 is a short circuit, an open circuit, and the nominal Z_{RHF} impedance of figure 6.

Table 1: Insertion loss between LINE and VDSL port for VDSL/POTS splitters

Frequency range	Insertion loss between LINE and VDSL port
32 kHz to 50 kHz	< 3 dB
50 kHz to 12 MHz	< 1 dB

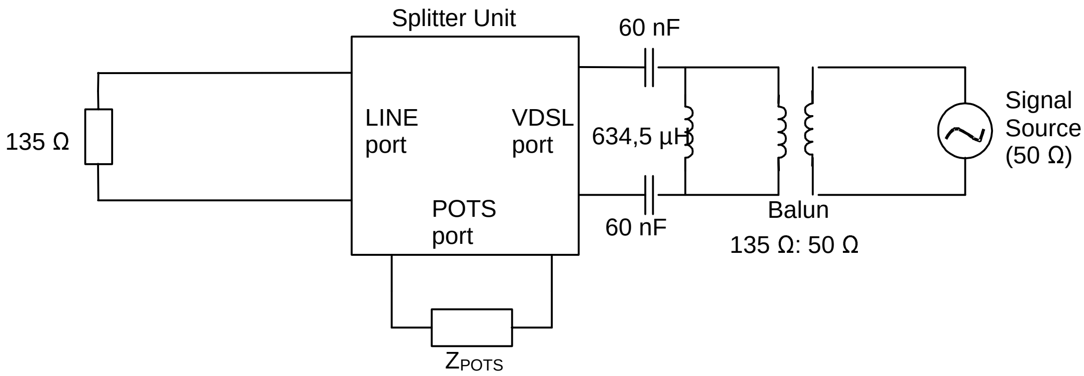


Figure 7: Example VDSL to LINE insertion loss test setup

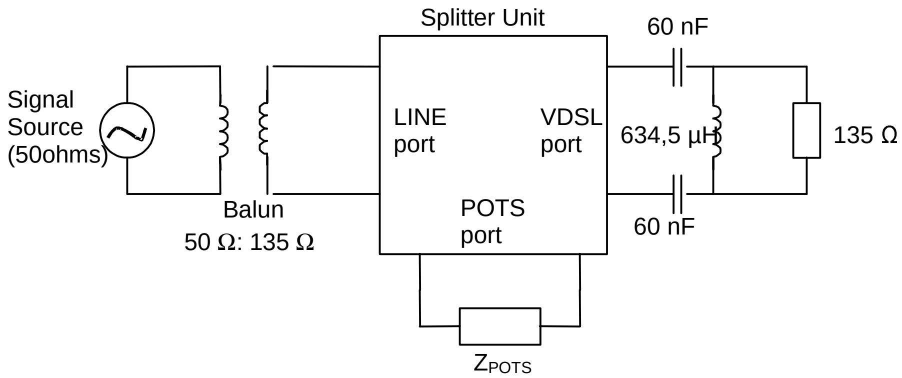


Figure 8: Example LINE to VDSL insertion loss test setup

7.1.2 Insertion loss requirements for option C

The insertion loss due to the insertion of the splitter (i.e. both the high pass filter and low pass filter) between LINE port and VDSL port shall be as specified in table 2. Examples of valid test setups are given in figures 7 and 8.

The insertion loss requirements of table 2 are to be met in the case where Z_{POTS} of figures 7 and 8 is a short circuit, an open circuit, and the nominal Z_{RHF} impedance of figure 6.

Table 2: Insertion loss between LINE and VDSL port for VDSL/POTS splitters

Frequency range	Insertion loss between LINE and VDSL port
50 kHz to 100 kHz	(for further study)
100 kHz to 12 MHz	(for further study)

7.2 Unbalance about earth requirements for options B and C

The basic test setup for measuring unbalance at the VDSL port is shown in figure 9. In the case of measuring at the LINE port, the test setup of figure 9 is used, however with the VDSL and LINE terminations reversed. The test shall be carried out for the combinations described in table 3. It should be noted that the source and measurement points are always at the same port.

Table 3: Unbalance about earth, test setups

#Test setup	Source and Measurement	S2
1	VDSL port	closed
2	VDSL port	open
3	LINE port	closed

The POTS port shall be terminated by a 600 Ω resistor for all unbalance tests described in the present document.

For each of the three test setups described above, the splitter shall meet the unbalance about earth requirements as specified in table 4.

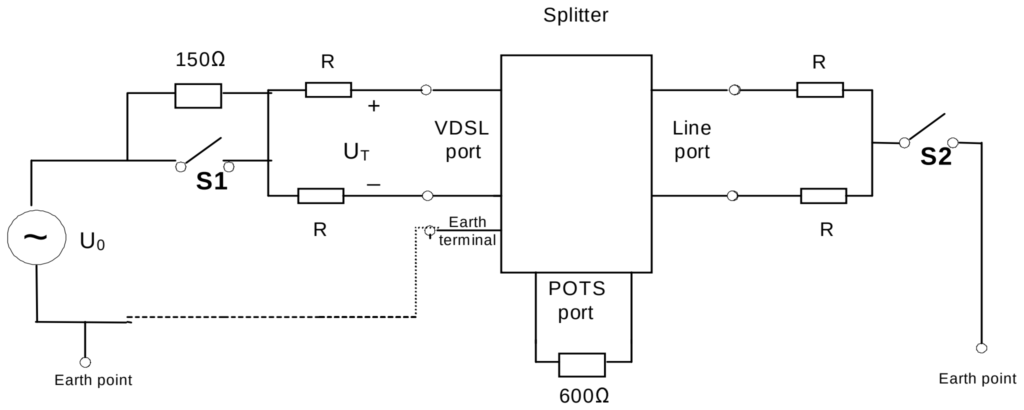
In the case of performing measurements at frequencies above 4 kHz, for reasons of practical testing a 150 Ω impedance should be used in series with the longitudinal source (i.e. S1 in figure 8 should be open).

Table 4: Unbalance about earth, minimum values

Frequency range	State of S1	Value of R	Minimum Unbalance value
50 Hz to 600 Hz	closed	300 Ω	40 dB
600 Hz to 3 400 Hz	closed	300 Ω	46 dB
3 400 Hz to 4 000 Hz	closed	300 Ω	40 dB
4 kHz to 30 kHz	open	68 Ω	40 dB
30 kHz to 1 104 kHz	open	68 Ω	50 dB
1 104 kHz to 12 MHz	open	68 Ω	30 dB

The unbalance about earth is calculated by using the following equation:

$$\text{Unbalance} = 20\log_{10}\left|\frac{U_0}{U_T}\right| \qquad (\text{dB})$$



NOTE 1: The dotted circuit is only used if the splitter has an earth terminal.

NOTE 2: The DC current feeding circuitry is not shown. Care should be taken that this circuitry is implemented in such a way as not to have significant influence on the accuracy of the measurement.

NOTE 3: For resistances R an equivalent circuit according to ITU-T Recommendation O.9 [2] can be used.

Figure 9: Unbalance about earth test set-up

If the splitter has no earth terminal, the test should be performed while the splitter is placed on an earthed metal plate of a sufficiently large size.

History

Document history		
V1.1.1	March 2003	Publication