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Technical Specification

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

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM) and in co-operation with ETSI Technical Committee Access and Terminals (AT).

The present document is part 1, sub-part 2 of a multi-part deliverable covering Access network xDSL transmission filters, as identified below:

Part 1: "ADSL splitters for European deployment";

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

Sub-part 2: "Specification of the high pass part of ADSL/POTS splitters";

Sub-part 3: "Specification of ADSL/ISDN splitters";

Sub-part 4: "Specification for ADSL/"ISDN or POTS" universal splitters";

Sub-part 5: "Specification for ADSL/POTS distributed splitters";

Part 2: "VDSL splitters for European deployment".

NOTE: The choice of a multi-part format for the present document 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 specifies requirements and test methods for DSL splitters. These splitters are intended to be installed at the Local Exchange side of the local loop and at the user side near the NTP. In the case of splitters at the user side, the present document specifies the master splitter that is intended for use at the demarcation point of the customer premises. Distributed filters are not within the scope of the present document.

The present document specifies requirements and test methods for the high pass part of ADSL/POTS splitters.

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.

[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 Abbreviations

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

ADSL	Asymmetric Digital Subscriber Line
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.)

4 General functional description of ADSL/POTS splitters

The main purpose of the ADSL/POTS splitter filter is to separate the transmission of POTS signals, and ADSL 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 ADSL signals. Equally it protects the ADSL transmission from transients generated primarily during POTS signalling (dialling, ringing, ring trip, etc.), and it must also prevent interference to the ADSL 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 ADSL transceiver, or may be integrated with the ADSL termination unit.

4.1 Functional diagram

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

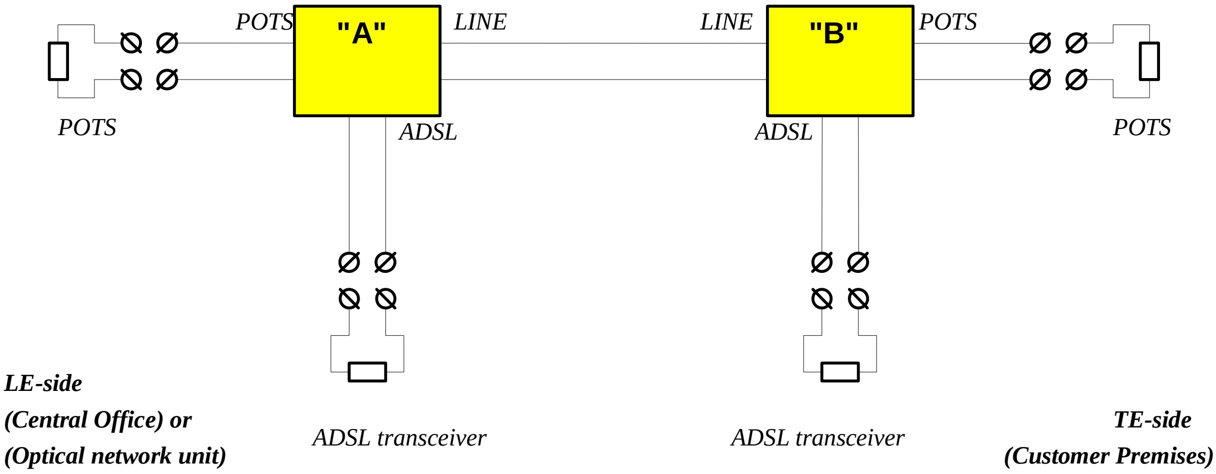


Figure 1: Functional diagram of the DSL splitter configuration

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 ADSL port to the POTS port and vice-versa to prevent undesirable interaction between ADSL and any existing narrowband services.
- The transfer function from the ADSL 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.

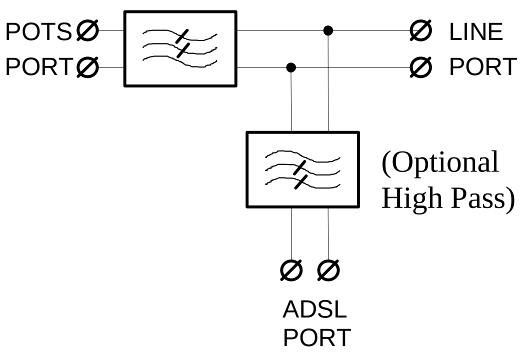


Figure 2: Structure of the ADSL splitter filter

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 ADSL modem, which is located in the ADSL 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 ADSL service;
- DC decoupling, to avoid "stealing" POTS service from the premises of an alternative operator;
- POTS privacy, when ADSL 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 ADSL, and presents a more controlled impedance to the low pass filter at the ADSL port (e.g. it potentially enables the POTS service to continue functioning in the case of a user short circuiting the ADSL port of the splitter).

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

- Option A: 0th order filter, i.e. no series high pass filter in the splitter unit;
- Option B: 1st 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.

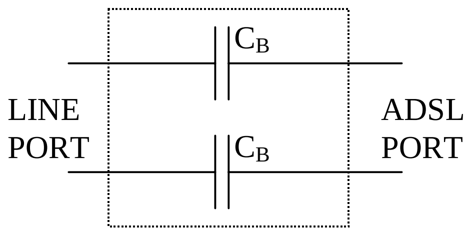


Figure 3: Implementation of 1st order high pass filter

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.

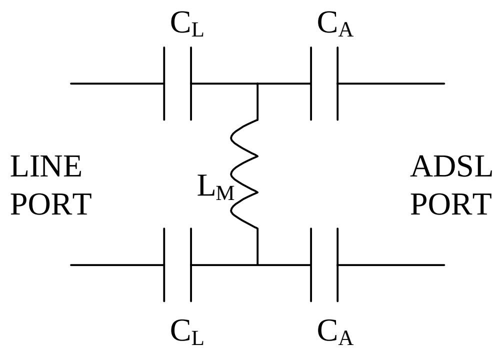


Figure 4: Implementation of 3rd order high pass filter

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 of the current document 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.

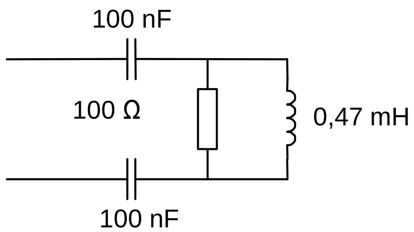


Figure 5: Schematic diagram of the Z_{ADSL-M}

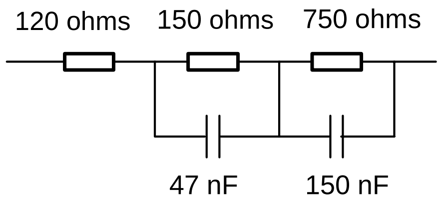


Figure 6: Impedance Z_{RHF}

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 ADSL 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 ADSL port for ADSL/POTS splitters

Frequency range	Insertion loss between LINE and ADSL port
32 kHz to 50 kHz	< 3 dB
50 kHz to 1 104 kHz	< 1 dB

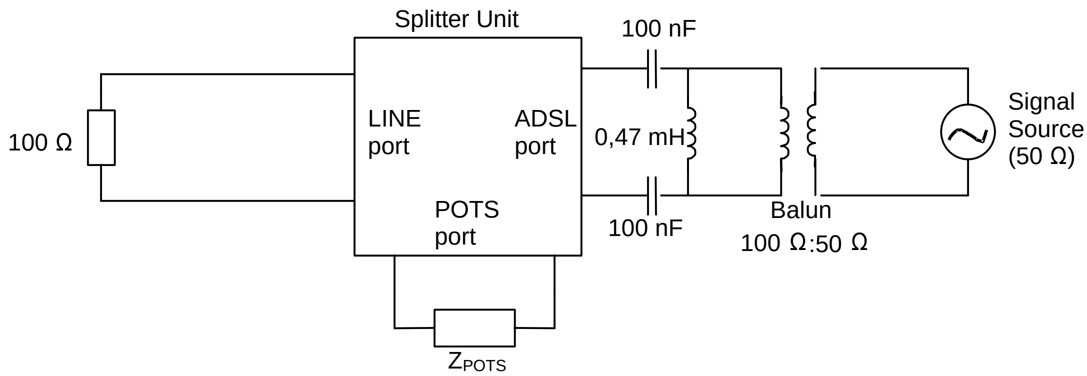


Figure 7: Example ADSL to LINE insertion loss test setup

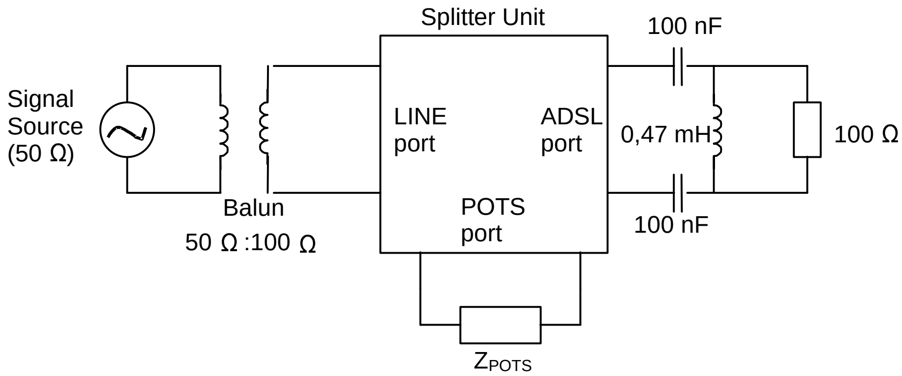


Figure 8: Example LINE to ADSL insertion loss test setup

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 ADSL 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 ADSL port for ADSL/POTS splitters

Frequency range	Insertion loss between LINE and ADSL port
50 kHz to 100 kHz	(for further study)
100 kHz to 1 104 kHz	(for further study)

7.2 Unbalance about earth requirements for options B and C

The basic test setup for measuring unbalance at the ADSL 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 ADSL 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	ADSL port	closed
2	ADSL 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.

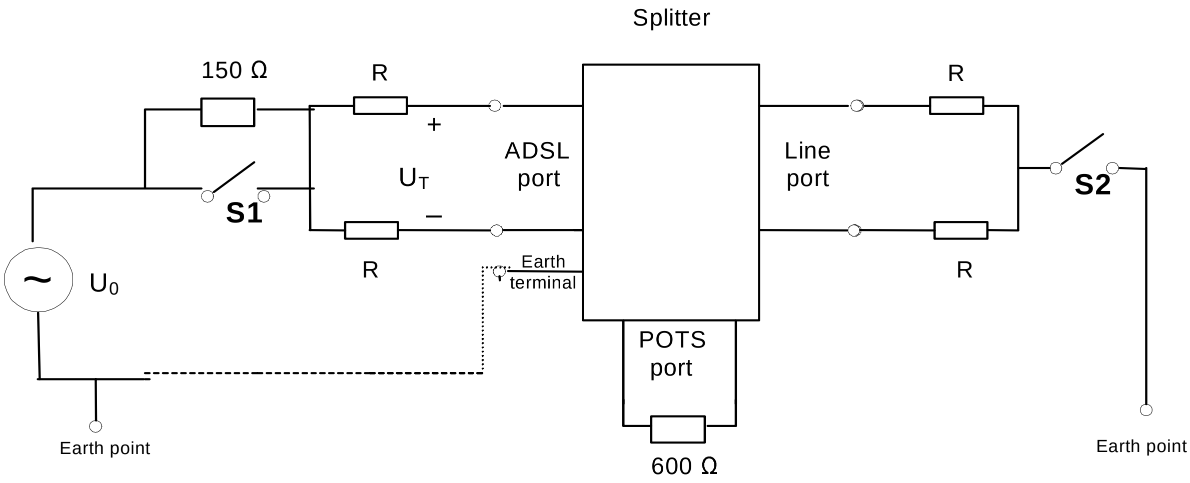
In the case of performing measurements at frequencies above 4 kHz, for reasons of practical testing a 150 Ω impedance should be used in series with the longitudinal source (i.e. S1 in figure 9 should be open).

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	50 Ω	40 dB
30 kHz to 1 104 kHz	open	50 Ω	50 dB
1 104 kHz to 5 MHz	open	50 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	May 2002	Publication