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# Terminal Equipment (TE); The technical feasibility of a harmonized plug and socket standard for European Public Switched Telephone Network (PSTN) access


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## Foreword

This ETSI Technical Report (ETR) has been produced by the Terminal Equipment (TE) Technical Committee of the European Telecommunications Standards Institute (ETSI).

## Introduction

This ETR describes a study into the technical feasibility of achieving a harmonized European plug and socket for use in the analogue Public Switched Telephone Network (PSTN).

The ETR surveys and describes the connection arrangements used at present in the various parts of the European Economic Area (EEA) and explains some of the reasons for their differences. It sets out desirable objectives for a harmonized connection system and describes the principle features of such a system.

It describes a possible future harmonized plug and socket arrangement for use throughout the EEA and also describes means of managing the transition from the present multiplicity of national plugs and sockets to a future harmonized system. These proposals are believed to represent feasible solutions for a wide range of European networks, although resources have not been available to determine whether these solutions are fully applicable to the whole range of installation arrangements that occur throughout the EEA.

The future preparation of a standard for a harmonized plug and socket for access to the PSTN would not imply that electrical and signalling access to the PSTN had already been harmonized. For these topics the reader should refer to the current situation relating to Technical Base for Regulation (TBR) draft prTBR 021 [18]. The reader should also refer to network requirements, for example those forming part of the Open Network Provision (ONP) directive. As this report covers only the technical feasibility of the harmonized plug and socket for access to the PSTN, no consideration has been given to the financial, social and regulatory implications arising from the preparation and adoption of such a standard. These aspects shall be studied before any progress can be made in preparing the standard.

The following requirements arise from the discussion and conclusions reached in this ETR. It is believed that the possible future harmonized plug and socket system described in this ETR can satisfy all of these requirements:

a) there should be a harmonized connection scheme for user's installations throughout the EEA;

b) in order properly to provide for the transition from old to new systems, an objective of any new system should be that it can be implemented rapidly without requiring existing systems to be replaced, and that old and new systems can easily co-exist on the same installation;

c) in order to facilitate rapid and low cost progress towards harmonized installation practices, users will be permitted to install their own extension sockets. It will be an objective of any future system to provide a simple method of connection for a number of terminals capable of being implemented on a "do-it-yourself" basis;

d) in the event that terminal equipment connected to a user installation fails to work correctly, it is necessary to determine whether the problem is due to the network or the user installation. Therefore any proposed system should provide a means for the user to isolate the user installation from the Network Termination Point (NTP) and test the network by connecting a functional terminal directly at the NTP;

e) in order to facilitate future developments of telecommunications and information services, flexibility could usefully be incorporated into the plug and socket system to allow the delivery of new enhanced communications services. It should therefore be possible to make provision within the network termination assembly for the incorporation of some circuitry, e.g. for remote line testing, meter filters, ISDN NTE 1 components, ADSL filters etc;

f) as required by the mandate, to avoid misconnection, it is preferable that the plug and socket arrangement should be different from any existing national installation.

In order that the proposals in this ETR can be fully implemented, the following recommendations are made for further action:

NOTE: Whilst the system described in this ETR is believed to provide a complete solution to the problems of harmonization, resources have not been available to confirm this by an exhaustive study.

**Recommendation 1:**

- it is recommended that a project be carried out to determine the whole range of current installation arrangements in the EEA and to confirm the universal acceptability of the proposed solution;

- it is recommended that further work be carried out to determine the financial and social impact of harmonizing the plug and socket throughout the EEA. This study should be performed by the appropriate experts before moving on in any technical consideration;

- once this work is done and depending on the output, consideration should be given whether or not to carry out further studies on technical issues such as installation arrangements in the EEA, technical acceptability of the proposed solution and final elaboration of a standard by the appropriate European standards body.

The proposed system may conflict with current interpretations of privacy legislation in some States.

**Recommendation 2:**

- it is necessary that steps be taken to ensure that any privacy legislation does not prevent progress towards the proposed harmonized solution.

Some countries have legislation that controls who is permitted to work on part of a telecommunications system which has the effect of preventing "do-it-yourself" installation.

**Recommendation 3:**

- it is recommended that steps be taken to ensure that such "do-it-yourself" installation is not prevented by any existing national regulation in individual States.

**Recommendation 4:**

To prevent the creation of a supply monopoly:

- the design should be available to a number of potentially competitive suppliers without problems of intellectual property rights.

In order to avoid seriously jeopardizing national transmission plans and undermining the current ETSI activity of harmonizing handset telephony.

**Recommendation 5:**

- the proposed plug and socket system should, if possible, not assist unapproved terminals designed for incompatible transmission plans to be connected to the network, so undermining the current activity of harmonizing handset telephony performance.

A specification of a suitable plug and socket arrangement is given in an annex to the ETR. This specification is given in an outline form which identifies the main requirements of a harmonized plug and socket arrangement in a way which would permit a manufacture to use it as the basis for an offer to tender for the supply of such an arrangement in the most cost effective manner.

**Recommendation 6:**

- it is recommended that suppliers be invited to tender against such a specification, offering their own solutions to the mechanical design requirements and quoting values for the dimensions and electrical parameters that are consistent with their production processes and which are in their judgement capable of meeting the requirements given.

Offers could then be compared to determine the best overall solution, which would form the basis of a harmonized European plug and socket standard and a harmonized installation standard.

**Recommendation 7:**

- it is recommended that the appropriate European standards body be invited to draw up a harmonized plug and socket standard based on the successful tender for a harmonized plug and socket system;

- it is recommended that further work be carried out to determine the financial and social impact of harmonizing the plug and socket throughout the EEA. This study should be performed by the appropriate experts before moving on in any technical consideration;

- once this work is done and depending on the output, consideration should be given as to whether or not carrying out further studies on technical issues such as installation arrangements in the EEA, technical acceptability of the proposed solution and final elaboration of a standard by the appropriate European standards body.

Any work would need to take note of the recommendations of the ETR on Installation.

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# 1 Scope

## 1.1 General

The aim of this ETSI Technical Report (ETR) is to determine whether it is technically feasible to produce a standard for a harmonized European plug and socket for use in the analogue Public Switched Telephone Network (PSTN).

The ETR surveys and describes the connection arrangements used at present in the various parts of the European Economic Area (EEA) and explains some of the reasons for their differences.

It sets out desirable objectives for a harmonized connection system and describes the principle features required for such a system.

It further provides a means of managing the transition from the present multiplicity of network presentation arrangements to a possible future harmonized system and provides recommendations on activities necessary to achieve such a transition in a speedy and effective manner.

It provides an outline in general terms of a specification for a harmonized plug and socket and suggests rapid means of determining the detailed requirements of such a standard.

The future preparation of a standard for a harmonized plug and socket for access to the PSTN would not imply that electrical and signalling access to the PSTN had already been harmonized. For these topics the reader should refer to the current situation relating to Technical Base for Regulation (TBR) draft prTBR 021 [18]. The reader should also refer to network requirements, for example those forming part of the Open Network Provision (ONP) directive. As this ETR covers only the technical feasibility of the harmonized plug and socket for access to the PSTN, no consideration has been given to the financial, social and regulatory implications arising from the preparation and adoption of such a standard. These aspects shall be studied before any progress can be made in preparing the standard.

## 1.2 Background

The original analysis of the application of ONP to voice telephony called for technical specifications to be drawn up for a harmonized single-line network interface suitable for the provision of access to and use of the public telephone network in all Member States of the European Union. These specifications were required to include the socket as well as the electrical conditions and signalling protocols presented by the network at the interface.

Subsequently a European Commission draft mandate (BC-T-033-SI [1]) was produced that was intended to implement this request. The mandate included an order voucher (see annex A) setting out the work programme and deliverables.

# 2 References

[1] Study and investigation mandate forwarded to CEN/CENELEC/ETSI in the fields of information technology and telecommunications BC-T-033-SI.

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

[3] ITU-T Recommendation I.430: "ISDN User-network interfaces - Basic user-network interface - layer 1 specification".

[4] ETS 300 012: "Integrated Services Digital Network (ISDN); Basic user-network interface. Layer 1 specification and test principles".

[5] EN 60 950: "Safety of information technology equipment, including electrical business equipment".

[6] ITU-T Recommendation K.21 (1988): "Resistibility of subscriber's terminals to overvoltages and overcurrents".

[7] IEC 68-2-1 (1990): "Environmental testing - Part 2: Tests. Tests A: Cold" (including am 1: (1993) and am 2: (1994)).

[8] IEC 68-2-2 (1974): "Environmental testing - Part 2: Tests. Tests B: Dry heat". (including am 1: (1993) and am 2: (1994)).

[9] IEC 68-2-3 (1969): "Environmental testing - Part 2: Tests. Test Ca: Damp heat, steady state".

[10] IEC 68-2-5 (1975): "Environmental testing - Part 2: Tests. Test Sa: Simulated solar radiation at ground level".

[11] IEC 68-2-9 (1975): "Environmental testing - Part 2: Tests. Guidance for solar radiation testing". (including am 1: (1984)).

[12] IEC 68-2-11 (1981): "Environmental testing - Part 2: Tests. Test Ka: Salt mist".

[13] IEC 68-2-14 (1984): "Environmental testing - Part 2: Tests. Test N: Change of temperature".

[14] IEC 68-2-30 (1980): "Environmental testing - Part 2: Tests. Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)". (including am 1: (1985)).

[15] IEC 68-2-42 (1981): "Environmental testing - Part 2: Tests. Test Kc: Sulphur dioxide test for contacts and connections".

[16] IEC 68-2-60 (1995): "Environmental testing - Part 2: Tests - Test Ke: Flowing mixed gas corrosion test".

[17] IEC 950 (1991); "Safety of information technology equipment".

[18] prTBR 021: "Terminal Equipment (TE); Attachment requirements for pan-European approval for connection to the analogue Public Switched Telephone Networks (PSTNs) of TE (excluding TE supporting the voice telephony service) in which network addressing, if provided, is by means of Dual Tone Multi Frequency (DTMF) signalling".

# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of this ETR, the following definitions apply:

**"a" wire:** One of the two basic leads provided for PSTN connection.

**"b" wire:** One of the two basic leads provided for PSTN connection considered as the reference.

**asymmetric digital subscriber line:** A line which allows the provision of Message Telephone Service (MTS) and a variety of digital channels.

**message telephone service:** A service providing message as well as voice telephony facilities.

**network termination point:** The physical point at the boundary of the PSTN intended to accept the connection of the Terminal Equipment (TE).

**R1:** Resistance between the two line terminals to be connected to PSTN.

**R2:** Resistance between the two line terminals when shorted together and any signal earth terminal.

**R3:** Resistance between the two line terminals when shorted together and all user accessible parts of the TE, other than earth or signal earth terminals.

### 3.2 Abbreviations

For the purposes of this ETR, the following abbreviations apply:

| | |
|---|---|
| AC | Alternating Current |
| ADSL | Asymmetric Digital Subscriber Line |
| Amd | Amendment |
| CLC/TC 115 | CENELEC Technical Committee 115 "Electrotechnical Aspects of Telecommunication Equipment" |
| CSE | Comité de Spécification des Equipements |
| CTT | Correios e Telecomunicações de Portugal |
| DC | Direct Current |
| EEA | European Economic Area |
| ISDN | Integrated Services Digital Network |
| MTS | Message Telephone Service |
| NTA | Norwegian Telecommunication Authority |
| NTE 1 | Network Terminating Equipment Type 1 |
| NTP | Network Termination Point |
| PABX | Private Automatic Branch Exchange |
| PBX | Private Branch Exchange |
| PCR | Punto de Conexión de Red |
| PNO | Public Network Operator |
| ppb | Part Per Billion or $10^{-9}$ |
| ppm | Part Per Million or $10^{-6}$ |
| PSTN | Public Switched Telecommunications Network |
| RMS | Root Mean Square |
| TE | Terminal Equipment |
| TLP | Telefones de Lisboa e Porto |

## 4 Survey of present arrangements

At present, within Europe there are many types of plug and socket using many different installation arrangements. Some countries have more than one type of connection arrangement. These differences arise mainly from the historical development of the various networks but in some cases arise from national legal requirements dealing e.g. with privacy. Details of many of these present national arrangements taken from ETS 300 001 [2] are given in annex B.

Some installation arrangements require switches in the sockets, operated when a plug is inserted. Others require switches or other special circuit arrangements in the TE to permit more than one terminal to be connected to a single installation.

Annex B also gives descriptions of current national installations, examples of a range of plugs and detailed circuits of national installation practices.

### 4.1 "2-wire" installation

The simplest currently used installation consists of a 2-wire extension of the PSTN wires with individual terminals connected in parallel across the pair.

Such an installation circuit is shown in figure B.10 and is used in Finland.

This arrangement has the advantage of simplicity and ease of installation. It has the disadvantage that ringers or tone callers need to be constructed so as not to suffer from bell tinkle caused by loop-disconnect signalling. Furthermore, impedances need to be high enough to prevent problems arising from a number of TEs being connected in parallel.

### 4.2 "3-wire" installation

A common method of preventing bell tinkle caused by loop disconnect signalling is to use a nominally three wire connection with the third wire acting as a ringer shunt. Some such arrangements use a common ringer capacitor. Others utilize separate capacitors in each TE.

Examples of such installation circuits are shown in figures B.11, B.12, B.13, B.14 and B.15 and are used in Cyprus, France, Ireland, Portugal and the United Kingdom.

A three wire connection system provides a simple solution to the bell tinkle problem but at the expense of a slightly more complex installation. It can be used with terminal equipment designed for two wire operation, but in this case bell tinkle can occur if the two wire connected equipment uses a loop dialling facility.

### 4.3 "Exclusive" installation

A more complex system used in some countries to achieve a measure of privacy requires facilities to be provided in all TE which disconnect other terminals from the pair when any TE on the installation goes off-hook. Such a system also requires switches in the socket to permit unused sockets to be bypassed.

An example of such an installation is shown in figure B.17 and is used in Austria, Germany, Iceland and Sweden.

Such systems have the advantage of providing privacy by not permitting two TEs to be connected simultaneously to the same line and offer the facility to give some terminals priority over others. These systems suffer from the disadvantages of requiring extra complexity in TEs, which leads to loss of reliability and extra expense, more complex and less reliable sockets and such additional difficulties in installation as to preclude "do-it-yourself" installation.

These systems require switching in the terminal equipment.

### 4.4 Other installation systems

There are various other systems using even more complicated installation arrangements. Some connect high impedance ringers in parallel, some connect low impedance ringers in series, others make special arrangements for equipment such as answering machines and facsimile apparatus.

Resources have not been available either to give detailed descriptions of these other installation arrangements or to provide an exhaustive allocation of the different installations to individual countries. Like the "exclusive" installation, these systems suffer from the disadvantages of extra complexity in TEs which leads to loss of reliability and extra expense, more complex and less reliable sockets and such additional difficulties in installation as to preclude "do-it-yourself" installation.

## 5 Objectives of a future system

In order to widen the terminal market and maximize the portability of TE, it is desirable that Network Terminating Points (NTP) for the connection of approved TE should be fully harmonized throughout the European Economic Area.

It therefore follows that it should be an objective of any future system that sockets provided as part of the user installation for the connection of approved TE should be the same as that of the NTP itself, and that the electrical functionality of the connectors should also be standardized.

**This implies that there should be a harmonized connection scheme for user's installations throughout the EEA.**

A harmonized access to the PSTN throughout the EEA cannot be implemented instantly. It is therefore necessary to provide for a managed transition from old to new plug and socket systems. Established network operators may be reluctant to rapidly to replace their existing NTPs with a new version, particularly if their existing interfaces have been recently installed. Users may not wish to change their old terminals so as to be compatible with new connection arrangements. New network providers on the other hand will probably wish to provide the harmonized NTP as part of their initial installation.

**It shall therefore be an objective of any new system that it can be implemented rapidly without requiring existing systems to be replaced, and that old and new systems can easily co-exist on the same installation.**

It is preferable that a new system should also be compatible with Private Branch Exchange (PBX) extension installation usage.

If as expected, the harmonization of connection arrangements leads to lower costs and improved flexibility in customer installations, it is probable that market forces will cause a rapid changeover to the new system.

The European Commission has stated that the mandatory approval requirements for TE intended to access analogue PSTNs, apply only to a single item of TE directly connected to the NTP. The relevant TBRs set out type approval requirements and tests of a single TE. This terminal may be intended to be the only terminal connected to any given analogue PSTN network termination point at any one time. It may also be one of a number, all of which are connected in some combination to form an installation which in turn is connected to any given analogue PSTN termination point.

In practice, the majority of NTPs have more than one terminal connected to them. The resultant "user installations" currently employ a multiplicity of series and parallel connection arrangements as described above, some of which are so complex as to require skilled installation at considerable cost to the user and/or the network operator.

**It shall be an objective of any future system to provide a simple method of connection for a number of terminals, capable of being implemented on a "do-it-yourself" basis.**

The simplicity of such a harmonized connection scheme should not be prejudiced by any national privacy legislation which may require complicated wiring and switching arrangements to prevent two TEs being connected to the line at the same time.

**It is therefore necessary that steps be taken to ensure that any privacy legislation does not prevent progress towards the proposed harmonized solution.**

Some countries have legislation that controls who is permitted to work on part of a telecommunications system, which has the effect of preventing "do-it-yourself" installation.

**It is therefore recommended that steps be taken to ensure that such "do-it-yourself" installation is not prevented by any existing national regulation in individual Member States.**

In the event that TE connected to a user installation does not interwork correctly with the network itself, it is necessary to determine whether the problem is due to the network and is therefore the responsibility of the network operator, or whether the problem is associated with the user installation (which may either be the responsibility of the network operator or of the user).

**Any proposed system should therefore provide a means for the user to isolate the user installation from the NTP, and test the network by connecting a functional terminal directly at the NTP.**

Inevitably, different configurations of user installations employing various types of terminal will apply different electrical loading effects at the NTP (which may itself have different capabilities due to different types of equipment in the networks) with the result that not all terminals may operate correctly under all conditions.

Guidance on the combination of loading effects of the various terminals in a user installation to ensure correct operation will need to be provided. This information is intended to be given in an ETR which is currently in preparation.

In order to facilitate future developments of telecommunications and information services, flexibility could usefully be incorporated into the plug and socket system to allow the delivery of new enhanced communications services.

**It should therefore be possible to make provision within the network termination assembly for the incorporation of some circuitry, e.g. for remote line testing, meter filters, ISDN NTE 1 components, ADSL filters etc.**

When selecting a plug and socket other additional factors need to be considered.

Firstly, choice of a proposed plug and socket which was identical to any existing NTP plug and socket could permit misconnection of TEs, particularly where the installation requirements lead to differing pin numbering which would lead to misoperation and false fault reporting, and could cause network harm in some cases.

**It is therefore preferable that the plug and socket arrangement should be different from any existing national installation.**

This does not preclude the use of existing basic designs of plugs and sockets provided the key way is modified so as to prevent the user from connecting existing incompatible terminals.

Secondly, the intellectual property rights need to be considered. No new plug and socket arrangement should be adopted unless, the design is available to a number of potentially competitive suppliers

**The design should therefore be available to a number of potentially competitive suppliers without problems of intellectual property rights.**

Thirdly, if the proposed plug and socket system were to enable unapproved but widely available terminals to be connected into a network, national transmission plans could be jeopardized and the process of harmonization could be seriously jeopardized (e.g. by connection of telephones designed to operate with non-European type transmission plans, and so undermine the current ETSI activity of harmonizing handset telephony).

**Therefore the proposed plug and socket system should not assist unapproved but widely available terminals designed for incompatible transmission plans to be connected to the network, so undermining the current activity of harmonizing handset telephony performance.**

## 6 Description of a possible future system

Figure 1 shows a plug and socket installation containing the elements of a possible future harmonized system. An example of a master unit is shown, together with a single slave socket. In a complete installation, there would be at least one slave socket per TE which is to be connected in parallel.

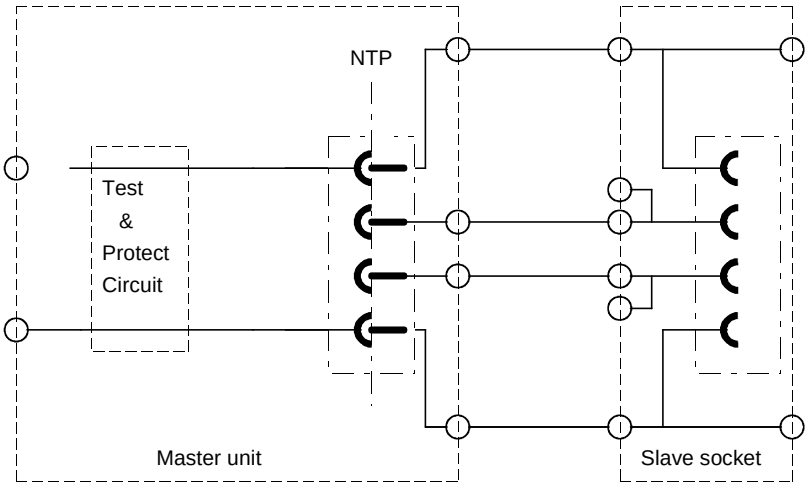



**Figure 1: A possible future plug and socket installation**

### 6.1 The master unit

The master unit is normally the property of the Network Operator, which contains the NTP and a means of isolation and test of the user installation

The proposed master unit could be divided into two parts, one accessible only to the Network Operator, and the other part to which the user has access.

The part accessible to the Network Operator could contain any necessary line test and protection circuitry and could possibly make provision for present and future supplementary services such as the fitting of a filter for metering or ADSL, or components for the conversion of the installation to ISDN.

The part to which the user has access could provide connectors to which the user's installation can be connected. It could contain isolation means to separate the user's installation from the network.

One possible and practical form of isolation is obtained by physically separating the two parts of the master unit to reveal a hidden socket at the NTP to which the user can connect a working terminal in order to check whether a fault is in the network or in the user's own installation.

At this separation point, the master unit would therefore have a harmonized plug and socket.

### 6.2 The Slave socket

The slave socket could be a unit which contains connectors for the installation wiring and a socket into which the TE can be plugged. It would in general contain no other components.

### 6.3 Installation wiring

The installation wiring only requires the provision of two wires, but it could with advantage be a four-wire or possibly six-wire installation. Two wire is all that is strictly necessary for a simple terminal installation, but four-wire provides for an earth recall connection in a PBX or for possible future conversion of a user's installation to the simplest ISDN connection.

Six or eight-wire installations are somewhat more complex, giving a greater possibility for incorrect installation, but could provide the maximum flexibility for future usage.

For a domestic "do-it-yourself" installation, two-wires are probably preferable, and four-wires are probably the limit.

For a business system, which is likely to be installed by a trained installer, four-wires are probably preferable and six or even eight-wires could be considered.

## 7 Management of transition (present to future)

Whilst clause 6 above describes a possible future harmonized connection system, no such system could be considered acceptable in the market place unless there were available suitable transition arrangements from the present multiplicity of network terminations to the new harmonized system, that do not require the scrapping of the present investment in installation systems.

Such transition arrangements may be different for each present National installation arrangement but should be arranged so as not to cause operational difficulties in any of the currently used systems. In order to limit the expense to any network operator it will be necessary to permit the installation of new harmonized extension sockets to be made on a "do-it-yourself" basis.

In general it will be preferable to install new "slave" sockets, connected to the existing installation arrangements by means of a suitable adapter. This will clearly identify that part of the installation that is the property of the user and separate the existing national installation wiring from the new harmonized system.

This adapter could take the form of a national plug with a lead, to which can be connected the new harmonized installation of the form shown in figure 2.

Such an arrangement has the great advantage that it would permit old and new installations to co-exist, thus preventing the existing terminal equipment from being rendered obsolete and so saving the cost of its replacement.

It has the further advantage that, in a domestic environment, a "do-it-yourself" installer could wire up the extension sockets and connect them to the NTP without having to disturb the network operator's own installation.

The plug would normally only have two wires connected to the line wires at the NTP. At a later stage, when the sockets provided by the original network operator are no longer required, the new installation could readily be hard wired into a "master" unit if required.

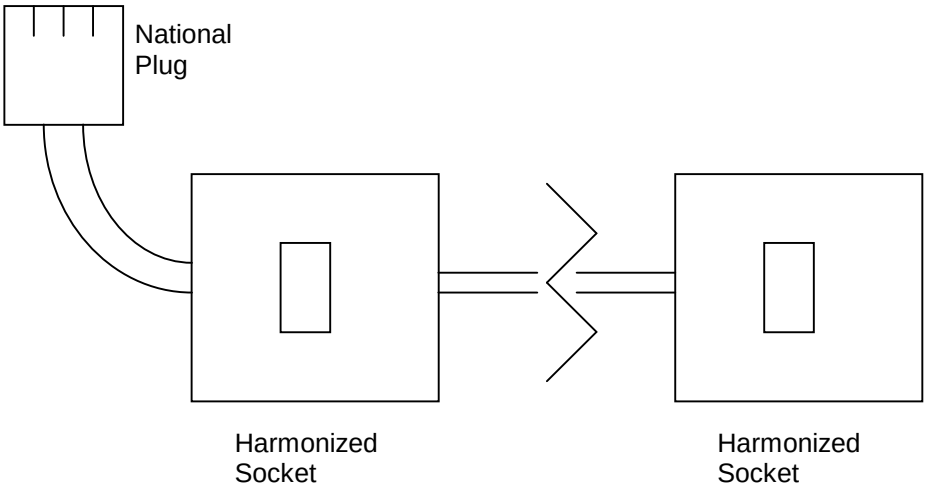



**Figure 2: A possible adaptor to a harmonized installation**

Figures B.19, B.20 and B.21 show some examples of suitable transitional circuit arrangements. Whilst these proposed arrangements are believed to represent solutions for a wide range of European networks, resources have not been available to determine detailed solutions for the whole range of installation arrangements that occur throughout the EEA. Such a project would require the provision of significant effort.

In many cases a discrete one-piece adapter could provide the simplest basic facility to permit a new TE with a harmonized plug to fit into an existing national socket arrangement. Most users would find this the easiest means of adaptation but it would be more obtrusive and less reliable than a proper installation.

A wide range of adaptors would be required, each with a national plug on one end, and a harmonized socket on the other. Such a range of adaptors could only reasonably be designed if the harmonized socket was small enough.

## 8 The ISDN plug and socket

In accordance with the requirements in the annex to the mandate, it has been necessary to give special consideration to the possible use of the ISDN plug and socket.

It is first necessary to consider the potential effects on any ISDN installation if the ISDN plug and socket were to be used and if an analogue terminal equipment were to be plugged in to the socket.

The configuration of the network termination shown in figure 3 is given in ITU-T Recommendation I.430 [3] and referenced in ETS 300 012 [4].

It can be seen that the installation effectively can be grouped into three pairs of wires, the first connected to terminals 1 and 2 carrying DC power, the second connected to terminals 3 and 6 carrying the digital output signal from the terminal to the network, the third connected to terminals 4 and 5 carrying the digital signal received from the network and the fourth connected to terminals 7 and 8, also carrying DC power.

A further source of DC power is connected to the phantom between pairs two and three.

A two wire analogue TE plugged into an ISDN installation should not cause harm to the network if the TE is connected to one of the pairs carrying the digital signal. It is preferable that the pair connected to terminals 4 and 5 be used so that the user could notice that no signal was being received from the network by any ISDN terminal on the same installation.

Connection to terminals 3 and 6 would produce interference with the digital signal being sent to the network that might not be noticed by the user.

Any other choice of wires from terminals 3, 4, 5 or 6 would cause power to flow from power source 1 and may damage either the power source or the terminal equipment.

Connection to either of the other two pairs could upset either power source 1 or 2, as could any interconnection between the two power sources.

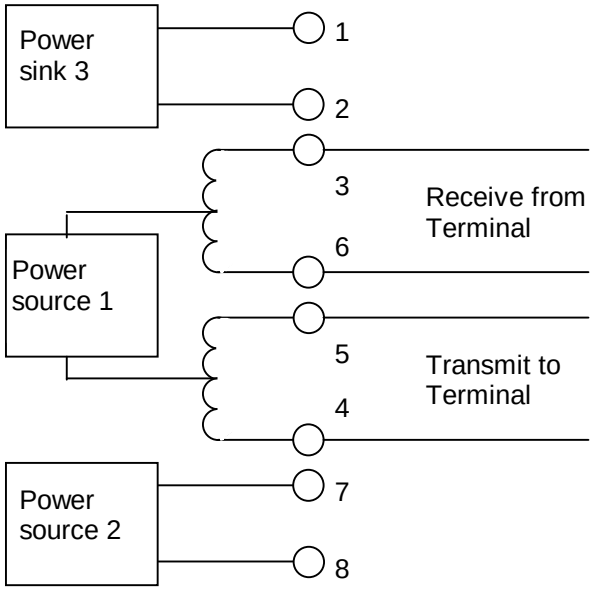



**Figure 3: The ISDN network termination**

It is likely that use of any pair of connections other than either of the signal pairs would seriously prejudice the EMC compatibility of the terminal or the installation. Connection of an analogue TE to either of the signal pairs could unbalance the system sufficiently to cause the formal EMC requirements to be breached whilst the faulty connection persisted.

The ISDN plug and socket system is currently used in Norway. For an analogue set, the line terminals are connected to contacts 4 and 5. The same connection system is used for several types of applications including leased circuits, data network connections and the ISDN.

The ISDN connector is also used in Denmark and Spain. In Denmark it is "available for special applications". The line terminals are connected to contacts 4 and 5, and other connections are made to contacts 1, 6 and 8.

In Spain it is used for the single line series connection method of installation where the input line is connected to contacts 4 and 5 and the output line connected to contacts 1 and 8. Contact 6 is used as a reference connection for 50 Hz meter pulses.

There could be potential advantages to a network operator by offering the chance to provide a common socket for both ISDN and analogue presentations. It would mean that early steps could be taken to provide a master unit ready equipped for conversion by the simple addition of an ISDN card at a later date. The local installation wiring could also be made a six or eight-wire system.

On the other hand, it is possible that the extra cost of such an adaptable master unit installed at all premises could to some extent outweigh the cost saving on that percentage of installations that would be subsequently converted to ISDN, a conversion that would in any case involve the significant cost of an installer's visit. Furthermore the provision of six or eight terminals on the "slave" sockets could increase their cost and complexity.

In a future competitive environment where the domestic installation would be carried out on a "do-it-yourself" basis, rather than by the network operator's trained installer, it would be difficult to justify the complexity of a local six or eight-wire installation, which would have too great a fault liability. The use of an eight contact master socket would not preclude the use of a simple two-wire local installation, but such an installation would have to be replaced at any subsequent conversion to ISDN.

For a small office environment there may be useful benefit in installing a full ISDN local installation to save the later conversion, as the wiring in these cases would probably be carried out by a trained installer.

Within a PBX environment, it is possible that many extensions would be on a two wire basis using a proprietary digital transmission system rather than the full ISDN connection. In this case there would be no financial advantage in using an ISDN connector. Where an ISDN connection is required, it would be normal to install a full eight-wire system.

Within most environments, as long as a digital connection is more costly than an analogue connection, the two types of connection will remain simultaneously in use, quite possibly side by side where a computer is connected to one socket and a simple telephone into the other. For many years therefore, until the digital network has fully supplanted the analogue presentation, a potential confusion will persist.

The biggest problem likely to arise from the use of the same connector for analogue and digital networks will arise from this simple human factor of confusion. An ISDN terminal mistakenly plugged into an analogue network socket will almost certainly be destroyed either by the DC current available from the analogue network or by the ringing current. This would be an expensive mistake which could lead to claims for damage from the network operator.

Even if damage is not caused when a terminal is plugged into the "wrong" network socket, it will not work. This will cause difficulties in any mixed environment where both analogue and digital connections are available. Such misconnection would cause significant frustration to the user, and significant cost to the network operator arising from false fault reports.

An attempt could be made to prevent this confusion by suitable marking of the sockets and of the differing types of terminal equipment, but this is unlikely to be effective. Experience shows that if a terminal equipment can be plugged into the "wrong" socket, then it will be.

On balance there is likely to be little, if any, financial benefit to the user arising from the use of an ISDN connector and there is likely to be a great potential for damage and confusion.

## 9 Benefits and impacts

The provision of a common network termination point for the analogue PSTN throughout the EEA, when combined with common access standards, would reduce barriers to trade, assist free circulation of terminal equipment, provide a greater market for any given terminal design and would help to reduce the cost of market entry for terminal manufacturers and suppliers.

A common European plug and socket arrangement should solve portability problems for apparatus such as modems which are often used with portable computer equipment. The ability to use the same socket throughout the EEA may impact on the growing use of mobile telephones to achieve such portability as it would provide a more cost effective solution to the problem.

A simple wiring arrangement combined with a modern design of plug and socket, compatible with both automatic and manual assembly, would provide a significant cost saving in those many countries with large plugs and complex wiring arrangements.

The provision of a well defined boundary between the responsibilities of the network operator and the user which also provided a point of isolation and testing would assist the resolution of complaints and reduce maintenance costs.

It would be expected that a standard socket arrangement as described in this ETR would rapidly be commonly provided at hotels and conference centres so as to assist businessmen travelling in the EEA.

# 10 Recommendations to the European Commission

This ETR describes a possible future harmonized plug and socket arrangement for use throughout the EEA. It also describes means of managing the transition from the present multiplicity of national plugs and sockets to a future harmonized system. These proposals are believed to represent feasible solutions for a wide range of European networks, although resources have not been available to determine whether these solutions are fully applicable to the whole range of installation arrangements that occur throughout the EEA.

The following requirements arise from the discussion and conclusions reached in this ETR:

a) in order to widen the terminal market and maximize the portability of TE, there should be a harmonized connection scheme for user's installations throughout the EEA;

b) in as much as it is necessary to provide for a managed transition from old to new plug and socket systems, it needs to be an objective of any new system that it can be implemented rapidly without requiring existing systems to be replaced, and that old and new systems can easily co-exist on the same installation;

c) in order to facilitate rapid and low cost progress towards harmonized installation practices, users need to be permitted to install their own extension sockets. It should therefore be an objective of any future system to provide a simple method of connection for a number of terminals, which is able to be implemented on a "do-it-yourself" basis;

d) in the event that TE connected to a user installation fails to work correctly it is necessary to determine whether the problem is due to the network or the user installation. Therefore any proposed system should provide a means for the user to isolate the user installation from the NTP and test the network by connecting a functional terminal directly at the NTP;

e) in order to facilitate future developments of telecommunications and information services, flexibility could usefully be incorporated into the plug and socket system to allow the delivery of new enhanced communications services. It should therefore be possible to make provision within the network termination assembly for the incorporation of some circuitry, e.g. for remote line testing, meter filters, ISDN NTE 1 components, ADSL filters etc.;

f) as required by the mandate, to avoid the possibility of difficulties caused by misconnection of incompatible apparatus, it is preferable that the plug and socket arrangement should be different from any existing national installation.

It is believed that the possible future harmonized plug and socket system described in this ETR can satisfy all of these requirements.

In order that the proposals in this ETR can be fully implemented the following recommendations are made for further action:

This ETR describes a simple harmonized installation system that utilizes harmonized plugs and sockets. Whilst the system described is believed to provide a complete solution to the problems of harmonization, resources have not been available to confirm this by an exhaustive study.

**Recommendation 1:**

- it is recommended that a project be carried out to determine the whole range of current installation arrangements in the EEA and to confirm the universal acceptability of the proposed solution;

- it is recommended that further work be carried out to determine the financial and social impact of harmonizing the plug and socket throughout the EEA. This study should be performed by the appropriate experts before moving on in any technical consideration;

- once this work is done and depending on the output, consideration should be given whether or not to carry out further studies on technical issues such as installation arrangements in the EEA, technical acceptability of the proposed solution and final elaboration of a standard by the appropriate European standards body.

The proposed system may conflict with current interpretations of privacy legislation in some States.

**Recommendation 2:**

- it is necessary that steps be taken to ensure that any privacy legislation does not prevent progress towards the proposed harmonized solution.

Some countries have legislation that controls who is permitted to work on part of a telecommunications system, which has the effect of preventing "do-it-yourself" installation.

**Recommendation 3:**

- it is recommended that steps be taken to ensure that such "do-it-yourself" installation is not prevented by any existing national regulation in individual States.

No new plug and socket arrangement should be adopted, the design of which was not available to a number of potentially competitive suppliers

**Recommendation 4:**

- the design should be available to a number of potentially competitive suppliers without problems of intellectual property rights.

In order to avoid seriously jeopardizing national transmission plans and undermining the current ETSI activity of harmonizing handset telephony.

**Recommendation 5:**

- the proposed plug and socket system should, if possible, not assist unapproved terminals designed for incompatible transmission plans to be connected to the network, so undermining the current activity of harmonizing handset telephony performance.

A specification of a suitable plug and socket arrangement is given in annex A. This specification is given in an outline form which identifies the main requirements of a harmonized plug and socket arrangement in a way which would permit a manufacture to use it as the basis for an offer to tender for the supply of such an arrangement in the most cost effective manner.

**Recommendation 6:**

- it is recommended that suppliers be invited to tender against such a specification, offering their own solutions to the mechanical design requirements and quoting values for the dimensions and electrical parameters that are consistent with their production processes and which are in their judgement capable of meeting the requirements given.

The resulting specification, thus known to be practical and achievable could then form the basis of a new harmonized standard.

**Recommendation 7:**

- it is recommended that the appropriate European standards body be invited to draw up a harmonized plug and socket standard based on the successful tender for a harmonized plug and socket system;

- it is recommended that further work be carried out to determine the financial and social impact of harmonizing the plug and socket throughout the EEA. This study should be performed by the appropriate experts before moving on in any technical consideration;

- once this work is done and depending on the output, consideration should be given whether or not to carry out further studies on technical issues such as installation arrangements in the EEA, technical acceptability of the proposed solution and final elaboration of a standard by the appropriate European standards body.

Offers could then be compared to determine the best overall solution, which would form the basis of a harmonized European plug and socket standard and a harmonized installation standard.

Any work would need to take note of the recommendations of the ETSI Report on Installation.

## 11 Conclusion

Bearing in mind that the financial, social and regulatory aspects of harmonizing the plug and socket have not been carefully evaluated before this ETR was requested from ETSI, and recognizing that there is no PSTN common access standard at the time of publication of this ETR, the harmonization of the plug and socket does not seem to need priority consideration. The content of this ETR shows that there do not appear to be any major technical problems to prevent a standard being prepared. However, no further work should be carried out until the economical and regulatory implications have been clarified.

# Annex A: A copy of the annex to the study and investigation mandate BC-T-033-SI

Order voucher No 45321 given to ETSI within the Framework Contract between the CEC and ETSI in the field of information technology and telecommunications dated 15/09/92.

**1) Object**

The objective is to produce an ETR that will set out the implications of a harmonized plug and socket for access to the European PSTN. This ETR might then be acceptable as the first stage ETR identified for this study.

**2) Activities**

An ETSI Ad-hoc group, headed by a Rapporteur from ETSI Project (EP) Analogue Terminals and Access (ATA), will analyse the various methods of connection currently in use, the impediments to providing harmonized access via a European plug and socket and any aspects of these methods that might be beneficially retained for the harmonized plug and socket. Having performed the analysis, the group will then consider whether the ISDN connector would be a suitable solution and, if not, record the reasons.

The analysis will take into account the requirements set out in ETSI/ONP 8(93), 15 in particular:

- use of the proposed plug and socket for harmonized access to the PSTN for a specific market sector (i.e. business users), as an addition to, and not a replacement of, existing national access arrangements;

- simple, optionless wiring arrangements to be included as part of the ultimate specifications, in order to allow two terminals to be connected;

- possible use of the proposed plug and socket "behind" PBXs;

- the new connector should be different from existing national connectors, to avoid misconnection.

The group will elaborate a draft ETR covering the following aspects:

- an analysis of the principles of the connection method and assignation of each country to a method;

- an indication of the benefits and problems arising from using that method;

- selecting a method of connection which maximizes the benefits while minimizing the problems;

- considering the implications for the use of adaptors when attempting to gain access to the PSTN via non-harmonized sockets;

- checking whether the ISDN connector would be suitable for such a mode of connection;

- if the ISDN connector is suitable, record any problems that might arise by permitting dissimilar terminal equipment to use the same connector (including potential damage if inadvertently plugged into the wrong socket);

- finally, based on these studies, to specify the characteristics of a suitable connector.

If the studies identify further work necessary to standardize this method of access, then a work plan for the development of a standard will be provided together with an indication of the required resources.

# Annex B: Present national arrangements

This annex sets out the mechanical and electrical methods currently used in each country for the connection of single line TE to the standard analogue PSTN interface.

## B.1 Network termination point for the PSTN

### B.1.1 Austria

In Austria, the basic network termination is a special threefold socket, which includes three sockets connected in series and a tone ringer for the last socket. The tone ringer serves as a line termination and shall conform to the requirements for a telephone set ringer. Each socket has 10 poles. When a plug of a telephone set is inserted into the telephone socket from the threefold socket, the tone ringer is disconnected from the line.

The installation of the socket(s) which is (are) connected to the PSTN is the monopoly of the PTT. The number of sockets is not limited. The last socket is always terminated by a (tone) ringer.

If several TEs are connected on one line, in quiescent condition the ringer circuits of the TE are connected in parallel. A parallel connection of TE with telephony functions in loop condition is not allowed.

### B.1.2 Belgium

In Belgium, the basic termination is a four pole socket, provided and installed by the RTT-BELGACOM at the subscriber's premises. This socket also contains an electrical load (RC Network) which terminates the PSTN line (a and b wires). There are two versions of this RC network:

- old model: R = 4 700 Ω in series with C = 1 μF. When a plug is inserted into the socket, the RC network is automatically disconnected from the line;

- new model: R = 47 kΩ in series with C = 0,47 μF permanently connected between the a and b wires.

### B.1.3 Bulgaria

The normal method of PSTN standard analogue subscriber interface presentation is by means of a socket on the network termination, to which TE is connected by means of a multi-contact plug complying with Bulgarian standard, BDS 4060-87.

### B.1.4 Cyprus

In Cyprus, the network termination is done by a "Primary Socket", which includes a RC-network and a voltage protection device. Other sockets (secondary sockets) can be installed in addition.

### B.1.5 Finland

In Finland the basic telephone network termination is a nationally standardized three pole socket at the subscriber's premises. A six-pole mini-connector is also used, but the use is very limited. All the equipment that are meant to be connected to the PSTN need to be provided with a plug that fits the socket.

The network provider supplies the network to the distribution frame in the building. The internal cabling, including sockets, can be installed by an authorized company.

### B.1.6 France

In France, the basic network termination point is the first cut-off point located at the subscriber's premises. This point is mainly provided by a nationally standardized 8-pole socket which contains an RC network (R = 20 kΩ, C = 2,2 μF) between the PSTN wires for testing the line. Also, a 6-pole socket and a 12 or 24-pole connecting strip are used, but only in old subscriber's installation in the first case and for some types of TE in the second case (e.g. meter pulse detector). The first socket (or connecting strip) is

provided and installed by the Public Telecommunications Operator or by any authorized company. Other sockets may be wired in parallel by the subscriber. The number of ringer circuits is limited up to 3 for each subscriber's line.

### B.1.7 Germany

In Germany, the basic network termination is a 6-pole socket, provided and installed by Deutsche Telekom A.G. at the subscriber's premises. Only the first socket is provided by Deutsche Telekom. Subscriber's may add additional sockets and installations. Direct parallel connecting is not allowed, this is done using manual or automatic switches (When TEs are in quiescent condition the ringer circuits are connected in parallel. Transmission circuits are individually switched, as required). The maximum number of ringer circuits is four. The first socket has a terminating circuit (R = 470 kΩ, diode) in it. When a plug is inserted into the socket the hard wired circuit behind this socket ($a_2$, $b_2$) is disconnected.

### B.1.8 Greece

Currently, the official physical connection method of the first telephone set is exclusively by a fixed means, namely by a small plastic termination box (rosette). All other connection points, are allowed to consist of a plug and socket system, the type of which is not yet specified.

### B.1.9 Hungary

In Hungary, the physical realization of connections to the PSTN are regulated by Basic Technical Plans as well as by national standards. These regulations apply first of all, to subscriber TEs and do not cover the connection points of separated or Private Automatic Branch Exchange (PABX) networks.

### B.1.10 Iceland

The PSTN is provided by the P & T at a main distribution frame and in the case of multi-subscriber premises, to a distribution box to which each individual subscriber is connected. All terminal cabling, including sockets, for each individual subscriber may be installed by an authorized person. All plans for internal cabling need to be approved by the P & T or its representative.

In Iceland the telephone network termination is a standard four pole socket. An eight pole socket is under study.

### B.1.11 Ireland

In Ireland, Telecom Eireann has the exclusive privilege of offering, providing and maintaining telecommunications services for transmitting, receiving, collecting and delivering of telecommunications messages within the State, up to (and including) a connection point in the subscriber's premises for any such service.

A PSTN signal line entering the subscriber's premises is required to be terminated on an appropriate Block Terminal. The Block Terminal is then connected to a Modular Jack 1M/1, by 4 (or 6) wire/0,5 mm cable. The Modular Jack incorporates a Western Electric Modular Socket.

### B.1.12 Italy

All PSTN line terminations for the ordinary telephone service consist of two kinds of socket.

### B.1.13 Luxembourg

In Luxembourg, the basic network termination is a four pole socket (ADo 4). Normally the first socket is provided and installed by the Posts and Telecommunications Administration at the subscriber premises. Additional sockets and installations may be added. No termination (e.g. RC-Network) for testing the line is provided.

### B.1.14 Netherlands

Starting from 1989 in The Netherlands the network termination point will be a special distribution frame which is placed in the meter cupboard of the subscriber. It has two compartments. In the first

compartment the connection to the PTT-line is made and some room for equipment is available. The second compartment is a strip with nuts and bolts, this is the connection point for the subscriber.

The wiring in the house including plugs and sockets is owned by the subscriber.

### B.1.15 Norway

Single PSTN lines are in Norway terminated by a standard socket provided by the public operator Telenor AS. The socket constitutes the boundary towards the public operator. The standard socket is an 8-pole modular socket (EN 28877).

Only the first, standardized socket is provided by Telenor AS as part of the PSTN subscription. Additional sockets shall be installed by an installation company licensed by Norwegian Telecommunication Authority (NTA). Additional sockets may also be installed by the subscriber, provided that a "do-it-yourself" installation material kit is used, including a plug-in connection into the first socket (which is Telenor AS property).

### B.1.16 Portugal

In Portugal, the network termination point for the PSTN may be a socket and, for permanently connected TE, either a connection box or a distribution frame.

The policy of network presentation has some differences in the areas of the two former public telecommunications network operators - Telefones de Lisboa e Porto (TLP) and Correios e Telecomunicações de Portugal (CTT) (from mid-1994, TLP and CTT were merged into a unique operator, called Portugal Telecom) - according to the types of TE.

In the area of TLP (Lisbon and Oporto) the socket for connection of single telephone sets is actually provided only by TLP; however, only telephone sets supplied by TLP are allowed to be connected to this socket. For other types of TE, TLP recommends a special socket (ADO 8) but the subscriber's may use any socket they want provided that it has been approved by TLP. For permanently connected TE (ALL types), connection boxes and distribution frames are allowed.

In the area of CTT (the rest of the country) a special socket (ADO 8) is always used to connect facsimile machines. For other types of TE any socket approved by CTT is allowed or, if the TEs are permanently connected, connection boxes and distribution frames may be used.

On the 1st of January 1988 a new regulation came into force introducing a nationally standardized 6-pin modular plug and socket system to be in full application in all new installations after a maximum transient period of 30 months. As a first step and after the transient period, this new connection system will be used only with single telephone sets but, in the future it is expected that it will be used with other types of TE as well. The new socket will be either provided by TLP and CTT or purchased in the market by the subscriber.

Meanwhile, non standardized sockets will be allowed to maintain the old installations or to connect TE not covered by the applicability of the new plug and socket system but, in both cases, they will have to be approved by CTT or TLP.

### B.1.17 Spain

In Spain, the network termination point for the PSTN is implemented by an "equipment" called PCR (abbreviation of the Spanish term: "Punto de Conexión de Red"; in English: "Point of connection to the network"). The PCR constitutes the outer boundary of the plant owned and provided by the Public Network Operator (PNO). At present a Single Line PCR is used, and a Multi-line PCR will be introduced shortly. The conversion of the existing old network to include a PCR is at this moment voluntary; when the subscriber asks for connecting to the network a private owned terminal equipment, the installation of a PCR and the possible internal re-wiring is compulsory.

Both types of PCR's are provided, installed, and owned by the PNO by charging authorized rates; by now the actual location of the PCR, inside the subscriber premises, is decided by the involved subscriber. The possible additional private wiring in the subscriber premises, that includes wires and sockets (to which the approved terminal equipments are plugged), is installed under the responsibility of the subscriber, and it is owned by him.

The PCR's have two compartments. The first compartment is normally closed, and it is accessible only by the representatives of the PNO; it contains the point to which the wires of the outside plant are connected. Usually, the first compartment contains also a network termination dipole; the termination dipole is formed by a resistor of 22 kΩ in series with a capacitor of 1 µF and when provided, is permanently connected across the two wires of the line for telemetering and maintenance purposes. In the future, instead of this passive termination circuit, it is planned to use an active remote operated circuit. At the time of publication, this circuit is undergoing a field trial. There are no access restrictions to the second compartment, and it contains a connecting point, a manually operated switch, and a socket. The private wiring (two wires are normally used) is connected to the connecting point in the second compartment. The switch allows disconnection of the private wiring from the network wires, either for functional purposes or for safe (re-)wiring. The socket is connected before the switch and in parallel with the network wires and is for the purpose of checking, with the help of a simple telephone set or other type of terminal equipment, the availability of the line, with non-interference (while the switch is opened) from the private wiring and the possible terminal equipments plugged into its sockets. The testing socket used is of one of the types standardized for private wiring, in order to match with the plugs or connectors stipulated for the terminal equipments.

### B.1.18 Sweden

In Sweden the network termination point for PSTN line (for normal telephone sets) is a standard 4-pin socket provided by Televerket. Only the first socket is installed by the PTT; other sockets within the subscriber's installation may be added and installed by the subscriber. No termination (e.g. RC-network) for testing the line is provided.

### B.1.19 Switzerland

The network termination point or delivery point for the PSTN line is normally a T + T 83 socket. In the case of multiline installations it can also be a special distribution frame. The in-house installation up to and including the socket is required to be installed by the PTT or by authorized companies. Additional sockets may be installed by the user.

### B.1.20 United Kingdom

The normal method of presentation of the standard analogue interface of the PSTN is by means of a socket on the network termination and testing apparatus (NTTA.), to which TE is connected by means of a multi-contact plug complying with British standard BS 6312 Part 1.

The NTTA contains network terminating circuitry; other sockets compatible with plugs conforming to BS 6312 Part 1 may be wired in parallel with the NTTA.

## B.2 Connection plugs

There are a number of differing types of plug currently used throughout the EEA. A few examples are illustrated in the following drawings.

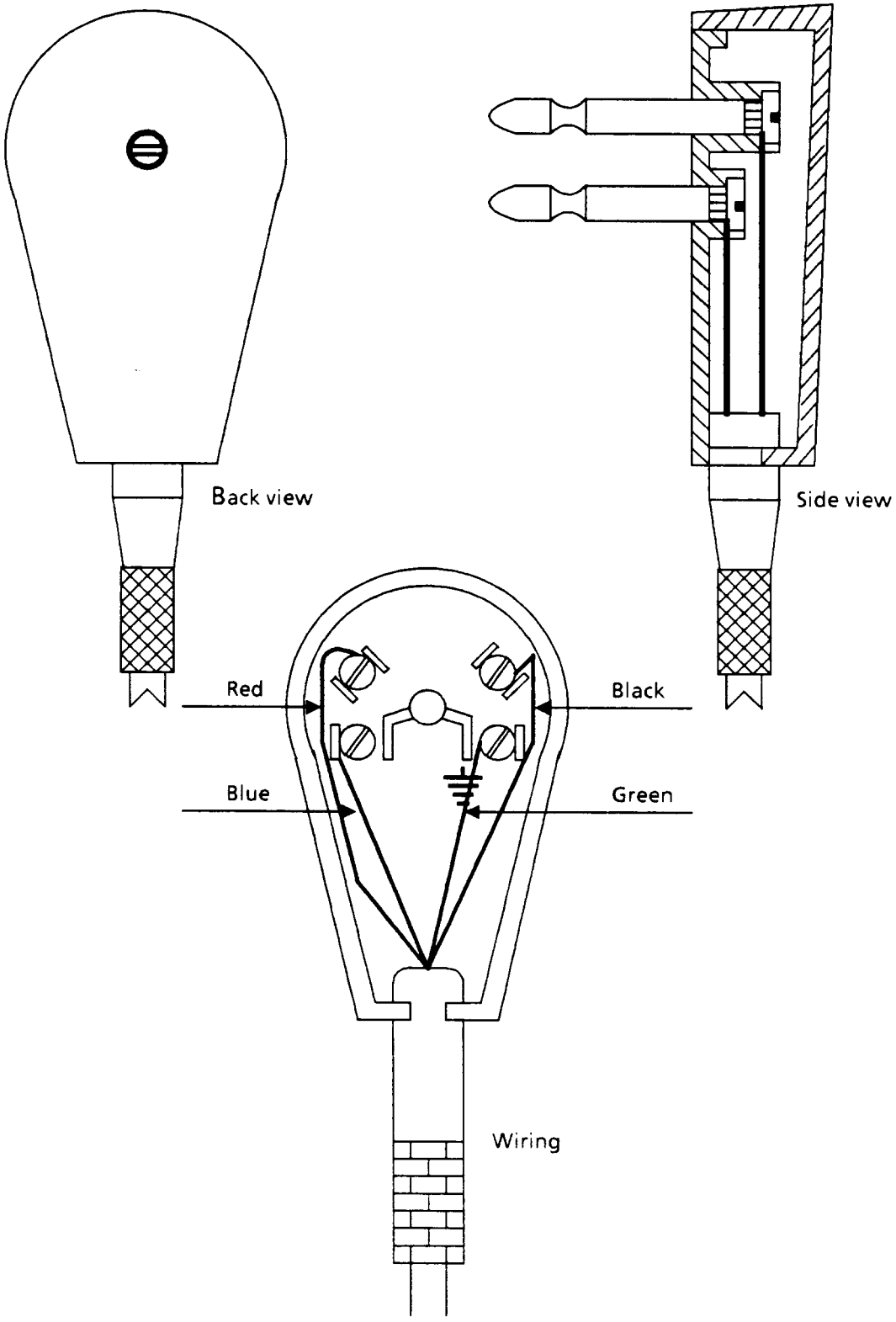



**Figure B.1: Used by Belgium**

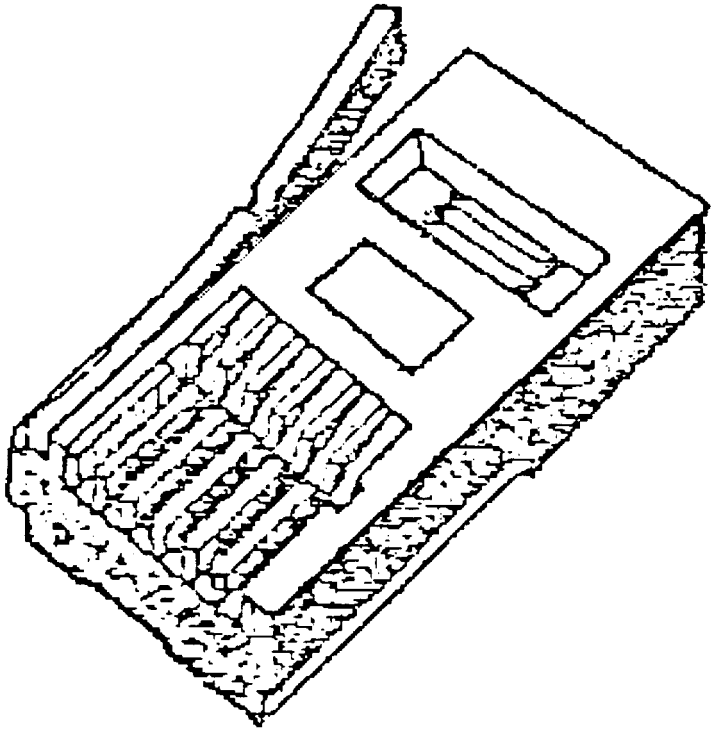


**Figure B.2: Used by Cyprus and the UK**

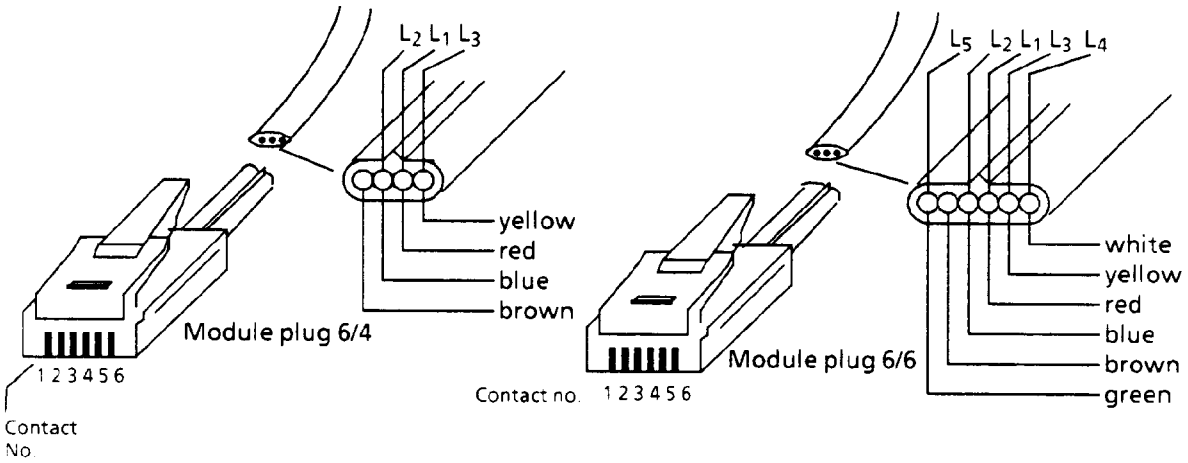



**Figure B.3: Used in Denmark, Finland (limited use), Ireland, Portugal and Spain**

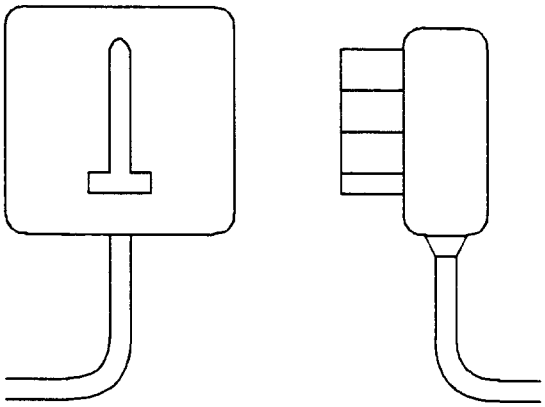
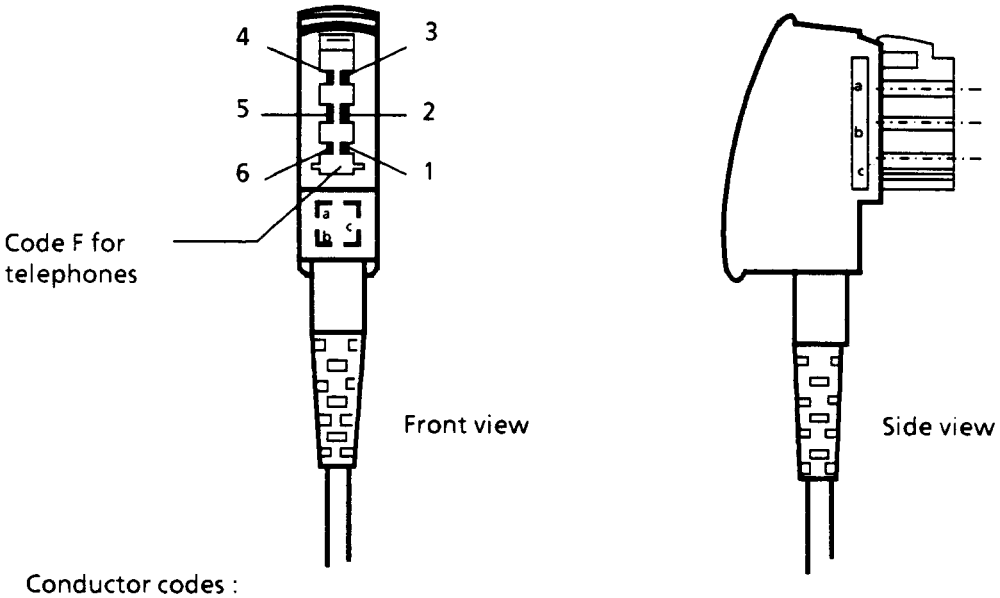


**Figure B.4: Used in France**




Conductor codes :

1 --> a
2 --> b
3 --> W
4 --> E
5 --> b2
6 --> a2

6-way right angle plug type R 1 conforming to DIN Standard 41 715 Part 3

**Figure B.5: Used in Germany**

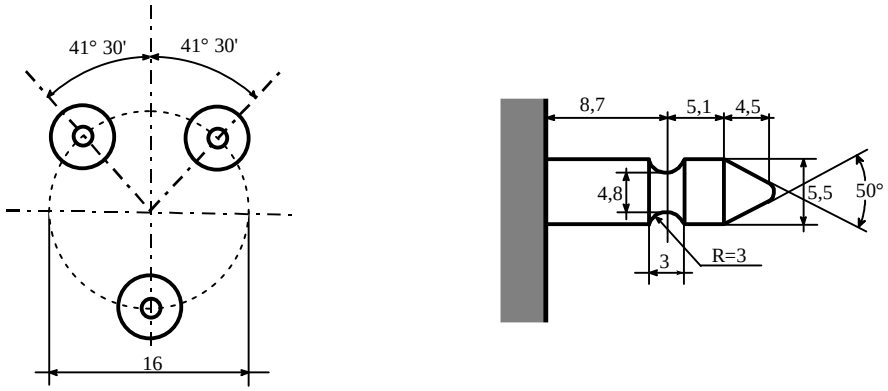



**Figure B.6: 3-pole plug used in Italy**

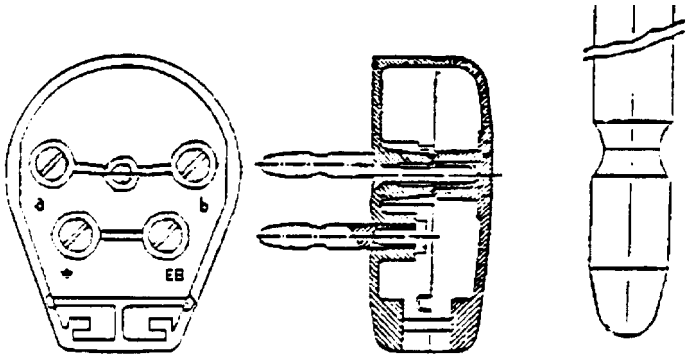



**Figure B.7: 4-pin plug used in the Netherlands**

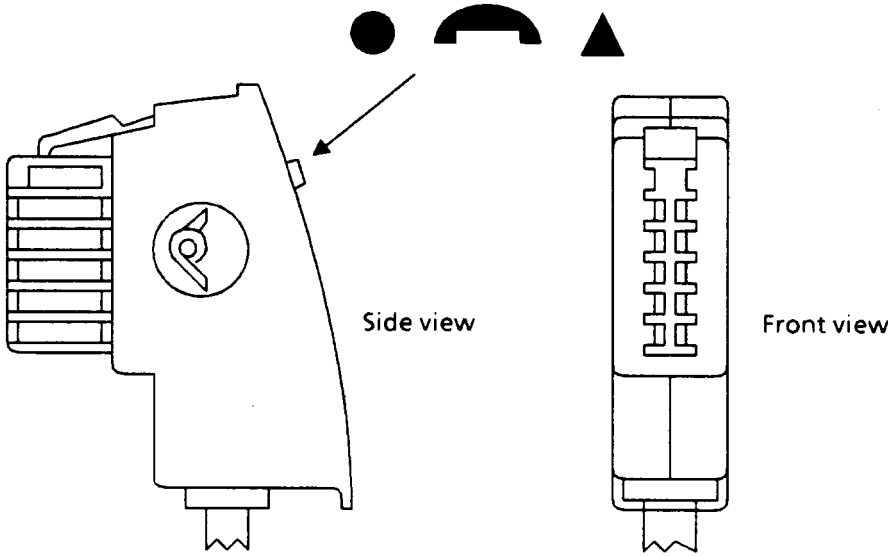



**Figure B.8: 10-pole plug used in Austria**

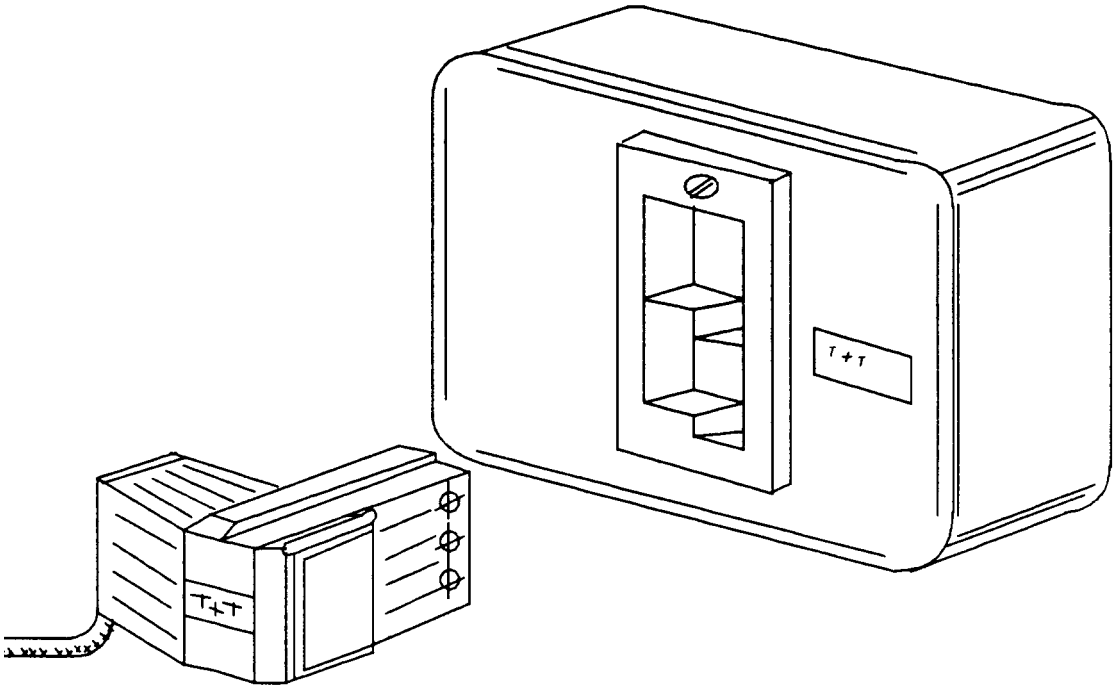



**Figure B.9: Plug and plug socket T + T 83 used in Switzerland**

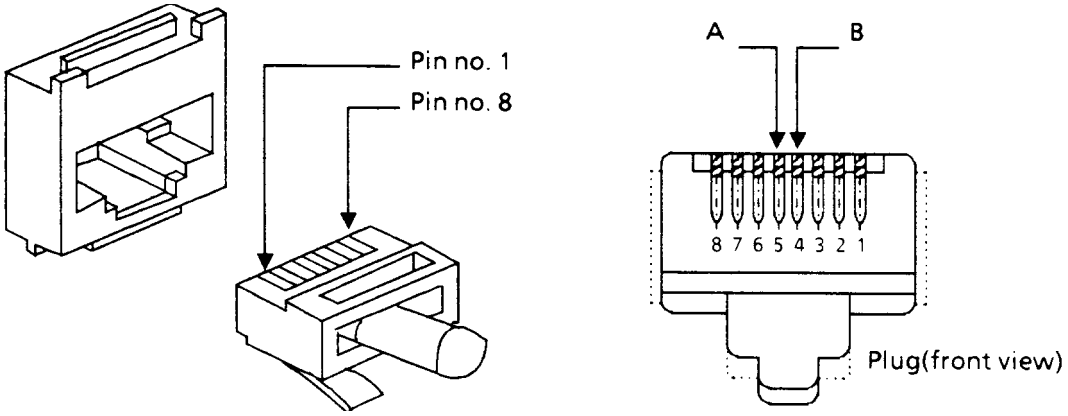



**Figure B.10: 8-pole modular plug and socket used in Norway and Denmark**

The above illustrations are by no means exhaustive. In some countries, more than one type of plug is currently in use.

Although the drawings are not to scale, it is evident that there is a large range of sizes and complexity.

## B.3 Connection circuits

There are a number of differing connection circuit arrangements used in subscriber's installations throughout Europe. In some countries, TE is connected in parallel, with or without additional components to prevent "bell tinkle". In other countries, special arrangements are made to prevent more than one TE from being connected to the line simultaneously. Certain countries use more than one connection arrangement. The following examples of simple installations are taken from ETS 300 001 [2].

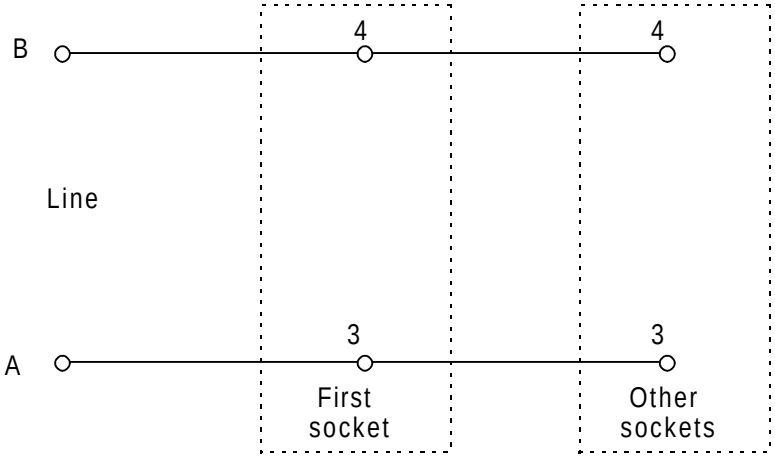



**Figure B.11: Installation circuit used in Finland**

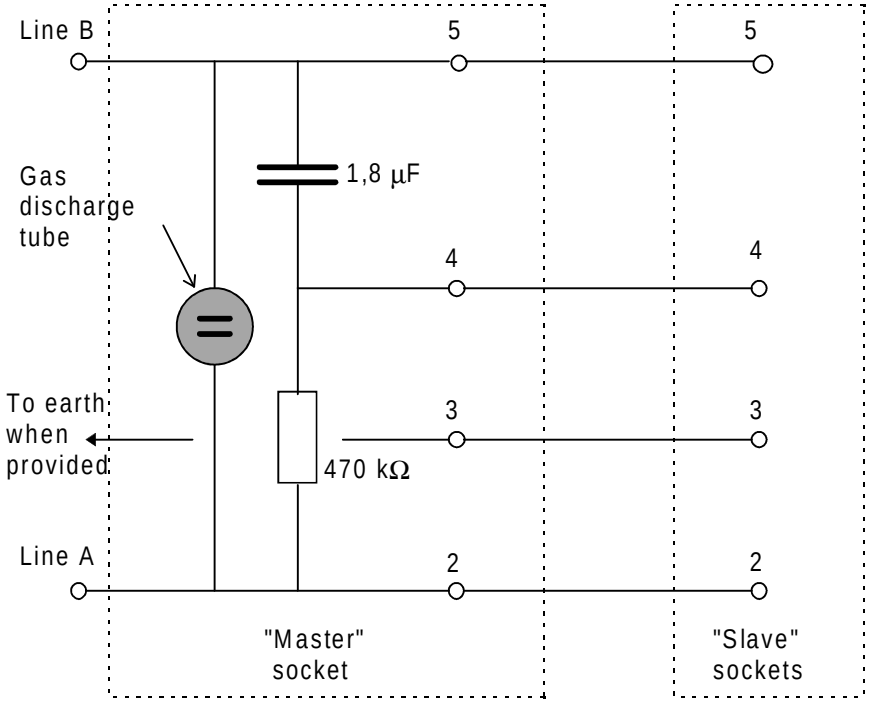



**Figure B.12: Installation circuit used in Cyprus and UK**

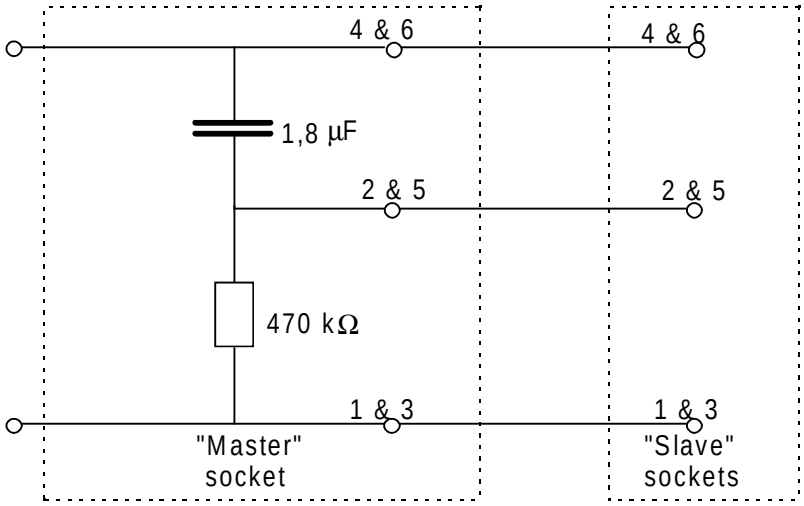



**Figure B.13: Installation circuit used in Ireland**

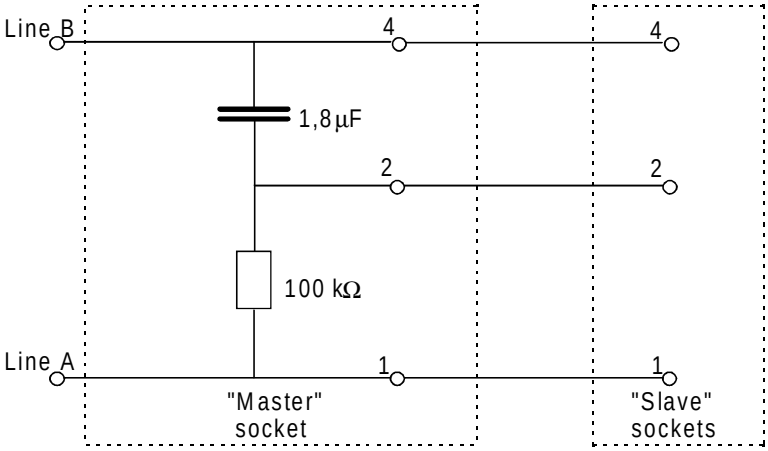



**Figure B.14: Installation circuit used in Portugal**

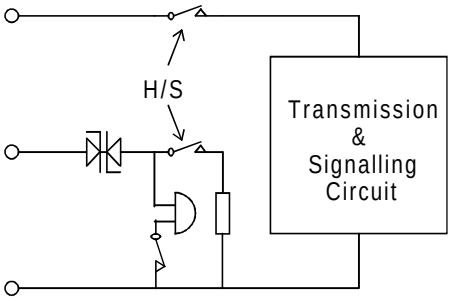



**Figure B.15: TE circuit compatible with Cyprus, Irish, Portuguese and UK installations**

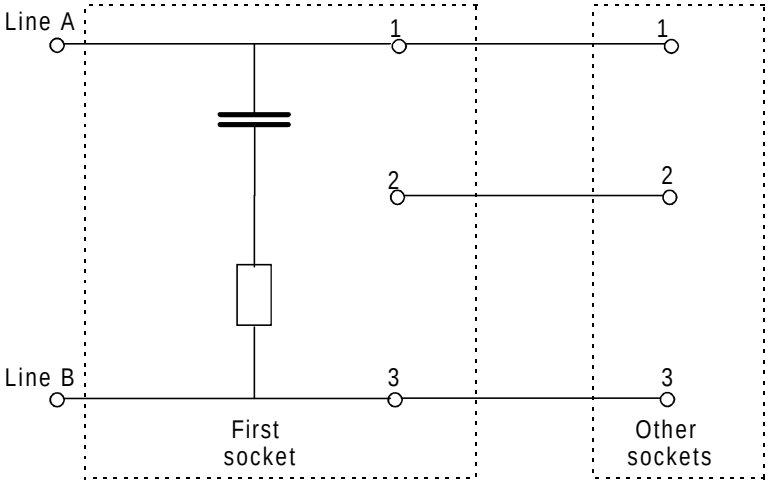



**Figure B.16: Installation circuit used in France**

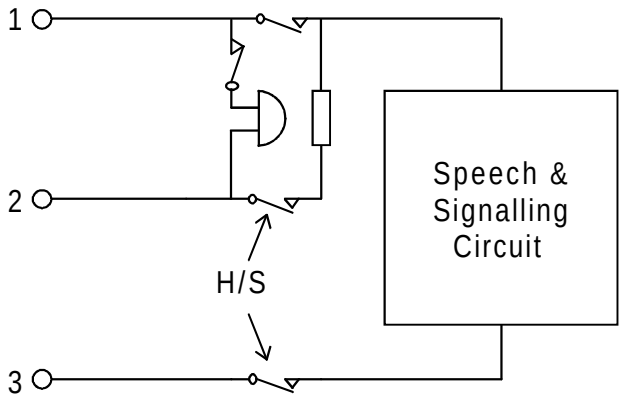



**Figure B.17: TE circuit compatible with French installations**

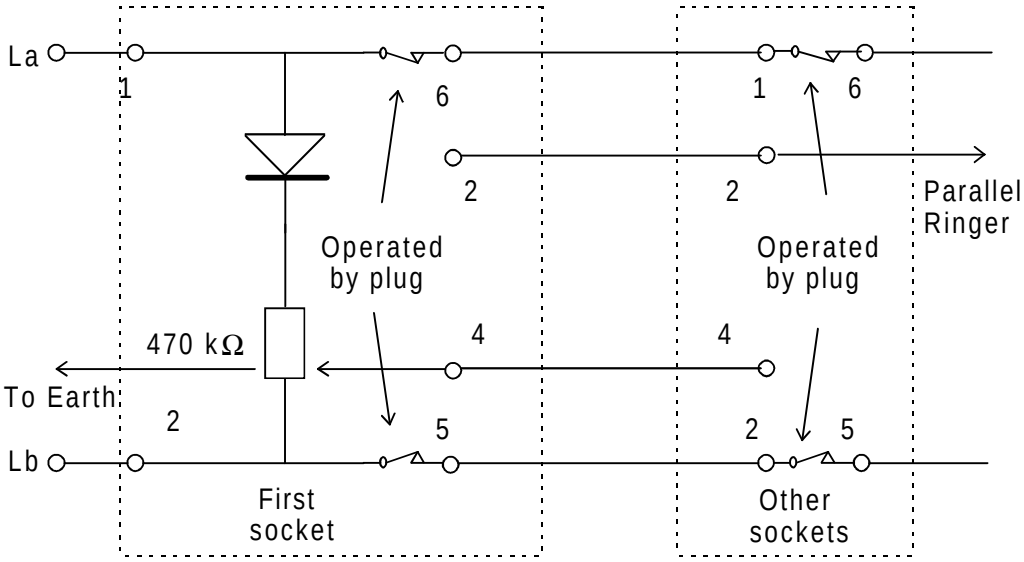



**Figure B.18: Installation circuit used in Germany**

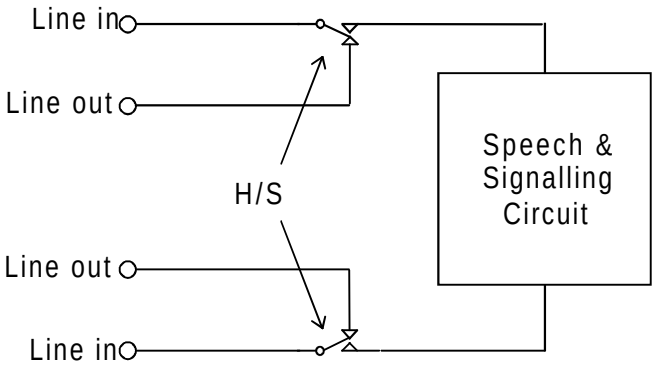



**Figure B.19: TE circuit compatible with German installations**

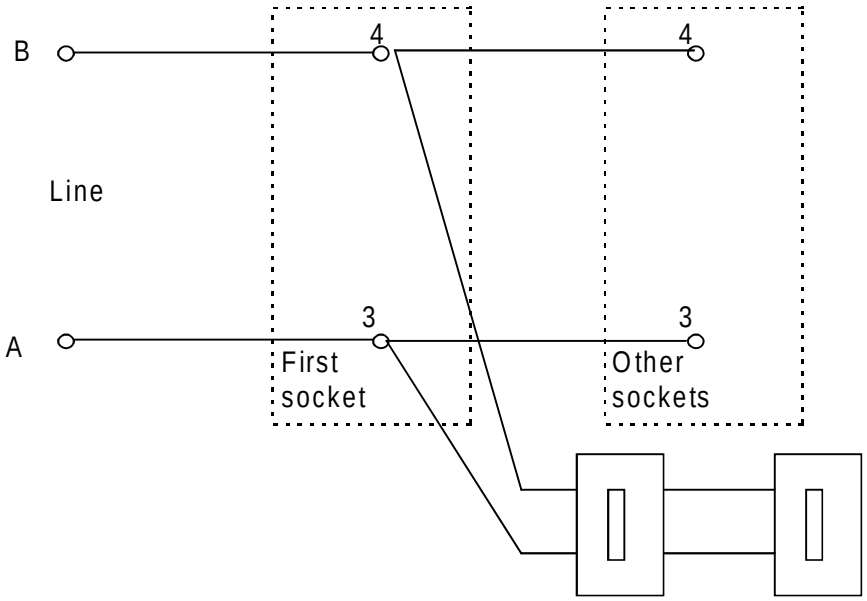



**Figure B.20: Adapted 2-wire installation circuit**

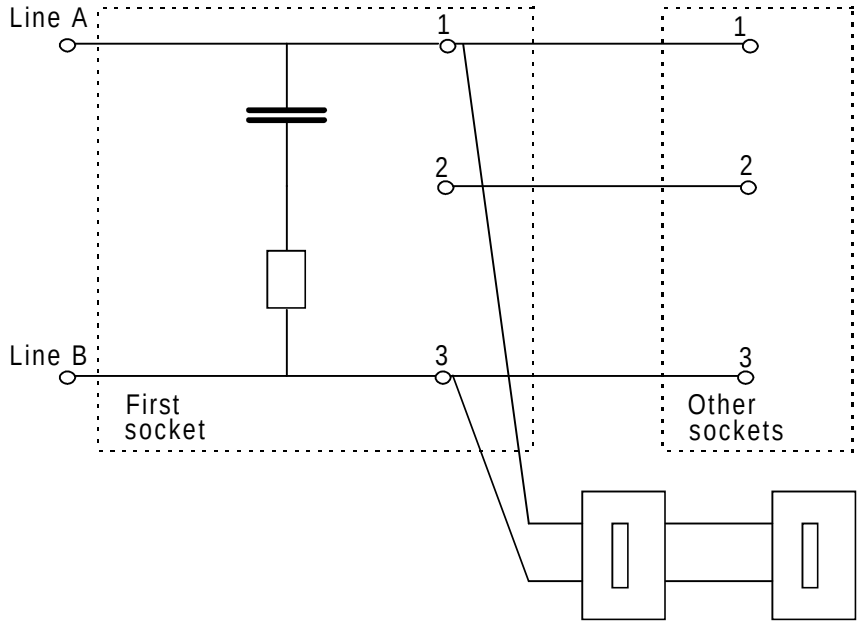



**Figure B.21: Adapted 3-wire installation circuit**

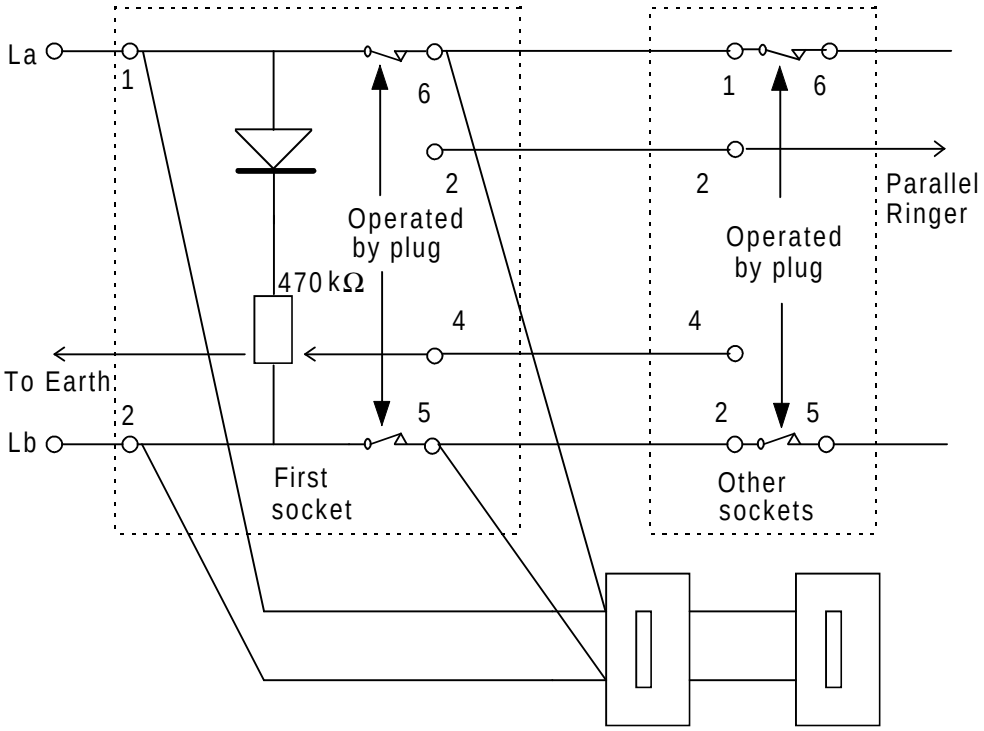



**Figure B.22: Adapted "exclusive" installation circuit**

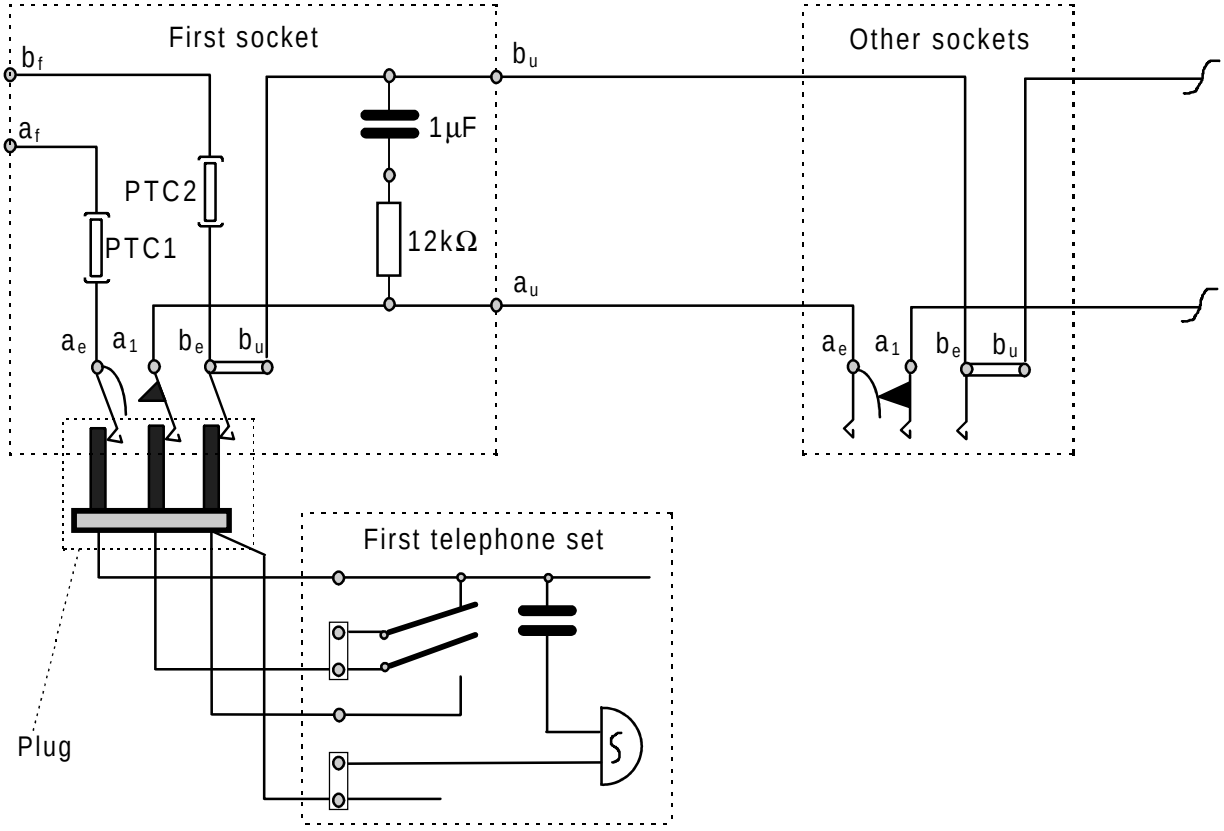



**Figure B.23:**

# Annex C: National identified characteristics

## C.1 Introduction

Prior to this ETR, data have been gathered in the various parts of the European Economic Area to get accurate and updated information from existing networks and corresponding arrangements. Meanwhile, variety and improvement steps through the long operational life of different networks lead to a complex situation where it is difficult to assure completeness of the characteristics given in the following survey even though carefully checked.

## C.2 Network voltage maximum ratings

Under normal circumstances, a wide range of different voltages (AC, DC and both superimposed, transients) can be developed between "a" and "b" wires or between "a" or "b" wire and earth if we consider the various operating conditions (loop state, line seizure, ringing and dialling) and even when voltages are applied from a high impedance by exchanges for test purpose.

Surges (spikes generated by lightning and similar hazardous effects) generated exceptionally are not considered in this clause whereas transients caused by switching are recorded.

### C.2.1 Maximum differential (or transverse) voltages encountered

$V_{DC}$ = 100 V

$V_{AC}$ = 100 V

$V_{DC}$ + $V_{AC}$ (superimposed) = 250 $V_{RMS}$

$V_{TRANSIENT}$ = 300 $V_{PEAK}$ for a duration up to 60 ms.

### C.2.2 Maximum common mode (or longitudinal or metallic) voltages encountered

$V_{DC}$ = 60 V

$V_{AC}$ = 124 V

$V_{DC}$ + $V_{AC}$ (superimposed) = 178 $V_{PEAK}$

$V_{TRANSIENT}$ = 250 $V_{PEAK}$ for a duration up to 20 ms.

## C.3 Extreme of current flowing through line

In operating conditions (loop state, line seizure, register recall, ringing etc.) very different magnitudes of current flowing through line wires can be observed. In addition, quiescent conditions for which very low current are generated by exchanges for test purposes have been taken into account.

As Installers, Network and Cabling Accessories Manufacturers Unions have been approached and they have shown interest for aspects related to upper frequency limits in view of connections and cabling specifications (different amendments to present standards are under way in CLC/TC 115), the maximum frequency requirement for a sinewave signal is mentioned.

### C.3.1 Maximum current values in steady state

$I_{DC}$ = 110 mA

$I_{AC}$ = 25 $mA_{RMS}$

$I_{DC}$ + $I_{AC}$ (superimposed) = 249 mA $_{PEAK\ TO\ PEAK}$ or 88 $mA_{RMS}$

$I_{TRANSIENT}$ = 84 $mA_{PEAK}$ for a duration up to 100 ms.

### C.3.2 Minimum current values and maximum frequency requirements

$I_{DC}$ = 300 µA

$I_{AC}$ = 250 $\mu A_{RMS}$

$F_{SINE}$ = 20 kHz.

## C.4 Contact resistance for mated connectors

### C.4.1 Basic requirement

In standard atmospheric conditions, connection points of mated connectors shall show an initial contact resistance of 10 mΩ in direct current and 20 mΩ in alternating current for a current of 10 mA or without specified current conditions.

### C.4.2 Specific requirement

If secrecy has to be preserved for telephone call, the contact resistance shall be as low as 10 mΩ both at 200 $\mu V_{AC}$ and at 10 $mA_{RMS}$

## C.5 Insulation parameters

### C.5.1 Insulation resistance required by functional needs

In the quiescent state, the minimum value needed to avoid any interference in normal operation shall be at least:

| DC Test voltage (in V) | $R_1$ (in MΩ) | $R_2$ (in MΩ) | $R_3$ (in MΩ) |
|---|---|---|---|
| low | 100 | 40 | 100 |
| 100 | 5 | 10 | 1 |
| 500 | 500 | 100 | no requirement |
| 1 500 | no requirement | 100 | no requirement |

### C.5.2 Insulation parameters enforced by safety regulation

Withstand DC and AC voltages plus insulation resistances are generally dealt with in EN 60 950 [5], but the requirements in Norway and Sweden exceed standard ones. Climatic and geological reasons justify the extra requirements as it can be difficult to get low impedance earthing in those countries.

| Country | Withstand voltage (in V) | | Insulation resistance |
|---|---|---|---|
| | DC | AC | (in MΩ) |
| Norway | 1 500 | 1 500 $_{RMS}$ | 500 |
| Sweden | | 1 410 $_{PEAK}$ | |

## C.6 Electrical behaviour under surges

The aim of this clause is to give a scale of ability to withstand hazardous currents independently of their magnitude and variation versus time (continuous, single or bursts of spikes etc.) regardless of its origin and nature (induced or direct contact, voltage or intensity etc.) including all possible sources (mains, lightning etc.) without affecting the operational features of the component or piece of equipment referred to. To a certain extent, the term "Resistibility" should cover this definition.

| Country | Surge (in $V_{PEAK}$) | Duration (in µs) 50 % of magnitude | Rise time (in µs) 10 to 90 % of magnitude | National specification reference |
|---|---|---|---|---|
| Austria | 2 000 | 700 | 10 | DIN 41715 part 2 |
| France | 1 500 | 700 | 0,5 | CSE I 31-21 |
| Hungary | 1 000 | 700 | 10 | MSZ-17-221: 1992 |
| Italy | 1 500 | 1 000 | 1 | CT 5/86 "Cordoni piatti con connettori modulari" |
| Norway TE | 1 500 | 50 | 1,2 | Televerkets miljoespesifi-kasjon ME-3, subclause 4.6 |
| Norway Connector | 4 000 I = 1,3 $A_{DC}$ | | | For 15 minutes applied to disconnected and mated connectors |
| Switzerland | 1 500 | | | ITU-T Recommendation K.21[6] |

## C.7 Climatic and physical environment

Climatic and physical environment conditions for testing are generally referred to IEC Publications such as:

- IEC 68-2-1 [7] for cold with a minimum temperature of -40 °C;

- IEC 68-2-2 [8] for dry heat with a maximum of +85 °C;

- IEC 68-2-3 [9] for damp heat at a temperature of 40 °C with 90 % RH and a maximum duration 1 000 hours.

In addition to previous parameters, some specific requirements have been mentioned by only one country in response to survey:

- UV exposure or simulated solar radiation according to IEC 68-2-5 [10], 700 W/m² for 500 hours (see also IEC 68-2-9 [11];

- salt spray test against IEC 68-2-11 [12], for a duration of 96 hours;

- rapid temperature change according to IEC 68-2-14 [13], 30 minutes at 45 °C and 30 minutes at -20 °C (a changeover time between steady states of under 2 minutes);

- slow temperature change test to IEC 68-2-30 [14].

## C.8 Chemical compliance

### C.8.1 Effects of gas pollutants

In order to reflect corrosion resulting of gas pollutants found in atmosphere of urban and industrial area, tests including hydrogen sulphide ($H_2S$) or sulphur dioxide ($SO_2$) exclusively or combined are found. At a temperature of 25 or 35 °C, with a relative humidity of 75 % and for a duration of 4 to 10 days, hydrogen sulphide and sulphur dioxide are respectively used in proportion ranging from 0,1 to 4 ppm and 0,5 to 25 ppm. Acceptance is limited to contact resistance increase of 50 to 100 % above the initial one. For the near future, we are advised to prefer the contamination IEC 68-2-60 [16] (including a variety of combinations in four methods) which is regarded as superior: with between 3 and 10 changes of the test atmosphere per hour, for preferred durations of 4, 10, 14 and 21 days.

| | Severity 1 | Severity 2 | Severity 3 | Severity 4 |
|---|---|---|---|---|
| $H_2S$ | 100 + 20 ppb | 10 + 5 ppb | 100 + 20 ppb | 10 + 5 ppb |
| $NO_2$ | | 200 + 50 ppb | 200 + 50 ppb | 200 + 20 ppb |
| $Cl_2$ | | 10 + 5 ppb | 20 + 5 ppb | 10 + 5 ppb |
| $SO_2$ | 500 + 100 ppb | | | 200 + 20 ppb |
| Temperature | 25 + 1 °C | 30 + 1 °C | 30 + 1 °C | 25 + 1 °C |
| Relative Humidity | 75 + 3 % RH | 70 + 3 % RH | 75 + 3 % RH | 75 + 3 % RH |

### C.8.2 Cord and connector material compliance

Only defined in three countries, such an experiment is considered as highly suitable in order to prevent leaks from appearing in connector material.

| Country | Temperature | Duration | Stress | National reference |
|---|---|---|---|---|
| France | 70 °C | 500 h | apply on cord | CSE B 11-21 "Cordons de ligne" |
| Italy | 70 ± 2 °C | 96 h | apply on sample weight = 50 g | CT 5/86 "Cordoni piatti con connettori modulari" |
| Switzerland | 85 °C | 16 h | apply on cord | |

For Italy, test sample dimensions are defined. Basic registered samples are ABS (acrylonitrile-butadiene-styrene), SAN (styrene-acrylonitrile), SB (styrene-butadiene), CA (cellulose acetate) and PMMA (polymethyl metacrylate).

## C.9 Mechanical characteristics and applied strains

An insertion strength under 20 N is admitted for effective coupling of plug and socket. When considering withdrawal, connectors with a latching device lead to an excessive strength which is close to connectors without such a device (45 to 76 N).

Ageing effect after 100 to 10 000 cycles (insertion/withdrawal) is related to withdrawal strength (acceptance is determined by a 50 % maximum reduction of nominal withdrawal strength) for connectors without latching device whereas a contact resistance variation (increase under 100 %) limit is preferred for those provided with latching devices.

## C.10 Faults identification and life expectancy

Only one cause of failure (voltage overload) has been mentioned in one response. This is not enough to draw conclusions about failure analysis. We therefore recommend further investigation into this aspect to clarify and weigh up different causes (with a view of a possible improvement in the surface roughness) and the corresponding level of acceptance (duration of microcuts).

Mean time between failures: 150 000 hours

Life expectancy (mechanical): 500 insertions/withdrawals

Life expectancy (electrical) 20 years

# Annex D: Example of an Outline Specification for a Euro Plug/Socket

## D.1 General characteristics

### D.1.1 Mechanical features

Both the plug and socket shall be small and compact so as to facilitate the design of a range of adapters compatible with the various existing network sockets.

A range of adapters shall be made available so as to permit the harmonized plug to mate with the existing sockets used within the European Economic Area.

The plug should not be so small as to be difficult to grasp, and its design should take account of users with disabilities.

The connector arrangement shall be polarized to ensure correct insertion and shall be such as to be incompatible and non-confusable with connectors that have other uses.

The basic design of the plug and socket shall be such as to be compatible with both automatic and manual assembly in an economic manner. Any fixed socket arrangement shall be simple to install without special tooling.

The design of the socket arrangement shall be modular in such a way as to permit the assembly of two or more sockets into a single unit.

Arrangements shall be made to prevent user access to that part of the connection system that is the property of the network operator.

In order to facilitate simple fault diagnosis by the user, the plug and socket system is required to provide a means of physically separating the NTP from the local installation wiring and provide an NTP in the form of a socket as well as providing facilities for the connection of the user installation wiring.

### D.1.2 Electrical features

The plug and socket arrangement shall be provided with facilities to permit the network operator to test the Network Terminating Point (NTP) independently of any local installation.

In order to facilitate simple fault diagnosis by the user, the plug and socket system needs to provide a simple means accessible to the user, of isolating the NTP from the local installation wiring.

Plugs and sockets shall be available in forms that provide between two and six electrical contacts so that similar components can be used, for example, on Private Branch Exchange (PBX) installations using earth recall. It is desirable that sockets should be available with plug operated switching facilities so as to permit more complex installation arrangements.

Provision shall be made for the fitting of adequate surge protection to protect the local installation against any excessive voltages that may be present on the network.

It would be desirable that provision should be made within that part of the system containing the NTP for the incorporation of some circuitry, e.g. for remote line testing, meter filters, Integrated Services Digital Network (ISDN) Network Terminating Equipment Type 1 (NTE 1) components, Asymetrical Digital Subscriber Line (ADSL) filters etc.

## D.2 Mechanical properties

The dimensions and tolerances of the design of the plugs and the sockets shall be such as to ensure successful mating and should permit the full interchangeability of parts sourced from different suppliers.

The plug and socket arrangement should provide an adequate minimum pull out force, (being provided with a latching arrangement if necessary) to prevent inadvertent disconnection.

The maximum pull out force shall not be so high as to cause damage to the cordage in the case of excessive tension being applied to the cord.

The contact arrangement shall not be damaged by insertion and withdrawal when line voltages or ringing current is applied.

The plug and socket system shall not be damaged by the range of climatic conditions likely to be found indoors within the European Economic Area.

The contact assembly of the plugs shall be suitable for use with either tinsel or stranded wiring of the dimensions normally found in TE cordage.

The contact assembly of the sockets shall be suitable for use with solid wiring of the dimensions normally found in telecommunications wiring installations.

The materials used in the design of the plugs and the sockets shall be recyclable so as to minimize adverse effects on the environment.

## D.3 Electrical properties

The contact resistance of the plugs and sockets shall be low and stable.

The plug and socket assembly shall be so constructed as to survive a reasonable number of insertions and withdrawals without an excessive rise in the contact resistance.

The contact arrangement shall not be seriously affected by insertion and withdrawal when carrying line current or AC ringing current both derived from typical inductive sources.

The contact resistance of the plugs and sockets shall not be seriously affected by being subjected individually to the Industrial atmosphere test described in IEC 68-2-42 [15] (with the conditioning atmosphere generated by combustion, as described in appendix B of that standard) for a period of 10 days.

The insulation resistance shall be high.

The insulation shall be of a strength such that breakdown shall not occur when subjected to voltages likely to be present on the PSTN.

## D.4 Safety

The plug and socket arrangements shall provide a level of safety compliant with IEC 950 [17].

## D.5 Intellectual Property Rights (IPR)

The design of the plug and/or socket should be free from potential complications arising from IPR, and should be available for manufacture by a number of competing suppliers.

## History

| Document history | |
|---|---|
| January 1997 | First Edition |
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