ETSI TR 101 768 V1.1.1 (2000-12)

Technical Report

Public Switched Telephone Network (PSTN);
Study on the generation of analogue ringing signals

Reference
DTR/AT-010087

Keywords
analogue, signal processing, signalling

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

Individual copies of the present document can be downloaded from:
http://www.etsi.org

The present document may be made available in more than one electronic version or in print. In any case of existing or perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF). In case of dispute, the reference shall be the printing on ETSI printers of the PDF version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at http://www.etsi.org/tb/status/

If you find errors in the present document, send your comment to:
editor@etsi.fr

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://www.etsi.org/ipr).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Access and Terminals (AT).

Introduction

During the drafting of analogue terminal and network standards it is often found that the same criteria and parameters are evaluated and discussed, even though it has already been discussed in detail before. Some of the often-discussed parameters are the different aspects of analogue ringing generation.

SLIC designers need information regarding the different aspects of ringing to ensure the design of interfaces that can fulfil the need of most clients, making the necessity for re-design slim and therefore promoting cost effective designs and equipment.

The aim of the present document is to point out the different aspects of analogue ring signals that should be taken into account when designing equipment that generates ringing, and when drafting new standards or specifications. This information will be useful to designers of terminal equipment and network equipment that generates ringing (e.g. PABX & Terminal adapters), and if implemented will reduce incidences of problems with ring detection.

1 Scope

The present document gives guidance on the different aspects of analogue ringing signals. The present document aims at listing the different parameters that must be taken into account when drafting specifications or other documentation on which analogue ringing signals have an impact or influence. The present document is also intended for use by terminal and network equipment designers.

The present document is applicable to analogue ringing signals generated by subscriber line interface circuits (or other types of ringing generators) of exchanges, access networks, PABXs etc. be it for the public or private domain.

The present document describes the electrical characteristics of analogue ringing signals.

2 References

For the purposes of this Technical Report (TR) the following references apply:

[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] ETSI TR 101 183: "Public Switched Telephone Network (PSTN); Analogue ringing signals".

[3] ETSI EG 201 188 (V1.2.1): "Public Switched Telephone Network (PSTN); Network Termination Point (NTP) analogue interface; Specification of physical and electrical characteristics at a 2-wire analogue presented NTP for short to medium length loop applications".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

answer signal: indication that a terminal is answering an incoming call

balanced ringing: the ringing voltage is applied to both A and B wires. Each line carries half the ringing voltage (with respect to earth potential), 180 degrees out of phase with the signal on the other line.

dc seize condition: dc condition presented by a terminal that will be recognized by the network equipment as a valid answer signal.

distortion: deviation between the actual waveform and the ideal sine wave

unbalanced ringing: the ringing voltage is applied between one line and earth. The full ringing voltage is carried by one line. The other line is kept near earth potential.

3.2 Symbols

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

µ	micro
µF	micro farad
%	percent
V	volt
Ω	ohm

3.3 Abbreviations

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

ac	alternating current
dc	direct current
DSL	Digital Subscriber Loop
Hz	Hertz
rms	root mean square
SLIC	Subscriber Line Interface Circuit

4 Technical requirements

4.1 Application to line

Two methods of ringing generation are commonly used, balanced ringing and unbalanced ringing.

The use of balanced ringing minimizes the risk of crosstalk in adjacent cable pairs. Modern SLIC design follows this principle and integrates ringing on the SLIC chip, saving a ring relay, additional ring generator and therefore cost. Using the integrated balanced ringing approach permits lower output impedance of the ring generator. A lower output impedance ensures less energy dissipation in the network equipment and therefore increased efficiency. Unbalanced ring generators cannot drive terminals at the same line length as balanced ring generators, due to over voltage protectors in place, see clause 4.8.

Unbalanced ring generation could be acceptable in the case where no adjacent cable pairs or other subscribers are involved, e.g. single subscriber (line) Terminal Adapters.

NOTE: Terminal conformance testing is typically performed with balanced ringing - unbalanced ringing detection can therefore not be guaranteed.

4.2 DC voltage

The traditional way to detect ring trip is to monitor the dc current drawn from line by terminal equipment during ring generation. The ac ringing signal was therefore superimposed on a dc voltage. Terminal manufacturers could rely on this dc voltage during ringing to draw limited current for powering certain low power functions of terminals. Another method of ring trip detection is by detecting the ac impedance variation between the on-hook and off-hook terminal states. This method of ring trip detection could however fail on long line applications. Short loop ringing generators sometimes only supply dc during the silent periods of the ringing cycle.

To ensure reliable ring trip detection by the network and the correct operation of terminal equipment, it is recommended that a dc voltage in the range 22 Vdc to 78 Vdc be presented to line at least during the silent periods of the ringing cadence.

NOTE: Terminal conformance testing is typically performed with ringing superimposed on dc - terminal operation without dc can therefore not be guaranteed.

4.3 Frequency

Ringing generators use various ringing frequencies. The most common frequencies used are 25 Hz and 50 Hz, with a tendency towards 25 Hz.

To ensure reliable detection by all terminals, a ringing signal frequency of 25 Hz ± 8 % is recommended for ringing generators, and for terminal equipment it is recommended to detect ringing signals of 25 Hz ± 10 %.

4.4 Waveform

The waveform of the voltage output of the ring generator should be sinusoidal, when measured directly at the output of the line card under specified loads (depending on the drive capability of the line card, or as required by the operator).

A peak to rms ratio (Crest Factor) of 1,2 to 1,6 is recommended to limit harmonics and ensure correct detection by some terminals. It must be noted that some PABXs generate trapezoidal ringing signals that do conform to a crest factor of 1,2 to 1,6. A sinusoidal waveform is however recommended for the local loop of the public network.

Symmetry of the waveform is required to prevent false detection of the ring trip condition.

4.5 Distortion

Ring signal distortion may be originated either from the ringing generator itself (distortion of the voltage source) and/or from the non-linear characteristics of the load (distortion of the ringing current). It is therefore necessary to specify the distortion of the output voltage of the generator, loaded with a linear load, and to recommend as good practice the use of linear ringing detectors in terminal equipment. The use of linear ringing detectors will limit the distortion of the current when it is fed from a pure sinusoidal ringing generator. The ring signal distortion on a line is therefore represented by a combination of the two distortion sources.

Both distortion sources may negatively influence the performance of DSL equipment. Induced crosstalk caused by a ringing signal on an adjacent cable pair in the same cable can influence the performance of DSL equipment, and improved high-pass filtering could be required when the ringing signal is applied to the same cable pair as the DSL equipment.

It is recommended that the voltage distortion of a ringing generator, when connected to an ac coupled resistive linear load, should be 5 % or less, when measured at the line card output. The load conditions should include maximum and minimum load conditions.

4.6 Switching noise

The ringing signal should be applied to line and removed from line at the dc-offset level during the ringing cadence in order to minimize switching transients. These transients generate switching noise that can cause crosstalk in adjacent subscriber connections and interfere with DSL applications.

For single line (subscriber) applications (i.e. standalone radio in the loop subscriber interfaces) this parameter is less important.

4.7 Maximum voltage level

The maximum ringing voltage under no load conditions should be 100 V_{rms}, in order to prevent potential damage to terminals. In any event, safety limits should not be exceeded.

4.7.1 Peak voltage

The peak voltage (ac plus dc), across the A- and B- wires should not exceed 184 V. This ensures the prevention of false ring tripping due to over voltage protectors firing. The clipping caused by the over voltage protectors will cause additional distortion that can influence DSL applications negatively.

4.8 Minimum voltage under load

A ringing generator should be able to produce a ring signal adequate for detection by terminals connected to the end of the subscriber line. Influential factors that need to be considered are the maximum number of terminals that will possibly be connected to one line, the minimum allowable ring impedance of each terminal (load) and the maximum allowable line length in the network the ringing generator will be used in.

It is recommended that the ringing generator provide sufficient ringing current so as to produce a voltage of not less than 35 Vrms across the minimum permitted load impedance at the end of the maximum line length, as specified for the network.

NOTE: The minimum ring impedance at 25 Hz of any terminal is 4 kΩ.

4.9 Ringing cadences

The ringing cadences used may differ between networks. To ensure interoperability it is necessary for terminal manufacturers to ensure detection of the various ringing cadences. Distinctive ringing is a reality, a universal ringing cadence is therefore not probable. Due to the high voltages usually associated with ringing generation, continuous (uncadenced) ringing should be prevented under all conditions, including fault conditions. Ring generator designers use ringing cadences to distribute the ringing signal between different subscriber lines by not ringing all lines at the same time. This ensures that the ringing generator can handle the required ring load.

Some network operators apply an initial ring burst at the instant of ringing application to the line (e.g. an alerting signal in CLI applications). In this case the timing between the initial ring burst and subsequent silent period, and the timing of the normal cadence can vary and must be supported by the ringing generator.

Some examples of ringing cadences can be found in EN 300 001 [1] and in TR 101 183 [2].

4.10 Ring trip

The ringing signal should be removed as quickly as possible (typically 100 ms) upon reception of an answer signal to minimize the possibility of acoustic shock, to increase user comfort (especially on terminals with headsets) and to minimize the negative influence on DSL applications. This influence is due to distortion of the ringing signal and to the high ringing current that can saturate coils in DSL splitters.

It must be noted that terminals should still incorporate protection against acoustic shock.

A valid answer signal is a dc seize condition, or a suitable ac impedance at 25 Hz or 50 Hz. The ac impedance as seen from the line card will depend on the line characteristics and length, and the terminal impedance. Further information can be found in EG 201 188 [3].

Ringing generators without dc during ringing typically take longer to trip than generators incorporating dc during ringing.

4.11 False ring trip

False ring tripping should not be caused by normal ring load conditions. This could result in:

a) The network returning false busy signals to the calling party.

b) False call completion or connect signals to the network which in turn results in the calling party being charged for a connection that was not made.

c) No incoming calls.

The definition of normal ring load will depend on the ring load (number of parallel connected terminals) specified by the network.

History

Document history		
V1.1.1	December 2000	Publication