PSTN Protection

The demand for voice and data communications has never been greater. Today, virtually everyone in the developed world has access to a land-line telephone, which carries their voice or data over pairs of copper wire back to the local exchange, where it is assimilated into the network.

The copper wire which forms the backbone of the telephone network runs from house, to business, to exchange suspended in the air on telegraph poles or buried just below the surface of the earth. The sheer number and length of these conductors make any equipment connected to them vulnerable to lightning and interference from nearby mains power lines. Damage to and destruction of electronics is common – injury to and even death of users is not unheard of.

Protection of equipment and people from disturbances on telephone lines is straightforward and economical. Considering the costs associated with equipment damage and downtime and the implications for personal safety and public liability, there is no installation in existence where some form of protection is not justified.

Types of equipment covered

There are five common systems which use the copper telephone network to connect to the outside world. This article provides guidelines for the protection of all of them.

Plain Old Telephone Service (POTS):

Used to describe traditional voice communications by subscribers using conventional telephony.

Fax / Modem

Systems which use a conventional POTS subscriber line to dial a compatible system and transfer digital data.

Digital Subscriber Line (xDSL)

A relatively new type of subscriber line which provides a dedicated high-speed data line to routing equipment at the telephone exchange, overlayed on the POT service.

Integrated Services Digital Network (ISDN)

A dedicated data line between two locations, most often connected over copper telephone wire.

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Private Automated Branch Exchange (PABX)

A localised telephone system which connects a large number of users to one another, and to a smaller number of outside POTS lines.

Types of disturbances

There are four general types of disturbances which may be encountered on copper telephone lines. Each type results in an unacceptably high voltage reaching equipment which is connected to the affected line, causing damage to components and possible injury to people.

Lightning

Direct and indirect lightning strikes on or around telephone lines introduce fast-rising, high-energy surges into the system. Any equipment which is connected to affected lines is prone to catastrophic damage. The high voltage potentials associated with lightning strikes also present a real risk of shock to users.

Induced transients

Fast-rising, high voltage transient "spikes" are caused by the radiated emissions associated with the switching of heavy loads, AC rectification practices and other types of electronic circuits which generate electromagnetic noise. Transients are generally faster, shorter and contain less energy than a lightning strike.

Mains faults

One of the most important safety considerations for equipment connected to telephone lines is the potential for the line to become live with mains power. This is an inherent risk due to the large physical topography of the network and the fact that telephone lines and mains power lines are frequently located near one another.

EMP

EMP stands for electro-magnetic pulse. When talking about over voltage protection, it usually refers to NEMP, or Nuclear Electromagnetic Pulse. This high energy pulse with a very fast rise time occurs as a result of the interaction of the radiation from an atomic blast with the atmosphere. Due to the extremely fast rise time of NEMP, only multi-stage protection is suitable.

Standards and ACA compliance

The ACA has responsibility under the *Telecommunications Act 1997* to regulate customer equipment and customer cabling. To achieve this, the ACA has introduced industry self-regulatory arrangements based on compliance with applicable standards and labelling. The ACA regulates these arrangements through the *Telecommunications Labelling (Customer Equipment and Customer Cabling) Notice* 2001 (the Labelling Notice). The Labelling Notice identifies applicable technical standards and the required compliance level for specific items.

For compliant items, the supplier must make a declaration that the item complies with applicable standard(s). They must also apply a compliance label, comprising of the A-Tick mark and the company identifier, to the item and hold records supporting claims of compliance. These compliance records are often referred to as compliance folders. Items, which are covered by the Labelling Notice, but do not comply with applicable standard(s), must be labelled with the non-compliance label.

In the case of surge protection the Labelling Notice refers to *AS/NZS 4117:1999 Surge Protective Devices for Telecommunications Applications.* This standard covers the electrical and packaging requirements of such devices and the methods of verification. Included are the procedures for establishing:

- That the protector meets network interoperability requirements.
- That the protector can effectively protect the equipment which it is connected.
- That the protector will not self-destruct under predictable fault scenarios, and,
- That the protector will not cause any harm to people.

Novaris maintains compliance folders for all of it's telephone line products and, through compliance with *AS/NZS 4117:1999*, has ACA approval to use the A-Tick mark.

Classes of Surge Protective Devices

AS/NZS 4117:1999 allocates surge protectors into one of three classes, based on the type of installation for which they are intended.

Class 1 devices "…may be used on all types of circuits (with or without ring or battery) in all types of installations." This class of protector is the most robust, with the ability to survive faults on the telephone line which are caused by contact with mains power. Any domestic or commercial installation which is away from the building distributor (BD) or campus distributor (CD) is considered to be Class 1.

Class 2 devices "…shall only be used on circuits without ring or battery and shall only be installed in a building distributor (BD) or campus distributor (CD)." This class of protector is for use in dedicated circuits without the higher ring and battery voltages, such as ISDN lines. They must be installed in a distribution frame with a high quality earth.

Class 3 devices "…may be used on all types of circuits (with or without ring or battery) but shall only be installed in a BD or CD." This class of protector is suitable for all types of subscriber line, but may only be installed in a distribution frame with a high quality earth.

Two-stage protection

The easiest way to provide some level of telephone line protection, whilst complying with *AS/NZS 4117:1999,* is to use gas discharge tubes as the sole means of protection. Otherwise known as gas arresters, these components feature low capacitance, high energy handling and a long service life. Once the nominal breakdown voltage of the device is exceeded, the gas contained within ionises, creating a low impedance current path to dissipate surge energy. Unfortunately gas arresters take a fairly long time to fire, by which time a significant voltage spike has already been delivered to the load. This is not such a problem in high power applications, but it is more than enough to destroy the sensitive components associated with low-voltage electronics.

With the addition of a second protection stage, the initial high voltage spike let through from the gas arrester can be clamped to a safe level. Depending on the particular product, this stage contains clamping diodes and metal oxide varistors as protection elements, along with an RC network which sets the frequency response of the second stage and balances it with the first. Controlling the frequency response of the second stage enables the use of components with low clamping values – this achieves low let-through voltages under surge conditions but prevents the circuitry from self-destructing when exposed to system operating and sustained over voltages. It also minimises the attenuation of signal traffic during normal operation.

Novaris selection guide

Class 1 Installations

	Pairs	Description	Stages
RJ12-PSTN	1	RJ12 socket / flying lead	2
RJ45-PSTN	1	RJ45 socket / flying lead	2
RJ12-2PSTN	2	RJ12 sockets	2
RJ45-2PSTN	2	RJ45 sockets	2
PP10-2C	1	Power filter incorporating RJ12 sockets	1
PP10-2C2	2	Power filter incorporating RJ12 sockets	1
SLxDIN-PSTN/1	1, 2, 4	Screw terminals, Din rail mounting	2

Class 2, Class 3 Installations

	Pairs	Description	Stages
KP1	1	Krone LSA connection	2
KP10	10	Krone LSA connection	2
KP10/HB	10	Krone Highband connection	2
SLxDIN-PSTN/3	1, 2, 4	Screw terminals, Din rail mounting	2

Notes for Product Selection

All of the 2-stage products listed above are suitable for all applications involving copper telephone lines. Specifically PSTN, ISDN, xDSL, PABX. These products supersede all previous versions of PSTN, ISDN ADSL, DSL protectors.

The SLxDIN-PSTN/1 (for class 1 installations) and the SLxDIN-PSTN/3 (for class 3 installations) are the only signal line protectors suitable for sale as telephone line protection. The SLxDIN-PSTN (standard SLP circuit) or the SLxDIN-200 is not to be sold for connection to public telephone lines.

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