COMPANY PROFILE – NORTHERN TECHNOLOGIES SA cc

NTSA
DEFINED POWER PROTECTION

SURGE AND LIGHTNING PROTECTION SPECIALISTS

Founded in 1998, Northern Technologies SA is committed to providing surge and lightning protection solutions which ensure maximum uptime of your equipment. Northern Technologies SA provides technical consulting, design and application engineering. We further undertake installations, power quality surveys for the protection of a single sensitive device to comprehensive systems which are mission critical to the business of major corporations.

We offer a broad spectrum of products including but not limited to:

Surge and Lightning Protection (Protec Range)

Northern Technologies provides a complete solution, which combines a graded approach consisting of CLASS 1 lightning protection utilizing high energy metal oxide varristors with fast acting CLASS 2 surge suppression utilizing silicon avalanche diode technology.

Transformers / Motors / Generator Protection (Protec Z)

Protec Z is a unique, high frequency transient over voltage surge suppressor for the protection of generators, motors and transformers from steep wave-front, short rise-time, high magnitude, spikes, surges and other transient voltages, generated by switching, induced lightning and other sources.

Protection Relays (Protecta)

Protection, automation and control relays for power industry and utilities. To supply your needs for HV protection relays that are reliable, easy to operate and program, at an affordable price. A comprehensive range including, transformer and reactor inrush protection, transformer burn out protection, capacitor as well as distance protection relays.

Surge and Lightning Protection – Protec

Transformers/Motors/Generator Protection - Protec Z

Protection Relays - Protecta

411 Jan Smuts Ave, Blairgowrie, Randburg, Johannesburg, South Africa | PO Box 413142, Craighall, 2024
Tel: +27 11 787 3787 | Fax: +27 11 787 3287 | Email: ntsa@mweb.co.za | www.ntsa.co.za

NTSA
DEFINED POWER PROTECTION

AC LIGHTNING PROTECTION

Richard Paul Evans

Northern Technologies SA
PO Box 41342
Craighall 2024
South Africa
Tel: +27 (011) 787 3787
Fax: +27 011) 787 3287

AUTHOR BIOGRAPHICAL NOTES

RICHARD PAUL EVANS

- Qualified as a Communications Engineer specializing in mobile telecommunications at Telkom - South Africa's parastatel telecommunications provider.
- Product specialist in power protection for 10 years.
- Technical Manager for Northern Technologies South Africa – a well known national leader in power protection.

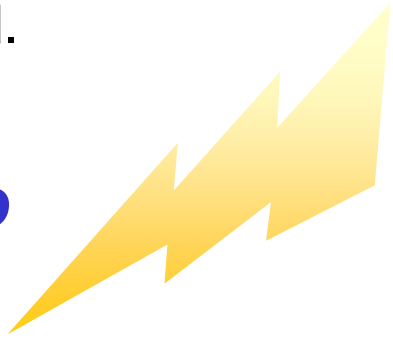
ABSTRACT

This paper will take you on a journey into the world of ac surge and lightning protection.

We will attempt to take the “guess work” and “marketing hype” out of the subject, explore the different topologies commercially available and explain their method of operation, strengths and weaknesses.

We will calculate what size transients can be expected and identify where and how to install ac surge protection in telecom installations, so as to ensure that the equipment is sufficiently protected.

WELCOME TO OUR WORLD



ABSTRACT cont.

Our goal is to provide you with a document which is practical and usable in the field for design purposes in terms of product comparison and selection of surge protection devices, as well as a maintenance tool to indicate where our existing facilities can be optimized.

The key areas covered are:

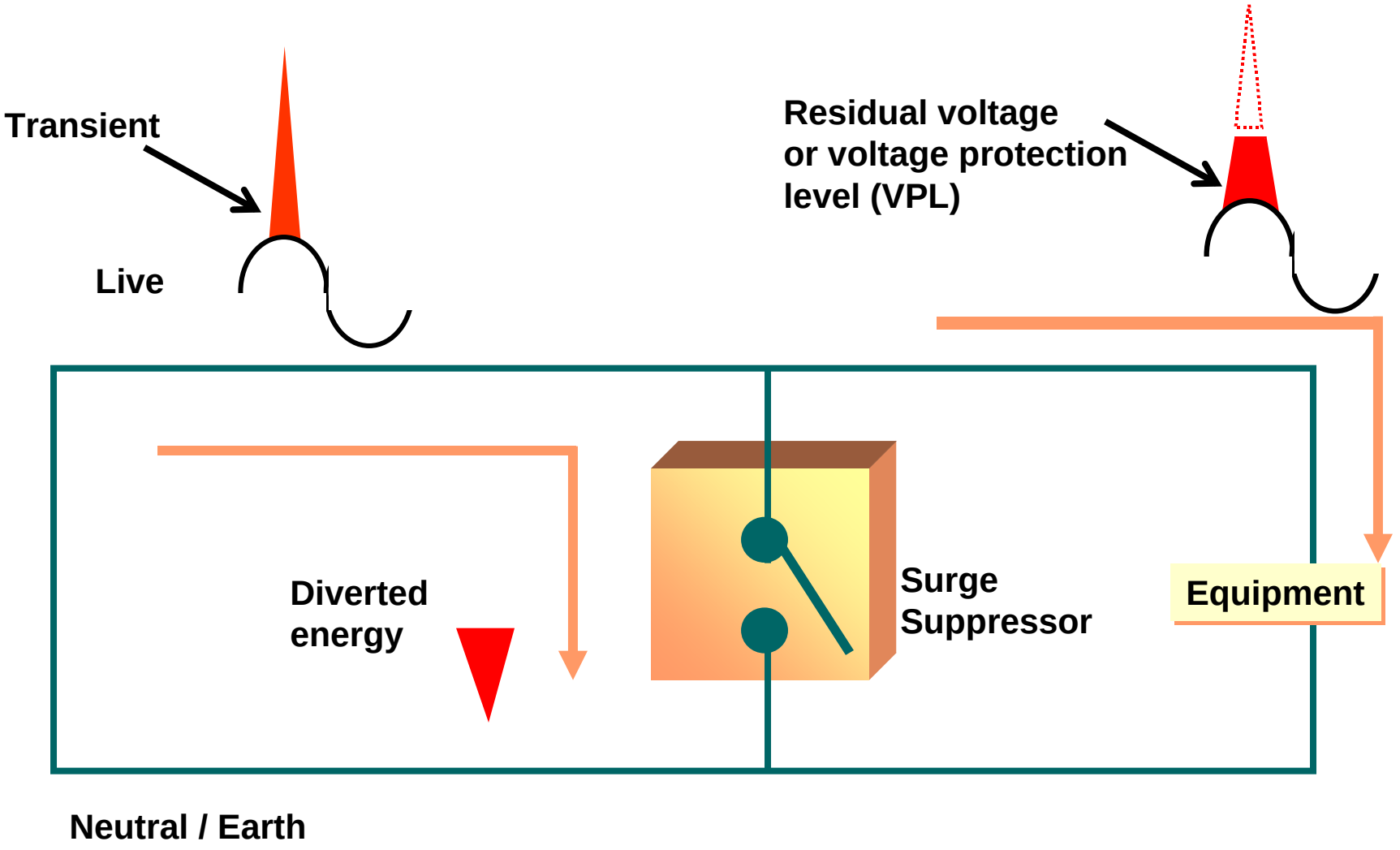
- Topologies – different technologies commercially available, technical comparison.
- Modes of protection – explanation of modes and how to install surge protection devices.
- Criteria for selecting the correct topologies for telecom facilities.
- Correct application of class1 and class2 surge protective devices.

PROCESS OF SURGE ARRESTING

Surge arresters can be viewed as a simple switch between two lines. When voltage rises as a result of a transient, the switch operates by diverting the energy away from our equipment. There will be a residual voltage left over.

The amount of residual voltage is determined by the speed of the operation of the surge arrester - the faster the device operates the lower the residual voltage.

PROCESS OF SURGE ARRESTING



TYPES OF SURGE ARRESTERS

There are two types of surge arrester on low voltage AC systems – namely Class 1 and Class 2.

The difference between them is their ability to divert energy in the form of a current.

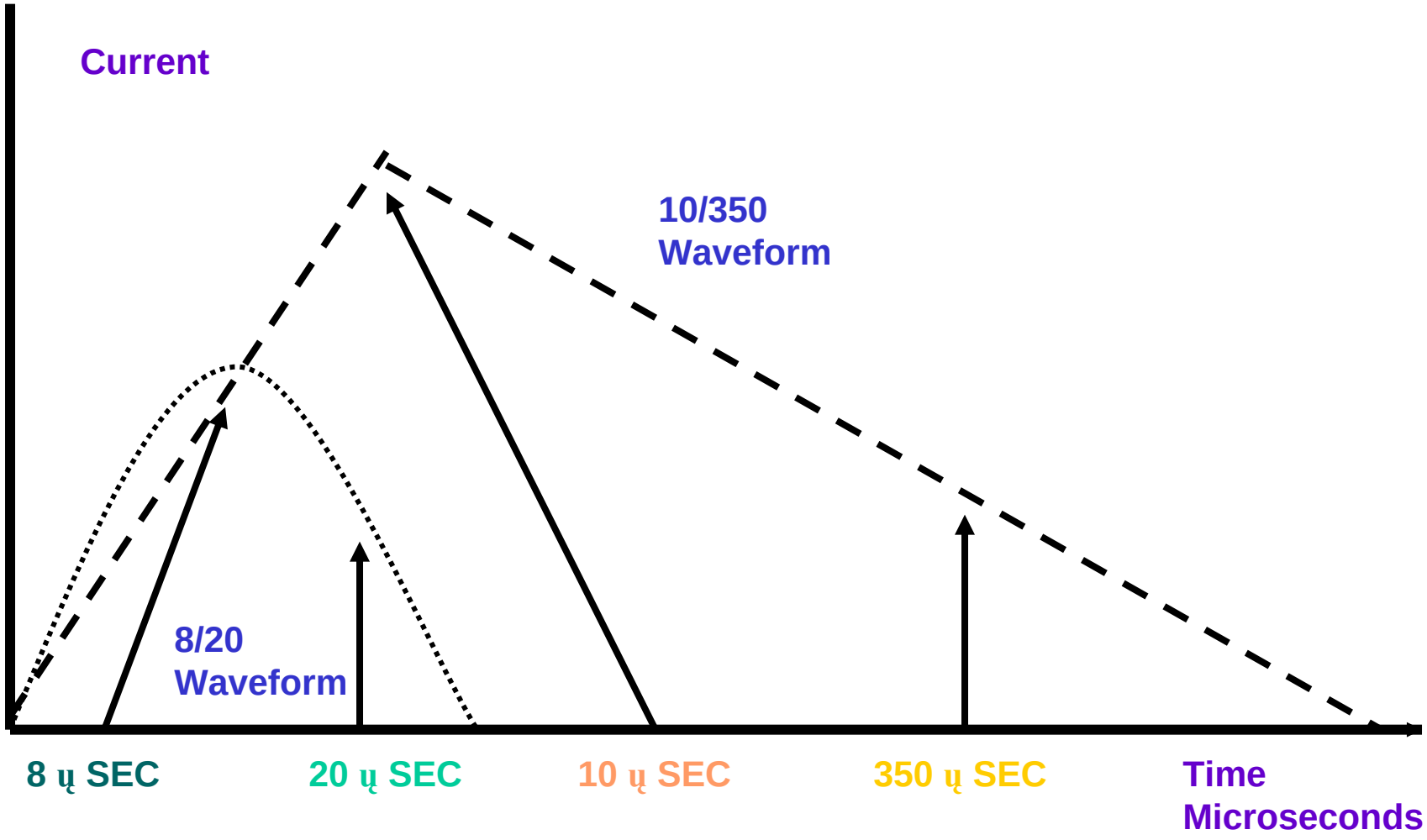
Class 1 (Lightning Protection)

Can divert energy with a current wave form of 10/350μs – the rise time is 10μs and the tail of wave is 350 μs to 50%
Typical current ratings 10Ka to 35Ka – 10/350μs wave form.

Class 2 (Surge Suppression)

Diverts energy with a wave form of 8/20μs – the rise time is 8μs and the tail of wave is 350μs to 50%
Typical current ratings 5Ka to 200 Ka – 8/20μs wave form.

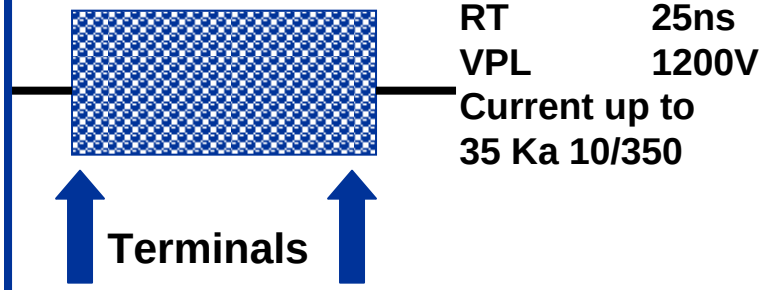
CURRENT WAVEFORMS



FOUR TOPOLOGIES COMMERCIALLY AVAILABLE

- Class 1 high energy MOV
- Class 1 gas discharge tube / air gap
- Class 2 SAD
- Class 2 MOV

CLASS 1 HIGH ENERGY METAL OXIDE VARISTOR (MOV)



RT 25ns
VPL 1200V
Current up to 35 Ka 10/350

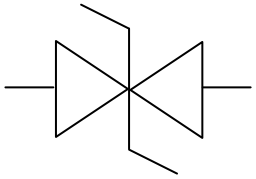
ADVANTAGES	DISADVANTAGES
▪ Cost effective ▪ Fast – 25ns ▪ Low protection level ▪ Accurate fault indication	▪ Can degrade with time and use ▪ New Technology ▪ Can be sensitive to overvoltage

CLASS 1 GAS DISCHARGE TUBE/AIR GAP

RT 100ns
VPL 1500 - 4000V
Current up to 25 Ka 10/350 for phase conductors

ADVANTAGES	DISADVANTAGES
▪ Rugged low incidents of failures ▪ Can handle high currents ▪ High tolerance for long over-voltage	▪ Slow – 100ns ▪ Follow on current can cause short circuit ▪ Poor protection level ▪ Degradation – deteriorates protection level and makes fault detection or indication difficult and unreliable ▪ High cost

CLASS 2 SILICON AVALANCHE DIODE (SAD)



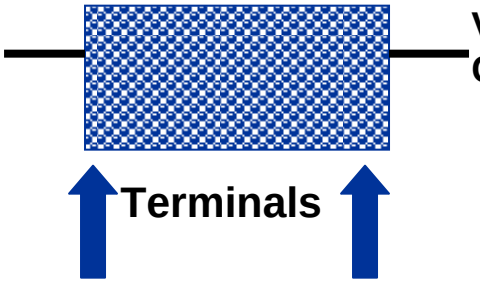
RT 5ns
VPL 500V
Current up to 25 Ka

High energy zener diode

ADVANTAGES	DISADVANTAGES
▪ Low VPL <500V ▪ Fast –5ns ▪ Non degrading ▪ Life expectancy – 20 years	▪ High initial cost ▪ Limited current – up to 20 Ka

CLASS 2 METAL OXIDE VARISTOR (MOV)

Metal Oxide Block



RT 25ns
VPL 1000V
Current up to 200 Ka

ADVANTAGES	DISADVANTAGES
▪ Low cost ▪ High current rating	▪ Slow – 25ns ▪ Thermally unstable ▪ Poor VPL 1000V+ ▪ Degradation – limited life

TOPOLOGY COMPARISONS CLASS 1

Parameters	TOPOLOGY COMPARISON CLASS 1	
Topology	Gas tube / Air gap	Class 1 High Energy Metal Oxide Varistor (MOV)
Speed of operation	100 nano seconds – one hundreds billionths of a second	25 nano seconds – twenty five billionths of a second
Residual voltage	2500 volts	<1200 volts
Current rating	Up to 25K 10/350	Up to 35K 10/350
Degradation	Degrades with use and time	Degrades with use and time
Lifespan	Extremely limited – can fail after one day or after one transient.	Extremely limited can fail after one day or after one transient.
Types of transients with percentage of occurrence		
Lightning transients 40%	Yes	Yes
Surges 10%	No	No
Switching transients 50%	No	No

TOPOLOGY COMPARISONS CLASS 2

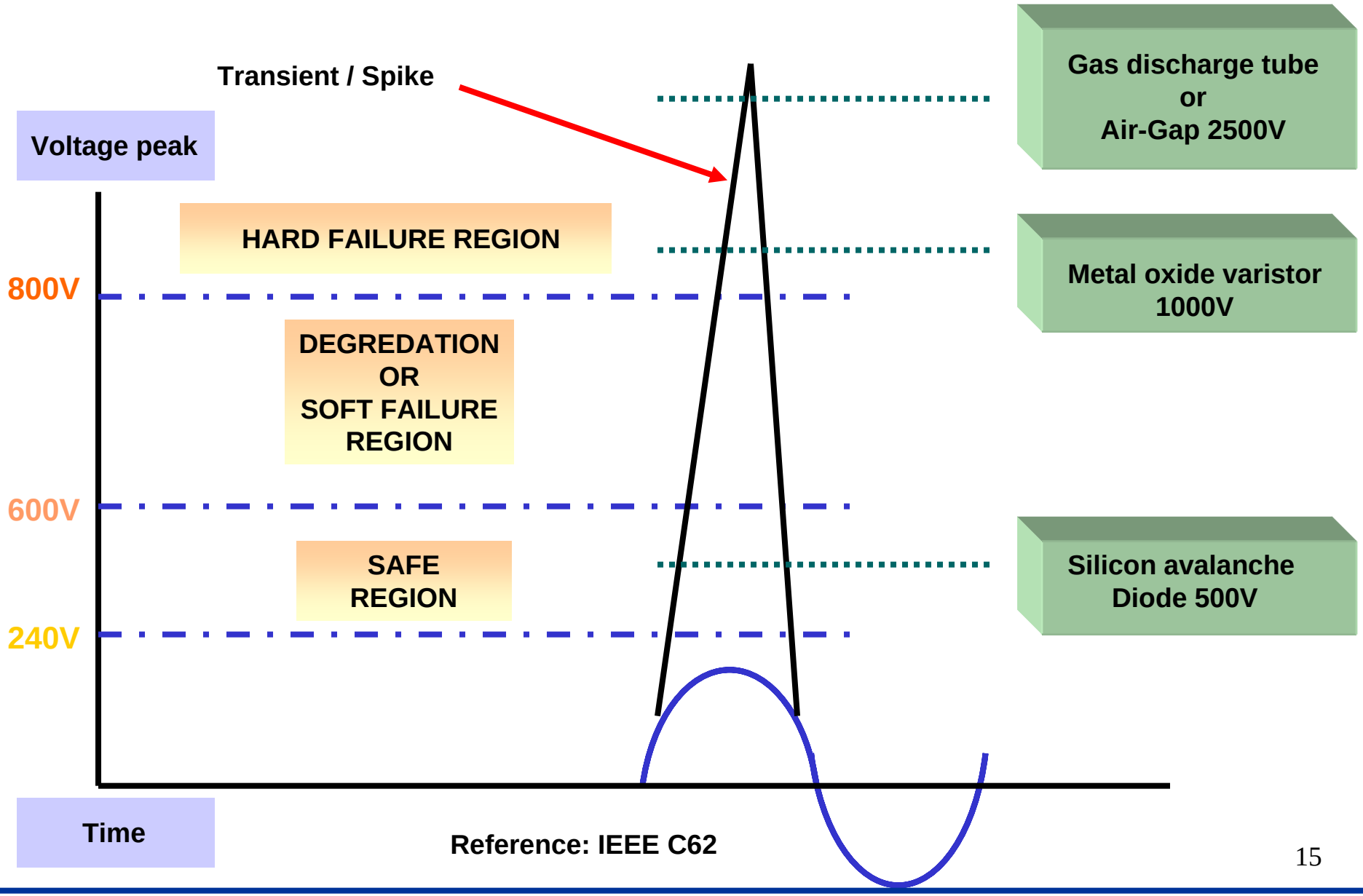
Parameters	TOPOLOGY COMPARISON CLASS 2	
Topology	Silicone Avalanche Diode (SAD)	Class 2 Metal Oxide Varistor (MOV)
Speed of operation	5 nano second – five billionths of a second	25 nan seconds – twenty five billionths of a second
Residual voltage	<500 volts	1000 volts
Current rating	Up to 20ka 8/20	Up to 200ka 8/20
Degradation	Non degrading	Degrades with use and time
Lifespan	20 years +++	Extremely limited can fail after one day or after one transient.
Types of transients with percentage of occurrence		
Lightning transients 40%	Yes	Yes
Surges 10%	Yes	No
Switching transients 50%	Yes	No

VOLTAGE PROTECTION LEVEL

The voltage protection level (VPL) refers to the residual voltage or clamping level of the arrester. The VPL of an arrester is directly related to the reaction time of the arrester ie: the faster the reaction time, the lower the VPL.

In many cases, the transient is lower in voltage than the VPL of the arrester, or faster than the arrester's reaction time. The arrester does not detect the transient and the transient damages the equipment. This is common with switching type transients which account for 50% of transients and are generated by inductive loads such as air conditioners, lift motors and standby generators - all of which are commonplace in most modern day facilities. The international electrical engineering spec (IEEE C62) clearly defines the level at which an arrester needs to operate in order to protect digital equipment. The following diagram illustrates this graphically, with reference to the different types of surge arresters commercially available.

VOLTAGE PROTECTION LEVEL



Reference: IEEE C62

MODES OF PROTECTION

There are two modes of protection:

Common mode – (live to earth and neutral to earth)
Most lightning transients are common mode and this refers to the live and neutral cables being at the same potential for that moment in time , and a potential difference (transient voltage) being present between live /neutral and earth.

Normal mode\differential mode – (live to neutral)
This refers to a potential difference (transient voltage) being super imposed onto the operating voltage. Digital power supplies such as computers, data switches, ups systems and telecom rectifiers draw their power in this area ie: draw current on the live conductor and return on neutral conductor, - this is their most sensitive area.

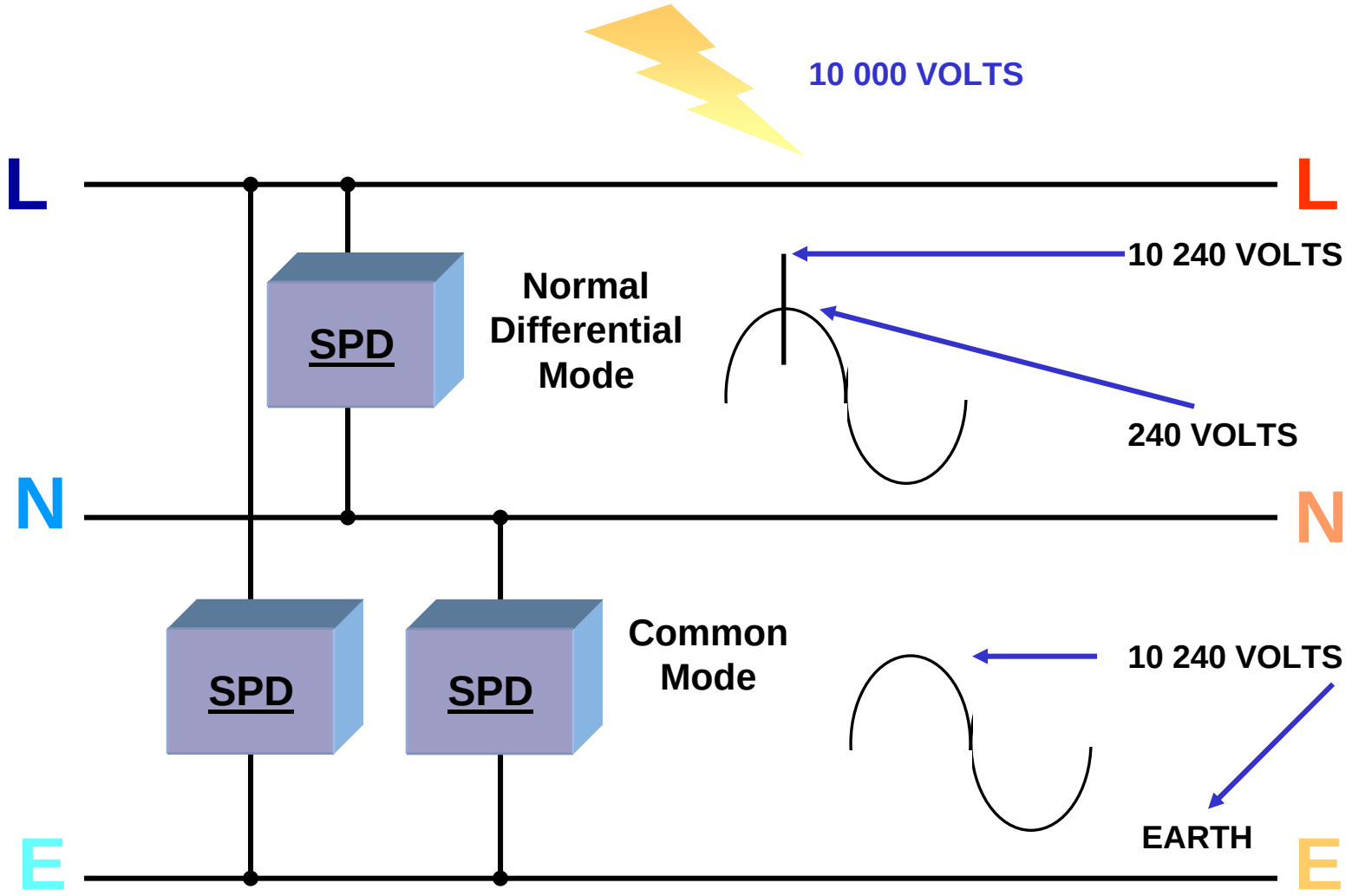
MODES OF PROTECTION cont.

Most lightning protection systems fail to provide normal mode protection, which leaves the equipment in question unprotected.

Note

The voltage figures indicated , illustrate the effect of an induced transient of 10 000 volts in both common and normal/ differential modes.

MODES OF PROTECTON



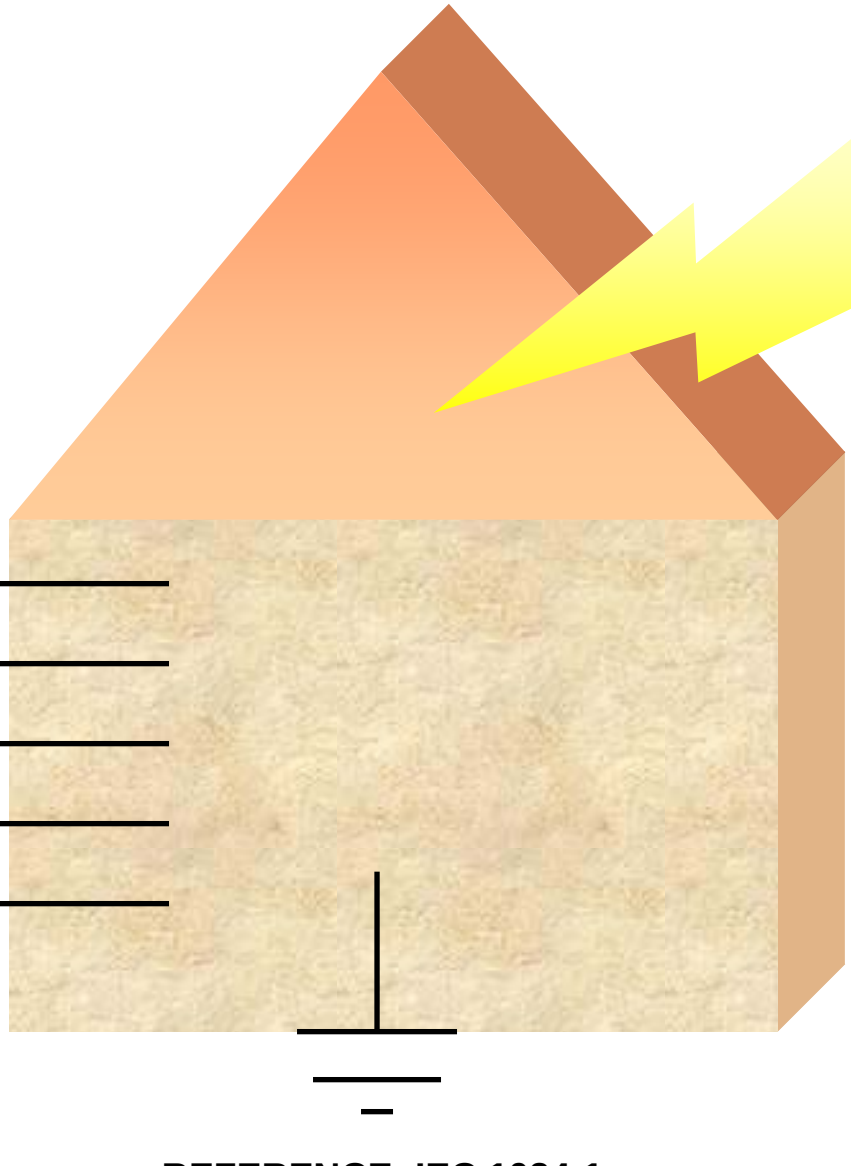
WHAT SHOULD THE CURRENT RATING OF THE ARRESTERS BE ?

IEC 1024-1 refers.

Should transient with a design current with a minimum Ka rating of 100 ampere and a maximum Ka rating of 200 ampere strike a facility, 50% will travel to earth and 50% will be divided by conductors entering this particular facility.

Worse case scenario: minimum rating of 12.5Ka and maximum rating of 25Ka

CURRENT CAPACITY OF INDUCED TRANSIENTS



DESIGN CURRENT
100KA MIN
200KA MAX

PHASE 1

PHASE 2

PHASE 3

NEUTRAL

EARTH

50%

Calculated current capacity

MIN = 50/4 = 12.5KA

MAX = 100/4 = 25KA

REFERENCE: IEC 1024-1

CRITERIA FOR SELECTING CORRECT TOPOLOGIES FOR DIGITAL APPLICATIONS

First incoming point

- Class 1 rated at 10/350 current wave form.
- Minimum current rating 12.5Ka – maximum current rating of 25Ka
- Thermal disconnect with visual and remote annunciation.
- Modular for easy maintenance
- VPL 1200V
- Reaction time less than 25ns

Digital equipment

- Class 2 rated at 8/20 wave form.
- Minimum current rating 12.5Ka – maximum current rating of 25Ka
- Thermal disconnect.
- VPL less than 600V
- Reaction time 8ns or less

CORRECT APPLICATION OF CLASS 1 AND CLASS 2 DEVICES

- Class 1 connection can be either TNS (L-E-N-E) OR TT (L-N N-E).
- One must ensure that grading is achieved through the distance between the distribution points or through the use of a grading device such as the Inductor Coil.
- Class 2 – to be installed on all sites.
- Class 2 device is always connected TT(L-N N-E).

References

- IEC 1024-1
- IEC 61643-1
- SABS 0142-1 National Wiring Code South Africa
- Motorola spec “ Transient over-voltage protection for telecom sites”