

ERITECH[®]

System 3000

Lightning Protection Products



ERICO[®]
100 YEARS YOUNG
1903 - 2003

ERITECH System 3000

Lightning strikes, and the dangerous surges and transients induced by lightning onto power and communications lines, represent a direct threat to people, buildings and sensitive electronic equipment. Today, the consequences of an unexpected lightning strike or power surge can be catastrophic for a facility. With over one hundred years of manufacturing excellence behind us, ERICO® is now established as a world leading manufacturer of lightning protection, earthing/grounding and surge protection technologies.

The ERITECH® System 3000 is an integral part of the ERICO Six Point Protection Plan for Total Facility Protection, providing the facility owner or design engineer an efficient method for lightning discharge capture combined with a controlled means to convey the lightning energy safely to ground.

The ERICO Six Point Plan of Protection

1. Capture the lightning strike
2. Safely convey this energy to ground
3. Dissipate energy into the grounding system
4. Bond all ground points together
5. Protect all incoming AC power feeders
6. Protect low voltage data/telecommunications circuits



ERICO is dedicated to providing the best lightning protection solution for any given application, whether this involves the use of the standards compliant ERITECH System 2000, the ERITECH System 3000, or a hybrid design utilizing a combination of both system types. ERICO manufactures lightning protection systems in full accordance with more than twelve national and international standards, as well as non-conventional systems based on enhanced air terminals and insulated conductors for applications where these provide an advantageous solution for the customer.



Complete systems approach

ERICO's approach is solutions driven. The aim is to provide the best solution for a given application. Some applications are more suited to the traditional conventional lightning protection – designs that require protection via complete building structure bonding. Other applications are more suited to a method that utilizes protection via isolation or applications that require area protection in addition to structure protection, or the decision may be purely based on a risk assessment evaluation. Whatever the application or protection problem presented, ERICO has the answer.

What is the System 3000?

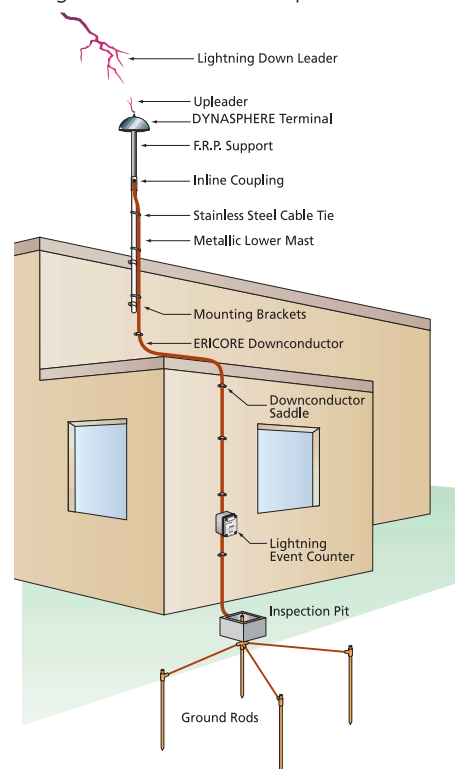
The ERITECH System 3000 is a technically advanced lightning protection system. The unique features of this system allow the achievement of superior performance, and therefore more reliable lightning capture.

The DYNASPHERE air terminal provides a preferred point for lightning discharges which would otherwise strike and damage an unprotected structure and/or its contents. The DYNASPHERE is optimally connected to an ERICORE down-conductor and low impedance grounding system in such a way as to provide a totally integrated system.

System 3000 comprises the following elements:

- DYNASPHERE air terminal
- ERICORE down-conductor
- Lightning event counter
- Purpose designed low impedance grounding system.

These components form an integral part of the ERICO Six Point Protection Plan. Each component must be considered independently and finally integrated together to form the complete lightning protection system. Without such integration there is limited protection.



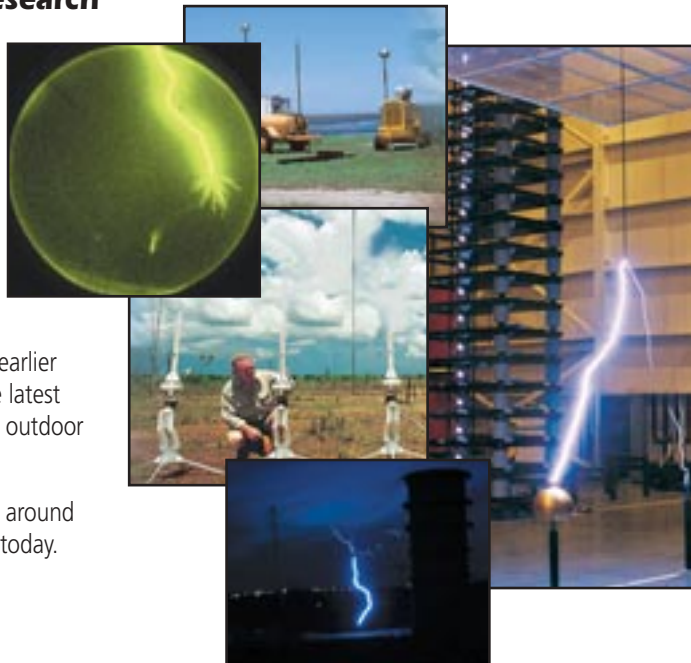
ERITECH System 3000

ERICO Involvement in Lightning Protection Research

ERICO has investigated the lightning protection process through years of research involving long term field studies. Laboratory testing, using some of the largest outdoor test laboratories, and countless research study programs, including joint ventures with accomplished scientists in the field have also been used in the research process. This extensive research has resulted in some of the most up to date published technical papers and journals. ERICO is committed to the development of a range of lightning protection standards around the world.

The ERITECH System 3000 has evolved from this research activity, with earlier versions of the ERITECH System 3000 providing a building block for the latest advancements through extensive field studies, leading edge indoor and outdoor high voltage testing and supported by computer modeling research.

ERICO is involved in the lightning protection industry in many countries around the world and acknowledges the diverse protection methods that exist today.

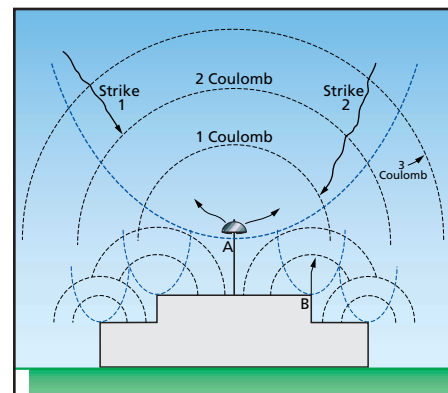


ERITECH System 3000 Supported by Collection Volume Method Placement

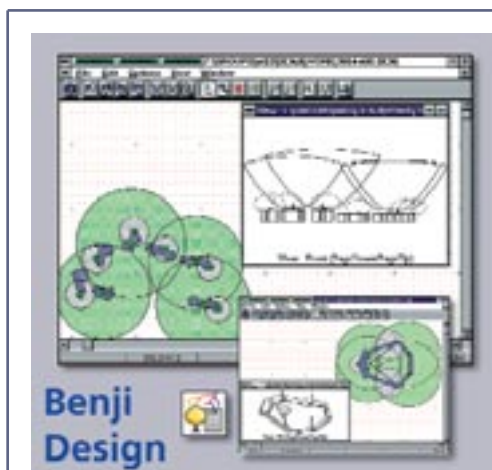
The placement of air terminals on structures is often performed with the Rolling Sphere Method (RSM), which is based on the simple Electro Geometric Model (EGM) for striking distance. The simple EGM does not account for the physical basis of the upward leader inception process and the importance of the structure height or the geometry of objects on the structure. The RSM uses a fixed striking distance, typically 45 m, irrespective of the structure height or width. This means that a structure of height 5 m is assigned the same capture area and strike probability as a 100 m communications tower.

An improved electro geometric model was initially developed by Dr A.J. Eriksson (1979,1980,1987). Beginning in the late 1980's, Eriksson's basic model was extended by ERICO scientists and engineers for application to practical structures. This has been done through computer modeling of electric fields around a wide range of 3D structures and by application of the concept of "competing features," to determine whether a structure is protected. This new method has been known worldwide for many years as the Collection Volume Method (CVM). The CVM takes the physical criteria for air breakdown, together with a knowledge of the electric field intensification created by different points on a structure. CVM then uses this information to provide the optimum lightning protection system for a structure, i.e., the most efficient placement of air terminals for a selected protection level.

Using the modern risk management approach, the CVM output depends on user-selected protection levels. Typical protection levels are in the range 84 - 99%. These values are taken from a standard distribution of peak lightning stroke currents.



The Collection Volume Method defines the lightning "capture volume" of potential strike points on a structure. This method is used in conjunction with the ERITECH System 3000 lightning protection system but is equally applicable for the placement of conventional terminals.



Design Support

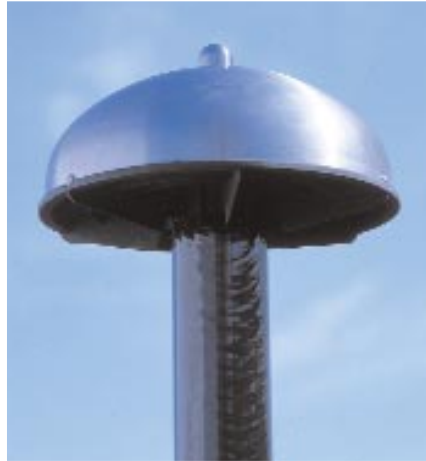
The placement and application of the ERITECH System 3000 is critical to ensure optimal protection is provided. ERICO's unique computer aided design program enables easier, reliable application of the ERITECH System 3000, taking into account individual site parameters and the variables required to complete an optimal design using the CVM. Please contact your nearest ERICO office for applications engineering support.

ERITECH DYNASPHERE Air Terminal

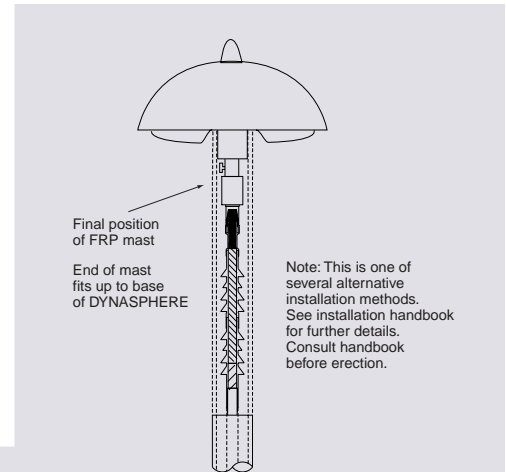
The ERITECH DYNASPHERE Enhanced Air Terminal

The patented ERITECH System 3000 DYNASPHERE is an enhanced air terminal. Features include:

- Non-radio active technology
- No External Power required
- No moving parts
- Selection of tip radii and variable impedance to adjust for optimum performance at different installation heights
- Dynamic response to the approach of a lightning downleader



Installation assembly of System 3000



Principles of the ERITECH DYNASPHERE

For over 200 years little improvement was made in lightning protection systems. However, modern research and recording methods have led to an improved understanding of the lightning discharge process, and various advancements have been achieved in the simulation of lightning electric-field conditions. Two fundamental concepts have emerged from these advancements in the lightning attachment process and air terminal performance:

- Air terminals that produce copious quantities of corona (space charge) are less efficient strike receptors.
- An optimum air terminal is one which launches an upward streamer when the ambient electric field is at a level to support the continual propagation of the streamer.

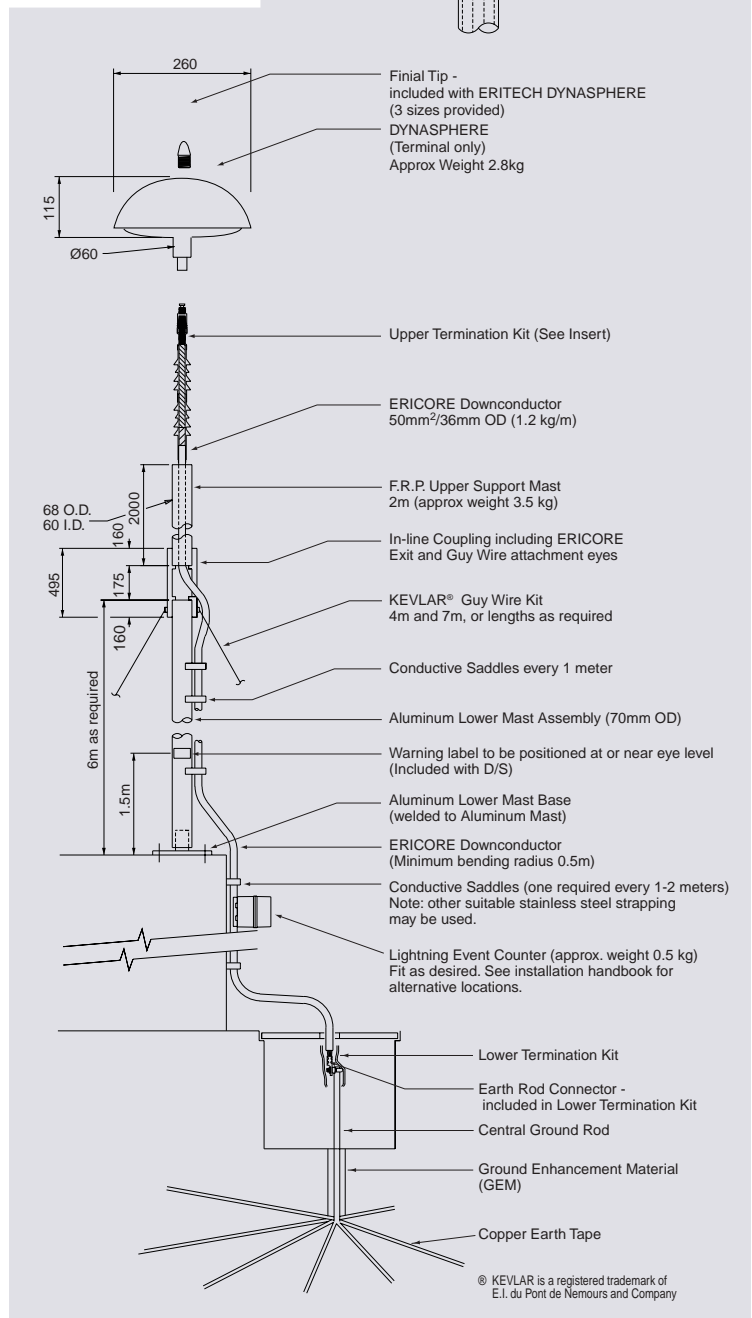
The ERITECH System 3000 DYNASPHERE has been developed with these two concepts in mind. The DYNASPHERE is an enhanced Franklin rod with a semi-spherical dome which is capacitively coupled to the electric field of an approaching lightning downleader.

This spherical conductive dome surrounds a central earthed lightning rod. The dome is insulated from the rod but connected to ground via a dynamic variable impedance with DC conduction.

The DYNASPHERE is isolated from the structure using an insulated support mast. The mast also enables the safe connection of the ERICORE downconductor to the air terminal.



ERITECH DYNASPHERE MKIV complete with ERICORE assembled.



ERITECH DYNASPHERE Air Terminal

During the dynamic phase of the thunderstorm, on closer approach of the downward leader, the semi-sphere or dome of the ERITECH DYNASPHERE will rise in voltage via capacitive coupling. When the voltage is high enough, a triggering arc is created across the air gap between the sphere and grounded rod.

The triggering arc has two effects:

- (i) it produces the large number of free electrons needed to initiate an upward streamer
- (ii) it causes a sudden "snap" increase in the electric field above the air terminal, which provides the additional energy to initiate and convert a strong propagating upward streamer.

These two effects develop stable leader propagation to ensure reliable lightning capture. The size of the air gap is optimized so that a triggering arc only occurs when the ambient electric field is high enough to ensure a stable upward leader can be developed to successfully intercept the downward leader.

The ERITECH DYNASPHERE has been designed to meet all of the criteria necessary for the controlled emission of a streamer. The concept of "controlled" is important because it is not effective to launch a streamer too early – the ambient field will not be large enough to convert the streamer to a leader and so the streamer will cease to propagate. This will leave a space charge behind which can inhibit future initiation attempts.



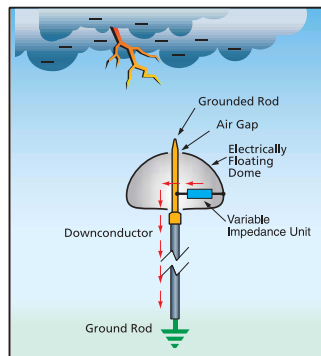
DYNASPHERE Enhanced Air Terminal
Capture point of the ERITECH System 3000 initiates an upward leader during thunderstorm conditions to capture lightning discharges over a greater radius than conventional protection.

Inset: DYNASPHERE MKIV supercedes the world renowned MKIII DYNASPHERE, with over 10,000 installations globally.

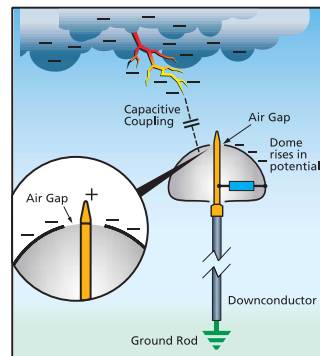
Characteristics of an optimum air terminal:

- Minimal pre-strike corona / space charge.
- Streamers released only when the ambient field can sustain leader initiation and propagation.

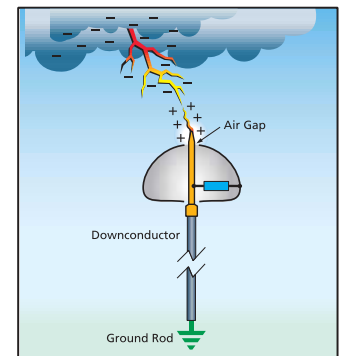
Both of these characteristics require a blunt configuration.



Static Thunderstorm Phase



Dynamic Thunderstorm Phase



Controlled Triggering Streamer Phase



Various mounting accessories and options

Part Number	Description	Unit	Weight (kg)
D/SMKIV-SS	ERITECH DYNASPHERE Air Terminal	1	2.8
FRP2MBLK	Insulated 2 Meter FRP Mast, 60mm ID 68 mm OD, black	1	5
FRP4.6MBLK	Insulated 4.6 Meter FRP Mast, 60mm ID 68 mm OD, black	1	11.5
ILCOUPL	Inline Coupling FRP to Support Mast	1	0.5
MBMAST3M	Welded Mast Base and 3 Meter Mast	1	9.6
MBMAST4M	Welded Mast Base and 4 Meter Mast	1	12
MBMAST5M	Welded Mast Base and 5 Meter Mast	1	15
MBMAST6M	Welded Mast Base and 6 Meter Mast	1	17
MBFRP4.6M	Welded Steel Base Plate: For FRP 4.6 meter mast only	1	5
Note: Other Mast arrangements available for special applications			
ALUM3M	3 meter Aluminum Mast	1	8.25
ALUM4M	4 meter Aluminum Mast	1	11
ALUM5M	5 meter Aluminum Mast	1	13
ALUM6M	6 meter Aluminum Mast	1	16
UBOLT	U-Bolt Securing Set	1	0.04
7000250S4	Stainless Steel Mount	1	1.12
GUYRING	Guying Ring for FRP Mast	1	0.11
GUYKIT4	Guying Kit 4M wire length	1	0.04
GUYKIT7	Guying Kit 7M wire length	1	0.07
INTCPTADM3/4UNC	Adapter, 3/4 Inch UNC Male	1	0.1
INTCPTADM2NSP	Adapter, 2 Inch NSP Female	1	0.1
INTCPTADF2BSPF	Adapter, 2 Inch BSP Female	1	0.1
INTCPTADBUTT	Adapter, FRP Mast Butt	1	0.05
TERMLUGCOUP	Adapter, Lug to Conventional Cable	1	0.1

ERITECH ERICORE Downconductor

The ERITECH ERICORE Downconductor

As an integral part of the ERITECH System 3000, the screened, insulated ERICORE downconductor conveys the lightning discharge current to ground with minimal danger of sideflashing. A unique semi-conductive outer sheath allows electrostatic bonding of the building through cable securing saddles.

The ERITECH ERICORE downconductor evolved after extensive studies of potential voltage rise in structures due to lightning injection. This cable is comprised of carefully selected dielectric materials, which create capacitive balance and ensure insulation integrity under high impulse conditions.

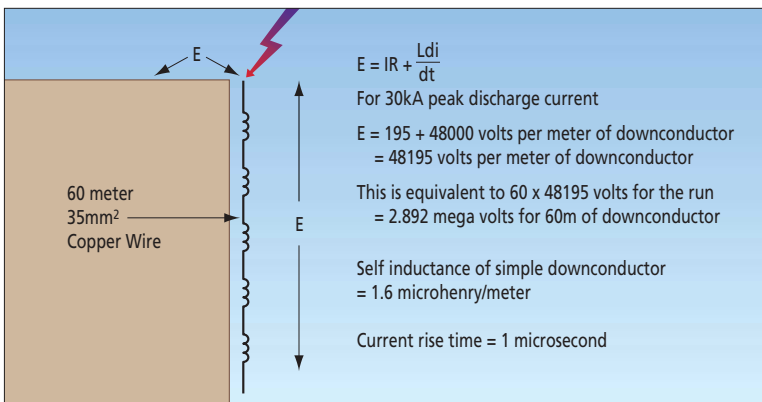
The unique ability of ERITECH ERICORE to confine a discharge current and simultaneously support electrical bonding ensures minimal risk to building, occupants and sensitive electronics.

Lightning parameters			Cable voltage developed at injection point (kV)	
Peak current (kA)	% of larger currents	Max. di/dt (GA/s)	Conventional downconductor	ERITECH ERICORE downconductor
10	92	12	580	13
30	55	40	1900	44
50	25	77	3700	85
90	5	160	7700	180

Example of the difference in reliability between a conventional downconductor and a screened, insulated downconductor.

To understand the technical value of the cable, it is first necessary to review the problems associated with normal downconductors. The diagram below shows how the self-inductance of a normal conductor causes very high voltages to be developed.

A value of inductance of 1.6 microhenries/meter is normally regarded as quite small. However, when a current is impressed which is rising at the rate of 10^{10} Amperes per second, the effect of this inductance becomes dominant. As an example, a single 60 meter downconductor will rise to a value in excess of 1,000,000 volts with the application of an average discharge. It is for this reason that the ERITECH ERICORE downconductor has a significant advantage over conventional downconductors.



The effect of self inductance in a single downconductor.



Cutaway diagram showing the composite layers of ERITECH ERICORE downconductor. Inset: ERITECH ERICORE upper termination.

Technical and Design Characteristics of ERITECH ERICORE

The ERICORE downconductors have been designed to meet all of the criteria for an effective and reliable downconductor, with the following key characteristics:

- low inductance per unit length
- low surge impedance
- carefully controlled internal electric field distribution to minimize field stresses under current impulse conditions
- carefully designed, stress reducing upper termination



The ERITECH System 3000 ERICORE downconductor is easily retro-fitted to existing structures. Inset: ERITECH Lightning Event Counter (LEC IV) installed to register strikes to System 3000.



ERITECH ERICORE Downconductor

ERICORE

Characteristic	
Characteristic impedance (Ω)	4.5
Inductance (nH/m)	22
Capacitance (pF/m)	1100
Cross Sectional Area of Conductor - mm ²	55
Resistance (m Ω /m)	0.5
Upper Termination Voltage withstand (kV)	250
Weight (kg/m)	1.2
Diameter (mm)	36

Characteristics of ERITECH ERICORE downconductor.

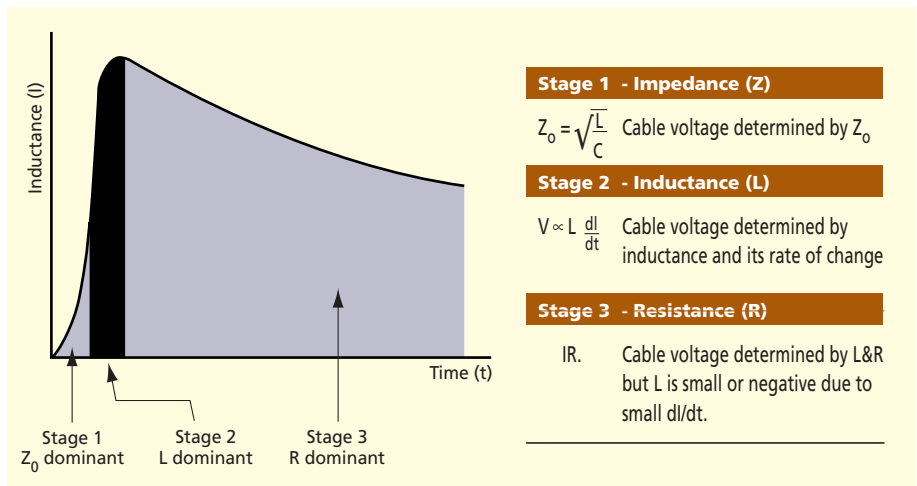
Why Use ERITECH ERICORE?

The ERITECH ERICORE downconductor cables are purpose-designed low inductance, low impedance cables designed to minimize voltage build-up due to lightning impulses. This cable provides significantly higher performance than any normal HV cable and is specially designed for the control of lightning impulses.

The main danger in controlling lightning impulses is the very fast voltage and current rise times following the capture of the lightning strike.

To further understand the technical value of the cable, it is necessary to review the lightning mechanism and resulting voltage build-up. The voltage between inner conductor and outer sheath is determined by three different parameters. These are dominant at different stages during the operation of the cable in conveying lightning energy to ground (as shown in The Typical Lightning Waveform Table.)

Typical Lightning Waveform



Summary of the three main stages of ERITECH ERICORE operation.

ERITECH ERICORE offers purpose-designed performance in each phase of the lightning control process to convey the energy safely to the grounding system.

As an example, consider the following comparison between the same 50 m length of conventional downconductor (25mm x 3mm copper tape) and ERITECH ERICORE downconductor, using the air breakdown electric field (nominally 3 MV/m) and cable termination voltage (200 kV) as the criterion for "failure" of the downconductors.

The conventional downconductor will, conservatively, cause a flashover or structure dielectric breakdown when carrying lightning currents of only ~ 30 kA. On the other hand, the ERITECH ERICORE screened/insulated downconductor can easily handle lightning currents of 90 kA. This magnitude of lightning current is exceeded in only ~ 5 % of lightning events or approximately once every 30 years in a region with a ground flash density of 5 strikes/km²/yr (approximately 80 thunder days/yr).

Main Benefits

- Lightning impulse is contained within the cable and the semiconductive outer sheath is bonded to the structure via metallic saddles, which means that the risk of sideflashing is negligible
- The low characteristic impedance of the cable minimizes internal dielectric failure
- The cable is able to be routed away from sensitive equipment, electrical wiring, structural steel and human work areas
- Use of a single downconductor as opposed to multiple downconductors
- Ease of installation
- Minimal maintenance

Part Number	Description	Unit	Weight (kg)
CONSAD E2 5	Conductive Saddle for ERITECH ERICORE	5	0.19
CAB TIE SS	Stainless Steel Cable Ties	1	0.01
ERICORE/UTKIT/A	ERITECH ERICORE Upper Termination Kit	1	1
ERICORE/LTKIT/A	ERITECH ERICORE Lower Termination Kit	1	1.5
CR37-2	Stainless Steel Tower Saddle	50	2
CR20-2	Stainless Steel Tower Saddle	100	4
LECIV	Lightning Event Counter, Mechanical Display	1	2

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