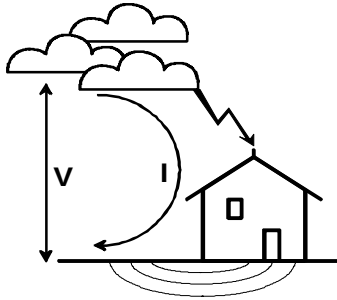


Introduction



Lightning is a natural phenomena occurring when a large static voltage potential exists between clouds in the sky and the earth below. When the potential difference rises to a very high value an electrical energy discharge (lightning strike) occurs between the sky and ground. This discharge results in a current path being established between the two points and will often include any conductor that helps to bridge the gap such as trees, buildings or other structures.

When the current path is established the resulting current flow will be extremely high, perhaps as much as 5000 amps. This current flows through whatever impedance there is in the route taken by the lightning strike and will produce large potential differences across relatively small impedances. For example if there is a 0.1 ohm resistance and 5000 amps there will be 500 volts developed across the resistance.

Although the voltage and current levels during a lightning strike are very high the time duration is extremely short. The period of the discharge is only a few milliseconds. This means that the actual power transferred is relatively small - perhaps as little as a 100 watts. In extremely intense tropical storms this could rise to about 1000 watts.

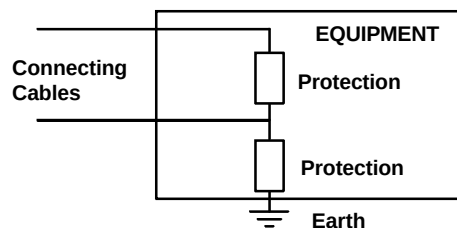
Whenever electrical equipment is located in a region where lightning strikes are likely to occur it is prudent to include protection for the equipment against these energy discharges. Electronic equipment is particularly vulnerable and where it is connected using long cables any discharge into the area around these cables is likely to induce currents in the cables. A direct strike onto the equipment itself will almost certainly damage the equipment as the protection devices available have a limited capability. Some of the effects of a direct strikes may be protected against by using lightning diverters, these often take the form of conductor rods specifically designed to provide a lower impedance discharge route for the current. In electronic terms these diverters are semiconductor devices used to route the energy away from the sensitive circuits.

Effect of Lightning Energy Surges

The result of energy surges such as lightning or heavy current flows in cables is to create a magnetic and electrical field which, in turn, induces currents and voltages in any nearby cables. The surge energy is distributed throughout the conductive materials near the source or current path of the energy. These induced energy flows are dependent on the coupling effects between the source and affected parts of the system.

If the induced currents are excessive they may produce voltage levels above those which the attached equipment can tolerate when the currents flow in the detector circuits. For this reason additional components are added to act as diverters for the induced signals.

There is virtually no protection possible against a direct primary strike of the lightning itself onto the equipment or cables connected to the equipment. Such an event will almost certainly destroy part of the system. For this reason critical plants in vulnerable areas often have arrays of conductor rods on the outskirts of the site.



Protecting Against Lightning

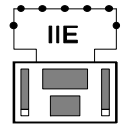
One very important factor to consider in any protection scheme is that the lightning induced current has to be able to flow to earth. The primary strike relies on dissipation to earth and any secondary currents should also have a suitable path back to earth. Earthing of equipment therefore plays a key role in protection.

The effect of the induced currents can be greatly reduced if the impedance through which they flow is small, that is if the resistance of the circuits is small.

Modern electronic circuits operate at low voltages and currents to minimise the power consumed, so keeping down the heat generated in the hardware. Conventional diverter protection circuits use discharge tubes but these are sometimes not suitable as the striking voltage of the tube is above the acceptable limits for the electronic circuits. More recent designs of diverter circuits employ Transorb and Varistor devices. These use special semiconductors that change their impedance characteristics as the applied voltage increases.

Pakscan IIE

Lightning and Surge Protection

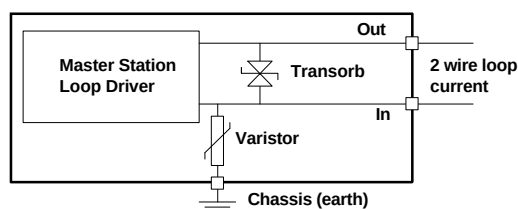


Pakscan Lightning Protection Methods

The Pakscan system uses two basic methods for protecting against lightning and a third is introduced in the installed system.

The impedance levels of all the two wire cable termination points and the cable itself are kept to a minimum. This has the effect of minimising the transient voltages resulting from the induced currents.

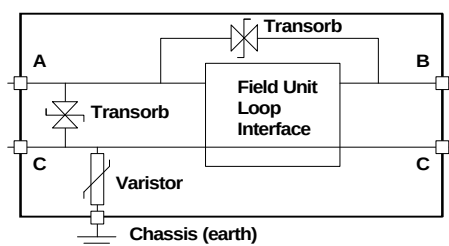
All the elements on the two wire loop have electronic protection circuits fitted using Transorb and Varistor components. The use of a correctly terminated and connected screen on the two wire cable reduces the effect of electrostatically induced signals.



PAKSCAN MASTER STATION PROTECTION

The master station two wire loop communication ports, A and B, are each fitted with a Transorb and Varistor.

Transorb: 1500 watt surge, 20 volt. 2.1 joules.
Varistor: 460 volt, 17 joules (10/1000 microsecond)



PAKSCAN FIELD UNIT PROTECTION

The field units are all fitted with two Transorb and one Varistor.

Transorb: 1500 watt surge, 20 volt, 2.1 joules.
Varistor: 460 vol, 17 joules, (10/1000 microsecond)

In all cases the protection devices are located as close to the field connections to the circuit board as possible.

In addition all the loop circuit components are optically isolated from the processor and field connections. This ensures that a failure of the field unit detector circuits is not transmitted to the actuator attached.

These components ensure that the equipment will withstand the discharging of a 1.5nF capacitor at 4500 volts. This equates to an energy discharge of 2.0 joules into the device from either line to the chassis earth point.

The protection complies with standard IEC 801-4 Level 4 (severe industrial category).

Installation

When correctly installed the two wire cable should be covered with a screen. This screen is only to be connected to earth at a single point to ensure that no circulating currents can flow. If the screen has multiple earth points these will cause the screen to be used in the dissipation of surge induced currents.

The actuator and master station hardware **must** be connected to a suitable safety earth protection point. This connection must be very low impedance (less than 0.1 ohm) if the lightning protector circuits are to function correctly. It is not normally acceptable to use the piping metalwork as a route to the safety earth.

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