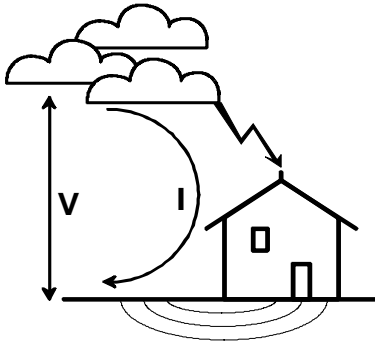


Introduction



Lightning is a natural phenomenon usually occurring during thunderstorms. When the potential difference between clouds in the sky or clouds and earth becomes very high, an electrical energy discharge (lightning strike) occurs between the two areas. This discharge results in a current path being established which 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, between 2,000 and 200,000 amps. This current flows through whatever impedance there is in the route taken by the lightning strike and will produce large potential differences (voltages) across relatively small resistances. For example, if there is a 0.1 ohm resistance and 5,000 amps flowing, 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 of each strike is extremely short, being only a few milliseconds. This means that the actual energy transferred may be relatively small. However, in extremely intense tropical storms this could be up to 1500 Megajoules—enough to boil 3 tonnes of cold water.

Effect of Lightning Energy Surges

Even if a direct lightning strike does not occur, energy surges can be caused by nearby lightning or heavy current flows in cables, e.g. electric welding. These surges create a magnetic and electrical field which, in turn, can induce 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.

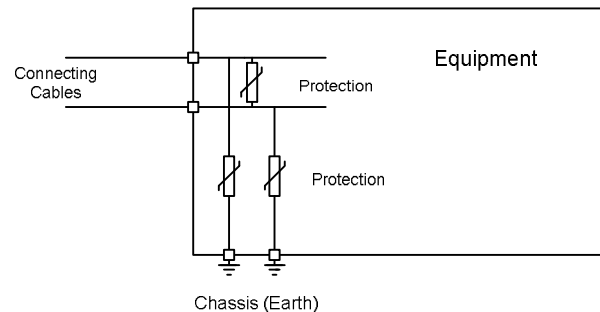
If the induced currents are excessive, they may produce voltage levels above those which the attached equipment can tolerate. For this reason, additional components are added to act as diverters for the induced signals.

Protecting Against Lightning

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 energy surges. Modern electronic equipment is particularly vulnerable and may be damaged by millijoules of energy. Where it is connected using long cables, any discharge into the area around these cables is likely to induce currents in the cables.

There is virtually no protection possible against a direct strike of 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 throughout the site. These provide an alternative, lower resistance discharge route for the current.

One very important factor to consider in any protection scheme is that the lightning induced current has to be able to flow to earth at the nearest point. 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. This keeps the voltages low. Therefore, all earthing should be done with short, straight, multi-strand cables of sufficiently large current-carrying capacity. Multiple strands conduct better than solid core cable at high frequencies.

Modern electronic circuits operate at low voltages and currents to minimise the power consumed. 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. They also take too long to respond. More recent designs of diverter circuits employ Transorb and Metal Oxide Varistor (MOV) devices. These are special semiconductors that change their impedance characteristics as the applied voltage increases, hence not affecting the circuit until they are needed, when they divert excess energy safely to earth.

Pakscan Lightning Protection Methods

The Pakscan system uses three methods for protecting against lightning. This involves the use of Transorbs, Varistors and optical-couplers.

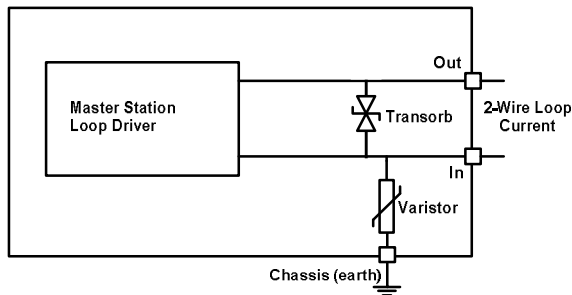
The impedance levels of all the two-wire network cable termination points and the cable itself should be kept to a minimum. This has the effect of minimising the transient voltages resulting from induced currents.

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 electromagnetically 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.

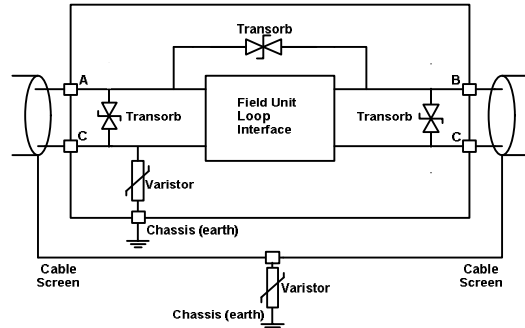
Transorbs: 1500 watt surge, 20 volt. 2.1 joules.
 Varistors: 460 volt, 17 joules (10/1000 microsecond).



Pakscan Field Unit Protection

The field units are all fitted with three Transorbs and one Varistor. The actuator screen connection has a Varistor connection to Chassis earth.

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



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

Compliance Specification

The protection complies with European standard EN61326-1:2006.

Installation

When correctly installed, the two-wire network cable should be covered with a screen. This protects against electric fields. The screen is only to be directly earthed 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 cable should further be encased in multiply earthed armour or conduit for protection from magnetic fields.

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

The actuator safety earth is in addition to the mains supply earth. The safety earth conductor should be as short as possible and should not be coiled. All earthing arrangements should comply with International Standard IEC 60364-5-54.

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