

Transient Protection Module

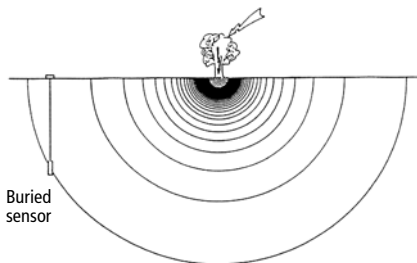
Application

Problems with noisy readings and bad sensors are more likely to be caused by voltage transients (such as lightning) than by poor quality or poor installation techniques.

Transient protection modules, when combined with other measures, such as minimizing the lengths of horizontal runs of cable, can help prevent these problems.

Transients and Buried Sensors

The drawing below shows lightning striking a tree. The concentric lines are iso-voltage levels at the instant of the strike. Each line represents a voltage difference of about 50 kV.



In the drawing above, the cable to the sensor cuts across part of one level, so there is about a 10 to 20 kV voltage gradient between the surface and the sensor.

Sensors and cables cannot withstand such high voltage differences. The typical result is arcing that can destroy the sensor and cable.

Even if the sensor is not destroyed, the cable jacket will have pinhole punctures. Water will enter through these punctures later, causing all the symptoms of a seal failure and a significant increase in noise and interference.

Protecting Buried Sensors

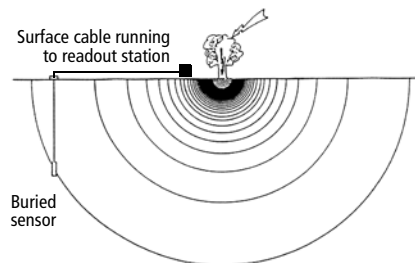
To protect buried sensors, we must try to eliminate voltage gradients that would affect the sensor and cable.

In the drawing above, the sensor cable is terminated at the surface and we must eliminate any gradient developing between the surface and



the sensor. This can be achieved by running a heavy gauge, bare grounding wire down the borehole, parallel to the sensor signal cable. The wire should extend several feet deeper than the sensor and should be isolated from the signal cable.

When signal cable is not terminated at the top of the borehole, but instead runs horizontally to a readout station or data logger, the simple grounding wire technique above is no longer effective. Now we must try to eliminate the voltage gradient between the readout station and the sensor.



One way to eliminate this gradient is to run a ground wire parallel to the horizontal signal cable and connect it to the grounding wire in the borehole. This is generally not cost-effective unless an existing grounding grid can be used.

One alternative is to place a transient protection module at the top of the borehole, between the horizontal and vertical runs of signal cable. The grounding lug of the protection mod-

ule is then connected to the grounding wire in the borehole.

With the protection module in place, transients on the horizontal run of signal cable are intercepted and shunted to the grounding wire in the borehole. This instantly raises the voltage levels around the sensor and signal cable, eliminating the voltage gradient that causes damage.

Note that the transient protection suggested above does not protect the horizontal runs of signal cable. These runs can be protected only by a conductor, such as grounding wire, a grounding grid, or a pipeline that runs parallel to the signal cable over its full length.

Protecting Data Loggers

Transient protection modules placed between signal cable and the data logger can protect the logger from transients arriving on the signal cable. In this case, the grounding lug on the module should be connected to the local facility ground, probably the same ground that the data logger is connected to.

Other measures to protect surface equipment include the use of isolated power supplies and optical isolation of communications lines.

TRANSIENT PROTECTION MODULE

Transient Protection Module. . . .52612520

Module includes 3-stage transient protection board and an enclosure with cable glands and grounding lug. Module protects four leads and shield.

Gas Discharge Tubes: Three tripolar gas discharge tubes with simultaneous sparkover of three electrodes for maximum efficiency. Sparkover at nominal 250 volts with impulse sparkover less than 600 volts. Handles 20 kA current.

Fast Response Transient Suppressors: Four 40V 1500 Watt suppressors protect four leads. Also two 15V 1500 Watt suppressors protect against voltage between leads.

Isolation Fusing Resistors: Replaceable fusing resistors, nominally rated for 100 mA, provide isolation for sensor and cable if other devices are overpowered.

DISCLAIMER

The suggestions in this datasheet for protecting sensors and cables are based the ideas presented in a paper by Dale Shoup titled "Sensors in the Real World," which is available on Slope Indicator's website.

Although there has been much research conducted on protection of buildings and equipment at the surface, there has not been much research conducted on protecting buried sensors. A search of the internet will verify this.

It is difficult to imagine all the variables that affect a particular site, and even more difficult to prescribe a sure solution that protects all buried sensors. Thus the suggestions in this datasheet should be viewed as an effort to be helpful, not as expert advice.