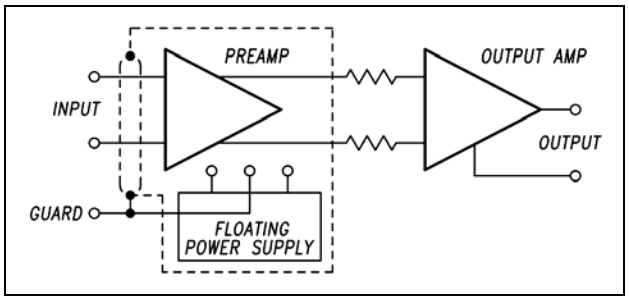
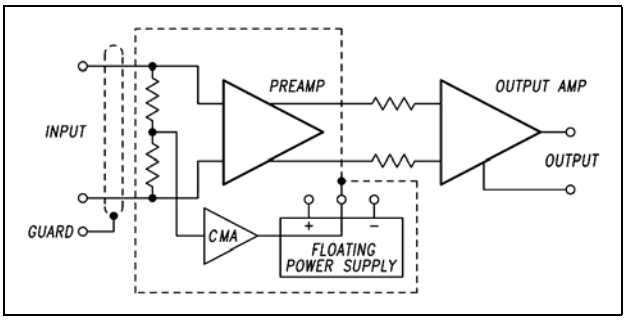
MODEL 751ELN VS THE GUARD-DRAGGER AMPLIFIER

As illustrated in Figures 1 and 2, there are two ways to handle the guard in a direct-coupled (dc) instrumentation amplifier. The amplifier in Figure 1 ties the guard directly to the preamplifier section and, therefore, depends on the external shield connection to drive the power supplies and circuitry of this section of the amplifier. This design approach has been termed a guard dragger.



Guard Dragger
Figure 1

Figure 2 illustrates a superior system that uses a common-mode amplifier (CMA) to drive the preamplifier circuitry. Used in the Ectron Model 751ELN amplifier, this approach eliminates much of the loading problem on the external shield. Also, since in the Ectron design the CMA signal is actually obtained from the two signal leads through a high-impedance divider, the amplifier will operate without the guard connected with little change in performance.



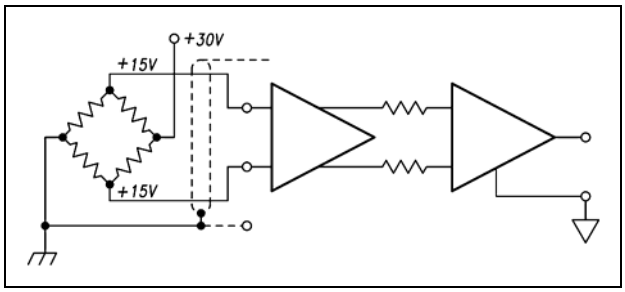
Model 751ELN
Figure 2

In the Model 751ELN amplifier (rated at ±300 V operating common-mode voltage), the load resistance between guard and output common is over 50 MΩ. For the typical guard dragger this resistance is approximately 500 kΩ. At a common-mode voltage of 300 V, this requires a load current of 0.6 mA (0.18 W). Although loading the external shield circuit to this extent can cause application problems, an even greater problem is that the current that flows into the guard of the guard-dragger amplifier must flow through the signal-carrying resistors that connect the preamplifier to the output amplifier. As a result, high-frequency common-mode signals that would be filtered out in the Model 751ELN will be mixed with the desired signal in these interconnecting resistors. Consequently, high-frequency common-mode rejection is usually poor in the guard-dragger amplifier. Common-mode rejection for the Model 751ELN at a gain of 1000 at 60 Hz is better than 130 dB; at 10 kHz, better than 80 dB.

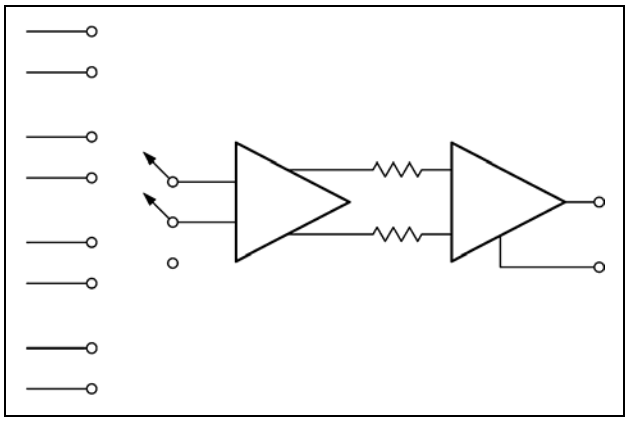
The following applications illustrate how the Ectron design offers several significant advantages over the guard-dragger amplifier.

Bridge Source with High Excitation Voltage

Figure 3 shows a conventional bridge source with an excitation voltage of 30 V. The shield should be tied to the negative excitation connection at the bridge, which is normally tied to ground. Since the guard-dragger amplifier is typically limited to a maximum of 10 V differential between guard and signal leads, it is not possible to use this type of amplifier under these conditions. In contrast, the Ectron Model 751ELN amplifier will operate normally in this application and, in fact, the guard-to-signal-lead potential can be up to ±300 V.



Bridge Source
Figure 3



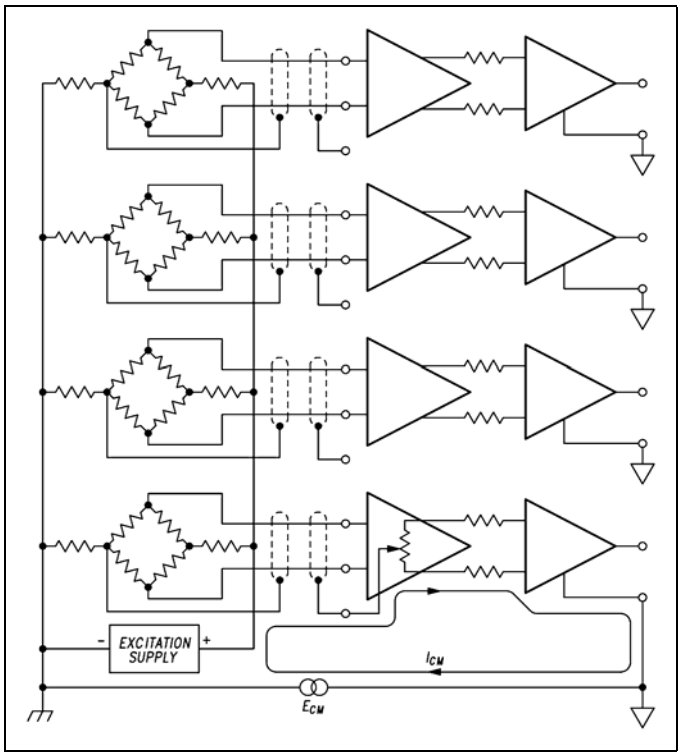
Two-Wire Scanner
Figure 4

Two-Wire Scanning

As shown in Figure 4, it is sometimes necessary to operate the amplifier following a two-wire scanner. Under these conditions, the amplifier must operate properly without a guard connection. If the input signals have common-mode voltages exceeding 10 V, the guard-dragger amplifier cannot be used. Since the Model 751ELN senses the CMV from the two signal leads, they will operate properly under these conditions.

Multiple Bridge Sources Operating on a Single Excitation Supply

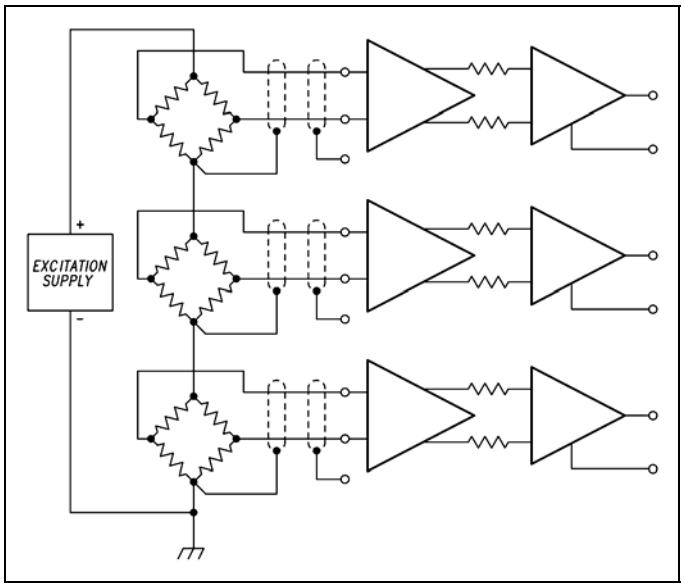
Figure 5 shows an application where several bridge-type transducers are operated from a common excitation supply. Because bridges often have to be normalized, resistance is added in the plus and minus leads to each bridge. A guard-dragger amplifier will cause a ground-loop current, I_{CM}, to flow as shown in the figure. Since the guard-to-output-low resistance of the Model 751ELN exceeds 50 MΩ, the resulting ground-loop current will be greatly diminished. Furthermore, the resulting current path in the Model 751ELN does not involve signal-carrying circuitry.



Multiple Bridges
Figure 5

Two-Wire High CMV Signal

Since the guard-dragger amplifier must have a low-impedance connection for the guard whenever the common-mode voltage exceeds 10 V dc or peak ac, this amplifier is difficult to apply when no suitable guard connection is available. For example, if several signal sources are in series (as in Figure 6), a significant guard load will affect the other signals. The Model 751ELN can usually be connected as shown with no loading problems. If more isolation is required, all guards could be tied to the ground point.



Series Bridge Sources
Figure 6

Ectron CORPORATION
8159 ENGINEER ROAD, SAN DIEGO, CA 92111
TEL (858) 278-0600 • *FAX 858-278-0372*
Email sales@ectron.com • www.ectron.com