

## HIGH VOLTAGE RELAY DESIGNS

Below is a discussion of typical high voltage relay designs used by Sensata for high voltage switching applications. Sensata's HV relays are sealed, providing rugged, small, and efficient high voltage designs for most demanding applications.

### Internal Armature Style

Figure 1 is a typical GIGAVAC design used in many GIGAVAC high current, high voltage relays. The armature is inside the vacuum or gas filled sealed ceramic envelope, and the coil is outside the sealed switching chamber. This is a single pole double throw relay. Depending on the switching application, various contact materials are used inside the sealed chamber. Tungsten / molybdenum is used for "Making or Breaking" loads in GIGAVAC G8, G15, G18, G50, G60 and G61 relays. Copper contacts have less contact resistance and are used for higher current "carry only" applications such as for RF in GIGAVAC G2 and G52 relays.

Figure 2 shows the same design but with a built-in internal shield that extends the relay life. When power switching a load using a vacuum relay, even hard contacts vaporize, and the material becomes deposited and plate-out the internal walls of the ceramic envelope. Over time, these deposits reduce the isolation voltage, which causes the relay's end of useful life. GIGAVAC has solved the plate-out condition by adding an internal shield as shown. The deposits hit the shield (GIGAVAC G18 relay) rather than the ceramic wall, resulting in a relay life many times longer than relays without the shield.

When power is applied to the coil of these relays, a magnetic field is transferred through a pole that runs through the center of the coil to the armature, that is located inside the sealed switching chamber. The armature moves the common contact to the normally open contacts. A spring inside the sealed chamber returns the moving contact to the normally closed contact when coil voltage is removed.



Fig. 1, GIGAVAC Internal Armature style, Double Throw relay design

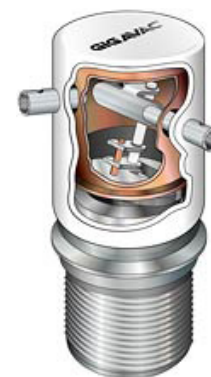


Fig. 2, GIGAVAC G18 relay. Same as Fig 1, but with built-in shield for power switching

### Diaphragm Style

Figure 3 & 4 show the GIGAVAC diaphragm style relays. The contacts are sealed in a chamber at the top of the relay. The chamber is sealed with a braze joint at the top, and with a diaphragm below. The external high voltage connections are integral to the braze seal. The relay armature is below the sealed chamber and is not shown. When power is applied to the coil, the armature moves, and a ceramic insulating rod that is attached to the diaphragm moves the common contact to the normally open contact (a small rod) inside the sealed chamber. Figure 3 is a single throw, normally open configuration. The top contact (A3) is open and the moving contact (A2) is below.

Figure 4 is a double throw relay. The normally open contact is at the top, the normally closed contact is in the center, and the moving contact is at the bottom. For this relay, the sealed chamber extends from the top of the relay down to the diaphragm that is the

moving contact. Both the normally open and normally closed contacts are in the same sealed chamber.



Fig. 3 , GIGAVAC Diaphragm Style, Single Throw relay design



Fig. 2 , GIGAVAC G18 relay. Same as Fig 1, but with built-in shield for power switching

### G81 Package Design

Figure 5 is the GIGAVAC G81 style relay. For this relay, the GIGAVAC G41 relay (Fig. 3 or 4) is packaged inside a cup that provides more mounting and high voltage terminal options. Because contacts of the GIGAVAC G41 are in a vacuum, the contacts can withstand more high voltage than the distance between the external terminals. By potting the GIGAVAC G41 relay inside the GIGAVAC G81 cup, the high voltage capabilities are greatly improved. GIGAVAC packages many relays for this same reason, such as the GIGAVAC G60 relay (figure 1 style) to make the G61 relay.

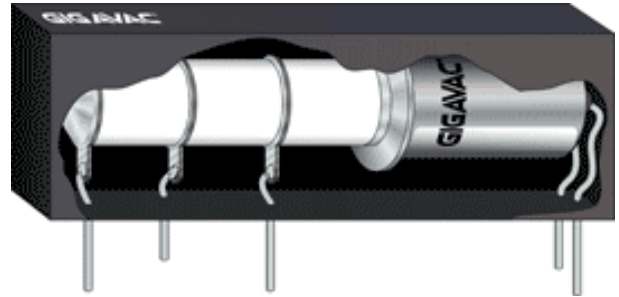


Fig. 5 , GIGAVAC G81 package, using GIGAVAC Diaphragm Style, Double Throw relay design.

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