TR Relay Operational Summary

Magnetically Latched Transformer Relay

Transformer Relay

The unique combination of a transformer and a relay in one magnetic combination offers several advantages in cost, system design and operation. An explanation of the magnetics of the Transformer Relay is necessary to fully understand how it operates within a system.

Figure 1 is a general representation of the relay showing the relative association of each of the important parts in the magnetic circuit. The transformer section of the device consists of a primary coil (120 or 277 volts), a secondary coil (15 volts), and a stack of transformer steel laminations. The leads from the secondary coil are color coded: Yellow and Brown. The relay section of the device consists of two permanent magnets, a steel bracket, a moving armature that supports the moving contacts, and a set of 90% silver, 10% cadmium stationary contacts.

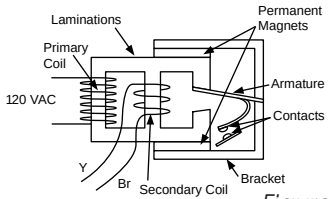

Figure 1

Magnetism Theory

By convention, magnetism "flows" FROM the north pole TO the south pole. When a diode is placed between the switching leads, an electromagnet is created across the gap. By using two diodes in opposite directions to each other, the Transformer Relay is able to create two magnetic polarities opposite to each other.

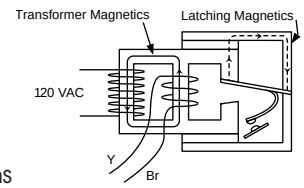

Figure 2

Figure 3A shows the magnetism that is applied to the gap of the core to CLOSE the contacts.

When a diode is placed between the switching leads (current towards the Yellow wire), the flux that is produced sets up a magnetic field on both surfaces of the gap (top North and bottom South). Because the flipper arm is always connected to the North sides of the permanent magnets, the flipper arm is repelled from the North surface and attracted to the South surface. Since the contact arm is connected to the flipper arm, the contacts will close.

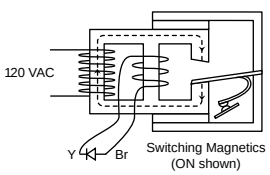

Figure 3A

Figure 3B shows the magnetism that is applied to the gap of the core to OPEN the contacts.

When a diode is placed between the switching leads (current towards the Brown wire), the flux that is produced sets up a magnetic field on both surfaces of the gap (top South and bottom North). Because the flipper arm is always connected to the North sides of the permanent magnets, the flipper arm is repelled from the North surface and attracted to the South surface. Since the contact arm is connected to the flipper arm, the contacts will open.

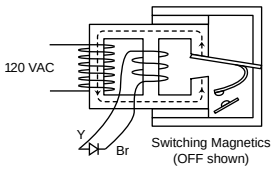

Figure 3B

As can be seen by examining Figures 3A and 3B, the electromagnet reverses its polarity to switch the relay ON and OFF.

TR Performance

The performance and reliability of the Transformer Relays have been proven in both the field and the laboratory. The original 3M products were installed in test sites in Minnesota, Ohio and Texas in 1980 and are functioning well to date. ILC has over a decade of service to the commercial building industry. Our lighting control systems have proven themselves in over 5,000 facilities nationwide. Applications testing in the laboratory and the factory have further attested to the performance of the TR and established expected lifetime data.

Transformer Relays have also been cycle tested under laboratory conditions. The most important of these tests is the "cycle to failure" test to help determine the anticipated life of the TR. There are two types of electrical loads that present severe conditions to any relay: a tungsten lamp load and a high inductive load.

A tungsten lamp electrical load is characterized by a high inrush current. A cool tungsten filament will pass ten times the current of a hot filament. When a tungsten lamp is first energized, there is a current surge that lasts only milliseconds, but that can cause erosion and welding in a relay. The typical life of a TR-120 subjected to a 16 amp (80% of circuit rating) tungsten load is 48,000–52,000 cycles.

An inductive load such as a ballast or motor is characterized by a large electrical arc as the circuit is broken (this is due to the collapse of the magnetic fields). The heat generated by these intense arcs can cause burning and erosion of relay contacts. The typical life of a TR-277 subjected to 16 amps power factor is over 200,000 cycles.