VIDEO#32: Electronic Basics #32: Relays & Optocouplers

Relays and Optocouplers

Introduction to Remotely Controlled Sockets

Remotely controlled sockets allow users to turn appliances on and off using a remote. These sockets contain internal components that handle mains voltage switching. By opening up such a socket, we can observe essential components such as a fuse, a radio frequency PCB, the HX2272 IC (a remote control encoder), and a relay, which clicks upon switching.

Understanding Relays

Relays are electromechanical switches commonly found in circuits. They consist of a coil and at least two contacts. Different relays may have various appearances, but their fundamental working principle remains the same.

Working Principle of Relays

When a voltage is applied to the coil terminals, current flows through the coil, creating a magnetic field. This field attracts the anchor on top of the coil, closing the previously open contacts. This allows an electrical connection between the circuit components, thereby switching on the appliance.

Relay Representation

A relay symbol typically consists of:

- A coil on the left side.
- A Normally Open (NO) switch on the right side. The NO switch remains open when no voltage is applied to the coil.
- A Normally Closed (NC) switch, which remains closed when the coil is not energized.
- Changeover contacts, which provide both NO and NC switching options.

Voltage and Current Limitations

Relays have specific voltage and current limitations, which are usually printed on the casing or found in the datasheet.

- If the coil voltage is too low, the relay will not activate properly.
- If the coil voltage is too high, excessive current may cause overheating and potential coil failure.

Flyback Diode Protection

When a relay coil is de-energized, a collapsing magnetic field induces a voltage spike. If a transistor is used to control the relay, these voltage spikes can damage it. To prevent this, a flyback diode is placed parallel to the coil, allowing induced current to circulate and preventing overvoltage damage.

Relay vs. MOSFET & TRIAC

Relays offer several advantages over MOSFETs and TRIACs:

1. **Power Loss Consideration:** MOSFETs and TRIACs have a voltage drop that, when multiplied by the current, leads to power loss. Relays, however, have a negligible voltage drop at high currents.
2. **Ground Isolation:** MOSFETs require the control voltage and load to share the same ground potential, whereas relays allow complete electrical isolation between the control and load circuits.
3. **Galvanic Isolation:** Relays enable microcontrollers to safely switch high-voltage loads (e.g., 230V) without risk of damage.
4. **Switching Speed:** While MOSFETs allow for fast switching and PWM dimming, relays are slower and unsuitable for such applications.
5. **Durability:** Relays are mechanical and have a limited lifespan due to wear on the contacts over time.

Understanding Optocouplers

Optocouplers, also known as opto-isolators, provide electrical isolation between circuit components. Inside an optocoupler, an infrared LED and a photosensitive sensor (usually a transistor or TRIAC) work together to transfer signals without direct electrical contact.

Working Principle of Optocouplers

When voltage is applied to the infrared LED, it emits light, which activates the photosensitive transistor or TRIAC on the other side. This allows signal transmission while maintaining electrical isolation between input and output.

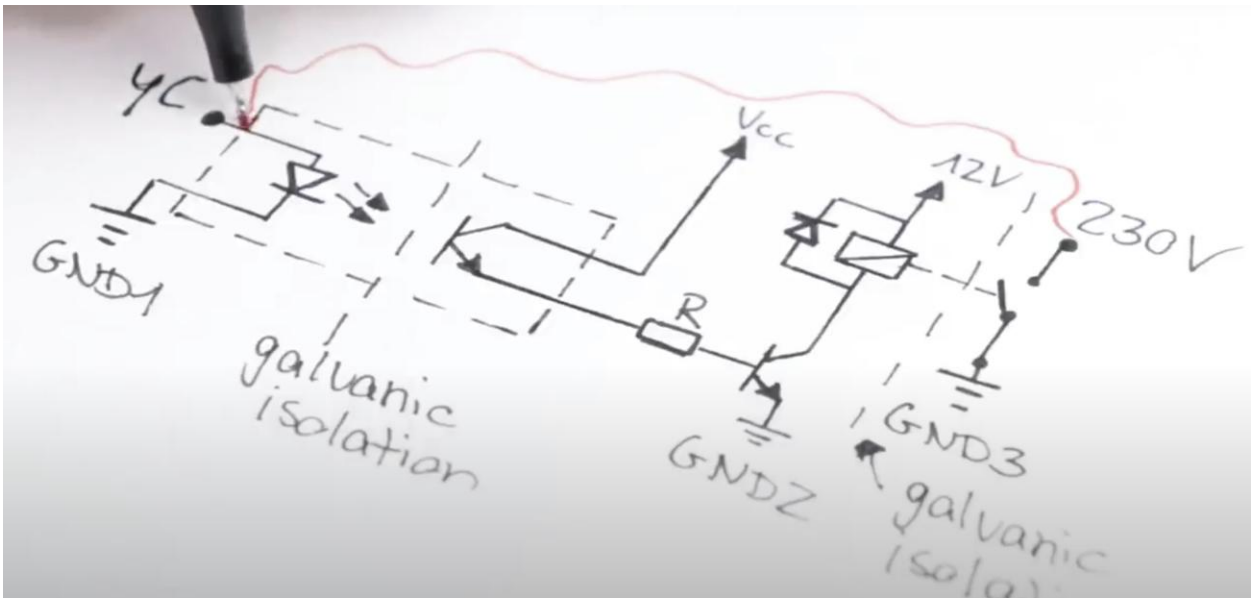

Fig: **Working Principle of Optocouplers**

Applications of Optocouplers

Optocouplers are ideal for:

- **AC Switching:** Used in circuits where relays are too slow for phase angle control, such as TRIAC-based AC control.
- **Microcontroller Protection:** Since optocouplers can handle up to 7500V isolation, they protect microcontrollers from high voltages.
- **Signal Isolation:** Transistor-based optocouplers can be used to control a secondary transistor, which in turn energizes a relay coil. This provides an additional layer of safety and isolation.
- **Relays** are ideal for switching large loads with low power loss and galvanic isolation but are slow and degrade over time.

- **Optocouplers** provide fast switching and excellent isolation but cannot handle large loads directly

- The combination of both components in circuits provides safe and efficient switching solutions.

Comparison: Relays vs. Optocouplers

Feature	Relays	Optocouplers
Switching Speed	Slow	Fast
Power Handling	High	Low
Wear & Tear	Mechanical wear	No wear
Galvanic Isolation	Yes	Yes
Activation Current	Higher	Lower
PWM Capability	No	Yes