Principle of Optical Coupler Circuit

Overview

The goal of this chapterOptical couplers is to examine in detail the practical side of integrated optical couplers.

Key Takeaways

An optical coupler circuit transfers electrical signals between two isolated circuits using light, allowing the input LED to control a phototransistor output without direct electrical connection.Basic Principle

An optocoupler (or opto-isolator) consists of two main components enclosed in a single package: a Light-Emitting Diode (LED) on the input side and a photodetector, usually a phototransistor, on the output side . When an electrical signal is applied to the LED, it emits infrared light proportional to the input current. This light travels across a transparent insulating medium and strikes the phototransistor, causing it to conduct. When the LED is off, the phototransistor remains non-conductive, effectively acting as an open switch .

Electrical Isolation

Because the signal is transmitted optically, there is no direct electrical connection between the input and output circuits. This provides high-voltage isolation, protecting sensitive low-voltage components from spikes or noise in high-voltage circuits . Typical isolation can reach several kilovolts, making optocouplers ideal for interfacing microcontrollers with mains power or noisy industrial signals.

Circuit Operation

In a typical optocoupler circuit:

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• Input side: A current-limiting resistor (R1) ensures the LED receives the correct forward current. The LED converts the input voltage or pulse into light .

• Output side: The phototransistor conducts when illuminated. A load resistor (R2) converts the transistor current into a voltage suitable for the next stage of the circuit. The transistor can be configured in common-emitter mode, providing switching or signal amplification .

• Current Transfer Ratio (CTR): The ratio of output current to input LED current, usually expressed as a percentage, indicates the efficiency of signal transfer. CTR varies by device type, temperature, and LED aging, typically ranging from 10% to 150% .

Applications

Optocoupler circuits are widely used for:

• Isolating digital logic circuits from high-voltage AC or DC circuits.

• Protecting microcontrollers from voltage spikes.

• Switching inductive loads like motors or relays while preventing back EMF from damaging the control circuit.

• Interfacing circuits with different voltage levels or logic families (e.g., TTL to CMOS), .

Types of Optocouplers

Optocouplers can have different output devices:

• Phototransistor: Standard switching and amplification.

• Photo-Darlington: Higher current gain.

• Photo-SCR or Photo-Triac: Suitable for AC load control . In summary, an optical coupler circuit works by converting an electrical signal into light, transmitting it across an insulating barrier, and reconverting it into an electrical signal, providing both signal transfer and electrical isolation. This makes it a versatile component for safe and noise-resistant circuit interfacing.

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The performance of the optocoupler circuit showing the result of using the calculated values is shown in Fig. 5.2.4. Note also the

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Figure 1: WL-OCPT Optocoupler Construction The device''s principle of operation is simple: an electrical-to-optical conversion takes

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The following figure shows how this technique may be applied for coupling an analogue audio signal. The op amp IC2

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The photosensor is the output circuit that detects the light, and depending on the type of output circuit, the output will be AC or DC.

Optocouplers in Electrical Isolation and Signal Transmission

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It details their working principles, types, advantages, and common applications, highlighting their significance.

BSc Chemistry

Regardless of the circuit design, the same operating principle is maintained, that is: optical coupling between circuits while achieving

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What is an Optocoupler (Optoisolator / Photocoupler)? An Optocoupler (Optoisolator / Photocoupler) is an electronic

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In this case, the fiber optical coupler acts as a Y or T coupler (where Y or T depicts the form of transmission route).

The Working Principle Of Optical Coupler

1)The working principle of optical coupler is that the photo-coupler produces optical current due to photoelectric effect,

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Optocoupler Basics: Definition, Types, and Features

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Optocouplers can be described by a variety of different names including optoisolator, and photocoupler. Essentially an optocoupler or

Optocoupler Circuit Operation | Specification | Applications

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In photo-transistor, the collector current slightly affected by the collector to emitter voltage, V CE The switching time

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