

Why is the optocoupler resistance low



Overview

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Key Takeaways

Low resistance in an optocoupler is primarily caused by high current transfer, transistor saturation, and low load or base resistances affecting the output stage. Current Transfer Ratio (CTR) Effects

The current transfer ratio (CTR) is the ratio of the output transistor current (I_C) to the LED forward current (I_F) and is a key factor in optocoupler behavior. A high CTR means that even a small LED current can drive a relatively large collector current, effectively lowering the output resistance of the optocoupler. Variations in CTR due to manufacturing tolerances, temperature, or biasing can also influence the apparent resistance.

Transistor Saturation

Optocouplers with transistor outputs can enter saturation when the collector-emitter voltage (V_{CE}) drops close to zero under sufficient LED drive and low load resistance. In saturation, the transistor behaves like a low-resistance switch, which reduces the effective resistance between collector and emitter. This is often desirable for switching applications but can appear as low resistance in analog circuits.

Load and Base Resistor Influence

The load resistor (R_L) and any base resistor connected to the output transistor significantly affect the optocoupler's resistance. A very low load resistance allows more current to flow, reducing the voltage drop across the transistor and lowering the effective resistance. Similarly, a low base resistance can prevent full turn-on of the transistor, causing incomplete saturation and variable resistance behavior.

Biasing and Circuit Design

Improper biasing of the LED or output transistor can also lead to low resistance. If the LED current is too high or the transistor is biased near saturation, the optocoupler will conduct more than intended, reducing resistance. Designers must consider worst-case CTR, temperature effects, and resistor tolerances to ensure the optocoupler operates within the desired resistance range.

Summary

Low resistance in optocouplers is generally caused by:

- High CTR leading to large output currents for a given LED drive.
 - Transistor saturation reducing collector-emitter voltage.
 - Low load or base resistances allowing higher current flow.
 - Biasing conditions that push the transistor into conduction beyond intended levels.
- Proper design, including selecting the correct CTR bin, adjusting LED current, and choosing appropriate load resistances, can control the effective resistance of an optocoupler in a circuit.

Article Content

Opto-isolator

An opto-isolator (also called an optocoupler, photocoupler, or optical isolator) is an electronic component that transfers electrical

Basic Characteristics and Application Circuit Design of Transistor

This document outlines the basic characteristics and application design of general-purpose transistor output photocouplers (optical

Optocouplers Working Principle

What is optocoupler? An optocoupler is an optical link and it connects two circuits via this link. The optical link is

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