INTRODUCTION TO ELECTICAL AND ELECTRONICS ENGINEERING

SUBMITTED BY GROUP 5

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INTRODUCTION

- Optocouplers, also known as optoisolators, are crucial for achieving electrical isolation in electronic systems.
- They use optical communication to transmit signals while maintaining separation. In this activity, we will construct an optocoupler using an infrared (IR) LED and an NPN phototransistor.
- This optical link enables communication between circuits while keeping them electrically isolated. We will also explore the operation of integrated optocouplers for analog signal isolation and current regulation.
- Through this activity, participants will gain hands-on experience and expand their knowledge in electronic circuit design and implementation.

Uses of optocouplers

- Optocouplers are used for electrical isolation in various applications.

- They protect components from voltage spikes and transients.

- Optocouplers ensure reliable signal transmission and data integrity.

- They find applications in power electronics, industrial control systems, and automotive electronics.

- Optocouplers are used in medical devices, audio equipment, and power supply designs.

- They provide isolation in aerospace, military, and renewable energy systems.

- Optocouplers are employed in motor control circuits for precise control and protection.

Advantages of optocoupler

- Electrical isolation: Optocouplers provide effective electrical isolation, safeguarding components from voltage spikes and damage.

- Noise immunity: Optocouplers eliminate noise and interference, ensuring reliable signal transmission.

- Signal integrity: Optocouplers maintain signal integrity, reducing distortion and improving system performance.

- Compact and versatile: Optocouplers are adaptable to different applications and can be integrated into compact designs.

- Wide voltage range: Optocouplers can handle high voltages and voltage transients, offering flexibility in various scenarios.

- Low power consumption: Optocouplers consume minimal power, making them energy-efficient.

- Easy integration: Optocouplers can be easily integrated into existing circuits without extensive modifications.

- Safety: Optocouplers provide galvanic isolation, enhancing safety and protecting sensitive equipment.

Disadvantages of optocoupler

- Limited bandwidth: Optocouplers have a limited bandwidth for high-speed applications.

- Temperature sensitivity: Optocouplers can be sensitive to temperature variations.

- Aging and degradation: Optocouplers may experience reduced performance and reliability over time.

- Response time: Optocouplers have a finite response time, introducing potential delays.

- Size and cost: Optocouplers can be larger and more costly compared to alternative solutions.

- Compatibility limitations: Optocouplers may have limitations with voltage or signal levels.

- Sensitivity to ambient light: Optocouplers can be susceptible to interference from ambient light.

Material required

a. **ADALM2000 Active Learning Module**
b. **Solder-less breadboard,**
c. **jumper wire kit**
d. **2 2.2 kΩ resistors**
e. **1 OP27 operational amplifier**
f. **2 QSD123 LED lights**

The NPN transistor Optocoupler Background

- Optocouplers transfer electrical signals using light across an isolation barrier

.- They protect components from high voltages and voltage spikes.- Input-to-output voltages range from 3kV to 10kV.

- Optocouplers can withstand fast voltage transients up to 10kV/µs

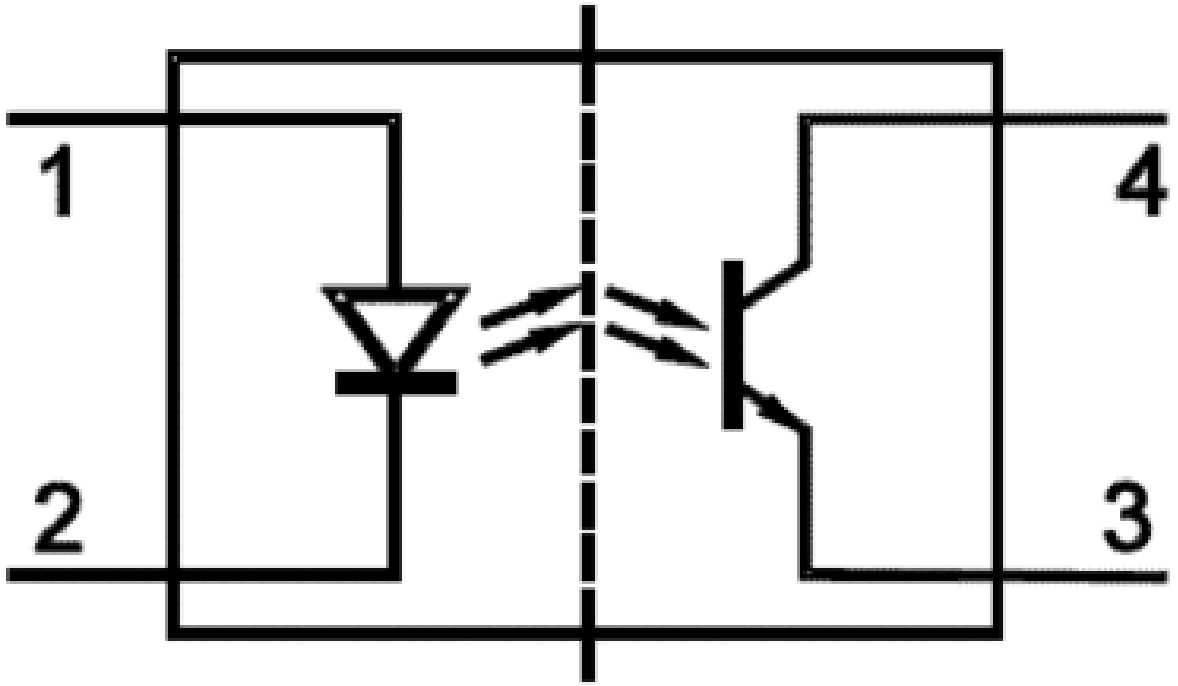
.- They consist of an infrared LED as the input and a photo-detector on the output side

.- An isolation barrier separates the input and output sections.- When the LED is off, no light is emitted, and the photo-detector remains off

.- When the LED is on and emits light, the photo-detector turns on if sufficient photo current is received

.- Optocouplers ensure signal transmission while preventing damage and interference.

Figure of NPN transistor Optocoupler



Construction Directions

- The first step of this activity is to construct an optocoupler using an infrared LED and NPN phototransistor.

- The components required for this construction are provided in the ADALP2000 Analog Parts Kit

.- If the ADALP2000 Analog Parts Kit is not available, similar devices can be used as substitutes, but the results may vary based on the components used.

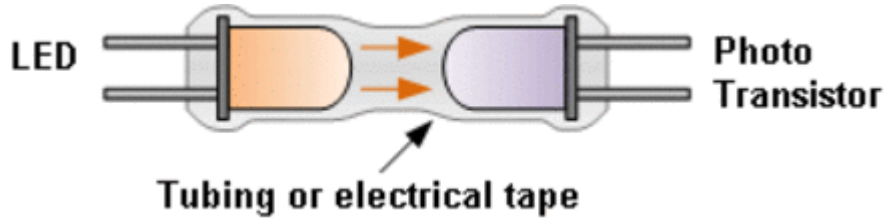
QED-123 Infrared LED

QSD123 Infrared Transistor

- Bend the leads of the LED and phototransistor 90 degrees to ensure they face each other and are at the same level when inserted into the solder-less breadboard.

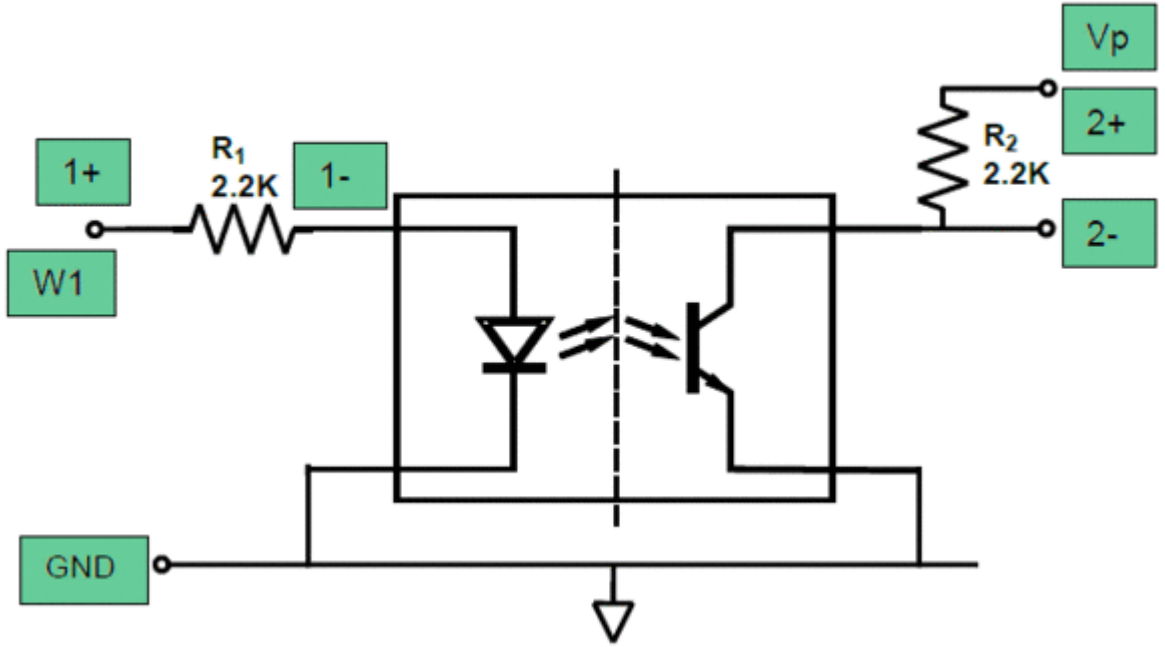
- Use a short length of tubing or black electrical tape, cut to the appropriate width, to wrap around the combined LED and phototransistor.

- This alignment and covering method helps maintain proper alignment, prevent stray ambient light, and ensure optimal performance.



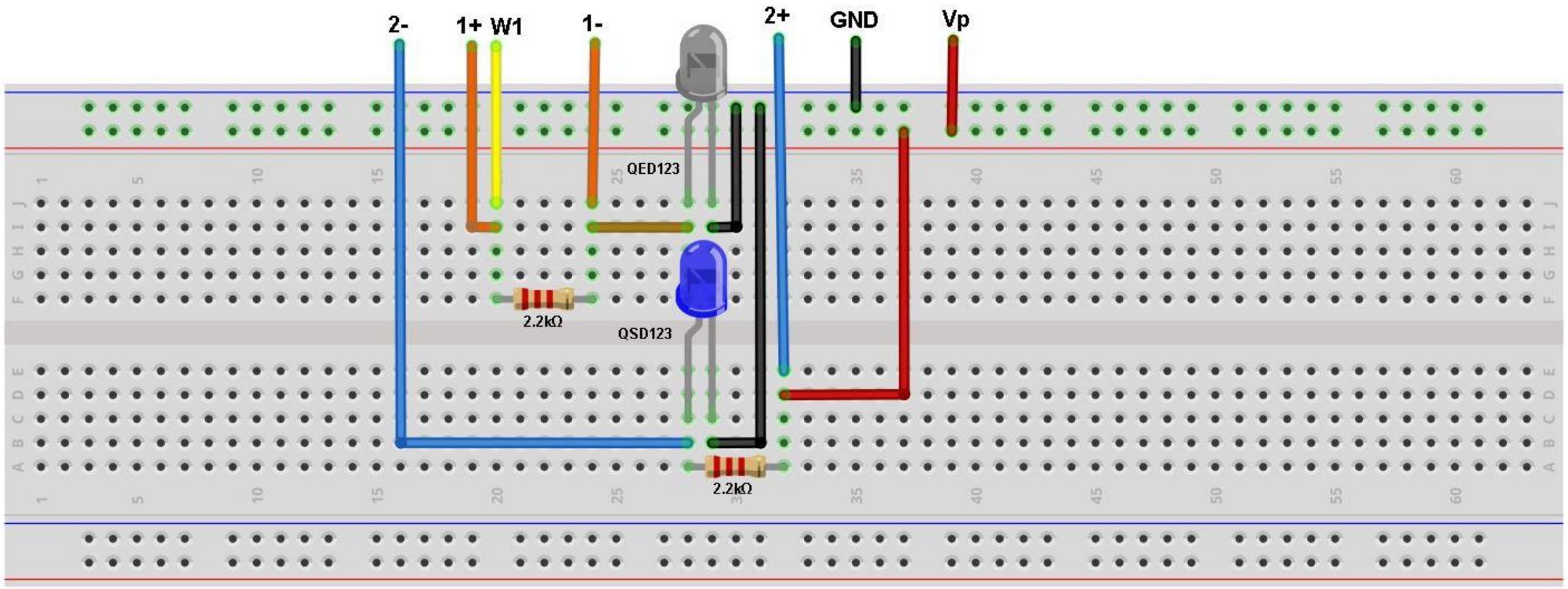
Completed coupler

Circuit diagram

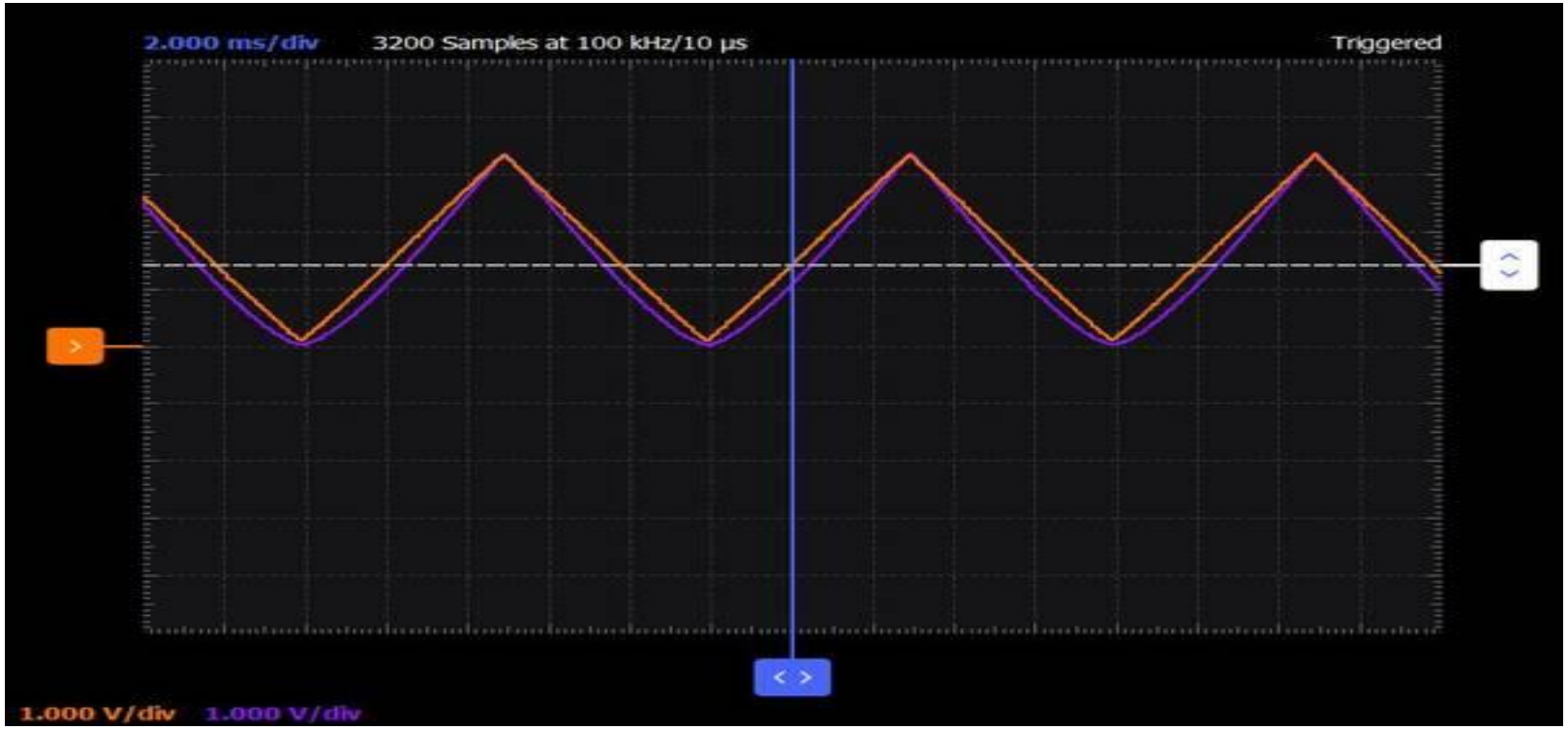


Optocoupler Input to Output characteristics

Hardware Setup



Result


2.000 ms/div
3200 Samples at 100 kHz/10 µs
Triggered
1.000 V/div
1.000 V/div

Contributions

- Meenakshy (CB.EN.U4AIE22032): About Optocouplers
- Naga Koushik (CB.EN.U4AIE22046) : Hardware setup
- Vishrut sawarnya (CB.EN.U4AIE22059) : Hardware setup
- Subhashini (CB.EN.U4AIE22061) : Circuit diagram