EE 230 design - Optical signaling device

Build a simple signaling device that transmits an optical signal from a two-button “remote” to a receiver that responds by lighting either a red LED or a green LED, depending on which button of the remote was pushed. The information must be passed from the transmitter to the receiver via an infra-red light pulses. In essence, this is a simple version of a standard remote control for a TV.

Design requirements

- When either of the transmitter buttons is pushed, an optical signal should be sent via an infrared LED to a detector circuit. Detection of the signal should cause either a red LED or a green LED to light up. When no button is pushed, neither LED should be lit. You can assume that the situation of having both buttons pushed simultaneously will never occur.

- The circuits should operate at separations up to 2 feet between the transmitter and detector.

- You can use up to three DC supply voltages for your project (i.e. one triple output supply). You won't need the function generator.

Comments / hints

- This is a moderately big project. It is important that you design, build, and test your circuit using the “sub-circuit approach”. A good way to start the design would be make a block diagram of how the various pieces will fit together.

- How to send the signal from the LED transmitter to the receiver?

  Since you only have to worry about three conditions — red, green, and neither — you could assign a frequency to each positive condition. For example, red could correspond to 1 kHz, green could be 10 kHz, and “no light” corresponds to having neither of these frequencies. So when the detector side of the circuit detects 1 kHz, it turns on the red LED, and when 10 kHz is detected, the green LED turns on. Otherwise, nothing happens.

  This suggests that the transmitter side might have two oscillator circuits that provide the required frequencies. (Or one oscillator whose frequency can be changed.) When the user closes a switch (which for our purposes can just be a wire that is plugged and unplugged) the transmitting LED is connected to the appropriate oscillator. (An aside: When you push a button on a "real" remote control, a digital code is sent to the instrument on the receiving end. This allows for more instructions, but of course requires extra circuitry for capturing and decoding the transmitted digital pulse train. This beyond the scope of what we’re trying to accomplish with this project.)

- You should use the infrared LED for your transmitter -- it generates more optical power and its wavelength is better matched to the detector. However, the IR LED has the disadvantage that you cannot see the light. You might consider starting out with a red LED in the transmitter for initial testing and debugging and then switch to the infrared LED later. Using a BJT to boost the current through the LED might be useful.

- On the receiving end, there must be a detector circuit of some sort.
- How do you discriminate between the two frequencies? With filters, of course. If the two signaling frequencies are relatively widely spaced, it should be easy to make filters that pass one frequencies while strongly attenuating the other.
- What to do with the signals coming from the filters? You probably will need to convert the AC signal to a DC voltage, which sounds very much like a rectifier. The converted DC voltage could be used in turn trigger a comparator, which lights the LED.
- If signal levels are low, they can always be boosted with an amplifier.
- Potentiometers are always useful for tweaking gains and corner frequencies and adjusting comparator threshold levels.
- The "push-buttons" mentioned above can be implemented by a simple wire that is moved between two points on the breadboard. If you happen to have momentary switches in your collection, those will work well, also.

Testing / Reporting

- Your lab supervisor will test your circuit, checking that each of the requirements has been met.
- Write a short report that includes:
    1. a complete circuit diagram,
    2. a photo of your circuit,
    3. a description of the design of the circuit, and
    4. any additional comments about the performance (or lack thereof) of your circuit.
    5. You might consider making a short video of your circuit under operation. This is not required, but you can do it if your lab supervisor is willing to accept it as the part of your report. (Note: A video complements the written report – it does not replace it.)