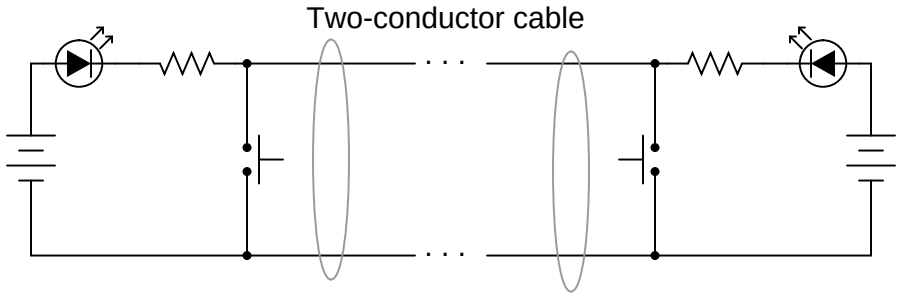
Design Project: Telegraph system

Your project is to design and build a working telegraph system, with at least two stations, each of which capable of both sending and receiving simple on/off "pulse" signals. Here is a sample schematic diagram for you to follow when designing your system:



Of course, you are not restricted to using this exact design.

Deadlines (chosen by instructor):

- Project design completed:
- Components purchased:
- Working prototype:
- Finished system:
- Full documentation:

Questions

Question 1

What voltage will you choose to use for each of the station batteries?

file 01490

Question 2

What resistor values will you choose for the "dropping" resistors in series with the light-emitting diodes? Remember that these resistor values will depend on the voltage and current ratings of the diodes, as well as the chosen power supply voltages.

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Question 3

Explain how it would be possible to have more than two telegraph stations working on your system. Where would you connect the third, fourth, and fifth stations? Would the station designs have to be changed in order to accommodate more than two stations? Will your working voltage have to change?

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Question 4

Modify your telegraph station design to incorporate *two* indicator lights: one for transmission and one for reception. How could the stations circuitry be changed such that there would be separate lights to indicate different directions of data travel?

Challenge: modify the circuit so that the "sending" light only illuminates if the other station's "receive" light actually has a complete circuit. In other words, if the receiving station's "receive" light fails open and does not light, the transmitting station's "send" light should not light either!

file 01493

Answers

Answer 1

I recommend 9 volts, because small 9-volt batteries are easily available and provide more than enough voltage to energize light-emitting diodes.

Answer 2

This may be determined by using Ohm's Law, once the component ratings and operating voltage are known.

Answer 3

It is very easy to add stations if the example design is used. If other designs are chosen, it may be more difficult.

Answer 4

There are several ways to accomplish this design change. Remember that you are not limited to using just the components shown in the example diagram. You could, for example, use a different kind of switch at each station.

Notes

Notes 1

I strongly recommend using batteries to power the telegraph stations instead of AC-to-DC power supplies, as batteries are easier and safer for beginning students to work with. I also highly recommend students choose the same voltage for each station (if using the example circuit), although it will function with different voltage batteries at each station. Of course, whatever voltage is chosen as the system standard will impact other factors in the design, most notably the dropping resistor sizes.

Notes 2

This is a very practical application of Ohm's Law, in a context simple enough for beginning students to understand.

Notes 3

This question forces students to really think about how their system works, and what considerations arise when system expansion is suggested.

Notes 4

It should be interesting to see all the different ideas your students come up with as they attempt to answer this design challenge. Be sure that your students have opportunities to share their ideas with the class at large, for maximum learning.