

EE 230 design - Frequency rate pulser

Design, build, and test a circuit that takes a single audio frequency input and flashes three light-emitting diodes (LEDs) of different colors corresponding to the sound level at three different frequencies. For example, you might choose a blue LED that corresponds to low frequencies, a red LED for medium frequencies, and a yellow LED for high frequencies. The LEDs will flash “with the beat”, meaning that when the sound at a specific frequency is loud enough, the LED will flash and the flash should be bright enough and last long enough to be clearly noticeable. The voltage threshold level for flashing should be set so that the LEDs will flash sometimes but will not be on all of the time.

Such circuits are known as “equalizer displays” or “color organs” – if you are googling for background information. (I made up the name above because I like the acronym.) However, the usual comments about over-using google for classwork apply here as well. You don’t need to look for crap on the internet – you can understand and design this circuit entirely using things you have learned in EE 230.

Comments / Testing / Reporting

- Clearly, you will need three filter circuits to sort out the different frequencies. You do not need to look at all frequencies, just a set that is representatively of low, middle, and (sort of) high frequencies. You can design the filters however you want, but bandpass filters with a reasonably high pole Q might be a good starting point.
- You can choose whatever frequencies you want, but a reasonable starting set might be 100 Hz for bass, 1000 Hz for mid-range, and 3000-5000 Hz for treble. While higher frequencies are possible, there is less content “up there” and you may not get as much flashing.
- Presumably, the source will be from a phone or computer or MP3 player. You will almost certainly have to amplify the signal before passing it to the filters. (Or as part of the filters, if using active filters.)
- NOW HEAR THIS! If you connect your phone or other expensive gadget to an active circuit, you must double- and triple-check connections before hooking your source in. Make sure that there are no DC power supply voltages accidentally attached at the input. A 10-V supply attached to the audio jack of your player will probably cause permanent damage. (Take it from me, if this happens you will be VERY UNHAPPY.)
- To make the LED flash more sustained and more noticeable, you may want to use a peak detector together with a comparator to sustain the length of the flash.
- You may want to make some aspects of the circuit adjustable using potentiometers. For instance, making the switching threshold for any comparators or the gain for any amplifiers adjustable will help in tweaking the operation of the circuit.

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- You can use one or two power supplies with voltages up to ± 15 V.
- If using the FRP has your third project, you might consider adding transistors to boost up the current. This would also allow you to add more LEDs. (More flash = better!)
- As always, take a “divide and conquer” approach. Start with one filter at one frequency. Build it and measure its frequency response. Then add whatever amplification may be needed. Finally, build and test a simple sample-and-hold comparator (peak detector) that will drive an LED. Once the pieces are working, hook it all together to make one complete “channel”. When you have one channel working to your satisfaction, repeat for the other two channels.
- When finished, demonstrate your circuit to the lab instructor and then write a short report that includes: (One report for the group.)
 1. a circuit diagram,
 2. a photo of your circuit
 3. a description of the design of the circuit,
 4. measured frequency response for each filter section, and
 5. any additional comments about the performance (or lack thereof) of your circuit.
 6. 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 would complement to the written report – it does not replace it.)