BAR GRAPH LED PROJECT

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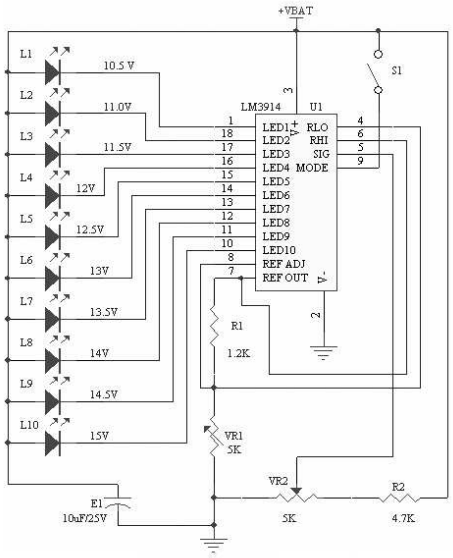
1 Abstract

The bar graph LED battery level indicator project is based on LM3914 monolithic IC from National Semiconductor that senses the voltage levels of the battery and drives the 10 light emitting diodes based on the voltage level that is detected. It provides a linear analog display output and has a pin that can be configured to display the output in moving dot or bar graph.

2 Introduction

The Circuit makes use of the 1 IC, LM3914, 10 LEDs of different colours, 1 SPST switch, 2 resistors, 2 variable resistors and 1 electrolytic capacitor. LM3914 senses the voltage levels of the battery and drives the 10 light emitting diodes based on the voltage level that is detected. The schematic shows how the various components are connected. Switch S1 is used to change the display type from moving dot to bar graph type. When S1 is ON, the display type is bar graph but when it is OFF the display changes to moving dot type. VR1 is used to set the lower limit of the display. By using a variable DC power supply, set the VBAT to required lower limit. Adjust VR1 until the LED L1 turns ON. Next, set the VBAT to required higher limit; adjust VR2 until all the LEDs turn ON (When S1 is ON).



3 Analysis

The LM3914 is a monolithic integrated circuit that senses analog voltage levels and drives 10 LEDs, providing a linear analog display. A single pin changes the display from a moving dot to a bar graph. Current drive to the LEDs is regulated and programmable, eliminating the need for resistors. This feature is one that allows operation of the whole system from less than 3V. The circuit contains its own adjustable reference and accurate 10-step

voltage divider. The low-bias-current input buffer accepts signals down to ground, or V-, yet needs no protection against inputs of 35V above or below ground. The buffer drives 10 individual comparators referenced to the precision divider. Indication non-linearity can thus be held typically to 0.5 percent, even over a wide temperature range.

Versatility was designed into the LM3914 so that controller, visual alarm, and expanded scale functions are easily added on to the display system. The circuit can drive LEDs of many colours, or low-current incandescent lamps. Many LM3914s can be ”chained” to form displays of 20 to over 100 segments. Both ends of the voltage divider are externally available so that 2 drivers can be made into a zero-centre meter.

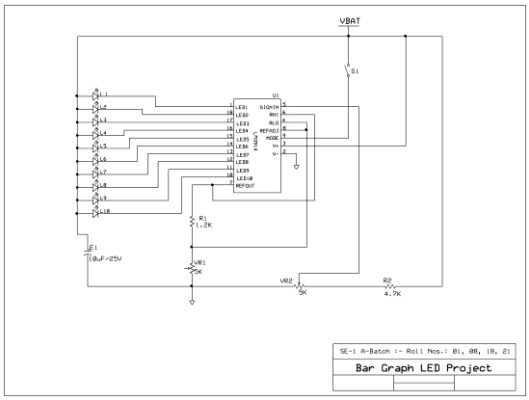
The LM3914 is very easy to apply as an analog meter circuit. A 1.2V full-scale meter requires only 1 resistor and a single 3V to 15V supply in addition to the 10 display LEDs. If the 1 resistor is a pot, it becomes the LED brightness control. The simplified block diagram illustrates this extremely simple external circuitry. When in the dot mode, there is a small amount of overlap or ”fade” (about 1 mV) between segments. This assures that at no time will all LEDs be ”OFF”, and thus any ambiguous display is avoided. Various novel displays are possible.

Much of the display flexibility derives from the fact that all outputs are individual, DC regulated currents. Various effects can be achieved by modulating these currents. The individual outputs can drive a transistor as well as a LED at the same time, so controller functions including ”staging” control can be performed. The LM3914 can also act as a programmer, or sequencer. The LM3914 is rated for operation from 0C to +70C. The LM3914N-1 is available in an 18-lead molded (N) package.

4 ExpressPCB

ExpressPCB manufactures double-sided boards (with 2 copper layers) and 4 layer boards (with 4 copper layers). Double-sided boards work well for most simple applications. They are somewhat less expensive and take fewer days to manufacture than four-layer boards. But four-layer boards offer advantages. They are better at controlling electrical noise and four-layer boards can be smaller with components closely spaced together. Also these boards are easier to lay out.Depending on the options you choose, your boards can have as few as two layers. or as many as seven. The layers from top to bottom are:

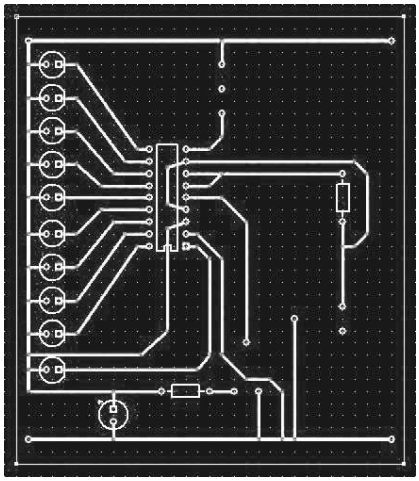
1. Silkscreen
2. Top Solder Mask
3. Top Copper



4. Inner Copper Ground Plane
5. Bottom Copper
6. Bottom Solder Mask

All boards have a Top copper and Bottom copper layer. The Top copper layer is on the component side of the board and is displayed in red by the ExpressPCB layout program. The Bottom copper layer is on the solder side of the PCB and is shown in green. The optional Solder masks layers are green coatings that cover the top and bottom of

the board. The coating is applied everywhere except over the pads where components are soldered. These masks make soldering easier by helping to prevent solder bridges from forming between adjacent pads and traces. Boards with solder masks also include a Silkscreen layer. The Silkscreen layer is used to show the outlines of components, and text identifying each part. The outlines and text are printed on the top of the board in white ink. Four-layer boards have two additional copper layers that are not included with Double-sided boards.



Sandwiched inside these PCBs are two inner layers, a Ground Plane and a Power Plane. Any through-hole pad on a four-layer board can be connected to or isolated from either of these planes. Because the inner layers are completely filled copper planes, they greatly improve the noise immunity of your circuit.

5 Applications

1. This project can be used at places where the voltage of the battery is to be found out.

2. The voltage detected by this project can help us to judge whether a battery has completely discharged or not.

3. Since the output is shown in the form of 10 LEDs, it becomes easy even for a layman to identify the voltage of the battery.

6 Result

Lower Voltage Limit = 3V
Upper Voltage Limit = 12V

Voltage detected by each LED(bottom to top):

1. LED1 = 3V
2. LED2 = 4V
3. LED3 = 5V
4. LED4 = 6V
5. LED5 = 7V
6. LED6 = 8V
7. LED7 = 9V
8. LED8 = 10V
9. LED9 = 11V
10. LED10 = 12V

VBAT = 9V

LED which glowed for VBAT = 9V is LED7(dot mode)

LEDs which glowed for VBAT = 9V are LED1 to LED7(graph mode)

7 Conclusion

A low cost device using LM3914 and LEDs. Moreover, the device provides a good precision and accuracy. The device provides a very good output in the form of LEDs that can be easily interpreted by humans.

8 References

1. Bookname: Electronics Projects Vol.25.
   Publication: EFY Enterprises Pvt Ltd.

2. Website: www.electroschematics.com

3. Datasheets