

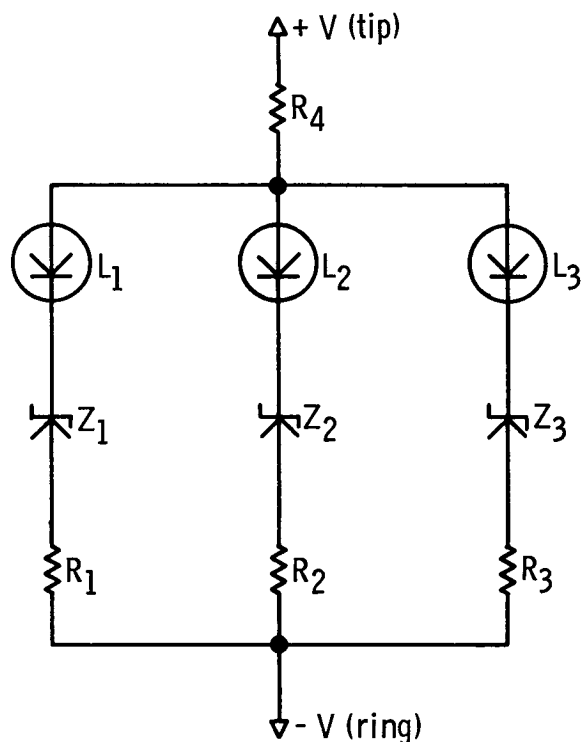
NASA TECH BRIEF

Lewis Research Center



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Reliable Low-Cost Battery Voltage Indicator for Light Aircraft and Automobiles



$$R_1, R_2, R_3 = 47 \Omega$$

$$R_4 = 39 \Omega$$

$$Z_1 = 9.8 \text{ volt zener diode}$$

$$Z_2 = 11.1 \text{ volt zener diode}$$

$$Z_3 = 11.5 \text{ volt zener diode}$$

$$L_1 - L_3 = \text{light emitting diodes}$$

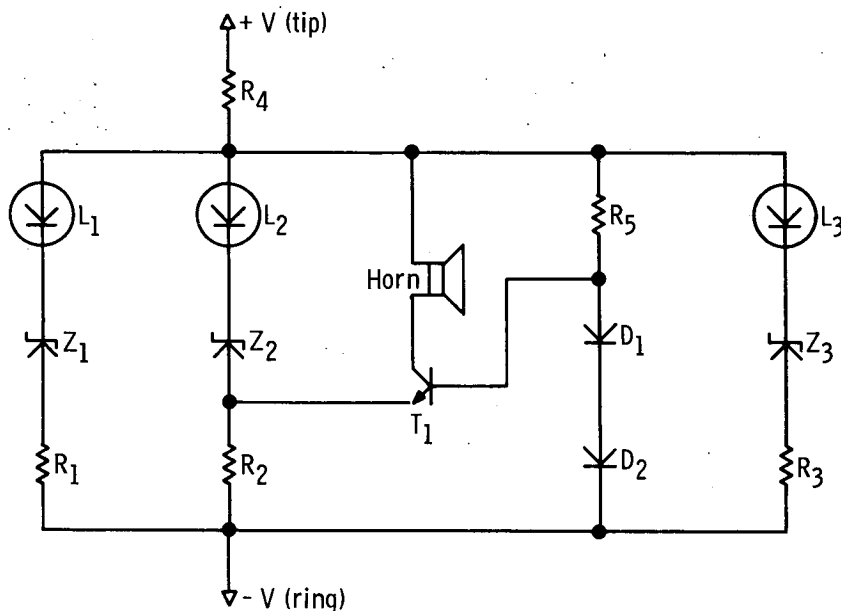
Figure 1

A new solid-state battery voltage indicator which fits into a conventional cigarette lighter socket utilizes light emitting and zener diodes to display three levels of battery voltage. Three zener-light emitting diodes are arranged so that two lights indicate normal voltage, three lights indicate overvoltage, and one light indicates low voltage (Figure 1). An audible alarm can easily be added also to signal low voltage (Figure 2).

This indicator is particularly useful for small aircraft. The nominal operating voltage for most small aircraft is typically 13.8 volts and must be maintained within ± 0.5 volts. Prolonged over- or undervoltage is detrimental and can be destructive to the electrical system, causing failure

of navigational and communications equipment. Conventional charge-discharge ammeters indicate current flow and certain types of electrical system malfunction but do not show battery voltage level. Particularly, they do not indicate whether a battery has been restored to normal voltage after a heavy discharge as in starting the engine. Conventional discharge warning lights have the same shortcomings. Conventional voltmeters are usually not sensitive enough to indicate the relatively small voltage changes which can cause electrical system failure. Expanded-range voltmeters resolve the problem but are somewhat delicate in construction and take up considerable space on the instrument panels. The lack of a positive

(continued overleaf)



$R_5 = 4.7 \text{ K}$
 $T_1 = 2\text{N } 3904$
 $D_1 = \text{silicon diode}$
 $D_2 = \text{germanium diode}$

Figure 2

indication of battery voltage level can result in unnoticed malfunctions of electrical system components, sudden and unexpected depletion of the battery, and failure of electrical power causing an emergency situation.

As shown schematically in Figure 1, the light emitting diodes L_1 , L_2 , and L_3 turn on, respectively, at 11.2, 13.3, and 14.5 volts. The "turn on" voltage is determined by the drop across the zener diodes Z_1 , Z_2 and Z_3 and the common resistor R_4 . Resistors R_1 , R_2 and R_3 limit the current through each light emitting diode. R_4 is used to maintain relatively constant brightness from each LED as it turns on, as the voltage ranges from the lowest "turn on" voltage up to 16 volts.

This indicator is superior to typical conventional electrical system indicators in that it gives a positive discrete indication of battery voltage. It is simple, inexpensive, and rugged. The components are housed in a plug which fits into a conventional cigarette lighter socket; thus it is portable, requires no installation, and does not take up instrument panel space. Pilots, automobile drivers, and other vehicle or equipment operators can carry this battery voltage indicator with them for use on whichever machine they are operating. Of course, a similar unit could be more permanently wired into an instrument panel.

Note:

No additional documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer
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 Reference: B73-10249

Patent Status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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