Battery Monitor

This simple device can be used to monitor a 12 volt car or boat battery and give warning if the battery voltage starts to fall to an unacceptable level. The unit has four LED indicators, and these switch on if the supply voltage falls below a certain threshold level, with a different threshold voltage being used for each LED. The approximate threshold potentials are 10, 11, 12 and 13 volts, but these can easily be changed, as explained later.

The circuit utilizes a quad comparator, and strictly speaking, this device is not a quad operational amplifier. The difference between a comparator and an operational amplifier is very small, and they are largely interchangeable. The device used in this circuit is the MC3302P, and this has four identical comparators which have common positive and negative supply pins. Like an operational amplifier, there are two inputs (inverting and non-inverting) plus an output for each section of the device.

The comparators only really differ from an operational amplifier in that the output terminal connects to the open collector of a common emitter (NPN) output transistor. In normal use the output transistor is used to supply current to a load of some kind if the inverting input is at a higher voltage than the non-inverting one, and cut off power to the load if the comparative input states are reversed. Of course, the fact that an operational amplifier does not have an open collector output does not preclude its use as a voltage comparator, and if a comparator is given a discrete output load of some kind (a resistor of a few kilohms in value is sufficient) it functions as an operational amplifier.

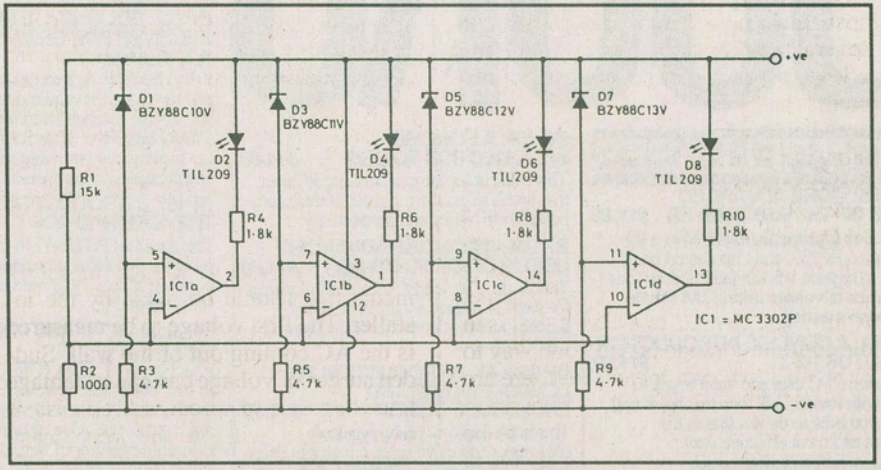

Fig. 1 The Circuit Diagram of the Battery Monitor

The Circuit

Figure 1 shows the full circuit diagram of the Battery Monitor, and this consists of four virtually identical stages. The only difference between the stages is the voltage of the zener diode used in each, and this voltage is chosen to give the desired threshold voltage.

If we consider the stage which utilizes IC1a, the load for the output transistor of IC1a is LED indicator D2 and its series current limiting resistor R4. There is no form of output current limiting built into the output stage of each comparator, and discrete components are needed to ensure that the maximum permissible output current of 20mA is not exceeded. The inverting input of IC1a is fed from the supply lines via the potential divider formed by R1 and R2. Obviously, the voltage fed to the invert-

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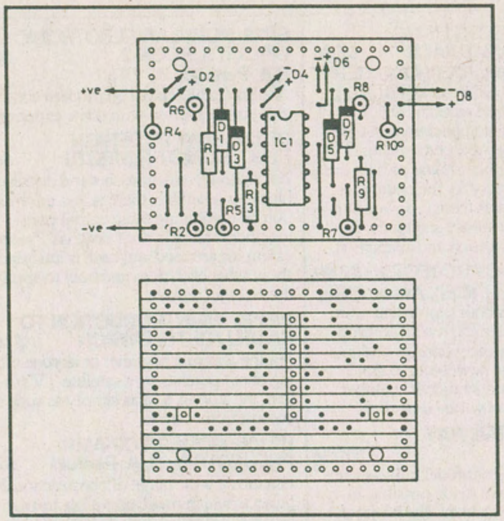

Fig. 2 Constructional Details of the Battery

ing input will vary with changes in the supply voltage, but it will always be quite small, and is unlikely to become more than 100mV (0.1 volts). This bias voltage is fed to the inverting input of each comparator. IC1a's non-inverting input is fed from the supply lines by way of zener diode D1 and D1's load resistor is R3. Under normal operating conditions the supply voltage should be a couple of volts or more above the avalanche voltage of D1, and about two volts or so will be present at the non-inverting input. The output transistor of IC1a is therefore switched off and D2 is not switched on.

If the supply voltage falls below about 10 volts, D1 ceases to conduct and the voltage fed to the non-inverting input falls below the small bias potential at the inverting input. The output transistor of IC1a then switches on and D2 lights up. The other sections of the circuit operate in exactly the same manner, but the zener diode is in each case chosen to give a different threshold voltage. The threshold voltages can obviously be altered if desired, and it is simply necessary to choose a zener diode having a voltage equal to the desired threshold voltage. The circuit will work using zeners having operating potentials of just a few volts, although it would be advisable to reduce R4, R6, R8 and R10 to 1k if the unit is to be used with low supply voltages in order to give a reasonable LED current and brightness. The supply voltage must not exceed 28 volts which is the maximum permissible supply voltage for the MC3302P device.

Construction

A 0.1 in matrix stripboard having 19 holes by 14 copper strips is used as the constructional basis of the Battery Monitor, as can be seen by referring to the constructional diagram shown in Figure 2. The MC3302P is not a MOS device and requires no special handling precautions. In fact electrical construction of the unit is perfectly straight forward and should not give the constructor any real problems.

Mechanical construction must obviously be varied to suit the circumstances under which the unit will be used. This is really just a matter of using a little initiative, and is again something that should not give any real difficulties. The current consumption of the unit with all the LEDs switched off is only about 1.5 to 2mA, but this obviously rises considerably when one or more of the LEDs are switched on. In fact, the increase is about 6mA per LED.

Parts List

Resistors, all 1/2 watt, 5%

R1 – 15k, R2 – 100 ohms

R3, R5, R7, R9 – 4.7k

R4, R6, R8, R10 1.8k

Semiconductors

IC1 – MC3302P (or Sylvania ECG 834) Quad comparitor

D1 – BZY88C10V (or Sylvania ECG 5019A)

D3 – BZY88C11V (or Sylvania ECG 5020A)

D5 – BZY88C12V (or Sylvania ECG 5021A)

D7 – BZY88C13V (or Sylvania ECG 5022A)

D2, D4, D6, D8 – TIL209 (or Sylvania ECG 3007) general purpose red LED