The use of the LM3914 allows a basic circuit building block to be designed which represents units 3 and 4 in Fig. 1, and which may be used in the whole range of instruments to be described in this series of articles. The block diagram in Fig. 3 shows the features of the basic 10-bar display module. Full-scale indication is achieved with an input of +5 volts, and the display may be set to either Dot or Bar graph mode. In the design of this basic module, consideration must be given to the range of possible supply voltages, and the attendant problem of power dissipation. In Bar graph mode, with +15 volt supply and an input of +5 volts, the power dissipation involved in the i.e. and i.e.d. supply regulator will be 120mW for each milliamper of individual i.e.d. current. Also to be considered are the decoupling requirements to prevent oscillations in applications where long leads are used. The circuit diagram of the 0–5 volt Dot or Bar graph display module suitable for use with supplies of 7–15 volts is shown in Fig. 4.

BATTERY CONDITION INDICATOR

A measure of the general condition of a motor vehicle battery may be obtained by measuring the terminal voltage under operational conditions. The nominal open-circuit terminal voltage of the conventional 6-cell lead/acid accumulator is 13.2 volts. This value falls under load, especially as the internal resistances of the cells rise due to physical deterioration; and the voltage rises when the cells are on charge. At no time, however, will the terminal voltage fall much below 10 volts, and the voltage regulator should ensure that the terminal voltage does not rise much above 15 volts when charging. For these reasons, a battery condition indicator need only have a display range of approximately 10 to 15 volts.

The transducer requirement is therefore to convert a voltage in the range 10–15 volts into a signal of range 0–5 volts, to be compatible with the display module described earlier. A Zener diode has characteristics ideally suited to this problem. The reverse characteristics of these diodes of Zener voltage above 6 volts are illustrated in Fig. 5 (three graphs). The nominal Zener voltage is usually given at a reverse current of 10mA. The Zener voltage may be increased by the use of a forward-biased conventional diode placed in series with the reverse-biased Zener. This also has the effect of reducing the overall temperature coefficient of the diode combination. The method of generating a zero-referred signal for driving the display unit (i.e. the signal processing unit number 2) in this application is shown in Fig. 6.

The overall circuit of the battery condition indicator is shown in Fig. 7 and it closely follows the block diagram of Fig. 1. The battery voltage is actually measured from the supply to the instrument, which is fully protected against reverse polarity. Using the circuit values given, the first i.e.d. will light at a supply voltage of 9.8 volts, and the tenth i.e.d. will light at a supply voltage of 15.2 volts.

CONSTRUCTION

The detailed construction of the battery condition indicator is a matter which is very much influenced by the preferences of the individual constructor. Two particular constructional examples will be described in some detail, but these are intended only as illustrations of the wide range of practical implementations which are possible. Individual constructors may wish to make different use of the range of displays currently available. There is, for example, a linear array of 12 matched i.e.d.s available in a 24-pin d.i.l. package for those wishing to produce a miniaturised display; such units may be cascaded using additional drivers.