State-of-the-art feature project

CAR COMPUTER PART ONE

Electronics Australia
JULY 1982

With this Car Computer you will have immediate moment-to-moment feedback on the effect of your driving habits on fuel consumption. You will be able to drive your car at optimum efficiency for all driving conditions and make a worthwhile contribution to energy conservation.

by LEO SIMPSON and JOHN CLARKE

At present, there are only a few cars which can be purchased with a dashboard computer and there is only one car computer, that we know of, which can be fitted as an accessory. That is about to change, particularly now that "Electronics Australia" has designed this computer to suit locally available cars and components. That means this computer is equally suited to measuring the fuel consumption of gas guzzlers and sippers – the economical four-cylinder cars which are becoming ever more popular.

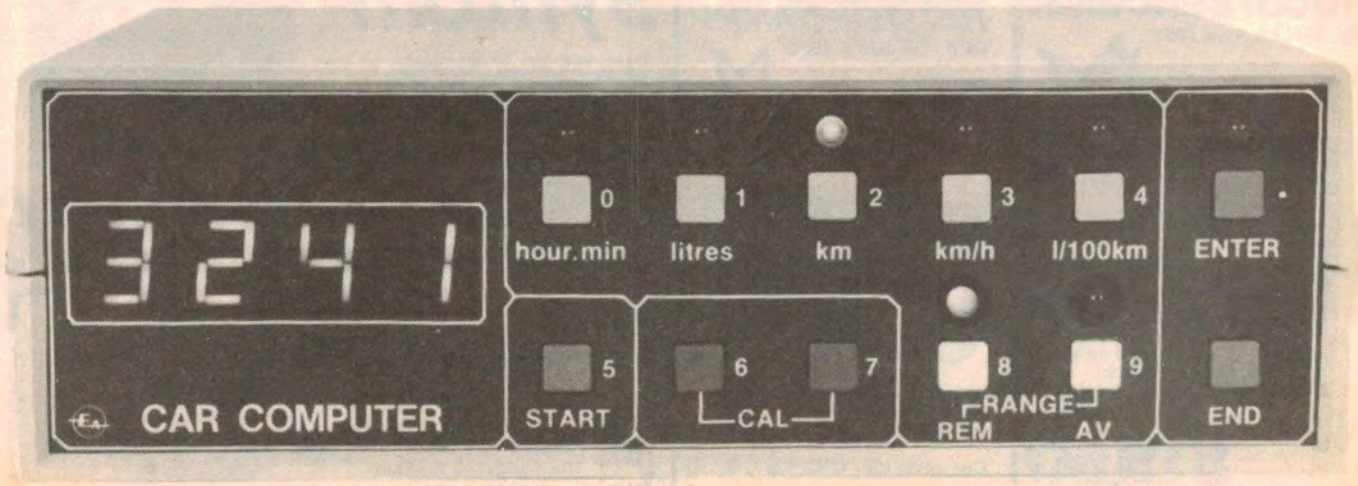
The EA Car Computer uses a microprocessor and other supporting integrated circuits to keep track of three parameters: *time, distance* and *petrol flow*. To keep track of time, the car computer has its own crystal controlled clock. To keep track of distance, there is a sensor which monitors the number of revolutions of the drive-shaft or speedometer cable. And to keep track of petrol flow there is a fluid flow sensor which can measure flow rates down to as little as one litre per hour! This rate of flow is roughly equivalent to that from a fast dripping tap! It is necessary to be able to measure this very low rate if accurate fuel consumption of small four-cylinder cars is to be recorded.

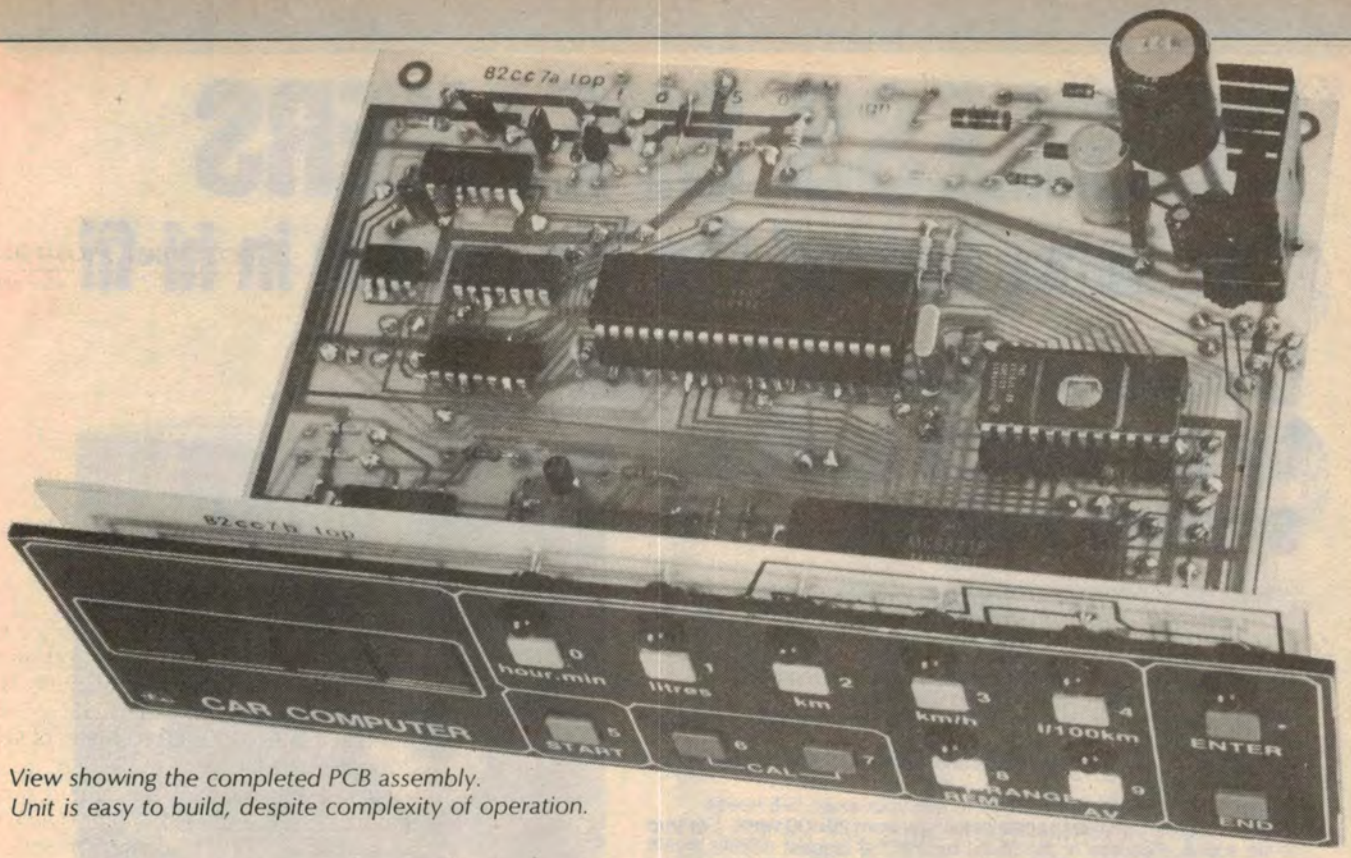
Depending on the type used, the fuel sensor can be one of two forms. One is a miniature turbine with a vane which interrupts a beam of light to a phototransistor. The other type uses a ball running in a circular race to also interrupt a beam of light to a phototransistor.

There are also two types of sensor for distance. One uses a coil placed close to magnets on the spinning driveshaft. The other uses a vane attached to the speedo cable to interrupt a beam of light to a phototransistor.

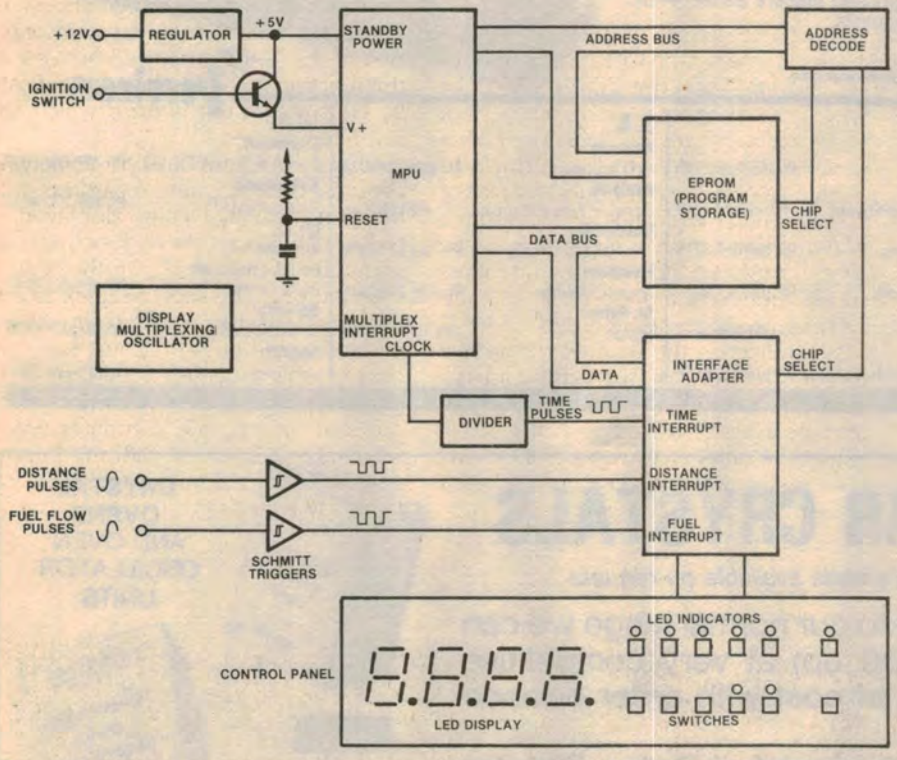
By keeping track of the above three parameters, the Car Computer is able to give readings of 11 separate functions from its four-digit seven-segment display. These are called up by pressing one or two of the 12 colour-keyed buttons and the function being displayed is indicated by LEDs above the buttons which have just been pushed.

All the functions are continually updated by the computer, regardless of the function actually being displayed. In order to display these functions, the computer is initiallised at the start of each journey. This sets the clock to zero. The length of the journey to be taken is entered and if petrol has just been purchased, this is entered in too. If the journey to be taken is identical to the previous journey the computer will be automatically initiated with this information, since its memory circuits are permanently energised.





View showing the completed PCB assembly.
Unit is easy to build, despite complexity of operation.



This block diagram shows the general concept of the Car Computer.

Functions

Twelve separate values can be displayed, as follows:

- hour. min – elapsed time. This is the time in hours and minutes since the start of the journey. The reading is updated every minute and the decimal point after the hours digit flashes at a one second rate.

This is called up by pressing button "0".

- hour. min REM – time remaining. This is the time in hours and minutes which will be required to complete the journey at the present average speed recorded since the start of the journey. Again, the decimal point flashes at a one second rate and the reading is updated with every kilometre covered or every minute. This is called up by pressing buttons "0" and "8".
- litres – fuel used. This is the amount of fuel consumed since the start of the journey. This is displayed in litres with 0.1 litre resolution. The reading is updated for every 0.1 litres of fuel consumed. This is called uyp by pressing button "1".
- litres REM – fuel remaining. This, as you might expect, is the amount of fuel remaining in the tank, not allowing for losses by leakage or evaporation. Again it is displayed in litres with 0.1 litre resolution and updated for every 0.1 litres of fuel consumed. This is called up by pressing buttons "1" and "8".
- litres REM RANGE – capacity of fuel tank in litres. This is called up by pressing buttons "1" and "9".
- km – distance travelled. This is the distance travelled since the "START" button was pressed. This can record a maximum trip length up to 9999 kilometres over a period of several days, weeks or months, as this information is stored whether the ignition is on or not. The reading is updated with every kilometre travelled and is called up by pressing button "2".
- km. REM – distance remaining of journey. Updated every kilometre travelled and called up by pressing buttons "2" and "8".
- km REM RANGE – distance that can

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be travelled in kilometres. This is based on the number of litres left in the fuel tank and on the average fuel consumption since the beginning of the journey. This is updated for every kilometre travelled or for every 0.1 litre of fuel used. Called up by pressing buttons "2" and "9".

- km/h – speed in kilometres per hour. This is updated every one second and is called up by pressing button "3".
- km/h AV – average speed. This is based on the elapsed time of the journey and distance travelled, since pushing the Start button. This is updated every minute or every kilometre travelled.
- l/100km – instantaneous fuel consumption. Gives the fuel consumption for every one or eight-second period, depending on the fuel sensor used. Press button "4".
- l/100km AV – average fuel consumption for journey, based on fuel used so far and distance travelled. Updated every kilometre travelled or 0.1 litres used. Press buttons "4" and "9".

Data entry

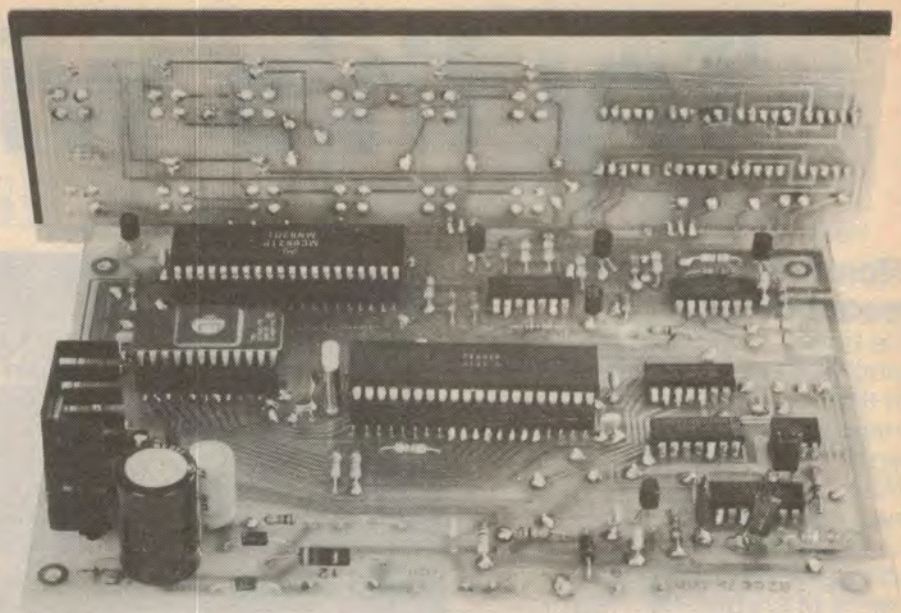
Data is entered into the Car Computer by pushing three buttons, START, ENTER and END. When the START button is pressed the computer displays "rEdY" and zeros the following functions: elapsed time, fuel used and distance travelled. It also enters in the previous journey, ie, km REM.

To change data in the computer, such as the amount of fuel in the tank, the ENTER button is pressed and this changes the function of all buttons (except END) to numerical data entry. The ENTER button itself is the decimal point.

When you have the correct data shown on the display, pushing the END button loads it and reverts all the buttons to their normal functions. If you have made an error in your data values, such as not entering the decimal point for the fuel quantity, the data will not be entered when you press END and the display will show "F. Err" which signifies an error in the fuel quantity. Brilliant, isn't it?

Calibration

Two buttons are provided for calibrating the sensors. Button "6" calibrates the fuel sensor (using the ENTER procedure briefly described above). Here the user enters the manufacturer's stated number of pulses per litre.



All the circuitry is accommodated on two double-sided printed circuit boards which are soldered together at right angles. Apart from connections to the sensors and battery, there is no discrete wiring.

Button "7" calibrates the distance sensor and this is done by trial and error between kilometre posts during an on-road test. Thus the Car Computer is not subject to the vagaries of normal car speedometers. Note though that the Car Computer does not take into account the varying effects of tyre slip – this can only be accounted for by using a fifth wheel.

Presentation

The Car Computer is housed in a compact and smart cabinet which will look well on or in the dash or console of any car. The front panel is black with labelling in white for easy legibility. The LED readouts have integral red filters for ease of visibility in high ambient light.

Inside there is almost no wiring at all with all the circuitry accommodated on two double-sided PC boards. A vertical board accommodates the LED readouts, eight LEDS and 12 pushbuttons while the larger horizontal board accommodates the integrated circuits.

All the connections from the Car Computer to the car battery and external sensors are made via a quickly detachable multi-way plug and socket. In fact, if you were so inclined, it would be possible to transfer the Computer from one vehicle to another, provided each vehicle was fitted with sensors.

Hardware

The total semiconductor complement is really quite small, as can be seen from the accompanying photographs. Apart from the previously noted four LED readouts and eight LEDs, there are three major integrated circuits and six minor, one 5V regulator, seven transistors and four diodes.

The block diagram shows the general concept of the Car Computer. The eight-bit microprocessor is the Motorola 6802 which is a variant of the well-known 6800 which has 72 instructions and six different addressing modes (see the series on "How to Program in Machine Language" beginning March 1982). The 6802 has all the facilities of the 6800 and has a built-in clock and a divide-by-four circuit to allow an external 4MHz clock to be used. In our particular case, the clock runs at 3.579MHz. Also incorporated into the 6802 is 128 bytes of RAM and the first 32 bytes of this memory may be operated in a low power mode to prevent loss of data when normal power is off (power down).

Teamed with the 6802 processor is the 6821 peripheral interface adapter which has two 8-bit bidirectional data buses and four control lines. This device scans the front panel push-buttons and the fuel and distance sensors for input signals and drives the LED readout in multiplex mode.

The machine language program for the Car Computer is stored in a 2716 2048-byte EPROM (Electrically Programmable Read Only Memory).

Next month we shall give the circuit and software description plus details of construction. Don't miss out on your copy of the August issue.