ETI CONCEPT

Robert Stevenson continues his description of the ultimate mains controller.

The construction of the Concept controller was covered last month. In this issue the calibration and operation of the controller will be described.

The Concept's operating system software is held in EPROM on the CPU board (IC3). The EPROM used can be either a 2764 (8K) chip or a 27128 (16K) chip depending on availability. Only just over 7K of the EPROM is used and the hex dump of the used portions is given in Listing 1.

Alternatively, pre-programmed EPROMs and the source and object code on a BBC micro disk are available from the author. See last month's Buylines for details.

Calibration

When the Concept is fully assembled and all the wiring checked carefully, plug in and switch on.

All the display LEDs should light for a second and then the Concept should go into time display mode. As this is the first power-up this should show *00.00*. The centre decimal point should flash at 1Hz and the top left LED should light to indicate time mode.

Press the mode (MDE) key and the Concept should go into cost mode and display *000.0*. Another press puts it into power mode. The display may show a figure now. This is meaningless until the unit is calibrated.

Switch off and connect the 'normal' link on the power board. Switch on again and allow at least a half hour for the unit to 'warm up'. Press the MDE key twice to enter power mode.

With an insulated trimmer tool and some care adjust RV1 to give a reading of *0005* on the display. Now press SET and MDE to initiate the auto-zero routine which takes about ten seconds. The offset value calculated is stored in the battery backed RAM and so this procedure should not need repeating.

Switch off again and change the link to 'calibrate'. After switch-on and warm up, the multi-turn preset RV2 should be adjusted to give a reading of *2450*. The last digit may fluctuate but this is quite normal.

Switch off and return the link connection to the 'normal' position. The Concept is now calibrated and ready for use.

In use, slight drift of the power measurement circuitry can cause a reading of 1W when nothing is even connected to the Concept. This is quite normal and although it can create a cumulative cost error, this is unlikely to exceed ½p a day. If a permanent drift is experienced, the calibration procedure should be repeated.

Certain types of appliance may give unexpectedly low power readings. This is particularly true of TVs and computers which use switch mode power supplies. The Concept measures the in-phase power that the domestic electricity meter counts on. The cost displayed is therefore the cost you pay.

Problems?

If the Concept fails to work first time, try switching it off and then on. If that doesn't solve the problem make another check on the orientation of all the ICs and for broken and shorted tracks on the PCBs.

Using an oscilloscope or logic probe check for address and data bus activity. If this is okay, monitor the 6502 IRQ line (IC1, pin4) for a low pulse every 5ms with a longer pulse every second.

If the CPU appears to be working, check that the relays can be switched on manually. If they cannot, examine the driving circuitry.

If the battery is not fully charged, the RAM can become corrupted causing occasional strange functioning of the Concept. The best cure for this is to switch off and short out the RAM, erasing it totally. Short across pins 12 and 24 of IC10.

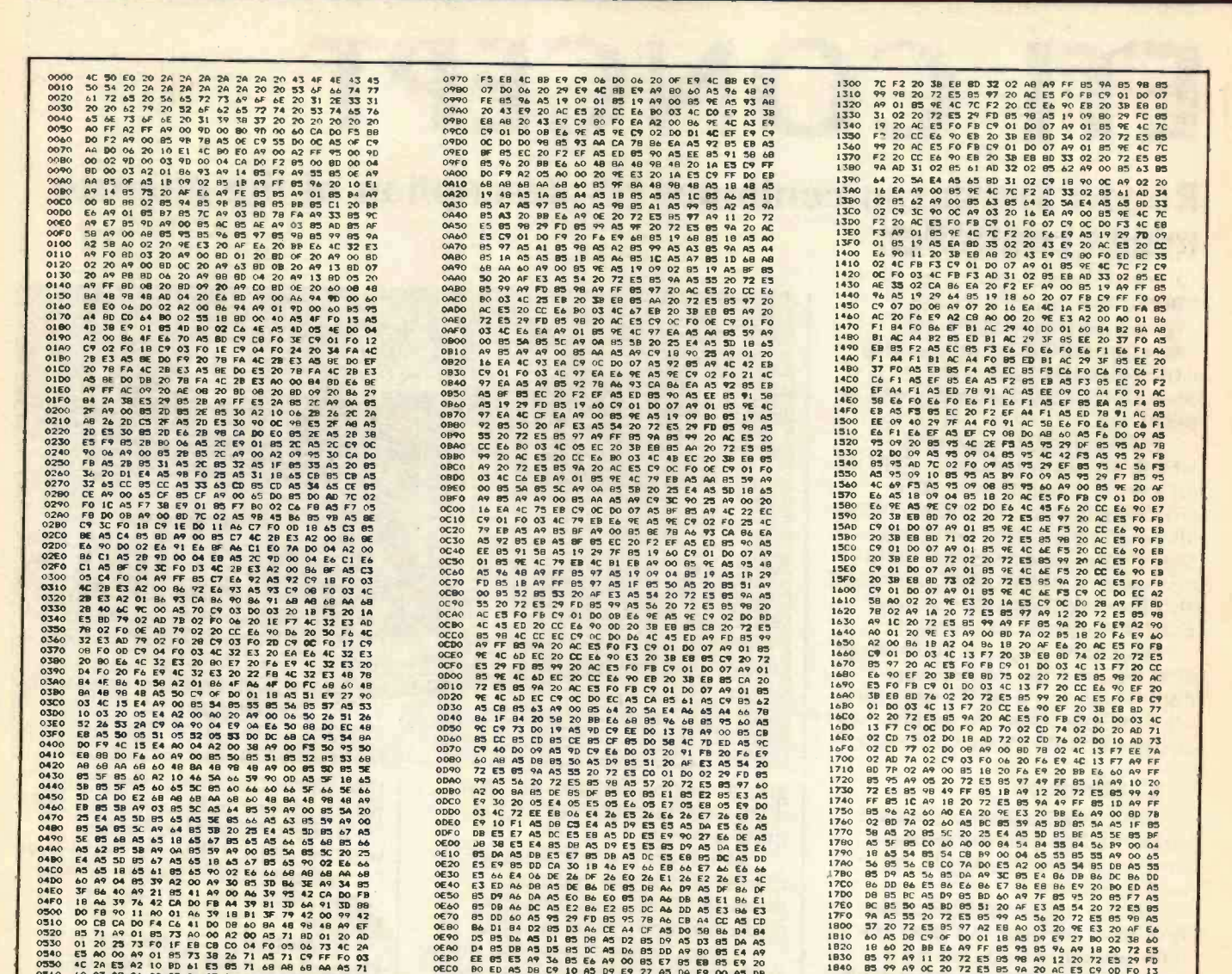
Operation

In general, the Concept is programmed with the sequence SET-function-data-SET. Pressing CE/C will cancel data entry or a selected function. The status LEDs light when a function is operating and flash when data entry is expected.

The time is set by pressing SET and then key 5 (HR). This blanks the hours digits and flashes the hour LED. Type in two digits for the hours in 24 hour format. A further press of SET stores the setting.

The minutes and day are set in the same way using keys 6 (MIN) and 4 (DAY). The day required is entered using the numbers 1 to 7 (Sunday to Saturday).

The mains outputs are turned on manually using the MAN key followed by keys 1 to 4. This toggles the output from its



Listing 1 The used sections of the 2764 EPROM (IC3 on the CPU board).

previous state. All four outputs can be toggled using the key 7 (ALL).

The countdown timer is started with SET—1 (CDN) followed by one of the keys 1 to 4 or 7 to select the output channel. Then enter the delay required (up to 99) followed by SET again to start the countdown.

At the end of the timed period the selected output is toggled. The countdown may be cancelled at anytime by pressing SET—CDN again.

The timer is programmed using the PRG key. Each channel can be programmed with seven separate on/off time program pairs. Select channel one (key 1) and the display will show either *P.1 1* or *u.1. 1.* The letter indicates if that on/off time has been programmed. The first number indicates the channel and the second the on/off time program number (1 to 7). The seven time programs can be selected by further presses of the PRG key. A seventh press exits the programming routine.

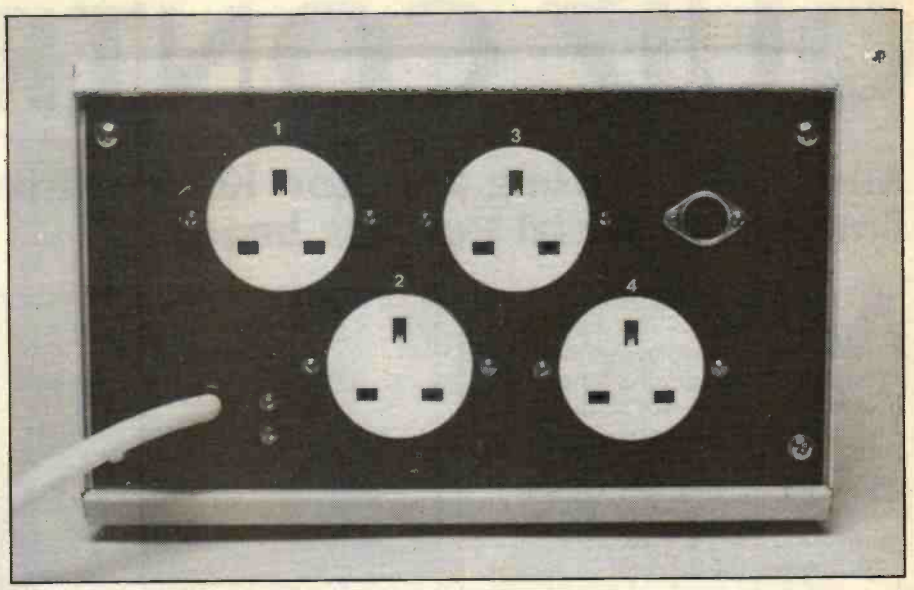
When the required program is selected, SET allows the on/off time to be programmed. The display shows the previously set on time (*00.00* if unprogrammed). A four digit number (hours then minutes) should be entered SET pressed and then the day number followed by SET to store this time. The off time day is then entered in the same way. The display will now show *P.1. 1.* If you are not programming another on/off time you must exit the routine by successive pressing of the SET key and not by using CE/C.

Needless to say, the other channels can be programmed by selecting the relevant channel number at the start of the procedure.

To set the same on/off time for each day of the week, program the first time program with the required times (the day is unimportant), exit the routine in the normal way and enter SET—0 (ED) followed by the channel number. This copies the set times into each time program for each day of the week.

Entering SET—9 (CAP) and then a channel number clears all the time programs assigned to that channel.

The output channels can also be turned off by external trigger signals applied to the DIN socket. The signal should be from a TTL type circuit with open collector



outputs. A logic low on the inputs will turn off an output and prevent it from coming on if a programmed on-time occurs.

The external controls are ignored by default and should be enabled first by entering SET—MAN (C-SW). The C.SW LED lights when the conditional switching is enabled.

The Concept's real time clock will run slightly slow. This can be compensated for by the software. The trim factor is entered after pressing SET—3 (TRM). The number entered should be between 0 and 999 and represents the number of $\frac{1}{100}$s to add every hour.

By carefully monitoring the Concept's timekeeping and adjusting the trim factor accordingly, an accuracy of better than five seconds a week can be achieved.

Cost Power

The Concept can display both the instantaneous power drawn by the outputs and the cumulative cost. Pressing the MDE key switches the display between the three modes of time, power and cost.

The cumulative cost is zeroed by entering SET—MDE (RST) when the display is showing the cost.

The rate at which the power is 'charged' is set by entering SET—8 (RTE). The cost in pence per kWhr is then entered as three digits up to a maximum of 99.9p.

The projected cost per day or per week can also be displayed. Entering PROJ.COST—4 and PROJ.COST—2 displays the cost per day and week, respectively, based on the instantaneous power consumption. PROJ.COST—3 and PROJ.COST—1 display the daily and weekly cost based on the power consumed during the past hour. PROJ.COST—7 displays the average power over the past hour.

The last function of the Concept is the software lock. The keypad of the Concept can be disabled to prevent unauthorised use. When locked, the MAN, PRG, MDE and PROJ.COST keys cannot then be used. Press SET—2 (LCK), enter a four digit number and remember it! The SET key should then be pressed and held for four seconds until the display shows Loc. The lock can be used in any of the three modes — time, power or cost.

To unlock the Concept simply enter the four digits and press SET. After three failed attempts at entering the code, the Concept displays *STOP* and totally locks up for five minutes. If the power is removed during this period, the lock-up period starts again on power-up.

The Concept software also includes extensive error coding. If an invalid input is entered the display shows *Err.* followed by a number identifying the error. The error display can be cleared by pressing C/CE. The error codes are as follows:

0 time minutes > 59
1 time hours > 23
2 timer hours > 23
3 timer minutes > 59
4 countdown = 0
5 CAP with all channels selected
6 PRG with all channels selected
7 ED with all channels selected
8 overflow on projected cost
9 overflow on compensation (requires re-adjustment)

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