elektor

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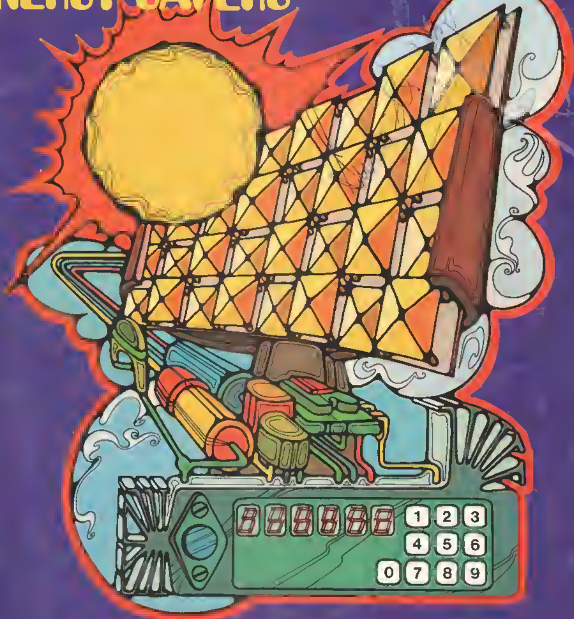
up-to-date electronics for lab and leisure

ENERGY SAVERS



m.p.g. meter
improved central heating
draught detector
petrol saver

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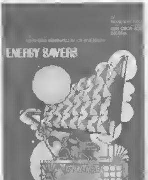

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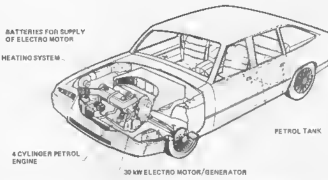


Car with hybrid drive

A team of leading automotive and technology firms from the U.S., West Germany, and Japan is currently producing two advanced 'hybrid' automobiles for the U.S. Department of Energy (DOE).

The experimental vehicles will have both a gasoline engine and an electric motor under the bonnet. They will run part of the time on gasoline, part of the time on batteries, and — when needed — on both simultaneously.

This is part of an overall DOE programme aimed at stimulating commercialisation of electric and hybrid vehicles as a means of reducing U.S. petroleum consumption. The hybrid design, for example, is expected to consume from 40% to 55% less petroleum than a conventional car of similar size over an 11,000-mile annual driving mission.

General Electric will provide expertise on the electric propulsion motor, the electronic controls for the motor, and the microcomputer controls for the entire hybrid system. Last year, the company delivered to DOE the Electric Test Vehicle-1, the nation's most advanced experimental electric vehicle.

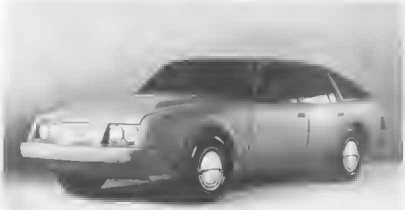
Major subcontractors to GE in the hybrid vehicle project are the Research Division of Volkswagenwerk AG, Wolfsburg, West Germany, which will design and build the specially modified gasoline engine; Globe-Union Inc., Milwaukee, Wiscousin, which will develop the advanced 12-volt lead-acid batteries that will power the electric motor; and Triad Services, Inc., Michigan, which will design and fabricate the body and chassis.

These companies worked together previously, in similar roles, in developing the ETV-1, as well as the GE-100 — an electric test car built from one-the-shelf components.

Daihatsu Motor Co. Ltd., Japan's leading manufacturer of battery-powered vehicles, will serve as a consultant on the project. The Osaka-based company has built more than 4,000 electric and hybrid vehicles since 1965.

Thanks to its dual drive system, the hybrid automobile is a promising approach to helping the U.S. meet its transportation requirements in the potentially fuel-short years that lie ahead. The hybrid car is designed to minimise trips to the gas station and maximise the use of the wall plug for the typical American driver. Its major advantage is that it burns less gasoline than conventional cars, but offers a much greater range then all-electric vehicles.

The hybrid's electric motor and gasoline engine will operate separately or in parallel. The electric motor will primarily be used for speeds from zero to 30 mph and the gasoline engine for most highway driving. In situations where both the electric motor and the gasoline engine are needed, such as in overtaking, the load will automatically be shared. A microcomputer will control overall vehicle operation.



The baseline vehicle selected by GE for this project is a mid-size, four-door car. It will utilise front-wheel drive, with the internal combustion engine and electric motor mounted longitudinally under the bonnet. The complete power train, including batteries, will all be located in front of the forward bulkhead. In addition, the vehicle's exterior will be redesigned for improved aerodynamics.

Curb weight of the car is estimated to be about 3,950 pounds. The vehicle will be equiped with an automatic three-speed transmission. The car's ten batteries will have a total weight of 770 pounds, and will have a life expectancy of approximately 800 recharge cycles. The battery pack may be recharged by regenerative braking, by the gasoline engine when it is in operation, and by wall-plug electricity.

Although the hybrid will weigh about 800 pounds more than its conventional counterpart, its dual propulsion system will require 5% less total energy.

It is estimated that the experimental hybrid auto will accelerate from zero to 50 mph in 12 seconds and will look, perform, and handle like conventional vehicles that will be marketed in the mid-1980s. Its design is planned to be suitable for mass production in the mid-1980s at a consumer price of about $ 7,600 (1978 dollars).

Although no plans at this time exist to manufacture or market electric or hybrid vehicles, long-range opportunities to supply components for the emerging electric and hybrid-vehicle market are foreseen.

A report by General Electric, Schenectady, N.Y.

(565 S)

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Electronics in Livingston

Recent major developments by electronics companies in Livingston have emphasised the town's leading role in this industry in Scotland and given the town a firm base to face the future and encourage the development of further high-technology industries.

Throughout this year, electronics firms have shown by their development programmes that Livingston is an ideal location for their operations — be they manufacturing, research and development, or sales.

Two American-owned companies, Burroughs Machines Ltd and MFE Ltd have moved over the summer period into purpose-built manufacturing plants on Kirkton Campus, a special industrial area of 80 hecteres which Livingston Development Corporation set up for companies with a high research or technological content in their operations and with the need to have close liaison with universities.

A third American company, Guardian Electric of Chicago, have established their European sales and marketing headquarters in an office block in the town.

The Burroughs factory, on a 5½ hecteres site, manufactures data processing equipment for the banking industry and is building up its workforce in the 8,350 square metres factory to around 200 people — many of them university graduates and highly skilled workers.

On a neerby site, MFE Ltd have moved into a 2,270 square metres factory — their first manufacturing plant outside North America They employ around 60 people and aim to increase this to 240 by the end of the next five years.

At Livingston they manufacture and market computer peripheral devices, including the high technology floppy disk drive. The success at Guardian Electric Sales and Marketting Co. Ltd., has exceeded the company's expectations since they moved into Peel House, Ladywell, in March.

Another well-known name to opt for Livingston when looking for a location for a research establishment was Ferranti, who announced earlier this year that they would move their computer graphics design facility from Edinburgh to an advance factory on Brucefield Industrial Park, Livingston.

The great majority of new companies moving to the town in both the industrial and commercial spheres originate from outside Scotland, attracted by Livingston's attractive amenities, its superb links with airports, container ports, railheads and motorways.

The hard commercial facts are that Livingston is demonstrably the main industrial growth point in Central Scotland, with easy access to deep water port and container facilities at Leith, Grangemouth and the Clyde ports, end major freight terminals at Edinburgh, 24 kilometres east, and Glasgow 48 kilometres west. Edinburgh Airport is only 15 minutes away by road, and every UK international airport is within 60 minutes flying time. These, in addition to Livingston's situation on the M8 Motorway, are powerful factors in favour of Livingston as a new location for an industry contemplating a move to Scotland.

Of the 145 companies already established in Livingston, more than 20 are involved in the electronics industry.

The town's popularity with the electronics industry was explained by Mr I.B. Alexander, engineering director of Merconi Communications Systems Ltd., who relocated a research and development facility in Livingston et the end of 1977.

Livingston he said, was ideally situated near Scotland's major universities, and the company had found that there were a lot of graduates emigrating from Scotland. A lot of companies coming to Scotland were not giving the right type of work for these graduates and there was a need to provide an outlet.

Marconi wanted an operations base in central belt of Scotland and Livingston's ideal position gave it a very important advantage.

Livingston is within easy reach of seven of Scotlend's universities. It has particularly close links with Heriot Watt University, which is less than ten minutes away by car. Also in close association is the Science Faculty of Edinburgh University.

University/industry liaison is also maintained with Strathclyde University, Glasgow, which has established a Centre for Industrial Innovation.

(572 S)

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New computing centre at Bristol

Since the beginning of the year a new £2 million computing centre housed in a purpose-built building has been in operation at British Aerospace Dynamics Group Bristol Division.

The main function of the centre is to provide a real-time computing service to scientists and engineers engaged in the design and development of guideweapon and space engineering systems.

The computer is an IBM 3031 with a 4Mb mainstore. Also included in the installation are eight IBM 3350 fixed disc drives and six IBM 3330 demountable drives giving a total on-line storage capacity of 3,736 Mb; plus four magnetic-tape drives, a card reader/punch, two line printers and an IBM 3705 communications controller to which are linked two remote batch terminals and 40 individual input/output terminals.

The Bristol computer is connected via two 9600 band channels to another British Aerospace Dynamics Group computer — an IBM 370-158 AP (shortly to be replaced by an IBM 3033) — situated at Stevenage which primarily performs commercial tasks with peripheral units of the Bristol installation being used for data input and output. In addition, the Bristol Division's remote batch terminals can be switched over two more channels to connect with another Dynamics Group computer (an IBM 370-158) for engineering and scientific work.

The Bristol centre is operated by the 69-member staff of the Management Services Department as a general service to the British Aerospace Dynamics Group Bristol Division, computing time being logged and charged to the user departments. The key to the operation of the Bristol centre is the 40 individual input/output terminals which are distributed thoughout the many sites the Division has in the Bristol area. Each input/output terminal consists of a visual display unit (VDU) with an associated keyboard. With the aid of such a terminal a scientist or engineer can develop and run his own programs in real-time calling up information or other set programs held in the computer's store files when needed, as though he were the sole user of the computer system. The computer is under the general control of MVS/SE (Multiple Virtual Storage/System Extensions) and the operation of the VDU terminals is organised by the VSPC system (Virtual Storage Personal Computer). Fortran, in its various dialects, is the language used for scientific and engineering applications, commercial programs are written in Cobol.

Nine Redifon Seecheck terminels linked to a 5 Mb fixed-disc store are employed for input data preparation. Verified data is transcribed from the disc store to magnetic tape for entry to the computer. Input data for commercial programs is mainly prepared this way. The smaller volumes of input data required for technical programs, or amendments, are usuelly presented on punched cards prepared by the individual users.

To avoid the need for engineering users having to queue it has been found that utilization should not exceed 12 hours per terminal per week. At present about 250 Bristol engineering staff are authorised to operate the terminals but this number is increasing rapidly as engineers gain experience in computer usage.

To increase the Division's overall data processing capability the possibility of linking other calculating devicas to the central computing installation is being investigated whereby the centre would provide the needed back-up capacity to ancilliary units in danger of becoming overloaded. Such ancilliary units would be programmable calculators and minicomputers dedicated to particular tasks, such as recording data of structural tests etc.

A scientific computing service based on tha Stevenage machines has always been available to the Bristol engineering staff and over the last three years the demand for such services has increased at en annual rata of 25%. This was the reason the new computing centre was established at Bristol and the initial experience is that this growth rate will continue, necessitating the addition of an extra 2 Mb of main store and at least another 10 terminals to the installation by 1981.

In addition to VSPC, terminals can operate with TSO (Time Sharing Option) which makes greater demands upon computing time. A VSPC user utilises about 1% of the existing computing capacity whereas for a TSO user the figure is nearer 4%. On this basis it is estimated that by strictly limiting the number of TSO terminal users, as many as 60 VSPC terminals could be supported by the existing installation.

Nowadays the computer is an essential tool of scientists and engineers engaged on advanced technological projects whether they are concerned with defence or space. The reason is that the costs involved and the time-scale in which projects have to be completed place increased emphasis on the engineering solutions being right first time.

The traditional engineering technique of building a prototype which is extensively tested and modified before the first production model is built is no longer acceptabla — this process is too slow and too expensive. Hence more detailed theoretical calculations have to be performed simulating the actual response to the expacted from the structure, equipment or systam being designed, in all possible operational situations long before the decision to build is taken.

A computer is the only means by which data covering all aspects of a design can be derived for the worth of a particular solution to be evaluated in the time allowed for the project. A typical example of the type of problem that needs to be investigated in this manner could be assess flexural modes and structural integrity resulting from differential heating by the sun of a proposed space structure exposed at varying attitudes to the sun. Accurate knowledge of these effects is particularly important since only one or two units will be built, therefore the margin for error is extremely small.

British Aerospace Dynamics Group Bristol Division is primarily concerned with the design and development of naval guided weapon systems (Seawolf and Sea Dart) and scientific space satellites and equipment including solar power arrays, attitude and orbit control systems, a range of HF antennas for aircraft and military vehicles.

(579 S)

Digital signal processor chips spur SP market growth

Stimulated by strong military spending on radar and sonor signal processing, the development of ultra-high-speed signal processing chips will accelerate in the 1980's, according to a new 141-page report from International Resource Development Inc The IRD report predicts 'major' technological fallout in the commercial-electronics market, particularly in medical, telecommunications and automotive applications. A doubling of the signal processing market (currently $1 billion) is expeeted within three years.

Rapid progress in array processors, charge devices, surfaca acoustic wava gear

Array processors are now being made for 'front-end' processing of signals which are destined for later processing in digital computers, according to the IRD report, which points to the recent link between Computer Signal Processor and Systems Egineering Laboratories in the marketing of a powerful combined signal-processing/data-processing system. But tha fastest progress in signal processing technology is probably occurring in the area of Charge Coupled Devices (particulerly CCD transversal filters) and in tha development of Surface Acoustic Wave (SAW) devices. And although the work being done on electronic countermeasuras is 'hush-hush', the IRD researchers believe that the military signal processing know-how is trickling down very rapidly into the commercial sector of the electronics market.

Major commercial applications in medicina, telecoms, automobiles

Signal processing technology has played a critical role in the development of Computerized Axial Tomography (CAT) scanners, and is now contributing to the rapid growth of ultrasound and infrared medical imaging equipment markets, says the IRD report. Digitization of speech, store-and-forward voice switching and other important telecommunications applications have also resulted from the continuing fallout of military signal processing know-how. One of the major commercial applications of signal processing technology in tha 1980's will be the use of LSI chips as part of on-board automotive electronics systems, whare fuel consumption and exhaust emissions are continuously monitored. Some of the signal processing techniques used in this application are diract offshoots of military SP technology.

Countarmeasures, sonar, 'smart' weapons to paca military SP market

The continuing race to develop electronic equipment capable of fooling enemy radar and weapons guidance devices has acted as a major stimulant to the signal processing market during the past twenty years, according to the IRD report, and has resulted in the production of low-cost, ultra-fast LSI signal-processing chips, which are key components in 'black box' devices. These 'black boxes', produced by such companies as Loral and E-Systems, have become essential to modern warfare, and future advances in the detection of submarines and in 'smart' weapons will be largely dependent upon the U.S. semiconductor equipment manufacturers' ability to stay ahead of Russian signal processing technology.

The IRD report identifies more than one hundred U.S. companies active in the market for signal processing components or systems. Technological leaders, according to IRD, include E-Systems, Time & Space Processing, Bell Labs, Loral and Bendix. Several semiconductor suppliers, including Advanced Micro Devices, Intel, National Semiconductor, Signetics, Standard Microsystems and Zilog, are also identified as being very active in the development of new-ganeration signal processing chips.

International Resource Development Inc. is an independent consulting firm which, since 1971, has been publishing research reports covering developments in the computer and telecommunications fields. IRD has also undertaken custom consulting studies for many high-technology firms, including Texas Instruments, Rockwell International, IBM and Xerox.

(573 S)

an R.P.M. indicator as an economy guide.

fuel economiser

A car engine is at its most efficient when the amount of energy it produces is closest to the amount consumed. This occurs at an engine speed that produces the maximum torque output. Outside of this quite small speed range energy is wasted. The fuel economiser provides both an optical and an acoustical guide to enable the driver to change gear at the optimum time and thereby keep the engine within its most efficient range.

Although an r.p.m. counter is a useful instrument, it is not vary helpful in terms of saving patrol. If it was to be used for this purpose it would have to be watched far too carefully to ba effective and this would be too demanding on the driver. The circuit described hera does not provide a complete r.p.m. indication but rather an indication of when to changa gear in order to keep the engina speed at its most afficiant. It also gives a warning when the maximum engina speed is approached and would therefore ba of use to drivars of high parformance cars as well.

The circuit has been designed to damand as little attention as possibla from tha driver. As well as giving a visual indication in the form of coloured LED's, it is able to produce an audible indication of the correct gear chance times.

How an r.p.m. counter can help save fuel.

It is often underestimated how much a person's driving style will affect fuel consumption. Figure 1 shows the factors which are involved. The consumption of a car without any technical defects has been set at 100%. The 'axtra's' piled onto that block should be avoided, and it is the 'driving style' section which depends exclusively on the driver.

As far as driving economically is concerned, this is easier said than done. Usually, we drive 'by ear' which is not always an objective mehtod. An r.p.m. countar is highly objective and can help break some bad habits.

The amount of anergy consumed by tha engine is largely depandent on the angine speed and the torque. Figure 2 shows the torque/revs curva of a typical engine with the energy consumption as a function of tha r.p.m. The engine will produce the maximum amount of torque at a certain number of ravs. (The exact amount will of course dapand on the angina). At this speed, the angine will be running at its highest efficiency. When engine speed is incraased significantly above this figure however, much mora fual will be consumed, with a prograssive decrease in actual power output per 100 r.p.m. From the graph tha following guidelinas for an economical driving style mey be deduced:

When accalarating (particularly in town traffic) the engine speed in every geer should reach the point at which the maximum torque occurs. As soon as this speed is exceeded, the driver should change gear.

- When accelerating depress the accalerator smoothly and not too quickly.
- The key to success is to accelerate smoothly and change gear on tima.

When the car is not accelerating, it will be apparent that the higher tha gear, the lower the fuel consumption. (For in a high gear the numbar of revs will be lower and as figure 2 shows, fuel consumption is et a minimum at low engina spaeds).

The number of revs should not exceed the level at which the maximum amount of torqua is produced. Unfortunately, prevailing these measures will be affected by traffic conditions. However, any attempt at saving fuel and whanever possible must be better than no attempt at all. This is where the Fual Economiser bacomes realy effective.

Which r.p.m. counter?

Of course any r.p.m. counter can be used to save anergy. Unfortunataly, es mentioned previously, the 'ordinary' type using a dial or, even worse, a digital display demand too much of the driver's attention. An r.p.m. counter which is meant to save fuel should only provide relevant information when required and not in such a way that the driver is distracted. It is better for it to indicate renges rather than exact values. In the Fuel Economiser these are indicated by LED's in the following manner;

yellow. engine speed lower than at maximum torque
green: engine speed about right for maximum torque
red: engine speed higher than maximum torque

1

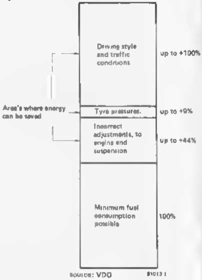

Figure 1. People underestimete how much their driving style can effect the fuel consumption. Even so, this hes been known to differ by 100%.

2

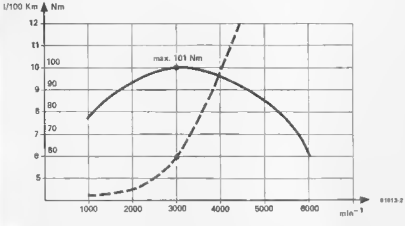

Figure 2. Consumption and torque as a function of the number of revs.

3

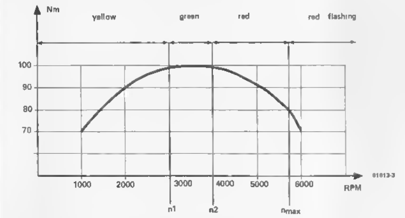

Figure 3. The fuel economiser does not indicate the exact number of revs, but gives a general idea of whether they are too low, too high or just right.

4

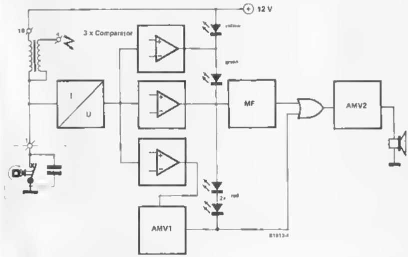

Figure 4. The block diagram.

red flashing: maximum permisible engine speed reached

Figure 3 shows how the display works in relation to the torque/rev curve. Three LED's are sufficient. An extra acoustic signal means you don't have to keep your eye on the LED's continuously. A short tone signals the transition from the green to the red range and indicates it is time to change gear. When the maximum number of revs is exceeded an intermittent warning note will be produced.

The fuel economiser itself:

The block diagram shows a frequency-to-voltage converter at the input to convert the contact breaker frequency into a linear, proportional DC voltage level. This is fed to three comparators which are used to switch the corresponding LED on when the measured engine speed complies with the preset threshold value. When the light switches from green to red, the monoflop MF sends a pulse to the tone oscillator AMV2, which then produces an acoustic signal with the aid of a loudspeaker.

When the threshold value for the maximum number of revs is reached AMV1 is triggered and produces the flashing frequency for the red LED. At the same time this signal is used to switch the output of the tone oscillator via an OR gate.

As can be seen in the circuit diagram (figure 5), the frequency-to-voltage converter is a fairly simple circuit. Transistor T1 acts as a pulse shaper and IC1 is a 555 timer IC in a monoflop configuration. By integrating its output with the two RC networks R7/C6 and R8/C7, a DC voltage level that is proportional to the pulse frequency is obtained. This DC level will arrive at the non-inverting inputs of op-amps A1 . . . A3. These three op-amps are used as comparators and are, together with A4, combined in a single LM 324 IC. The voltages to be compared are adjustable with preset potentiometers P2 . . . P4. Until one of the threshold values is reached, (the number of revs being below the economical value) the outputs of the three comparators will be low. In this condition the yellow LED D7 will light and the others will remain unlit.

When the first threshold is reached (lowest limit of the maximum torque range) the output of A1 will be at the positive supply voltage (about 12 V); causing the green LED (D8) to light and D7 to go out. At the second threshold A2 will switch, the green LED will go out and the red LED's D9 and D10 indicate that the torque output is falling. The positive edge of this signal triggers the tone oscillator. Integration through C11 and R19 causes a tone with a descending pitch to be produced. This is to advise the driver to change to a higher gear.

5

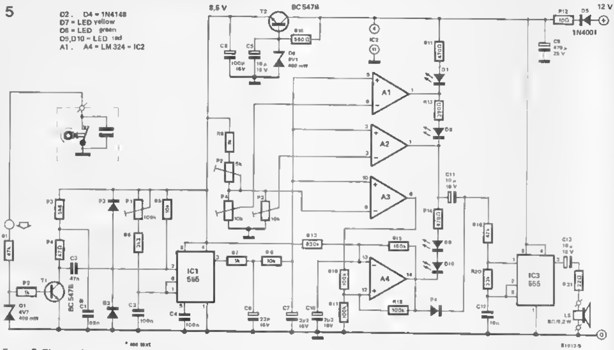

Figure 5. The circuit.

When the engine speed reaches the value set by P2, comparator A3 will switch on the astable multivibrator A4. This will cause the red LED's D9 and D10 to flash once every second and modulates the tone oscillator IC3 via D4 to give an intermittent warning signal. IC3 controls an 8 Ω/0.2 W loudspeaker. If a greater volume is required, a piezo tweeter can be used instead. If the volume is too loud, R21 can be increased.

To enable the fuel economiser to work efficiently in the car a voltage stabiliser is needed and this consists of zener diode D6 and transistor T2. Diode D11, resistor R12 and capacitor C5 serve to suppress transients.

Construction and setting up

Thanks to the printed circuit board shown in figure 6, construction should pose no problems. It is advisable to use sockets for the three IC's. It is also an advantage to use tantalum electrolytical capacitors for C7, C10 and if possible for C14 and C11 too.

Setting up requires a multimater, a small transformer and a bridge rectifier. In addition, the following engine data should be obtained:

1. The highest acceptable engine speed in r.p.m. (n_{max}). This can usually be found in the car manual but if in doubt, 5,500 r.p.m. will be close enough. To save the engine a slightly lower figure should be taken, say about 5,250.
2. The lowest (n1) and highest (n2) limits of engine speed are derived from the engine torque/rev curve (see figure 3). If this is not given in the manual, you should ask your car dealer.
3. The number of revs at a contact breaker frequency of 100 Hz.

The following ratio exists between frequency f (Hz), number of revs $n\,(\frac{1}{min})$ and the number of cylinders Z:

$f = \frac{n \cdot Z}{120}$ (for 4-stroke engines) and

$f = \frac{n \cdot Z}{60}$ (for 2-stroke engines).

From this it follows that for 100 Hz in a 4-cycle engine $n_{100\,Hz} = \frac{12000}{Z}$ is required.

Once these r.p.m. values have been calculated, the voltage value can be preset for n_{max} at 5 V with P2 measured either at the rotor or at pin 9 of IC2). The following voltage for n2 is then preset at the rotor of P3:

$$U_{P_3} = 5\,V \cdot \frac{n2}{n_{max}}$$

Analoguous to this tha voltage for n1 is preset at the wiper of P3:

$$U_{P_4} = 5\,V \cdot \frac{n1}{n_{max}}$$

Finally, the frequency-to-voltage converter will have to be adjusted to tha engine's r.p.m. For this the 100 Hz generator (figure 7) is connected to tha rev counter and P1 is set so that tha following DC level is measured at capacitor C7:

$$U_{C_7} = \frac{n_{100\,Hz}}{n_{max}}$$

The value of C1 is calculated for the maximum revs per minute (4 cylinder 4-stroke).

That covers regulation. Now for a practical example.

Engine data: 4 cylinder 4-stroke, maximum torque 101 Nm at 3800 - 4600 r.p.m., maximum power at 5800 r.p.m. and maximum r.p.m. 6600. Since the greatest power is already reached at 5800 revs, the maximum number of revs (5 V at P2) is set at 6000 r.p.m. Therefore U_{P3} should have a voltage of 3.8 V and U_{P4} 3.1 V. With 100 Hz at the input P1 is adjusted to a voltage of 2.5 V across C7.

Hints for building the circuit into the car

The circuit can be mounted in a standard plastic or aluminium case. The connection of the positive supply voltage is made at a convenient point on the ignition switch or the fuse box. The negative supply voltage (ground) is connected to the closest earth point (in cars with the negative of the battery to earth). The input of the circuit will be connected to the contact breaker side of the coil.

In cars where the connecting pins are according to the DIN 72552 standards, the positive supply voltage is derived from pin 15, the earth from pin 31 and the contact breaker from pin 1.

To avoid interference from radio, the connection between the contact breaker and the rev counter should be laid close to metal parts of the bodywork. Even better would be to use a cable with an earth shield. Make sure that the wiring does not touch any 'hot parts' of the engine.

If after fitting the display should 'jump' and the circuit shows a false alarm once or twice, the value of R1 may be

6

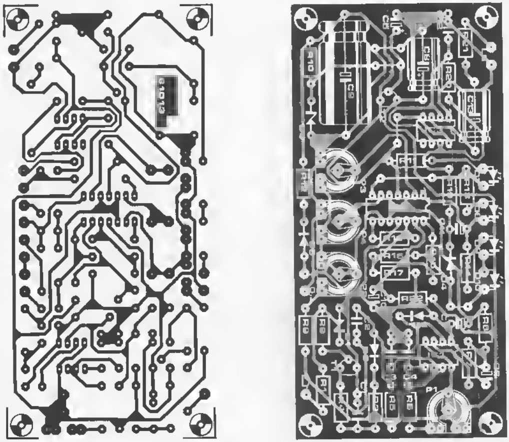

Figure 6. The component layout of the printed circuit board.

Parts list

Resistors:
R1,R19 = 47 k
R2,R7,R9 = 1 k
R3 = 5k6
R4 = 47 Ω
R5,R8 = 10 k
R6 = 3k3
R10 = 560 Ω
R11,R14 = 470 Ω
R12 = 10 Ω
R13 = 390 Ω
R14 = 470 Ω
R15,R16,R17,R18 = 100 k
R20 = 33 k
R21 = 22 Ω
R22 = 820 k
P1 = 100 k preset
P2 = 5 k preset
P3,P4 = 10 k preset

Capacitors:
C1 = 68 n
C2 = 47 n
C3,C4 = 100 n
C5,C11,C13 = 10 μ/16 V
C6 = 22 μ/16 V
C7,C10 = 2μ2/16 V
C8 = 100 μ/16 V
C9 = 470 μ/25 V
C12 = 10 n

Semiconductors:
T1,T2 = BC 547B
IC1,IC3 = 555
IC2 = LM 324, CA 324
D1 = zener diode 4V7/400 mW
D2,D3,D4 = 1N4148
D5 = 1N4001
D6 = zener diode 9V1/400 mW
D7 = LED yellow
D8 = LED green
D9,D10 = LED red

Loudspeaker:
LS = 8 Ω/0,2 W

lowered to a minimum of 4k7. It is also possible that P1 is incorrectly preset and so has to be readjusted.

Guarantee for economy

It is difficult to determine how much fuel an economiser circuit could save, because the consumption does not depend on the circuit, but on the driver. The circuit will merely give a helping hand. If the driver is prepared to be 'advised' then some reduction in consumption is bound to be achieved. Naturally, a driver who is converted from a 'quick-off-the-mark' speeder to an energy-heeder will save a great deal more than someone who drives economically anyway. In any case, much more will be saved in town traffic than on the motorway.

One guarantee can be given for certain and that is that it is considerably cheaper to use a fuel economiser than the 'on-board computer' with which cars are likely to be equipped in the near future and which serves exactly the same purpose.

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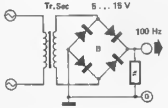

Figure 7. A very simple '100 Hz generator'.

sources:
Dr. E. Spoerer, W. Thieme,
'The technique to drive economically'
VDO Vertriebsgesellschaft mbH,
Postfach 2220,
6232 Bad Soden 2.
Elektor no. 17 (September 1976),
'Rev counter'.

draught detector

However well insulated you think your house is, there are bound to be a few nooks and crannies which will allow interior heat to escape. Once they are found they can be dealt with quite easily — it is the act of locating them that is the major cause of headaches! With the aid of this electronic draught detector you can easily trace the source of your stiff neck and keep the house warm.

There are many elementary ways of checking for draughts in a house. You can, for instance, moisten a finger and hold it up in the air to see from which direction the wind is blowing. Another method is to wander around with a burning match or candle, but this seems to attract gas leaks (in which case your worries are over) and nasty grease marks on the carpet. A much simpler solution is to use the electronic draught detector described here.
By mounting the sensor on the end of a long probe, no draught will be able to escape undetected.

The principle

The circuit is based upon a very simple principle: when an object is warmer than the surrounding air, it will dissipate heat, especially if the air is moving. The temperature of the air is raised causing it to move away and be replaced by cooler air. If the temperature difference between the outgoing and the incoming air is great enough, the object will be cooled rapidly. This is in fact why we are able to 'feel' a draught on small areas of our bodies.
It follows then that a draught may be detected electronically by measuring the cooling rate of a semi-conductor. The forward voltage of a semi-conductor diode is temperature dependent (2 mV/°C). If the forward voltage of a diode in an open air current is compared to that of a reference diode at ambient temperature an indication of the location and intensity of the draught may be obtained.

The design

How the principle is put into practice in the form of a circuit is shown in the diagram of figure 1. Transistor T2 is connected as a diode and acts as the sensor. Since the sensor must be warmer than the air around it, T1 has been added as a form of 'haater'. These two transistors are literally 'glued' to each other. As T1 has a continuous current flowing through it, it will tend to warm up T2. Transistor T3 is also used as a diode, but it will be at ambient temperature, that is the average room temperature. The output voltages from T2 and T3 are fed to the non-inverting and inverting inputs respectively of an opamp (IC1). This opamp, and its associated components, is preset for a gain of 1000.
The output of IC1 provides a base drive current for the heating transistor, T1, via resistor R1. This effectively heats up T2 indirectly. There will then be a slight difference in voltage at the two inputs of IC1 (since T3 is not heated). A high sensitivity is obtained by making the temperature of T2 about five degrees higher than its surroundings. This is

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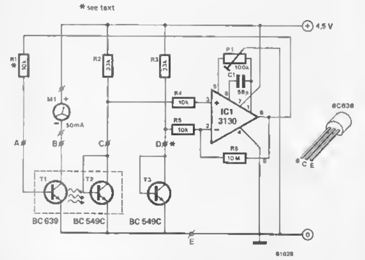

Figure 1. The complete circuit diagram of the draught detector.

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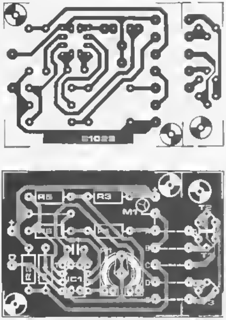
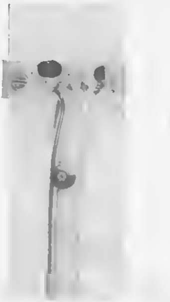


Figure 2. The component overlay and track pattern of the printed circuit board for the draught detector. The three transistors can be mounted on a suitable probe.



Parts list

Resistors.
R1,R4,R5 = 10 k
R2,R3 = 33 k
R6 = 10 M
P1 = 100 k preset potentiometer

Capacitors:
C1 = 56 p

Semiconductors
T1 = BC 639 (BC 547 can be used, but its connections differ from those on the board)
T2,T3 = BC 549C
IC1 = 3130

achieved by presetting the meter to give an offset of about 5 mA by means of P1.
When the sensor is placed in a cold current of air the temperature of T2 will drop. Its output voltage will then rise by 2 mV/°C. The voltage difference at the inputs of IC1 will increase causing its output voltage to rise as well. As a result, the collector current of T1 increases and more heat is generated by this transistor until a new balance is obtained. The meter indicates the increase in collector current and therefore the intensity of the draught.
The value of R1 should be chosen so that the collector current of T1 is not excessive. This is important both for the instrument and for T1!

Construction

All the components (except for T1, T2 and T3) are mounted on the printed circuit board shown in figure 2. Both the meter and the completed board can be installed in the same (small) case. Transistors T1 . . . T3 are fitted in a sort of probe, a length of tubing (see photo) would be ideal. The two transistors, T1 and T2, are coupled by gluing their flat surfaces together with a heat conducting adhesive.
If the finished circuit tends to oscillate, the value of R5 may be increased. Two 4½ volt batteries, connected in parallel, are all that is required for the power supply.
The sensitivity of the unit may be increased (if required) in two ways: firstly by presetting the quiescent current to a higher value, thereby increasing the temperature of T1/T2. Secondly by enlarging the cooling surface area, for instance by inserting a metal strip between the two transistors.
A little experimenting is all that is needed now to prove how useful the draught detector can be . . . according to our chief draughtsman! ■

how to recycle dry cell batteries

facts and figures about a controversial subject

'Reviving dry cell batteries' is a topic which often comes up in electronics magazines and professional 'shop-talk'. Remarkably perhaps, so little is known about the subject that it seems to give rise to nothing but speculation. On the basis of our experience with batteries, we will try to establish a few facts to solve the mystery.

Disposable batteries nevertheless use up a great deal of energy and raw materials, which could be saved by regeneration or electrochemical recycling. Recently, a magazine in East Germany published a series of articles on the subject. Telefunken is manufacturing portable radio's including a recycling circuit called 'long life technique'. Battery manufacturers are also working on recycling projects. Dne of them, Mallory, has developed a successful alkali manganate battery to be available on the American market soon.

Looking at some specimens

The most well known example is the 'classical' recycling circuit shown in figure 1, for which E. Beer holds a patent.

Basically, this is a half-wave rectifier. Tha rectifiad voltage is superimposed with an additional alternating current across R2. During the positiva half-wave a charge current flows across D1 and R1 (R2's influence is negligible since it is bridged by D1). During the negativa half of the AC waveform. D1 will be high impedance, so that a discharge or 'reverse' current passes across R1 and R2. The value of R2 would normally be ten times the value of R1. The voltage of the recycling current is preset so that tha peak valua is not higher than tha normal voltage of a new cell.

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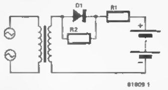

Figure 1. A simple but effective recycling circuit.

The superimposed alternating currant should causa the dissolved zinc to be deposited in a more aven and densa layer on tha inside wall of the container than when recycling is carried out with a direct current only.

In the Varta battery handbook the procedura for a successful recycling has been summarised as follows:

a. The peak value of the charge voltage may not rise above 1.7 V per cell.
b. The recycling current is determined by the size of the cell and should be between 1/4 and 1/3 of the battery's discharge current.
c. The recycling time required is about 4.5 to 6 times the preceding discharge time, as, due to the low efficiency, the reactivating current must be about 50% larger than the amount lost.
d. The shorter the discharge interval, the more effective recycling will be. During a discharge period the battery should only lose a tenth of its total capacity.
e. The battery should best be recycled straight after discharge.
f. When dry cell batteries have been almost or completely discharged, they can never be recycled.

As far as the optimum size and efficiency of reverse current components is concernad (currant across R2 in tha basic circuit) opinions differ widely. Telefunken, for instance, finds that equally good results may be obtained using direct currant only, since in practice recycling is very hard to achieve anyway. With regard to tha results there is also a good deal of disagreement. Some say the capacitance is increased by a factor of 3 and others by a factor of 30 (!). The true level should be somewhere in between the two. In any case, the results depend on the 'circumstances' (the size of the battery, tha type of battery, duration of the charge and discharge periods, interval between charging and recycling, etc.). One thing however is certain: recycling lengthans a battery's life-span.

To start with, a dry cell battery cannot be recharged like an accumulator.

It is however possible to reactivate dry batteries by means of a corresponding similar 'charge process', that is to say, by reversing the capacitance loss which occurs during discharga to a certain extant. Since 'charging' a dry battery is much more complicated than a nicad cell, it is impossible to reviva one when it is almost totally discharged.

The first attempts to regenarata dry battarias data back to the twenties. In the past thera were all sorts of devicas for this purpose, but their operation usually led to unsatisfactory results, which is why these 'chargers' have all disappeared from the market.

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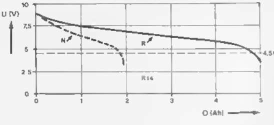

Figure 2. Tests show that recycling can increase the operational hours of a penlight cell by a factor of 3.

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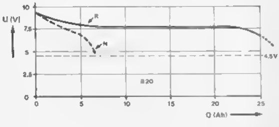

Figure 3. Recycling tests on a standard cell showed an increase of up to a factor of 4 in the operational hours count.

4a

b

c

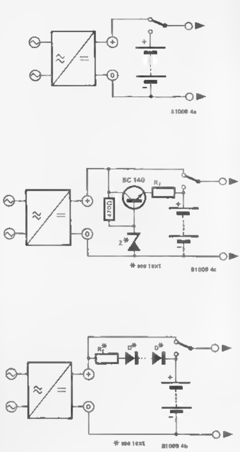

Figure 4. These circuits can be used to extend the life of batteries in portable equipment provided they have a built in mains power supply. Changeover from mains to battery (a) can be automatic via a mains connection socket switch.

Which batteries can be recycled?

Generally speaking, most types of zinc carbon batteries ('normal' dry cells) can be recycled with successful results. This is not the case with 'high power' batteries since tests on these have proved inconclusive.

The alkali manganate and mercury types should also be able to be recycled, but so far experiments have come up with nothing definite. It is not advisable to try recycling mercury batteries due to the danger of poisoning when mercury leaks out. Even more dangerous, In fact lethal, would be to recycle lithium cells — these are highly explosivel

Tests

It might be interesting at this stage to examine the tests carried out et Telefunken and the results that were obtained.

During an extensive serias of experiments six batteries (nominal voltage 9 V) were subjected to four hours' operation (charging the battery with a charge resistance of 82 Ω) and 20 hours' rest every day. The batteries to be recycled were connected to a constant direct voltage of 9.5 V across a charge resistance of 47 Ω during the 20 hour period.

From figures 2 and 3 it can be seen that the dischargeable capacitance (operational hours count) in penlight baby cells may be increased by a factor of 3 and in single cells even by a factor of four. The high power type on the other hand showed no increase in capacitance worth mentioning.

All in all, therefore, normal cells can be recycled and used at very low cost per operational hour, provided the equipment they are in is mostly connected to mains.

Circuits

The following circuits to be discussed here were designed on the basis of Telafunken's experiences with direct current charging.

Thay can be incorporated into any portable devica (such es a transistor radio cassetta recorder) that includes a built in mains power supply. Switching from battery power to mains can be done either manually or automaticelly by plugging the supply cable into its socket (see figure 4a). For recycling purposes, the sama switch will now be bridged by the charge resistor R_r and the diodes switched in series (see figure 4b). The most important requiremant which must be met during recycling is that the charge voltage must not ba higher than that of a fresh battery (1.7 per cell) to prevent it from being overcharged. If the open-circuit voltage of the power supply (which must be measured!) is higher, it will have to be limited with diodes to a value between 1.5 and 1.7 x the number of cells for recycling to take place. There is a drop in voltage of about 0.6 V per diode.

Let's look at an example: a device fed with 9 V battery voltage is to be converted for recycling. The open-circuit voltage of the built-in power supply is measured at 10 V. Thus, the maximum charge voltage will be: number of cells x1.7 V = 6 x 1,7 V = 10.2 V. In this case it is not necessary to use diodas. It would be a different matter if the power supply were to produce an open-circuit voltage of 11 V, for example. Then diodes will hava to 'lose' at least 0.8 V. Since the drop in voltage of a dioda with 0.6 V would be too small, 2 diodes are used. This gives a maximum charge voltage of 11 V – 1.2 V = 9.8 or 1.63 V per cell. If the power supply voltage is below the nominal battery voltage, recycling will not be possible.

The charge resistanca should be set at about 5 Ω per volt of battery voltage. Thus, for the most commonly used battery voltages the following values may be calculated: 12 V/68 Ω; 9 V/47 Ω; 7.5 V/39 Ω; 6 V/33 Ω and 4.5 V/22 Ω. For miniature cells the value of the charge resistor should be doubled.

Of course the charge voltage can also be limited by a small stabiliser circuit (instead of the diodes), as shown in figure 4c. Again, the zener diode voltage is chosen not to exceed the maximum charge voltage of 1.7 V per cell. The zener diode voltage will then be about 0.6 V higher than the maximum charge voltage. To enable the batteries to be recycled for as long as possible an excessive discharge must be avoided. This can be achieved by the circuit in figure 5, which switches the battery off when a voltage of about 1.2 V par cell is reached.

The zener diode voltage must be calculated as follows: number of cells x 1.2 V – 0.6 V. The zener voltage shown is valid for 9 V batteries and the system is switched off at 7.4 V. If discharge is to continue below this limit a switched bridge (drawn as a dotted line) can be included.

A design for a recycling power supply is shown in figure 6, again for an output voltage of 9 V. The maximum output current is 500 mA.

During mains operation a recycling current flows through diode O2 and charge resistor R_r. The supply current for the connected load will pass via diode O3. When the mains supply is switched off, switch S1 will enable T2 to conduct and the battery will switch on. If the battery voltage drops below a value of about 7.3 V, both T3 and T2 will turn off thereby switching off the battery. Oiode O2 now prevents the battery from discharging any further via R_r. If in exceptional cases the battery is to be further discharged (for instance if there is no mains supply within reach) switch S1 can be used to bridge T3 and maintain the battery supply. ◀

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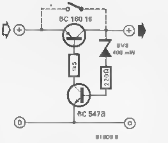

Figure 5. This circuit will avoid an excessive discharge by switching the battary off when a cell voltage of 1.20 is reached.

Sources:

Deussing, G.: Energy supply for Telefunken transistor radio's. Telefunken-Sprecher, no. 66, Feb. 1975, p. 26-28.

Huber, R.: Dry cell batteries. VARTA technical series, vol. 2, 1968, p. 110-112.

Glöckner, G., Petermann, 8. and others: 'Recycling batteries using a symmetrical alternating current charge – problems and results of experiments'. FUNKAMATEUR 28 (1979), nos. 2, p. 73; 3, p. 127; 4, p. 187; 5, p. 238; 6, p. 284; 7, p. 345; 8, p. 388.

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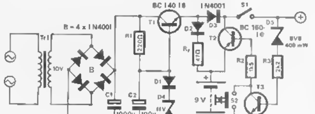

Figure 6. A recycling circuit for an output of 9 V at up to 5C0 mA is shown here.

special energy issue

This issue is devoted to a series of articles and hints on how to save energy. Originally, tha contents were to deal with subjects which often appear in the media, such as solar energy, windmills tidal calculation centres, biogas, heat pumps and fuel cells. However, things turned out rather differently!

Oelving further into the matter led us to the conclusion that a different approach would offer far more interesting possibilities: small, simple circuits to reduce energy consumption in everyday life. Once we got started, it was found that a surprising amount of energy could be saved in this manner: 10% on fuel consumption, 10 . . . 30% on gas in the central heating, more than 50% on electricity in the central heating pump, etc, etc.

We hope this issue will at the same time provide some food for thought. Why for instance is so much attention paid to revolutionary central heating boilers (which save about 10%), when simply adjusting the 'old' system correctly could save you up to 30%?? And this is just one example . . .

energy saving know-how

The 'energy crisis' sounds as familiar to our ears as VAT — it's something we have to cope with every day of our lives. Although the government seems to be continually harping on the 'save energy' theme, a clear indication as to how and where energy could be saved in the home is rarely given. This article takes a look at the central heating system, one of the largest domestic energy consumers.

It is not common practice for Elektor to be concerned with central heating systems, but the fact is that this is an area where a surprising amount of energy could be saved. Let's look at the following example: in one way or another (the actual method isn't relevant at the moment) 10% could be saved on the gas consumption of the central heating or water boiler. Where the overall annual consumption of a central heating system is 3000 m^3 this would mean a saving of 300 m^3, whereas in a hot water system that uses 600 m^3 up to 60 m^3 can be saved.
This article discusses methods of saving energy without modifying the heating system in any way, in other words, without having to invest a penny. Correct adjustment of the system itself is a must!!

The boiler and radiators

First let us see what happens when heat is generated. The gas burned in the boiler heats up water or air which in turns warms up the room via a radiator. The boiler's performance largely depends on maintenance, the amount of gas burned, efficiency (insulation/lagging) and finally the amount of energy that is lost 'up the chimney'.
Maximum efficiency will be achieved by making sure the burner's air pipes remain clear. It is advisable to leave any adjustments required to the boiler to the professionals — leave well alone! What you can do is check the whole system as follows: take note of the reading of the gas meter and then let the boiler burn for a while, half an hour for instance. The new meter reading will give you an indication of the amount of gas consumed, which should correspond to the figures marked on the boiler. The manufacturer has designed the boiler for a specific gas consumption and any deviation will usually have an adverse effect on the boiler's performance. If there is quite a large difference, you'll have to call in a heating engineer.
When the system was designed, the pipes and radiators were selected to reach a specific temperature in every room. For instance, 15° in the bed-

1

Photo 1. In some thermostats an extra heat source is switched on at night to warm up the thermostat to the required level.

rooms end 24° in tha bathroom. Calculations of this type however can only be a close approximation and so to be on the safe side, the radiators are always made slightly larger than necessary. As a result, a number of rooms can get warmer than is strictly necessary and this is usually where a considerable saving could be meda.

Naarly all radiator taps can be adjusted. This means the maximum amount of water flowing through the tap can be regulated. So if the room gets too werm, the tap setting will have to be adjusted. Then less water will flow through the radiator and the temperatura will drop. You can either let specialists do the job for you (which could take a fair amount of time) or you can try yourself with the aid of a thermometer. This will than at least give you an idea of the possible areas where energy can be saved.

It was found in tests on 17 houses that an improvement of up to 7 or 8% could be achieved by adjusting the tap setting — in one particular case the saving was es high as 24%! It might be a good idea to have a chat with your neighbour to see how your systems compare.

Be critical when extending the heating system. Don't be tempted to use cheap second-hand radiators. Let the company who installed your central heating advise you, since different standards ara often applied. The addition of wrongly measured radiators and pipes could 'unbalance' your system!

The room thermostat

A separate article has been devoted to this aspect elsewhere in this issue, so we don't need to go into the reasons for using a thermostat again. What we didn't mention wes the fact that it is possible to check whether or not the thermostat is working correctly with the aid of e minimum/maximum thermometer. This is a dual thermometer which records the highest and at the same time the lowest temperatures to have been measured. If, for instance, the thermostat is set to 20° and the thermometer indicetes 18° to be the lowest and 22° to be the highest temperature, the thermostat will be incorrectly set. Ideelly, the room temperature should be constant to within at laast 1° and preferebly 0.5°.

It is obvious that this kind of measurement should not be carried out with childeren playing neerby who leeve doors open.

Of course, if the temperatures are automatically lowered at night, regulation has to be precisely controlled. The minimum/maximum thermometer will indicate whether the temperature hes exceeded the preset value during 'warm-up'. If not, the setting can be eltered until there is an overshoot. Then reduce the setting e little so that the temperature can no longer rise above the required value and the thermostat will be set at the optimum level.

Lowering temperatures at night

Unfortunately, this does not save as much energy as the advertisements would have us believe, but between 5 and 10% can be achieved. The best method is to adjust the thermostat by hand, although then of course this will have to be done systematically. Tests have shown that in this manner 25% more can be saved than when using an automatic timer. (Please note: not 25%, but 25% *more* then the original 10%, in other words, 12.5%).

For an automatic night reduction system ell you need is a timer. The thermostat can quite easily be 'fooled' by incorporating a heeting elament, such es an ordinary resistor. At night this resistor, for instance a 4k7/¼ W type, will be connected across a 24 V supply by the timer and the air inside the thermostat will become a little warmer than the surrounding air. As a result, the temperature of the room will drop until the room temperature plus the heating caused by the resistor is equal to the preset value given on the thermostat. Thus, no mechanical controller (motors, couplings, gearboxes etc.) is required to adjust the thermostat setting by a few degrees.

With the aid of the minimum/maximum thermometer we mentioned before you can control the night temperature reduction. Lower than 5° will not give any more gain. For then so much extra heat will be required to warm up the floors, walls and ceilings, which cooled off during the night, that this will end up costing more energy than was saved during the reduction.

Investment

In a number of cases a little money will have to be spent before any appreciable amount of energy can be saved. This is particularly true of the automatic pump; however, its cost can be earned back within a few years. In addition, about 20% of the warmth is lost 'up the chimney'. At least half of this can be won back with e so-called *economiser*. This useful device is placed behind the boiler to cool the fumas as much as possible. With a little bit of luck, these devices will be on the market before the year is out.

The economiser cools fumes from about 200° to almost the temperature of the return water of the central heating. This causes condensation: steam is produced and must be extracted. In addition, extre heat is released.

The fumes are now so 'cold' that the chimney or flue no longer draws them out. For this reeson a ventilator will have to be installed to make sure the fumes are extracted. This involves an extensive (alectronic) security system to check whether the ventilator is functioning as it should. The requirements which this system must meet are related to the dangar of fire end explosions. Therefore, it is not advisable to start experimenting in this field, but rather to purchese a recommended type.

As far as fume valves are concerned, they can be dealt with quite briefly. They are all forbidden, for if one is used the same security system must be included as in the case of the economiser. In spite of the 20% which the fume valve would save, it just isn't worth it. In any case, the 20% refers to the static losses which the valve would reduce, not the gas consumption. The static losses amount to about 7% of the total gas consumption. Thus, the valve would cut this down to: 20% of 7% = 1.4%.

Static loss is the amount of energy lost up the chimney while the boiler is not burning. By using an economiser these static losses also disappear, so it is preferable to use an economiser.

If the old boiler is dua for replacement you can buy a new, economical version. If the entire system naeds to be renewed, you might like to consider an *air heating* unit. This saves energy, as a lower air temperature manages to maintain the same degree of comfort.

Other methods to save energy include a rather curious one: if you like plants, don't be afraid to build e wide window still in front of tha windows. One that juts out by 20 cm saves eround 14% more than none et all!

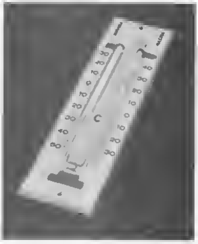

Photo 2. An example of e minimum/maximum thermometer.

Insulation and ventilation

Subjects like double glazing, pipe insulation, filling up cracks etc. have received emple coverage so there is no need to go into these particuler espects again. Whet happens, howevar, if your house is well insulated but now faels damp and clemmy and hes an unpleasant smell? Of course, one way to get the ventiletion going again is to re-open all the cracks, but it is far better to install an electric vantilator — like the ones included in newly built

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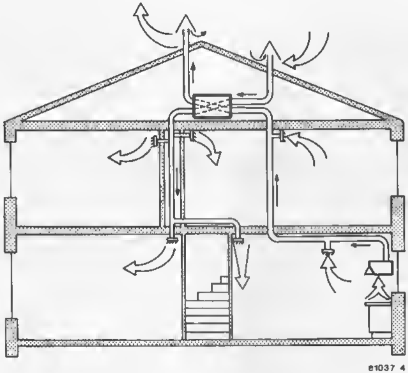


Figure 1. A ventilator makes sure that the air is constantly refreshed.

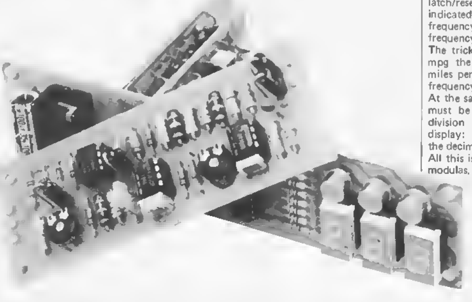
houses — to ensure a constant ventilation regardless of weather conditions (very windy, slight wind etc.).
The minimum prescribed ventilation is $225\,m^3$ of air per hour, allowing for less ventilation at night. The hot air is replaced by cold outside air which requires about *1000 m³* of gas a year to heat it. Since ventilation is an absolute must, heat losses seem inevitable. Fortunataly, a solution for this has been found in the form of a heat exchanger. This is a device which enables the hot air passing out to give its warmth to cold incoming air. Such devices manage to save at least 80%. With a ventilation loss of $800\,m^3$ a year and a total consumption of $3000\,m^3$ the new consumption figure using a heat exchanger will become $2360\,m^3$, meaning that more than 20% of the total gas used is saved. Again, it does involve a slight increase in electricity consumption.
It should be possible to go one step further: by feeding the fumes from an ordinary central heating boiler through the heat exchanger. Quite a lot of electronics is involved to ensure the fumes are fully extracted as in the case of the economiser. The total performence will, however, be very good. As this development has not yet gained official approval, it will take some time for it to be put into practice.

The future

It looks as if economy will prove to be the most reliable 'energy source' in the near future. Soler and wind energy systems are still in a primitive state of development. It may be possible (special kits are available) to cover half of the hot water requirements with solar energy, but it is still not economically viable compared to other fuel prices. This need not deter the enthusiastic constructor of course; after all, the sky's the limit!
Real saving will be possible with the aid of gas heat pumps. These extraordinary devices succeed in producing more heat than seems possible from the indications on tha boiler. In other words, they exceed a performance of 100% (up to about 140%!). This is because the pump can derive warmth from its surroundings, such as from the air or from water in the ground. Unfortunately, such devices ara also very expensive end at the moment are reserved for large office buildings etc. It is estimated that tha situation will improve in the next few years however.
Information on how to save energy in the home can be obtained from your local gas board, or from the firm who installed your central heeting system.

simple fuel consumption meter

A meter indicating fuel consumption while the car is moving would appear to be a popular circuit.
The fuel consumption meter described in the April issue however suffered from a major disadvantage, unfortunately the transducers required could not be delivered. To remedy this the characteristics of all the transducers we could find were examined and on the basis of the results three 'universal adaptation modules' were developed. With the aid of these modules it should be possible to use virtually every transducer!



This article describes a simple version of a fuel consumption meter in addition to the modifications required to the 'luxury' version.
The basic principle is very simple, as illustrated by figure 1. Take two transducers: one for speed and one for fuel consumption in mpg (flow transducer) using two interface modules. These are connected to a printed circuit board which takes care of the necessary scala division (in mpg) and gives a digital indication of the result. By changing round the connections on the circuit board, the opposite result may also be obtained: gpm divided by mpg produces gallons per (100) milas.
However, when various transducers are examinad a little mora closely, things turn out to be somewhat more complicated. Table 1 lists a few of the most commonly used types. It shows two main types of speed transducers: pulse and tacho generators. In the case of the former, tha output frequency is equal to speed, in the latter, it is the output voltage. Thus, two basically different kinds of adaptation modules will be required for a start. The flow transducers will in fact generate all tha pulses required, but then varying from about 32000 to 108,000 pulses per gallon.

What are the possibilities?

Thus, the fuel consumption meter could either be based on mpg or g/100 m. In addition there are two different kinds of speed transducers to be reckoned with: pulse and tacho generators. This leads to four different block diagrams, as shown in figures 2 . . . 5.
Even so, the basic principle will remain the same, as can be seen from the right-hand half of the diagrams. To put it briefly: a digital frequency counter is really a divider as well! The counted pulses — and thus the figures in the display — are equal to the frequency at the clock input, and also to that of the latch/reset pulses. In other words, the indicated result is equal to the clock frequency divided by tha latch/reset frequency.
The trick now is to make sura that for mpg the clock frequency is equal to miles per hour and that the latch/reset frequency is equal to gallons per hour. At the same time, the frequancy ratio's must be such that the result of the division corresponds to the raquired display: mpg, with one figure behind the decimal point.
All this is achieved by using the correct modulas. Figure 2 illustrates what happens when the speed transducer is a pulse generator. Module 1 is e presettable frequency multiplier and module 2 is a frequency divider. The two modules are preset to provide the correct ratio of clock to latch/reset frequency. Figure 3 on the

Table 1

Speed transducers	
Halde	4 pulses per rev
ITM	6 pulses per rev
tacho generators	direct voltage equal to speed
Flow transducers	
FloScan 201A	
203A	25600 pulses/litre of petrol
211A	26417 pulses/litre of diesel
213A	
FloScan 261PB-15	12680 pulses/litre of petrol
263PB-15	
FloScan 300-1	11386 pulses/litre LPG
KDM (opto)	9500 pulses/litre
KDM (inductive)	8500 pulses/litre

Table 1. A general survey of the flow and speed transducers available in the U.K. and of the number of pulse rate generated per gallon or per revolution.

1

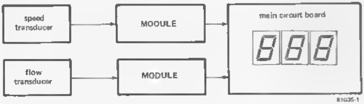


Figure 1. The block diagram of the fuel consumption meter.

other hand shows a speed transducer with a tachogenerator output. As a result a direct voltage equal to speed is produced. A module will therefore be required which converts this voltage into the (clock) frequency that is needed: a (presettable) voltage-to-frequency converter. This is module 3.
The other two figures (4 and 5) are basically the same, with the only difference that the speed and fuel transducer have exchanged places.

The diagrams

The circuits themselves can be dealt with briefly. Their purpose has already bean considered and the block diagram (figures 2 . . . 5) illustrate this.

Module 1 (figure 6)

This has the purpose of carrying out a presettable frequency multiplication to convert the pulses from the speed or flow transducer into the required clock frequency.
The module consists of a trigger circuit (IC1) which converts the input pulses into a symmetrical square wave and is followed by a frequency-to-voltage converter (IC2) and by a presettable voltage-to-frequency converter (IC3).
Potentiometer P1 is used to adjust the trigger level. With respect to opto-electronic transducers the voltage at the wiper is set at 1 . . . 15 V and with induction types at a few hundred mV.

Module 2 (figure 7)

In addition to the presettable frequency

2

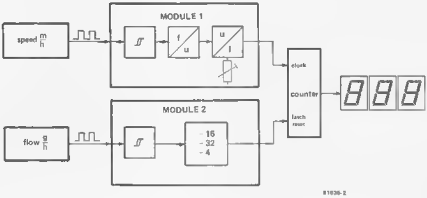
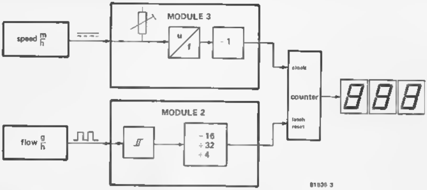


Figure 2. The block diagram of the pulse generating transducers and the read-out in miles per gallon.

3



Figures 3. The block diagram showing how a tacho generator is used and the read-out in miles per gallon.

4

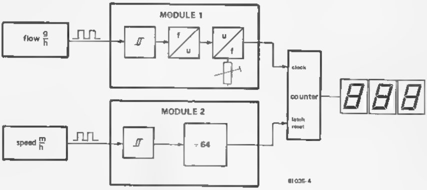


Figure 4. The block diagram for pulse generating transducers and the read-out in gallons per 100 miles.

5

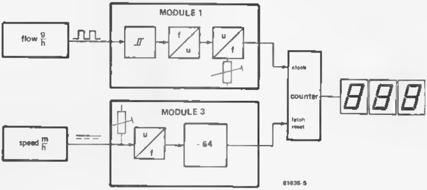


Figure 5. The block diagram showing how to use a tacho generator and giving the readout in gallons per 100 miles.

6

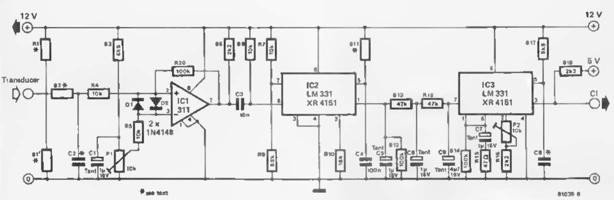


Figure 6. Module 1.

multiplier a programmable frequency divider will also be required to produce the latch/reset pulses. This is module 2. Since a single fully presettable converter will be enough for calibration, it is acceptable to use a divider (IC2) one of the outputs of which can be chosen with the aid of a wire link. Here too, the input pulses are initially 'cleaned up' by IC1.

Module 3 (figure 8)

Finally the voltage-to-frequency converter: module 3. Even less needs to be said about this. IC1 takes care of the conversion. In order to be able to produce either clock or latch/reset pulses as required (figure 2 or 4) a fixed divider has been included (IC2).

The main circuit board (figure 9)

Figure 9 gives the count/display section. The IC manufacturers have made life easy for us by including a complete counter with e seven-segment display decoder/drivar. In other words, on ona sida thera are clock, reset and latch pulses and on the other tha outputs to the seven-segment displays.

Up to now wa have been mentioning 'latch/reset' pulses. Tha countar IC prefers thesa to be split up into latch and reset pulsas. This is no problem, as gates N1 . . . N4 connected in series constitute a 'pulse dalay'. As soon as a latch/reset reaches the input, N2 generates a short latch pulse. This makes sure the count in IC1 is 'remembered' and that it is on display. After a short delay (by means of N3) Nr will then generate the reset pulse which the counter in IC1 can reset to zero, ready for the following count cycle.

Construction

Building the circuit with the right

7

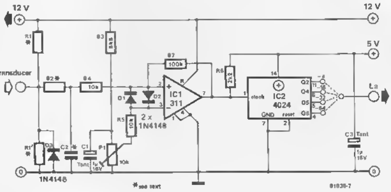


Figure 7. Module 2.

8

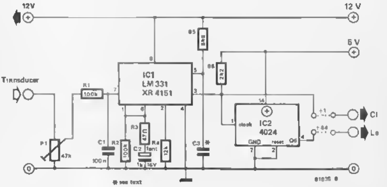


Figure 8. Module 3.

9

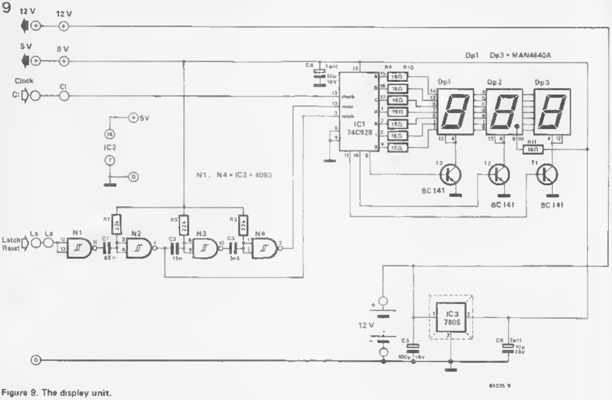


Figure 9. The display unit.

10

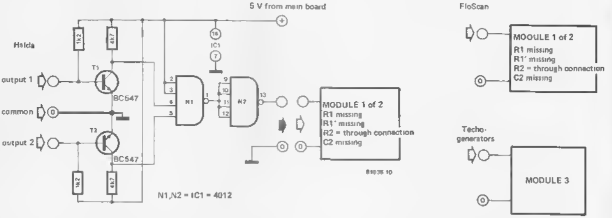


Figure 10. The adaptations required by various speed transducers.

modules and components is rather complicated, but the following survey will help.

1. How to choose the right flow and speed transducer

There is only one solution for this: go to your dealer and find out which transducers he can get hold of to mount in your car. The flow transducer will generally prove more easily obtainable than the speed transducer, but attention must be paid to see whether it is suitable for the fuel your car runs on: petrol, LPG or diesel.

It is advisable to select one of the transducers mentioned in this article. A car accessories dealer with a large assortment may well have them in stock. On each module the adaptations and component values for all the above transducers are indicated. Other types may also be used, provided the calculations given further on in this article are taken into account.

Assuming a flow and speed type has been chosen, let us now see what the possibilities are.

2. What indication should be given?

Either the transducers can indicate miles per gallon (mpg), or gallons per 100 miles (1/100 miles). Once the choice has been made, figures 2 . . . 5 will show the modules which are required. Two different types may be used for mpg and two for gallons per 100 miles, depending on the type of speed transducer selected. Check whether the transducer you bought is a pulse generator or a tacho generator. Only one figure can meet the above requirements, so that it is not difficult to see which two modules are needed.

3. The values of the components which are transducer dependent.

These are provided in figures 10 and 11 and in tables 2 and 3. Figures 10 and 11 illustrate the components required by the speed and flow transducer respect-

11

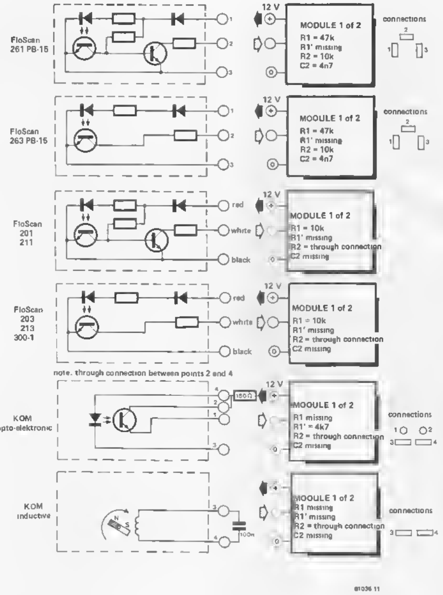


Figure 11. The adaptations required by various flow transducers.

ively. Table 2 contains several component values for the gallons per 100 miles versions. It might be a good idea to make a note of all these values as you go along to avoid confusion later!

4. The construction of the modules

Now the two modules and the main circuit board can be built (after buying the components first of course). The components required may be found in the parts lists given.

The two modules are mounted at the rear of the main board. Make sure they are positioned correctly. This depends on the module chosen (2, 3, 4 or 5). It shows which modules should be connected to the clock and reset/latch input of the main board. Next, the circuit will have to be calibrated. Don't connect the transducers yet!

5. Calibration

Calibration occurs in two steps, depending on the type of transducer chosen.

a. If a speed transducer is used which generates (opto-electronic or inductive) pulses, the calibration circuit shown in figure 12 must be utilised. This will generate 50 Hz pulses and should be connected to the inputs of *both* modules. After the supply voltage has been connected, the display should show the result of the following formula:

$$\text{reat out} = \frac{y}{1000 \cdot k \cdot X}$$

for miles per gallon and

$$\text{reat out} = \frac{100000 \cdot k \cdot X}{y}$$

for gallons per 100 miles.

Where X stands for the number of pulses per speed transducer revolution and y for the number of pulses per litre that the flow transducer generates. The

Table 2

mpg

Speed \ Flow	FloScan 261, 263, KDM 300-1	FloScan 201A, 203A, 211A, 213A
Halda	module 2 wire link ÷ 16 / module 1 R11 = 22 k C8 = 15 n	module 2 wire link ÷ 32 / module 1 R11 = 22 k C8 = 12 n
ITM	module 2 wire link ÷ 16 / module 1 R11 = 15 k C8 = 15 n	module 2 wire link ÷ 32 / module 1 R11 = 15 k C8 = 12 n
Tacho-generator	module 2 wire link ÷ 16 / module 3 wire link ÷ 1 C3 = 4n7	module 2 wire link ÷ 32 / module 3 wire link ÷ 1 C3 = 3n9

Table 2. The values of the components which are transducer dependent for the readout in miles per gallon.

Table 3

g/100m

Speed \ Flow	FloScan 261, 263, KDM 300-1	FloScan 201A, 203A, 211A, 213A
Halda	module 1 R11 = 82 k C8 = 12 n / module 2 wire link ÷ 64	module 1 R11 = 33 k C8 = 12 n / module 2 wire link ÷ 64
ITM	module 1 R11 = 82 k C8 = 8n2 / module 2 wire link ÷ 64	module 1 R11 = 33 k C8 = 8n2 / module 2 wire link ÷ 64
Tacho-generator	module 1 R11 = 82 k C8 = 12 n / module 3 wire link ÷ 64 C3 = 6n8	module 1 R11 = 33 k C8 = 12 n / module 3 wire link ÷ 64 C3 = 8n8

Table 3. The values of the components which are transducer dependent for the read-out in gallons per 100 miles.

display will also show the result to one figure behind the decimal point. The number of pulses generated by the transducers is calculated by means of table 1. The k factor in the formula is a constant which is mentioned on the car's speedometer. This will be between 0.6 and 1.6 or between 600 and 1600. The former relates to the number of revs per meter, the latter to the number of revs per mile. Here we are concerned with the number per mile, so that the figure between 600 and 1600 must first be divided by 1000 and then be used in the formula.

With P2 of module 1 the read out can be adjusted to the value calculated. Then the circuit can be fitted in the car and the transducers can be connected according to the illustrations (either figure 10 or 11).

b. If a speed transducer is used which generates a DC voltage level, calibration will be a little more complicated because the speed transducer will have to be adjusted while the car is being driven. It is therefore advisable to take someone with you . . . unless you can drive with your feet!

Calibrate P1 of module 3 at a speed of 50 miles per hour to a voltage of 0.5 V at the junction of P1 and R1. In the mpg version this will complete the fuel consumption meter.

In the gallons per 100 miles version module 1 still has to be calibrated. Connect the calibration circuit to the input of the flow transducer module and connect a DC voltage of 1 V to the input of the speed module. The read out on the display will then be the result of:

$$\text{read out} = \frac{180\,000}{y}$$

where y again represents the number of pulses generated per gallon by the flow transducer used. This value is set with P2 of module 1.

This completes calibration here too and again the circuit can be built into the car and the transducers connected according to figures 10 and 11. Check whether P1 in module 1 is still set to the correct value, just to be on the safe side. (See the corresponding diagram.)

Finally a word about the supply. The 12 V for the circuit must not include

12

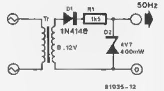


Figure 12. The calibration circuit used to set up the meter.

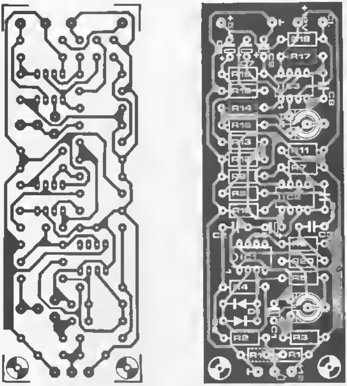
Parts list module 1 (figure 6)

Resistors:
R1,R1',R2,R11 = see text
R3 = 6k8
R4,R5,R7,R8 = 10 k
R6,R16,R18 = 2k2
R9,R17 = 68 k
R10 = 18 k
R12,R14,R20 = 100 k
R13,R19 = 47 k
R15 = 47 Ω
P1,P2 = 10 k preset

Capacitors
C1,C5,C6,C7 = 1 μ/16 V tantalum
C2,C8 = see text
C3 = 10 n
C4 = 100 n
C9 = 4μ7/16 V tantalum

Semiconductors.
IC1 = 311
IC2,IC3 = LM 331, XR 4151
D1,D2 = 1N4148

13a



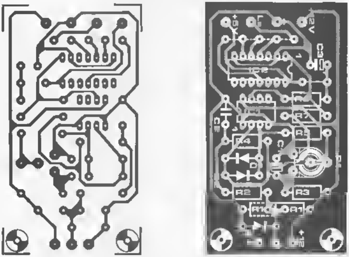
Parts list module 2 (figure 7)

Resistors:
R1,R1',R2 = see text
R3 = 6k8
R4,R5 = 10 k
R6 = 2k2
R7 = 100 k
P1 = 10 k preset

Capacitors:
C1,C3 = 1 μ/16 V tantalum
C2 = see text

Semiconductors:
IC1 = 311
IC2 = 4024
D1 . . . D3 = 1N4148

13b



any interfering pulses from the car electrical system and this can be avoided by using a noise filter, like the ones used for car radio's. That covers the use of all the transducers described here.
This fuel consumption meter is really universal. It can be adapted and calibrated for almost any transducer, provided enough information is available.

The luxury consumption meter

The meter we described in the April issue can be switched to four measuring ranges: gallons per 100 miles, gallons per hour, miles per gallon and rev count. This if of course ideal and not surprisingly many readers are still searching for the transducers required.
The same solution which was provided for the simple version can now also be applied here using the adaptation modules. Two input signals are required: a pulse signal equal to the fuel flow (about 3400 pulses per gallon) and a DC voltage level equal to the speed (about 5 V at 60 miles per hour). Since the existing circuit already offers ample calibration range, the output signal levels of the modules need only be roughly estimated.

How to use the flow sensor

Table 1 provides details of a number of different types of flow sensors. It can be seen that the conversion ratio's can vary between 32,000 and 108,000 pulses per gallon. Some sensor may show even wider tolerances. In any case the frequency of all these sensors will have to be reduced with the aid of an interface circuit as described with respect to the simple meter.

How to adapt the speed transducer

Since the luxury circuit is meant for a

Parts list module 3 (figure 8)

Resistors:
R1,R2 = 100 k
R3 = 47 Ω
R4 = 12 k
R5 = 6k8
R6 = 2k2
P1 = 47 k preset

Capacitors:
C1 = 100 n
C2 = 1 µ/16 V tantalum
C3 = see text

Semiconductors:
IC1 = LM331, XR 4151
IC2 = 4024

Parts list main board (figure 9)

Resistors:
R1,R2,R3 = 22 k
R4 . . R11 = 18 Ω

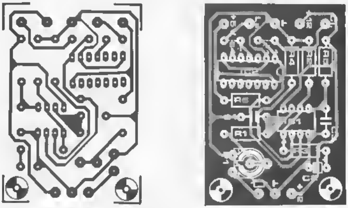
Capacitors:
C1 = 68 n
C2 = 15 n
C3 = 3n3
C4,C6 = 10 µ/16 V tantalum
C5 = 100 µ/16 V

Semiconductors:
IC1 = 74C928
IC2 = 4093
IC3 = 7805
T1,T2,T3 = BC 141
Dp1 . . Dp3 = MAN 4640A

Miscellaneous
heatsink for IC3

tacho generator, this kind of sensor can be connected directly. Pulse generator transducers (and there are any more of these available) require the frequency to voltage converter in first half of module 1 (up to and including junction R13/C6). ◼

13c



13d

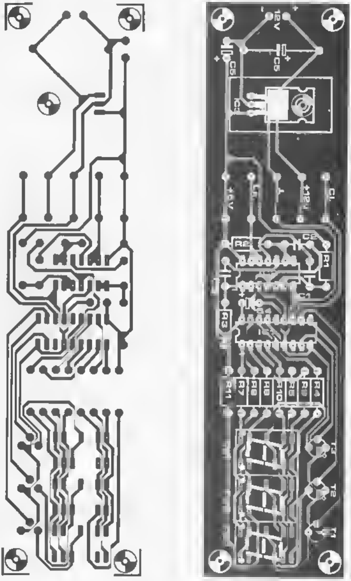


Figure 13. The component overlay of the circuit boards.

automatic pump control

economy switch for the central heating system

With energy prices continually rising, it isn't a bad idea to take a look at the amount of energy consumed by 'small consumers' in the house. One which could certainly function a lot more cheaply, once it were properly used is the central heating pump. This is because in most systems the pump has to work continually both day and night even during the summer months. Considering that a small pump can use up to 100 watts, it can be seen that an automatic control to switch the pump off whenever possible would be a good investment.

Few people realize how much energy is consumed by devices that are continually switched 'on'. This article deals with a central heating pump using water as a means to transport heat. In a hot air system, for instance, the pump is controlled by the thermostat and so it will only operate when the heating is switched on. In a central heating system using water, however, the pump is often on for long periods. Strangely enough, this is often to save energy, for if there is still a lot of hot water in the boiler once the burners have been switched off, it would be a pity to let it cool off, which is why it is usually pumped to the radiators. This means the pump has to keep going after the boiler has been turned off. During summer water also has to circulate through the system now and then to prevent the pipes from blocking. This not only shortens the pump's lifespan continually, but also puts up the electricity bill. All in all, an economical alternative would be most welcome.

Figure 1 shows the type of central heating system for which the pump control is designed. It is a very simple unit where the room thermostat switches the burners in the boiler on and off directly. The pump operates continuously so that after the burners are switched off the heated water in the boiler is still pumped through the radiators. Some time after the boiler has been switched off, the system starts to operate in the opposite manner: the water is warmed in the radiators and cooled in the boiler. In other words, the warmth in the room is pumped out through the chimney!

A better solution is to let the pump continue for only a quarter of an hour after the burners have been switched off (thus, once the preset room temperature has been achieved). If in addition the pump is switched on occasionally during the summer months to prevent the bearings from rusting, the central heating's performance may be improved considerably with the aid of a simple circuit.

Before we consider the circuit itself it is important to know the requirements to met. It is, for instance, forbidden to modify an approved system (such as a central heating boiler!). This means that

1

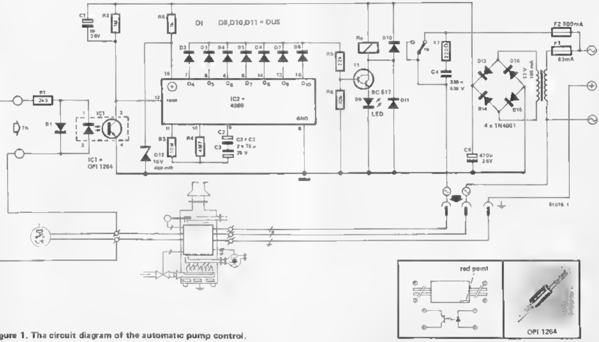


Figure 1. The circuit diagram of the automatic pump control.

2

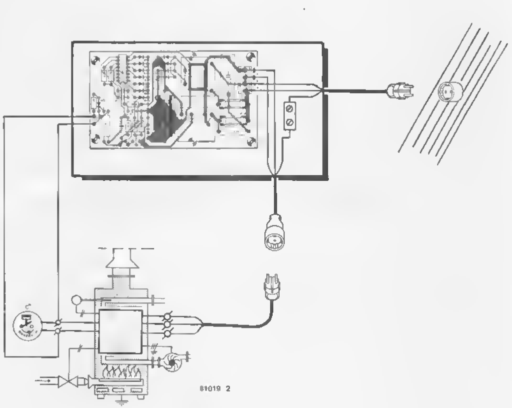


Figure 2. The central heating system is connected to the mains via the automatic pump control.

an auxiliary device may only be added if it is connected to mains and to the wires leading from the room thermostat. Once it is connected to the gas system, the device must also be approved by the Gas Board. We mention this fact, because there are many automatic pump controls in existence which do *not* meet these standerds and which could be dangerous! With regard to electrical safety, according to official requirements, there should be at least 8 mm space on a printed circuit board between the 220 V and the 24 V circuits. Furthermore, the optocoupler should have an insuletion voltage of 4 kV. The system should also be electrically 'fail-safe', that is, the boiler should be unable to burn if the pump does not go into operation due to a fault in the circuit. This has been solved here, because when the pump receives no voltage, the gas valve will automatically be closed.
Another aspect to take into consideration is whether the boiler is in fact suitable for such a device. If the boiler is not connected to the mains via a plug and socket, you can be pretty sure it is not suitable. If in doubt, consult the local Gas Board.

The circuit

Figure 1 shows the circuit diagram of the automatic pump control. The circuit's input terminels are mounted in parellel to the switch in the room thermostat. If the thermostet switch is open, there is a difference in voltage between the two input terminals and the LED lights. When the thermostat switch is closed, this will of course not be the case. The LED forms the input of an opto-coupler which has a very high isolation voltage (4 kV).
The output of the opto-coupler is a photo transistor. As soon as the LED lights, this transistor conducts so that the reset of IC2 will be connected to 0 V. When the room is not at the correct temperature, the thermostat switch will be closed and the LED will not light. The transistor will then not conduct either, so that the reset input of IC2 will be high. In that case, all the outputs of the IC will be low, T1 will close, D9 will not light and the relay will be at rest. Since the pump is connected to the supply voltage via normally closed contacts of the relay, it will be activated. As soon as the right temperature is reached, the LED will go out and the reset line of IC2 will become low. Then the outputs $Q_0 \ldots Q_{10}$ will become high in sequence with intervals preset by the RC time constant of R3, R4, C2 and C3. Outputs $Q_0 \ldots Q_3$ are not used, so that, for the period up to Q_4 going high, nothing will happen. The $Q_4 \ldots Q_{10}$ outputs will still be low, T1 will remain closed and the relay will remain closed ellowing the pump to continue to operate. It is not until Q_4 becomes high, which is after about 15 minutes, that T1 will conduct causing the relay to be activated and the pump to be switched off. IC2 is a binary counter and thus the 15 minutes are a result of counting to 8 in binary to the clock frequency. (Eight times 1 minute 53 seconds is about a quarter of an hour.) Once Q_4 has become high and the pump is switched off, the IC continues to count. It carries on until Q_{10} after which all the outputs will automatically become low again. One complete counting cycle takes 32 hours. The IC will then start a new counting cycle, but because $Q_0 \ldots Q_3$ are not being used, the pump will operate for another 15 minutes. During the summer

3

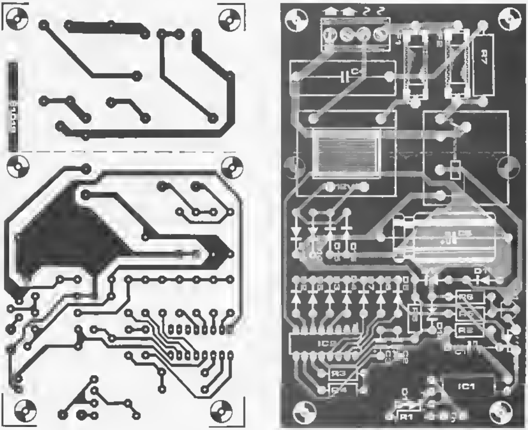


Figure 3. The track and component layout of the printed circuit board.

Parst List

Resistors:
R1 = 3k9
R2 = 1 M
R3 = 10 M
R4 = 4M7
R5 = 22 k
R6 = 10 k
R7 = 220 Ω/1 W
R8 = 1 k

Capacitors:
C1 = 1 μ/25 V
C2,C3 = 15 μ/25 V
C4 = 0,33 μ/630 V
C5 = 470 μ/25 V

Semiconductors:
D1 . . D8,D10,D11 = DUS
D9 = LED
D12 = zener diode 15 V/400 mW
D13 . . . D16 = 1N4001
IC1 = OPI 1264
IC2 = 4060
T1 = BC 517

Miscellaneous
transformer secondary 12 V/100 mA
relay 12 V 1 normally closed
printed circuit fuse holder
fuse 63 mA

the pump will operate for a quarter of an hour after every 32 hours, but in the winter the room will of course cool off long before 32 hours have passed and so the thermostat switch will close again before the entire counting cycle can be completed. In that case, the LED of the opto-coupler will have gone out again. The reset line of IC2 will then be high so that it will stop counting at the same time all the outputs of the IC will become low and the pump will go into operation again.

The construction

Figure 3 shows the component layout for the printed circuit board for the simple central heating automatic pump control. The complete circuit including the relay, can be mounted on the board (the distances between the tracks meet safety requirements). If another supply is available, the part of the printed circuit board incorporating the supply circuit will not be required. That part of the board can then be sawn off.
The LED (D9) indicates whether or not the pump is in operation and so should be mounted where it can be clearly seen. When the light is out, the pump will be working, when it is on, it will be inactive. Of course, the LED will only indicated whether or not the relay is activated and so will not show up any mechanical defect the pump might have. For the relay it is best to use a 12 V type, which can switch at least 1 A. Figure 2 illustrates how the circuit is connected to the central heating system.

K

Between 20,000 and 100,000 operational hours using "ordinary" light bulbs.

When the famous Berlin clock was put into operation its inventor Dieter Binninger was faced with a problem. The time indication used an array of ordinary bulbs. Unfortunately, they only lasted a matter of weeks due to the constant switching on and off and the vibrations caused by passing traffic. Since the clock is so high up that scaffolding is needed to change the bulbs, this became an extremely expensive business. Using special light bulbs, so-called SIG lights, didn't help matters, as their failure rate was still too high in spite of their special construction.

long-life technique in light bulbs

The standard household light bulbs currently on the market are designed to last about 1000 hours. Whare bulb failure leads to security risks or high maintenance costs, it would be an advantage if their lifespan could be prolonged. How this can be done without cutting out to much light will be seen in the present article.

Thus, a new solution had to be found. It is common knowledge that the lifespan of a light bulb can be lengthened by reducing the operational voltage. This however also means that the brightness will be less. In order to lengthen the lifespan without losing any brightness, the clock's designer Mr. Binninger resorted to a simple trick: when reducing the operational voltage in standard light bulbs he at the same time used a higher wattage thereby achieving the same degree of brightness as before. The bulbs now only have to be changed once a year and thus cutting down maintenance costs considerably.

Experimenting with light bulbs

The lifespan of a light bulb at normal voltage levels in vibration-free surroundings is about 1000 hours. This period is determined by the speed at which the filament material condenses, which in turn depends on the temperature of the filament. During under voltage operation the lifespan will increase exponentially according to the reduction in bulb temperature (colour temperature). Figure 1 shows the relationship between operational voltage and lifespan. Thus, by adapting the operational voltage the lifespan can be lengthened infinitely. It must be taken into account however that a drop in colour temperature causes the colour spectrum to shift and the brightness to be reduced. Thus, a compromise between brightness, colour temperature and lifespan can be found by changing the operational voltage of the light bulb (deviating from the 1000 hour compromise set by the manufacturer).

Figure 2 gives a diagram of the colour temperature values pertaining to 40, 75, 100 and 150 watt/220-230 V household bulbs in relation to the operational current. These are usually designed for a lifespan of 1000 hours at 227 volts

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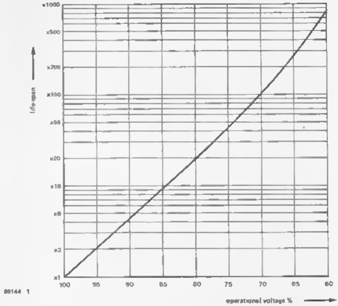

Figure 1. When the operational voltage of a light bulb is reduced the lifespan will be increased exponentially.

operational voltage. The nominal operational values of light bulbs form a 1000 h curve (to the far right) in the diagram. It can be seen that colour temperature increases with bulb power rating at a given nominal voltage.
It can also be seen for instance that if a 75 W light bulb were to have its colour temperature reduced to that of a 40 W light bulb (about 2500°K) en average lifespan of more than 10,000 hours can be achieved.
Light bulbs for edvertising purposes, signals and effects usually require but one colour. Traffic lights for instance use a filter effect with red, yellow and green diffusing screens. The colour of the red and yellow light would therefore not reelly change even if the colour temperature of the light bulbs were to drop to 2000 K. The green light will start to turn slightly brown when the filament temperature drops below 2250 K. Here the colour temperature can therefore be reduced much more than in light bulbs used for lighting purposes such as street lamps, etc. As shown in figure 2, when the filament temperature of a 150 W all purpose lamp is reduced to 2350 K, an average lifespan of a million hours will be the result!

Applications

Signal and traffic light installations would definitely benefit from this idea. Cities like London have to spend millions of pounds on trafic light maintenance. Thus, not only could costs be cut, but the systems would be more reliable aswell and fewer accidents would be caused by light failure. Generally speaking, the long-life technique described is an advantage wherever special lights are being used and wherever changing bulbs is a difficult or costly operation. It might also be a good idea in vehicles, brake lights and indicators, for instance. As in the case of traffic lights, the colour temperature may be reduced considerably due to the coloured glass coverings.
The operational voltage in vehicles can be reduced by pulse width modulation. Instead of the commonly used 12 V bulbs, it would be better to take 16 V or 18 V bulbs. Unfortunately, such bulbs are not yet available for motorised vehicles.

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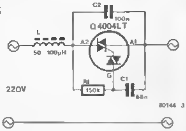

Figure 3. The circuit diagram of the 'long-life unit'. It consists of a phase cutoff control with a predetermined cutoff angle re reduce the operational voltage of light bulbs. With this circuit light bulbs can be operated up to 400 watts total power.

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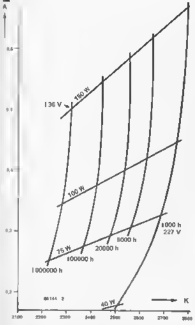

Figure 2. The diagram shows the relationship between the colour temperature and the operational current for four all purpose light bulbs with different performances (horizontal curves). The vertical lifespan curves connect the operational points of an identical life expertation. The 1000 h curve (to the far right) is valid for a nominal 227 V operational voltage rate.

How to put the idea into practice?

Photo 1 shows a switching unit built by Pieter Binninger to reduce the operational voltage of 220 V all-purpose light bulbs. The circuit is shown in figure 3. It consists of a standard light dimmer circuit with a diac/triac the phase cutoff angle of which is preset by resistor R1 and capacitor C1. Naturally, a light dimmer may also be used. If resistor R1 in figure 3 is replaced by a trimming potentiometer, the user can establish the compromise (operating point) between the colour tempereture (brightness) and the bulb's lifespan.
The unit shown in photo 1 was used to operate e new 100 W light bulb and compared to a new 60 W version (same brand). It was tried out on a number of people who where unable to tell the difference in brightness between them. Even the slight shift in phase spectrum of the dimmed 100 W lamp escaped all notice. More than half of the observers even thought the 100 W bulb to be slightly brighter than the 60 W operated on full voltage. ◼

The long-life technique for light bulbs was patented by Binninger Berlin Uhr GmbH in West Germany under nos. P 3001 755.1 and P 2921 864.2.

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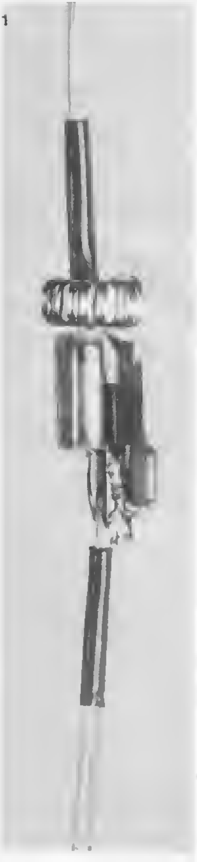
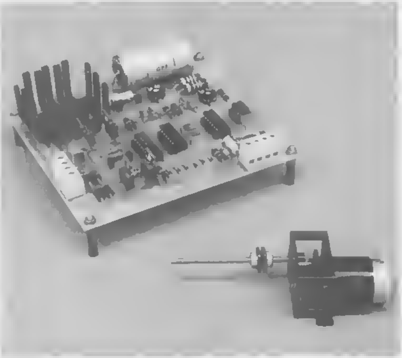


Photo 1. A prototype switching unit corresponding to the circuit in figure 3.

automatic curtain control

'curtains' for draughts

Quite a lot of energy can be saved if the curtains are drawn as soon as the light begins to fade. This is something which can quite easily be forgotten and so if it can be done automatically, so much the better. The circuit described here does the job electronically and although it costs a little electrical energy, it has many advantages, one of them being that it keeps burglars in the dark when you're away on holiday, since it continues to operate in your absence.



Last April the Organisation for Applied Scientific Research in The Netherlands (TNO) published a report on the energy-saving possibilities provided by curtains, especially with regard to their use in the home and in the office. The object of the exercise was to see how much heat dissipation through the outside walls is affected by curtains, window sills, the position of the radiators, etc. Research was carried out in a special climatised room in the Institute of Health and Environment and the report provides detailed results of the (many) measurements taken.

Curtains and window sills were found to have considerable influence on the loss of warmth. Figure 1 gives a few results of the research. The average situation is that where the radiator is placed under a single glazed window with a sill. The energy consumption of the central heating was preset to a fixed value (0%). When the sill is removed (see figure 1a) the heat dissipation increases at once by 13%. Thus, the window sill appears to deflect the hot air (into the room) instead of letting the cold glass absorb it. If the radiator is placed a little further away from the window, enabling curtains to hang (down to the floor) between the wall and the radiator, dissipation is seen to drop by 21%. In the fourth situation (figure 1d) the radiator is placed beneath the window sill and the curtains and net curtains are hanging from the ceiling to the window sill (so they're relatively short). Then, *25% less* heat is lost.

In the given example the total amount of money saved during an entire heating season when gas was priced at £ 0.08p per m^3 amounts to about £ 0.75p per m^2 of house front. In the course of the years, therefore, curtains prove to be a good investment. Even more money can be saved if the curtains are closed at the correct time, so curtains that shut automatically are also well worth the money. As a matter of fact, such a mechanism can save you more than money, for when you're away on holiday, burglars will be fooled into presuming you are still at home when they see the curtains open during the day and closed at night. They will therefore think twice before selecting your house as a possible target.

Block diagram

To close curtains automatically a mechanical system is required, which relies on an electric motor. This article describes a control circuit for such a motor, but the mechanical section will differ from case to case and therefore design is best left to the individual. One motor is enough to close two curtains of the same width if they are activated/driven simultaneously with the aid of small chains. The best time to close the curtains is at dusk, for in winter the temperature drops as soon as it gets dark. In any case the lights will already be on, so that no energy will be lost by

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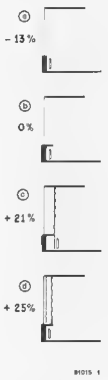

Figure 1. How to save heat by using curtains and window sills. Figure 1b shows the normal situation where no heat is saved.

2

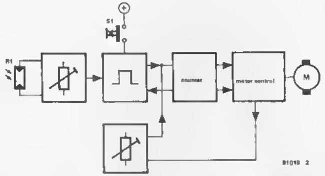

Figure 2. The block diagram of the automatic curtain control.

shutting out the dim half-light. Thus, an essential requirement is a switch that is sensitive to light. Of course, it should also be possible to operate the system manually.

The sensitivity of the system must be adjustable and the motor must stop automatically whenever the curtains are fully open or closed. This can be detected by micro-switches mounted on the curtain rails, but there is another method. When one of the extreme positions is reached the motor becomes overloaded. The curtains stop moving and the motor stops running. This causes the motor's back-emf (electro motive force) to drop and the current through the motor to increase. The increase in current can be detected and an adequate stop mechanism can be based on it.

The block diagram of the automatic curtain control is shown in figure 2. The light sensitive switch with an adjustable threshold is situated in the square to the far left. The circuit generates a pulse whenever the switching time is reached. This output pulse is fed to a logic circuit operating a counter. This counter takes care of the actual motor control and is

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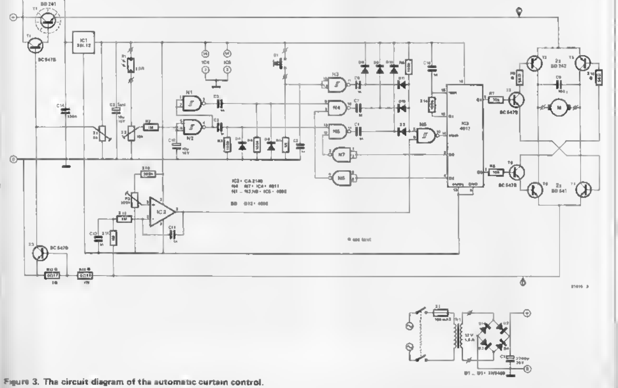

Figure 3. The circuit diagram of the automatic curtain control.

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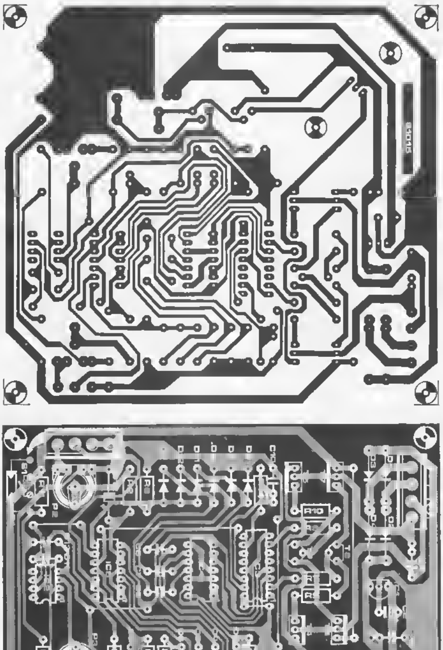


Figure 4. The printed circuit board and componant overlay for the automatic curtain control.

also connected to a detector. The detector establishes whether there is too much current flowing through the motor (the curtains are then in an extreme position) and then transmits a pulse to the counter. The counter then stops controlling the motor. In actual fact the counter acts like a memory in the circuit. It remembers in which direction the motor last turned and ensures that it turns in the opposite direction at the following start instruction.

Circuit diagram

Figure 3 shows the circuit diagram of the automatic curtain control. It is based on a motor which turns according to the direction of the current flowing through it, in other words, it is a DC motor. There are several suitable motors available on the market.

The motor control consists of a total of six transistors of which three conduct depending on the direction in which the motor is to turn. Transistors T8, T4 and T7 conduct when the motor turns anti-clockwise (left) and T9, T5 and T6 conduct in the other direction. The two output stages are controlled by IC3 (a 4017 counter). This counter receives clock pulses from either the switching circuit or from a pushbutton. These pulses are gated by N4 and N5 before being fed to the counter. These gates are in turn controlled by the counter itself via N8 and N7.

The counter can only count to four, for the O4 output is connected to the reset input. Whenever O4 goes high, the IC receives a reset pulse so that O0 goes high and all the other outputs go low.

Even when the supply voltage is connected to the circuit for the first time, the reset is activated automatically (via the network C10/R14). This causes one of the inputs of N5 to go low via N7, preventing the first clock pulse from reaching IC3 through N5. The first clock pulse to be received by the counter will be generated by the light sensitive circuit via N1, N2, N4 and N8 or via the pushbutton, N3 and N8. The clock pulse causes O0 to go low and O1 to go high. As a result, transistors T8, T4 and T7 start to conduct and the motor starts to turn anti-clockwise. The curtains close until their limit is reached. Resistor R12 and transistor T3 ensure that the current never becomes excessive while the motor is turning. This is because the voltage across R12 determines whether T3 is conducting. If so, T1 and T2 turn off and the motor no longer receives supply voltage.

The motor current also passes through R13. If the curtain is in the extreme position the back-emf of the motor will decrease and the current through it (and R13) will increase. This voltage is monitored by IC2 to see whether it exceeds a preset value (adjustable by means of P3). If it does, IC2 generates a new clock pulse for the counter via N8. Output O1 then goes low again and O2 goes high. One of the inputs to N4 is then taken low via N6 so that the former gate is inhibited.

When it starts to get light again a new clock pulse is generated which reaches the counter via N5 and N8. The O2 output of the counter then goes low and O3 goes high. Transistors T9, T8 and T5 then conduct and the motor starts turning in a clockwise direction. When the curtains are completely open IC2 will generate another pulse. Then O4 goes high and the counter is reset.

The circuit around N1, N2, N4 and N5 is designed so that a positive-going clock pulse is generated at every change in light intensity (from dark to light and vice versa). If the pushbutton is operated a positive pulse will also reach the clock input of IC3 via N3. The pushbutton allows the curtains to be brought into any (mid-)position as required. Press once to start and again to stop.

Parts list

Resistors:
R1 = LDR 1 M
R2,R5,R11,R15 = 1 M
R3,R4,R6,R14 = 100 k
R7,R8 = 10 k
R9,R10 = 56 Ω*
R12,R13 = 0Ω47/1 W*
R18 = 390 k
P1 = 5 k preset
P2 = 10 k preset
P3 = 100 k preset

Capacitors:
C1 = 2200 µ/25 V
C2 = 10 µ/16 V
C3 . . . C8,C10,C11,C13 = 1 n
C9 = 100 n
C14 = 330 n

Semiconductors:
T1,T6,T7 = BD 241
T2,T3,T8,T9 = BC 547B
T4,T5 = BD 242
D1 . . . D4 = 1N5408, BY 133
D5 . . . D12 = DUS
IC1 = 78L12
IC2 = CA 3140
IC3 = 4017
IC4 = 4011
IC5 = 4093

Miscellaneous:
S1 = pushbutton
Tr = 12 V/1,5 A transformer
M = motor 3 . . . 4 V
Z1 = 100 mA fuse
board fuseholder
heatsink for T1

* see text

Construction

It is best to use a DC motor with a (built-in) gearbox or similar reduction mechanism. Such motors are available from most model shops. The prototype is pictured in the accompanying photograph. The motor's voltage must be between 3 and 4 volts. The current passing through the motor will be about 800 mA during normal operation. The values of R9 and R10 can be altered to suit different types of motors. The following formula can be used to calculate their values:

$$\frac{U_{CD}}{R9 \text{ or } R10} = \pm 80 \text{ mA}.$$

When the motor voltage is 3 V, U_{CD} must be about 5 V and the value of R9 and R10 must be about 56 Ω.

The current threshold should be set to about 1.2 A. The limitation does not operate when the motor is running, but when the motor stops turning, after reaching the extreme position, the current will exceed 1.2 A.

The current threshold is determined by the value of R12. As soon as the current exceeds 1.2 A, T3 will conduct and T1 and T2 will turn off. The voltage across R12 must therefore become greater than 0.6 V. If the value of 1.2 A is maintained R12 will have to be about 0.47 Ω. The voltage across R12 + R13 is monitored by IC2 to determine whether or not the curtains have got as far as they can go. Usually, R13 will have the same value as R12. The adjustment range of P3 is large enough to preset the correct current threshold.

The printed circuit board designed for the automatic curtain control is shown in two perspectives in figure 4. Transistor T1 must be provided with a sufficiently large heatsink. Room has been reserved for this on the board. The other transistors do not require heatsinks.

Of course, the finished curtain control will look different for each individual system. It is up to the constructor to find the easiest solution to complete the mechanical section.

To achieve a good switching sensitivity, the LDR must be mounted in such a place that the light intensity outside the house is measured. The site must be chosen so that street lights and passing cars, for instance, have no effect on the circuit. And, of course, the LDR must not be placed in the artificial light of the living room.

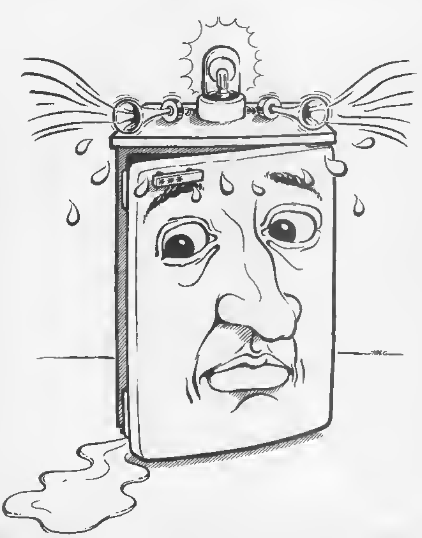
For those of you who think that this is all rather complicated another solution is to place a time switch either in parallel to or instead of S1 to enable the curtains to be opened and closed at pre-determined times. ◼

Literature:
Documentation sheet 106 by TNO, 'Saving energy with curtains'.

fridge alarm

'freeze' energy

Most modern fridges are made up of thick layers of insulating material to reduce energy consumption to a minimum. Even so, however well the fridge is insulated, if the door is opened frequently or left open for longer than necessary no amount of insulation will keep costs down.



It is easy to see that however careful the family is when going to the fridge, the chances of the door being left ajar, for quite lengthy periods, are fairly high. We are informed, from a reliable 'sauce', that on occasion things can become somewhat hectic during cooking and checking to see whether the fridge is closed would not be on the list of high priorities. Understandable, but expensive all the same. Thus, some kind of warning device to attract your attention to the open fridge door would be a great help.
The alarm circuit here is activated by the fridge interior light, that is, whenever the door is opened. The alarm will remain silent for a preset period of time after which it will emit a high pitched tone every two seconds.

Block diagram

The block diagram for the fridge alarm is shown in figure 1. The simplest method of triggering the alarm is to measure the light level inside the fridge, since opening the door will turn the light on. A light dependent resistor (LDR) is used for this purpose in the Elektor fridge alarm since they are fairly cheap and readily available. The LDR switches the power to the alarm circuit by means of a series pass transistor.
The first part of the circuit is a timer which has an adjustable delay period of between 5 and 30 seconds. Once the preset time has elapsed, a low frequency oscillator will start to generate a short pulse every two seconds. This in turn controls a second oscillator so that a tone is emitted by the loudspeaker every two seconds. The pitch of the second oscillator can also be varied.

Circuit

The circuit diagram of the fridge alarm is shown in figure 2. Very few components are required and it is constructed around a single 4093 IC. The power supply is provided by a 9 V battery. The series transistor T1 is connected in the positive supply lina. The base of this transistor is connected to the voltage divider consisting of R1, R2 and the LDR (R3). The base drive voltage therefore depends on how much light falls on the LDR. The variation in resistance between 'dark' and 'light' is sufficient to make the transistor conduct.
As soon as T1 starts to conduct the rest of the circuit receives power and C1 charges up via R4 and P1. This, of course, takes a certain period of time which is adjustable by means of P1. When C1 is sufficiently charged, pin 1 of N1 will be 'high' and the oscillator constructed around N1 will start up. The output of N1 will then go low for a period of time determined by the values of R6 and C2 and will go high

for a period determined by the values of R5 and C2.
With the values shown, the output will be high for about 2 seconds and low for about 0.3 seconds. This signal is then inverted by N2 to provide a trigger pulse for the second oscillator. This second oscillator is constructed around N3 and its frequency may be varied between 3 . . . 10 kHz by means of P2. The output signal (or 'burst' signal) from N3 is inverted by N4 before being fed to a darlington transistor. This transistor provides sufficient signal amplification for the loudspeaker.
A special piezo 'buzzer' (TOKO) could also be used instead of the loudspeaker and output transistor. In this case the components R8, R9, T2 and the speaker may be omitted.

Construction

Construction of the circuit should not pose any problems, especially if the printed circuit board shown in figure 3 is used. The completed board should be mounted in a plastic case as the whole unit must be placed inside the fridge. One battery should last for one or two years, so there is no need to make any complicated mains power supply connections.
It is advisable to mount the LDR case.

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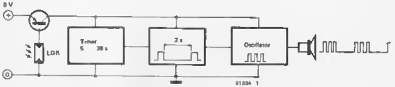

Figure 1. The block diagram of the fridge alarm.

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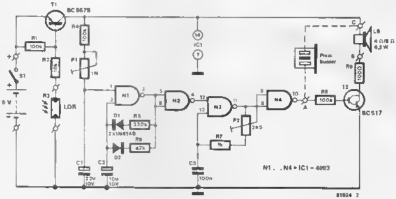

Figure 2. The circuit diagram of the fridge alarm. The 'delay' time can be altered with P1 and the tone frequency can be adjusted with P2. If a piezo buffer is used then P2 will have to be adjusted to give its resonant frequency (about 4,6 kHz). The buzzer will then produce the ideal volume.

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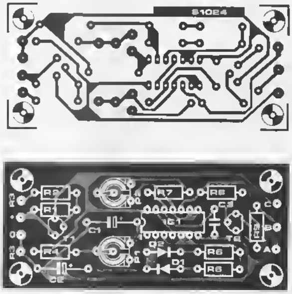

Figure 3. Component overlay and track pattern of the printed circuit board for the fridge alarm.

Parts list

Resistors:
R1,R4,R8* = 100 k
R2 = 10 k
R3 = LDR
R5 = 330 k
R6 = 47 k
R7 = 1 k
R9* = 100 Ω
P1 = 1 M preset potentiometer
P2 = 2k5 preset potentiometer

Capacitors:
C1 = 22 µ/10 V
C2 = 10 µ/10 V
C3 = 100 n

Semiconductors:
T1 = BC 557B
T2* = BC 517
D1,D2 = DUS
IC1 = 4093

Miscellaneous:
LS = loudspeaker 8 Ω/0.2 W
or TOKO buzzer type PB 2720

* see text

know the ins and outs of your central heating

Before fitting up your central heating system with all sorts of energy saving circuits, it might be a good idea to find out how such a system works. It happens quite often that a considerable amount of energy can be saved by conventional means. To start with, the heating system should satisfy particular needs and its individual parts should be well adjusted to each other. This may seem a platitude on the face of it, but in practice things have been found to turn out quite differently.

Nowadays where the reigning motto seems to be 'the more complicated, the better' and just about everything from sewing machines to cameras is controlled by electronics, a central heating system appears delightfully simple in construction. In fact, you may wonder what on earth there is to say about it. It consists of a boiler in which water is heated, a pump to transport the hot watar to a number of radiators throughout the house which in turn heat up the air in the rooms and finally a thermostat to switch the boiler on and off.

That last component, the thermostet, however is something we wish to draw your attention to, for many people are not aware that there are a number of different types. There are wall or room thermostats, radiator thermostats, ones with or without a presettable pre-heating element. Research has shown that in many cases the thermostat used either just does not go with the heating system or has been incorrectly preset.

Let us take a closer look at the various types.

Room thermostats

Wall or room thermostats are either two of three wire versions. We'll come back to the difference between them later. The two wire version is by far the most common.

Both types contain a temperature sensor and a switch. For the sensor a bi-metallic strip is usuelly used end the switching function is generally provided by a mercury switch. The thermostat's case is made in such a way that the surrounding air can easily pass through. If the room temperature drops below a value lower than the preset level, the switch will close and turn the boiler on. When the temperature rises above tha set level the heating is switched off again.

In practice, the necessary difference in temperature between the 'on' and 'off' point (1 or 2 degrees) is too great. The moment the heating is switched off, a fair amount of heat in the system is 'under way' so that the room temperature will rise higher. As far as the switching on point is concerned, the opposite obviously happens. This delay causes unnecessarily large fluctuations in the room temperature, which is illustrated by the curve in the drawing of figure 1.

The thermostat here is preset at 20°C. The 'on' and 'off' switching points are at 19.5 and 20.5°C respectively. If the heating is switched off at e room temperature of 20.5°C, there is still enough hot water in the system to allow the temperature to rise to about 22°C before starting to drop. When the heating is switched on, the opposite occurs. In other words the room temperature will vary between 18°C and 22°C. Very inconvenient and a waste of energy.

To bring the 'on' and 'off' points closer to each other, an 'anticipation' device is incorporated in the bi-metallic strip. As a result, the boiler is switched off sooner than the switching-off temperature is reached. What we now have is a kind of thermostat 'with initiative' which calculates the delay effect beforehand.

The curve in figure 1 describes the reduction in room temperature fluctuations when a heat 'anticipation' device is used. Whereas the 'ordinary' thermostat switched on and off twice per hour, now it will switch six times. As a result the room temperature remains fairly constant and nearer the preset level.

As previously mentioned, there are differences between the two and three wire thermostat versions, in the three wire type the 'anticipation' device (a heating element) is switched in parallel to the control circuit. In the two wire version, however, it is switched in series with the electrical gas control valve, so that the current through the valve passes through the device as well. Since the current consumption of such e valve will vary according to the type of heating, the device will either have to be adjusted to the system, or be mede presettabla to ensure the heat generated is at the right level. Thus, although two wire thermostats all include a non-presettable device (they are set by the manufacturer), the two wire version can be obtained with or without the preset feature. The non-presettable are designed for a specific system. The value of the device is usually mentioned somewhere on the inside of the thermostat and needs to correspond roughly to the current consumption indicated on the electrical gas valve.

Some non-presettable types include a voltage stabiliser, so that the amount of heat generated by the device does not depend on the current passing through the valve. The presettable version can be adapted to the current consumption of the gas valve with the aid of a small lever. Figure 2 gives an example of this. The scale division may vary according to the manufacture, but usually the preset range will be between about 0.1 and 1A. Weighing up the pros and cons of both systems, the two wire presettable type has important advantages. It is compatible with most types of central heating, so that if the boiler is changed, it merely has to be readjusted. This also means that if the system is not perfect, it can always be (slightly) modified.

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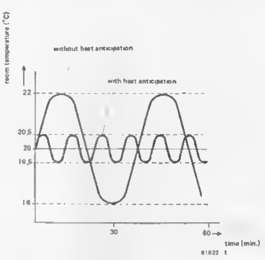

Figure 1. The delay in a central heating system can be reduced by providing the thermostat with an anticipation device.

Choosing the right system

The above description by no means implies that all you need is a good room thermostat for the central heating to work properly. An ideal compromise between comfort and economy is usually very hard to reach. Let us for instance look at an 'ordinary' system using a room thermostat based on a minimum outside temperature of −12°C and a room temperature of 22°C. Let us suppose the temperature outside varies to see what happens to the heat generated inside the living room and the bedroom at a required temperature of 15°C.

When the temperature outside is −12°C, the difference in temperature between indoors and out will be 22 + 12 = 34°C with respect to the living room and 15 + 12 = 27°C in the bedroom. This is the situation on which the power of the radiators is based. If, for example, the outside temperature rises to −4°C, the difference in temperature will be 26°C for the living room and 19°C for the bedroom. The living room requires heat to be generated with respect to the former situation in a ratio of $\frac{26}{34}$ = 0.76.

Since the heat production is regulated in the living room, the same 0.76 ratio will apply to the bedroom. The question is now whether this is necessary. If we consider this room in the two situations, the former will give us Δt of 27°C and the lattar (−4°C) Δt of 19°C. The heat *requirement* ratio will therefore be $\frac{19}{27}$ = 0.70. Quite a difference from that 'forced' on it by the living room!

Things are different when the outside temperature rises to +6°C. Tha Δt for the living room will then be 22 − 6 = 16°C and 15 − 6 = 9°C for the other room. When the system is based on an outside temperature of −12°C, the living room will have a heat requirement ratio of $\frac{16}{34}$ = 0.47. The bedroom will again have this ratio forced on it, since temperature is regulated in the living room. This actual requirements are in a ratio of $\frac{9}{27}$ = 0.33. Clearly, it is overheated. The best way to save this energy is to instal a radiator thermostat.

Radiator thermostats

A radiator thermostat stops the hot water supply when the required room temperature has been reached thereby maintaining the room's temperature at a constant level. When used efficiently, radiator thermostats ensure additional comfort and an effective system. One practical system consists of the following: 'Ordinary' radiators including air valves are installed in the living room. A room thermostat is also installed to act as a central switch for the whole house. Radiators including radiator thermostats ara placed in the rooms where the temperature is to deviate from that of the living room. This means it is now possible to regulate the temperatura separately here. At least, provided a few things are borna in mind, for if radiator thermostats are to function properly, they must fulfil two conditions:

Firstly, the radiator will have to be a little larger than is strictly necessary, for otherwise the thermostat would be continually open and thus totally useless. Secondly, the circuit must produce hot water — if the living room doesn't require any heat, there won't be any available for the rest of the house either and there is nothing a radiator thermostat in the bedroom can do about it.

A system like the one described is very economical and, provided it is well balanced — it comas close to the 'ideal compromise'. Sometimes, however, it may not provide enough warmth. If, for instance, the living room is additionally heated by the sun through the the entire system will become colder because the room thermostat will demand less warmth. Thus, a study which is used during the day and which happens to be in the shade will become very cold indeed.

In the latter case, it will mean heaving to increase the energy consumption in favour of a little more comfort. This can ba done by replacing the room thermostat with radiator thermostats in avery room, including the living room and in addition use a control system that is weather dependent (outside thermostat) as a pre-regulator. The latter needs to be preset so that the desired temperature is achieved in every room, winter and summer. The rest of the temperature regulation will now be taken care of by the radiator tharmostats. This system costs a little more, energy-wise, but is ideal as far as comfort is concerned.

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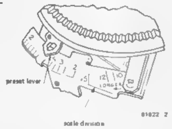


Figure 2. In the case of the two wire thermostat, the 'anticipation' device can usually be regulated.

Avoiding waste

When a room is being heated by a radiator and radiator thermostat, more heat will be provided than is actually needed in most cases. In a system partly equipped with radiator thermostats a night reduction of 5°C, for example, can be introduced on the thermostat in the living room, but the irritating delay problem will crop up again. This is because it will take thermostatically regulated radiators some time to lose their excess in hot water before the room temperature will drop. Furthermore, that delay will be smaller then the preser 5°C. If in a certain room the radiator happens to be much bigger than necessary, the night reduction may not take effect in that room at all. (This could be useful — think of a night childs room). The reason for this is that even the reduced amount of heat available is still to great for that radiator. The thermostat cannot change this, since it can only cut down on the amount in axcess of its preset value.

This is therefore a clear exampla of energy being wasted. It can be avoided by making the night reduction much larger, or by presetting the radiator thermostats at a lower level at night too. Anothar form of wastage occurs when bedrooms are aired. The radiator thermostat must in any case be set at its minimum level, but even then the effect will not be the same as when a radiator tap is closed. If the outside temperature is lower than the minimum level of the thermostat (in winter) the radiator will start giving off heat while the room is being aired. Although it is difficult to avoid this dissipation, there are ways to reduce it to a minimum. In the first place of course by making sure the airing does not take too long. In the second by mounting radiator thermostats with various minimum ranges, using the lowest when airing the room. A crafty solution is to cover the thermostat with a cushion so that it can't feel the cold outside air.

A word on radiators

If a room is heated by a radiator system, the warmth will not only depend on the air temperature but also on the radiation factor. Both will have to be as constant as possible. If the temperatura throughout tha house is regulated by a room thermostat that fits in well with the system and this contains in addition a considerable amoutn of water, it is possible to maintain the temperature of the water within certain limits enabling the radiators to produce a fairly constant output.

Things are different when as often is the case nowadays, radiators with very low water contents are applied. When the heating is switched on, these heat up very quickly and so radiate a lot of heat. When the room cools off, howaver, they become cold very quickly, which isn't very pleasant. To remedy this the thermostat is usually set at a higher level (at 22 or 23°C). If the heating is switched on again, it will again cause discomfort as the radiators will now give off too much heat. Thus, although such radiators react to changes very rapidly, the result is that you are either too warm or too cold.

Radiators with a minimum water contents ara therefore not suitabla, in systems where the temperature is regulated by means of a room thermostat. They are however useful in systems regulated on the basis of a constant pipe temperature such as a weather dependant control system.

Conclusion

We have reached the point now thet we can set up a list of general requiremants, the fiva commandments for any central heating user:

1. Always start by checking the special needs with regard to heating in the home. Only then can you find out what the idaal system would be. Is an 'ordinary' systen with a single room thermostat suitable? Do certain rooms perhaps raquire a radiator thermostat?
2. Make sure the right type of radiator is being used. 'Fast' radiators have disadvantages as well!
3. Don't be too stingy about the installation costs. Technicians have a hard enough time as it is what with amateurs trying to set up their own systems. More often than not radiator thermostats are wrongly mounted. The sensor mus not be situated in the rising warmth of the pipe or near the radiator itself and will therefore scan a totally wrong temperature. What also sometimes happens is that people forget to include a bypass pipe between supply and return in a system where all the radiators are fitted with thermostats valves. When all the valves are 'closed', no water movement will be possible in the circuit and the pump will ovarheat. Extremely bad for the pump, not to mention the boiler.
4. If tha system has a two wire non-presettabla thermostat check whethar the 'anticipation' device matches tha currant consumption of the electrical gas valva. This check will not ba necessary if it is a thraa wire typa.
5. If the thermostat involves a presettable haat anticipation device, you will have to check whether the preset corresponds to tha current value indicated on the gas valve. Sometimes it may be necessary to introduce a slight correction. If, for instance, the system is correctly regulated and the delay effect appears to be such that the thermostat only switched on and off once or twice during the space of ona hour, it is often bettar to set the device at a lower value, by way of experiment, than the level indicatad. Generally speaking an efficient system should switch about 5 or 6 timas an hour for the room temperature to be maintained at a constant level. ■

december....

With Christmas and the festive season in mind, the December issue of Elektor promises something completely different.

The whole of the magazine is devoted to circuits designed entirely for fun with hardly a hint of any serious note at all. Some of the circuits are outrageous, even crazy, and strangely enough a few are extremely useful, but without exception, all are very ingenious.

They do however, all have one similarity, they are all designed to fit a common case.

What are they? Simple, they are circuits that can . . . . .

But that would be spoiling the fun! Buy the December issue and find out for yourself, we guarantee you will enjoy it.

(They will be on the Elektor stand at Breadboard, come and see us, you're welcome.)

missing link

Nicad charger

Elektor 63/64 Summer Circuits 1980, circuit 49. The value of R3 should be 82 Ω, not 82 K!

*

VFET amplifier

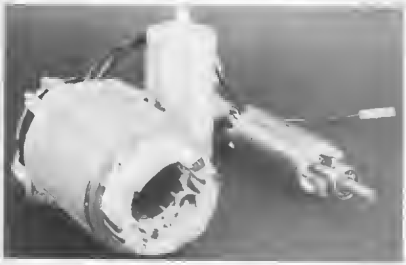
Elektor 63/64 Summer Circuits 1980, circuit 14. The substrate of IC1 (pin 13) must be connected to −36 V to maintain insulation between transistors and to provide for normal transistor action.

*

Car alarm

The car alarm device which was published in Elektor's April issue ('Stop Thief') p. 4-28, unfortunately does not work exactly as described. With the alarm switched on, the engine stalls automatically after a few seconds, but it cannot then be started again — unless the 'hidden' switch is operated, of course. In order to 'simulate engine trouble' — so as to drive any prospective thief 'up the wall' — it is best to replace R1 by two 47 k resistors in series; the junction between these two resistors is then connected to pin 7 of the IC

energy-saving motor control



Improved motor control systems can cut consumption down by 50%. Incredible as it seems, this is perfectly true under certain circumstances in some of the biggest domestic appliances, such as fridges, ventilators and washing machines, for instance.

How can such motors be made to run more economically? When a fridge is designed all the worst possible events that could occur are taken into consideration. If for instance the mains voltage were to drop to 200 volts, the fridge should still continue to work. As a result of this foresight the motor chosen will more often than not be larger in size than strictly necessary. What happens is that they are not often 100% loaded so that a considerable amount of energy is irretrievably lost in the form of heat. The less loaded a motor, the higher the percentage of energy wasted. In completely unloaded motors up to 50% can be saved, whereas this is impossible if they are fully loaded.
An improvement in this situation is nothing new and in fact industry has been making use of energy-saving motors for years. The present circuit, however, is based upon a radically different principle, for it gets rid of the source of the evil rather than correcting it later on with the aid of large capacitors switched in parallel, which is how the problem is normally taken care of.

How does a motor work?

Not all motors can be made to run economically. With the short circuit armature type, and luckily most domestic motors belong to this category, it can be done. This type of motor consists of a fixed ring of coils inside the case to generate a rotating magnetic field.
The rotor is made of iron to be highly inductive. The rotor also contains a certain amount of copper wire in the form of an armature, the ends of which are connected together, in other words, a short circuit. The whole system may be regarded as a transformer in two parts. One half contains the case with the coils (the primary of the transformer) and the other is constituted by the rotor with the copper wire (the secondary side). The primary and secondary are separated by an air gap, but provided this is not too large, the device will still act like a transformer.
The secondary winding (the rotor) is short circuited! As soon as a voltage is connected to it, the primary will generate a field. This causes a voltage in the secondary as well, but since it is short circuited a large current will be generated. A wire situated in a magnetic field through which a current is passing will exert a mechanical force in a certain direction, according to elementary physics. The wires in the rotor are therefore pushed aside and the rotor starts to turn . . .
The field generated by the 'primary' rotates at a speed dependent on the frequency of the mains and on the way in which the motor is wound (the number of 'poles'). In any case the speed of this field will remain constant. The rotor will now be subjected to a magnetic force and unless it is braked it will start to rotate faster and faster until it is turning at the same speed as the field. At this point it will keep up with the field and so the latter will appear to it to be standing still, no longer changing. A non-changing field will however not cause induction, so that the current through the wires will decay and the rotor will no longer be driven. The rotor will of course still have some friction in the bearings and the speed will therefore drop slowly. Then there will be a difference in speed between the field and the rotor and the latter will be held at the same speed.
In actual fact, the above process happens very gradually. In a non-loaded state the rotor turns practically as fast as the field, so that it will hardly be driven at all. If the load of the rotor is increased, the driving power must also be greater. This can only be done if the rotor slows down to allow a magnetic force to affect it. Figure 1 shows a graph in which the relationship between speed and load is clearly apparent. The difference between the speed of the field and that of the rotor is termed slip. In a non-loaded state the slip will be slight; the more load, the more slip. If the motor is overloaded, the speed will drop suddenly. On the other hand, some motors are designed in such a way that the torque will continue to increase for a very long time (curve B). Most motors feature the characteristics of curve A. When there is a nominal load (the 100% line) the speed will drop between 5 and 10%.

How energy can be saved

Now we know the basic principles behind a short circuit motor, but still not how to save energy. The simplest solution is to carry on considering the motor as a transformer. In a non-loaded state a transformer will still (unfortunately) consume energy. This is because when it is connected to mains, the current throuth the primary winding will cause the core to become magnetised. The supply voltage is alternating and as the voltage increases an increasingly powerful field will be generated. When the voltage drops, the energy 'stored' in the magnetic field will be released. This causes the current through the coil to lag by 90° on the voltage. In practice, however, power will be consumed, because there will be losses. Dissipation incurred when the core is magnetised and resistance in the windings (through which the current is passing). An unloaded transformer is useless and guarantees a 100% loss. If the transformer is fully loaded a little energy will be dissipated, but the produced to lost energy ratio will keep improving until a maximum level at full load.

The same is true of the short circuit motor: unloaded all the energy entering the motor will be lost, whereas the increasing the load will improve its performance. The best and most economical performance is achieved at maximum load.

One problem still remains to be solved, the relation-ship between performance and cosine φ. The motor speed dictates how much the current lags behind the voltage. This is defined by the term cosine φ. This has the added advantage that cosine φ can be directly multiplied with voltage and current to determine

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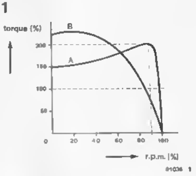

Figure 1. The relationship between the number of revs and the torque (the 'power') of a short circuit motor. 100% stands for the load at which the motor may rotate continuously under normal conditions. Most motors will feature a curve like curve A. They cannot be regulated very well; even with the motor control, starting-up may give some trouble. Motors featuring the B curve on the other hand are much easier to control.

the power in calculations.

If a motor is not consuming energy although an alternating voltage is connected to it, the cosine φ can only be zero according to the above formula (for current and voltage are *not* zero). Expressed in a simplified manner this means that energy is stored in the magnetic field and is later generated causing a current which is exactly 90° behind the voltage. In the ideal situation where all the electrical energy taken in is converted into mechanical energy without involving any dissipation, the cosine φ will equal 1 and voltage and current will be exactly in phase.

The true state of affairs is somewhere between these two extremes: the cos φ varies according to the amount of load and can be used to indicate the performance of a motor. With the aid of a circuit which ensures that cos φ remains constant, a motor will always run at maximum efficiency.

A second possibility would be to apply a real rev counter control. The motor will then continuously run at full load, so that performance will always be at optimum level.

The circuit

The circuit in figure 2 can be experimented with. The idea is to use the control only with motors which are more or less constantly loaded, or at least do not suddenly change in load. The circuit reacts too slowly a very rapid change in power intake, with the danger that the motor might stop.

The amplifiers in the 3900, A1 . . . A4, generate a sawtooth waveform synchronised to the 50 Hz mains supply. A3 is used to measure the current. The current causing a drop in voltage across R9 is converted into a square wave. At the output of A3 the square wave is compared to the square wave output of A1 derived from the mains. After diode D2 the voltage will then be a parameter for the phase shift between voltage and current. This voltage is integrated through several 50 Hz cycles by means of A4. A5 compares the voltage from A4 with the sawtooth orginated by A2 and switches on the triac via T1.

The operation is illustrated in figure 3:

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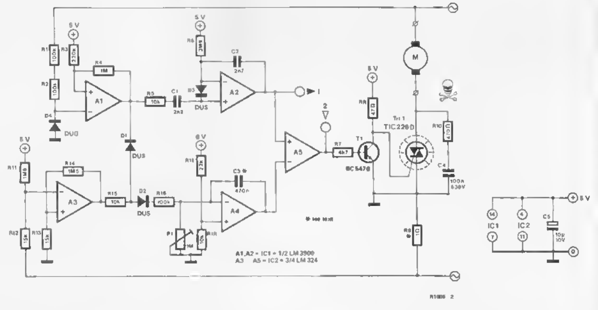

Figure 2. If you would like to experiment with the motor control system, this diagram will show you how. The mains earth may not be connected to the circuit's ground (so use a plastic case). An oscilloscope to examine the various wave forms is an absolute requirement.

square wave voltages are produced out of voltage and current. Only if the two outputs are both 'high' at the same time will a current be able to flow into integrator A4 by way of D2. The pulse width of this signal will be equal to the shift between voltage and current. About 1/3 of the supply voltage will be at the non-inverting input of A4, whereas the inverting input will be grounded by way of P1, except when a pulse is generatad via D2. A DC voltage level will appear at the output of A4 which will remain constant provided tha average value of the signal at the non-inverting input is equal to that at the inverting input.
If the φ decreases (more motor load), the average signal at the inverting input will be reduced and the output voltage will therefore rise. This will cause the triac to be triggered sooner and the motor will therefore receive more power. A4 continues to regulate the system until the average voltages at its inputs are about equal again. Due to the large time constant of this integrator stage regulation happens gradually, rapid changes in load (and thus in the φ) cannot be followed.
The value of R9 depends on the current intake of the motor. A voltage drop of 0.35 (effective) across it is sufficient. Check this with a multimeter. P1 sets the required angle. Thus must be done slowly owing to the delay in reaction mentioned before. Check that the setting does not prevent the motor from starting up. C3 determines the integration time and can be increased in value if the motor does not run smoothly.

Conclusion

The circuit described here shows how much energy can be saved with electronics. When testing it is advisable to use an old motor and to wait until you're absolutely sure it works properly before inserting the circuit into your appliance.
Progress continues to be made in this field. It won't be long before an IC will ba available with all the components required integrated on a single chip!
The principle of this energy-saving mathod was inventad by Mr. Nola, a gentleman working for NASA. He is bound to have takan out a patent for it.

3

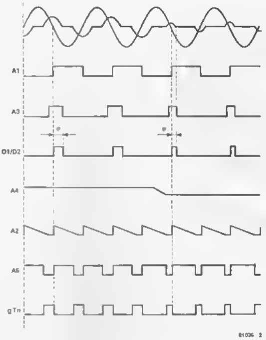

Figure 3. The wave forms pertaining to the diagram shown in figure 2. The change in output of A4 has been drawn too short due to lack of space; in practice this will last for quite a few cycles.

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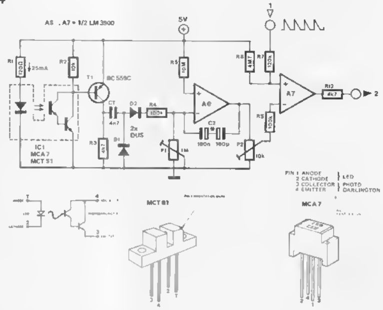

Figure 4. In our test circuit we used a paper disc with black and white stripes which were illuminated by LED D1. The reflected light was detected by the photo darlington T1. The speed may be adjusted with P1. P2 has been added to limit the maximum speed. C1 (4n7) determines the maximum input frequency of 150 Hz. By modifying C1 it is also possible to deal with other frequencies. A frequency that is twice as high will require a capacitor of half the size. C2 determines the regulation constant, the time delay it takes the circuit to react. This must be matched to the motor to ensure smooth running. If C2's size is to be such that an electrolytic capacitor is to be chosen, it is necessary to use two as drawn.

coffee machine switch

Did you know that even your coffee machine could save energy? With the aid of this clever little circuit it can make up for its user's forgetfulness, namely, by switching off the hot plate as soon as the coffee pot is picked up. A warning signal is then sounded, so that if the remaining coffee is to be kept warm a button must be pressed.

More and more people are taking to drinking coffee these days and coffee machines certainly prepare a good cup efficiently. They even keep your second cup warm for you. The trouble is, you don't always want another cup, which means a fair amount of electricity is going 'down the drain' — 500 watts to be exact.

This circuit switches the hot plate off automatically whenever the coffee pot is removed. When it is replaced a buzzing tone is heard as a reminder that the plate is no longer 'on'. If the coffee is to be kept at drinking temperature e button will have to be pressed.

A micro switch is mounted on the machine in such a position that it will be closed when the coffee pot is on the hot plate and open when it is removed. When switching on the coffee machine, the push button has to be operated to heat up the hot plate. This continues until the coffee pot is taken away, it then switches off. When the pot is put back, a buzzer sounds for a second as a reminder that the coffee will no longer be kept warm. If more coffee is to be drunk later, a button will have to be pressed. Then the hot plate will be 'on' until the coffee pot is removed again. In other words, the circuit is an 'active warning device'. First it is activated (switches off) and then it issues a warning (buzzes).

The circuit

The circuit shown in figure 1 has been kept as small as possible to enable it to be incorporated in the coffee machine. It can be split into two parts: an electronic zero-crossing switch (everything behind the opto-coupler IC2) and the section in front of it that detects the coffee pot and gives the warning.

Switch S1 is the micro switch which detects the presence of the coffee pot and is closed when the coffee pot is on the plate. The output of the flipflop built up with N2 and N3 has however not yet been defined. Operating push button S2 causes the output to become low. Then T2 will conduct and LED D3 (optical indication) and the LED in the opto-coupler will light. The thyristor in IC2 can then switch on the triac TR1 via the diode bridge D4 . . . D7. Due to the presence of transistor T3, the photo thyristor can only switch on at the beginning of every half cycle of the mains supply. When the mains voltage reaches about 20 V, T3 will start to conduct causing the gate and the cathode of the photo thyristor to be short circuited so that this will switch off.

When the coffee pot is removed, S1 will open causing the flipflop N2, N3 to swing round and T2 to close. The photo thyristor will no longer be illuminated and the hot plate will be off.

S1 will close again when the coffee pot is put back. During the RC time of C1 and R2 the output of N1 will become low so that transistor T1 will conduct and the buzzer will sound. With the values of C1 and R1 chosen here the buzzer will continue for about one second. Depressing S2 causes the output of the flipflop to become low again, T2 to conduct and the triac to switch on the hot plate.

Since the position of the flipflop depends on S1 *and* S2, the plate can only be switched on if S2 is operated after the coffee pot has been replaced.

The supply is very modest; a small

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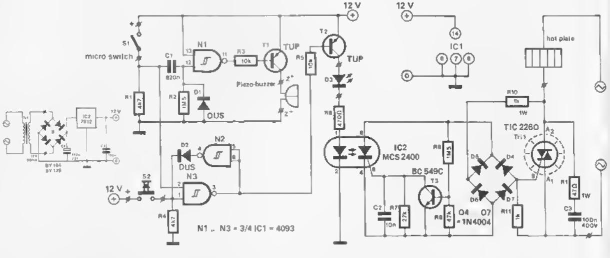

Figure 1. The circuit diagram of the switching-off device. To the left of the opto-coupler the low-voltage section takes care of detection end to the right the high-voltage section switches the circuit on during the zero-crossing.

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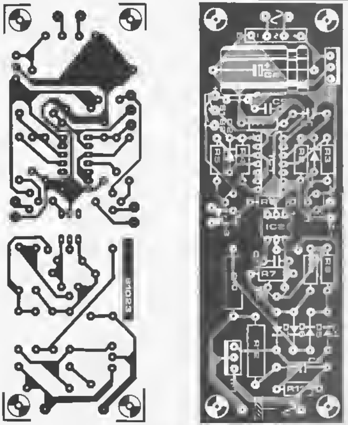


Figure 2. The component layout for the switching device. Only the transformer is yet to be included. It has been kept as small as possible in size so that it will easily fit into the coffee machine.

Parts list:

Resistors:
R1,R4 = 4k7
R2 = 1M5
R3,R5 = 10 k
R6 = 470 Ω
R7 = 27 k
R8 = 1M5
R9 = 47 k
R10 = 1 k, 1 watt
R11 = 1 k
R12 = 47 Ω, 1 watt

Capacitors:
C1 = 820 n
C2 = 10 n
C3 = 100 n/400 V
C4 = 470 μ/25 V
C5 = 100 n

Semiconductors:
T1,T2 = TUP
T3 = BC 549C
D1,D2 = DUS
D3 = LED
D4 . . D7 = 1N4004
IC1 = 4093
IC2 = MCS 2400
IC3 = 7812
Tr1 = TIC 226D

Miscellaneous:
transformer 12 V, 50 mA
bridge cell BY 164, BY 179
Piezo-electric buzzer 12 V
S1 = micro switch
S2 = pushbutton 1 x type
heatsink for the triac

transformer, a bridge, a voltage regulator and a few capacitors.

The circuit board and construction

The layout of the printed circuit board is shown in figure 2. One half contains the high-voltage section and the other low-voltage section with the opto-coupler between them. If there is enough room in the coffee machine, the board including the transformer can be built in. This is the most simple solution. The primary side of the transformer can be connected to the mains switch of the coffee maker. The two triac connection points on the board should then be connected in series with one supply lead to the hotplate. It should be noted that the triac will require a small heat sink to prevent it from becoming overheated.

Push button S2 is mounted on the coffee machine where it can be clearly seen and then a suitable place for the micro switch must be found. This will call for a little experimenting, for the coffee pot is not usually in a fixed position on the plate. It will largely depend on the design of the coffee maker, of course, but one method is given in figure 3 as a suggestion. No doubt our readers will devise other highly ingenious methods, as usual.

Should there not be enough room in the coffee machine, the board can be housed in a separate case together with switch S2. This has the disadvantage that it will require a cable between the machine and the case. It will have to be taken into account that half of the circuit board is carrying supply voltage and so extreme care must be taken.

Finally, a word on the buzzer. This is a piezo ceramic type with a low current consumption (only 15 mA). This is the only way to keep the circuit small and yet produce a loud enough tone. ◼

3

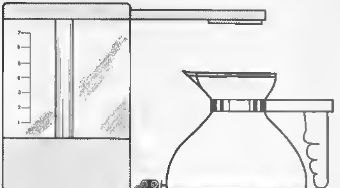


Figure 3. The drawing shows where to place the micro switch. The coffee pot is not in a fixed position on the hot plate, which will have to be taken into account.

what is your central heating costing you?

operational hours counter

In the case of a device which only operates now and then, such as a central heating boiler for instance, it may be interesting to find out the true number of effective operational hours. For then the energy consumption per hour or the life of certain components can be calculated. This article describes an electronic operational hours counter which uses very little energy.

If it is known how many hours a central heating system (whether gas or oil) is in operetion, it is a simple matter to determine how much energy can be saved by turning off one or several radietors. The number of operetional hours can also indicate the correct time to switch from the day thermostet to the night and vice versa.

When experimenting with the radiators all that is needed to errive et the most efficient setting, is e comparison of the number of operational hours before end after adjustment. The different totals of operational hours per 24 hours will be in the same ratio as the energy consumption levels to each other. Obviously, the ebsolute value of the amount of energy consumed can also be calculated. If the heating system is oil fired that will be eesy since the heating boiler is usually the only consumer unit connected to the oil tank. The number of litres used can be divided by the number of operational hours in order to obtain the amount of litres per hour. By multiplying that amount with the price per litre, the cost of an operational hour will be found.

As far as gas systems ere concerned, it is often a little more complicated to calculate the price per hour because several systems (gas oven, fire) will be connected to the one gasmeter, so that the centrel heating system's consumption cannot be calculated separately. One method would be to switch off the other gasappliances, leaving the central heating on, and then read the gas meter for a period of, say, ten minutes. This cen also be calculated per operational hour. To find out the centrel heating costs per quarter the operational hours counter cen be used.

In order to determine the correct time to switch the thermostat from the dey to the night level and vice versa, the minimum number of operational hours in the dey time during which the house is comfortably warm can be empiricelly established.

The block diagram

Figure 1 shows the block diagrem of the operational hours counter. The input of the circuit is connected in parellel to the thermostat switch. When closed, this switch sterts an AMV (astable multivibrator) which has an output frequency of ebout 4.5 Hz. Its output signal reaches a divider which divides the signal by 2^{14} so that one pulse per hour is available. The output of the counter will be the number of clock pulses in binary. The outputs can be reed with LEDs to make the information visible. Using a single LED for the reading may involve some calculation work, but on the other hend current consumption will be a lot lower. If the LED is used to indicate the output information via a pushbutton switch, the power consumption will be even less.

The circuit diagram

The circuit diagram of the operational hours counter is given in figure 2. Again with a view to saving energy CMOS-ICs ere used. When the thermostat switch is open, C1 is charged. A1 will then be closed and the reset input of the 7555 will be grounded so thet the AMV will be off. The hours counter will likewise be off. As soon as the thermostat switch closes, C1 will be discharged across R2 opening A1. Pin 4 of the 7555 is then taken high end the AMV will start to operate. Its frequency should be set to 4.5 Hz with the aid of P1. Pin 3 of the 7555 is connected to the clock input of IC2. The Q14 output of this IC will generate a pulse every hour if the AMV is properly regulated. Thus, IC3 will receive e clock pulse every hour.

At the first clock pulse the output Q0 will become high. At the second Q1 will become high end Q0 low again and so on in a binary format. For those reeders who are not too familiar with binery, the values of all twelve outputs are given in the table. If several outputs are '1', the (decimal) values of those outputs ere added to each other. Thus, 000001010010 : 2 + 16 + 64 = 82 hours. The LED D3 will indicete which outputs ere high when pushbutton S2 is operated. The switch S3 enables each output to be selected in turn. If a selected output is high, A2 will be closed and the LED will light when S2 is depressed. If en output is low, A2 will be open and the LED will not light, even if S2 is depressed. Depressing S1 will cause the counter to be reset and start counting from zero again.

1

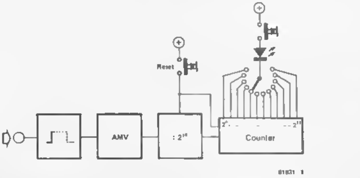


Figure 1. The block diagram of the operational hours counter.

2

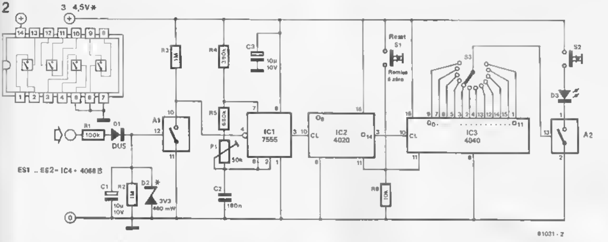


Figure 2. The complete circuit diagram of the operational hours counter.

3

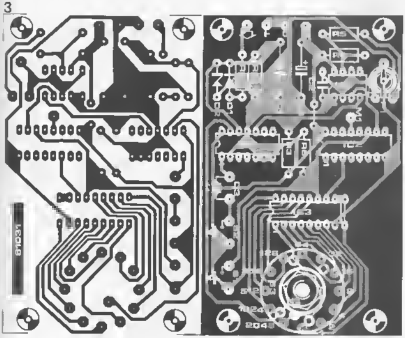


Figure 3. The component and copper layout of the printed circuit board.

Parts list

Resistors:
R1 = 100 k
R2,R3 = 1 M
R4 = 390 k
R5 = 680 k
R6 = 10 k
P1 = 50 k (47 k) preset

Capacitors:
C1,C3 = 10 µ/10 V
C2 = 180 n

Semiconductors:
D1 = DUS
D2 = 3V3/400 mW zener diode (see text)
D3 = LED red
IC1 = 7555
IC2 = 4020
IC3 = 4040
IC4 = A1 . . . A4 = 4066B

Miscellaneous:
S1,S2 = single pole pushbutton
S3 = 12 position switch

The construction

Figure 3 shows the printed circuit board on which the circuit can be mounted. The input is connected to the thermostat switch by means of wires. The supply can be provided by two or three penlight cells in series or by means of a single 4.5 V battery. The batteries last for quite a long time because the LED of course only has to light occasionally and the quiescent current consumption is not more than 45 µA. Zener diode D2 should have a slightly higher value than the supply voltage. At a supply of 3 volts, 3.3 V is a good value, at 4.5 volts, a 4.7 V zener will be required. The best way to set P1 is to use output Q8 of IC2. This output should change in level after about every 28 seconds (1 cycle per 56¼ seconds) if P1 is correctly set. Once this has been achieved, P1 can be locked with glue or nail varnish. The frequency of the AMV is independent of the supply voltage, in other words at lower battery voltages the count will still be correct.

The entire unit may be fitted in a plastic case with the switches mounted so that they are easily accessible and the LED placed where it is clearly visible. The circuit can of course also be used to count the operational hours of other devices as well as the central heating. To adapt it to other circuits another two switches (A3 and A4) can be used. The pins 5 and 6 belonging to them will then obviously not be grounded.

Table 1

Q11	Q10	Q9	Q8	Q7	Q6	Q5	Q4	Q3	Q2	Q1	Q0
2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
2048	1024	512	256	128	64	32	16	8	4	2	1

TUPTUNDUGDUS

Wherever possible in Elektor circuits, transistors and diodes are simply marked 'TUP' (Transistors, Universal PNP), 'TUN' (Transistor, Universal NPN), 'DUG' (Diode, Universal Germanium) or 'DUS' (Diode, Universal Silicon). This indicates that a large group of similar devices can be used, provided they meet the minimum specifications listed in tables 1a and 1b.

	type	U_{ceo} max	I_c max	h_{fe} min.	P_{tot} max	f_T min.
TUN	NPN	20 V	100 mA	100	100 mW	100 MHz
TUP	PNP	20 V	100 mA	100	100 mW	100 MHz

Table 1a. Minimum specifications for TUP and TUN.

Table 1b. Minimum specifications for DUS and DUG.

	type	U_R max	I_F max	I_R max	P_{tot} max	C_D max
DUS	Si	25 V	100 mA	1 µA	250 mW	5 pF
DUG	Ge	20 V	35 mA	100 µA	250 mW	10 pF

Table 2. Various transistor types that meet the TUN specifications.

TUN		
BC 107	BC 208	BC 384
BC 108	BC 209	BC 407
BC 109	BC 237	BC 408
BC 147	BC 238	BC 409
BC 148	BC 239	BC 413
BC 149	BC 317	BC 414
BC 171	BC 318	BC 547
BC 172	BC 319	BC 548
BC 173	BC 347	BC 549
BC 182	BC 348	BC 582
BC 183	BC 349	BC 583
BC 184	BC 382	BC 584
BC 207	BC 383	

Table 3. Various transistor types that meet the TUP specifications.

TUP		
BC 157	BC 253	BC 352
BC 158	BC 261	BC 415
BC 177	BC 262	BC 416
BC 178	BC 263	BC 417
BC 204	BC 307	BC 418
BC 205	BC 308	BC 419
BC 206	BC 309	BC 512
BC 212	BC 320	BC 513
BC 213	BC 321	BC 514
BC 214	BC 322	BC 557
BC 251	BC 350	BC 558
BC 252	BC 351	BC 559

The letters after the type number denote the current gain

A α' (β, h_{fe}) = 125-260
B α' = 240-500
C α' = 450-900.

Table 4. Various diodes that meet the DUS or DUG specifications.

DUS		DUG
BA 127	BA 318	OA 85
BA 217	BAX 13	OA 91
BA 218	BAY 61	OA 95
BA 221	1N914	AA 116
BA 222	1N4148	
BA 317		

Table 5. Minimum specifications for the BC107, -108, -109 and BC177, -178, -179 families (according to the Pro-Electron standard). Note that the BC179 does not necessarily meet the TUP specification ($I_{c,max}$ = 50 mA).

	NPN	PNP
	BC 107 BC 108 BC 109	BC 177 BC 178 BC 179
U_{ceo} max	45 V 20 V 20 V	45 V 25 V 20 V
U_{ebo} max	6 V 5 V 5 V	5 V 5 V 5 V
I_c max	100 mA 100 mA 100 mA	100 mA 100 mA 50 mA
$P_{tot.}$ max	300 mW 300 mW 300 mW	300 mW 300 mW 300 mW
f_T min.	150 MHz 150 MHz 150 MHz	130 MHz 130 MHz 130 MHz
F max	10 dB 10 dB 4 dB	10 dB 10 dB 4 dB

Table 6. Various equivalents for the BC107, -109, . . . families. The data are those given by the Pro-Electron standard; individual manufacturers will sometimes give better specifications for their own products.

NPN	PNP	Case	Remarks
BC 107 BC 108 BC 109	BC 177 BC 178 BC 179		
BC 147 BC 148 BC 149	BC 157 BC 158 BC 159		P_{max} = 250 mW
BC 207 BC 208 BC 209	BC 204 BC 205 BC 206		
BC 237 BC 238 BC 239	BC 307 BC 308 BC 309		
BC 317 BC 318 BC 319	BC 320 BC 321 BC 322		I_{cmax} = 150 mA
BC 347 BC 348 BC 349	BC 350 BC 351 BC 352		
BC 407 BC 408 BC 409	BC 417 BC 418 BC 419		P_{max} = 250 mW
BC 547 BC 548 BC 549	BC 557 BC 558 BC 559		P_{max} = 500 mW
BC 167 BC 168 BC 169	BC 257 BC 258 BC 259	!	169/259 I_{cmax} = 50 mA
BC 171 BC 172 BC 173	BC 251 BC 252 BC 253		251 . . 253 low noise
BC 182 BC 183 BC 184	BC 212 BC 213 BC 214		I_{cmax} = 200 mA
BC 582 BC 583 BC 584	BC 512 BC 513 BC 514		I_{cmax} = 200 mA
BC 414 BC 414 BC 414	BC 416 BC 416 BC 416		low noise
BC 413 BC 413	BC 415 BC 415		low noise
BC 382 BC 383 BC 384			
BC 437 BC 438 BC 439			P_{max} = 220 mW
BC 467 BC 468 BC 469		!	P_{max} = 220 mW
	BC 261 BC 262 BC 263		low noise

market

DIL changeover switches

The Erg SDC range of spring loaded DIL-switches have switching contacts that are hard gold plated on nickel to give reliable and repeatable switching operations. With non-switching voltage ratings from 1 μV to 100 V (current 1 μA to 1 A), and switching ratings up to 10 VA, these high reliability components have an initial contact resistance of 8 mΩ typical at 10 mV/10 mA max. Storage and working temperatures range from −55 to +100°C. Erg DILswitches feature a high insulation resistance (100 GΩ at 500 V DC) with dielectric strength tested for 60 s at

500 V RMS 50 Hz. Of modular design, a single c.o. DILswitch measures only 8.9 x 10.6 mm. Any number may be fitted side by side on a standard 2.54 mm pitch without loss of space. These DILswitches are available as single switch modules or in multiples comprising 2, 3, 4 or 5 switches contained in a single, compact package. Switching actuators are both colour coded and numbered for fast identification of individual switch status.

Erg Components,
Luton Road,
Dunstable,
Beds LU5 4LJ.
Telephone: (0582) 62241

(1636 M)

Audio frequency test meters

The first ever hand-held digital level meter capable of making weighted and unweighted noise measurements on telephone channels to CCITT recommendations, as well as being able to measure signal levels from −70 to +10 dBm on telephone and audio channels over the frequency range 30 Hz to 20 kHz, has been introduced by Wandel & Goltermann (UK) Ltd., London.

Designated PMP-20, the meter is to be marketed alongside a similar meter, the PM-20, which does not have the noise measurement capability, but which can measure very high levels from −50 up to +30 dB over the extended frequency range 15 Hz to 20 kHz. Resolution is 0.1 dB for both noise and level readings. Two switchable impedances are provided at 600 ohms and 100 k ohms for terminated and through measurements.

Both meters are lightweight, portable instruments which will also measure DC voltages from zero to 100 V (± 0.1 V). Autoranging and a large digital display, always

showing the correct sign, allow repetitive values to be read quickly and easily.

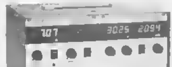
Housed in a rugged, shock-proof case, the meters are powered by an internal dry battery, or alternatively a rechargeable nickel-cadium cell. A warning arrow starts to flash two hours before the battery is discharged, and if the voltage drops further, the meter switches itself off to avoid erroneous readings.

Wandel & Goltermann (UK) Ltd.,
40 - 48 High Street,
Acton,
London, W.3.,
Telephone: 01-992 6791.

(1627 M)

Digital readout power supplies

Precision power supplies just announced by Havant Instruments are believed to be the first offering digital monitoring of voltage and current. The PL 310 uses two 3½-digit displays to provide a resolution of 10 mV at all settings from 0 to 30 volts, and of 1 mA at all current levels from 0 to 1 amp. To realise the full value of such an accurate readout, the supplies utilise band-gap voltage reference diodes, in place of the usual zener diodes, for voltage and current stabilisation.



Separate terminals are provided for the fully floating output and for the sensing circuits — allowing precise monitoring of the conditions at a remote load. A switch caters for no-load voltage and current limit setting without alteration to external wiring. There is also a damping switch, enabling mean current levels to be read with fluctuating loads.

The PL 320K incorporates a 5 volt 7 amp output with ± 1 volt variability, remote sense,

and a user adjustable overvoltage protection crowbar. Two further outputs are available, each of which can be set between 0 and 30 volts at currents of up to 2 amps.

Suitable for 110 or 240-volt nominal supplies, the PL series achieve a line stability of better than 0.01% of max. o/p for a 10% change, and a load regulation of better than 0.01% of max. o/p for a 50% change. Ripple is typically below 1 mA and the transient response is less than 20 microseconds for stabilisation to within 50 mV following a 100% load change. Automatic indication occurs when the unit commences to operate in a constant current mode. This level can be set anywhere from 0 to 110% of the rated maximum output.

Havant Instruments Ltd.,
Unit 3, Westfields, Portsmouth Road,
Horndean, Hants.
Tel: (0705) 596020/596045
Telex: 86845

(1639 M)

Photodiode arrays for position detection

The Symot 320/2 range of photodiodes now includes type PN-100-1. This comprises 100 photodiodes, each of which, under test conditions of 1000 Lux has photo-voltage 0.38 V and photocurrent 13 V, at 1000 Lux

and 25°C. The dark current is 0.01 mA at 3 V and the capacitance 130 pF. The elements are spaced at 1.0 mm pitch (centre to centre) and the peak sensitivity is at 830 nM. This photodiode array is particularly suitable for use in edge position detection, pattern reading, and also in shaft encoder applications.

Symot Limited,
22a Reading Road,
Henley on Thames,
Oxon RG9 1AG,
Tel: (049 12) 2663,
Tlx: 847333 SYMOT G

(1628 M)

market

Remote control garage door operator

The NuTone computerised garage door operator, is now newly available, throughout the U.K., from the Haos Company Ltd., of Bromley, Kent. It offers advantages over systems already on the market in that it is advanced, both technically and in appearance; more secure; operates from the greater distance of 400 yards; has a computer that does its own adjustments (to help the do-it-yourself installer); and is competitively priced.

This garage door opener will fit most up-and-over garage doors: it is simply installed by the do-it-yourselfer, (using step-by-step instructions), local electrician or builder or Haos agent. In response to a signal from the hand control, it has the facility to open a heavy garage door, turn on the light, allowing the driver sufficient time to get out of the car and leave the garage, automatically turn off the light, and close and securely lock the door.

The Haos Company Ltd,
The Built-In Centre,
32 Letchworth Drive,
Bromley,
Kent
(tel.: 01 460 2136).

(1685 M)

Economical medium-size enclosures

OK's series CL PacTec enclosures provide instrument and electronics manufacturers and designers with a creative and adaptable, medium- to large-size enclosure package at a considerably lower cost than made-to-measure moulded plastic or fabricated metal enclosure.

The CL enclosures are ideal for oscilloscopes, strip recorders, minicomputers, printers, large amplifiers, medical instruments and larger power supplies, as well as for many other applications. They measure 317.5 mm (12.5 in) wide, 295.3 mm (11,63 in) deep, and are available in heights from 114.6 mm (4.51 in) to 146.3 mm (5.76 in).

Moulded from heavy-weight ABS material the units are attractive, durable, strong, and impact resistant, and use a special system of internal mounting bosses, PC card guides, mounting rails, accessories, and other hardware to give the designer the unlimited flexibility in creating precisely the custom enclosure he needs. In addition, he can create an attractive custom with three-dimensionally moulded front panels which can also incorporate production features such as posts, clips and slots

The range is available in four standard colours — blue, tan, black and grey — plus fifteen special colours. Options include custom trim, special finishes, special bezels, strap handle, EMI and RFI shielding, construction from UL listed material, sloped top or bottom cover, rear panel extensions and card guides and mounting rails. Tilt stands can also be supplied.

The CL enclosures enable the user to create prototypes, easily and inexpensively, using low-cost designer kits. Depending on which kit is selected, it can contain top and bottom covers, side panels, front and rear panels (which can be drilled, cut, punched and silkscreened), card guides, mounting rails, hardware and a tilt stand. The user simply selects the size case needed, picks the hardware and accessories from the kit necessary to mount components and easily assembles the case

OK Machine & Tool (UK) Ltd.,
Dutton Lane, Eastleigh,
Hants SO5 4AA,
Tel: 0703 - 610944

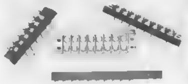
(1678 M)

Miniature terminal strip has 7A rating

A series of miniature barrier terminal strips are available for applications in electrical and electronic equipment and instrumentation such as modular power supplies.

The M24F is a range of miniature barrier terminal strips offering a wide range of cavity and termination possibilities. While compact in design, they present no compromise to electrical safety: their 3 mm high barriers are proofed at up to 7 A at 6.2 KV, depending upon the types of termination fitted, and permit working voltages of up to 1 KV r.m.s. The overall dimensions of the strip are 8.5 mm high x 16.0 mm deep, with up to 14 cavities on 6.35 mm centres. End fixing is by unthreaded holes, which can be fitted with terminations according to individual user requirements.

A variety of termination styles may be incorporated on the M24F. These include



screw, solder tail and printed circuit types, together with a fanning strip of up to 14 ways. The M24F miniature barrier terminal strip is moulded in either blue glass-filled nylon, or black glass-filled nylon or polyester UL 94 V-O rated to +120°C, according to application requirements.

H & T Components,
Crowdy's Hill Estate,
Kembrey Street,
Swindon,
Wiltshire SN2 6BN.
Tel. (0793) 693681-7.

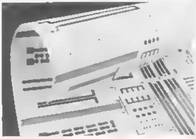
(1688 M)

Flexible copper clad laminates from 3M

CuFlex 6550 flexible copper clad laminates — a new range — has been introduced by 3M United Kingdom Ltd's Electronic Products Group for the production of high quality flexible printed circuit boards

The CuFlex flexible copper clad dielectric consists of a flexible flame retardant epoxy/polyester resin, reinforced by an organic fibre non-woven web. It has all the properties to provide the highest quality printed circuits. These properties include good adhesion to copper, good thermal and dimensional stability, solder ability, mechanical strength, flame retardancy and the ability to produce reliable plated through holes.

Other qualities include a high peel strength eliminating the need for covercoats in certain applications, good dimensional stability, high tear resistence and the ability to mount components without rigidising. It can also be wave soldered — without blistering — at 260°C for 10 seconds.



CuFlex 6550 flexible circuitry is currently being used in military and aerospace applications, computers, instrumentation and in telecommunications. Other major areas of application include telephone handsets, back plane wiring, electronic switching and speaker phones.

Products Group,
3M United Kingdom Ltd.,
3M House,
PO Box 1,
Bracknell,
Berks RG12 1JU.
Tel.: (0344) 58436

(1686 M)

market

Silicon photodiodes

The Centronic TOP TEN collection of silicon photodiodes is a range of advanced specification devices carefully selected to cover a wide field of applications. Offered at very competitive prices, they are not merely mass produced items but conform strictly to their specification.

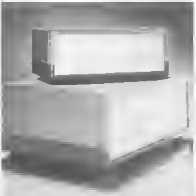
The uses are as diverse as colour grading, energy monitoring camera exposure control, precision positioning — typically $< 1\ \mu m$, — optical surveying, laser alignment, temperature sensing, missile guidance, optical star sensing, fibre-optic communications and modems.
Included are the fast, high-sensitivity BP x 65 — which can also be supplied in chip form for maximum utilisation, — the 'eye-response' BPW 21, the 100 sq mm area OSD 100 - 5T, the position-sensing dual-element LD 2 - 5T, the quadrant QD 50 - 5T and the single-element hybrid OSI - 5K. A speciality is the PP 65 - 25 having optical input by way of a 25 cm length of plastic fibre.

Centronic,
Centronic House,
King Henry's Drive,
New Addington, Croydon,
CR9 0BG England
Tel: (0689) 42121/8

(1692 M)

New two-tone brown case boxes

To complement their comprehensive range of two-tone grey plastic Veroboxes, Vero Electronics Limited have introduced two models in an attractive two-tone brown colour scheme
The first is a Type I Verobox with an overall width of 205 mm, height of 75 mm and depth of 140 mm. Consisting of a top and bottom section held together by four screws which enter through the plastic feet located on the base, it includes front and rear panels and fixing points for horizontally mounted printed circuit boards or chassis plates.
The second is a Type III Verobox with an



overall width of 154 mm, height of 60 mm and depth of 85 mm. This box has a unique clip-together design which requires no fixing screws, the front and rear panels are retained in position when the two halves are assembled and four stick-on feet are provided. Printed circuit boards can also be mounted vertically in the same plane as the front panels
Both models are moulded in high impact polystyrene and incorporate anodised aluminium front and rear panels that can be machined, engraved or silk screened.

Vero Electronics Limited,
Industrial Estate,
Chandlers Ford,
Eastleigh,
Hampshire SO5 3ZR
Tel.: (04215) 66300

(1690 M)

Digital clip-on wattmeter

The model 2433 is a new instrument and thought to be the first clip-on wattmeter to be introduced to the U.K. market. With a LCD digital readout, the instrument will measure volts up to 600 V, amps with a 20 A or 200 A version and watts 20 kW or 200 kW, it is auto-ranging on all measuring ranges and accuracy is 1%. True R.M.S. AC measuring circuits are used enabling accurate determination of distorted waveforms such as thyristor outputs. Single phase and balanced three phase circuits may be monitored.

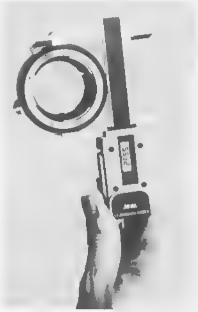
Battery option gives 15 hrs continuous use and an analogue output is provided for recording purposes
The 2433 will be particularly useful for energy studies and power service supervision.

Martron Ltd.,
20 Park St., Princes Risbourough, Bucks,
Tel: (08444) 4321.

(1681 M)

The ultimata caliper?

This digital caliper according to comprehensive, tests reduces reading time by 50% and the spread of readings by as much as 90%. Furthermore it requires no operator training time and it is just as handily sized as any traditional vernier or dial caliper.
JOCAL, which is the name of this new instrument, can be zero-set anywhere within the 150 mm (6") measuring range. This enables measuring of variations from reference size, measuring of centre distance between two identical holes etc. It also has an inch/metric switch option.
The JOCAL is based on a completely new, patented scale/transducer system plus a specially designed IC-circuit. The measurement is shown digitally on an LCD display with 0,01 mm (·0005") resolution over the whole measuring range. The patented electronics plus the automatic switch-off 2 min. after the last measurement contribute to a battery life of more than 12 months with regular use.
The design of the JOCAL makes it insensitive to dust, oil, filings, shavings or other impurities



prevailing on the workshop floor. Its advanced semiconductor technique makes it also intensitive to surrounding electronic and magnetic interferences, which previously caused serious problems with other electronic instruments.

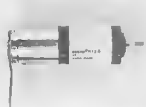
C.E. Johansson Limited,
66, High Street,
Houghton Regis,
Dunstable, Beds. LU5 5BJ,
England,
Tel.: Dunstable 68 181

(1689 M)

market

Precision planetary gearbox

A new gearbox has been designed and made utilising the very latest available technology. Knows as the R22 precision planetary gearbox, it is available with two or three gear stages and a range of six different ratios from 16.2:1 to 190:1. It has torque rating of 0.6 Nm (85 oz. ins). The diameter is 22 mm; for ratios up to 33.1:1 the length is 32.5 mm, and for ratios up to 190:1, it is 40 mm.



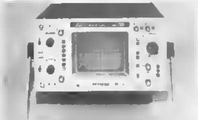
To ensure reliable and trouble-free operation, the R22 is made with hardened steel shafts and pinions and the stainless-steel output shaft runs in pre-lubricated sintered bronze sleeve bearings; the satellite wheels and housing are moulded from synthetic materials. This new gearbox can be fitted to the 22, 23, 26 and 28 PL series of d.c. motors.

Portescap (U.K.) Limited,
204 Elgar Road,
Reading, RG2 0DD
Tel: (0734) 861 485/6/7/8

(1691 M)

LBO-520A · New oscilloscope from Leader

The LBO-520A dual-trace oscilloscope from Leader provides all the features required of a wide-band laboratory instrument at a highly attractive price. With a 5" rectangular screen, using the latest PDA CRT technology, this dual-trace unit also boasts a 5 mV sensitivity and a true 35 MHz bandwidth. In addition, a built-in signal delay line ensures ease of viewing those fast leading edges, whilst all-round versatility is assured by the most comprehensive trigger facilities.



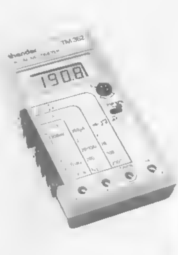
Weighing only 8.5 Kgm, and complete with low-capacitance probes, the LBO-520A is available from Sinclair Electronics Ltd. at £ 475,00.

Sinclair Electronics Ltd.,
London Road, St. Ives,
Huntingdon, Cambs PE17 4HJ,
Tel: (0480) 64646.

(1676 M)

TM352 — New hand held LCD multimeter from Thandar

Sinclair Electronics announce the latest product in the Thandar range of low-cost, portable test equipment. The TM352 is a battery operated 3½ digit hand-held multimeter with a large 0.5" liquid crystal display. With an input impedance of 10 MΩ, it covers 16 ranges, including DC voltage (100 µV - 1000 V), AC voltage (100 mV - 1000 V), DC current (100 nA - 10 A), resistance (1 Ω - 20 MΩ). Also featured are an audible continuity check and an h_{FE} measurement facility.



Push button controls allow rapid and easy operation, whilst compact size, robust construction and long battery life (typically > 150 hours) make the TM352 truly portable. The TM352, complete with battery, test leads and a full 1-year warranty costs £ 49.95.

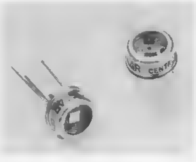
Sinclair Electronics Ltd.,
London Road, St. Ives,
Huntingdon, Cambs PE17 4HJ,
Tel: (0480) 64646.

(1675 M)

Avalanche photodetector APDO5-4R

Centronic has applied modern semiconductor technology with the use of ion implantation, silicon nitride passivation and a totally depleted flip-chip precision assembly for this reach-through avalanche photodiode.

The premium unit of the two grades offered has typical parameters: responsivity 23 A/W at 1064 nm and 85 A/W at 900 nm, rise and fall times of 1.2 nanoseconds and NEP's of 3×10^{-12} W/$\sqrt{Hz}$ at 1964 nm.



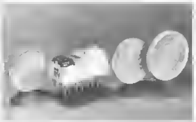
The unit is designed for operating over the temperature range −40°C to +70°C and is assembled in a low profile isolated TO-5 package for applications which include laser range finding, laser proximity fusing and fibre-optic communications.

Centronic, Centronic House,
King Henry's Drive,
New Addington,
Croydon, CR9 0BG England,
Tel (0689) 42121/8.

(1677 M)

DILswitch modules

The Erg SDC4 DILswitch module contains four, two-pole changeover dual in-line switches. Each switching member has its own, unique colour and is also individually numbered. This, together with the comparatively large size switching members, makes the components very easy to use. The status of all switches is also very quickly distinguished at a glance. All switches have contact ratings of



1 µV to 100 V, 1 µA to 1 A (10 VA maximum switching). Initial contact resistance is 8 mΩ typical, while insulation resistance is 100 GΩ. The switches have a break-before-make action and the modules may be mounted side by side on a standard 0.1 in pcb pitch withoutloss of space.

Erg Industrial Corporation Ltd.,
Luton Road, Dunstable, Befordshire,
LU5 4LJ England,
Tel: 0582 - 62241.

(1679 M)

market

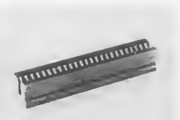
Low cost modular pcb connectors from UECL

Two new low cost pcb connector series have been introduced by Ultra Electronic Components Limited. The series 1585 and series 1855 are both modular 0.1 inch pitch types with from 5 to 85 ways (single-sided) or 10 to 170 ways (double-sided)

The contacts are of cantilever design and are selectively gold plated to reduce the volume of redundant gold on areas other than the point of contact. Five types of terminal post are offered, suitable for hand soldering, wire wrap and flow soldering (three types). Solder terminals are tin plated and wire wrap terminals gold plated.

The two series only differ in moulding material. Series 1585 uses a thermoplastic polyester moulding, with higher stability DAP being used for series 1855. Operating temperature range for both series is −55°C to +125°C

Contacts are designed to give consistent insertion and withdrawal forces, and a mechanical endurance of up to 100 matings with 0.5 µm gold plating (250 matings with 1.8 µm plating). As with other UECL connectors, these types have been tested in the Company's own B.S 9000 and D.Q.A.B. Approved test house to relevant B.S 9000 specifications.



Applications are varied and include computer and microcomputer peripherals, commercial instrumentation, professional assemblies and other high reliability non-military equipment.

Ultra Electronic Components Ltd.,
Fassetts Road, Loudwater,
High, Wycombe, Bucks,
Tel: 0494-26233.

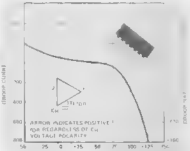
(1682 M)

High-accuracy Sample-Hold amplifier

Precision Monilithics introduces the SMP-11, a data-acquisition sample-and-hold amplifier featuring 0.015% accuracy and a low combined offset voltage and step transfer error of 0.45 mV. The SMP 11 employs a diode bridge switch design which minimizes charge transfer errors.

Typical acquisition time is 3.5 µs and slew rate is typically 10 V/µs. A unique transconductance amplifier (super-charger) enhances the diode bridge switch during acquisition by providing up to 50 mA of charging current to the hold capacitor. The super-charger turns off as the S/H amplifier acquires the signal. As a result, smooth charging of the hold is achieved with minimum noise. The super-charger, in conjunction with the device's high-slewing rate input and output buffer amplifiers, permits fast acquisition operation.

Because it uses a bipolar Darlington amplifier input stage, the SMP-11 maintains low droop rate over the entire operating temperature range. Most sample-and-hold amplifiers emply FETs to obtain low droop currents at 25°C. However, the droop current for FET amplifiers double every 10°C rise in temperature whereas the SMP-11's droop current actually decreases for temperatures up to 70°C or more.



Other important characteristics of the SMP 11 are a low aperture time of 50 ns, low hold mode settle time of 1.5 µs, a high sample current/hold current ratio of 1.7×10^8 and compatibility with DTL, TTL, and CMOS logic.

The SMP-11 comes in a 14 pin DIP and is available in both military and commercial operating temperature ranges.

Bourns AG,
Baar,
Switzerland
Tel. 042333333

(1683 M)

10 kHz to 100 MHz USB/LSB transceiver building block

Ambit's 91600 receiver is based on an SL 1600 series Plessey application design by James Bryant — modified to accept an 8-pole 10.7 MHz SSB crystal filter to enable the frequency offset of the system to be used with the Ambit OFM 7 LCD frequency readout module for 1 kHz resolution in the HF bands.

By using the correct first mixer, the range 10 kHz to 100 MHz may be spanned — although for most users, the standard 1 - 500 MHz range is quite sufficient. The unit provides approx. 10 mW of SSB in transmit mode, and a complete SSB receiver with 1 W output stage.

An external local oscillator and bandpass

filter/preselector is required to cover the frequency band desired — full USB/LSB switching is provided on the board.

Priced around £ 40.000 (in kit form), the 91600 offers a versatile basis for SSB TX/RX systems for HF to UHF.

Ambit International,
200 North Service Road,
Brentwood,
Essex. CM14 4SG,
tel (0277) 230909

(1687 M)

Microspeech 2

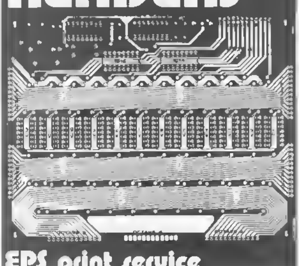
Microspeech 2 is a stand alone speech synthesizing unit. It converts phonetic code or any text (which is input via a standard RS 232 connection) into a speech output. Microspeech 2 may be interfaced to any computer system because all the computation necessary to synthesize speech is performed by its own dedicated microprocessor. In fact it is possible to run the unit from just an ASCII keyboard. Up to one thousand phonetic characters, representing about one minute of speech, may be assembled in the units internal buffer before it is commanded to speak. The controlling microprocessor has a spare ROM capability of 8K bytes which can be used to store an optional text to phonetics translator program. This includes the phonetic equivalents of all the standard ASCII symbols,

and thus enables the unit to be driven directly from English text. Although the speech in this mode is less fluent than that produced in the phonetic mode, it does allow messages to be rapidly programmed, and also makes the unit extremely useful to the blind.

Costronics Electronics,
13 Field Heath Avenue,
Hillingdon,
Middlesex
Tel: (89) 38791

(1684 M)

SERVICES TO READERS



EPS print service

Many Elektor circuits are accompanied by printed circuit designs. Some of these designs, but not all, are also available as ready-etched and pre-drilled boards, which can be ordered from any of our offices. A complete list of the available boards is published under the heading 'EPS print service' in every issue. Delivery time is approximately three weeks.

It should be noted however that only boards which have at some time been published in the EPS list are available, the fact that a design for a board is published in a particular article does not necessarily imply that it can be supplied by Elektor.

Technical queries

Please enclose a stamped, self-addressed envelope, readers outside UK please enclose an IRC instead of stamps.

Letters should be addressed to the department concerned — TQE (Technical Queries). Although we feel that this is an essential service to readers, we regret that certain restrictions are necessary:

1. Questions that are not related to articles published in Elektor cannot be answered.
2. Questions concerning the connection of Elektor designs to other units (e.g. existing equipment) cannot normally be answered, owing to a lack of practical experience with those other units. An answer can only be based on a comparison of our design specifications with those of the other equipment.
3. Questions about suppliers for components are usually answered on the basis of advertisements, and readers can usually check these themselves.
4. As far as possible, answers will be on standard reply forms.

We trust that our readers will understand the reasons for these restrictions. On the one hand we feel that all technical queries should be answered as quickly and completely as possible; on the other hand this must not lead to overloading of our technical staff as this could lead to blown fuses and reduced quality in future issues.

CLASSIFIED

CONDITIONS OF ACCEPTANCE OF CLASSIFIED ADVERTISEMENTS

1 Advertisements are accepted subject to the conditions appearing on our current rate card and on the express understanding that the Advertiser warrants that the advertisement does not contravene any Act of Parliament nor is it an infringement of the British Code of Advertising Practice.

2 The Publishers reserve the right to refuse or withdraw any advertisement.

3. Although every care is taken, the Publishers shall not be liable for clerical or printer's errors or their consequences.

4. The Advertiser's full name and address must accompany each advertisement submitted.

The prepaid rate for Classified Advertisements is 13 pence per word (minimum 12 words). Semi-display setting £4.40 per single column centimetre (minimum 2.5 cms.). All cheques, postal orders, etc. to be made payable to Elektor Publishers Ltd. Treasury notes should always be sent by registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Elektor Publishers Ltd., 10 Longport, Canterbury, Kent CT1 1PE.

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SFMI-OISPLAY SETTING WILL BE INCREASED TO £5.50 PER SINGLE COLUMN CENTIMETRE (MINIMUM 2.5 CMS).