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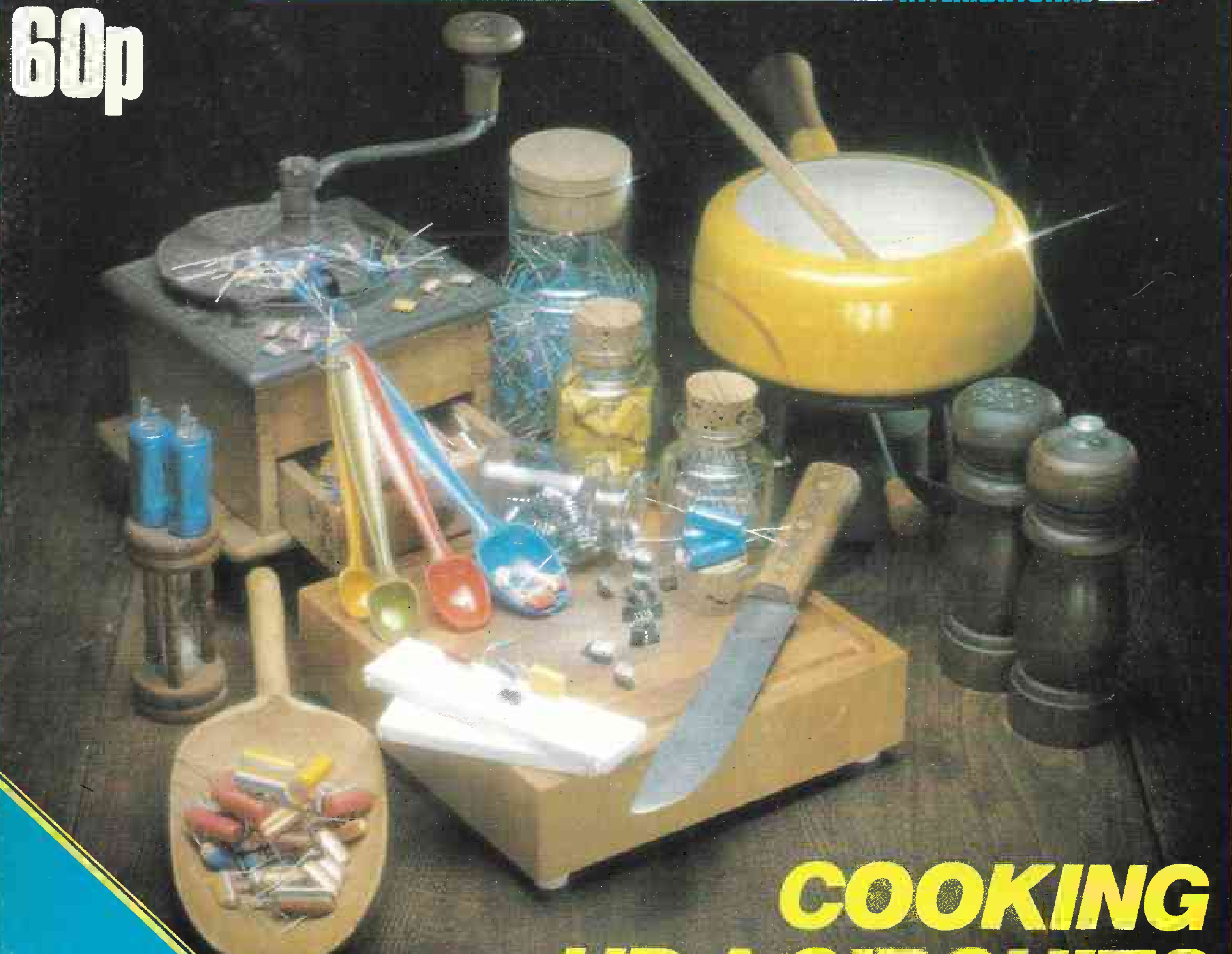


COOKING UP A CIRCUIT?

Over EIGHTY Recipes Inside!

FREE 16 PAGE CIRCUITS SUPPLEMENT

Smart Dimmer

Auto Charger

Analogue Switches

. . . NEWS . . . . PROJECTS. . . . MICROPROCESSORS . . . . AUDIO . . .

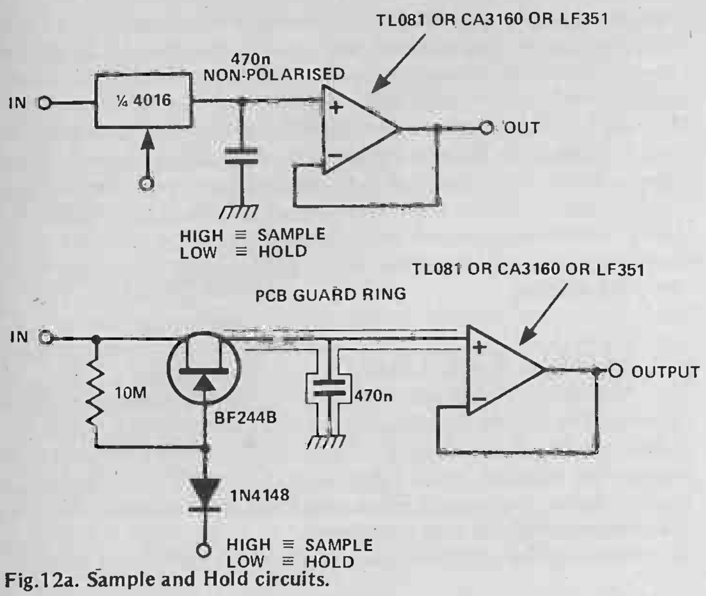


Fig.12a. Sample and Hold circuits.

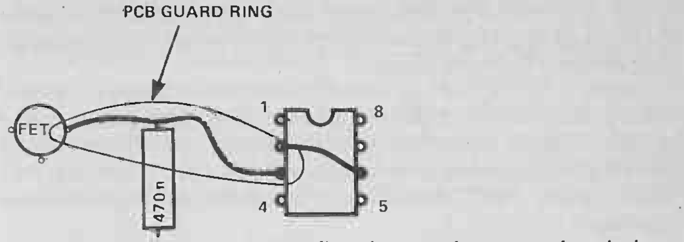


Fig.12b. A guard ring surrounding the capacitor can reduce leakage across the PCB.

Hold On To It

Sample and Hold circuits also employ analogue switches. During the sample period, the storage capacitor is connected to the input voltage via the switch which is turned on. When the switch is turned off (Hold period) the voltage on the capacitor has got three possible discharge routes.

1. As leakage across the printed circuit board. This can be greatly reduced by provision of a guard-ring that surrounds the capacitor with a potential exactly the same as that on the capacitor. Surface leakage which is a function of potential difference is thus reduced by removing the potential difference.
2. The switch can discharge the capacitor with leakage currents. These are generally very small and insignificant.
3. The input bias current of the op-amp can discharge the capacitor, but if a FET op amp is used this effect can be insignificant. If all three discharge routes are small, then a long hold period can be expected.

More and Mode

The 4051 is an 8 way multiplexer (Fig. 13). This device has a 3 bit binary code input which it decodes internally to turn on one of the eight analogue switches. The 4051 is effectively an 8 way single pole, code selected switch. There is also an inhibit input; a logic 1 at this pin turns off all the switches.

There are some problems to be encountered when using this ▶

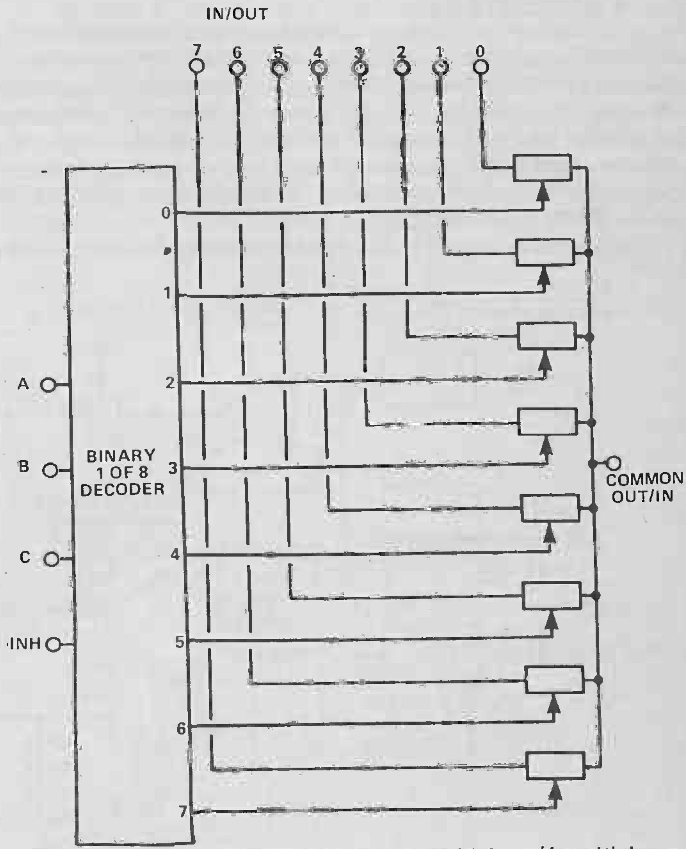


Fig.13. A 4051 analogue 8-way multiplexer/demultiplexer.

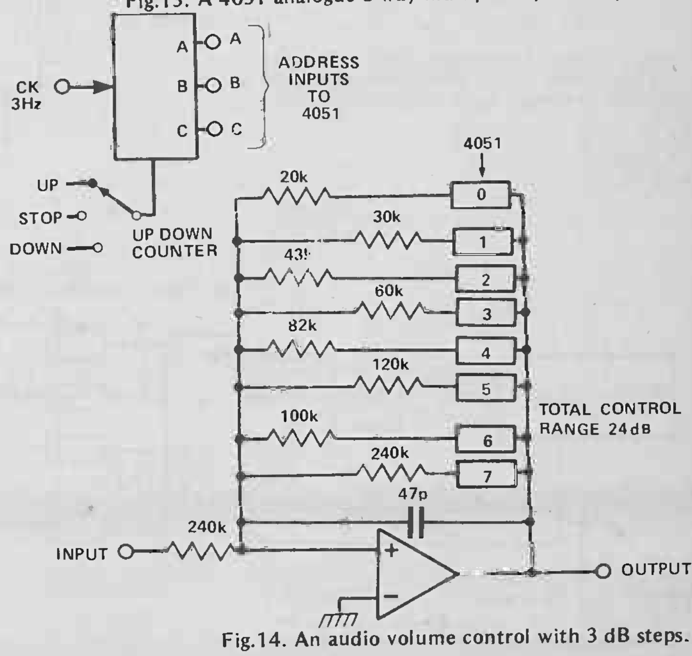


Fig.14. An audio volume control with 3 dB steps.

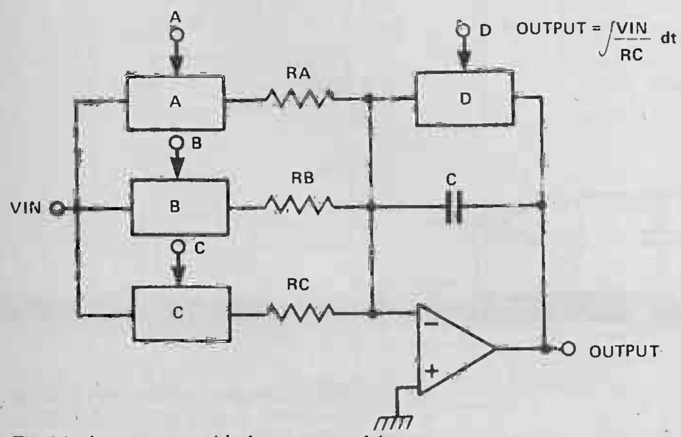


Fig.11. A programmable integrator with reset to zero.

device. The internal decoding exhibits some race conditions when the input address changes which may cause switches to momentarily overlap in their ON states.

If the 4051 is used as demultiplexer with sample and hold outputs, then the data on each output capacitor gets spread around to other outputs during the overlap periods. This 'make before break' effect can cause serious problems to occur. (There are JFET 'break before make' multiplexers but these tend to be rather expensive).

Louder Yet

A programmable volume control can be constructed with a 4051 and an up down counter (Fig. 14). The state of the count at any point in time determines which resistor is in the feedback loop of the op amp. The resistors are arranged such that there is a 3dB change in gain for each LSB change in the address code. By making the counter count up the gain will increase and vice versa. It is necessary to stop the counter at 000 and 111 otherwise the gain will roll round giving an abrupt change in level.

It is possible to construct an 8 bit analogue Random Access Memory using a 4051 (Fig. 15). Analogue information is written into memory by first selecting the address and then enabling the 'write' switch. The capacitor at this address is charged up to the voltage level of the data in signal. Reading is performed continuously using a FET op amp so as not to discharge the storage capacitors.

This gives the RAM a tristate output capability, which when used with the INH input allows several RAMs to be built into a larger memory system. Improved performance may be obtained by using 'break before make' multiplexers. An analogue RAM can be used for producing short time delays and perhaps some rudimentary pitch shifting.

MPUs Get Theirs

Analogue switches are used in microprocessor data acquisition systems (Fig. 16). An input multiplexer, addressed by the microprocessor selects which channel to look at. A sample and hold then freezes the selected input signal so that the ADC can perform a conversion on it. National Semiconductors make a single chip that performs most of this data acquisition.

The chip, the ADC0817 has a 16 channel multiplexer, an ADC

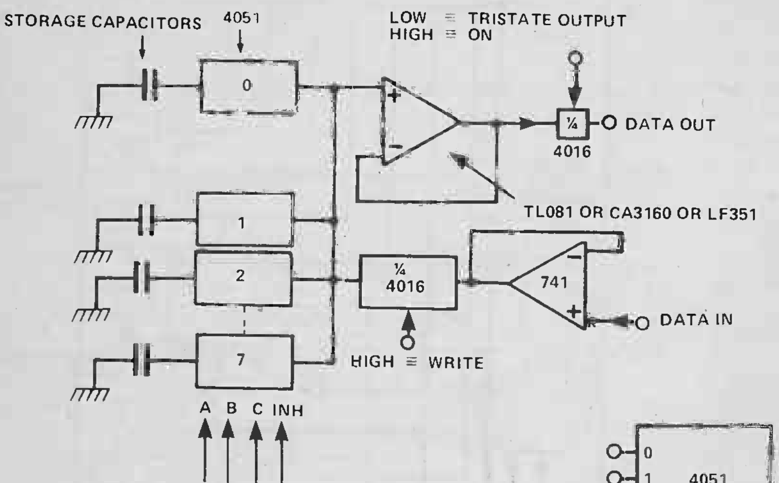


Fig.15. (left). An 8-bit analogue RAM using a 4051.

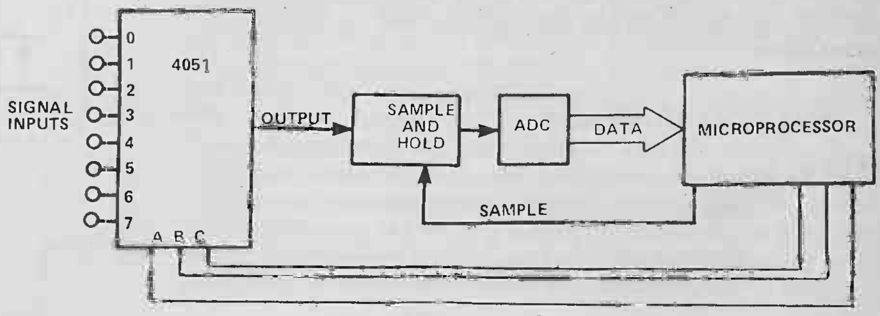


Fig.16. (right). A microprocessor data acquisition system using analogue switches.

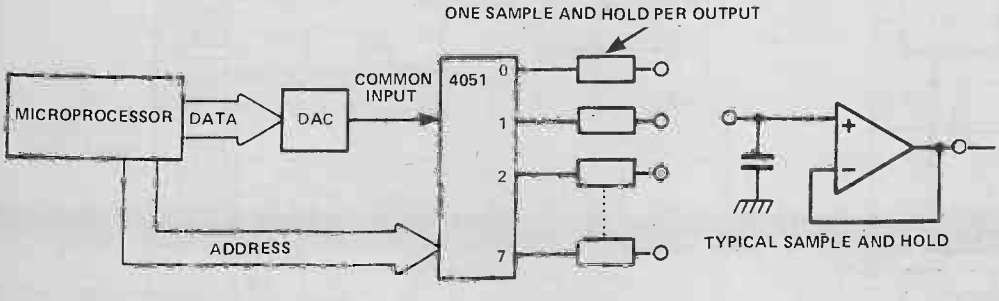


Fig.17 (left). Analogue switches can also be used in a microprocessor data distribution system.

and output latch, but you have to provide your own sample and hold. Analogue switches are also used in microprocessor data distribution systems (Fig. 17). Data generated by the microprocessor is converted into an analogue voltage by the DAC and is then multiplexed into sample and hold circuits. This is a common technique for systems that require a large number of analogue parameters such as microprocessor controlled music and speech synthesisers.

Plexing Info

In most telecommunication systems, a major cost is that of the wire that links transmitter to receiver. If several channels of information can be transmitted down one wire then the cost of the overall system may be considerably reduced. (Fig. 18).

Eight audio channels, band limited to 10 kHz in this example, are fed into an 8 way analogue multiplexer. Each channel is sampled every 50 nS for a duration of 6.25 nS. The eight audio signals can thus be fed down one wire pair as a sequential series of pulses that represent the instant values of the signals in the eight channels. The process is known as Pulse Multitude Modulation (PAM). Sync pulses are mixed with this signal so that the channels may be decoded at the receiver end.

Decoding is performed by stripping off the sync signal and using it to address the demultiplexer. The required channel can then be selected by monitoring the respective demultiplexer output with a sample and hold followed by a 10 kHz lowpass filter. It is important that the sampling frequency is at least twice the audio bandwidth so that aliasing effects can be avoided.

Mixing It In

Monitoring the signal levels in an audio mixer can cause problems, due to the large number that have to be observed. There are now several devices that use a conventional oscilloscope or TV to display all the information on one screen (Fig. 19). Each audio channel is processed by a peak detecting envelope follower. This generates a signal that describes the peak signal amplitude in that channel and it is known as a PPM (peak programme) response. These PPM signals are then multiplexed and passed through a single log compressor to give a display of level in dBs versus channel number on an XY screen. **ETI**

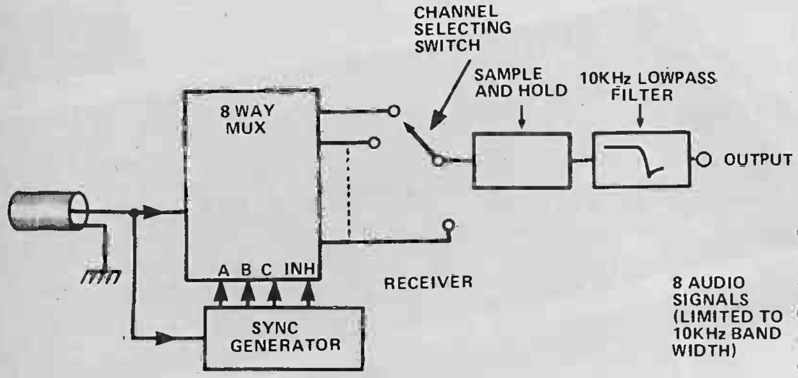


Fig.18a. The receiver used in a pulsed amplitude modulation (PAM) multiplexed sound system.

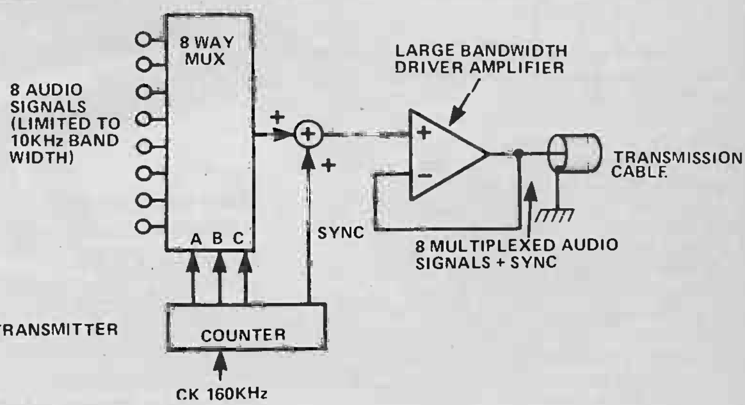


Fig.18b. The multiplexed sound system transmitter.

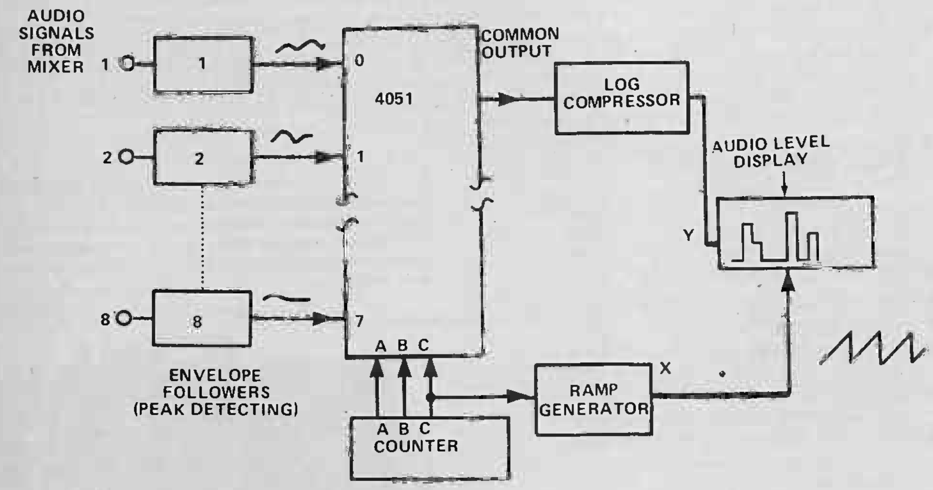


Fig.19. (left). The levels of any number of mixer channels can be displayed on one screen with this multiplexed system.

RADIO CONTROL GUARDIAN

A superb project for the radio control enthusiast. This unique unit automatically sets as many as four servos or other control units to pre-set 'safe' positions in the event of control-signal loss. The unit has four channels, each with fully independent fail-safe control.

Radio control fail-safe units are intended to be connected between the radio control receiver/decoder and the system's servounits. Under normal operating conditions the decoded command signals pass straight through the fail-safe unit, enabling the servos to operate in the normal manner. If, however, the command signals are lost (because of a system failure or by the receiver going out of range), the fail-safe unit automatically feeds internally-generated pre-set command signals to the servos and causes them to move to pre-set 'safe' positions.

In a boat or a plane the fail-safe unit may, for example, cut the speed and put the craft into a gentle turn in the event of control failure, thus ensuring that the craft does not simply disappear into the wild blue yonder. In reality, only the most important of the system's servos need to be subjected to fail-safe control, so a four-channel fail-safe unit is more that adequate for all practical applications.

Fail-safe units are already available commercially but all of them suffer from a number of defects. The Chromatronics PP1M-4CH is one example. This 4-channel unit measures only 41mm x 62mm x 23mm and is highly recommended for use in craft with limited space and/or limited weight carrying capacity. Specific defects of the PP1M-4CH, however, are that it gives fail-safe operation only in the event of TOTAL signal failure on all four channels and gives no fail-safe operation if any one of the decoder output channels locks high. Also, all the servos are pulsed simultaneously (rather that sequentially) in the fail-safe mode, thus generating high (and possibly harmful) transient currents in the system.

The ETI fail-safe unit described here has been designed specifically as a 'De-Luxe' unit that it gives a virtually fool-proof performance. It is probably the most advanced fail-safe device ever published. It has four FULLY INDEPENDENT channels, each giving fail-safe operation if its own decoder input signal is lost or latches high. The servos are pulsed sequentially (rather that simultaneously) in the fail-safe mode, ensuring that excessive transient currents are not generated in the system. Also, the fail-safe frame width is adjustable, enabling the unit to be used with electronic motor-speed control units as well as with all types of servo.

The performance sophistication of the ETI fail-safe unit necessitates the use of a total of six ICs in the design. The unit is in fact built up on two PCBs which, when stacked, give overall dimensions of about 52mm x 90mm x 25mm (uncased), making it roughly twice the size of the Chromatronics PP1M-4CH. The unit is thus suitable for use only in craft with a fairly substantial amount of free space. The unit can be used with any 3 to 9 volt positive-pulse radio control receiver producing nominal pulse widths of 1 to 2 milliseconds (the 'standard' range) and can control virtually all types of 3-wire servo.

Construction & Use

This is not a project for the beginner. Construction calls for a good deal of care. The first point to note is that one of the PCBs is double sided, so unless you are really good at making your own PCBs you'll have to wait until ready-made boards become available from one of our advertisers. Assuming that PCBs are available, double-check all their tracks to make sure there are no breaks or shorts, particularly on the double-sided unit.

Start construction with the double-sided PCB. Use miniature components throughout. Note that the three ICs are CMOS types (normal 555s must NOT be used in the IC5-IC6 positions) and should be mounted in suitable sockets. If you have a 'scope you can give the completed PCB a functional check by connecting it to a 6 volt battery supply and checking that pulses with 1:3 mark/space ratios are available at outputs R4-R8-R12-R16 and a variable 4-pulse train is available at the R17 output.

Construction of the double-sided PCB calls for extra care. Veropins or similar must be pushed through the board in various places (see overlay photos) and used to connect the upper and lower tracks by soldering to both sides of the PCB. Use miniature components throughout the rest of the assembly procedure, taking care to observe the polarities of all devices. The three CMOS ICs can be mounted in suitable sockets. When assembly is complete decide on suitable casing arrangement (we favour the idea of stacking the boards in a home-made box) and then set about interconnecting the two PCBs. Seven interconnection leads are required and their positioning requires particular care, with constant reference to both the circuit diagram and the overlay. There are two power supply interconnections and five interconnections to resistors 4-8-12-16 and 17.

When construction is complete, set RV5 to mid position and give the circuit a quick functional check by connecting a servo and suitable supply to channel 1 (A) output and check that the servo position can be varied via RV1. If all is well, recheck the servo functioning on channels 2 (B), 3 (C) and 4 (D), using RV2, 3 and 4 respectively to give control.

The procedure for fitting the completed unit into an installation is quite simple. The unit connects between the receiver/decoder outputs and the servo inputs. When installation is complete switch the receiver on and the transmitter off and adjust the fail-safe unit's pre-sets to set the servos to the desired fail-safe positions. Finally, switch on the transmitter and confirm that the system responds to normal remote control and reverts to fail-safe when control is removed. ▶

BUYLINES

All components used in the R/C Fail-Safe unit should be readily available from major stockists.

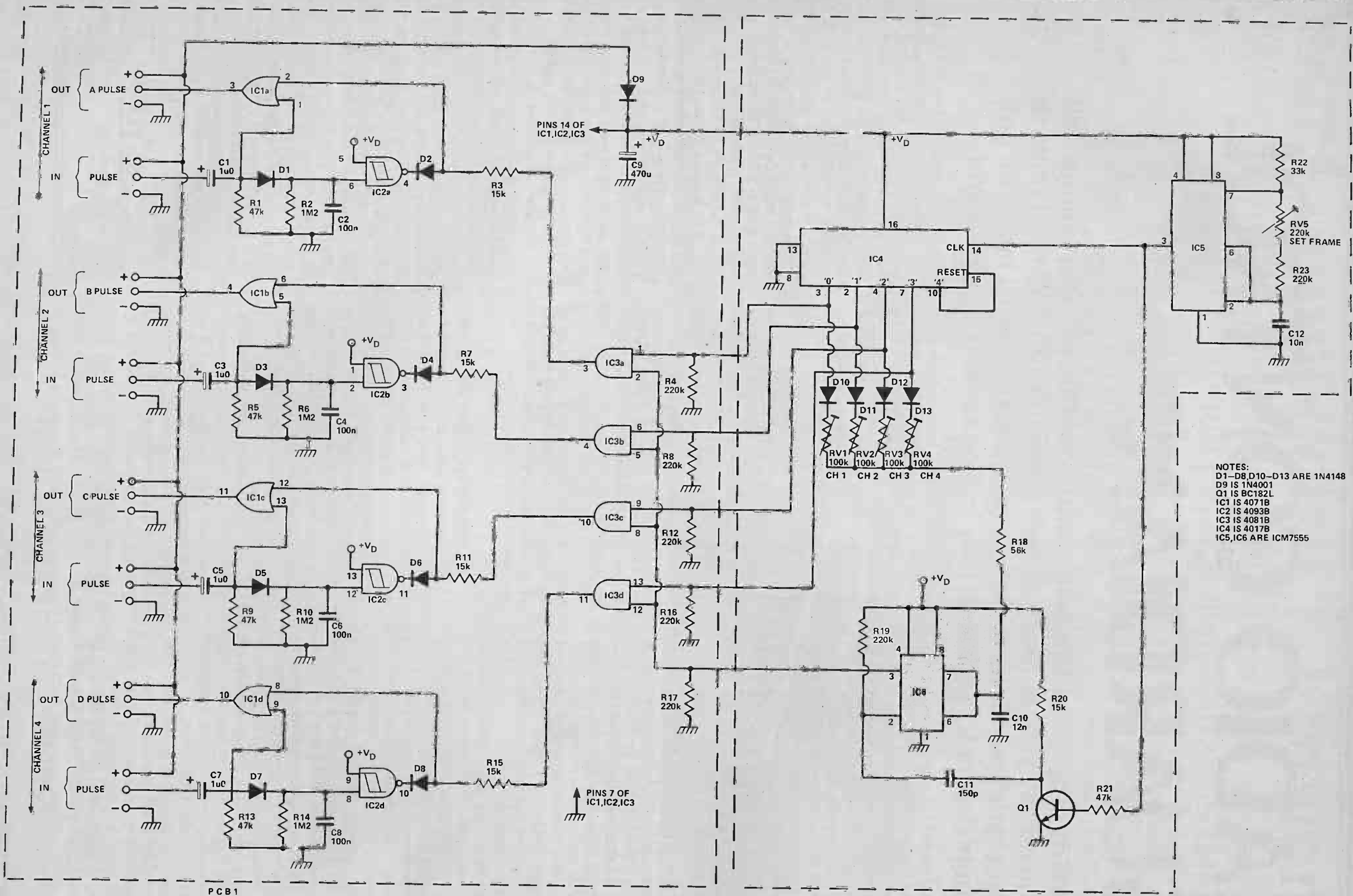


Fig.1. Circuit diagram. Dotted lines show which components are mounted on each PCB. PCB A left, PCB B right.

HOW IT WORKS

In a conventional multi-channel 'proportional' radio control system a variable-width (1–2 mS) pulse is passed to each servo via the transmitter-receiver-decoder 'link' roughly once every 20 mS (the 'frame' time.) The pulse width of each channel is variable at the transmitter (via joy-stick, etc) and determines the position of the servo. At 1 mS the servo may, for example, be full left, at 1.5 mS 'neutral' and at 2 mS full right. If the servo command signals are lost (due to system malfunctioning or because the receiver goes out of range) the servos simply lock into their existing positions, causing the craft to either crash or sail off into the wild blue yonder. Fail-safe units are designed to prevent such mishaps and automatically set the servos to pre-set 'safe' positions in the event of signal failure.

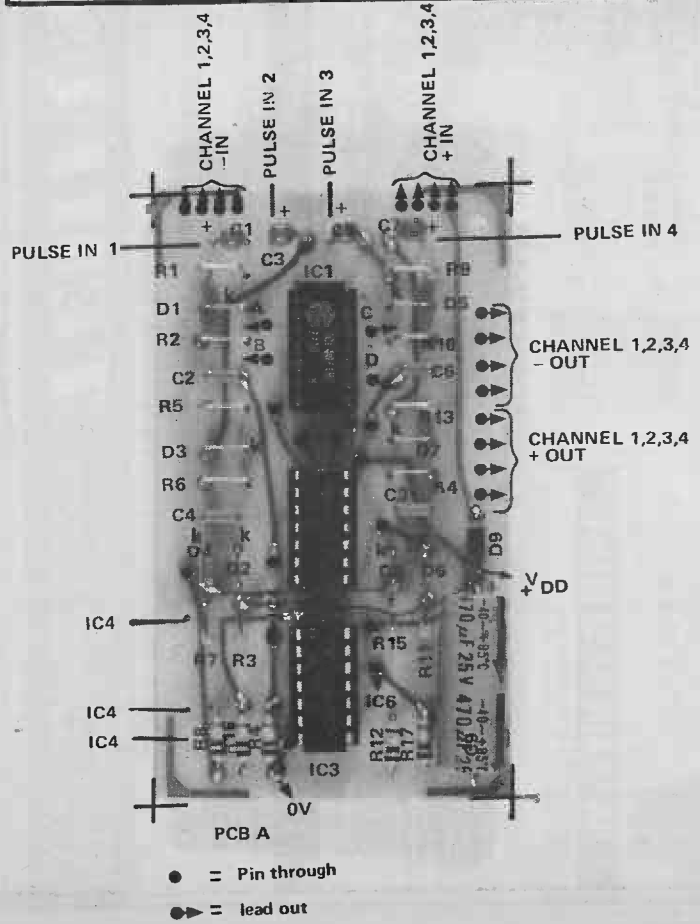
Our fail-safe unit incorporates a four-channel sequential pulse generator (IC3–4–5–6 and Q1) and four independent 'automatic data selection' networks, each built around one quarter of IC1–IC2. These data selectors feed command signals to their respective servos directly from the receiver decoder if the radio control system is functioning correctly or from the internal pulse generator if a system defect (loss of command signal) occurs. Each channel takes about 60 mS to switch from the 'normal' to the 'fail-safe' mode.

The internal pulse generator functions as follows. IC5 is a low voltage astable which feeds clock pulses to a divide-by-four counter with four decoded outputs designed around IC4. The action of these two ICs is such that the four outputs of IC4 switch high (one at a time) sequentially with a repeat or 'frame' time that is variable between 12 mS and 24 mS via RV5. The IC5 clock signals also trigger monostable multi IC6 via Q1 and the timing periods of the mono are controlled sequentially by the RV1 – RV4 pulse-width presets as the system clocks through each frame. The circuit thus sequentially generates a series of four independently adjustable pulses. Each of these pulses is steered to its own independent output channel via the IC3 circuitry. Thus, each of the four IC3 output signals consists of an independently pre-settable pulse.

The 'automatic data selection' circuitry consists of four identical and independent networks. Let's take the example of the channel 1 network. The circuit consists of an input signal detector (C1–R1–D1–R2–C2), a pulse selector (IC2a–D2–R3) and a servo driver (IC1a). If decoded input pulses are available they are passed through blocking capacitor C1 and fed to one input of servo driver IC1a. Simultaneously, the input signals charge C2 via D1 and the resulting DC drives the output of IC2a low, thereby removing the internally generated fail-safe pulses from the IC1a input. Thus, only the input pulses are presented to IC1a input and are fed directly through to the servo.

If the input command signals are lost, the bias voltage is no longer generated at the input of IC2a, so its output goes high and enables the internally generated fail-safe pulses to be fed to the input of IC1a and thence on to the servo. Blocking capacitor C1 ensures that the unit will switch to the fail-safe mode even if a decoder output locks into the 'high' position.

Note that the fail-safe channels of this system are fully independent, so if a control signal is lost on (say) only a single channel, that channel will go to fail-safe but the remaining channels will retain normal operation. Also note that, as is normal practice, the unit is powered from the receiver/servo battery via the decoder/servo harness connections. The supply is, however, decoupled via D9–C9.



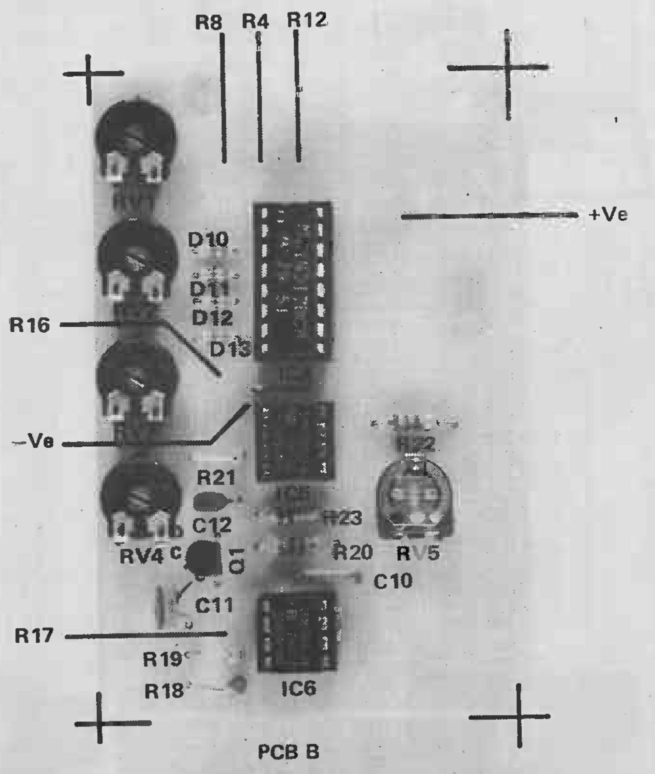


Fig.2. PCB A component overlay (left). PCB B component overlay (right).

PARTS LIST

RESISTORS

R1,5,9,13, 21	47k
R2,6,10,14	1M2
R3,7,11,15, 20	15k
R4,8,12,16, 17,19,23	220k
R18	56k
R22	33k

POTENTIOMETERS

RV1–4	100k
RV5	220k

CAPACITORS

C1,3,5,7	1u0 35V tantalum
C2,4,6,8	100n ceramic
C9	470u 25V electrolytic
C10	12n polycarbonate
C11	150p ceramic
C12	10n ceramic

SEMICONDUCTORS (all CMOS ICs are 'B' type series)

IC1	4071
IC2	4093
IC3	4081
IC4	4017
IC5,6	ICM7555
Q1	BC182L
D1–8, 10–13	1N4148
D9	1N4001

DESIGNER'S NOTEBOOK

In this month's 'Notebook' project editor Ray Marston takes a peek at the fascinating world of 'touch switch' technology.

If you ever get involved in the design of electronic equipment, there is a fair chance that you will eventually come accross a circuit that requires the use of a 'press-to-do-something' switch. You'll then have to decide whether to use an electro-mechanical push-button switch or a solid-state 'touch' switch to do the job.

The main disadvantages of the push-button switch are that it is unreliable, tends to be a bit expensive and is available only in those designs that manufacturers care to produce. These switches are also 'noisy' in that they generate contact-bounce spikes that can play havoc with fast digital circuitry.

This last mentioned problem can be overcome by using the 'debouncer' circuit of Fig 1. Here, one quarter of a 4093B CMOS quad 2-input NAND Schmitt is used as a simple Schmitt trigger. When PB1 is closed, C1 charges rapidly to full supply volts and the Schmitt output switches high: When PB1 is released C1 discharges slowly via R1 until eventually the Schmitt output switches low again. The circuit is thus unaffected by switch contact bounce and produces a clean on/off signal at the Schmitt output.

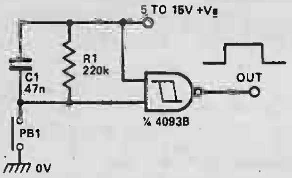


Fig.1. Push-button debouncer circuit.

Fig. 2 shows a useful way of obtaining a toggle (alternate on-off) action from a simple push-button switch. The switch signal is debounced by R1-C1 and is then used to clock one half of the 4027B dual JK flip-flop, which divides the clock signal by two. Thus, the 4027B output goes high on one press, low on the next, high on the next and so on. Two of these toggle switches can be built from each 4027B IC.

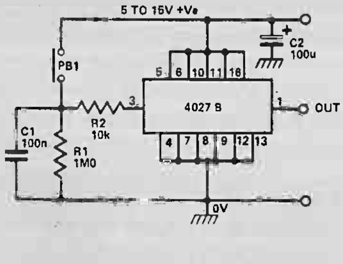


Fig.2. Push-button toggle switch.

Touch Switch Circuits

The main advantages of solid-state switches are that they are reliable (they have no troublesome mechanical parts), can be less expensive than their electro-mechanical counterparts and can readily be produced in almost any shape or form that the designer or home constructor wishes.

Touch switch circuits come in three basic types (ignoring 'freak' circuits such as thermo-switches, etc). The crudest and least attractive of these are the 'resistive' types, which use the 'touched' or 'untouched' resistance change that occurs between two adjacent touch contacts to give activation.

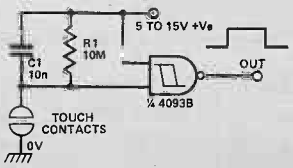


Fig.3. Resistive touch switch.

Fig. 3 shows a typical resistive touch switch circuit. Normally, with the contacts untouched, R1 holds the Schmitt input high and its output is low. When a finger is used to bridge the two contacts the resulting skin resistance (less than 3MO) pulls the Schmitt input low and drives its output high. C1 is used to 'debounce' the circuit. Fig. 4 shows how the circuit can be modified to give 'toggle' action.

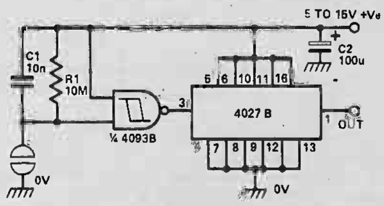


Fig.4. Resistive touch toggle switch.

A very serious disadvantage of the resistive touch switch is that it can be disabled by moisture or contamination bridging the contacts. Also, it may be disabled by persons with damp fingers or may be immune to operations by persons with very dry skins.

A great improvement in reliability is given by a second type of 'hum detecting' touch switch. This type of circuit relies for its operation on the fact that the human body acts as a kind of antenna

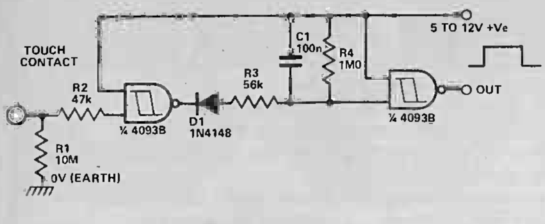


Fig.5. Hum-detecting touch switch.

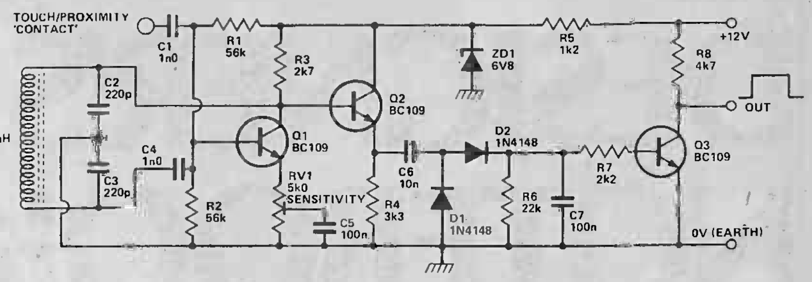


Fig.8. Damped oscillator touch/proximity switch.

that is coupled to the mains and carries a high-impedance mains signal. Fig. 5 shows an example of this type of circuit. When the input contact is touched the hum pick-up signal is fed to the input of the first Schmitt stage via limiting resistor R2 and produces a full-amplitude square wave at the Schmitt output. This square wave is converted to DC and debounced by the D1-R3-R4-C1 network and drives the final output of the second Schmitt high. The Schmitt output goes low again some 60 mS after the input touch is removed. Fig. 6 shows how the above circuit can be modified to give toggle operation: D2 and C2 prevent unwanted feedback from the 4027B to the Schmitt.

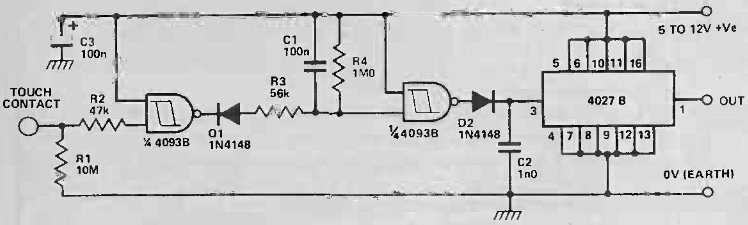


Fig.6. Hum-detecting touch toggle switch.

Capacitive Touch/Proximity Switches

The third and most important class of switch are those that work on the capacitive loading principle. In most simple cases, these circuits rely on the fact that the human body acts as a small capacitor that is earthed at one end. The actual value of capacitance depends on physique and on environmental conditions, but is reckoned to have a value of 150 - 300 p under normal domestic/industrial conditions.

Fig. 7 shows a number of basic ways of using the body capacitance effect. In Fig. 7a it causes loading of an HF oscillator, in Fig. 7b it causes capacitive potential-division and in Fig. 7c it causes filtering of oscillator harmonics. Of particular interest is Fig. 7d, which shows that these effects can be obtained without physical contact, by capacitive or 'proximity' coupling.

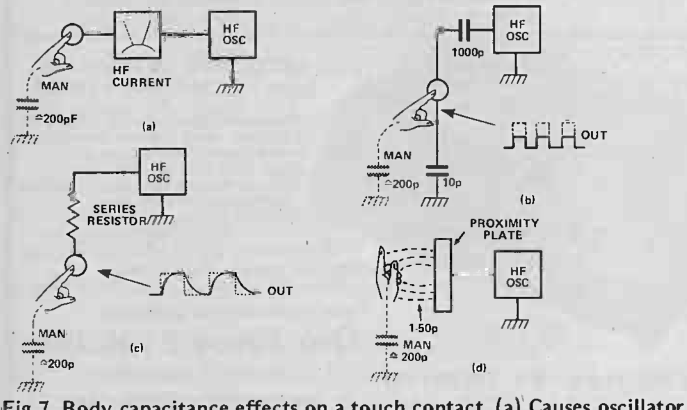


Fig.7. Body capacitance effects on a touch contact. (a) Causes oscillator loading, (b) capacitive potential divider action or (c) degradation of oscillator waveform (harmonic filtering). (d) If contact is of sufficient area, loading and other effects can be obtained without physical contact, by capacitive or proximity coupling.

Fig. 8 shows the practical circuit of a touch/proximity switch that works on the oscillator damping principle. The oscillator is a Colpitts, working at about 300 kHz. RV1 is carefully adjusted so that oscillation is barely sustained when the contact is untouched. Under this condition the rectified output of the oscillator drives Q3 to saturation and holds the circuit's output low. When the contact is touched the resulting capacitive loading kills the oscillator, causing Q3 to turn off and switch the output high. The output has relatively slow rise and fall times, but can be speeded up with a Schmitt circuit if required.

The zero volts line of the Fig. 8 circuit should (ideally) be grounded. The touch contact must be made from a conductive material, but can be any shape or size that is desired: in most cases the 'contact' face can be covered with an insulating material without detracting from the circuit's performance. Pin-head sized contacts will require actual-contact operation, but 'contacts' with surface area of a square metre or so can be proximity-operated at ranges up to 20 - 40 cms.

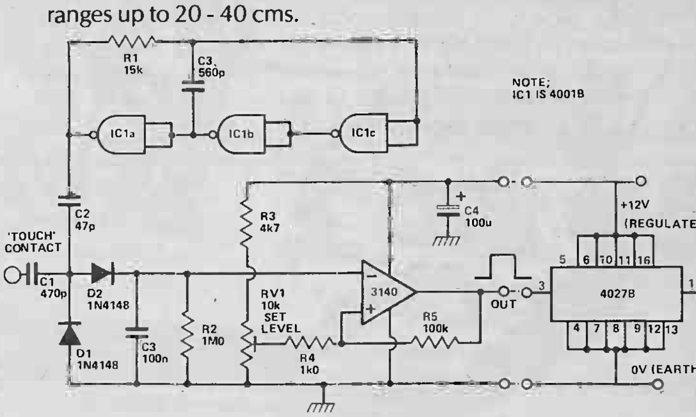


Fig.9. Capacitive-divider touch switch (left) with modification for toggle operation (right).

Finally, Fig. 9 shows the circuit of a touch switch that works on the capacitive-divider principle. Here, IC1 is wired as a ring-of-three oscillator working at a frequency of a few hundred kHz. The oscillator output is fed to a capacitive potential divider formed by C2 and the stray capacitance around D1 and the touch contact. The resulting potential divider output signal is rectified by D1-D2-C3-R2 and fed to the 3140 regenerative voltage comparator, which is adjusted (via RV1) so that its output is just switched to the low state when the input contact is untouched. When the contact is touched, the resulting capacitive loading increases the effective capacitance of the lower half of the potential divider, thereby reducing the divider's output voltage and causing the 3140 output to switch high. Fig. 9b shows an add-on section that can be used to convert the circuit to toggle operation

As in the case of the Fig. 8 circuit, the zero volt line of Fig. 9 should be grounded. The touch contacts can again be any desired shape or size. **ETI**

AUTOMATIC BATTERY CHARGER

A 12 volt battery charger project that automatically switches to a 'trickle charge' mode when the battery reaches full charge. The circuit can be built as a stand-alone project or can be used to up-date an existing charger.

Conventional car battery chargers are simple and inexpensive devices which continuously charge the battery (at a rate of a few amps) for the duration of the switch-on period. The owner has to occasionally check the state of the battery with a hydrometer and switch the charger off when the battery reaches the 'fully charged' state. If the owner does not switch the charger off the battery will overcharge and its electrolytic solution may eventually be lost through evaporation or the cell plates may buckle and destroy the battery.

Our ETI battery charger overcomes the deficiencies outlined above. It incorporates an electronic charge-state sensing and feedback control network which causes the battery to charge at maximum rate until full-charge is attained, at which point the charger automatically switches to 'trickle charge' mode which maintains the battery in the fully charged state indefinitely. A red LED illuminates when the battery is fully charged.

Our charger is designed to charge 12 volt batteries only. The unit can either be built as a self-contained 'stand-alone' project, complete with transformer and case, etc, or alternatively the electronics can simply be added to an existing charger unit, to update a conventional design. We have included the circuit of a typical 'conventional' charger, for comparison purposes.

Construction & Use

Construction of the unit should present few problems. If you decide to build the complete 'stand alone' project, assemble the PCB components exactly as shown in our overlay, noting that the two LEDs are mounted off-board. If you decide not to fit the optional meter (a difficult-to-get component, which MAY be available from some car accessory shops) short the two M1 connections together using heavy gauge wire.

If you decide to simply use the automatic charger circuit to update an existing battery charger, omit BR1 from the PCB and take the outputs of your existing charger rectifier directly to the appropriate '+' and '−' points on the PCB track. Whichever version of the unit you decide to use , be sure to use a reasonably heavy gauge of wire for the main interconnections.

When construction is complete, turn RV1 slider fully to the 'ground' position and give the unit a functional check as follows.

1 Check that, with no battery connected, both LEDs illuminate.

2 Connect a car battery into place on the charger. Check that LED No. 2 turns off and that a charge current (typically 2 to 4 amps) flows to the battery.

3 Rotate RV1 and check that LED No.2 can be turned on and the charge current cut off via the pot.

4 Return RV1 slider to the 'ground' position and charge the battery up using the normal 'hydrometer' technique. When the battery reaches full charge, carefully adjust RV1 so that LED No. 2 just starts to turn on and the charge current falls to a 'trickle' level of a few hundred milliamps.

If RV1 is correctly set, you'll find that on subsequent charges LED 2 will first start to flicker as the 'full charge' level is attained. The LED will subsequently turn on at reduced brightness or will alternatively cut on and off as the 'fully charged' state is maintained. RV1 should require no further adjustment throughout the life of the charger. ▶

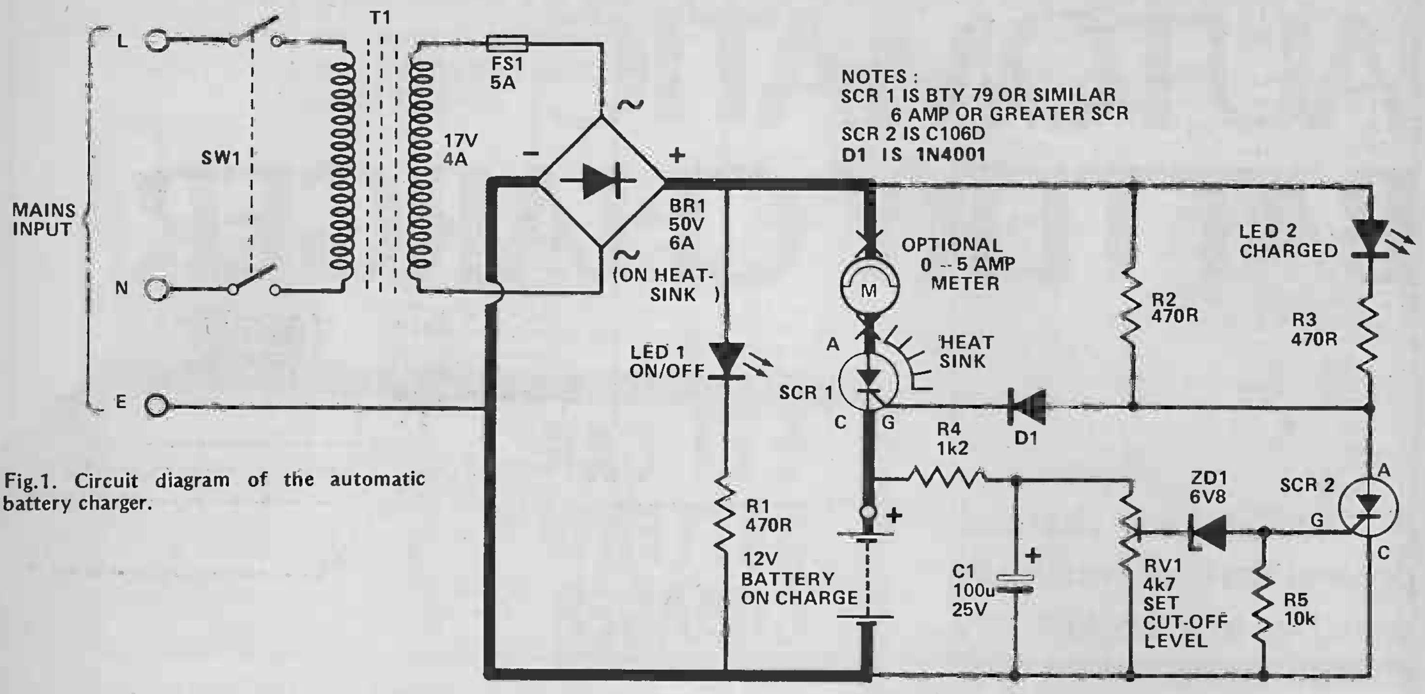
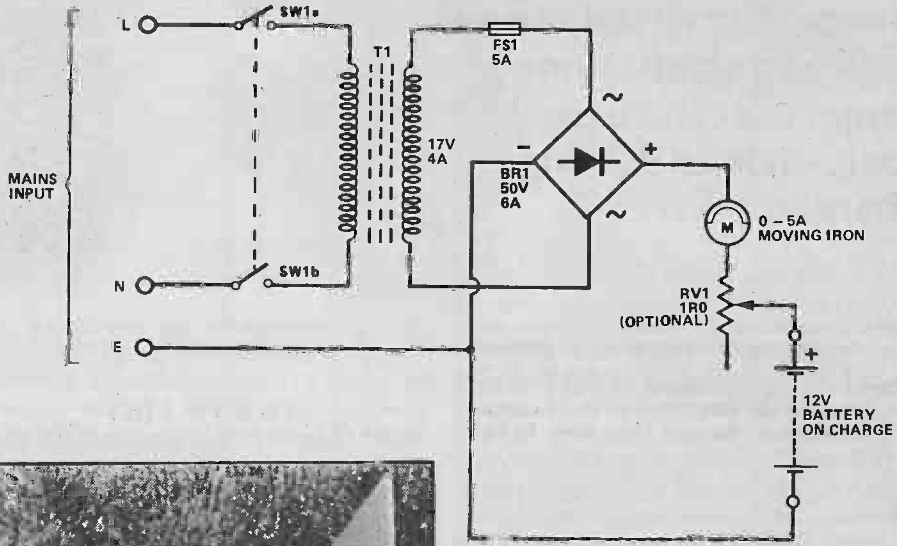
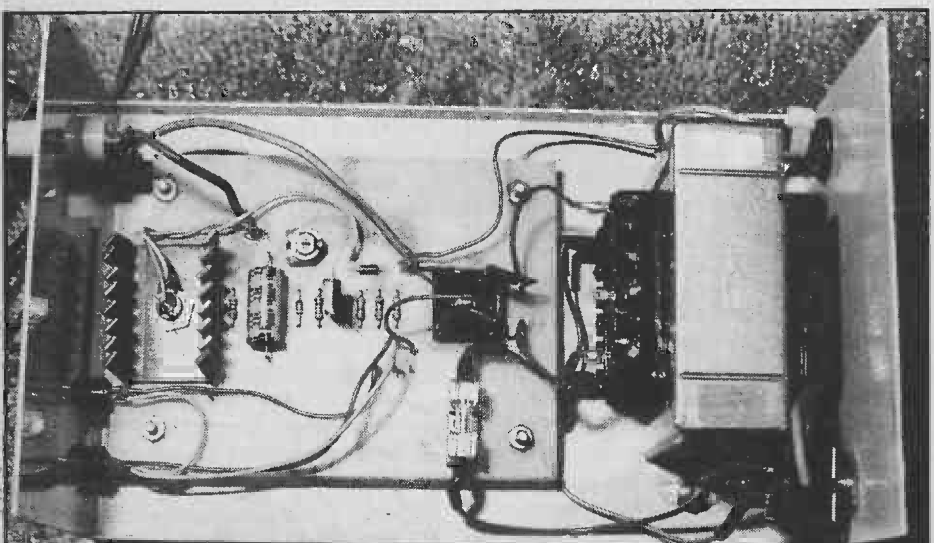


Fig.1. Circuit diagram of the automatic battery charger.

Fig.2. (right). For comparison we have included the circuit diagram of a conventional charger.



(Below). The PCB and transformer installed in a suitable case. Note the heatsink on SCR1.



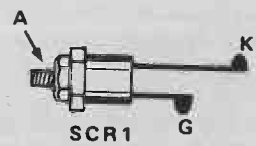


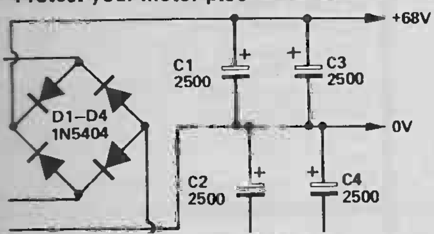
Fig.3. Connections to SCR1, the BTY79.

electronics today INTERNATIONAL

APRIL 1980 Vol 9. No 4

A complete budget system p.44

Protect your motor p.50



Circuit supplement p.55

A phone with a difference p.80

FEATURES

PROJECTS

INFORMATION

OVERSEAS EDITIONS

AUSTRALIA : Roger Harrison Editor
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HOW IT WORKS

In a conventional battery charger (see diagram) the unsmoothed full-wave rectified output of a 17 volt transformer is fed to the battery via a moving-iron 0-5A monitor meter. The battery is charged by a 'pulsed' current at a rate determined by the differential voltage between the battery and the charger and by the total series resistance of the circuit (the effective resistance of the transformer, rectifier, meter and battery). A 'flat' battery has a low terminal voltage and typically draws an initial charging current of about 4 amps, falling to about 2 amps as the terminal voltage rises to the full charge value. The total series resistance of the circuit is usually sufficient to limit the charge current to a safe value: 'De Luxe' battery charger sometimes have a low-value rheostat in the series network, enabling the charge rate to be varied over a limited range.

You'll notice from the above description that the battery terminal voltage rises as the battery charges up and can thus be used to give an indication of the state of charge of the battery. This fact is put to practical use in our automatic battery charger, which operates as follows.

Silicon controlled rectifier SCR1 is wired in series with the battery circuit and can be gated on via the R2–R3–LED 2 network: this network can be disabled by gating on SCR2. The battery terminal voltage is monitored by the R4–C1–RV1–ZD1 network and turns SCR2 on when the terminal voltage exceeds a value pre-set by RV1.

When a 'flat' battery is first put on charge its terminal voltage is low. Under this condition SCR2 is cut off and SCR1 is gated on in each half cycle via the R2–R3–LED 2 network. SCR1 acts as a simple rectifier under this condition and the battery charges at maximum rate: the forward volt drop of SCR1 is only a few hundred millivolts and is insufficient to turn LED 2 on.

As the battery charges up its terminal voltage rises. If the terminal voltage rises above the trip level pre-set by RV1, SCR2 is gated on via ZD1. Under this condition SCR2 removes the gate drive from SCR1, which turns off and no longer passes a charge current to the battery: LED 2 is turned on via SCR2 and R3, indicating that the battery is fully charged.

In practice, the terminal voltage of the battery depends on both the battery state and the magnitude of the charging current and decreases when the charging current is removed. Consequently, the circuit does not abruptly stop providing a charging current when the battery reaches full charge, but goes into a progressive skip-cycling mode, which progressively reduces the mean charging current to a low 'trickle' value. This action automatically maintains the battery in a fully charged (but not overcharged) state.

The correct setting of pre-set pot RV1 is established initially by charging the battery up in the conventional (hydrometer, etc) manner until it reaches the fully charged state. RV1 is then carefully set so that the charger goes into a skip-cycling or trickle-charge mode under this condition. The RV1 setting is then valid for all subsequent 'automatic' recharging actions. Current monitor meter M1 is an entirely optional component in this circuit.

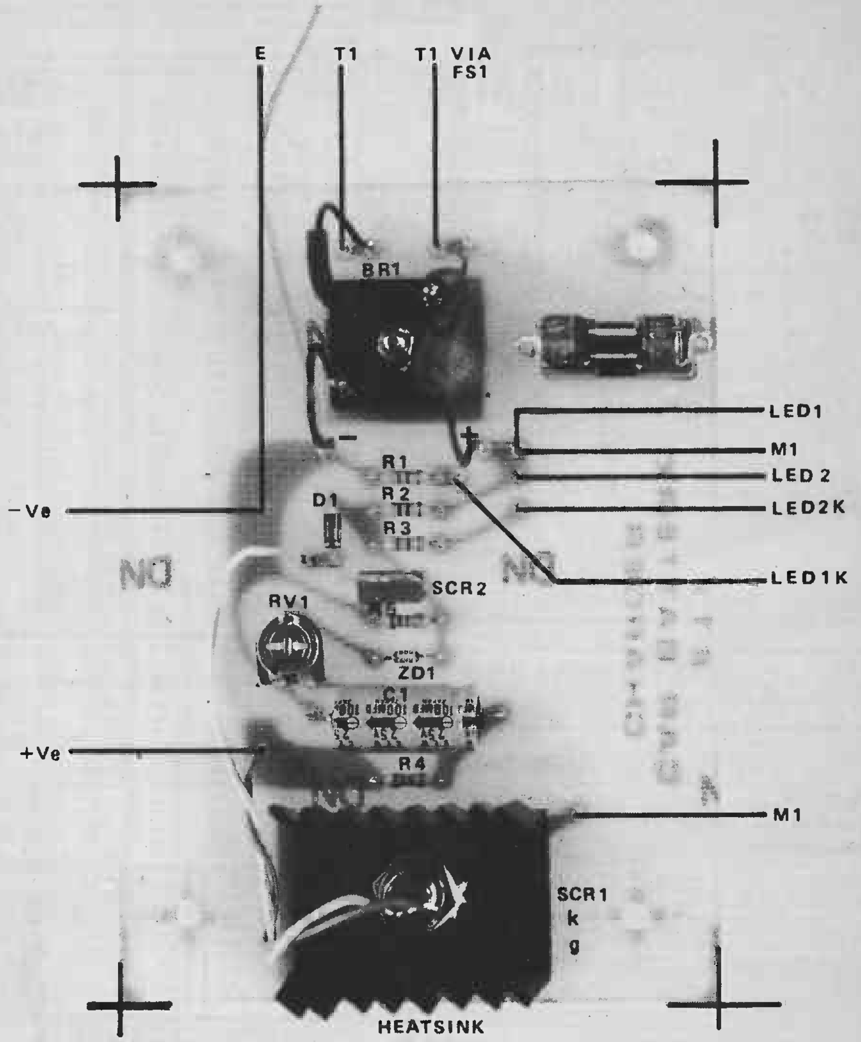


Fig.3. Component overlay. Short the meter connections together with heavy gauge wire, if you decide not to fit the meter.

PARTS LIST

RESISTORS :

R1,2,3	470R
R4	1k2
R5	10k

POTENTIOMETERS :

RV1	4k7 preset

CAPACITORS :

C1	100u 25V electrolytic

SEMICONDUCTORS :

SCR1	BTY79
SCR2	C106D
D1	1N4001
ZD1	6V8 400 mW
LED1,2	TIL220
BR1	200V @ 6A

MISCELLANEOUS :
Charger transformer CT4, 5A fuse, dPdT Toggle, instrument case, H 95, W 125, D 220mm.

ETI

BUYLINES

All components used in the Battery Charger are available from major stockists. The Charger transformer can be obtained from ElectroValue.

AUDIOPHILE

Ron Harris goes gardening with some rogue speaker boxes and shifts his sights to budget hi-fi.

Around the middle of this month I got lost. Nothing unusual in that, you may say, some of the best people get lost from time to time. This was in the country though, surrounded by all these woolly pre-packed lamb chops and things. Healthy things too, like fresh air, grass and circular brown patches of earth that heave up and drown your shoes when you step in them...

Being of sound mind and thirst, the first thing I do when lost is head for a pub. One of Britain's real strong points that is, regardless of where you are or who you are, you're never more than half-an-hour from a pint of bitter and a barmaid.

Sure enough after about ten minutes of 40 MPH down these 'roads' a suitably shaped building loomed in the headlights. All would be well now, with a pint inside us and some worldly words of wisdom from the friendly landlord we'd soon be heading back into civilisation.

Oh yeah?

This pub turned out to be the one Hammer films line up werewolves outside for howling practise. Weird it was, surrounded by a massive car park which was totally devoid of cars. Just the wind and us.

Once inside I suppose it wasn't that bad, empty but not bad. The only customer was the 'local character', otherwise known as the tramp, a little lumpy old man whose party trick turned out to be saying 'Hello Sailor' in ten languages. Probably explains the lumps. Stranger yet was the manner in which music issued forth into the bar. Had they been playing church organ or choir stuff I'd had been across those fields faster than the Russians in Afghanistan.

No speakers you see. A nice plain ordinary music centre, being played by a nice plain ordinary barmaid and nice plain ordinary music, but no speakers. We searched the place, - plenty of pretty beams and dead animals around the walls, but no speakers. Upon enquiring at the bar I was informed by a suspicious look, a grunt and a wave which took in half the known Universe, that they were 'over there'.

Not wishing to look *too* ridiculous, I looked around again. Slowly it dawned that the only things in approximate position to be producing sound were two massive cylinders covered in *green-grocers grass*! From zero feet away it became clear that was indeed the source of the treble-less thudding which prevaded the building.

Green Green Grass of Ohm

Oh my God! A closer look into these apparitions acquired overwhelming importance. 'In the name of Audiophile, I command thee - revelest unto me thine drive units.....' sort of thing.

Anyway, while our illustrious Art Director distracted the barmaid - a brilliant tactical maneouvre involving a pint glass, the tramp and two felt tip pens - I managed to peel back the turf a little. Inside resided three KEF B200s and a T27, no crossover, and no padding. The tweeter pointed up out of the top of the cylinder while the mid-ranges units attempted to push the rest of the sound straight through the grass, failing miserably.

A great deal of work h ad obviously gone into the construction of these enclosures and no doubt someone somewhere thought that grass finish attractive. The end result was nothing short of an horrific treble free thudding which occasionally coincided with the music.

As I've no idea where the pub is, short of saying it's somewhere north of London but south of Colchester, at least I ain't gotta go back and be thudded at.

If there's a moral to this tale at all it must be to avoid home-brew speakers, even in pubs.

Budget Time

Three hundred pounds is not a lot by today's standards. Right now it buys you ½oz of gold, or maybe the rear bumper of a new car. Once upon a time (of inflation) it would have bought you a very nice little hi-fi too, although to-day around five hundred is more like an average starting price.

However, the arrival at ETI of a JVC amplifier, the AS5, with a retailing price of around £85 and a nice sound indeed provoked some debate as to how possible it is to assemble a complete (record playing) system of good quality for that £300......................

That then, is the starting point for the system described here. All in all, at present prices, the outfit totals between £293 and £327 depending on the state of your discounts.

Giving names to it all produces a list which looks a little like:-

TURNTABLE:	JVC QLA5R - quartz lock, auto return. Wow/flutter 0.04% DIN. s/n 75dB DIN.
CARTRIDGE:	CORAL 555E - elliptical stylus. Compliance = 15/20 cu. FR. 20-20k = 2dB. output 4mV (5 cm/sec lk).
AMPLIFIER:	JVC AS5 - 30W rms at 0.06% thd across 20-20 kHz phono:- 2mV/47k, overload 150mV, s/n 70dB.
SPEAKERS:	VIDEOTONE GB2 - 5OW (RMS) power holding, two unit ported design.

OK, so I know that there is nothing British in there and that the Goldring G900E and any one of several British loudspeaker manufacturers have good reason to feel left out, but then most of those products have been reviewed to death elsewhere and the components employed here all have a great deal to offer in their own right.

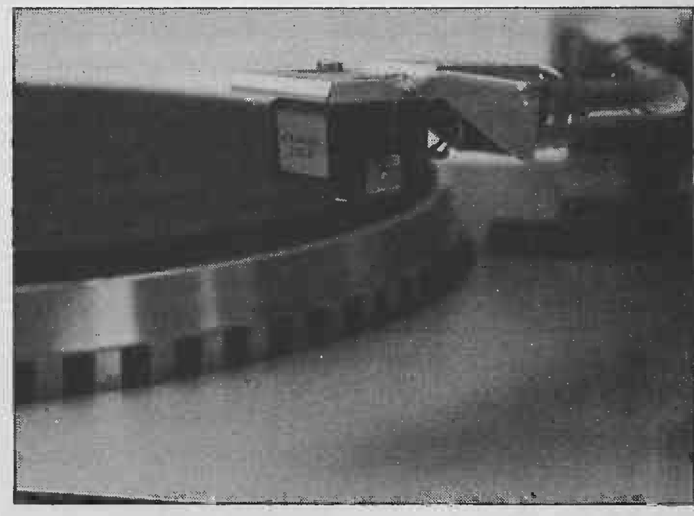
So no Union Jacks in the post, eh? (I've got one anyway!) Photographs of Felicity Kendal are of course *perfectly* acceptable...

Around a Roundtable

The turntable, JVC, QLA5R, is fairly new and retails at the £100 mark. For that you acquire an auto-return quartz-lock machine with a good (but flimsy) construction and the possibility of varying the speed, should you so desire, by ± 6%. Quaintly entitled a pitch control, this facility is even endowed with some nice little lights to show how far away from the correct speed you are.

All these speed change facilities have one thing in common - they are totally and utterly useless. Better to have spent the pounds on a more solid plinth. A turntable that goes around at 29 or 37 RPM is *wrong*, whether by design or not.

Right: the JVC QLA5R turntable. As you can see the finish is to a very high standard and good adjustment is provided on the pickup arm. Noise level from the deck was around the –45 dB mark under test and no meaningful comment could be made about the quartz-lock speed control – except that is is accurate! Experiments seemed to suggest that this deck is a good partner for low compliance moving coil cartridges.



Below right: the Coral 555-E installed in the deck. Its depth necessitated raising the arm pillar an appreciable amount, which the deck could cope with, but the instruction book couldn't! A good cartridge and excellent value for money.

The arm is of a good standard with high quality bearings and a nice range of adjustments - unusual on an automatic in this league. The turntable switches on as you move the arm from the rest, and is turned off once the arm returns, its duty done.

The strobe markings around the rim are machined into the platter itself and, having sharp edges, are the best reason you'll find for not touching the deck until it has stopped! (I've got the scars to prove it, too).

At first I was less than happy with the deck - the lift/lower behaved like a Kamakaze pilot for a start - and I thought the plinth too light. However, once you have adjusted the arm height for a good clearance, totally ignoring the misleading instruction manual, the lower control performs more sensibly. The deck is certainly more prone to acoustic feedback than I might like, but a good solid mounting shelf (no coffee tables entertained) should prevent any trouble there.

Getting the Point

My cartridge is from the same stable as the amazing MC81 (which remains my nomination for God's gift to hi-fi) and all sarcastic cries of 'surprise' 'surprise' will be studiously ignored. The Coral 555E is a moving magnet design of more restrained ambition and hence more general appeal. At its price of somewhere beneath £20 it faces numerous competitors of varying ability, so there is no lack of units to compare it against!

Physically the 555 is quite a deep unit with a medium/low compliance rating, and a weight of six grammes. Output is high-ish at around 5mV at 5cm/sec, and so an amplifier with a healthy overload is called for, lest it clips away at the peaks other beers can't refresh.

Once the arm height had been suitably adjusted the Coral proved a good match for the QLA5R and gave a satisfyingly musical reproduction in the test system. Substituting the deck into our reference system could only be called unfair I suppose, but still it's a cruel world anyway so what the hell...

The deck itself is a competent offering, very good mechanically and producing a good sound quality at its price. Compared against a high quality reference the sound is shown to be a little boomy, probably due to its constructional failings. A slight edge is imparted to the higher regions too.

However, being unfair has the advantage that once you start you may as well carry on, so I took the 555E out of the QLA5R and the reference MC81 was parted from its carressing SME 111 and the two interchanged. The JVC handled the moving coil unit very well indeed and the results were very, very impressive.

The 555 in its turn was shown to be a high class unit by absolute standards, lacking only that subtle handling of complex signals which comes only with a high pile of poundnotes. Tracking is competent, if not outstanding, and the sound balance is a well restrained mixture on the right side of bright - if you'll pardon the rhyme. ▶

Centre Point?

And so to that from where we came. JVC's A-S5 began this and is indeed a worthy offering. As you can see from the photo it has a simple appearance (if I was polite I could call it restrained) but it is in full possession of all necessary controls. The tone controls are of the 'click' variety and worked well in use producing no deterioration in the quality of sound for a moderate amount of tonal correction.

Although 30W is not a great deal of power by today's standards, the JVC performed well in most situations. A large room with large speakers is not the universe in which this star shines brightest, nor is it intended to do so. When used sensibly the A-S5 has a clean sound with good smooth treble extension and a firm bass response. With speakers of the ABR type i.e. Celestion 15's etc. a certain lack of control was noted, which vanished with infinite baffle or ported speakers such as the Videotone GB2s married to it here.

There is nothing in the specification to explain this oddity. The damping factor holds up well at all frequencies - which is the first place one searches in a case like this. Anyway, a minor condition, a trifle in fact. Choose your speakers well and enjoy the best amplifier sound available under £100. All comes included! Congrats JVC.

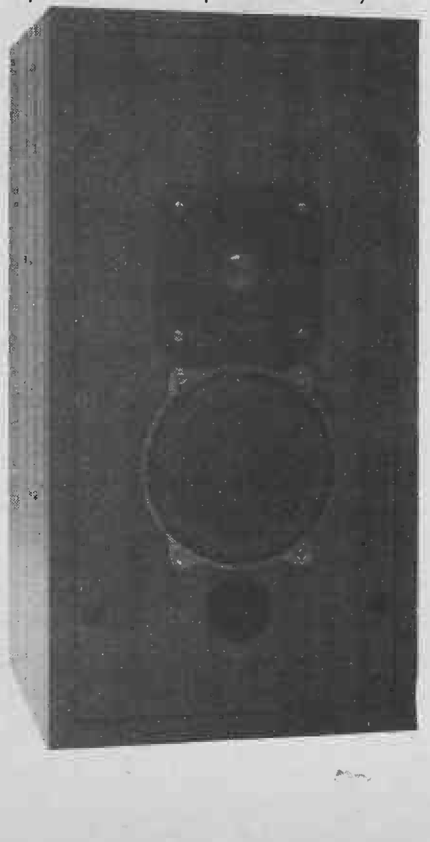
Point of Speech

Hands up all those who have not heard of the Minimax. No takers?... One?... Who? Never heard of *him* either.

Oh very well...... they were the greatest thing since ears a few years back, sweeping all before their cones - including the reviewers. Singlehandedly they... etc... etc... etc... That's right, a past rave machine. Correctly so, at the time. Videotone established themselves in the UK with the Minimax's and have consolidated since.

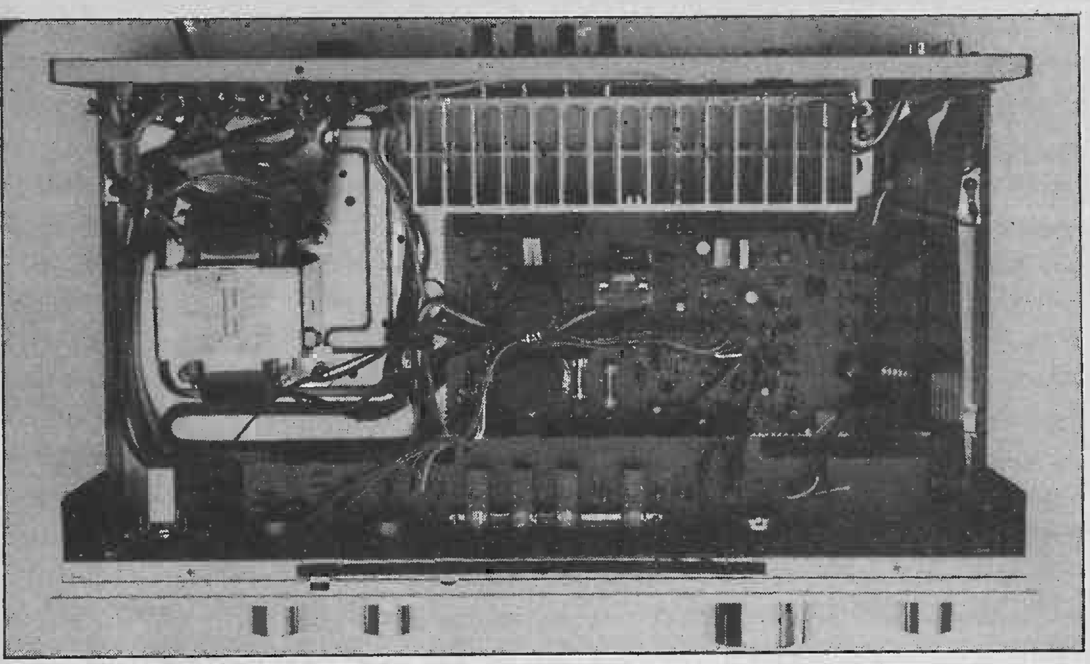
The GB2 is a well made little two unit enclosure of ported intent and a hefty bass punch for its size. It matches the A-S5 very well and for its £100 asking price returns a good deal of perfor-

Right: a naked GB2. The port is visible below the bass unit in the photograph. The bass unit itself seems small for the enclosure size at first but gives a good account of itself. The only criticism I had of the speakers was that they were more directional than most enclosures with a dome HF unit. Perhaps that (relatively) wide baffle had something to do with it. Overall though the GB2 is a fine little speaker which will take a bit of power and return a healthy bass punch.



A metal tape. Anyone who has tried to buy one of these elusive plastic cases will no doubt appreciate the sight. Machines to play the metallic illusions DO exist however and next month I'll be revealing the ferric truth about the Sony TCK 55 II — a £200 example of the iron art.

The cassette? Oh, well that is because Sony are shipping them in quantity which means that TDK no longer have it all their own way.



Left and Far Left : the machine which is to blame for this months Audiophile, AS5 from JVC. As you can see from the internal shot the amp is very well made with sensible heatsinking. I hasten to add that the tone control settings shown were put on by our photographer and NOT by me. He even managed to press the loudness button in — before I decapitated him for sacrilege. I tried hard to find something wrong with this amp and was sorely disappointed! Highly highly recommended.

mance. The overall sound is smooth, with a slightly recessed mid-range and may be a little lacking in that presence so beloved of hard-rock enthusiasts. Nonetheless, the compromise is a good one at this price level and one which will tune many a phono cartridge. A good match here for the Coral 555E, lending a balanced and well extended sound to the system overall.

So there you have it. A £300 system of fine pedigree and performance. It will not fill the Albert Hall with 100 dB of suicide watts, nor will it rattle the neighbour's china from his mantlepiece.

It *will* provide a good accurate rendition of vinyl information presented to it in the average living room, however, and that is all you could ask in a system - is it not?

No?

Why not?

ETI

CAR SECURITY DEVICE

Bring your ETI Car Alarm up to date with this add-on alarm control module from Compu-Tech Systems. This module's muscle is guaranteed to double your alarm's scare coefficient.

Many readers who have built and installed the Compu-Tech Systems car alarm (featured in ETI, December 1978) have expressed an interest in two additions to the alarm system, which increase its effectiveness at night and in noisy or high theft risk areas. This unit is also recommended if your horn is prone to faults or if it is located in an easily accessible place. If it's easy for you to get at, it's equally easy for a thief to get at.

The first requirement of the design is a method of sounding the horn, flashing the vehicle's lights and breaklights simultaneously when the alarm is activated. Whilst maintaining complete isolation between these circuits while the car is in normal use. The second design requirement is a method of driving a continuous supply of 12 volts for a siren from the pulsating DC alarm signal without recourse to a large capacitor and the resulting slow run down of the siren when the alarm is switched off.

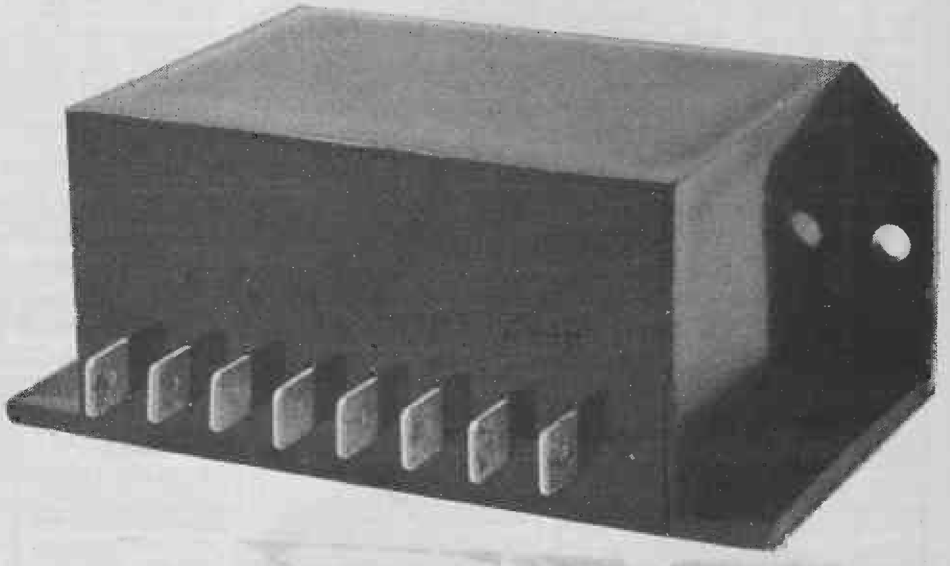
The project outlined has combined these two requirements into a compact weather resistant housing suitable for mounting in the engine compartment.

Add-on Power

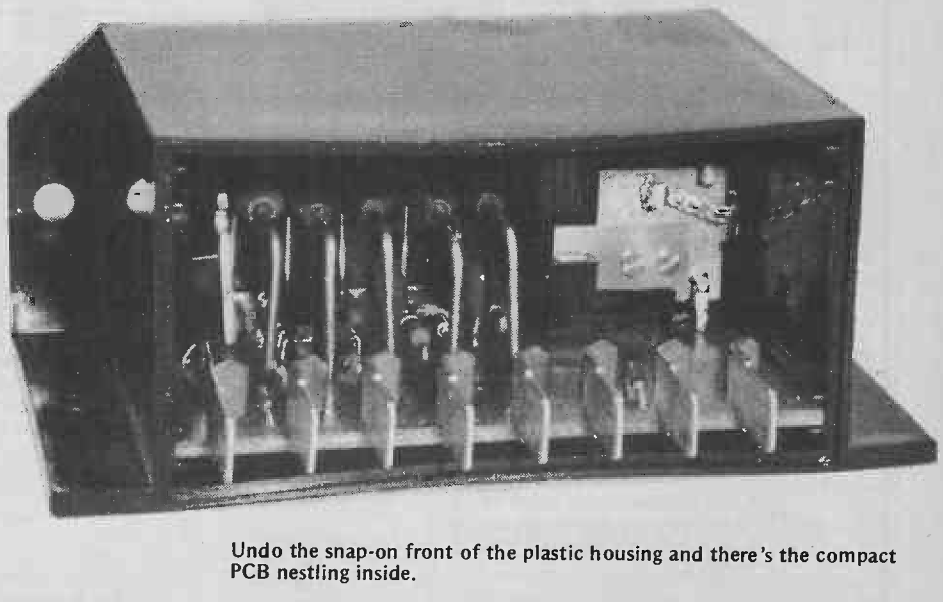
The current rating of the Alarm Control Module is 15 A, which is adequate for the demands of vehicle horn circuits ranging from seven to twelve amps. In order to meet the increased current demands of the vehicle lighting circuits, which range from six to ten amps, an additional fused circuit, independent of the Main Alarm Control Module, must be provided and independently switched by the alarm signal.

Construction

Construction is straight-forward with the Compu-Tech kit Of course, this little project must be used in conjunction with the ETI Car Alarm (Dec. 1978). Photocopies of this article are available from ETI for 50 pence.



Compu-Tech's add-on alarm control module comes complete with weather resistant housing to give trouble-free service from its hiding place.



Undo the snap-on front of the plastic housing and there's the compact PCB nestling inside.

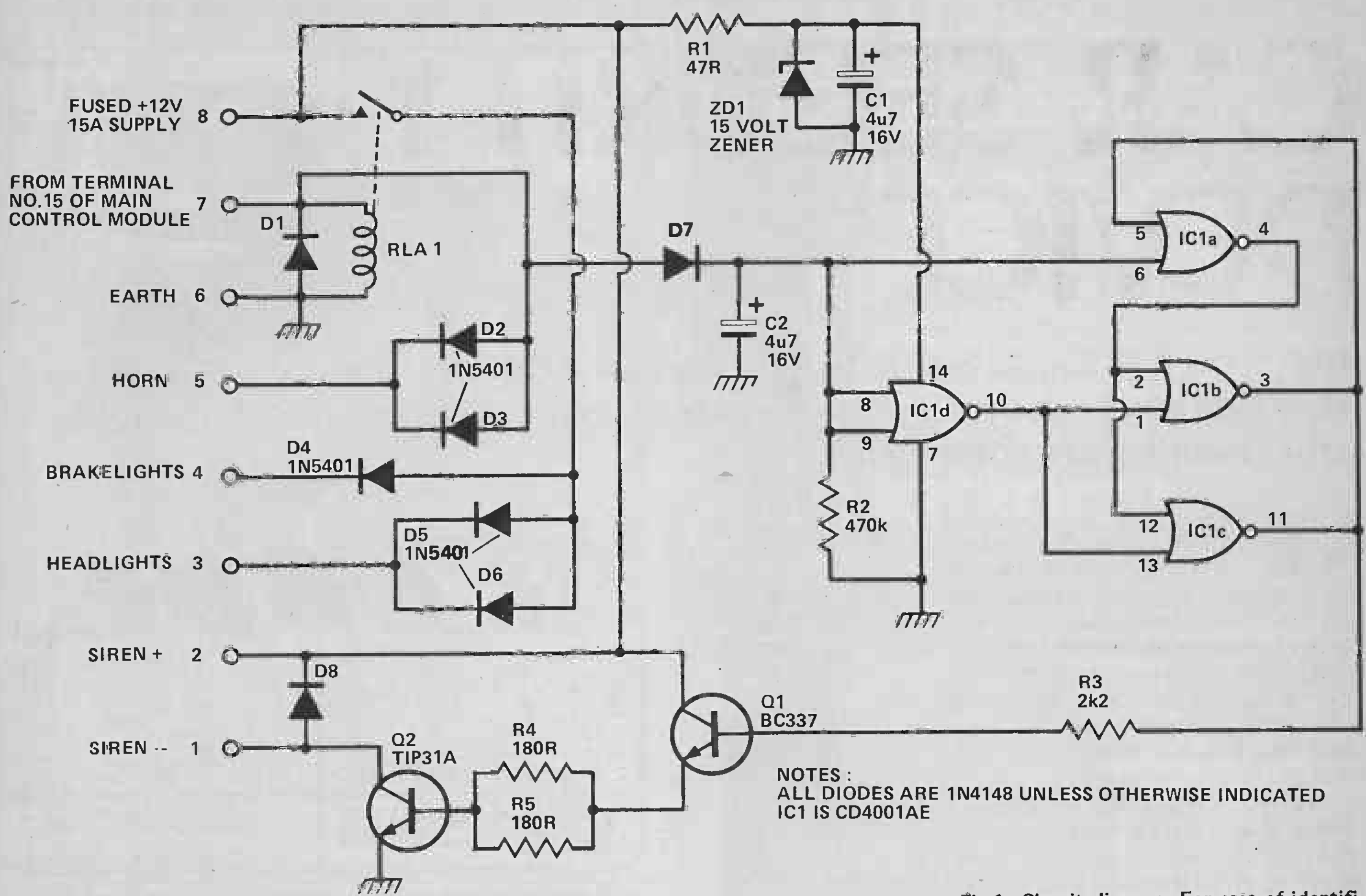


Fig.1. Circuit diagram. For ease of identification the terminal numbers are marked on the case front.

HOW IT WORKS

The 1 Hertz pulsating alarm signal from the Main Alarm Control Module is connected to the Flasher Module via terminal (7). The horn output is derived directly from this signal at terminal (5) via blocking diodes D2 and D3. The signal from the alarm control module also energises RLA1. D1 absorbs the spikes created by the collapsing magnetic field of RLA1 which occurs during the pause in the alarm signal. Whenever RLA1 energises the second DC supply provided at terminal (8) is switched to the brakelight circuit at terminal (4) via blocking diode D4 and to the headlight circuit at terminal (3) via blocking diodes D5 and D6. Blocking diodes D2–6 ensure that the horn, headlight and brakelight circuits remain isolated when in normal use.

The DC supply provided at terminal (8) supplies the siren directly via terminal (2) and also supplies the internal logic circuitry via R1. ZD1 limits the DC supply to 15 volts which protects the IC from spikes that may be present on the incoming supply. C1 filters out any noise that may interfere with the operation of IC1. IC1 is connected as a set-reset flip-flop. This arrangement provides a quick snap action to switch the siren on and off thereby avoiding prolonged rundown of the siren. The alarm signal, when present at terminal (7), is coupled to IC1 via D7. The alarm signal will charge C2 to 12 volts which is sensed as a logic '1' by IC1 locking it to a stable state with a logic '1' at the output of IC1b/IC1c. IC1b is parallel with IC1c for increased output current drive capability. The logic '1' present at the output of IC1b/IC1c drives a modified darlington pair consisting of R3, Q1, R4, R5 and Q2 into conduction which provides an earth return path for the siren at terminal (1). This particular darlington configuration exhibits a very low saturation voltage across Q2 when it is conducting which minimises the power losses that would occur with a conventional darlington saturated switch. D8 absorbs the spikes created by the commutator in the siren. The time constant of C2 and R2 is approximately two seconds which is twice the period of the alarm signal from the control module. Therefore, the pulsating alarm signal will be seen as a continuous logic '1' as long as the alarm signal continues. Once the alarm signal is reset C2 will discharge to a logic '0' which will reset the set-reset flip-flop to its quiescent state with a logic '0' at the output of IC1b/IC1c silencing the siren.

BUYLINES

Compu-Tech Systems, Laundry Loke Industrial Estate, North Walsham, Norfolk will supply a complete kit of parts for this project including wire, connectors and hardware for £11.95; Siren £7.75 extra. (PCB only: £1.00).

A prerequisite for proper operation of this project is the installation of the Vehicle Alarm Project in the December 1978 issue of ETI. A complete kit of parts for this project which also includes wire, connectors, hardware and switches is still available for £14.75. (PCB's only: £1.00 each).

Both projects and Siren for £29.95. (Prices are all inclusive; UK only).

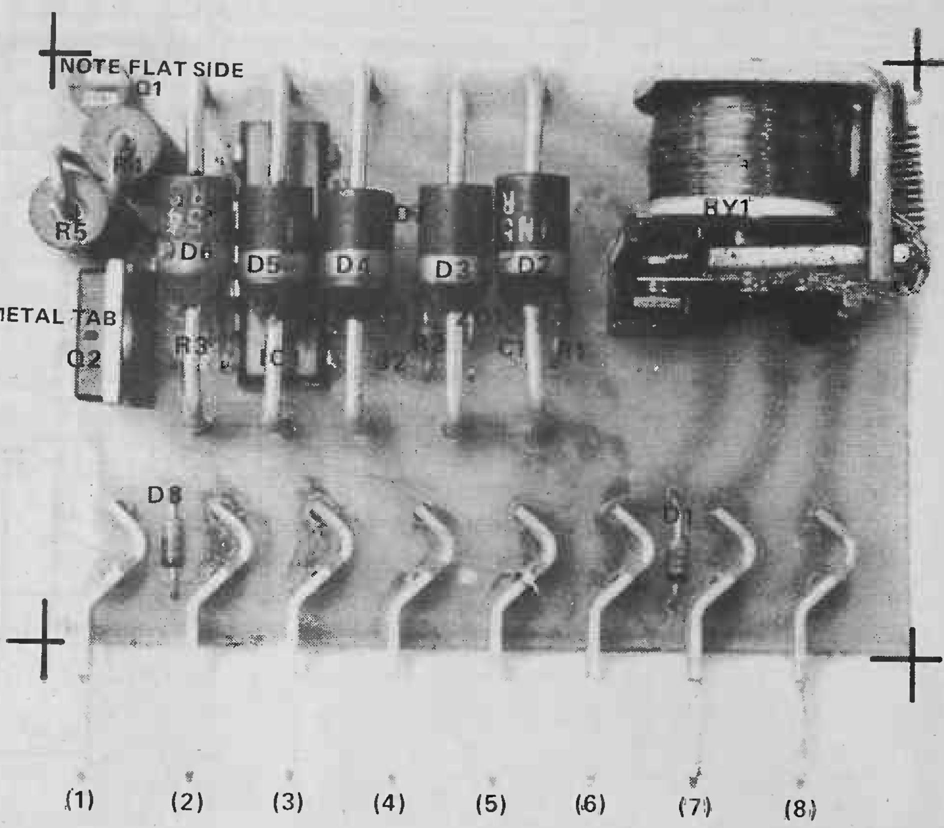


Fig. 2. Component overlay. Make sure you connect all the diodes the right way round.

PARTS LIST

RESISTORS		SEMICONDUCTORS		MISCELLANEOUS
R1	47R	IC1	CD4001AE	12V relay, 120R with s.p. n/o contacts.
R2	470k	Q1	BC337	Compu-Tech Systems' kit of components for this project includes a smart, compact snap-front, weather resistant case. When using an alternative, make sure it's weather-proof.
R3	2k2	Q2	TIP31A	
R4,5	180R	D1,7,8	1N4148	
CAPACITORS		D2–6	1N5401	
C1,2	4µ7 16V tantalum	ZD1	15V 400 mW zener	

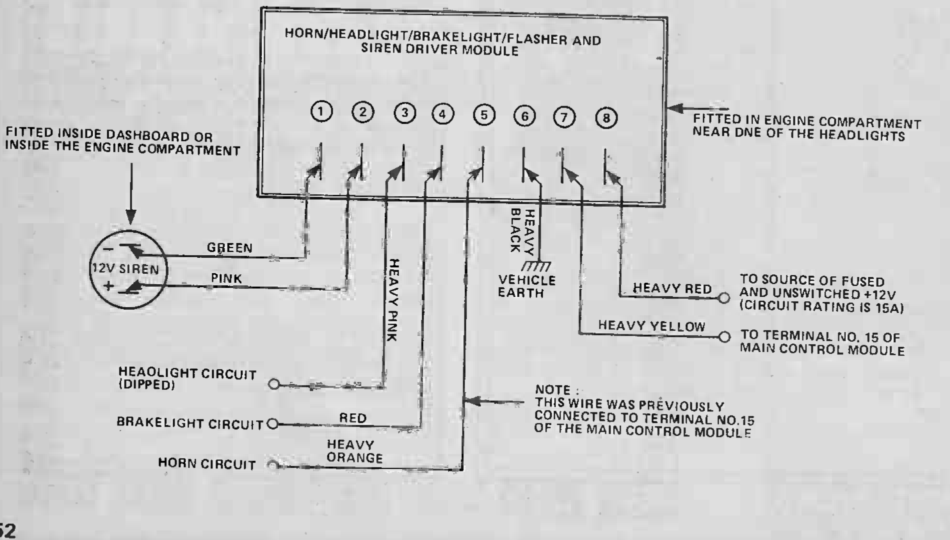


Fig.3. This is how you connect the box of tricks to your wheels. You shouldn't encounter any problems here.

ETI CIRCUIT COOKBOOK

Project Editor Ray Marston digs into his treasure chest of 'Tried and Tested' circuits and pulls out over fifty of the best for his special ETI feature.

Power Amp Circuits

A wide range of special-purpose single and dual ICs are available for use as audio power amplifiers giving maximum outputs from a few hundred milliwatts to a respectable 'several watts'. The specific IC chosen for a given application depends mainly on the constraints of the available power supply voltage and on the required output power level or levels.

In cases where supply voltages are restricted to the 6 to 12 volt range and power levels less than a few watts are needed, the National Semiconductor LM388 range of ICs can be used.

The LM388 uses a high-impedance gain-programmable ground-referenced differential input stage that is automatically biased to a quiescent half-supply value, for maximum non-clipped output swing. In the interest of power efficiency, the output stage has no short-circuit protection network.

The output stage of the LM388 is designed for use with a bootstrapped external bias network. The LM390 is a similar IC but has an improved output stage which enables 1 watt to be fed to a 4RO speaker load from a 6 volt supply. The LM386 is also similar to the LM388, but has a simplified output stage incorporating a built-in bias network. Finally, the LM389 circuit is identical to the LM386 but additionally an array of three fully accessible NPN transistors are built into the IC package.

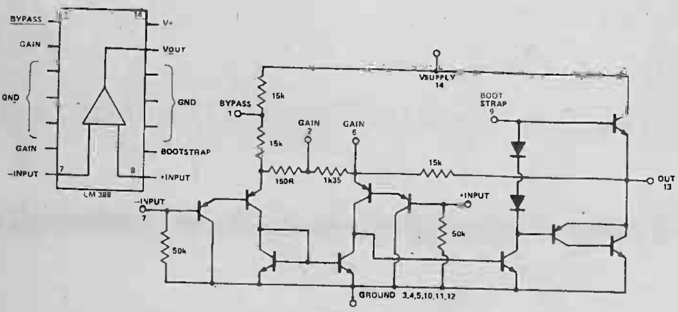


Fig.1.1. The outline and equivalent circuit of the LM388 1.5 watt device, specifically designed for low voltage applications. The IC has a built-in 'frame', which acts as a heatsink and is connected to six of the IC pins. Power dissipation can be enhanced by soldering these pins to a large area of copper track on a PCB, which thus serves as an additional heatsink.

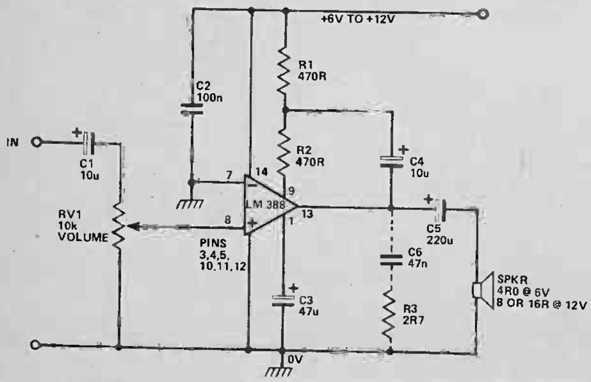


Fig.1.2. One way of using the LM388 as a 1-watt non-inverting power amplifier with grounded speaker. The voltage gain is internally set at 20. R1—R2 are the output stage bias resistors, bootstrapped by C4. C3 improves supply ripple rejection and C2 provides high frequency decoupling. The dotted C6—R3 components (also shown in all other practical circuits in this section) form a Zobel network that is intended to damp parasitic oscillations from low-impedance loads and should ONLY be used if instability problems are experienced.

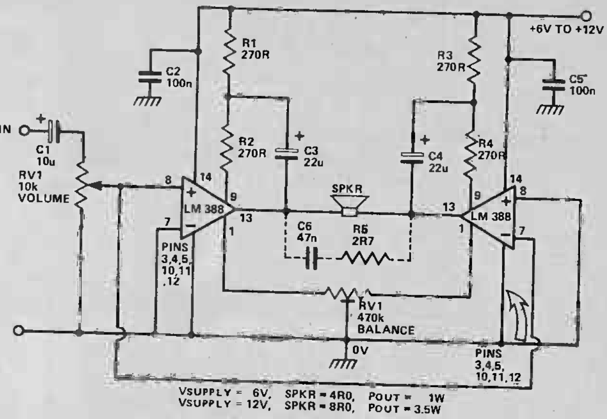


Fig.1.3. Maximum available output power can be increased by bridge connection of a pair of LM388s, so that the power losses are shared between the two. RV1 is used to set the quiescent speaker current to zero.

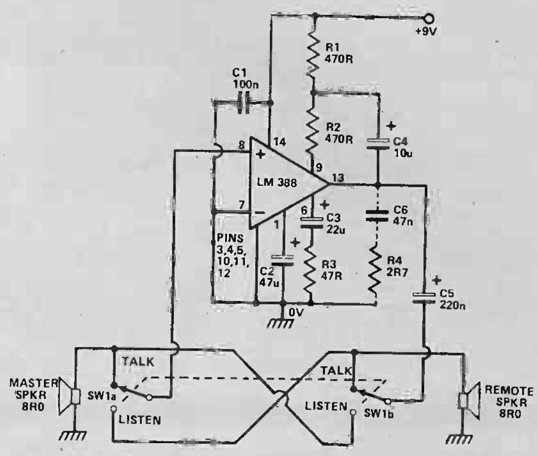


Fig.1.4. An LM388 can be used as a simple intercom circuit. The IC voltage gain is set at 300 by the C3—R3 decoupling network.

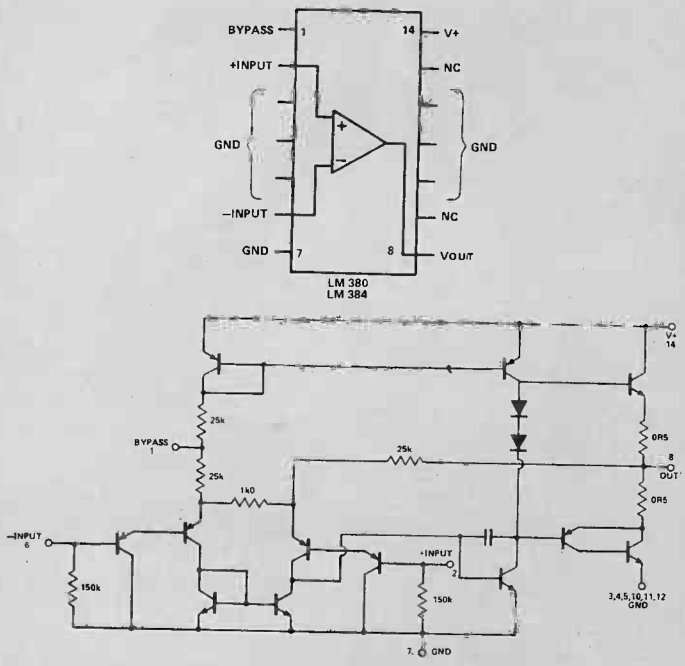


Fig.1.5. In cases where supply voltages are not restricted to the 6 to 12 volts range and output powers of only a few watts are required, the popular LM380 2-watt or its identical, but uprated LM384 5-watt 'brother' can be used. These ICs have full output short-circuit protection and use the same type of heatsink 'frame' as the LM388.

DIGEST

Nevada News

From January 5th to 8th a large contingent of electronic retailers, wholesalers, agents and distributors once again descended upon Las Vegas, Nevada for the Winter Consumer Electronic Show - to date the World's largest showpiece reflecting current and future trends in audio, video, computer games, telephones, personal communications/computers and allied electronic products. This menagerie was staged at three venues: the Las Vegas Convention Centre, the Hilton Hotel and the Jockey Club.

The emphasis from the Japanese contingets was centred on remote control, including ultra sonic, infra red, and voice control! That's right, I said voice control. 1980 could be the year in which voice activated electronic products finally live up to their vast potential.

Industrial uses for voice activation are already in effect while consumer products have yet to hit the market. For example, in America United Parcels Service has a voice activated parcel sorting system. Other industrial uses involve warehousing and distribution inventory and quality control as well as aids to the handicapped such as voice activated wheelchairs.

One company, Heuristics Inc. of Sunnyvale, California, has sold between five and ten thousand speech recognition units for use with personal computers. However, all existing equipment requires close talking or a hand held microphone, making it only slightly more advanced than many remote control units.

A television set that can be operated by human voice and confirms command is one of the latest developments announced by Toshiba. They also have a hi-fi system which responds to fifteen words. At a recent Japanese electronic show, Sharp showed a device able to recognise three voices, twenty-two words each. Such products are speaker trained, meaning each system can recognise onlyone or two voices. This form of recognition will be prevalent for some time since speaker independent systems, capable of responding to a pre-trained vocabulary spoken by anyone, pose extreme difficult technical and pricing problems. An existing speaker independent system with thirty words vocabulary sells for $50,000. So, it seems in the very near future, your hi-fi system will truly respond to 'HIS MASTER'S VOICE'.

Last year's magic phrase in video cassette recording waslonger playing time. This year's magic phrase appears to be special effects as supplies of both VHS and Beta systems used this Winter's C.E.S. to unveil a new generation of feature laden home decks and portables with such special effects as visual slow motion, freeze frame, single frame advance and fast forward at up to fifteen times normal speed.

Now the VHS camp has also jumped into the visual scan frame. Although JVC was the first VHS supplier with visual scan model, RCA, Quasar, Magnavox and MGA have unveiled new models with special effects visual scan features. RCA coupled its mid-December video disc announcement with the introduction of new 2, 4 and 6 hour decks with visual freeze frame, variable slow motion, single frame advance and double speed playback. All functions can be operated by remote unit and the suggested list price for the new deck is $1,395. Hitachi also introduced their model VT5800A. This is a new 2, 4 or 6 hour deck with ten key programming for up to seven days plus a new lightweight camera which will sell in the US for less than $800. Whilst the VHS and Beta camps slug it out on the video cassette recorder market, Toshiba has added a dramatic new element to the fight, marketing plans for the first consumer LVR systems. Toshiba is introducing two units, the L10A (standard) and the L10S with electronic programmable tuner and full mode remote control. If Toshiba realises its plans, the units will be the first and only LVR's in the domestic market. BASF has shown a competitive prototype in Germany, but has taken no further initiative so far.

Matsushita has the Visc system - Visc 2. It's the closest design to normal a record with the information in the grooves of the disc. All the above systems are totally incompatible. 1,800 rpm is common to most of the systems. This number is derived from the fact that there are sixty seconds in a minute and thirty seconds per frame in US video, so one revolution of the disc gives you one video frame.

So it appears on the surface that the consumer is faced with another non-standard consumer orientated video product.

As television, audio and games manufacturers add more microprocessor controlled units to their product lines, it seems manufacturers can count on expecting continued chip shortages throughout 1980. When allocating chips, the semiconductor industries look more favourably on such financially established industries as computers, television and audio, according to sources within the consumer electronics industry. There has been a demand for chips building up in the television industry for some time.

It appears that both the audio and video categories will get the chips that they want for 1980. Supplies of microprocessor audio components which sell far fewer units than the $500,000,000 electronic games industry report no difficulties in obtaining chips. Almost every product in the future will incorporate microprocessors hence companies like Atari, who have planned on introducing eight new products, have to limit themselves because of the shortage of chips.

There just are not enough chips to go around. The games industry has had a very steep growth. In the last two years, a ten fold increase in demand which is still growing at the same rate, but if the current trend in games diminishes, semiconductor manufacturers will be in embarrassing positions should they increase their chip manufacturing facilities.

Gerald Chevin

Hot 'n' Fast

This powerful little package can deliver up to 75 watts in only five seconds at the touch of its fingertip control lever. The miniature iron uses the unique Scope carbon heater and is powered from the Scope 3V3 transformer.

The Mini-Super-Speed Iron costs £12.50 plus VAT, the 3V3 Safety Transformer £7.50 plus VAT, and the element/tip spares pack £2.50 plus VAT. All Scope products, which are manufactured in Australia, are available exclusively in the UK through Tool-range Ltd, Upton Road, Reading RG3 2JA.

Metal Locator (March)

The Metal Locator project from the March issue has already caused quite a stir at Altek Instruments' office in darkest Surrey. Now, do you want the good news or the good news. Well, the good news is that Altek have been inundated with orders to such an extent that they have been able to reduce their prices. The complete kit is now £79.70. The search head alone is £13.55. And now the good news. Both prices include VAT and postage - no extras to pay.

The Shadow VLF Metal Locator is available in kit form from Altek Instruments, 1 Green Lane, Walton-on-Thames, Surrey KT12 5HD.

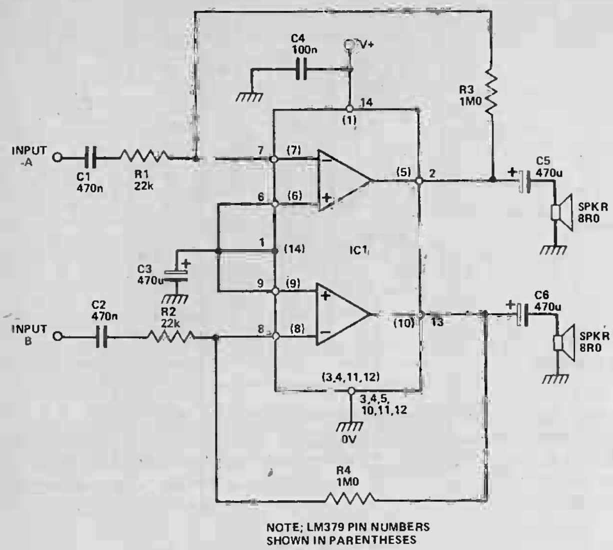


Fig.1.6. A simple inverting stereo amplifier using the LM377, LM378 or LM379 dual amplifier IC.

V+	LM377	LM378	LM379	MAX OUTPUT POWER PER CHANNEL INTO: 8R0	16R
12V	LIMIT TO 2.5W PER CHANNEL	LIMIT TO 5W PER CHANNEL	LIMIT TO 6W PER CHANNEL	1.6W	1W
16V				2.2W	1.5W
18V				3W	1.8W
20V				3.8W	2.4W
22V				4.6W	2.8W
24V				5.4W	3.6W
26V				6W	4.2W
28V				7W	5W
30V				–	5.5W

Fig.1.9. The approximate performance characteristics of the three ICs. All three ICs have similar internal circuits with ground-referenced differential input stages and fully protected output stages.

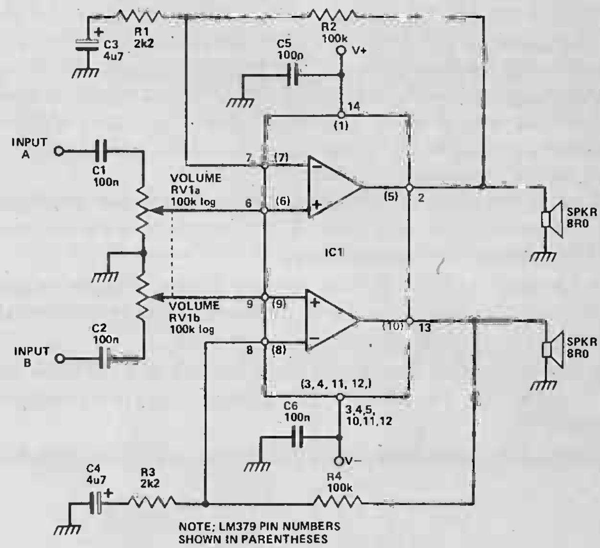


Fig.1.10. A non-inverting stereo amplifier using a split supply.

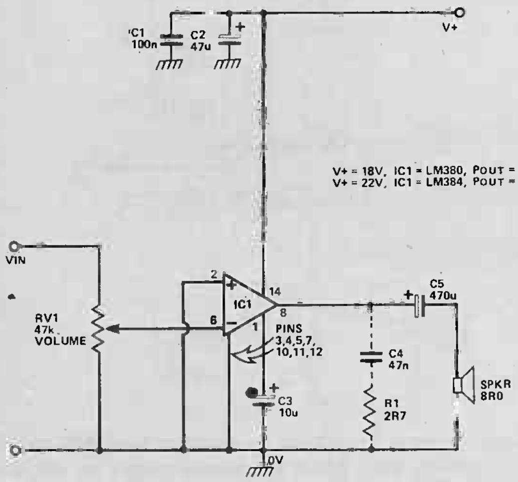


Fig.1.7. A 2 watt or 5 watt amplifier with simple volume control and ripple rejection.

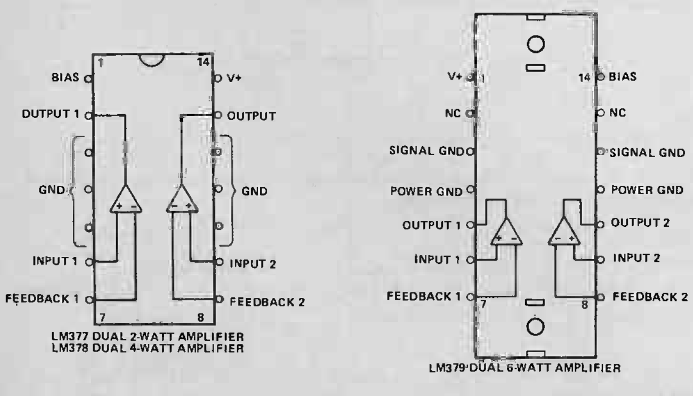


Fig.1.8. The outlines and pin notations of the LM377, LM378 and LM379.

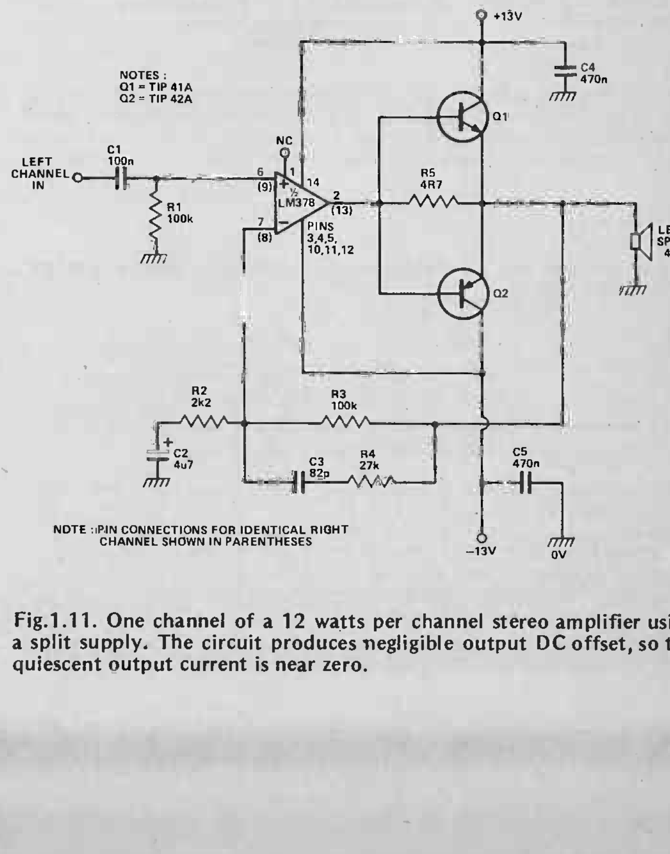


Fig.1.11. One channel of a 12 watts per channel stereo amplifier using a split supply. The circuit produces negligible output DC offset, so the quiescent output current is near zero.

Audio Preamp Circuits

Audio preamplifier ICs are specifically designed to give very low noise figures, excellent supply 'ripple' rejection, low distortion and wide bandwidth. They give small-signal performances that are superior to those obtainable with conventional op-amps.

IC pre-amps usually come in the 'dual' form, with two identical but independent (apart from the supply connections) circuits in one package. National Semiconductors produce a range of five popular low-noise dual pre-amplifier ICs, the LM381 and LM381A, the LM382, the LM387 and the LM387A. The 'A' suffix devices are premium versions of their type, with superior low-noise figures.

All five ICs use the same basic amplifier circuit and essentially differ only in minor details and in their pin-outs. All amplifiers accept differential or single ended inputs, use internal compensation, use internal power supply decoupler - regulator circuitry and can provide large output voltage swings and wide power bandwidths. The LM381 and LM381A have provisions for externally optimising noise figures and for adding external compensation for narrow-band applications. The LM382 has a built-in resistor matrix that enables the user to select a variety of closed loop gain options and frequency response characteristics. The LM387 and LM387A are 8-pin 'utility' versions of the LM381/LM381A.

In most of the practical circuits that follow, only one amplifier of the IC is shown in use. Equivalent IC pin numbers forthe remaining amplifier are shown in parantheses.

The LM382, with its built-in resistor matrix, enables many amplifier designs to be achieved with a minimal number of external components.

The small physical size of the 8-pin LM387 and LM387A IC makes it attractive for use in many low-noise pre-amplifier applications.

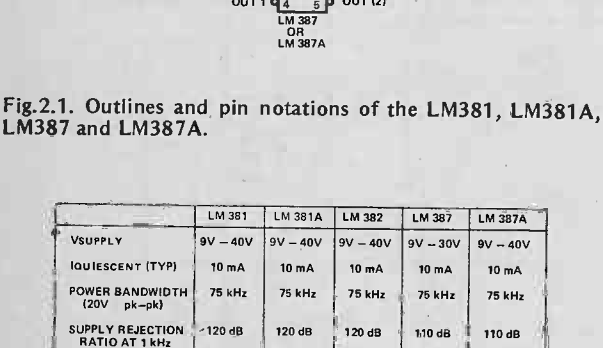


Fig.2.1. Outlines and pin notations of the LM381, LM381A, LM382, LM387 and LM387A.

		LM 381	LM 381A	LM 382	LM 387	LM 387A
VSUPPLY		9V – 40V	9V – 40V	9V – 40V	9V – 30V	9V – 40V
IQUIESCENT (TYP)		10 mA	10 mA	10 mA	10 mA	10 mA
POWER BANDWIDTH (20V pk–pk)		75 kHz	75 kHz	75 kHz	75 kHz	75 kHz
SUPPLY REJECTION RATIO AT 1 kHz (TYP)		120 dB	120 dB	120 dB	110 dB	110 dB
EQUIVALENT NOISE INPUT FIGURE uV RMS	TYP	0.5	0.5	0.8	0.8	0.65
	MAX	1.0	0.7	1.2	1.2	0.9

Fig.2.2. Typical performance of the five low-noise dual preamplifier ICs.

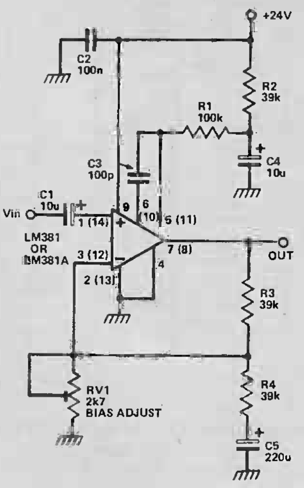


Fig.2.3. A low-noise X1000 amplifier circuit. Bias is determined by R3–RV1 and gain by R3–R4. R1–R2 set the amplifier to optimum minimum noise conditions.

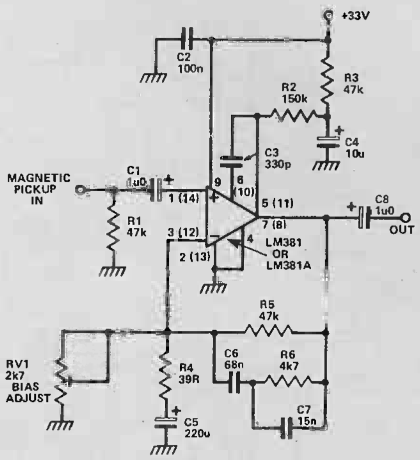


Fig.2.4. The circuit shown in Fig.2.3 can be modified for use as an ultra low-noise phono preamp, with RIAA equalisation given by the R5–R6–C6–C7 network. The circuit gives 42 dB gain at 1 kHz.

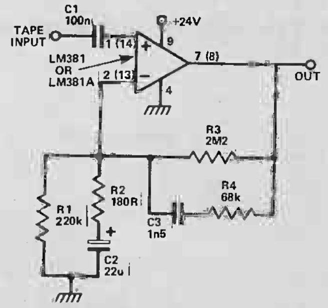


Fig.2.5. A simplified version can be used as a low-noise tape playback amplifier, with NAB equalisation.

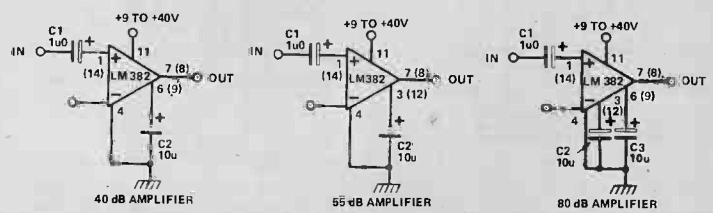


Fig.2.6. Alternative methods of connecting the LM382 to make fixed gain non-inverting amplifiers.

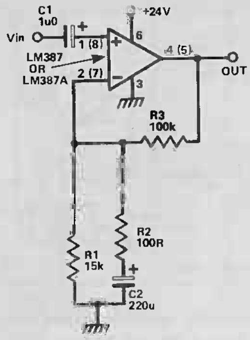


Fig.2.7. Fixed gain (X1000) non-inverting preamplifier. The gain is determined by the ratio of R2 and R3. Alternative values of gain can be obtained by changing the value of R2. The circuit is biased by R1–R3.

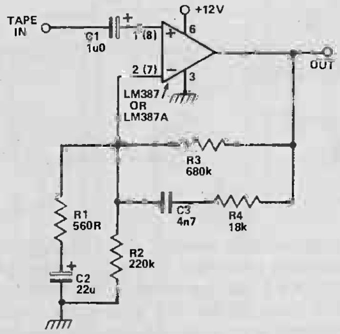


Fig.2.8. 12 V NAB tape playback preamp.

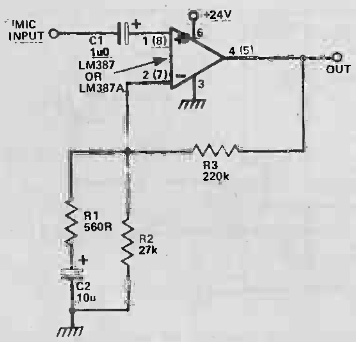


Fig.2.9. Low-noise microphone preamp with a gain of 52 dB. The circuit is intended for use with low to medium impedance microphones.

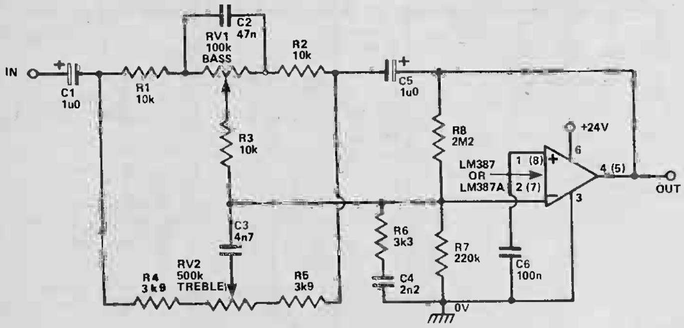


Fig.2.10. A high performance active tone control.

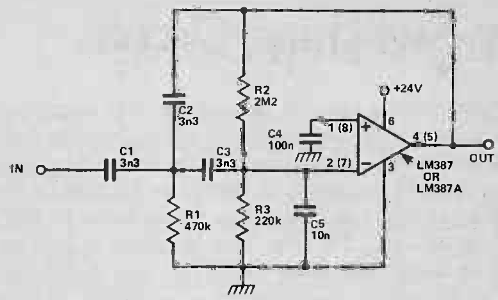


Fig.2.11. 50 Hz rumble filter with 12 dB/octave roll-off.

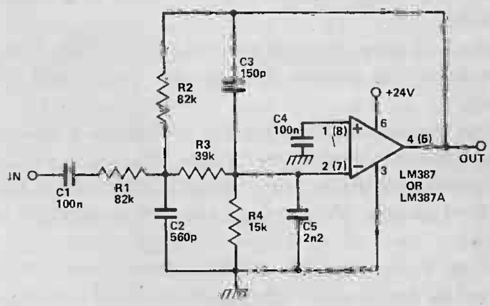


Fig.2.12. 10 kHz scratch filter with 12 dB/octave roll-off.

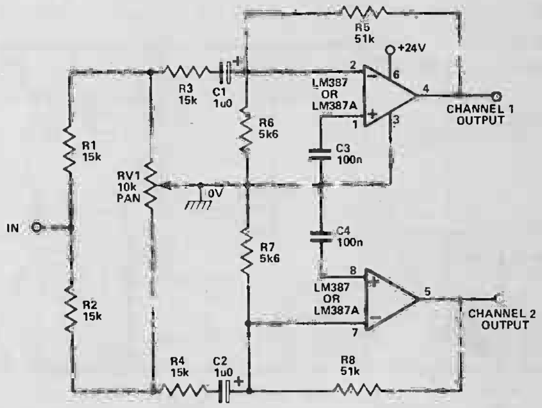


Fig.2.13. This two channel panning circuit enables a mono input to be swept or 'panned' between two channels in any desired ratio determined by RV1. It can be used to make a sound source appear to originate from any point between two widely spaced speakers.

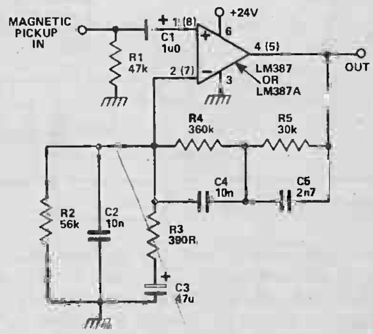


Fig.2.14. RIAA equalised, single supply rail, pre-amplifier for magnetic pickup cartridges. Input impedance 47k, determined by R1.

Relay-Switching Circuits

Relay-switching circuits are popular and useful projects and are always in demand by ETI readers. The relay may, depending on the individual circuit configuration, be made to switch on in response to increases or decreases in light or temperature levels, or by voltages or by currents going above or below pre-set values. Alternatively, the relay may be made to turn on or off in response to some time-delay factor, or may merely be made to respond to the presence or absence of a voltage, as in the case of some car anti-theft and immobilisation circuits. A wide variety of such circuits are shown in the following section.

These are circuits that activate if a parameter falls outside of two pre-set limits.

Figs. 3.10 to 3.12 show time-delay switching circuits. Figs. 3.10 and 3.11 operate in the simple 'C-R timing' mode and call for no explanation.

To complete this section, Fig. 3.13 to 3.15 show a selection of car immobiliser and anti-theft alarm circuits. The Fig. 3.13 circuit turns on and immobilises the ignition automatically when the ignition switch is first closed: the ignition can be re-enabled by briefly opening PB1.

The Figs. 3.14 and 3.15 anti-theft alarm/immobiliser circuits are designed for use in cars with negative ground electrical systems. Before trying to fit either of these systems, however, check that your vehicle is fitted with door switches that connect the dome (courtesy) light to chassis, as shown, when they are activated.

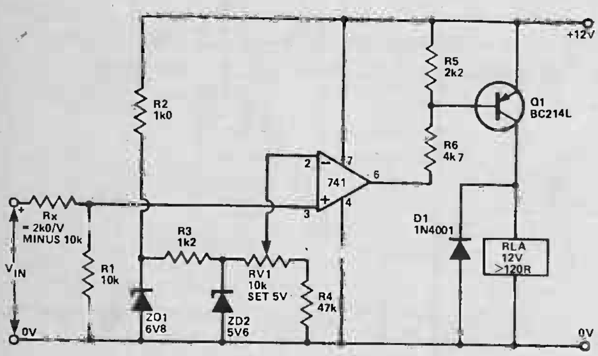


Fig.3.1. A precision DC under-voltage relay switch. The op-amp is wired as a voltage comparator, with a reference voltage applied to pin 2 and the test voltage applied to pin 3: the relay turns on when the pin 3 voltage exceeds that of pin 2. The circuit can be made to trip at any voltage in excess of 5 volts by suitable choice of Rx value.

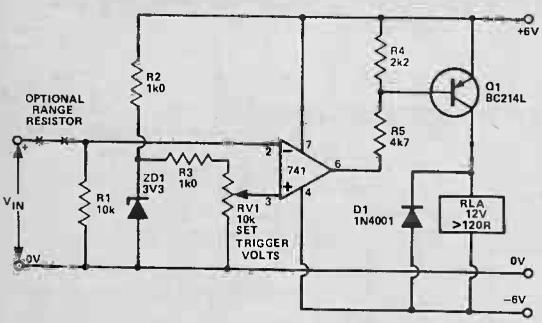


Fig.3.2. An over-voltage switch that can be used to trip at any pre-set voltage in excess of about 10 mV. The input voltage can be connected directly to pin 2 if trip values in the range 10 mV to 3 volts are required. For voltages in excess of 3 volts, a suitable range resistor must be connected in the position shown, to keep the pin 2 voltage drive to a suitable level. The circuit can be converted to an under-voltage switch by transposing the pin 2 and pin 3 connections of the op-amp. The circuit can be used as an AC voltage switch by first rectifying the AC input signal.

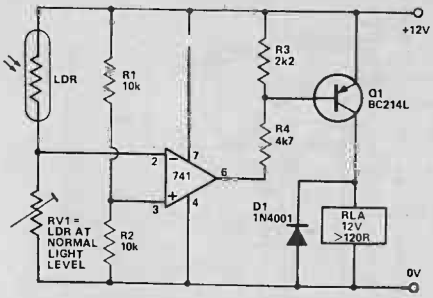


Fig.3.3. A precision light-sensitive switch that activates when the sensed quantities go above or below pre-set values. The LDR can be any cadmium-sulphide unit that has a resistance in the range 500R to 20k at the required trip level.

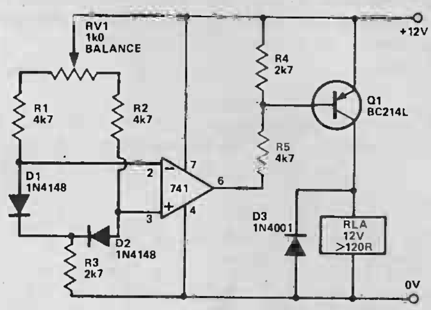


Fig.3.4. A differential temperature switch circuit using ordinary silicon diodes as temperature-sensing elements and responding to differentials of a fraction of a degree. RV1 can be used to apply an effective offset of several degrees to the two diodes. To adjust the circuit, apply the required differential temperature to the diodes and then adjust RV1 so that the relay just turns on. The circuit responds to the relative temperatures, rather than the absolute temperatures, of the two diodes.

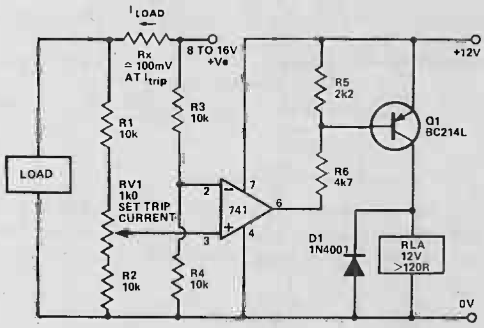


Fig.3.5. A DC current-sensing switch, in which the current is applied from an 8 to 16 volt supply. The Rx value is chosen so that it generates roughly 100 mV at the required trip current.

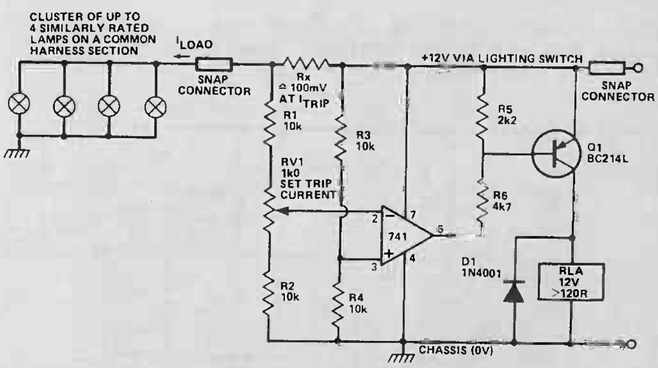


Fig.3.6. shows how the above circuit can be made to act as a car lamp-failure switch which turns on if any of the monitored lamps burn out. Rx is wired in series with the wiring harness feed to a selected 'cluster' of up to four similarly rated lamps.

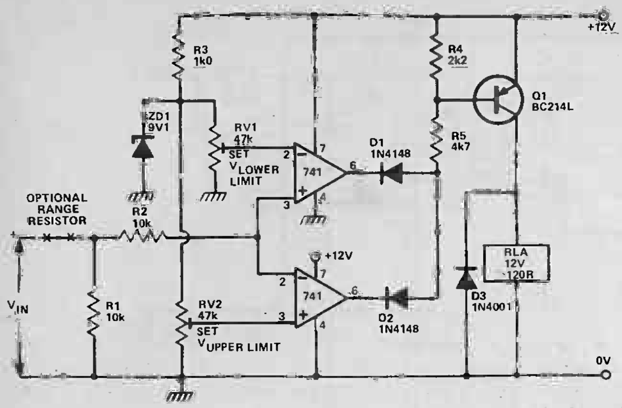


Fig.3.7. A voltage-window switch. In practice the basic lower window limit of this circuit is roughly 3 volts and the upper limit is 9 volts. The window range can be extended by fitting a suitable range resistor in the position shown.

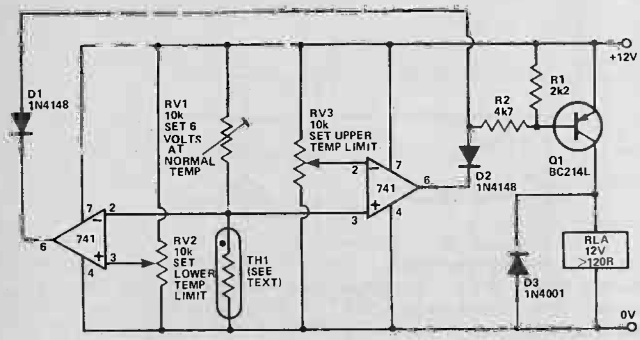


Fig.3.8. is basically a resistance-sensing window switch, except that the 'resistor' takes the form of an ntc thermistor and the circuit thus responds to temperature. TH1 must have a resistance in the range 500R ot 9k0 at the desired 'mean' temperature. RV1 is used to set half-supply volts on the RV1–TH1 junction at the 'mean' temperature.

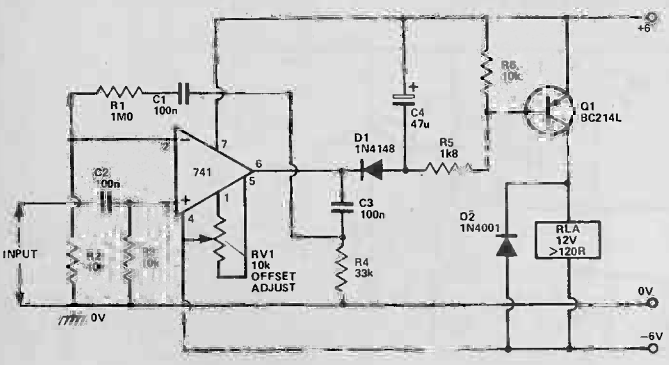


Fig.3.9. A sensitive switching circuit that responds to AC inputs in excess of about 5 mV rms. It responds to all signals in the 50 Hz to 3 kHz 'voice' range. RV1 is adjusted so that the relay is just off with zero input.

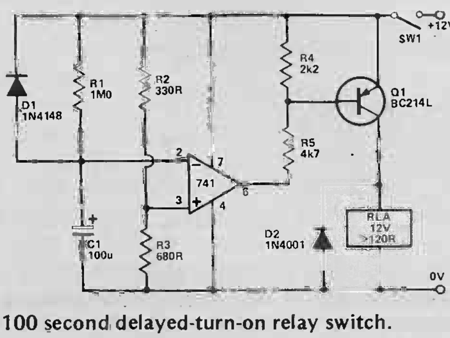


Fig.3.10. A 100 second delayed-turn-on relay switch.

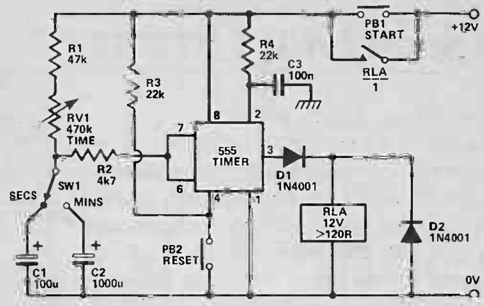


Fig.3.11. A two range 6–60 second and 1–10 minuted auto-turn-off relay timer circuit.

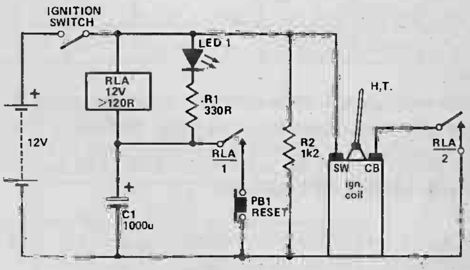


Fig.3.12. An automatic immobiliser circuit for cars fitted with negative ground electrical systems.

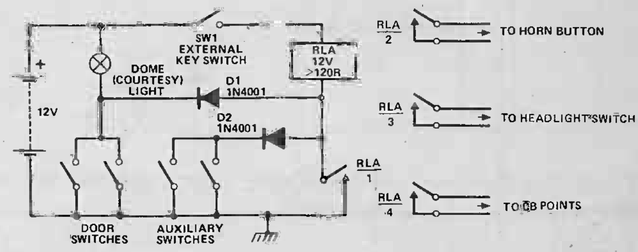


Fig.3.13. An anti-theft alarm/immobiliser for cars, which operates horn and lights until switched off or until the battery runs flat.

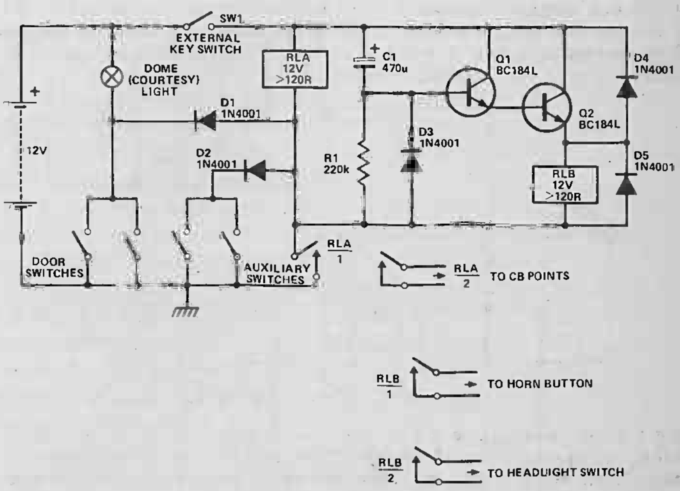


Fig.3.14. An improved car alarm/immobiliser, which disables the ignition indefinitely but turns the horn and lights off automatically after four minutes.

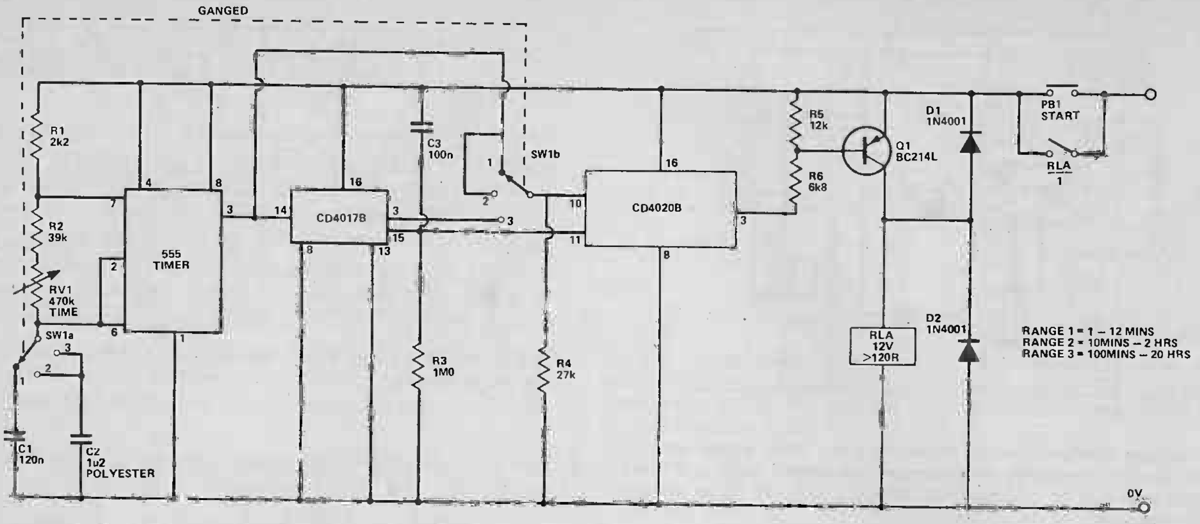


Fig.3.15. A wide-range auto-turn-off timer covering 1 minute to 20 hours in three ranges. As soon as power is applied to the circuit the 555 starts to oscillate happily and feeds clock pulses to the 4017. The 4017 and 4020 give a combined count rate of 81920 before the output of the 4020 goes high and turns Q1 on.

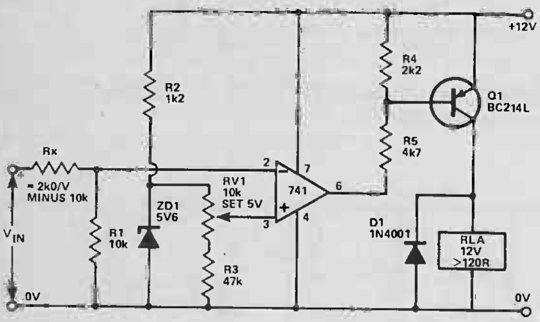


Fig.3.16. Precision DC over-voltage relay switch, covering 5V upwards.

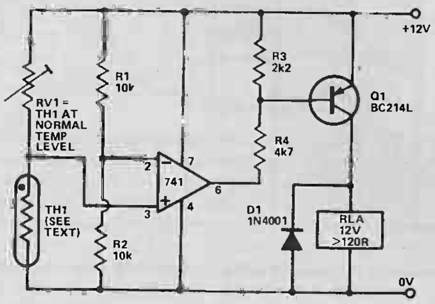


Fig.3.17. Precision over-temperature, or 'FIRE' switch. This circuit can be converted to a 'frost' or under-temperature switch by transposing RV1 and TH1.

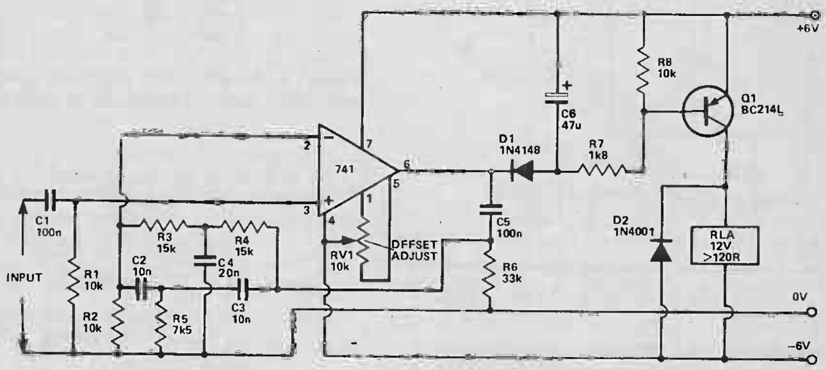


Fig.3.18. A sensitive (1 kHz) tone activated relay switch, which has a typical sensitivity of 5 mV RMS at the input.

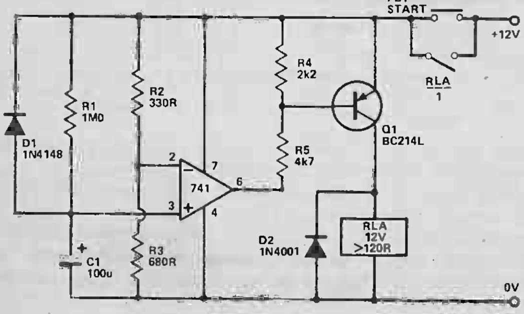


Fig.3.19. A delayed turn-off relay switch. With component values of R1 and C1 as shown, the time delay is determined at 100 seconds.

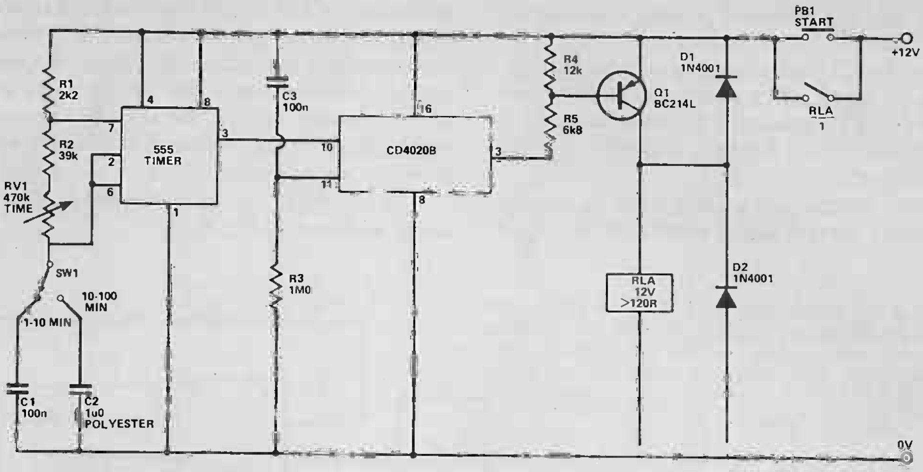


Fig.3.20. A two-range 1—10 minute and 10—100 minute auto turn-off relay timer circuit. Different ranges can be obtained by varying the values of capacitors C1 and C2.

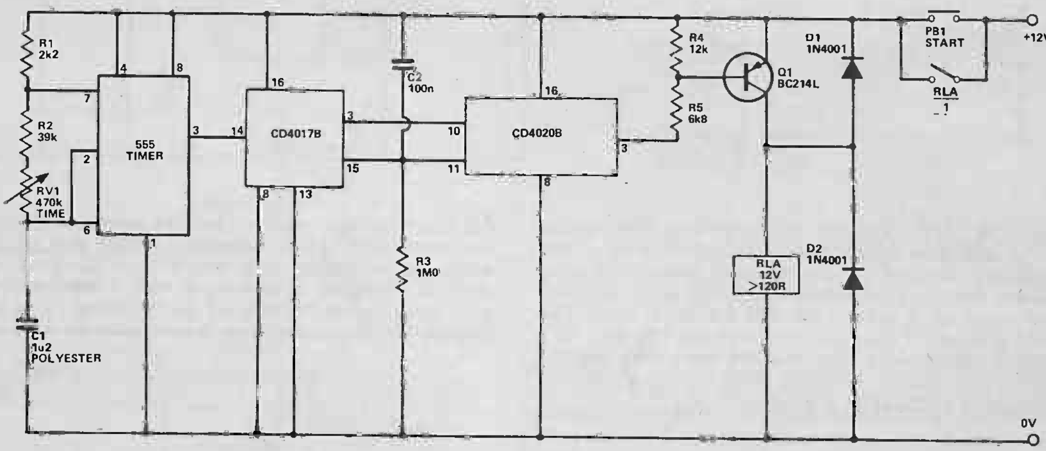


Fig.3.21. An extra-long period timer, which could be used as a long process cycle controller. The period obtainable from this circuit is between 100 minutes and 20 hours. Auto turn-off operation has been selected.

Waveform Generators

Waveform generator circuits are widely used both as pieces of test gear and as simple 'noise making' gadgets. Types of waveform generated range from accurate sine, square and pulse waveforms to 'mushy' white and pink noise forms.

If you need a variable sine wave generator for audio or ultrasonic testing purposes, you are faced with a number of circuit choices, depending on which parameter you consider to be most important. If low cost is important and a distortion factor of up to 0.5% is acceptable, the lamp-regulated Wien-bridge oscillator (Fig. 4.1) is a good choice.

If low distortion is your most important parameter, the thermistor-regulated Wien-bridge oscillator in Fig. 4.2 is a good choice. This circuit typically produces about .05% distortion at 1 kHz and shows how range switching can be incorporated.

If minimal bounce is your most important parameter and a distortion factor of 0.5% is acceptable, the circuit of Fig. 4.8 is an ideal choice. The circuit uses a special function generator IC (available from several ETI advertisers) and a single frequency-control pot and spans its frequency range with absolutely zero bounce.

If you ever need to generate a fixed or variable HF or RF signal you'll have the option of using either a Hartley (Fig. 4.4) or a Colpitts (Fig. 4.5) oscillator. The Hartley oscillator uses a tapped coil and is easily tuned over a wide range.

If you are a dedicated 'radio' listener you'll need a BFO circuit to enable you to listen to CW transmissions. Fig. 4.6 shows a practical BFO unit. An alternative BFO circuit is shown in Fig. 4.7.

Square wave forms are very easy to produce. The circuit in Fig. 4.8 can be used to generate a variable-frequency variable-mark/space ratio waveform. Two excellent CMOS square wave generator circuits are shown in Fig. 4.9. Both circuits produce clean output waveforms and can accept a very wide range of C - R timing components.

Pulse generator circuits can be readily built from standard 555 timer chips or from CMOS ICs, but in these cases have typical rise and fall times of a hunderd nanoseconds or so. Where brief rise and fall times are important (as in standard test gear circuits), TTL ICs offer a good solution to the pulse-generator problem. The 74121N monostable multivibrator IC (in either standard or LS form), for example, produces pulse rise and fall times of only a few nanoseconds.

Fig. 4.10 shows how a 74121 can be used as an add-on pulse generator, triggered by an external clock signal. Fig. 4.11 shows how two of these circuits can be cascaded to make an add-on delayed pulse generator in which both the delay and the width can be varied from 100 nS to 100 mS.

White and pink noise sources are widely used for testing amplifiers and for generating special sound effects. White noise produces a +3 dB rise in amplitude per octave of frequency change (equal energy per constant bandwidth). Pink noise has a flat amplitude response per octave change in frequency (equal energy per octave). White noise is best produced by a pseudo-random sequence generator, such as the MM5837 shown in Fig. 4.12: unfortunately, this IC is rather difficult to find. The MM5837 is housed in an 8-pin package.

White noise can be converted to pink via a simple filter network, as shown in Fig. 4.13.

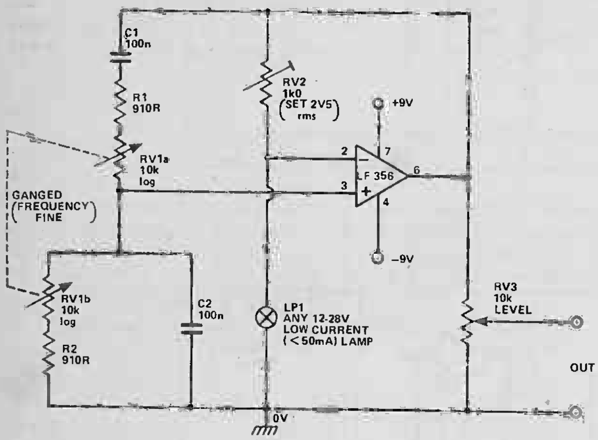


Fig.4.1. A low-cost 150 Hz – 1k5 Hz lamp-regulated Wien-bridge oscillator, producing a sine wave with a typical distortion factor of less than 0.5%. The frequency range of the circuit can be changed by using different C1–C2 values. Reducing the values by a factor of ten (to 10n) raises the frequency range by a decade (to 1k5 Hz – 15 kHz). The specified op amp will give useful operation up to about 150 kHz. LP1 can be any 12 – 28 V low current (less than 50 mA) lamp and the circuit is set up initially by simply adjusting RV2 to give a nominal maximum sine wave output of about 2V5 RMS.

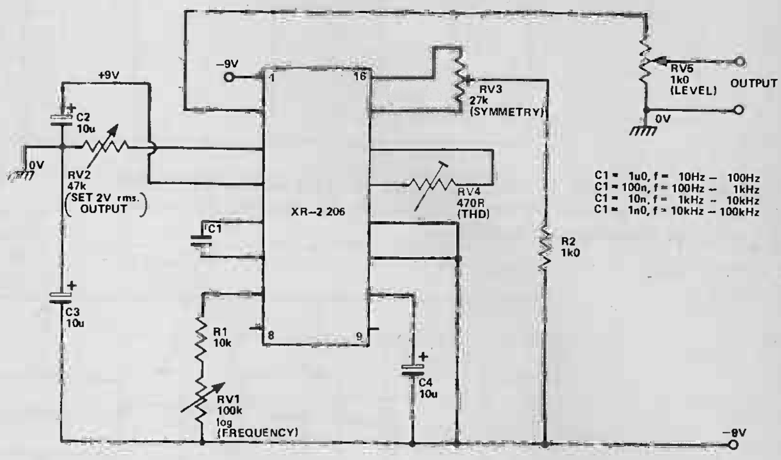


Fig.4.3. The high quality function generator IC produces 'bounceless' sine waves with typical distortion factors of 0.5%. Initial setting up is a matter of twiddling with the RV2–RV3–RV4 controls to obtain a minimal distortion output signal with a maximum RMS value of about 2 V. Once you've initially set up the circuit, you can forget these pots forever. The frequency range is controlled by RV1 and C1.

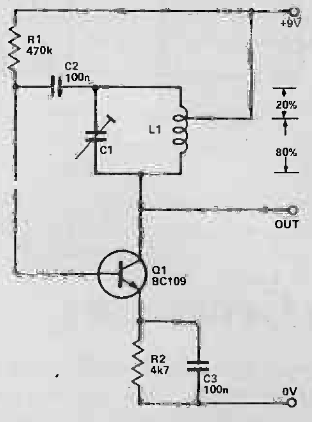


Fig.4.4. In the Hartley oscillator the frequency = $1/2\pi\sqrt{L_1C_1}$ x L1 must be a tapped inductor.

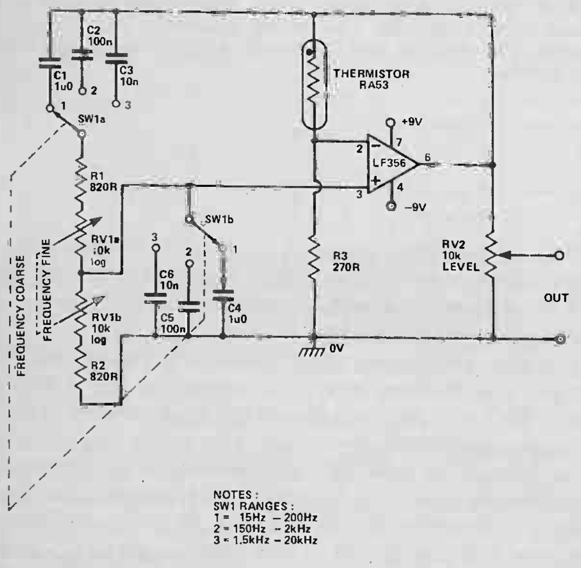


Fig.4.2. This low-distortion (0.05% typical) Wien-bridge oscillator spans 15 Hz to 20 kHz in three decade ranges (with the component values shown). The only defect of this low-distortion type of circuit is that it suffers from 'amplitude bounce' as the frequency is varied from one value to another, which is a bit of a pain if you are testing the frequency response of an amplifier. The degree of 'bounce' depends on the quality of the pot used in the RV1 position.

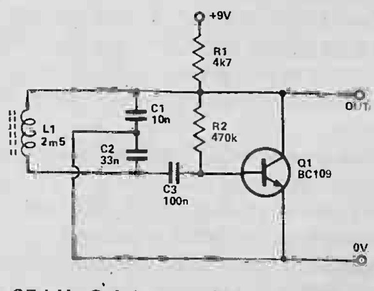


Fig.4.5. In this 37 kHz Colpitts oscillator the frequency = $1/2\pi\sqrt{L_1C_x}$, where Cx is the equivalent series capacitance of C1 and C2. L1 is untapped. It is effectively an 'autotransformer' tapped by the C1–C2 ratio.

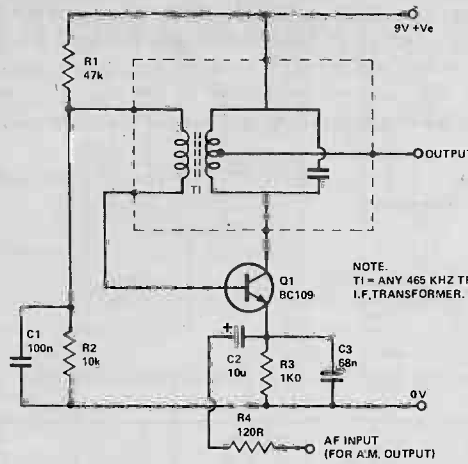


Fig.4.6. A 465 kHz BFO with amplitude modulation facility. T1 can be any standard IF transformer. The output can be modulated via an AF signal.

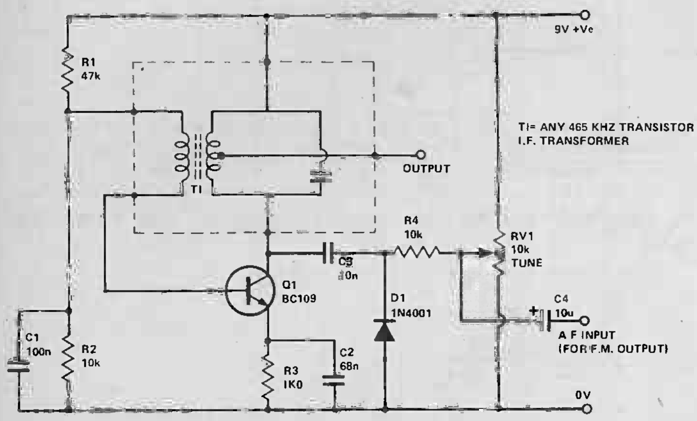


Fig.4.7. A 465 kHz BFO with 'varicap' tuning and FM facility. D1 is used as a varicap diode and the oscillator is tuned via RV1. The oscillator can be frequency modulated via an AF source.

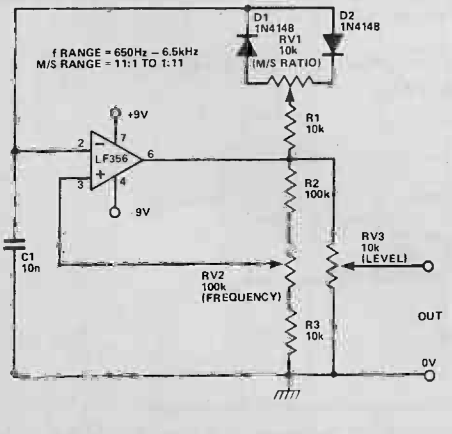


Fig.4.8. A variable-frequency, variable M/S ratio 'square wave' generator. The mark/space ratio is controlled by RV1, the frequency by RV2 and the output level by RV3.

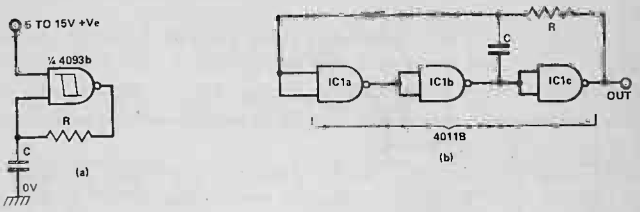


Fig.4.9. Two excellent CMOS square wave generators are the Schmitt oscillator (a) and the ring-of-three oscillator (b). Both circuits produce clean otuputs. 'R' values can be varied from a few kilohms to many megohms. 'C' values can vary from a few dozen picofarads to many microfarads.

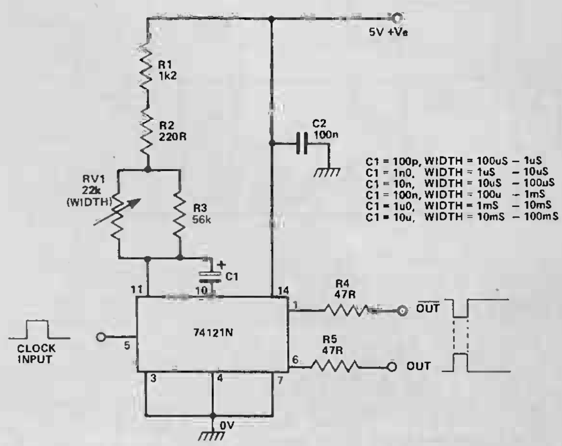
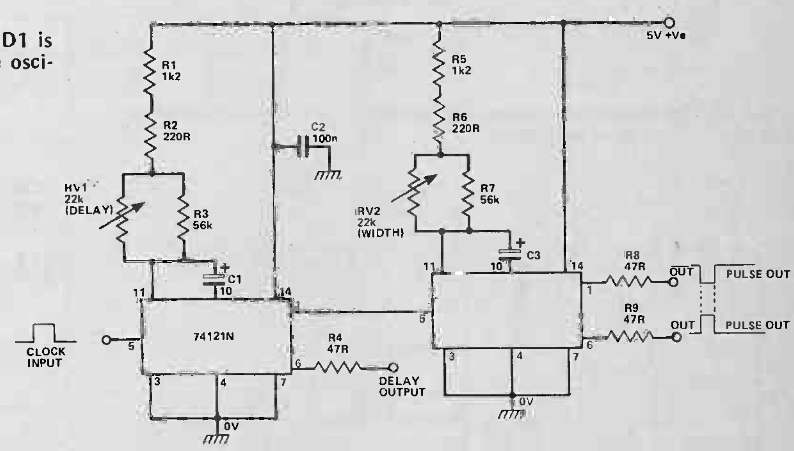


Fig.4.10. An add-on pulse generator covering the range 100 nS to 100 mS, using a 74121 triggered by an external clock signal. The circuit produces fixed amplitude inverted and non-inverted outputs, each protected against short-circuit damage by a 47 R series resistor. By suitable choice of the value of C1 the triggered pulse width can be varied from 100 nS to 100 mS.



C1/C3	WIDTH
100p	100nS – 1uS
1n	1uS – 10uS
10n	10uS – 100uS
100n	100uS – 1mS
1u0	1mS – 10mS
10u	10mS – 100mS

Fig.4.11. An add-on delayed pulse generator covering delay and width ranges of 100 nS to 100 mS.

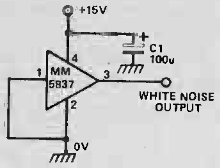


Fig.4.12. The National Semiconductor's MM5837 is an MOS/MSI pseudo-random sequence generator, designed to produce a broad-band white noise signal for audio applications. It is housed in an eight pin package.

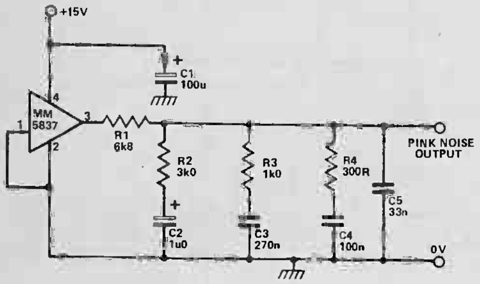


Fig.4.13. Pink noise generator.

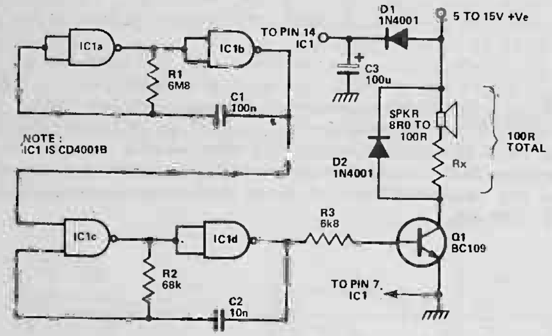


Fig.4.14. This pulsed-tone alarm call generator produces a typical output of a few hundred milliwatts.

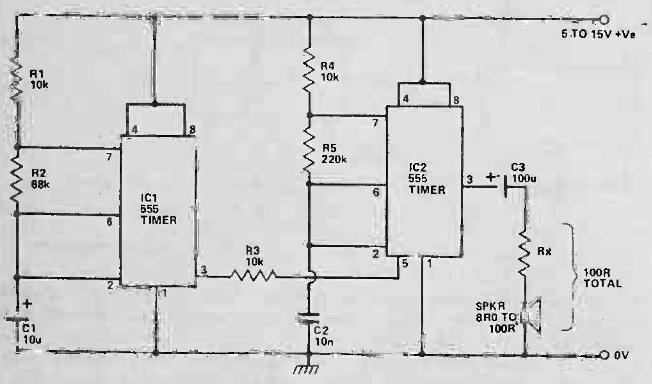


Fig.4.15. This warble-tone generator simulates a British police car 'Dee-Dah' siren.

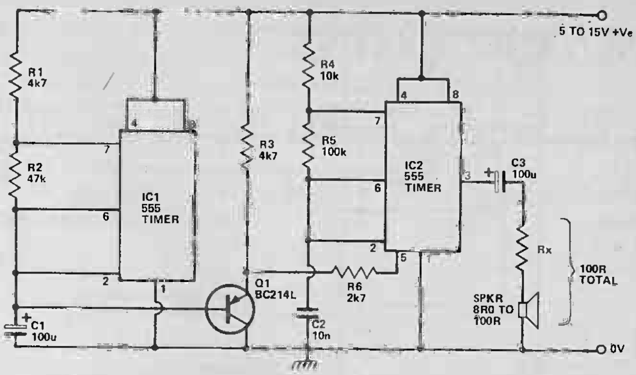


Fig.4.16. This wailing alarm simulates an American police siren.

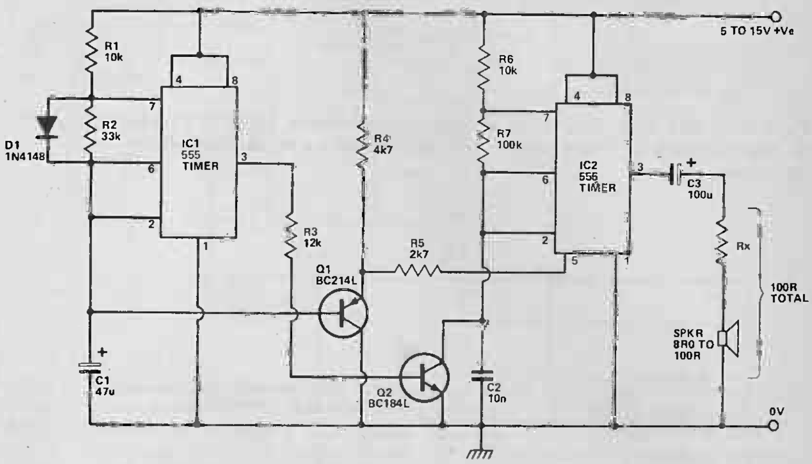


Fig.4.17. This 'Red Alert' generator simulates the 'Star Trek' alarm signal.

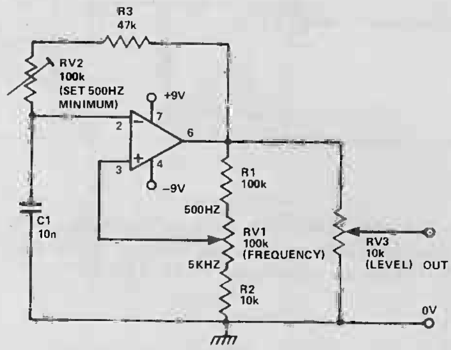


Fig.4.18. An op-amp relaxation oscillator producing a good quality 500 Hz to 5 kHz square wave.

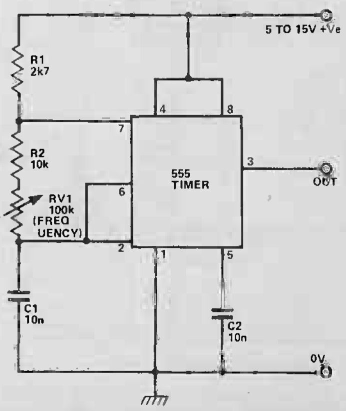


Fig.4.19. A variable-frequency, variable mark-space ratio square-wave generator which takes longer to say than it does to build!

Text To Talk

Kurzwell Computer Products of Cambridge, Massachussetts has developed a machine to turn written text into speech.

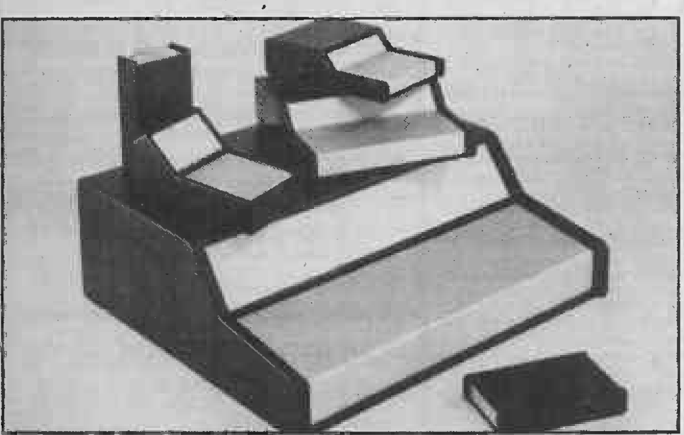
The machine contains an optical scanner, a small computer, a small synthesiser and a loudspeaker unit.

The page to be read is placed over the scanning unit which then converts the written text to digital signals for the computer. The computer then converts them into sound with the speech synthesiser.

Syntax analysis is also incorporated to ensure that the right stress is placed on the correct word in a sentence.

The optical system can accommodate a wide range of type faces, but must be programmed to do so.

If the machine is a success it offers enormous benefits to the blind. It is curently being tested by the Royal National Institute for the Blind.



Building Block

New from National Semiconductor, the LM13600 is a programmable dual operation transconductance amplifier designed to be used as a fundamental building block in current controlled amplifiers, filters and oscillators. It can also be used in multiplexers, timers and even sample and hold circuits. In some cases it could be used to replace mechanical potentiometers. It is well suited for use in electronic organs and music synthesisers, because it can modulate waveshapes with ease.

The 16 pin LM13600 is programmable over six decades, allowing it to function as a basic building block in a broad range of electronically programmable resistors and filters. Use of novel circuit technique incorporating linearising (Gilbert) diodes on the inputs so they can accept higher level signals while reducing distortion results in 10 dB S/N ratio improvement reference to 0.5% THD.

The recently announced Dolby HX Headroom Extension System for noise reduction uses the LM13600 for dynamic control of recording bias.

The remarkable LM13600 is made by National Semiconductor (UK) Ltd., 301 Harpur Centre, Horne Lane, Bedford.

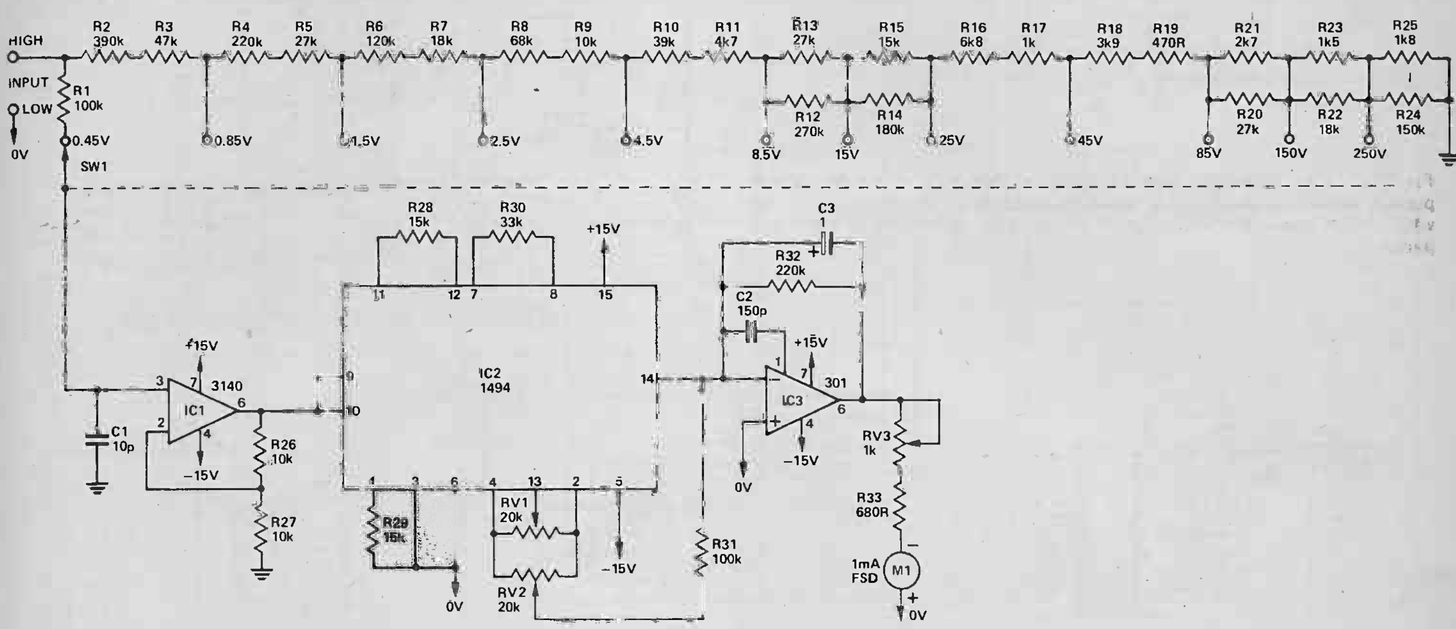
Case Study

PCB finished and nowhere to put it? Well, we can tell you where to go. You can get nearly 1000 different instrument cases in almost 650 sizes from West Hyde Developments. That includes a new range of 19" housings and keyboard, VDU and display enclosures.

Once you've cased your project, you might want to fit it with handles, feet, knobs and/or switches. West Hyde have them all. Their latest catalogue has details of these and much, much more.

The latest copy of this 80 page Alladin's cave is available free of charge from West Hyde Developmnets Ltd., Unit 9, Park Street Industrial Estate, Aylesbury, Bucks HP20 1ET.

Test Meter Circuits



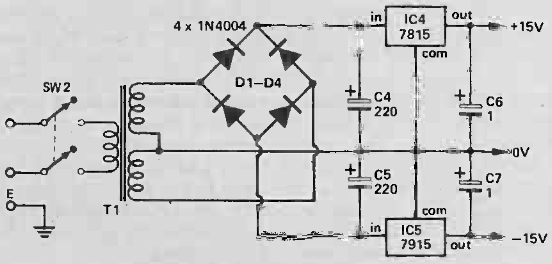


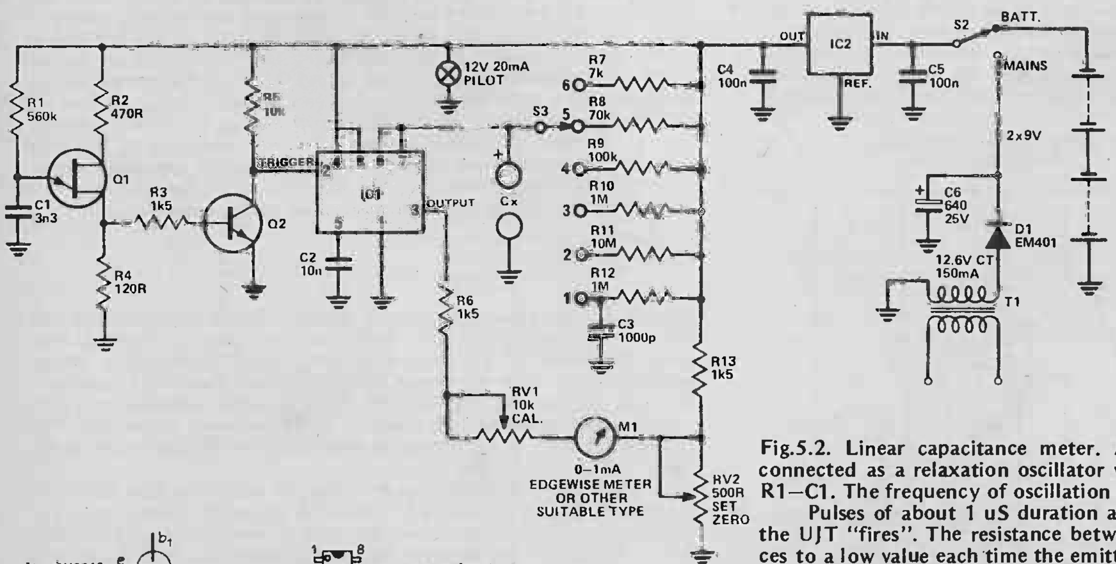
Fig.5.1. A true RMS voltmeter. The input voltage is divided by the input network such that the input IC1 is 0.47 volts (DC or RMS) for full scale deflection. IC1 provides buffering and a gain of two.

Squaring of the output of IC1 is done by IC2 (1494), a four quadrant multiplier, which gives a current output proportional to the produce of the voltages at its two inputs (pin 9 and 10). As we are feeding the same signal into both inputs the result is the square function.

The output of this IC is a current which is converted to a voltage by IC3 which also provides the averaging network (C3, R32). Its output drives the meter whose scale is a square root function.

Adjustments are provided for the input offset of IC2 (RV1) output offset (RV2) and overall calibration (RV3).

As the power requirement of all the ICs is ±15 V we use a mains supply and three-terminal regulators. Current drain is about 15 mA on both supplies.



NOTES:
R7–R12 ARE ½W, 1% OR 2% RESISTORS OR SELECTED 5% RESISTORS. ALL OTHER RESISTORS ¼W, 10%.
C1, C3 ARE POLYSTYRENE OR SILVER MICA.

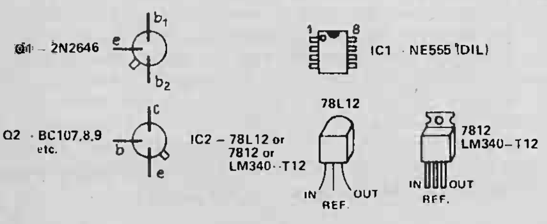


Fig.5.2. Linear capacitance meter. A unijunction transistor, Q1, is connected as a relaxation oscillator with a frequency determined by R1—C1. The frequency of oscillation in this instance is about 1 kHz.

Pulses of about 1 uS duration are produced across R4 each time the UJT "fires". The resistance between b2 and b1 of the UJT reduces to a low value each time the emitter conducts. Much of the charge stored in C1 is "dumped" across R4 for the short duration that the c-b1 junction of Q1 conducts.

The narrow pulses across R4 drive the base of Q2 via R3, which serves as a base-current limiting resistor. The pulses cause Q2 to conduct for the same duration, that is, about 1 uS, and negative-going pulses from the collector of Q2 drive the "trigger" input of the 555 timer, IC1. This is connected to operate as a monostable in this circuit.

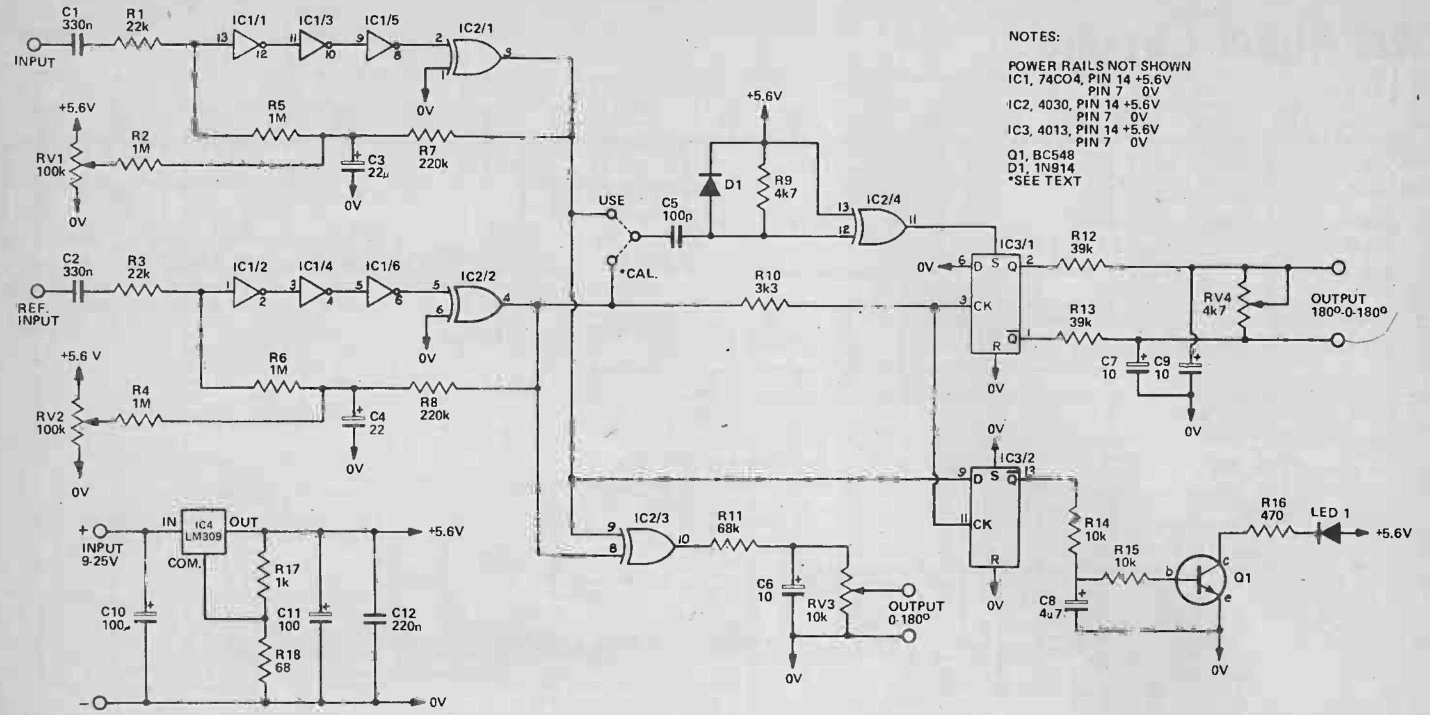


Fig.5.3. Phase meter circuit. The two inputs are first squared. For example the reference input is amplified by gates IC1/2, IC1/4 and IC1/6 and then applied to IC2/2, one of the spare EX.OR gates whose other input is grounded. This conveniently behaves as a Schmitt trigger type of bistable circuit. The average of the output of this gate is formed by R8 and C4, and this is inserted via R6 as the DC level at gate IC1/2.

This produces two important consequences. Firstly it forces the output of IC2/2 to a symmetrical 180° on/180° off condition which is kept stable by almost complete DC feedback. And secondly, because we now have a true squaring circuit rather than a zero-crossing detector, all errors due to even-order harmonic distortion are cancelled. R4 and RV2 are used to adjust for input offset and set the exact 180° condition.

IC gates IC1/1, IC1/3, IC1/5 and IC2/1 process the signal from the other channel in an identical manner, and the two squared outputs are fed to gate IC2/3 which is the gate that forms the EX.OR of them. Its output is filtered by R11 and C6 and a voltage proportional to the phase difference of the inputs may be taken from across C6. RV3 is used to set this to a convenient value — for instance it may be set to 180 mV for a 180° phase difference and read it on a digital multimeter.

In order to detect which of the inputs is leading the other, the two voltages from the squaring circuits are also fed to the D type flip-flop IC3/2. One voltage is used for the clock input and the other as a data input. This type of flip-flop is really a data latch, and whatever voltage is present at the D input at the moment when the clock voltage changes from low to high is held until the next clock pulse. Thus if the D input stays low until after the clock input goes high, the output Q will always remain low showing that the D input lags the clock input. The complementary output Q will be high and this is used to turn on the transistor and LED indicating this lag condition. Since any noise arriving at the clock input can cause spurious resetting of the flip-flop, it is preferable to use a clean voltage to drive it. This is why this channel has been designated the reference. Noise on the other channel is almost completely ignored.

These then are the basic EX.OR functional parts of the phase-meter, and his would leave one flip-flop unused. In fact it turns out that there are two functions that these gates can usefully perform. First, for setting up the input squaring circuits: if the flip-flop is slaved to the squaring circuit, the exact 180° condition can be set when the complementary outputs Q and Q have equal average values. Secondly these gates can be arranged to turn the flip-flop on and off to give a conventional phase meter circuit output. While this does not give as accurate a reading, it does give one which is of opposite polarity for leading and lagging voltages and which can therefore be recorded graphically and unambiguously on an instrument such as a chart recorder. This is therefore designated the recorder output.

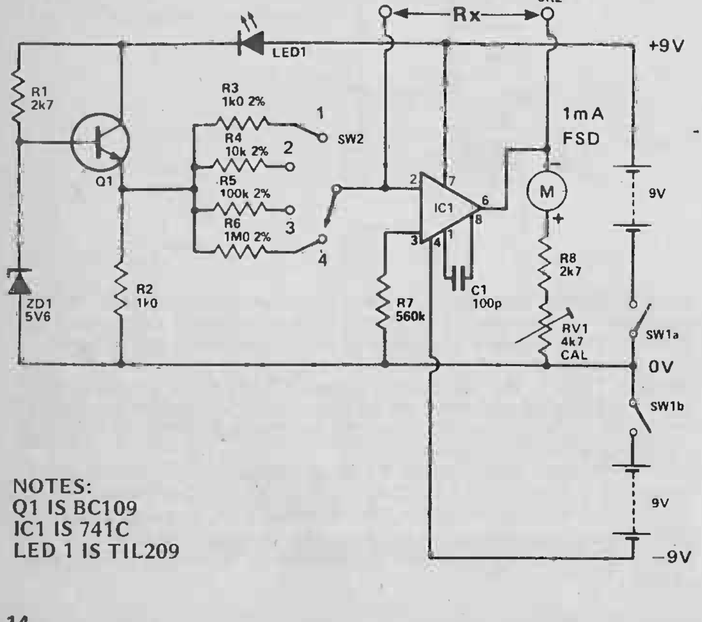


Fig.5.4. (Left). Linear ohm-meter circuit. The circuit is divided into two parts: a reference voltage generator and a readout unit that indicates the value of the resistor under test. The reference voltage generator section of the circuit comprises zener diode ZD1, transistor Q1, and resistors R1 and R2. The action of these components is such that a stable reference of about 5 V is developed across R2. This reference voltage is fed to the op-amp resistance-indicating circuit via range resistors R3 to R6.

The op-amp is wired as an inverting DC amplifier, with the 1 mA meter and R8-RV1 forming a voltmeter across its output, and with the op-amp gain determined by the relative values of ranging resistors R3 to R6 and by the negative feedback resistor Rx. RV1 is adjusted so that the meter reads full scale when Rx has the same value as the selected range resistor. Under this condition the op-amp circuit has a voltage gain of precisely unity. Since the values of the reference voltage and the ranging resistors are fixed, the reading of the meter is directly proportional to the value of Rx, and the circuit thus functions as a linear-scale ohm-meter and has a full scale value equal to the value of the selected range resistor.

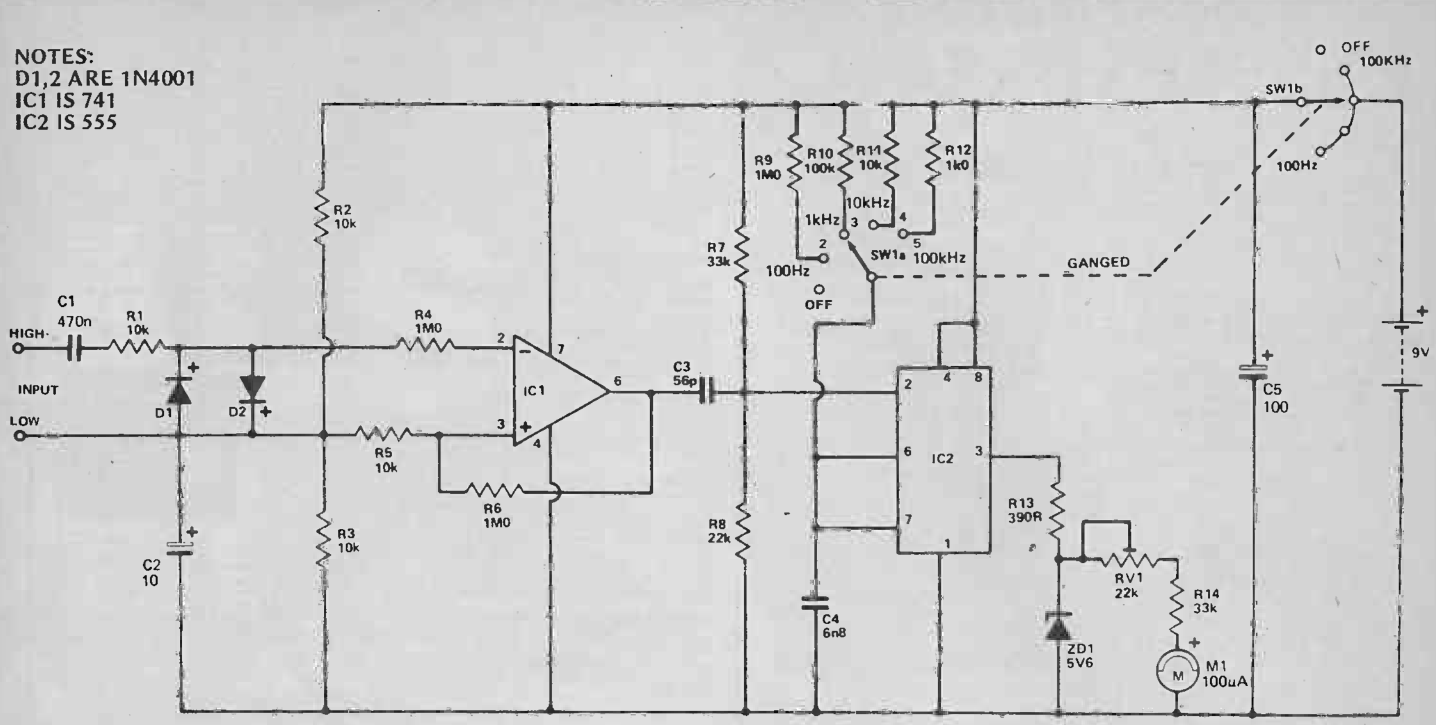


Fig.5.5. Linear frequency meter. The circuit consists of an op-amp operated as a Schmitt trigger to amplify and square the input signal, followed by a 555 timer wired as a monostable, giving a short output pulse of fixed width for each cycle of input signal. This pulse drives a moving-coil meter, the reading being an average of the pulse amplitude, which is proportional to the pulse frequency. As the pulse frequency is directly related to the input frequency, the meter reading is directly proportional to the input frequency.

The input signal is coupled into IC1 via C1, which provides DC blocking. Protection from overload caused by high amplitude input signals is provided by a diode clipper consisting of D1, D2 and R1. The diodes are connected in an inverse-parallel arrangement so that both positive and negative peaks, above the diode forward conduction voltage, are clipped.

The output of IC1 is a train of square waves at the same frequency as the input. The output of IC1 is differentiated to provide short trigger pulses for the 555 timer, IC2. The differentiating network consists of C3, R7 and R8. This network is arranged to provide a trigger pulse that is always shorter than the output pulse of the 555. Capacitor C3 is selected to give the shortest possible pulse to the 555 consistent with reliable triggering.

The output of the 555 monostable will be a pulse of fixed width, determined by the range resistors, R9 to R12, and capacitor C4. The ranges are arranged to give a 75% output duty cycle at frequencies of 100 Hz, 1 kHz, 10 kHz and 100 kHz on the input.

The output pulse from the 555 is clipped at 5V6 by a zener diode, ZD1, to avoid inaccuracies caused by falling battery voltage (as the battery ages). The meter responds to the average value of the clipped pulses. As the frequency increases, the duty cycle (on/off ratio) of the pulse train increases, increasing the average voltage and thus the meter current in direct proportion. Thus the reading on the meter will be linearly related to frequency.

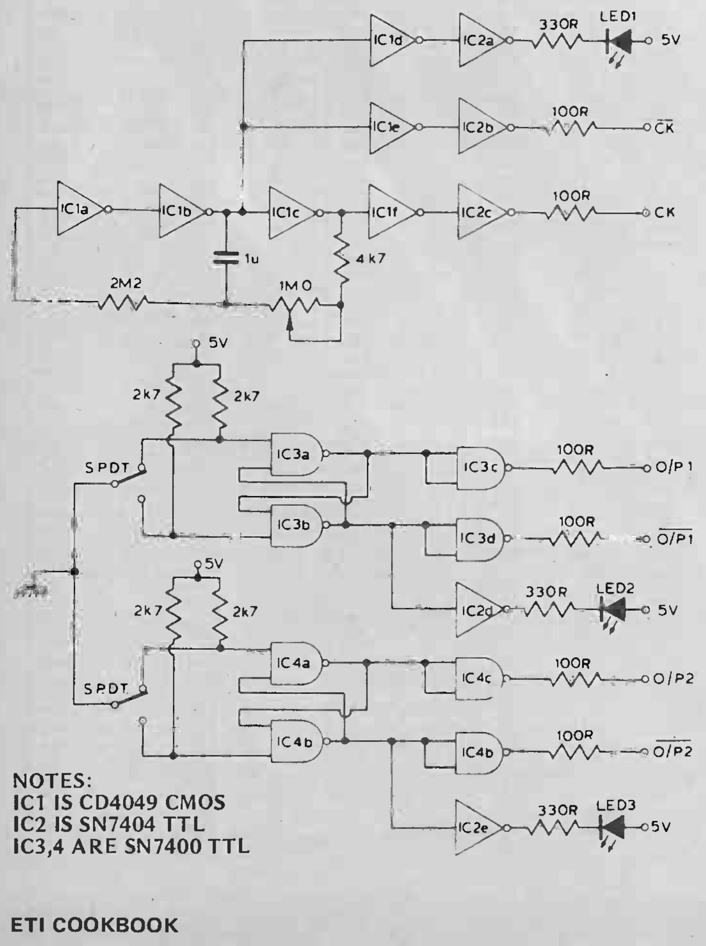


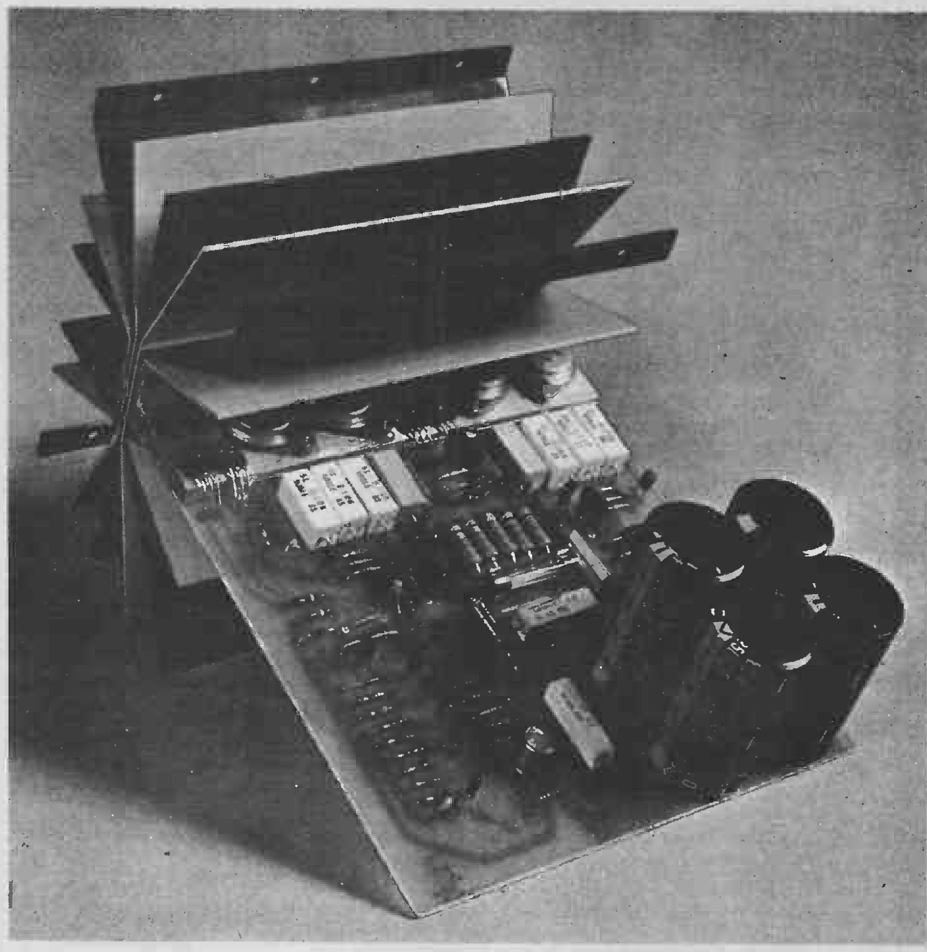
Fig.5.6. (Right). Sequential Logic Tester. Anyone testing a sequential logic circuit requires input pulses free of contact bounce. This unit does this, providing two switched, jitter-free outputs and a 'slow' variable speed clock. The complements of these signals are also provided.

The components shown give the clock a frequency range of 1-200 Hz. The clock's buffered output will drive up to two TTL inputs.

The 100R resistors on all outputs provide some measure of accidental short circuit protection.

300 WATT AMP MODULE

For many applications there's no substitute for sheer power - low efficiency speakers, outdoor sound systems, or maybe you like the full flavour of the dynamic range of a high power amp. Whatever your requirement - this 'super power' module should fit the bill.



Hi-fi amplifiers are becoming more and more powerful, and with good reason. Modern recordings, especially direct-cut discs, have a useful dynamic range approaching 40 dB between the quieter musical passages and the peaks of the crescendos. If the quieter passages are played at at a power output of 100 mW, which is not untypical in a domestic environment, to faithfully reproduce the full recorder dynamic range of a good record without clipping the peaks would require an amplifier capable of delivering 1000 watts! This, coupled with the current trend amongst some manufacturers to build speakers having quite low efficiency, plus the number of people who like their music loud (*and* undistorted) makes the case for high power amplifiers very strong indeed.

Over the past six or seven years we've had many requests for a *high* power amplifier. It would have been possible to design a unit using a large number of readily available power transistors in the output - in fact, one design used a total of 24 devices in the output stage! Difficulties for the home constructor in this approach are obvious, regardless of expense.

For various reasons a bridge amplifier was ruled out when the design of this amplifier was considered. Hence a plentiful source of suitable output transistors was first sought.

There are really not too many transistors available that meet the requirements. Firstly, adequate safe operating area (SOAR) is of prime importance. Next, and probably of equal importance, is availability. Let's have a look at the SOAR problem first. Some high power transistors don't compare too well with the ubiquitous 2N3055 (and its complement, the MJ2955) when operated as an amplifier. Take a look at the set of curves plotted on the accompanying diagram. This compares the safe operating area curves of a number of power transistors. Operation of any power device must be confined to the area inside the device's curve at worst case. If the current/voltage operating point is allowed to fall outside the area of the SOAR curve during any part of the operating cycle for the device, it will be destroyed - with amazing rapidity. Now, the 2N3773 and MJ802 transistors have been around for some time and at first glance would seem good choices for a high power amp, but note that their SOAR characteristics are not much better than the 2N3055. In fact, at 40 V (Vcc) the MJ802 is actually worse. In contrast, the MJ15003 is quite a long way outside the curve for the 2N3055 and therefore has a much higher power rating when used in an amplifier. Hence the MJ15003 and its complement - the MJ15004, were chosen as the output devices for this design.

Another problem that arises with a design such as this is protection for the output devices. Amplifiers using transistors such as the 2N3055 can easily be protected with a fuse. In high power amplifiers where supply rails of 60 - 70 volts are necessary, the energy available (from the filter capacitors) will easily destroy the transistor *and* the fuse - in that order. The answer is to use electronic current limiting in the output. This adds complexity, but is cheap insurance against accidental (or deliberate!) abuse. The curve showing the limiting effect on the SOAR characteristics of the MJ15003 for the protection network used in this amplifier is shown on the diagram with the other SOAR curves.

Output Cost

The main cost of the amplifier is in the output stage, transformer and heatsink. We therefore decided to go to a slightly more complex input stage to improve the performance. This type of amplifier usually uses a Class A driver which introduces second harmonic distortion. By using a complementary-differential input circuit we have been able to eliminate the Class A driver and therefore kept the second harmonic distortion very low indeed. The distortion curve shows the distortion is well under 0.1% until almost full power output. The 'bump' in the curve around the watt is the point where the output stage changes from Class A (peak output being less than the bias current) to Class AB operation.

The complete amplifier, including the power supply components and the output transistors, is assembled on a single PCB. An aluminium bracket holds the output transistors conducting heat from the output stage to the heatsink. Only three sets of external connections are made to the PCB: input, output and power supply AC input from the transformer.

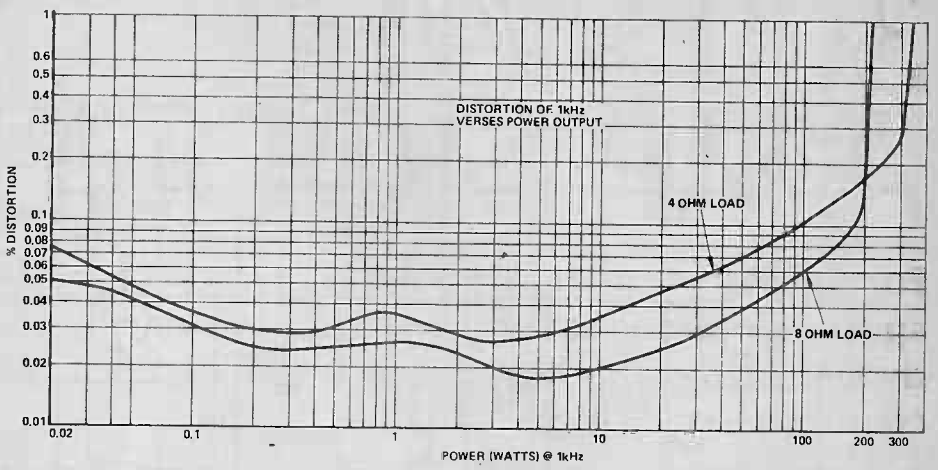
Construction

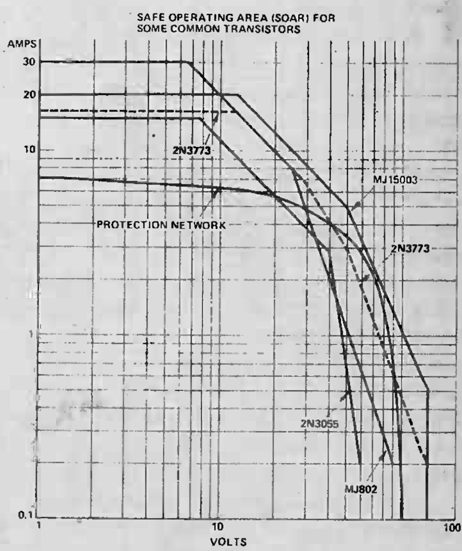
Start the construction by making the aluminium bracket. We used two length of 3 mm angle. This bracket is 3 mm thick and two must be placed back to back to make the required 6 mm thickness for adequate thermal conduction to the heatsink assembly. If you elect to use a Philips 6 5D6CB heatsink (see the box on 'Heatsinks'), a single 6 mm thick angle extrusion can be used, fixed to the flat side of this heatsink.

Heatsinks

There are several alternatives you can choose from for heatsinking the amplifier output stage. The heatsink shown was made from sheet aluminium and has a thermal rating of 0.55 C/watt. This is the rating we recommend for any heatsink if the amplifier is to drive a four ohm load, particularly for pop group use. If it is driving an eight ohm load in typical domestic use, half the fins may be left out (every second one) resulting in a thermal rating for this heatsink arrangement of 0.75 C/watt. Use 1.6 mm thick aluminium sheet - certainly nothing thinner. A heatsink with about 1 C/watt rating and substantial fan cooling is another alternative.

Remember that dissipation in the heatsink will be about 200 watts at full power output. That means a temperature rise of 110 C above ambient if the amplifier is run continuously. Poached eggs anyone? Temperature rise with music or intermittent use is considerably less, of course, as average power dissipated is much lower. ▶





Above and right: operating characteristic of the 300W module circuit.

SPECIFICATION

Power output		4 ohm load	1 V for 300 W output
8 ohm load	200 watts RMS		
4 ohm load	310 watts RMS	Total harmonic distortion	see graph
Frequency response 20 Hz to 20 kHz	±0.5 dB		
Hum and noise re 200 W into 8 ohm	−105 dB	Damping factor 20 Hz to 3 kHz	65
		5 kHz	55
Input sensitivity		10 kHz	45
8 ohm load	1 V for 200 W output	20 kHz	35

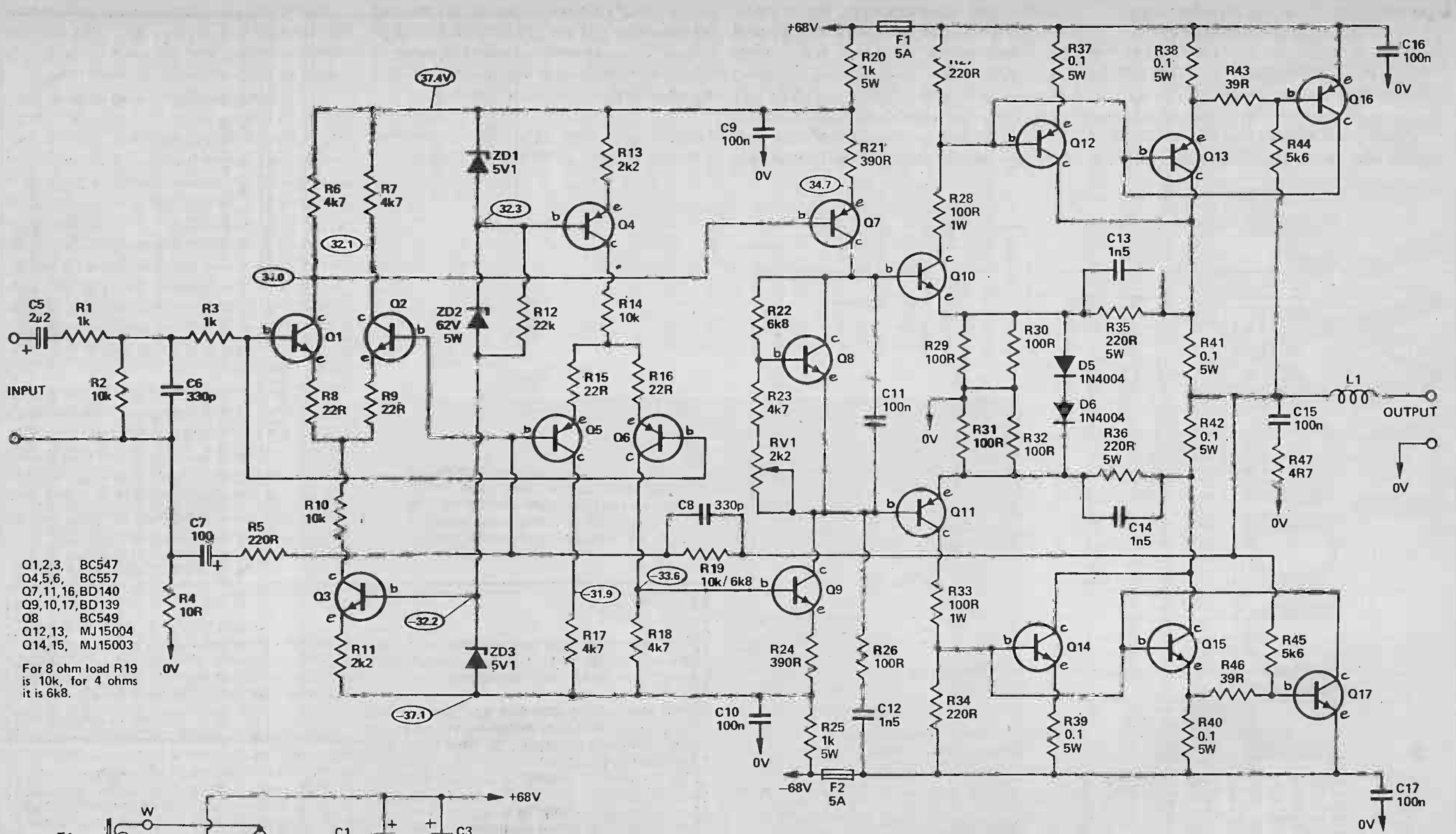
BUYLINES

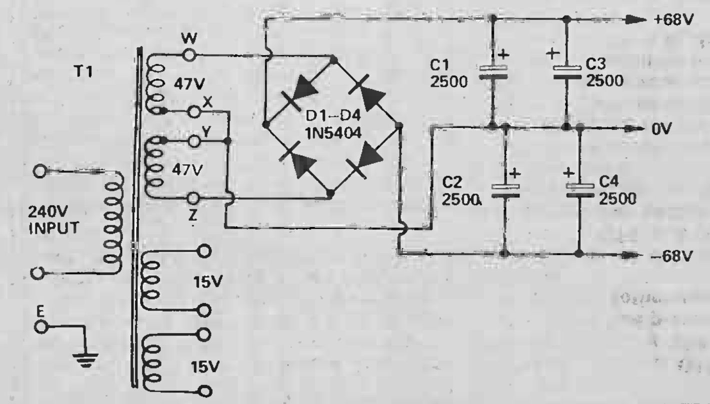
Most of the components used in the 300 W power amplifier module are standard and readily available. The output transistors (types MJ15003 and MJ15004) are available from Macro Marketing Ltd. If you don't feel up to making the heatsink shown, Maplin can supply a suitable heatsink — type 60DN (order code YB26D).

The power supply transformer and capacitors may prove a little more elusive. If you are unable to find the 2500u 80 V types, you can use 100 V capacitors mounted off the board. The transformer specified is a high power type, which you may have to have wound to order. Several firms advertise a transformer winding service in the classified sections of electronics publications. Shop around for the best price. Trent Transformers will supply the transformer for £16.95 plus postage.

Macro Marketing Ltd.,
396 Bath Road,
Slough, Berkshire.
Tel : 06286 4422.

Trent Transformers Ltd.,
26 Derby Road,
Long Eaton, Nottingham.
Tel : 06076 66716.





Above: the complete circuit diagram of the 300W amplifier module and a suggested PSU circuit on the right. All that really matters is that there is sufficient smoothing and the correct rail voltages.

HOW IT WORKS

The amplifier can be divided into three separate parts. These are: the input stage — which consists of Q1 — Q9, a high gain, low power driver; the output or power stage — which only has a voltage gain of four but enormous power gain; and the power supply.

The input stage is a complementary-differential network, each 'side' with its own current source. Each transistor in this stage is run at a collector current of about 0.7 mA. Emitter resistors are employed to stabilize the gain and improve linearity. The output of Q1 — Q6 drives Q7 and Q9. The latter are virtually two constant-current sources run at about 7 mA collector current. With an input signal these 'current' sources are modulated out of phase — the collector current of one decreases while the other increases. This configuration provides quite an amount of gain.

In between the bases of these two transistors is Q8, the thermal sensing-bias transistor. The voltage across Q8 may be adjusted by RV1, thus setting the quiescent bias current for the output stage.

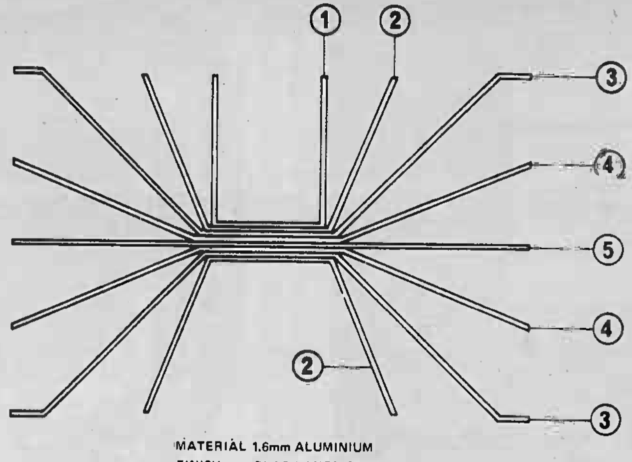
The output stage, Q10 — Q15, has a gain of about five, set by R39 and R29 plus R30. Diodes D5 and D6 prevent reverse biasing of Q10 and Q11 (otherwise the output would be limited.)

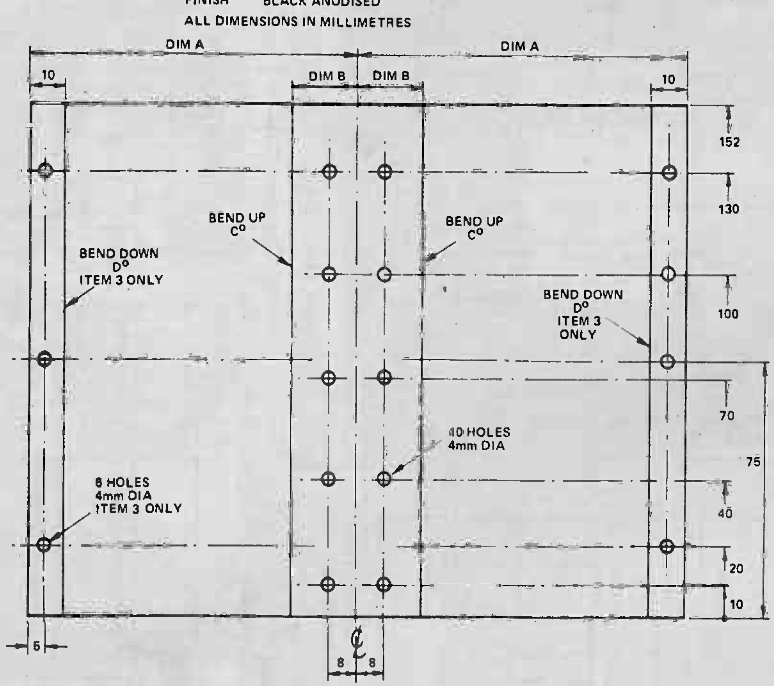
Protection of the output transistors is provided by Q16 and Q17 which monitor both current and voltage in the output transistors and bypass the base current if the limit is exceeded.

The power supply is a full-wave rectifier, with a centre-tap on the transformer giving the 0 V rail, providing ±68 volts. A total of 5000u is used across each supply rail for filtering. The amplifier input stage works on a reduced supply rail, derived from ZD1—ZD3 via R20 and R25.

Frequency stabilisation is provided by capacitors C8, 13, 14 and the RC networks R26/C12 plus R47/C15. Frequency response of the amplifier is set by C5 and C7 (lower limit), C8 sets the upper frequency limit.

The transformer has two additional windings of 15 V AC each. These are not used here but are suitable for powering a preamplifier.





	ITEMS				
	1	2	3	4	5
A	58	65	95	80	75
B	15	17	19	21	–
C	90°	67.5°	45°	22.5°	0°
D	0°	0°	45°	0°	o

Right: metalwork details for the heatsink fins. Don't skimp on these lest the output pair set light to themselves and pass on to that great heatsink in the sky.

PCB Assembly

The components may be assembled on the PCB starting with the smaller resistors and capacitors. Carefully follow the overlay drawing. When you come to the OR1 5 W resistors note that they should be mounted about 2 - 3 mm off the board to allow a free air flow around them. Next mount the power supply electrolytics. Note that the recommended types have three pins projecting from the base. This is to provide mechanical rigidity. All three pins are soldered to the board and the capacitors can only be inserted one way round. The inductor L1 is made by winding a layer of 26 swg enamelled wire (or the nearest equivalent gauge) along the body of a 1 W resistor. The number of turns is not critical, just wind enough wire on the resistor to cover the body with one layer. The value of this resistor may be anything over 100 ohms. Two 5 A fuses are mounted on the PCB, held in place with fuse clips.

Next come the semiconductors. Leave Q7, 8, 9, 10 and Q11 plus the output stage devices Q12, 13, 14 and Q15 until last. Be *careful* with the orientation of the diodes.

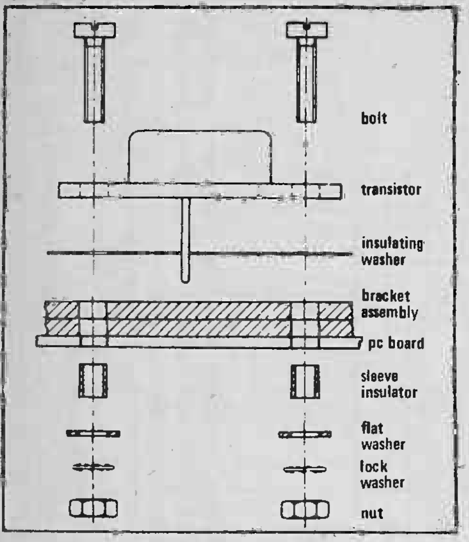
Now you can assemble the heatsink bracket to the PCB plus Q7 to Q15 inclusive.

First smear heatsink compound on the two mating surfaces of the bracket assembly. Note that insulating washers are used on all the transistors, Q7 to Q15, mounted on the bracket assembly (except Q8 of course). Smear both sides of each washer with heatsink compound. Place the bracket pieces on the board - component side - and secure Q7, Q9, Q10 and Q11 with nuts and bolts. Only tighten the nuts finger tight at this stage. Now, take the whole board and place the bracket ends against a flat surface - such as the flat heatsink fin - and juggle the brackets until the end faces are flush. Check that all holes line up and then tighten the nuts and bolts.

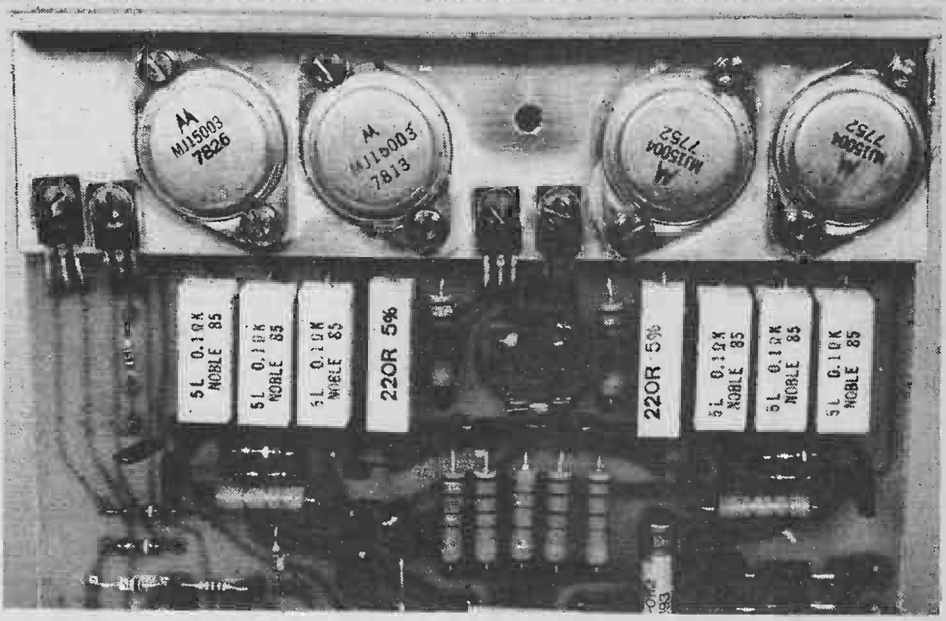
The TO3 power transistors Q12, 13, 14 and Q15 may now be assembled to the bracket and PCB.

Don't solder any leads yet.

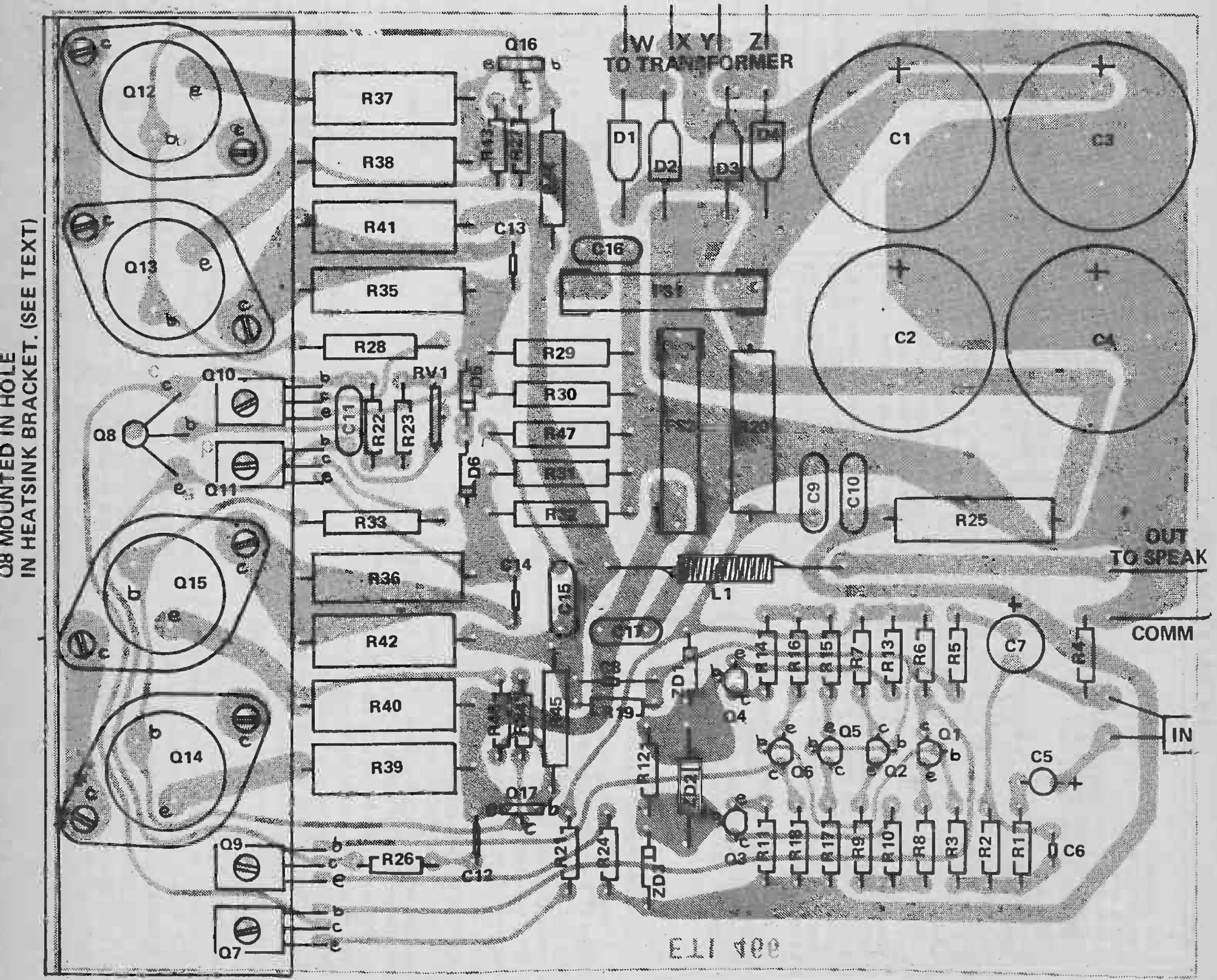
Allow time for the heatsink compound ▼



Exploded view of how the TO3 output transistors are assembled to the angle brackets.



Below: Component overlay for the module.



PARTS LIST

RESISTORS All ½W, 5% unless noted

R1,3	1k0
R2,10,14	10k
R4	10R
R5,27,34	220R
R6,7,17,18, 23	4k7
R8,9,15,16	22R
R11,13	2k2
R12	22k
R19	10k (6k8 for 4 ohm loads)
R20,25	1k0 5W
R21,24	390R
R22	6k8
R26	100R
R28–33	100R 1W
R35,36	220R 5W
R37–42	0.1 ohm, 5W
R43,46	39R
R44,45	5k6 1W
R47	4R7 1W

POTENTIOMETERS

RV1	2k2 trim

CAPACITORS

C1–4	250uu 80 V electrolytic
C5	2u2 35 V tantalum
C6	330p ceramic
C7	100u 25 V electrolytic
C8	330p ceramic
C9–11	100n polyester
C12–14	1n5 polyester
C15–17	100n polyester

SEMICONDUCTORS

Q1–Q3	BC547
Q4–Q6	BC557
Q7	BD140
Q8	BC549
Q9,10	BD139
Q11	BD140
Q12,13	MJ15004
Q14,15	MJ15003
Q16	BD140 or BC640
Q17	BD139 or BC639
D1–D4	1N5404
D5,6	1N4004
ZD1	5V1 300 mW
ZD2	62 V 5W
ZD3	5V1 300 mW

MISCELLANEOUS

Heatsink – see text, PCB, Transformer (47 + 47V – 300W), 4 fuse clips, 2 x 5A fuses.

to spread under compression and finally tighten all nuts. Last of all insert Q8. Smear the inside of the hole it sits in with heatsink compound to ensure good thermal contact.

Now you can solder all transistor leads.

Check the component placement against the overlay now, just to ensure all is in order. If you wish, you can test the amplifier up to the driver stages for correct operation before assembling the the unit to the heatsink. Remove the fuses before applying AC input from the transformer. Refer to the 'powering up' procedure. If there are any problems, look for errors in component placement or orientation - particularly with diodes. If all is well, assemble the module to the heatsink and you're ready for the big test.

Powering Up

The set of output transistors are expensive to replace. Therefore, we recommend you follow this test procedure in the interest of conserving supplies of same.

The power supply AC input should be connected to the transformer (see the overlay) but no power applied. You'll need a multimeter of at least 20k ohms/V sensitivity.

1. Remove the two fuses.
2. Solder a small link across C11.
3. Solder a wire between this link and the ouput pad.
4. With no load connected and no input signal, switch the power on.
5. Check the supply rail voltages. These should be about 68 volts each (plus and minus).
6. Check the voltages on the cathode of ZD1 (should be about +37 V) and the anode of ZD3 (should be about −37V) with respect to 0 V.
7. If these two voltages differ with respect to each other by a volt or so, check other voltages around the input stage to determine the reason.
8. Check the DC voltage on the output (with respect to 0 V). It should be within 20 mV of zero.
9. Inject a sinewave signal into the input at a level of about 20 mV (RSM). Don't use a higher input level. Output should be 1 V RMS.
10. Switch off the main power and allow the filter capacitors to discharge. Remove the input signal.
11. Solder a 10 ohm ½W resistor across each fuse holder. Rotate the trimpot RV1 so that it is set at maximum resistance. Remove the short across C11 and the link from there to the output pad.
12. Switch on........ if the 10 ohm resistors immediately vaporise you either have a short or some fault in the output stage!
13. If all is well, check the DC output voltage. It should be near zero.
14. Measure the voltage drop across one of the 10 ohm resistors placed across the fuse holders and adjust RV1 to give a reading of 1.0 V.
15. Switch off, allow the filter capacitors to discharge and remove the two 10 ohm resistors. Replace the fuses.
16. Connect suitably rated loudspeakers, warn the neighbours, connect a signal source to the input (turn down the volume), switch on the power and put the amp through its paces.

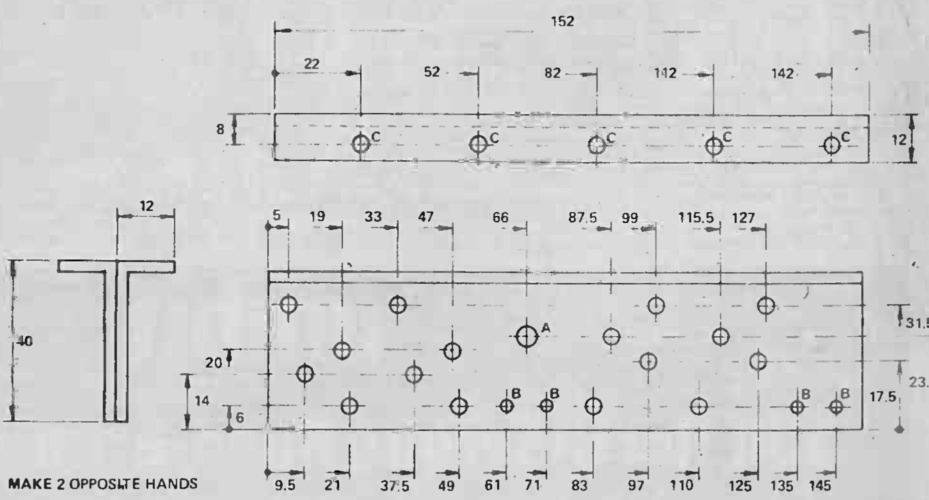
At this stage we'll leave the applications of this module up to you. No doubt you have plenty in mind already.

We are preparing a follow-up article for a later issue in which we may cover such things as pre-amps, bridge operation, design parameters and variations etc.

Keep reading.

ETI

HOLES MARKED A 4.5mm DIA
HOLES MARKED B 3mm DIA
HOLES MARKED C TAP 4BA OR 4mm DIA
ALL OTHERS 4mm DIA
MATERIAL 40 x 12 x3 ALUMINIUM ANGLE EXTRUSION



Below: heatsink bracket metalwork details.

MICROFILE

We've seen hide nor hair of Henry Budgett, since he took delivery of two new machines. He's finally returned to the land of the living with his reports on the new HP85 and Microtan systems and more besides.

Two months may only be eight weeks to you but to someone in here it has been a very packed time. Certainly in terms of the home and personal computer market it has been a very fast moving time indeed. Owing to a wide variety of reasons last month's offering never reached your waiting eyes so some of the news may be a little less than fresh - it is slightly less than boring, though.

This is really a preview offering. I shall be dealing with at least two of these machines again, probably devoting a whole month to each. The first two are now well known, but I have been fortunate enough to have one of a very limited quantity of the top system for review and.................

The Dream Machine

The reason most people give when asked why they chose a PET is that it is a complete unit; VDU, keyboard and mass storage all in one small unit. Whilst this new system from Hewlett Packard has all the previously mentioned parts and a thermal printer as well it resembles a PET in about the same way as a racing car resembles an MG; they are of the same genus but the HP is so far advanced that it outstrips almost anything in the personal computer market. This is a *personal computer* and not a home machine. Why the difference? Well, with some few notable exceptions, the home computers currently available are overgrown programmable video games, not that that in any way detracts from their worth. This has been designed for research laboratories, education and other serious users who will be able to benefit from the superb range of facilities that are offered.

Basically, the HP85, for that is its name, consists of a single box, slightly larger than an Apple, with a 5" VDU, tape cartridge, thermal printer/plotter and full ASCII, numeric and function keyboards. Inside is a complete custom designed system. For example, the CPU card consists of the custom built CPU, four ROMs holding 32K of BASIC/operating system, eight RAMs (16 K of dynamic) controlled by yet another custom built chip, the keyboard controller (again custom) and finally the bus driver chip which is, quite naturally, custom built. Grand total is sixteen chips! The VDU has a totally independent memory of four screens-full that can be scrolled or copied direct to the printer *at any time* or under program control.

The graphics capability is excellent with an available by points. Program access is simple, you can manipulate scales and put labels on graphs and diagrams. To make life a little easier for the user the built in plotter turns diagrams on their edge for printing, this allows continuous strip charts to be produced.

Finally on the hardware side we have the tape system. This is mechanically the same as that used on the HP minis but unfortunately the format has been slightly changed. The method used is

Hewlett Packard's new HP85 (right) is a powerful machine in a compact package and at a reasonable price. The Atari 800 (far right), one of two new Video Computer Systems on their way.

Fireside Viewing

Once upon a time there was a Mr Slaymaker whose factory in Esher was almost completely destroyed in a fire. While tiptoeing through the ashes, Mr Slaymaker found his telly - hanging chain broken from the intense heat, case badly distorted, front panel non-existent and full of water from the firemen's hoses. After a few months Mr Slaymaker unwelded the controls and plugged it in. Using a hacksaw for an aerial, he obtained a near perfect picture. There's a moral there somewhere. If you're intending to burn your house down round your ears during crossroads I should get hold of a JVC Videosphere colour telly pretty quickly.

Shell Kit

Got yourself a circuit diagram for a metal locator? Construction of the PCB's no problem, but if the tantalising treasure-tracing tit-bit doesn't come as a complete kit, where do you get your hardware from. At worst, you can end up using plant pot saucers to house the search coil and broom handle (complete with splinters) for the shaft.

Fear not - Sonasonics comes to the rescue. They can now supply a metal locator shell in kit form from £17.25 including VAT and carriage. The kit includes a search coil case, shaft, handle and a case for the electronics. The case can be supplied drilled or undrilled, if requested.

Further details from Sonasonics Electronics, 11 Park Road, Ashford, Kent TN24 8LU.

similar in many ways to a soft sectored floppy disc; you have a directory which is searched for your required program, this is then located and loaded. The speed of this operation is considerably faster than that of the conventional cassette.

Super Software

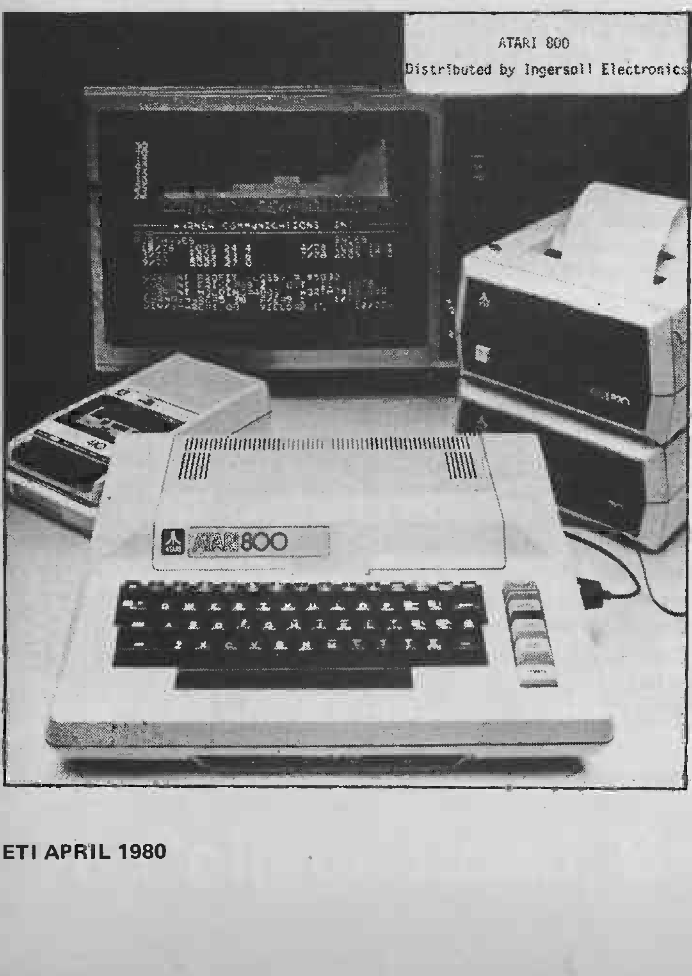
The HP has tucked away inside its diminutive frame the best version of BASIC that I have come across on a micro. It meets, and often exceeds, all the latest ANSI standards for this, much abused, language. I strongly suspect that anyone who had been brought up solely on a Microsoft type implementation would get severe brain damage! In fact this BASIC has everything you could wish for, and it's logical too. For example, you get renumbering, full error checking programmable user keys, full debugging, single stepping, optional screen (DISP) or printer (PRINT) displays, or both... the list goes on and on.

One of the most common complaints about home produced software is that it isn't 'bombproof'. Well I've written more than a few on the HP and you can protect them very easily, even to the point of securing your files on the tape so that no-one can list or edit them.

A possible moot point is that, to quote any of my rivals in the game, 'HP do not even say what processor the 85 uses'. As you may have guessed I'm talking about machine code, and as mentioned earlier the HP has a custom chip. Not only did someone not read their press release carefully they also didn't listen when it was stated that an assembler will be available soon! Anyway you don't really need machine code as in the main this machine will be used as an instrumentation controller, or as a system to analyse results produced by other systems.

In Brief

There you have it, unfortunately in brief form because of a lack of white space to fill, but the HP 85 has arrived, bringing with it a whole new generation of professional computers that are cheap enough to be dished out to each member of a research team. I said 'cheap enough', it does cost £2000 but this price is artificially high - they can't make enough to go round - and it is quite possible that it will fall to around £1200. If that happens it could well clean up the micro market overnight. After all, people are generally prepared to pay for quality! (My thanks are due to the team at HP who let me keep the system until they lost all hope of ever seeing it again!)



ATARI 800
Distributed by Ingersoll Electronics

Video Strikes Back

Ingersoll, the watch people who expanded into electronics recently, are to distribute the Atari 400 and 800 Video Computer Systems in this country. Information is scarce at the moment, but it appears that the top model, the 800, will be equipped with 8K RAM - expandable to 48K - and 8K ROM - expandable to 40K. CPU is the trusty old 6502 and the system will handle four floppies and has a full feature ASCII keyboard with programming being done in Atari Basic. Prices will range from £400 to £750 approximately and features such as full colour and sound are standard. For more details watch this space.

The Odd One

Whilst making one of my occasional tours around London's Computer shops I came across a familiar sight. There, sitting on a service bench, was what appeared to be a 32K, large keyboard PET. However, on closer peeking it turned out to be something rather different. It had a full terminal style keyboard. Some of the keys had been moved to more sensible places (such as the cursor controls) and there were no graphics legends on the keys. What was it? Simple really, it's the PET Business Machine. Owing to the fact that some of the RAM had expired I couldn't see it going but apparently the lower case, that you normally have to POKE out, is available and you have to POKE the graphics if you want them. A very sensible idea really, but this machine had an American transformer so I decided to track down some details. Commodore say that they are not yet available in this country but they are planned to arrive in the near future, a few months but that's their estimate.

If you are planning to set up a business system with a PET in the driving seat I reckon this would be much better and easier to use than having graphics floating about. If anyone out there has one or knows more about it please drop me a line and give me your impressions.

Tone Deaf

Regular readers may remember that I wrote a piece on modems not so long ago. Well, Microfile bears fruit occasionally, we are going to publish a design in the march issue of Computing Today, but just for those of you who want to go your own way here is the standard frequency set for data transmissions.

ETI

US Standard			**CCITT Standard**		
	Mark	1270 Hz		Mark	980 Hz
Originate			Chan. 1		
	Space	1070 Hz		Space	1180 Hz
	Mark	2225 Hz		Mark	1650 Hz
Answer			Chan. 2		
	Space	2025 Hz		Space	1850 Hz

CTs modem project is being produced in PCB form by ZOT Engineering Ltd of Bogpark Road, Musselburgh, Lothian. Naturally it uses the above frequencies and runs at 600 Baud.

Sinclair's ZX80 — a Tiny BASIC machine in every sense.

And Now For The News

So much for last month's delayed offerings, here is the news. As most of you will probably be aware Britain's enterpreneur extraordinaire, Clive Sinclar, launched his new micro onto the british public in a blaze of TV and Press publicity. Called the ZX80 (well it uses a Z80 so why not) it s about the smallest home computer with built in BASIC yet, you could even call it hand-held. I have not yet received a sample for review but when it comes in I'll take a close look. Here, however, are a few observations from the launch and subsequent perusal of the handbook.

Based on the Z80A, running at 3.25 MHz to save timebase dividers, it has a sealed, touch sensitive keyboard which offers single key programming of *most* BASIC functions. I say most because this is really only a Tiny BASIC but it has been squashed even further by use of a look-up table system where each command word is reduced to a single digit number. It is very restricted, as you would expect, on data processing functions like string handling and because of the design the CPU has to produce all the functions of the system, hence the blurring of the screen when a program line is entered. Each line is syntax checked on entry at the bottom of the screen before it is allowed to move up and join the others at the top, an unusual feature on small systems.

Overall the new Sinclair has very interesting possibilities, and at £99.95, inclusive of VAT but not power supply, it does represent one of the cheapest entry points to high level programming.

With no facility for machine code, and not much mention was made, so one presumes, that the MK 14 will continue to support this area of the Sinclair market. In my humble opinion this machine will be excellent for education on the mass scale but once people have had a taste they may well find that they cannot expand enough to meet even moderate needs. Still, as *the* executive toy for 1980 its success is assured.

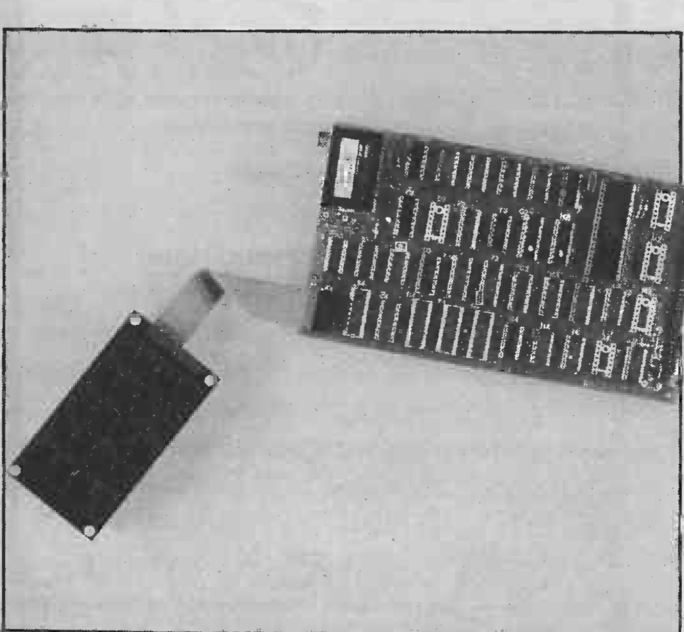
Further design restrictions have meant that you can only add an extra 16K of RAM onto the unbuffered bus. These expansions are in 3K blocks for which you pay £12 for the board and a further £16 per K of RAM. Talk was made of adding new ROM sets, masking the board, new extras like languages, disks, etc but as the CPU is already rather overworked I somewhat doubt the practicality of these ideas.

Orange Blossom

From the stable that brought forth the Tangerine VDU system about a year ago now comes a new micro system called the Microtan. This is an excellent kit, also available ready built, that sells for a mere £69. It offers an excellent start in 6502 based systems. I have built one up in the last week, it worked first time, and I would seriously suggest that if you feel unsure about soldering on double-sided, plated-thru boards you buy the ready-built system. It is not a beginners' kit; I spent over an hour and a half soldering and I'm no novice, but what you get at the end is really worth all the trouble.

The monitor is one of the best 1K versions I've come across in quite a while and the concept is excellent. Basically at this stage you need a five volt power supply, the Microtan and a hex keypad to start on the machine code. However, if you want a full ASCII you can plug it in place of the hex pad - the monitor actually works out which type you are using. Many people will make comparisons with the Acorn. Both are low cost 6502-based kits, but the Microtan gives you a VDU, rock steady I'm glad to say, right from the start with optional graphics and lower case rather than a sub-calculator type LED display.

Expansion is by a way of second board called Tanex, cunning names these, which gives you an extra 7K RAM, 6K ROM, 8K Microsoft BASIC, cassette I/O and enough general purpose parallel and serial I/O to get most of you frothing at the mouth. And, believe it or not, both cards are on PCBs not much bigger than a Eurocard. Further expansion is by way of a 40K, yes that's forty, RAM board and a disk board which will offer up to four units. Not only is the cost extremely reasonable but the design hasn't been skimped. In the days of Britain-Knocking dare one even say that Microtan will probably knock the (expletive deleted) out of the lower end of the market and possibly make at least one other UK firm look to its laurels in haste? I will be presenting a complete Microfile on this gem at a later date so keep your ears on. **ETI**



Microtan — an excellent introduction to 6502 based systems.

PROGRAMMABLE TOUCH DIMMER

A sophisticated multi- function touch-controlled lamp dimmer with built-in memory and a few other special features.

This unsusual lamp dimmer project does away with the usual on/off/dim control knob and replaces it with a single touch-sensing pad or switch. The touch pad is coupled to a sophisticated IC which processes touch-duration information and then controls the brilliance of the lamp (via a track) in accordance with that information.

If the pad is simply touched for a brief period (60 to 400 mS) the lamp merely changes state; ie, from OFF to ON, or vice versa, depending on its previous state. A longer touch (greater than 400 mS) causes the lamp brilliance to cycle slowly from dim to bright or vice versa for the duration of the touch, taking about seven seconds to span the full brilliance range: when the touch is removed the prevailing brilliance level is 'remembered' and maintained indefinitely. At switch-off (a brief touch) the chosen brightness level is stored: this brightness level is set again at switch-on (another brief touch). In the case of dimming, control starts from the stored value.

Remote Control

The dimmer unit can be controlled locally either by the touch pad already mentioned or via a simple press-to-close switch. Additionally, however, the unit is provided with a pair of 'extension' pins which enable the unit to also be fully controlled by any number of remotely positioned switches or touch-pad modules. All control points work in the 'OR' mode.

The touch dimmer circuit uses the 'hum pick-up' principle of touch detection and is specifically designed to operate with 'modern' house wiring in which the lamp is connected to the Neutral side of the mains and the on/off switch (or dimmer) is connected to the Live side. The basic dimmer circuit can, however, also be used in 'old' house wiring systems, in which the lamp is connected to the Live side of the mains and the switch is connected to the Neutral, but in this case the unit must be activated via push-button (rather than 'touch') contacts. In either case, the circuit can be used to control up to 300 watts of lamp power.

The ETI Touch Dimmer is designed to fit into a standard plaster-depth lighting switch box. The triangular touch plate from Maplin gives the project a professional finish.

Construction & Use

Our prototype unit is designed to fit into a standard plaster-depth lighting switch box. Before starting construction, check the project's suitability to your existing wiring by making an accurate cardboard cut out of the PCB and checking that it will fit comfortably into an existing lighting switch box. If all is well you can proceed with the construction.

Construction calls for a certain amount of care. Note that the capacitors are miniature types (see Buylines). Components L1-C1 and R10 are RF interference suppression components. L1 consists of approximately 50 turns of 0.5 mm enamel copper wire, wound on the body of C1.

When construction of the PCB is complete, connect the unit to the mains via a suitable lamp in accordance with the circuit diagram and the overlay and give the unit a functional check via the touch pad lead. Check that the unit dims and turns on and off as already described. Also check that it does not cause excessive interference on your radio set: if excessive interference is experienced, try reducing the value of R10 to 47R.

When you are satisfied that it is operating correctly you can fit the PCB and the touch pad (see Buylines) to a standard blanking plate (available from your local electrical shop) as shown in the photos. The plate is provided with a central 'knock-out' hole. Open the hole, push the touch pad through the plate hole and the central hole on the PCB and bolt the two units firmly together. Now connect the touch pad to the PCB touch pin via a solder tag and nut. Finally, check that the holes on either side of the PCB line up with the securing holes of the blanking plate. ▶

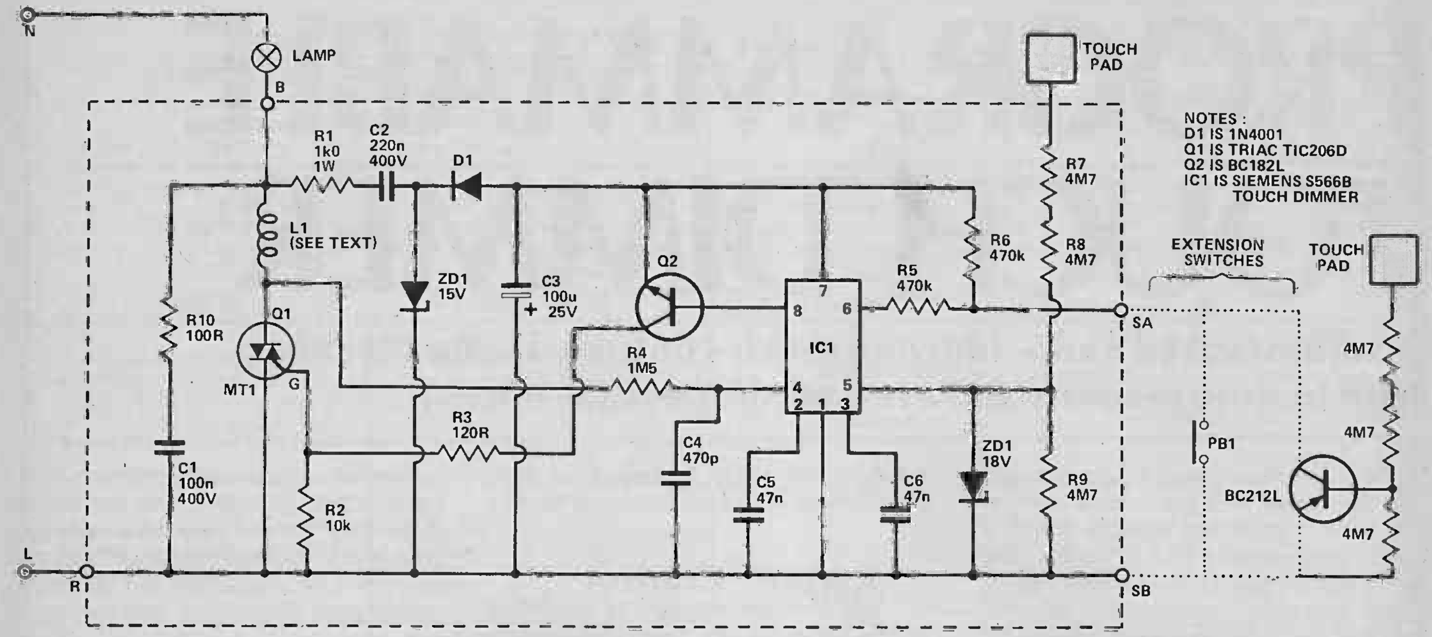


Fig.1. Circuit diagram of the dimmer.

When you finally fit the completed unit into its switch box take care to ensure that no short circuits occur. You can cover vulnerable components such as L1 with insulation tape if you wish. When fitting the unit, note that the box's earthing lug should, in most instances, be at the C1-C2 corner of the PCB.

If you decide to fit extension switches to the unit note that the connecting leads carry live mains and normal safety precautions must be taken.

NOTE: The S566B IC used in this project is a special-purpose touch dimmer device manufactured by Siemens and must not be confused with the similarly numbered NE566N voltage controlled oscillator IC.

PARTS LIST

RESISTORS

R1	1k0 1W
R2	10k
R3	120R
R4	1M5
R5,6	470k
R7,8,9	4M7
R10	100R

CAPACITORS

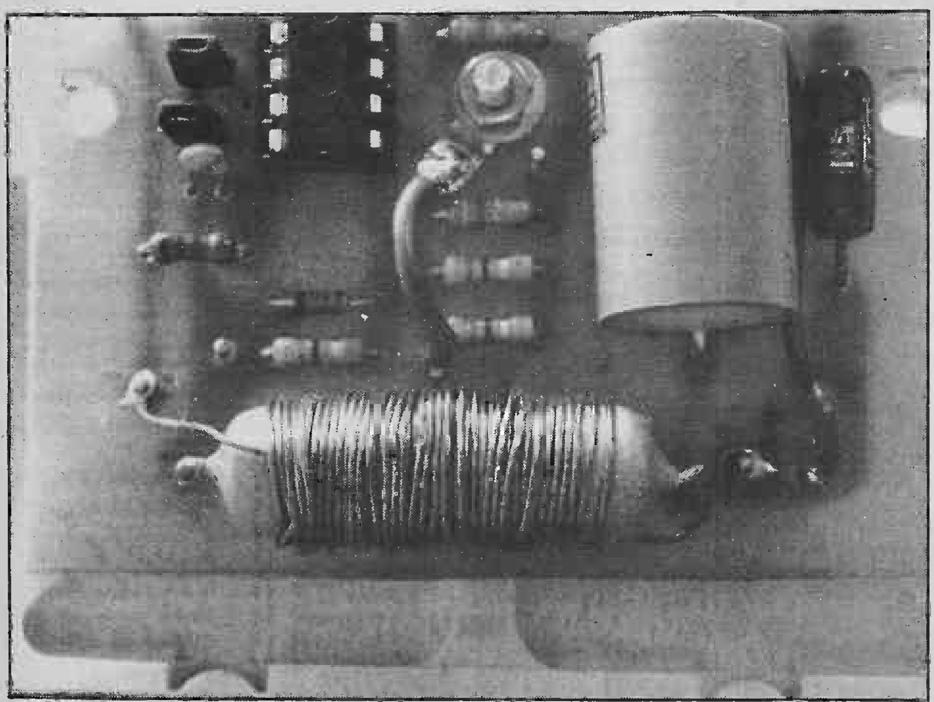
C1	150n 400 V polyester
C2	220n 400 V polyester (see Buylines)
C3	100u 25 V electrolytic
C4	470p ceramic
C5,6	47n (see Buylines)

SEMICONDUCTORS

IC1	S566B Touch Dimmer
Q1	TIC 206D
Q2	BC182L
ZD1	BZY88 15V
ZD2	BZY88 18V
D1	1N4001

MISCELLANEOUS

MK blanking plate, touch pad, 2-way terminal block (2A rated), Coil — 50 turns of 0.5 mm enamelled copper wire on C1.



L1 is wound on C1 — 50 turns of 0.5 mm enamelled copper wire. As an additional safeguard, a turn of insulating tape keeps it out of harms way in the box.

HOW IT WORKS

Most of the 'intelligent' action of the circuit is carried out in special-purpose P—MOS integrated circuit IC1. This IC receives instructions via a touch pad or touch switch. It processes the input touch-duration information and then does or does not send appropriate gate drive pulses to lamp-switching triac Q1 via pin 8 and current-booster transistor Q2.

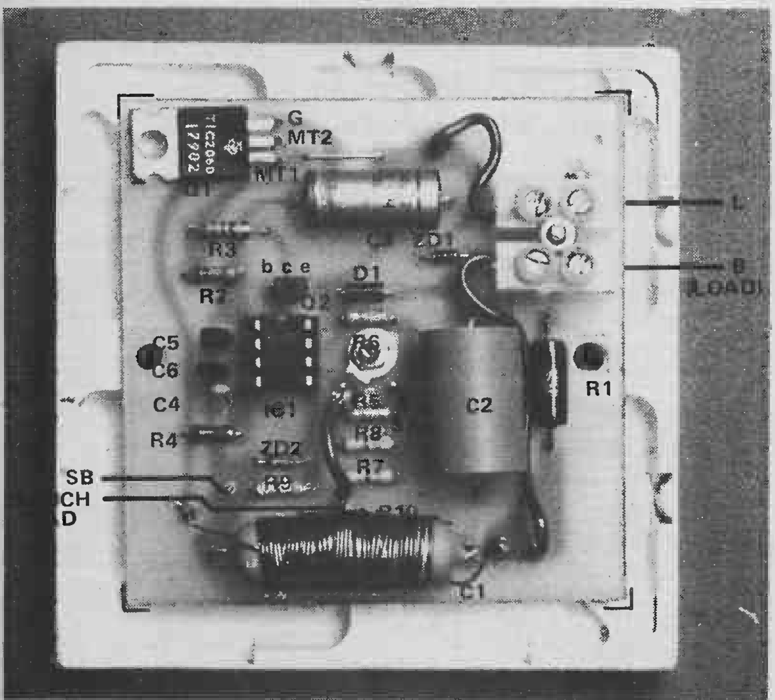
If the IC decides that the lamp should be switched on it sends one 30 uS, 100 mA gate pulse to the triac in each mains half cycle (every 10 mS), at some phase-delayed time after the start (zero-crossing point) of each half cycle. The magnitude of the phase-delay determines the brilliance of the lamp: if the triac is triggered shortly after the start of each half cycle (short delay) the lamp burns brightly: if it is triggered near the end of each half cycle (long delay) the lamp burns dimly. The maximum and minimum phase delays are limited to 150° and 30° respectively, enabling the lamp power to be varied from roughly 3% to 97% of maximum via the triac.

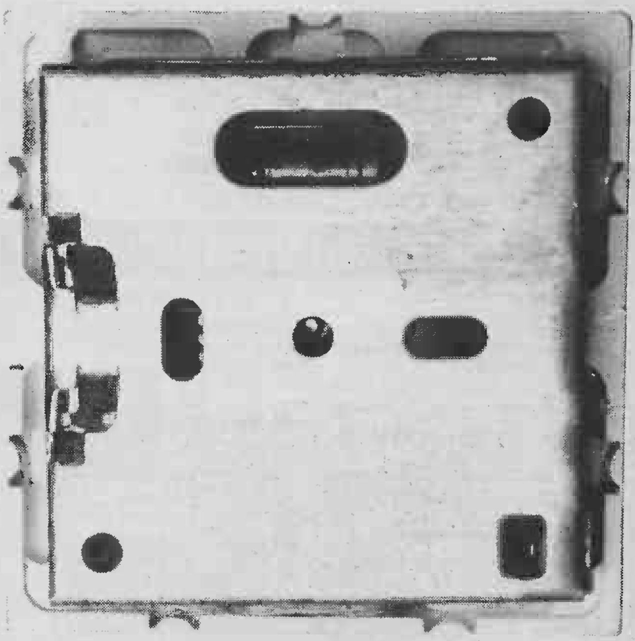
Although IC1 and Q2 generate relatively high peak drive power (1.2 watts), their MEAN power dissipation is very low (about 12 mW). This power is derived from the mains via R1—C1—ZD1—D1 and C3 and is delivered to IC1 and Q2 as a smooth 14 volts DC from 'reservoir' capacitor C3. This method of operation is only made possible by the fact that the triac is not gated on until at least 30° after the start of each half cycle, thereby enabling C3 to attain and maintain a virtually full 14 volt charge throughout each half cycle. The IC logic operations are synchronised to the zero-crossing points of the mains signal via the R4—C4 network.

'Touch' information can be fed to either pin 5 or pin 6 of IC1. The pin 5 input is intended for genuine 'touch contact' use and works on the high-impedance hum-pickup principle. The touch pad is effectively connected to the mains live terminal via high-value resistors R7 and R8, which limit the touch pad currents to safe and minimal levels. ZD2 limits the pin 5 'hum' signal amplitudes to safe values.

The pin 6 input is intended for use with push-button touch switches or with any number of parallel-connected 'extension' switches. The extension switches can either be normal push-button switches or 'touch switch modules', each comprising one transistor and three 4M7 resistors connected as shown.

The dimmer can be used with lamp loads up to 300 watts. L1 and C1 and the associated resistor are RFI-suppression components.





BUYLINES

Due to miniaturisation certain components have been selected for their physical size. These are C5, C6 and C4 and are Siemens type B37448, which are available from Electrovalue. C2 has also been carefully chosen. This capacitor is an ERO type MKC 1864 and can be obtained from Watford Electronics. The following companies stock the S566B touch dimmer — Electrovalue, Watford Electronics and TK Electronics. An anodised touch plate which can be purchased from Maplin Electronics gives an attractive appearance to the completed project.

All the other components should not prove difficult to obtain from major stockists advertising in this issue.

Fig.2. (above left). This is how you fit a quart into a pint lighting box. Q1 is mounted flat on the board to save space. Note the orientation of C3.

The PCB fits neatly into its box (above). If you have any bits sticking out, you've done it wrong!

ETI

RAVEN ON...

Jet-setter Dave Raven of Metac Electronics reports on his latest trip (purely business, of course) to Hong Kong, complete with holiday snaps

The first indication that Hong Kong is overcrowded came as the aircraft made its final approach to the runway. Washing billowed from the network of multi-storey buildings which appeared almost close enough to reach out and touch. Kai Tak Airport is situated on the side of Kowloon Peninsula with its runway projecting out towards Victoria Harbour. The giant Jumbo hurtles itself down between the skyscrapers and races out towards the end of the runway, which of course is surrounded by water. Reminding myself that the pilot must have done this many times before and that it would be extremely unlucky for this particular aeroplane to overshoot, I nestled down into my seat and thought about how many times the stewards had demonstrated putting on and inflating the life jackets. The sweet placid smile of the Singapore Air hostess hadn't cahnged throughout the landing, which I had monitored continuously knowing that tell-tale signs of trouble would first appear there.

Street Life

If Hong Kong can survive the effect of its massive over population then the future growth of their electronics industry looks set to follow the same pattern as Japan. If the Government could somehow restrict any poor quality products leaving the country as happens in Japan by subjecting all exports to independent quality checks, then the effect of this would up-lift their whole product image.

Hong Kong is split into two main parts - Hong Kong Island, which is the original British Colony, and Kowloon, which is on the mainland tip of China. Kowloon is the controversial part of Hong Kong and also the adjoining New Territories which are on lease to Britain until 1999. The site of so much construction and land reclamation must infer that no one is particularly worried about the likely outcome of events when our lease does run out. A new multi million pound underground railway system has just been opened. Motorway sections, bridges, flyovers and a road tunnel under the harbour increase your confidence that the British expect to be here for some time yet. On occasions I found it necessary to remind myself that this was, in fact, still a British colony, since the life style was certainly different from any other I have seen. How much a part of Britain the Chinese felt, I just could not gauge. I did, however, notice when walking around the Chinese districts of Mong Kok that most of the corner street players, strange fortune tellers with caged birds and story tellers had a lot more common with say Pekin than with Manchester.

While U Wait

The other area in which we differ is our capacity for work. Never before have I been so amazed at the speed in which things can happen. All readers must have heard tales of the Hong Kong tailor-made suits. Well, I can confirm they are true. In just three days which included Saturday and Sunday my colleague and I had a suit made to measure and three shirts each. This included a fitting of course which all took place in our hotel rooms. This story will of course inflame the wrath of clothing manufacturers in this country who will try to make me feel guilty by pointing out the rate at which companies that manufacture suits are going out of business. While feeling genuine sympathy I cannot help feeling that it takes a little more than sweated labour to be as efficient as the Hong Kong Chinese. Wage rates are generally regarded as good and working conditions are not dissimilar to those I have seen in many British factories. A visit to the East End of London will demonstrate this point, particularly the little clothes manufacturers off Middlesex Street (Petticoat Lane). My admiration for the tenacity of the Chinese in building up such a prosperous country in an area about the size of Leicester is tremendous. The contribution which has been made by our own Government deserves praise too when one considers that the whole country is administered by British Civil Servants.

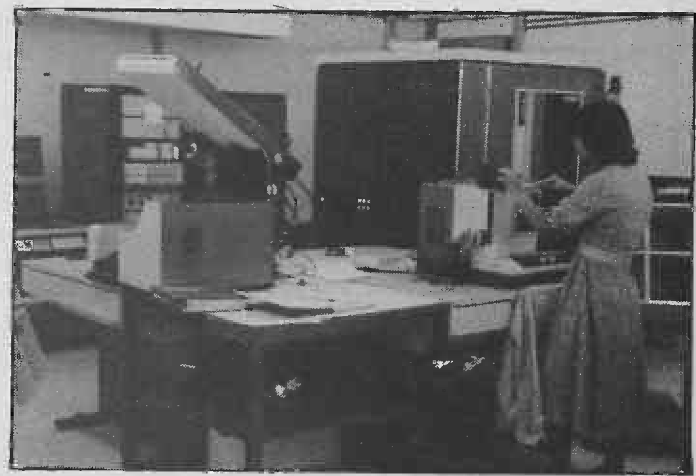
Visiting the industrial area of Hong Kong is an experience in itself. This must be a unique environment of multi-storey blocks of factories containing more people than I think I have ever seen. Walking through the little street markets during the lunch hour (they do have one), I can only describe it as similar to trying to traverse the crowds at Wembley Stadium on Cup Final Day. As part of my brief was to discover the source of the Digital Watch it was with much trepidation that I entered the factory blocks. Travelling up in a lift with about three times as many people as I would think was safe, I hesitantly made my entrance. Where were the rows of children assembling my watches? No sign of malnutrition or overseers lashing the workers to produce more.

Swiss Watches - Chinese Style

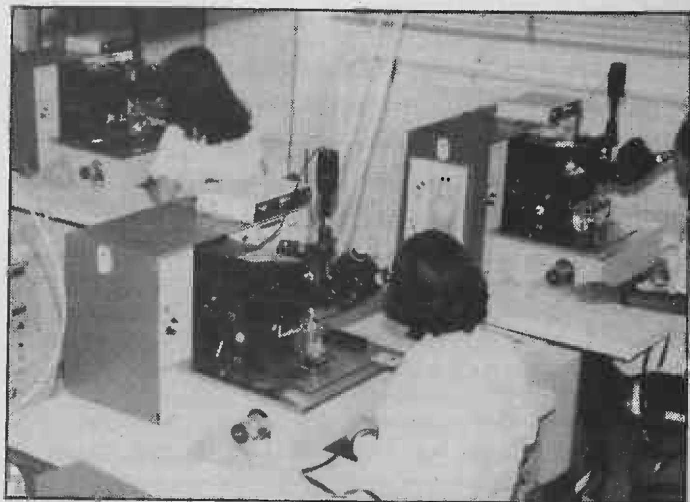
I am afraid to report to the sceptics of Hong Kong products that I was only confronted by modern UK style offices with splendid clean modern production lines, manned by rows of pretty healthy looking girls who were carefully assembling the products. Rows of computerised automatic bonding machines were churning out watch modules and automatic computer testing was being carried out on a million pound computer system. The design engineers, quality assurance managers and factory managers were all highly competent people whose only crime against the workers of Britain is a high level of job satisfaction and a level of productivity that we can only hope to aspire to. One of the companies visited has a complete in-house design capability so forget the stories that all the products are ripped-off from American or British designs. This same firm is building a new factory to give them their own wafer fabrication plant which reduces their reliance on American chip manufacturers. Stainless Steel, mineral glass watches, water proofed to three hundred atmospheres are soon to be typical specifications coming out of Hong Kong. Some of these companies are now approved to Swiss Watch Industry standards and to prove it some well known names are being assembled here. Hand held games are to be very important products this year, probably as big as the early TV Game. Models to watch out for are the LCD varieties with little stick-figure football players that dart about on the display. These nay not be ready this year in the UK but this has to be the start of a flat screen, LCD hand held television.

Rural Smells

No visit to Hong Kong can be made complete without visiting the New Territories, and this rural part of Hong Kong must be very similar to Main Land China (only 22 miles from Hong Kong). We travelled to the China border on a train full of young Chinese youths off on a Sunday outing. The journey took about two hours due to delays caused by trains coming from the opposite direction loaded with ducks, cattle, pigs, sheep and also armed guards at the rear. In the station these trains were halted along side our own train and with the windows down the smell managed to ruffle our normal calm British decorum. The houses in the rural areas are still very small by our standards. I was amazed to see how every available patch of ground was beautifully cultivated and tangerines were being grown in pots for part of the New Year celebration. The China border is not too impressive, but then how could it be, with just open fields and a twisting road leading off into the distance. With binoculars you could just make out the guards at the border and I was amazed to see a few people wandering across carrying shopping bags. I later learned that they live on the border and are free to cross into Hong Kong but clearly prefer to go back to China. I must confess that I had an urgent desire while standing there, to walk off down the road and discover if there really are nearly one billion people living over those hills all capable of being as industrious as the 5.5 million on the side I was on.



This computer is used at Elcap Electronics in Hong Kong for automatic testing of watch chips.



Automatic wire bonding of watch modules at Elcap.

Arab Solar Energy

While in Britain we rapidly use our scant supplies of oil, energy conscious Arabs in the Middle East are investing millions of pounds in conserving their own. The future of solar energy looks very promising according to a report published by the political editor of Middle East Magazine. The arab world receives solar energy equivalent to an average of 275 watts per square meter. With a land area of over 11.5 million square kilometers and assuming that only one percent of this could be utilised for solar energy collection, a total of over 30 billion megawatts is potentially available. This could be converted to usable electricity at an efficiency of at least 10 per cent producing over 3 million MW or the equivalent of 3000 large power stations, generating 1000 MW each.

SOLERAS

Large scale solar projects are under way and include a 1.5 million dollar solar-powered heating complex for a massive air force school that is being built at Tabuk. It involves 4370 sq. m. of solar collectors and is being built by an American firm on subcontract. By far the biggest project undertaken to date is the SOLERAS programme with the USA. On the American side the Department of Energy has set up an agency, the Solar Energy Reasearch Institute (SERI), run by the Mid West Research Institute in Colorado.

Most effort so far has gone into building a 350 kW solar power station near Riyadh using photovoltaic cells to supply electricity to two villages. Plans are also under way to build a desalinating plant and contracts will shortly be awarded for this work. By introducing greenhouses into agriculture, Jordan has increased its production of cucumbers and tomatoes fivefold, especially in the winter. Perhaps the most spectacular innovation has been the construction of a solar powered emergency roadside telephone system. most major roads now have such phones and the director of the Jordan Telecommunication Corps is investigating the possibility of introducing solar powered television sets to remote areas (he obviously hasn't heard about Sinclair's Microvision).

ETI

TOMORROWS OFFICE?

Take a step into the future at the Design Centre. Ian Graham reports on time travel in the Haymarket.

If you find yourself within visiting distance of London's Haymarket between now and March 8th, it's worth popping into the Design Centre. They've collected together a handful of exhibits to show what the office of tommorrow might be like and they've called it 'Tomorrow's Office Today'.

The typewriter has been the office workhorse since granny was knee-high to an abacus, but two boxes of tricks on display may well see it off the the scrap heap - the Supertyper word processor and the Microwriter.

Box No. 1

The Supertyper FD85 word processor takes much of the repetition out of typing. When I visited the show, a demonstration of the FD85 had attracted a small crowd of exhibitionists (or do I mean exhibition goers?). Corrections or major alterations to typewritten text usually means retyping. Not so with the word processor. The letter that needs an alteration can be displayed on a screen above the keyboard. Then, at a touch of a button or two, words or letters can be added or deleted, columns can be shifted, lines ruled, paragraphs moved and so on ad miraculum. When the boss is happy with his words of wisdom, the processor can print out as many copies of them as he wants in his favourite type face.

If you have to send out a few dozen standard letters, the processor can print them out, adding a different name and address to each.

Box No. 2

If you're working away from the office and you want to make a few notes you could reach for the nearest scrap of paper or use one of those pocket cassette recorders. The scrap of paper stands a good chance of getting lost and the cassette recording has to be transcribed on your return to the office. How about giving a Microwriter a try?

Five Finger Excercise

The Microwriter is about the size of a large pocket calculator, but it only has six keys (five plus control). These can be used in various combinations to enter letters (upper and lower case), numerals, punctuation and all the other normal keyboard symbols. The text is displayed as you write it on a twelve character LED display, moving from right to left. There is also an optional TV display for sixteen line read-out and editing.

The control functions let the operator read or jump forwards or backwards and allow instant editing - the deletion or insertion of letters, words or even complete paragraphs.

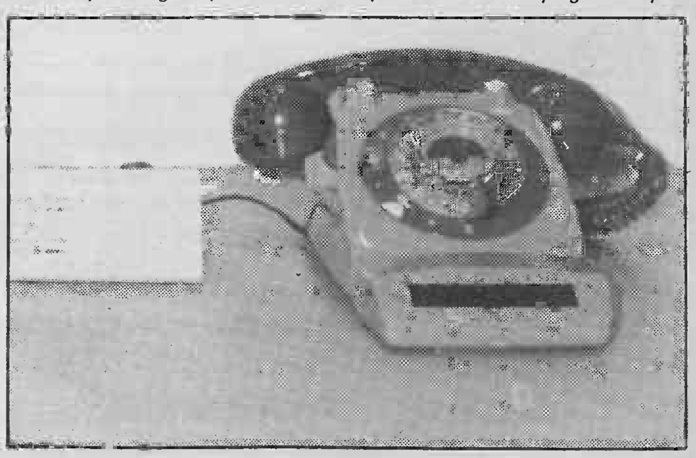
Microwriter's memory can hold 8,000 characters (about 1500 words) in RAM and further storage is possible by means of micro-cassette.

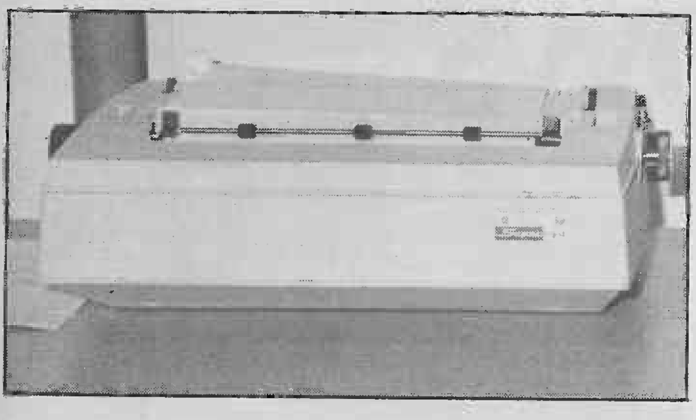
The contents of the memory can be printed out when you finally get round to calling in at the office or it can be transferred to micro-cassette for playback later.

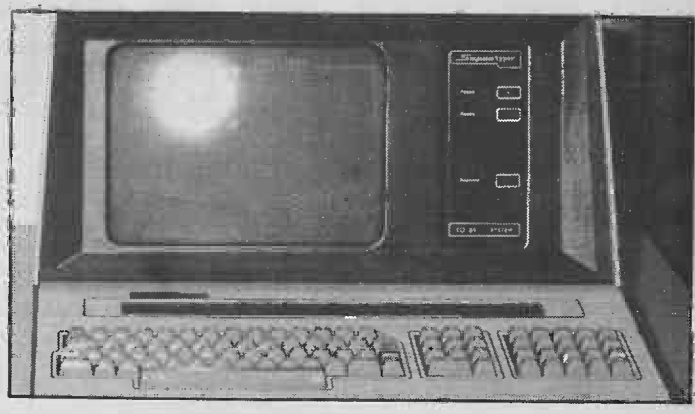
When the Microwriter is plugged into its automatic, high speed printer, your notes are transferred on to paper at up to ten times the speed of your best secretary. Each printer can handle between ten and fifteen Microwriters.

Now meet SUE, designed by Tom Stout and on show for the first time. Sue is an automatic draughtsman. The hardware includes a display screen, a plotter and a disc memory system. The drawing and the typewritten additions from the keyboard are shown on the display. When the drawing is satisfactory SUE can transfer the display on to paper. If your paper copy of the drawing is lost or damaged or needs further alterations, don't worry - the original is still stored on the disc memory.

When you hear that spine-chilling word — time — and have to toddle back to the office, the Logatel phone aid shows you who's been trying to call you.







The several-secretary-power Supertyper word processor system takes the repetition out of office paperwork.

Phone Bugs

Minster Automation would love to come and bug your phones. It's worthwhile, though. Their Tiger Cub telephone management and accounting system records the length, cost and distance of outgoing calls and the number of incoming calls that go unanswered. What good is that? Well, Tiger Cub can identify under-used extensions which you could do without. All the recorded information can be printed out if necessary.

Call Again

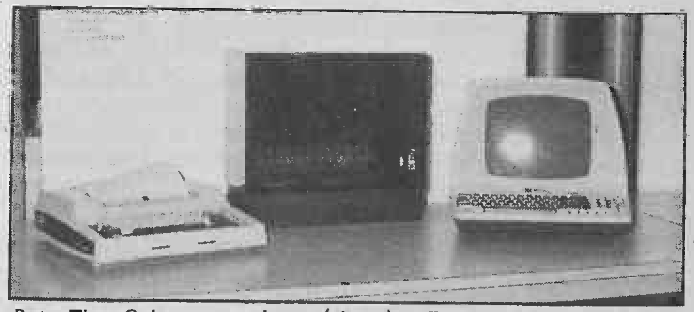
When you ring an extension on your internal phone system for the sixth time and no-one answers, the atmosphere can start to go a bit blue. Why waste all that time and effort dialling and hanging on the end of a deserted extension? Instead of regularly ringing back, why not just ring once and let the phone do the rest? If your system is fitted with the Logatel aid, you can ring once, wait for the tone that begins when the phone is left unanswered and then dial your own number. When the phantom phoner finally returns to his office, Logatel can display the numbers he has to ring back - yours among them. Logatel is manufactured by Feedback Ltd of Crowborough.

First Class Chips

The silicon chip has even got into the post room. Although your accounts department and your company records may be computerised à la space age technology, is your post room staffed by little old men in frock coats using a steam franking machine under one of Edison's original light bulbs? Mailtronic's postal weighing device is aimed at you. You put your letter or package on top and touch the finger sensitive keys for postal zone, class of post, registered post, etc and the chip in Mailtronic uses all the information to compute the correct postage. When there's an increase in postage, all is not lost. You just change the chip. ▶

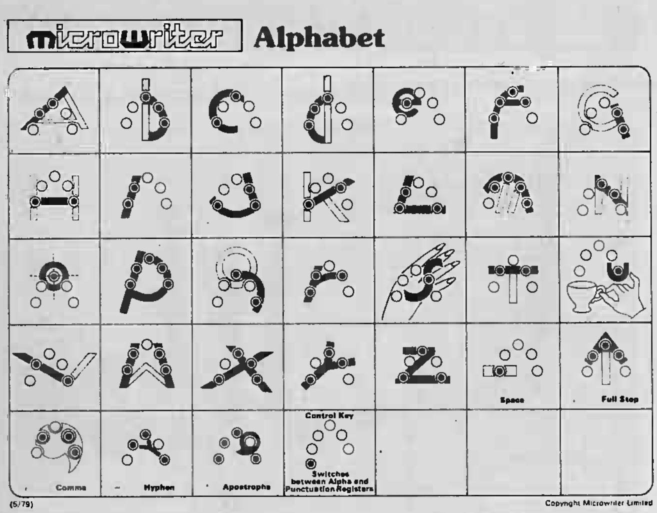
Push-button postal charges from Mailtronic.

16 lines at a time from Microwriter (above) can be displayed on TV.



Put a Tiger Cub on your phones (above) or Euro C your accounts (below).

Once you've mastered Microwriter's keyboard (right) you can happily tap in up to about 1500 words, without a tape recorder or reams of paper. Like everything else, mastering the keyboard alphabet (shown below) is just a matter of practice.



Instant Accounts

EuroC is a British-made desk-top microcomputer system designed to handle a company's entire accountancy procedures at low cost. It is capable of being operated by staff without any computing or accounting knowledge. Produced by Eurocalc Ltd of London, with hardware form Plessey, the system can store up to 12,000 transactions per month for 1,000 clients, so it is particularly suitable for small to medium sized companies. Each daily purchase or sale is entered via the keyboard on one of eight standard 'input' forms displayed on the screen. As each form is completed, the computer automatically updates the firm's records. Every month a set of management accounts can be printed out. Necessary reports can be printed out at any stage.

Paper Mill

If you have several thousand sheets of paper and you need to assemble sets of notes from them, it could take your Girl Friday hours to get all the sheets in the right order. The Watkiss all-purpose collator could do it for you and much quicker (it doesn't have to stop to powder its nose). It can handle a wide variety of material at the rate of 45,000 sheets per hour.

The Film Business

When you keep some of your records on microfiche, reading them can be a bit of a strain on the eyes. Take the load off your lenses with the Alpha microfiche reader from CAPS Microfilm of London. It will magnify the sheet of film to an easily readable size. The reader has a special grid index plate with a moveable pointer to select a particular page in seconds.

Seeing Is Believing

Many of these exhibits are demonstrated from time to time. You can try some of them out yourself. If you want to know when your favourite box of tricks is going to be demonstrated, give the Design Centre supervisor a ring on 01-839 8000 ext 309. **ETI**

Firm Finding

SUPERTYPER LTD
33 Lower Combe Street
Croydon CR0 1AA
Tel: 01-680 3477

MICROWRITER LTD
7 Old Park Lane
London W1Y 3LJ
Tel: 01-493 5633

TOM STOUT & PARTNERS
6 College Avenue
Formby
Merseyside L37 3JJ
Tel: 07048 74266

MINSTER AUTOMATION LTD
Stone Lane
Wimborne
Dorset BH21 1HD
Tel: 0202 880251

FEEDBACK LTD
Park Road
Crowborough
Sussex TN6 2QR
Tel: 08926 3322

MAILTRONIC LTD
300 Neasden Lane
London NW10 0AD
Tel: 01-450 7535

EURO-CALC LTD
55-56 High Holborn
London WC1
Tel: 01-405 3223

WATKISS AUTOMATION LTD
Holme Court
Biggleswade
Bedfordshire SG18 9ST
Tel: 0767 313853

CAPS MICROFILM LTD
7 Westmorland Road
London NW9 9RG
Tel: 01-204 4111

MCC Preamp (Jan)

We've had enquiries about the power supply for the Moving Coil Cartridge for use with the Audiophile System 4000 project. You don't have to build a separate supply. The MCC Preamp will run happily from the 15-0-15 volts System 4000 preamp supply (see ETI Oct 79).

If you're just building the MCC Preamp and not the complete system, then have a look at ETI October 1979 for details of the 15-0-15 supply.

Foiled Again

Carel Components have announced a new range of thermofoil heaters designed and made by Minco Products, the pioneers of etched foil heater technology.

The flexible, chemically etched foil heater elements are laminated between thin insulating layers to provide a uniform or profiled heating pattern. Applications? Temperatures of everything from inertial guidance systems to batteries, baths and ovens can all be controlled.

For a complete temperature control system, foil or wirewound sensors can be integrated with the heater element for more accurate temperature control. For further details contact Carel Components Ltd, 40-44 The Broadway, Wimbledon SW19.

World-beater

Hitachi's new HA12017 is claimed to be the world's lowest noise audio preamp IC. The Hitachi silicon surface process ensures that the exceptionally low noise characteristic is reliably repeatable in mass production.

So you want to see some figures. Under standard pick-up conditions, a S/N ratio of 82.6 dB is achieved, with an equivalent input noise of just 0.185 uV. Moreover, the IC has less than 0.002% THD over the audio band (20 Hz to 20 kHz) at an output level of 10 V rms (under RIAA conditions). The SIL package provides maximum isolation between stages.

If you're just dying to design a preamp round the HA12017 you can get hold of one for £1.57 from Ambit International, 200 North Service Road, Brentwood, Essex CM14 4SG.

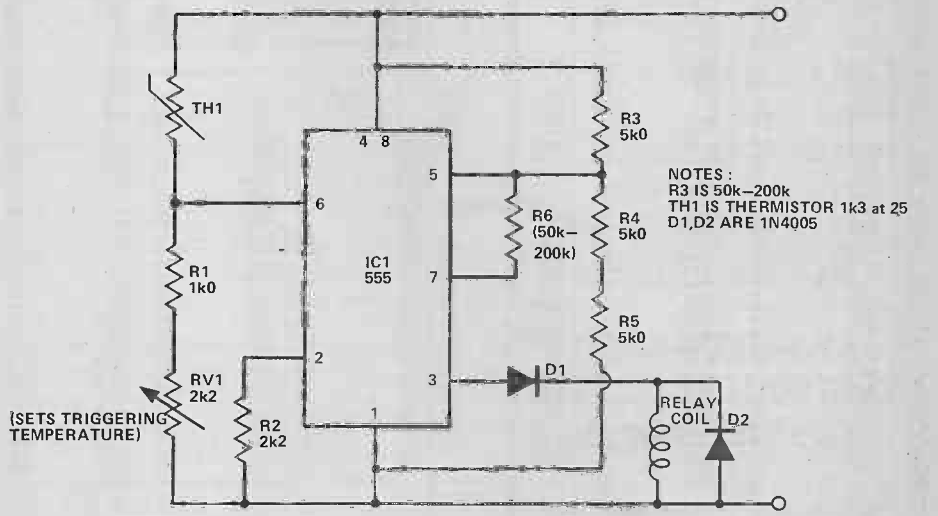
TECH TIPS

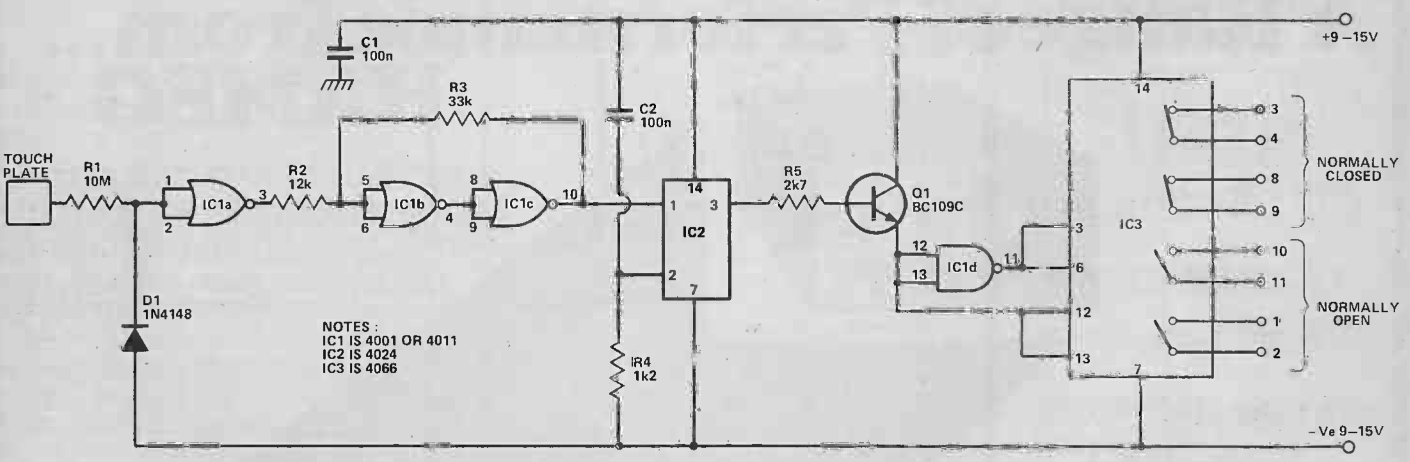
Boat Heater Thermostat

B. Kongstad

When the thermistor R1 senses it is time to start the heater it is essential that the relay pulls distinctly even if temperature falls slowly. The heater must be on till temperature has risen by at least 2 C, otherwise it has to start and stop too often. The desired Schmitt action is achieved in the following way. When temperature falls the resistance of the thermistor increases and the comparator at pin 6 triggers the flip-flop. Then pin 3 goes high and pulls the relay. At the same time pin 7 goes low. Resistor R6 shunts the lower part of the 5-5-5 k voltage divider and this helps the comparator to give a definite trigger for the flip-flop.

If the thermistor is replaced by an LDR the trigger action will take place when it is sufficiently dark. By this means a riding light can be lit at dusk when at anchor and the light turns off at dawn. But don't use 50 Hz incandescent or fluorescent light when setting the sensitivity. Your eye will not sense the flickering but the LDR does.





One Contact Touch Switch

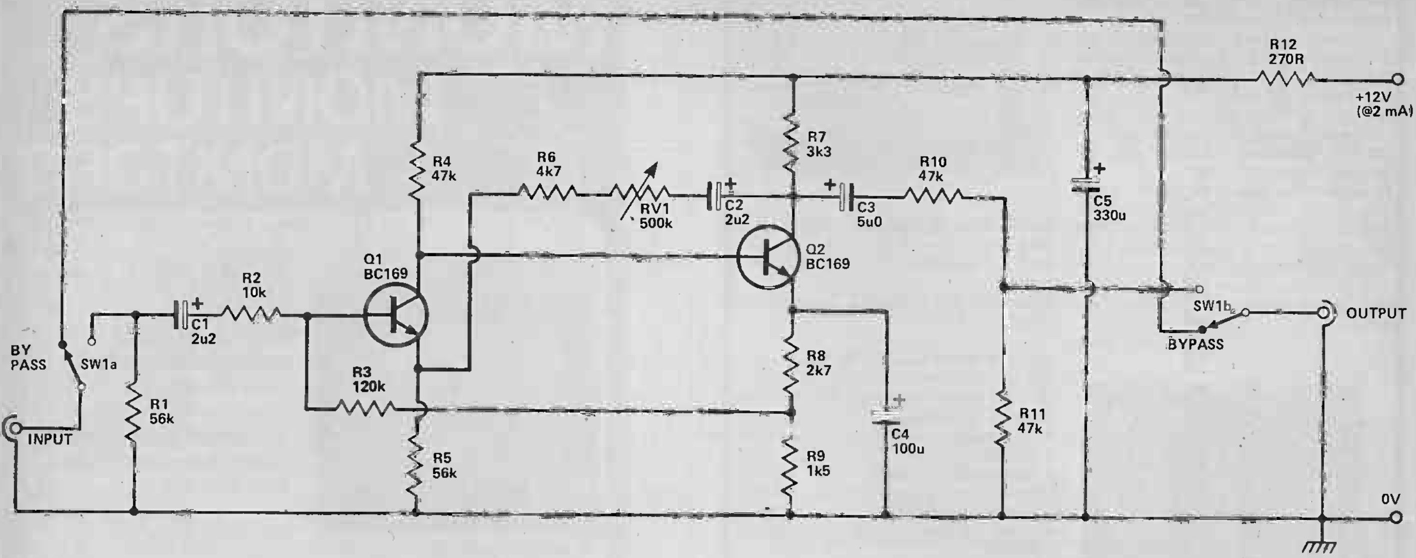
G.N. Durant

The switch is operated by stray mains hum, connected to the touch plate when briefly touched. The hum is coupled to the input of IC1a (used as an inverter) via R1 (a low pass filter). The output of IC1a is not sufficient to operate the final stage, so it goes through a Schmitt trigger (IC1b,c). Once the trigger output starts to change, R3 provides the trigger for a rapid change.

IC2 is a seven stage ripple counter. Q1 is driven from the output of the seventh stage via R5 (current limiter resistor). C2 and R4 reset IC2 at switch-on so the outputs are all low and the switching transistor is off. When the touch-plate is touched, IC2 will receive a 50 Hz signal. At pin 3, the logic state changes every 64 pulses, switching Q1 on and off. The plate is touched until the desired state is obtained and then released.

Q1 sends a pulse through to IC3, a solid state CMOS switch. This can be fed via an inverter if desired. The switch must not be used at more than its supply voltage - up to 15 V. The 'off' switch resistance is about 10^{13} ohms and the 'on' resistance is about 80 ohms at 15 V V_{DD} (at 9 V V_{DD} it is 120 ohms99

Tech-Tips is an ideas forum and is not aimed at the beginner. We regret we cannot answer queries on these items.
ETI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for. Drawings should be as clear as possible and the text should preferably be typed. Circuits must not be subject to copyright. Items for consideration should be sent to ETI TECH–TIPS, Electronics Today International, 145 Charing Cross Road, London WC2H 0EE.



Transcendent 2000 Preamp

R.N. Johnson

If this preamp is connected between the External VCF Audio Input socket and some musical instrument such as a guitar, then the output from the synthesiser will consist of the guitar sound modified by the synthesiser's VCF, mixed with the normal output of the synthesiser. The preamp is necessary because the VCF requires about 1 V to work, but most guitars produce only 10-20 mV. The voltage gain needed is about 36 dB. Most other musical instruments should also work as long as they have a pick-up which produces about 10 mV or more (even a microphone works and produces some pretty weird noises). The level controls of the synthesiser and the preamp can be used to determine the mixture of synth/guitar in the output.

The circuit itself is suitable for low or high impedance microphones/guitars and RV1 varies the gain from about 10-36 dB. The power supply of the synthesiser can be used and the preamp will easily fit inside the cabinet of the synthesiser (near socket SK6 but away from the mains leads). The switch is provided to bypass the preamp if necessary.

Magnetic Light Dimmer

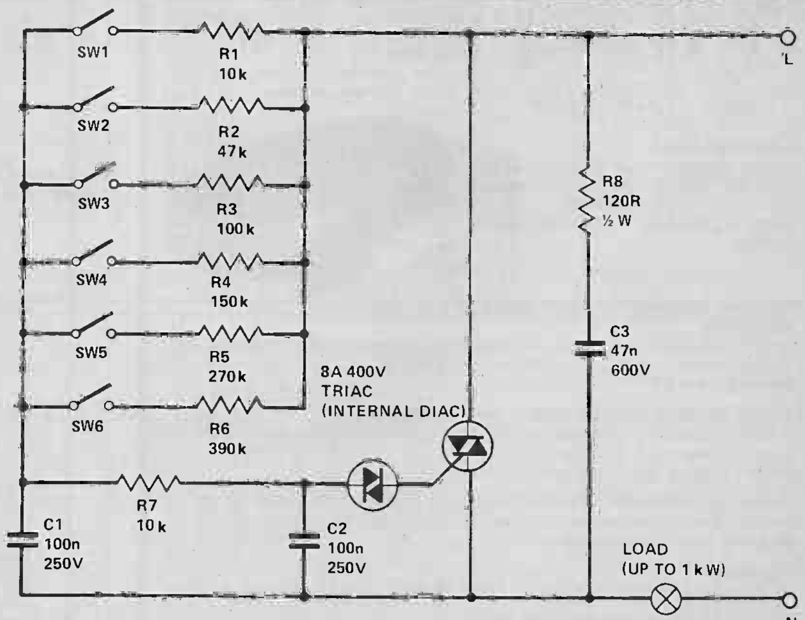
T. Hopkins

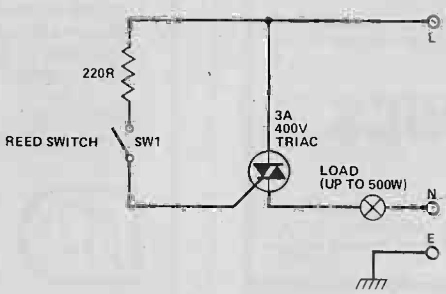
A partial solution to the problem of leaving lighting on unnecessarily is to have a resettable timer in place of a switch. However, The choice of delay is difficult, particularly when the room may be used continuously.

Ideally, it should be impossible to leave the room without turning out the light. One solution, shown in Fig. 1 is to build the circuit into a wall box and carry a small magnet on a keyring. When the magnet is placed over the reed switch, the lights are turned on and, if the circuit is mounted on a steel front panel, the magnet will stay in place for as ling as is required.

The magnetic dimmer shown in Fig. 2 allows a choice of six different light levels depending on which reed switch is operated. The resistor values shown were chosen to suit the available triac. Other triacs may require changes to some of these values.

The reed switches used measured approximately 1.125" and were mounted on a piece of tinplate with epoxy resin (Fig. 3). The front was then covered with a thin layer of plastic. A magnet of ½" diameter was used to operate the dimmer.



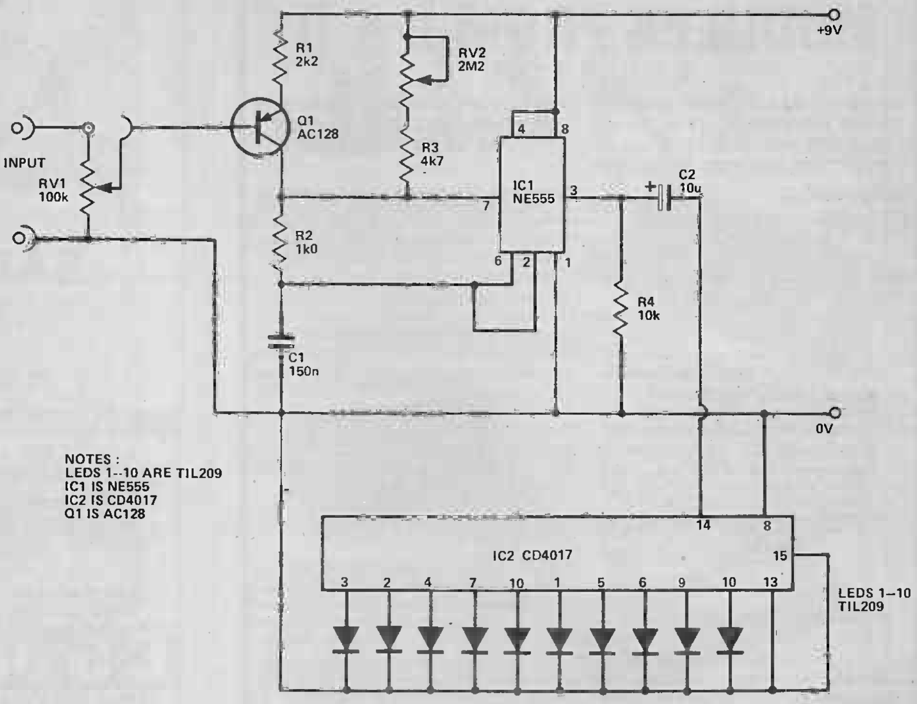


Audio Display
C.S. Histed

This circuit is a novel LED display, which when plugged into your hi-fi will send a dot of light zooming around a ring of LEDs at different speeds, depending on the music. The input signal from your hi-fi is fed into a voltage controlled oscillator (IC1), which then sends its variable length pulses to the clock input of a 4017.

This causes each LED in turn to be briefly lit and, because the clock input changes, the time taken for the dot of light to move along the LEDs varies in time with the music. The best visual output is achieved if the LEDs are arranged in a circle of about 1½" to 2" in diameter.

The input voltage can be adjusted by the 100k preset and the normal speed of the leds can be adjusted as desired using the 2M2 preset. The 4017 is able to drive the LEDs directly and no current limiting resistors are needed.

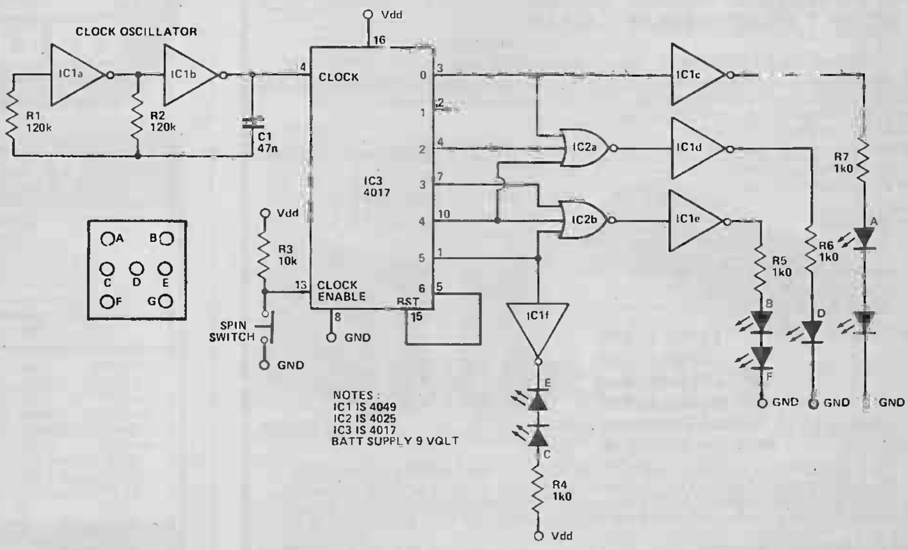


LOC	CODE	KEY	15	61 1	SBR 1	32	71	RST
			16	32 3	STO 3	33	00	0
00	34 6	SUM 6	17	33 1	RCL 1	34	81	R/S
01	33 6	RCL 6	18	22	x t	35	71	RST
02	35	Yx	19	33 2	RCL 2	36	86 0	2nd LBL 0
03	30	2nd	20	76	2nd x t	37	55	X
04	85	=	21	22	x t	38	01	I
05	−35	INV Yx	22	33 3	RCL 3	39	00	0
06	05	5	23	76	2nd x t	40	85	=
07	85	=	24	51 5	GTO 5	41	32 5	STO 5
08	−49	INV 2nd INT	25	333 7	RCL 7	42	49	2nd INT
09	36	2nd PAUSE	26	39 4	2nd PRD 4	43	−61	INV SBR
10	34 6	SUM 6	27	51 6	GTO 6	44	86 1	2nd LBL 1
11	61 0	SBR 0	28	86 5	2nd LBL 5	45	35 5	RCL 5
12	32 1	STO 1	29	39 4	2nd PRD 4	46	−49	INV 2nd INT
13	61 1	SBR 1	30	86 6	2nd LBL 6	47	61 0	SBR 0
14	32 2	STO 2	31	56	2nd DSZ	48	−61	INV SBR

Electronic Travelling Dice
M.G. Argent

The heart of the unit is the 4017 divide by n counter, IC3. The outputs in turn give a logic 1 level (+9 V) with each clock pulse. To divide by six as required by a dice, the seventh count (output six, confusingly) is connected to the reset (RST) input. This resets all outputs to logic 0 and the count starts all over again ad infinitum.

So long as the clock enable input is connected via the 10k resistor to V_{DD}, the count carries on as normal. If it is connected to 0 V the counter stops and remains in the state it was in at that time. This is achieved by a normally-open push switch which acts as the SPIN switch. When the switch is operated it stops the counter.



ANALOGUE SWITCHING

Tim Orr, ETI's man of a thousand and one circuits, presents another of his astounding features. This time his subject is analogue signals. How to switch and with what.

There are many electronic functions that need to be able to turn off and on analogue signals just as they would be by conventional mechanical switches. The relay used to perform that task but it has almost entirely been superceded by electronic analogue switches. The relay is still in use but it is now generally used to handle heavy voltages and currents. A small version of the relay, the reed relay (Fig. 1), still has many advantages that have not yet been overcome by electronic technology, these being very low contact resistance, virtually zero noise generation and distortion and almost total isolation between the control and switching section.

These features make the reed relay an ideal switch for high quality audio signal routing. The device drawbacks are, that it is physically large, heavy, expensive, consumes considerable power, is susceptible to vibrations and generates interference.

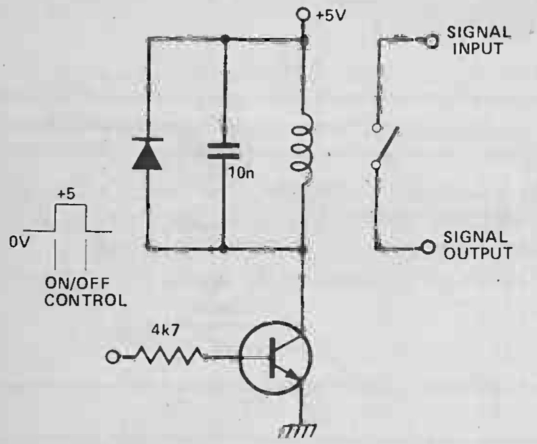


Fig.1. A typical reed relay.

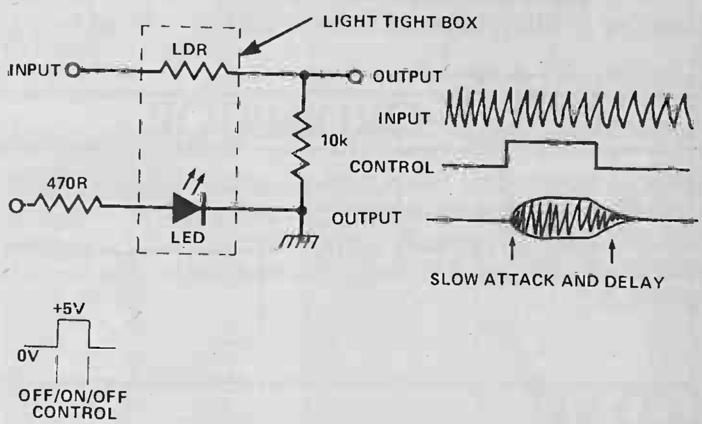


Fig.2. A light dependent resistor can be used to make an analogue switch.

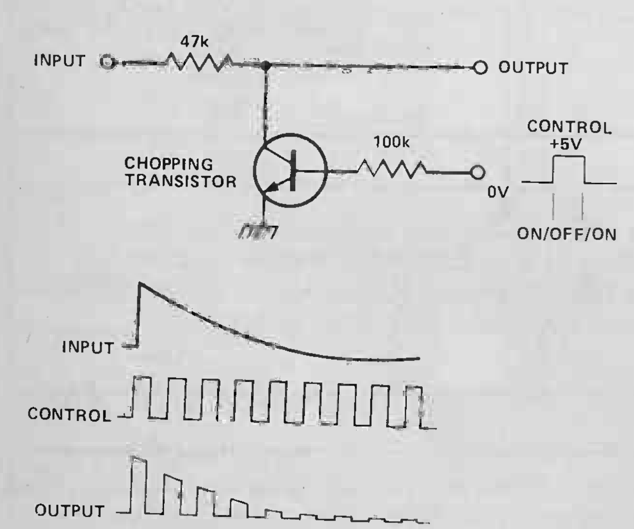


Fig.3. A transistor chopper, often used to turn off an analogue signal.

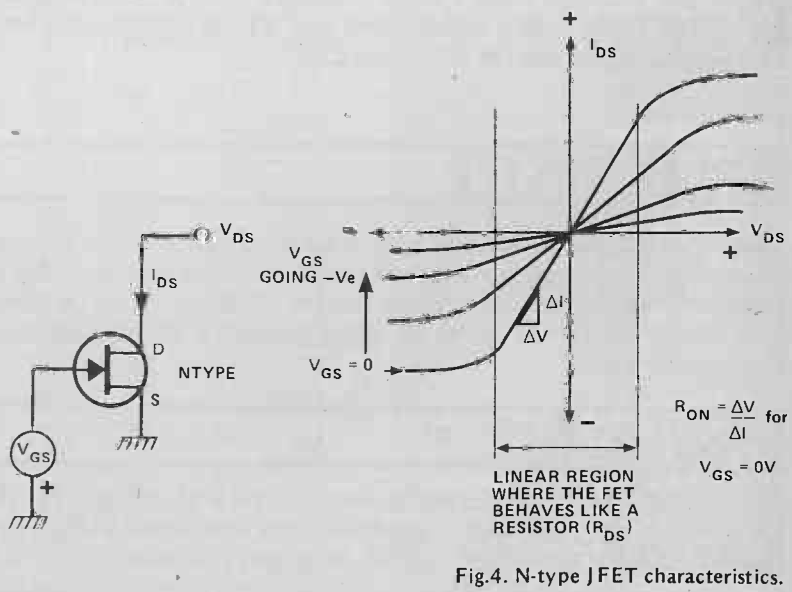


Fig.4. N-type JFET characteristics.

Dependable Resistor

A simple electronic analogue switch can be made from a light dependent resistor (Fig. 2). When light from the LED shines onto the LDR, the resistance drops from a few meghoms to a few hundred ohms. The device generates very little distortion and noise and is thus suitable for routing audio signals.

The response time of the LDR is very slow, sometimes taking 100 mS to switch, it is both relatively expensive and large and it consumes a large LED current. The transistor chopper, (Fig. 3), is often used as a simple device to turn OFF an analogue signal. This is done by turning ON the transistor and driving it hard into saturation, which in turn shorts the signal to ground. The transistor chopper is often used in organ and electronic piano circuits to produce audio tones by chopping the envelope waveforms with square-waves generated by a tone divider network. It is not easy to use the bipolar transistor as a floating switch, as most applications require but the JFET lends itself readily to this purpose. The characteristics of a JFET (Fig. 4) show that in the region where the curves pass through the origin the device is behaving very much like a voltage controlled resistor.

When V_{GS} is O V, the curve passing through the origin is at its steepest, the FET having at this point its lowest Drain Source resistance (R_{DS}), known as R_{ON}. This is typically a few hundred ohms. However, as V_{GS} is increased negatively for an N type FET, the slope resistance increases until the pinch off voltage is exceeded. The **FET** is then 'PINCHED OFF' and the effective R_{DS} is typically a few hundred meghoms. The JFET can be used as a variable resistance device changing from a few hundred ohms to a few hundred meghoms in times much shorter than a micro-second. This, combined with smallness of size, low cost, low power consumption, a very high impedance at its control input and the ability of the drain and source to float, makes the JFET an ideal analogue switch.

The series switch (Fig. 5) passes the signal with very little attenuation when the FET is on and stops the signal when the FET is off. There is a small stray capacitance (a few picofarads), between the drain and source and this causes high frequency breakthrough when the switch is off.

The shunt mode shorts the signal to ground when the FET is turned on (switch off). The attenuation in this mode is R/R_{ON} which requires large values of R to get a large attenuation. To get the advantages of both types of arrangement, a series/shunt switch can be constructed using two FETs (Fig. 6).

When a FET switch is rapidly turned on there is often a click generated, partly as capacitive breakthrough from the gate and partly as an abrupt amplitude modulation of the analogue signal. This can be greatly reduced by band limiting the gate voltage (C2, R3) and by removing any DC component from the analogue signal (Fig. 7). ▶

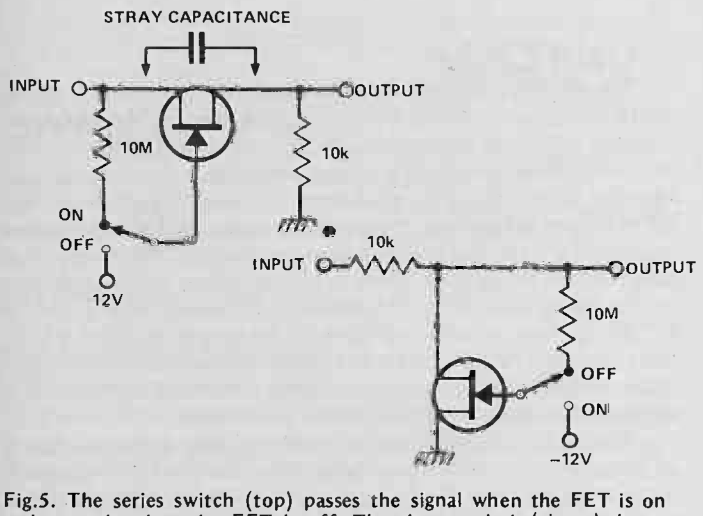


Fig.5. The series switch (top) passes the signal when the FET is on and stops it when the FET is off. The shunt switch (above) shorts the signal to ground when the FET is turned on.

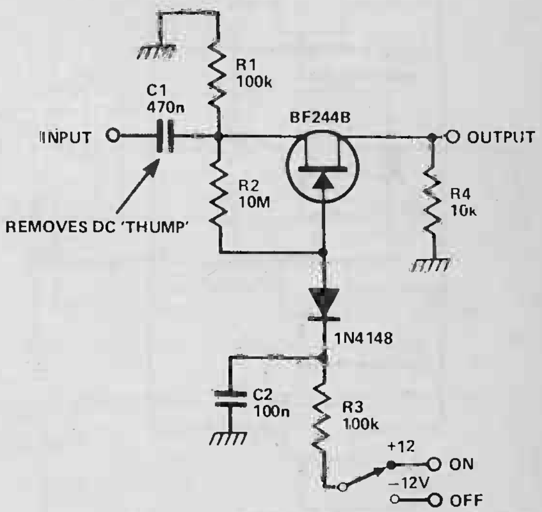


Fig.7. A silent series switch for audio applications.

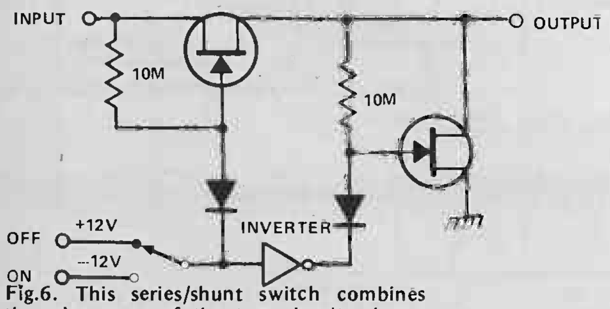


Fig.6. This series/shunt switch combines the advantages of the two circuits shown above.

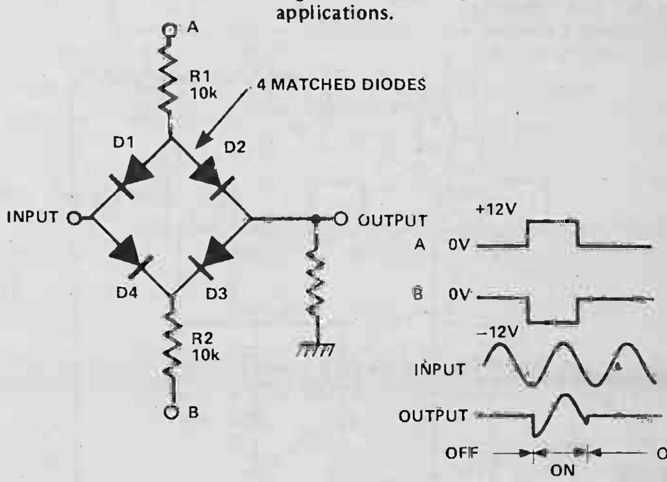
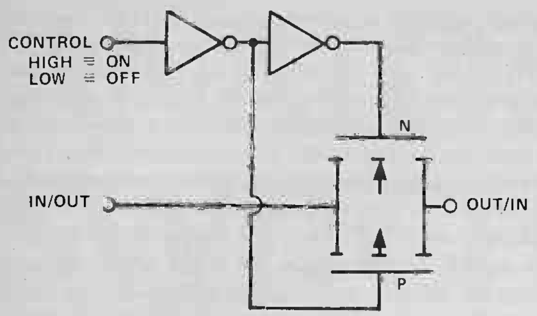


Fig.8. The diode ring switch can operate at very fast speeds.



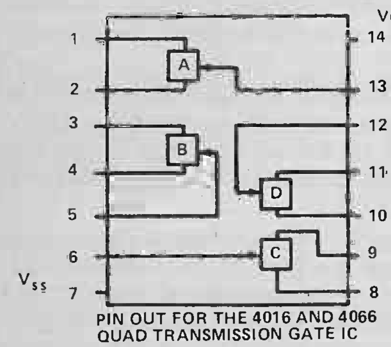
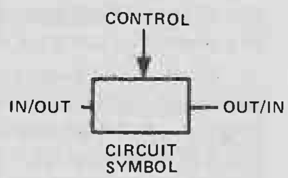


Fig.9a. The CMOS analogue transmission gate (top) with 4016 and 4066 pin-outs (left).



* THE INPUT VOLTAGE MUST NOT EXCEED THE POWER SUPPLY VOLTAGE LEVELS OF THE 4016

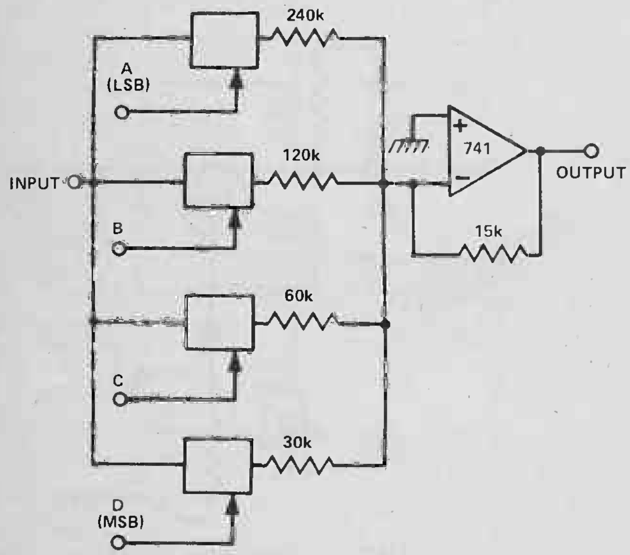


Fig.9b. The 4016 can be used to construct a 4-bit multiplying DAC.

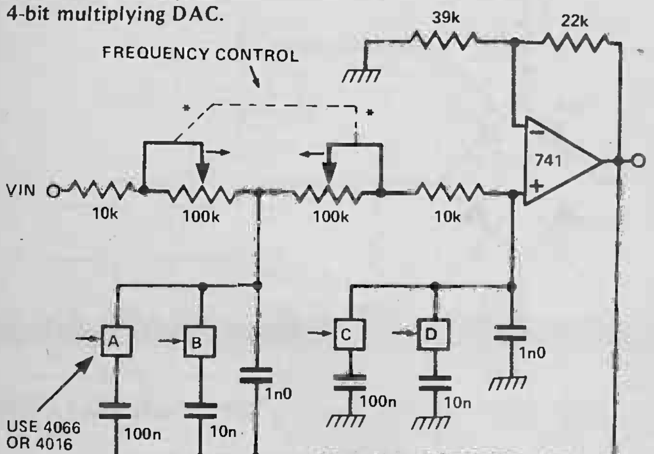


Fig.10a. A switched-range low pass filter.

Ring An Ode

The diode ring switch (Fig. 8) is very simple in concept and can be operated at very fast speeds. When A and B are both at O V no signal can pass through the ring switch because there is always a reverse biased diode in the route. When A is +ve and B −ve (both with same amplitude), then the 4 diodes are all conducting. Any voltage at the input of this bridge will cause the same voltage to appear at the output.

Switch In Packs

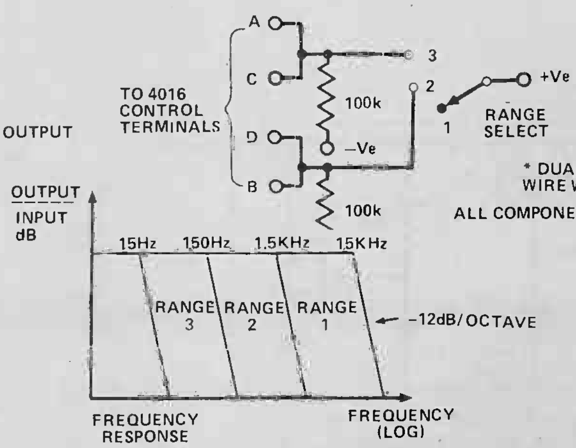
It is now possible to buy a wide variety of integrated circuits that perform analogue switch functions. There are perhaps over a hundred different types available, many of which are JFET configurations. These are usually rather expensive and I shall only discuss the more common (and relatively inexpensive) CMOS devices. The CMOS analogue transmission gate (Fig. 9) is a bidirectional switch element, having a relatively low on resistance of a few hundred ohms and a high off resistance.

The input and output terminals can float anywhere in between the power supply rails and the control input has a high input impedance. A high (logic 1) connected to the control input turns the switch on. To avoid distortion problems, the supply voltage should be kept as high as possible (10 to 15 V) and the load on the output above 10k. There are two commonly available analogue gate IC's, the 4016 and the 4066. These are both quad devices with the same pin-out, the 4066 has the lower R_{ON} resistance, typically about 100R.

Gain Code

The 4016 is a very versatile electronic building block. It can be used to construct a simple multiplying DAC (Fig. 9). The gain of the amplifier is linearly proportional to the size of the 4 bit digital code and can be programmed to give any one of sixteen gains. A low pass filter (Fig. 10) can have its break frequency programmed by switching in timing capacitors. When all the gates are OFF, the timing capacitors are 1n. The low pass filter can then be tuned by the dual gang pot over the range 1.5 kHz to 15 kHz. When gates B and D are on, the timing capacitor is 11n and so the frequency range is 150 Hz to 1.5 kHz. Also, when A and C are on, the timing capacitor is 101n and so the filter range is 15 Hz to 150 Hz. It is possible to build quite elaborate filter structures, fourth or even sixth order designs and to make them programmable with analogue switches.

The analogue switch can be used to modify the parameters of an integrator (Fig. 11). The integrator slew rate can be programmed by a combination of RA,B,C and the output may be reset to zero using gate D, which shorts out the timing capacitor.



* DUAL GANG 100k LIN WIRE WOUND POTS

ALL COMPONENTS 2% TOLERANCE

Fig.10b. The low pass filter frequency response.