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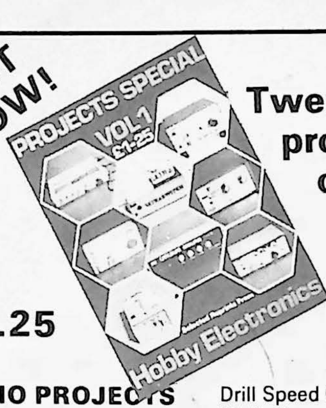

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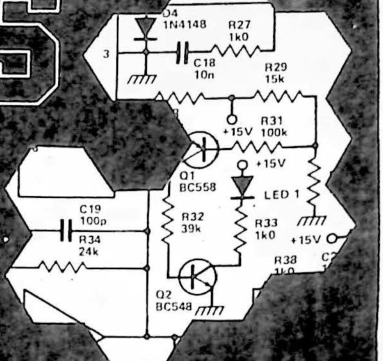

Vol. 1 No. 1
SUMMER 1980

ELECTRONICS DIGEST SUMMER 1980 collects ETI CIRCUITS from the last two years. The editorial concept is the same as our popular ETI CIRCUITS BOOK No. 1, published in 1976, and ETI CIRCUITS BOOK No. 2, published in 1978. The basic idea behind this issue is to provide quick inspiration for designers wanting a novel approach to circuit design. The circuits are taken from Tech Tips published in ETI; designers will find it much easier to use this classified guide rather than searching through back issues trying to remember where they saw a particular circuit.

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THIS ISSUE IS AN IDEAS DIRECTORY FOR EXPERIMENTERS AND IS NOT MEANT FOR THE BEGINNER. WE REGRET WE CANNOT ANSWER QUERIES ON ANY OF THESE CIRCUITS.

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ELECTRONICS DIGEST is a new quarterly from the publishers of Electronics Today International, Hobby Electronics, and Computing Today. The bulk of the editorial will be taken from our monthly magazines according to the particular theme of the issue. The Autumn issue will look at the top projects in ETI. The Spring issue will be a compilation of projects from Hobby Electronics. Summer and Winter issues will look at different aspects of electronics.

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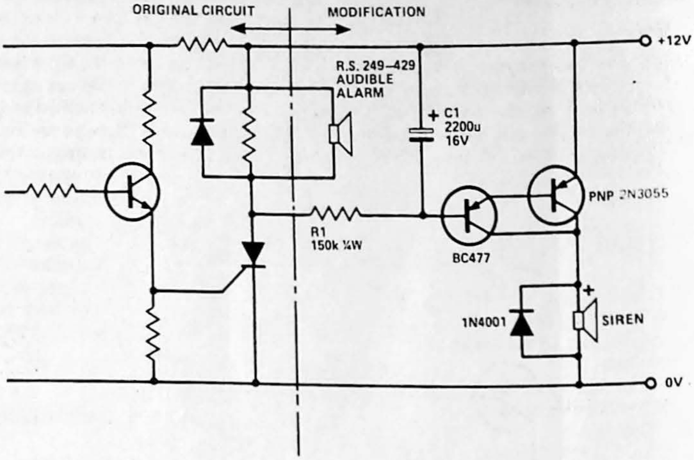
MISCELLANEOUS

ALARMS

Less Alarming

J. Master.

The April, 1977 ETI Burglar Alarm works well enough but I thought you may be interested in this modification which enables a low power audible alarm to sound 40 seconds before the main alarm. The main advantage is that the alarm can be set when one is retiring to bed at night and if the alarm is inadvertently triggered at least there is enough time to turn the unit off before the main alarm sounds. This also applies when people come home with the alarm set, no front door by-pass switch is required and accidental setting off of the alarm is avoided. The delay time can be varied by altering R1 and C1.

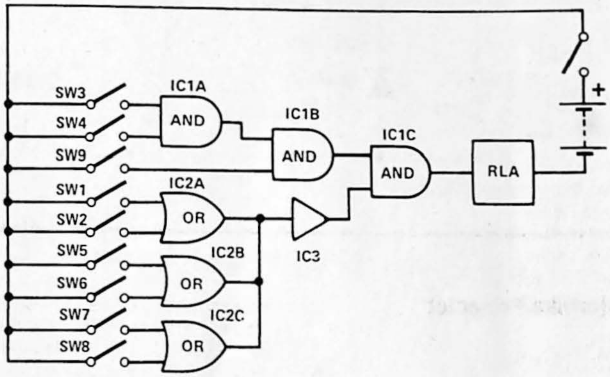


Selective Alarm Controller

S. Butler.

This circuit provides greater versatility than the simple "in-series" switches mode of alarm, but is still cheap and easy to build.

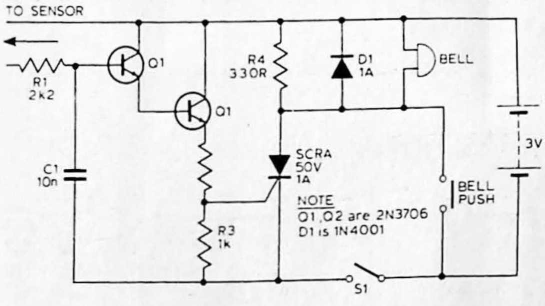
When SW3 and 4 are closed, the output of the AND gate goes high. This high is fed to the second AND gate only when SW9 is pressed. The output of this gate goes high and providing no other switches are pressed, it will operate the relay: if any other switches are pressed, the OR gives an output to the inverter and cuts off the power to the AND gate, preventing the coil being energised.



Rain Alarm/Door Bell

S. Lamb

With S1 open the circuit functions as a doorbell. With S1 closed, rain falling on the sensor will turn on Q1, Q2 and the thyristor will trigger activating the bell. R4 provides the holding for the thyristor while D1 prevents any damage to the thyristor from back EMF in the bell coil. The sensor is made from 3 square inches of copper-clad board with a razor cut down the centre. C1 prevents any mains pickup in the sensor leads.

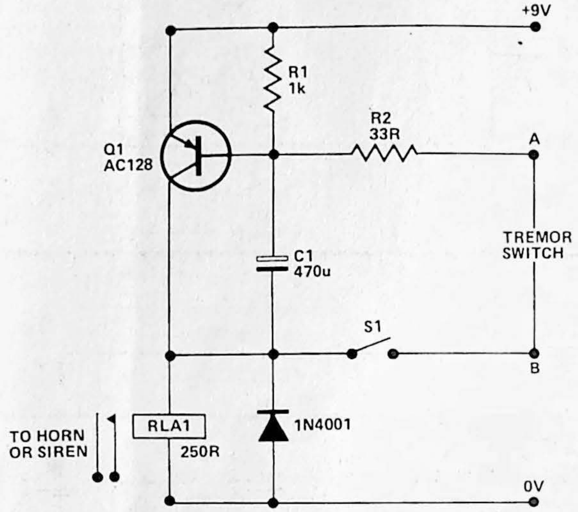


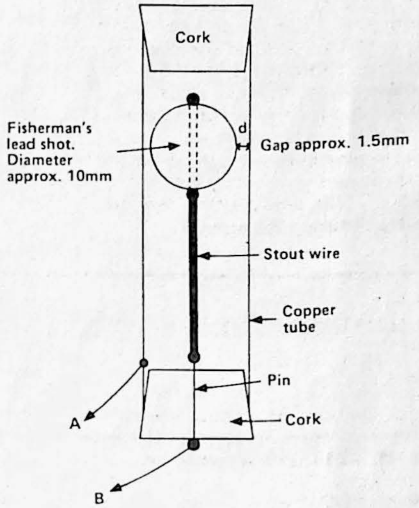
Motorbike Alarm

P. Mann

When the motorcycle is tampered with its horn (better to have a siren independent of the motorcycle's battery) blares for ten seconds before the device is reset. Battery drain is approximately 20-30μA, so low that no on-off switch has been incorporated. SW1 isolates the tremor switch for riding. R2 prevents high current flowing on discharge of the capacitor which was found to weld the lead shot to the copper tube. Design of the tremor switch I think is up to the constructor and the bits and pieces he or she has available. Sensitivity lies solely on the construction of this, (weight of shot, gap and length of wire).

My siren consists of a NE555 design from ETI Jan '77 and an LM380 power amp.





TREMOR SWITCH

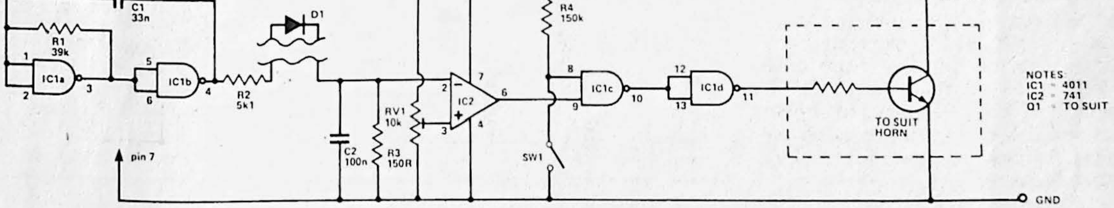
Motorbike Protector

P. M. Jessop

Many of the accessories fitted to a motorbike can be quite valuable and easily removed by a thief. On a motorbike, a top-box may be lockable but can easily be removed complete.

This circuit will protect such accessories. Diode D1 is mounted *inside* the box or other accessory and two leads are run to the rest of the circuit which should be mounted near to the horn. Gates IC1a and IC1b form an oscillator which charges C2 through D1 and R2. The voltage on C2 (normally nearly V_{cc}) is fed to comparator IC2. If D1 is removed from circuit by cutting the leads, C2 discharges through R3 and the comparator is triggered. However, if an enterprising thief tries to bypass the alarm by shorting the leads, the voltage on C2 falls to about $\frac{1}{2}V_{cc}$ and again the comparator is triggered.

SW1 which should be well concealed, disables the alarm which will otherwise sound the horn if triggered.



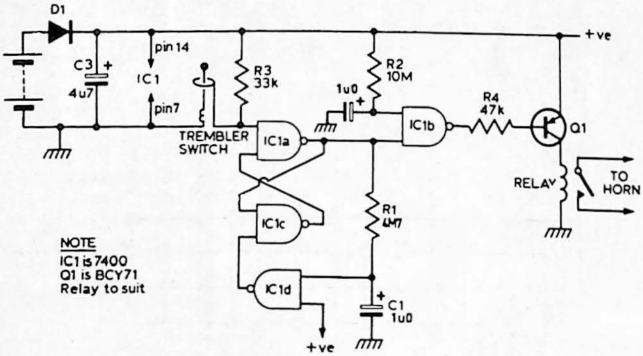
ALARMS

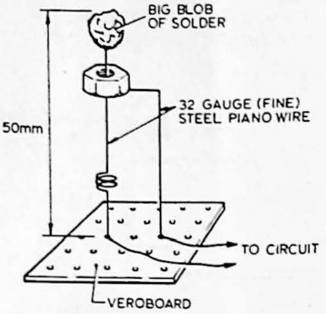
Motorcycle Burglar Alarm

N. Hone

Currently available motorcycle alarms are either very expensive or ineffective. This circuit provides protection against theft, or tampering with the machine.

The alarm, a cross coupled latch is activated by a trembler switch (whose construction is shown), which will sound the alarm for 5 seconds before resetting. As the device is very sensitive, there is a 10 second delay (set by R2, C2) which gives enough time for the trembler switch to stop oscillating, and the keys to be removed. D1 and C3 prevent the supply to the circuit dropping when horn draws a high current and pulls the battery voltage down.





Speed Alarm

D. Ian

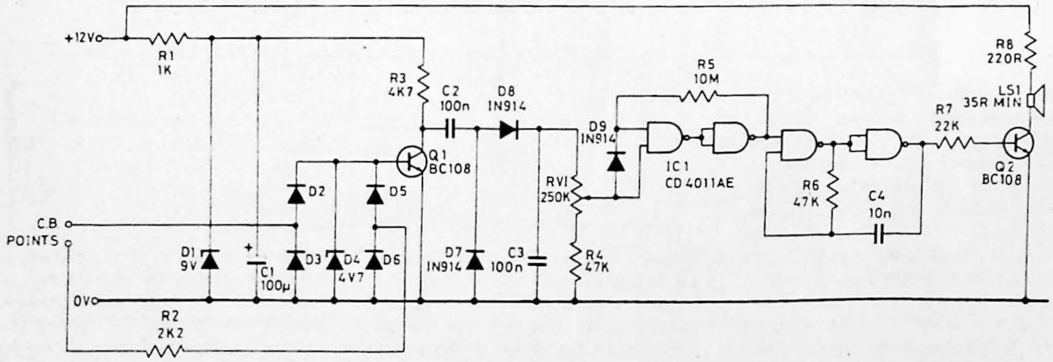
It is all too easy, during a long journey on a motorway, to allow one's speed to gradually creep beyond that point which the boys in blue take an unwelcome interest; this alarm gives an audible nudge whenever you drift over a pre-set speed.

Pulses from the distributor points (due to the ignition coil up to 400V may be developed as the points open) are passed through a current limiting resistor, rectified and clipped at 4V7. Via Q1 and the diode pump a DC voltage, which is proportional to engine revs, is presented to RV1; the sharp transfer characteristic of a CMOS gate, assisted by feedback, is used to enable the oscillator formed by the remaining half of the 4011.

At the pre-set 'speed' (revs) a non-ignorable tone emits from the speaker, and disappears as soon as the speed drops by three or four mph.

Calibration of RV1 may be conducted with an accurate pulse generator remembering that, for a four stroke engine, frequency = revs per minute times the number of cylinders divided by 120; for a car with a specification of 17½ MPH per 1000 revs, in top gear, f = 133Hz at 70 MPH, 124Hz at 65 MPH (4000 RPM and 3714 RPM). The necessary frequency should be fed to Q1 and RV1 set so that the alarm is *just* off. Reliable switching occurs on the prototypes with a change of only 5Hz (150 RPM), ie less than 3 MPH for the above example.

Direct calibration 'on the road', while covering discrepancies due to tyre size, etc, will only be as good as the speedometer and obviously should be carried out by a passenger rather than the driver.

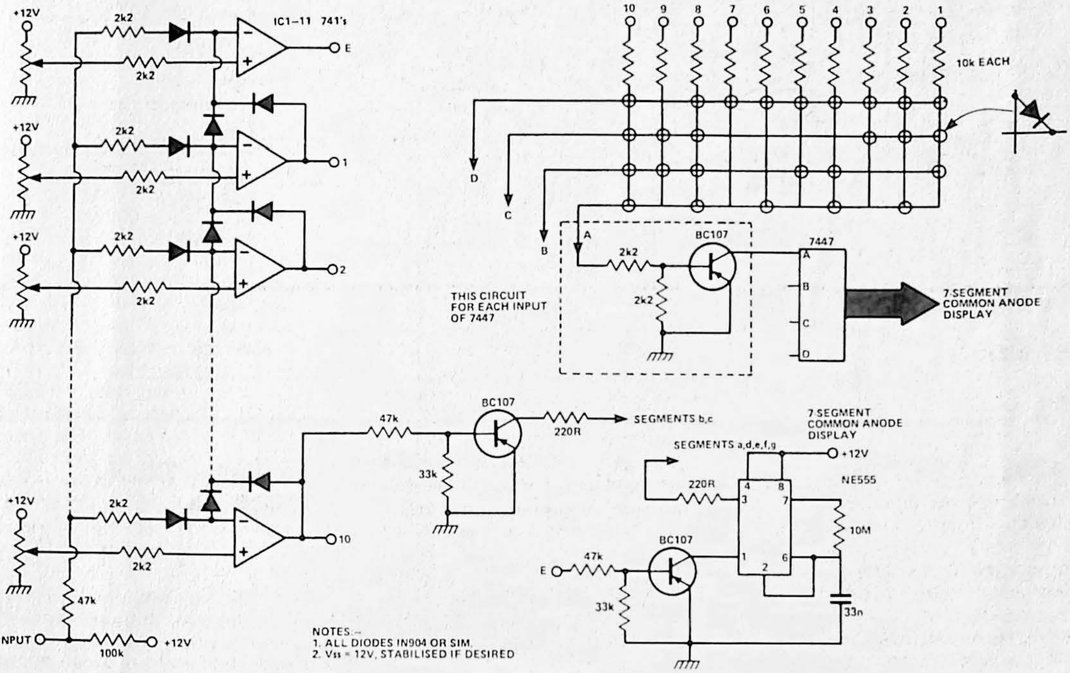


10 Gallon Digital Fuel Gauge

B. R. H. King

This circuit is based on the design published in ETI Circuits No 2, but has been extended to ten gallons without the need for the large number of diodes which would be required if the original circuit were used. Also incorporated is a flashing E when the tank is nearly empty.

The input is the voltage across the fuel-tank 'sender' which typically rises from zero at full tank, to about 5V when empty. As the voltage falls, the higher-numbered 741 comes on, extinguishing all the lower-numbered ones via the diode network. The outputs are fed to a decimal-to-BCD encoder (two pieces of veroboard with tracks at right-angles, with diodes sandwiched between). Each of the four outputs drives a BC107 to sink the inputs of a 7447 BCD-to-7 segment converter. This system is more economical in space and components than a discrete diode, decimal, 7 segment matrix. Output ten also provides drive to segments b and c of another display to give the figure one. This display is also used to show an E which is flashed by a 555 turned on by output from the E 741. A certain amount of 1rial-and-error is required to get values to suit individual cars, display types etc and the voltage divider at the input provides bias to compensate for the non-zero output of the 741's in their off-state. The circuit needs to be calibrated by filling the tank gallon gy gallon and adjusting the 10 k presets. The prototype works very satisfactorily.

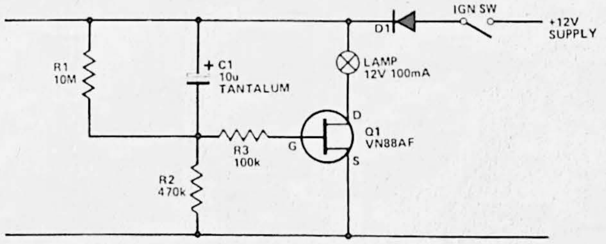


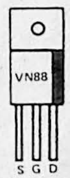
NOTES:–
1. ALL DIODES IN904 OR SIM.
2. Vss = 12V, STABILISED IF DESIRED

Seat Belt Indicator for Vehicles

S. Winder

As a reminder to put the seat belt on, a small opaque panel with the inscription "SEAT BELT" can be fitted to the dashboard with a lamp behind, which lights up for ten seconds after the ignition has been turned on. The new VMOS power FET can be used in a very simple circuit to achieve this. The current between source and drain is dependent upon the gate/source voltage. When the ignition key is turned the +12 volt supply is initially dropped across R2, since the voltage across a capacitor cannot change instantaneously (C1 is discharged by R1 when the supply is removed). As the capacitor charges up the gate potential of Q1 drops and the lamp extinguishes. The current drawn by the circuit falls to about 50 uA after a minute. The gate resistor R3 is provided to protect the zener diode which is between gate and source of Q1, the input resistance of Q1 is too high to be affected by this resistance normally.



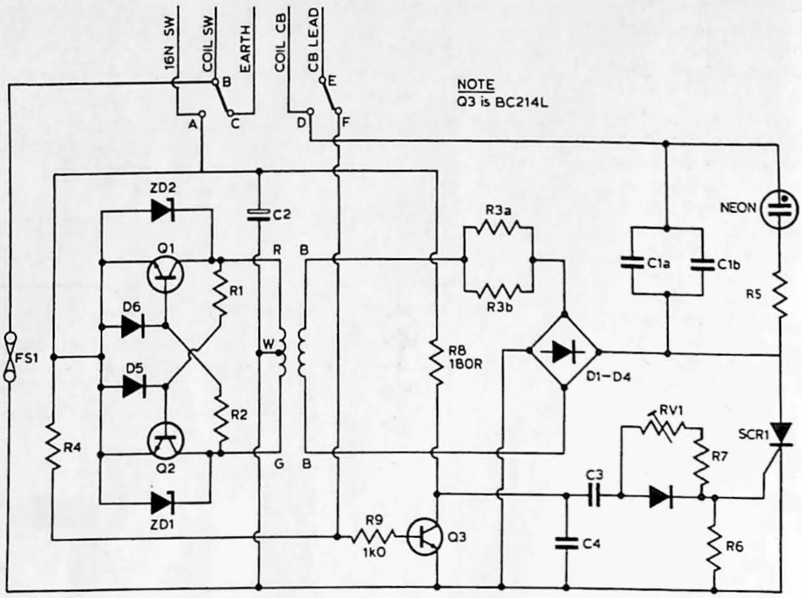


CDI for Positive Earth

R. Vivian

The CDI Mk II ignition published in the May 1978 issue has been designed for negative earth cars. Attempting to install it in positive earth vehicles by reversing the supply connections will lead to problems caused by SCR1 triggering as C3 is discharged (ie as the contact points close, and not as they open).

This modification provides a solution by discharging C3 through a transistor Q3 which conducts when the points open. Any general purpose PNP transistor capable of sinking 200mA (eg BC212, BC214L) will do.

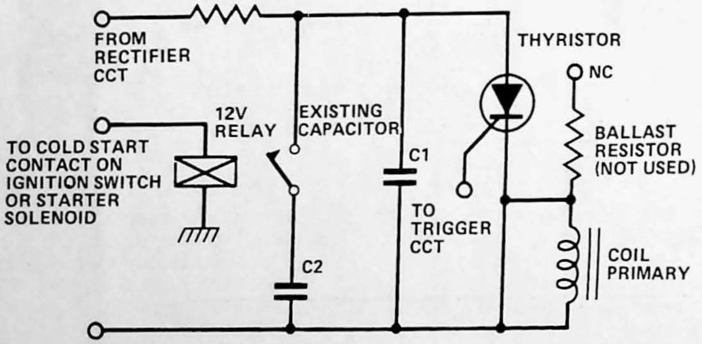


'Cold-start' For CD Units

T. Lyons

Many cars are fitted with cold-start coils, which operate at full current only on starting, then are fed via a ballast resistor. This resistor is normally discarded when CD ignition is fitted, and the coil is run at 'full power' all the time. It's a simple matter to arrange for the cold-start circuit to operate a relay inside the CD unit which switches in a second capacitor C2 across the main one, thus increasing the energy of the spark when the engine is starting. After starting, C2 is no longer in circuit and the main capacitor C1 alone supplies current to the coil, thus alleviating any charging problems with attendant loss of power at high revs.

RLA is any 12 volt relay, and C2 can have the same value as the existing capacitor C1, usually 470n or 1u0.



Car Warning Flasher System

S1a is fitted between the ignition supply and flasher unit and S1b between flasher warning lamp terminal and warning lamp so that with S1 in the *off* position the system is normal. When S1 is *on*, the flasher is supplied from an independent supply, so as to operate with the ignition off, and RL1 coil is connected to the flasher warning lamp terminal.

Now when the flasher switch is put in the LEFT position, the left hand lamps will flash and at the same time RL1 will be energised, so lighting the right hand lamps through RL1 contacts. The existing warning lamp will light under normal conditions but the lamp across RL1 coil will flash with the emergency system in use. D1 provides a path for the back e.m.f. to protect the contacts in the flasher unit.

The bulbs should be 12V, 2.2W types.

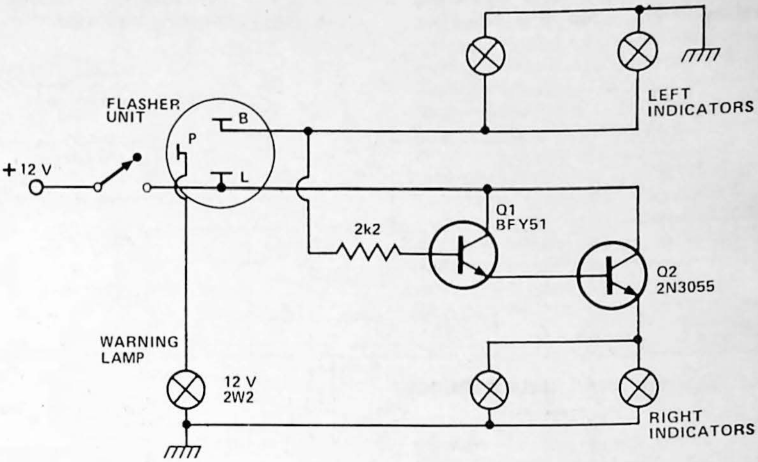
Hazard Warning Flasher

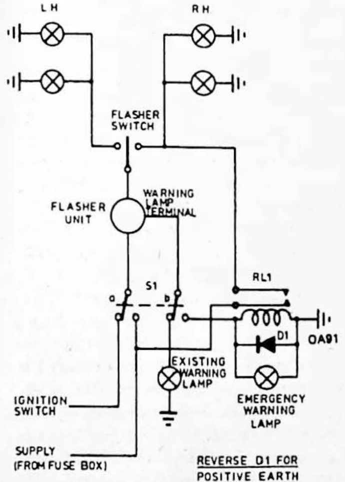
D. Warren

Hazard warning lights can be a life-saver in motor vehicles. But the high cost of commercial units prevents some people from fitting them. The circuit I have devised is both simple and inexpensive to install.

A flasher unit is used to operate the left hand indicators. At each flash a current of 5mA is supplied to the base of Q1, switching it on. The emitter now goes high switching on Q2 which connects the right hand indicators. If more lamps are to be lit (ie. when a trailer is being towed) a more powerful flasher unit is required. As Q2 carries the full current of the right hand indicators (3.5A to 5.25A) it must be mounted on a suitably large heatsink. This can be achieved by fitting the circuit in an aluminium case 4" x 3" x 1¼" and mounting Q2 directly using a mica shim and rubber bushes to isolate it from earth. The flasher unit should be mounted on the outside of the case for ease of replacement.

The circuit shown is for negative earth, but is easily adapted for positive earth vehicles.





REVERSE D1 FOR POSITIVE EARTH SYSTEMS.

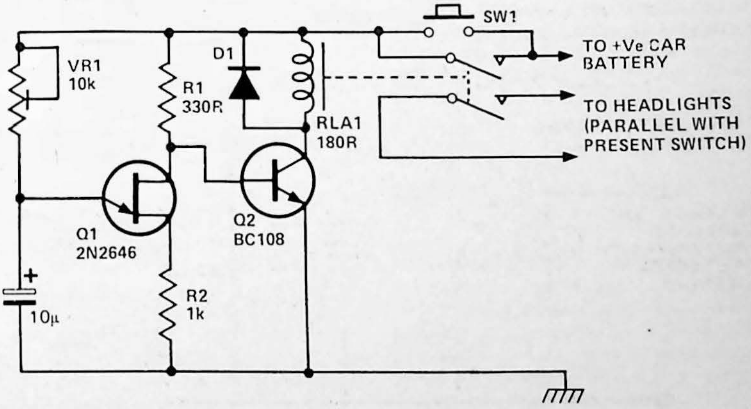
Headlight Delay Unit

D. Chivers

This circuit will operate a car's headlights for a predetermined time to light up the driveway or path after the driver has left the car, thus enabling him (or her) to open the front door without knocking over the milk bottles.

SW1 is pushed and Q2 is turned on closing the relay and turning on the car's headlights. C1 begins to charge through VR1 until Q1 turns on, turning Q2 off. The relay will then open switching off both the lights and the unit.

The delay is governed by the time taken for the capacitor to charge, which is about one minute.

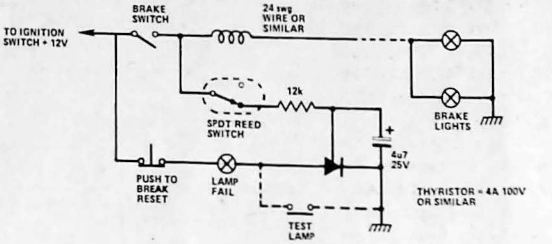


Car Lamp Failure Warning

A. Taylor

Many lamp failure warning circuits indicate only when both bulbs are working or only when the lamps are on. The circuit shown solves this and has the added effect of not dimming the lamps as some failure circuits do.

A suitable gauge enamelled copper wire is wound around an SPDT reed switch until a certain number of turns is found that will only open the contacts when both lamps are working. If either or both of the lamps should fail, the contacts remain closed and the thyristor is triggered, illuminating the lamp failure indicator until the ignition switch is turned off or the circuit is reset.

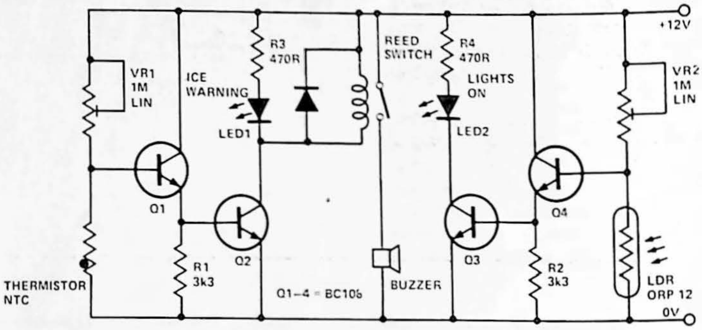


Ice Warning and Lights Reminder

D. Chivers

This simple device will tell a driver if his lights should be on and will warn him if the outside temperature is nearing zero, by lighting a LED and sounding a buzzer.

The unit's action is self explanatory; VR1 adjusts sensitivity for temperature, VR2 for light. Both thermistor and LDR should be well protected. Most high gain NPN transistors will work and the experimenter's junk box will almost certainly hold some.



Car Lights Reminder

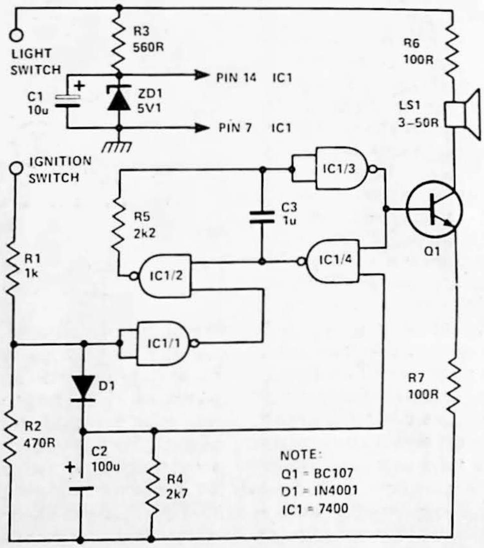
D. J. Rayner.

Many circuits to warn motorists that they have left their headlights on after switching the engine off have appeared in the past. I feel this circuit is an improvement over many of these in that it requires no switches, and it is only necessary to make three connections to the car's electrical system.

If the ignition is switched off while the lights are on, an audible warning is sounded for about ten seconds. This tone is produced by NAND gates IC1/2, IC1/3 and IC1/4. Operation of this oscillator is inhibited by an '0' on the gating input of IC1/2. This in turn corresponds to a logic '1' present at the input to IC1/1 while the ignition switch is on, supplying a high logic level to IC1/1, the oscillator is thus disabled.

When the ignition is switched off, the output of IC1/1 goes high, enabling the oscillator. At this stage C2, which has until now been charged up via D1, begins to discharge via R4. While the voltage on C2 is high, the gating input of IC1/4 allows oscillator operation, however as C2 discharges, this action is inhibited. This occurs after about ten seconds.

Power for the circuit is provided by R3 and ZD1 from the vehicle's 12 V rail.



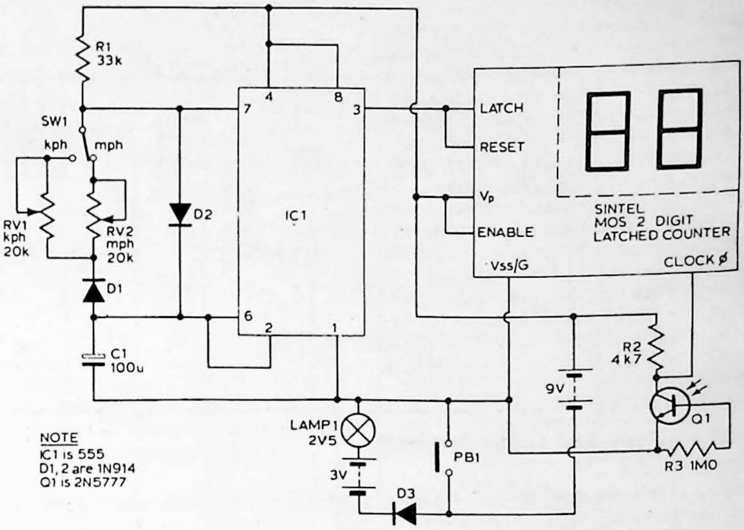
Digital Bike Speed

B. Lemming

This unit provides push-bike speed measurement between zero and 100 km/hr or 100 mph! The circuit is based on the Sintel MOS counter block, which counts the pulses from the photo transistor Q1.

These pulses are provided by fixing 18 aluminium 'barriers' to the wheels. Q1 was an unmarked type in the prototype, in a TO 18 package. This mounts in an old felt-tip pen case opposite the lamp so that the barriers interrupt the beam in operation. The counter operates whilst PB1 is pressed, but latches after a time determined by RV1 or RV2. IC1 and associated components. IC1 forms a square-wave oscillator with variable mark-space ratio. The time for which pin 3 is taken low is determined by RV1/RV2 — this enables the counter.

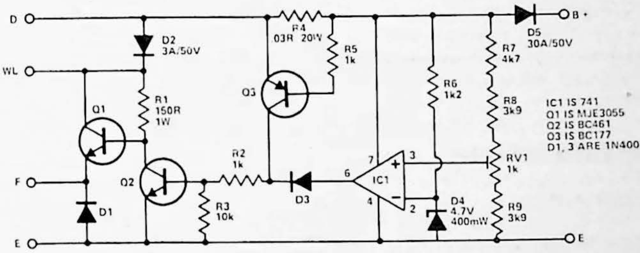
The speedo accuracy is determined by the accuracy of setting of controls RV1 and/or RV2.



Car Voltage Regulator

C. Gibbons

This circuit provides solid state control of battery charging. The field winding of the dynamo is initially energized via the ignition light as in a conventional system. Current flowing down the WL lead passes through Q1 to the F lead then to the field coil. Once the engine has started, current from the dynamo passes through D2 to Q1. The ignition light goes out because the WL lead rises in voltage to that of the battery. Current also passes through D5 to the battery. The battery voltage is sensed by IC1, which is wired as a comparator, once the voltage of the non inverting input, rises above that of the inverting input (Held at 4.6 volts by D4) the output goes high. Current then flows through D3 and R2 to the base of Q2 turning it on. This then pulls down the base of Q1 turning it off and cutting off the current to the field winding. The output from the dynamo then drops bringing down the battery voltage. This holds the battery voltage constant. The battery voltage is adjusted by RV1 to approximately 13.5 volts.

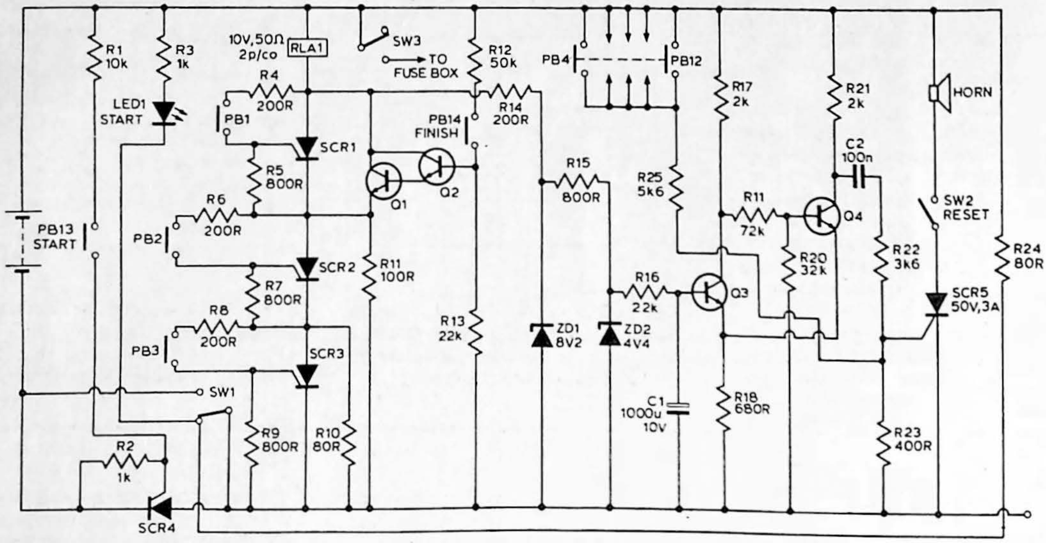


Under cold weather starting the battery voltage drops very low. Once the engine has started the internal resistance of the battery is also very low, which would draw excessive current from the dynamo causing possible damage. To limit the current R4 is inserted in the main power lead from the dynamo, the resistance of R4 is chosen so that at maximum current (Typically 20 amps) 0.6 volts is developed across it, this then turns on Q3. When Q3 turns on current flows from the power rail through R2 to the base of Q2 turning it on, which in turn, turns off Q1 and cuts off current to the field winding. The output from the dynamo then drops.

No changes have to be made to the existing wiring. The circuit can be housed in an old regulator box. Q1, Q2 and D5 should be mounted on a heat sink.

Electronic Ignition Switch

K. A. Last



NOTE
Q1 is BFY50
Q2,4 are BC108
Q3 are BC108C
SCR1-4 50V,1A TYPES
SCR5 50V,3A
LED1 is TIL 209
RLA1 is 10V,50R COIL WITH 2p/co CONTACTS

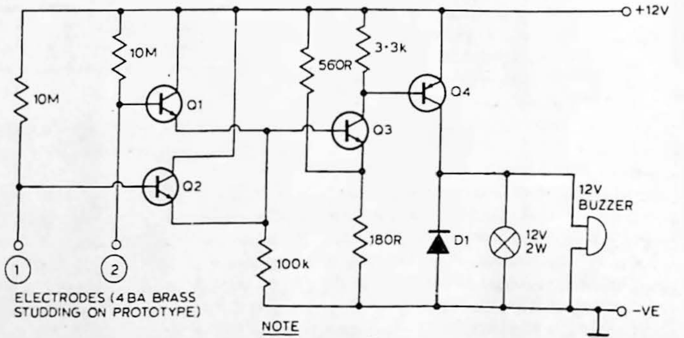
When used with a calculator type keyboard, this circuit provides a 'combination lock' ignition switch which only activates if the correct sequence of three numbers is keyed in. The keyboard has 14 keys numbered 1 to 12, 'START' and 'FINISH'. To start the car, the 'start' key is pressed and the start LED will light. The correct sequence of 3 numbers is then keyed in. If the sequence is wrong, the car's horn will be sounded. If the right sequence is entered, the 'START' LED will extinguish and the ignition will be energised. The correct sequence will be PB1, PB2, PB3, but these can be arranged amongst the other keys in the keyboard, and given any numbers.

Brake Fluid Indicator

D. Shorthouse

This circuit indicates by means of a warning light and a buzzer when the fluid in the tank of a braking system is getting low.

Normally both electrodes are immersed in the brake fluid, and the bases of Q1 and Q2 are at ground potential (the fluid makes a connection between the electrodes and the brake cylinder which is connected to the car chassis). If the fluid level should fall, and either of the electrodes becomes dry, Q1 or Q2 will turn on which will turn on Q3 and Q4 and the alarm energised.



NOTE
Q1,2,3 are BC107
Q4 is BC461
D1 is 1N4001

Noise Limiter

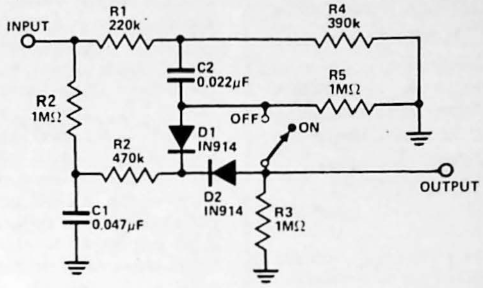
Noise pulse interference from motor vehicle ignition systems (another form of pollution – cars just can't win) can render a communications or shortwave receiver unuseable, completely blanketing reception of all signals except the very strong ones.

The limiter shown will very effectively improve the signal-to-noise ratio so that even quite weak signals can be copied.

It is connected between the detector output and the audio input (if high impedance) or at some relatively high-impedance section between two audio stages – preferably the low level stages.

The diodes, D1 and D2 can be any diode having relatively low forward resistance and very high back resistance. Types OA202, IN457, IN458 or IN459 are suitable. Resistors of ¼ watt or 1/8 watt rating can be used if miniaturization is desired.

The circuit is excellent for receivers having bandwidths down to 2 or 3 kHz. Increase the value of C1 for receivers having narrower bandwidths.



Channel Splitter for Radio Control

G. Bathe.

This circuit is designed to replace the electromechanical reed units used as channel-splitters in radio controlled models.

The circuit is based on the MC 1310P integrated circuit, a chip that is primarily a stereo decoder for use in stereo radio tuners. When used as a stereo decoder, the MC 1310P automatically switches itself from the mono mode to the stereo mode whenever its input contains the 19 kHz subcarrier of a stereo multiplex signal at a sufficiently high level (16 mV), and switches back to the mono mode when the 19 kHz subcarrier ceases to be present. Pin 6 of the integrated circuit drives a stereo indicator lamp to give a visual indication of whether the circuit is operating in the stereo or mono mode.

It is this lamp driver facility of the MC1310P that makes it an ideal chip to use as a channel-splitter. When used as a channel-splitter the circuit is not tuned to the 19 kHz of the stereo decoder but to the audio frequency that the circuit is required to detect, and the lamp driver output from pin 6 is used to drive a power transistor controlling a motor or other device.

The output from the detector of a radio receiver is amplified by the BC 108 and then fed into a series of MC 1030P channel-splitters (connected in parallel) each tuned to a different audio frequency.

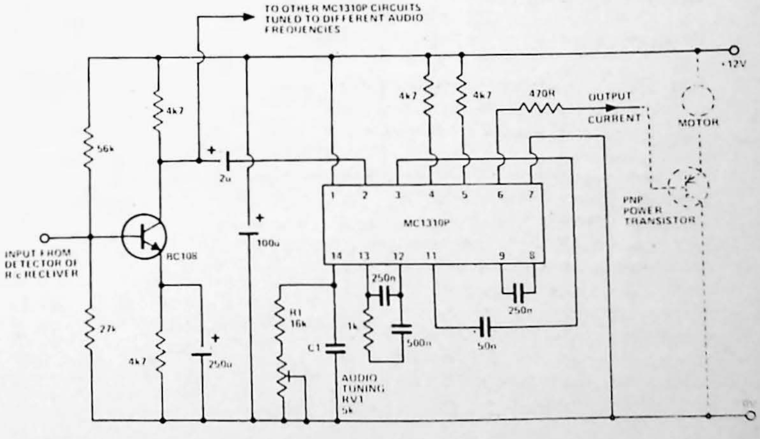
The audio frequency to which the channel-splitter responds is determined by the tuning circuit R1, VR1 and C1, and is given by the formula:-

$$f = \frac{1}{2\pi \ C1\ (R1 + RV1)} \text{ Hz}$$

The value of C1 is chosen to give the required tuning range for the preset RV1. For example, if C1 is 10,000 pF, then the tuning range is approximately 750 Hz to 1,000 Hz.

The output is a switched current output between Pin 6 of the chip and the positive supply rail. This current should not exceed 35 mA and so a 470 ohm resistor is inserted in the output connection from Pin 6 as short circuit protection. If a voltage output is required then a resistor can be connected from Pin 6 to the positive supply and the voltage output taken from Pin 6.

The MC 1310P is triggered when the input to Pin 2 contains its tuned frequency at a level greater than 16 mV. It can be triggered by noise if the noise level is greater than 16 mV. Some radio control transmitters tend to transmit noise when they are not transmitting a tone, and if this is the case the transmitter should be modified to prevent noise being transmitted. This could be done by making the transmitter transmit an extra unused tone whenever it is not transmitting one of the used audio tones.



RADIO

Simple RF Preamp

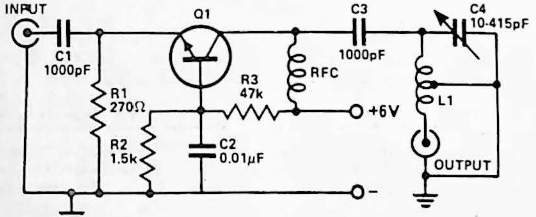
Many shortwave receivers of the cheaper variety and old surplus general coverage receivers (i.e. RBZ, AR8 etc) don't have a great deal of sensitivity, and are prone to image problems due to poor front-end selectivity.

This circuit considerably improves matters, providing a worthwhile increase in sensitivity and considerable improvement in front-end selectivity.

The transistor, Q1, can be any of BFY90, 2N3653, BF115, SE3001, TT3001, BC108 or any good RF amplifier transistor.

The tuning capacitor can be any standard broadcast-type (i.e. Roblan RMG-1). The RFC can be either 1 mH or 2.5 mH (i.e. Aegis C13 or C4 or C2).

The coil, L1, can be 20 turns on a suitable toroid tapped at 4 turns (try also tapped at 7 turns). Alternatively it could be any suitable coil tapped at about one fifth of the total turns.



Upgrading Valve Tuners

R. N. Soar

Older valve tuners often use an ECC85 type valve as the RF amplifier-mixer amplifier. The performance of these tuners can be permanently upgraded by using a solid state replacement such as a Fetron. A typical example is the TS12AT7, a plug in replacement for the ECC81/12AT7 range of valves but the performance is almost the same as the ECC85, only the heater connections are different and this does not apply to solid state. The advantages of replacement are that gain never falls off, thermal drift does not occur and performance is generally better. The only disadvantage is that the Fetrons cost several pounds but can be obtained from East Cornwall Components Ltd.

Simple AGC

Audio derived automatic gain control is one of the simplest methods of obtaining signal compression in a radio receiver. It is of particular value with short wave receivers used in areas where deep fading is prevalent.

The simple circuit shown here requires a minimum of components and may be used with both valve and transistor receivers.

In use, the main volume control should be set for the desired signal strength whilst the radio is tuned to a weak station, the radio is then tuned to a strong station and the AGC potentiometer is adjusted to a comfortable listening volume.

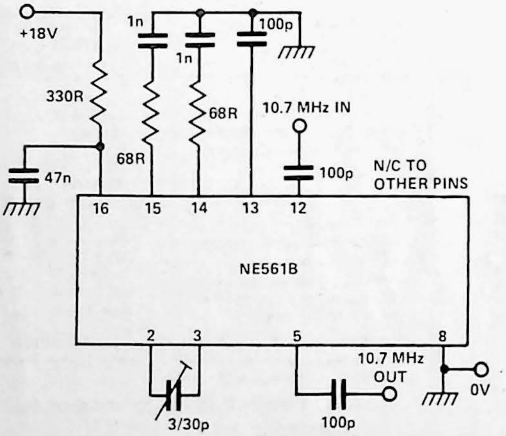
FM Signal Conditioner

R. N. Soar

As an alternative to an extra IF stage in an FM tuner, a PLL IC can be used as a signal conditioner. The VCO of the PLL tracks the input signal to provide a less noisy and stronger signal at its output.

The circuit shown is built around the Signetics NE561B PLL. The only thing necessary is adjustment of the 3/30 p trimmer which sets the VCO's centre frequency to 10.7 MHz.

The circuit should be effectively screened to avoid interaction with the FM front end that provides the circuit's input.

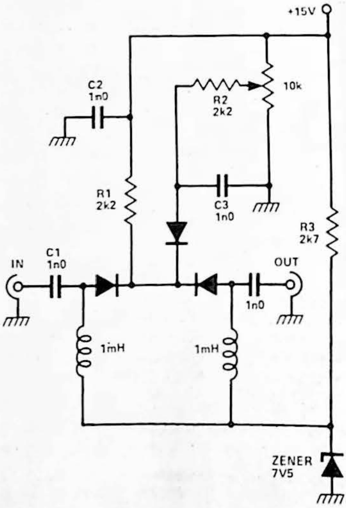


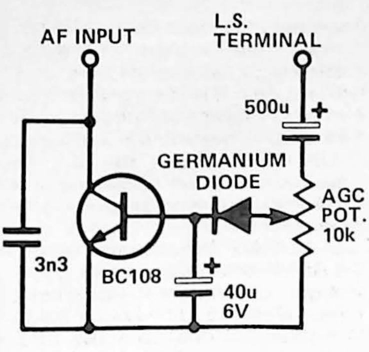
Variable RF Attenuator

This circuit can provide variable RF attenuation from 1dB to approximately 40dB.

If intended for use up to UHF, the components should be mounted in a shielded enclosure and feedthrough capacitors used for C2 and C3. Leads must be kept short. Low capacitance high speed diodes are recommended.

The potentiometer can be mounted remotely if desired, along with R3 and the zener.





CMOS Radio

J. P. Macaulay

The circuit shown is of a simple MW receiver based on the 4011 CMOS IC.

The four gates in this package are used as linear amplifiers by connecting their inputs together and applying negative feedback.

L1, 80 turns of 22 SWG enamelled wire close wound on a 3/8" diameter ferrite rod, is the pickup coil. This is tuned by the 500p trimmer and the resulting tank circuit referred to earth at RF by C1.

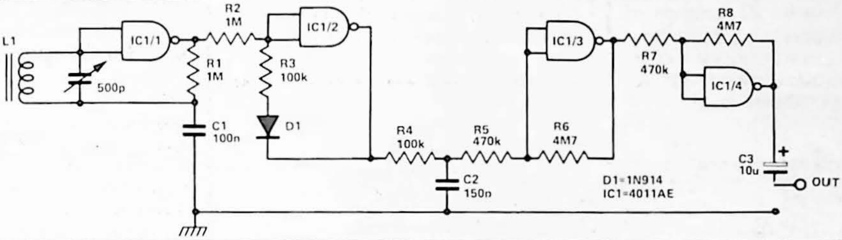
The high input impedance, that of IC1/1, 'seen' by the tank circuit ensures that little damping occurs, and thus the receiver is highly selective. The output of IC1/1 is an amplified RF signal and is passed to IC1/2 for detection.

The unwanted RF appearing at the output of the detector is removed by the lowpass filter formed by R4 and C2.

The audio signal is then fed to an amplifier formed by IC1/3 and IC1/4.

The circuit's current consumption is about 10 mA when operated from a 9 V supply.

Note that the IC used must be a 4011AE and not the 4011B whose input protection network will prevent it from operating in the linear mode.



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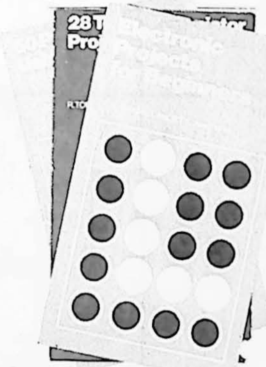

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5 Watt Audio Amplifier

A circuit for the TBA800 IC audio amplifier which requires a minimum number of external components is shown here. The mean output voltage at pin 12 of the device is about half of the positive supply potential and therefore a capacitor C4 must be employed in series with the speaker to prevent a steady current from flowing through the latter. If the value of this capacitor is reduced, the bass response will be reduced.

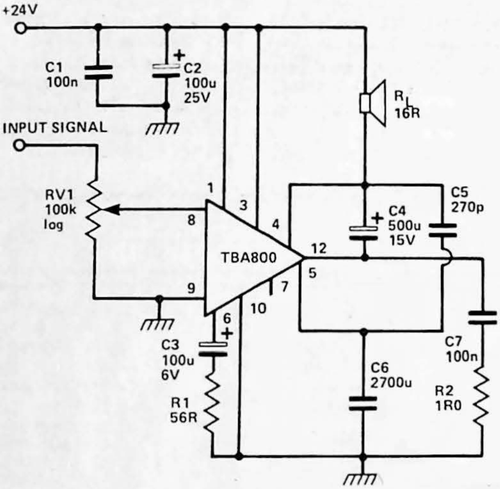
The bootstrap connection to pin 4 of the device is obtained from the junction of C4 and the loudspeaker. The high frequency response of the circuit is affected by the value of C5. When the value of this capacitor is 270p, the response is level to ± 3dB from about 40Hz to 20kHz. If, however, C5 is increased to 470p, the upper 3dB point is about 10kHz.

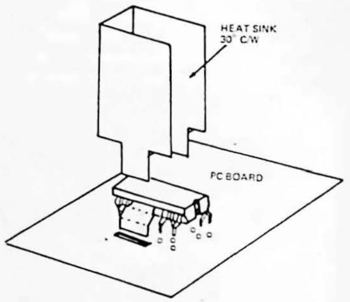
Feedback is taken from the output via a 7kO internal resistor to a point which is connected to pin 6. The feedback voltage is developed across R1; if the value of this resistor is increased, the gain will fall owing to the increased amount of feedback. However, the value of R1 also affects the frequency response.

The input is shown as being fed directly to the volume control RV1. If, however, the input does not have a mean potential equal to the earth potential, a capacitor of about 220n should be placed in series with the input. The input impedance of the TBA800 is typically 5MO (minimum value 1MO for any TBA800); however, a resistor not exceeding about 100k must always be present between pin 8 and the negative line.

C1 should be soldered close to pin 1. It provides good decoupling of the power supply lines at high frequencies, whilst C2 provides good low frequency decoupling. Capacitor C7 and resistor R2 help to prevent instability.

A method of connecting a heatsink is shown below. The tabs and the external heatsink are soldered together into a common hole and are earthed. The maximum output without a heatsink is limited to about 2.3W.



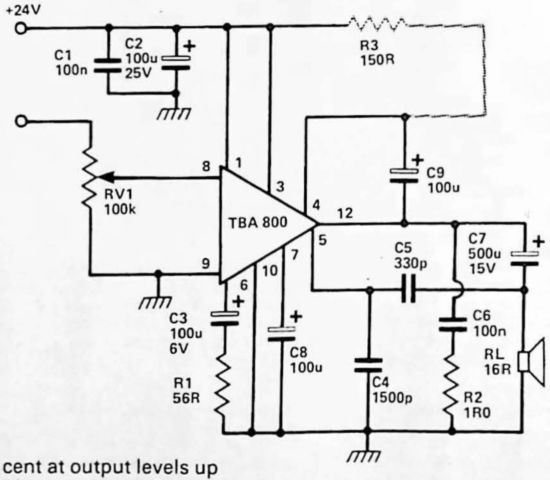


Alternative Circuit

In this circuit, the capacitor C9 provides a bootstrap between the output of the device and pin 4. This enables a performance similar to that of the circuit above to be obtained when one side of the loudspeaker is earthed.

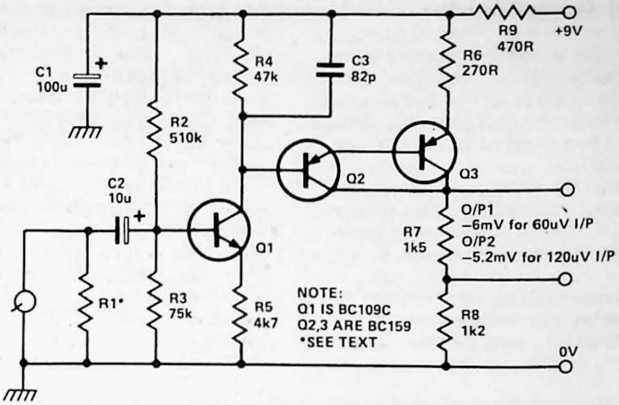
If the supply voltage is low (up to 14V), a 150R resistor should be connected between pin 4 and the positive supply line. A capacitor C8 may be connected between pin 7 and ground to prevent hum from the power supply line being present at an appreciable amplitude at the output of the device. The value of C8 may be 10u to 100u, 25V.

The distortion rises rapidly with power output at high power levels. When a 24V supply is employed with a 16R load, the distortion introduced by the circuit shown here at 1kHz is about 0.5 per cent at output levels up to 3W. At 4W it rises to about 2-4 per cent and at 5W to 10 per cent.



Moving Coil Cartridge Preamp.

J. Macauley



Although moving coil cartridges undoubtedly give better reproduction from disc they usually require an expensive step up transformer to enable them to be used with conventional RIAA equalisation.

The reason for this is that most cartridges of this type have outputs of 60-150uV and like to 'see' an input impedance between 60-330R.

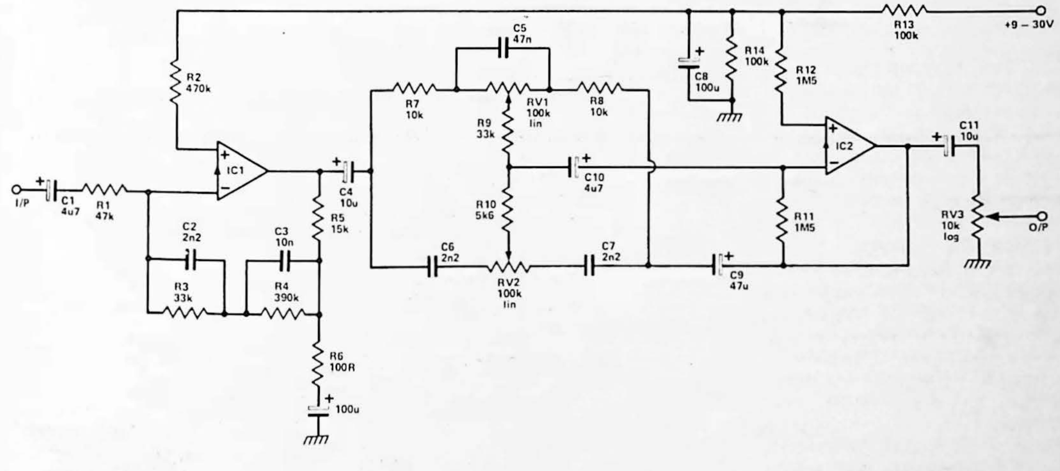
The circuit shown was developed to cater for a particular cartridge of this type although by modifying the value of one component, R1, it is possible to cater for the complete range of inputs detailed above.

Input signals are coupled to the base of Q1 via the isolating capacitor C1. R1 damps the input impedance to the correct value to match the particular cartridge in use. R2 and R3 bias Q1 which is employed in the common emitter mode. Heavy local AC and DC feedback is introduced by R5 and this defines the gain of the stage at 20dB. To minimise noise a BC109C is used here operated with a low collector current, 50uA. The output stage of this amplifier is the darlington pair Q2 and Q3, output signals being taken from across R7, R8.

R1 should be determined by experiment but can be initially found by using a 470R preset in the R1 possition and adjusting this for optimum sound quality by ear.

One Chip Preamplifier

J. P. Macaulay



The circuit shown utilises the four Norton op amps contained within an LM3900 to produce a high quality stereo preamp, catering for magnetic cartridges.

IC1 is used in the inverting mode. Signals from the cartridge are fed via the blocking capacitor and R1 to the inverting input. R1 defines the input impedance and provides the right damping for the cartridge.

R5 and R6 define the midband gain of the stage whilst the network R3, R4, C2 and C3 provide the required RIAA equalisation. From here the equalised signal is fed to a standard Baxendall tone control network built around IC2. This requires little comment although it should be noted that individual volume controls are employed for each channel. This not only reduces crosstalk between channels but also works out cheaper in that only two single gang potentiometers are used.

Performance is good with overall distortion below 0.1% and a S/N ratio of —67db unweighted, ref 500 mV out.

AMPLIFIERS & PREAMPLIFIERS

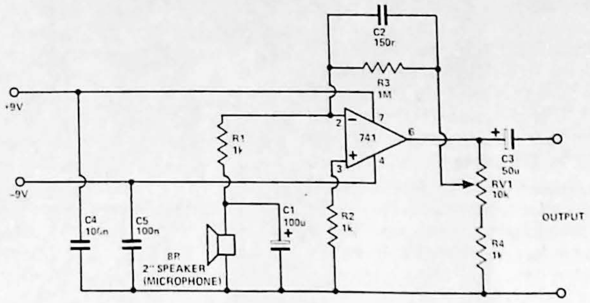
Heartbeat Preamplifier

P. J. Tyrrell

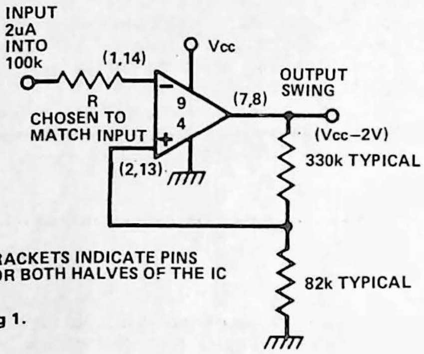
This simple circuit, when connected to an audio amplifier, allows one to listen to heartbeats. The low frequency gain is set by R1 and R3, in conjunction with RV1 and R4. RV1 permits the gain to be varied over the range 60-80 dB.

C1 and C2 introduce some low frequency cut, reducing 50Hz pickup whilst C4 and C5 help prevent instability caused by the high gain of the circuit.

The output should be connected to the magnetic cartridge input of the audio amplifier, with the bass turned up high.



LM381 Applications



BRACKETS INDICATE PINS FOR BOTH HALVES OF THE IC

Fig 1.

Fig 2.

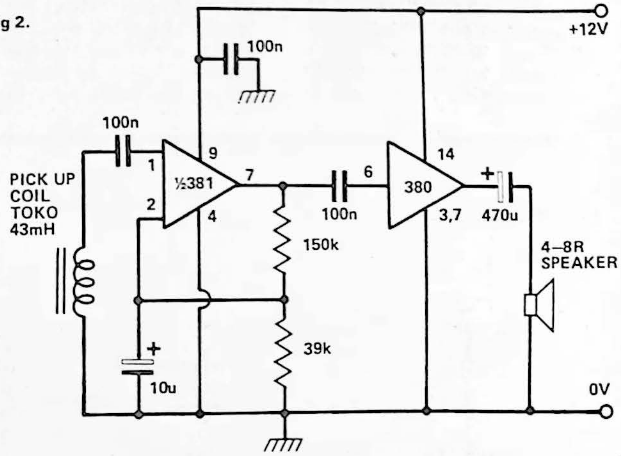
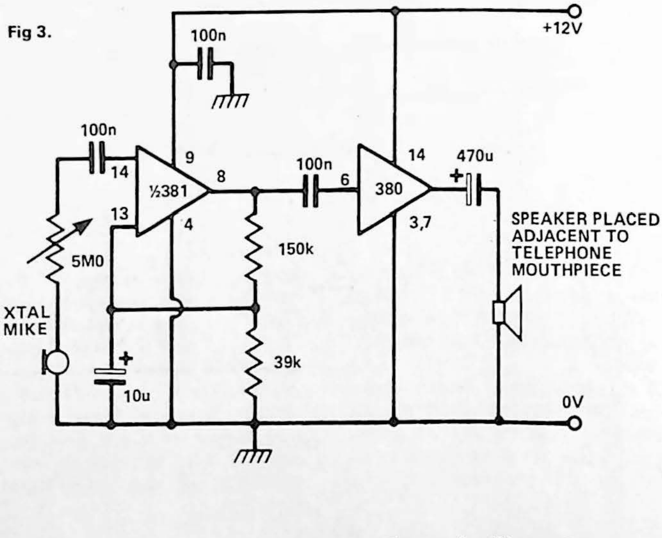


Fig 3.



The LM381 dual op-amp has appeared several times in its usual guise as a low noise stereo audio preamplifier device. Indeed, it requires the barest minimum of external components, since the function of the feedback resistors and capacitors is simply to determine the audio frequency response and gain.

Because it is a dual op-amp, the LM381 can be used for most op-amp purposes where the many features can be used. The maximum voltage gain is 320,000 times and the output voltage swing can be as great as the supply voltage less 2V. (Maximum supply voltage is 30V).

So the LM381 can be easily empoyed for instrumentation amplification, and the configuration for a basic DC amplifier is shown in Fig. 1.

Figs. 2 and 3 are for a telephone pickup and speech amplifier. The pickup coil is placed near the earpiece while the speaker in Fig. 3 is placed adjacent to the mouthpiece. No electrical connections are made to the telephone.

Telephone Amplifier

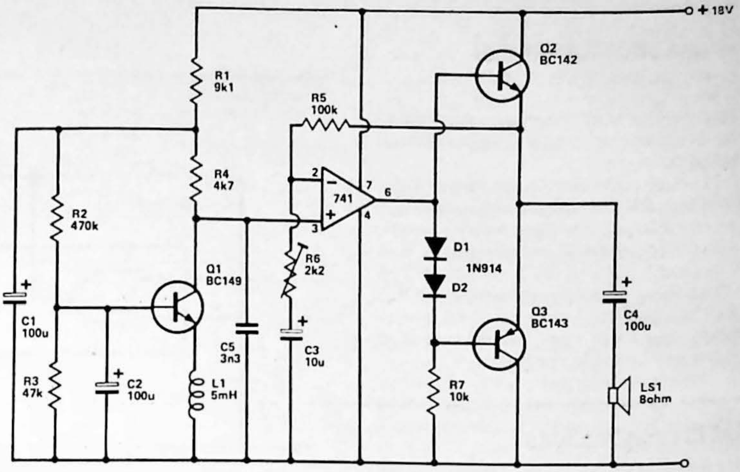
J. P. Macaulay

One of the most frustrating things in life must be to wait in line whilst one's wife converses (nags?) on the phone. What makes the matter worse is that only one side of the conversation is heard. The circuit here will at least enable you to hear what's going on at the other end of the line.

The signals are picked up by the coil L1, a 5 mH RF choke taped to the side of the set. Q1 operates in the common base mode with the output signal appearing across the collector resistor, R4. The output stage consists of two complementary transistors fed from the output of IC1 and included in its feedback loop.

The gain provided by the IC is made variable by the inclusion of R6 and this should be adjusted for a comfortable output level. D1, D2 in conjunction with R7 provides the small but necessary bias required by the output pair.

The interstage capacitor provides a 13db point in the bass end at 300Hz. C5 defines the upper frequency limit of the circuit at 3 kHz, the best bandwidth for maximum intelligibility. Quiescent current consumption is less than 5 mA so the circuit can be easily run from a pair of PP3's in series.



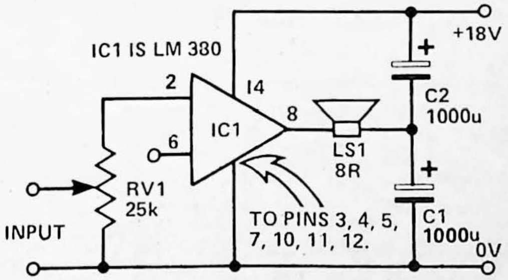
Novel Loudspeaker Coupling Circuit

P. Mills

In most amplifier designs the speaker is fed by a high value capacitor to provide DC blocking, but this may result in a heavy switch-on surge, as the capacitor charges up.

An alternative approach, which is worthy of experiment, is shown in the diagram here. The ground side of the speaker is connected to the junction of two equal high value capacitors (1000u is typical) across the supply.

The amplifier output voltage will be at V+/2, and so will the voltage across C1 (if C1 and C2 are equal); so as the supply voltage builds up, the DC voltage across the speaker will remain zero, eliminating the switch-on surge. C1 and C2 will also provide supply smoothing. The circuit is shown with the LM380, but could be applied to any amplifier circuit, providing that the DC voltage at the output is half the supply voltage.



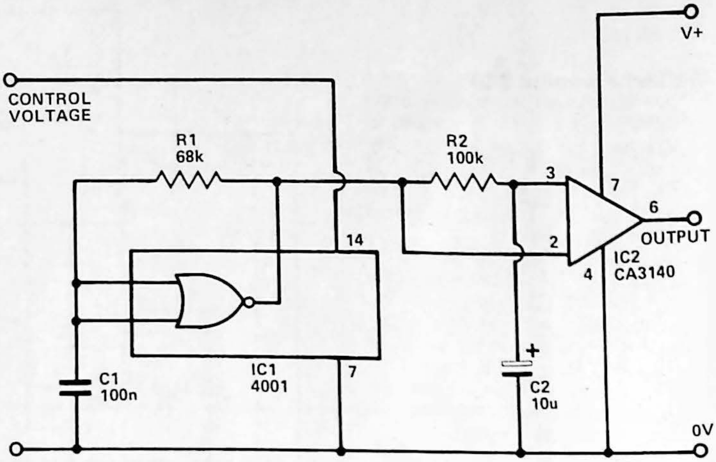
Simple Wide Range VCO

A. J. Richardson

Any section of IC1 can be used but all unused inputs must be taken to ground.

This circuit takes advantage of the fact that CMOS gates readily oscillate in the circuit configuration shown. The control voltage, which ideally is in the range 1V5 to 3V5, is applied to the power supply connection of IC1. IC2 is used to square up and buffer the output of IC1 and can be operated from any suitable voltage rail.

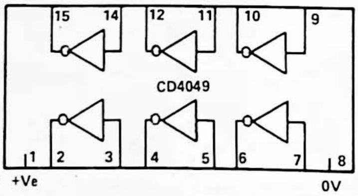
With the values shown a frequency range of approximately 50 Hz to 20 kHz is obtained with almost equal mark to space ratio, but if this is unimportant the lower end can be extended down to approximately 1 Hz. Other frequency ranges can be obtained with suitable values of R1 and C1.

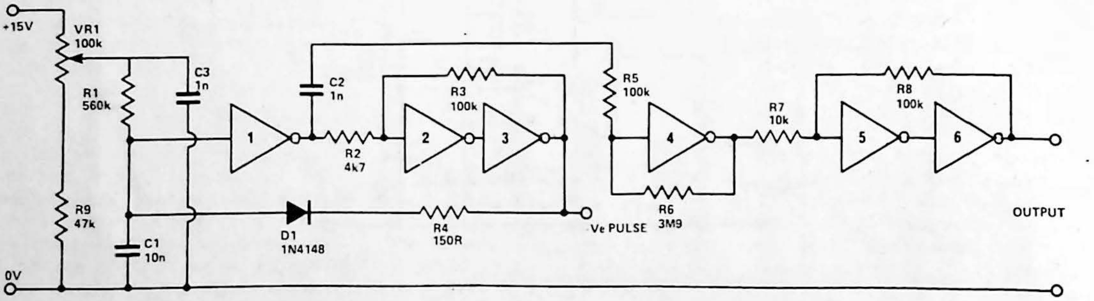


Cheap VCO

A. J. Richardson

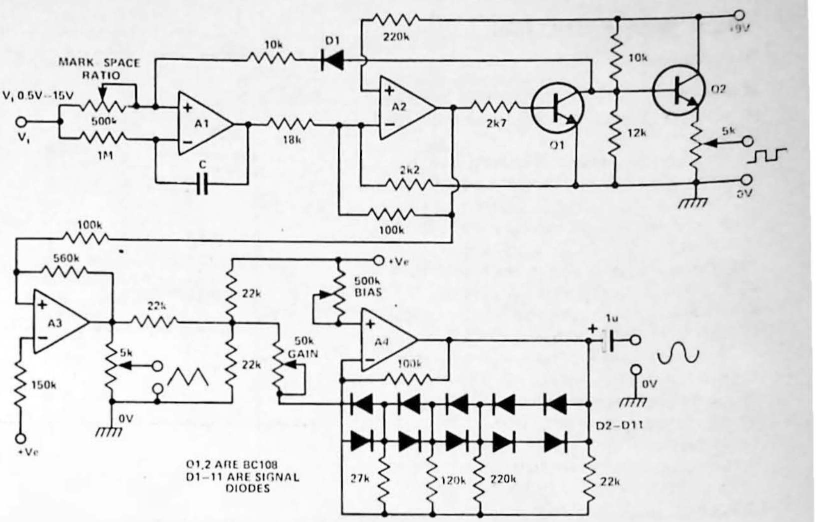
This circuit provides a cheap solution to a non precision voltage controlled oscillator. C1 charges towards the voltage set on VR1 until inverter 1 output goes low whereupon the output of inverter 3 goes low and discharges C1 via D and R4. Inverters 2 and 3 form a Schmitt trigger circuit with positive feedback supplied by R3. Inverter 4 forms a linear amplifier with its gain set by the ratio of R5 to R6 which squares up the signal appearing on inverter 1 output. The signal is further squared up by the Schmitt trigger action of inverters 5 and 6 to provide a square wave of approximately 50% duty cycle at the output of inverter 6. With the values shown a frequency range of at least 100 Hz to 15 kHz is guaranteed with VR1 but other ranges can be covered with suitable values of R1 and C1. The circuit works well at lower supply voltages but the frequency range covered for a given set of components may be slightly less. If a square wave is not required a negative pulse of approximately 200 nS is available at the output of inverter 3 thus enabling two VCOs to be built with one chip.





Battery Operated VCO

R. Zaman.



By using the LM 3900N quad-op-amp, a simple portable battery operated VCO can be made very cheaply. A1 forms an integrator, the ramp rate depending on the voltage Vi and capacitor C. This ramp is fed to a Schmidt trigger which switches at about 5V8, making A1 ramp down, generating a triangular wave of about 0V85.

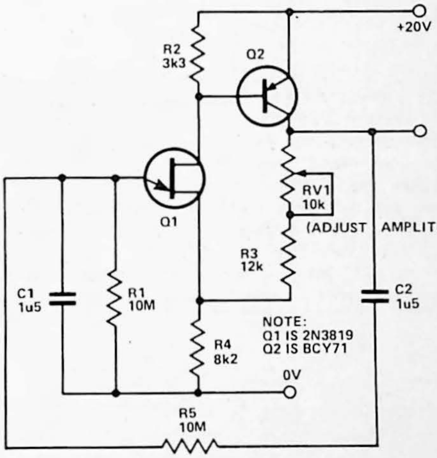
The Schmidt trigger feeds a transistor switch and an emitter follower.

The triangular wave is then fed to A3 which acts as an inverting amplifier, and the output is fed to A4 which is an exponential integrator set at a pseudo-ground of 4V5. The bias and gain pots must be adjusted to give the best sine waveform.

Vi can be any positive voltage from +0.5 ↔ +15.0 V, giving a frequency range of about 1:100. Capacitor C can be any value from 10n to 47n and the outputs have a low distortion up to about 20 kHz.

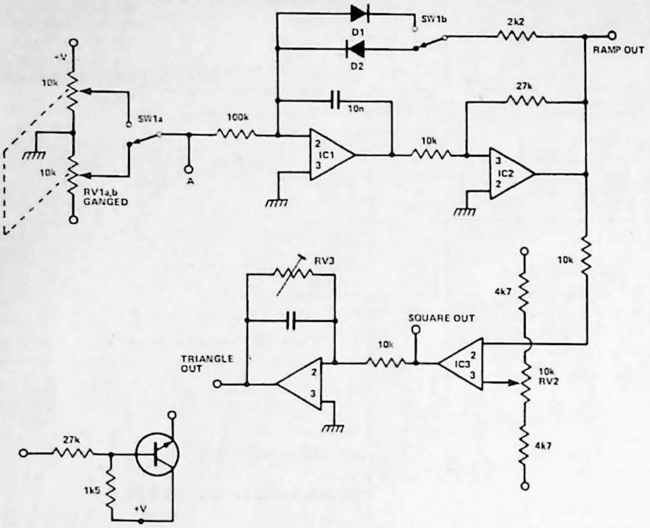
VLF Sine Generator

G. Loveday



Generating very low frequency sine waves (i.e. less than 0.1 Hz) presents several problems. Timing capacitors usually have to be large value electrolytics, any amplifier used must be D.C. coupled, and the amplifier's input impedance must be very high. One standard method is to first generate low frequency square waves, and then to shape these into an approximation of a sine wave by the use of several non linear devices, such as diodes. The circuit shown in Fig. 1 is a relatively simple approach based on the familiar Wien bridge. An n-channel FET and a PNP transistor are arranged in a DC coupled circuit and the voltage gain is determined by the negative feedback R3 and R4. The gain need only be about three, thus if the bias required by the FET is 3V the output level will be approximately half the supply voltage.

Since R1 can be a high value resistor the value of the capacitor is only 1u5 for sine wave outputs of 0.01 Hz. This capacitor is available in polycarbonate. The amplitude of the output can be adjusted by RV1 to give low harmonic distortion and to be about 10V peak to peak. As expected, with this Wien bridge circuit, frequency stability is good with changes in both supply voltage and temperature.



Function Generator

J. S. Paterson

IC1 is an integrator which, along with IC2, etc, forms a voltage controlled ramp oscillator, the frequency of which is set by RV1. SW1 and diodes D1, 2 control the direction of the ramp. The output of IC2 is taken to IC3, which is a comparator providing a square output at pin 6. RV2 provides control of symmetry. Lastly, this square wave is fed to an integrator, which gives a triangular waveform. If the control voltage is applied via the circuit in Fig. 2 the frequency will vary logarithmically with voltage — useful for synthesizers.

With RV1 slider grounded, a ramp can be fed into the circuit at point A, so the oscillator will sweep through its range — useful for testing filters, etc.

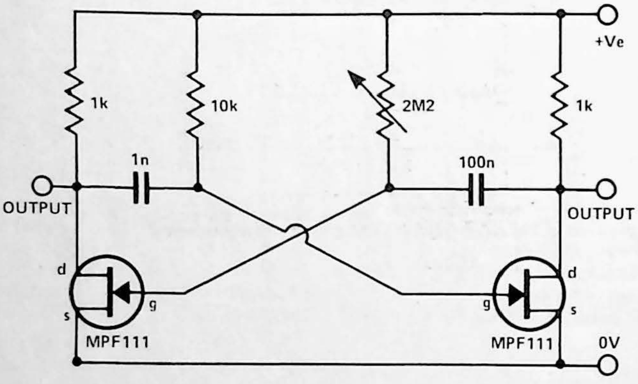
Wide Range Astable

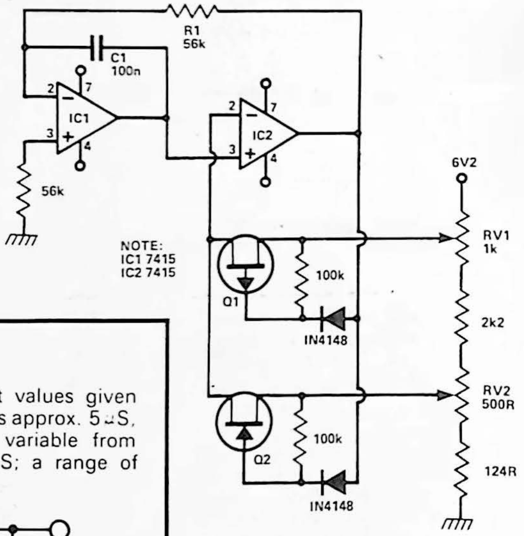
P. D. Maddinson

In a conventional astable, the bipolar transistors take a significant amount of base current, which limits the use of high value timing resistors. By replacing bipolar transistors with FETs, which consume a much smaller 'gate' current, we can use much higher values of timing resistor and hence get a much wider range.

N-channel FETs were chosen, so that a positive Vcc rail could be used, and with a 5V supply the circuit was able to drive TTL without trouble.

With the component values given one time constant was approx. 5µS, and the other was variable from 5µS to approx. 2mS; a range of 400:1.





Triangle Generator

R. I. Harrison

The circuit consists of a comparator IC2 driving an integrator constructed from IC1, C1 and R1. The output of the two circuits is controlled by the JFET switches Q1 and 2. The peak and trough of the generator is controlled by RV1 and RV2 respectively. The frequency is set by C1 and R1.

Gated 123 Oscillators

M. James.

The action of two distinct types of gated oscillator is shown in Fig 1. Type A stops immediately the inhibit signal goes low, and starts immediately it goes high. (Hence fractional output pulses may be produced).

Type B finishes its current pulse before stopping when the inhibit signal goes low and like A starts immediately it goes high.

A is used when an oscillator has to be synchronized using pulses shorter than the output pulse and B is used when a number of whole pulses are required (the inhibit signal is obtained from the output of a counter).

It can be quite difficult to achieve a type A oscillator that starts up without jitter using TTL. The circuit of Fig 2 shows how an SN74123 may be used to construct both types. A type A oscillator is obtained if the dotted connections are left out. The times t_1 and t_2 are set by the usual timing components see Fig 3 — the diode is needed if $C_{ext} > 1000p$ (across P_A – M_A and P_B – M_B respectively). The times may be calculated using:–

$$t = 0.32 R_T\ C_{ext}\ (1 + 0.7/R_T)$$

if the diode is not required and

$$t = 0.28 R_T\ C_{ext}\ (1 + 0.7/R_T)$$

otherwise.

R_T is in kilo-ohms, C_{ext} is in picofarads, t is in nanoseconds and the max value of R_T is 20k.

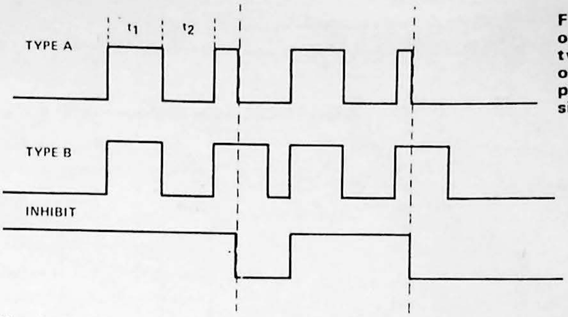


Fig. 1. Left — operation of the two types of oscillator with respect to the inhibit signal.

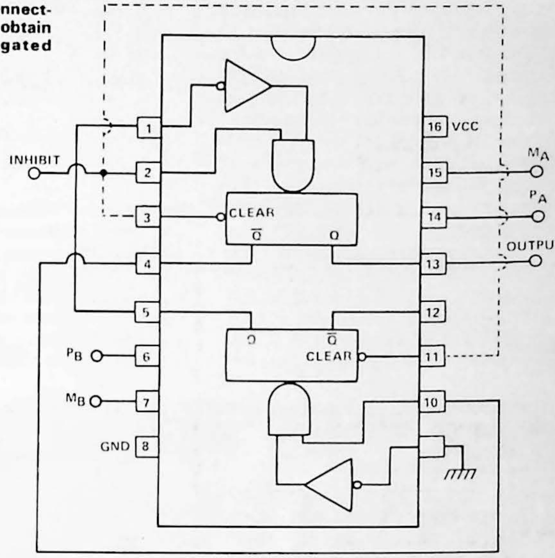
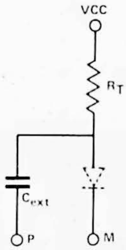


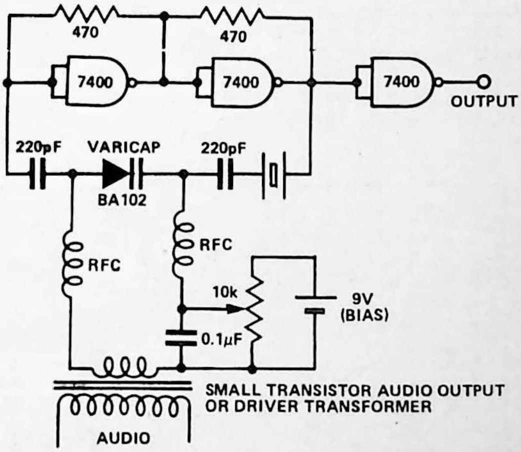
Fig. 2. Right — connection to a 74123 to obtain both type of gated oscillator.

Fig. 3. Below — arrangement of the timing components.



FM TTL Crystal Oscillator

This TTL crystal oscillator is useful for checking FM receivers or to drive multipliers-amplifiers for an FM transmitter. It will accept crystals between 1 and 18 MHz. Output level is quite high and rich in harmonics. Audio can be provided at a low level from an audio oscillator or a microphone amplifier.

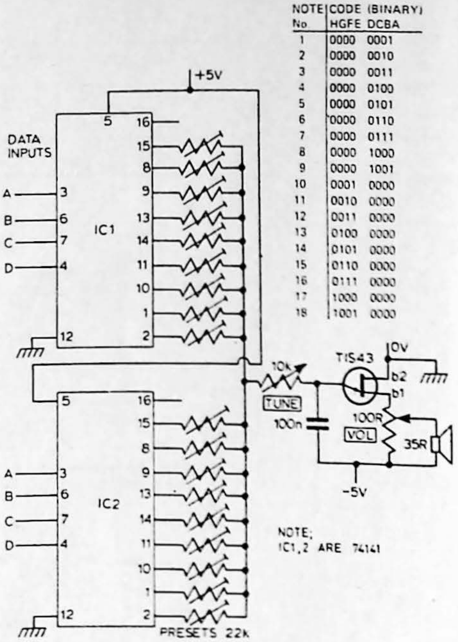


BCD Tone Generator

P. Bailey

When one of the binary codes in the table is set up on the data inputs, a corresponding preset connected to IC1 and 2 will be grounded, and the unijunction will start to oscillate, the frequency of oscillation depending on which output of the ICs is grounded.

If the 18 presets are tuned to form a chromatic scale and the inputs interfaced to your MPU data bus — hey presto you have a simple MPU controlled organ!



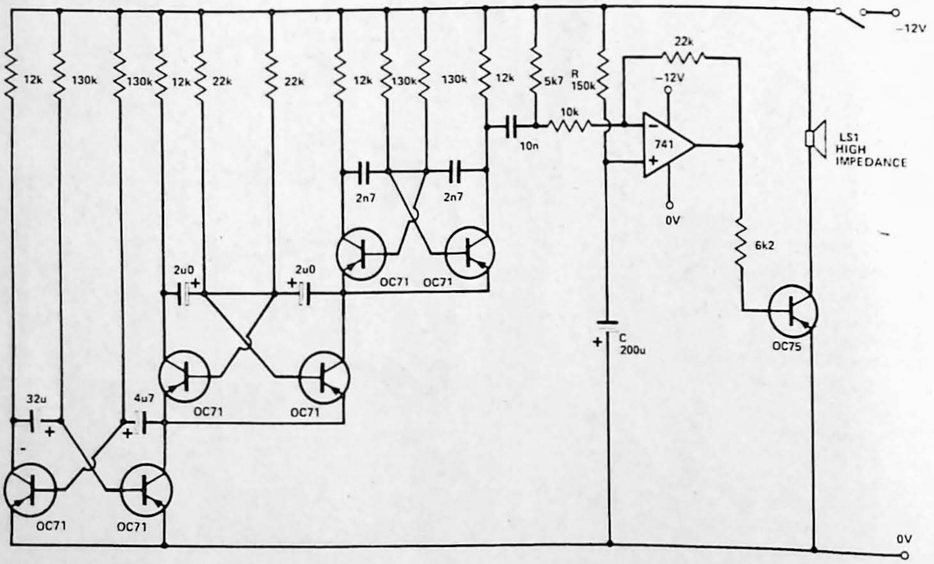
NOTE No	CODE (BINARY) HGFE DCBA
1	0000 0001
2	0000 0010
3	0000 0011
4	0000 0100
5	0000 0101
6	0000 0110
7	0000 0111
8	0000 1000
9	0000 1001
10	0001 0000
11	0010 0000
12	0011 0000
13	0100 0000
14	0101 0000
15	0110 0000
16	0111 0000
17	1000 0000
18	1001 0000

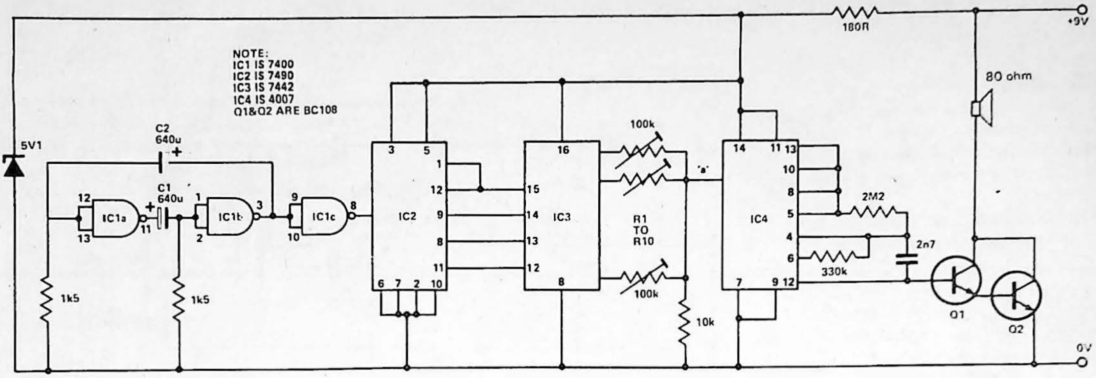
Gentle Clock Alarm

I. Hill-Smith

RING! RING! BUZZ! This is DLT CLANG! PIP PIP PIP!

There are gentler ways to wake up. This circuit provides an alarm which builds up from being inaudible to loud over about one minute. As a result you are always woken by the minimum volume required to wake you: a far more comfortable experience than the usual trauma. The three multivibrators in cascade provide a signal like the sound of a warbler telephone. As C slowly charges through R a larger fraction of the signal is amplified by the op amp producing a louder output.





Musical Tone Generator

P. Reynolds

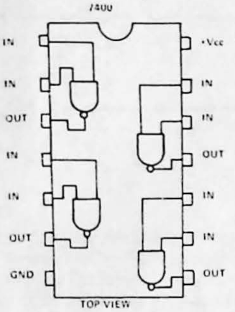
This circuit provides a means of generating a series of up to ten musical notes.

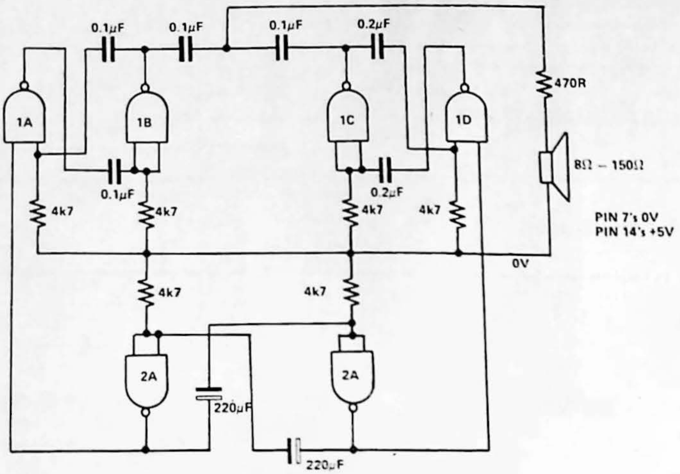
The 7400 oscillator produces pulses at about 1 second intervals. These pulses, after being buffered are fed to a decade counter which produces a BCD output. The output is fed to the 7442 which produces a decimal output. Each output is taken to a preset forming a potential divider. The VCO senses the voltage at point 'a' and changes the frequency of the output tone. Careful adjustment of the presets can give a reasonable range of notes. The length of each note as well as the time between notes can be varied by changing the timing components in the 7400 oscillator.

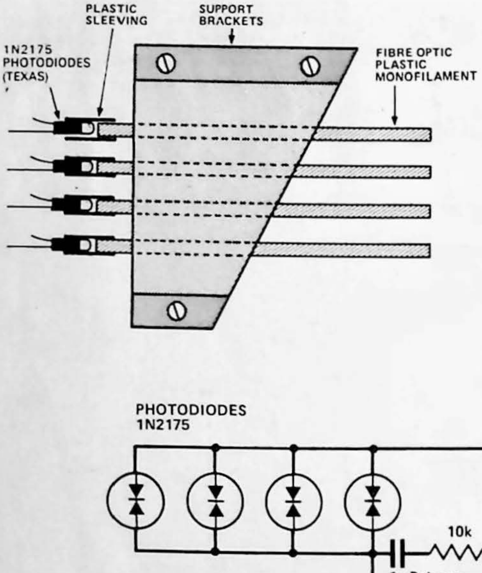
7400 Siren

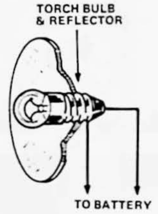
The siren consists of two oscillators which generate the tones. A third oscillator is used to switch the others on and off alternately, giving the two tone effect

By changing the capacitor values different tones can be produced.





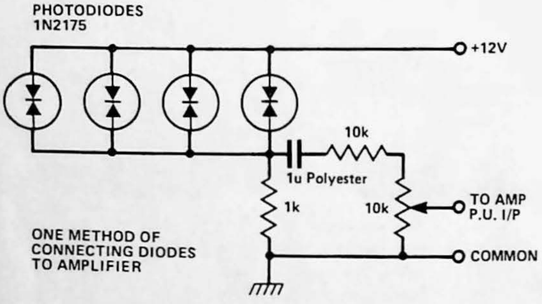




Fibre Optic Bass Guitar

J. Smith.

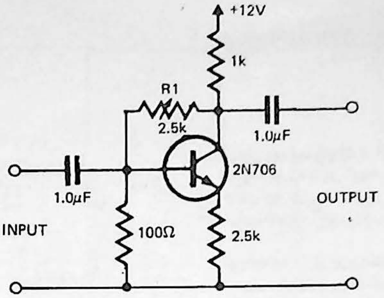
This item is in effect a simple musical instrument. It consists of a number of short lengths of plastic monofilament fibre optic material arranged in such a way that when a fibre is touched then released it vibrates at its own natural resonant frequency (like a ruler twanged on the edge of a desk). When in a light beam supplied from a torch battery the vibrating end sends sine wave impulses along the fibre, at the fixed end there is a photodiode which with suitable circuitry feeds a signal to a normal audio amplifier. The sound produced is similar to that obtained using a tea chest, piece of string and broom handle, remember those days? Thickness of the fibres and length are not critical and it is best to experiment to obtain the sound that pleases the constructor. The fibres need be no longer than about 60m/m. Remember the shorter they are the higher the note produced.



ONE METHOD OF CONNECTING DIODES TO AMPLIFIER

Audio Doubler

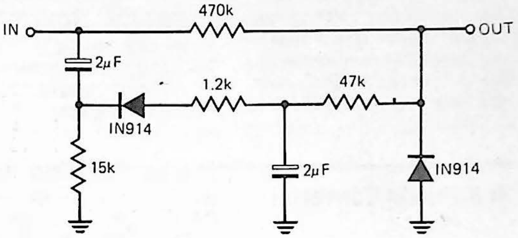
Audio frequencies may be doubled by this circuit which relies on the non-linear characteristic of a transistor to provide half-wave rectification. R1 is a feedback control and is adjusted to obtain a pure output waveform.



Simple Compressor

This simple compressor is very effective when tape recording from the speaker terminals of a receiver.

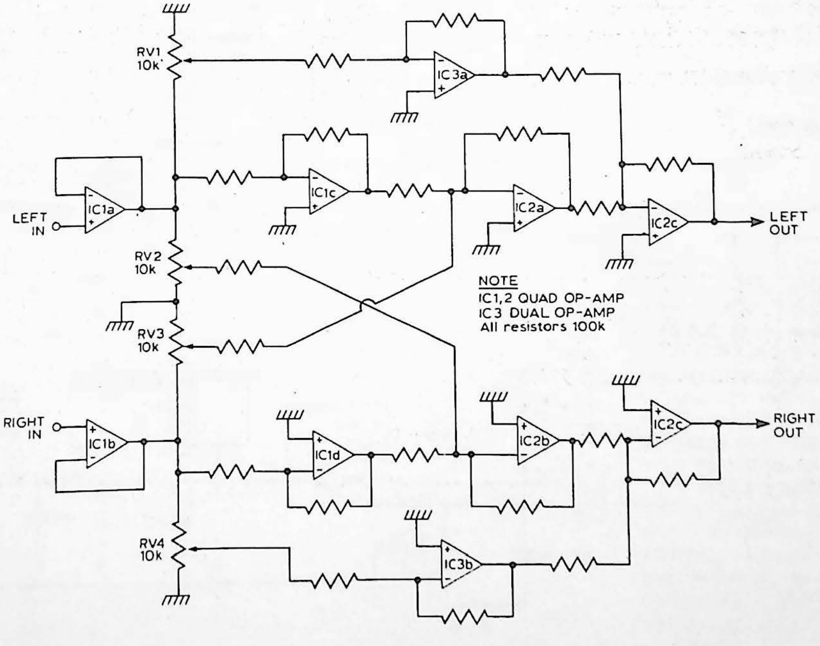
Input can vary anywhere from 200mV to six volts and the output will remain very close to five millivolts. Attack time is approximately three milliseconds and release time is approximately one hundred milliseconds. The diodes should be high back resistance types; 1N914s should be suitable.



4 Channel Synthesizer

T. Huffinley

This circuit will synthesize two rear channels for 'quadraphonic' sound when fed with a stereo signal. The rear output for the Left channel, is a combination of the left channel input 180° our of phase, added to a proportion of the right hand channel (also out of phase). The right hand rear output is obtained in a similar way.



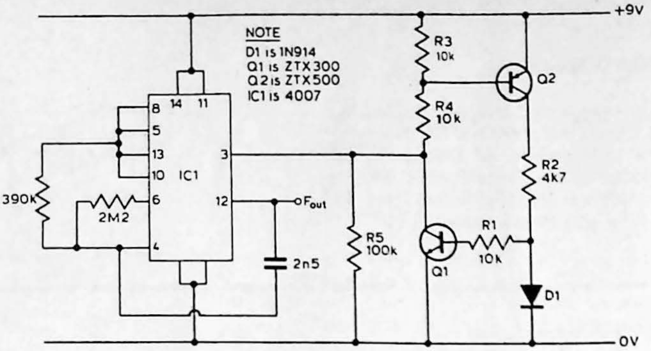
NOTE
IC1,2 QUAD OP-AMP
IC3 DUAL OP-AMP
All resistors 100k

Temperature to Frequency Convertor

P. Reynolds

This circuit uses the fact that when fed from a constant current source, the forward voltage of a silicon diode varies with temperature, in a reasonably linear way.

Diode D1, and resistor R2 form a potential divider, fed from the constant current source. As the temperature rises the forward voltage of D1 falls tending to turn Q1 off. The output voltage from Q1 will thus rise, and this is used as the control voltage for the CMOS VCO. With the values shown, the device gave an increase of just under 3HzC^{-1} (between 0°C and 60°C) giving a frequency of 470Hz at 0°C.



Precision AC to DC Converter

T. K. Tay

The circuit is a precision AC to DC converter (amplitude). The important feature is that the system operates happily with amplitude and frequency of Vin varying (e.g. speech signal).

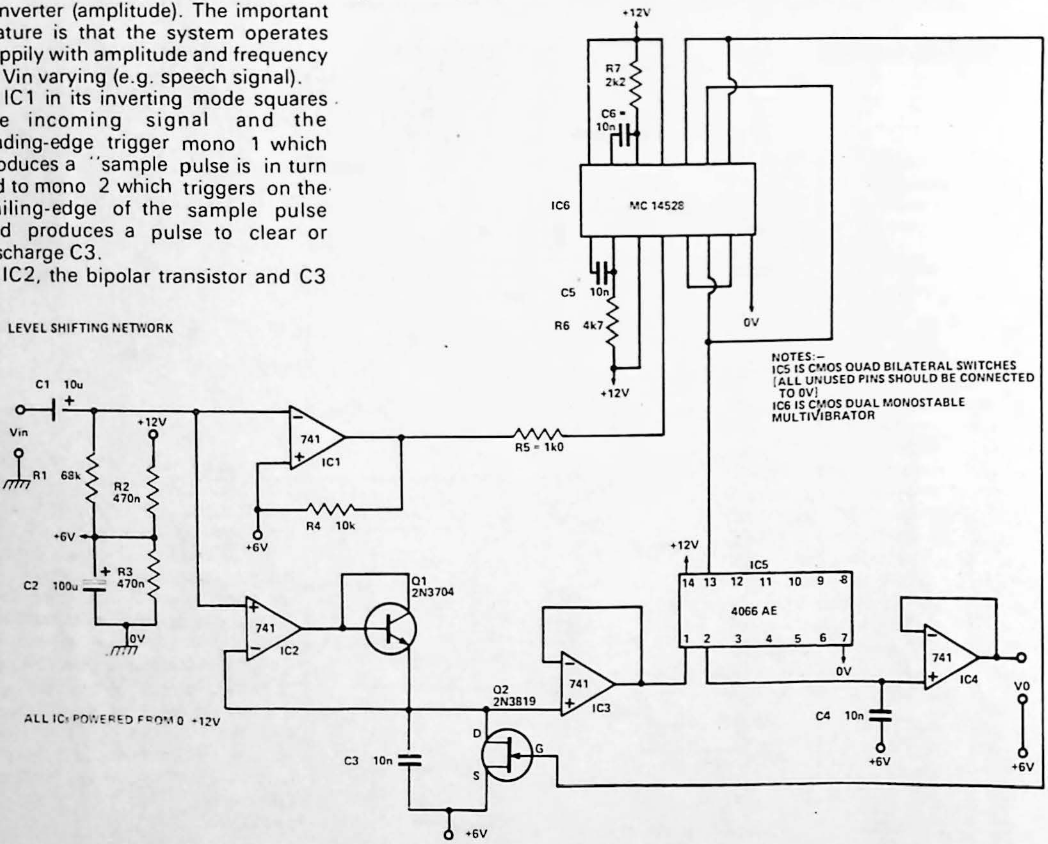
IC1 in its inverting mode squares the incoming signal and the leading-edge trigger mono 1 which produces a "sample pulse is in turn fed to mono 2 which triggers on the trailing-edge of the sample pulse and produces a pulse to clear or discharge C3.

IC2, the bipolar transistor and C3 form the rectifier and first hold circuit. C4 acts as the second hold circuit.

Thus after every ½ cycle of Vin, the DC level of the first hold is being transferred to the second hold circuit by the sample pulse before the first hold is clear again.

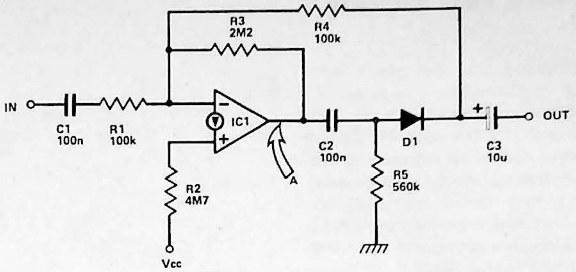
A level shifting network is used to shift the reference level to +6V.

With the components used in the circuit, the system works very well from 25 Hz to 20 kHz.



Precision Rectifying with the LM3900

A. Winsor



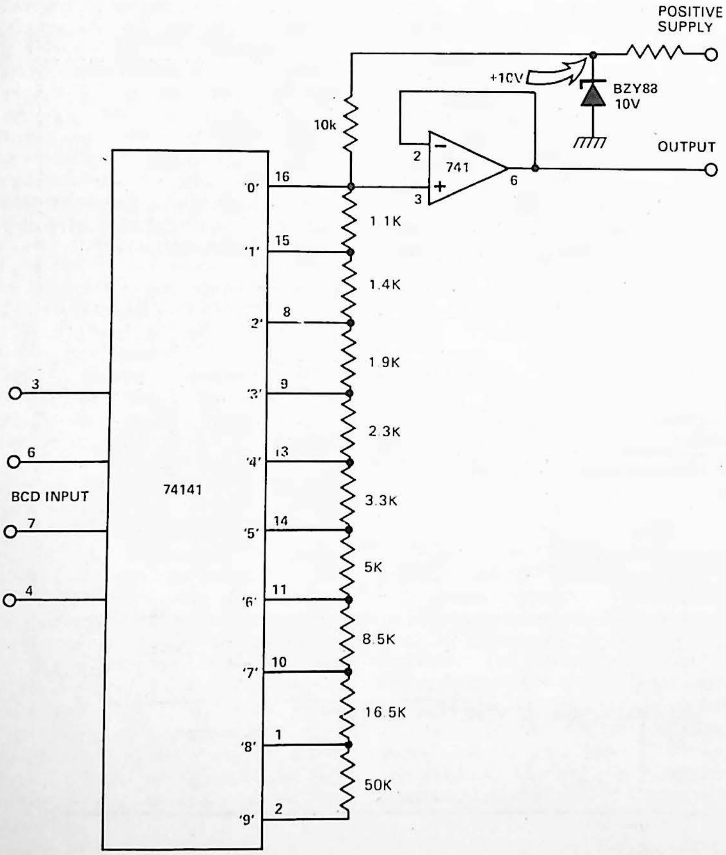
NOTE:
IC1 IS ¼ LM3900
D1 IS ANY GENERAL PURPOSE DIODE

The LM3900 is different from most op-amps in that it is current differencing and operates from a single supply rail, which mean that the inputs bias at one base-emitter voltage above ground. Hence standard techniques are not applicable as the diode would always be forward-biased. Two feedback paths are therefore provided:— R3 for DC stability, and R4 for the AC signal after C2 and R5 have filtered out the DC bias. When R2 = 2 × R3 point A will be at Vcc/2, allowing the diode to be reversed at will. For large positive input returned to ground, input impedance equals R1, and voltage gain equals — R4/R1 since R4 is made very much smaller than R3. C1 and C3 are DC blocking capacitors and determine the low frequency roll-off. Component values quoted are those used on the prototype and may be altered to suit individual requirements.

This circuit has obvious potential, especially in portable equipment where the 4 amps. in one package and single supply rail yield a more compact, more convenient unit.

BCD to Analogue Converter

C. R. Poole



This circuit will convert four-bit BCD into a variable voltage from 0-9V in 1 volt steps. Only two ICs are used, both are readily available.

The SN74141 is a 'Nixie' driver, and has ten open-collector outputs. These are used to earth a selected point in the divider chain, determined by the BCD code at the input, and so produce a corresponding voltage at the output.

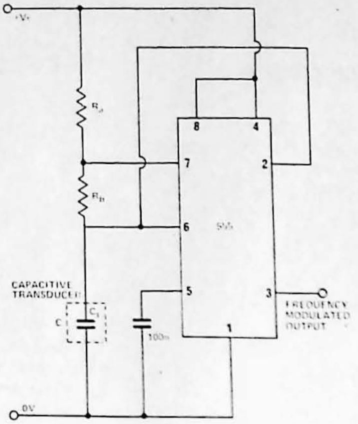
The accuracy of the circuit depends on the tolerance of the resistors and also the accuracy of the reference voltage. However, presets can be used in the divider chain, with correct calibration. The 741 is used as a buffer.

Low Cost Transducer Amplifier

T. Barnett

Capacitative tranducers are often used to measure displacement or pressure. The versatility of the low-cost 555 integrated circuit timer can be utilised with these types of transducer to provide a frequency modulated output. This output, fed into a frequency-to-voltage converter, will give an analogue output voltage proportional to the capacitance of the tranducer.

The 555 module is connected with the tranducer C_t substituted for the external timing capacitor. Precise setting of the duty cycle is obtained with resistors R_a and R_b and with pins 2 and 6 connected together, the device will trigger itself and thus free-run as a multivibrator. As the output will source or sink current up to 200 mA or drive TTL circuitry, it can be fed directly into most types of frequency-to-voltage converter.



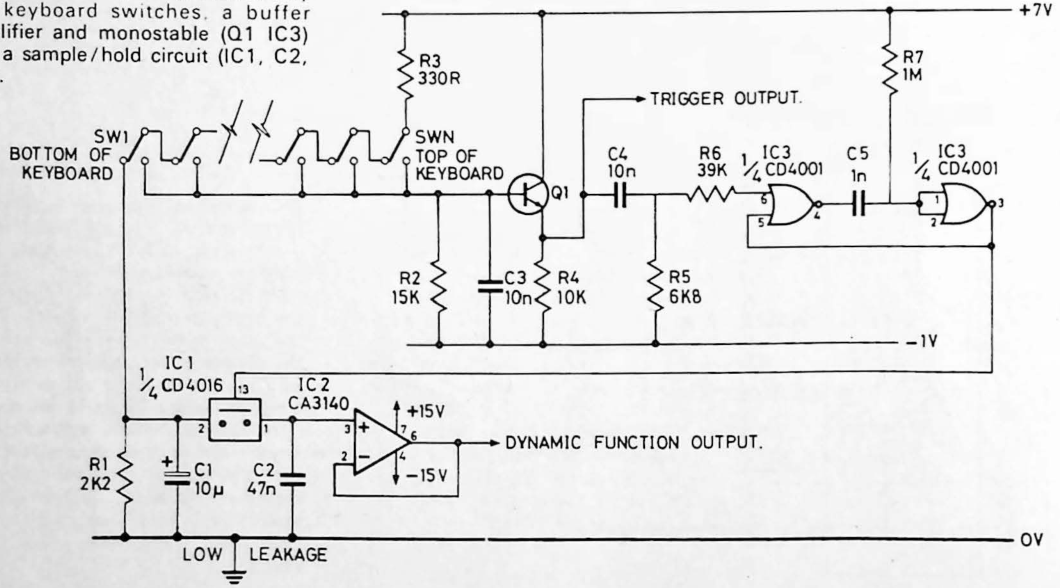
Dynamic Sensitivity

W. Stride

A dynamic function (touch sensitivity) greatly increases the flexibility of expression available to the player of a music synthesizer. This circuit achieves the dynamic function by measuring the change over time of the keyboard switches, and hence the velocity of the key depressed.

The circuit is basically composed of three parts; firstly an RC time-constant network (R1C1) controlled by the keyboard switches, a buffer amplifier and monostable (Q1 IC3) and a sample/hold circuit (IC1, C2, IC2).

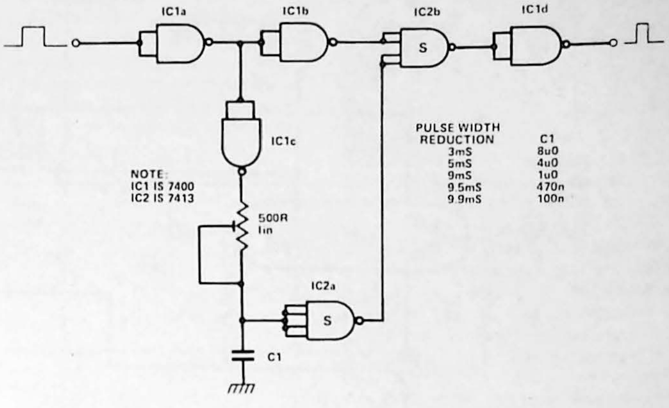
Normally C1 is kept charged up to +7 volts through the 'chain' of closed keyboard switches. When a key is depressed, the 'chain' is broken and C1 discharges through R1. As the key is further depressed, contact is made with the trigger busbar, Q1 is turned on, and the monostable triggered. The monostable gives out a 1 millisecond pulse, which causes the analogue switch (IC1) to close allowing C2 to charge up to the voltage on C1 at that time. After this, the voltage is stored on C2, the output being buffered by IC2. Since the input impedance of IC2 is ~ 1.5×10^{12} ohms the delay time of C2 is very long. An output is available from the emitter of Q1 to trigger envelope shapers etc. To make sure the response is the same all over the keyboard, the distance between the gold wires on all the contact assemblies should be made the same.



Digital Pulse Compressor

N. C. Hall

Whilst constructing a digital frequency meter the author found it necessary to be able to accurately trim the width of a gate pulse. The circuit shown uses only two ICs and can reduce the width of a pulse applied at its input by up to a few milliseconds. The table shows the reduction achieved by using different values of C1.



PULSE WIDTH REDUCTION	C1
3mS	8u0
5mS	4u0
9mS	1u0
9.5mS	470n
9.9mS	100n

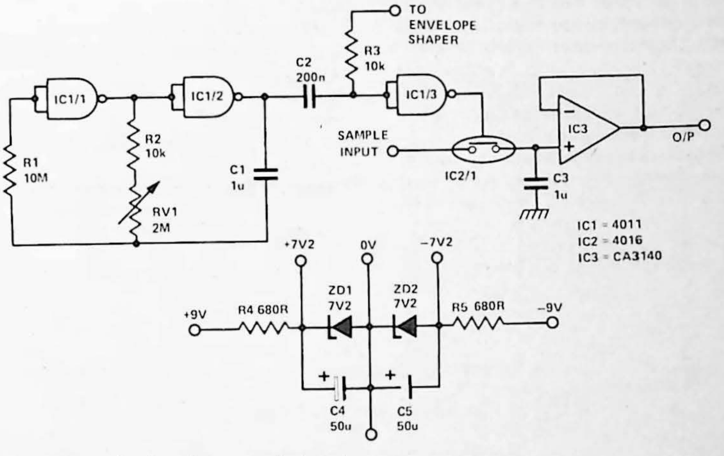
Sample And Hold For Music Synthesizers

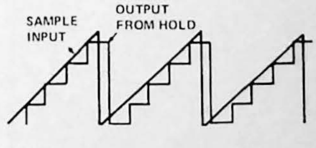
L. Robinson

Sample and hold is a useful effect for use with music synthesizers and consists of 'sampling' an input voltage function such as a waveform for a very short time and then 'holding' it at this selected voltage level for the duration of the clock period. This voltage is then used to control the frequency of a voltage controlled oscillator, filter etc.

It is therefore possible to produce random or repeating sound patterns by varying the input waveform and frequency, pink noise can be used as a sample source to create authentic random voltages.

The circuit shown is much simpler than previously designed sample and hold circuits, this is possible by the use of CMOS technology. The clock oscillator is a standard CMOS square wave oscillator as found in RCA application notes, and this is used to provide a variable frequency rate from 0.2 Hz to 45 Hz. The output then goes to the synthesizer envelope shaper which should be of the ADSR type for maximum effect. The clock output also goes into a monostable which produces an output pulse of approximately 20 mS which opens the 4016 analogue gate for this period. The voltage input is therefore sampled and the value of the amplitude at this point of the waveform is remembered by the high input impedance (10^{12} Ohms) CA3140 voltage follower. This output is then used to control the VCO etc. The oscillator and monostable can be constructed from either a CMOS 4001 or 4069, ensuring that unused pins are connected to the high or low power supply line via a 1k resistor. The input waveform to the analogue switch can have an amplitude of ± 7 V maximum.





If a FET was used as the gate, it would only respond to negative voltages, so the more expensive analogue switch is used for this reason. The total cost of the circuit, including the ± 7 V rail, is less than £3.

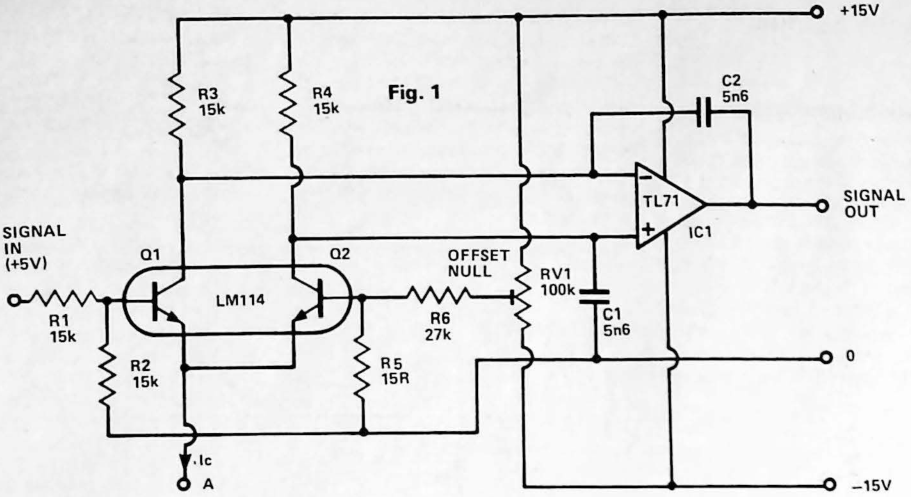


Fig. 1

Voltage Controlled Filter

T. W. Stride

The voltage controlled state variable filter has become almost standard in sound synthesizers, especially since the advent of the CA3080 transconductance amplifier. However, the CA3080 is a reasonably noisy device and this can be annoying when large passbands and / or high Q values are being used in the filter. This circuit is for a low noise, high performance transconductance multiplier, which though not cheap, will offer a truly Hi-Fi performance.

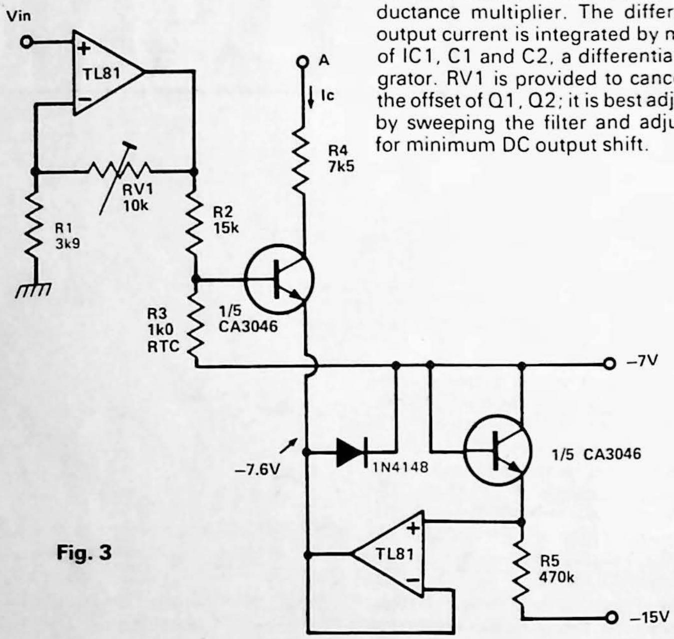


Fig. 3

R1 and R2 attenuate the input signal to keep distortion low, and Q1, Q2 with R3, R4 form the transconductance multiplier. The differential output current is integrated by means of IC1, C1 and C2, a differential integrator. RV1 is provided to cancel out the offset of Q1, Q2; it is best adjusted by sweeping the filter and adjusting for minimum DC output shift.

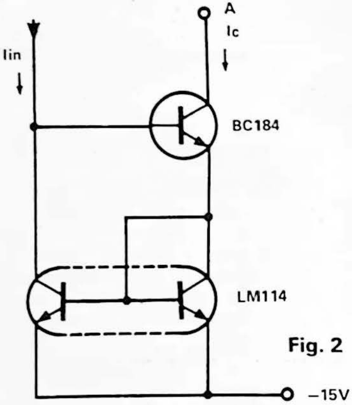


Fig. 2

As can be seen from Fig. 1, the gain of the integrator is controlled by a constant current Ic. This current can be provided in two ways, either from a current mirror (Fig. 2) which then makes the circuit an almost exact replacement for the CA3080, or for original equipment designs, from a current source. If it is desired to use this circuit as a replacement for a CA3080 in, for example, the Transcendent 2000 synthesizer, the following modifications are necessary. The integrating capacitor on the output of the 3080 must be replaced with a 10 k resistor and the input attenuator on the above circuit is discarded. The control current that would flow into pin 5 of the 3080 is input to the current mirror and the output current is drawn from the transconductance multiplier (point A).

High Quality Tone Control

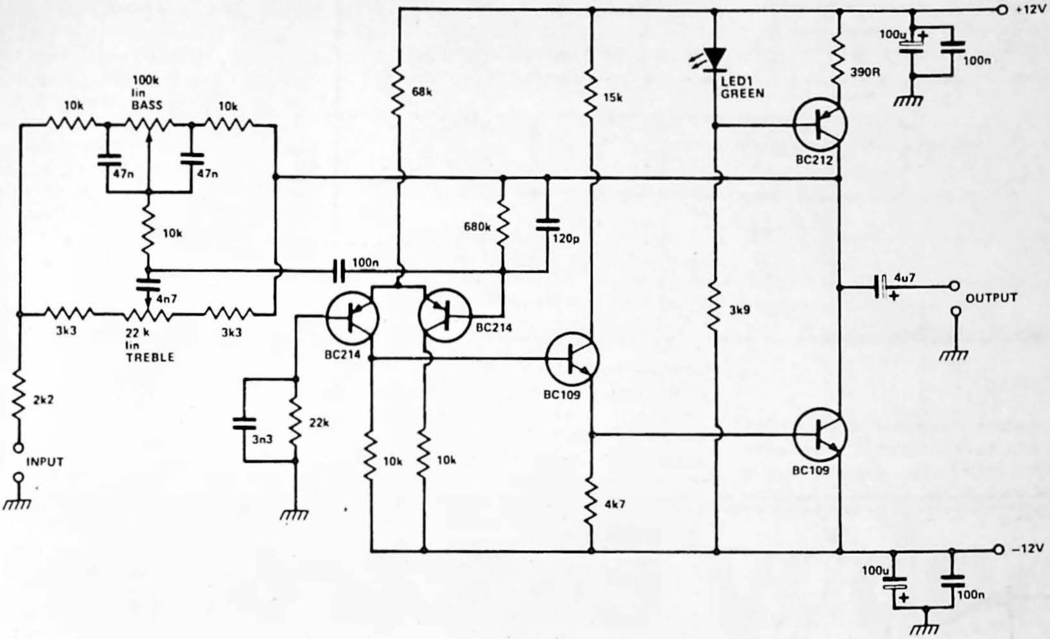
P. Mills

When designing a high quality pre-amp, the author was faced with the problem of designing a suitable tone control stage. Op amps such as the 741 are commonly used, but in general have a poor slew rate, fairly high distortion and high noise when used in this application.

The circuit shown is based on an inverting op amp using discrete transistors to overcome the above problems. The output stage is driven by a constant current source, biased by a green LED to provide temperature compensation.

With the controls flat the unit provides unity gain, so the stage can be switched in or out.

The design is suitable for inputs between 100 mV and 1VO, and provides a good overload margin at low distortion for the accurate reproduction of transients. The usual screening precautions against hum should be carried out.



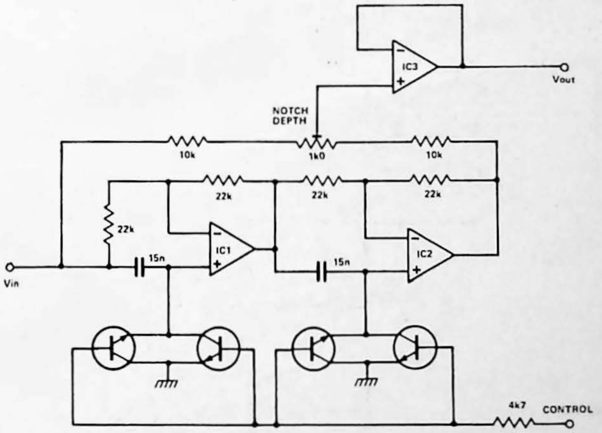
Variable Notch Filter

P. McChesney

In electronic music circuits there is need for an all-pass notch filter possessing a movable notch frequency. The circuit shown is capable of moving the reject frequency over a 10 kHz range throughout the full range of audio frequencies, the position of the notch being dependent on the voltage applied to the control input.

IC1 and IC2 are both all-pass filters possessing a flat frequency response well beyond the audio range, but having a phase difference between input and output signals of 0.5/CR. This phase difference becomes 180 degrees, so that if the output and input are mixed, signal cancellation occurs i.e. the circuit is now working as an all-pass notch filter, letting through all frequencies except at 0.5/CR.

The two transistor networks Q1, 2 and Q3, 4 act as voltage controlled resistors which allow the notch frequency to be moved when the control voltage is changed.

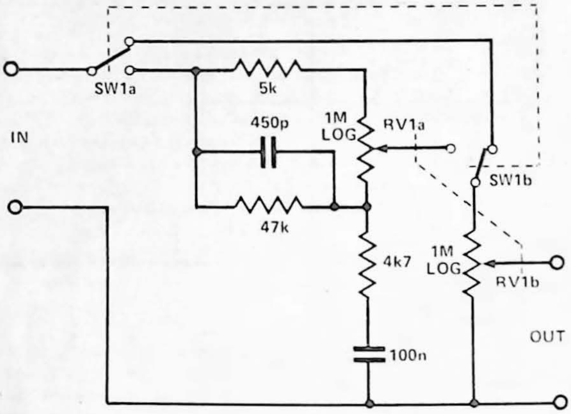


Loudness Control

David Chivers

This loudness control works with the volume control to provide a more even listening contour. Since the human ear can hear sound in the middle of the audio spectrum better than at the extremities, it is desirable to attenuate high and low frequencies less than the middle frequencies as the volume is cut.

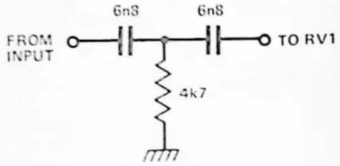
With SW1 on, bass and treble are boosted relative to middle frequencies. RV1a is ganged to the volume control, this varies the strength of loudness control so that at low volume the effect is more noticeable. This unit will replace the volume control in a present system, coming between the preamp and power amplifier. If a stereo unit is to be made, SW1 should be four pole two way, and it is best to have separate volume / loudness controls for each channel since four way potentiometers are hard to find.



Modification to Tape Noise Limiter Feb '79

P. Burns

The performance of this unit may be greatly improved by this simple modification. The original circuit assumes that a high level music signal will mask background noise. In reality a high level bass signal will trigger the filter, giving an audible 'whoosh' of noise. This can be alleviated by adding a simple high pass filter to the control circuit. The filter removes signals below 5 kHz, resulting in a cleaner, less breathy, sound. It should be noted that the input impedance of this circuit is only about 3 k and it may be advisable to precede this circuit with an emitter follower.



Extension Trigger Device for Synthesizers

J. Trinder

The following device is intended to provide a trigger pulse for a synthesizer when using an external input source, e.g. a guitar.

The output from the guitar must first be amplified by a small power amplifier in order to bring the signal to a sufficient level to operate the device.

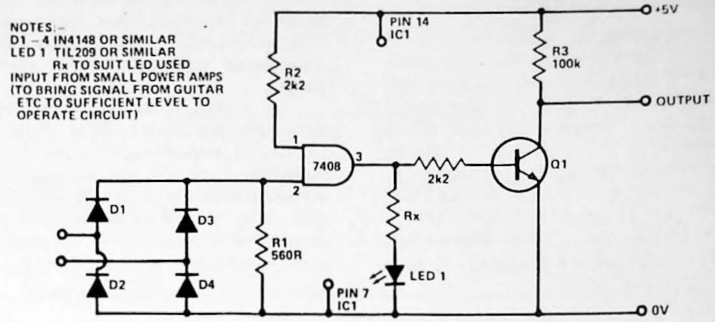
The AC input to the device is converted to DC by the bridge rectifier. When the DC level reaches a sufficient level the input of the AND gate is taken high. As the other input is already high its output becomes high.

When this happens the transistor is turned on, thus taking the output voltage to nearly zero. When the DC level at Pin 2 falls below the required level its output goes low thus turning the transistor off.

The output from the device is approx 3V5 (off) and approx 0V (on). The LED is on when the unit is triggered.

The synthesizer intended for use with the circuit has an extension trigger input which requires less than −3V on, thus the common and output connections of the external trigger device have to be reversed so that the external trigger input usually sees −3V5 (off) instead of +3V5.

The circuit can be easily modified to suit individual needs. An example of its use is to trigger a filter sweep when the input of, e.g. a guitar, reaches a certain level.


NOTES:–
D1 – 4 IN4148 OR SIMILAR
LED 1 TIL209 OR SIMILAR
Rx TO SUIT LED USED
INPUT FROM SMALL POWER AMPS (TO BRING SIGNAL FROM GUITAR ETC TO SUFFICIENT LEVEL TO OPERATE CIRCUIT)

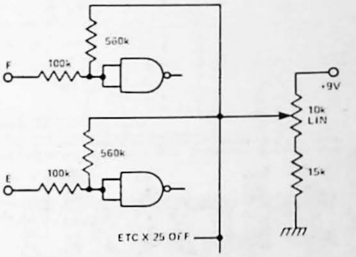
Organ Modification

I. Cole

One of the problems with the ETI Touch Organ (December 76) is that peoples skin resistance varies enormously and with the 4M7 pull up resistors as specified, when a person with moist skin touches the keyboard the note is sustained for several seconds even when the finger is removed.

This modification provides a solution in the form of a sensitivity control.

The pull up resistors are removed and replaced by 560k resistors stood vertically on the board. The free ends of the resistors were then joined with a piece of rigid wire and connected to the wiper of the "sensitivity" pot.

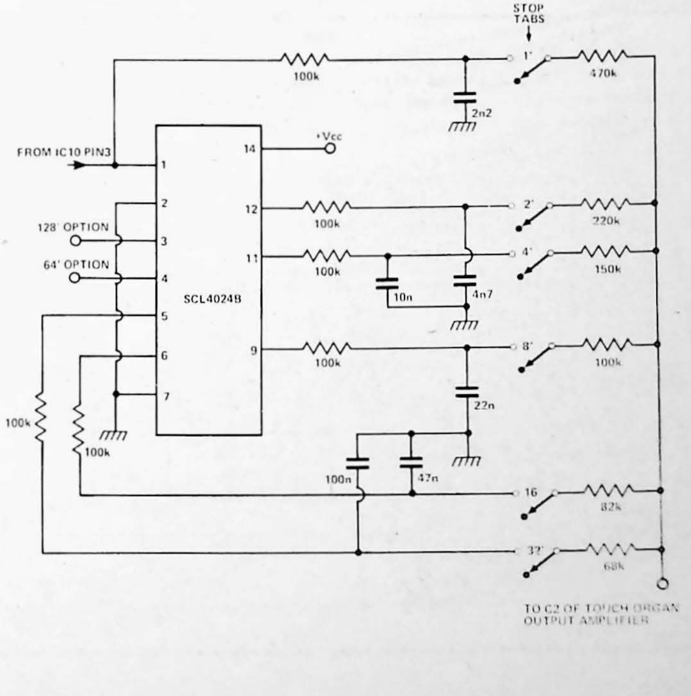


Electronic Organ Divider

J. L. Errington

In order to improve the versatility of the ETI Touch Organ it proved desirable to enable further octaves to be used. The circuit shown uses a CMOS divider IC to produce up to seven octaves below the fundamental. To increase the upper limit of the range, the original value of C1 in the touch organ was reduced to 5n6, so that the basic two octaves were from 699Hz to 2796Hz.

This was designated as the 1′ pitch, and the first five divided outputs from the 4024 were 2′, 4′, 8′, 16′, and 32′ pitches. All these were then fed via separate RC filters to stop switches, then through a resistive mixer to the existing audio amplifier. The values used in the mixer may be adjusted to suit individual requirements. The input to the divider is fed directly from the output (pin 3) of the 555. Although designed specifically to complement the Touch Organ, this circuit is also suitable for many other simple organ circuits.



MUSIC & SPECIAL EFFECTS

Keyboard Guitar

A. Parker

The purpose of this project is to convert the waveform from a guitar or other instrument into pure square or pulse waveforms of the same frequency. The circuit is basically a frequency to voltage converter feeding a linear VCO.

The construction is straightforward provided the usual care is taken with the CMOS chips. For RV1, 2 and 3 we suggest 20 turn presets as these will be needed for fine tuning of the circuit later. Also as an aid in testing we suggest that RV1 should NOT be soldered in until after initial testing has been completed.

The tuning of the circuit is best done using a Meter, PSU, Signal Generator and frequency meter if possible. First set the sig gen to some suitable frequency (ie 100 Hz) and using the meter between point A and earth adjust RV2 to give a voltage according go the formula

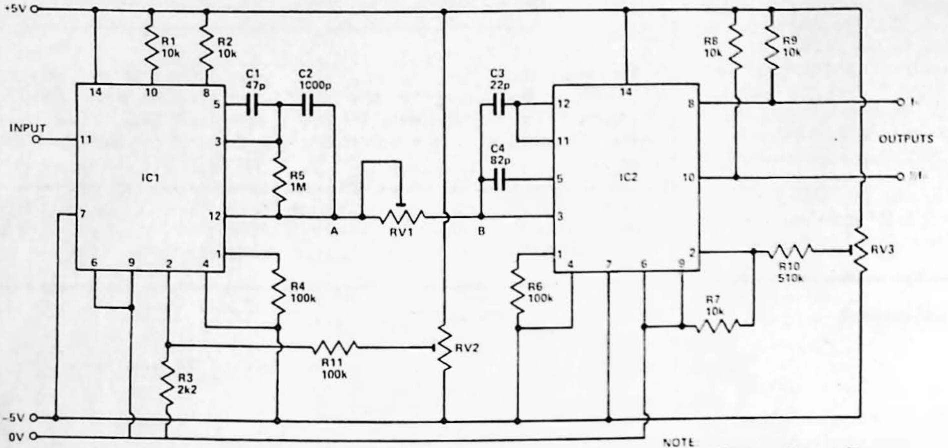
$$V = F_{in} x 10^{-3}$$

(for 100 Hz V = 100 mV)

Now using an ACCURATE PSU set point B to +1 V and using RV3 adjust the output to 1 kHz then set to +10 V and adjust to 10 kHz. Now solder RV1 and adjust until

$$F_{in} = F \text{ out}$$

(NB This is a gross over simplification and patience is vital. Remember the price of the chips before you throw them out of the window).



NOTE:
IC1,2 are RS Voltage to Frequency Chip
No. 307-070
RV1,2,3 are 50k 20 turn trimmers

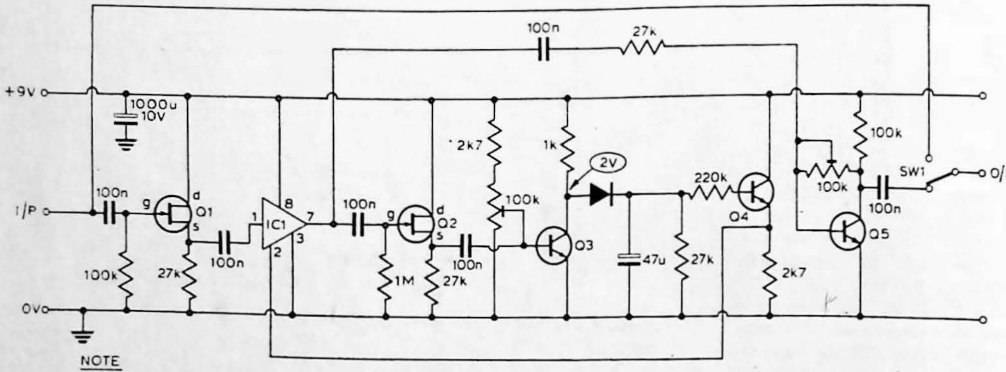
Guitar Sustain Unit

S. D. Maistre

The sustain to be described here holds the output at a constant level over a wide range of input levels. It was designed for use with electric guitars and has a maximum effect with the guitar pick-up volume full up.

The principle employed is that of an AGC, whereby the circuit output is monitored by a DC voltage follower which controls the gain of the VCA through which the signal passes. The advantages of this circuit are that, unlike many such devices, it does not use opto-coupling which draws too much current for battery powered equipment; it produces no audible distortion; components are easily obtained — and cost is low.

Construction method is not critical.

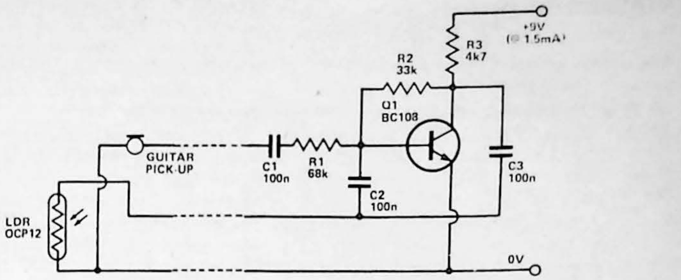


NOTE
Q1,2 are 2N3819
Q3,4,5 are BC109C
D1 is OA91
IC1 is MC3340

Autowah Without Tears

S. N. Goodwin

The main disadvantage of a simple wah-wah circuit is that it requires a manual trigger for the effect, usually provided by a foot-pedal, which needs solid (and often expensive) mechanical construction and also prevents the guitarist from moving freely about the stage. After a couple of hand-made pedal systems collapsed in use, the standard wah-wah circuit was modified as follows. A light dependent resistor was mounted on the soundboard of the guitar about 2 cms from the highest string, pointing out about 1 cm from the front of the instrument. The shadow of the player's hand moving across the guitar triggers the effect — the more light shining on the LDR, the higher the frequency-range boosted by the circuit.



It is tolerant of quite a wide range of light levels and if the range is found to be incorrect this can be rectified in two ways. Lenses or filters can be put across the LDR, or resistors can be connected in series/parallel with it.

Fluorescent lights could give problems with mains hum, but, under normal incandescent lighting, none were experienced. The wire to the LDR should ideally be screened, but over short distances this is not vital. Avoid bending its leads close to the body, as they can be snapped off very easily.

Shifty Phase Adaptor

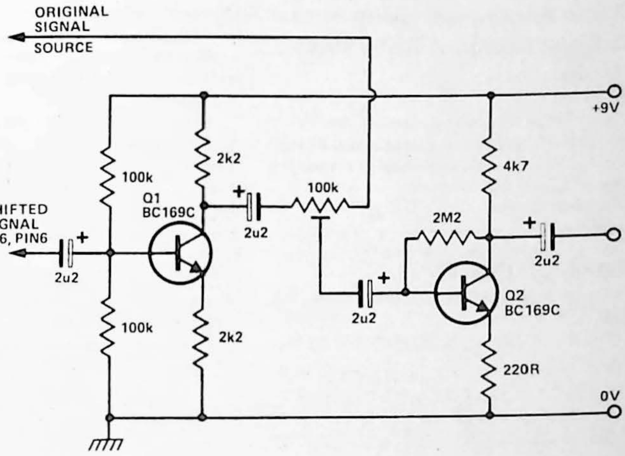
Q. Rice.

This circuit can be used in conjunction with the Audio Phaser from the December, 1976 ETI, or with any other phasing unit for that matter. The circuit provides a complementry (antiphase) shifted waveform which is mixed with the original waveform and amplified.

When this is fed through stereo speakers, it provides the ear with some very peculiar sounding phase information.

At slow speeds, the effect is very much like panning, except that the image is ambient irrespective of the position of the listener. At higher frequencies, where actual frequency shift occurs, a delayed tremelo effect is obtained.

This phase or frequency shifted panning would be most useful in stereo PA systems where the only place where all of the instruments can be heard is in the middle of the dance floor!



CCD Phaser Modification

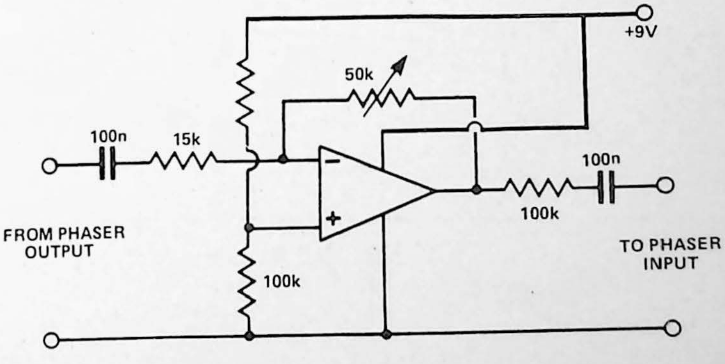
M. Headey

I constructed a simple variable gain op amp inverter and connected it between the output and the input.

When the feedback amp was switched into circuit the effect was dramatic. The phaser sounded much deeper.

The modification is simple enough and though can be adjusted to feedback (audio) level, sounds very good if the gain is kept down.

The circuit as shown gives very good results although you may be able to suggest some component value changes.



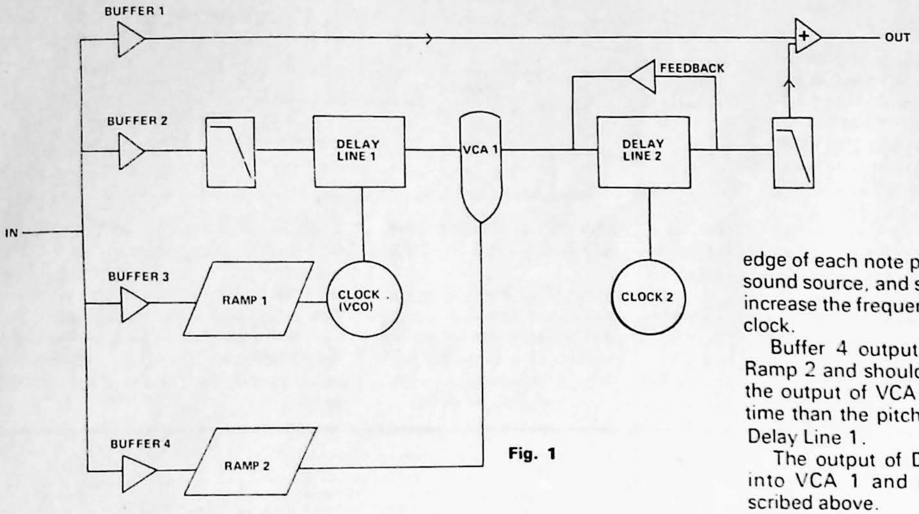


Fig. 1

Audio Harmoniser using Bucket Brigade Analogue Delay Lines

S. Giles

Object:

To create an audio signal which is increased in pitch by up to one octave from the original, and sustain it for the duration of the original.

Applications:

- (a) electric guitar
- (b) synthesisers with one VCO
- (c) human voice???

Description of Block Diagram (fig. 1)

The input signal is buffered into four separate paths which are dealt with as follows:

Buffer 1 output is unprocessed and will apear at the mixer as original signal.

Buffer 2 output is low pass filtered and fed to the input of Delay Line 1. This should consist of as many TDA 1022's that are required to create a one octave pitch change when clocked by a VCO which is modulated by Ramp 1.

Buffer 3 output is converted into Ramp 1 for modulating Delay Line 1 clock to produce the pitch change. The ramp is triggered by the leading edge of each note played on the input sound source, and should be set up to increase the frequency of Delay Line 1 clock.

Buffer 4 output is converted into Ramp 2 and should be set up to hold the output of VCA 1 for slightly less time than the pitch change is held in Delay Line 1.

The output of Delay Line 1 is fed into VCA 1 and controlled as described above.

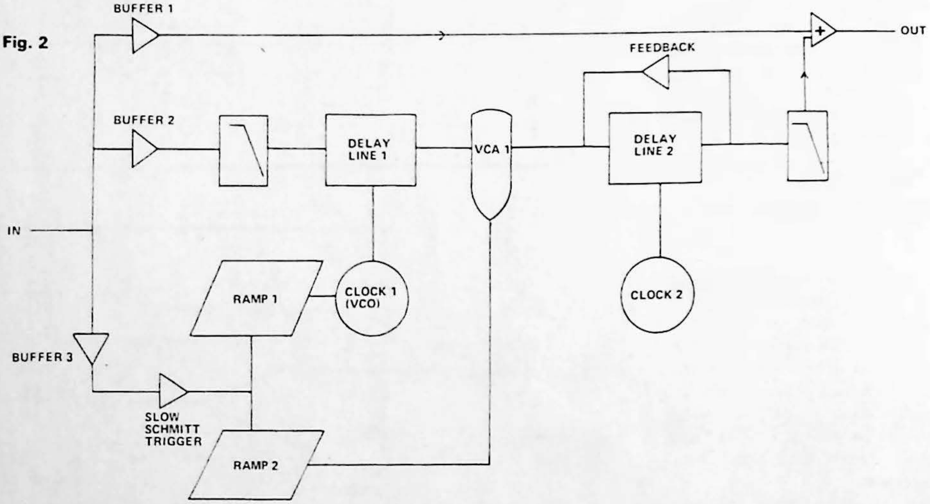
The output of VCA 1 is fed into Delay Line 2 which is wired as a reverberator with its feedback set very high, but not over-loading.

The output of Delay Line 2 is low pass filtered and mixed with the original unprocessed input from Buffer 1 in the required proportions.

Alternative Approach (fig. 2)

This should enable Ramps 1 and 2 to be triggered more than once during each note thus sustaining the signal which is changed in pitch even longer. Only three input buffers are required in this arrangement.

Fig. 2



Digital Echo Unit

J. A. Murdie

The Digital Echo Unit described below may be constructed on standard Eurocard PCBs with 31 way connectors, and utilizes the cheap 2102 1K static RAM, of which from any amount from (say) 32-64K may be used to achieve a (continuously variable) delay of up to a second. The delay time is of course directly proportional to the amount of memory used. There are three PCB designs used: Fig. 1: Input/Clock board (1 off), Fig. 2: Output/Control board (1 off), Fig. 3: 8K Memory Board (max. 8 off).

Dealing with the input board first, it may be seen that the 555, 7476 and 7408 constitute a non-overlapping two phase clock whose outputs are 'Enable Read' (ER), and 'Enable Write' (EW). During the write phase a bit is taken from the digitized input and fed to the 'Data Write' (DW) line. The AD convertor used is the FX209 which was featured in the ETI June 1976 Data Sheet. The bits created are placed in the memory location addressed by the 12 bit counter ('Bit Address'). on this board and the 4 bit counter on the Output/Control board ('Block Address').

When the ER line goes high a bit is taken from the memory address pointed to by the counters with the 4 bit value produced by the Hexadecimal Priority encoder (Delay Switches) being added to the block address. Thus the 'distance' between the write and read 'heads' may be altered to place them any number of blocks apart, and thus create a choice of 16 basic delay lengths. The bit read is placed on the DR line and is then converted to an analog value by the DA convertor. Note that some of the output may be fed back to the input ('Regen') to create multiple echo effects.

After this sequence of a write and a read cycle the bit/block address is incremented by one so a succession of bits may be placed in memory by input, and read from the memory by the output. The rate at which this sequence occurs is controlled by the clock rate of the 555 astable, and thus this not only controls the delay time as do the delay switches, but also the quality of the reproduced sound as this is independent on the number of samples taken per second in the digitizing process. The device may be set up to digitize the analogue input at a maximum of 125 K bits/second — which is quite adequate for (say) an electric guitar which requires a bandwidth of some 10 KHz.

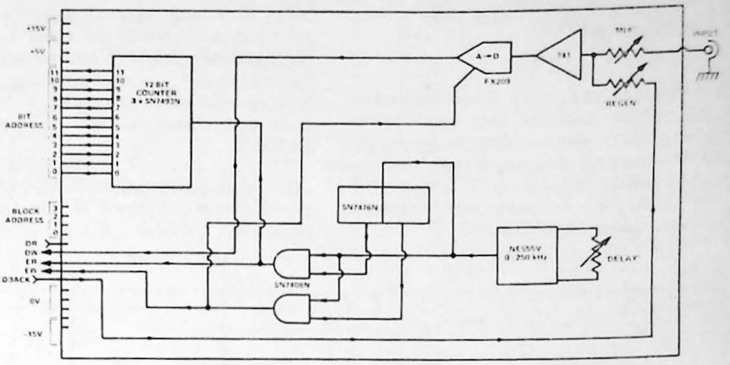


Fig 1. Input/Clock Board

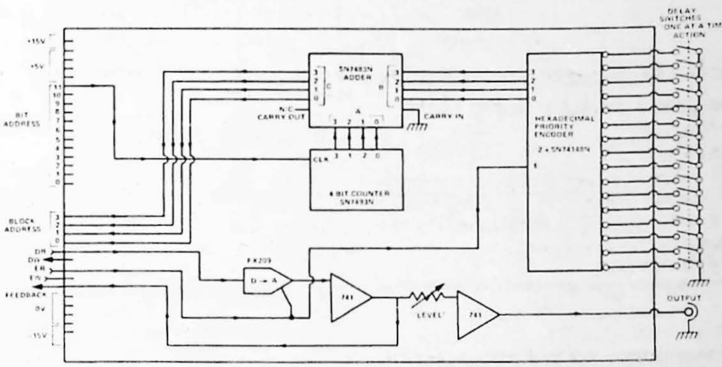


Fig 2. Output/Control Board

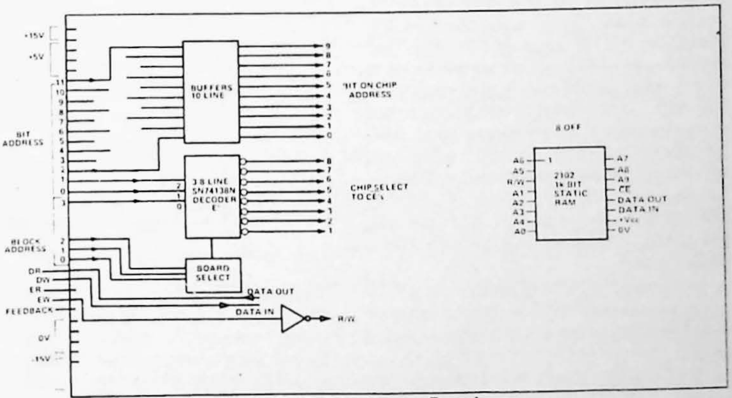


Fig 3. 8K Memory Board

Metal Detector

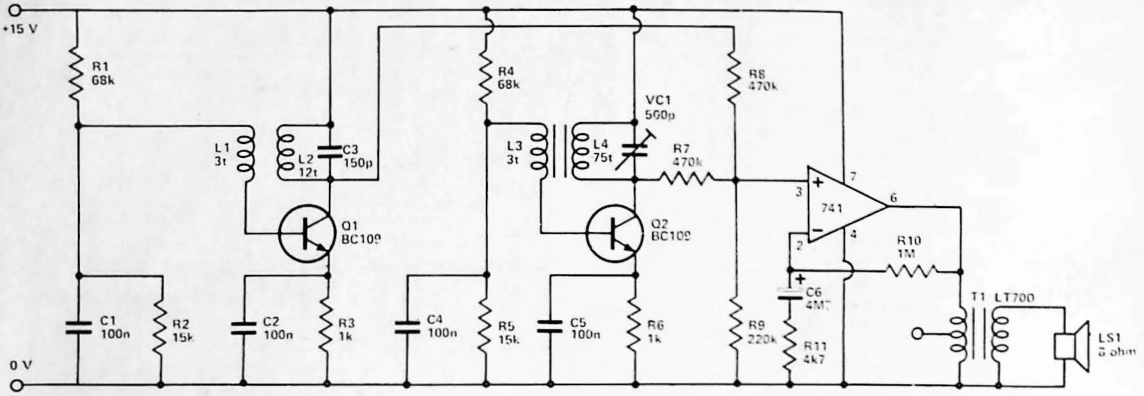
J. P. Macaulay

In common with most simple detectors, this circuit uses the fact that the inductance of the search coil changes when it nears a metallic object.

The search coil, L2, is 12 turns wound on a 6 inch diameter non magnetic former, using 26 SWG wire.

The pickup coil, L1, consists of 3 turns of similar wire wound next to L2 on the former. C3 tunes L2 to approximately 700 kHz and L2 and L1 are connected in the collector and base circuits of Q1 to form, with the associated components, a simple oscillator.

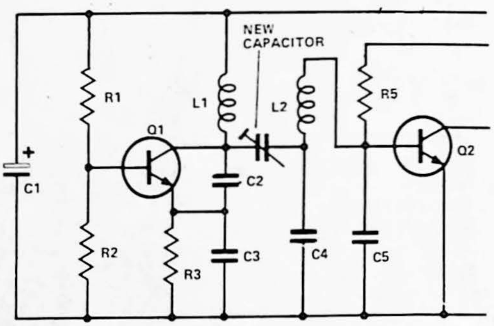
The local oscillator, built around Q2 is essentially the same as the search oscillator. L3 and L4 are however close wound on a .375 inch diameter ferrite rod, 3 inches long. Output from both oscillators is fed via a passive mixer, R7 and R8, to the non-inverting input of IC1. R9 in conjunction with R7 and R8 provides the IC with the required bias voltage. Because of the IC's internal roll off it will not amplify the RF, but will pass the audio beat frequency. T1 interfaces the output of the IC to the speaker, LS1.



Balance Circuit For ETI Metal Locator

C. Bray

This modification is an imimprovement to the ETI IB metal locator Mark 2, as published in the February 1978 issue of ETI. The first two stages of the circuit showing have been redrawn showing the modifications, the additional trimmer capacitor is a Wingrove and Rogers type S60 multiturn tubular 2-25p, although any similar type giving smooth control between 1 and 8p will do. The function of the trimmer is to balance out coupling between the search head coils L1, L2.



In practice, the trimmer is set to approximately 3pf and the search head coils adjusted as in the original article.

Before a search is started, the trimmer should be adjusted for minimum meter reading, with gain control RV1 set as high as possible. This should be done in free air, but if it is found that lowering the head to the ground produces a slight change, this effect can also be trimmed out.

Even if the coils are mounted very substantially, and should not move, the degree of imbalance that occurs over quite short periods of time is surprisingly high and makes the fitting of this device well worthwhile.

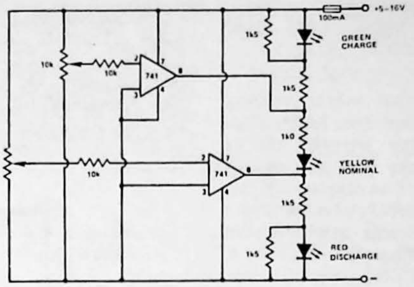
Battery Charge/Discharge Indicator

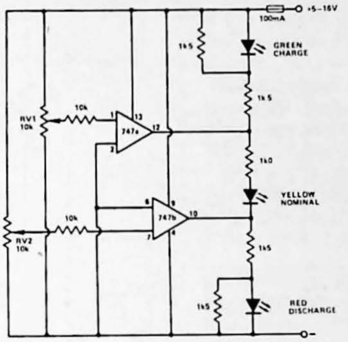
A. A. C. McInnes

This circuit is intended to monitor car battery voltage. It differs from other circuits in that it provides indication of the nominal supply voltage as well as low or high voltage. This makes it particularly useful for indicating deviation of the supply voltage from the nominal.

Three LEDs are used — red, yellow and green. Yellow indicates the nominal voltage and red and green indicate low and high values respectively. RV1 and RV2 adjust the point at which the red/yellow and yellow/green LEDs are on or off. Therefore, a wide supply voltage may be monitored.

The prototype has been installed in a car and set so that the red LED comes on at 11V7 and the green LED at 12V8. The yellow LED is on between these values.



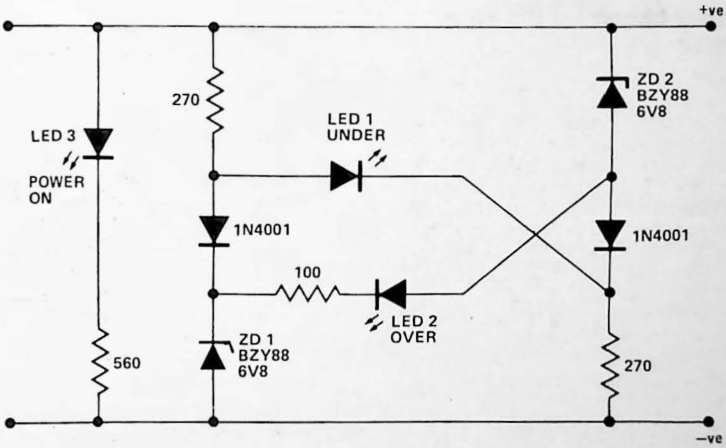


Supply Telltale

D. Shorthouse

Here is an idea for supply voltage monitoring, in the form of a voltage monitor for 12V supplies, indicating both over or under tolerance voltages. Using three LED's the user can see at a glance whether power is on, over-voltage or under-voltage.

This is achieved by means of a balanced bridge that uses zener diodes ZD1 and ZD2 in the bridge's opposite arms and back-to-back LEDs between the mid-points of the bridge arms, if the input voltage does not exceed the two zener breakdown voltages (2 × 6V8 = 13V6), LED1 lights but above 13V6 LED1 becomes reverse biased and remains off. When the input voltage increases to the extent that at the junction of ZD2, it exceeds the zener voltage of ZD1, plus the LED voltage of 1.6V, then LED2 is turned on, with resistor 100R limiting the current through the LED. Note total drain of unit is about 50 mA.



Bite Detector

David Chivers

Since there are over three million fishermen in the country, there must be many, who like myself, try to combine their hobby with electronics.

This circuit is for a simple bite detector, and construction of such a unit represents a considerable saving over the buying of a commercial instrument, while at the same time offering many additional advantages.

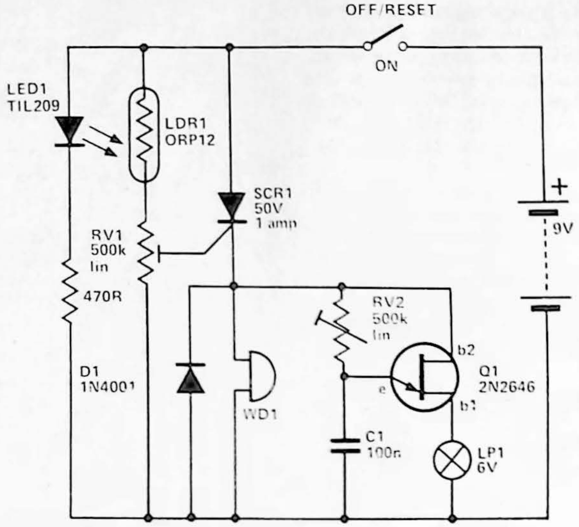
In operation, a piece of silver foil is folded over the line, and placed between the LED and the LDR. When a fish pulls on the line, the foil will jump up, and light will shine on the LDR, causing the resistance to go low, firing the SCR. Even if the foil drops again, due to its latching action, the SCR will remain on. WD1 will now emit a loud note, and the unijunction transistor, Q1, acts as a relaxation oscillator making LP1 flash (the rate of flashing being dependant on the setting of RV2). SW1 is the on/off reset switch.

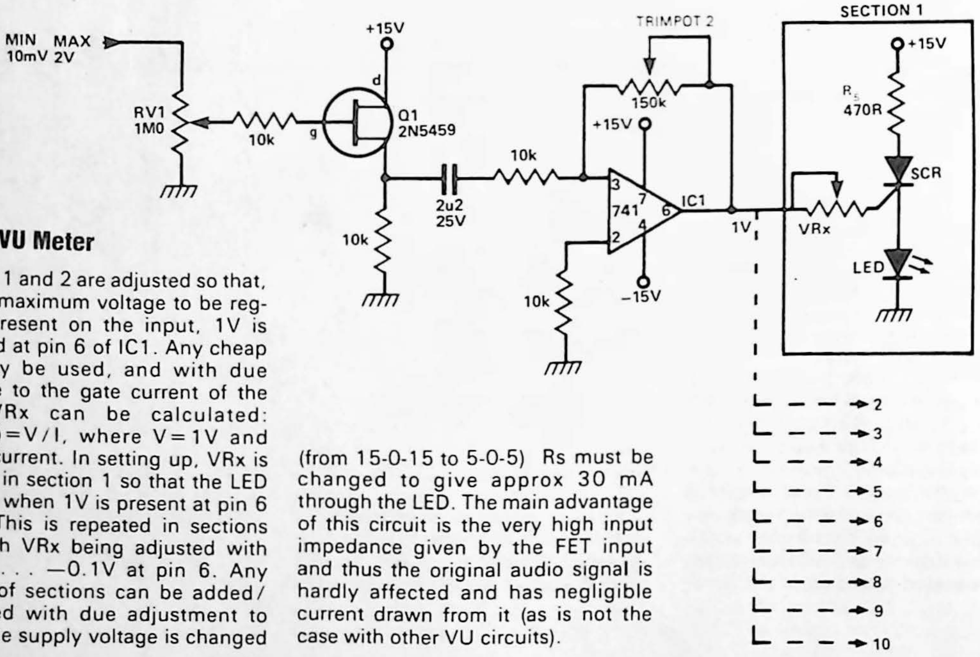
The setting of RV1 will depend on the amount of light reaching the LDR under quiescent conditions. The circuit is, if anything, too sensitive and in strong winds or heavy currents, additional weighting of the line may be necessary, in this case lead foil should be used.

WD1 and LP1 may be taken from the unit via an extension lead, and kept by the anglers tent or sleeping bag. The unit may be built onto a rod rest and should be fully waterproofed.

The devise has other applications; it may be used as a burglar alarm with a "trip wire" type detector, or perhaps even as a device to tell you when the cat has come in!

WD1 should be the type of device that draws a continuous current once energised.





Simple VU Meter

Trimpots 1 and 2 are adjusted so that, with the maximum voltage to be registered present on the input, 1V is registered at pin 6 of IC1. Any cheap SCR may be used, and with due reference to the gate current of the SCR, VRx can be calculated: R(ohms) = V/I, where V = 1V and I = gate current. In setting up, VRx is adjusted in section 1 so that the LED lights up when 1V is present at pin 6 of IC1. This is repeated in sections 2-10 with VRx being adjusted with 0.9:0.8 . . . —0.1V at pin 6. Any number of sections can be added/subtracted with due adjustment to VRx. If the supply voltage is changed (from 15-0-15 to 5-0-5) Rs must be changed to give approx 30 mA through the LED. The main advantage of this circuit is the very high input impedance given by the FET input and thus the original audio signal is hardly affected and has negligible current drawn from it (as is not the case with other VU circuits).

Stereo Balance Meter

JP Macaulay

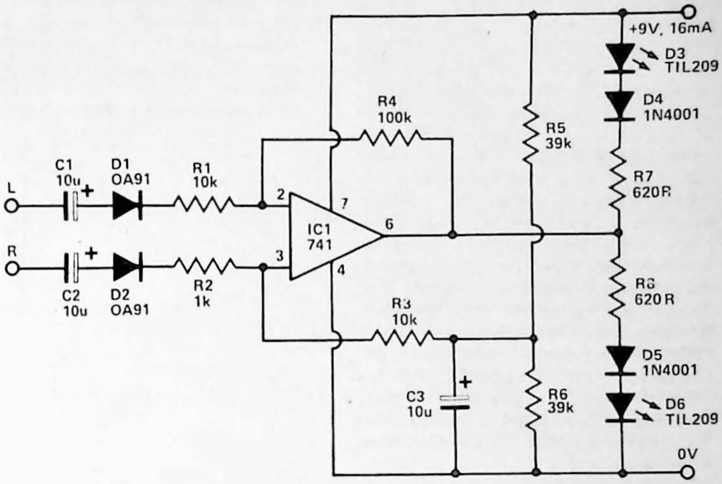
One of the more irritating aspects of owning a stereo system is the need to keep both channels in balance. What often sounds right when adjusting the controls turns out wrong when resuming one's normal listening position.

This circuit offers a solution to this problem provided that one's equipment is fitted with a stereo/mono mode switch.

IC1, a 741 op amp, is used as a differential amplifier. L and R signals are taken from across the speaker terminals. D1 and D2 rectify these and the resulting dc voltages are applied to the inputs of the IC.

The output voltage from the IC1 is applied to the LEDs D3 and D6 via the current limiting resistors R7 and R8, and the diodes D4 and D5. These latter components allow the LEDs to extinguish at extremes of the IC's voltage swings.

To use the indicator, switch the amplifier into the mono mode and adjust the the balance control until both LED's are equally illuminated. The amplifier can now be switched back into stereo mode and will be found to be in perfect balance.



Speaker Power Indicator

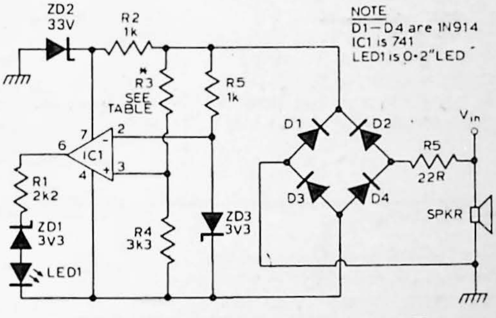
J. Macauley

This circuit will indicate the peak level of an input signal applied to a speaker. It is primarily intended as a fail safe device when connected to an amplifier of higher power rating than the speaker.

The circuit is unique in that no separate DC power supply is required since the circuitry operates from the input voltage to the speaker.

R5 isolates the amplifier's output stage from possible fault conditions in the circuit. D1 to D4 full wave rectify the input signal and the resulting DC is used to supply the op amp.

The 741 is used as a comparator a reference voltage being obtained from across ZD3 and fed into the inverting input of the op-amp. The non inverting input samples the rectified input signal. When a peak is fed into the circuit the IC's output goes high and the led flashes. ZD1 prevents the LED turning on when the output of IC1 is low due to the output being unable to go less than 1.5V above earth under these circumstances. ZD2 defines the upper limit of the op amp's supply voltage in the presence of large transients whilst R2 is the current limit resistor. It should be obvious that the level at which the led lights is dependent upon the value of R3. The accompanying table shows the value required for this component for different input powers across an 8 ohm load. If different load values are to be used for the speaker the value of R3 can be determined from the equation.



WATT/8Ω	5	10	15	20	25	30	35
R3kΩ	5·6k	9·1k	12k	15k	16k	18k	22k

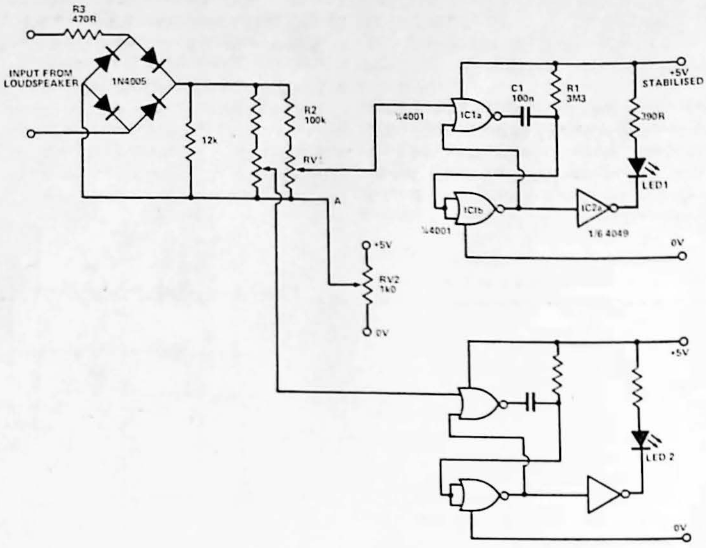
$$R3 = 1.4\sqrt{PR} - 3.3\ k\Omega$$

P = Pout

R = load in Ω

LED Audio Power Indicators

M. P Downes



The circuit diagram shows the input circuitry from the loudspeaker terminals. For simplicity only two of the monostable and LED driver cuits are shown. Six of these circuits can be constructed using three 4001s and one 4049 CMOS ICs. The circuit is based on the fact that CMOS has an input threshold of approximately half the supply voltage (actually 0.45 — 0.55 supply volts). IC1a and IC1b are dual input NOR gates connected in a monostable configuration with timing components R1 and C1. When the input to IC1a exceeds the threshold voltage, the monostable's output goes high for a period determined by R1 and C1 (with values shown approximately 200 mS). This output is inverted and buffered to drive a LED for this period. The input to trigger the monostable comes from the speaker terminals where it is full wave rectified and appears across RV1. R3 is a safety resistor in case of bridge failure. IN4005 diodes have the desired voltage and frequency characteristics for the bridge. R2 is to limit the current flowing into IC1a's internal protection diodes under large signal conditions and the value of RV1 depends on the desired input triggering voltage.

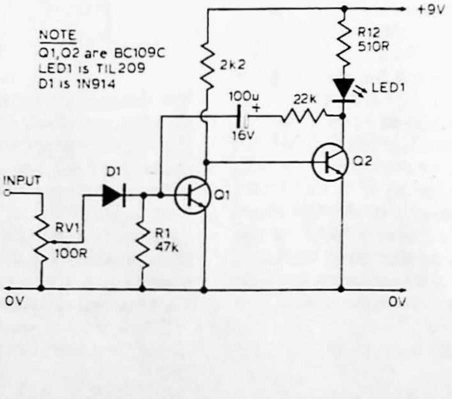
The lowest input voltage that can trigger the monostable is limited by the voltage drop across the bridge (0V8) and the threshold voltage of IC1a (approximately 2V5). The threshold limit is largely overcome by using RV2 to bias point A to just below the threshold voltage. In practice, the circuit operates on an input frequency of from less than 5 Hz to more than 50 kHz sinewave and at an input voltage of from approximately 1V4 RMS (0.25 W into 8R) to more than 90 V RMS (1 kW into 8R). A single positive or negative 4 uS wide pulse will also operate the circuit.

The +5 V supply must be stabilised to ensure stable threshold levels and the usual decoupling of ICs and supply is advisable. If two units are required for stereo use, two completely separate +5 V power supplies are essential to prevent partial shorting out of the input bridge, due to a possible common loudspeaker terminal in the amplifier. Greater input sensitivity can be achieved by using 0A91 diodes in the input bridge, but with slight loss in high frequency response and a lower maximum input voltage. If there is a variation in the threshold voltage of individual ICs then the lower threshold ICs should be used in the most sensitive positions of the circuit, i.e. 0.25W.

Peak Level Indicator

T. Norris

The diagram shows a simple monostable multivibrator with a LED which is normally lit, but will be briefly extinguished if the input exceeds a preset (by RV1) level. A possible application is to monitor the output voltage across a loudspeaker, when the LED will flicker with large signals.



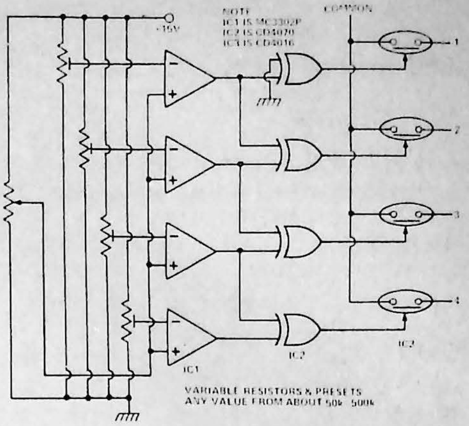
Slide Switch

C. Jordan

One of the disadvantages of slide pots is the unavailability of matching slide switches, as with rotary switches and pots, but slide pots can be given switching action by the use of this circuit.

Each analogue switch is only turned on when the comparators driving the respective EX-OR gate are in opposite states, i.e. when the voltage on the slider wiper is between the appropriate two preset voltages.

The example is a 4-way, 1-pole switch with off but any-way, any-pole switches can be made, using 741s as comparators if economic. A little mechanical ingenuity can provide click stops, if required.

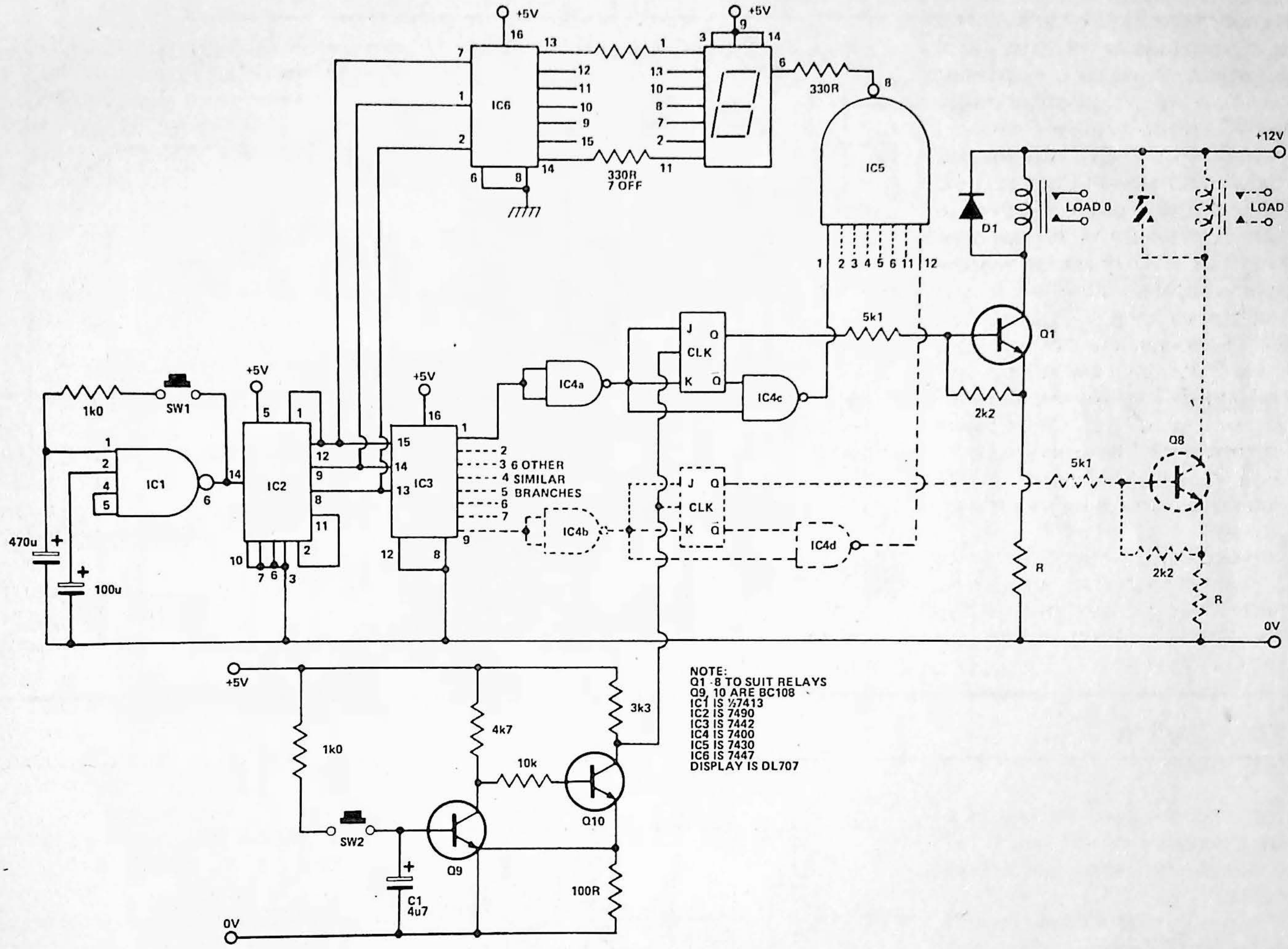


Electronic Switch

S. Yacu

This circuit provides remote switching of up to eight loads, and uses only two switches for selection. One switch is used to select the load to be controlled, the second controls whether the load is energised or not. If the state of one of the loads needs to be changed, SW1 is depressed until the number of the load appears on the 7-segment display. The decimal point then indicates whether or not the load is energised. To change the state of the load, SW2 is depressed (pressing SW2 again will change the load's state again).

The circuit is based on a 7442, BCD-to-decimal decoder and a 7490 binary counter. When SW1 is closed, the Schmitt trigger IC1 will oscillate and clock the 4-bit counter. This drives the 7-segment decoder/driver and the BCD decoder. The outputs from the BCD decoder are inverted and fed to the J-K flip-flops. When SW2 is pressed and released, a pulse will occur at the collector of Q10. The pulse will clock the selected flip-flop and activate or deactivate the relevant relay driver transistor (Q1-8).

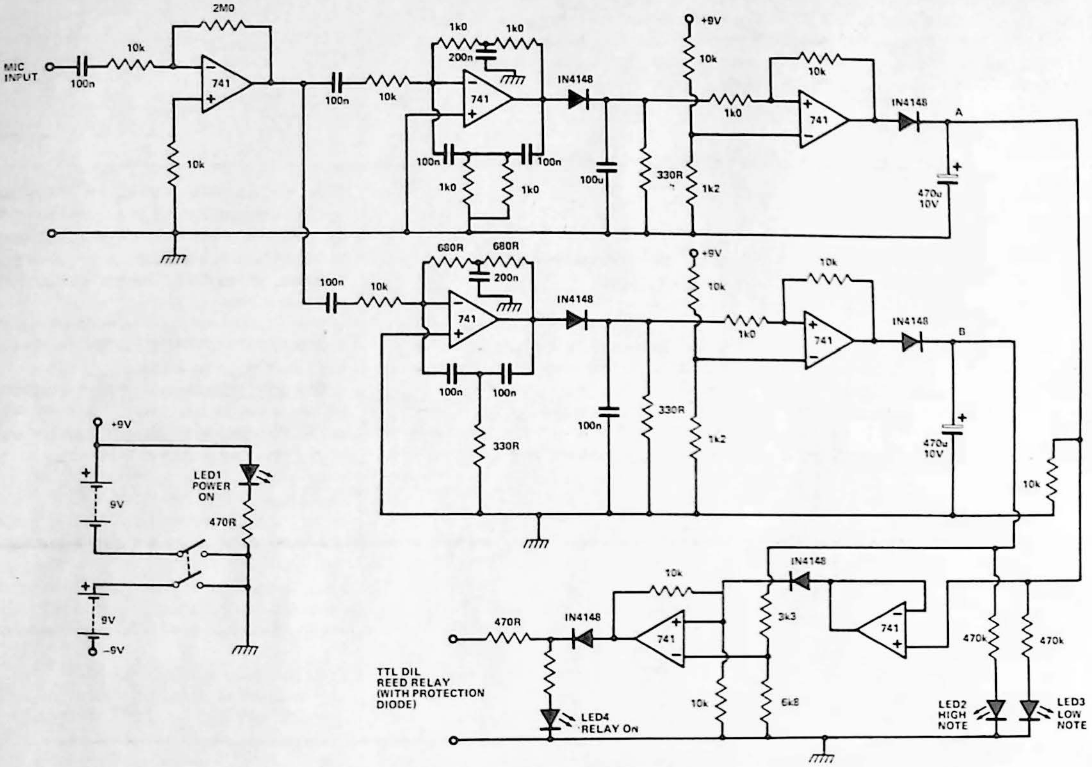


Whistling Switch

R. C. W. Gate

The circuit acts as a remote control switch, activated by whistling a high note and reset by a low note.

The input from the microphone is amplified by IC1 and then processed by two notch filters. The outputs of these are rectified and smoothed and used to fire the Schmitt trigger constructed from two operational amplifiers, ICs 6 and 7. The output points A and B can be used separately to drive other logic functions provided that if high impedance logic is used a 10 k resistor is placed in parallel with the 470 uF capacitor at these points.



Solid State Switch

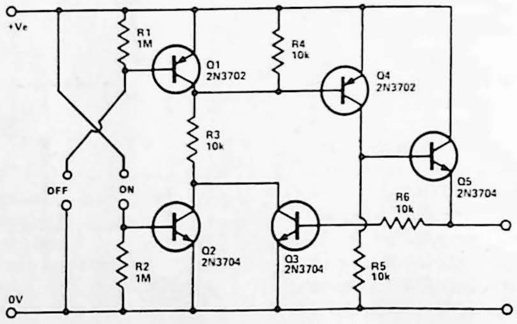
N. C. Burkinshaw

The circuit was designed for use as a solid-state calculator on-off switch, as the mechanical equivalent was found to be unreliable.

Layout is not critical and the switch will operate with a supply from +6V to +15V and current consumption in the 'OFF' state is a negligible 30μA.

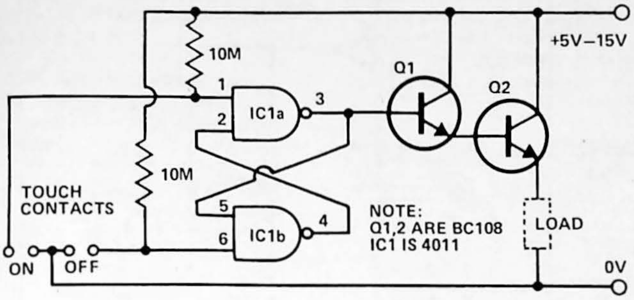
A finger across the 'OFF' contacts turns Q1 on and takes the base of Q4 to the +ve rail, turning Q4 off. This in turn stops Q5 conducting, and R6 and Q3 latch the circuit in this state.

Touching the 'ON' contacts takes R3 to ground turning Q4 on. Q5 now conducts and again R6 and Q3 latch the circuit.



Low Current Touch Switch

D. Ian



NOTE:
Q1,2 ARE BC108
IC1 IS 4011

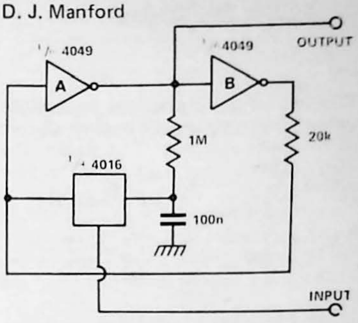
The cost of many CMOS ICs is now lower than a mechanical on/off switch. Using only one half of a 4011, plus a couple of general purpose transistors, a touch operated switch can be constructed which is ideal for many battery powered projects.

Assuming that the inputs to the remaining half of the 4011 are tied low, the current drawn in the off state is almost negligible and battery life is hardly affected.

Touching the 'on' contacts with a finger brings pin 3 high, turning on the darlington pair and supplying power to the load (transistor radio etc). Q1 must be a high gain transistor, and Q2 chosen for the current required by the load circuit.

Improved SPST Switch Flip-Flop

D. J. Manford



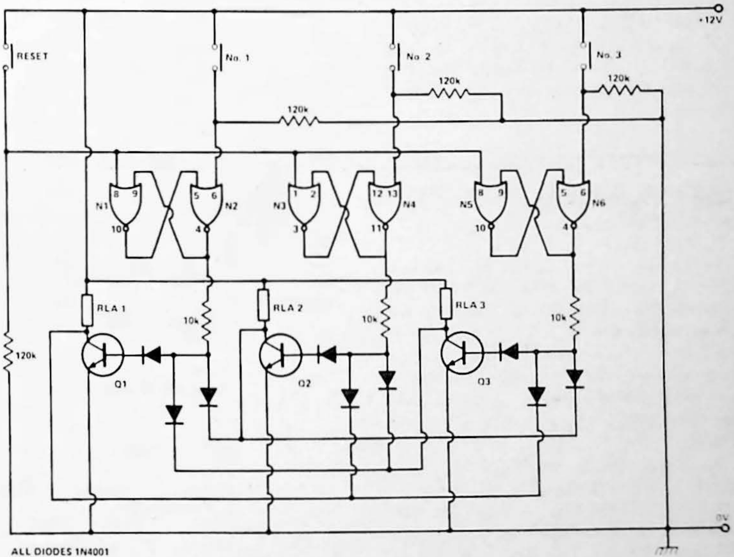
This circuit was developed from the SPST switch flip-flop shown in ETI Circuits No. 1 and has the advantage that it can be driven by an input referred to earth — logic outputs or push-buttons.

When the input to the 4016 goes high it connects together the input to A, and C. This 'flips' the latch.

The 20k resistor between the output of invertor B and the input of A is needed as the 4016 cannot pull the output of inverter B down directly.

Sequence Switch

B. Willis.



ALL DIODES 1N4001
Q1,2,3 BFY51
N1 – N4 CD4001
N5, N6 ½CD4001
RELAYS 120R OR ABOVE

The circuit right was designed to enable three relays to be individually switched by their appropriate buttons but such that only one relay can be energised at any one time. When any one relay has been energised the corresponding collector falls to near zero volts, which is connected to the base of the remaining two transistors; now if another relay is attempted to be energised the base of its transistor will remain bottomed and keep the relay off. The reset button must be pressed before another relay can be energised. The diodes ensure that each transistor is kept off until the voltage applied to the base exceeds 0.6 V.

The flip-flops and push buttons can of course be replaced with standard switches if momentary action is not required.

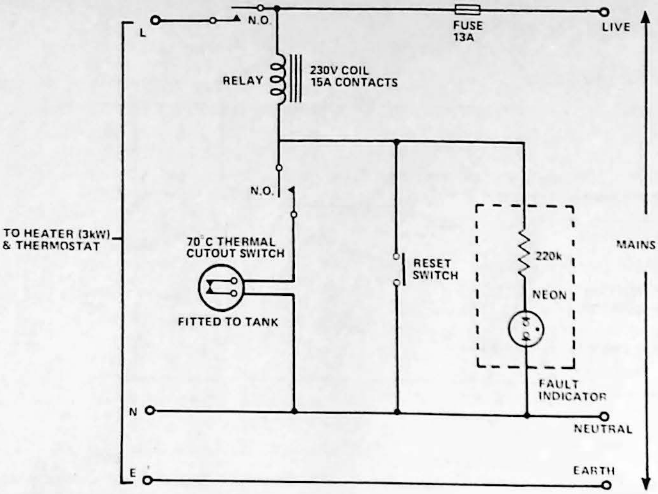
The circuit was used to control three radio transmitters where it was important that two should not be switched on at the same time. The circuit lends itself to further applications; for example, switching various inputs into an amplifier where it can replace the self-cancelling selector buttons.

Immersion Heater Protector

K. Cooper

The circuit was designed to cut the power to an immersion heater should the thermostat fail. This stops the water boiling over and all the subsequent damage. The cutout is fitted to a warm part of the tank (not too hot, or it will trip in normal use). Thus, if the water starts to boil, the cutout trips, cutting all power and lighting the neon.

The unit must be fitted in a well insulated box and care should be taken with the wiring to the cutout, which can be fixed and insulated with epoxy resin.



3-way CMOS switch

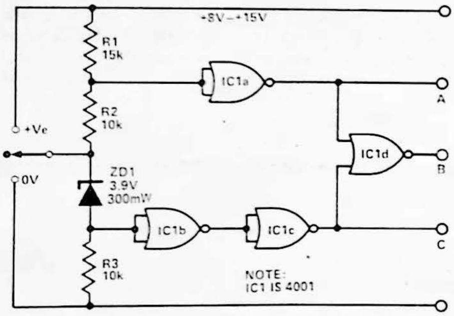
G. Warburton.

When the input is switched positive the voltage across the zener is sufficient to bias the junction between R3 and the zener high, producing a high output at C.

With the input unconnected, the junction between R1 and R2 is high while the junction between the zener and R3 is low. This will produce a high output at B.

Connecting the input to 0V causes output A to go high.

The circuit was primarily designed to be used with quad CMOS switches (i.e. 4016, 4066) for audio switching but can be used for a variety of applications.



Touch Switch with Noise Immunity

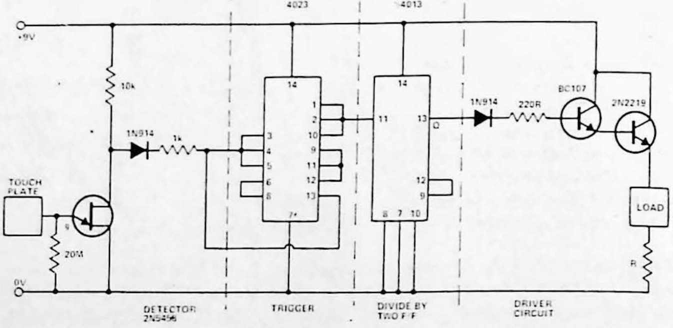
P. Reynolds.

Many designs for touch controls suffer from the disadvantage of low noise immunity, and this circuit was designed seeking to rectify this fault.

AC voltage from, for example, the hand is applied to the gate of the FET buffer. The resultant positive signal is applied via the diode, to the input of IC1. This IC is made up from three triple gates connected in a Schmidt trigger configuration. At the threshold voltage, a positive pulse is fed to the clock input of IC2, a D-type flip-flop. Connection is made between Q and the D input, so as to cause the flip-flop to run in the 'triggered' mode. Thus the input signals are divided by two and the output appears at the Q terminal.

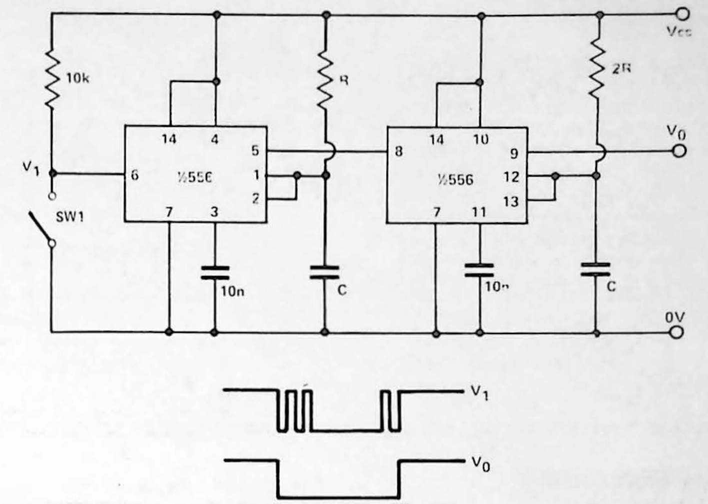
In operation, a single positive pulse sets the Schmidt trigger to its low level. (Removal of the hand causes reversion to the 'high' state). This, in turn, feeds the clock input of IC2, which changes the state of the Q output. When this is high, the output stage is driven on, enabling current to flow in the external load and the current limiting resistor, R.

A second positive pulse changes the state of Q to its low level, causing the output stage to be biased off.



Contact Debounce

A. V. Bates.



The circuit described below can be used to provide contact debounce, or can be used as a dual retriggerable monostable.

With SW1 in the off position, pin 5 is low, and holds pin 9 high - the same as the input. When the switch closes, pin 6 goes low causing the monostable to start timing. Pin 5 goes high allowing pin 9 to go low. As the monostable is retriggerable, any contact bounce only extends the timing period.

When the timing period is complete, pin 5 remains high, due to pin 6 being held low by the switch. Releasing the switch allows pin 5 to go low which triggers the second monostable. Pin 9 now goes high and remains high after the timing period as pin 8 is being held low. Any bounces during this period merely retriggers the first monostable. For this reason, to ensure correct operation, the period of the second monostable must be twice that of the first.

The period of the bounce suppression is the timing period of the first monostable, and is given by:

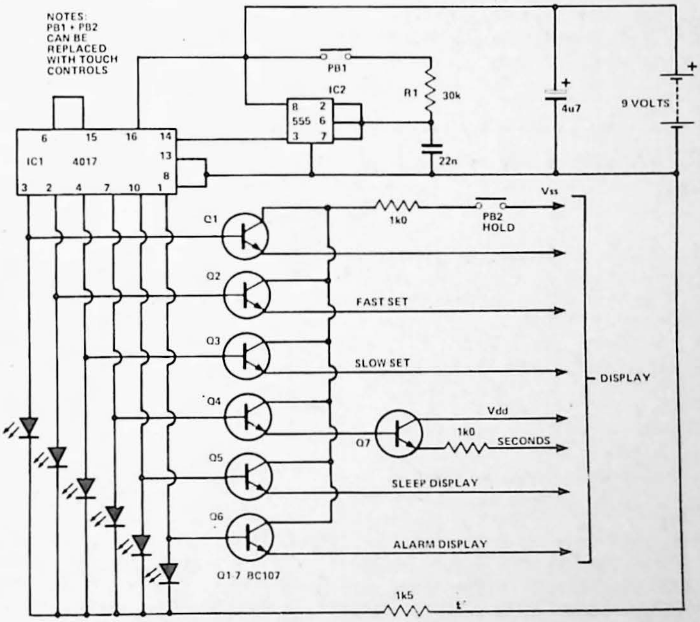
T (seconds) = 0.693 x R x C.

Clock Switching Unit

A. Claughan

On normal clock modules such as the National MA1002 or the Liton LT701 six bulky and untidy looking pushbuttons have to be used. This circuit cuts these six to two.

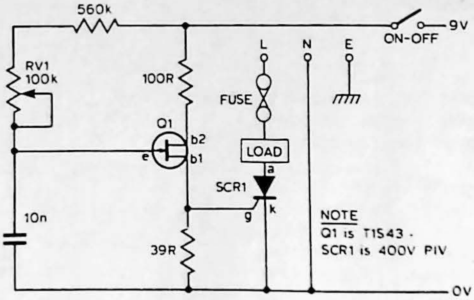
The output of IC2 is connected to the clock input of IC1. On reception of the first pulse, the first output goes high. Each time the output goes high, a corresponding LED is switched on and the base of the adjoining transistor goes positive. When the correct LED is switched on, pushbutton two is pressed. This switches on the transistor, completing the corresponding function. The rate at which the LEDs light up is adjusted by changing the value of R1. The seventh output of the IC is used as a pause so that the clock can run normally. The eighth output is connected directly to the reset input on IC1. This causes the IC to automatically reset on the eighth pulse. The 9 V supply is obtained by regulating one of the clock inputs.



Lighting Effects

D. Stewart

This circuit can be used to produce some interesting lighting effects. A unijunction relaxation oscillator is used to trigger the thyristor. The frequency of the oscillator iş controlled by RV1. The load (a light bulb) will not be triggered at the same frequency as the unijunction oscillator, and some interesting effects can result. Care should be taken with this circuit as it is not isolated from the mains.



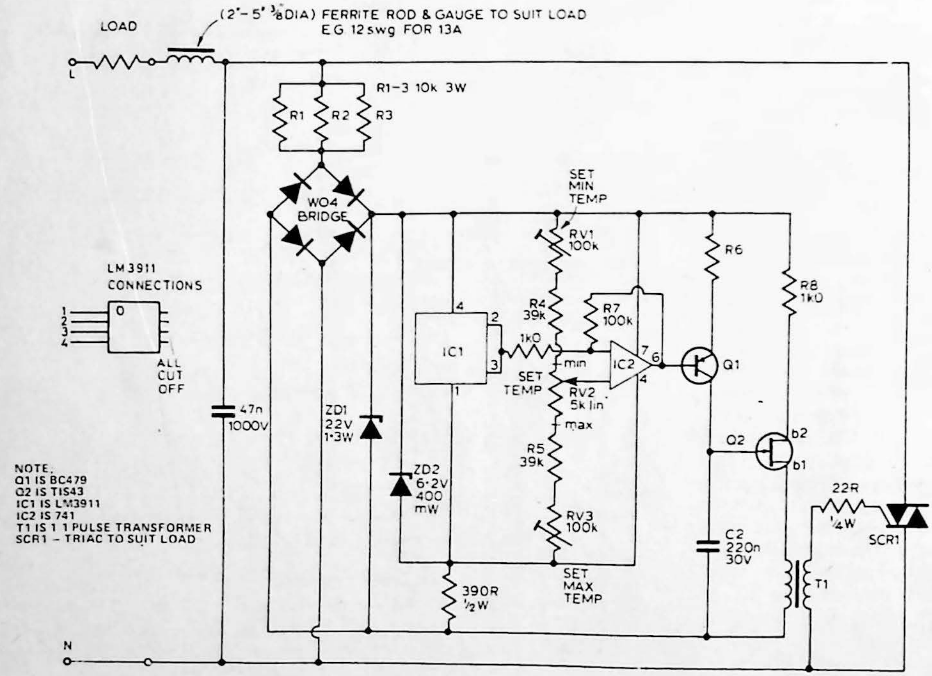
Temperature Control

S. H. Alsop

This circuit provides full phase proportion control of a heater, infrared lamp etc, uses no expensive transformers for its own power, and is extremely sensitive.

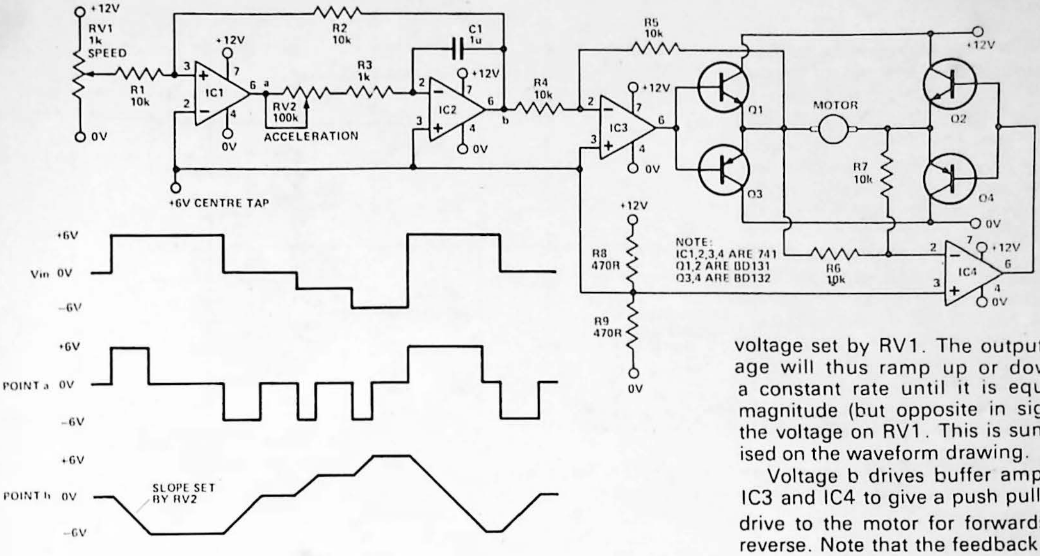
The LM3911 sensor is connected to the sensor via a 3 core cable, and enclosed in a rubber sleeve to enable it to be used as a probe. The output of the LM3911 varies by 10mV/°C and the minute change is amplified by the 741. Any increase in temperature will increase the output of the 741 which will lower the base current through Q1 and so reducing the constant charge current to C2. This variation of charge current with temperature will alter the time taken for the UJT to fire, changing the phase angle of the power to the load.

The 5k lin pot is set to the temperature required and is linear over its entire range. The upper and lower limits of this control can be changed by adjusting the 100k presets.



Controller For Model Trains

E. Parr

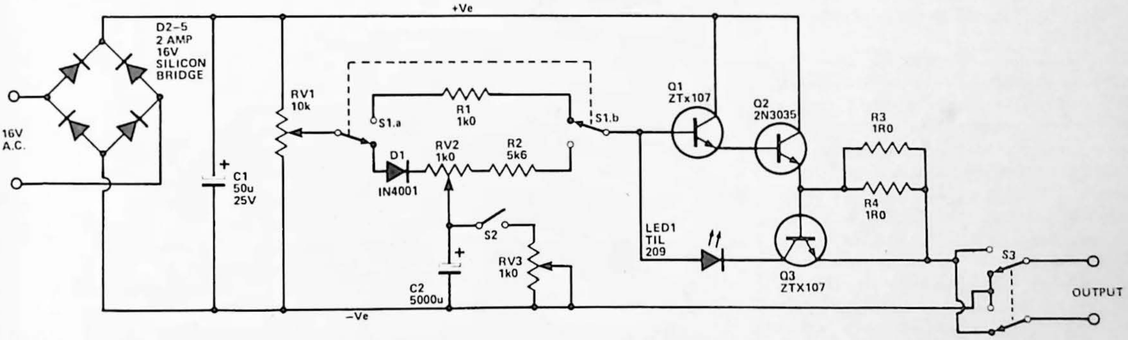


Most model railway controllers have the unfortunate characteristics of giving instant starts and stops to the train which would be very unnerving for the model passengers. The circuit described gives a steady acceleration or deceleration on speed changes, and the speed and acceleration controls do not interact.

The power supply is 12V split by R8 and R9 so it appears to the op amps as a ± 6 V supply. Voltages in this description are referenced to the 6V centre tap. IC1 and IC2 together form a unity gain inverting amplifier, with the gain determined by R1 and R2. The slope of IC2's output, is determined by C1 and R3/RV2. The output of IC1 will thus take up one of three states: +6 V (hard positive), 0 V (balanced), −6 V (hard negative) dependent on the output voltage being more positive that equal to, or more negative than the voltage set by RV1. The output voltage will thus ramp up or down at a constant rate until it is equal in magnitude (but opposite in sign) to the voltage on RV1. This is summarised on the waveform drawing.

Voltage b drives buffer amplifiers IC3 and IC4 to give a push pull 12 V drive to the motor for forwards and reverse. Note that the feedback resistors R5 and R7 are taken from the transistor emitters to compensate for the transistor V_{be} drops. The motor should have some current cut-out or limit connected in series with it to protect the transistors.

In use RV1 sets the speed, and RV2 the acceleration. It gives a very realistic train control, although much more skill is needed to stop a train accurately at a station platform. In this respect it is very close to driving a real train.



Train Controller with Inertia and Brake

M. Bright

D2-5 full wave rectifies the AC and C1 smooths the output. RV1 acts as a regulator controlling train speed. Switch S1 switches in the inertia simulator (comprising D1, RV1, R2 and C2). S2 switches in the brake, the action of which is altered by RV3. RV2 controls the amount of inertia, so that the train can take as long as ten seconds before even moving. Q1,2 act as a Darlington pair, supplying current to the output. Q3 monitors the output and provides short-circuit protection. When a short occurs, LED 1 lights up and the current into Q1 is reduced. Hence, the output is reduced. Two 1W resistors are used for R3,4 rather than a wirewound ½W resistor, which would cost more. S3 simply reverses the polarity and hence the train.

POWER CONTROL

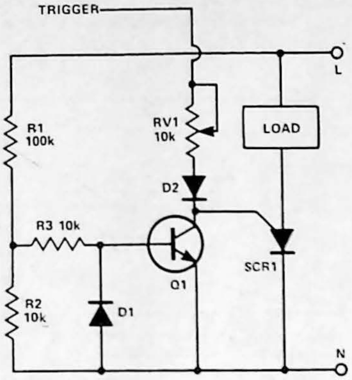
Zero Crossing Switch

J. R. W. Barnes.

When switching loads with the aid of a thyristor a large amount of RFI can be generated unless some form of zero crossing switch is used. The circuit shows a simple single transistor zero crossing switch which, using surplus components, can be built for as little as fifty pence.

R1 and R2 act as a potential divider, the potential at their junction being about one tenth of mains. This voltage level is fed, via R3, to the transistor's base. If the voltage at this point is above 0V2 the transistor will conduct, shunting any thyristor gate current to ground. Only when the mains potential is less than about 2 V it is possible to trigger the thyristor.

The diode D1 is to remove any negative potential that might cause reverse breakdown.



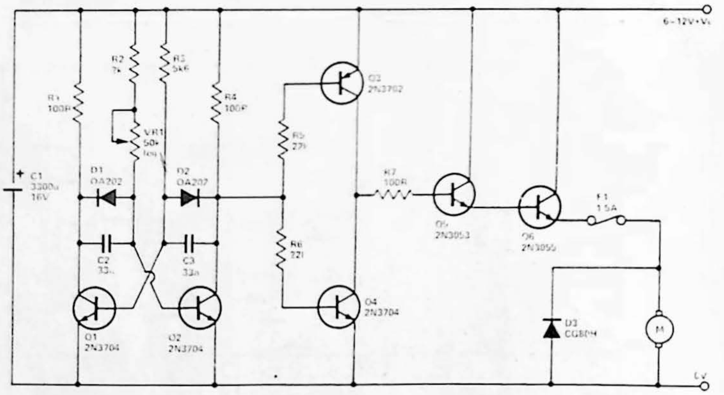
Q1=GENERAL PURPOSE GERMANIUM
D1,2=GENERAL PURPOSE SILICON
SCR1=TO SUIT APPLICATION

DC Motor Speed Controller

D. Strange

Simple controllers for DC motors as previously published have been found to be limited in their application. This new design is capable of controlling a wide range of DC motors enabling high torque to be available at low speed.

In the circuit, Q1 and Q2 form a multivibrator operating at about 7kHz. VR1 is used to alter the mark/space ratio of the square wave which is fed via R5 and R6 to the bases of complementary transistors Q3 and Q4. The joined collectors of Q3 and Q4 are switched hard between positive rail and zero volts, turning on and off completely the output transistors Q5 and Q6. Consequently the dissi-pation of the output transistors is very low. D3, a power germanium diode, is inserted across the motor to suppress transients which were found to reduce torque by approximately 30% in the prototype. A silicon power diode with a germanium diode such as the OA5 in parallel is equally efficient at transient suppression.



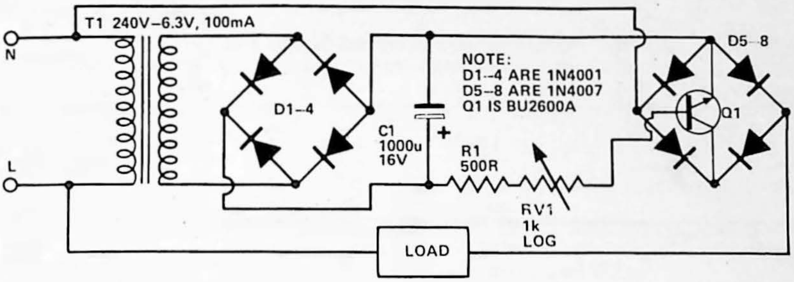
Speed Controller

J. Harris

Some AC motors judder badly at low speeds when controlled by triacs, using phase control. This circuit gives very smooth operation with no RFI.

Q1 acts as a 'variable resistor' in the mains supply, with diodes D5-8 ensuring unidirectional current flow through the transistor.

Bias to the transistor is supplied by the mains transformer and controlled by RV1. Q1 must be able to withstand peak mains voltage (—350V).



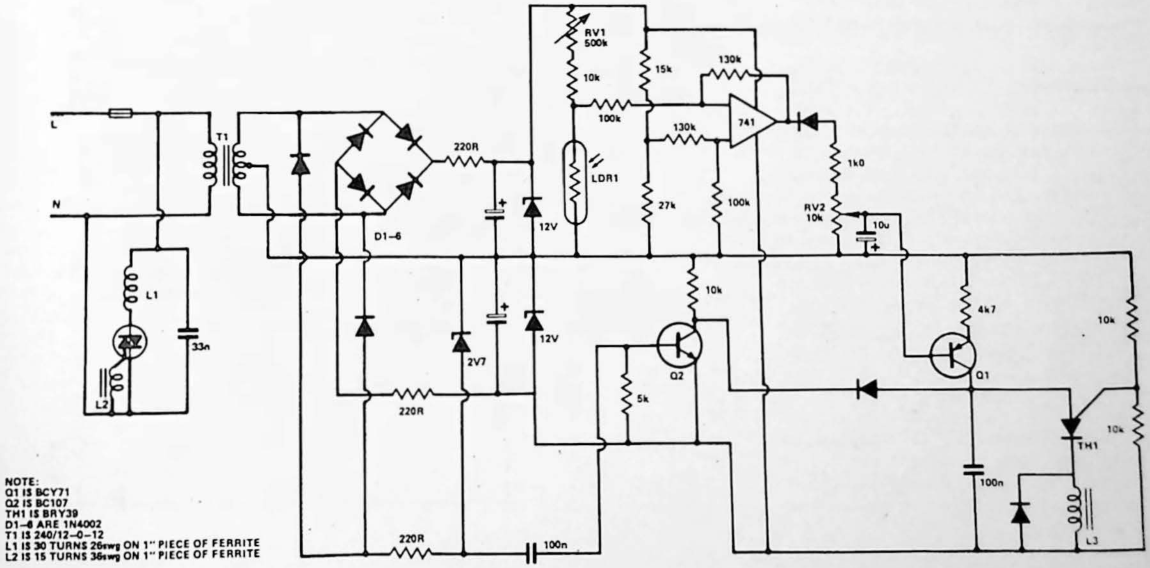
Porch Light Controller

R. Johnson

This circuit controls a light bulb, so that its brightness is approximately inversely proportional to the surrounding lighting conditions. This may be useful for a porch light, which would begin to switch on at dusk, reaching full brightness late in the evening. In the morning it would switch off again.

The dimmer consists of Q1, TH1 and their associated components. Q2 provides synchronisation pulses. RV1 effectively alters the time of day at which the light switches on and RV2 alters the maximum brightness of the bulb.

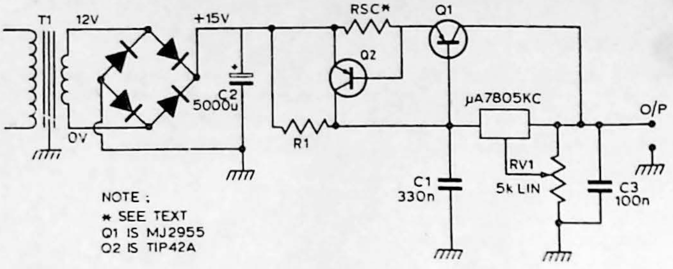
The LDR is connected to a differential amplifier whose output voltage rises when the resistance of the LDR is above about 600 kilohms (corresponding to dusk) and reaches a maximum when the resistance is about six megohms (corresponding to complete darkness).



High Current Regulator

N. Gray

This circuit can supply 10A at 5V which falls to about 8A at 15V, — (make sure your transformer can take it!). The circuit is fairly straightforward. Most of the output current flows through Rsc and Q1 (less than 1A flows through the regulator), the current being regulated by the current flowing through the e-b junction of Q1. Voltage is regulated by the µA7805 and controlled by RV1, giving a variation from 5V to 15V.



NOTE :
* SEE TEXT
Q1 IS MJ2955
Q2 IS TIP42A

Output current is limited by Rsc and can be calculated from

$$Rsc = \frac{0.9}{I\ max}$$

For currents greater than 5A, Q1 should be mounted on a heatsink. Q2 and the regulator should run cold (if not there's something wrong!).

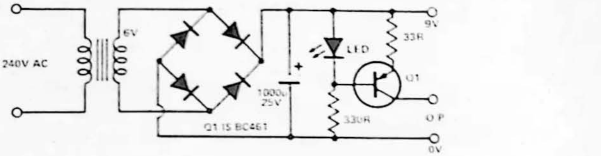
Constant Current Source

S. Callaghan

This circuit uses a standard panel mounting LED to provide a constant reference voltage for a transistor in a constant current generator.

The output current I, is given by the equation

$$I = \frac{V_{LED} - V_{BE}}{R_E}$$



Q1 IS BC461

When the circuit is not connected to a load, the LED is extinguished, giving a visible indication of when the circuit is operating.

Switchable Constant Current Source

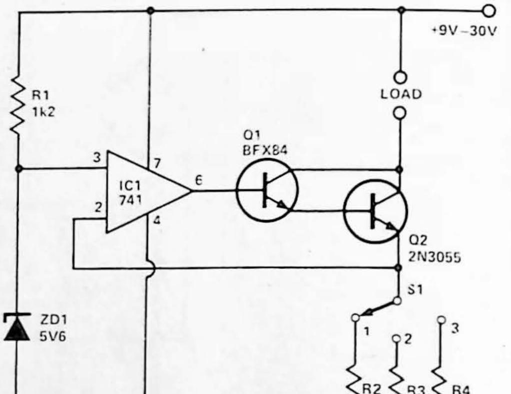
J Macaulay

The circuit shown will provide 3 preset currents which will remain constant despite variations of ambient temperature or line voltage.

ZD1 produces a temperature stable reference voltage which is applied to the non inverting input of IC1.

100% DC feedback is applied from the output to the inverting input holding the voltage at Q2's emitter at the same potential as the non inverting input.

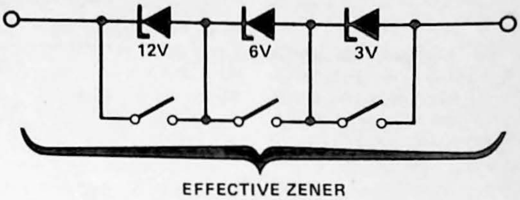
The current flowing into the load therefore is defined solely by the resistor selected by S1. With the values employed here, a preset current of 10mA, 100mA or 1A can be selected. Q2 should be mounted on a suitable heatsink.



The Multi-zener

R. N. Soar

This is an application of zener diodes based on the binary system. In the example shown three zener diodes are used 3 V, 6 V and 12 V (ie. 3.0 V, 6.2 V and 12 V) plus three S.P.S.T. switches. In the "on" position of a switch the diode is short circuit. In the 'off' position the diode is in circuit. Thus the effective diode by suitable operation of the switches is 3, 3+6, 3+12 etc. ie. 3,6,9,12,15,18,21 volts By the addition of the next in the series 24 V and another S.P.S.T. switch the range is 3,6,9,12,15,18,21,24,27, 30,33,36,39,42,45 volts.



Increasing Power Rating of Zener Diodes

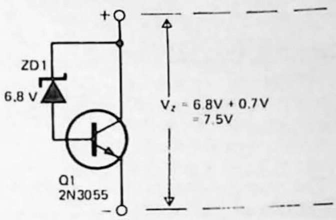
There are occasions when a higher power Zener diode is required and one is not readily available. Here is a circuit which with the aid of a power transistor can increase the power rating of any Zener diode.

By simply shunting the base-collector junction of the transistor by a low power Zener and if the gain of the transistor at the operating current exceeds 30, then across the collector-emitter terminals the device will behave as a Zener diode.

If the original diode is a 250 mW device then the power dissipation of the system will be 30 x 250 mW = 7.5 watts. It should be noted that the Zener voltage thus obtained will be 0.7 V higher than the diode rating.

Thus if originally a 6.8 V diode was used then the new voltage will be 6.8 V + 0.7 V = 7.5 V. Thus for a power of 7.5 W, the maximum permissible current will be 7.5 W/7.5 V = 1A.

ZENER DIODE POWER BOOSTER



Overvoltage Protection for Logic

E. Parr

With the introduction of integrated circuit voltage regulators it is very easy to make power supplies for logic circuits. Unfortunately it is only too easy to blast a board of TTL by letting the voltage rise above 7V as could happen if the common line came off a regulator IC or the sense lines came off a commercial power supply.

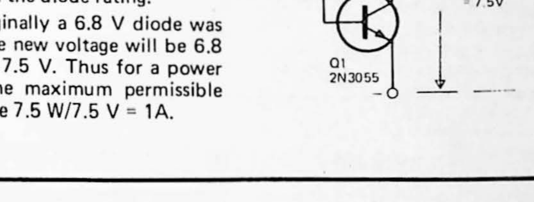
The described circuit was designed by the author as a "last ditch" defence after a disconnected sense line allowed a commercial 5V supply to rise to 9V and blast 50 TTL chips. The circuit is simple to add onto any power supply, and it is the author's intention to build it "on board" with any future system containing more than about 10 TTL chips.

Zener diode ZD1 senses the supply, and should the supply rise above 6V Q1 will turn on. In turn Q2 conducts clamping the rail.

Subsequent events depend on the source supply. It will either shut down, go into current limit or blow its supply fuse. None of these will damage the TTL chips.

The rating Q2 depends on the source supply, and whether it will be required to operate continuously in the event of failure. Its current rating obviously has to be in excess of the source supply. If the source supply is likely to shut down, LED1 should be added to indicate the circuit has operated.

The circuit will operate in approximately 500 nS space, so it will also protect the logic from transient spikes which a normal regulator would not block.



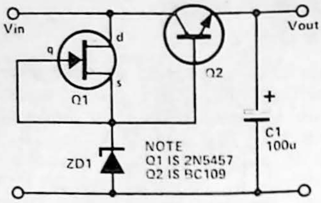
Voltage Stabiliser

J. Nicholls

Here is a voltage stabiliser with good performance and low component count which will operate well, even when $V_{in}-V_{out}$ drops to 2 V. Only a few milliamps are dissipated through the zener, making it suitable for battery operated equipment.

Most circuits of this type (but with the FET replaced by a resistor) suffer from zener saturation when V_{in} is getting low, or excessive zener current when V_{in} is high.

Actual component values can be varied to suit individual applications.



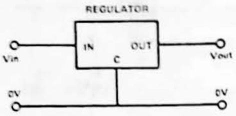
Fail-safe For IC Voltage Regulators

Andrew Bain

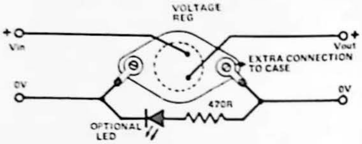
One of the problems with using power supplies based on IC voltage regulators is the chance that the common (case) connection could come off, allowing the output to rise to the full input voltage. If the regulator was driving TTL there could be disastrous consequences.

By using the regulator as shown and taking the output from another connection to the metal case, the output will drop to zero if a lead becomes disconnected.

An LED can be connected as shown, if required, to provide an indication of a fault.



NORMAL CONFIGURATION



Increasing Regulator Outputs

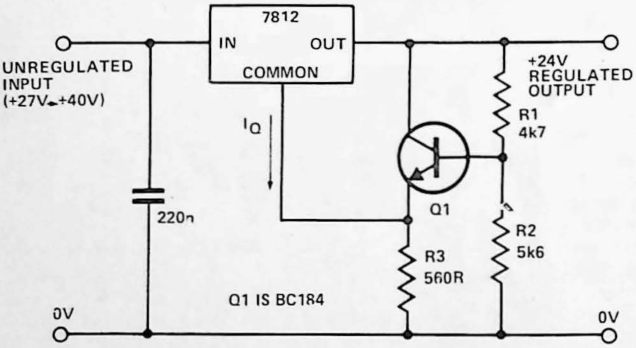
D. Self

It is often necessary to arrange an integrated circuit 3-terminal voltage regulator to give a higher output voltage than that set by the regulator alone. The normal way of doing this is to connect the "common" terminal to the mid-point of a potential divider hung between the regulated output and ground. The regulator voltage now appears across the top divider resistor; hence, if for example equal divider resistors are used, the output voltage is twice that maintained by the regulator between its common terminal and output.

The problem with this method is that most IC regulators (eg the 78-series) have a small quiescent current (approx 10mA) flowing out of the common terminal to ground. The magnitude of this current is not closely controlled, and hence the total output voltage becomes somewhat unpredictable due to this extra current flowing in the bottom half of the divider. Low divider resistor values help, but there are likely to be the complications of heat dissipation and inefficiency.

The circuit below avoids the problem by using transistor Q1 to generate a low impedance at the regulator common terminal by emitter-follower action, while transferring the voltage derived from a relatively high-resistance divider network. The value of R3 is not critical, but must be low enough to accept the highest likely quiescent current without causing Q1 to turn off.

The circuit shows a practical 24 Volt supply using a 7812 regulator.



Anti-surge Voltage Regulator

A. Wey

This high gain voltage regulator with only two transistors has characteristics superior to those of the commonly used compound emitter-follower type.

The circuit was used in a 30 watt stereo amplifier which not only required a well regulated supply but also an output voltage that would rise slowly from zero volts when the system was first turned on. This slow application (about 2 seconds) to the power amplifiers allowed the 2000μF output capacitors to charge without causing excessive collector current in the output transistors.

Typical regulator output impedance is 0.1 ohm.

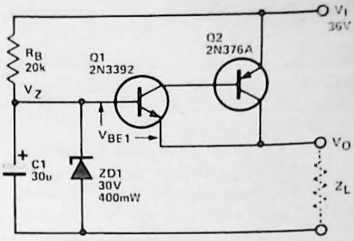
Output voltage is expressed by:

$$V_O = V_Z - V_{BE1}$$

Output voltage rise time is expressed by:

$$T = R_B C_1 \ln(1 - V_Z/V_I)$$

Some digital systems require a preset turn on sequence for their power supplies. By setting appropriate R_B/C_1 values, the circuit's output rise time can be set to provide this sequence or delay.



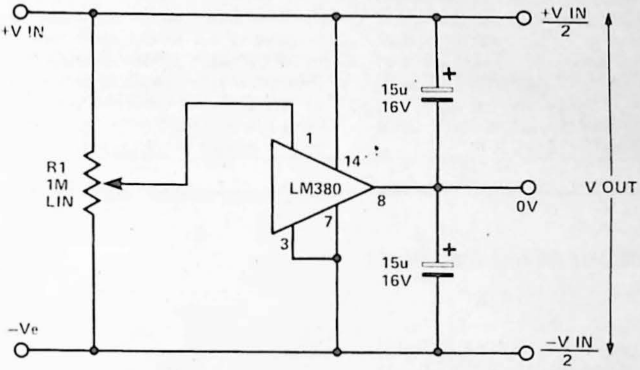
Simple Dual Power Supply

L Swann

This circuit offers a cheap and simple way of obtaining a split power supply (for op-amps etc.), utilising the quasi-complementary output stage of the popular LM380 audio power IC.

The device is internally biased so that with no input the output is held mid-way between the supply rails.

R1, which should be initially set to mid-travel, is used to nullify any inbalance in the output. Regulation of V_{OUT} depends upon the circuit feeding the LM380, but the positive and negative outputs will track accurately irrespective of input regulation and unbalanced loads.

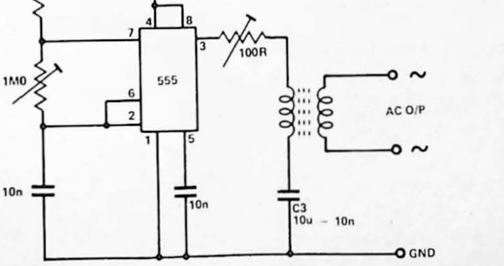


The free-air dissipation is a little over 1 watt, and so extra cooling may be required. The device is fully protected and will go into thermal shutdown if its rated dissipation is exceeded, current limiting occurs if the output current exceeds 1A3.

The input voltage should not exceed 20 V.

Milli-power Inverter

J. S. B. Dick



Many home-grown projects require a high voltage, low current source. The simplest and safest means of providing this is by an inverter. The circuit described here is versatile, efficient and easily capable of providing power for portable Geiger counters, dosimeter chargers, high resistance meters, etc.

The 555 timer IC is used in its multivibrator mode, the frequency being adjusted to optimise the transformer characteristics. When the output of the IC is high, current flows through the limiting resistor and the primary coil to charge C3. When the output goes low, the current is reversed. With a suitable choice of frequency and C3 a good symmetrical output is obtained.

POWER SUPPLIES

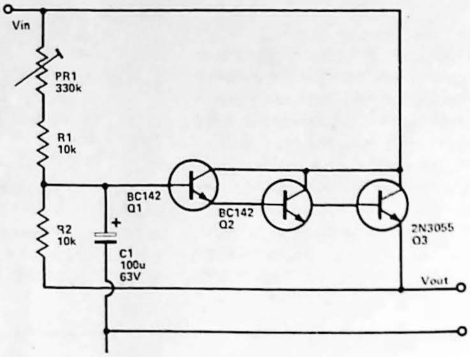
Active Decoupling Circuit

J. P. Macaulay

What do you do if faced with the problem of running say a tuner which requires 30 V / 100 mA from a power supply of say 55 V?

This circuit is designed to drop a predetermined voltage and supply a reasonably large current to its load. The voltage drop between the emitter and collector of Q3 is directly proportional to the setting of PR1. In effect, Q1,2,3 can be considered as a single transistor with high current gain.

C1, between the base of Q1 and earth, performs a vital function, because its filtering action is amplified by the circuit and thus smooths the output voltage. If we assume that each of the transistors has a gain of 30, the circuit will possess an overall gain of 2700 times and an apparent capacitance will appear across Q3's emitter and earth of 0.27 F.



The circuit works with an input voltage of up to 60 volts, but this must be taken as an absolute maximum due to the breakdown voltages of the devices used. When using fairly low voltage drops, up to say 10 V the maximum current that the circuit can supply will be limited to the size of heatsink employed.

Several amps can be supplied as long as the resultant heat can be safely dissipated. With the component values shown, the circuit can be adjusted by PR1 between 3-30 V.

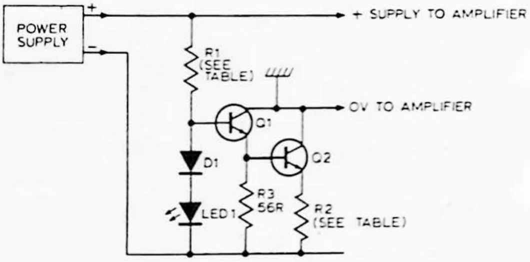
Protection For Power Amplifiers

A. Hiley

In many amplifiers, the only protection against overload is a single fuse. Experience has shown that output transistors can blow faster than fuses. The simple circuit shown below will protect the amplifier in the event of a fault or gross overload.

Normally, the current through R1 biases both the transistors fully on. The P.D. across the LED is less than 2V, and it will not light up. In the event of a fault or overload, the current consumption of the amplifier will increase. The forward bias on the transistors will decrease, and they will tend to turn off. This will cause the potential across R to decrease, which will increase the bias on the transistors, turning them on again. The overall effect is that current limiting takes place. Under these conditions, the LED will light up, indicating a fault condition. If the fault or overload persists, the main fuse in the amplifier will probably blow. The actual protection circuitry needs no resetting.

Under fault conditions, the dissipation in Q2 will be very high, and so it must be bolted onto the chassis or the heatsink.



SUPPLY VOLTAGE	R1
10V to 22V	1k, $\frac{1}{2}$W
22V to 40V	1.8k, 1W
40V to 70V	2.7k, 2W

AMPLIFIER POWER (RMS Watts)	R2
15W, 8R or 4W + 4W, 8R or 4W, 4R	0.5R
60W, 8R or 15W +15W, 8R or 15W, 4R	0.2R
30W +30W, 8R or 30W, 4R	0.15R

NOTE

Q1 is BD131 (up to 45V supply)
or BD139 (up to 90V supply)
Q2 is 2N3055
D1 is 1N914
LED1 is a RED LED

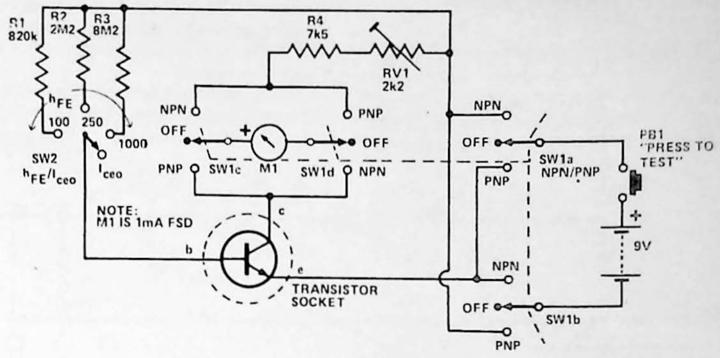
Transistor Tester

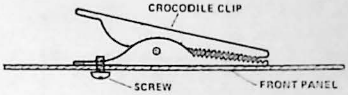
G. Smith

This transistor tester works by injecting a known current into the base of the transistor under test, and measuring the collector current. The values of R1, R2 and R3 give a base current of 10, 4 and 1uA which gives a FSD on the meter for transistors with a gain of 100, 250, and 1000 respectively. Since the collector current of the transistor is proportional to its gain, the gain can be easily deducted from the reading on the meter. Leakage current is measured by leaving the base open circuit.

SW1 reverses the polarity of the battery and the meter to allow the testing of both NPN and PNP transistors. R4 and RV1 protect the meter from excessive currents, and do not affect the reading on the meter. RV1 should be adjusted so that the meter needle just touches the end stop when the collector and emitter terminals are connected together.

A simple transistor socket can be made by mounting three crocodile clips as shown in the diagram.





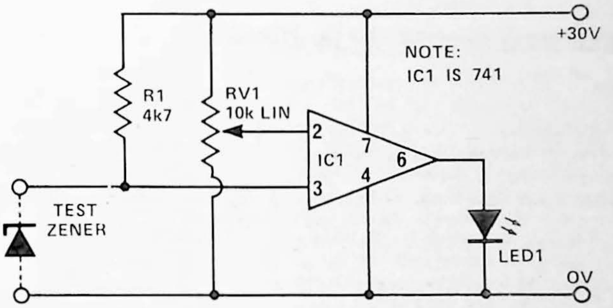
Zener Tester

M Ibions

This circuit is to provide a cheap and reliable method of testing zener diodes.

RV1 can be calibrated in volts, so that when LED 1 just lights, the voltage on pins 2 & 3 are nearly equal. Hence the zener voltage can be read directly from the setting of RV1.

The supply need only be as high a value as the zener itself. For a more accurate measurement, a precision pot could be added and calibrated.



Dec-ed Out

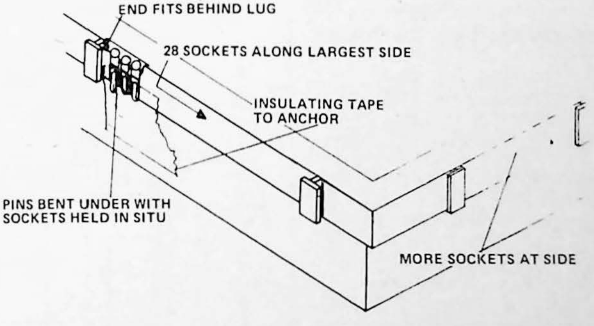
D. F. Tranter

When using S-Decs to test circuits, one often finds that several groups of the Dec contacts are taken up for one common connection, particularly the contacts which run to the battery connections.

In order to extend the capacity of a single S-Dec I fit a row of sockets along each of the two Dec sides which have lugs for connecting to other Decs, using the lugs as end fixing points.

If the sockets are bent and a strip of insulating tape used to anchor the lower ends, one gets a reasonably robust fitting which greatly extends the capacity of the Dec.

The lug recesses along the other two sides can also be used for attaching more rows of sockets.



NPN-PNP Indicator

F Read

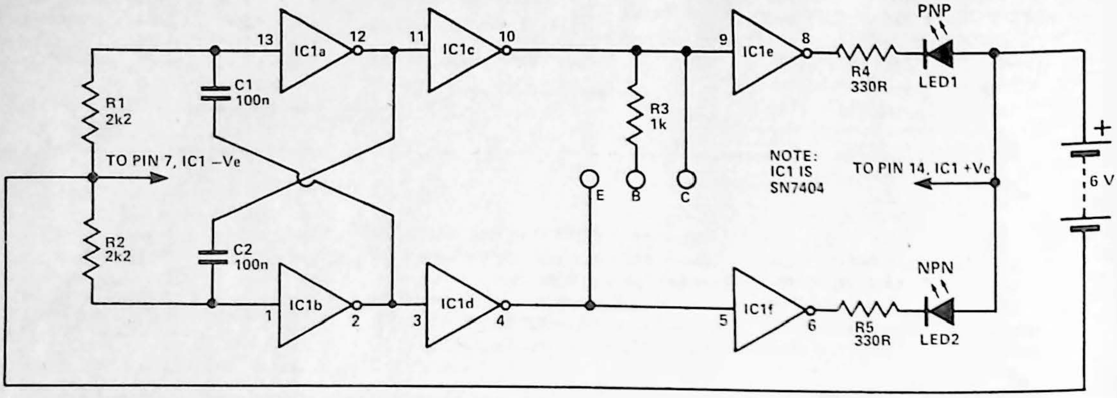
The first 2 inverters IC1a and IC1b form a multivibrator running at approximately 2 kHz. The next two inverters buffer the multivibrator outputs, which then go to the collector and emitter of the transistor under test.

The signal applied to the base of the transistor is always in phase with the collector so the transistor, whether PNP or NPN, will always be turned fully on every half cycle.

When an NPN transistor is being tested the collector will always be near OV and when a PNP transistor is being tested the emitter will always be near OV.

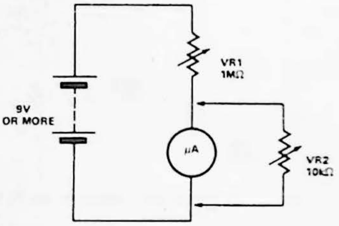
The last two inverters detect which terminal is held at OV and drive the appropriate LED via the current limiting resistors R4 and R5.

The six inverters needed are all contained in a single IC package - the SN7404.



Measuring Micro-ammeter Resistance

When it is required to measure the unknown resistance of a microammeter, then an ordinary multimeter on the necessary ohms range will send too much current through the meter coil, with the chance of causing damage. To avoid this, set up VR1 to give full scale deflection on the meter. Then shunt the meter with VR2 and adjust so that the meter reads exactly half scale. Remove the measure VR2, which, to a good degree of accuracy, will be equal to the meter resistance.

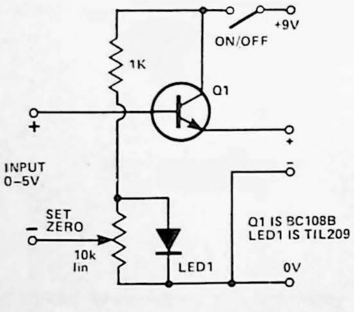


More Ohms Per Volt

R. Soar

This circuit is designed to improve the performance of a low cost 1k/volt multimeter on the 0.5V DC range.

The BC108 emitter follower provides an impedance transformation with a gain of 250 or more, so that the effective input impedance of the multimeter is now 250k/volt. The LED provides a fixed reference voltage for the set zero control, which compensates for the voltage drop across the transistor.

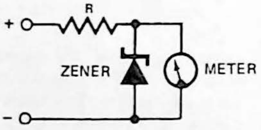


Meter Protection With Zener

A zener diode may be used to protect a meter from overloads without greatly reducing its accuracy. The zener is connected in parallel with the meter and under normal circumstances has such a high impedance that the accuracy of the meter is not affected. If the meter is overloaded, the diode breaks down and the meter is shunted by about 10 ohms, preventing damage to the bearings and pointer of the movement.

Breakdown voltage of the zener should be about 1.5 to three times the full scale deflection voltage of the meter.

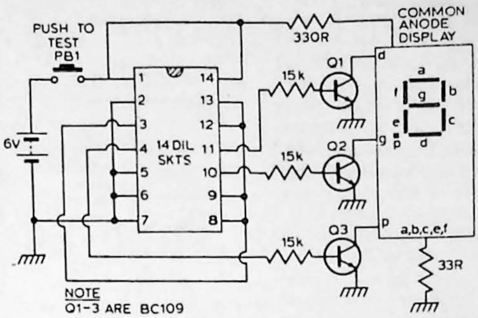
The zener also prevents the meter from reading on reversed voltages and thus gives dual protection.



CMOS Gate Identifier

C. Ching

This circuit can be used to distinguish four types of dual input gates — AND, OR, NAND, NOR — it is also a quick method of checking IC function. If an AND gate is inserted into the socket, an A appears on the LED. An O denotes an OR gate. The decimal point is used to denote inverted function, i.e. .A is an NAND gate.



Versatile CMOS Test bed

J. Anderson

It is a cheap and easily constructed transistor tester utilising inexpensive and readily available CMOS ICs.

It not only carries out the normal GO/NO-GO test but will differentiate between PNP & NPN type as well as identifying their base leads.

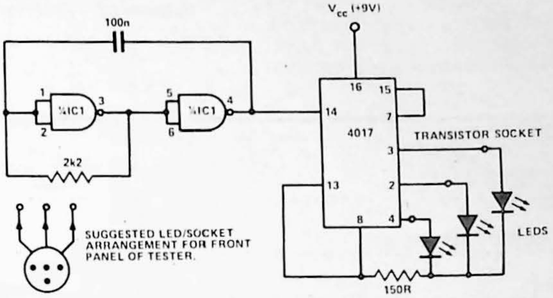
Use of the tester is simple and is as follows:

1) GO/NO-GO:—If the transistor is "a dud", either all the LEDs will come on or they will all go out.

2) PNP/NPN differentation —
a) PNP only one of the LEDs will come on.
b) NPN one of the LEDs will go out.

3) base lead identification:—the base lead is identified by the "odd LED out". (ie the one LED that is on with the other two out or the one that is out with the other two on).

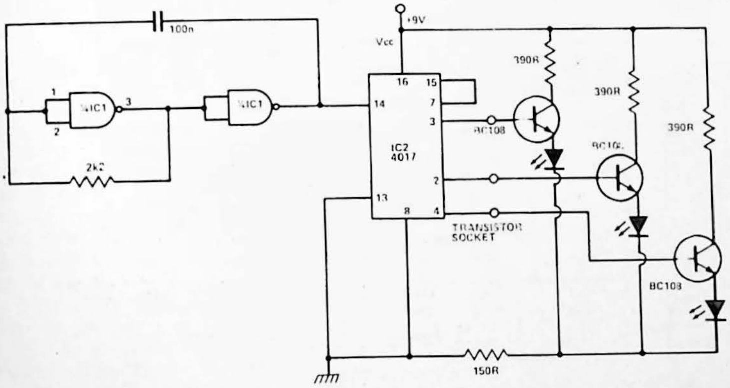
The unit will also test diodes by the use of only two of the sockets of the transistor socket in this case the anode of the diode is identified by the LED associated with its lead going out. The device also tests and identifies the gates of JUGFETs, SCRs & TRIACS.



Improved CMOS Test Bed

G. Scott

Having made Mr Anderson's CMOS test bed I found that the LEDs were barely bright enough to be seen. In this circuit, with the addition of three, one transistor amplifiers, the LEDs are easily viewed and the current drain is only 13 mA.



Battery Tester

R. N. Soar.

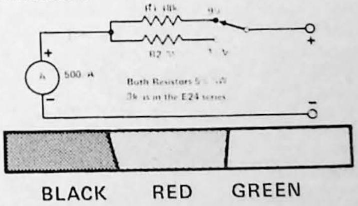
This circuit was designed as a simple tester for 1.5 and 9 volt batteries.

It uses a cheap 500μA recording level meter of the kind used in cassette recorders, costing around 80p.

The scale is as indicated in the diagram and can be interpreted as follows—

BLACK—Replace battery
RED—Weak battery
GREEN—Good battery

A new battery should give a full scale deflection.

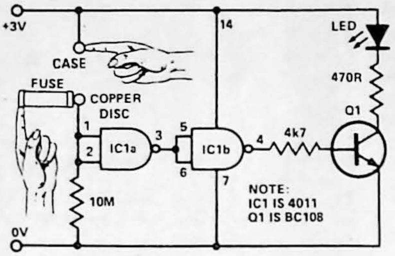


Fuse Tester

R Heggie.

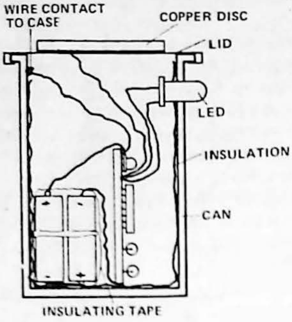
This circuit can be used for testing fuses, and has the advantage of being much smaller and easier to use than an ohm meter. The circuit is built into a 35mm aluminium film can, and is powered by two small mercury cells. An old penny glued to the plastic lid of the can forms one of the touch contacts, and the case forms another.

To test a fuse, the case is held on one hand and the fuse in the other, the end being touched onto the copper disc, if the fuse is OK a small current will flow through to the first gate of IC1a taking the input high and the output low. This is inverted by IC1b, which turns Q1 on, lighting the LED. As current consumption with the LED extinguished is almost negligible, a battery switch is not required.



NOTE:
IC1 IS 4011
Q1 IS BC108

IMPORTANT All unused inputs on ICI should be grounded.



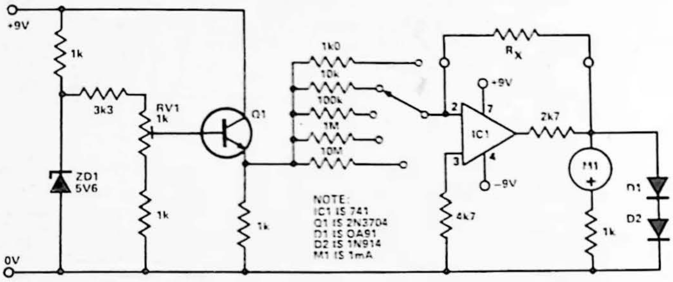
Linear Scale Ohmmeter

M. Roberts

This circuit has several advantages over other linear scale ohmmeters.

Only one preset resistor is used for all the ranges, simplifying the setting up and reducing the cost. Diode clamping is included to prevent damage to the meter if the unknown resistor is higher than the range selected.

When the meter has been assembled, a 10k precision resistor is placed in the test position, Rx, the meter is set to the 10k range and RV1 adjusted for full scale deflection.

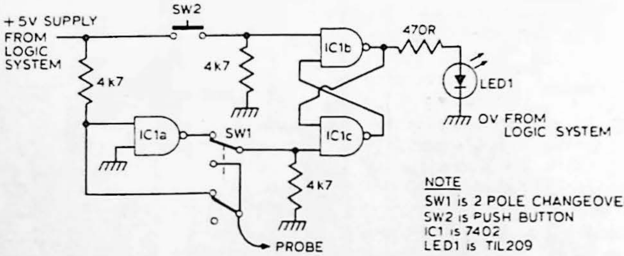


NOTE:
IC1 IS 741
Q1 IS 2N3704
D1 IS OA91
D2 IS 1N914
M1 IS 1mA

Logic Noise Detector

G. Robinson

Ever since the advent of binary logic, spurious noise spikes and pulses have been the curse of the designers of even elementary systems. This circuit will help detect 'noisy' logic levels. With SW1 in position 1, any logic zero spikes occuring on a steady logic '1' will set the R-S latch and the LED will be illuminated. With SW1 in position 2, an extra inverter is brought in, and the circuit will be triggered by any logic '1' spikes.



NOTE
SW1 is 2 POLE CHANGEOVER
SW2 is PUSH BUTTON
IC1 is 7402
LED1 is TIL209

Crosshatch Generator Update

D. M. Lauder B.Sc.

Re the ETI Crosshatch Generator — it is rather difficult to make a 555 timer work at 249.6 kHz. The author tried three different devices, but none could quite manage it, even with the timing capacitor reduced to 100 p. Reducing R1 to 220 ohms helped, but greatly increased the power consumption. The final solution was to connect a 1N4148 diode between pins 3 and 7, with the cathode connected to pin 7. This turns the discharge transistor off more quickly by pulling it up with the output. It is then necessary to increase the timing capacitor to 270 p, as the internal propagation delays of the 555 have been reduced.

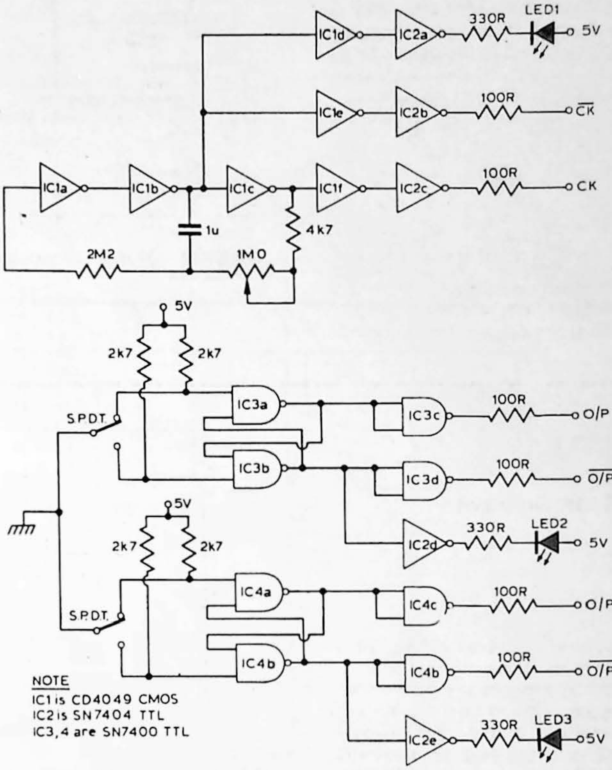
Test Unit for Sequential Logic

D. Rayner

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 1-200Hz. 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.



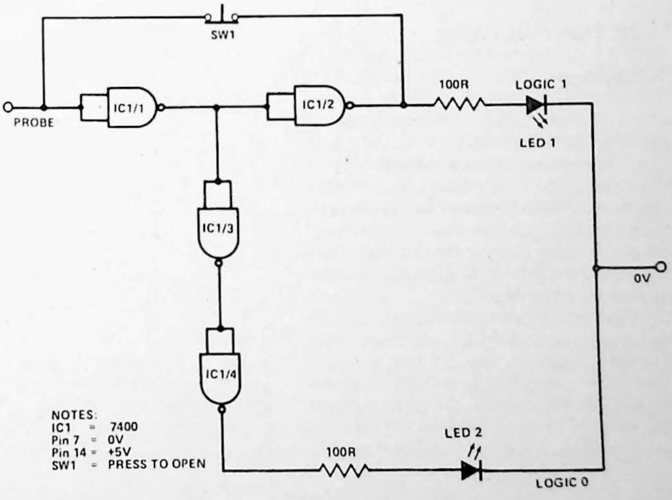
NOTE
IC1 is CD4049 CMOS
IC2 is SN7404 TTL
IC3,4 are SN7400 TTL

One Chip Logic Probe

K.D.Hedger

This circuit, although very cheap and with a low component count, is very effective. When logic 1 is at the input of IC1/1 output goes low causing IC1/2 output to go to logic 1 lighting LED 1. Logic 0 at the input of IC1/1 causes the output to go high, IC1/3 goes low and IC1/4 goes to logic 1 lighting LED 2.

SW1 takes the output of the IC1/2 back to the input of IC1/1 so locking LED one on until the push to open switch is released.



NOTES:
IC1 = 7400
Pin 7 = 0V
Pin 14 = +5V
SW1 = PRESS TO OPEN

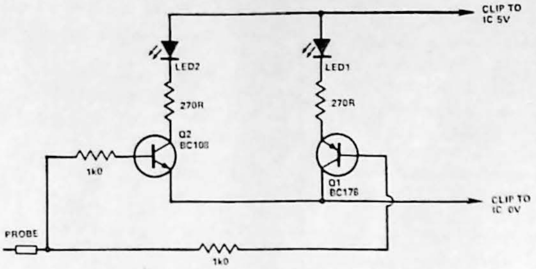
Simple Logic Probe

David Boreham

This simple piece of test equipment can be built using widely available components for little more than £1.

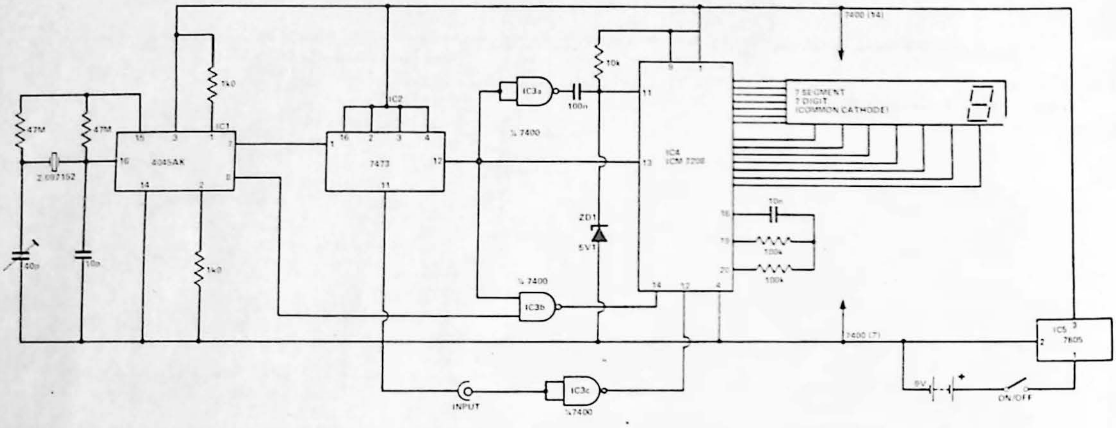
If the probe is connected to an IC pin which is at logic 0, Q1 will be turned on, lighting D1. If, however, the pin is at logic 1, Q2 will be turned on, lighting D2. In the case of a damaged IC there may be no connection to the pin. If this is so, both D1 and D2 will light together.

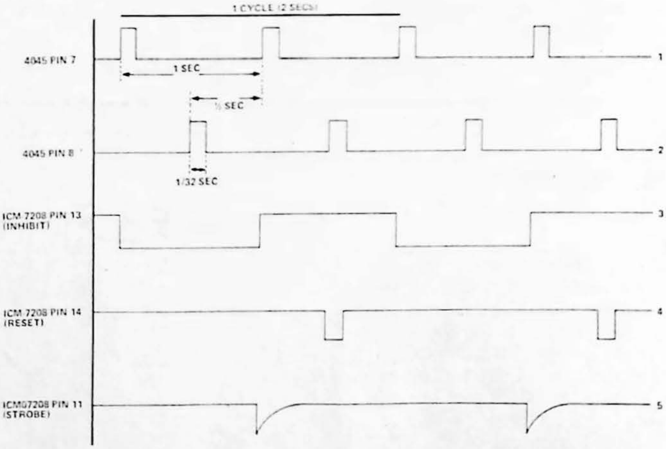
The author used a BC178 and BC108 for Q1 and Q2 respectively, but any NPN or PNP transistors will do. Similarly, D1, 2 can be any LEDs.



A Pocket Digital Frequency Meter

S. J. Barlow





The circuit uses only five ICs and 13 passive components. It is designed to fit into the casing of a pocket calculator and makes use of the calculator's seven segment display.

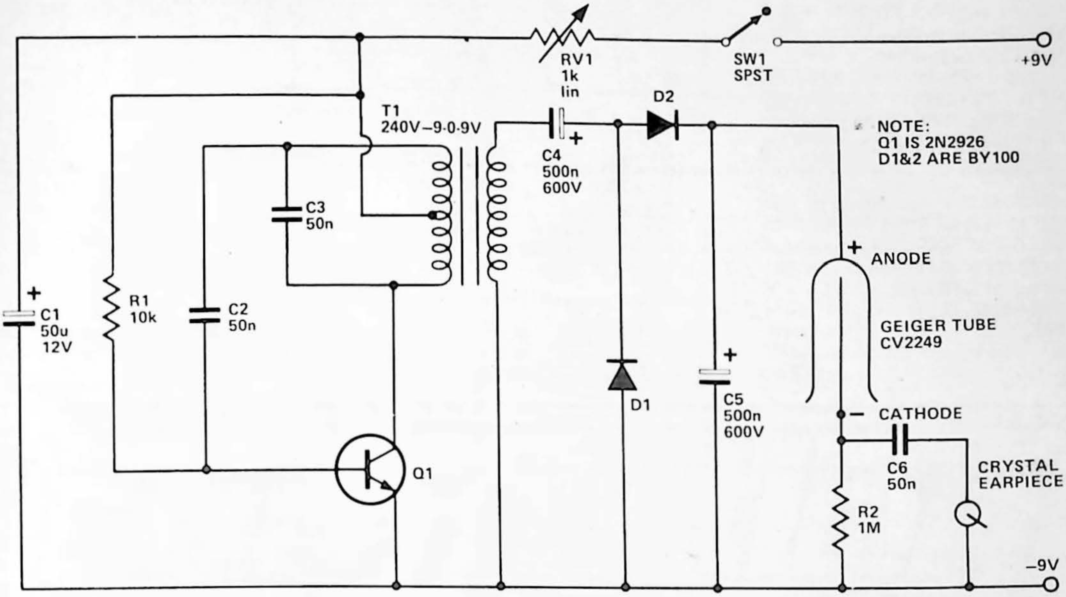
It has a single range measuring up to 10 MHz. The display is updated with a reading every two seconds. The preceding frequency count is held in the display during this period, thus avoiding a flashing display during the sampling interval.

The 7805 provides the 5V supply for the logic. The 4045 and the crystal form an oscillator and 21 stage binary counter producing 1/32 second pulses at 1 sec intervals as shown in waveforms 1 and 2. The 7473 flip-flop produces the one second gating pulse (waveform 3). Waveforms 2 and 3 are NANDed into pin 14 of the ICM 7208s counter chip to produce the RESET signal. Waveform 3 is also inverted before driving a differentiator with a 5V1 zener diode providing a clamp and discharge path. The differentiated waveform (5) gates the new frequency reading into the display.

Geiger Counter

A. Wheatley

Although the circuit is inexpensive and simple it is just as sensitive as many commercial devices. The important part is the geiger tube and this will probably cost about £1.90. It needs a high voltage supply which, in this case consists of Q1 and its associated components. The transformer is a low current 250V 9-0-9 and is connected in reverse. The secondary is connected into a Hartley oscillator, the base bias being provided by R1. RV1 is connected to control the voltage to the Geiger tube. A device to double the voltage is included because otherwise the voltage would still be insufficient to drive the tube. This comprises D1, D2, C4 and C5. This also rectifies it and smooths it. It is very important that C4 and especially C5 are of good quality and have low leakage. RV1 should be set so that each click heard is a nice clean one because over a certain voltage all that will be heard is a continuous buzz. The high voltage section is perfectly safe although if touched it will give a slight shock. This is unpleasant but quite harmless.

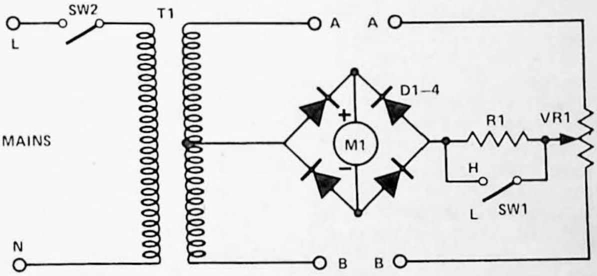


Capacity checker

D. Chivers.

This bridge was originally designed to find values for odd, unmarked or undecipherable capacitors. While not being of great accuracy, it does give a very good indication as to the value of the capacitor.

A known value component is placed across terminals A–A, polarity is not important, but polarised capacitors must not be used, and cannot be tested. The capacitor under test is inserted in B–B, the unit is switched on and VR1 rotated until a maximum value reading is obtained on meter M1. At this point, a reading is taken from the calibration scale on the pot which initially must be calibrated in ratios, ie:
1000:1, 100:1, 10:1, 1:1, 1:10, 1:100 etc. The unknown value is then calculated from this reading. Original calibration is from known values.



	H	L
10n	X	
100n	X	X
1u		X

M1 = 100uA
D1–4 = 1N4001
R1 = 25k
VR1 = 10k Lin
T1:240V/3V–0–3V

To increase the range of the circuit switch SW1 has been included to bypass R1. Since the frequency used is 50 Hz from the mains, ranges are limited; if another source were used, driving an audio output transformer, the versatility of the unit would then be further increased.

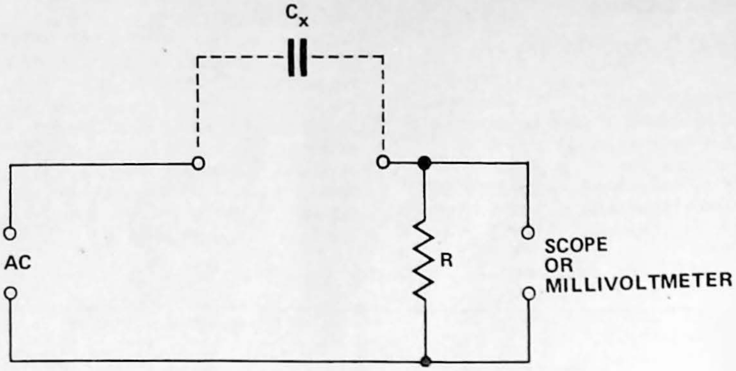
Capacitance Measurement

W. Winder

Few amateurs have a reliable method for measuring small capacitors. They may have a 50 Hz bridge, but the reactance of 10 pfs. at 50 Hz is some 320 megohms, which can well be of the same order as the bridge insulation, which leads to indeterminate and incorrect results. However if one has an A.F. signal generator and a measuring oscilloscope (or a.c. millivoltmeter), one can measure down to 2 or 3 pfs. with quite as good an accuracy as more complicated methods using square wave generators and diode pumps. The following very simple circuit is all that is necessary.

As long as the reactance of the capacitor is several times larger than the resistance of R, the output voltage will be directly proportional to the capacitance of C. By supplying a 1.6 volt input signal, the mathematics are simplified, and the output measurements are as the table given below.

The input wave form should be fairly good, as any harmonics present are exaggerated by the capacitor, and the shape of the output waveform can be anything but a pretty sine wave. However it has to be a poor signal generator that does this.



Capacity Range	Input Frequency	Value of R	Output
0 to 20 p	100 kHz	10 k	10 mV, per p
20 to 200 p	10 kHz	10 k	1 mV per p
200 to 2000 p	1 kHz	10 k	0.1 mV per p
2000 to 20,000 p	1 kHz	1 k	0.01 mV per p
0.02 to 0.2 μF	1 kHz	100 R	0.001 mV per p

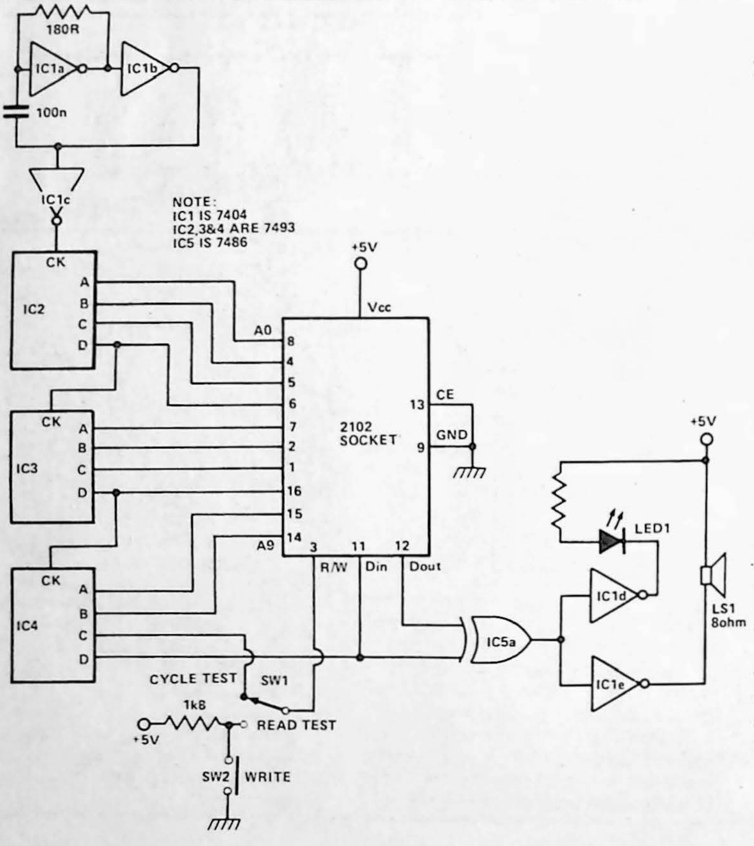
2102 Memory Tester

S. Sunderland

This circuit provides for the testing of 1024 Bit X1 memories, such as the 2102 series, in two modes. Mode-1 cycles the memory continuously through write and read, alternately writing zeros and ones then reading to ensure the write was successful. Mode-2 allows the write of a signal onto the memory, then continuously reads it to ensure the data is stable.

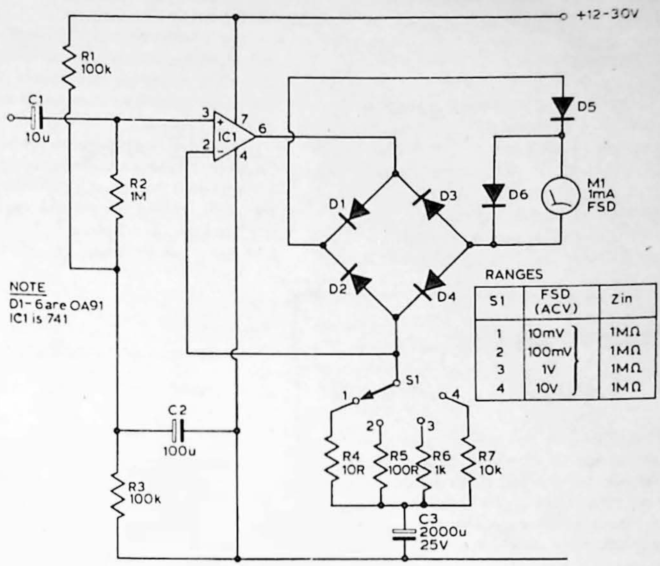
In both modes, the output from the memory is compared with what should be there, and if there is a difference, an LED flashes, accompanied by a click from the speaker. In mode-2, on power on, a continuous noise will be heard from the speaker, on pressing the 'WRITE' button this should vanish, similarly, a brief pulse of noise will be heard in mode-1 before the write is completed. The oscillator frequency is about 20 kHz with components shown.

In mode-2, when the supply voltage drops below 4.5V memory is not stable for more than a fraction of a second, although this does not show up using mode-1.



Audio Millivoltmeter

J. P. Macaulay



RANGES

S1	FSD (ACV)	Zin
1	10mV	1MΩ
2	100mV	1MΩ
3	1V	1MΩ
4	10V	1MΩ

The circuit shown is of a very simple but effective and accurate millivoltmeter. The non inverting input is biased at half supply by the voltage divider R1/R3, decoupled by C2. The input impedance is defined by R2, whilst C1 isolates unwanted DC.

Due to normal op-amp action the inverting input follows any voltage present at the non inverting input. Because of this the current flowing through the meter, and the resistor selected by S1 is V_{RMS}/R. C3 prevents any DC flowing and hence makes offset nulling unnecessary.

With the component values shown the circuit has a flat response from 8Hz-50kHz (-3db) on the 10mV range. The upper limit remains the same on the less sensitive ranges but the lower frequency limit goes under 1Hz.

D5 and D6 provide protection for the meter under reverse bias and overload conditions respectively. The circuit will work from supply rails between 12 and 30V, and in the quiescent state consumes only 2mA.

Calculator Radio Alarm

T. Corringham

This very simple circuit, used with a Sinclair Cambridge Programmable calculator, enables a transistor radio to be turned on after a predetermined time. (within the range of a few seconds to five months).

None of the components are critical, but the SCR should have a sufficiently high voltage and current rating for the radio used.

If a transistor radio is used the SCR is connected in series with the battery, but if a cassette recorder/player is used it can be connected to the remote socket.

The LDR is placed above the left hand three digits of the display. RV1 is adjusted so that the circuit is triggered by '888' being displayed, but not by the background light only.

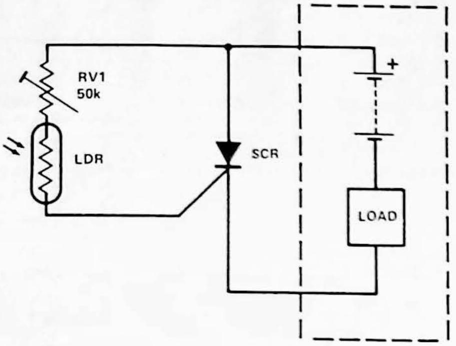
Using the program given, the time in minutes of the required delay is put in and /RUN/ pressed to start the timing period.

To stop the program prematurely /÷/c/CE/ is pressed.

The calculator should be used with a mains adaptor.

The timing is accurate to within five minutes in eight hours.

If a buzzer or similar alarm is used the same circuit can be used to give an audible indication of the termination of long programs.



```
X    .   00
÷    3   01
4    4   02
5    5   03
1    1   04
.    A   05
8    8   06
1    1   07
—    F   08
+    E   09
÷    3   10
1    1   11
=    —   12
▼    A   13
gin  1   14
0    0   15
9    9   16
÷    3   17
8    8   18
8    8   19
8    8   20
=    —   21
stop0    22
```

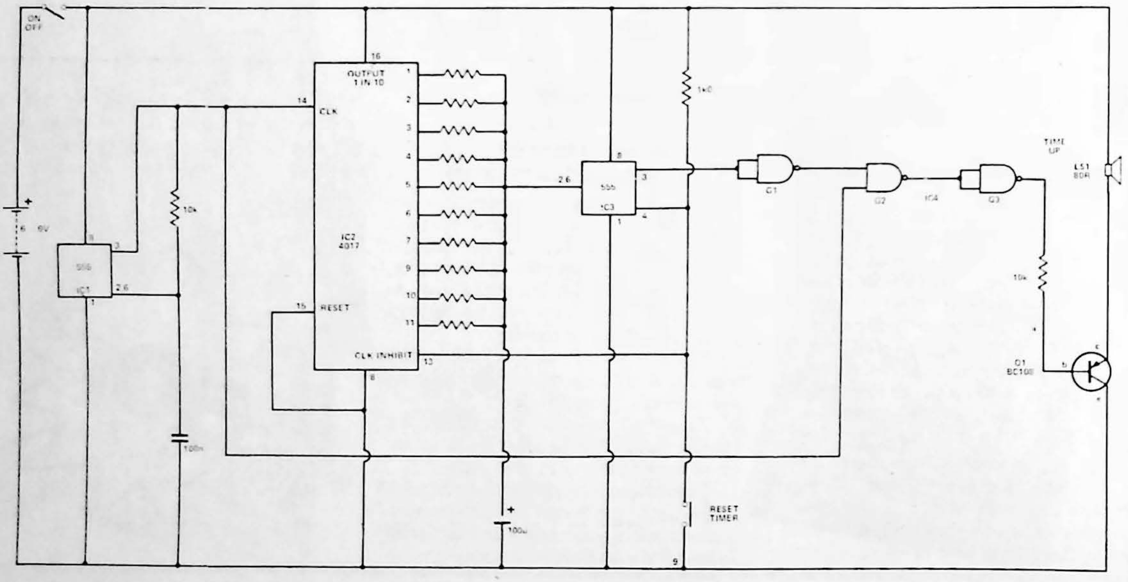
Random Delay Timer

S. D. Lang

This circuit is designed to add to the excitement of many board games. Players must make their moves within a random unknown time. The delays can be adjusted and the circuit uses only four ICs and a few passive components.

The 555 (IC1) provides a clock frequency for the 4017 and the 'time up' tone frequency. Normally the 4017 clock is inhibited as the clock inhibit pin 13 is high. However, when the 'reset timer' button is pushed, pin 13 is grounded and counting starts. The high output moves wildly between the outputs until the switch is released. Only one output will then be high, which one being entirely a matter of chance. The resistor connected to this high output determines the charging time of the capacitor. For the 100 u capacitor shown, 10 k should be allowed for each second of delay. When the capacitor has sufficiently charged up, IC3 switches off. This is inverted by G1 and appears high. The tone from IC1 is gated by this high signal to drive the loudspeaker via Q1.

Pressing the switch at any time clears the monostable and selects a random delay resistor. The delay resistors can be of any value selected by you. G1-3 are any NAND gates from a single 4011/7400. If the battery voltage is greater than 6 V a 4011 must be used.



A Simple Sequencer

P. Hill

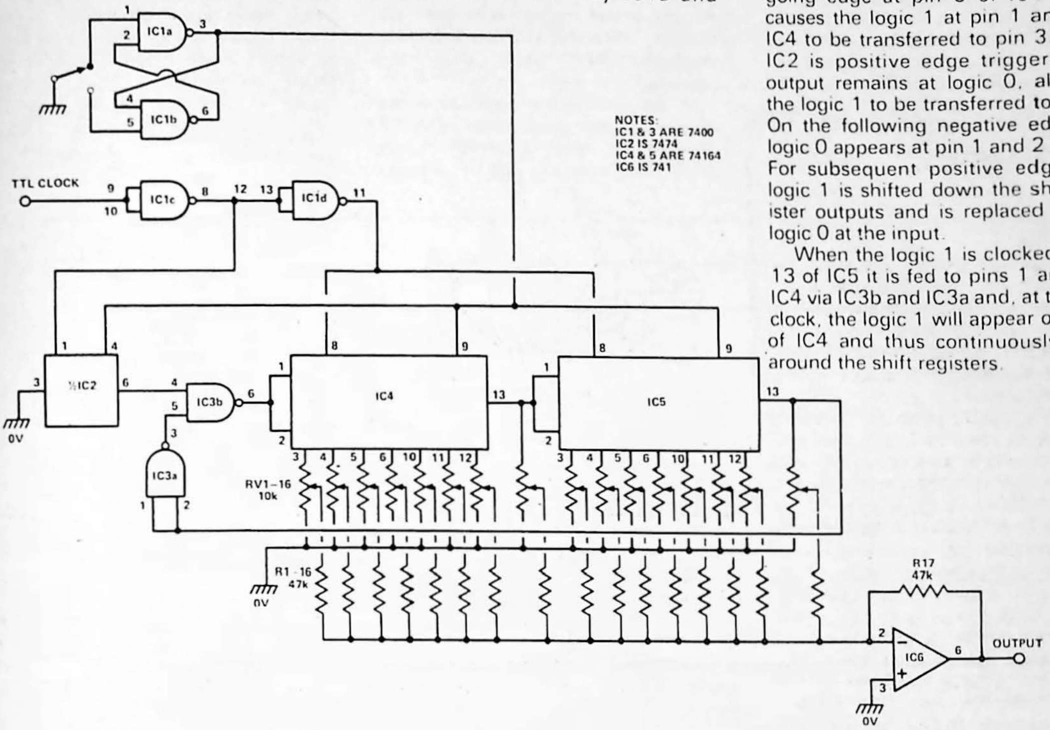
A simple sequencer can be constructed using shift registers.

A logic 1 is shifted down the shift registers (IC4, 5) outputs, otherwise at logic 0, at each clock pulse. This places a voltage across the variable resisters RV1 — 16 in turn. A preset DC voltage is thus available at the output, after being buffered by R1 - 16 and IC6 for each clock pulse. A sequence of control voltages can be set up and used to drive a voltage controlled oscillator.

The sequencer is reset by S1. The switch is debounced by IC1a and IC1b. Resetting zeros all shift register outputs and results in a logic 1 appears at the input of IC4.

When a clock is applied a positive going edge at pin 8 of IC4 and 5 corresponds to a negative-going edge at pin 1 of IC2, due to inverters IC1c and IC1d. The first positive going edge at pin 8 of IC4 and 5 causes the logic 1 at pin 1 and 2 of IC4 to be transferred to pin 3. Since IC2 is positive edge triggered its output remains at logic 0, allowing the logic 1 to be transferred to pin 3. On the following negative edge the logic 0 appears at pin 1 and 2 of IC4. For subsequent positive edges the logic 1 is shifted down the shift register outputs and is replaced by the logic 0 at the input.

When the logic 1 is clocked to pin 13 of IC5 it is fed to pins 1 and 2 of IC4 via IC3b and IC3a and, at the next clock, the logic 1 will appear on pin 3 of IC4 and thus continuously cycle around the shift registers.



NOTES:
IC1 & 3 ARE 7400
IC2 IS 7474
IC4 & 5 ARE 74164
IC6 IS 741

Talk Timer

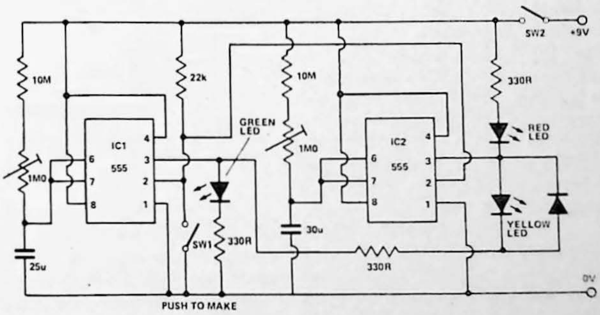
A. G. Mitchell

This circuit was designed for use as a timer for educational talks, providing a timing period of 5 minutes. During the talk, a green LED is turned on, but half a minute before the end, the green LED is extinguished and the yellow LED lit, giving a warning that only half a minute remains. At the end of the 5 minutes, the yellow LED turns off and the red LED turns on.

The circuit is simply two one-shot monostables connected together, the first with a timing period of 4½ minutes, and the second 5 minutes.

Timing is started by momentarily closing SW1, pin 3 of both ICs goes high turning on the green LED and off the red and yellow LEDs.

At the end of the first timing period, pin 3 of IC1 goes low turning the green LED off and the yellow LED on. When at the end of the second timing period, pin 3 of IC2 goes low, the yellow LED is turned off and the red LED lit.



SEQUENCE & TIMING

Tape Recorder Controller

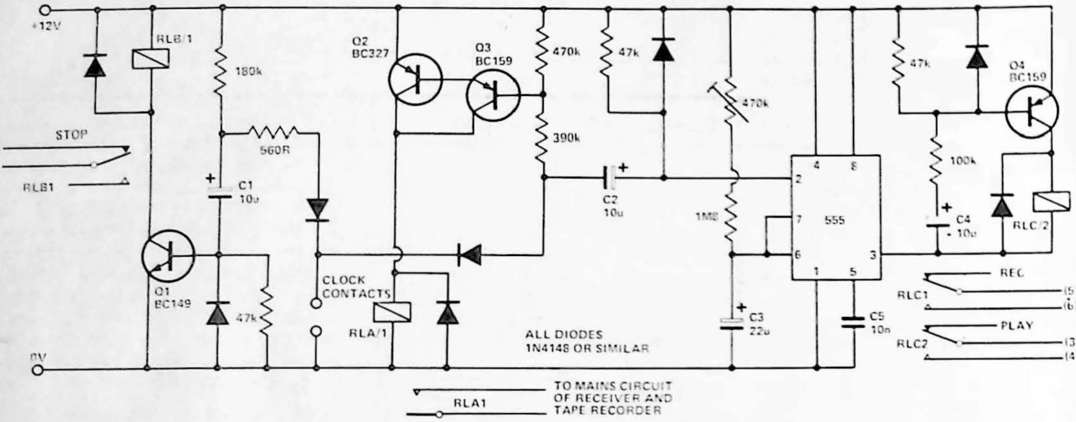
P. B. Cordes

The circuit shown enables a solenoid operated tape recorder to be left to record a programme unattended. It was originally designed to be used on a Revox A77, in conjunction with a digital clock based on the Caltex CT7001, but could be adapted for other recorders, clocks, or mechanical time switches. The clock is set to switch on one minute before the programme starts, and switch off as it finishes.

When the clock contacts close, RLA is operated via Q2 and Q3, applying power to the receiver and recorder. At the same time C1 is discharged, and C2 applies a negative pulse to pin 2 of the timer, which triggers, discharging C4. The output of the timer goes high for one minute, allowing time for the recorder and receiver to warm up. As the timer output goes low, C4 charges through Q4 momentarily, operating RLC which starts the recorder.

At the end of the preset time the clock contacts open, discharging C2 through Q2 and Q3 which delays RLA from dropping out by approximately 5 seconds. As the clock contacts re-open C1 charges through Q1, operating RLB opening the normally closed stop contacts for a short period, stopping the recorder. After the 5 second delay has elapsed, RLA opens, removing power from the equipment.

RLB and RLC may have light contacts, but RLA must be a heavy duty mains rated type. Ideally the digital clock should be crystal controlled, to eliminate short term mains frequency fluctuations. The numbers shown in brackets are the appropriate pin connections on the 10 way remote control plug of a Revox A77.

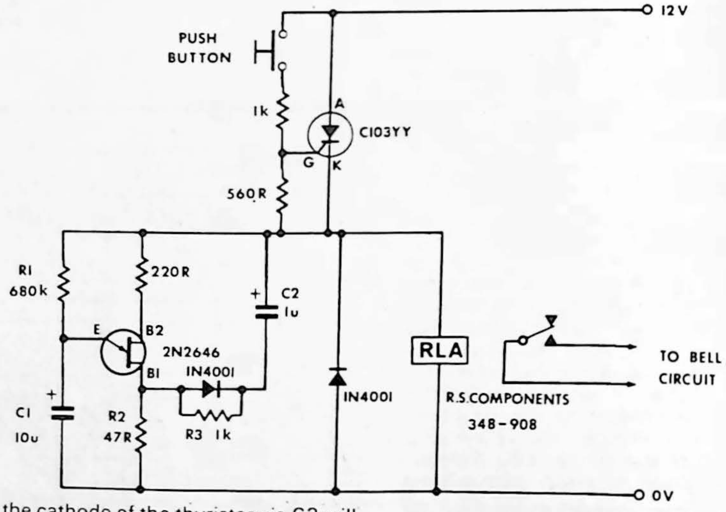


Unijunction Pulse Stretcher – Door Bell Extender

D. Wedlake

The circuit presented is a practical monostable timer which was designed to extend the ringing time of a door bell. It can be useful in cases when the bell push button might not be engaged long enough to attract attention, though it could be used in many other applications.

When the push button is closed the thyristor will switch on delivering power to the unijunction transistor timing circuit and energising the relay, the contacts of which are used to control the bell circuit. At the same time, capacitor C2 quickly charges to the load voltage potential via R3. After a time interval given approximately by 0.8 C1 R1 (about 6 seconds in this case) the unijunction transistor will fire and the corresponding output pulse which is coupled to the cathode of the thyristor via C2 will put the thyristor in reverse bias switching it off. With these values the relay will become energised for at least 6 seconds.

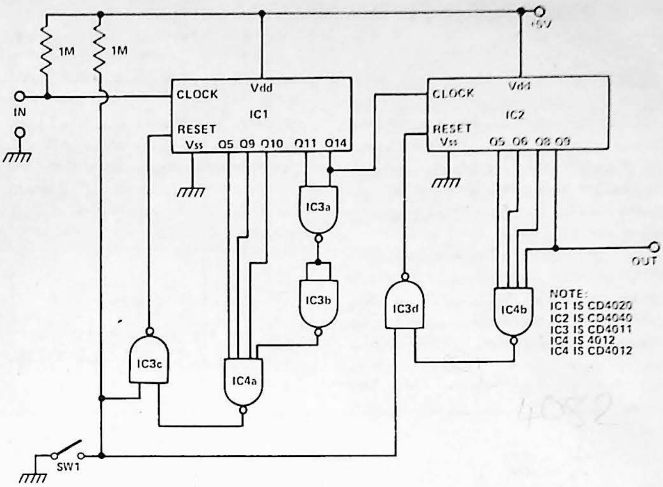


Divide by 4,320,000 Counter

J. Stark

So what is a 4320000 counter good for? Well, 50x60x60x24 = 4320000 so that if you feed in 50 Hz at the input the counter will give 1 pulse per 24 hours, i.e. it can form the basis of an extremely accurate 24 hour alarm. Such an alarm never requires setting once the counter has been reset to zero at the required time of day and will thereafter give the alarm at exactly the same time every day. It can thus be used for instance to wake oneself up every morning without fail.

Such a circuit is very easily built using just 4 cheap CMOS chips. IC1, a 14 stage binary counter is set to divide by 10000 (binary 10011100010000) by reseting to 0 on the count of 10000. Similarly IC2, a 12 stage binary counter divides by 432 (binary 110110000). IC3 and IC4 provide the necessary decoding to reset the counters (which are reset by a logic '1' unlike TTL where a logic '0' is usually required). Additionally the gating allows the counter to be reset to 0 by SW1.



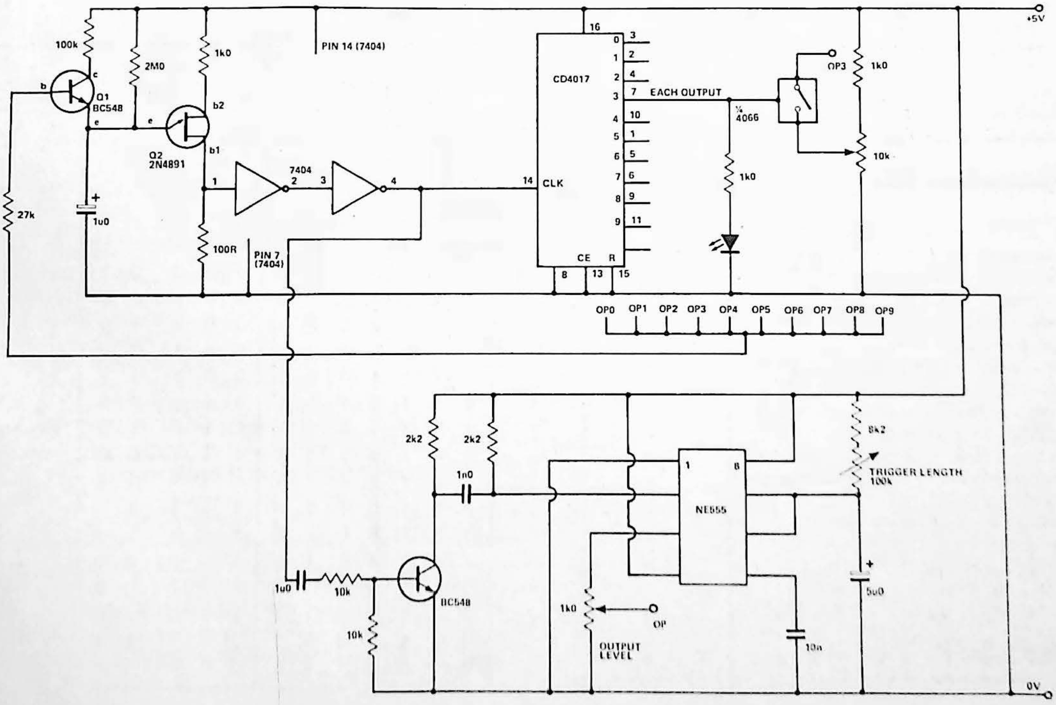
Simple Rhythm Generator

J. J. Trinder

The circuit was designed to be used with a synthesiser to play simple repeating rhythms automatically. All that was required in this case was a trigger signal, although a pitch signal could be added easily by duplicating the switch and resistor networks on the 4017 outputs.

The clock drives the 4017, which sequentially takes its outputs high. These are used to turn on switches. The output voltage from each switch can be varied by adjusting the pot.

The outputs are added together and fed back to the base of Q1, thus varying the speed of the clock depending on the setting of the pot on the output selected. The clock is also used to trigger a monostable formed around an NE555. This circuit provides the gate pulse for the synthesiser. The gate length can be varied by adjusting the 100 k pot.



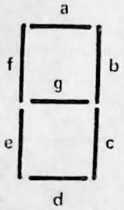
DIGITAL

Seven to binary with a special bit!

T. Nash.

This circuit, which uses only four TTL or CMOS ICs, converts a seven segment digit to binary, with indication of the 'special' characters: minus, E (exponent or overflow), and optionally blank. Both types of 6, 7 & 9 can be handled, and for ease of manipulation blank is encoded as binary zero.

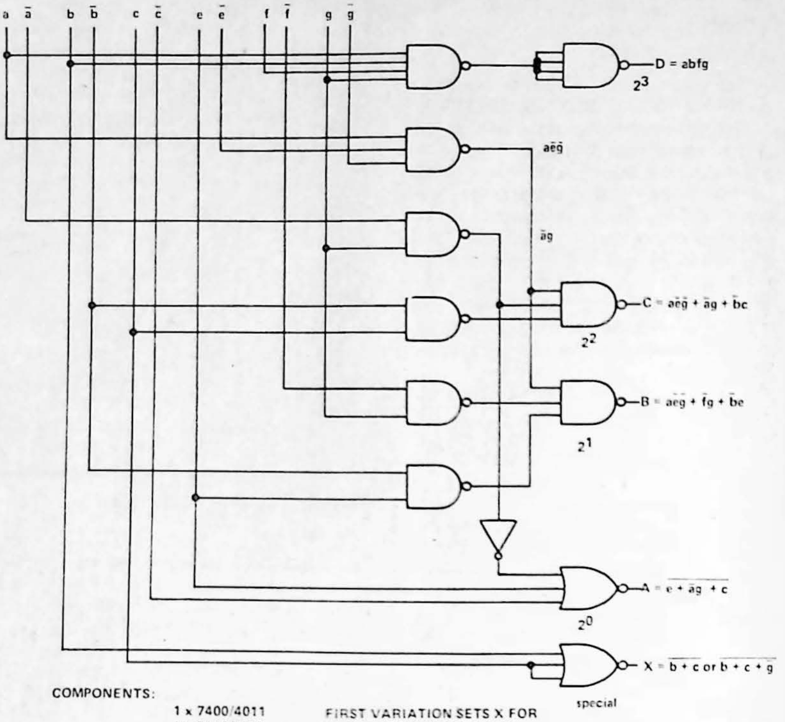
For a calculator – microprocessor interface the 'X' output should be fed to the sign position for ease of testing: this method is more economical in time and memory space than testing for a specific binary value. The extra bits needed for the equivalent ASCII character could also be added at the interface.



The segment identification shown above is the standard seven segment lettering system and so should be familiar to most constructors.

The letters also refer in this case to the circuit diagram and the truth table given below on the right hand side of the page.

No power supply connections are shown for the circuit as this depends on which version, TTL or CMOS is constructed.



COMPONENTS:

1 x 7400/4011
1 x 7410/4023
1 x 7420/4012
1 x 7427/4025/4000 (4000 SHOWN)

FIRST VARIATION SETS X FOR BLANK, SECOND DOES NOT.

* FOR TTL AND 4025 VERSIONS, use 3 input nor.

SEE DIAGRAM

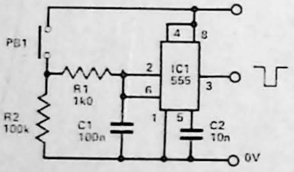
TRUTH TABLE

7–SEG	a	b	c	d	e	f	g	D	C	B	A	X
BLANK	0	0	0	0	0	0	0	0	0	0	0	*
0	1	1	1	1	1	1	0	0	0	0	0	0
1	0	1	1	0	0	0	0	0	0	0	1	0
2	1	1	0	1	1	0	1	0	0	1	0	0
3	1	1	1	1	0	0	1	0	0	1	1	0
4	0	1	1	0	0	1	1	0	1	0	0	0
5	1	0	1	1	0	1	1	0	1	0	1	0
b	0	0	1	1	1	1	1	0	1	1	0	0
6	1	0	1	1	1	1	1	0	1	1	0	0
7	1	1	1	0	0	0	0	0	1	1	1	0
7	1	1	1	0	0	1	0	0	1	1	1	0
8	1	1	1	1	1	1	1	1	0	0	0	0
q	1	1	1	0	0	1	1	1	0	0	1	0
9	1	1	1	1	0	1	1	1	0	0	1	0
–	0	0	0	0	0	0	1	0	1	1	1	1
E	1	0	0	1	1	1	1	0	0	1	1	1

555 Micro Input Reset

P. Davidson

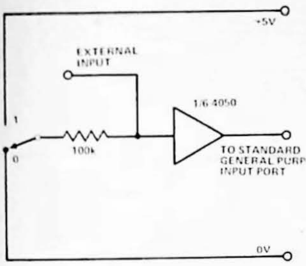
When dealing with a microprocessor system, there are several features which place requirements on the duration of their input leg reset. These signals are usually negative (in the author's experience) and so, with the use of a 555, these requirements can be filled reliably (as opposed to the normal flip-flop debounce circuit). The circuit saves on logic used to invert the normal 555 monostable action.



External Input For Micros

P. F. Tilsley

This simple circuit provides a micro with an 8 bit switch/external signal input port. The state of the switches controls the byte read by the micro, but any totem pole TTL signal applied to the external input socket over-rides the signal from the corresponding switch. The value of the resistor is not as critical. The circuit is shown for only one bit.



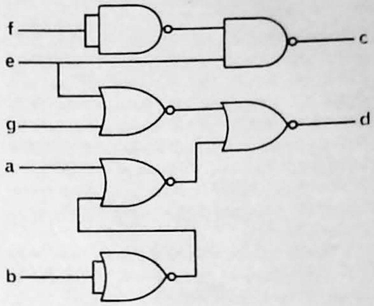
Seven Segment Decoder

Yap Sue-Ken

As not all of the possible seven segment codes are used, only 5 lines are required to define the ten numerals without ambiguity. The logic circuitry required to recover the other two segments are as shown in the figure.

In the case of microprocessor controlled displays this can save two valuable I/O pins.

DECIMAL DIGIT	INPUT SEGMENTS a	b	e	f	g	OUTPUT SEGMENTS c	d
0	1	1	1	1	0	1	1
1	0	1	0	0	0	1	0
2	1	1	1	0	1	0	1
3	1	1	0	0	1	1	1
4	0	1	0	1	1	1	0
5	1	0	0	1	1	1	1
6	1	0	1	1	1	1	1
7	1	1	0	0	0	1	0
8	1	1	1	1	1	1	1
9	1	1	0	1	1	1	1



NOR GATE = CD4001 OR SN7402
NAND GATE = CD4011 OR SN7400
POSITIVE LOGIC: '1' = ON

$c = \overline{e.f}$

$d = \overline{\overline{(g+e)} + \overline{(a+b)}}$

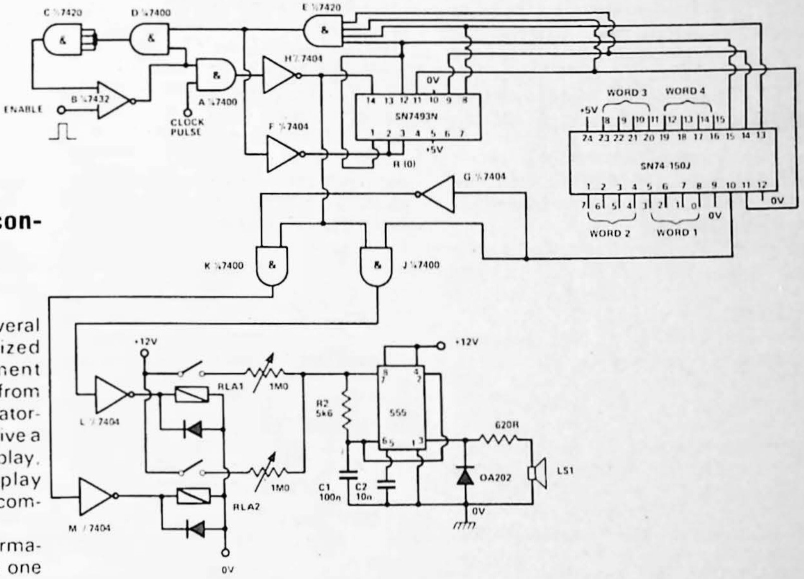
Keyboard/display sound converter

K. G. Reid

This circuit can be used in several modes: It can provide quantized feedback (a distinct improvement over the normal single 'bleep') from the key actions made on a calculator-type keyboard: It can be used to give a 'sound' translation of a digital display, or completely replace the display when sound would be a better communication medium.

The keyboard or display information (a maximum of 16 bits with one 16-line 74150 multiplexer) is translated into a series of 16 high or low frequency tone pulses, corresponding to the 'high' or 'low' logic state of the 16 bits.

The circuit illustrated was used in conjunction with a digital multimeter, requiring three 4-bit words for the digits and three additional bits for over-range, negative and decimal point. Thus, 15 lines only were required, the 16th being used for resetting.



The 15 bits are latched on to the inputs of the 74150 multiplexer. Presentation of the enable pulse results in a logic '1' appearing at the output of gate B, allowing clock pulses to pass via gates A and H to the 7493 counter. Gates B, E, D and C form a latch which remains 'set' until all 15 bits have been sampled. As each bit is sampled, the inverse state appears at the multiplexer output, opening gate J or K and thus operating one of the two reed relays. As a count of 1111 appears from the counter, the output of F drops low, resetting the latch and counter. The operation of either relay results in a tone appearing at the loudspeaker (or earpiece), the tone frequencies being set (1.2 kHz maximum) by the 1 megohm pots. The tone pulse length is governed by the clock rate.

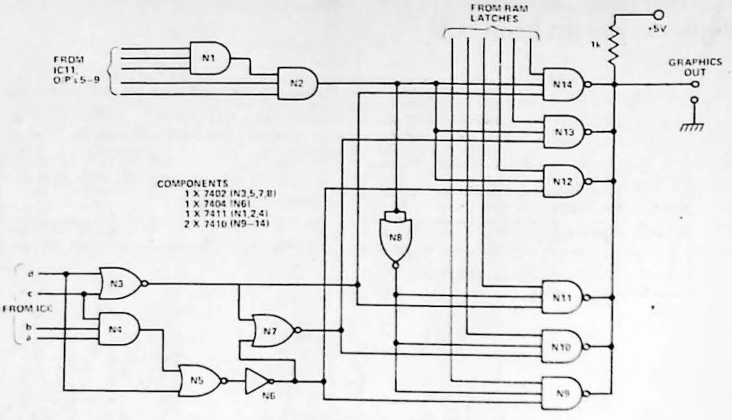
Graphics for the 560 VDU

M. Jackson

This circuit can be added to the 560 VDU published in ETI in September 1976 to allow the display of simple graphics. The rows and columns of each character position are gated by N1 to N8 to make up the graphic character sections. This information is ANDed with the RAM data to determine whether ot not a particular section is on or off.

The graphics/character selection may be controlled by the spare bit in RAM after it has been latched.

Note: RCLK must be disconnected otherwise blank lines will appear in the graphics display.



COMPONENTS
1 X 7402 (N3,5,7,8)
1 X 7404 (N6)
1 X 7411 (N1,2,4)
2 X 7410 (N9–14)

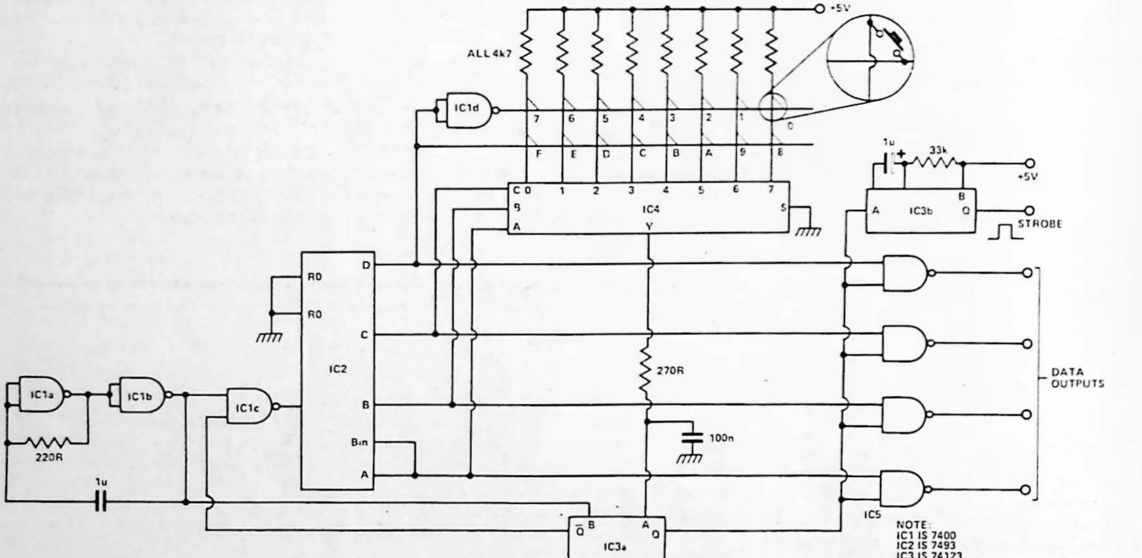
Hexadecimal Keyboard

C. N. Harrison

Programming a microprocessor can be a time consuming business if instructions are entered in binary using rows of toggle switches. A far more convenient method is to enter the code in hexadecimal notation using an appropriate keyboard. A suitable keyboard should be fully debounced, provide a strobe whenever a key is struck and use standard power supplies. The following circuit provides all these features.

The eight by two matrix of keys is scanned sequentially by the 74151 data selector, IC4 and the D output of the 7493 four bit counter, IC2. If no keys are pressed the Y output of IC4 is always logic 1 since all eight inputs are pulled high by the 4k7 resistors. When a key is pressed the Y output remains high until the counter reaches the inverse of the required 4 bit data. The appropriate input of IC4 is then pulled low and the Y output changes to logic 0. This triggers monostable IC3a which disables the clock input to the counter, enables the data outputs via IC5 and triggers IC3b to provide a data strobe. While the key is closed IC3a is retriggered by the clock so that the data remains stable on the output lines until the key is released.

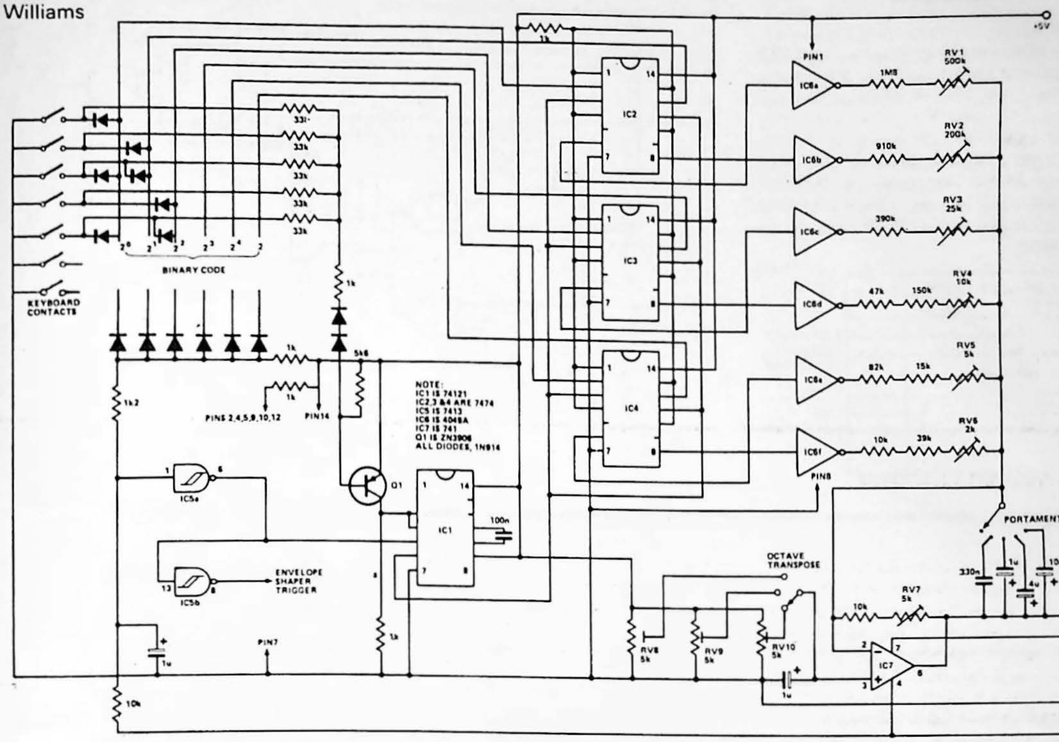
If latched data outputs are required IC5 can be replaced by a 7475 quad latch clocked from the output of IC3b. The data would be available at the Q outputs of the latch.



NOTE:
IC1 IS 7400
IC2 IS 7493
IC3 IS 74123
IC4 IS 74151
IC5 IS 7400

Digital Keyboard Controller

P. Williams



This circuit was designed to overcome all the problems associated with resistor ladders and analogue memories normally found in synthesisers. The key depressions cause a diode matrix to set up binary patterns which are memorised on a bank of flip-flops.

The main advantages of this method are infinite memory hold; more accurate output since there are only six main tuning resistors (it is economical to make them variable). If more than one key is depressed at a time, no "out of tune" notes will be produced because of a multiple key depression detector. Only one set of single make contacts is required for the keyboard. Octave transpose and portamento is included.

When a key is depressed, the binary code set up by the diodes is clocked into the flip-flop (IC2-IC4) by the monostable (IC6). IC7 along with its associated resistors forms a D/A converter. The 33k resistors along with Q1 form the circuit which inhibits further data being clocked into the flip-flops if more than one key is pressed, and IC5 provides a pulse to trigger envelope shapers.

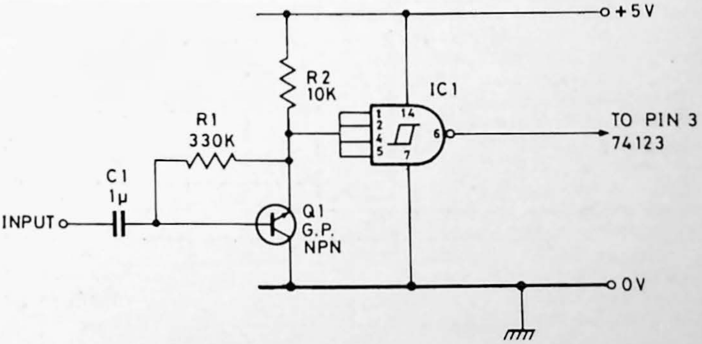
Up to 63 semitones (over five octaves) can be catered for using six data bits as shown, although more bits can be added.

RV1 to RV6 should be adjusted so that each successive bit causes twice as much change in the output voltage. RV7 adjusts the voltage/frequency relationship. RV8-10 adjust the starting voltage; they should be set to give the required octave shifts on the transpose control.

Cuts Above

B. Houseley

The circuit here is an improved version of the original cuts encoder. If Q1 is preceded by a high impedance buffer, quite low signal levels can be accommodated successfully — and still trigger the 74123. A 74C02 or a 7402 was found to trigger only unreliably in this circuit.



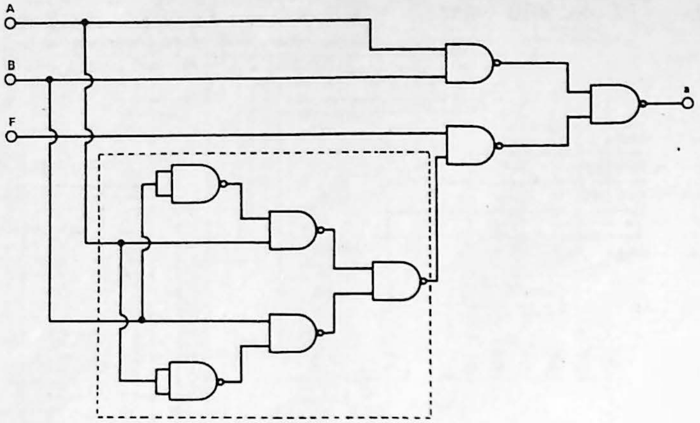
Programmable Gate

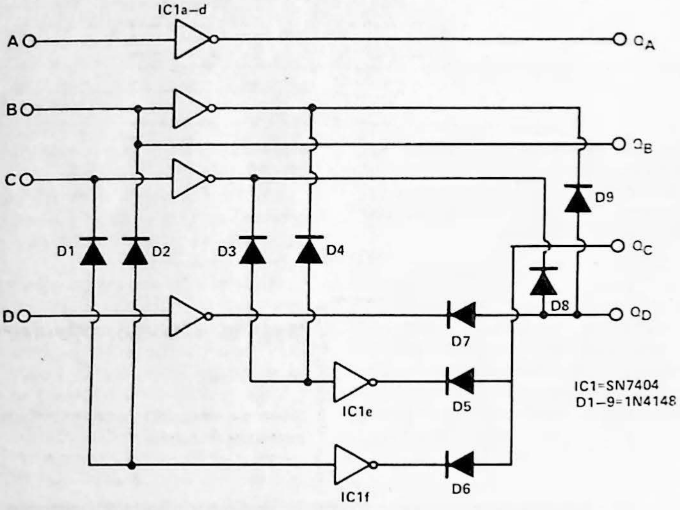
P. Mead

The Programmable Gate is a gate which converts an AND gate to an OR gate by applying a logic '1' on the function input.

The logic design uses 8 x 2 input NAND gates. The number of gates may be reduced by replacing the 5 NAND gates enclosed by the dotted line, with a 2 input exclusive OR, such as the TTL 7486.

FUNCTION INPUT	INPUTS A	INPUTS B	OUTPUT	
0	0	0	0	AND FUNCTION
0	0	1	0	
0	1	0	0	
0	1	1	1	
1	0	0	0	OR FUNCTION
1	0	1	1	
1	1	0	1	
1	1	1	1	





BCD COUNT	INPUTS D	C	B	A	OUTPUTS Q_D	Q_C	Q_B	Q_A	COMPL–EMENT
0	0	0	0	0	1	0	0	1	9
1	0	0	0	1	1	0	0	0	8
2	0	0	1	0	0	1	1	1	7
3	0	0	1	1	0	1	1	0	6
4	0	1	0	0	0	1	0	1	5
5	0	1	0	1	0	1	0	0	4
6	0	1	1	0	0	0	1	1	3
7	0	1	1	1	0	0	1	0	2
8	1	0	0	0	0	0	0	1	1
9	1	0	0	1	0	0	0	0	0

$Q_A=\overline{A}$
$Q_B=B$
$Q_C=\overline{(B\cdot C)}\cdot\overline{(\overline{B}\cdot\overline{C})}$
$Q_D=\bar{B}\cdot\bar{C}\cdot\bar{D}$

Cheap Down Counter

AF Bush

This circuit, when presented with a 4 bit binary number in the range 0000–1001 will present the nines complement of that number at the output.

Connecting the circuit between a 7490 and a 7447, will, instead of the usual up count, provide a display which counts down from nine.

This provides a useful alternative to the expensive 74192 when only a down count is required.

Retriggerable Flip-Flop

G. S. Wills

The following circuit was devised as a cheap retriggerable flip-flop using a single Quad-NAND chip (4011).

It is sometimes useful to have a single input flip-flop instead of the usual SET & RESET, this one being used on the end of an ultrasonic remote pause for a cassette recorder and switching to its opposite state for each received pulse.

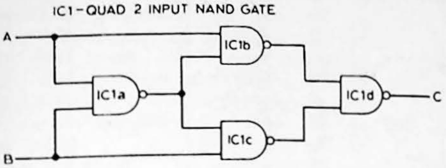
Gates 3 and 4 are wired as a standard flip-flop configuration, their inputs going to gates 1 and 2 which steer the input pulse alternately.

The only requirement to remember is that the input pulse must be shorter than the CR constant of the circuit, but this is easily arranged by including a differentiator network (at the input) with a lower time constant.

Exclusive OR and NOR gates

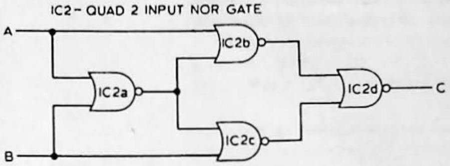
D. S. Smith

When constructing logic circuits which need either an exclusive OR or exclusive NOR gate, and one is not available, the following arrangement of NAND or NOR gates can produce the required results. The circuits can be constructed using standard TTL or CMOS gates.



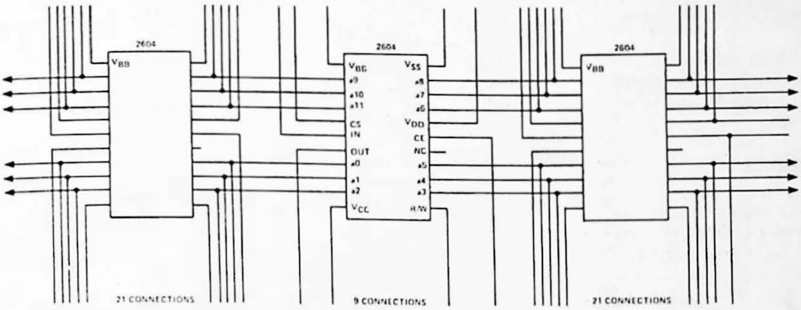
TRUTH TABLE

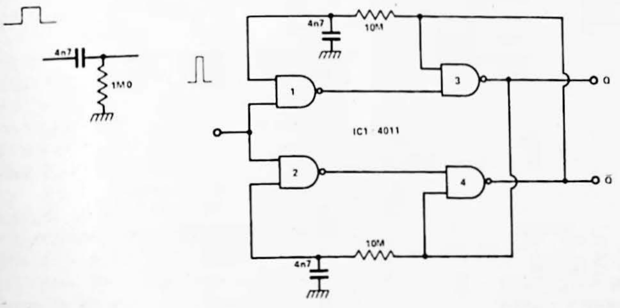
A	B	C
0	0	0
0	1	1
1	0	1
1	1	0



TRUTH TABLE

A	B	C
0	0	1
0	1	0
1	0	0
1	1	1





Minimising Memory Connections

M. T. Clarke

Anyone who has connected together memory ICs may well be appalled at the number of connections, especially those which simply parallel the IC pins.

Realizing that the address pin designations are purely notional means that address lines can be rearranged before they reach an IC, as convenient. This eases considerably PCB design.

An example is shown where connection of 4K dynamic RAMs (2604) was undertaken on Vero-board. The copper tracks provide all address connections for every alternate IC without any wiring from the surrounding ICs (this saved almost 100 connections on a 4K x 16 board).

Dynamic RAMs require segregating the row and column addresses, but within each they can be freely mixed.

Mine sweeper

E. A. Johnson

The object of the game is to locate and destroy a moving minesweeper. The ship moves along a set course, but, to avoid destruction it can deviate slightly from the course and alter its speed.

Playing the game

The game is started by entering a number (in the range 0 to 1) into register E, to set the initial position of the minesweeper through a random number generator. A shot is made by entering the xy co-ordinates (into the A and B registers respectively) of the square where the ship is believed to be. The calculator determines the position of the ship and displays the distance by which the shot missed. If the shot is within five units of the ship, damage occurs which slows the ship down in proportion to the nearness of the shot. When the ship is destroyed the display flashes.

After the ship has been destroyed, the number of shots used can be displayed by pressing 'C', and a new game can be started by pressing 'D'.

Method of calculation

The initial value of Θ, which determines the ship's position is determined using the calculator's random number package. The ship's co-ordinates are then calculated by the following equations:

$$x = (50 + 45 \cos 3\Theta) + \text{RNUMX}$$

$$y = (50 + 45 \sin 2\Theta) + \text{RNUMY}$$

where RNUMX and RNUMY are random numbers (in the range of –3 to +3) to give the ship its avoiding action.

The distance of the shot from the ship is calculated using pythagoras and displayed in integer mode.

The next value of Θ is then given by

$$\Theta = \Theta + \Theta\text{INCR}$$

where ΘINCR is originally set to 5, the calculator then determines the new co-ordinates of the ship.

When the distance of the shot from the ship is less than five units, the value of ΘINCR is reduced to slow the ship down. The new value is given by $\Theta\text{INCR} = \Theta\text{INCR} - (5 \div \text{distance})$.

The above procedure continues until $\Theta\text{INCR} \leqslant 0$ when the ship is destroyed.

A new game, if required, is started by automatically generating a new random initial value of Θ.

MINESWEEPER PROGRAM FOR TI 58 & 59

```
LOC  CODE  KEY       |      03  3     |      00  0
                     |      58  Fix   |      65  x
000  43    RCL       | 040  00  0     | 080  02  2
     01    1         |      36  Pgm   |      54  )
     44    SUM       |      15  15    |      38  som
     00    0         |      71  SBR   |      71  SBR
     43    RCL       |      88  D.MS  |      33  X
     02    2         |      65  X     |      85  +
     91    R/S       |      03  3     |      05  5
     76    Lbl       |      06  6     |      32  x⇌t
     33    X         |      00  0     |      95  =
     65    x         |      95  =     |      34  √x
010  04    4         | 050  42  STO   | 090  42  STO
     05    5         |      00  0     |      02  2
     85    +         |      25  CLR   |      77  x≥t
     05    5         |      91  R/S   |      00  0
     00    0         |      76  Lbl   |      00  00
     85    +         |      11  A     |      55  ÷
     36    Pgm       |      69  Op    |      32  x⇌t
     15    51        |      23  23    |      95  =
     71    SBR       |      75  —     |      35  1/x
     88    D.MS      |      53  (     |      22  INV
020  65    x         | 060  53  (     | 100  44  SUM
     06    6         |      43  RCL   |      01  1
     75    —         |      00  0     |      29  CP
     03    3         |      65  x     |      43  RCL
     95    =         |      03  3     |      01  1
     33    X         |      54  )     |      77  x≥t
     92    INV SBR   |      39  cos   |      00  0
     76    Lbl       |      71  SBR   |      00  00
     15    E         |      33  X     |      25  CLR
     42    STO       |      32  x⇌t   |      35  1/x
030  09    9         | 070  00  0     | 110  22  INV
     76    Lbl       |      91  R/S   |      58  Fix
     14    D         |      76  Lbl   |      91  R/S
     05    5         |      12  B     |      76  Lbl
     42    STO       |      75  —     |      13  C
     01    01        |      53  (     |      25  CLR
     00    0         |      53  (     |      43  RCL
     42    STO       |      43  RCL   |      03  3
                     |                |      91  R/S
```

Example Game

Comment	Enter	Display
Enter a number between 0 & 1	0.258 E	0
Enter guess for x co-ordinate	50 A	0
Enter guess for y co-ordinate	11 B	65 (Distance)
x co-ordinate	84 A	0
y co-ordinate	70 B	62
x	40 A	0
y	85 B	7
x	43 A	0
y	87 B	3
x	51 A	0
y	89 B	3
x	54 A	0
y	90 A	9.9999999 99
		(Flashing)
To display number of shots	C	6
To start a new game	D	0
x co-ordinate	50 A	0
y co-ordinate	11 B	42
ETC.		

Lunar Landing

Sarah J. Owen.

This program was devised for use on the Commodore PR.100 calculator, but is easily adapted for use on any other programmable ones. Imagine you are the Astronaut controlling the final descent of a lunar module, at regular intervals the speed of descent is displayed, the period of burn of the retro–rocket has to be calculated, after allowing for the reducing weight of the fuel on board. . . . . Five speed corrections are allowed, after which the final impact velocity is displayed. If an error is made and all fuel is used, there is just time to transmit an urgent S.O.S. message before destruction on the lunar surface. . . . . . . Due to the lack of program space, the method of selecting the initial random speed is unusual, but ranges between 20 and 100 m.p.h.

Result of impact speed:–

0 – 5 m.p.h.	PERFECT LANDING
6 – 10 m.p.h.	SLIGHT DAMAGE, LIFT OFF DELAYED.
11 – 15 m.p.h.	STRUCTURAL DAMAGE LIFT–OFF DOUBTFUL
16 – 25 m.p.h.	SEVERE DAMAGE & INJURY – USE SUICIDE PILL.
ABOVE 25 m.p.h.	MODULE & ALL LIFE DESTROYED . . .

SET UP:–

F–CA–F–FP–8–GOTO–00
Mode switch to load – enter program – mode switch to run – goto – 00 enter any two or more numbers (date etc.) Each followed by Xn key. Press R/S – speed of descent displayed.
Allow for weight of fuel remaining, enter period (in seconds) of rocket burn to reduce speed, press R/S – new rate of descent displayed, correct as before. After five speed corrections, impact speed will be displayed. If fuel in excess of 20 seconds is used, module transmits an urgent message before destructing.
Press R/S to re – start.

Recommended periods for Retro–rocket firing

SPEED	BURN
5	1.6
7	1.9
10	2.3
15	2.7
20	3.0
30	3.4
40	3.7
50	3.9
60	4.1
70	4.2
80	4.4
90	4.5
100	4.6
110	4.7
120	4.8
130	4.9
150	5.0
160	5.1
180	5.2
200	5.3
220	5.4
250	5.5
270	5.6
300	5.7
330	5.8
365	5.9
400	6.0
450	6.1
500	6.2
550	6.3
600	6.4
660	6.5
730	6.6
800	6.7
900	6.8
1000	6.9

Memory 1 – Seconds of fuel left
Memory 0 – Accurate descent speed

N.B. Adjust burn period for weight of fuel, allow 1 m.p.h. for each Second of fuel remaining (approx)

PROGRAM

LOC	CODE	KEY
00	21	F
01	63	S
02	21	F
03	51	FRAC
04	74	X
05	81	1
06	91	0
07	95	=
08	51	M
09	91	0
10	53	Xn
11	82	2
12	91	0
13	51	M
14	81	1
15	71	4
16	51	M
17	82	2
18	52	MR
19	91	0
20	74	X
21	62	8
22	84	+
23	52	MR
24	81	1
25	95	=
26	51	M
27	91	0
28	21	F
29	52	INT
30	13	R/S
31	21	F
32	85	M–
33	81	1
34	21	F
35	32	e^x
36	85	–
37	52	MR
38	81	1
39	85	–
40	52	MR
41	91	0
42	74	X
43	95	=
44	35	×
45	51	M
46	91	0
47	52	MR
48	81	1
49	94	+/–
50	15	SKIP
51	14	GOTO
52	73	6
53	63	9
54	52	MR
55	82	2
56	85	–
57	81	1
58	95	=
59	15	SKIP
60	14	GOTO
61	81	1
62	73	6
63	52	MR
64	91	0
65	13	R/S
66	14	GOTO
67	91	0
68	91	0
69	72	5
70	91	0
71	72	5

Mastermind

P. R. Kemble B.Sc.

This program enables the popular game Mastermind to be played on a Hewlett–Packard HP29C calculator.

A five digit number (no two digits the same) is set by one player, and then the second player must deduce what it is. There are 30,240 possibilities.

After each guess the calculator indicates how many digits in the guess were correct and in the right position, and how many were correct but in the wrong position.

To play:

Player A enters a 5 figure number and then presses GSB 1.

Player B enters his guess and presses R/S. After several seconds calculation the display shows a number such as 1.2 which means 1 digit in the right place and 2 more correct figures but in the wrong position.

Player B then enters another guess and presses R/S, etc. until he achieves a score 5.0.

For cheats (!) or if the number set has been forgotten, it is held in STO .5.

The use made of the calculator's stores is shown below.

If the number set was ABCDE, and the guess is FGHIJ, then:

STO	0	Used
	1	J
	2	I
	3	H
	4	G
	5	F
	6	Used
	7	Used
	8	Used
	9	Used
	.0	E
	.1	D
	.2	C
	.3	B
	.4	A
	.5	ABCDE

```
STEP    INSTRUCTION

01      gLBL1
        fFIX1
        STO.5
        1
        4
        CHS
        GSBO
        gLBL9
        0
10      STO7
        STO8
        R
        R/S (Enter guess)
        5
        CHS
        GSBO
        1
        STOO
        gLBL5
20      RCLi
        9
        STO+0
        x≷y
        RCLi
        –
        gx = 0?
        GSB3
        8
        STO–0
30      RCLO
        6
        fx = y?
        GTO4
        GTO5
        gLBL3
        1
        STO+7
        RTN
        gLBLO
40      STO 0
        x ≷ y
        EEX
        4
        ÷
45      gLBL2
        fINT
```

```
STEP    INSTRUCTION

        STO i
        fLAST x
        gFRAC
50      1
        0
        x
        gISZ
        GTO 2
        RTN
        gLBL 4
        1
        4
        STO 9
60      gLBL6
        RCL 9
        STO 0
        RCL i
        STO 6
        5
        STO 0
        gLBL 7
        RCL i
        RCL 6
70      –
        g x = 0?
        GSB 0
        gDSZ
        GTO 7
        1
        STO–9
        RCL 9
        9
        f x ≠ y?
80      GTO 6
        RCL 7
        STO–8
        1
        0
        STO÷8
        x ≷ y
        RCL 8
        +
        GTO 9
90      gLBL 0
        1
        STO+8
        RTN
```

CBM Shoot

I. Holdstock

Shown here is the Shooting Program that I have devised for use on the Commodore PR-100 Programmable Calculator.

The idea is to try to shoot at targets that appear at random ranges. To do this the operator has to guess the correction that is necessary to score a Bullseye. To make things more difficult it is assumed that there is a strong wind blowing from the left, and the correction has to accommodate for this as well. The program works out where the shot would have hit the target and gives a score accordingly out of 5. Points are deducted for complete misses. The number of shots actually fired is stored, together with the total score. To use the program you enter the keystrokes and go to 00. Then 1000 is entered in memory 6. Then take the Sin of any integer less than 100 and run the number obtained. A random range will be displayed. Using the chart below the program listing, the operator has to guess the corrections necessary to score a bullseye and enter them at the correct stages into the program. A score will be displayed after the last correction. To re-use the program, simply press run after the score has been displayed, and a new range will be shown. Before the second correction is entered, 0 will be displayed. If the present range has been forgotten, it is simply obtained by pressing MR 1. (See instructions at the end of the program listing).

STEP NO	KEYSTROKE	CHECK CODE
00	M	51
01	0	91
02	1	81
03	F	21
04	M+	84
05	7	61
06	MR	52
07	0	91
08	+	84
09	pi	45
10	=	95
11	y'	34
12	5	72
13	=	95
14	F	21
15	Frac	51
16	M	51
17	0	91
18	X	74
19	MR	52
20	6	73
21	=	95
22	M	51
23	1	81
24	STOP	13
25	—	85
26	MR	52
27	0	91
28	inv	31
29	tan	24
30	=	95
31	F	21
32	int	52
33	SKIP	15
34	GO TO	14
35	3	83
36	8	62
37	÷	94
38	M	51
39	2	82
40	C/CE	25
41	STOP	13
42	—	—
43	(	64
44	MR	52
45	1	81
46	X	74
47	2	82
48	tan	24
49	=	95
50	F	21
51	int	52
52	SKIP	15
53	GO TO	14
54	5	72
55	7	61
56	÷	94
57	F	21
58	M+	84
59	2	82
60	5	72
61	—	85
62	MR	52
63	2	82
64	=	95
65	F	21
66	M+	84
67	8	62
68	STOP	13
69	GO TO	14
70	0	91
71	2	82

TO USE: FIRSTLY F C/CE THEN.
A) GO TO 00
B) 1000 in memory 6
C) Any 2 digit number, then SIN it
D) RUN — the range is displayed
E) Enter elevation guess-RUN
F) 0 will be displayed
G) Enter windage guess — RUN
H) Score will be displayed
I) RUN — a new range is displayed
J) Enter elevation guess — RUN
K) 0 will be displayed
L) Enter windage guess — RUN
M) Score will be displayed
— and so on.

USEFUL HINTS

RANGE	ELEVATION	WINDAGE
000	0	0
100	5	3
300	16	10
500	26	17
700	34	24
1000	45	35

The number of shots fired is in memory 7, the score is in memory 8.
BULLSEYE is 5
INNER is 4
MAGPIE is 3
OUTER is 2
MISS is 0 or —N. Points are deducted for misses.

Extra Memories On The TI58

A. Fleming

Key code 82 is not used in the users' manual. However, if it is entered into the program (by pressing STO 82 and deleting STO) the registers used for storing data during arithmetical calculations can be used like the calculator's memories. That is, numbers can be stored, recalled, added, subtracted, divided or multiplied into these registers. This works on the TI58 and may also work on the TI59.

Any operation using one of these registers requires two program steps. The first one contains the keycode 82. The first digit of the second step defines the operation and its second digit defines the register. Table 1 shows how to work out the digits of the second step.

The calculator uses these registers for other operations. It is, therefore, necessary to know which ones the calculator will use. Each time the calculator has to remember a number during calculations, it goes into the next register in the sequence A,B,C . . . Table 2 shows the other functions which use these registers.

The blank boxes indicate registers which may contain numbers (which can be recalled using 82) but are now ignored in calculations.

First Digit	Second Digit
0 ≡ store (STO)	1 ≡ reg. A
1 ≡ recall (RCL)	2 ≡ reg. B
3 ≡ add into (SUM)	3 ≡ reg. C
4 ≡ multiply into (Prd)	4 ≡ reg. D
5 ≡ Subtract into (INV SUM)	5 ≡ reg. E
	6 ≡ reg. F
6,7,8 or 9 ≡ into (INV Prd)	7 ≡ reg. G
	8 ≡ reg. H

(Words in brackets indicate indicate the equivalent memory function)

Examples

keycodes	function
82 38	add into reg. H
82 04	store D
82 66	divide into reg. F

Σ+	uses	G and H
x	''	1st L.A.R. *
INV x	''	1st & 2nd L.A.R. & H
OP 11	''	1st & 2nd L.A.R.
OP 12	''	1st, 2nd & 3rd L.A.R.
OP 13	''	1st, 2nd, 3rd & 4th L.A.R.
OP 14 & OP 15	''	1st, 2nd & 3rd L.A.R. & H
P → R	''	1st L.A.R. and G & H
INV P → R	''	2nd L.A.R. and G & H
DMS & INV DMS	''	1st & 2nd L.A.R. and H

*L.A.R. stands for "lowest available register(s)" i.e. the next registers after those being used for arithmetical calculations.

Example

The following is a section of a program:–

π + 6 x (RCLO + 1 + RCL 1 P → R =

Program execution	A	B	C	D	E	F	G	H
	Registers and contents							
π + 6x	π	6						
(RCL 1 +	π	6	contents mem. 0					
1 + RCL 1	π		contents mem. 0 + 1					
P → R	π	6	contents mem. 0	Used			Used	Used
=								

Texan Roulette

J. Blandford.

This roulette program has been devised for a Texas TI57 programmable calculator. You choose the number on which you want to bet. The calculator then generates ten random numbers in the range 0 to 36. A lose deducts one chip from your initial pile of 100 (in memory 4) and a win adds 36. The winning number also flashes on the display.

After ten random numbers, the calculator stops. Pressing SBR4 displays the amount of chips left in your pile. Press R/S to reload the memories, enter a new number and press R/S to start again.

KEY	LOC	CODE
2nd Lab 1	00	86 – 1
2nd π	01	30
+	02	75
RCL 1	03	33 – 1
=	04	85
yx	05	35
8	06	08
–	07	65
2nd INT	08	49
=	09	85
STO 2	10	32 – 2
1	11	01
INV SUM 4	12	– 34 – 4
RCL 2	13	33 – 2
STO 1	14	32 – 1
x	15	55
3	16	03
7	17	07
=	18	85
2nd INT	19	49
2nd PAUSE	20	36
2nd x=+	21	66
GTO 2	22	51 – 2
2nd INV DSZ	23	– 56
R/S	24	81
GTO 1	25	51 – 1
2nd Lab 2	26	86 – 2
STO 5	27	32 – 2
RCL 4	28	33 – 4
+	29	75
3	30	03
6	31	06
=	32	85
STO 4	33	32 – 4
RCL 5	34	33 – 5
+	35	75
x	36	55
2nd Lab 4	37	86 – 4
RCL 4	38	33 – 4
R/S	39	81
CLR	40	15
1	41	01
0	42	00
STO 0	43	32 – 0
CLR	44	15
R/S	45	81
STO 7	46	32 – 7
CLR	47	15
GTO 1	48	51 – 1

PRESS	DISPLAY
100 STO 4	100 stored for starting score
SBR 4	100 score
R/S	Enter number (0 – 36)
R/S	Start 10 random numbers (0 – 36) each wrong number subtracts 1 chip from score right number flashes adds
CLR	36 to score
SBR 4	Displays score
R/S	Enter new number
R/S	Re start

Passionometer

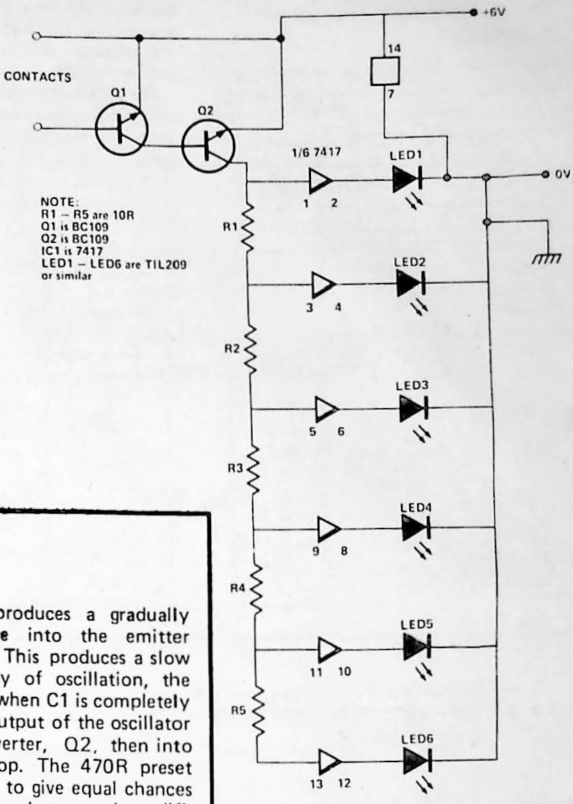
D. Geary

This device is, to say the least, fun at parties!!!

The unit relies on skin resistance, picked up by 1 and 2, which form a Darlington Pair. The output of the amplifier is fed to a bloc buffer via a resistor network.

At each stage, if the threshold voltage is reached, the associated LED will light. Previous stages will also light.

It may be found useful to fit a 25k pot in series with the base of Q1. The higher the ratings the better!!!

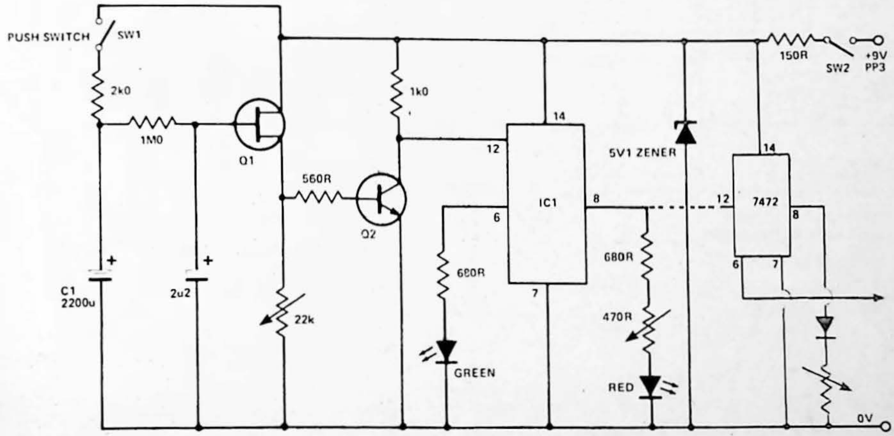


NOTE:
R1 – R5 are 10R
Q1 is BC109
Q2 is BC109
IC1 is 7417
LED1 – LED6 are TIL209
or similar

Heads Or Tails

Steven Snook

This circuit differs from previous Heads or Tails circuits in that when the switch is released the LEDs will continue to flash at a continually-decreasing speed, until eventually they stop and one or the other will remain on. When SW1 is depressed C1 charges via the 2k resistor, when SW1 is released C1 produces a gradually decreasing voltage into the emitter junction of Q1. This produces a slow drop in frequency of oscillation, the oscillation ceases when C1 is completely discharged. The output of the oscillator is fed into an inverter, Q2, then into the 7472 flip flop. The 470R preset must be adjusted to give equal chances of each LED. A novel, untested, modification would be to omit the red LED and drive another 7472, this would give four combinations instead of two.



NOTES:
IC1 IS 7472 FLIP FLOP
Q1 ANY GP UNIJUNCTION
EG T1843
Q2 BC108 OR SIMILAR

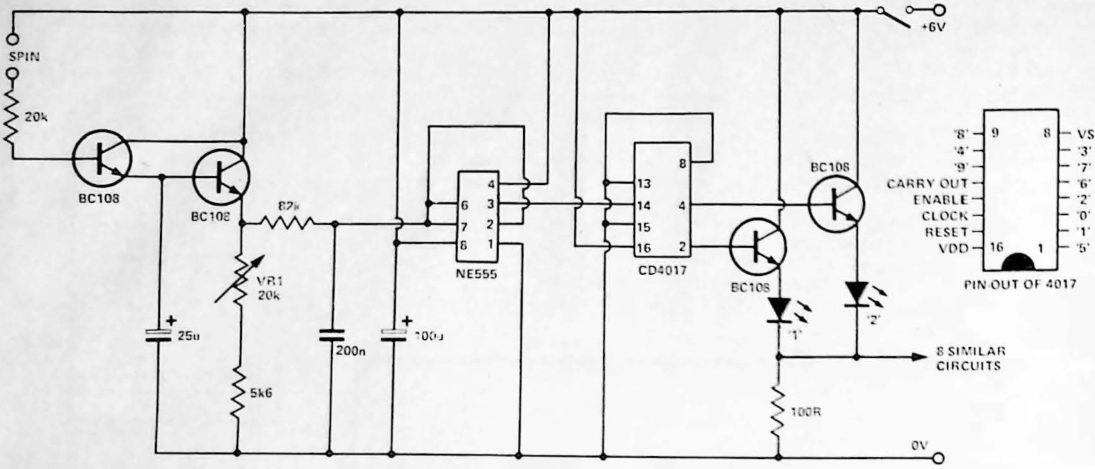
Touch-Spin Mini Roulette

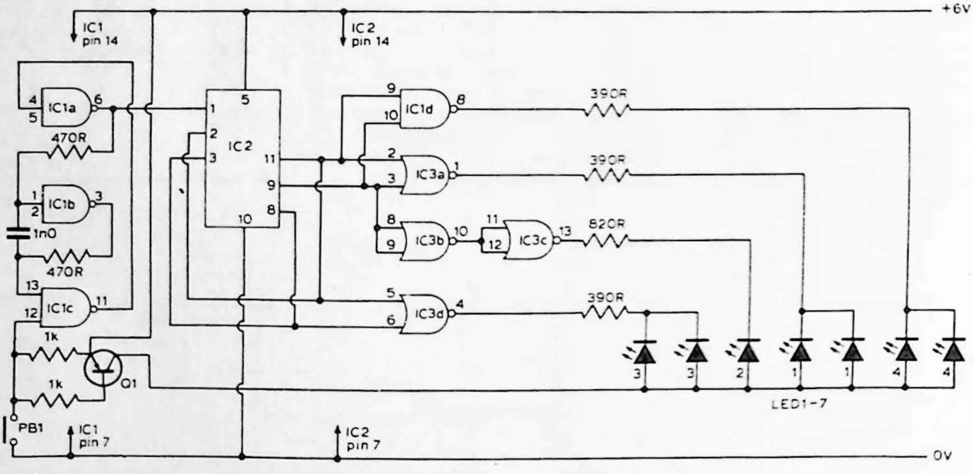
David Ian

Ten LEDs arranged in a circle form the 'wheel' for this miniature roulette.

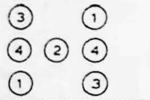
A finger held on the 'SPIN' contacts will cause the LEDs to flash in order round the circle, the speed slowly increasing. When the finger is removed the flashing will slow and one LED will remain lit.

The LEDs are mounted behind a red translucent perspex panel with the numbers 0 to 9 marked on a clear sheet of celluloid mounted between the LEDs and the perspex. With a current of 20 to 30mA through the LED the winning number is clearly illuminated. VR1 can be adjusted to change the time taken for the 'spinning' to stop.





NOTE
LED1-7 are TIL209 or equivalent
IC1 is 7400
IC2 is 7493
IC3 is 7402
Q1 gen purp PNP Icmax > 50mA
PB1 is normally closed



LED ARRANGEMENT

Electronic Dice

G. Vance

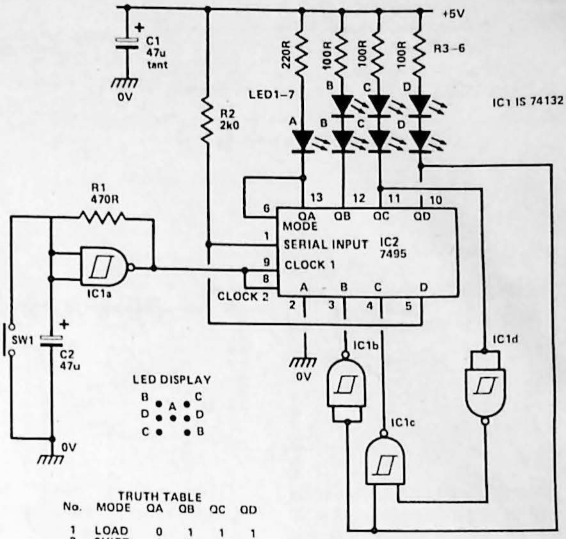
This dice circuit is interesting, as the six LEDs are arranged to produce a display the same as the dots on a dice. When PB1 is depressed, the display is blanked and the oscillator (IC7a, b, c) clocks IC2 at about 1MHz. IC2 counts from zero and resets on seven. When PB1 is released, the display is enabled and a novel decoding system produces the correct output on the LEDs.

2 Chip Electronic Dice

P. Adams

This electronic dice produces a true dice display using only two ICs — a 74132 and a 7495. The 7495 is a 4-bit parallel-access shift register. It can either operate as a shift-register or be parallel (broadside) loaded at inputs A-D. Control over these two functions is by a mode control unput. When the mode is high data is loaded into Qa — Qd from inputs A - D on the next negative-going clock edge. When the mode is low data is shifted on Qa — Qd on the next negative-going clock edge.

By connecting the mode control to Qa so that the register alternates between load and shift and making the input word a function of the existing output word, with some simple logic, the register can be made to execute a count that will drive LEDs in a dice display. Note LEDs are lit when outputs are low. IC1a is connected as a conventional Schmitt oscillator providing clock pulses to the register. SW1 stops the oscillator and halts the count. On switch-on the register may start on an invalid count, but in a couple of clock cycles it will produce a valid count and then remain in that sequence.

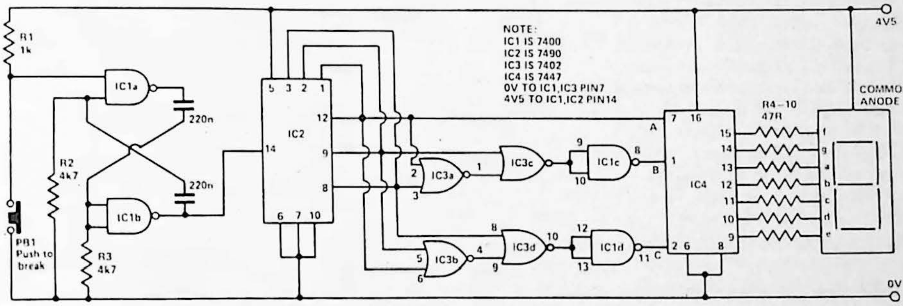


TRUTH TABLE

No.	MODE	QA	QB	QC	QD
1	LOAD	0	1	1	1
2	SHIFT	1	0	1	1
3	LOAD	0	0	1	1
4	SHIFT	1	0	0	1
5	LOAD	0	0	0	1
6	SHIFT	1	0	0	0
1	LOAD	0	1	1	1
ETC					

Digital Die

A. Slimming

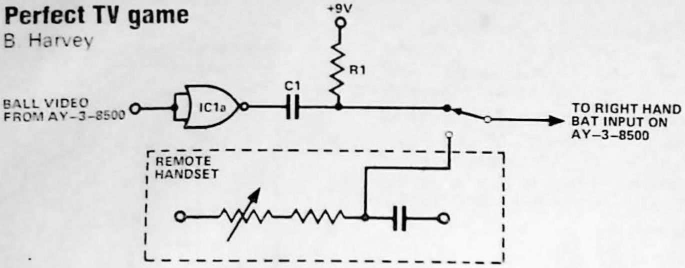


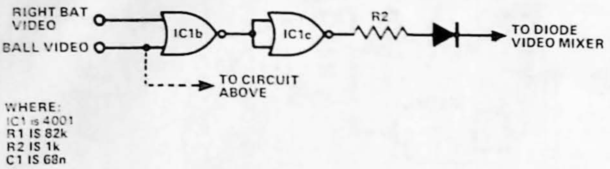
NOTE:
IC1 IS 7400
IC2 IS 7490
IC3 IS 7402
IC4 IS 7447
0V TO IC1,IC3 PIN7
4V5 TO IC1,IC2 PIN14

IC1a and IC1b form an oscillator running at a few kilohertz. The output is fed to a 7490 binary counter which is wired to produce an output of 0 to 5 in BCD. So that the display is the same as a dice the display must read 1-6 and not 0-5, when the output of the 7490 is all '0's, the display must be made to show 6. IC1c, d and IC3 perform this task, and convert an output of 000 from IC2 to 110 (b). IC4 is a BCD to 7-segment decoder which drives the display through the current limit resistors R4-R10.

Perfect TV game

B. Harvey





The circuit shown allows a player to play tennis or squash against a perfect opponent, which is useful if one wishes to practise and cannot find another player.

The circuit 'plays' tennis or squash simply following the ball up and down the screen, thus it is always in the right place in order to hit the ball.

Although the circuit appears simple, (it only uses one gate from one IC!) the way it works is quite complex, suffice to say that it relies upon the way the AY-3-8500 games chip determines bat position from the setting of the hand controls.

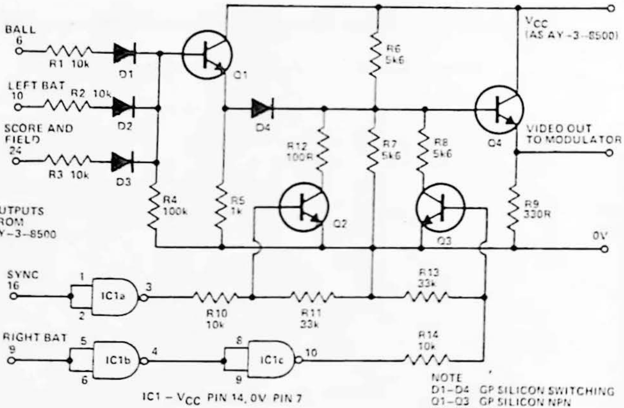
The only modifications to the TV game are: (i) One lead connected to the ball video output of the games chip.

(ii) A switch wired in, selecting either a manual or an automatic player on the right hand bat.

(iii) This may not be necessary in home built games that use CMOS video mixers, but may have to be used in commercial units that sometimes use diode mixing circuits. The modification is shown and uses gates from the same IC. This will give a brighter bat and ball which is useful when playing squash.

Proper Identification for T.V. Game Chip

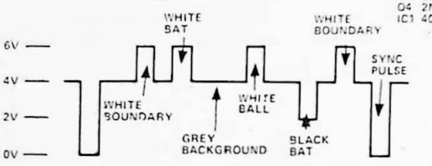
E. Parr



Many of the T.V. game circuits, whether ready built or as a magazine project, use the popular GI 8500 chip. The standard circuit gives white players, ball and court on a black background. The circuit described below gives a grey background, one white and one black player and a white ball and court. This is aesthetically more pleasing and has the advantage of making the squash game less confusing.

The modifications are shown below. The output on Q2 emitter spends the majority of the time at a "grey" level, and this "grey" voltage is defined at the junction of R6 and R7.

The three signals from the 8500 requiring a white output are Ball (pin 6), left player (pin 10) and the score and field (pin 24). These are "Or'ed" together by Q1 to produce a white level defined by the ratio of R1-R3 and R4. The white level on Q1 takes the output on Q1 to white via diode D4.



WAVEFORMS (LINE SCAN)

The one black signal is the right bat (pin 9). This is buffered by two stages of a CMOS 4011 chip, and turns on Q4. This takes the output to a black voltage defined by R6, R7, R8. If a white and black signal occur together (as happens when the bats cross in squash) the white from Q1 will predominate.

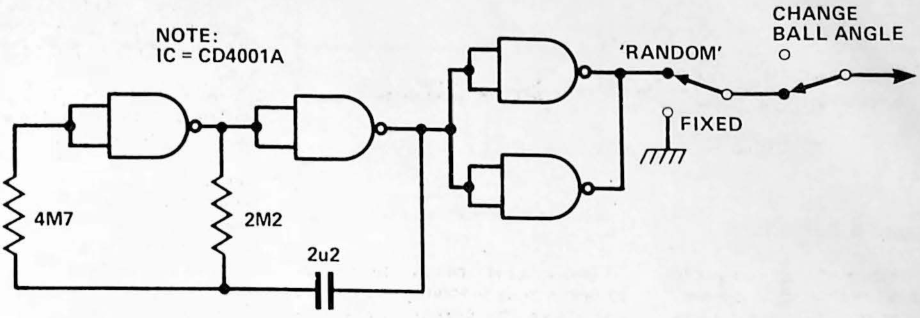
The sync output from pin 16 is inverted and turns on Q3 pulling the output down to sync level, 0V.

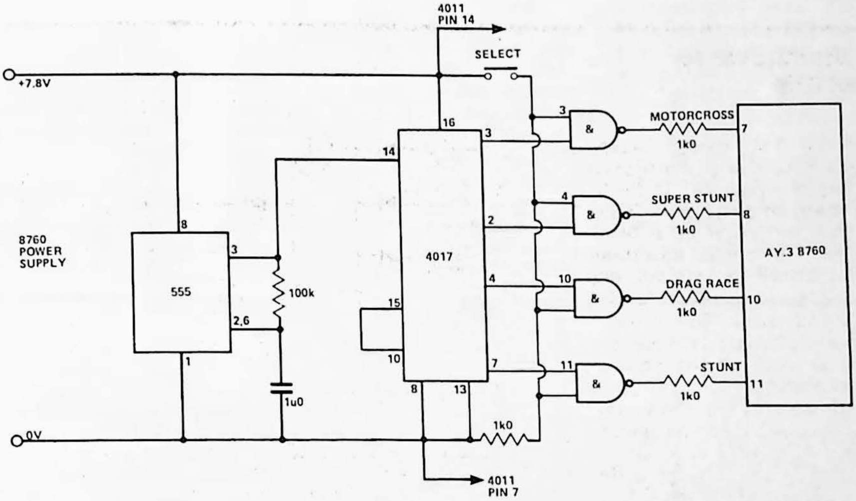
With the values shown and a supply of 9V the open circuit output voltages are White 6V, Grey 4V, Black 2V and sync bottom 0V. The output is positive going video.

TV Game Resurrection

S. Rice

Now that the novelty of TV games has worn thin and most of the units are gathering dust in the corner reserved for other five-minute wonders, here's a chance to add new spice to leisure time. The circuit is an oscillator clocking at about one cycle per 4 seconds. This switches the ball angle "randomly" making the game unpredictable and difficult. Also this prevents the ball from getting stuck and bouncing back and forth from the bats and boundaries. Do not use B suffix CMOS except for Schmidt trigger and gates.



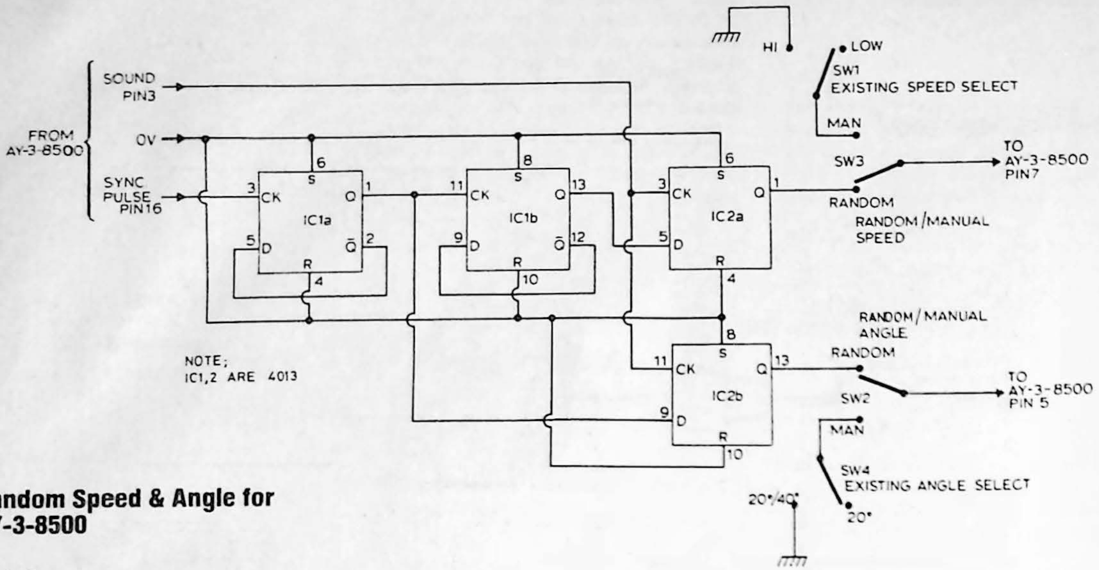


Auto Select for AY 3-8760 Stunt Cycle

S. D. Lang

Constructors of the Stunt Cycle TV game may wish to economise on switches and panel space by trying this circuit for game selection. Originally, game selection was by grounding the relevant game select pins. This requires four push switches; extravagant on switches and panel space. In this circuit, three of those switches are made redundant in a novel game selection method. The only switch required is a push switch now entitled 'game select'. Upon depression of this switch, all four games are displayed upon the screen, one a time. When the playfield of the required game is displayed, the game select switch is released and play continues.

The circuit works from the power supply of the AY 3-8760. Circuit operation is straightforward, as follows: the 555 and associated components form a pulse generator of period approx. 1 second. This pulse is applied to the input of the 4017 decade counter. Every pulse received advances the high output by one, so the high pin is 3,2,4,7 in that order. When pin 10 becomes high, the reset circuitry is operated. If the select switch is open, the output of all the NAND gates is high, so the game is played. When the select switch is closed, the selection circuitry may now operate, and the outputs of the NAND gates go low in turn, selecting the appropriate game.



Random Speed & Angle for AY-3-8500

E. A. Parr

Many of the early TV games use the GI AY-3-8500 chip. This has the facility to switch ball speed pin 7, and the angle of rebound on pin 5. These two pins are usually brought out to a switch for selection by the users.

The games can be made more exciting and realistic if the speed and rebound angle vary randomly at each bounce or when a player hits the ball. This can be simply achieved with the addition of two 4013s (Dual D type).

SW1 and SW2 are the existing manual select switches. IC1 forms a two bit counter, clocked on by the sync pulses from pin 16 on the AY-3-8500 chip. This counter will assume a random state from bounce to bounce.

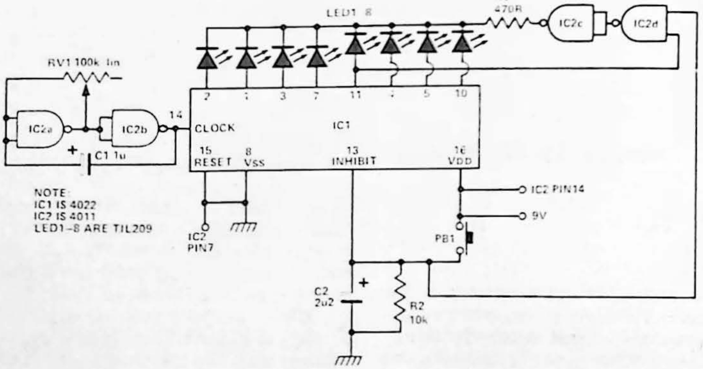
The two D type flip flops in IC2 are connected to pins 5 and 7 on the AY-3-8500 chip via the random select switches. To ensure that these only change at a bounce, these two D types are clocked by the sound output (which consists of a 32ms pulse train at each bounce). This pulse train will, of course, overlap several sync pulses, but the effect of the angle and speed changing rapidly for 32ms is not noticeable and the ball speed and angle stays constant after leaving the bat or boundary until the next interception.

Because the two ICs are of CMOS construction they will have little effect on battery consumption, and the circuit can be easily incorporated into TV games units.

Pot Shot

A. Kenny

This is a circuit for a game of the shooting gallery variety. IC2a and b form an astable multivibrator clocking IC1 which causes LEDs 1-8 to flash in turn LED 5 is the "target" LED and the object of the game is to depress PBI just as LED 5 comes on. If this is done, the whole display is blanked for a few seconds signifying a hit. Otherwise, the LED which was lit remains lit. When the push button is released, C2 discharges through R2 taking 8 pin 13 low again and the LEDs will start to flash again.



Electronic 'Spirograph'

A. Sharp.

The circuit will generate 'Spirograph' patterns on a conventional oscilloscope. The circuit consists of two sinewave generators followed by allpass filters which we use to phase shift the input signals by 90°. Applying a sinewave to the y input gives a circular trace. If a second set of sin and cos signals are mixed in, a 'Spirograph' pattern is obtained. A block diagram of the system is shown in Fig 1.

RV1 is a balance control which varies the contribution of each oscillator to the pattern without affecting the size, so that once set up there is no need to readjust the gain controls on the oscilloscope. This type of control can only be used if the oscillators have a low impedance output.

SW1 is a reversing switch which has the effect of turning the pattern inside out.

An existing sinewave oscillator can of course be used and the 50 Hz mains could be employed (attenuated to about 2 V RMS from a low voltage transformer secondary) as the fixed oscillator. However flickering is a problem with lower frequencies (complex patterns requiring four or more cycles to complete will flicker at about 10 Hz using the mains frequency as an oscillator). I found 150 Hz to be a good compromise (higher frequencies require more critical tuning).

The allpass filter is recommended for phase splitting as it has a unity gain for all frequencies and settings of RV5.

First connect the y input of the scope to the output of an oscillator and adjust RV2 until a two volt RMS sinewave is obtained, repeat for second oscillator. Then connect up the x and y inputs as shown in Fig 1, turn the balance control to one end so as to look at the output of the fixed oscillator then adjust the 100 k pot until a circle is obtained (with suitable x and y gains). Now put the balance control in the middle and adjust the frequency controls until a stable pattern is produced. SW1 and RV1 the balance control can be used to alter the nature of the pattern without affecting its overall size, stability or symmetry. Adjust RV5, the phase control (following the variable oscillator) for symmetry. — Have fun!

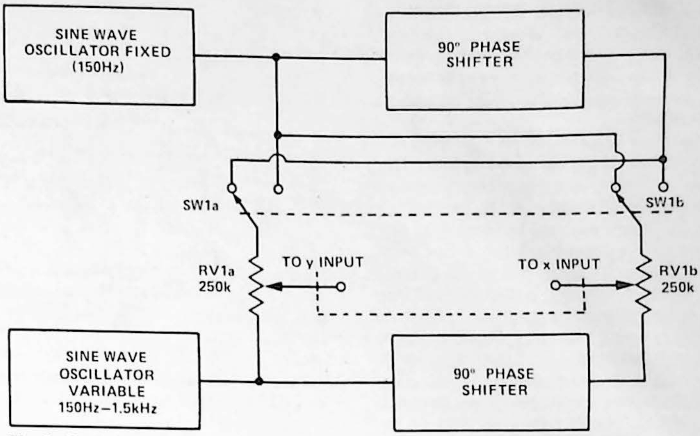


Fig. 1. Block diagram of the 'spirograph'

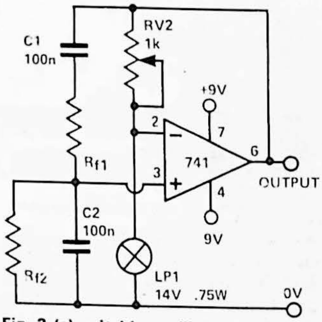


Fig. 2 (a) suitable oscillator for the 'spirograph'

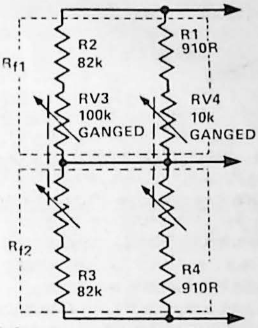


Fig. 2 (b) Arrangement to give fine control of the frequency of the oscillator shown in Fig. 2 (a). For 150 Hz fixed frequency use $R_{f1} = R_{f2} = 10k$

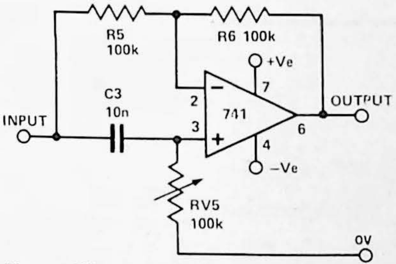


Fig. 3. Phase shifter circuit for use in 'spirograph' circuit.

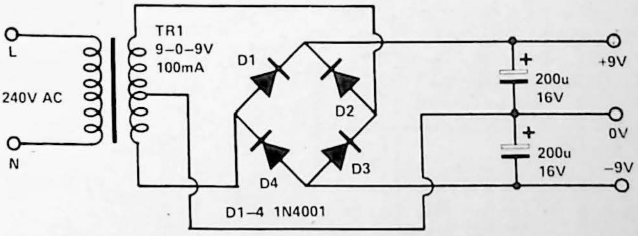


Fig. 4. PSU for 'Spirograph'

Model Railway

E. A. Parr.

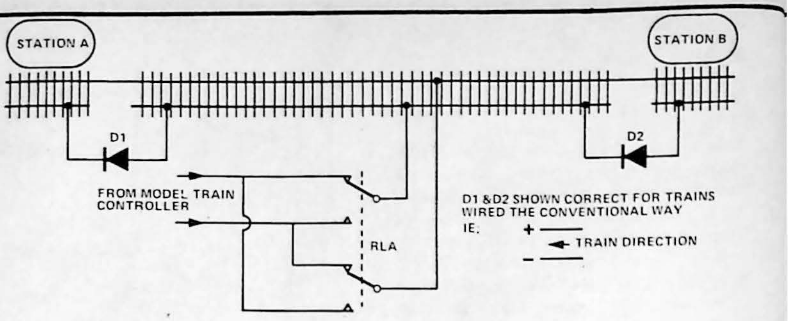
This simple circuit provides an interesting little branch line service for a model railway. A small country railbus starts at a station , stops, then returns to the first station again, the cycle repeating indefinitely.

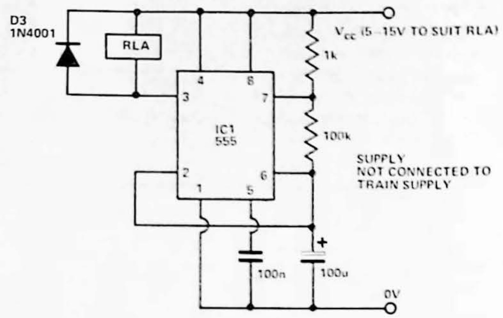
The track is arranged to have two isolated station sections at each end. The power is fed to the centre long section via a changeover relay, RLA. Diodes D1 and D2 feed the staion sections and ensure that a train in station A can only move towards station B and vice versa. The diode connections are correct for conventionally wired trains.

RLA is under control of a 555 timer. This is connected as an oscillator with almost equal mark/space ratio. The period is longer than the time taken for the train to travel from one station to the other. When the train reaches the station, as the diode will be reverse biased, it will stop. When, however the relay changes over the diode will con—duct, and the train can return to the first station.

The half period of the oscillator should be made equal to the journey time plus the stop required at the station. The values shown give about 12 seconds which should be sufficient for most layouts.

The stop/start is unramped, but this is not particularly noticeable at the speed all self respecting branch line trains travel.





CMOS Mixer

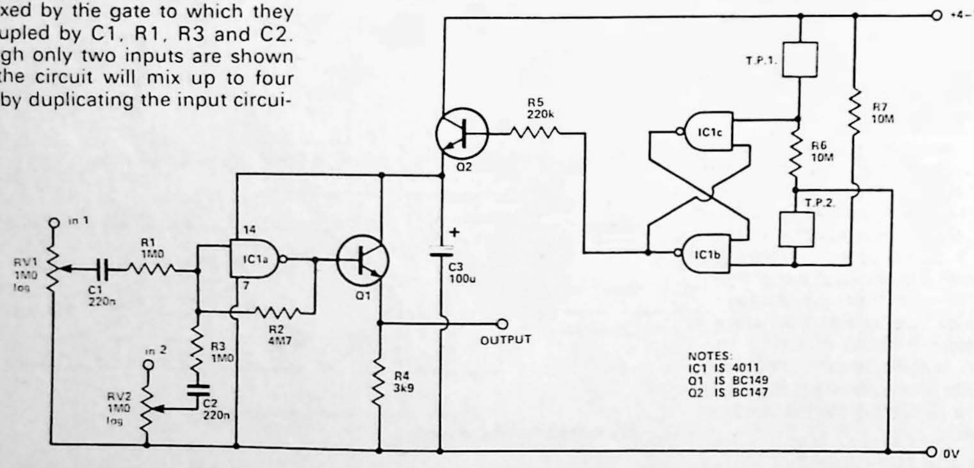
J. P. Macaulay

Although this circuit employs only one cheap CMOS IC and two transistors it is capable of high quality results. The IC, a 4011, contains four dual input NAND gates. Two of these are used with their inputs connected together to form inverters and biased into the linear mode by means of the feedback resistors, R2. Inputs are applied through the pots RV1/2 and are mixed by the gate to which they are coupled by C1, R1, R3 and C2. Although only two inputs are shown here, the circuit will mix up to four inputs by duplicating the input circuitry.

For clarity only one mixer gate is shown in the schematic. The other gate, along with all the components to the left of C3 are duplicated on the other channel. The other two gates are used in a touch operated on-off switch.

The plates, which may consist of a small piece of Veroboard with alternate strips linked together and connected to the input of the gate and line respectively, control the output polarity of the gates.

When the circuit is turned on, by placing a finger on the touch plate, the output of this gate goes high switching Q2 hard on and supplying the circuit with current. To switch off the other touch plate is touched with the finger. The output then goes low removing the operating current from the circuit. The transistor Q1 gives the circuit a low output impedance and the gain with the input pot at maximum is four. The circuit will only work with A-series CMOS.



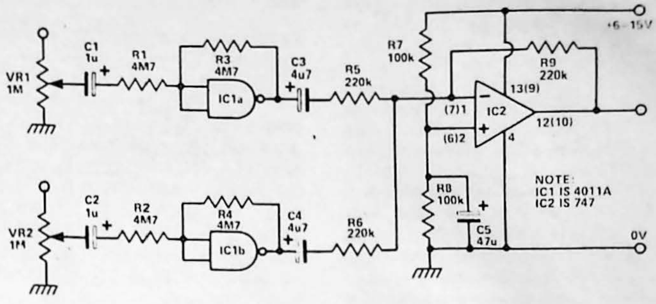
Hybrid Mixer

J. Macauley

This circuit shows one channel of a stereo mixer, the other channel being identical. The input signal is applied to the volume controls RV1&2 and from thence to the NAND gates via the blocking capacitors and R1&2. These gates are first used as inverters by strapping both their inputs together, and are biased into the linear region by the feedback resistors, R3&4. In this way the gates act as high impedance, high quality, unity gain amplifiers.

The output from the gates are summed by the mixer, IC2. This IC is a dual op-amp of the same specification as the commoner 741, which could be used instead. As a single power supply is used the non-inverting input must be biased at half the supply voltage. This is done by the potential divider, R7&8, C5 decouples this point to earth.

The output impedance of this IC when used in the manner described is less than 1 ohm and so can be fed directly into a line socket. This circuit will only work with 'A' series 4011's as the B series contains protection circuity which will prevent it working in the linear mode.

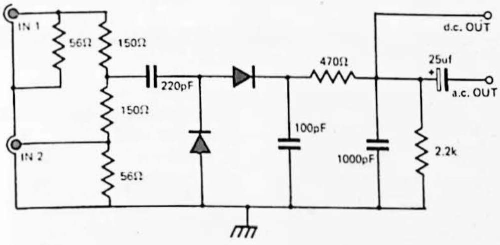


Simple Mixer

A mixer is a very useful device in any workshop. It may be used as a frequency meter (signal generator in one input, unknown signal in the other, listen for beat note at ac output), to find parasitics in tuners, as an untuned detector-monitor etc.

For best wideband performance, all leads should be kept as short as possible. Input impedance is close to 50 ohms, and shorting one input has little or no effect at the other input.

Germanium diodes are the best types to use for good sensitivity. Hot carrier diodes are even better.



Darlington Drivers for a few pence

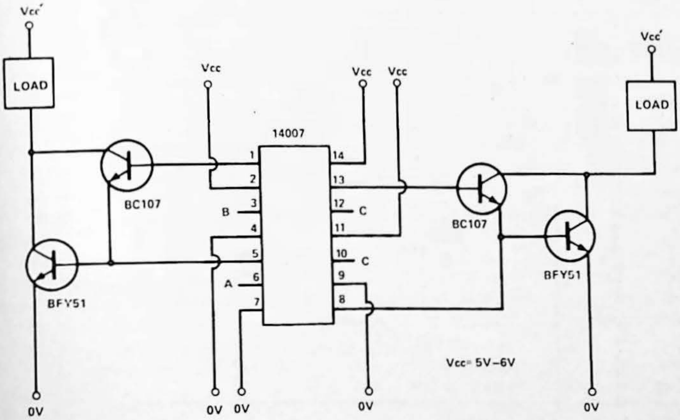
C. J. Ramey

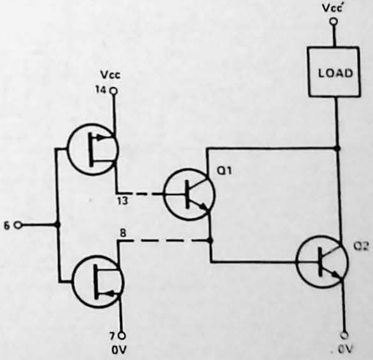
This circuit offers a very efficient way of driving a pair of transistors in Darlington configuration from CMOS. The circuit in Fig 1 shows how two loads of up to 1A may be driven from a single 14007 chip with no external resistors. Using a 2N3055 in place of the BFY51 will enable loads of up to 3A to be driven at voltages limited only by the Vceo of the transistors (Vcc)'.

Fig. 2 shows the internal circuit of one section of the 14007. A high on pin 6 switches the lower CMOS transistor on, holding Q2 off and sinking the leakage current of Q1. A low on pin 6 drives Q1 and switches the lower CMOS transistor off and the upper CMOS transistor on.

The result is fast switch off at low cost and efficient switch on.

A bonus is the inverter between pins 10 and 12. Note: Vcc should be 5-6V to prevent excessive current being drawn from the CMOS chip.





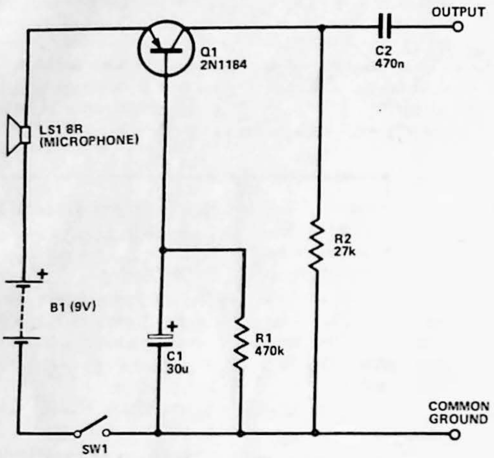
MISCELLANEOUS

Microphone Speaker

J. Smith

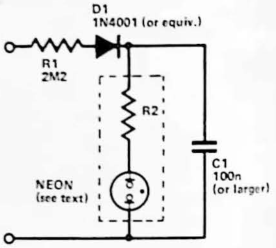
What do you do if you need a microphone in a hurry — the shops are closed and your friends are on holiday? Or you are just a little short of money? The answer is to build the following circuit from your odds and ends box. This circuit uses a small speaker as a microphone, one transistor and only four other parts, draws only about 2 mA of current from a 9 volt battery so an on / off switch is not really necessary.

The transistor shown is 2N1184 and is a PNP germanium medium power type but is not critical — try the ones you have first before buying this new type. The components too are not critical and the prototype was found to work OK with 20% variation in values. The output is high impedance and is fed into the mic input of a tape recorder or pick-up input of an amplifier.



Neon Flasher Warning

A flashing pilot light is likely to be more attention-getting than a pilot light which is continually on. This circuit will cause a neon to flash at a rate determined by the value of the capacitor placed in series between the diode and mains, neutral line. The neon may be used on its own or with a 270 k resistor in series with it as used in ready assembled 240 V pilot lamps. However, the value of R2, if used at all, is dependent on the flashing rate and effect desired by the individual constructor. All voltage ratings on components have been deliberately increased to protect the components from overload. R1 should be left as 2.2 Meg., the flashing rate being determined by the values of C1 and R2.



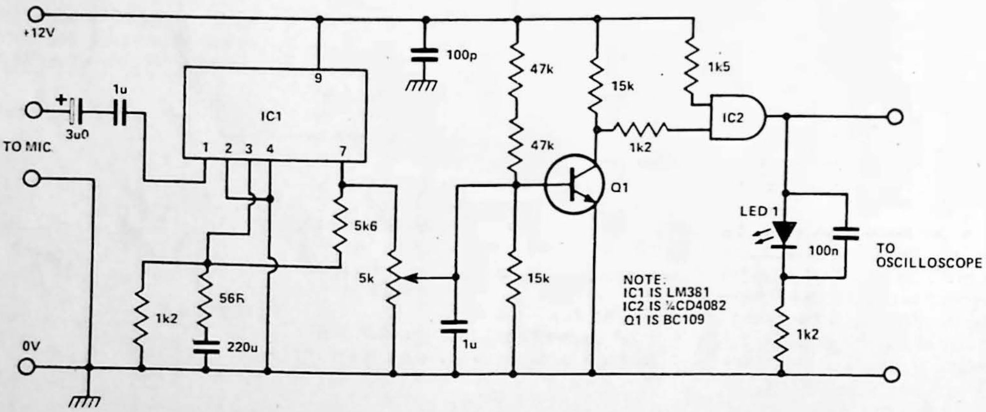
Morse Code On The Oscilloscope

S. J. Stamps

This circuit enables morse code to be displayed as dots and dashes on an oscilloscope screen. By speaking into a microphone, saying 'dit' and 'dah' as appropriate, short and long pulses appear on the screen in a format similar to that of written morse.

One half of an LM381 and a BC109 are used to amplify the signal from the microphone, which is then clipped into digital form by the AND gate. The output from the circuitry is fed to an oscilloscope set to 2V/cm and 5ms/cm, set to trigger on the start of a 'dit'.

Input to the circuit can be from a microphone, or tape recorder. If words are recorded onto the tape with the microphone and then played back via the circuit, practice at reading morse is possible.



NOTE.
IC1 IS LM381
IC2 IS ¼CD4082
Q1 IS BC109

Micro-Digital Car Clock

D. Ian

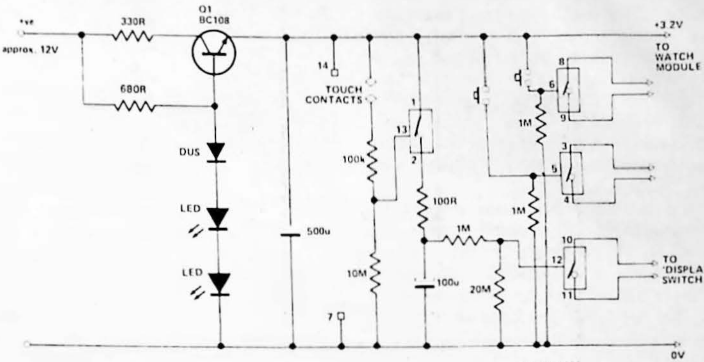
With the availability of economical LCD wristwatches has come a surplus of very cheap LED types which, with a little ingenuity, are eminently suitable for a permanent display installation; one obvious use is a cheap digital car clock.

The majority of these timepieces use two silver oxide cells in series to give 3.2 volts; current consumption, with the display on, is rarely more than 30 mA, easily provided by a simple stabiliser circuit.

Remove the back of the watch-case and discard the cells; the contacts of one cell holder are shorted together and the 3V2 supply soldered, noting polarity, to the two remaining contacts: with the 'display on' switch shorted out the result is a highly accurate mini-clock with negligable current drain as long as the vehicle is in regular use; even 35 mA will eventually flatten a car battery that receives no charge. Most simple LED watches have a brass tag, bearing on the metal case, as a common terminal to the various controls, these generally being spring loaded pins pressed, as required, into contact with clips on the perimeter of the module. These connections can be extended to panel mounting push switches, allowing the unit to be housed in a suitable box.

If the car is used infrequently it is prudent to arrange for the display to automatically extinguish at the end of a fixed amount of time; this also implies the simplest possible 'on' switch to minimise loss of attention when driving. One half of a CD4066 quad bilateral switch is connected as a touch-operated monostable and wired, as shown, across the LED display switch: C and R may be selected for a shorter or longer time period, those specified will enable the display for about 15 minutes. The remaining two sections of the 4066 are used to control the other functions, set time, etc., of the watch module.

Note that, in the stabiliser section, LED's are deliberately used to provide the reference voltage at the base of T1 since they 'zener' at appreciably smaller currents than a normal zener diode; total current of the stabiliser and clock (display off) is about 2 mA — the smallest car battery should be able to supply this for about a year!



GSR Meter

D.Chivers

The galvanic skin response meter is probably the easiest both to construct and to use. Fig.1 uses a single BC108 — incidentally, the meter used was simply the 1mA range of a multimeter. While the circuit shown had the required sensitivity, it was not selective enough and under all sorts of stresses and strains the needle refused to budge from a set position. The darlington pair configuration of Fig.2 greatly increases sensitivity and the 100k pot will bring the reading down to a usable level — without this, the current passing through the meter would be about 30mA. This modified circuit proved to be amply selective.

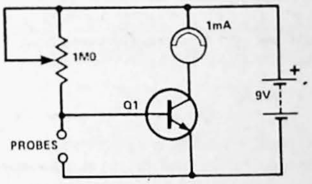
For use as probes, silver foil taped onto the tips of the first and second fingers proved to work well, though for more permanent use steel gauze is recommended. Naturally the hand must be kept as steady as possible during experiments.

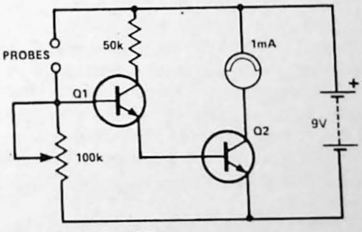
First experiments proved highly successful; the meter needle drifted at first and frequent use of the sensitivity control was required, but after a few minutes the needle stabilised.

Since the needle responds to stress within the body or mind, it is easy to make it move; talking, thinking hard or biting a finger all cause the needle to move up, making it go back down by removing the factor causing the stress. Moving the needle below its mean value was far more difficult especially while watching the meter and actually trying to relax — in fact to start with this actually caused tension. The easiest way to do this is to simply close the eyes and relax, while an observer takes note of the results. On opening the eyes the reading would jump up to what it had been before relaxation commenced.

This circuit will of course function as a lie detector but since stress is caused by any question the results are not too reliable and certainly of no significance.

An unexpected use for the circuit of Fig.1 is that of a transistor tester. If a fixed value resistor of about 2M25 is used in place of the pot the gain of the transistor may quickly be tested; FSD= approx. hfe 250. For PNP transistors, polarity of the meter and battery must be reversed.





NOTE:
Q1-2: BC108 OR SIMILAR

MISCELLANEOUS

Anti — Acoustic Feedback System For Group Or Disco

G.T.Edwards

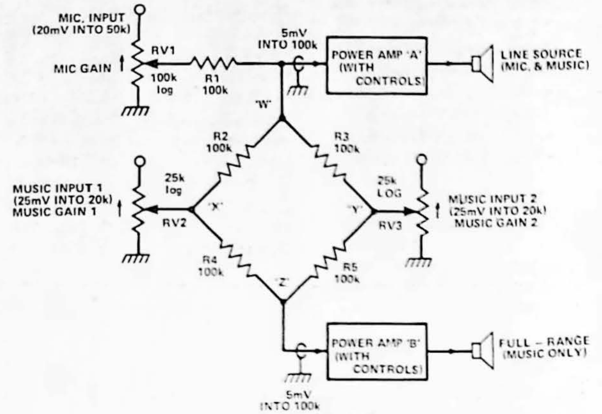
The directional properties of Line-Source Loudspeakers are best for minimising acoustic feedback ("Howl-Round"); unfortunately their bass response is usually inadequate for the full musical range. The ideal system would consist of a completely separated amplifier system for microphone inputs terminating in line-source loudspeakers, the "music" being amplified independently and fed at suitable power levels to less-directional full-range loudspeakers. However, as this is costly and increases transportation problems, a system was evolved in which a full-range non-directional loudspeaker would respond to "music" inputs only, a line-source being used at the same time responding to both "music" and "mic." inputs.

The principle has been proved in practice using the passive network shown in the diagram. As the microphone input is attenuated successively by three potential dividers before reaching the full-range loudspeaker system, the risk of feedback from this speaker is negligible. Typically there is at least 26 dB reduction in microphone signal voltage between the input to amplifier 'A' and the input to amplifier 'B'.

The circuit is easily adapted to other signal levels and impedances by modifying component values on a proportional basis; a more elaborate "active" system is possible using virtual-earth summing amplifier stages.

Simulated stereo is possible from monophonic programme material by connecting a capacitor (about 2n2) between point 'Z' and earth; another capacitor (about 1n0) being connected in series at 'W'.

An inherent advantage of the system is that a "music" output is obtained even if one of the power amplifiers, or one of the loudspeakers, should go faulty during a performance.



LED Spotting

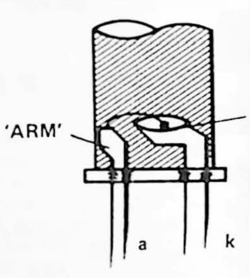
A. Kenny

Since the leadout on LEDs varies according to the manufacturers preference, leadout diagrams are not always worthy of the trust placed in them. In some cases a reverse connection will destroy the device being used.

A simple way to avoid this is to use the following technique

If the LED is held up to the light, the structure can be clearly seen. There is a "cup" and an "arm" carrying a fine wire to the LED itself, which is in the "basin" of the cup (see drawing).

The lead with the cup is the cathode, and the other is the anode (of course).

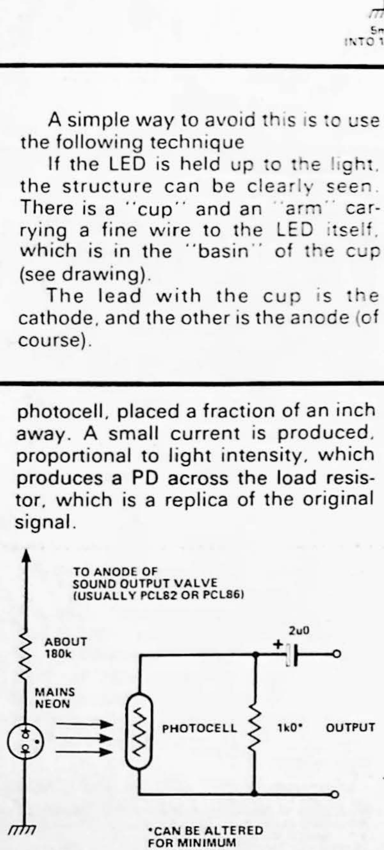


Television Optoisolator

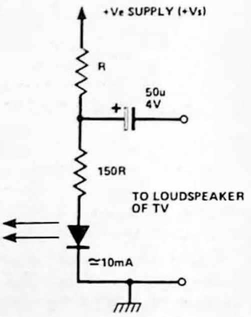
A. P. Hiley

The problem of how to connect a tape recorder, or amplifier, to a television set is not an easy one to solve, because most televisions, having no mains transformer, have the chassis connected directly to the mains. The easiest, and simplest solution is to incorporate some form of optoisolation between the television and the external equipment. This particular design is simple, has a very low noise level, and introduces negligible distortion.

The LED or neon is brightness modulated by the output of the television sound channel. The light is picked up by a small, cheap silicon photocell, placed a fraction of an inch away. A small current is produced, proportional to light intensity, which produces a PD across the load resistor, which is a replica of the original signal.



*CAN BE ALTERED FOR MINIMUM DISTORTION



R (in kohms) = $\frac{Vs - 4}{10}$

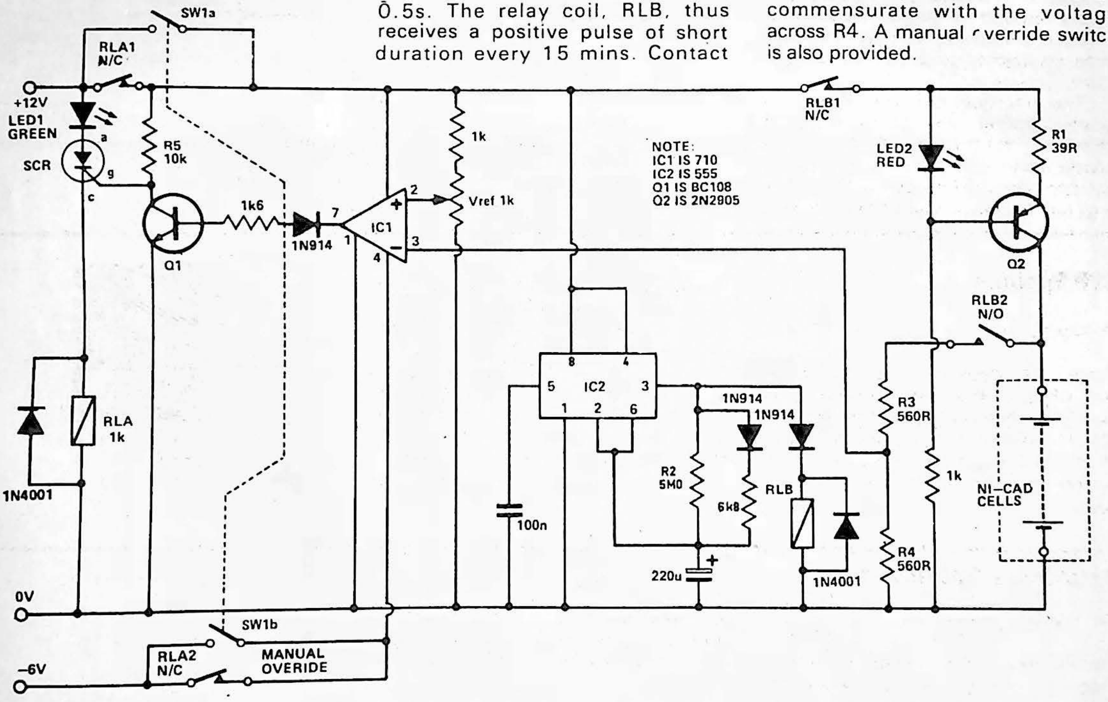
Automatic Nicad Charger

P. Reynolds

The problem of ensuring that expensive Nicad cells are not damaged in the recharging process is twofold. First, as the cells have a low internal resistance, they are susceptible to damage by excessive charging currents. Second, damage will also occur if the charging process is carried out for too long a period.

The first problem may be overcome by charging at a constant current. The second problem may be overcome by the use of an automatic sensing comparator circuit, which compares the voltage from the cells with a preset voltage, related to the fully charged value. In practical terms, the circuit appears as shown in Fig 1. A red LED supplies the voltage drop to ensure that Q1 passes a constant current of about 25 mA to the cells under charge. This charging current may be adjusted, if desired, by changing the value of R1. The 555 runs in the astable mode. However, the duty cycle is adjusted to be *less* than 50%, by incorporating a diode and resistor in parallel with R2. How this is accomplished may be easily understood if one remembers that charging of the capacitor takes place through these paralleled components, whereas, due to the blocking diode, discharging current only flows through R2. The 'off' time is around 15 mins. and the 'on' time less than 0.5s. The relay coil, RLB, thus receives a positive pulse of short duration every 15 mins. Contact RLB1 opens, disconnecting the charging supply and contact RLB2 closes. A sample of the total voltage across R3 and R4 is applied to the variable input of the 710 comparator. This input voltage is compared to the preset reference voltage and if found to be greater, the output will drop to −0V5 (from +3V2). The inverting action of Q2 causes the gate of the thyrister to undergo a positive transition, via R5. The gate causes the device to conduct, causing the contacts RLA 1 & 2 to open and disconnect the supply from the rest of the circuitry. The green LED is illuminated, indicating the termination of the charging period.

This circuit may be used to charge a total of six 1V5 cells. Of course V_{ref} may need adjustment so as to be commensurate with the voltage across R4. A manual override switch is also provided.



NOTE:
IC1 IS 710
IC2 IS 555
Q1 IS BC108
Q2 IS 2N2905

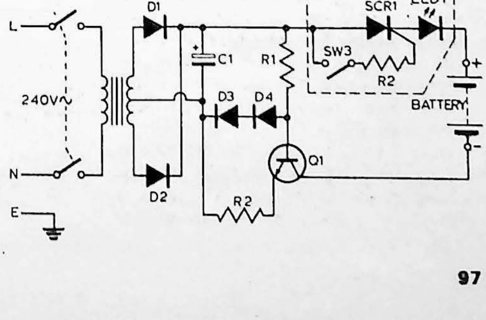
Nicad Charger Modification

B. V. Barton

This modification was made to the ETI 519 Ni-cad charger to protect the cells in case a power cut occured while the cells were charging. Normally the cells on charge would rapidly discharge through the charging circuitry, causing possible damage.

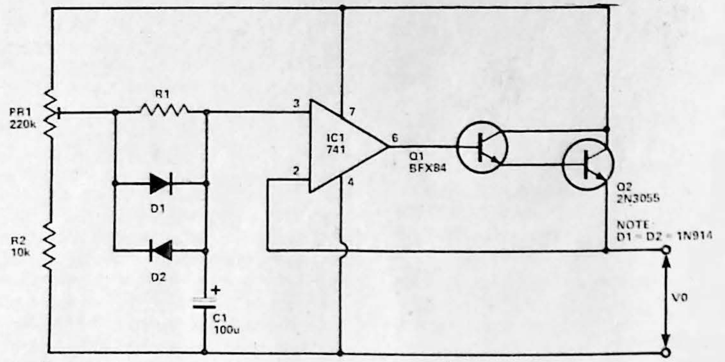
The modification involved the addition of a low voltage thyristor in series with the battery. If power fails, the battery cannot discharge. When power is reapplied, the battery will not continue to charge until SW3 is closed momentarily.

NOTE;
LED1 IS TIL209
SCR1 ANY LOW VOLTAGE THYRISTOR
R2 SELECTED TO GIVE ONLY ONE CHARGE RATE OF 45mA INSTEAD OF SIX POSITION RANGE SWITCH GIVEN IN ORIGINAL DESIGN



Electronic Capacitor

J.P.Macaulay



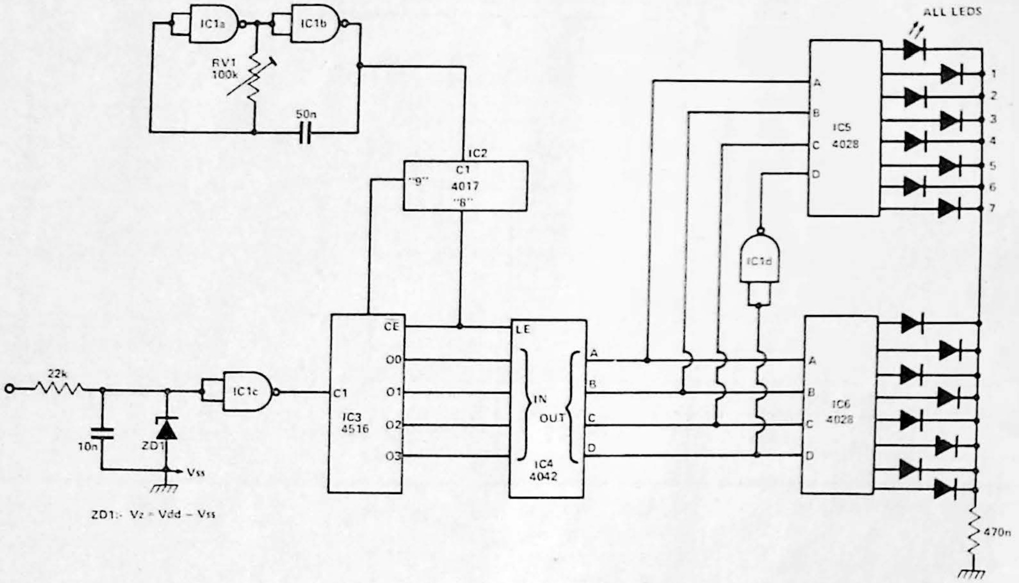
The circuit shown is essentially a gyrator which amplifies the effect of C1 to produce an equivalent capacitance at the output, many times the value of C1.

PR1 is used to set the output voltage to the required level whilst C1 charges through D1. Once the voltage across the diode drops to less than 0.6V C1 will continue to charge through R1 until the voltage across C1 is equal to that on the slider of PR1.

The equivalent capacitance at the output is equal to the product of the current gain of the circuit and the value in Farads of C1. If we assume that the input impedance at the non-inverting input of the 741 is 1M0 and the output impedance is 1R0 then this capacitance will be equal to 10^{-4} FX10^6=100F!

In practice the input impedance at low frequencies is many tens of megohms whilst the output impedance is a small fraction of an ohm, so the above figure is very conservative.

D2 is included to allow the output voltage to be quickly adjusted by allowing C1 to discharge to earth through R2. In practice however the output voltage will only respond rapidly to input voltage changes of more than 600mV.



Solid State Tacho Circuit

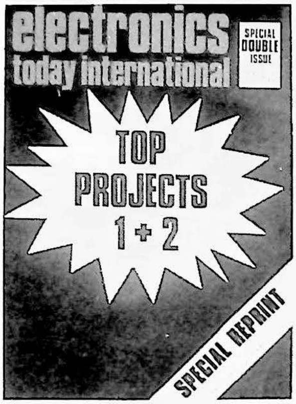
P. Stephenson

The circuit is designed to give a non-critical display for those who like (cheap) gadgets.

IC1a/b form an oscillator which drives decade counter IC2. During eight tenths of each cycle of this section, binary counter IC3 is counted up. On count "8", the counting stops and IC4 latches the outputs. On count "9" IC3 is reset.

The number now on IC4 output is decoded by IC 5/6 to light up one of 16 LEDs corresponding to rpm.

Calibration is by adjusting RV1 whilst inputing a known frequency (e.g. mains frequency 50 Hz).



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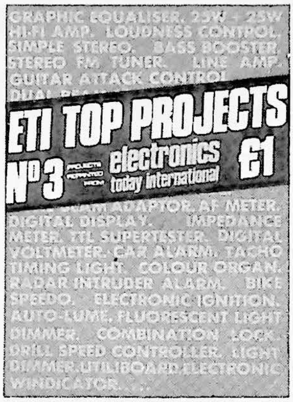

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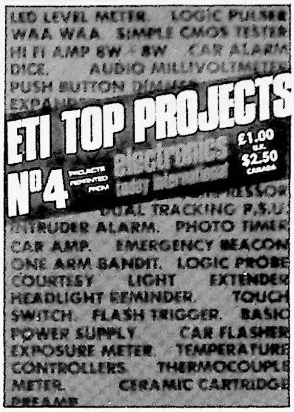

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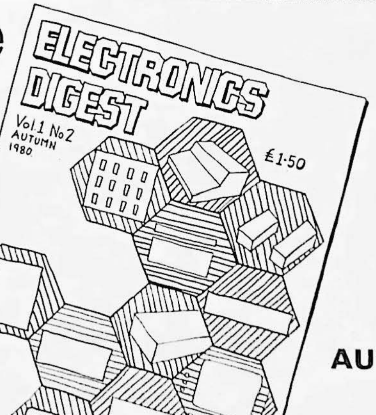

The next issue of Electronics Digest will reprint recent top projects from Electronics Today International. So make a note in your diary: to pop down to your newsagent's on 15th August.

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