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ETI CIRCUITS No 3

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Contents:

ETI CIRCUITS No 3

ideas and data for experimenters

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The 'Ideas for Experimenters' section published each month in Electronics Today International has for many years been one of the most popular parts of the magazine. But by the very nature of being a monthly feature, it becomes impossible (without an elaborate filing system) to remember particular circuits — or compare them with similar ones.

Our answer to this problem is this series of Circuit Books. This, the third book in this series, is the best yet. It contains a substantial number of circuits not previously published in the Australian edition of ETI. This edition has been totally assembled and produced in Australia.

CIRCUITS NO. 3 IS AN IDEAS DIRECTORY AND IS NOT MEANT FOR THE BEGINNER. WE REGRET WE CANNOT ANSWER QUERIES ON ANY CIRCUITS IN THIS PUBLICATION.

Electronics Today International will consider circuits or ideas submitted by readers for inclusion in ETI magazine and/or future editions of this series of books. All items used will be paid for. Drawings should be as clear as possible and text preferably typed. Each submission must be accompanied by a declaration that the circuits or ideas are not subject to copyright. Send your ideas to ETI, 15 Boundary St, Rushcutters Bay NSW 2011.

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All reasonable care is taken in the preparation of this publication to ensure accuracy but we must emphasise that in many instances the circuits included originate from readers and have not necessarily been assembled or tested by the publishers. The Circuits Books are essentially 'ideas directories', and are not intended for use by beginners.

*Recommended and maximum price only.

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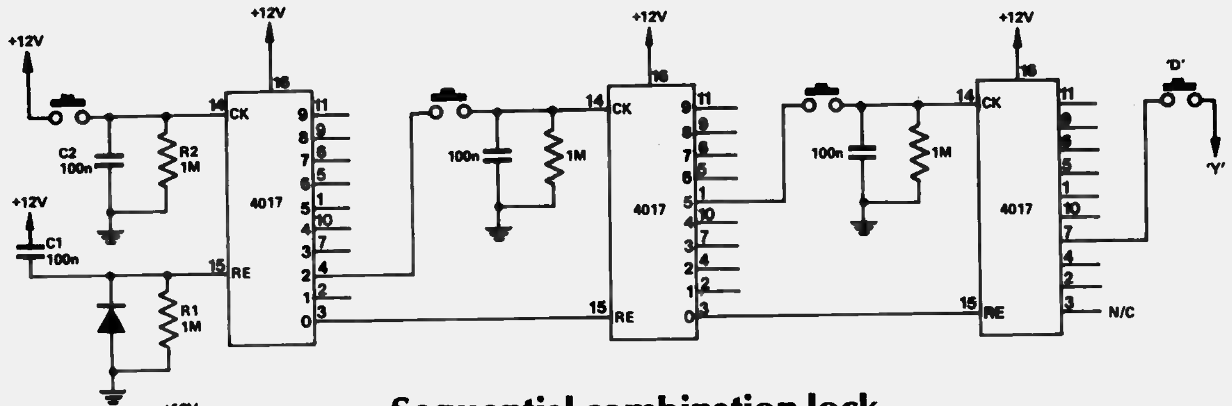
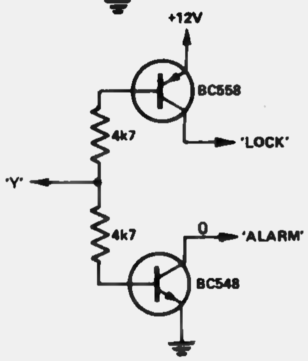




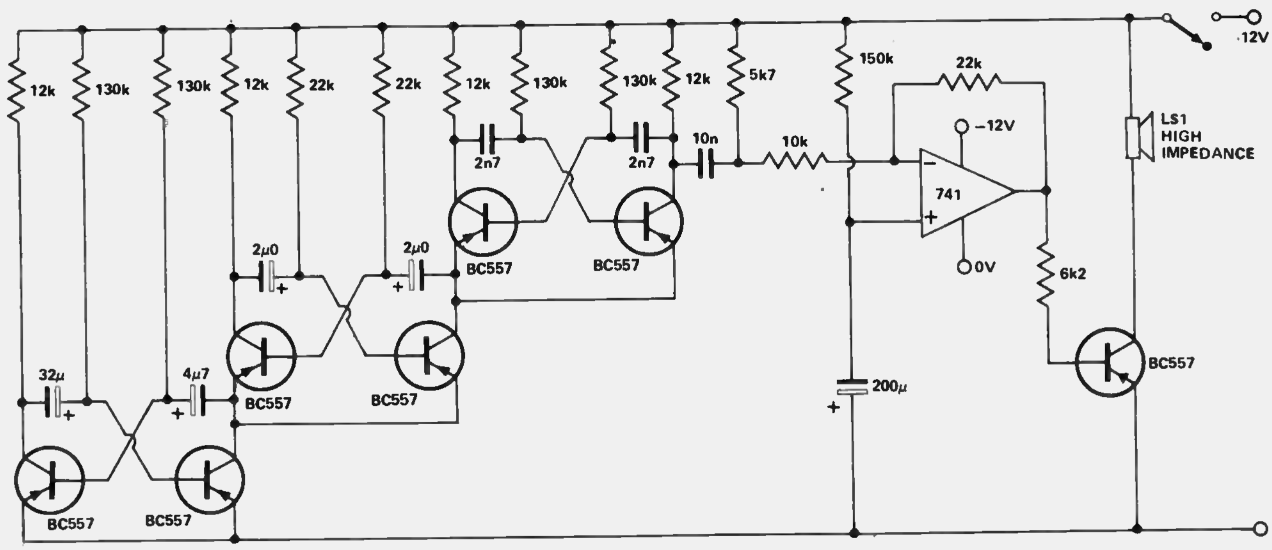
Sequential combination lock

Another combination lock, this one from **Ronald Mellor of Peakhurst, NSW.** To operate the lock, the buttons must be pressed the right number of times and in the right order. If the 'D' button is pressed ahead of time the alarm sounds.

Here, the combination is 2, 5, 3, 1. The odds against pressing the right number first up are 17 496 to 1, not good odds for a potential thief!

Three 4017 decade dividers are used to count the combination which can be easily changed by simply changing the output pin of each divider. The network R1 and C1 ensures all counters reset at switch-on, while R2 and C2 are for debouncing.

The output transistors both remain conducting in the quiescent state. A '0' or '1' signal on the 'Y' line will turn Q1 or Q2 off respectively, giving either an unlock or alarm signal.



Gentle clock alarm

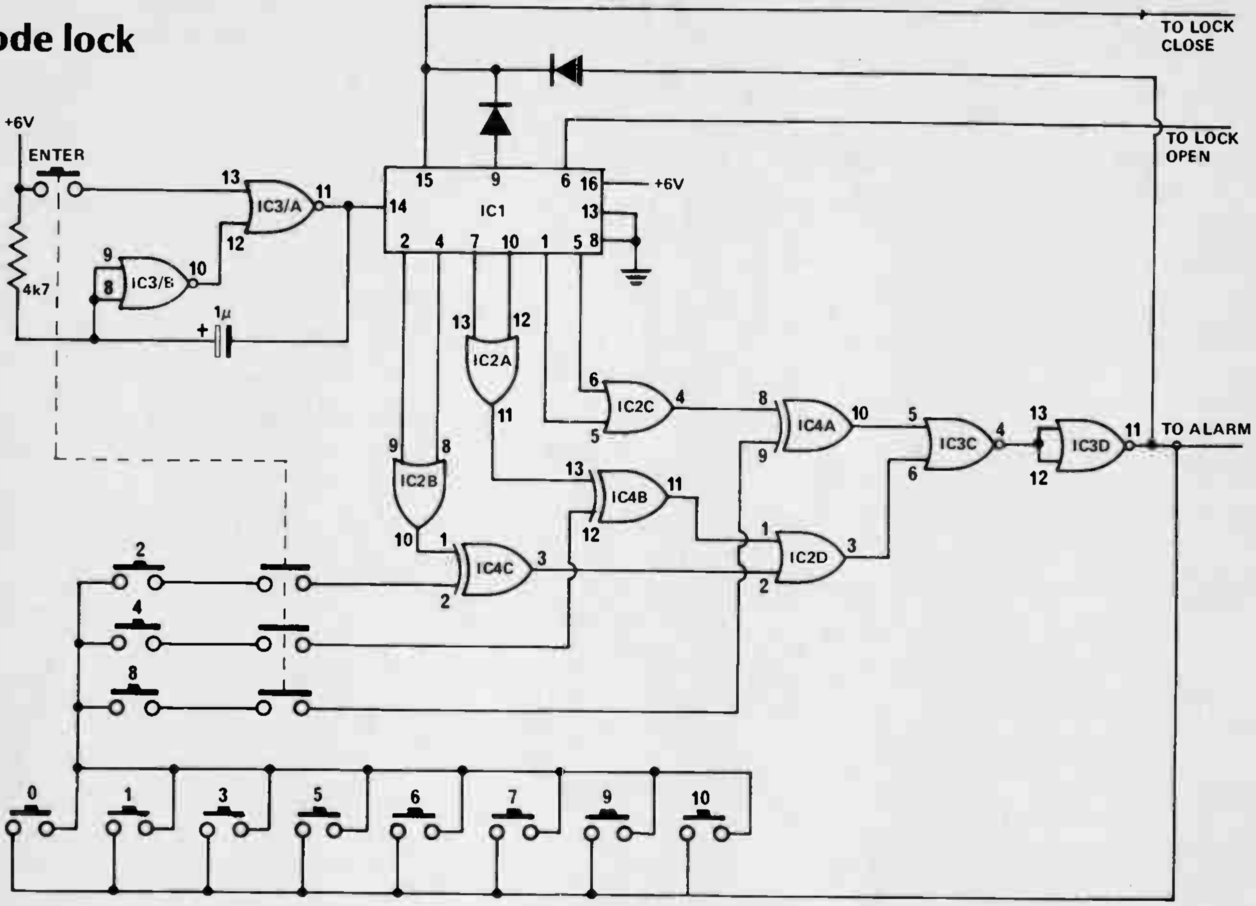
RING! RING! BUZZ! CLANG! PIP PIP!

This is hardly the sound that anyone wants to hear first thing in the morning (especially one of *those* mornings!)

There are gentler ways to wake up. This circuit provides an alarm which builds up from being inaudible to fairly loud over the course of about a minute. As a result, you are always woken up by the minimum volume required to wake you: a far more comfortable experience than the usual trauma!

The three multivibrators are connected so that the first two modulate the power supply of the third. The resultant signal is a rather pleasant warbling sound. This is shifted in dc level by the voltage at the non-inverting input of the op amp, and since this voltage is provided by R and C, it will rise slowly, shifting the signal in dc level and thus increasing the dc bias of the transistor. Thus the output of the circuit will rise slowly in volume.

Code lock



This circuit, featuring separate LOCK and ALARM outputs, was sent in by **Michael Saleeba of Croydon in Victoria.**

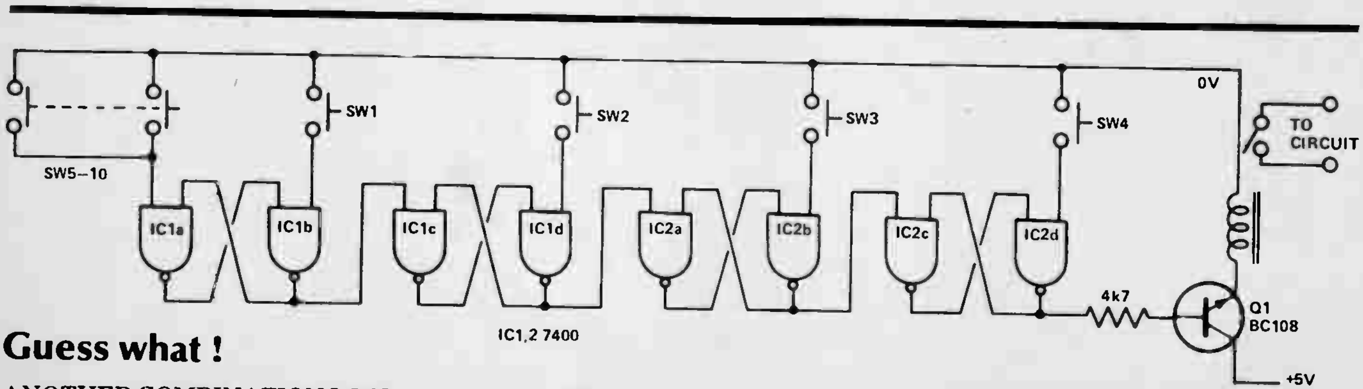
When the ENTER button is pressed it triggers a monostable, formed by IC3A and IC3B. The output pulse from this monostable goes to the input of IC1, a decimal decade counter. The outputs are safeguarded from shortcircuits by OR gates IC2A, B and C.

The ENTER button also takes outputs from the keyboard. If one of the correct buttons is pressed, logic 1 goes through the ENTER button to IC4A, B or C. This IC is an exclusive-OR gate, so if you press the wrong button a logic 1 will appear on the output of one of the gates. The outputs of these gates are safeguarded by IC2D and IC3C. When you press the wrong button a logic 1 appears on the output of IC3D which goes to the reset and the alarm.

The code number for this circuit is 2,8,4,4,2,8. To operate the code lock you must press this number and then the ENTER button. Then you press the ENTER button one more time for the door to open. To close and reset, press the ENTER button once again.

As the circuit is very versatile, you could get almost any code by extending the code button sequence; e.g: 1,2,3,4, 5,6,7,8,9 or 2,2,2,2,2,2,2,2,2,2. Another idea would be to have your phone number as a code (although that does present a security risk . . . Ed.).

The ICs are: IC1-4017A, IC2-4071B, IC3-4001A, IC4-4030A. The two diodes may be any small signal silicon diode.



Guess what !

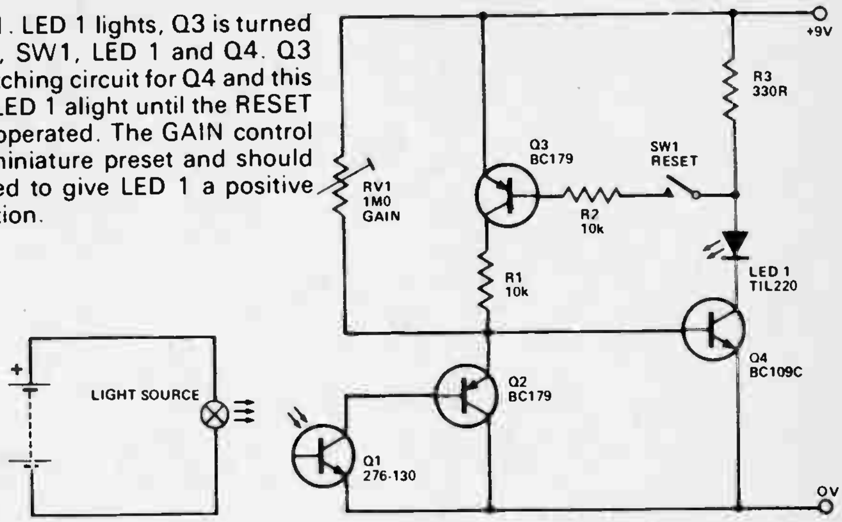
ANOTHER COMBINATION LOCK we hear you say! This one, **from Denis Dowling of Mulwala, NSW,** only operates the relay when the switches are pressed in the correct order. The unit provides a large number of combinations to foil the would-be thief. By the way, the correct order for this circuit is SW1, SW2, SW3, SW4, but of course, when you build the unit these switches can be mounted in any order. If any of the switches SW5 - SW10 are pressed the circuit will reset. The ten switches should be mounted in a matrix and wired in the combination you want.

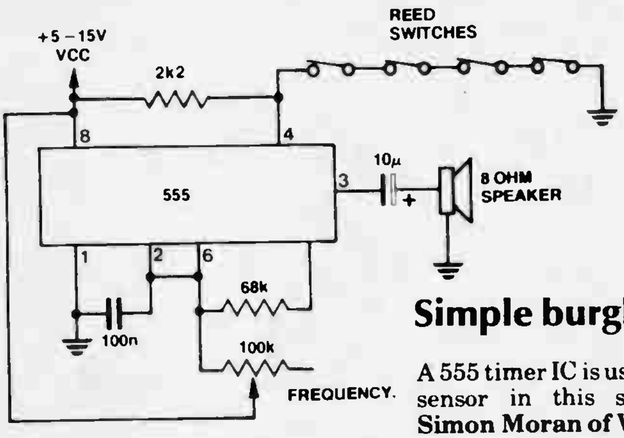
Silent sentry

B. J. Lowery

The 'Silent Sentry' is a form of intrusion alarm. It will indicate the breaking of a light beam by means of lighting a Light Emitting Diode, which will remain lit until the RESET switch is activated. Q1 may be any suitable NPN photo-transistor available, eg 276-130 (Tandy) and BPX 25 (Maplin).

When light from the light source is falling on Q1, Q2 is turned on, causing both Q3 and Q4 to be turned off, therefore LED1 will not light. As soon as the light beam is broken Q2 is turned off, allowing Q4 to be turned on via RV1. LED 1 lights, Q3 is turned on via R2, SW1, LED 1 and Q4. Q3 forms a latching circuit for Q4 and this will keep LED 1 alight until the RESET switch is operated. The GAIN control is a sub-miniature preset and should be adjusted to give LED 1 a positive on/off action.





Simple burglar alarm

A 555 timer IC is used both as alarm and sensor in this simple circuit from **Simon Moran of Wollongong, NSW.**

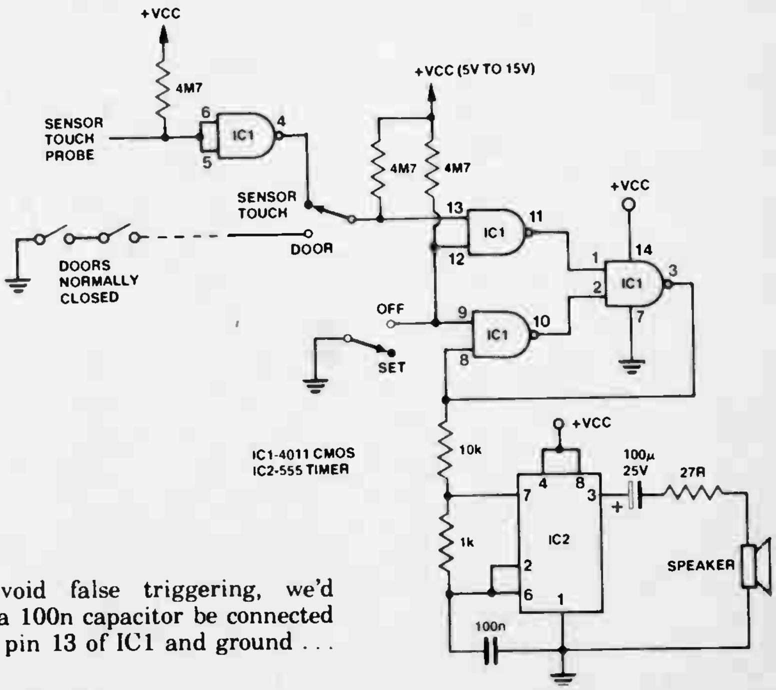
A normally closed loop system is employed, using reed switches, trip wires, window tape, photoelectric relays etc. These hold the 555's 'inhibit' pin low during normal operation. When the loop is broken, the 555 will commence to oscillate and the alarm will sound.

The circuit operates from any supply rail from 5 V to 15 V; standby current is less than 3 mA at 6 V, so the alarm is capable of being run from a small battery. Set the 100k potentiometer for the desired alarm tone. A horn loudspeaker is recommended.

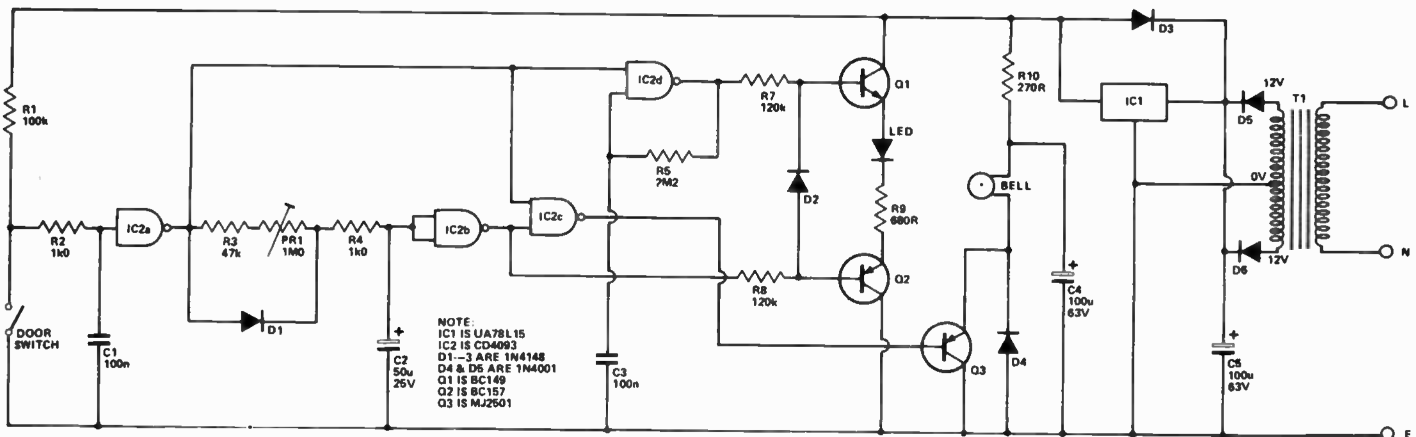
Burglar alarm cum water level detector

This circuit can be used to suit your own alarm applications and comes from **Lim Beng Cheng of Singapore.**

The 'sensor touch probe' can be used to trigger the alarm circuit from a person touching it or from a probe in a water vessel being covered by the water (or some fluid). For conventional burglar alarm operation the alarm can be triggered by normally closed contacts such as reed switches, window tape etc. A switch permits selection of the mode of operation. Another switch permits the alarm to be 'SET' or turned 'OFF'. IC1 is a 4011 CMOS quad NAND-gate while IC2 is a 555 timer used to derive an audio alarm. Three gates from IC1 are connected as a flip-flop. When both inputs are high, the output goes high and IC2 will oscillate, providing an audio alarm. The sensor touch alarm is simply one CMOS NAND-gate connected as an inverter. When the sensor touch probe is touched, the gate input will go low and the output high, activating the flip-flop.



(To avoid false triggering, we'd suggest a 100n capacitor be connected between pin 13 of IC1 and ground . . . Ed.).



Shop doorbell

R. Gamester, Chesham

This unit was designed to give a remote indication of a shop door opening. The bell rings once as the door opens and a flashing LED indicates that the door is open. To prevent the unit being repeatedly triggered, a time delay operates from the closing of the door for a period of 20-30 S, during which time the LED is constantly illuminated.

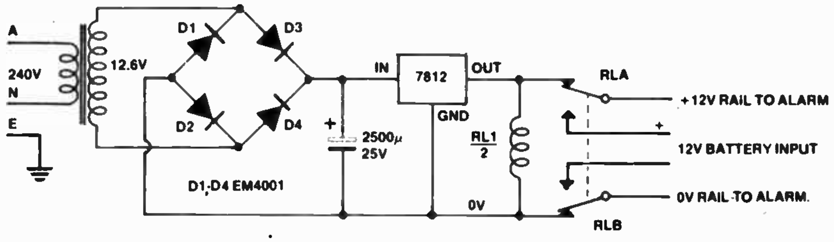
When the door opens, C2 charges quickly through D1 and IC2b turns Q2 on. The oscillator (IC2d) is running and interrupts the LED by switching Q1 on and off.

When the door is closed the oscillator is stopped, leaving Q1 on. This gives a constant indication until C2 discharges through R3, PR1 and R4.

The bell is a standard 3 V vibrator type and is powered by C4, this being discharged through the armature by Q3. IC2c generates the drive pulse, its duration being the charge time of C2.

Alarm power supply

House alarms require a power source in the event of a mains failure. This unit, from **Mark Tiddy of Highgate S.A.**, is a simple unit to fulfil that function. Most alarms operate from a 12 Vdc rail so that a 12 V battery may be used to supply power during mains failures. The circuit employs a conventional transformer-bridge rectifier configuration and a three-terminal 12 V regulator. The coil of a relay is connected directly across the 12 V regulated supply rail and is held operated during mains operation.



During mains failure, the 12 V supply rail from the regulator will discharge and the relay will drop out, connecting the supply rail for the alarm through to a 12 V battery.

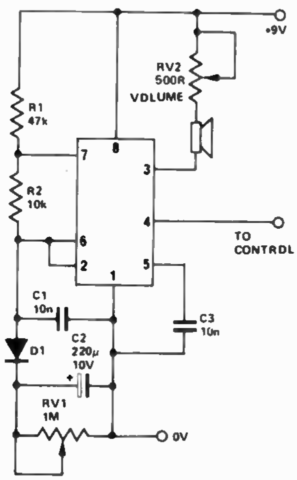
A suitable resistor (or even a diode) from the positive output of the bridge rectifier to the positive terminal of the battery, plus a diode between the 0 V RAIL TO ALARM and bridge rectifier negative will keep the battery trickle charged.

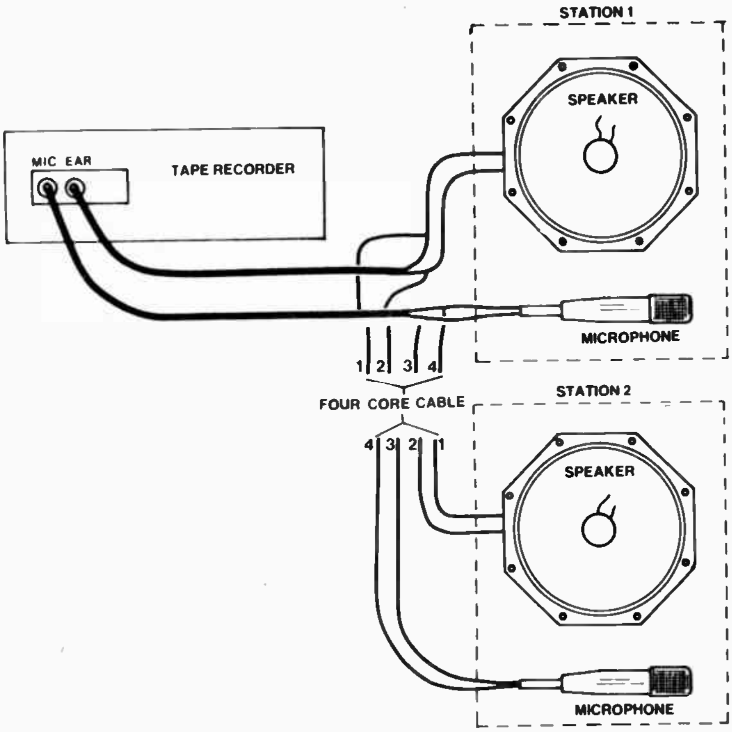
Warbling alarm

A warbling alarm has a certain attractiveness compared to the usual nerve-wracking attention getters. This circuit, rescued from deep within our files, is quite simple and may be activated in a number of ways. Centred on a 555 timer IC, the alarm works as follows: the CONTROL pin activates the oscillator when it is taken high (to the supply rail). Capacitor C2 will charge up via R1, R2 and D1. When the voltage across C2 reaches 2/3 of the supply voltage (i.e: 6 V), pin 7 of the 555 goes low (to zero volts). This reverse biases D1 and C2 is effectively taken out of circuit. The 555 then operates as an astable oscillator, the frequency being determined principally by R2 and C1. Meanwhile, C2 will discharge via RV1 until the voltage across it is low enough that D1 again becomes forward biased. The whole cycle then repeats. The charging cycle of C2 causes a frequency variation in the oscillation of the 555, giving the warbling sound. Output is via pin 3 of the 555 and either a 16 ohm or higher impedance speaker is recommended.

The alarm is controlled via pin 4 of the 555. When held low (connected to zero volts) the circuit is inactive. Connecting this pin to the positive supply rail will activate the oscillator after a short delay. Either logic circuitry or a simple switch may be used.

Diode D1 may be any silicon switching diode (1N4148, 1N914, 1N916 etc) and C2 may be either a standard electrolytic type or a tantalum capacitor.





'Jury-rig' intercom

This intercom can be 'jury-rigged' in an instant (well, ... almost), yet is very effective. You need a tape recorder (say, a cheap cassette deck or whatever you have on hand), two small speakers and two crystal or dynamic microphones (crystal types are best).

It uses the 'monitoring' function in the tape recorder in the recording mode. When a person at either station talks into the mic. the signal passes through the recorder, is amplified and passed to the speakers. To avoid feedback, levels should be kept low and the mic. and the speaker physically shielded from each other at each station. Alternatively, a DPDT slide switch could be connected to switch the mic. in and speaker out during 'talk' and vice versa during 'listen'. A 'dummy' cassette has to be inserted to 'fool' the recorder.

That's quite an ingenious idea from **Craig Forsythe of Williamtown, Vic.**

Class A amplifier

The main advantage of class A amplifiers is the absence of crossover distortion. Against this major advantage must be weighed the disadvantage of permanently hot heatsinks and large capacity power supplies.

The circuit shown here contains several novel features and will deliver 5W of pure class A sound into an 8 Ω load.

Q1 and Q2 form, with the associated components, a high quality voltage amplifier with overall ac and dc feedback applied from the collector of Q2 via R6 to the emitter of Q1.

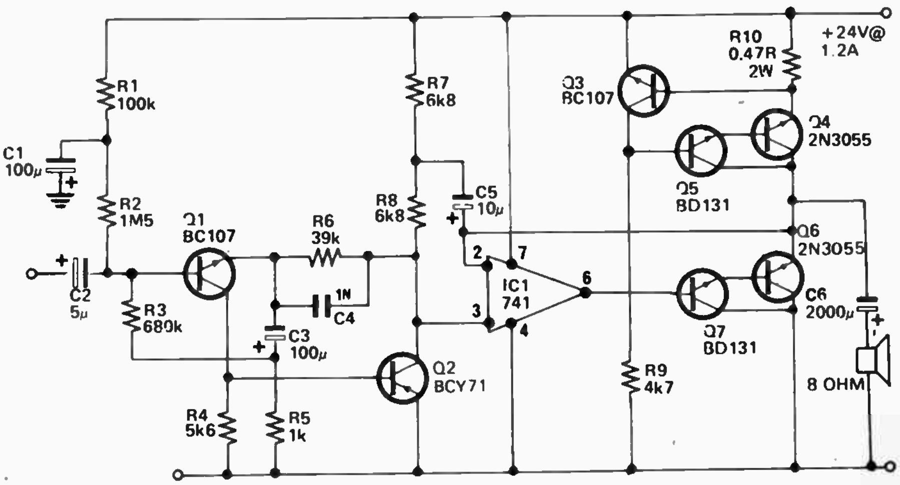
The output stage proper, consists of Q6 and Q7 connected as an emitter follower darlington pair. These transistors are driven by IC1, a 741 op amp, and are included in the latter's feedback loop.

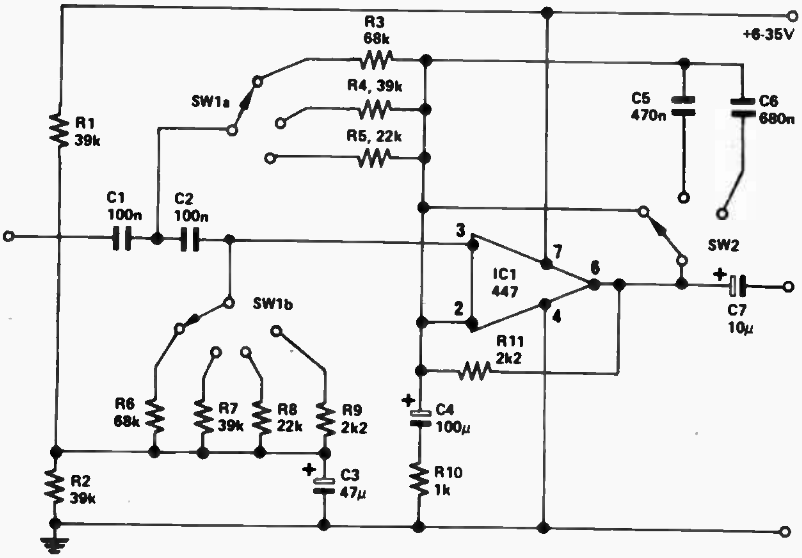
These three form a near perfect output stage with an input impedance of several megohms and a bandwidth extending from dc to over 100 kHz.

Quiescent current is provided by the constant current source Q3, Q4, Q5, R9 and R10. The use of a constant current source here effectively isolates the output from line variations and ripple.

With the components shown, the circuit has a bandwidth of 10Hz – 30kHz at -3dB, a distortion of less than 0.1% before the onset of clipping, an input impedance of 1.5MΩ and a sensitivity of 180mV for full output.

Transistors Q4 to Q7 must be mounted on an adequte heatsink, a 5" by 4" finned type is suitable, but must be mounted vertically and in such a position as to allow ample ventilation.





SW2	+3dB
1	Flat
2	150Hz
3	100Hz

SW1	-3dB
1	25Hz
2	40Hz
3	80Hz
4	FLAT

Switchable rumble filter

The circuit shown provides a cut-off at 25, 40, or 80Hz. C1 and C2 in conjunction with R3-9, form second order Butterworth filters with 12db/octave roll-off below the turnover frequency.

Unlike most designs, the feedback is taken from the inverting input. In practise this works well once the signal at this point follows exactly that at the non-inverting input.

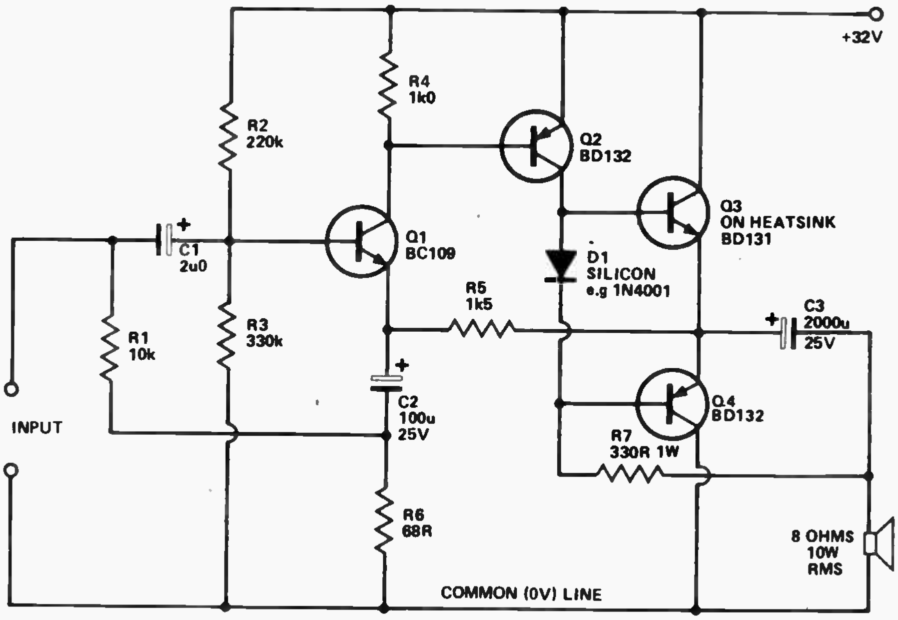
A useful feature is the deep bass boost provided by the feedback loop proper.

S2 in position 3 gives a +3db point at 100Hz whilst position 2 provides a +3db point at 150Hz. A supply 6-35V DC at 10mA is required.

Simple ten watt amplifier

A Hiley, Woking.

This is an extremely simple and inexpensive general purpose amplifier. The design is conventional, the only point of interest being that the output transistors are under-biased: This means that there is no possibility of thermal runaway - it should, however, introduce large amounts of distortion, but, in fact, due to the high level of negative feedback employed, the distortion is reasonably low. Frequency response is extremely good.

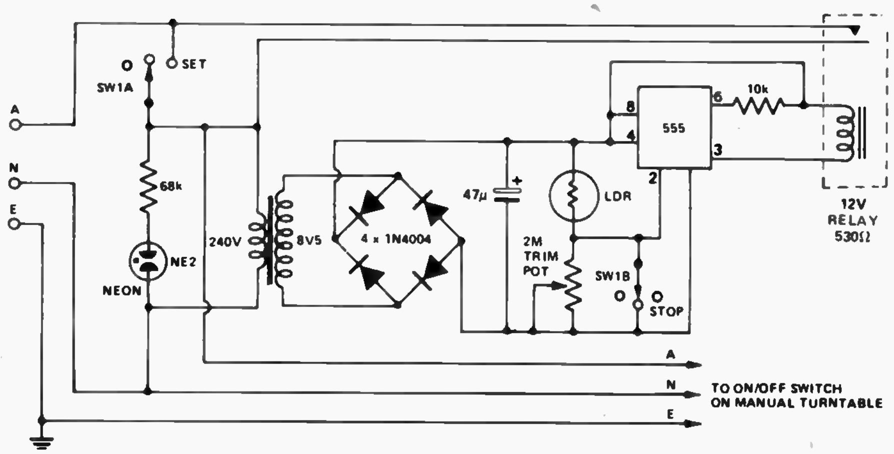


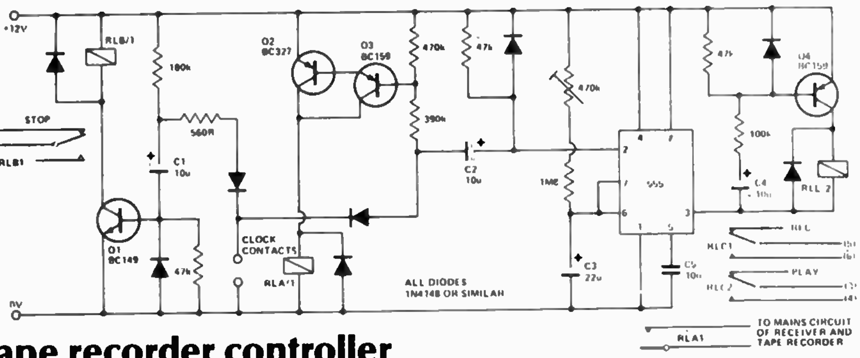
Automatic cutoff for a manual turntable

Mr. T. Threlfall of West Perth, WA, built this unit into a manual turntable to prevent the record being carved up, or more likely, to prevent stylus wear if he forgot to take the tone arm off after the record had finished.

A neon tube is mounted in the end of a black plastic tube and an LDR in the other end. A slot is cut across the tube so the light beam can be interrupted by a small plastic flag connected to the tone arm shaft. The flag must be light, to allow proper operation of the tone arm, and positioned so the light is interrupted when the tone arm is at the end of the record.

The 555 latches when the voltage on pin 2 rises, operating the relay and starting the turntable. When the beam is broken the voltage on pin 2 falls, the relay drops out and the turntable stops. The potentiometer is adjusted for correct operation.





Tape recorder controller

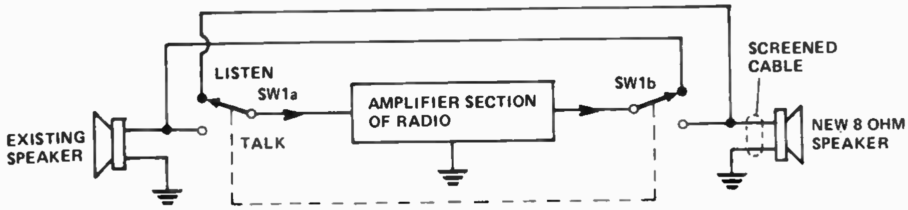
The circuit shown enables a solenoid operated tape recorder to be left to record a programme unattended. It was originally designed to be used on a Revox A77, in conjunction with a digital clock based on the Caltex CT7001, but could be adapted for other recorders, clocks, or mechanical time switches. 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 by 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.

Inexpensive intercom



A small transistor radio can be converted into an intercom by adding a switch, a bit of cable and another speaker.

First, sever the 'tuner' section from the rest of the circuit by cutting the appropriate pc tracks. Then connect a wire to the input of the amplifier section – the wiper of the volume control is the best place. The extra speaker and DPDT switch can then be fitted as shown in the diagram.

The output of the amplifier section will usually go the the earphone socket and so an earphone may be used in the 'listen' mode.

Moving coil cartridge preamp

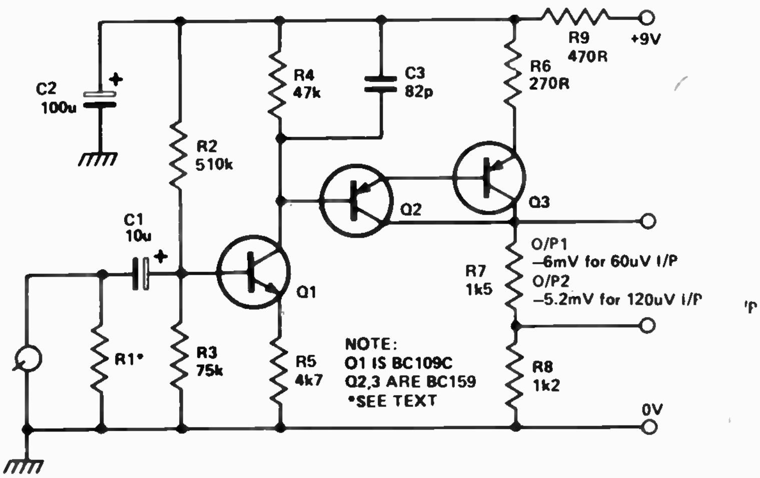
Although moving coil cartridges undoubtedly give better reproduction from disc they usually require expensive step up transformers to enable them to be used with conventional RIAA equalisation.

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.

Inputs 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 position and adjusting this for optimum sound quality by ear.

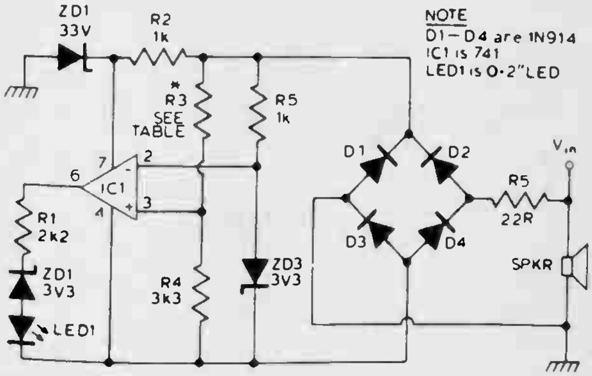


Speaker power indicator

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.

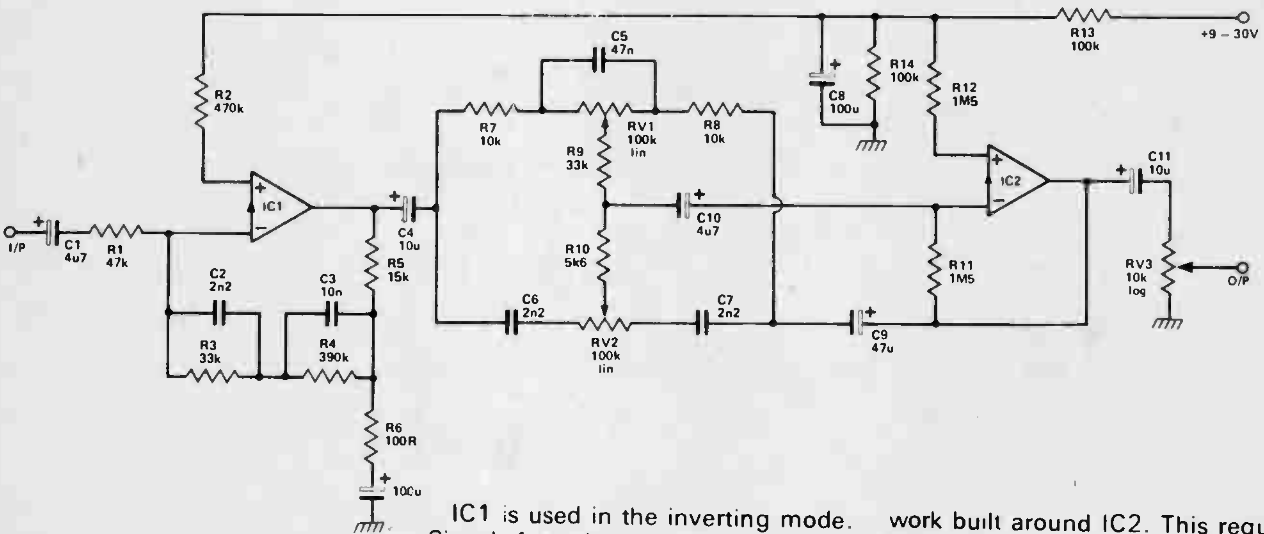


V	5	10	15	20	25	30	35
R3 kΩ	5·6k	9·1k	12k	15k	16k	18k	22k

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 the 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,

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

P = Pout
R = load in Ω



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 required little comment although it should be noted that individual volume controls are employed four each channel. This not only reduces crosstalk between channels but also works out cheaper in that only two single gang potentiometers are used.

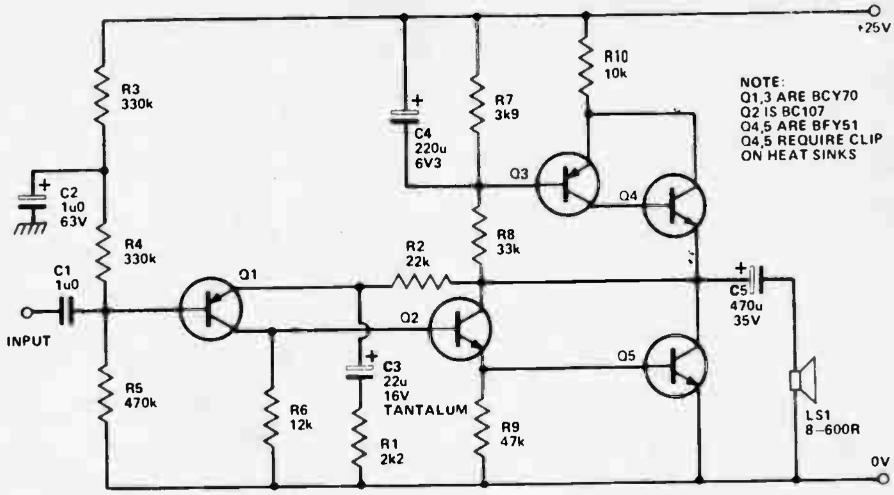
Performance is good with overall distortion below 0.1% and a S/N ratio of −67db unweighted, ref 500 mV out.

High quality headphone amplifier

A. J. Jones, Cobridge

This circuit is capable of high performance using low cost, readily available components. The class A amplifier is designed to drive efficient, high impedance headphones of 150R and above, although it will drive 8R headphones with reduced performance.

Feedback is applied by R1,2 and gain with the specified components is 11. For maximum output the input sensitivity is 0 dB. Q3,4 and C4 form a gyrator circuit and present a high impedence to AC signals. This gives the circuit a high open-loop gain.



for maximum output. Noise is less than −80 dB unweighted. Power bandwidth is less than 10 Hz to over 50 kHz. Slew rate is greater than 5 V/uS.

Quiescent current is set by R9 (approximately 60 mA).

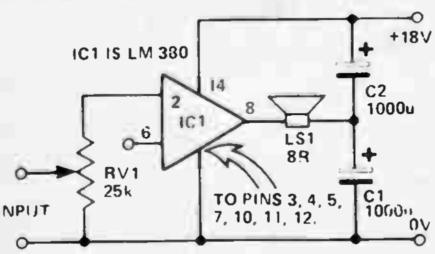
Performance is good with distortion and noise measured on Radford test kit at less than 0.01%

Novel loudspeaker coupling circuit

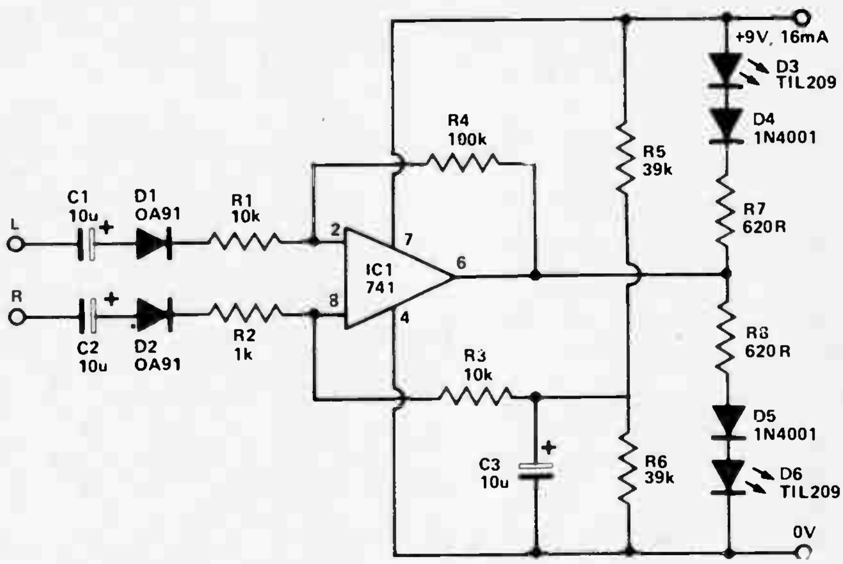
In most amplifier designs the speaker is fed by a high value capacitor to provide DC blocking, but this may result in a heavy switch-on surge, as the capacitor charges up.

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

The amplifier output voltage will be at $V_S/2$, and so will the voltage across C_1 (if C_1 and C_2 are equal); so as the supply voltage builds up, the DC voltage



across the speaker will remain zero, eliminating the switch-on surge. C_1 and C_2 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.



Stereo balance meter

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.

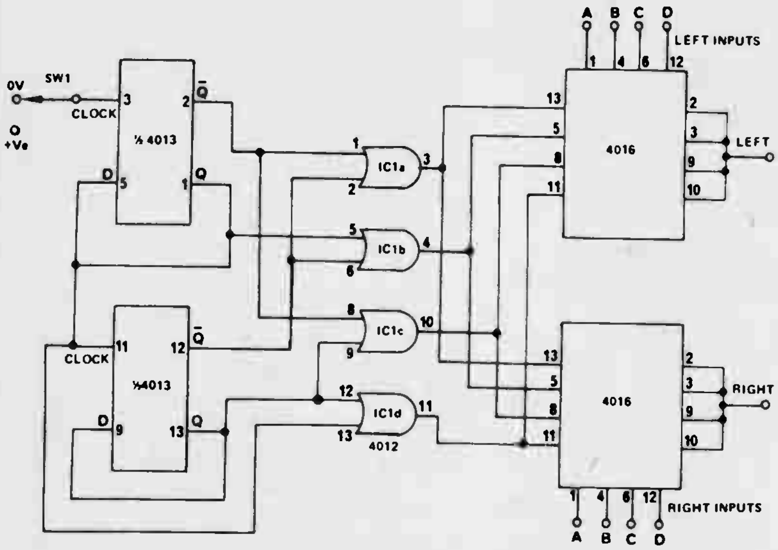
This circuit offers a solution to this problem provided that one's equipment is fitted with a stereo/mono mode switch.

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 LED's D3 and D6 via the current limiting resistors R7 and R8, and the diodes D4 and D5.

These latter components allow the LED's to extinguish at extremes of the IC's voltage swings.

To use the indicator, switch the amplifier into the mono mode and adjust 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.



Single point stereo input selector

Four different inputs can be switched through by the continual pressing of SW1.

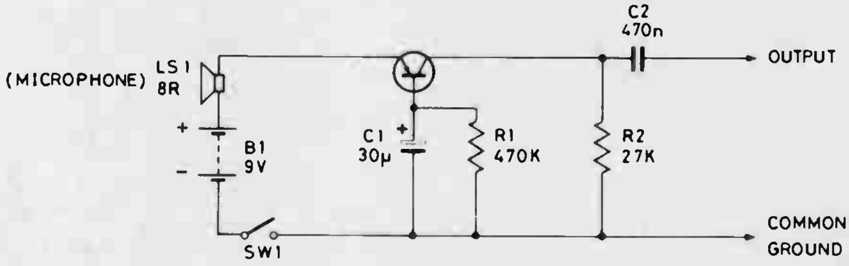
IC1 is a dual 'D' type flip flop. The Q outputs are connected to the D inputs so that the clock inputs are divided by two. The two flip flops are connected in series, giving a two-stage binary counter.

IC2 is a quad AND gate. This is used to decode the four states of the counter. The outputs are used to control the quad switches at IC3 and IC4 (4016AE).

Cheap microphone

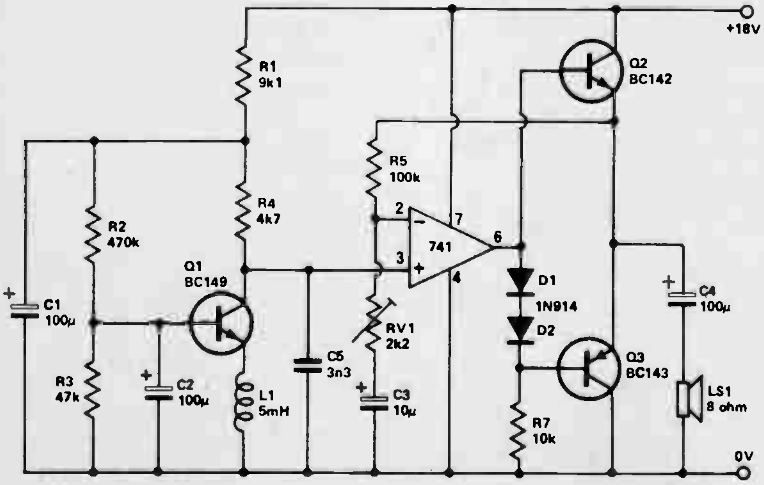
What do you do if you need a microphone in a hurry – the shops are closed and your friends are on holiday? Or you are just a little short of money? The answer is to build the following circuit from your odds and ends box. This circuit uses a small speaker as a microphone, one transistor and only four other parts and draws only about 2 mA current from a 9 volt battery.

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 ceramic pick-up input of an amplifier.



Telephone amplifier

Have you ever had occasion where two or more people needed to listen to a telephone conversation? Normally, a 'phone conversation is a one-to-one affair. This simple amplifier, from J.P. MacAulay of the UK, solves the problem neatly.



No direct connection to the telephone is necessary. Mr MacAulay has cunningly used an ordinary 5 mH RF choke as a pick-up coil – taped to the side of the phone set. Q1 is a common-base amplifier, the output signal on its collector driving the input of a 741 op-amp. The power output stage is driven by the output of the 741. Two complementary transistors are used and feedback is applied to the inverting input of the 741.

The gain of the op-amp may be varied by R6 and you can use either a preset pot or a standard pot and knob.

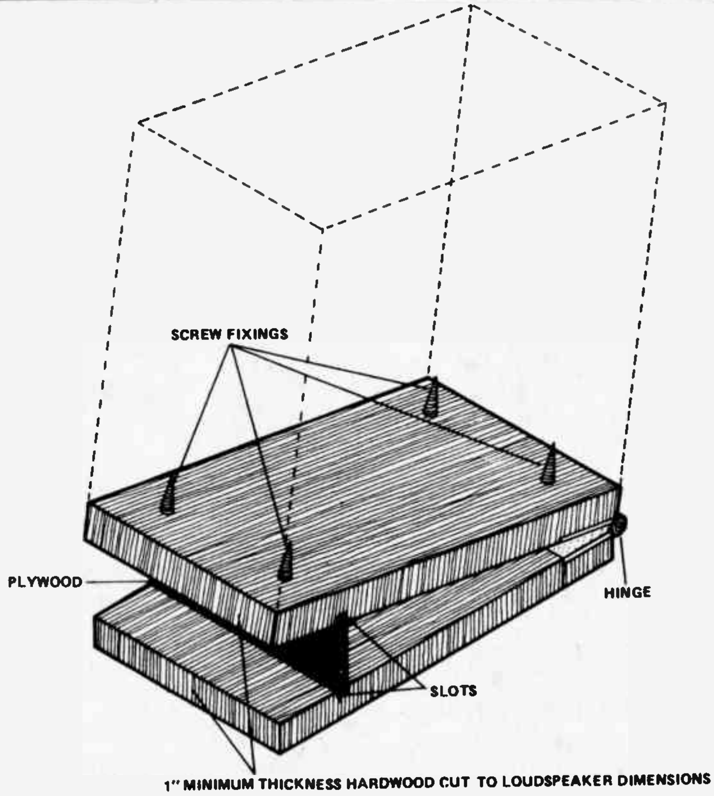
The frequency response of the amplifier is tailored to suit the voice characteristics of the telephone. Quiescent current consumption is less than 5 mA so the circuit can be run easily from a pair of PP3 9 V batteries connected in series.

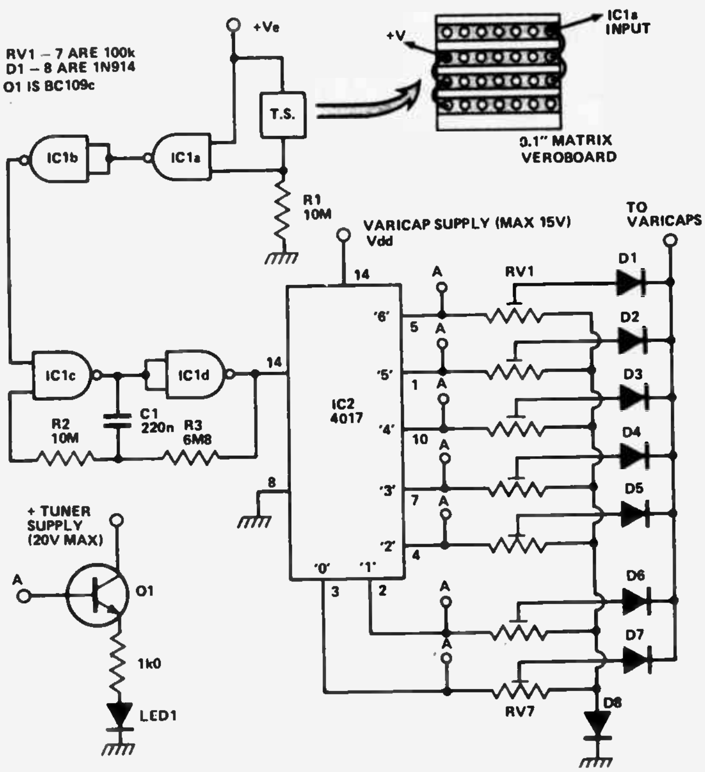
Getting off the ground — cheaply

G. Adams, Poole.

The cost of loudspeaker stands prohibit many from buying them, although they are important to floor-standing arrangements for two reasons. They reduce possible colouration via floorboards etc. and, more importantly, they effectively heighten floor-standing loudspeakers so that the sound from each is directed where it should be, to one's ears, *not* to the upholstery and one's ankles!

With the latter problem particularly in mind, this design was finally decided upon. It is rather uniquely versatile, in that by using different sizes of plywood any degree of lift may be obtained. However, a lift of around 10° is considered a useful stone upon which to build.





Touch station selector

J. P. Macaulay

This circuit, used in conjunction with an FM tuner, will enable stations to be selected by means of a single touch pad.

Under quiescent conditions the output of IC1a is high. In consequence the output of IC1b is low and the astable formed around IC1c/d is disabled. The astable produces an output square wave of 0.5 Hz, when enabled. When a finger is applied to the touch pad IC1a's output goes low sending IC1b's output high, enabling the astable whose output is loaded into the decade counter, IC2. The ten outputs go high sequentially with the leading edge of the square waves provided by the astable. When the finer is removed the counter will 'freeze' retaining the last count.

Tuning is accomplished by the presets attached to the outputs of IC2. As shown, the circuit caters for seven stations but this can be extended to ten by making similar connections to all the outputs. Diodes D1 - 7 ensure that the individual tuning voltages don't interfere with one another whilst D8 helps to stop drift due to temperature variations. In order to know which station has been selected the display and driver transistor is fitted to the outputs.

In this manner a LED corresponding to the chosen station is displayed. The touch switch used in the prototype is simply a small piece of 0.1 inch vero with alternative strips connected together.

If the outputs of the decade counter were to be connected to CMOS transmission gates the circuit could also be used as a multiway switch for audio signals.

Super bass excavator

The main problem with small infinite baffle speaker systems is that the bass response rolls off rather sooner than their larger brothers. This circuit overcomes this problem by boosting the deep bass response of the power amp driving the speakers. Certainly this is not an altogether new idea as regular readers of this magazine well know but this particular circuit does the job rather better than most and the audible improvement is well worth the time and money spent.

The circuit is based around the well known quad op amp LM324. This device contains four independent op amps of the 741 type. Before any purists hold up their hands in horror it should be noted that these are capable of delivering 2 V RMS of 20 kHz sine wave without slew rate problems and that is more than enough to drive 99.99% of all known power amps into clipping.

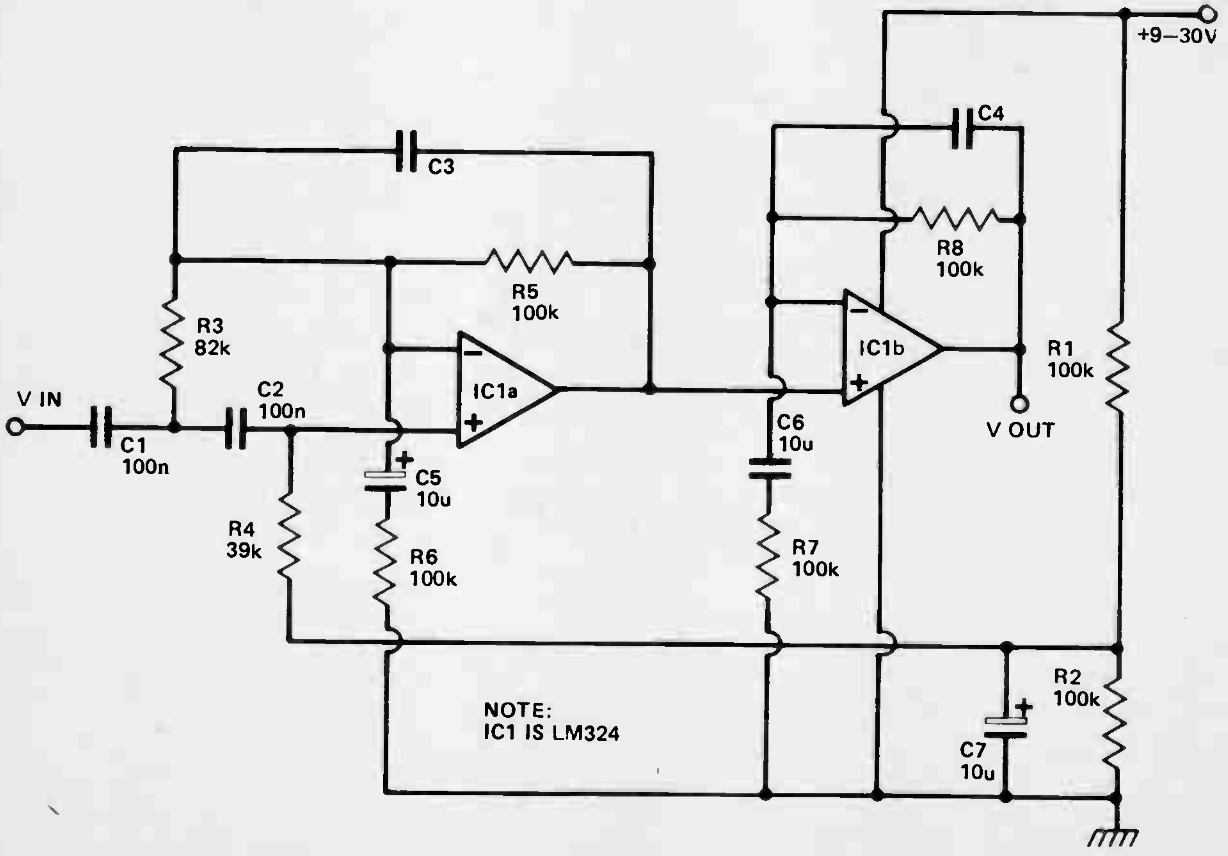
In order to overcome the crossover distortion problems of these op amps the output stage of each is biased into class A by R7 and R10. C1, C2, R3 and R6 form a Butterworth second order filter which removes any signals below 20 Hz thus preventing amplifier overload from record warp signals. R5 and C2 in conjunction with R8 and C4 produce a shelf in the circuit's response below the frequency determined by the reactance of the capacitors.

Now it so happens that the rate of roll-off of infinite baffle enclosure is 12 dB per octave and the slope of the filters is the same. Thus, by the simple expedient of choosing the capacitor values to be equal in value and by matching the quoted -3 dB point of the speakers with the +3 dB values in the table one extends the lower -3 dB limit of the speakers by half an octave.

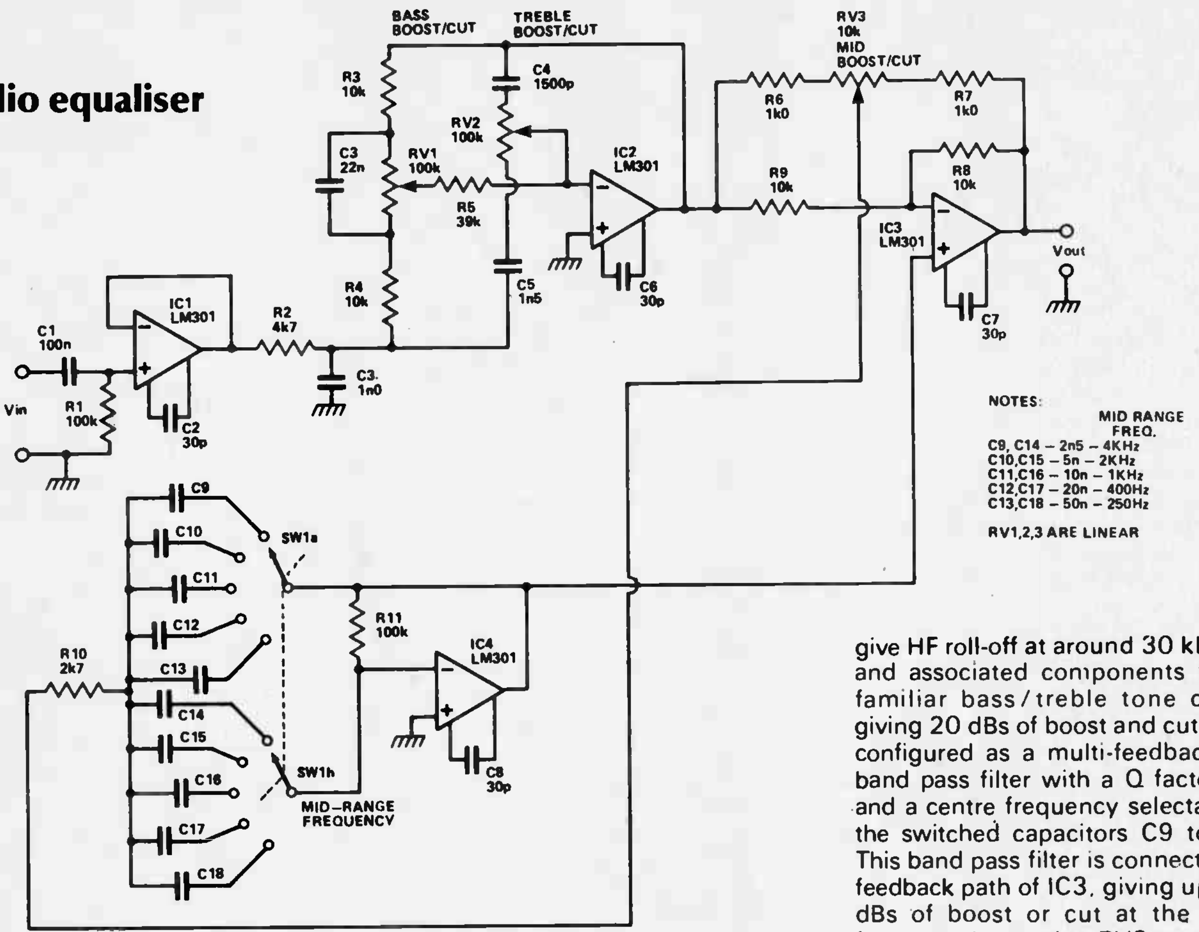
The device must be inserted between the pre and power amplifiers and has a unity gain except in the bass. The maximum gain has been set at 6 dB to prevent amplifier overload.

(+3 dB)

NEW CUTOFF –3 dB POINT	OLD CUTOFF –3 dB POINT	C3,C4
38 Hz	50 Hz	47 nF
45 Hz	60 Hz	39 nF
52 Hz	70 Hz	33 nF
60 Hz	80 Hz	27 nF
68 Hz	90 Hz	22 nF
75 Hz	100 Hz	18 nF



Audio equaliser



The circuit is a versatile line level audio equaliser providing many of the useful functions of a multi-channel equaliser but using only one band pass filter and, therefore, far fewer components.

IC1 acts as a buffer, providing an input impedance of 100 k. R2 and C3 give HF roll-off at around 30 kHz. IC2 and associated components form a familiar bass/treble tone control giving 20 dBs of boost and cut. IC4 is configured as a multi-feedback type band pass filter with a Q factor of 3 and a centre frequency selectable by the switched capacitors C9 to C18. This band pass filter is connected in a feedback path of IC3, giving up to 20 dBs of boost or cut at the centre frequency by varying RV3.

All three potentiometers give no boost or cut at their centre (midway) positions and give a smooth increase in boost or cut on rotation to the right or left respectively.

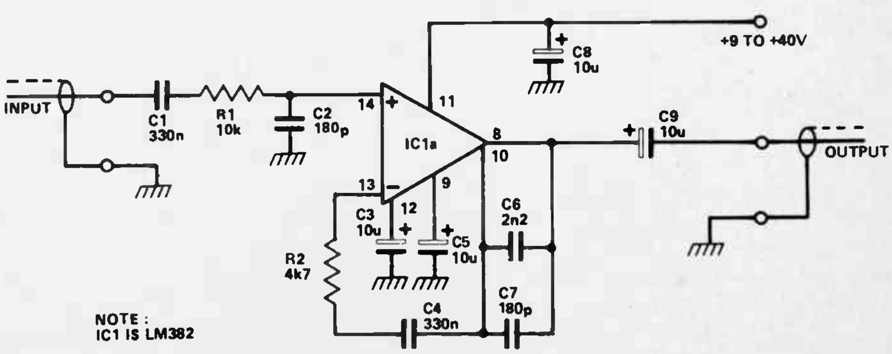
Cassette tape preamp

R Willis, Felsted.

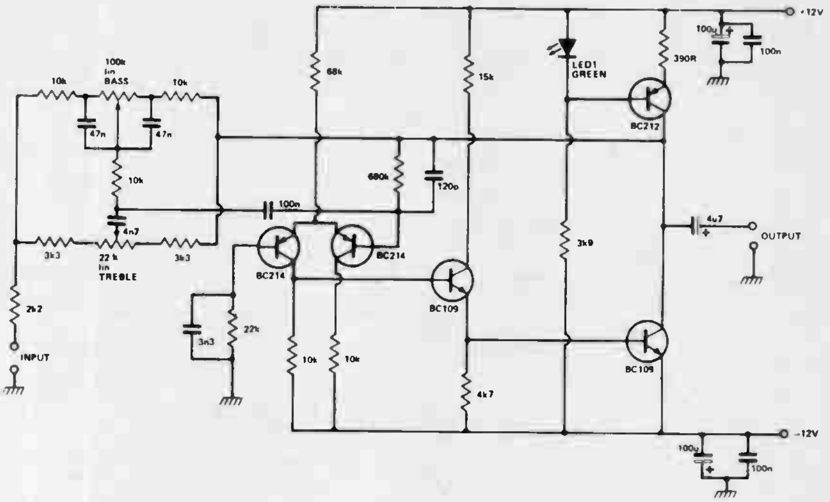
Preamp circuits utilising the LM382 low-noise preamp chip have been used in ETI before. However, when using them in conjunction with a cassette player the results can be disappointing as the cassette equalisation was to NAB standards.

This circuit is equalised for the Philips cassette system and will provide a high quality output of about 100 to 200 mV when driven from a stereo tape head.

The circuit will work on supply voltages from +10 V to +40 V, taking about 10 mA and is suitable for industrial, PA, domestic, portable and automatic application. In operation R1-C1 and R3-C11 provide RF immunity. R2-C4 and C15-C16 provide the 120 uS time constant. C3-C5-C12-C14 decouple the internal feedback loop of the IC and C8 decouples the supply line. C1-C8-C10-C17 AC couple the input and output screened wires.



High-quality tone control



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 1V0. 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.

Priority audio switch

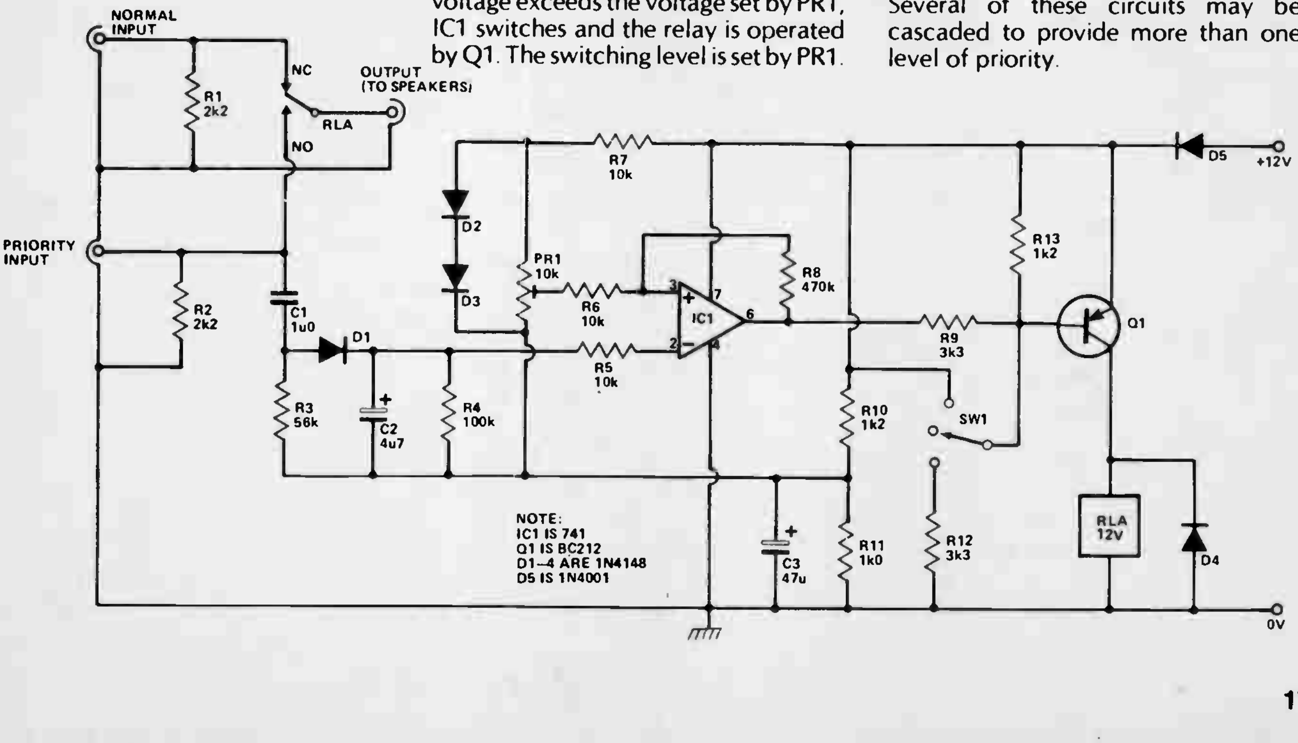
T.P. Hopkins, Manchester.

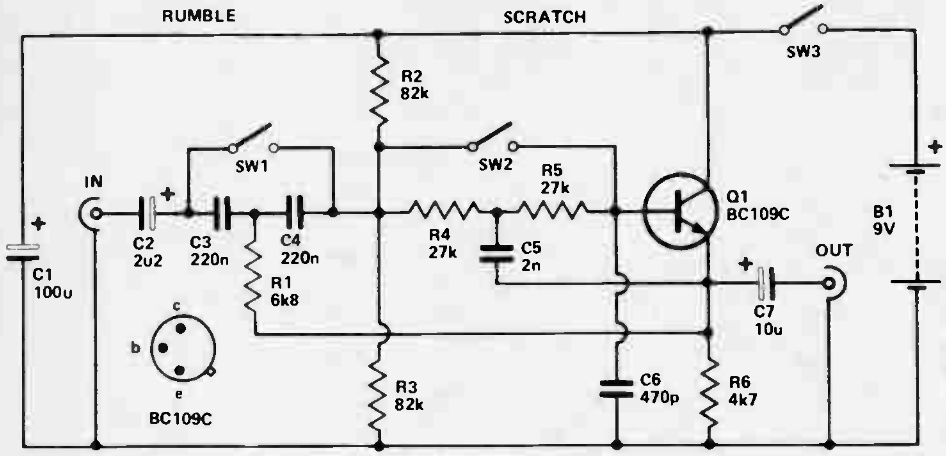
This circuit switches a single loudspeaker from a 'normal' to a 'priority' circuit whenever a signal appears on the priority input. The prototype was used to switch between a cassette player and a two-way radio whenever a call was received. Other uses include priority calls in PA systems, monitoring several infrequently-used radio channels, etc.

Audio from the priority input is rectified and applied to the Schmitt trigger circuit, IC1. If the rectified voltage exceeds the voltage set by PR1, IC1 switches and the relay is operated by Q1. The switching level is set by PR1.

The hysteresis is controlled by R8 and the delay before the relay switches back to the normal channel at the end of a priority call depends on C2 (approximately 2 S with the value shown).

If stereo outputs from the cassette recorder, etc. are to be switched, RLA will require two changeover contacts. Several of these circuits may be cascaded to provide more than one level of priority.





Circuit of the Scratch and Rumble filter. This unit may be mounted on matrix board and mounted inside your amplifier — don't forget two will be needed for stereo. If you construct it as an outboard unit it should be mounted in a metal box and connected into your amplifier system with short lengths of shielded cable. It may be connected between the "preamp out" and "main in" sockets.

Scratch and Rumble Filter

SCRATCH AND RUMBLE filtering is a valuable feature in a hi-fi amplifier but is one which is absent from many designs, or if this filtering is present it may well be in the form of a relatively ineffective 6 dB per octave type filter. This circuit is a 12 dB per octave add-on scratch and rumble filter which can be connected into the 'tape monitor' circuit or some similar facility of the amplifier.

This is a conventional second order filter circuit having passive high pass filter formed by the series capacitance C3 and C4, plus the parallel resistance of R2 and R3 (the latter also being used to bias emitter follower transistor Q1). A passive filter of this type gives only a very slow initial roll off and an ultimate attenuation rate of only 6 dB per octave. A bootstrapping resistor is therefore used to improve performance.

Above the cutoff frequency, where the gain of the circuit would otherwise fall off somewhat, R1 has the effect of reinforcing the input signal from the output of the buffer amplifier based on Q1. Well below the cutoff frequency, losses through C4 result in the signal level at Q1 emitter being well below that at the junction of C3 and C4. This results in some of the signal at the junction of C3 and C4 being tapped off through R1, with C3 and R1 effectively forming a second high pass filter network. This eliminates the slow initial roll off rate (in fact there is a small and insignificant peak of about 0.5 dB above the cutoff frequency) and speeds up the attenuation rate to a nominal 12 dB per octave.

The low pass filter works in much the same way as the high pass one, except of course the R and C filter elements have been transposed so as to give the correct filter action.

If only low pass filtering is required, SW1 can be used effectively to bypass the high pass filter components. C2 then maintains dc blocking at the input. SW2 can be used to bypass the low pass filter components when only high pass filtering is required.

With the specified component values the rumble filter response falls below unity at approximately 45 Hz, reaches the −6 dB point just above 30 Hz and then falls away at a nominal 12 db per octave. The scratch filter response crosses the unity gain point at about 6.5 kHz, reaches the −6 dB point at approximately 10 kHz, and then falls away at a nominal 12 dB per octave. The worst-case input impedance is around 30 k to 40 k with SW1 and SW2 closed.

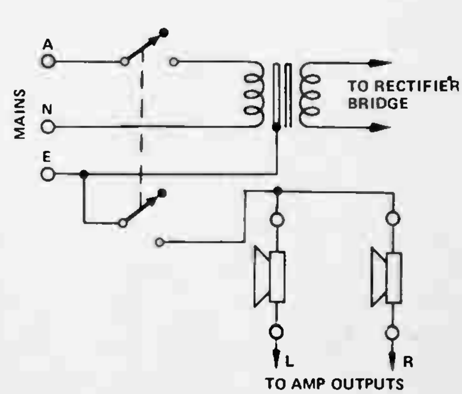
A BC549 or similar transistor may also be used for Q1. The circuit should be housed in a shielded enclosure to avoid hum pickup. Use shielded input and output leads. A dual circuit, with two-pole switches for SW1 and SW2, is necessary for stereo operation.

Pop killer

After building a small 12 W/channel amplifier, Brian Modra of Elizabeth Vale set about developing a means of stopping it from making annoying pops and bangs as it was switched off.

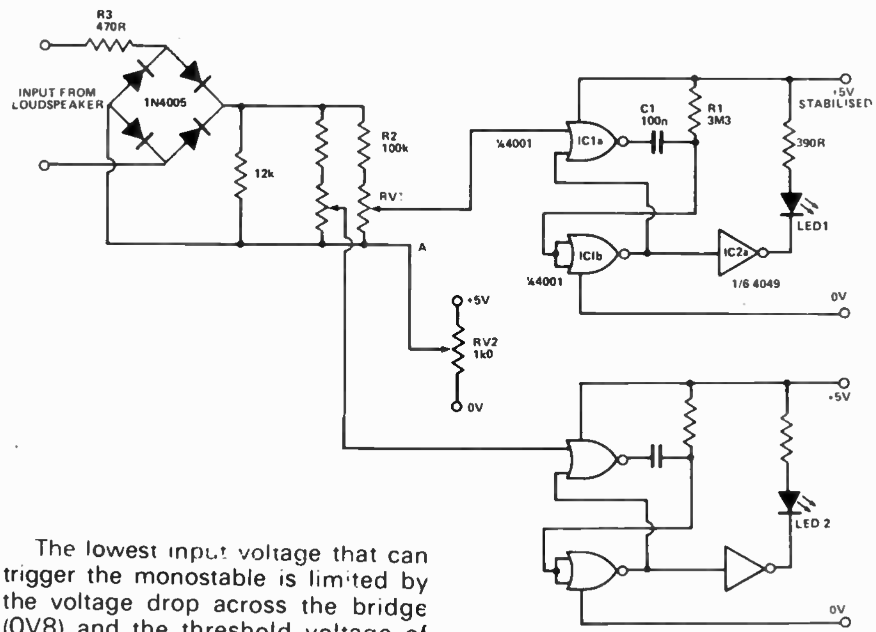
This little circuit uses only a double-pole switch (which must be capable of handling mains) which cuts off the speakers at the same time as the power is switched off.

Unfortunately, this circuit is not suitable for use with bridged amplifiers, but a little thought and a three pole switch should sort things out.



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.

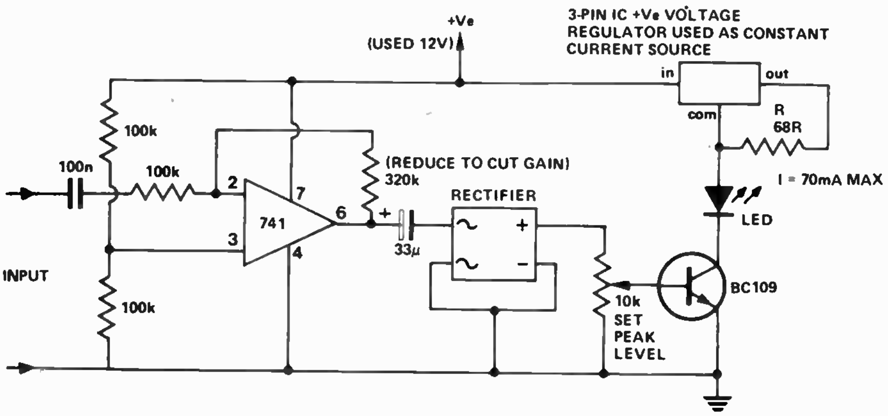
The lowest input voltage that can trigger the monostable is limited by the voltage drop across the bridge (0V8) and the threshold voltage of IC1a (approximately 2V5). The threshold limit is largely overcome by using RV2 to bias point A to just below the threshold voltage. In practice, the circuit operates 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.

LED indicator's many uses

This circuit, from T. Threlfall of Nedlands WA, was originally designed as a peak audio detector to supplement inaccurate moving-coil VU meters in a recording preamplifier susceptible to clipping. In this application it has limitations as the LED brightness varies with the variable conductance of the transistor: an improved circuit may use a UJT or FET with better results.

An alternative use is as a low cost visual display — a "musicolor" on a very small scale with low-level input requirement; while level displays using several LEDs may be better, the cost is high.



The gain of the 741 can be adjusted down if desired, by reducing the 320 k resistance.

The "rectifier" used was from a damaged moving coil meter; connecting the negative output to ground gave a higher output than leaving it floating. This type of rectifier has a lower voltage drop than silicon diodes, and may be useful if extreme sensitivity is needed. Otherwise, a single diode suffices.

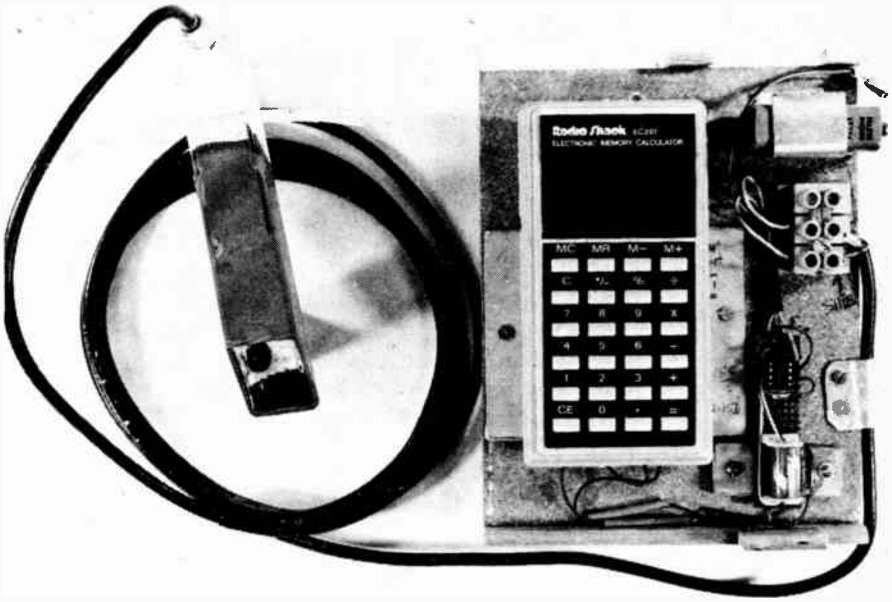
The voltage regulator output current was made high for brighter illumination and can be reduced by increasing R from 68 ohms.

The transistor type is unimportant if current rating is not exceeded. A PNP type could be used if the positive output terminal of the rectifier is grounded and the negative terminal is used as output.

Electronic odometer

THIS DEVICE, which is inexpensive and easy to build, will measure accurately how far a vehicle has travelled over the ground. It is of particular interest to persons who want to know accurately how far they have travelled down any of the thousands of unmarked bush tracks in Australia.

The device works by counting the revolutions of the back wheel of the vehicle using a phototransistor which looks at a white strip painted on the tyre. Signals from the phototransistor are processed in an integrated circuit to provide pulses at high enough level to operate a relay. Counting is achieved by making the relay operate in parallel with a function key on a cheap electronic pocket calculator.



Overall view of my odometer. The calculator and electronics are attached to a chipboard base. The phototransistor sensor is mounted on the wheel guard and connects via shielded cable.

The Circuit

A 555 is connected to operate in the monostable mode as shown in the circuit. Its operation is controlled by a phototransistor type 4PT100 which has excellent sensitivity. The base connection of the phototransistor is not used.

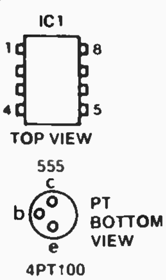
Under "dark" conditions the collector-emitter resistance of the phototransistor is high and this holds the 555 in the 'off' state (pin 3 low). When the phototransistor is illuminated its resistance falls and the voltage at pin 2 falls. When this reaches about two thirds of the supply voltage, pin 3 is switched to the high state. Potentiometer RV1 provides control of the triggering point of the 555, permitting adjustment of the level of lighting which is to trigger the device.

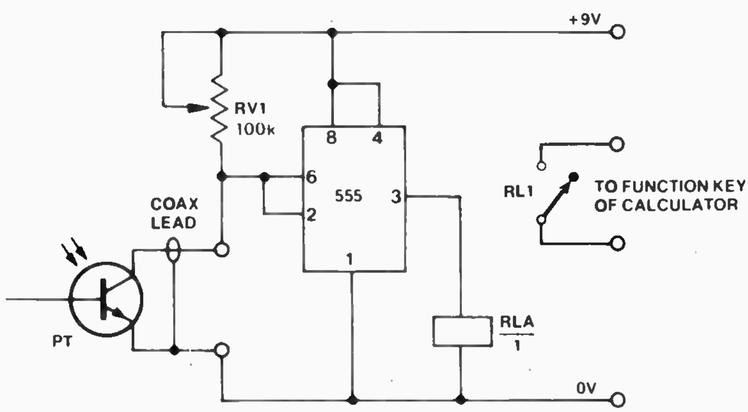
The output from pin 3 operates a small reed relay. This can be any small relay with a coil resistance greater than 60 ohms. The type used was a Marble MEL 400, available from Dick Smith.

A Tandy pocket calculator type EC-201 was chosen to do the counting because successive unit additions or subtractions can be achieved by the operation (after setting up) of one function key, in this case the (=) key. Not all cheap calculators have this "totalling" facility. The contacts of the reed relay are parallelled across this function key.

Care has to be exercised when opening the calculator to ensure that the four moulded locking tags are not broken off. When opened, peel the sheet of switch retaining plastic back from the area of the = switch and solder two 100 mm long tails to the printed circuit runs leading to each side of this

COMPONENT PINOUTS





The circuitry is simplicity itself. The potentiometer (RV1) provides control of the triggering point of the 555. The function key you use on the calculator will depend on the make — the Tandy EC-201 (like most) will totalise using the = key, others employ the + key.

switch. Spend some time preparing the surface and ensure that a good soldered joint is made.

The switch board inside the calculator sits on four plastic spigots and a way has to be found to get the board back onto these spigots while closing the case, otherwise there might be problems with the relative positioning of the keys on the case and the switches on the printed circuit board. When you have closed the calculator I suggest that you secure the wires to the case with epoxy glue to take the strain off the soldered connections.

The sensor assembly is shown in the photograph. It is made of 23 mm square-section lightweight steel tube with a flange welded to it to match the turned-in flange of the mudguard. It is secured to the mudguard by two self-tapping screws.

One end of the tube is sawn off at an angle to give an end parallel to the tyre. The other end is drilled and a small steel tube welded over the hole to form a gland. The purpose of the gland is to take the strain of the cable off the electrical connections of the device inserted into the tube and to make it watertight. When mounted, the sensor is no more than 20 mm from the tyre.

The phototransistor, which incidentally can be obtained from Tandy, and terminals were fixed to a strip of paxolin and slipped into the sensor tube and sealed in place with silicone rubber. To eliminate the effect of glare, a small plastic tube, painted with matt black, was slipped over the phototransistor and held in place with silicone rubber. The coax lead was fed through the gland and soldered to the terminals. The gland was then sealed with epoxy glue and the sensor tube was sealed with silicone rubber.

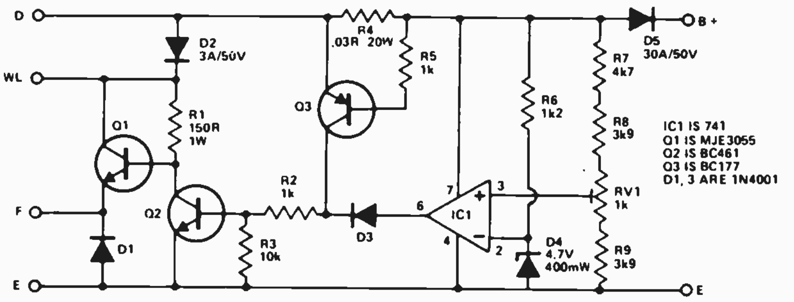
A point which must be taken into consideration is movement of the wheel vertically with respect to the mudguard (when the vehicle is laden or when it lunges). The ideal mounting point for the sensor is at 3 o'clock. Thought should also be given to covering the end of the sensor tube with clear plastic to keep it free from dust and water.

The few components used in association with the calculator were mounted together with the calculator on a wooden board as shown in the photograph. In the arrangement shown, the calculator and relay circuit each have their own nine volt batteries.

Setting up

Test the circuit in stages during construction. Set RV1 to mid position to start with and adjust it subsequently to take account of the light level. The unit is so simple that there is really nothing else to do. This unit has been used at speeds up to 50 kph but it might do a lot more and be of some interest to rally drivers. Cyclists might even be interested: I built my system to help me find my way to remote gold mining sites located in the depths of State forests.

The advantage of using a calculator to do the counting is that, apart from being ready-made, it will allow a constant to be keyed in so that it will display the exact distance travelled in yards, metres, miles etc., instead of just wheel revolutions.



Car voltage regulator

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 ICI, 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.

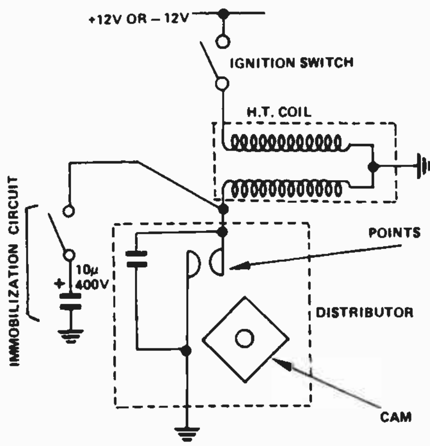
Under cold weather starting the battery voltage drops very low. Once the engine has started the internal resistance of the battery is also very low, which would draw excessive current from the dynamo causing possible damage. To limit the current R4 is inserted in the main power lead from the dynamo, 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.

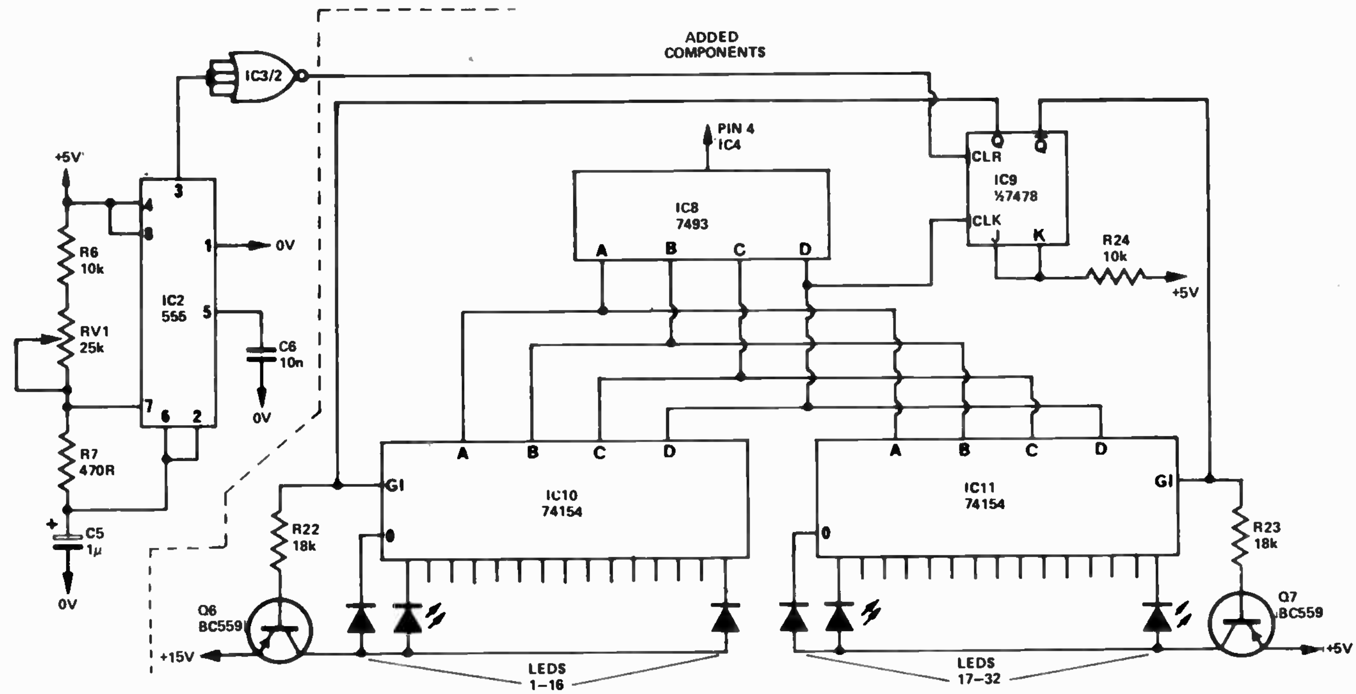
No changes have to be made to the existing wiring. The circuit can be housed in an old regulator box, Q1, Q2 and D5 should be mounted on a heat sink.

Automobile immobilisation

In order to discourage theft of an automobile, many people incorporate a 'secret' switch to break the ignition circuit (usually in series with the key switch). This system is very easily bypassed using 'jumper' leads.

A more effective method of immobilisation is shown in Fig. 1, also using a 'secret' switch. A 10uF/400V capacitor is switched across the points preventing the ignition being started; at the same time this prevents the use of 'jumper' leads.





NOTE
THESE COMPONENTS FROM ORIGINAL DESIGN ARE NOT USED

IC5,7
Q2–5
C9,C10
R11,13,15–21
DISP 1

GND IC10,11 PIN 12
GND IC8 PIN 11
GND IC7 PIN 7

+Ve IC10,11 PIN 24
+Ve IC8 PIN 4
+Ve IC9 PIN 14

Analogue readout for ETI-318 digital tacho

Here is a modification to the ETI-318 digital car tacho to produce an analogue readout in a bar or ring display of LEDs.

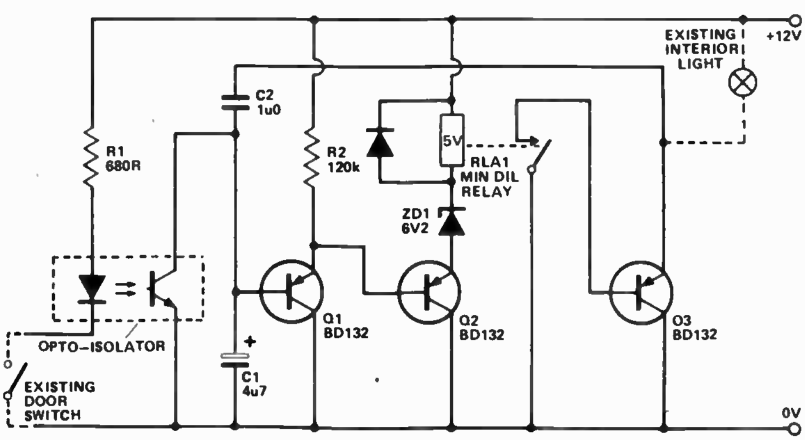
The LEDs each represent 200 rpm, when the unit is calibrated properly, which gives a range of 0-6200 rpm, sufficient for most cars.

The prototype had the LEDs mounted in a ring surrounding a digital clock and the LEDs were green from 0-4800 rpm and red above 5000 rpm. This gave a clear indication when the engine was being over-revved. Another fine idea from **D.L. Shaw of North Ryde, NSW.**

Interior light delay

S.A. Johnson, Newcastle

The circuit shown will delay the car interior light by about 10-15 S, depending upon the time constant of R2-C1.



One big fault with most delay units is that the delay is so long that the light is still on when you drive away, which can be very annoying at night. This unit, however, will extinguish the light either 10-15 S after the door is closed, or when the engine is started, whichever occurs first. The unit may be fitted without running any extra wires to it and may be fixed behind the interior light.

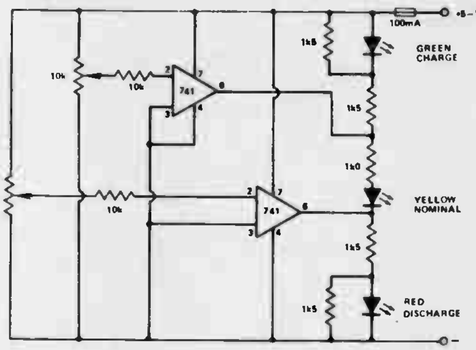
Capacitor C1 charges up through R2, thus turning Q1, Q2, RL1 and Q3 off after 10-15 S. When the door is opened C1 is discharged by the opto-isolator and begins to charge up after the door is closed.

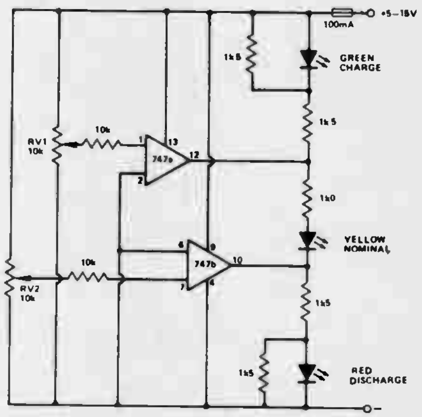
If, however, the engine is started before 10-15 S the supply voltage will drop sufficiently to de-energise RL1, (approx 3V) and give C2 a positive pulse via Q3 which will charge C1 up sufficiently to switch Q1 off. **NOTE:** The value of C2 and ZD1 may need to be altered to get this effect.

The unit draws very little current when not in use and has only ten components.

Battery charge/discharge indicator

A. A. C. McInnes

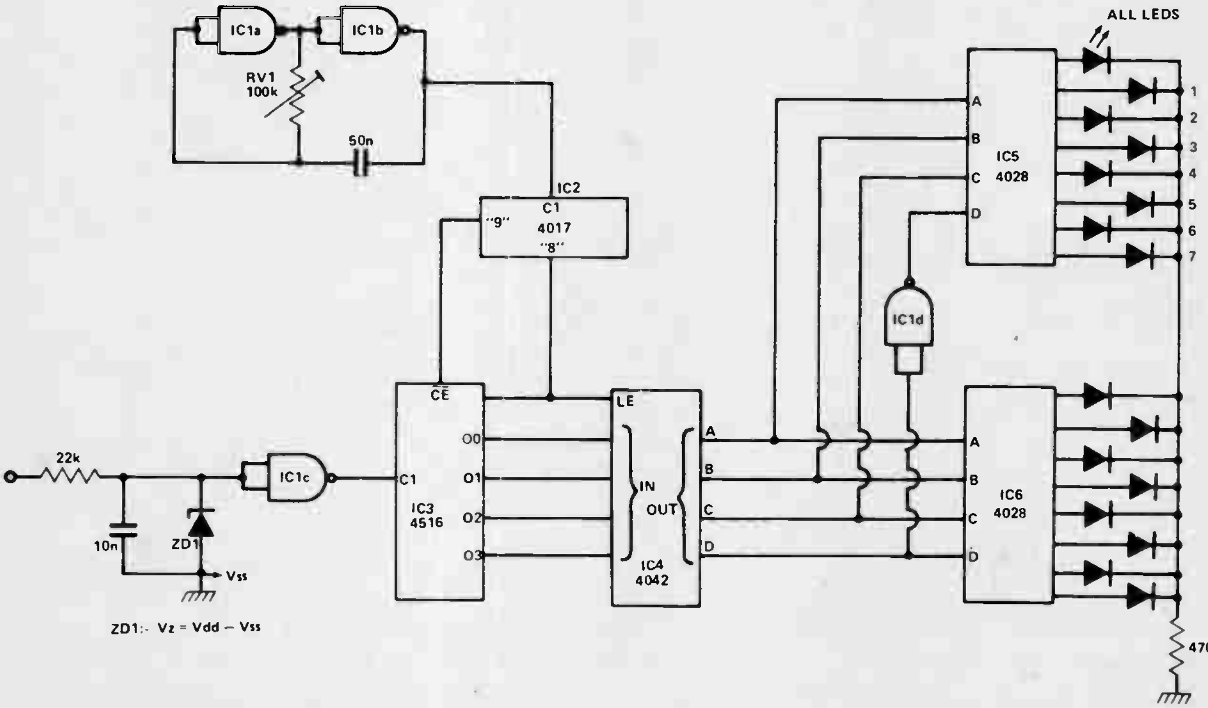




This circuit is intended to monitor car battery voltage. It differs from other circuits in that it provides indication of the nominal supply voltage as well as low or high voltage. This makes it particularly useful for indicating deviation of the supply voltage from the nominal.

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 11V.7 and the green LED at 12V.8. The yellow LED is on between these values.



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.

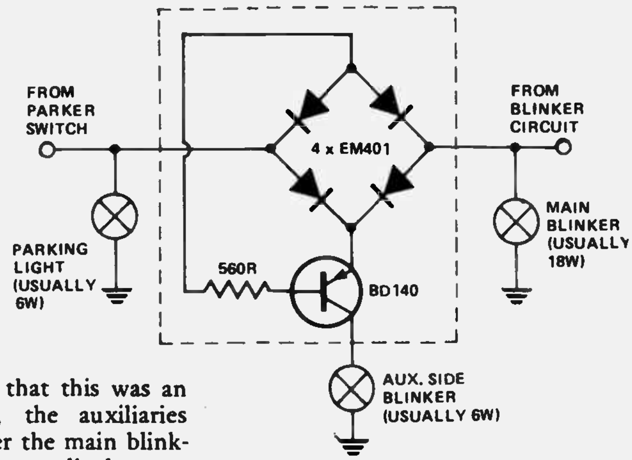
Calibration is by adjusting RV1 whilst inputing a known frequency (e.g. mains frequency 50 Hz).

Blinker controller

Having fitted a set of auxiliary blinker lights to his car, **Kris McLean VK2ZKL** of Granville Tech. was faced with the problem of how to turn them on and off. No problem, you say, put them in parallel with the main blinker circuitry.

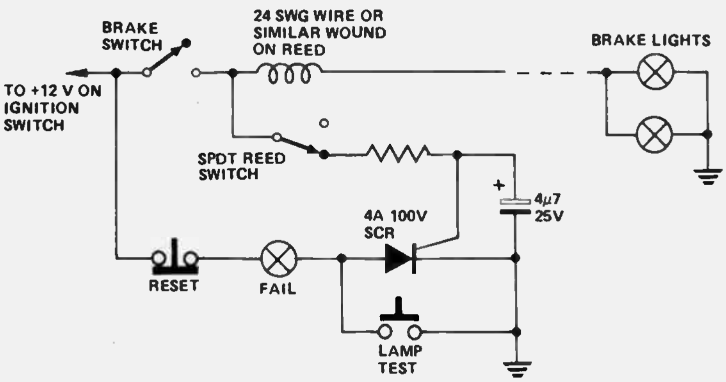
That is all very well if all you want tham to do is blink on and off, but what if you want:

1) The auxiliary lamps to go on when the parking lights are on.
2) The auxiliary blinkers to light at the same time as the main ones when the parkers are off.
3) The auxiliaries to go on in an inverted cycle (ie to light up when the main blinkers go out and vice versa) when the parkers are on – presumably for 'hazard flasher' operation.



Kris spotted the fact that this was an exclusive-or function, the auxiliaries coming on when either the main blinkers or the parking light was lit, but not if both were lit. He devised the circuit here which he then fitted into a plastic pill bottle (useful things) and inserted into the wiring at each side of his car.

Car lamp failure warning



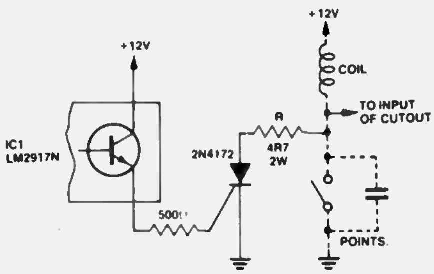
Many lamp failure warning circuits indicate only when the lamp being monitored is supposed to be on. This circuit will 'latch' to show that the brake lights are faulty – even if the fault is intermittent, as is often the case with wiring faults.

Enamelled copper wire is wound onto an SPDT reed switch until a certain number of turns is found (by experiment) that will open the contacts when both lamps are working. If either of the lamps should fail, the contacts will remain closed, triggering the thyristor.

Over-rev safety cutout

In the ETI-322 Over-rev Alarm project (March 1980, p.45), it was pointed out that for road use, the alarm should never be used to cut the ignition. However, **N. Pollock of Sandringham, Vic.** points out that many high performance engines used in racing cars and boats have a very small speed margin between maximum power and physical destruction! For such engines, used in competition, it may be desired to have an over-rev ignition cutout to prevent the otherwise very expensive consequences of a missed gear change or a broken propellor shaft.

An ignition cutout cannot simply turn off the low tension supply to the ignition system since this would deprive the cutout of its engine speed information. This problem is easily overcome for a capacitor discharge ignition system

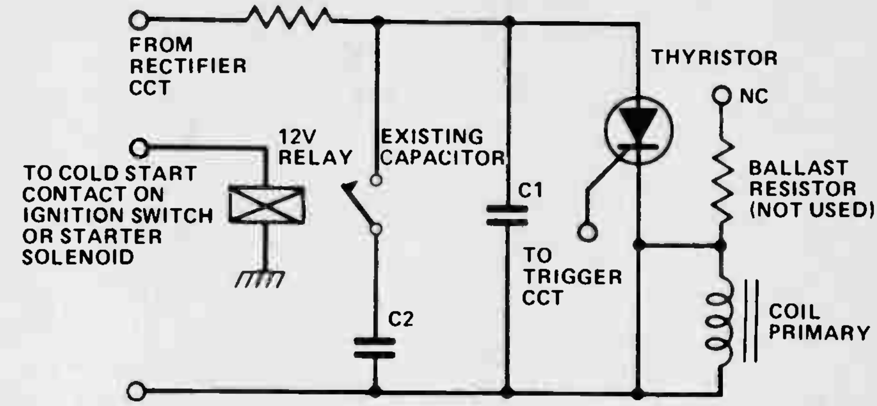


but requires somewhat more work for a conventional system. The following suggestions should assist those wishing to convert the ETI-322 project to a cutout.

For a CDI system (referring to the original article) Q1 can be used to pull the gate of the CDI's SCR to ground, but a germanium transistor (i.e: AC127) should be used so that its c-e voltage hard-on is lower than 0.6 V else the SCR may still trigger. Alternatively, Q1 could drive a relay, the contacts of which short the SCR gate to ground in the CDI. Mount the relay close to the SCR. It is suggested that R7 be reduced to 1k.

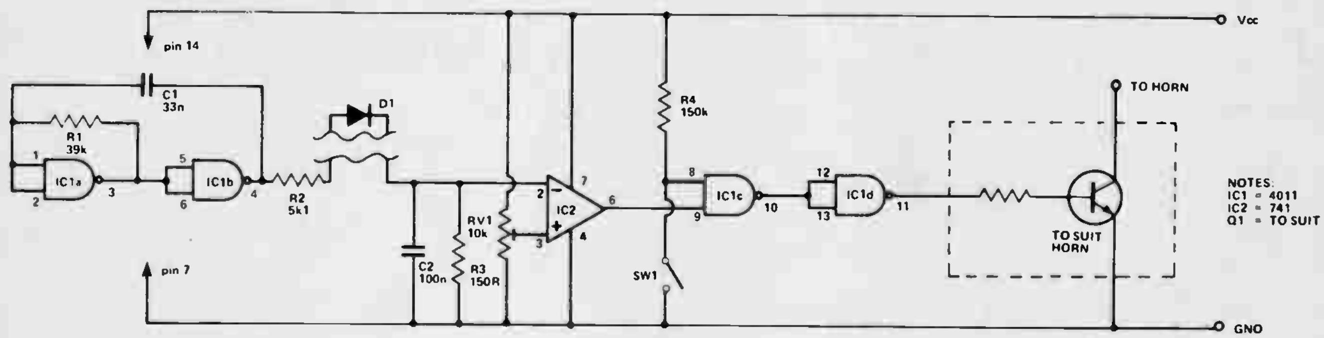
For a conventional ignition system, the circuitry shown here should do the trick. The output stage of IC1 in the ETI-322 alarm is taken via a 500 ohm resistor to the gate of a 2N4172 SCR, shunting the points. The resistor R (4R7, 2W) effectively shunts the points when the engine exceeds the rev limits, and its value must be low enough to prevent spark production, but high enough to leave sufficient signal for the input comparator on the LM2917 in the ETI-322 alarm. It should be noted that a cutout of this type will have some small delay in operation when the engine speed is increasing rapidly. To reduce this delay it is suggested that C4 be removed and C3 reduced in value.

'Cold-start' for CD units



Many cars are fitted with cold-start coils, which operate at full current only on starting, then are fed via a ballast 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 1μ0.



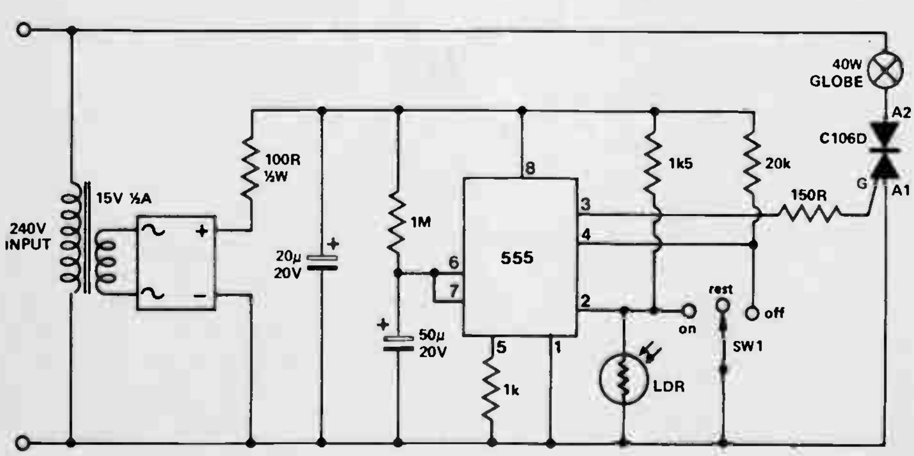
Motorbike protector

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 ½V_{cc} and again the comparator is triggered.

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

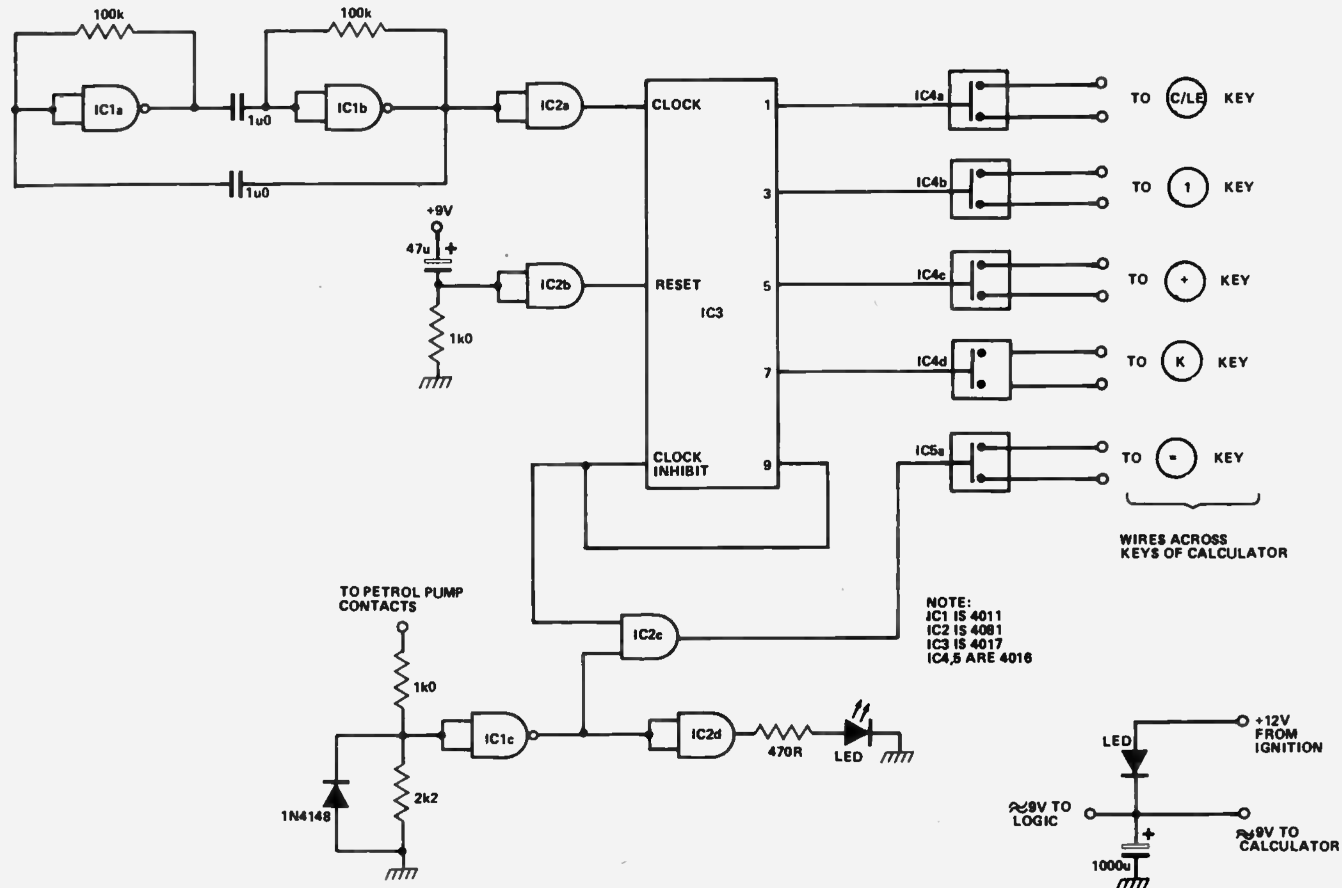


Auto garage light

The circuit here, from Andrew Murn of Clarence Gardens in South Australia, was used to turn on a 40 Watt light in a garage.

The car headlights drop the resistance of the LDR, triggering the 555 timer, turning on the light.

The light can be manually turned on or off by the single pole two position switch SW1. The LDR must be shielded from daylight or it will trigger at sunrise. The time delay for the light to turn off is set by the value of the 47 μF electrolytic capacitor.



Trip petrol meter

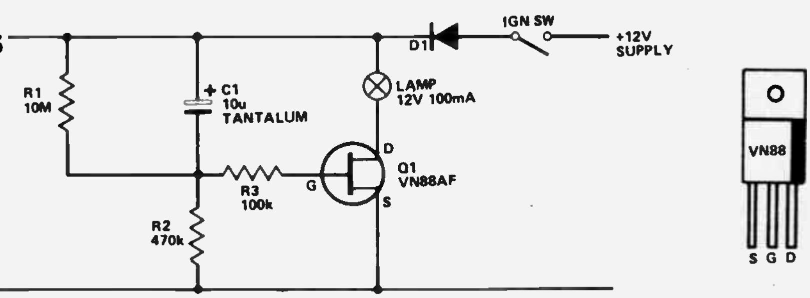
This circuit can be used to measure the amount of fuel used in a single car journey with greater accuracy than that of the standard petrol gauge. The circuit counts the number of pulses of the (electric) petrol pump over the journey, using a converted calculator to give a digital display. Interesting results can be obtained by taking measurements of the same journey whilst varying the route or just the driving style.

Circuit operation depends on the 'junk' calculator chosen — a suitable calculator can be bought for the price of a couple of seven-segment displays alone.

The function of most of the circuitry is to initiate the calculator chip to increment by one on each simulated press of the = key. I used a TI30 machine, so the sequence on power up was; C/CE , 1 , + , K. On power-up the reset pin of the 4017 is held high. As the capacitor charges, the reset pin goes low and the counter counts from zero. As each output goes high the respective switch of the 4016 is enabled, simulating a key press. When the counter reaches '9', the clock is disabled and the pulses from the petrol pump are enabled to switch the = key. Now each time the petrol pump pulses, the displayed value on the calculator is incremented by one. At the end of the journey the displayed value thus reflects the volume of petrol consumed since switch-on.

Seat belt indicator for vehicles

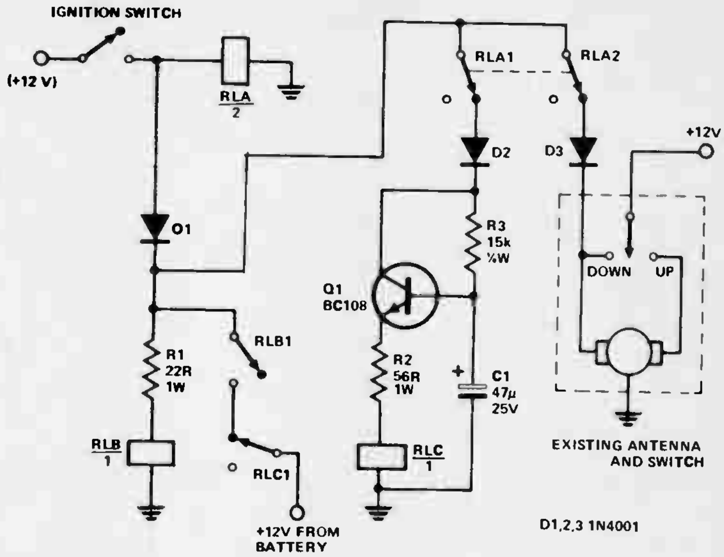
S. Winder

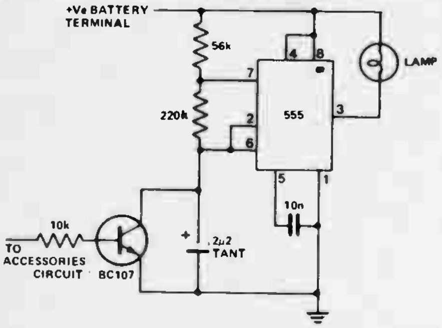


As a reminder to put the seat belt on, a small opaque panel with the inscription "SEAT BELT" can be fitted to the dashboard with a lamp behind, which lights up for ten seconds after the ignition has been turned on. The new VMOS power FET can be used in a very simple circuit to achieve this. The current 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.

Automatic antenna retract

This circuit was designed to retract automatically a motorised car antenna every time the ingnition is turned off. With ignition on, relays A and B are energised (total current drain about 100 mA). When the ignition is turned off, relay A is turned off and 12V from the battery drives the antenna down and charges C1 via R3. With the values shown for C1 and R3, after about a three second delay relay C is energised and interrupts power to relay B, removing supply voltage from the circuit. This circuit suits the two-wire control motorised antennas commonly available and comes from **Ian Hawke of North Richmond, NSW.** The values of R2 and R3 may need to be adjusted to suit different motors as the retraction time varies.

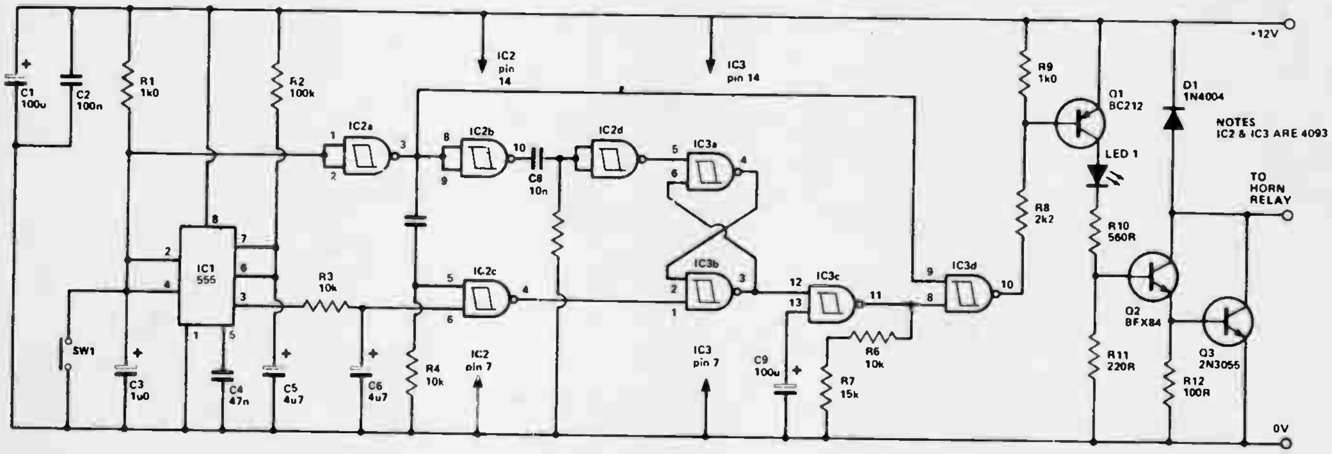




Dummy car alarm

A flashing light on your car dashboard could be an effective deterrent to thieves, leading them to believe that an alarm system lurks behind it.

This circuit, from **Gregory Smith of Meadowbank NSW,** uses a 555 timer (what would we do without them?) to flash a small lamp. When the key is in the ignition and the accessories circuit is completed, the BC107 conducts and the 555 is inactivated. As soon as the accessories circuit is opened (by removing the ignition key), the transistor is cut off and the 555 activated. So the dummy alarm is set every time you leave the car.



Car horn repeater

I. Hopkins

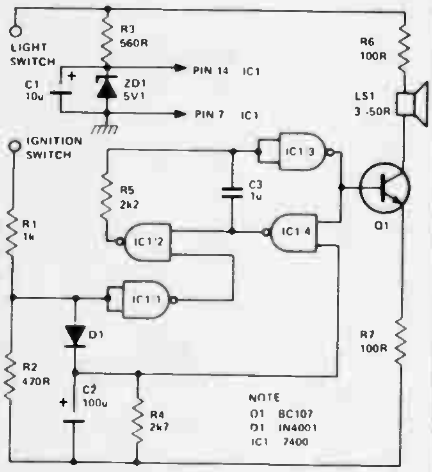
This circuit allows the horn to sound either continuously or repetitively while the horn switch is pressed. The second option is activated by pressing the horn button twice in quick sucession.

When SW1 is pressed initially, gates IC2a and IC3d propagate the signal, turning on transistors Q1 -Q3 and sounding the horn in the conventional manner. Releasing SW1 triggers the monostable IC1 (a 555 timer). If SW1 is pressed again while IC1 is active, flip-flop IC3a/b is set, enabling oscillator IC3c and causing the horn to operate intermittently as long as the switch is closed.

LED 1 is optional and monitors the operation of the horn — very useful during testing. The oscillator frequency can be varied by altering C9, while the monostable period is adjusted using R2 and C5. C3 and C6 suppress the effects of switch bounce and R7 sets the mark/space ratio of the oscillator to approx 3:1.

Car lights reminder

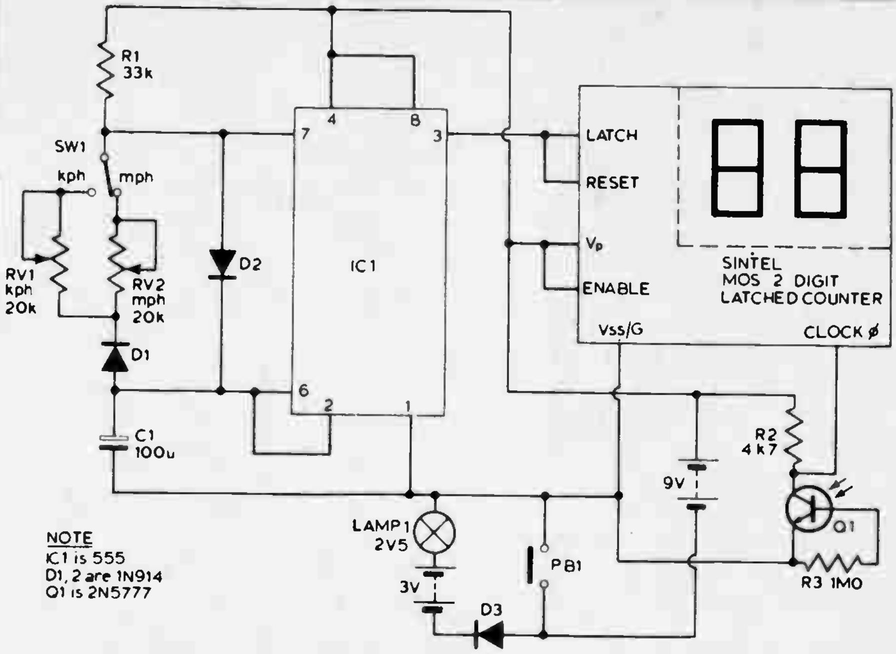
Many circuits to warn motorists that they have left their headlights on after switching the engine off have appeared in the past. I feel this circuit is an improvement over many of these in that it requires no switches, and it is only necessary to make three connections to the car's electrical system.



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.



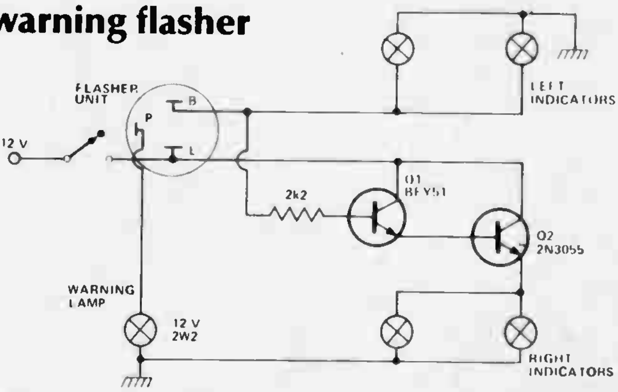
Digital bike speed

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.

The 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.

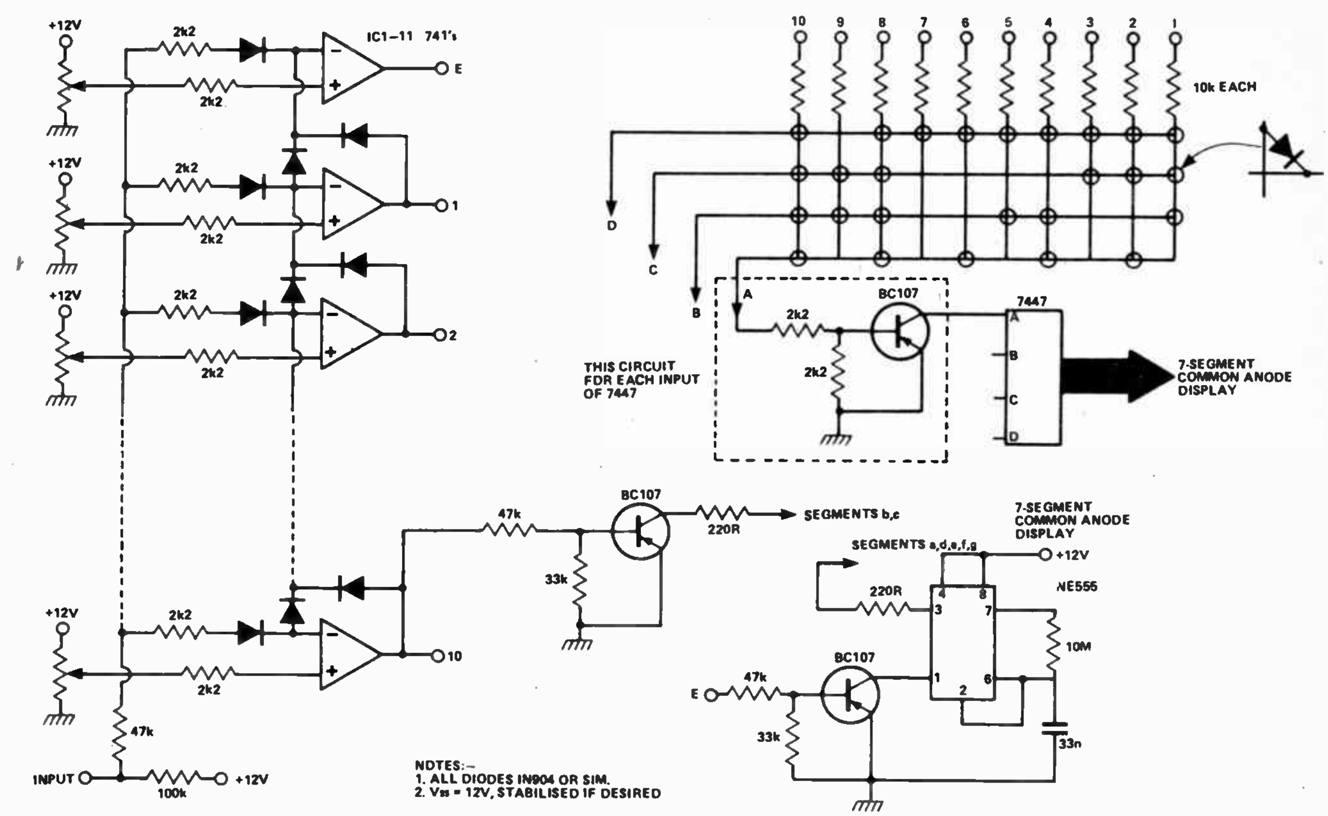
Hazard warning flasher



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 (i.e. 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 alluminium 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.



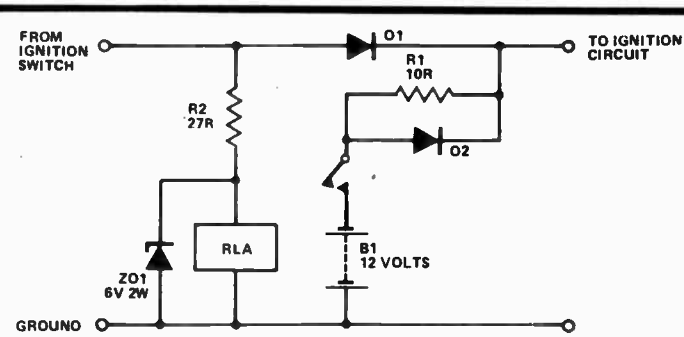
10 Gallon digital fuel gauge B. R. H. King

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.

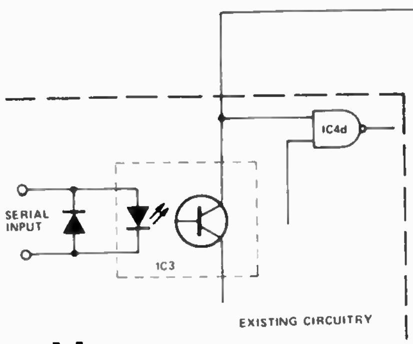
The input is the voltage across the fuel-tank 'sender' which typically rises from zero at full tank, to about 5V when empty. As the voltage falls, the higher-numbered 741 comes on, extinguishing all the lower-numbered ones via the diode network. The outputs are fed to a decimal-to-BCD encoder (two pieces 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 trial-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 by gallon and adjusting the 10 k presets. The prototype works very satisfactorily.

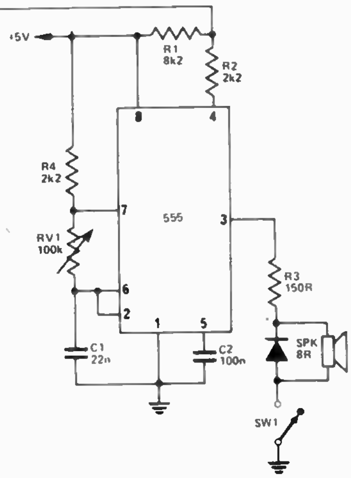
Cold start ignition

M. C. Polgreen



The heart of the circuit is a small auxiliary battery with a capacity of one or two amp hours. If a nickel cadmium battery is used then R1 should be increased in value so that the maximum trickle charge current is not exceeded. R2, ZD1, and RLA connect B1 into circuit when the ignition is switched on, thereby reducing the amount of additional wiring. Any small 6 volt relay with a contact rating of 5 amps will do, and ZD1, R2 ensure that the relay will remain energised when the starter motor causes the main battery voltage to drop. When the main battery voltage falls, D1 becomes reverse biased and D2 forward biased, therefore allowing B1 to supply current to the ignition circuit. When the engine is running, the main battery voltage rises, forward biases D1 and reverse biases D2. Therefore the ignition current comes from the main battery, and B1 is trickle charged via R1. The two diodes D1, D2 should be rated at 50 V, 10 A.





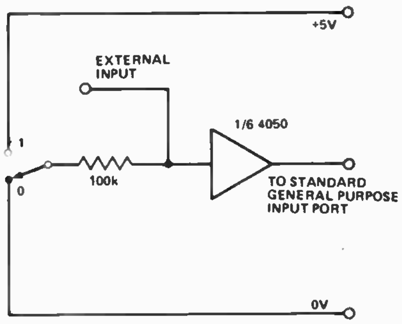
VDU bleeper

When using the ETI 630/631/632 VDU, one problem I've come across is it's totally silent operation! Being used to a teletype (which is far from silent), I find that when entering lists of numbers, for instance, it is necessary for me to keep looking at the screen for the processor's 'prompts'. To alleviate this problem, the following circuit modification will produce audible 'bleeps' whenever characters are received from the processor.

The operation of the circuit is fairly straightforward, the reset pin of the 555 being used to gate its oscillation. RV1 sets the frequency (which is largely a matter of personal preferrence) and the switch allows the bleeper to be switched off when dumping onto tape.

External input for micros

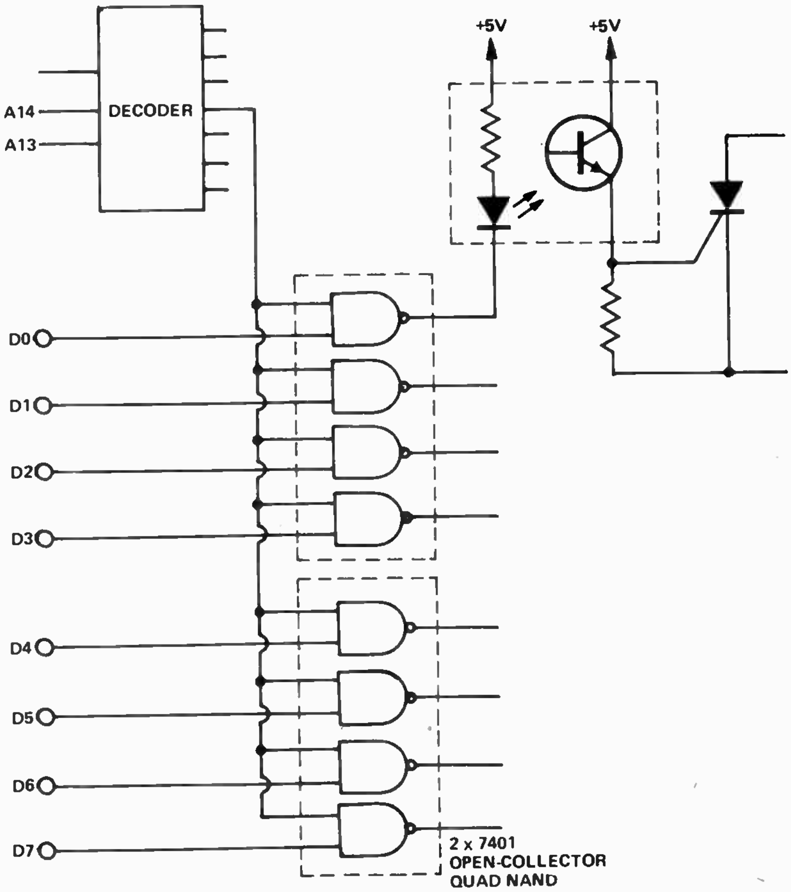
This simple circuit provides a micro with an 8 bit switch/external signal input port. The state of the switches controls the byte read by the micro, but any totem pole TTL signal applied to the external input socket over-rides the signal from the corresponding switch. The value of the resistor is not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

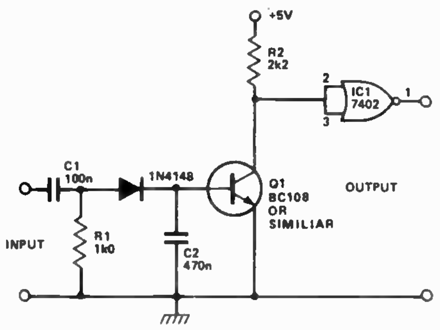


Cheap micro output

In simple systems were little or no output bus buffering is needed, users may shy away from using standard TTL due to the drive requirements this places on the μP chip. Where unlatched outputs are acceptable, buffers are often used if standard TTL is to be driven. This is not always necessary.

Looking at the diagram, it *appears* that the micro will have to pull down one TTL load per gate and so many TTL loads if several of these ports are used. This is not so, due to the nature of the input to the gate — once one input is low, only a few μA are required to drive the other and so the bus loading is negligible. Of course, the enable line still needs to be driven from a TTL output but as this is usually derived from a decoder, it should prove no problem.





Simple cassette interface

R Thomas, Port Talbot

The cassette interface on my NASCOM1 has never worked correctly and despite many frustrating fault finding sessions the only solution was to replace it. No originality is claimed for this circuit. Indeed anyone with a basic knowledge of electronics or radio will recognise part of it as an envelope detector or demodulator. No alteration of the cassette output of the NASCOM is required assuming it dumps properly. Take the output of the 7402 to the serial input link LK3.

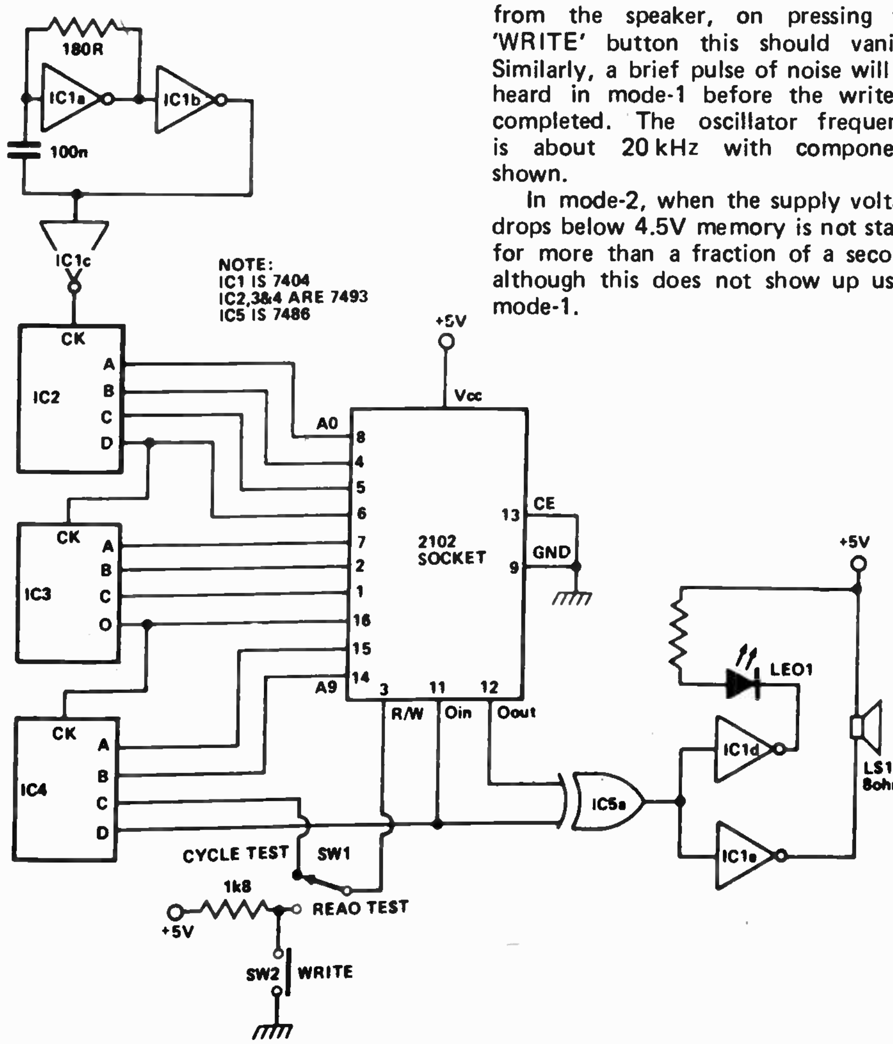
Component values are not that critical and by inserting another resistor and capacitor of the same value in front of C1 and R1 the response will be improved, although I did not find these necessary. The interface does require a fairly large input signal and the volume setting is rather precise but once set the interface should work perfectly. Although built for the NASCOM, the interface will work with any low speed cassette interface system that switches an audio frequency on or off.

2102 memory tester

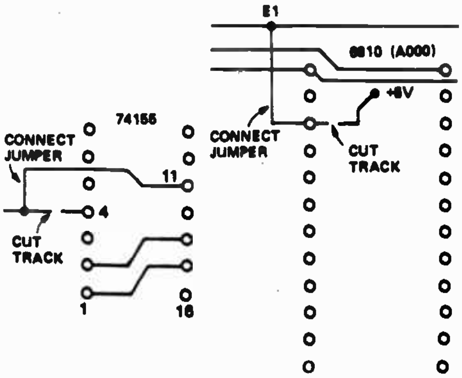
This circuit provides for the testing of 1024 bit X 1 memories, such as the 2102 series, in two modes. Mode-1 cycles the memory continuously through write and read, alternately writing zeroes and ones then reading to ensure the write was successful. Mode-2 allows the write of a signal onto the memory, 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 hearc 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.



D2 kit modification



When using the Motorola D2 kit with external RAM located at 0000, the 512 bytes of RAM supplied with the kit is 'overlayed' by the external chips. This means that the user has 'lost' his 512 bytes.

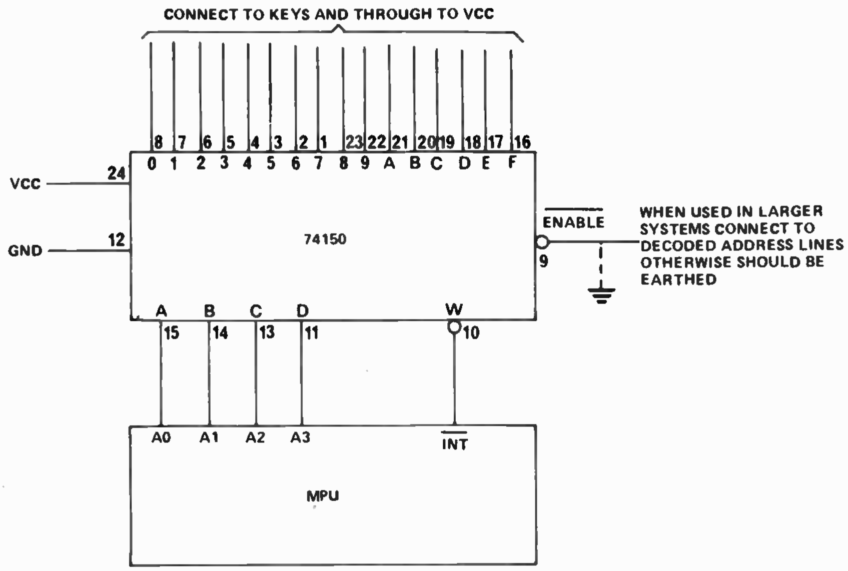
Allen Bruce of Millfield thought that this was a bit of waste (excuse the pun — Ed) and decided to do something about it. He has effectively moved the on-board RAM so that is starts at A000, allowing the use of all the RAM in the system.

The modifications are as follows:

Cut the track from the MC74155 at pin 4. This is the 'not RAM' signal going to the four RAM sockets. Connect a piece of wire between pin 11 of the 74155 and the track going away to the four RAM sockets.

Pin 10 of A000 RAM is connected to +5V. Cut this track and take pin 10 to address line 9. The best place to connect this is at the place where "E1" is marked on the top side of the board.

Simple software-controlled keyboard encoder



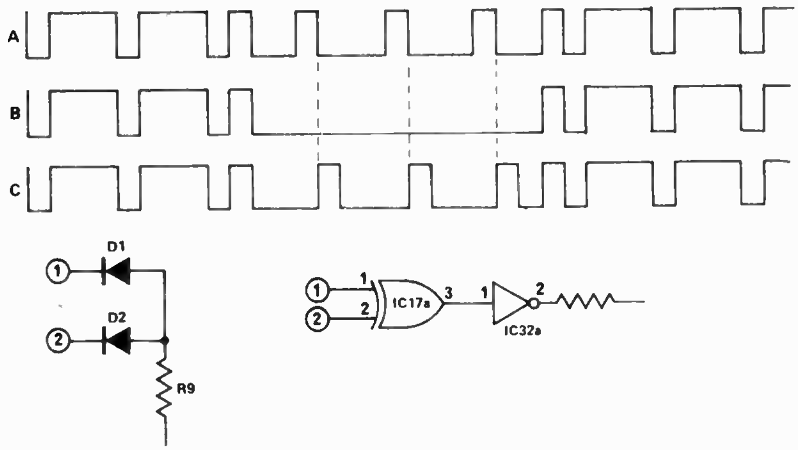
This circuit, sent in by **J. Hardy** from Cheltenham in Victoria is suitable for encoding hexadecimal and can be adapted for baudot or even ASCII. The encoder is based on an inexpensive 74150 16:1 line multiplexer which is connected to the MPU address lines and is controlled by a simple program which could reside in the microcomputer ROM or RAM.

The MPU utilizes an internal 16-bit data counter to address the multiplexer and is incremented if no response is received. The address is cycled through over and over until an interrupt is received from the keyboard. This indicates that a key has been pressed and that the address in the MPU data counter is the binary equivalent for that key (least significant bits).

The interrupt service routine could transfer the four least significant bits of the data counter to the user program area and then loop back to collect the next keypressings.

The encoder can also be adapted to longer codes by using more multiplexers, 16 lines each and using more address lines to enable each multiplexer one at a time (i.e. short form ASCII-6 bits can be encoded by four multiplexers, four lines address all multiplexers and the other two lines select only out of four multiplexers to be enabled).

Improved sync for the 640 VDU



Having spent some time getting his 640 VDU to produce sync which his modified TV would lock on, **Mark Johnson** of Wahroonga in Sydney, sent us this remarkably simple modification. This change will improve the stability of the display, particularly on the first lines following the vertical retrace.

True composite television sync has horizontal sync pulses during the vertical retrace. A *simplified* TV sync pulse waveform is shown in A in the diagram here, compared to the original 640 VDU sync in B and the sync produced by this modification in C.

The simple sync pulses generated by the 640 VDU are often not adequate to drive modified TVs which many 640 owners may be using. Whilst the sync pulses produced by this modification are not ideal, life is made a little easier for the TV's horizontal oscillator during retrace (or just after!).

The changes are simple. The diode OR gate, D1 and D2, is replaced by an exclusive -OR gate, followed by an inverter. As both the ex-OR and the inverter are available spare in packages on the VDU board, this modification can be made without extra parts or cost!

Diodes D1 and D2 are removed and their cathode pads connected to the inputs of the ex-OR (in IC17) by flying leads. The output of the ex-OR (pin 3, IC17) is linked to the inverter (in IC32) input, the inverter output being returned to the anode pads of D1 and D2.

In normal TV sync, horizontal sync pulses are transmitted during the vertical sync period, allowing continued phase lock of the horizontal oscillator. The ex-OR approximates this characteristic allowing horizontal sync pulses during the vertical retrace. While not ideal, this modification enables quicker phase lock after the retrace, stabilizing the first few lines.

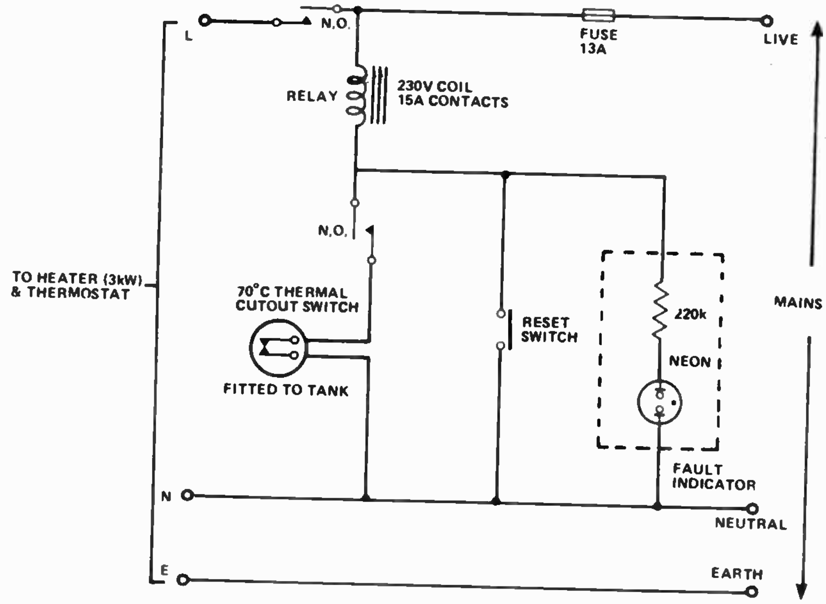
At the same time, without the diode voltage drops, the overall sync magnitude available is a little greater, generally resulting in better locking.

Immersion heater protector

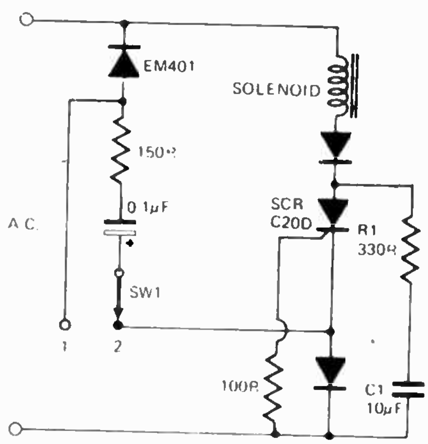
K. Cooper

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.



Impulse power

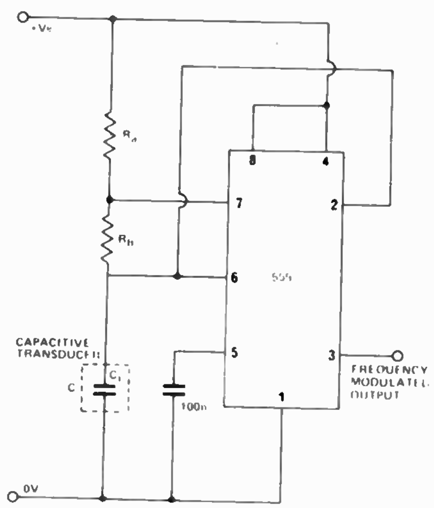


This circuit is often used in electrically powered stapling machines, impulse hammers etc. and causes load current to flow through the load for one complete half-cycle of the ac supply whenever SW1 is actuated (i.e. moved from its normal position [1] to energise-load position [2]). The circuit is arranged so that the SCR is always triggered at the beginning of a positive half-cycle of the ac supply, even though the switch may be closed randomly at any time during the previous two preceding half-cycles.

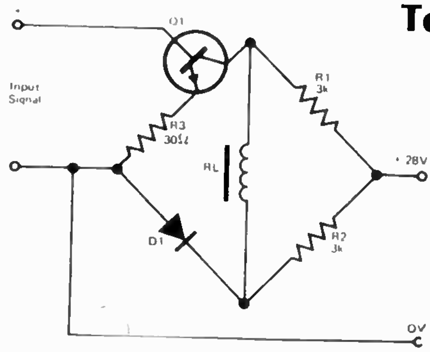
Low cost transducer amplifier

Capacitative transducers 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 analog output voltage proportional to the capacitance of the transducer.

The 555 module is connected with the transducer 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.



Temperature stabilized relay



Accurate relay trip-point operation can be obtained over an ambient temperature range from −50°C to +90°C using this simple circuit.

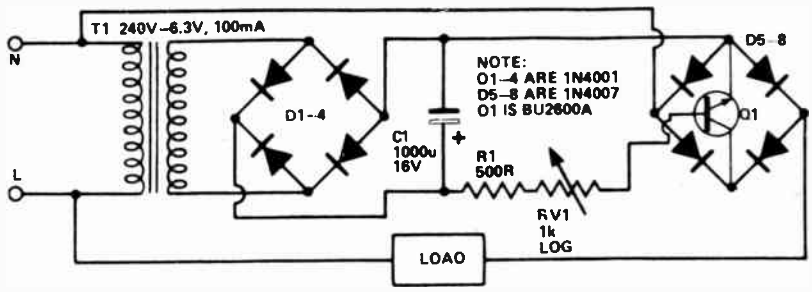
The temperature sensitivity of the silicon transistor Q1 is balanced out by the silicon diode D1. Gain/temperature stabilization may be obtained if required by using a positive temperature coefficient resistor for R3.

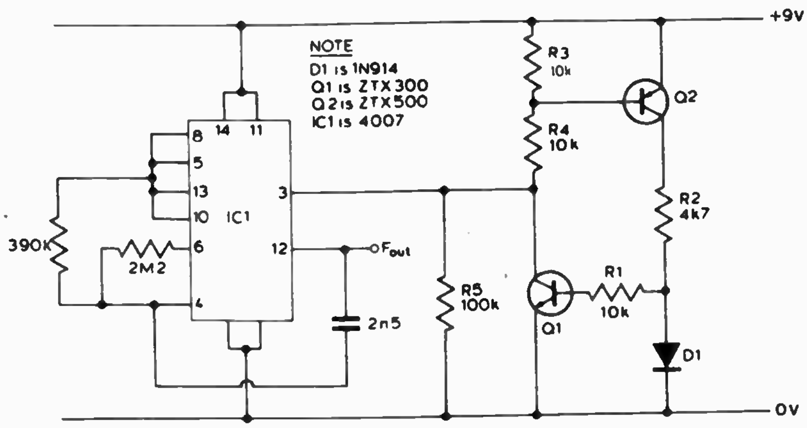
Speed controller

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).



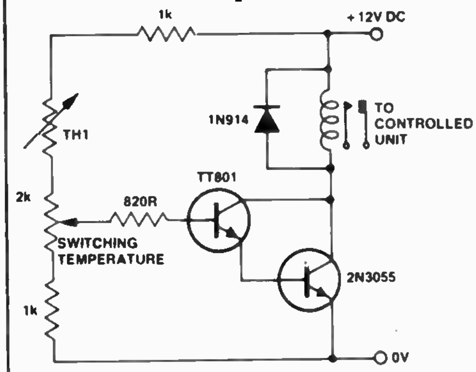


Temperature to frequency converter

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 reasonable 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 3 HzC^{-1} (between 0 C and 60 C) giving a frequency of 470 Hz at 0 C.

Variable temp. controller



This thermostat circuit, from **P. Schoenwald of Doonside NSW,** employs the pull-in current of a relay to determine the trip point, the trip temperature being set via a potentiometer. The sensor is a common thermistor.

The thermistor is part of the bias circuit for a super gain Darlington pair using a TT801 and 2N3055. When the voltage on the wiper of the potentiometer exceeds about 1.2 volts, the two transistors will be biased on. When the bias current increases, determined by the decrease in resistance of TH1 and the setting of the potentiometer, the 2N3055 collector current will exceed the relay pull-in current at a particular temperature and the relay will operate. At a temperature lower than this point, the bias current to the Darlington pair will decrease such that the collector current will fall below the relay hold-in current and the relay will return to the non-operated condition.

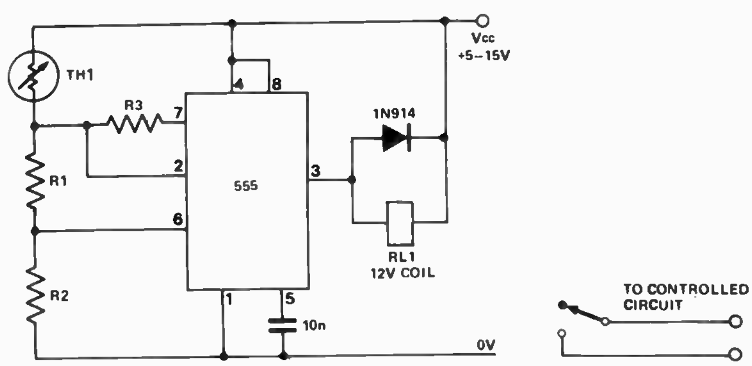
The switching temperature is determined by the exact range of resistance variation with temperature of TH1 and the setting of the 2k potentiometer.

The 2N3055 may need a small heatsink depending on the relay used. TH1 should be mounted remote to the circuit such that it measures the temperature of the controlled unit.

Electronic thermostat

Yet another idea for a 555. This circuit, **from Benjamin Simons of Beecroft, NSW,** uses a 555 timer IC to switch a relay when the temperature on a thermistor reaches a preset upper level and turn it off when the temperature reaches a preset lower level. The on and off states are determined by the values of R1, R2 and R3 and on the resistance of the thermistor. You'll have to experiment to find them.

Mr Simons suggests the circuit may be used to control a ventilator, fan or chemical bath.

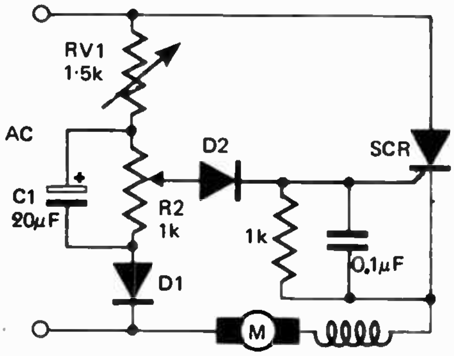


Half-wave control

One of the most common applications for SCR phase control systems is speed control of commutator motors – such as those used for food mixers, sewing machines, pottery wheels etc.

However one of the disadvantages of controlling motor speed by varying input power is that as the effective power input is reduced to slow down the motor – the torque available is reduced as well.

This may be overcome by using a feedback signal to advance the firing angle in proportion to the load on the motor – thus increasing the power input if more torque is required.



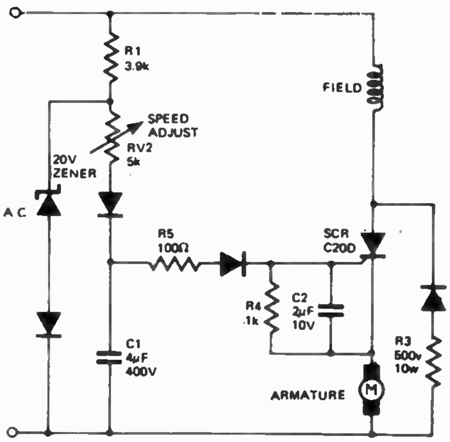
The circuit shown (right) achieves this load compensating function by deriving a feedback signal from the armature back-emf (produced by the residual field of the motor). In this circuit, the SCR is triggered when the voltage on the wiper arm of potentiometer R2 rises to a high enough value to forward bias diode D2 – thus allowing gate current to flow. As the back emf tends to reverse bias D2, the firing point of the SCR depends largely upon the back emf and this in turn is a function of speed. If the motor is loaded, the speed reduces, thus also reducing the back emf – hence D2 becomes forward biased earlier in the cycle (triggering the SCR earlier in the cycle), and thereby supplying the motor with more power to offset the effect of the loading.

The component values shown are suitable for most fractional horse-power motors – for optimum results it will be necessary to adjust component values to suit the motor used.

The circuit described above will provide stepless speed control over a wide range of motor speed – but tends to cause jerky operation at low speeds.

Improved half-wave

As may be seen from the circuit diagram it is necessary to bring out separate connections from the armature and field windings. This is generally a simple operation and providing it can be done the circuit will provide stepless speed control down to virtual standstill. In this circuit the 20 V zener diode provides a constant voltage for the discharge of C1. Capacitor C2 and resistor R4 are connected from gate to cathode of the SCR to stabilize the circuit by preventing the SCR from being triggered by extraneous signals.



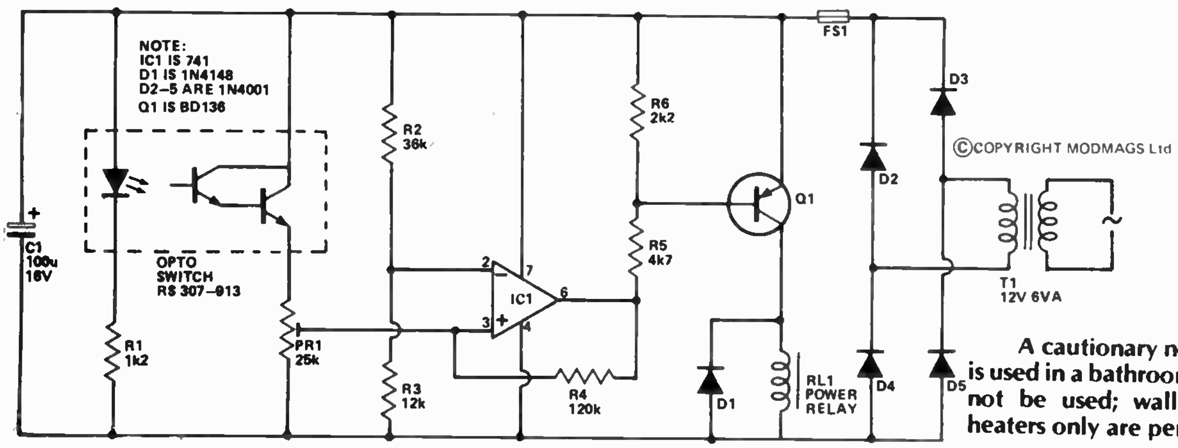
Condensation detector

T.M.H. Jenvey, Langport.

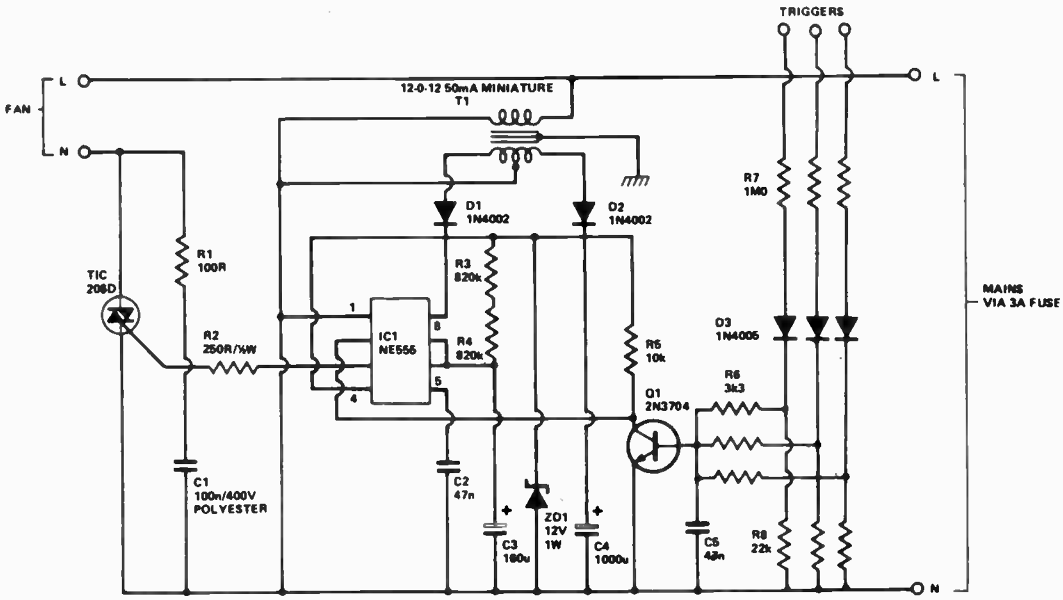
This circuit was designed to prevent condensation on a glider when stored in its trailer, by switching on a fan heater as soon as condensation occurs and off again when the condensation has evaporated, but it is equally applicable to kitchens, bathrooms or anywhere with a condensation problem.

The detector is built around an RS307-913 reflective opto-switch. This consists of an infra-red diode and a photo Darlington transistor in one package arranged so that when a reflector is placed close to the switch (optimum distance 4.6 mm) the photo Darlington is turned on. In this device the reflector is a small piece of highly polished stainless steel, the reflectivity of which is reduced when misted by condensation, thus switching the heater on.

A reference voltage of about 4 V is applied to the inverting input of the 741 op amp from the voltage divider R2 and R3. The voltage at the non-inverting input can swing either side of the reference voltage depending upon the conduction state of the photo Darlington and the setting of the sensitivity control, PR1. Positive feedback is obtained via R4, providing Schmitt trigger action to prevent relay chatter at the changeover point. The rest of the circuit is straightforward, but ensure that the relay is adequately rated.



A cautionary note – if the device is used in a bathroom a fan heater must not be used; wall mounted radiant heaters only are permissible.



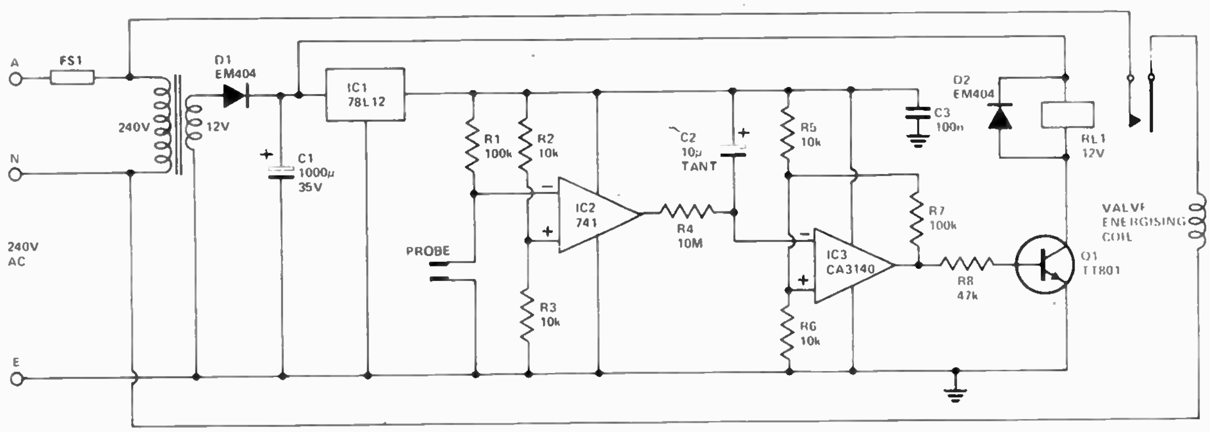
Extractor fan controller

B. Carrol, Aldershot

This timer is useful for controlling a bathroom extractor fan, if your family forgets to use it or leaves it running indefinitely. The trigger or triggers are connected to the live side of one or more lights, which, when switched on, cause Q1 to conduct and trigger IC1. This is a monostable which gives a pulse period of about four minutes and its output gates the triac so that the fan runs. R1, C1 protect the triac against reswitching; C2, C5 protect against mains transients.

If the light is still on at the end of the timing period, the IC is retriggered, but, because C3 has not been fully discharged, the next pulse is less than four minutes. Thus, the fan runs for four minutes or the period the bathroom light is on plus two minutes, whichever is greater.

Note: Careful insulation of the PCB from the case is necessary.



Electronic ballcock

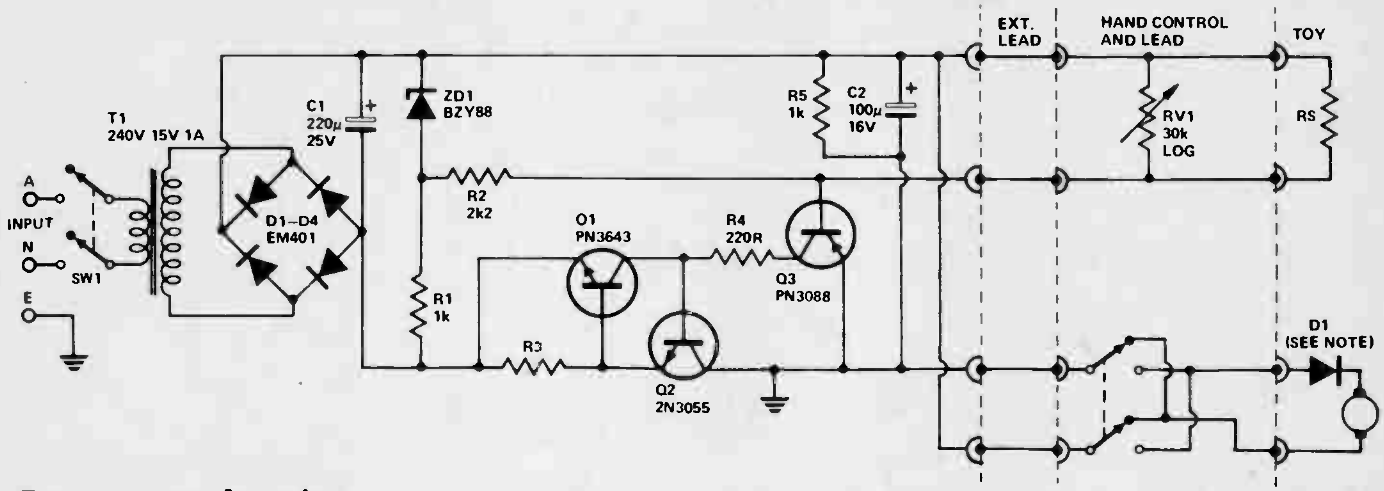
After fitting a filter system to his pool, **Clifford Heath** of Camberwell found that the pump had to be re-primed every time the water level dropped due to evaporation.

This circuit detects low water level in a swimming pool and switches the water supply on for about 20 seconds when it occurs.

The inverting input of IC2 is held low by a short across the probe (which can simply be a couple of bolts through the side of a fibreglass pool). When the water level is low the probe will go open circuit and the output of IC2 will go low. C2 will begin to charge and after about 2 minutes, the output of IC3 will change state. This 2 minute delay is to prevent waves from setting the device off prematurely.

Once triggered, IC3 (which is connected as a Schmidt trigger) will give a high output voltage for at least 20 seconds – this is the length of time needed for IC2 to change the inverting input voltage of IC3 past it hysteresis point.

While the output of IC3 is high, Q1 will turn on and energise the water supply valve coil. Care should be taken with the valve mains supply – it's a good idea to put the end of the water supply hose into the pool. This will remove the possibility of mains-voltage water falling into the pool due to a short inside the valve.



Power supply suits battery-operated toys

Here is a power supply for toys such as race tracks, cars, Meccano motors etc. modified from the ETI 221 Basic power supply.

The power supply components are fitted inside a metal box with the 2N3055 in contact with the case. R6 is a hand-made wire resistor adjusted to get one amp output current with the output shorted. A small four pin socket is mounted on the case for the output.

A four core extension lead is made to go between the power supply and the toys, with plugs on both ends.

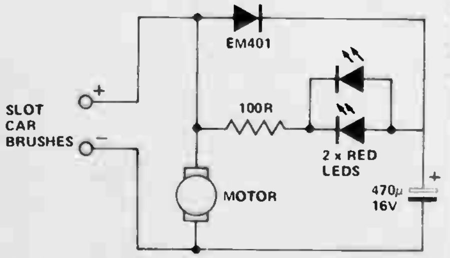
A four pin socket is fitted to each toy so that one extension lead is sufficient for all toys. Resistor RS is fitted to this socket to set the correct voltage. RS is 1k for 3 volts, 1.8k for 4.5 volts, 3k for 6 volts and 10k for 9 volts.

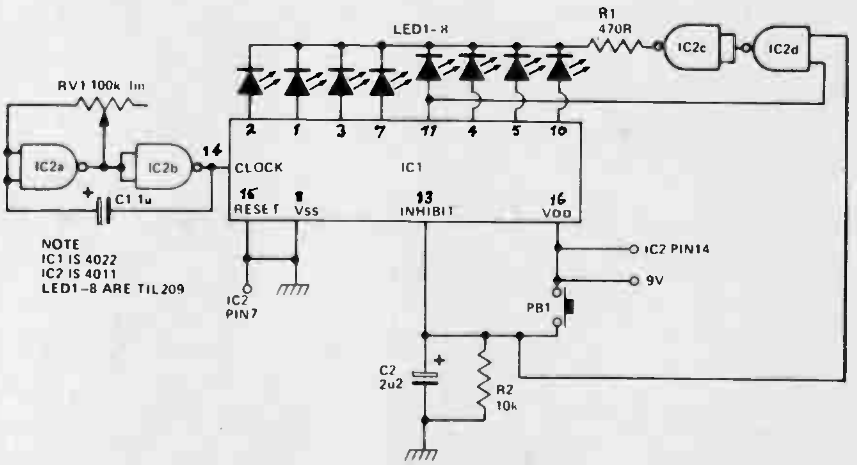
For cars with no speed or direction control a hand control unit goes between the extension lead and the cars. Control is by a 30 k log pot and a double pole change over switch fitted in a tobacco tin.

Diode D5 is fitted only to toys that must not go in reverse.

Slot car brake lights

A novel circuit for all you modellers. P. Ruse of Ferntree Gully has added some realism to his slot cars by building this little circuit into them. When the voltage on the track reduces, the LEDs light up. Neat and simple. Unfortunately, this circuit is not applicable to model railways as trains don't have brake lights.





Pot shot

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.

Proper identification for T.V. game chip

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.

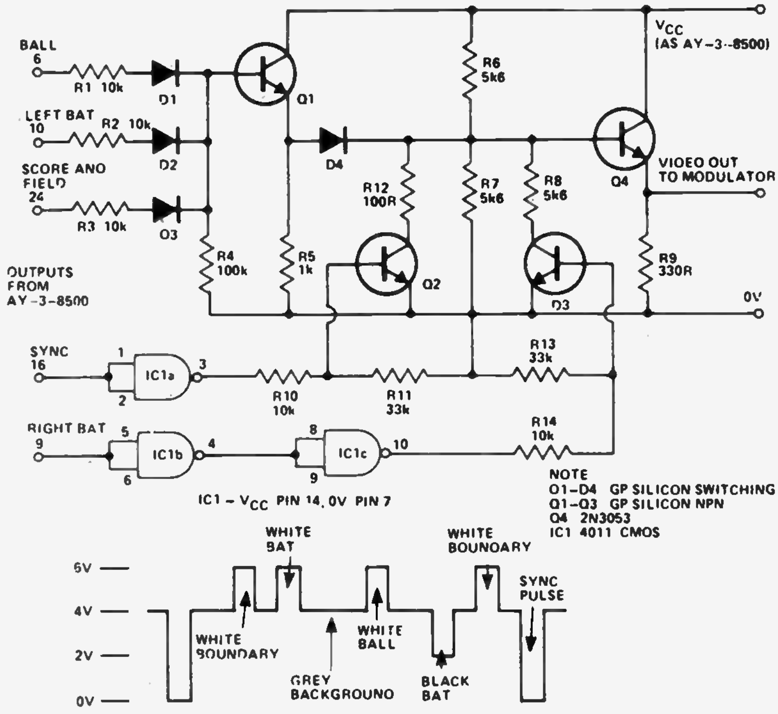
The modifications are shown below. The output on Q2 emitter spends the majority of the time at a "grey" level, and this "grey" voltage is defined at the junction of R6 and R7.

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.

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.



WAVEFORMS (LINE SCAN)

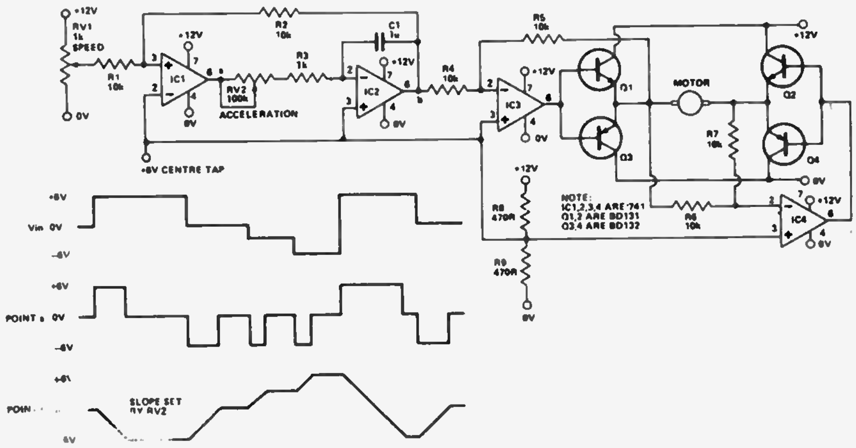
Controller for model trains

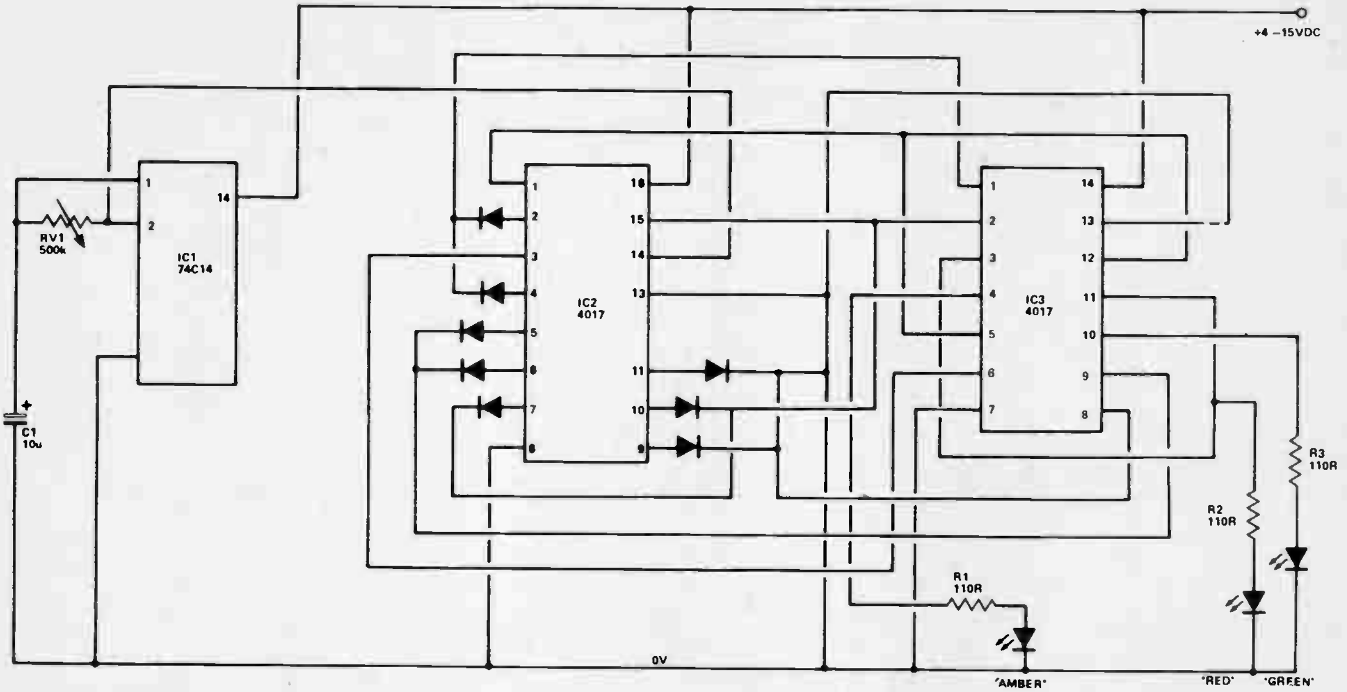
Most model railway controllers have the unfortunate characteristics of giving instant starts and stops to the train which would be very unnerving for the model passengers. The circuit described gives a steady acceleration or deceleration on speed changes, and the speed and acceleration controls do not 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 6 V 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 than equal to or more negative that the output voltage set by RV1. The output voltages 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.





Traffic light controller

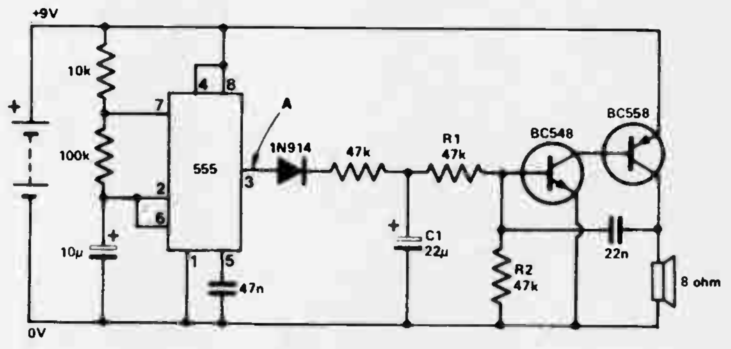
Michael Miller

This circuit is relatively simple and gives a realistic timing sequence. IC1 sets the timing clock pulse and can be adjusted by RV1. IC2 is a decade counter, whose output pulses are mainly fed through diode buffers (any small cheap diodes will do), to IC3, a quad OR gate, which sorts the consecutive decade pulses into three groups, monitored by the three coloured LEDs.

To couple this circuit to a similar one, for the other intersection of the crossroads, the pulse from pin 1 of IC2 should be taken to pin 15 of the IC2 of the other circuit. This second circuit should have pin 15 biased to 0V via a 100 k resistor. When the first circuit is showing red, the second circuit will be showing green.

Supply protector

For those expensive (computer) boards, place a 1W (or bigger) zener diode across each supply rail, with a voltage rating 1–2V above the rail voltage. A 6.2 V one will be ideal for a 5 volt rail, for example. It doesn't cost much and when you drop the 50 V supply leads across the 5 V rail (accidentally), the zener will protect the circuit and in the case of gross overload will go short (usually). You blow a 50c zener instead of $50 of ICs.

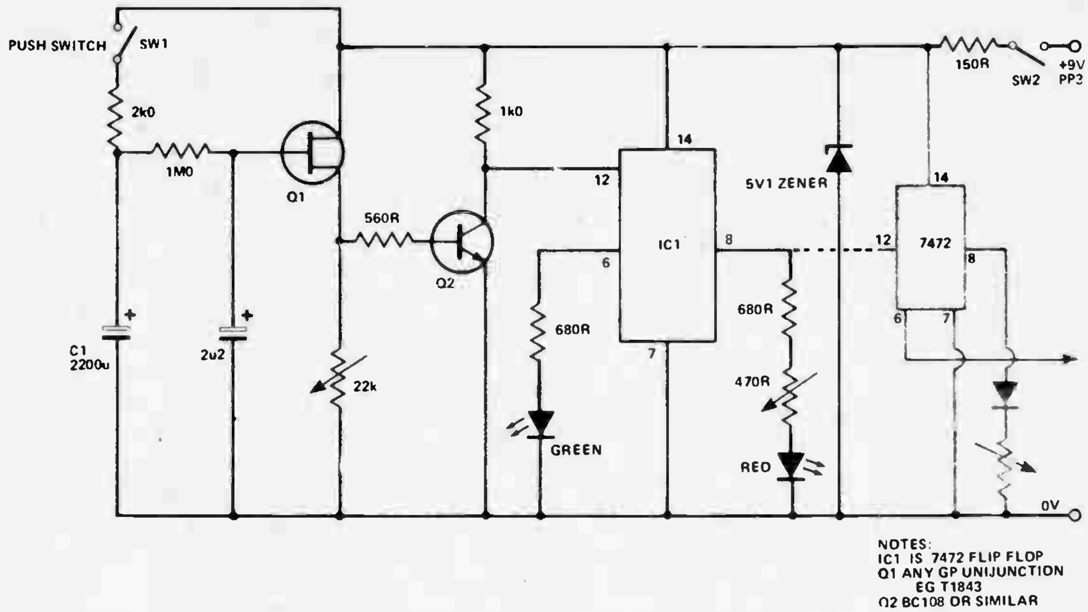


Siren circuit

This circuit simulates the sound of an American police car. Just the thing to stimulate a child's ebbing enthusiasm for an expensive Christmas present!

The 555 timer is used as a very low frequency oscillator giving regular charges to the 22u capacitor, C1. The capacitor discharges through R1 and R2 until the next pulse comes from the 555. The changing voltage on the base of the first transistor changes the frequency of the oscillator, rising quickly in frequency and falling slowly.

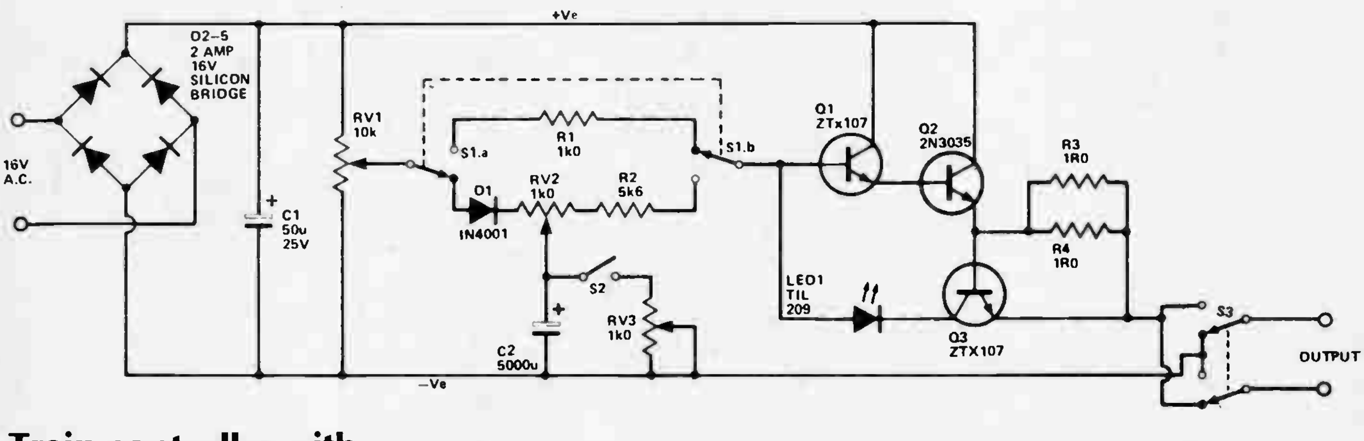
Flashing LEDs can be added with a current limiting resistor at the point marked 'A'. Submitted by **David Brighton of Huonville, Tasmania.**



Heads or tails

Steven Snook

This circuit differs from previous Heads or Tails circuits in that when the switch is released 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.



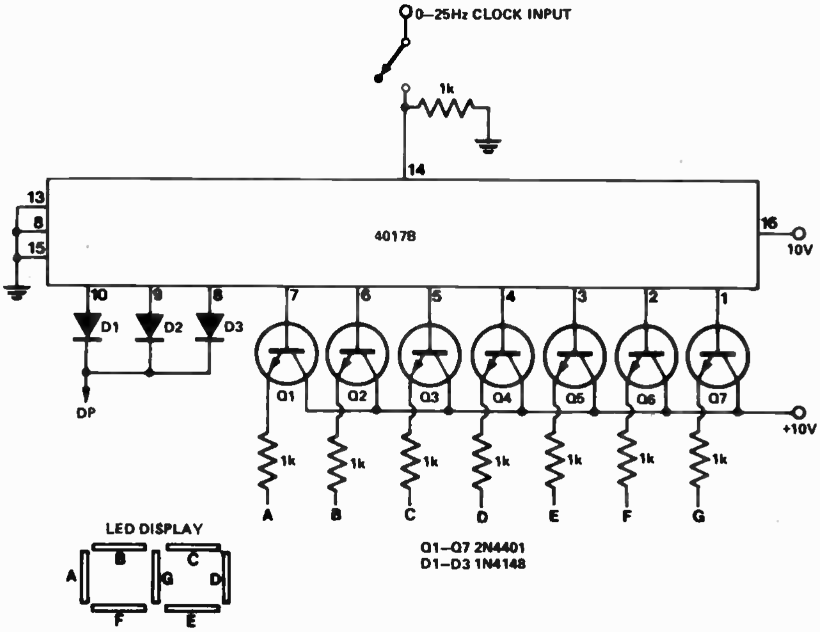
Train controller with inertia and brake

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, D2 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.

Electronic casino

This is a game of chance which can be played by up to seven players. The decimal point has three connections which gives the house a three out of ten chance of taking all bets. The clock is set at a frequency which gives a rapidly flickering display. When a player holds down a key for a few seconds and releases it the display stops and a number or point is displayed. The odds are on the point. Submitted by Keith Bennet and Peter White of Burwood, Victoria.



Channel splitter for radio control

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 MC 1310P 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.

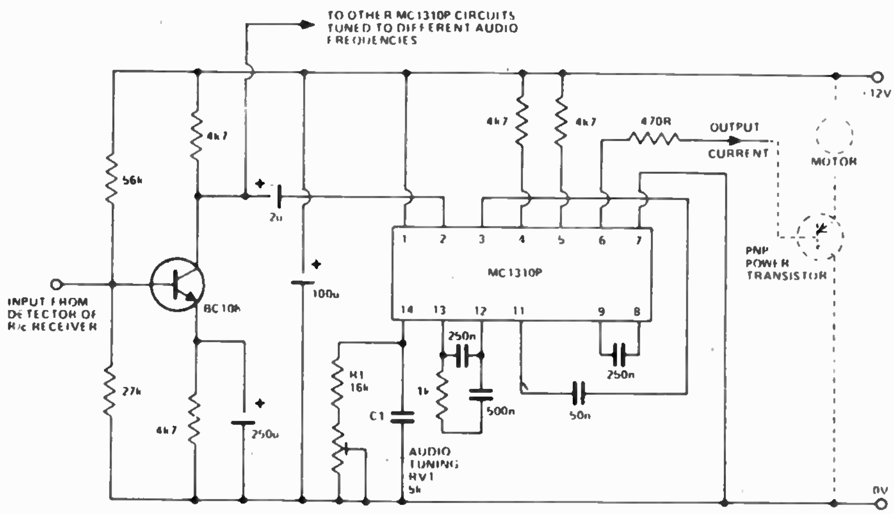
The audio frequency to which the channel-splitter responds is determined by the tuning circuit R1, VR1 and C1, and is given by the formula:–

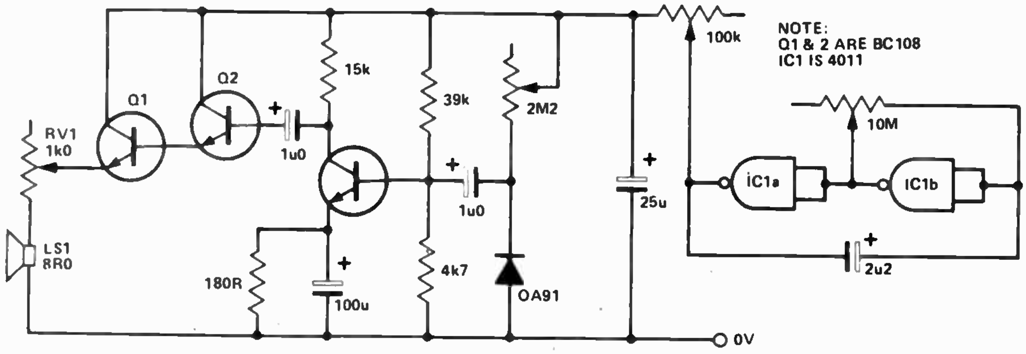
$$f = \frac{1}{2\pi \quad C1\,(R1 + RV1)}\ \text{Hz}$$

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 MC1310P 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.





Train chuffer

C.S. Histed, Chislehurst

This circuit will produce a 'train chuffing' noise and might prove interesting to anybody with their own train layout.

The circuit consists of a white noise generator, which only switches on with the 'high' part of the square wave output from the clock circuit. The frequency of the clock is adjusted with the 10M pot and the output voltage of the clock is adjusted by the 100k pot (these pots control the rate of chuff and the volume of the chuff).

The 2M2 pot controls the amount of noise produced and the 1k pot on the speaker controls the pitch of the average noise.

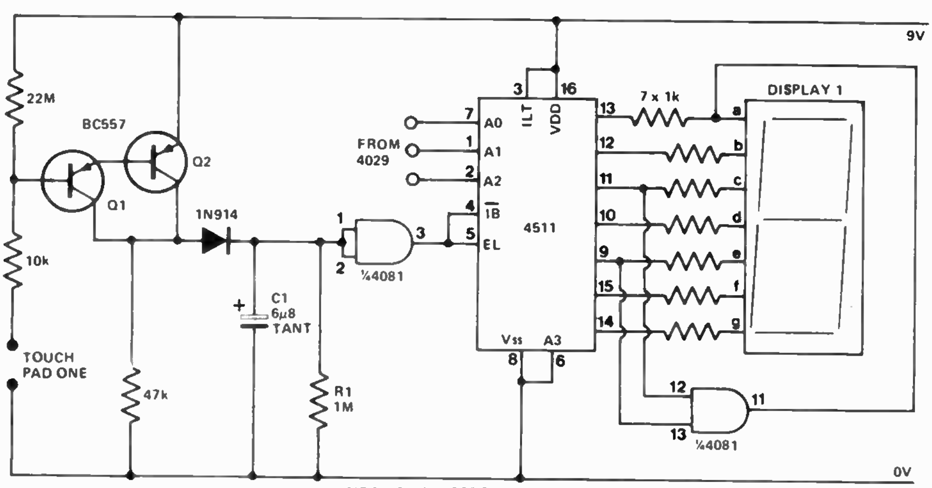
The circuit works by amplifying the amount of noise let through by the seemingly wrong way round diode and only letting the circuit be 'on' when the output of the clock is at logic 1.

Dual digital dice

Two identical seven-segment display driver circuits, driven from a common counter circuit, provide the numerals for this dice devised by **Russell Sharp of Belmont, Victoria.**

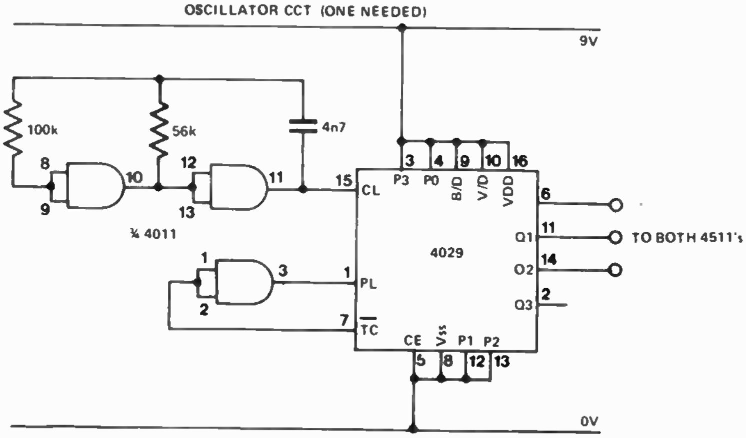
The counter is driven from a 2 kHz oscillator, the 4011, and generates a count sequence from 1001 to 1110. The terminal count (low on output 1111) is inverted to load 1001 into the parallel input of the 4029. When your finger is pressed on the touch pad the collectors of Q1 and Q2 go high and pins 4 and 5 on the 4511 are held high for about three seconds after your finger is removed from the touch pad. The delay is provided by C1 and R1, together with the 4081 gate. The high on pin 5 of the 4511 loads the last data present on the address inputs (A0 to A2) into the latch of the 4511, whilst a high on pin 4 releases the display from the 'blank' mode to display the contents of the latch. The number is then displayed. When pin 4 goes low again after three seconds, the display is blanked to conserve battery power.

The high clock frequency ensures that the dice has a random result. Even if you attempt to touch both pads simultaneously, each die shows a different throw.



CIRCUIT 1 (2 NEEDED)

OSCILLATOR CCT (ONE NEEDED)

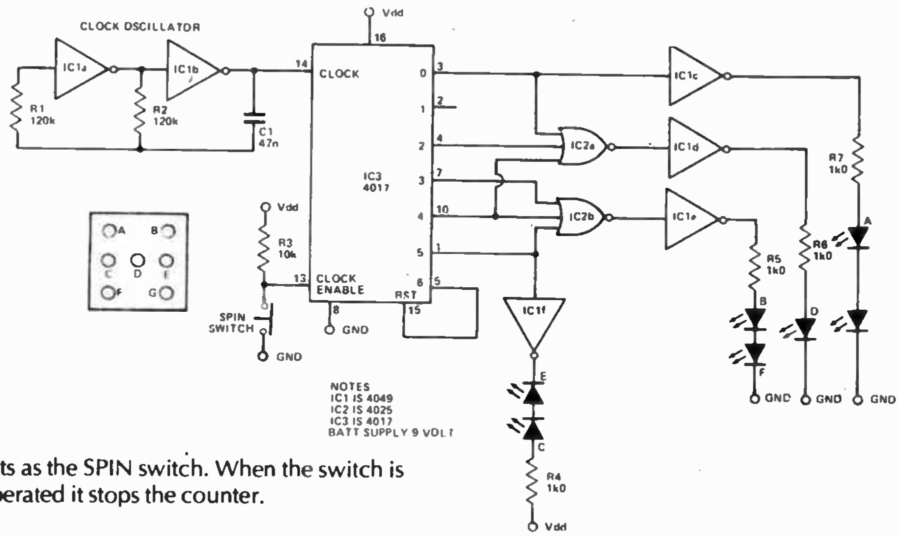


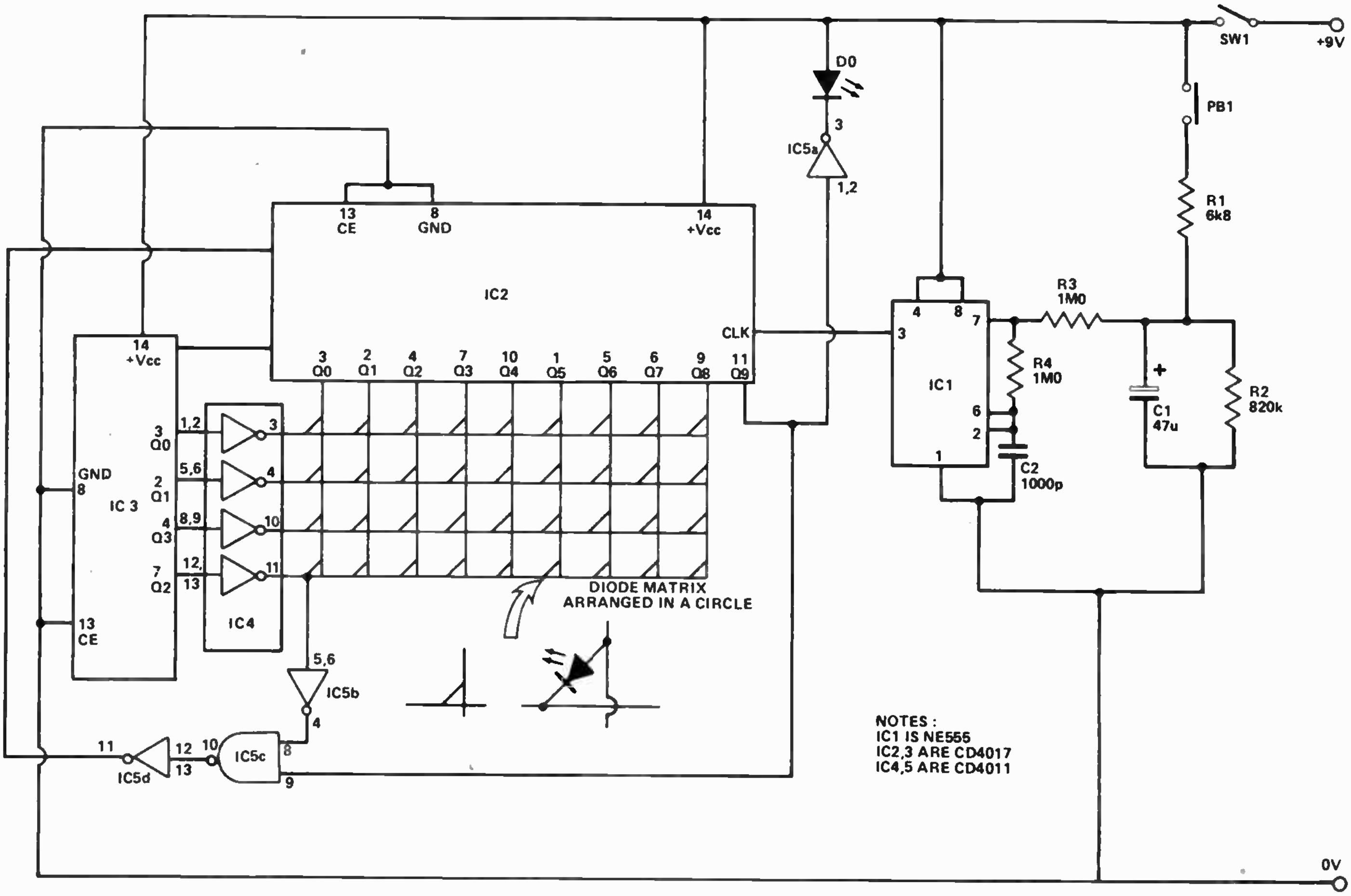
Electronic travelling dice

M.G. Argent

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

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



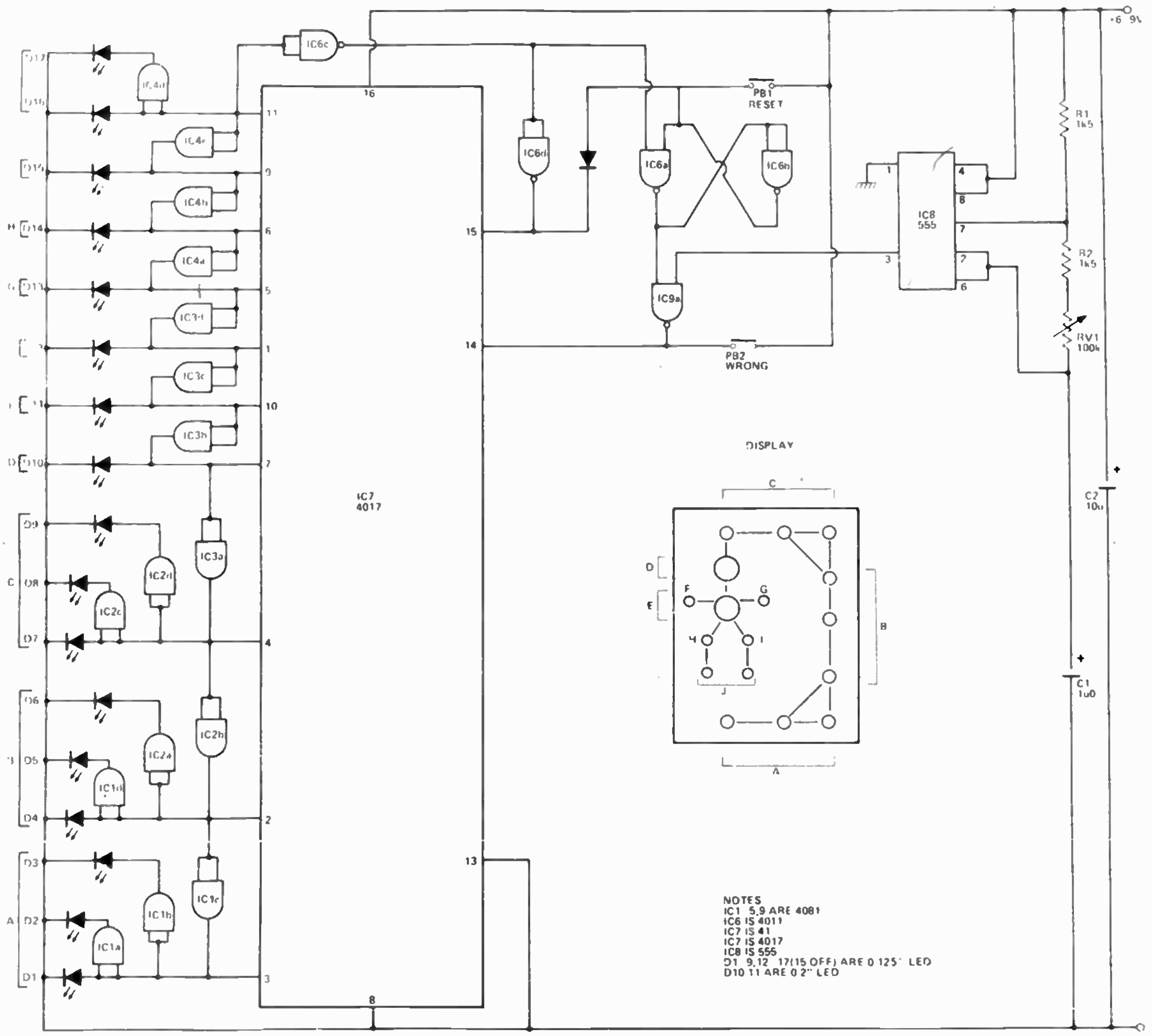


Electronic roulette

AC Dickens, Leicester.

The advantage of this design over ten number versions, is that all 37 numbers are catered for, as in a conventional game, and the electronic circuit remains cheap and simple.

Initially, when PB1 is depressed, C1 charges via R1. The voltage on IC1 pin 7 rises, causing IC1 to start generating pulses which rapidly increase in frequency. IC2 & IC3 are decade counters, arranged so that each one of the 36 red LEDs in the matrix is illuminated in turn. The gates of IC5 are arranged so that D (which is green in my circuit) is illuminated after D , and followed by D . Hence an apparent circular motion is generated. After the 'wheel' has been spun, PB1 is released. C1 now discharges via R2 and R3, so that the 'wheel' apparently slows down and then stops at one of the 37 numbers, each of which has an equal probability of occuring. The running time, and speed of 'revolution' can easily be altered by changing the value(s) of appropriate capacitor(s) or resistor(s).



Electronic hangman

G.N. Durant, Selby

The circuit diagram shows a design for an Electronic Hangman Game. The scoring display is made up of 0.125" and 0.2" LEDs, as shown. The controls consist of two one pole make push-buttons. The first button is pressed every time a letter is wrongly guessed. At the start of the game, the other button is pressed, to reset the display, blanking it. When a letter is wrongly guessed the 'wrong' button is pressed once, and the first part of the display, (A), is illuminated. Every time another wrong letter is guessed, the 'wrong' button is pushed, and the next part of the display is lit up. When the display is all lit up, and the victim is 'hung', the display automatically blanks.

Now this is where the clever bit comes in. To show that the victim has lost, the display is blanked, then the first part of the display lights itself, then the next part and then the one after that. In fact, all the parts light up in sequence, until the last part lights, when the display blanks again, and the whole 'chasing' process starts again. This process repeats itself until the 'Reset' button is pressed, when the display blanks, ready for a new game to begin.

The circuit consists of eight ICs, one of them being a 4017B CMOS device. This device is a ten stage decade counter. Each output is fed directly to its own LED and, because some outputs require more than one LED and there is not enough current from the 4017 to drive more than one, the affected outputs are connected to a CMOS 'AND' gate which is in turn connected to a LED, so the required power is obtained from the power supply and not the outputs of the 4017. The input of the 4017 is triggered by a push button connected to the positive supply rail, so when it is pushed (Wrong button) the IC is triggered and the next part of the LED display is illuminated. The 'lower' LEDs are kept lit by another AND gate, connected as a chain linking each output of the 4017, so their outputs will go high, when a 'higher' LED is lit.

When the top LED is lit, another AND gate (gate 3, IC 6) goes low, locking a latching flip-flop formed by gates 1 and 2 of IC6, a CMOS NAND gate. This latch allows the output of an astable multivibrator to go to the trigger input of the 4017 and to start the automatic sequencing. The reset button makes the input of one of the gates go high, unlatching the flip flop and resetting the display. The small preset varies the clock rate over a wide range, speeding or slowing the sequencing.

If desired, a 'Display PCB' can be designed to ease the LED wiring. When the circuit is known to be functioning correctly, lines can be painted onto the display to join up the LEDs, and to make them appear as a 'picture'.

When all the LEDs are illuminated, the circuit will take a great deal of current, so a mains power supply is advised.

2 chip electronic dice

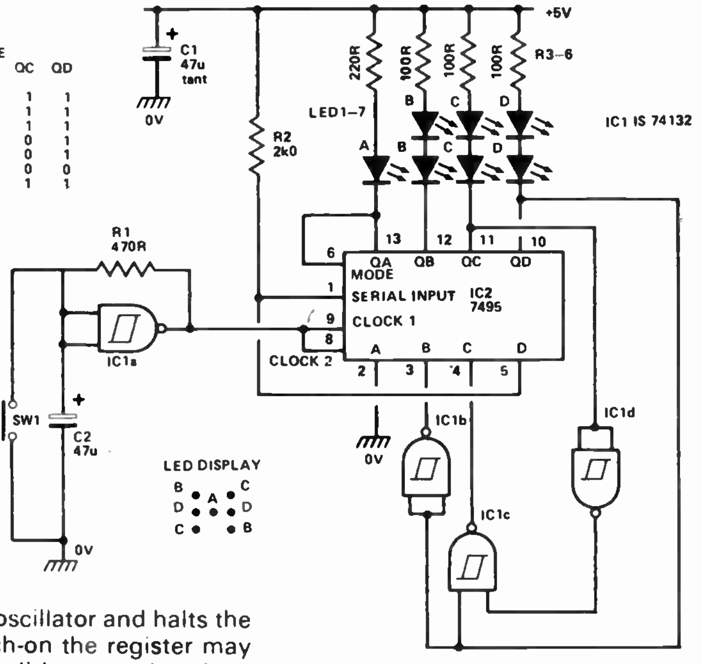
P. Adams

This electronic dice produces a true dice display using only two IC's — 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.

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					



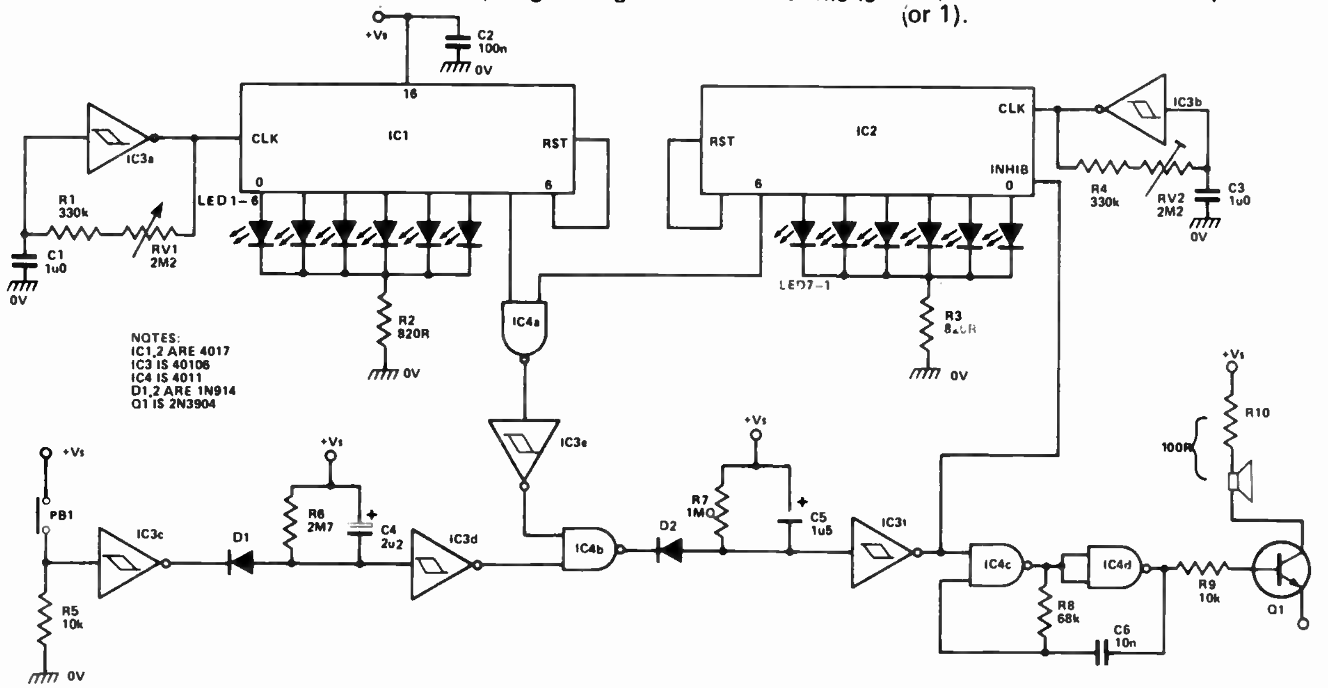
SW1 stops the oscillator and halts the count. On switch-on the register may start on an invalid count, but in a couple of clock cycles it will produce a valid count and then remain in that sequence.

LED chaser

This game is a test of skill and patience. The aim is to align a LED chaser (under your control), with another preset chaser.

A matching pair of outputs are fed to an AND gate (IC4a, IC3e). This gate feeds the NAND gate IC4b, its other output taken from the monostable formed around IC3d. This has a duration of about 6 seconds to ensure the display is fully counted.

When you think you've matched the displays up PB1 is pressed. IC3d output goes high and if while this is high, the two matching outputs both go high, the monostable formed around IC3f is triggered. This enables the astable formed by IC4c,d, to signal success. The unit can also be automatically reset by feeding IC3f's output to the clock inhibit pin of IC2 (or 1).



TV opto-isolator

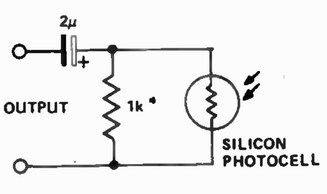
The problem of how to connect a TV s sound to an amplifier or tape recorder is basically one of safety — TV sets use very high voltage. One approach is to pick up the IF from the set, but this requires that you strap a coil onto the back.

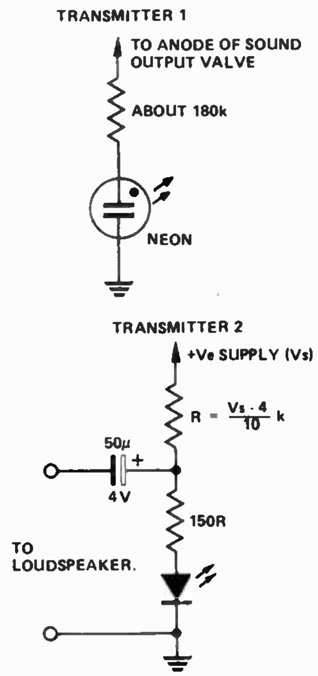
One way of getting an audio signal out without the risk of high voltage outside the set is to use an opto-isolator.

This uses circuitry which converts the audio into a changing light level, and then detects this modulated light using another stage — electrically isolated from the first.

Two types of light modulator are shown here — the one with the neon attaches to the anode of the sound output valve and the other attaches to the loudspeaker terminals of the set.

The photocell has to be very close to the light producing part of the circuitry (it's a good idea to tape the cell to the neon or LED — but be careful that you preserve the electrical isolation) and shielded from outside light sources. The output of the detector is probably best fed to the most sensitive amplifier input you have, as the amplitude will be small.





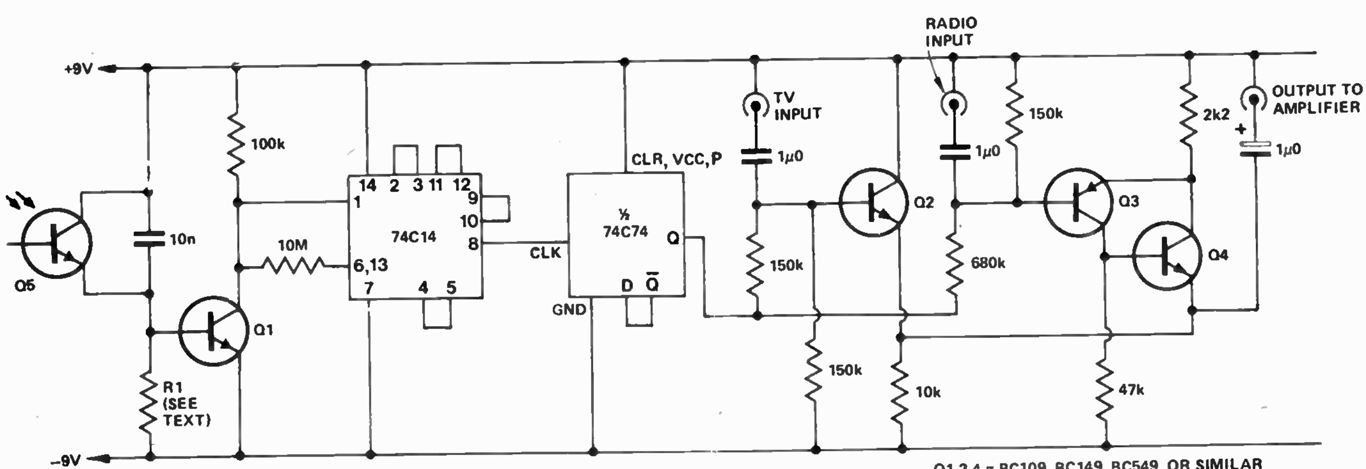
TV ad blanker

If you dislike having to watch TV adverts, then this idea, from Graham Taylor of Glen Iris, may be to your liking.

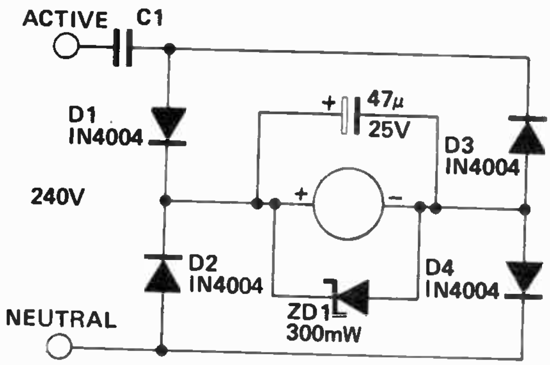
Basically, it's a light-controlled AB switch. When the photo-transistor receives a pulse of light — from a hand torch held by the person watching the TV — it toggles the bistable IC2 and changes the state of its Q output. Depending on whether this output is at +9 V or −9 V, either the TV sound input or the radio sound input will be fed to the amplifier output. This can either be connected to your hi-fi amplifier or, if you feel capable of tackling it, back into the sound section of your TV set.

Operation is simple. You're watching TV, and suddenly the action is interrupted by a commercial. Quick as a flash, you pick up the torch (which you keep on the coffee table) and point it at the Ad Blanker, which sits on top of the TV set. The circuit senses the light and cuts off the advert's sound, replacing it with some soothing intermission-like music from the radio. As soon as the ad is over, you fire another light beam at the unit and it reverts to its original state.

The use of this device has another, hidden advantage. Listening to the TV with the radio sound playing instead sometimes produces hilarious combinations.



Q1,2,4 = BC109, BC149, BC549, OR SIMILAR
Q3 = BC179, BC159, BC559, OR SIMILAR
Q5 = AY8140, TT801, OR SIMILAR



Operating a sonalert from 240 Vac mains

There are occasions when it is convenient to operate a Sonalert-type piezo-electric alarm from the 240 Vac mains. The accompanying circuit, from **Barry Wilkinson of Nebula Electronics**, shows how it's done.

The 'ACTIVE' input is switched to activate the alarm. Capacitor C1 acts as a current-limiting device, the four diodes being arranged as a bridge rectifier, with the alarm across the output. The zener diode across the alarm limits the maximum voltage and the electrolytic capacitor provides smoothing.

The value of C1 depends on the type of alarm used and its current drain. As an example, for the popular "Murata" make, two 33 nF, 250 Vac rated capacitors in parallel gave reliable operation. Current drawn was around 5 mA. This gave about 8 Vdc across the alarm and adequate sound output.

Not that C1 *must* be rated for 250 Vac operation.

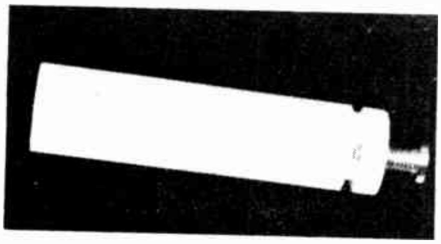
Copying pc board designs

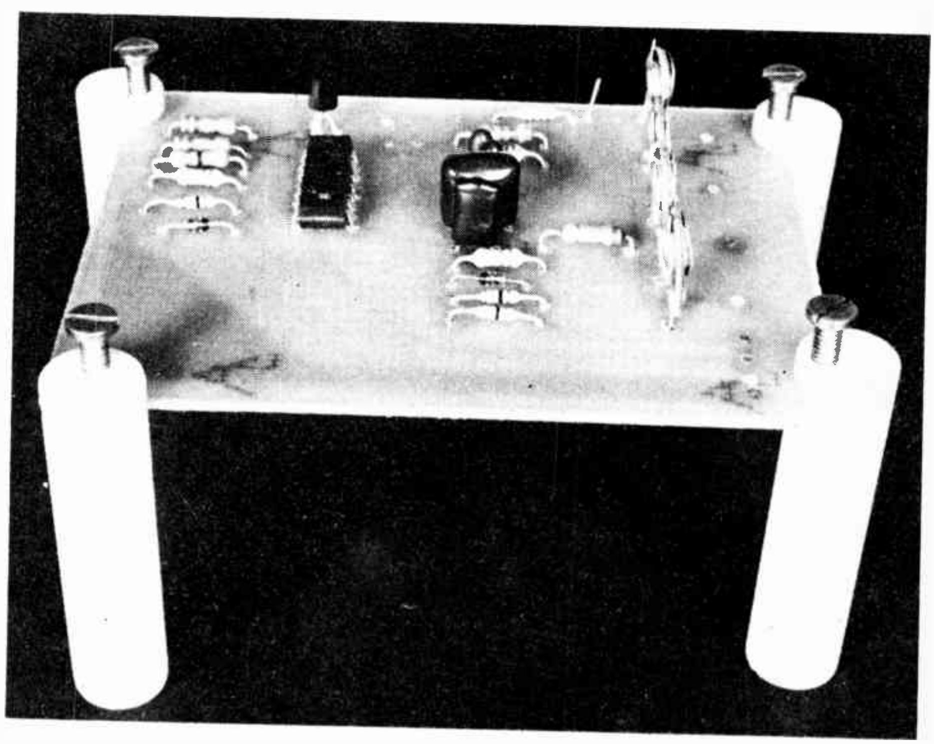
Bill Materna of Kilkenny S.A. found an easier way of copying a circuit board design that "... is as old as kindergarten games".

Simply hold the design over the prepared piece of blank board and with a compass or sharp scriber make pin pricks through the drawn component holes on to the board. Then it is a simple matter of joining up the marks with a resist pen.

TO-3 template

Sometimes it's a bit trickey trying to mark out the holes for a TO-3 case on a heat sink. If, however, you keep a blown TO-3 device (and most people will have plenty of those!), then by removing the cap and the leads it will form a useful template for centre-punching the holes.





Extra hands !

This neat, nifty idea comes **from Otto Patterson of Cammeray, NSW.** Four rods of a suitable plastic are slotted at one end and a bolt inserted in a tapped hole such that it passes into the slot. The rods are slipped onto the pc board of the project you're about to build up and secured by tightening the bolts — with your fingers is enough. Load all the components on the upper side then slip the rods off the board, invert the board and slip them back on. Stand the board up and you're ready to solder everything !

The rods are made quite easily. Any suitable solid plastic rod material about 9 mm to 15 mm or so in diameter will suffice. Cut them about 60 - 80 mm long. Next drill and tap a hole in one end, a little off-centre. About 4 - 5 mm down from this end cut a slot about 2/3 of the way through the rod. This slot should be about 2 mm wide to take pc boards of the usually-available thickness. The accompanying photographs tell most of the story.

That's it ! No more awkward juggling with that pc board on the bench.

Electronic 'Spirograph'

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 re-adjust the gain controls on the oscilliscope. 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!

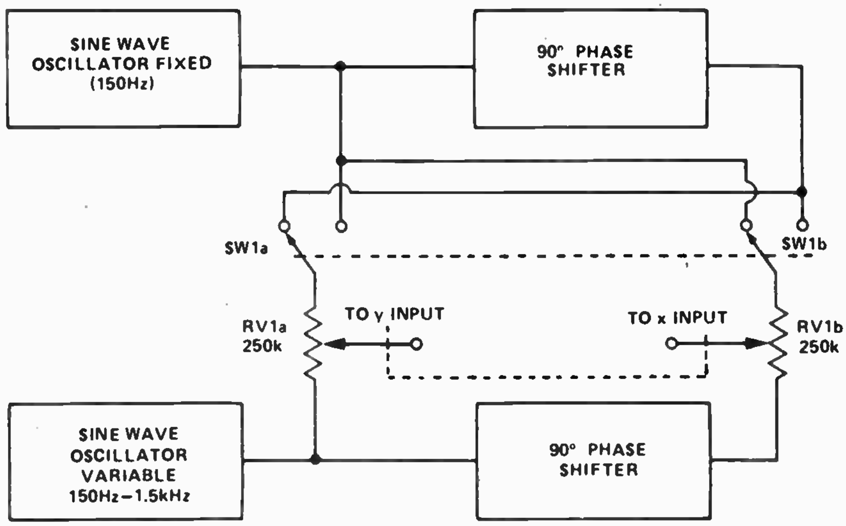


Fig. 1. Block diagram of the 'Spirograph'.

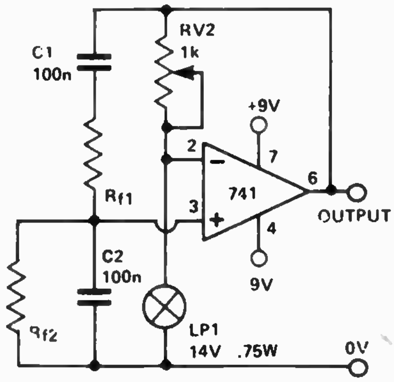


Fig. 2(a). Suitable oscillator for the 'Spirograph'.

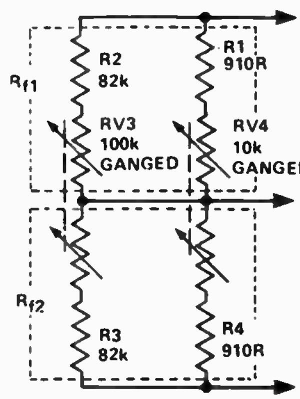


Fig. 2(b). Arrangement to give fine control of the frequency of the oscillator shown in Fig. 2(a). For 150 Hz fixed frequency use Rf1 = Rf2 = 10 k.

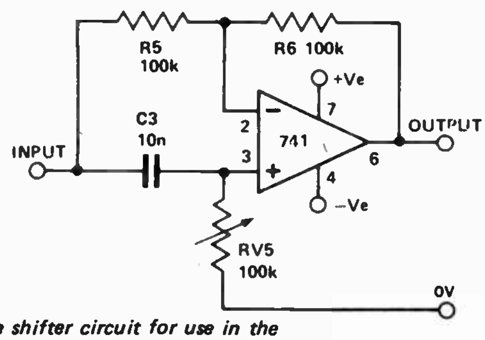


Fig. 3. Phase shifter circuit for use in the 'Spirograph' circuit.

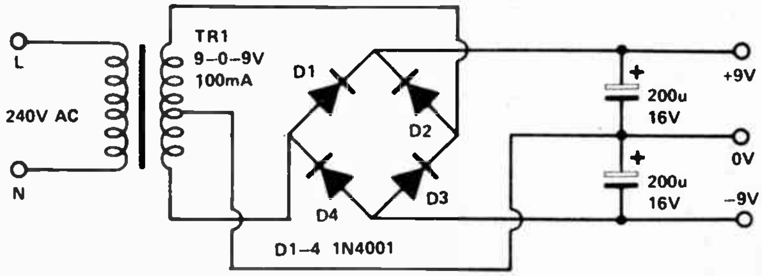
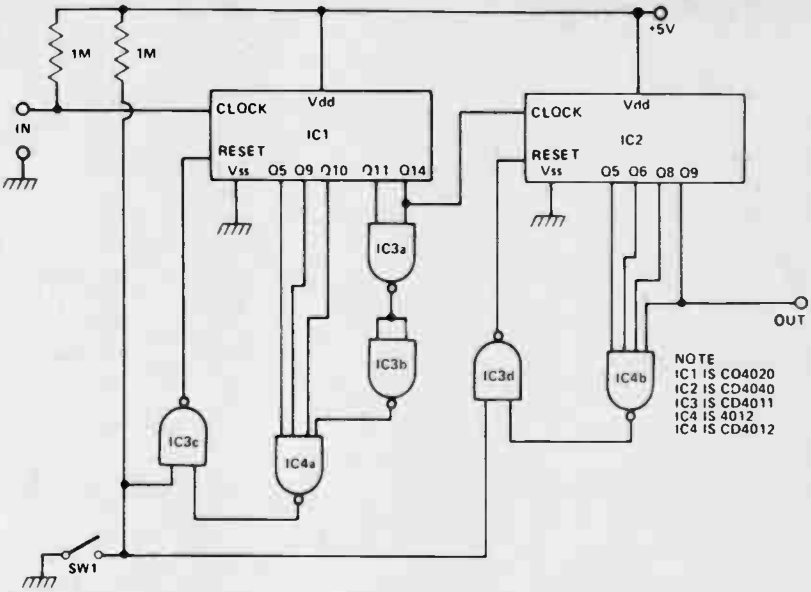


Fig. 4. PSU for 'Spirograph'.

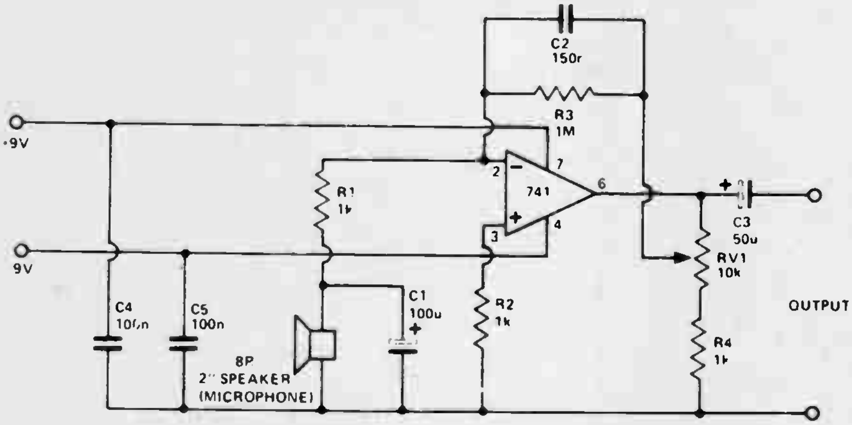
Divide by 4,320,000 counter



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, e.g. 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 'O' is usually required). Additionally the gating allows the counter to be reset to 0 by SW1.

Heartbeat preamplifier



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 VR1 and R4. VR1 permits the gain to be varied over the range 60-80 dB.

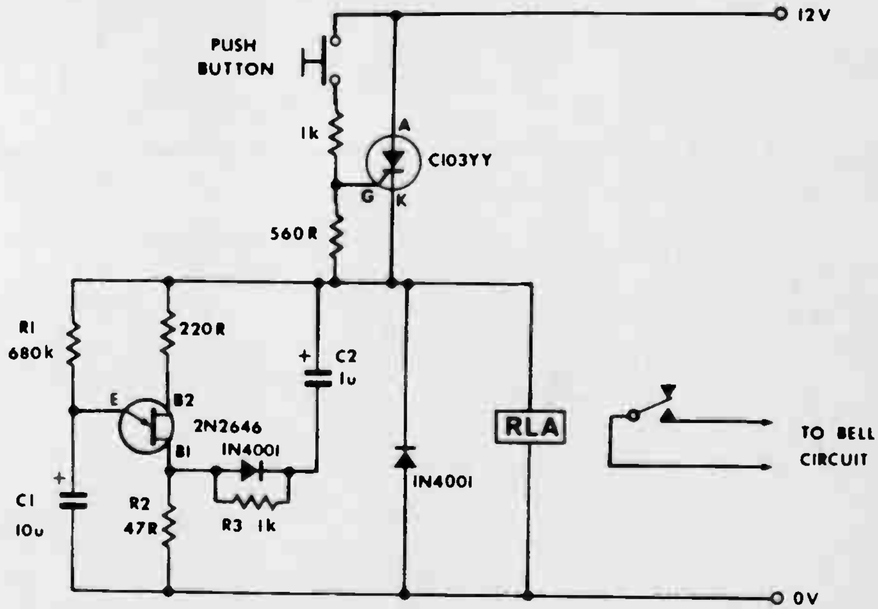
C1 and C2 introduce some low frequency cut, reducing 50 Hz pickup whilst C4 and C5 help prevent instability caused by the high gain of the circuit.

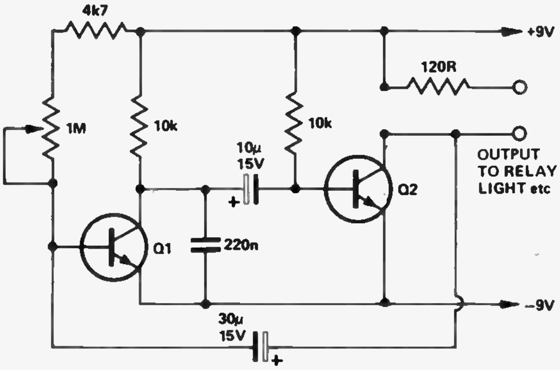
The output should be connected to the magnetic cartridge input of the audio amplifier, with the bass turned up high.

Unijunction pulse stretcher — door bell extender

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.



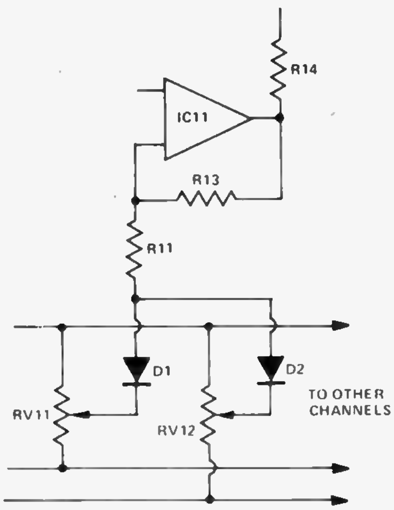


Flip-Flop flasher

This simple flip-flop circuit from **Paul Taylor**, of Eltham Vic, can be used to operate a relay or flash a lightbulb on and off at a rate that may be varied between three flashes per second to one flash every five seconds. The speed is altered by the 1M potentiometer. Component values are not critical and most general purpose NPN transistors will work. A relay with a coil resistance between 50 and 180 ohms should work well (delete 120 ohm resistor).

Dimmer modification

Readers involved in stage lighting may be interested in a modification to the ETI 588 theatre dimmer.



We are indebted to the reader who phoned this suggestion in to Nebula Electronics. Unfortunately, he didn't leave his name.

Resistors R12, R22, R32 ... et cetera are removed and the two diodes shown are added, one pair to each channel. This gives the dimmer the same operating format as commercial ones.

To explain: In most dimmers, the value of the master setting is multiplied by each individual fader and the *maximum* of the values from the two masters is used for the output. In the ETI 588, however, the *sum* is used instead of the maximum.

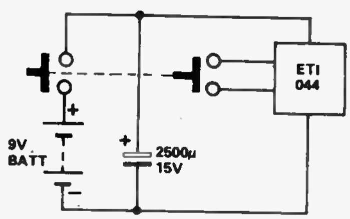
For example, if on Channel 1 both channel faders are at maximum, Master A is at half maximum and Master B is at zero, on the ETI dimmer *before* modification the output on Channel 1 will rise as Master B is moved from zero to half. After modification it will only start to rise after Master B passes the half-way mark.

Doorbell current saver

Graeme Scott of Surrey Hills, Victoria developed this little trick when he was teaching Electronics in schools. It's an elementary way of saving current in a doorbell circuit. (Why didn't we think of it? – Ed)

The circuit uses two components – a two-pole momentary action switch and a very large capacitor. Operation is self-evident.

Although it is shown in conjunction with the ETI 044 electronic doorbell, the technique will probably be useful in many other applications.



Ballpoint spacers

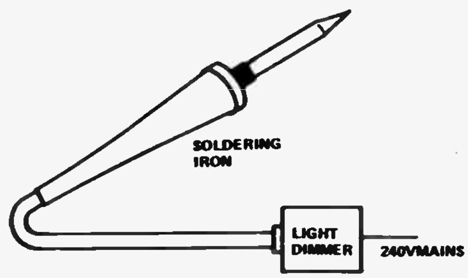
W. McEwan, Argyll

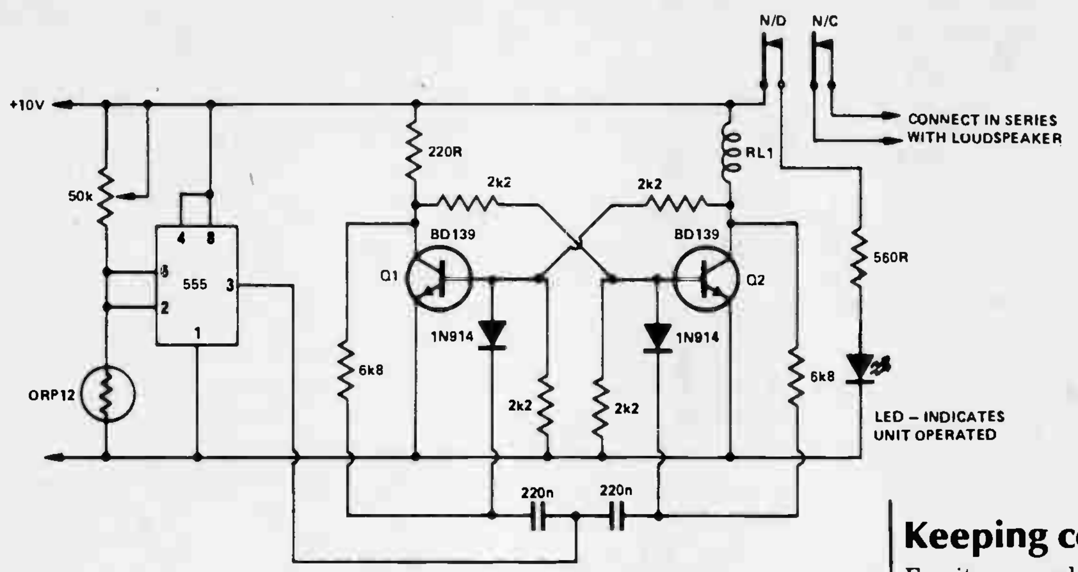
The use of dried-out ballpoint pen plastic bodies as test prods is well known. Recently, I discovered that they also make excellent spacers for printed circuit boards. Simply cut them to size with a Junior hacksaw — excellent for awkward lengths. The internal hole is suitable for either M3 or M4 bolts.

Incinerated ICs — stopped !

Now here's a good idea if your soldering iron is a bit too hot for soldering delicate components to a printed circuit board — why not use a standard light dimmer between the iron and the mains?

A reader from Pentland in Queensland, **Mr B.D. Dever**, found this an ideal solution to soldering-without-sizzling.





Silence those ads !

This circuit, from **G.B. Wolfe of Bombala NSW**, will switch off the sound from a TV when those annoying adverts come on just as the programme is getting interesting. All you need is a torch handy in order to flash a light at an LDR.

The circuit operates as follows: when light is incident on the photodiode its resistance drops, driving pins 6/2 of the 555 towards 0V. This produces a positive-going pulse from pin 3 which is passed to the collectors of Q1 and Q2. Suppose the flip-flop is set with Q1 on, Q2 off when power is switched on. The positive pulse on the collector of Q2 has no effect but the positive pulse on Q1 collector is passed on to the base of Q2 via the 2k2 resistor and Q2 begins to switch on. The collector voltage of Q2 now begins to fall rapidly and this drives base of Q1 towards 0V, switching the transistor off. The circuit thus rapidly changes state to Q1 off, Q2 on. When Q2 is on, the relay operates, the loudspeaker is disconnected and the LED goes on.

A further flash of the torch on the photodiode will cause a pulse from the 555 and the flip-flop switches back to Q1 on, Q2 off. The loudspeaker is reconnected and "Cop-Shop" comes back into your living room!

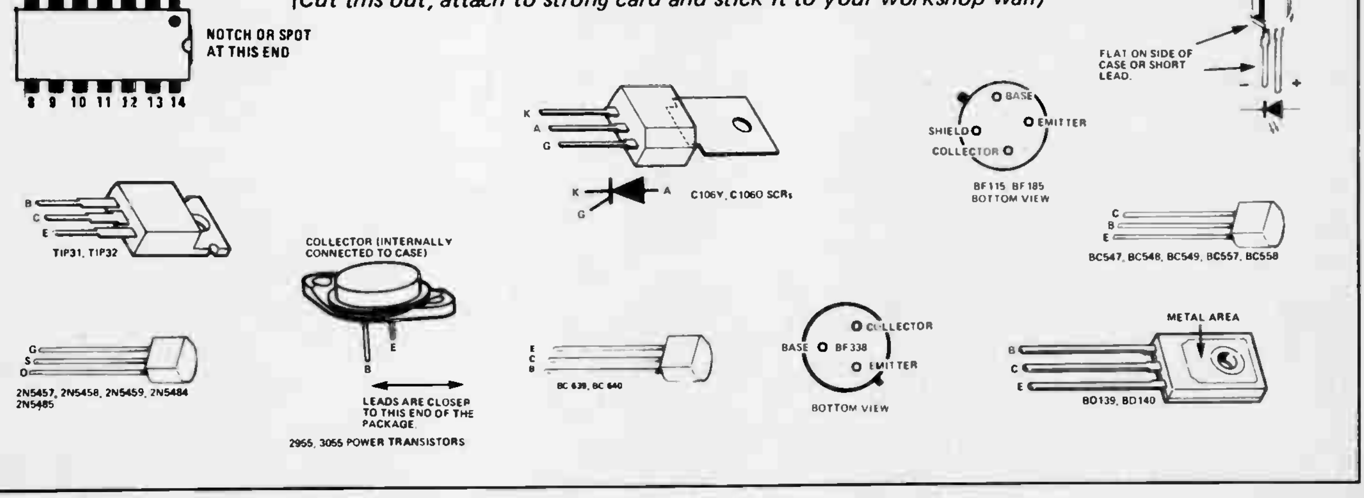
Keeping coil slugs in place

Ferrite or powdered iron slugs are widely used to adjust the inductance of RF coils. There are many ways to secure the slug in the coil so that it does not move after initial adjustment (causing some measure of inductance value drift), yet to allow subsequent adjustment. Some manufacturers employ rubber 'string' or 'tape', others specify a sticky rubber solution, or something similar. As usual, Murphy's Law gets into the act and the stuff disappears when you most need it.

A neat idea from **Gary Brooker, of Newcastle NSW,** is to use Teflon thread-sealing tape that plumbers use. Wrap a small piece around the thread of the coil slug and then insert it in the coil former. The tape will hold the slug quite well following initial adjustment.

COMMON SEMICONDUCTOR PIN-OUTS

(Cut this out, attach to strong card and stick it to your workshop wall)



Magnetic light dimmer

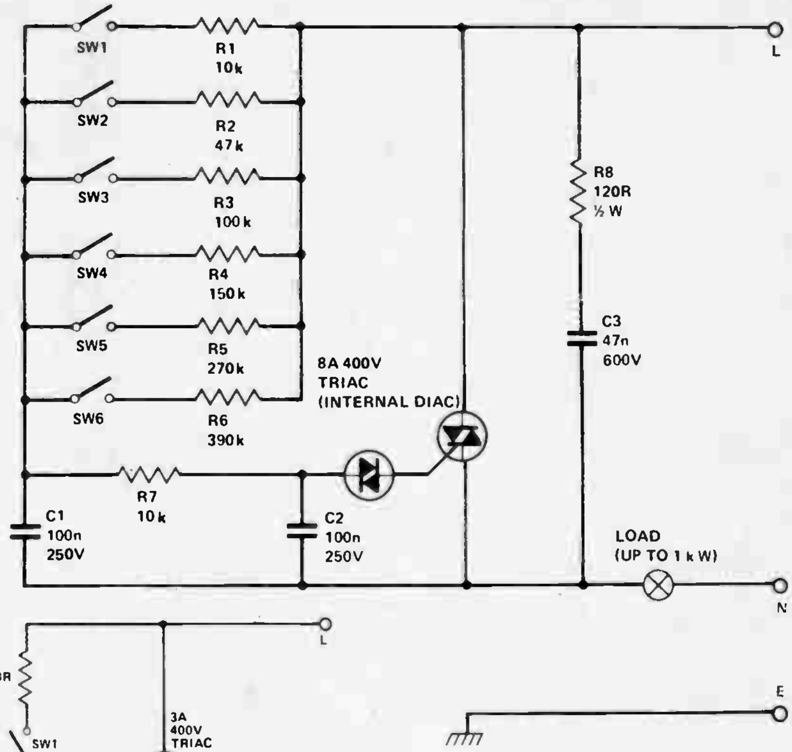
T. Hopkins

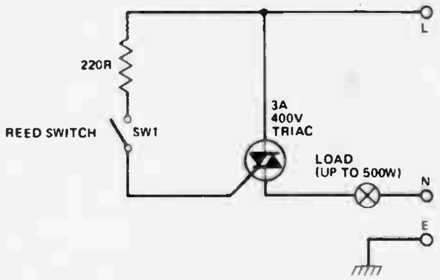
A partial solution to the problem of leaving lighting on unnecessarily is to have a resettable timer in place of a switch. However, The choice of delay is difficult, particularly when the room may be used continuously.

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

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

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



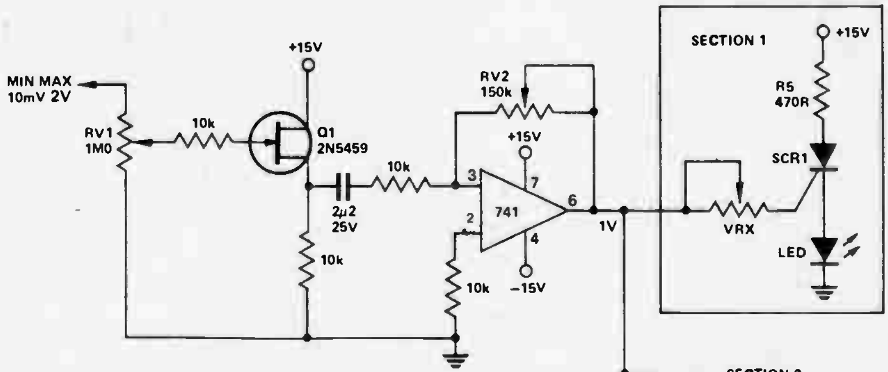


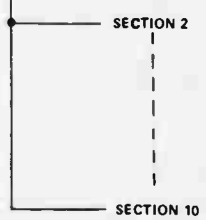
Sound to light modulator

Modulating a light, or a bank of lights, from a sound source (such as a tape recorder or record player) is an ever-popular topic so we dragged this circuit from the depths of our files.

A high impedance input is provided by a source-follower, Q1, so that the unit may be driven from either a high or low impedance source. An op-amp (a 741) then provides sufficient gain to trigger the SCR which drives the LED. As the input varies, the drive to the LED will vary, modulating the light output. Each 'Section' (1,2,3 . . .) drives a LED, all the LEDs being mounted in a row.

When setting up, RV1 and RV2 are adjusted so that with the maximum input voltage available, 1 V is available at pin 6 of the op-amp. Then VRX is adjusted so that the LED lights. Then Section 2 is tackled; adjust VRX for that section so that its LED lights with 0.9 volts at pin 6 of the 741. Continue with the subsequent sections so that each LED lights at 0.8 V, 0.7 V etc at the output of the 741. The display produced is rather like a VU display; with the column lighting up as the sound rises and falls.





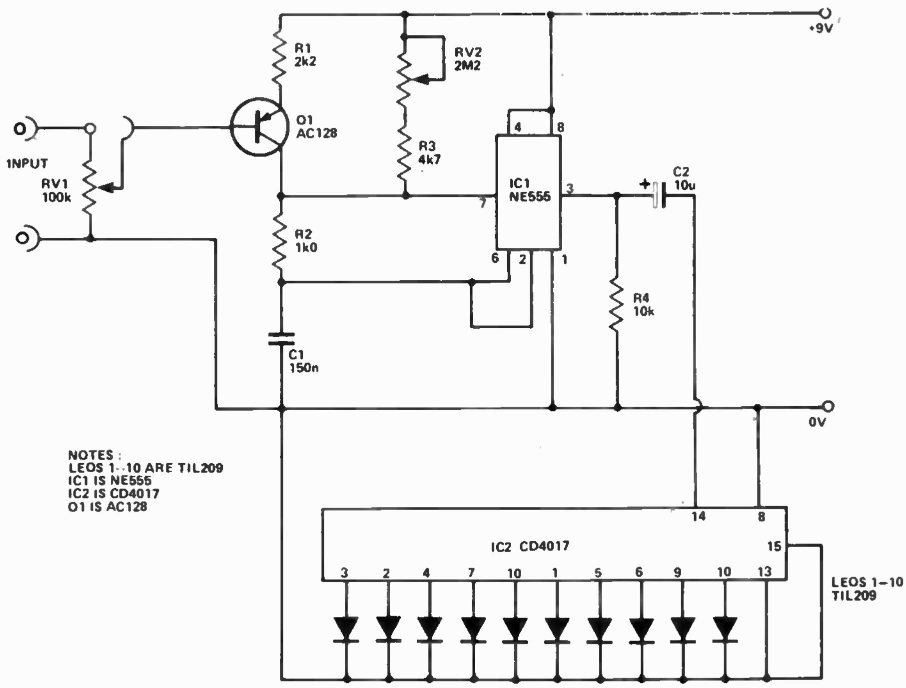
Audio display

C.S. Histed

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

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

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



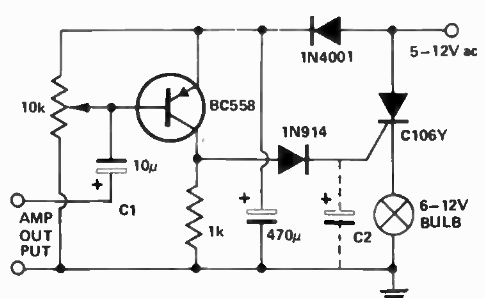
LOC	CODE	KEY
00	34 6	SUM 6
01	33 6	RCL 6
02	35	Yx
03	30	2nd
04	85	=
05	−35	INV Yx
06	05	5
07	85	=
08	−49	INV 2nd INT
09	36	2nd PAUSE
10	34 6	SUM 6
11	61 0	SBR 0
12	32 1	STO 1
13	61 1	SBR 1
14	32 2	STO 2
15	61 1	SBR 1
16	32 3	STO 3
17	33 1	RCL 1
18	22	x t
19	33 2	RCL 2
20	76	2nd x t
21	22	x t
22	33 3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

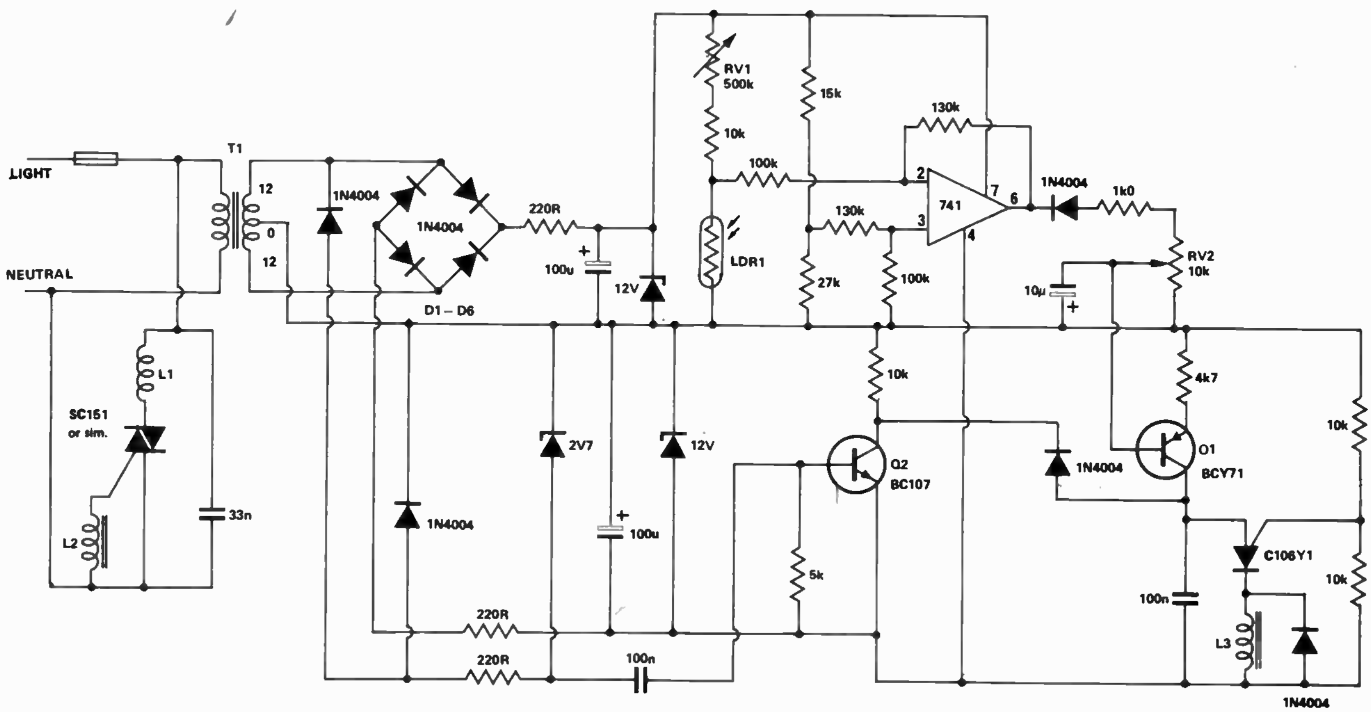
Sound-modulated light source

This circuit, submitted by Michael Thong of Crawley WA, modulates a light beam with voice or music from the output of an amplifier. If the 10k pot is adjusted to slightly less than the Vbe of the transistor, the circuit forms a peak detector.

This drives the gate of the SCR, lighting the globe, the brightness of which will vary as the sound level varies. C2 may be removed for a faster response.

Michael used his original circuit for a low cost colour organ from his amplifier.





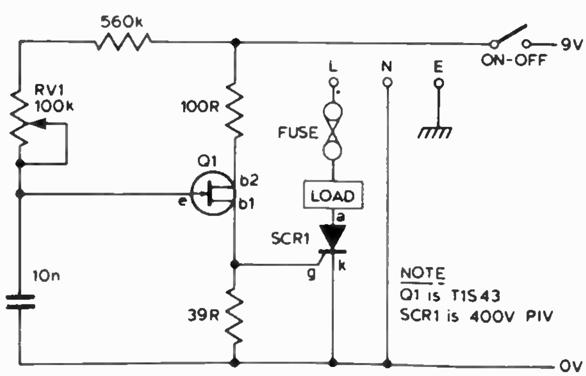
Porch light controller

Mr. R. Johnson from the UK has designed this auto-dimmer for turning on a porch light at dusk and then controlling the brightness such that it is inversely proportional to the surrounding lighting conditions. It sets the porch light brightness to a minimum at dusk, increasing the brightness until it reaches a maximum after total sunset. In the morning, the light is slowly reduced in brightness as the sun rises, turning it off at full daylight.

The dimming circuit uses a triac to control the brightness of the porch light, conduction angle being controlled by Q1 and an SCR pulse circuit via a transformer, L2/L3.

The potentiometer RV1 varies the light level at which you wish to have the porch light turn on. Potentiometer RV2 sets the maximum brightness (maximum conduction angle of the SC151) of the porch light. the LDR determines when the dimmer starts and ceases to operate. Its resistance varies between 600k at dusk to about 6M at dark. A suitable type might be an LDR03 or LDR04, or similar. Note that Q1 is a BCY71, Q2 is a BC107/BC547/BC207 etc. The transformer T1 is a 12-0-12 low current type. L1 is an interference suppression choke and consists of 30 turns of 20 swg enammelled wire on a 12 mm length of 'loopstick' antenna ferrite. The transformer L2/L3 consists of 15 turns wound bifilar (two parallel wires) on a 15 mm length of loopstick antenna ferrite also.

A fuse is connected in series with the lead going to the porch light for safety.



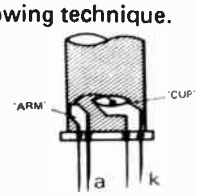
Lighting effects

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 is controlled by RV1. The load (a light bulb) will not be supplied 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.

LED spotting

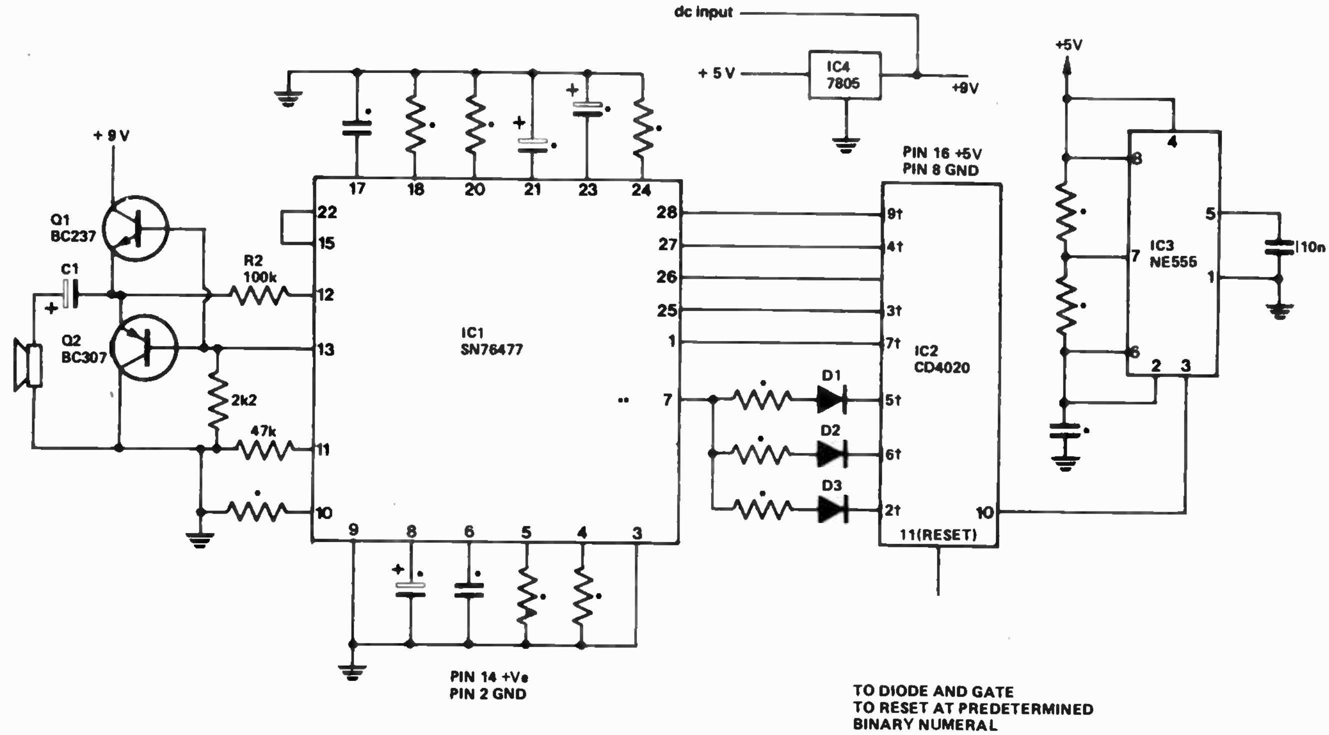
Since the leadout on LEDs varies according to the manufacturer's preference, leadout diagrams are not always worthy of the trust placed in them. In some cases a reverse connection will destroy the device being used.

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).



*SELECT COMPONENTS TO SUIT
**PIN 7 IS ONE EXAMPLE, ALL OF THE OTHER PINS COULD BE RIGGED IN A SIMILAR WAY
†PIN SEQUENCE CAN BE CHANGED

Computer music — without the computer !

Those seemingly random musical sound effects one hears on movie tracks when a computer on screen is "thinking" are familiar to just about everyone. More recently, the sounds of 'machine music' have been heard. This circuit can be arranged to produce a whole range of similar sounds, play tunes, random notes and sounds, etc, with that familiar machine music sound.

Centred on a Texas Instruments SN76477, a 'sound synthesiser' chip, plus two other ICs, selecting the values of a group of resistors and capacitors will determine the 'sounds' you want, while selecting the speed of a 555 clock and the way the SN76477 is interfaced to a divider chip will determine the sequence of sounds to be played.

The 555, IC3, is connected as an astable multivibrator. The two timing resistors (between pins 8-7-6) and the timing capacitor determine the repetition rate. Consult the data on the 555 to select values for these components so that IC3 runs at the speed you wish (anything from say, 10 Hz to 1 kHz). The output of the 555 drives a 4020 divider and its outputs drive the SN76477 'function select' inputs. The resistors and capacitors around the SN76477 marked with an asterisk are chosen from the data sheet and applications circuits to produce the desired sounds. Output from the SN76477 drives a simple audio power output stage (Q1 and Q2) and an eight or fifteen ohm speaker. C1 is a 1000 uF electrolytic.

So that the sound sequence repeats, the 4020 is reset using a diode AND gate. Note that the sequence of output pin connections of the 4020 can be changed around.

Pins 1, 9, 22, 25, 26, 27 and 28 on the SN76477 all require TTL level pulses (generally active high) to select the appropriate function. The table here shows what is selected when each pin is high and low (0 or 1).

G.P. Hicks (L/App) from the RAAF Base, Laverton, Victoria, who sent in the idea, says that a 4017 could be used instead of the 4020. He also notes that if the VCO resistor on the SN76477 is altered experimentally, and using a similar circuit arrangement to drive pin 7 as shown here, it may be possible to play tunes.

Pin 9 (system enable)	
0	(system enabled)
1	(system disabled)

Pin 22 (VCO/SLF select)	
0	(VCO selected)
1	(SLF selected)

Pin 1	Pin 28	O/P (envelope logic)
0	0	VCO
0	1	Mixer only
1	0	One shot (mono)
1	1	VCO/mono

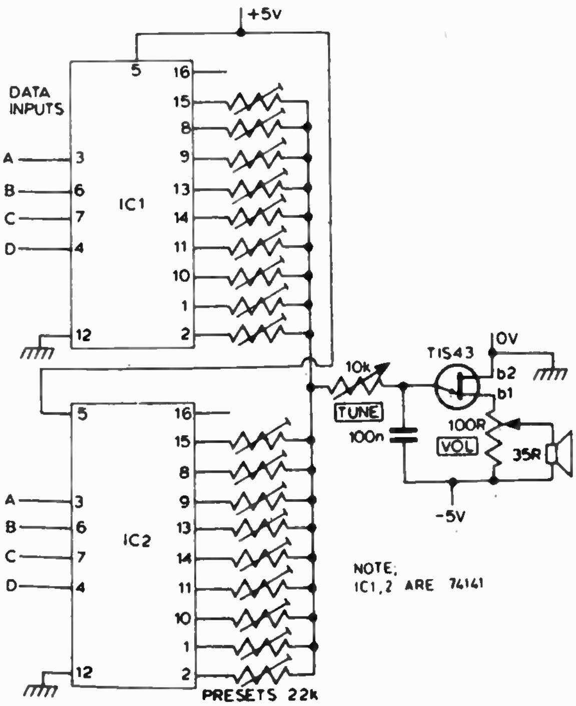
Pin 27	Pin 25	Pin 26	Output (mixer)
0	0	0	VCO
0	0	1	SLF
0	1	0	Noise
1	0	0	SLF/noise
1	0	1	SLF/VCO/noise
1	1	0	SLF/VCO
1	1	1	inhibit

Any ideas ?

Have you had a bright idea lately, or discovered an interesting circuit modification? We are always looking for items for these pages so naturally, we'd like to hear from you.

We pay between $5 and $10 per item — depending on how much work we have to do on it before we publish it.

The sort of items we are seeking, and the ones which other readers would like to see, are novel applications of existing devices, new ways of tackling old problems, hints and tips.



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

BCD tone generator

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.

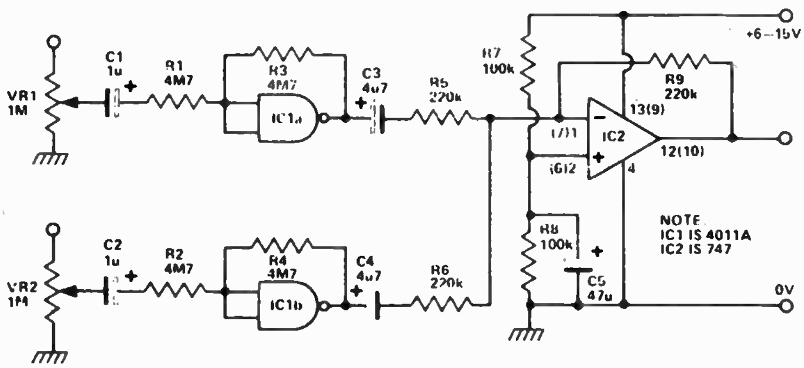
If the 18 presets are tuned to form a chromatic scale and the inputs interfaced to your MPU data bus – hey presto you have a simple MPU controlled organ!

Hybrid mixer

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 de-couples 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 circuitry which will prevent it working in the linear mode.



A perfect . . .

As any orchestral player knows, a source of 440 Hz, perfect or standard A is essential if he is to be in tune. On many occasions a piano will not be available – hence this circuit.

In the following a standard crystal at 32.768 kHz is used to stabilise an oscillator. This frequency is then divided by 149 and doubled to give 439.8 Hz, an error of only 0.05%!!!

To enable a division of 149 to be obtained, a dual AND gate is used. The first gate detects the 149th pulse, and the second resets the binary counter on the 150th pulse.

The resulting 30us pulse may be fed to a suitable amplifier.

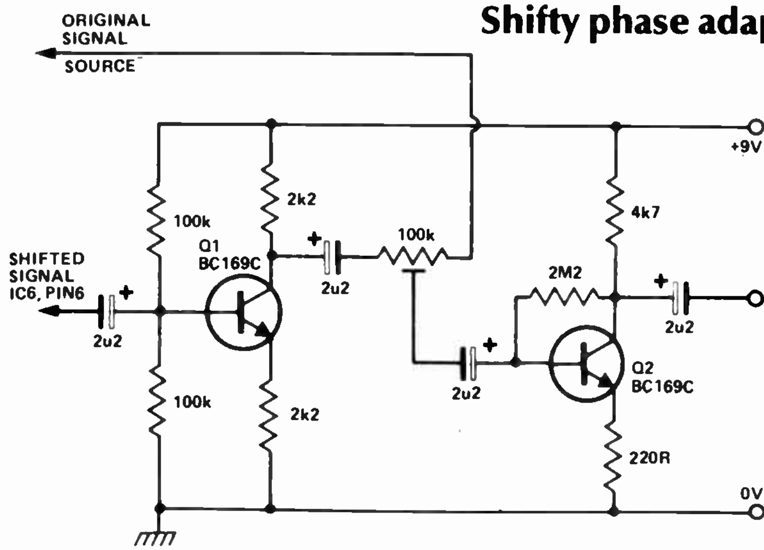
Shifty phase adaptor

This circuit can be used in conjunction with the Audio Phaser from December's ETI, or with any other phasing unit for that matter. The circuit provdes a complementary (antiphase) shifted waveform and amplified.

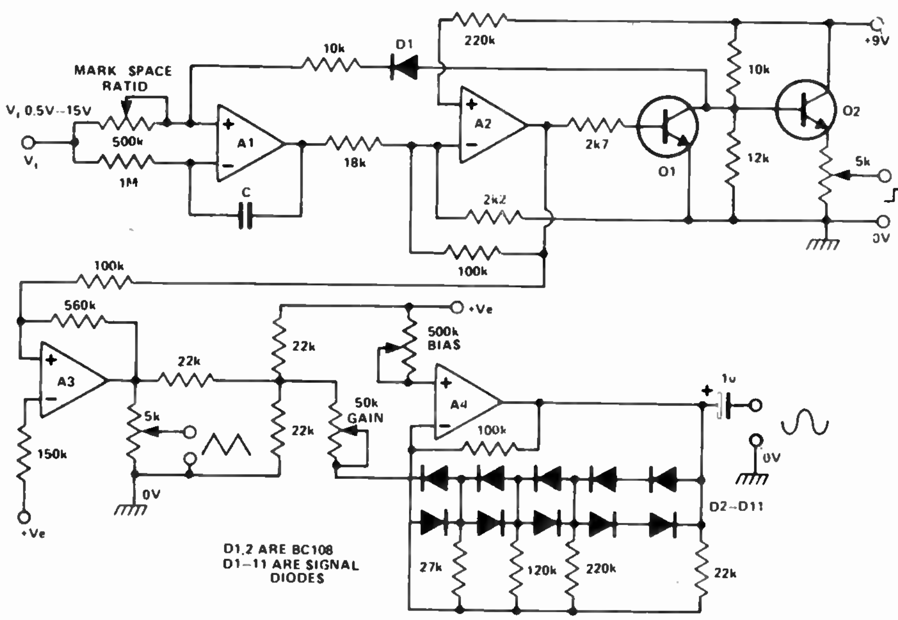
When this is fed through stereo speakers, it provides the ear with some very peculiar sounding phase information.

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!



Battery operated VCO



By using the LM3900N quad-op-amp, a simple portable battery operated VCO can be made very cheaply. A2 forms a 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.

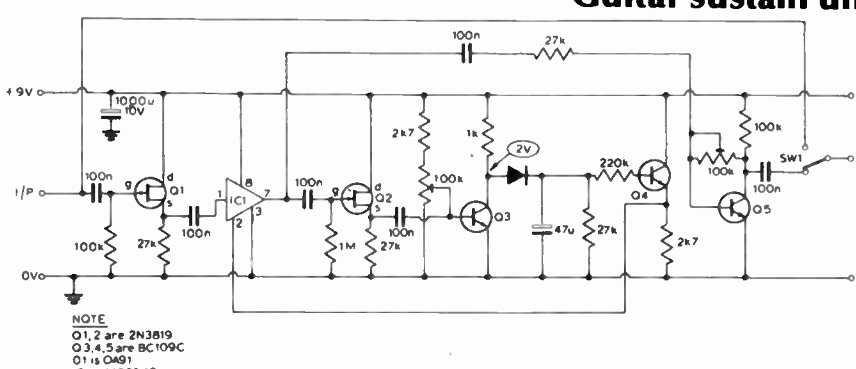
Vi can be any positive voltage from +0.5 ↔ + 15.0 V, giving a frequency range of about 1:100. Capacitor C can be any value from 10n ↔ 47n and the outputs have a low distortion up to about 20 kHz.

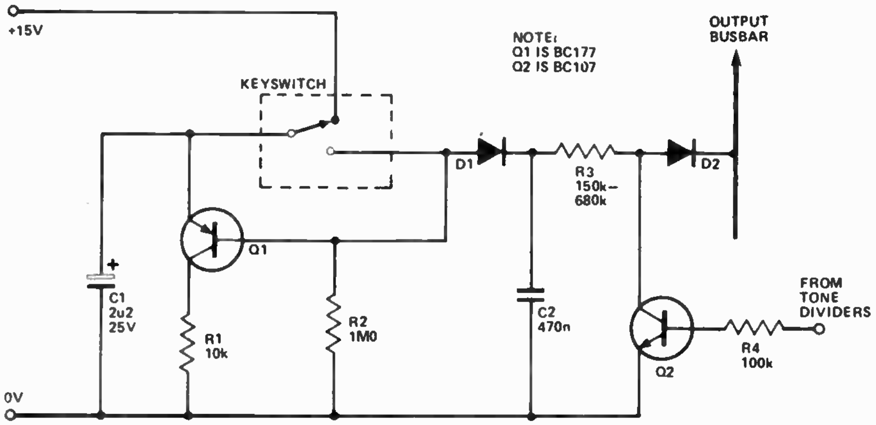
Guitar sustain unit

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





Touch-sensitive piano keying

The circuit is operated by a single-pole change-over key switch. When the key is in the fully released position C1 is held charged from the 15 V rail. Q1 is turned on by the bias current supplied by R2. When the key is depressed C1 is disconnected from the 15 V rail and starts to discharge through Q1 and R1. When the key is fully depressed Q1 is turned off and the remaining voltage on C1 then charges up C2 via D1. Both capacitors then discharge via R3. The envelope produced by this decaying voltage is chopped by Q2, driven directly from the tone dividers. Upon the release of the key, C1 is disconnected from the chopper circuit and C2 discharges rapidly via R3, simulating the action of the dampers. D1 is included to prevent C2 discharging through R2 when the key is released and D2 prevents interaction with other keying circuits.

As the voltage remaining on C1 at the completion of a keystroke depends on the key velocity, a degree of touch-sensitivity is obtained with this circuit.

CMOS mixer

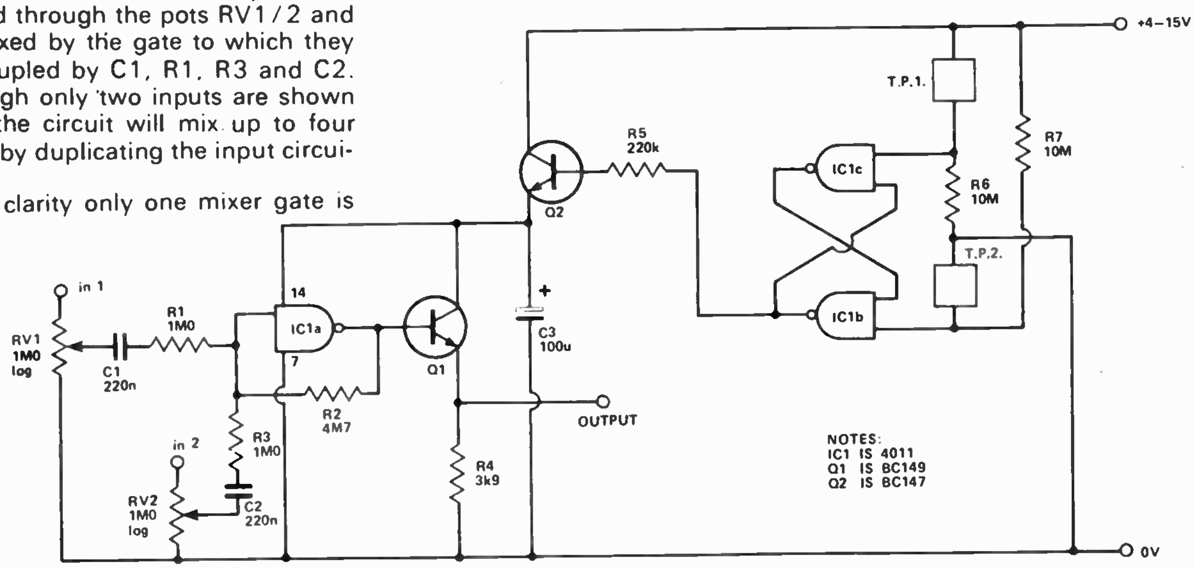
J. P. Macaulay

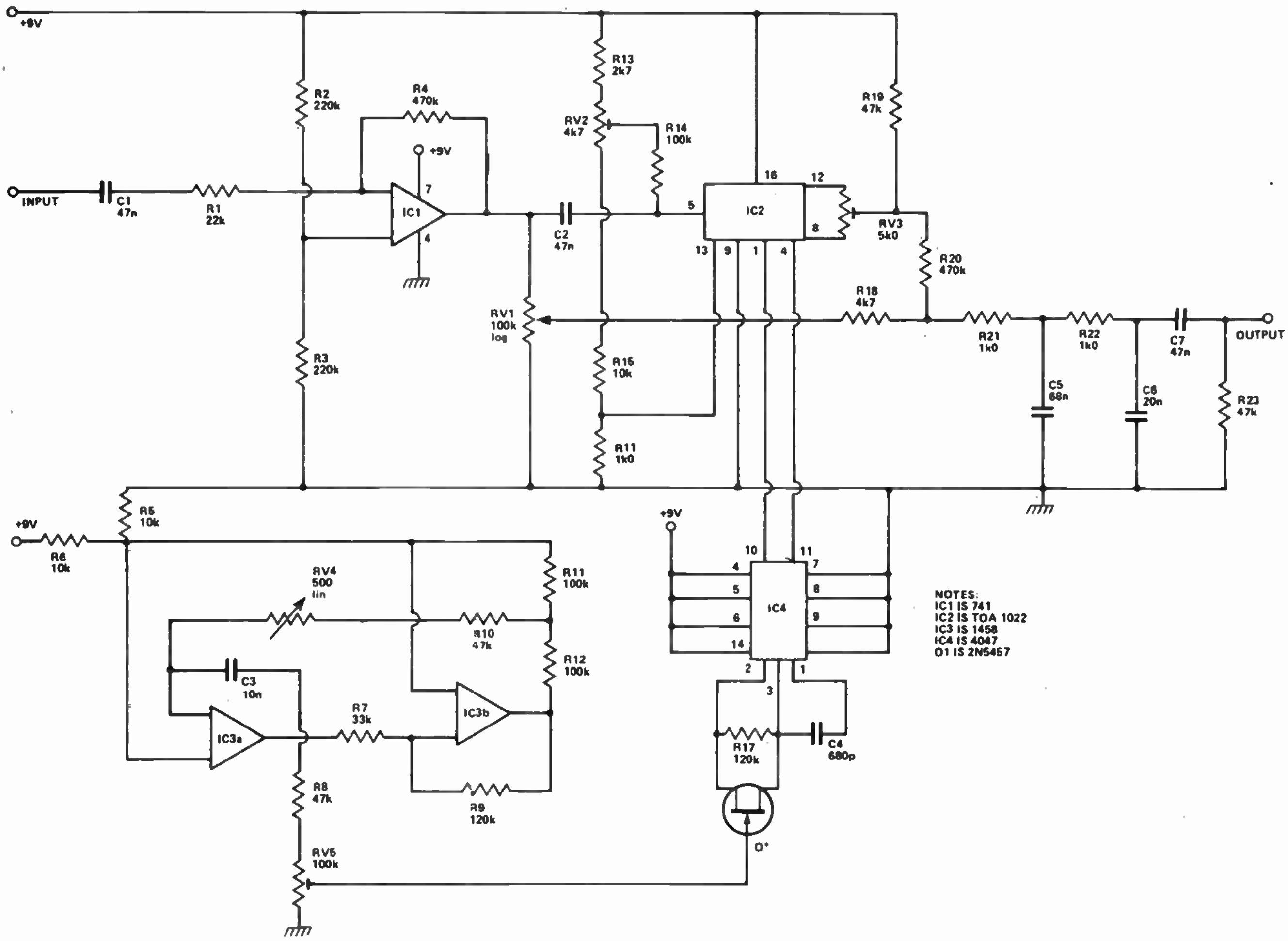
Although this circuit employs only one cheap CMOS IC and two transistors it is capable of high quality results. The IC, a 4011, contains four dual input NAND gates. Two of these are used with their inputs connected together to form inverters and biased into the linear mode by means of the feedback resistors, 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 Q2 gives the circuit a low output impedance and the gain with the input pot at maximum is four.





A simple sequencer

S. Giles

This is an example of how not to use a bucket brigade IC (according to the manufacturer's specifications). The circuit shown is basically that of a normal flanger but with two important differences

1. The clock modulation oscillator operates within the audio range.
2. There is no input filtering and output filtering is kept to a minimum.

The usual precautions should be taken when handling the TDA 1022 (in other words — don't use an IC insertion clip).

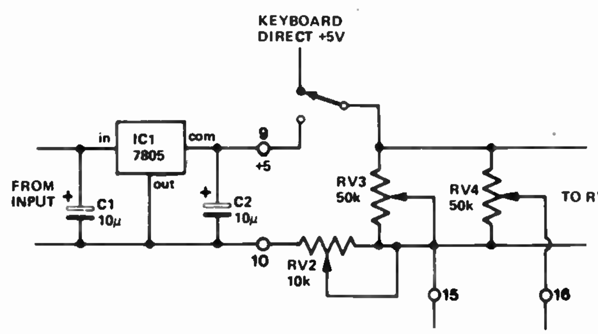
The setting up procedure is as follows

RV2 should be at its mid-point, although this is not too critical. Turn RV5 full on and the clock modulation oscillator should be heard at the output. Tune this with RV4 to the open 6th string on the guitar and then turn RV5 until the oscillator is barely audible. If the guitar is now played with RV1 fully on, both the guitar note and the oscillator will appear at the output, with the oscillator tending to follow the guitar's change in frequency. For best results the oscillator should be turned to the key being used. Finally, clock breakthrough can be minimised by use of RV3, which should preferably be a 20 turn preset.

Keyboard tracking for the ETI sequencer

Val Starr of Canberra, ACT, has made a small modification to our sequencer to allow it to track up or down in key with the keyboard, giving a very noticeable effect on short runs of four notes or so. This effect is used extensively on modern pop recordings.

The +5V line is broken between IC1 and RV3 and fed to a switch. The +5V supply can then be taken from the regulator as before, or from the keyboard for tracking.



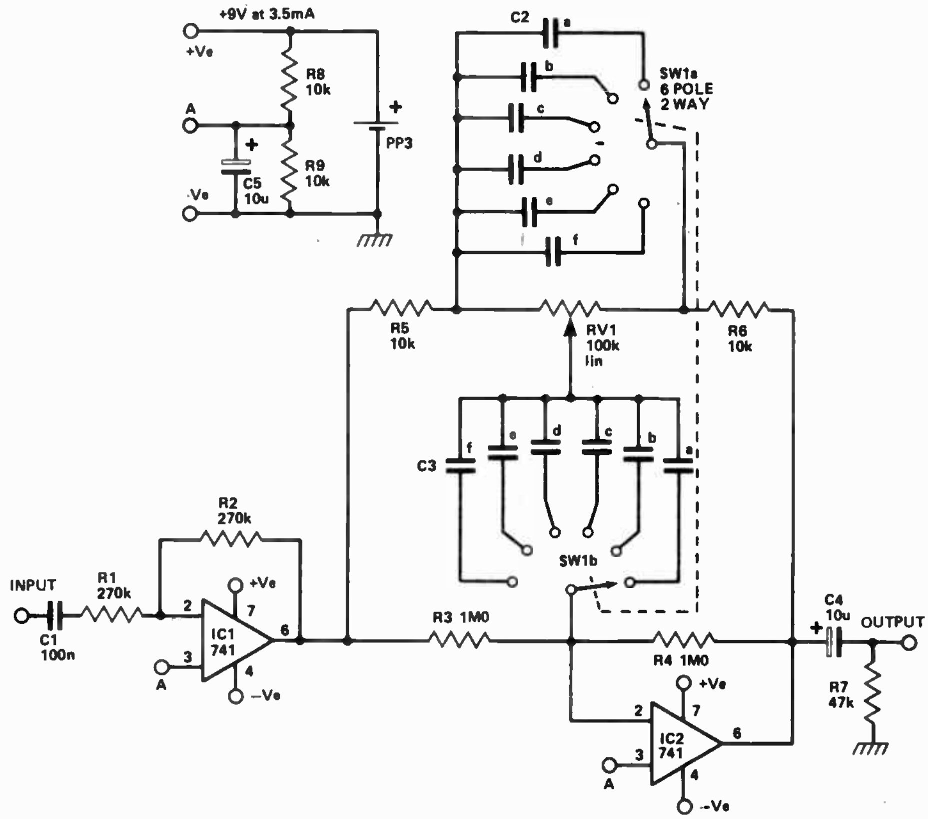
Parametric equaliser

C.E. Read, Norwich

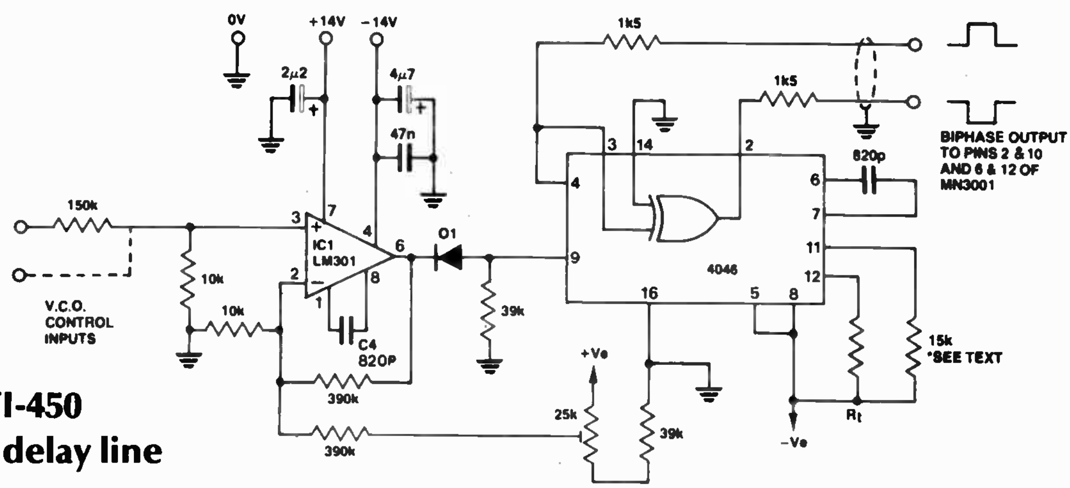
The parametric equaliser offers six bands of tone control separated by an octave in frequency, each frequency band being selected by the six position rotary switch.

Potentiometer RV1 permits the selected frequency band to be boosted or cut by 12 dB. The filter is particularly ideal for use with a guitar to modify and enhance the tonal qualities of the instrument.

For example, the 500 Hz setting with cut gives a hollow funky sound, whilst the 500 Hz setting with boost gives an overdriven valve amplifier, the raunchy sound favoured by many rock guitarists, but without the unpleasant muddy, harsh should resulting from boosting the entire audio frequency spectrum.



	FREQ (Hz)	C2 (pF)	C3 (pF)
a	125	47000	4700
b	250	22000	2200
c	500	12000	1200
d	1k	5600	560
e	2k	2700	270
f	4k	1500	150



VCO for the ETI-450 bucket brigade delay line

The ETI-450 Bucket Brigade Delay Line (see December 1977 ETI, or Top Projects Vol.5. or 30 Audio Projects) has many uses. In some applications (i.e: phasing or flanging) it requires a variable clock. This circuit, submitted by **Hugo Bramall of Canterbury, Vic.** will interest those enthusiasts considering the use of the Bucket Brigade Delay Line project.

An op-amp, IC1 (LM301), sums control voltages and amplifies them to about 14 V to control a 4046 CMOS VCO chip. The 25k potentiometer sets the minimum range of control voltage and hence the minimum frequency. In this case it's set to about 20 kHz, just beyond the audible range.

The phase comparator in IC2 is an exclusive-OR gate; wired as shown, it becomes an inverter, providing one opposite-phase output to drive the MN3001 bucket brigade chip in the ETI-450. The components C5, R8 and R9 may need adjustment "to taste" as the oscillator tracks over a wide range. Decreasing the capacitor value or increasing either resistor will increase the frequency, whilst Rt also trims the oscillator range (though this component is optional). Several control voltages can be mixed if the inputs are sourced from an impedance around 150k.

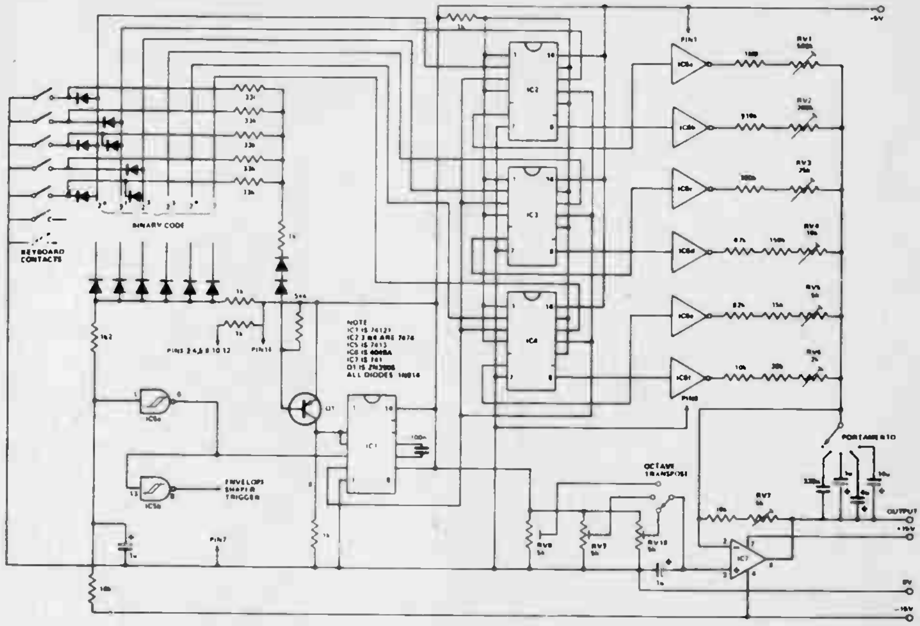
Sweep generator for VCO

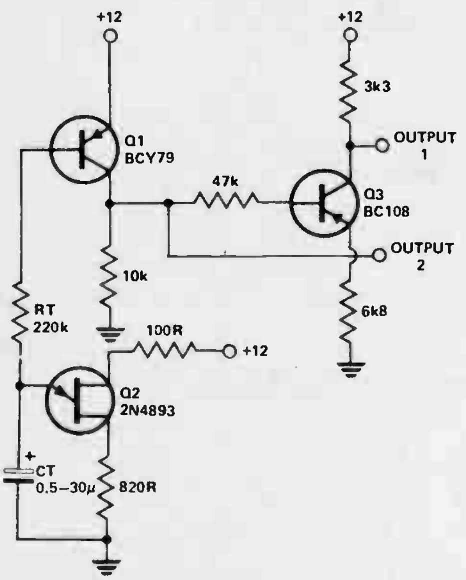
A sudden and immediate need for a sweep circuit to drive a 566 VCO led J. Elkhorne, of Chigwell Tas., to devise this circuit.

The circuit is by no means critical as several different general purpose active devices were tried.

Forward bias through the emitter-base junction of Q1 provides a charging current for a timing capacitor; this exponential curve is amplified in Q1 and taken from the collector circuit to provide a descending sweep of the 566. The signal is also routed to Q3, a simple inverter, to provide an ascending sweep voltage.

The UJT will not drive the 566 directly, as voltage divider action between the timing resistor and the IC drops enough voltage to keep the unit from firing.





Digital keyboard controller

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 a circuit which inhibits further data being clocked into the flip-flops if more than one key edge to trigger envelope shapers.

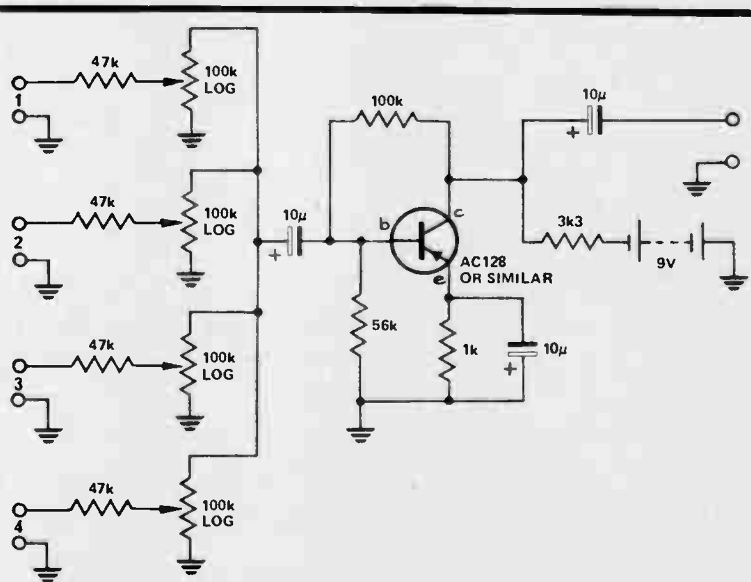
Up to 63 semitones (over five octaves) can be catered for using six data bits as shown, although more bits can be added.

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.

Four-input mixer

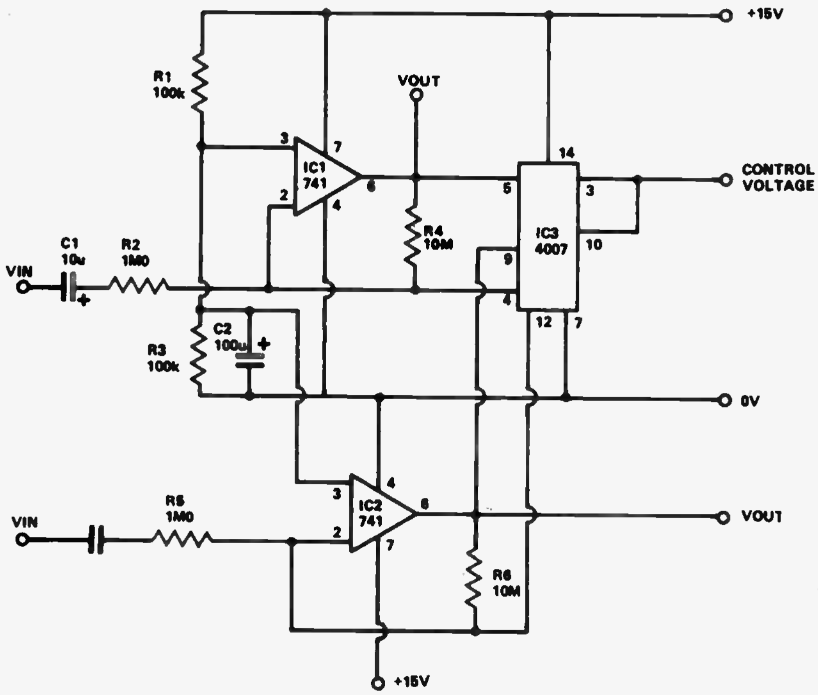
Mr D. Marzolla of Leichhardt claims that this mixer circuit has very low current drain and can give an operating life of three to four months from a No. 216 9-volt battery with moderate use.

The input impedance is 47k and the gain of the mixer is 3 dB. Perhaps a good use for those old germanium transistors you were going to throw out but knew they would come in handy sometime!



Stereo VCA

J. Macaulay



The circuit shown is of a stereo VCA whose gain can be varied over a 90 dB range by the application of a control voltage between 0-15V.

Maximum gain is limited to 20 dB and occurs when the control voltage is 0V. Minimum gain occurs with the application of +15V at the control input.

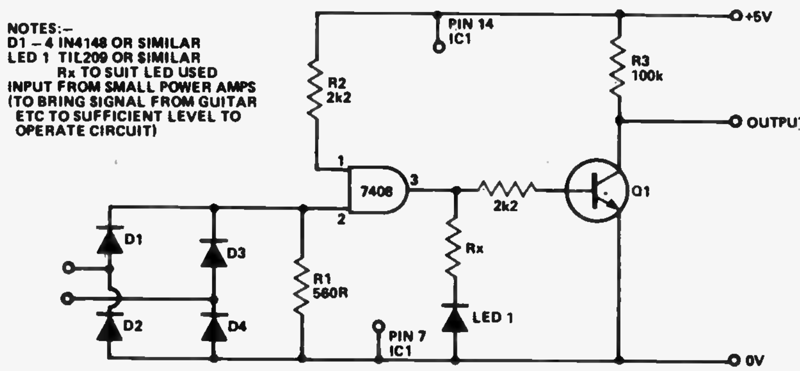
The circuit works as follows. IC1/2 are 741 op amps operated in the virtual earth mode with R1, R5 determining the input impedance at 1M, regardless of gain. The feedback loop from the output of the IC's are completed by the resistors R4, R6. A pair of MOSFETs, internal to IC3, are connected in parallel with these resistors and the control voltage is applied to their gates, pins 3 and 10.

When zero volts are applied to the gates the resistance across the feedback loop is some 10^9 ohms in all with R4-6. In consequence these latter components determine the gain of the stage. When the control voltage is increased in a positive direction the impedance across the FETs decreases and the gain of the amplifier decreases in sympathy. Once the voltage is increased to 15V the impedance across the FETs lowers to roughly 300R.

The frequency response of the amplifier extends from approximately 5 Hz-100 kHz at the —3 dB points whilst the distortion at maximum gain is about 0.1% at 1 kHz. If the feedback resistors are close tolerance types, 2%, the gain will be found to be within ±1 dB between channels due to the closely matched characteristics of the FETs within IC3.

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.

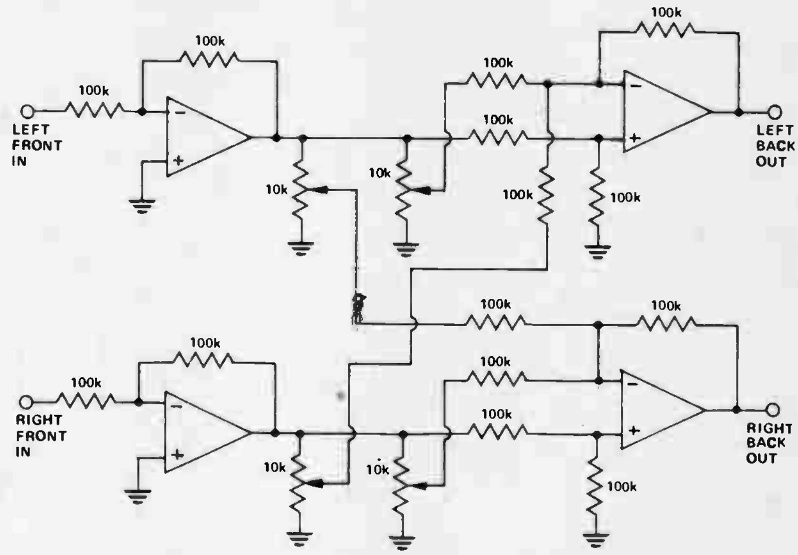
The synthesizer intended for use with the circuit has an extension trigger input which requires less than —3V on, thus the common and output connections of the external trigger device have to be reversed so that the external trigger input usually sees —3V5 (off) instead of +3V5.

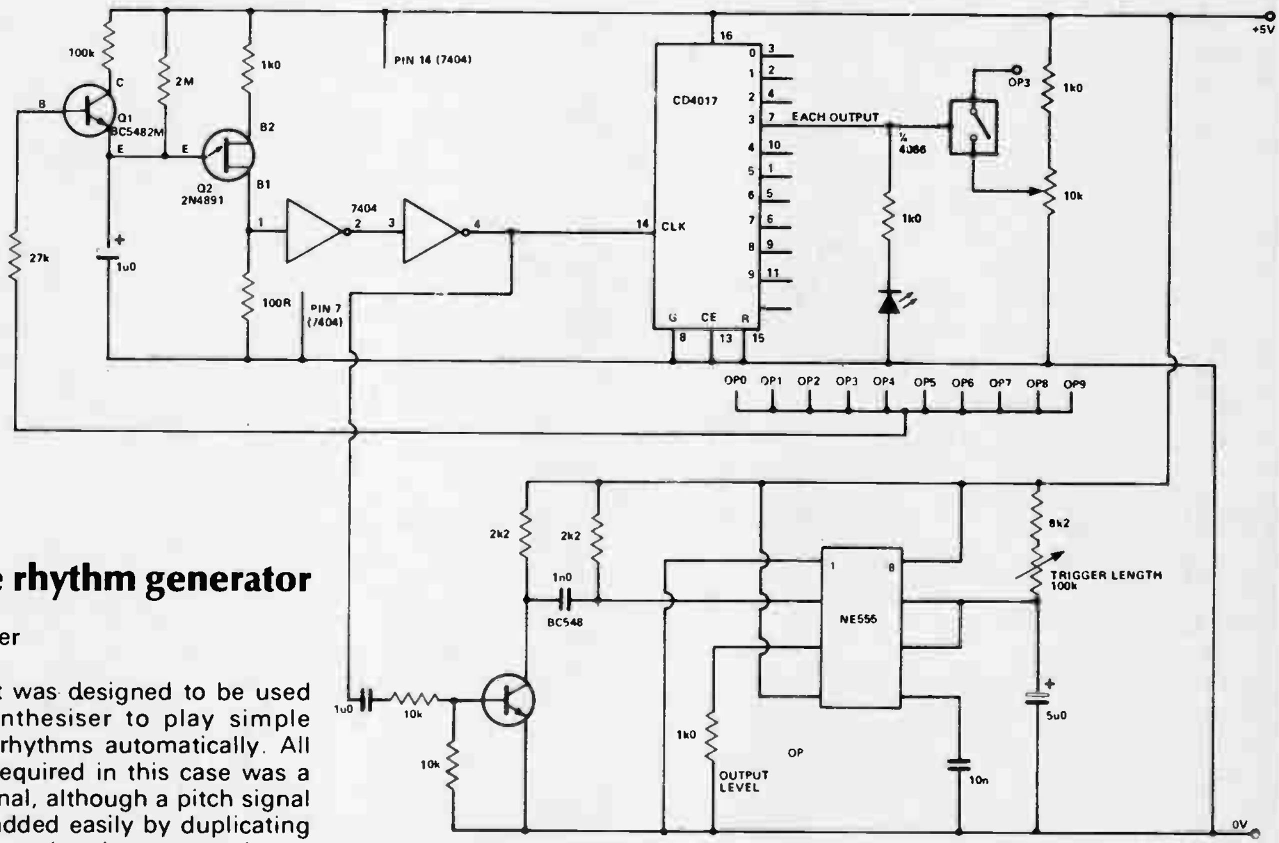
The circuit can be easily modified to suit individual needs. An example of its use is to trigger a filter sweep when the input of, e.g. a guitar, reaches a certain level.

Simpler 4-channel synthesizer

In March this year (p 105), we published a design for a circuit which synthesised the back channel signals for an 'artificial' 4-channel system, using the existing front channel signals.

Mr. P. Dennis of Berala has pointed out to us that the circuit we published can be massively simplified without affecting its operation. The above circuit uses less than half of the number of op-amps that the original used. It does this partly by utilising the op-amps as mixers with both inverting and non-inverting inputs, instead of separate inverters and inverting-only mixers as in the March circuit.





Simple rhythm generator

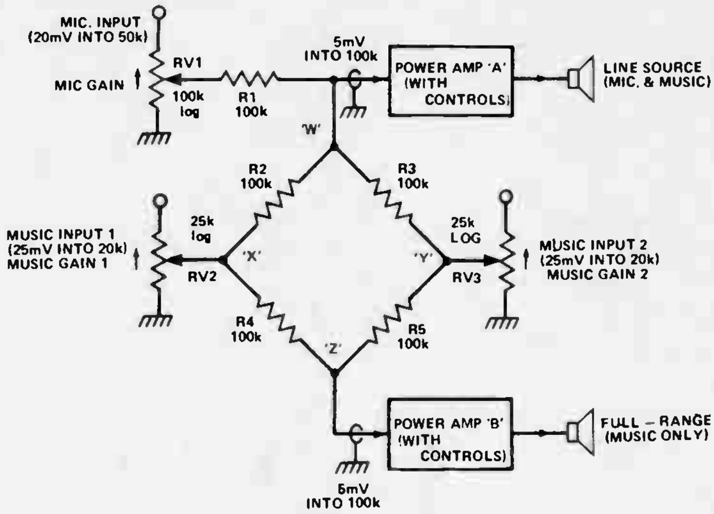
J. J. Trinder

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.

Anti-acoustic feedback system for group or disco



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.

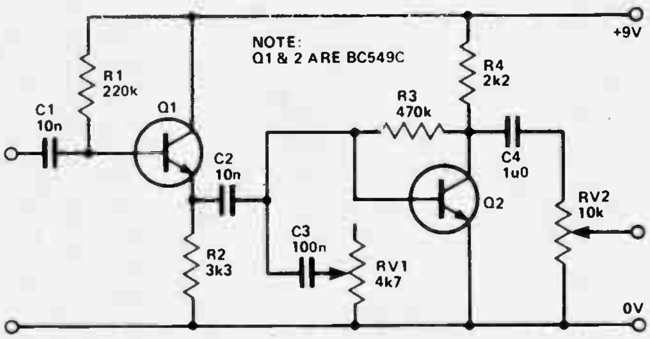
The principle has been proved in practice using the passive network shown in the diagram. As the microphone input is attenuated successively by three potential dividers before reaching the full-range loudspeaker system, the risk of feedback from this speaker is negligible. Typically there is at least 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.

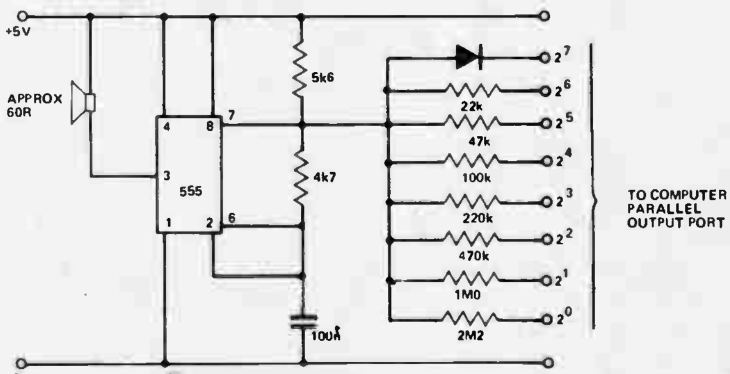
Guitar treble boost



Q1 is connected as an emitter follower in order to present a high input impedance to the guitar. C2, being relatively low capacitance, cuts out most of the bass and C3 with RV1 acts as a simple tone control to cut the treble and hence the amount of treble boost can be altered. Q2 is a simple preamp to recover signal losses in C2, C3 and RV1.

Cheap micro music box

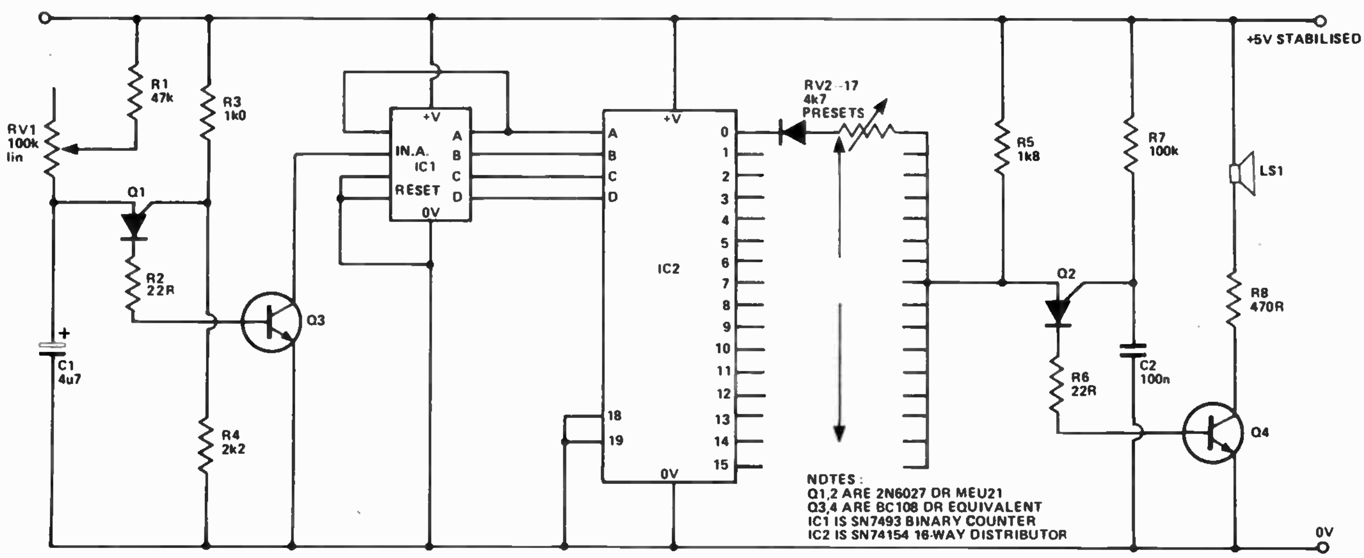
T.M. Tobin, Birmingham



This circuit may be connected to the output port of any micro to generate musical notes over a range of about 1½ octaves. On/off control is provided by the most significant bit and the resistors provide seven bit resolution. Alternative on/off control methods can be used to give eight bit resolution, eg by using the handshake lines, if available.

If the diode is replaced by a resistor, say 10k, it will be found that below a certain output value the voltage at pin 7 is insufficient to charge the capacitor. Thus the sound can be switched off.

The resolution is sufficient to enable values to be found corresponding to tones and semitones throughout the frequency range. Current consumption depends largely on the loudspeaker impedance and is generally low enough for power to be taken directly from the computer.



16 Note-sequencer

P Gatehouse, Buckingham

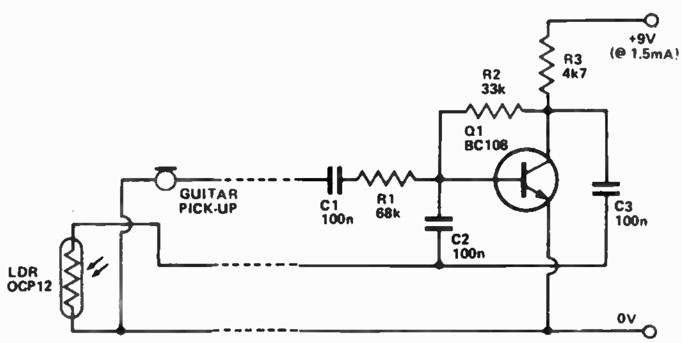
This circuit is designed to play a repeating sequence of 16 notes which are programmed by variable resistors. IC1 is a binary counter which runs off a PUT oscillator. The oscillator is built around Q1, which can be a 2N6027 or MEU21. The RC time constant connected to the anode charges up, causing the voltage at the anode to rise. At a certain voltage, controlled by R3 and R4, the PUT conducts. This allows the capacitor to discharge through Q3 as a good clean clock pulse. Q3 inverts the pulse to suit the TTL requirements. The frequency of these events is easily changed by altering the time constant – a 100 k variable resistor was used.

IC1 generates a binary count on its four outputs – only if you ground both the reset terminals. IC2 selects a single output line for each of the sixteen possible input combinations. The result is that the presets are connected one-by-one, in sequence. Q1 is the audio frequency oscillator, whose frequency can be changed by altering the resistors which determine the anode voltage of the PUT. Don't be tempted to leave out the diodes in series with the presets as they block the normally 'high' outputs from interfering with the selected 'low' output. The type of diode used is not critical. 1N914s are probably the best (and cheapest).

Interesting results can be obtained by connecting a fairly large capacitor to various parts of the gate terminal of the second (AF) oscillator. Connect the other terminal ground or positive line – watch the polarity, if it's electrolytic. Another oscillator can be connected to the same outputs provided it is fitted with diodes isolating it from the first oscillator. If the outputs are mixed, polyphonic effects are possible.

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.

Automatic nicad charger

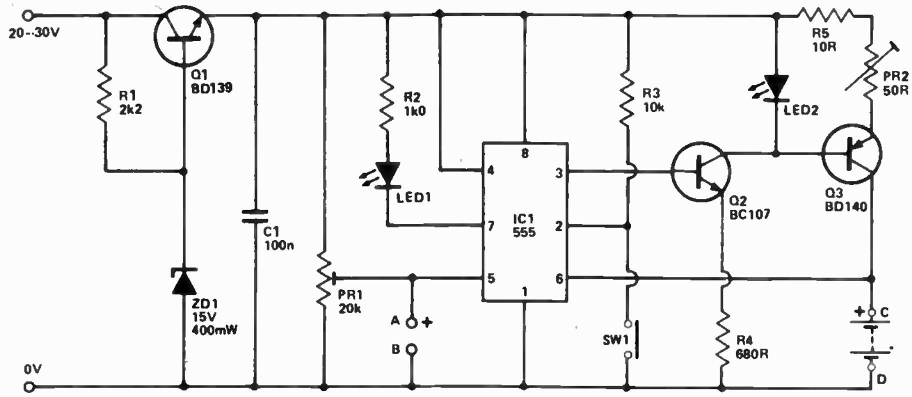
M.G. Baker, Port Elizabeth

This circuit will charge up to eight 1V25 Nicad cells at a constant current of up to 100 mA. When the battery voltage reaches a preset level, the charger trips and charging ceases.

The voltage of a Nicad cell increases as it is charged and reaches a value of approximately 1V45 when fully charged. A battery of eight cells would, therefore, be fully charged when its voltage is 11V6. The recommended charging current of a Nicad cell is usually 10% of its mAh rating ie 50 mA for a 500 mAh battery.

To set up the circuit, connect a voltmeter across terminals A and B. PR1 is adjusted to the desired trip voltage eg 11V6 for eight cells. A milliammeter is then connected between terminals C and D. Reset button SW1 must be momentarily depressed and the required charging current is adjusted by PR2.

The battery may now be connected between terminals C and D. When SW1 is depressed, LED 2 comes on indicating the battery is charging. When the battery voltage exceeds the preset trip voltage, the charging current drops to zero and LED1 comes on indicating the battery is fully charged.



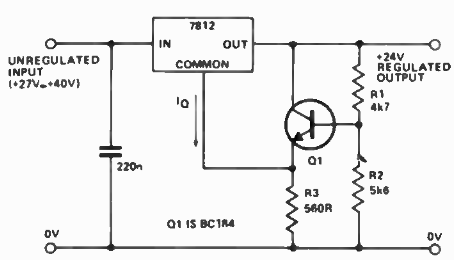
Increasing regulator outputs

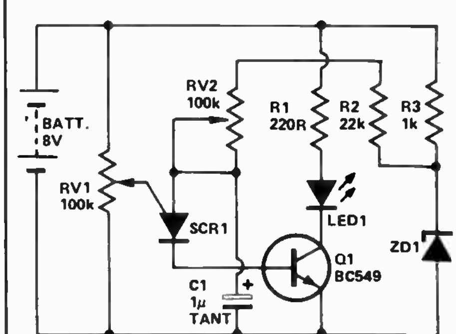
It is often necessary to arrange an integrated circuit 3-terminal voltage regulator to give a higher output voltage than that set by the regulator alone. The normal way of doing this is to connect the "common" terminal to the mid-point of a potential divider hung between the regulated output and ground. 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 above 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.





Battery state indicator

A flashing LED can be used to give an accurate indication of the state of a battery, without using a lot of battery power. The circuit shown can be adapted to batteries from 4V to 16V by selecting R1 to limit the LED current to about 20 mA and choosing ZD1 about 1V lower than the voltage of a flat battery.

RV1 sets an upper voltage, below which the LED flashes; the flash rate increasing as the voltage drops. RV2 sets a lower voltage, below which the LED is continuously lit, and this should be used to indicate the need for immediate battery charging or replacement.

If a stable reference voltage is available elsewhere in the equipment, this may be used instead of R3 and ZD1.

Now that's quite a cunning idea, from F. Gillespie of Findon W.A.

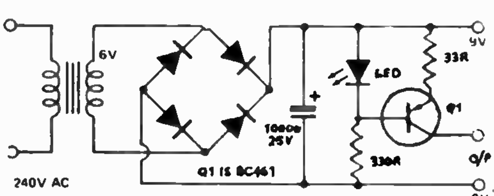
Constant current source

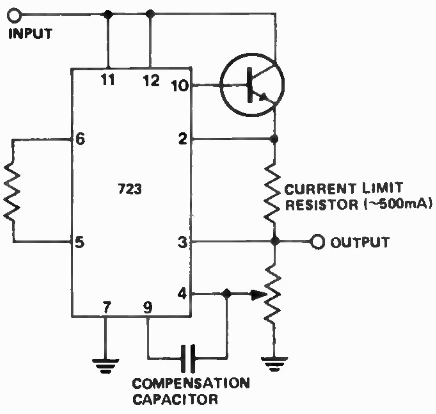
This circuit uses a standard panel mounting LED to provide a constant reference voltage for a transistor in a constant current generator.

The output current I, is given by the equation

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

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





PIN NUMBERS FOR 14–OIL

Regulator problems

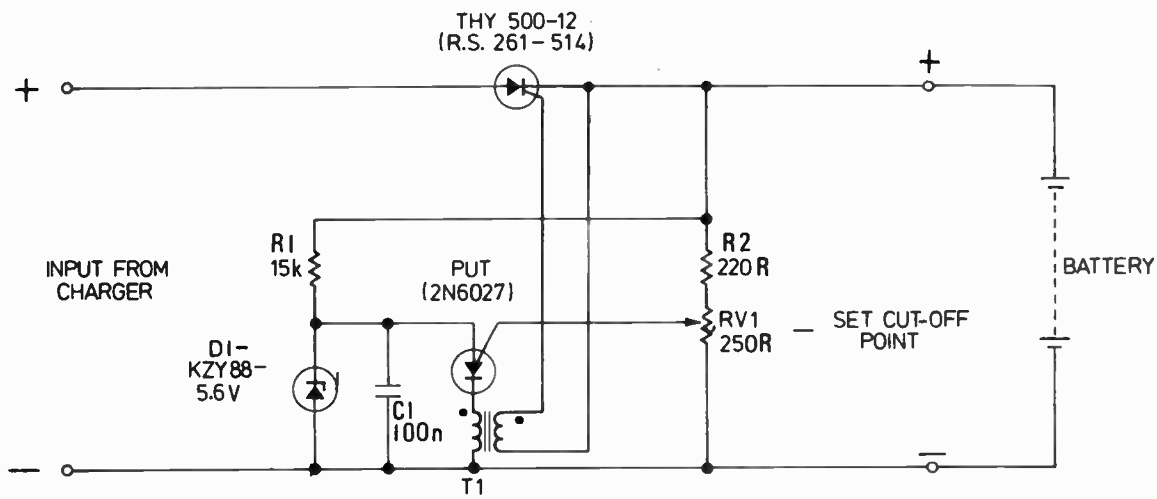
Also from **Mr P. Dennis**, some comments on the use of the 723 regulator IC.

Firstly, the shown circuit configuration, designed to supply about 500 mA, will oscillate at times, even with a 220p compensation capacitor. The solution to this one is to use a transistor with lower gain. As long as the f_t stays the same, then the 3 dB corner frequency will go up by the same amount that the beta goes down.

Usually the lower gain presents no problem to the 723, although it does represent a higher load.

Secondly, if for any reason the wiper of the output voltage preset pot goes to earth, the IC may be damaged as the amplifier differential voltage (5 V max) may be exceeded. This usually occurs with multi-turn pots where the wiper position cannot be seen. It can easily be avoided by pre-setting the wiper to the output end of the track before switch-on.

Thirdly, when operating the 723 without an output transistor (in which case it can supply up to 150 mA), remember that it may heat up, causing the reference voltage to drift.



Battery charger controller

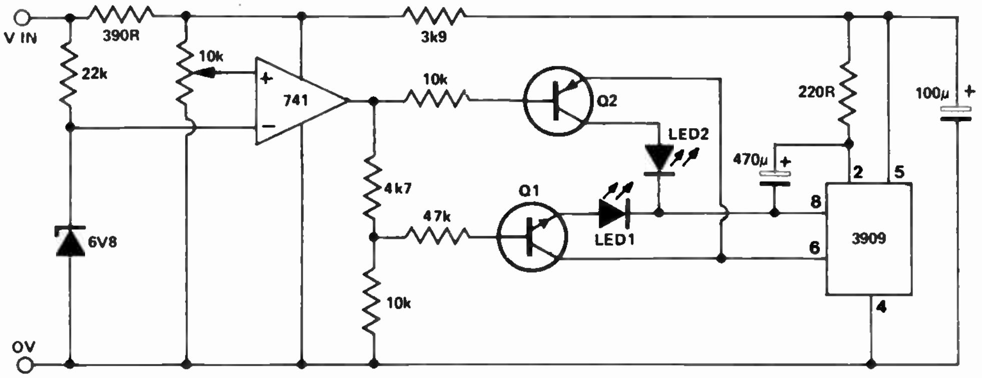
D. Wedlake

The battery charger circuit illustrated was designed to be incorporated in any conventional battery charger rated up to 10 amps, where the output is full-wave rectified and unsmoothed. It is fully protected as it cannot be damaged by short circuit or reverse battery connection. Furthermore, charging ceases when the battery voltage reaches a pre-set voltage (normally 13V8 for a fully charged battery).

The design is based on the Programmable Unijunction Transistor (PUT) oscillator which senses the battery voltage to determine when charging should cease. The battery being charged provides the power for the oscillator which, in turn, triggers the thyristor via the pulse transformer T1. As the anode of the PUT is clamped to 5V6 by the Zener Diode, ZD1, it follows that the circuit will not oscillate if the potential at the slider of RV1 is correspondingly higher. Therefore, RV1 controls the cut-off point which should be set to 13V8. This is best set under actual operating conditions and the charging current will gradually reduce as this voltage is approached.

The charger is fully protected as the circuit cannot oscillate under short circuit conditions or reverse battery connections. However, as the power for the oscillator is derived from the battery, the circuit will naturally not be self starting if the battery is completely flat or charged to less than about 7 volts. This problem could be overcome by providing a push-button shorting switch across the thyristor to initiate charging. In a short while the battery voltage should have risen sufficiently to maintain normal operation. However, one should bear in mind that the charger will not be protected when the start push button is pressed, so if included, one should provide a fuse as additional protection.

If used at full load current, the thyristor should be mounted on a suitable heat sink having a thermal dissipation of 4 C/W (eg RS 401-497).

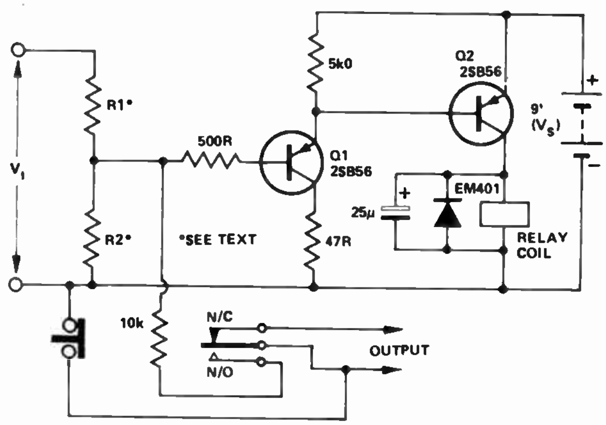


Voltage level indicator

This circuit, by Fred Zickar of Bellambi, indicates the state of nickel-cadmium batteries in portable equipment.

LED 2 indicates a low battery voltage and the 3909 IC will make it flash when this occurs. The 3k9 resistor in the 3909 supply line varies the brightness of the LEDs. You can change it to suit ambient lighting conditions. The potentiometer sets the required 'battery OK' voltage. The circuit draws less than 10 mA.

Relay PSU protector



This circuit may prove very useful when trying out a project for the first time. Any power supply shorts will pull the supply voltage (Vi) down, turning the transistors on and tripping the relay. This then causes the 10 k resistor to latch the circuit in the 'tripped' mode. The relay is connected so that it disconnects the supply to the circuit being tested. The circuit can be reset by pressing the momentary-contact switch shown.

R1 is selected so that Vi/R1 is greater than Vs/R2. R2 must be greater than R1 and Vs/R2 must be large enough to turn the first transistor on.

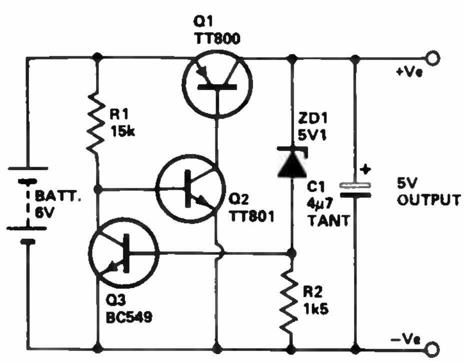
The circuit (which was sent in by Scott Field of Taree) work with Vi ranging from 3 to 18 volts.

Stabiliser for battery supplies

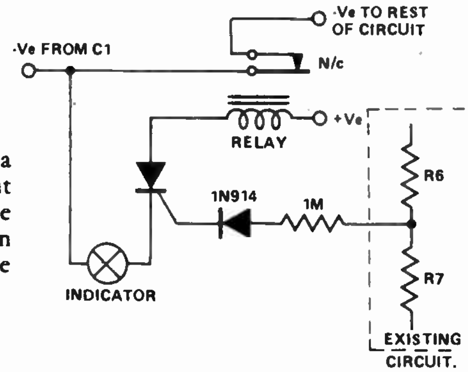
The accompanying circuit, is useful when voltage sensitive devices (such as TTL ICs) must be battery operated. It uses very little power from a good battery; whilst with a flat battery, the output voltage is within 0.1V of the battery voltage.

ZD1 should be selected to obtain approximately the desired output voltage; for fine trimming, R2 may be selected between 470 ohms and 3k3. With the components shown, the output voltage varies less than 2% for battery voltages from 5V to 8V and output currents from zero to 200 mA. For higher currents, R1 may need to be decreased.

Always use a power transistor for Q2 or it will overheat when the battery is nearly flat. Both Q1 and Q2 should have a current gain of at least 40, while the gain of Q3 should be as high as possible.



Short circuit protection for ETI-132



John Peschar of Marks Point found that the overload indicator of his ETI 132 power supply gave insufficient warning. He developed this circuit which cuts the output of the supply when the current drawn reaches approximately 1.3A, latches and turns on an indicator to show that an overload condition has occurred.

The SCR used in his device was a C106D1, which had sufficient current capability to drive the indicator he used. D1 can be almost any silicon diode. It prevents feedback from the SCR gate to the rest of the circuit.

'Zener-less' battery eliminator

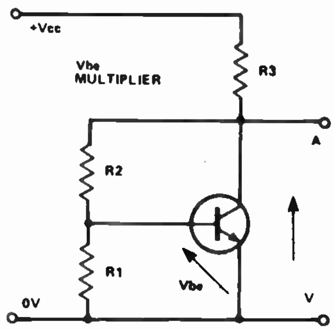
P.J. Hunt, Wimborne

Designed as a variable-voltage battery eliminator, this circuit provides a stabilised output without Zener diodes as the reference source. Instead, a V_{be}-multiplier is employed, so that the output voltage may be continuously varied by PR1 over the range 6-10 V.

The V_{be}-multiplier is shown schematically in the inset. Provided that V_{cc} is high enough, the potential across R1 will be about 600 mV for a silicon transistor. The current through R1 can thus be adjusted so that the base current of the transistor may be ignored for practical purposes. In this case, the current through R1 will equal the current through R2. The potential at point A is thus given by:

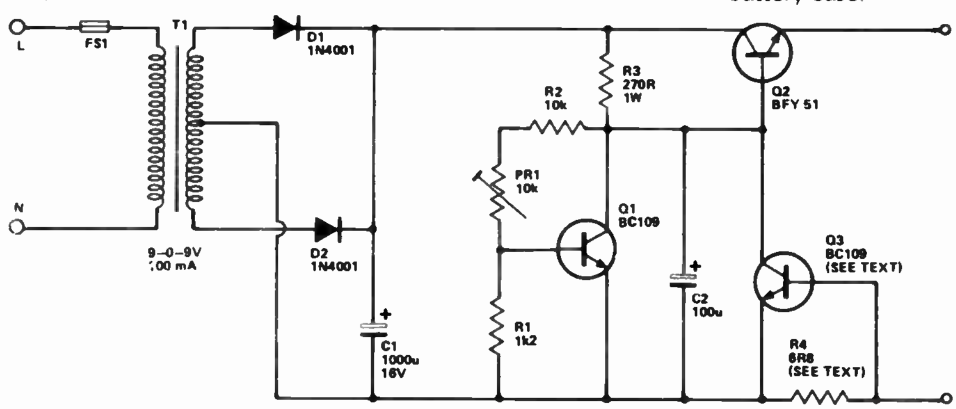
$$V = V_{be} \times \frac{(R1 + R2)}{R1}$$

- hence the name V_{be}-multiplier.



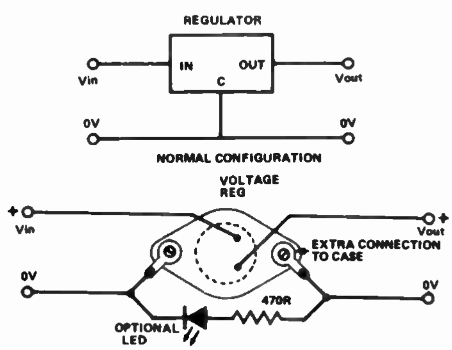
R3 limits the current through the parallel combination of the transistor and R1/R2. Suppose as an example that V_{cc} tries to rise. The potential divider formed by the three resistors will try to raise the voltage across R1. This will tend to increase the collector current and thus increase the potential drop across R3, leading to a stabilising effect at point A. This is a case of voltage-derived series feedback.

In the practical circuit, R3 also provides base current for the series transistor Q2. Q3 and R4 form a current limiter. If the output current exceeds approximately 100mA, Q3 starts to turn on, reducing the output voltage. If desired, Q3 and R4 may be omitted, in which case R3 may be de-rated to ½ W. The whole unit fits easily inside a PP9 battery case.



Fail-safe for IC voltage regulators

Andrew Bain



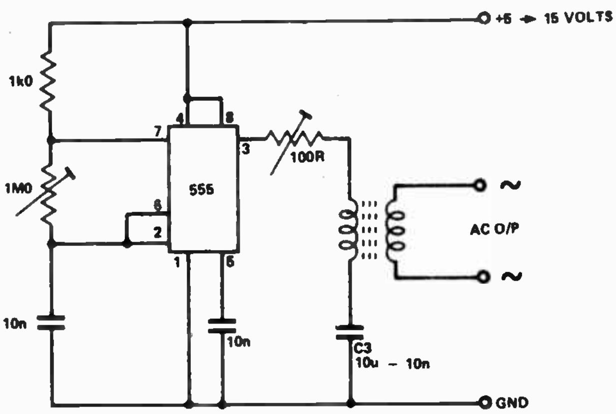
One of the problems with using power supplies based on IC voltage regulators is the chance that the common (case) connection could come off, allowing the output to rise to the full input voltage. If the regulator was driving TTL there could be disastrous consequences.

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.

Mille-power inverter

J. S. B. Dick

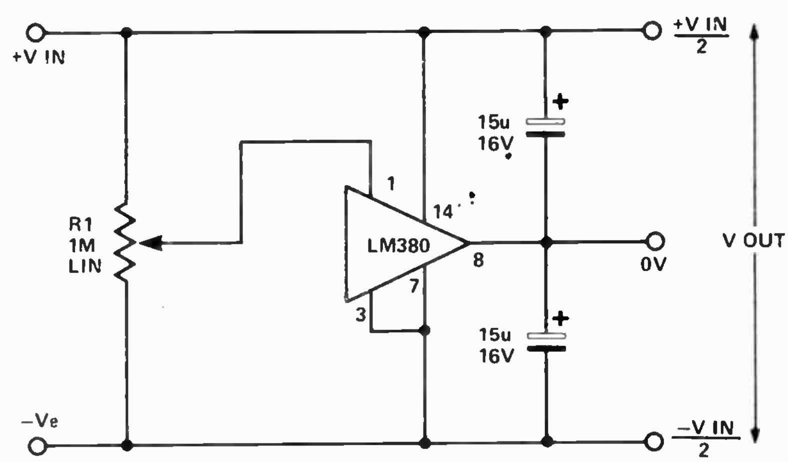


Many home-grown projects require a high voltage, low current source. The simplest and safest means of providing this is by an inverter. The circuit described here is versatile, efficient and easily capable of providing power for portable Geiger counters, dosimeter chargers, high resistance meters, etc.

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, 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 symmetric output is obtained.

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.

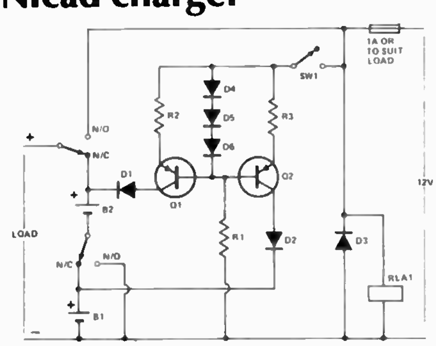
The device is internally biased so that with no input the output is held mid-way between the supply rails.

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.

Nicad charger



Quite a number of portable appliances use battery supplies for which NiCad batteries are ideally suited. This circuit, from Ron Smith of Rockhampton QLD, charges two sets of 6 V NiCads from a 12 V source. This allows a 12 V NiCad battery supply to be charged from the 12 V supply in a car or boat, and used as an emergency power source. It would be useful for charging NiCad batteries used in handheld transceivers.

The circuit splits the NiCads into two 6.25 V groups and charges from two current regulators with a common voltage divider on their bases. The output normally comes directly from the vehicle's battery supply until the voltage falls and the relay drops out. The values shown provide about 100 mA charge which is suitable for NiCads of 1 AH capacity or larger. The charge rate may be varied by changing the value of R2 and R3.

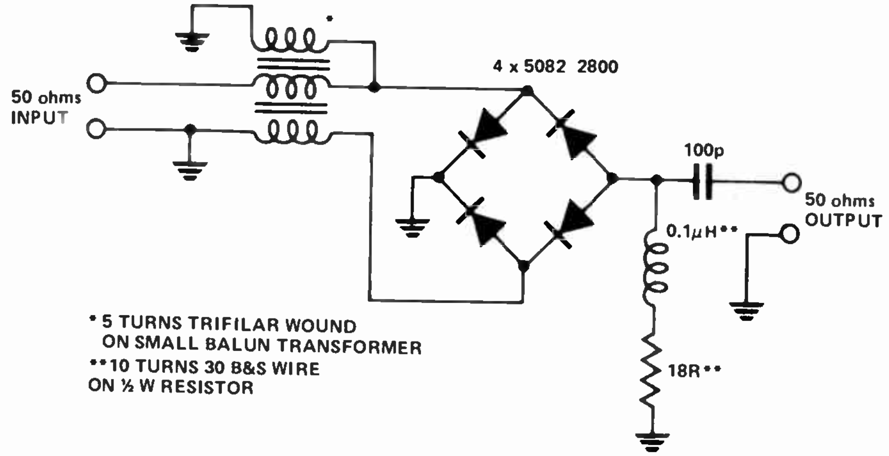
Q1, Q2	MJ2955
D1 – D6	1N4004
R1	330R, 1 W
R2, R3	15R, ½ W
RLA1	12 V relay, DPDT

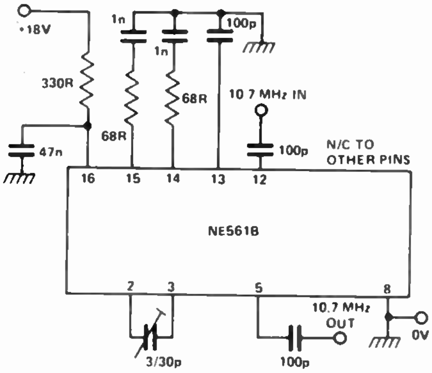
Frequency doubler

This circuit from staff files can be used to double the frequency of an RF signal generator. A generator with a top range of say, 100 MHz, can be used to provide signals of up to 200 MHz. Fundamental, third and fourth harmonic are about 20 dB or more below the second harmonic (desired) content provided the diodes are all well matched.

Input and output impedances are around 50 ohms. All wiring should be as short and direct as possible. The whole circuit may be mounted in a short piece of tube with a BNC connector on each end.

This could also be used in an oscillator/multiplier chain and for VHF/UHF converters or transverters and would most likely be followed by some sort of tuned amplifier.





CMOS radio

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 500- trimmer and the resulting tank circuit referrred 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.

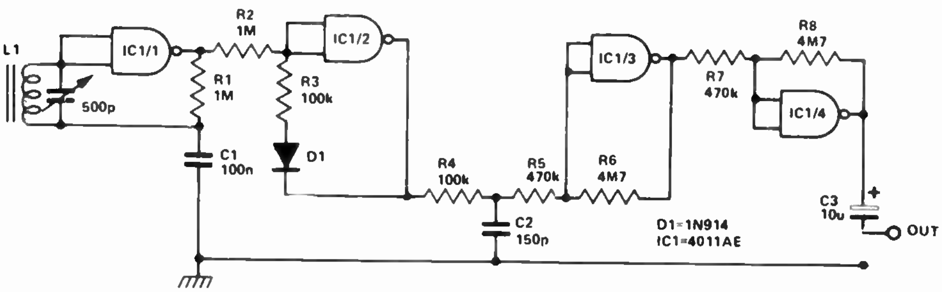
Note that the IC used must be a 40011AE and not the 4011B whose input protection network will prevent it from operating in the linear mode.

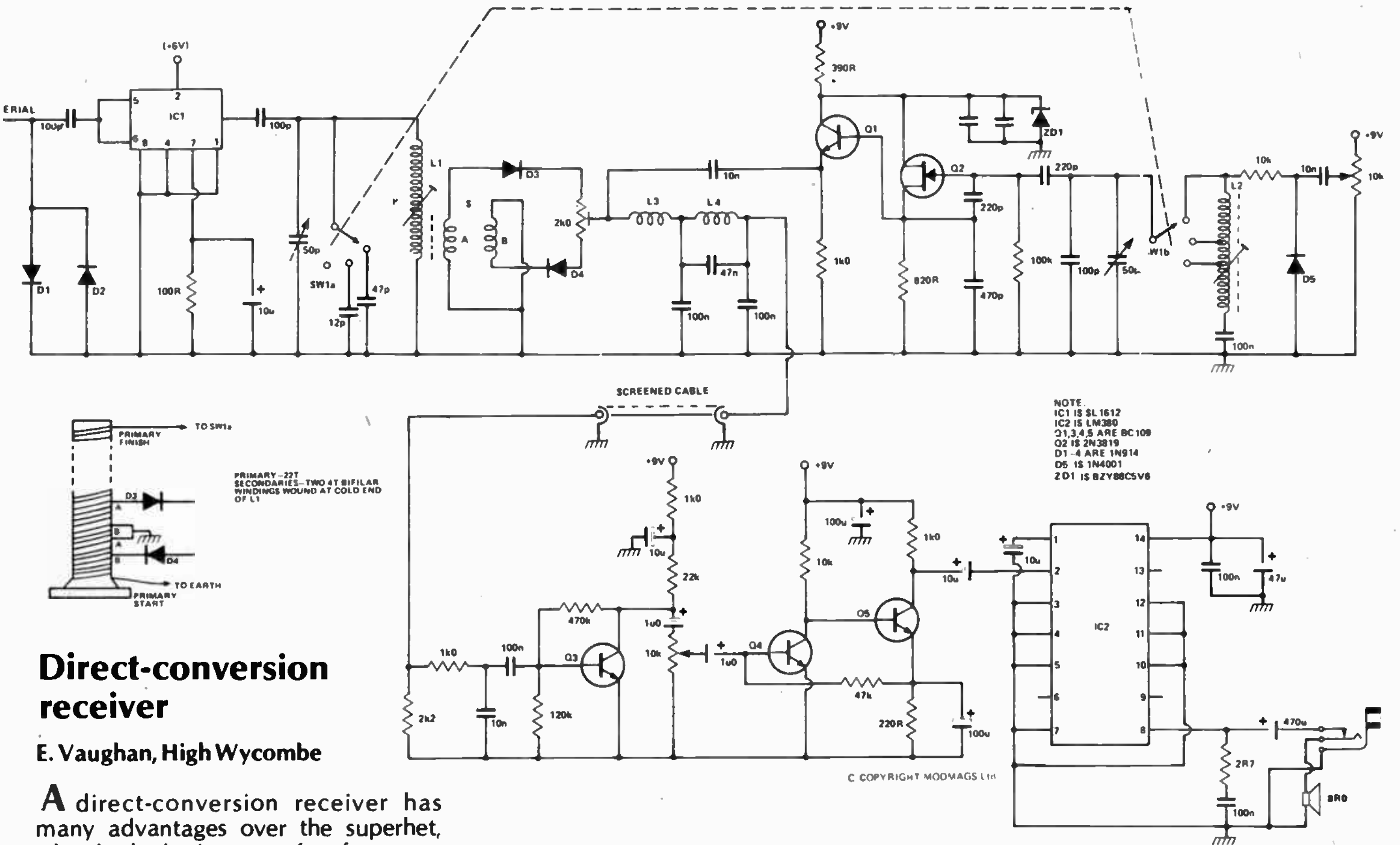
FM signal conditioner

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

The circuit shown in suilt 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.





Direct-conversion receiver

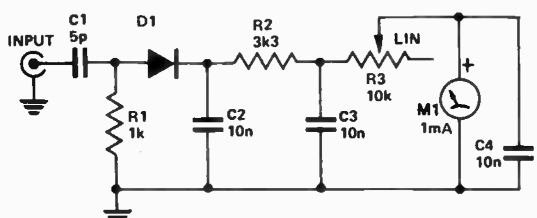
E. Vaughan, High Wycombe

A direct-conversion receiver has many advantages over the superhet, when looked at in terms of performance versus complexity and cost (this receiver can be built for around fifteen pounds or less). The SL1612 is an RF amplifier providing premixer gain. D1,2 protect the IC. The mixer is a balanced type, driving an M-derived single section lowpass filter with a cut-off frequency of 3 kHz. The oscillator is a Colpitts type followed by a buffer stage to prevent pulling of the oscillator when tuning. Although mainly for SSB and CW, AM can be resolved by tuning to zero beat. The circuit employs varicap tuning.

Using a wire aerial 66 feet long, separated at 33 feet by an insulator and fed with 75R coax, it is possible to pick up stations from all over Europe, North and South America and Africa. When correctly set up, this receiver should switch-tune to the 14 MHz, 21 MHz and 28 MHz amateur bands.

L1,2 are wound on ⅜ inch diameter slug tuned formers using 36 SWG wire. Winding details of L1 are shown in the diagram. L2 is 25 turns tapped at 9 and 14 turns. L3 is 1 mH and L4 10 mH.

RF monitor meter



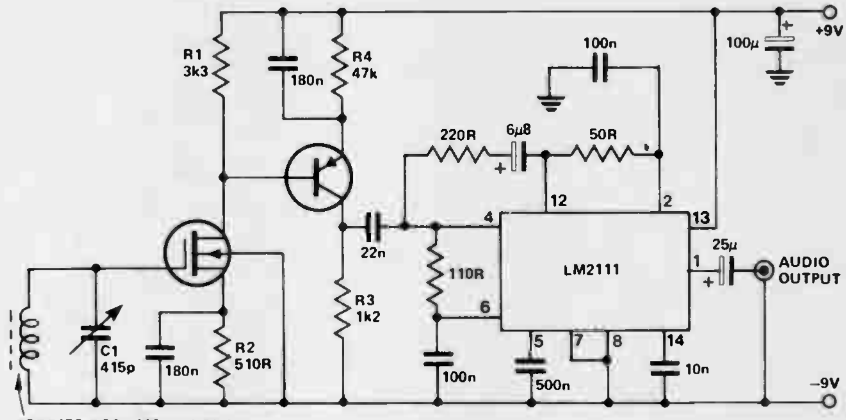
A simple RF and modulation monitor is always a handy instrument to have around the shack. This one should cost less than $10 — half that if you use a 'surplus' bargain meter movement. The input could be taken from two coax connectors mounted in a small box with their centre conductors connected together — providing a through connection so that the unit may be slipped in series with the transmission line to the antenna.

Just about any small signal silicon or germanium diode may be used for D1 — like 1N914, 1N4148, OA200, OA202, AA119, OA90, OA91, OA95 etc.

Capacitor C2 should have very short leads for best effectiveness. At VHF its value could be reduced to 470 pF or 1 n. The pot, R3, is a sensitivity control. The value of C1 should be varied so that full scale deflection is obtained with the usual RF power used with R3 at maximum resistance. Alternatively, the 'free' end of R3 could be connected to ground to provide a greater range of control.

When using the monitor on SSB transmissions, C3 may be increased to say 100 n or as much as 1 uF to provide some 'hand' for the meter indication.

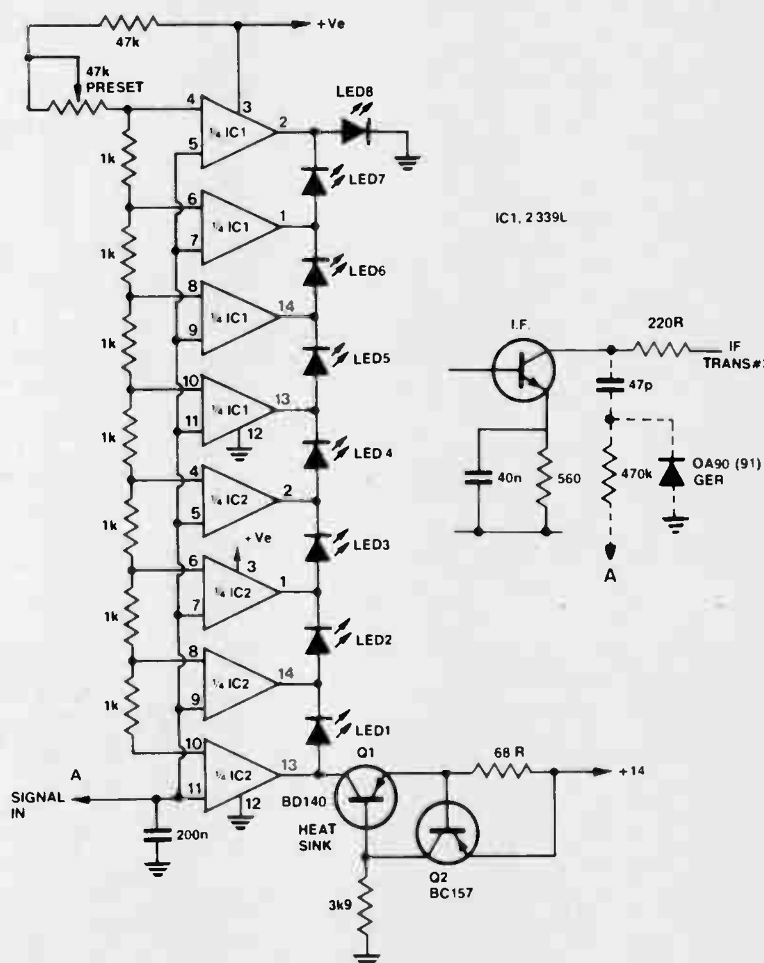
Synchrodyne tuner



The main component of this design, from **H. Lee of Vaucluse NSW**, is the integrated circuit which can be any of the many types of FM detector and limiter chips such as LM 1351, MC 1351, LM 1841, ULN 2136A, LM 2111, ULN 2111A, LM 2113 and ULN 2113A. There is very little difference among these ICs, except the pin connections. The detection of the AM signal takes place when two synchronous signals are fed into the balanced product detector (or multiplier) section of the chip. The two signals are obtained from the same RF amplifier, MOSFET-PNP combination, Q1 and Q2 (hence the name synchrodyne). The de-emphasising capacitor, C2 at pin 14 of the LM 2111 IC smooths the audio output at pin 1. The author does not find it necessary to incorporate a 10 kHz whistle filter.

The selectivity is rated fair for the high frequency end of the AM band but stations like 2FC Sydney on the lower end are entirely satisfactory. However at a small increase in cost and a little effort of alignment, selectivity can be increased greatly if R3 is replaced by another LC tuned circuit similar to L1 C1. This was not used since the author is a 2FC fan most of the listening time! If a replacement is used for Q2 then it must be a high fT variety and R4 can be trimmed for the required gain of the RF stage.

LED S-meter



This circuit, from **Ivan Zaletel of Liverpool, NSW,** employs two quad comparator ICs connected to drive a row of LEDs in a bargraph arrangement with the input coming from the detector dc output or AGC line of a receiver. Thus, signal strength is indicated on the row of LEDs.

Transistors Q1 and Q2 provide a constant current drive for the row of LEDs. All the comparators have one input tied together and driven from the detector output ("signal in"). Each other input of the chain of comparators is connected to taps on a resistive divider 'ladder'. As the input voltage increases, it will exceed the voltage on each successive tap of the ladder and the comparators will each change state in turn. The output of each comparator will initially sink current until it changes state and thus the LEDs will only turn on in sequence, commencing with LED1. The output from my receiver was derived from the point A in the supplementary circuit (I added the 47p capacitor, 47 k resistor and OA90 germanium diode). The voltage at point A varies from 0 V with no signal to just under 1 V for a strong signal. The 47k preset pot in the S-meter is set so that no LEDs are lit when no station is being received.

The ubiquitous 555

These two circuits come from the pen of **F. Zickar of East Corrimal NSW** and illustrate some interesting applications of the ever-present 555 timer IC.

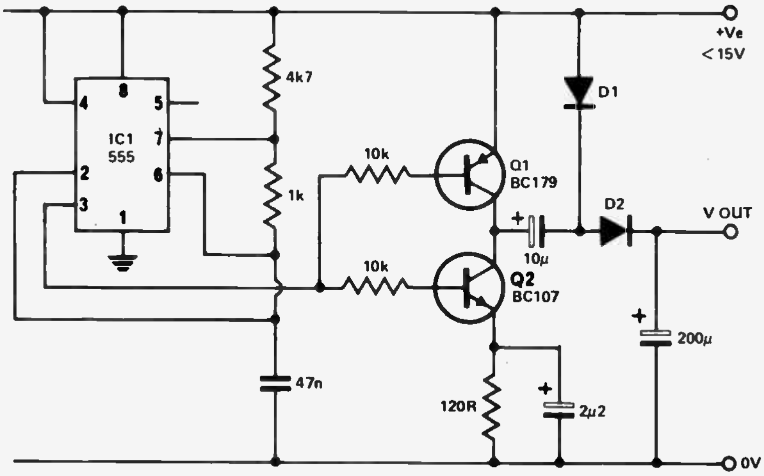
Circuit (1) shows a voltage doubling dc-to-dc inverter which consists of a 555 as an oscillator driving a complementary pair of transistors, Q1 and Q2, followed by a voltage-doubler rectifier.

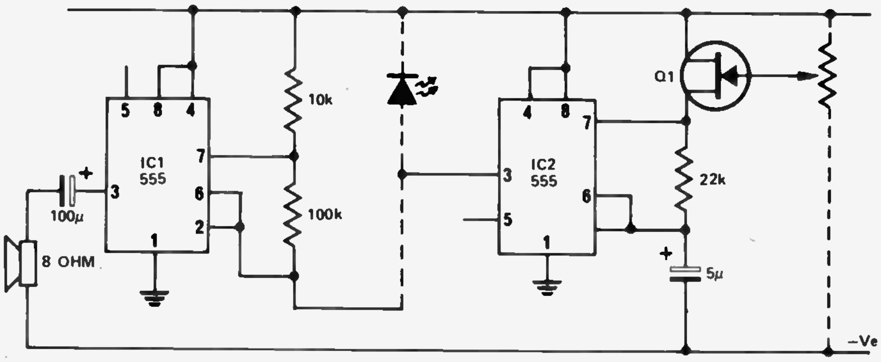
When pin 3 of the 555 goes high, the collector of Q2 drops to near 0V as it turns on (Q1 is off) and the 10u capacitor charges through D1 and the collector-emitter of Q2, reaching a value almost equal to the supply voltage.

When pin 3 of the 555 goes to 0V, Q2 turns off and the collector of Q1 goes to the positive supply rail as it turns on. Now, the 10u capacitor discharges into the 200u capacitor through D2 and the process repeats with every cycle of ICI. After a few cycles, this latter capacitor is fully charged to a value equal to almost twice the supply rail voltage. If the supply is 12 V say, Vout will be about 22 V.

This can be used to supply an audio preamp, for example, in an amplifier that has low voltage supply rails, in order to improve overload margin etc. Load current may be about 10 - 15 mA.

The circuit in (2) is a suggestion for a voltage-controlled oscillator (VCO). Here, a FET (Q 1) is used as a voltage-variable resistance to control the voltage on pin 7 of the input 555 (IC2). As Q1 forms part of the CR timing network, this varies the frequency of the pulse from pin 3 of IC2.





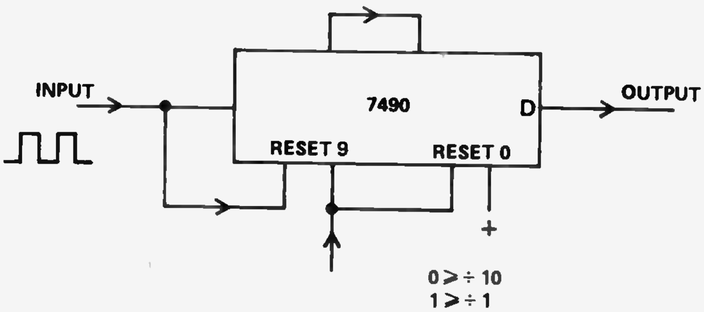
IC2 can then be used to drive, for example, an LED (dotted circuit). Its brightness would vary with the variation of the output frequency pulses from IC2. The gate of Q1 could be connected to the AGC line of a receiver and the LED used as a simple signal strength indicator in place of a more expensive 'S-meter'.

The rest of the circuit shows how to 'slave' another 555 (IC1) to provide an audio output.

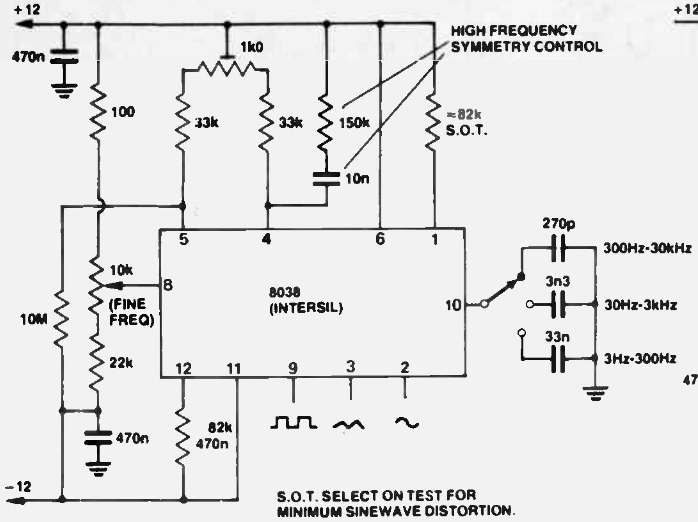
Simplest 'divide by 1 or 10' scaler

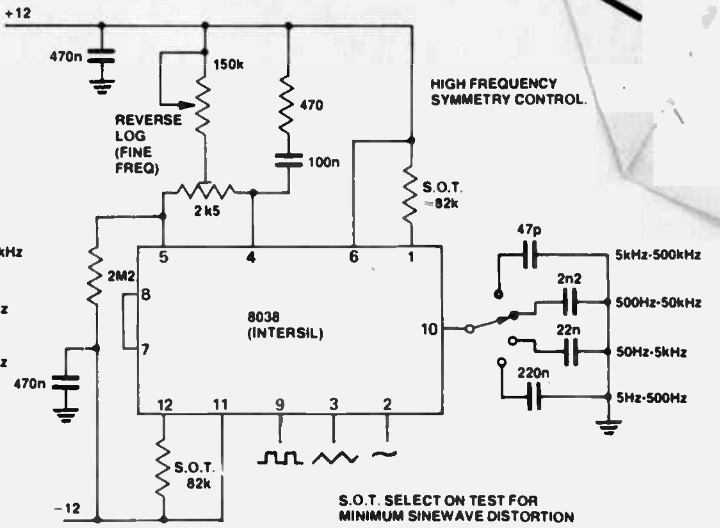
Variable division of clock signals is a nuisance to implement, because of the gating and switching it usually requires. Inspection of the internal circuitry of 7490 indicated an ultimately simple method of scaling.

Reset 9 overrides reset 0 in 7490. Thus if reset 0 is active and reset 9 is cycled, the D output will rise and fall in time with reset 9. When the common reset line is at 0 the counter divides by ten in the normal fashion.



The technique, from D. Brown of Lindfield NSW, can be extended to any number of cascaded 7490s.



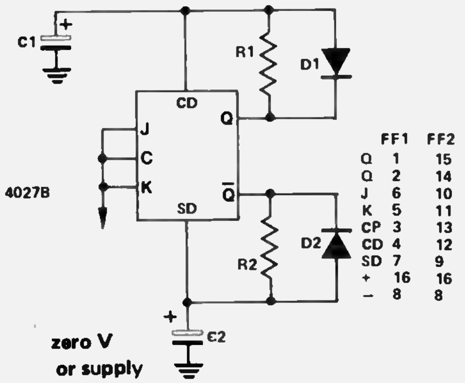


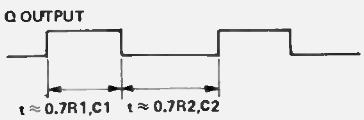
Improving performance of the 8038 function generator

When using the popular 8038 Function Generator IC in a switched range oscillator, connect a series RC network between pin 4 and the positive supply rail to retain waveform symmetry when operating on the higher frequency ranges. This avoids the need for re-adjusting or switching the symmetry control resistors along with the frequency determining capacitor.

The bypassing RC network on pin 4 is proportioned to counteract the distorting effects of the IC's internal parasitic circuit paths on the high frequency charge-discharge characteristic when the frequency determining capacitor is less than 1nF. Values are given for two typical circuit configurations. The maximum rate of frequency sweep is reduced in this circuit, with all other IC functions being unaffected.

This suggestion comes from **R. Beaumont of Pennant Hills, NSW.**





Oscillator has variable mark/space ratio

This oscillator allows the period of each half-cycle of the output wave form to be independently set by the RC networks R1C1 and R2C2. D1 is only necessary if $t_2 < 5t_1$ while D2 is necessary if $t_1 < 5t_2$ approximately. This is to speed the discharge of the associated capacitors. R1 may be any value in the range 1k to 22M, while C1 should be between 10p and 100μ.

The circuit may latch up with both outputs high if the power supply rises slowly at power-up or if the outputs are shorted to the positive supply, according to its designer, **Barry Wilkinson**, of Nebula Electronics.

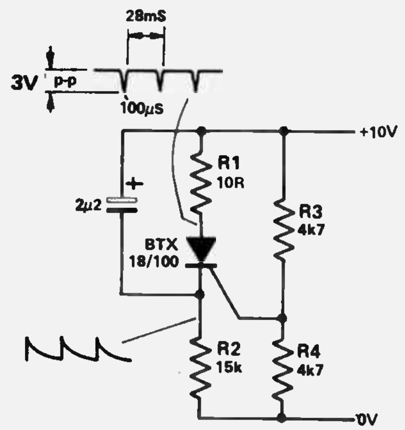
SCR oscillator

An SCR can be made to oscillate when connected in the circuit as shown. The component values specified give 100 us pulses at intervals of 28 mS. The output voltage with a 10 V supply is about three volts.

The current through the bias resistors, R3 and R4, must be high enough to allow adequate gate current for reliable switching. The charging resistor, R2 and the supply voltage are chosen so the current through the SCR is below its minimum holding current.

The frequency is determined by the gate voltage and the value of the capacitor and the charging resistor, R2. The output voltage is largely dependent on the voltage on the capacitor when the SCR fires. Pulse width is determined by the value of R1 and the capacitor.

The circuit can be voltage controlled by altering the gate voltage, but this will also alter the output voltage. Another cunning circuit from **Phillip Denniss of Chippendale, NSW.**



[S]imple sequencer

Hill

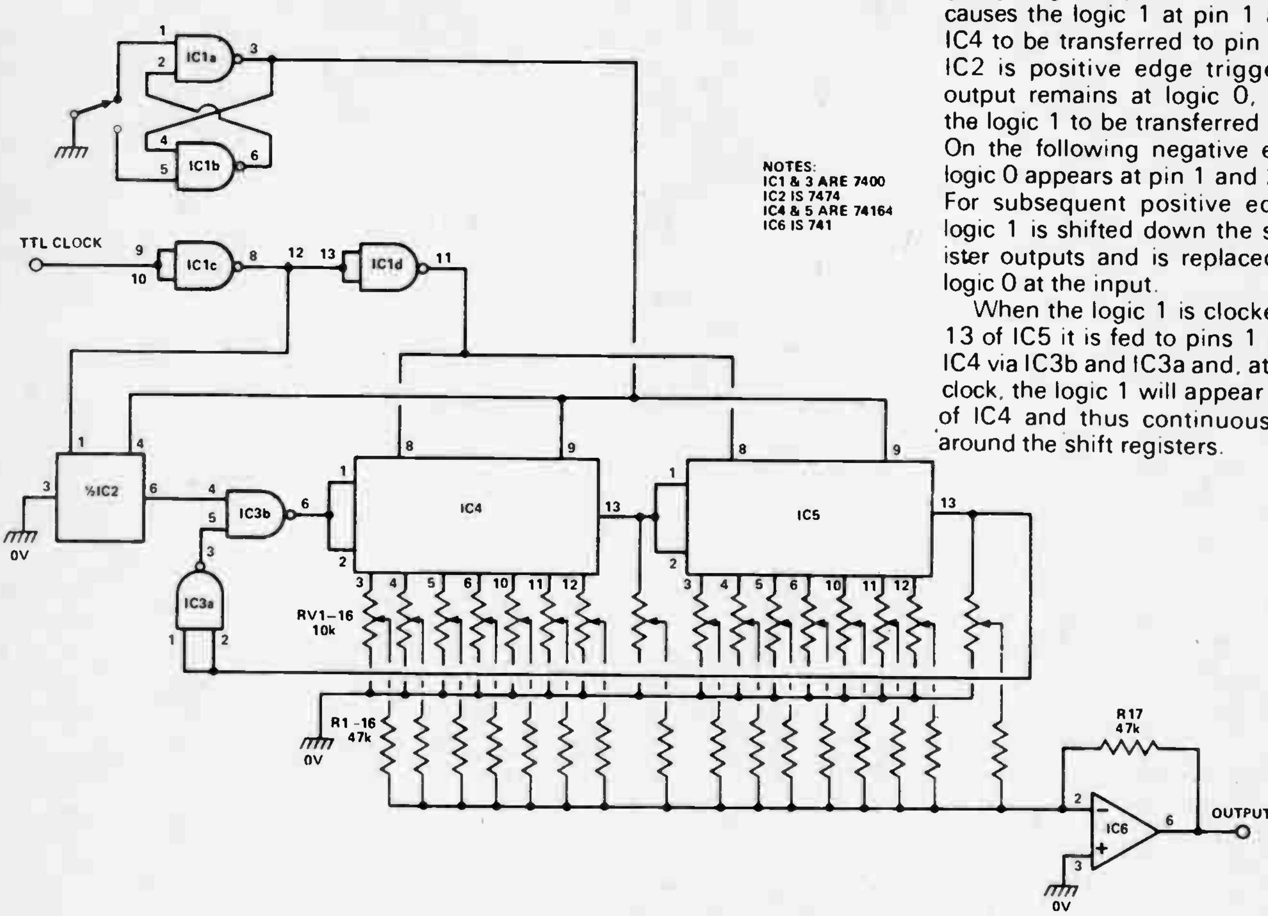
A simple sequencer can be constructed using shift registers.

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 oxillator.

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.

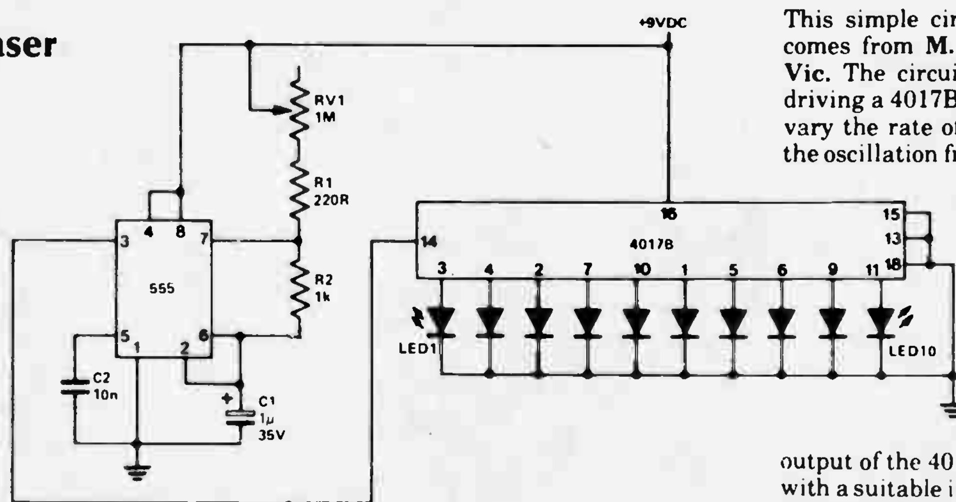
When a clock is applied a positive going edge at pin 8 of IC4 and 5 corresponds to a negative-going edge at pin 1 of IC2, due to inverters IC1c and IC1d. The first positive going edge at pin 8 of IC4 and 5 causes the logic 1 at pin 1 and 2 of IC4 to be transferred to pin 3. Since IC2 is positive edge triggered it's 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.

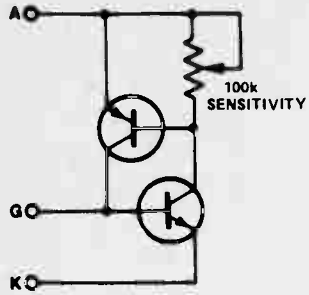
When the logic 1 is clocked to pin 13 of IC5 it is fed to pins 1 and 2 of IC4 via IC3b and IC3a and, at the next clock, the logic 1 will appear on pin 3 of IC4 and thus continuously cycle around the shift registers.



LED chaser

This simple circuit for a LED chaser comes from **M. Spokes of Glen Iris, Vic.** The circuit uses a 555 oscillator driving a 4017B counter. RV1 is used to vary the rate of the chaser by varying the oscillation frequency of the 555. The output of the 4017 drives ten LEDs, but with a suitable interface it could be used with light bulbs.





Transistors mimic SCR

This circuit, **from J. da Silva of Croydon, NSW,** simulates an SCR. The 'sensitivity' trimpot is useful to set the triggering voltage and prevents the circuit sefl-triggering from the leakage current of the transistors.

By reversing the polarity of the transistors the circuit becomes a PUT (programmable unijunction transistor) and by replacing the lower transistor with a phototransistor the circuit can be light activated. Any complementary silicon transistor pairs are suitable for this circuit. (Ed. Note: whilst we are aware that this circuit is not really new or original, it is not one that is widely known amongst hobbyists).

Multivibrator

E. Vaughan, High Wycombe

The frequency of a conventional multivibrator is controlled by the R-C times constant of its feedback loops. This circuit has fairly good rise and fall time and will operate at repetition rates as high as 10-15 MHz. The disadvantage of this kind of circuit is poor frequency stability. Also, the frequency can by affected by temperature, voltage variations, and variation (within tolerance ranges) between capacitors and resistors in the feedback loops, the latter affecting not only frequencies, but waveform symmetry.

With the circuits shown, all these disadvantages can be eliminated and the advantages of a conventional multivibrator will not be lost. The same number of components are required as the crystal or crystals replace the capacitor in one or both feedback loops. The resistor value in the feedback is not critical. As it is used with a crystal it no longer controls the time constant.

Both CT cut or AT cut crystals are suitable. The circuit in Fig. 1 uses a crystal of 7 MHz with a low activity. Crystal activity was down to about one tenth of its 7MHz value when in the circuit, so it was not possible for it to operate below 750 kHz. To get below this a higher activity crystal would have to be used. Varying the feedback resistor in a conventional multivibrator changes the frequency. This had no effect on the frequency the crystal controlled circuit. Then the capacitance of the 7MHz and 3.5MHz crystals in Fig. 2 were measured and came out as 13pF and 12pF respectively.

These capacitors are not in the range that create an R-C time constant that permits the circuit to work at the above frequency, so there is no doubt the crystal was controlling the frequency. With a crystal the circuit operates only at its rated frequency. Frequency tolerances in the order of 0.001 to 0.0001 percent can be obtained with this circuit. The 2N2475 used is a very fast switch. If another transistor is used it need not be as fast, but should have a switching time that will permit operation at the desired frequency.

The circuit (Fig.1 modified) controls symmetry by employing different frequency crystals in the two feedback loops. R3 and R4 were changed to 10k and X2 to 3.5 MHz. The 7 MHz crystal remained in the second feedback loop. All other values are the same as shown in Fig. 1. This produces a symmetry of 2:1, but maintained a frequency stability of 0.007 percent with a 20 percent supply voltage variation. This modification has other advantages. It can be used to produce an extremely stable asymmetrical square wave. Crystals for this type of operation must have a harmonic relationship.

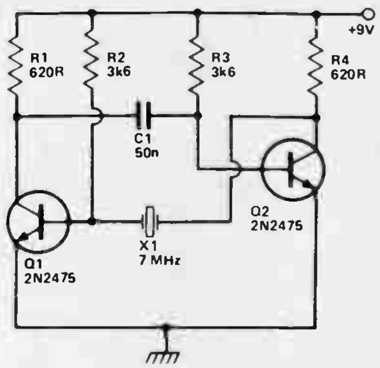


Fig. 1.

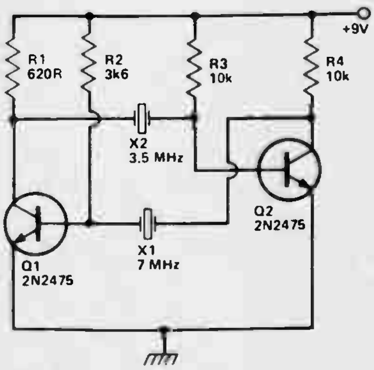
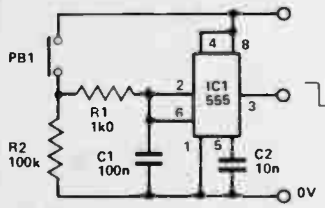


Fig. 2.

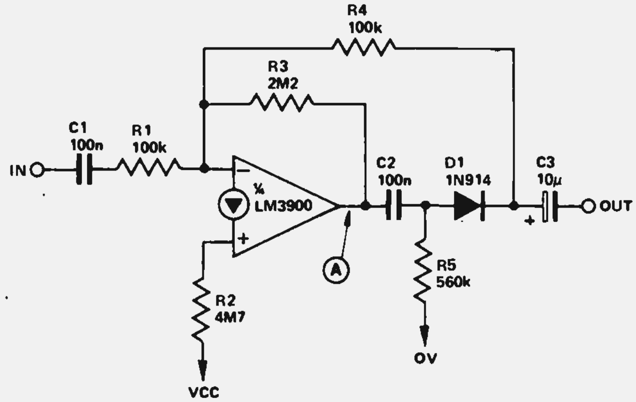


555 micro input reset

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.

Precision rectifier



The LM3900 is different from most op-amps in that it is current-differencing and operates from a single supply rail. Standard precision rectifier circuits are not applicable for this device but the circuit shown here works well.

Two feedback paths are provided – R3 for dc stability and R4 for the ac signal after C2 and R5 have filtered out the dc bias. When R2 = 2 x R3, point A will be at half the supply voltage, allowing the diode to be reversed by the input signal.

For large positive input, input impedance equals R1 and voltage gain is – R4/R1, since R4 is made much smaller than R3. C1 and C3 are dc blocking capacitors and determine the low-frequency roll-off.

Precision AC to DC converter

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).

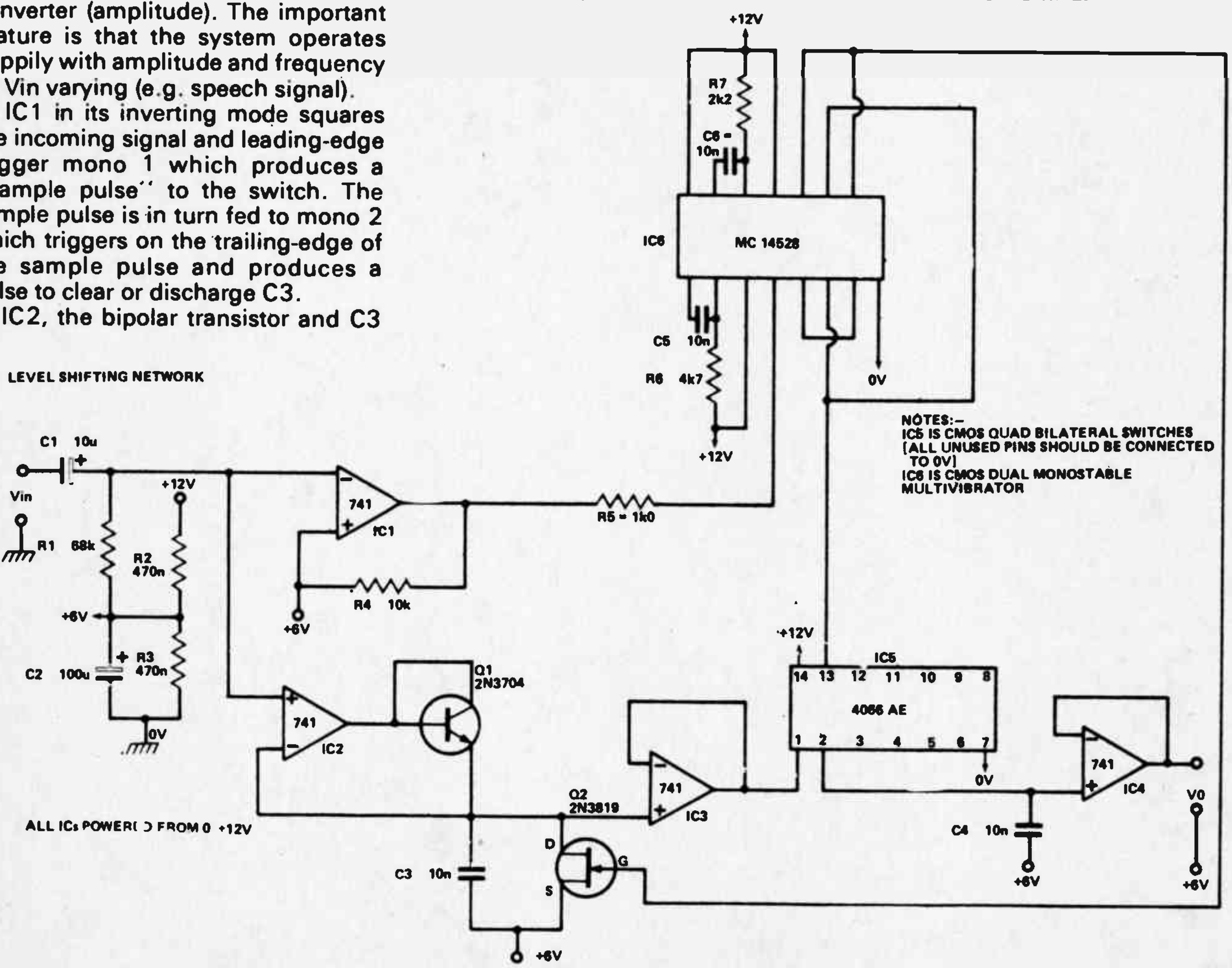
IC1 in its inverting mode squares the incoming signal and leading-edge trigger mono 1 which produces a "sample pulse" to the switch. The sample pulse is in turn fed to mono 2 which triggers on the trailing-edge of the sample pulse and produces a pulse to clear or discharge C3.

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

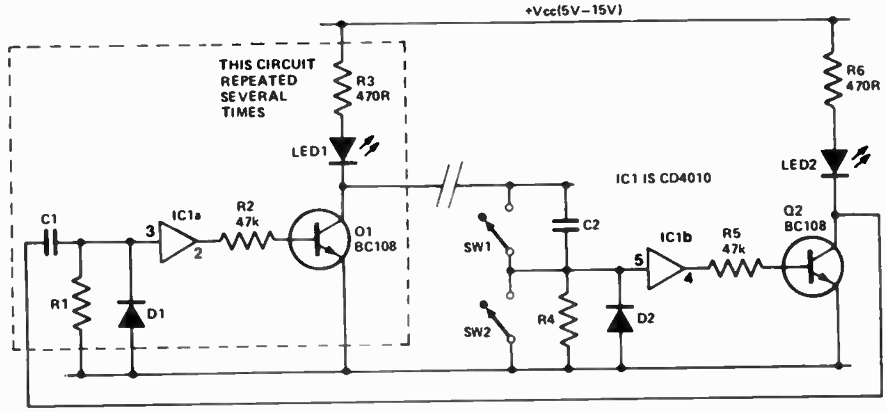
Thus after every ½ cycle of Vin, the DC level of the first hold is being transferred to the second hold circuit by the sample pulse before the first hold is clear again.

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.



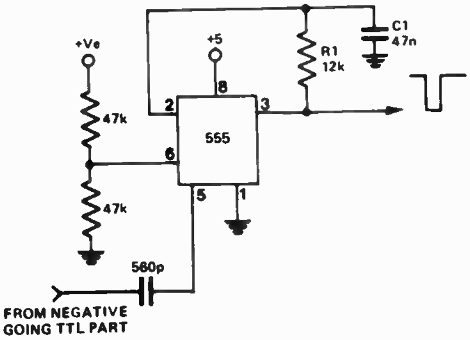
'Endless' LED chaser



This unusual LED or lamp chaser employs a 'chain' of inverter stages connected in a ring. The portion of the circuit inside the dotted box is repeated as many times as you wish, the collector of the transistor in each stage going to the input capacitor of the following stage and so on. Finally, the circuit arrives at SW1 and SW2 and the stage involving IC1b, Q2 etc.

According to **Greg Thamm of Burra North, S.A.,** who submitted it, the whole thing works like this: after applying power, close SW2 until all the LEDs go out. Then, open SW2 and momentarily close SW1 (a pushbutton could be used here). This starts the chaser as the collector of the transistor connected to C2 will be at supply potential, Q2 will turn on and LED2 will light when you close SW1. However, C2 will charge via the LED and dropping resistor of the preceding stage until the input to IC1b goes below its lower threshold. When it does, the output of IC1b will go low and Q2 will turn off. Then, C1 will charge via R6 and LED2, but the initial pulse will turn Q1 on via IC1a and LED1 will light. When C1 charges such that the input of IC1a goes below its lower threshold, Q1 will turn off, triggering the next inverter stage in the chain and so on, right around the chain. The input R-C for each stage (C1, R1 etc) determines the 'on' time. The diodes (D1-D2, etc) discharge C1-C2 etc when the preceding stage transistor turns on.

By using high dissipation transistors and 12 V lamps instead of LEDs, the circuit is suitable for such applications as Christmas tree light displays, etc.



The 555 upside down!

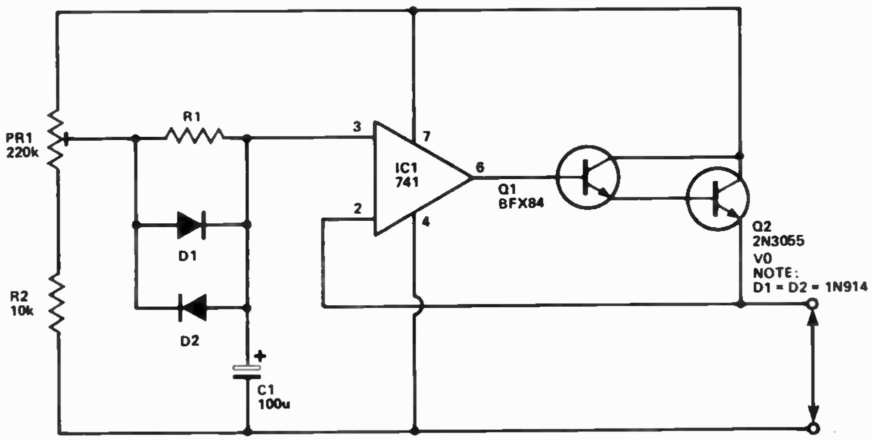
Normally, a 555 is used with negative triggering for a positive output pulse but it doesn't have to be this way, as pointed out by **J.L. Elkhorne of Chigwell, Tasmania.** An inverted scheme can also be used, giving positive triggering and a negative-going output.

The lurk is to use the upper comparator in a different way by biasing the threshold port, pin 6, at half supply and using the control voltage port, pin 5, as the trigger input.

The pulse length is determined by the time constant of R1 and C1, the larger either value, the longer the pulse.

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.

Constant current source

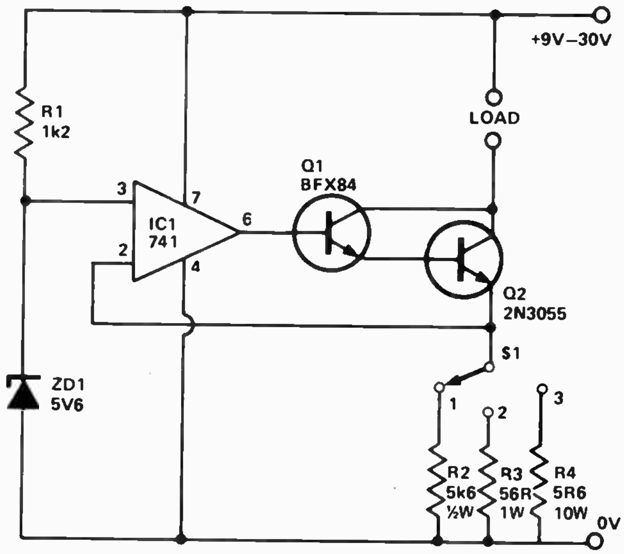
J Macaulay

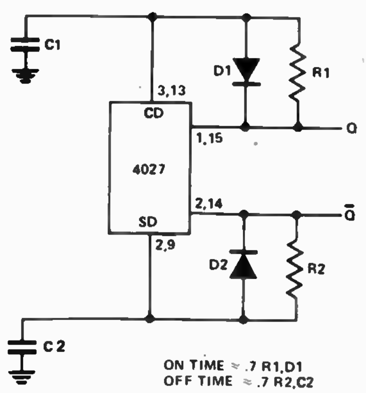
The circuit shown will provide 3 preset currents which will remain constant despite variations of ambient temperature or line voltage.

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 Q2s 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.





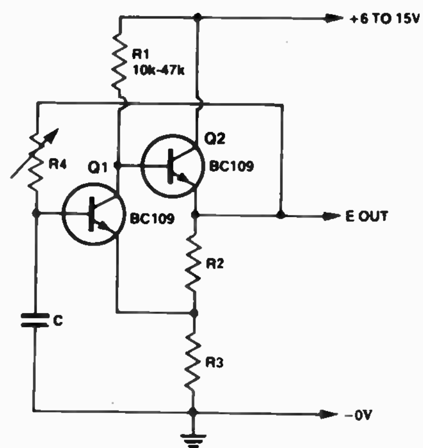
4027 oscillator

Taking Barry Wilkinson's idea one step further (see ETI Nov '79 p. 61) an oscillator can be made using half a 4027. The 'on' time is set by R1, C1 while the off time is set by D2 and R2. Another idea from **Phillip Denniss of Berala, NSW.**

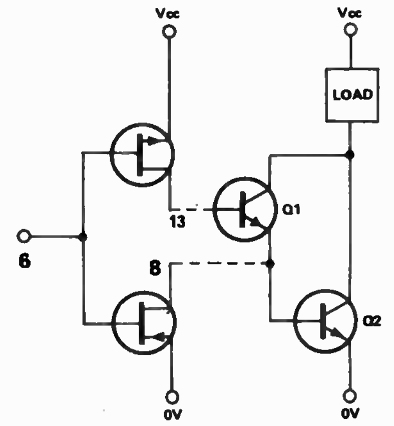
Simple square wave generator

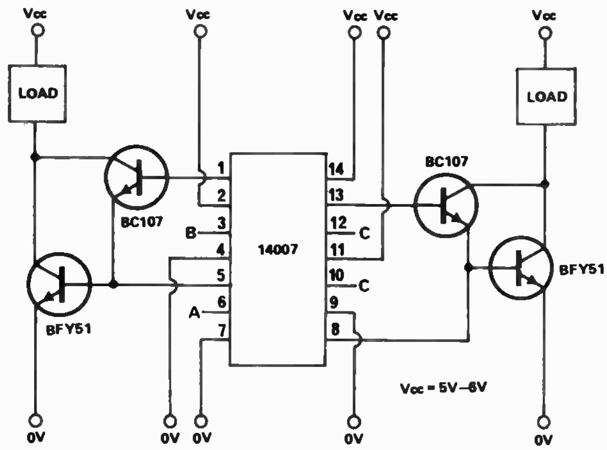
This circuit employs a non-inverting amplifier using two transistors with an RC network in the positive feedback path between the output and the input.

Benjamin Simons of Beecroft, NSW submitted the circuit and explains that it works as follows: when power is first applied, C is not charged and Q1 is not conducting. Q2 is thus hard on and its emitter will be at a potential near Vcc. Capacitor C will charge via R4 until Q1 begins to conduct. This will cause Q2 to cease conducting, and as the action is regenerative, cutoff will be very rapid. The voltage on the emitter of Q2 will then fall to a voltage determined by the ratio of R1 to R3 and C will discharge through R4 until Q1 cuts off and the whole cycle repeats itself.



The transition time is extremely rapid and the rising and falling edges of the square wave produced have very short durations. The circuit will work with many common small signal transistors and pulse repetition rates beyond 500 kHz can be obtained. The output has very nearly an equal mark-to-space ratio over a wide frequency range. This can be trimmed if required by adjusting the ratio of R2/R3, or by placing a small value 'trimming' resistor in series with the base of Q1. Top frequency will be influenced by the input capacitance of Q1 and circuit strays.





Darlington drivers

This circuit from C.J. Ramey, UK, offers a very efficient way of driving a pair of transistors in Darlington configuration from CMOS. The circuit at right 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.

The circuit at left 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.

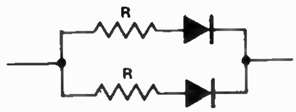
The result is fast switch off at low cost and efficient switch on.

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

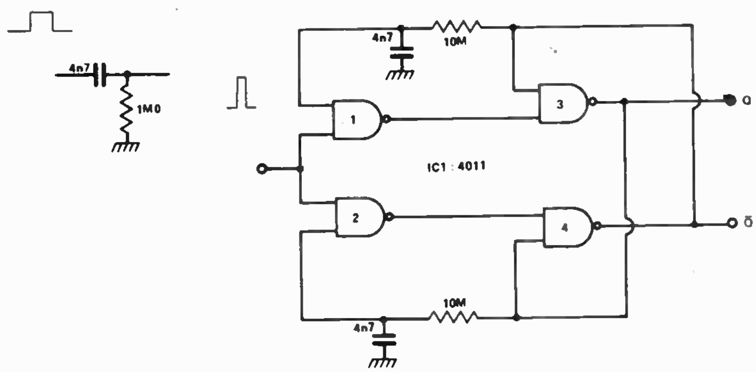
Current-sharing for diodes

The current handling capacity of a diode can be increased by adding a second diode in parallel. However no two diodes have exactly the same characteristics. This will result in one of the diodes taking more than its share of the current and destroying itself.

If a small value resistor is put in series with each of the diodes the effect of differing junction resistance will be swamped by the external resistor and the current will divide equally between the diodes. The resistors should be selected for a one volt peak drop across them and, at one amp, would require a one ohm one watt resistor.



Mr G. A. Bundell of Nedlands, Perth shows how it is done.



Retriggerable flip-flop

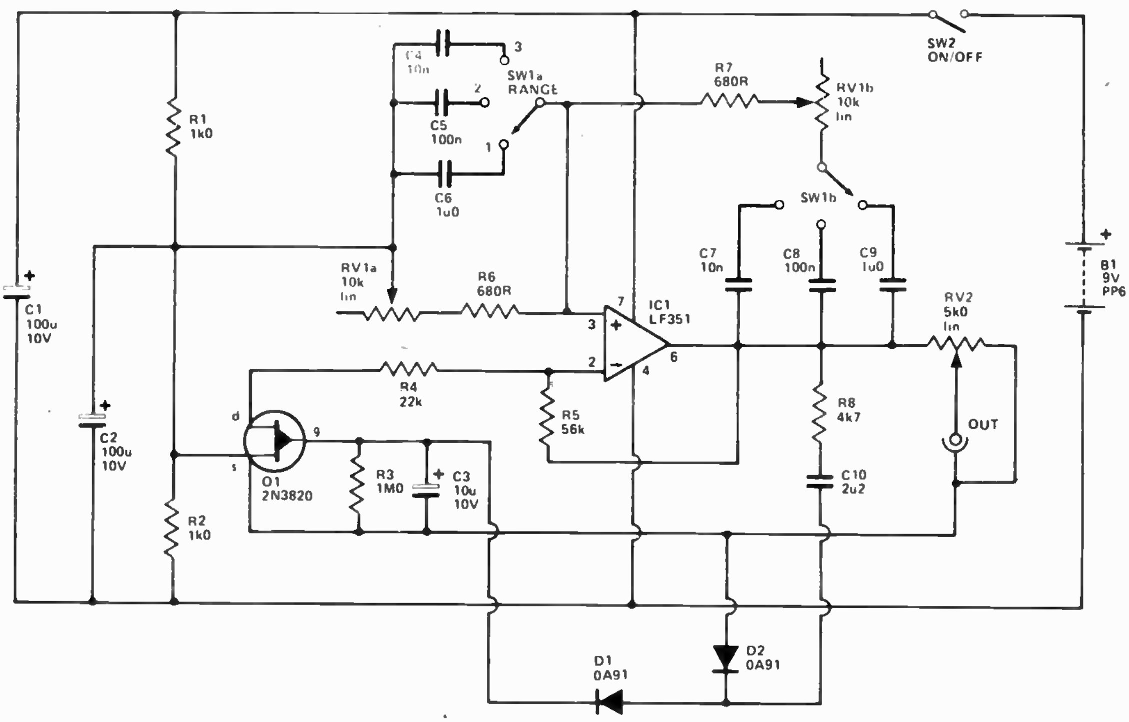
G. S. Wills

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.



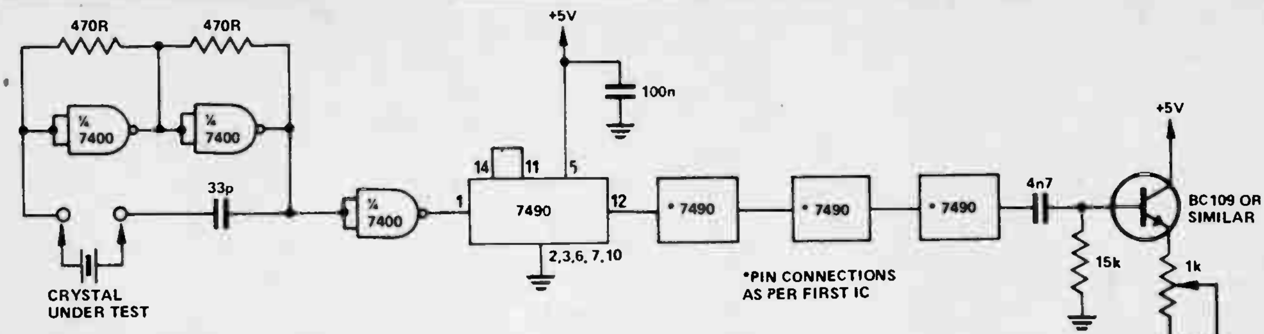
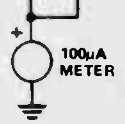
AF signal generator

ONE OF the most useful items of test equipment to have, especially if one has an interest in any type of audio gear, is an AF signal generator. The circuit shown here provides a good quality sinewave output over three continuously variable ranges (Range 1, below 20Hz to above 200Hz; Range 2, below 200Hz to over 2kHz; and Range 3, below 2kHz to over 20kHz) covering more than the entire audio frequency spectrum.

The circuit uses the usual Wien Bridge type circuit, and this form of oscillator consists of an amplifier having frequency selective positive feedback provided via a C-R network. The capacitive elements of this network are whichever two capacitors are selected by SW1, the three sets of capacitors giving the unit its three ranges. The resistive elements are R6, R7 and RV1, the latter permitting the unit to be tuned over the ranges quoted above. This network provides positive feedback over operational amplifier IC1, which is a FET type giving low noise and distortion levels. VR1a and R6 also bias the non-inverting input of IC1 to a central tapping on the supply produced by R1, R2 and C2.

The closed loop gain of IC1 must be maintained at precisely the correct level if good results are to be attained. Insufficient gain would lead to less than full compensation for the losses through the C-R Wien network, with insufficient feedback and consequent violent oscillation with the output signal becoming clipped and seriously distorted. An automatic gain control (AGC) circuit is used to maintain stable operating conditions and a constant output level. R5, R4 and the drain to source resistance of Q1 form a negative feedback network which controls the closed loop gain of IC1. Initially Q1 is forward biased by R3 so that there is enough gain to give strong oscillation. Some of the output from IC1 is coupled by R8 and C10 to a rectifier and smoothing network comprised of D1, D2 and C3. These produce a positive bias which tends to cut off Q1, producing reduced circuit gain. The stronger the circuit oscillates, the larger the bias, and the lower the gain becomes. Lack of oscillation produces reduced bias, more gain, and stronger oscillation. The required stabilising action is thus obtained.

Variable attenuator VR2 enables the output to be adjusted from zero up to about 1.5V RMS. The current consumption of the circuit is about 7 mA.

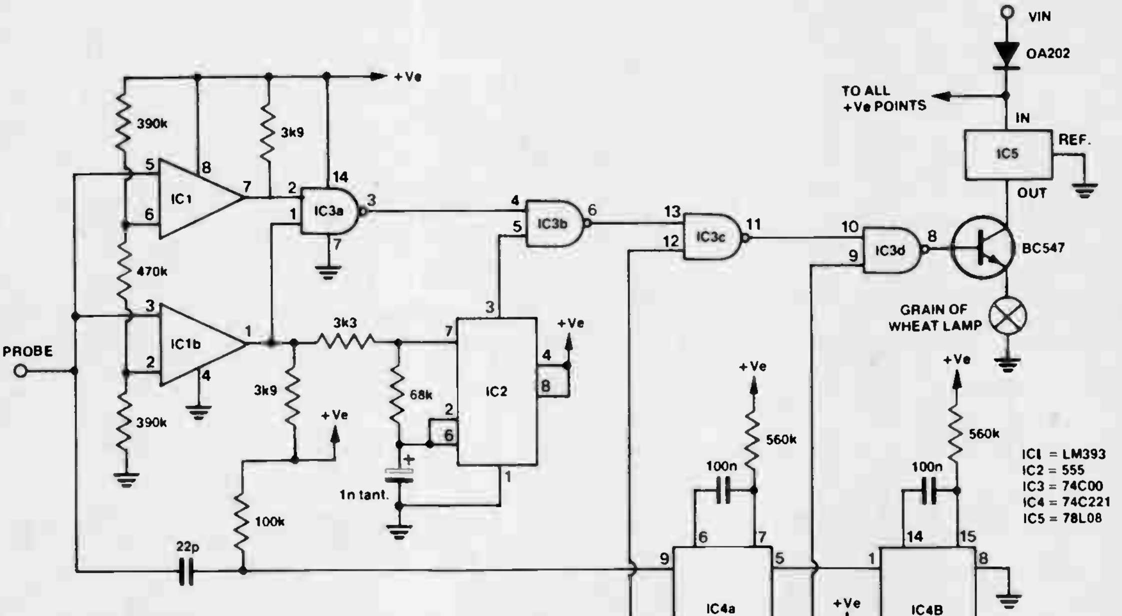
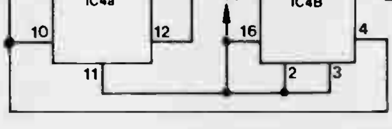



Simple crystal frequency meter

Have you ever had a whole heap of crystals which are unmarked or stamped with a frequency which is not the crystal frequency but rather the output frequency of a transmitter.

John Rickard of Heathmont, Vic. Certainly has and he has submitted his circuit for a crystal frequency meter. The meter gives a direct reading of frequency on a moving coil meter for crystals in the range 500 kHz to 10 MHz.

Two gates of a 7400 form a crystal oscillator with a third gate used as a buffer. Four 7490s divide the crystal frequency by 10,000 to give an output between almost zero and 1 kHz. This output is differentiated by C2 and R3 and the meter integrates the pulses giving a linear frequency scale. Overtone crystals will oscillate at their fundamental in this circuit which may be misleading. To calibrate the instrument adjust R4 with a known crystal in circuit.

Logic probe mimics H-P unit

This logic probe was designed to operate in similar manner to the Hewlett-Packard Logic Probe. It uses a single lamp to indicate all states including open circuit and pulse trains, says **R.A. Jackson of Glenelg, S.A.**

IC1 is a dual comparator: IC1a detects the logic 1 level threshold and IC1b detects the logic 0 level. The resistor network is set for CMOS levels but can easily be changed for TTL.

With the probe input open circuit, IC1a output is low and IC1b output is high. IC2 oscillates at about 100 Hz and the square wave output is fed through gates IC3b, c and d to drive the lamp with a 50% duty cycle square wave. This gives half brilliance.

When a logic 1 is applied, both the comparator outputs go high. IC3a output goes low thus inhibiting gate IC3b and driving the lamp to full brilliance.

A logic 0 input gives low outputs from the comparators. IC2 stops oscillating and its output goes high. This gives IC3b two high inputs and the lamp is turned off.

If a pulse is present at the input, its negative-going edge is coupled to the trigger input of IC4a. This is one half of a dual monostable. Pin 5 goes high for approximately 50 ms, and then goes low. This triggers IC4b for 50 ms. The Q output of IC4b is connected to the inhibit input of IC4a. This prevents retriggering until 100 ms after the first pulse. The Q outputs of IC4 drive gates IC3c and d. This arrangement turns the lamp off, then on, giving a positive indication of a pulse, regardless of the input level or the pulse frequency.

IC5 is an 8 V regulator. This limits the lamp voltage when the input voltage is high (up to 18 volts). The diode protects against reverse voltage.

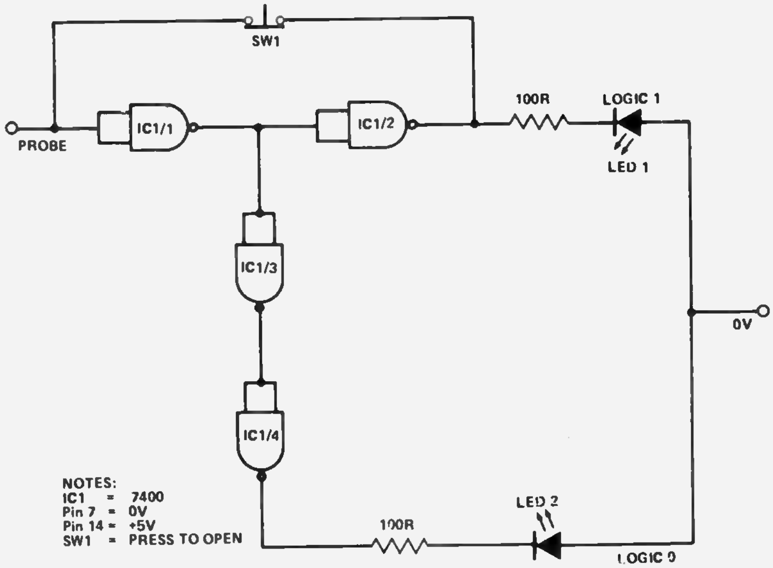
With careful construction the probe can be built into a penlight torch case.

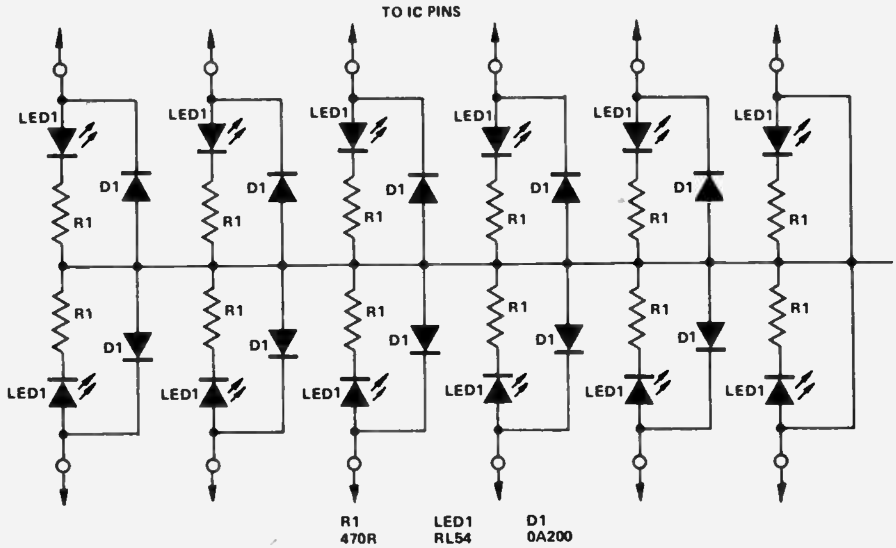
One chip logic probe

K.D.Hedger

This circuit, although very cheap and with a low componant 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.





LED 'logicator'

This circuit, submitted by **Michael Kyrannis** of **Pascoe Vale** Vic, can be used as a logic monitoring device to plug into an IC socket. A 'high' level on each of the pins will light its corresponding LED. One good idea might be to build the indicator onto the pins of an IC test clip. The indicator could then be simply clipped over the top of an operating IC. Be careful though that the circuitry can drive the LEDs.

Simple voltage reference

This circuit, from R. Gibson of Shortland NSW, uses a 741 op-amp and a zener diode to produce a stable reference voltage, which can be used in regulated power supplies or for calibration applications.

An unusual feature of this circuit is that the zener voltage is used by the op-amp to define a constant current in the zener and thus stabilise it's own voltage. To keep the temperature coefficient of the output low, an EM401 is connected in series with the 6.2 V zener. At 5 mA the BZX79C6V2 has a temperature co-efficient of +2.3 mV/°C while the EM401 has a temperature coefficient of -2.2 mV/°C approx. The twc cancel each other giving a low temperature stable output. The output voltage, Eo2, is determined by the values of R2 and R3 while the zener current is set by R1. R4 is included to equalise the impedance at the imputs of the 741 and thus minimize the effect of input off-set current drift. The component values shown give Eo1 = 6.8 V, Eo2 = 9 V, zener current = 5 mA.

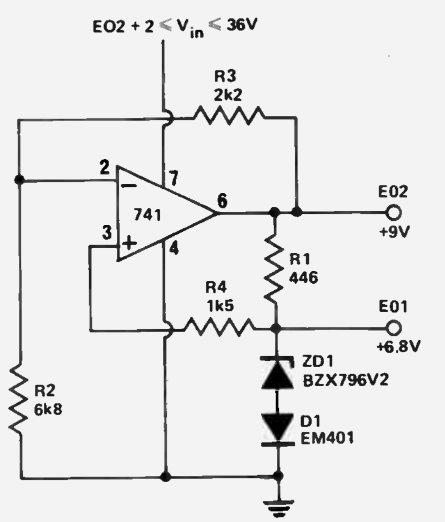
The maximum current drawn from Eo2 should be no more than 2 mA. If a slight variation of the output with temperature can be tolerated, then R4 and D1 can be omitted and R1 and R3 changed to 560 ohm and 3070 ohm, respectively.

For different output voltages and zener currents, the component values are given by:–

$Eo2 = Eo1 (R2 + R3)/R2$

$R1 = (Eo2 - Eo1). Izener$

$R4 = R2. R3/(R2 + R3)$, approx.



AC range booster for your multimeter

MEASURING small audio frequency signals is often impossible using an ordinary multimeter because most of these have a lowest ac range of about 1 V to 5 V full-scale deflection (fsd). A simple and inexpensive solution to the problem is to add an amplifier, such as the one shown here, ahead of the multimeter.

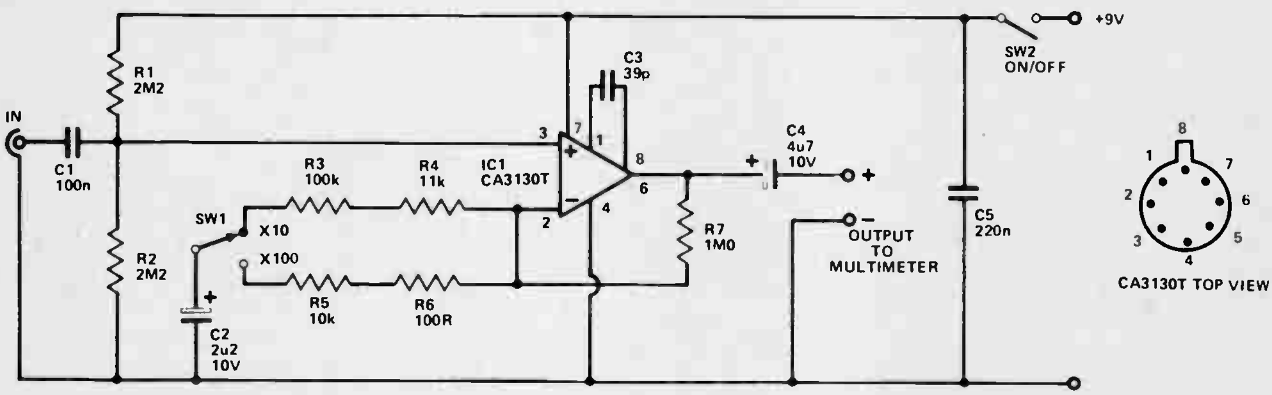
The amplifier has a switched voltage gain of 10 or 100 and would therefore boost the sensitivity of (say) a multimeter switched to the 2.5 Vac range to 250 mV and 25 mV fsd respectively. Measurements down to just a few millivolts rms can then be made with reasonable accuracy.

The circuit uses a CA3130T operational amplifier in the non-inverting mode. The non-inverting input is biased to about half the supply voltage by R1 and R2 and the input signal is coupled to this point by C1. The input impedance of the circuit is set at over 1 M by R1 and R2 so that the unit places little loading on the circuit under test. R7 biases the inverting input and gives a quiescent output voltage of about half the supply potential.

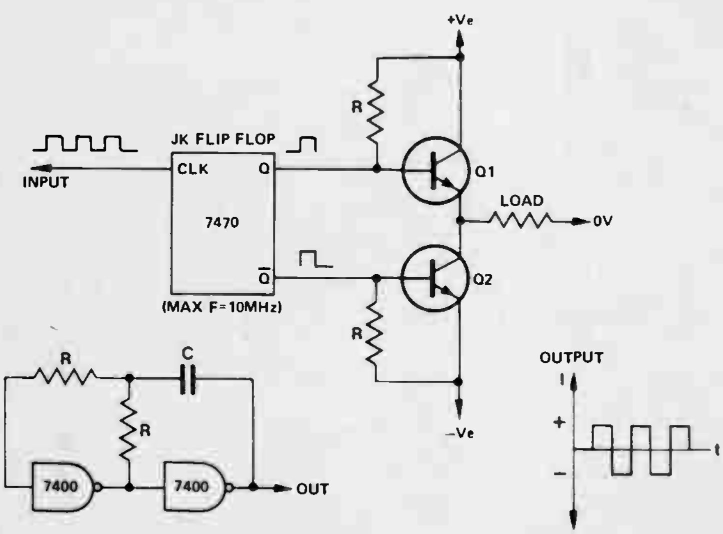
Although IC1 has an extremely high (open loop) voltage gain, the voltage gain of the amplifier as a whole (closed loop) is much lower, and is set by the ratio of two resistances. With SW1 in the x10 position the two resistances are R7, and R3 plus R4. The voltage gain is equal to the sum of the two resistances divided by the shunt resistance (R3 + R4) in this negative feedback network. This gives almost exactly the required figure of 10 with the specified values. With SW1 in the x100 position the lesser shunt resistance of R5 and R6 is switched into circuit, boosting the voltage gain to almost exactly 100.

Capacitor C4 provides dc blocking at the output. C5 is a supply decoupling capacitor and should be mounted physically close to IC1, C3 is the compensation capacitor for IC1 and prevents the device from becoming unstable. Note that a carefully designed layout having the input and output well isolated from one another is required or the circuit as a whole may become unstable.

Screened input and output cables should be used to prevent stray signal pickup affecting the signals. The unit has a maximum output of about 3 V rms. It should therefore be used with the multimeter set to a range of 3 V or less, or if a higher range must be used, the part of the scale above 3 V is ignored. The amplifier has a flat response up to about 30 kHz in the x100 mode, and up to about 300 kHz in the x10 mode.



R3, R4, R5 AND R7 ARE 2% OR BETTER

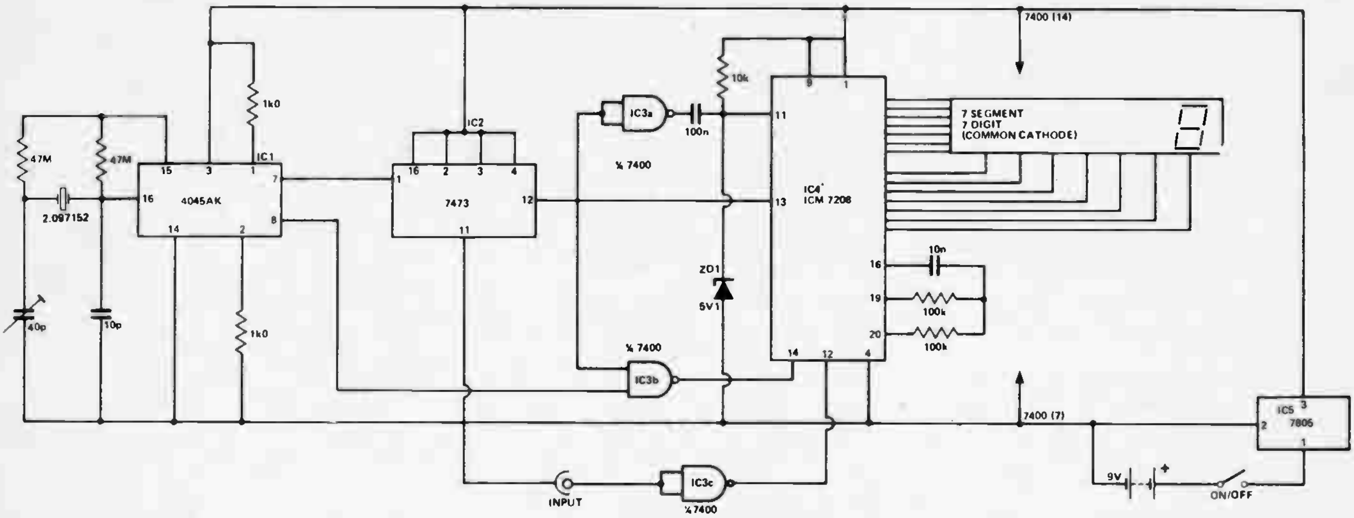


TTL squarewave generator has 5 watt output

Although many square wave generators have been designed in the past many have two inherent disadvantages; namely, low power and pulses offset above OV.

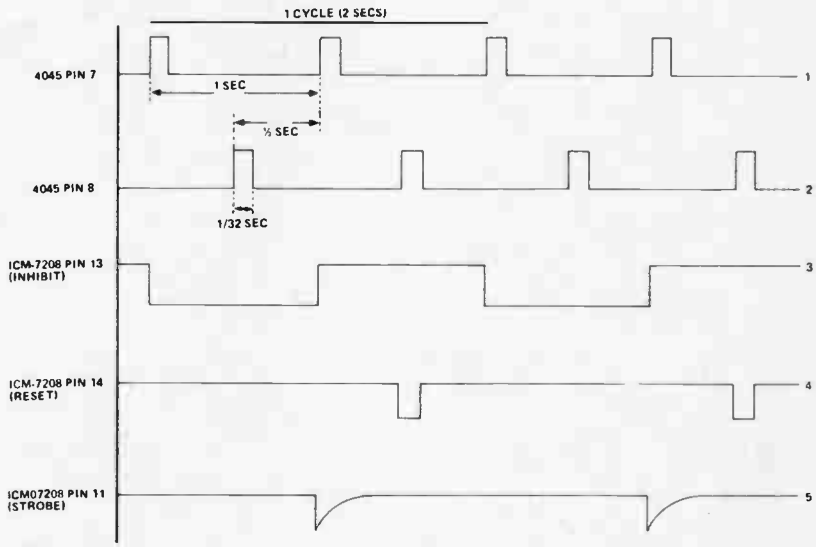
This square wave generator, from **William Carson of Mt Waverly Victoria**, gives a power output of 5 W with a ±5 V supply in an 8 ohm load. Transition between levels is fast and no ringing occurs on the edges.

The transistors should be fast switching types such as 2N3563 or 2N3564. The input to the flip flop can be a TTL or unijunction oscillator.



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 new 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.

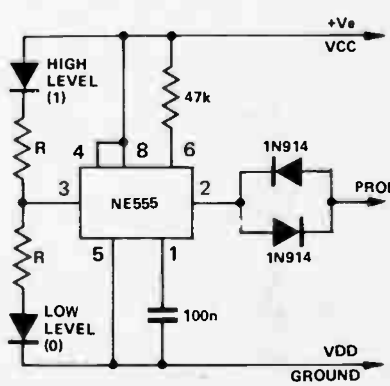
The 7805 provides the 5V supply for the logic. The 4045 and the crystal form an oscillator and 21 stage binary counter producing 1/32 second pulses at 1 sec intervals as shown in waveforms 1 and 2. The 7473 flip-flop produces the one second gating pulse (waveform 3). Waveforms 2 and 3 are NANDed into 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.

Simple logic probe uses 555 chip

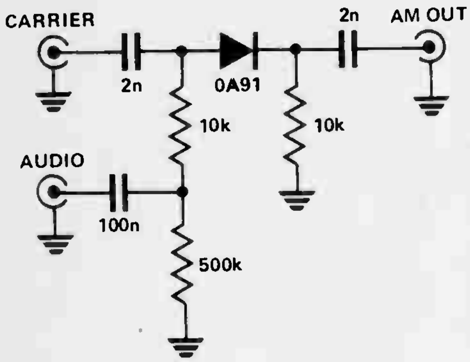
Alan Reek, of Woolwich in Sydney, devised this simple logic probe around a 555 timer IC. This circuit has the advantage that it places very little load on the circuit under test. As shown, the circuit can be used with TTL (R=120 ohms). For CMOS circuitry using a supply rail above 5V, the LED current limiting resistors should be increased.

Power for the probe is taken from the device under test. Because of the few components it can be housed in a small pill container (plastic) or a commercial probe container can be used.

Square wave inputs will cause both LEDs to light equally and the duty cycle of the input can be estimated by the relative brightness of each led. A small silicon diode could also be connected in series with the Vcc line so as to prevent damage to the probe if the wrong polarity is applied to the circuit.



All-round modulator



A very handy device around any hobbyists workshop or serviceman's bench is a simple modulator. For aligning IF amplifiers, receiver front ends etc – especially with only basic test instruments, it's a must.

Reader, G.J. Armitage of Melbourne Vic, sent this circuit in. A common signal diode is used as a 'mixer'. You'll need to drive the audio input with more signal than the RF input to get good modulation depth.

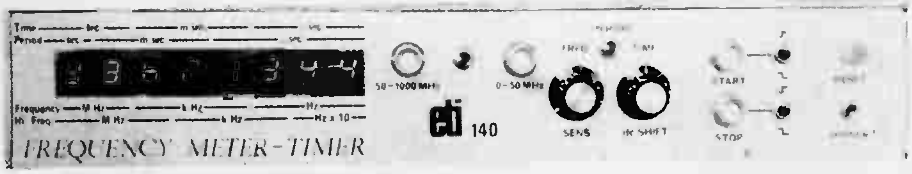
The circuit will work across a very wide frequency range, from very low frequencies to well into the VHF region. The diode can be any germanium signal diode. such as OA90, OA91, OA95, OA202 etc. drive will need to be arou hundred millivolts.

A silicon signal diode, o carrier, diode may be used, b need around half a volt of RF drive.

Constructed in a small shielded container, with coax input and output connectors (RCA connectors are good), prevents radiation of signals and a switched attenuator may be connected on the output.

The circuit may also be used as a product detector. BFO injection should be fed in the 'Audio' input and the resultant audio taken from the output (add a 'pi' RF filter using two 1n capacitors and a 1nH RF choke).

Mods to the ETI-140 1 GHz frequency counter



The following modifications to the ETI-140, **from Kit Scally of North Ryde NSW**, will make it a little easier to use.

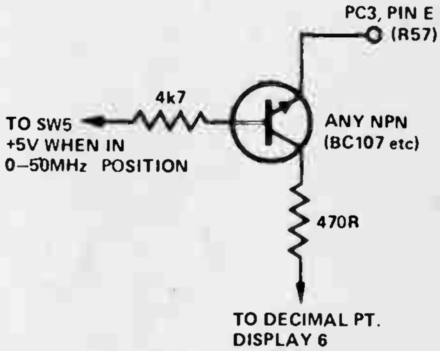
Firstly, an extra two decimal points on the display improves the appearance of the reading. Change R75 from 470R to 220R and common the decimal point on display 1 to displays 4 and 7 (pin 6 on each IC).

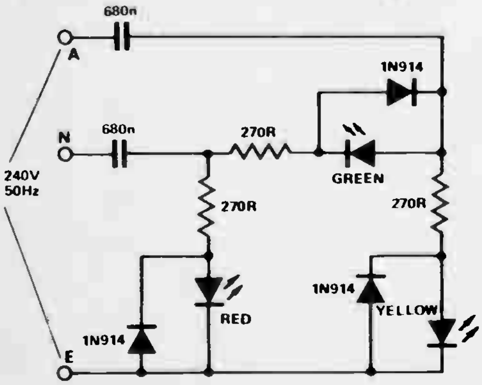
If the decimal point on display 5 lights dimly when using the "time with pre-scale", this can be cured by adding a 1N914 diode in series with pcb pin E and SW5, anode to the switch.

To produce a MHz/kHz decimal point on the 0-50 MHz range, add the extra circuitry shown here. The components may be 'hung' off the board.

The PL18/20VA transformer in the power supply runs hot and this may be replaced by a PL18/40VA unit to reduce the temperature. A one amp, quick blow 3AG fuse placed in the primary circuit is also a good idea.

Erratic readings when measuring frequencies below 100 Hz can be cured by using a 1M resistor as a dc ground return. Place it from input to ground for these signals.





NOTE
BOTH CAPACITORS MUST
BE GREATER THAN 350V DC
WORKING

Simple LED mains tester

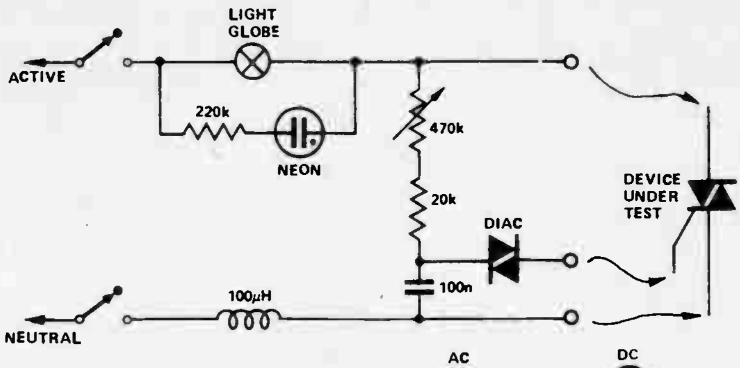
This simple little circuit from **D.L. Shaw of North Ryde NSW**, will help you find out if your power wiring is ok. The circuit indicates the following wiring conditions:

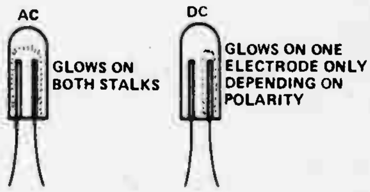
Normal ... green and yellow LEDs lit
Active and Neutral Interchanged .... red and yellow LEDs lit
Earth open-circuit ..... all LEDs lit
Neutral open-circuit .... all LEDs lit
Active open-circuit .... none of LEDs lit

Note that when Active and Neutral are interchanged the red LED will be lit even when the power switch is off. Both 680n capacitors should be rated at 350 Vdc working or greater — 630 V polystyrene or 1kV polyester capacitors would be prefered.

...iac tester

...his circuit was made to fill a need to quickly test triacs under a light load. By observing the neon it is possible to tell whether ac or dc is flowing through the light-globe. The device to be tested is connected to the circuit with clip leads and the 470k potentiometer advanced until the globe lights. If the neon glows on both stalks the globe is fed with ac and the triac is working properly. If one stalk only glows, one cycle of the waveform is passing through the globe signifying a fault with one junction of the triac. Of course, if it doesn't glow at all and the light is not lit, the triac is completely faulty.

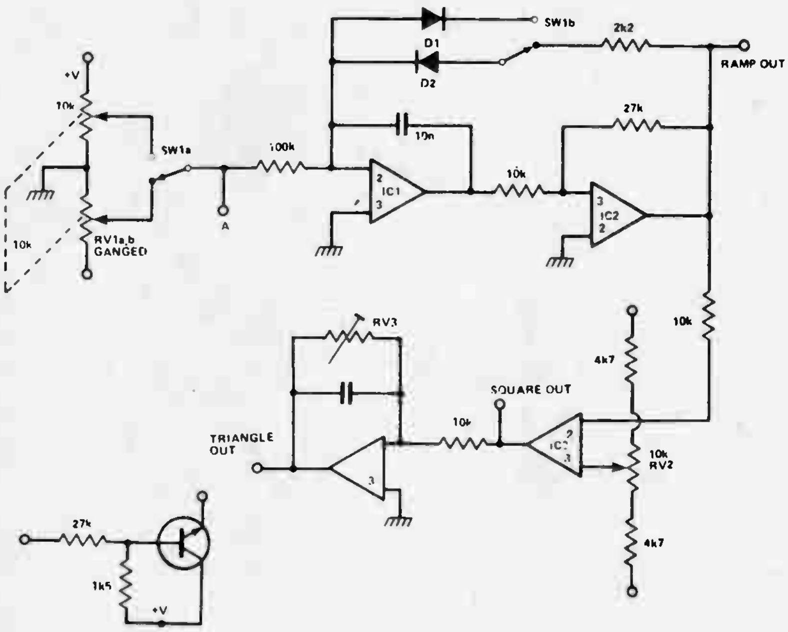




Kevin Benson, of Quakers Hill NSW, built the unit on a light dimmer pc board with only minor modification to the board.

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. S1 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.

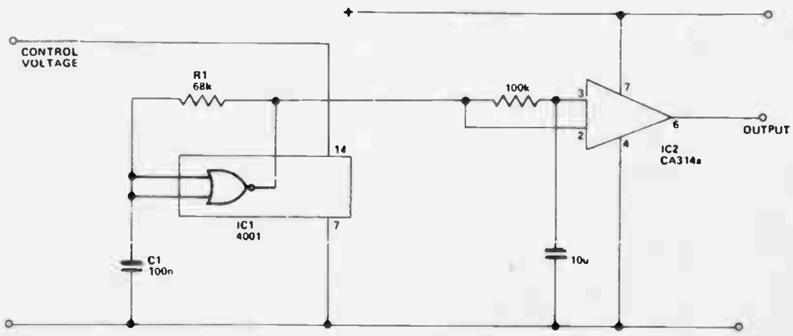
Wide range voltage controlled oscillator

This little circuit comes from our London office – it's an example of the lateral thinking for which the British are famous!

Any section of IC1 can be used but all unused inputs must be earthed – otherwise the CMOS will pick up mains hum and operate in its linear region, overheating as a result.

With the values shown, a frequency range of about 50 Hz to 20 kHz is obtained – just right for an audio sweep oscillator. If the mark/space ratio is unimportant, it can go down to 1 Hz.

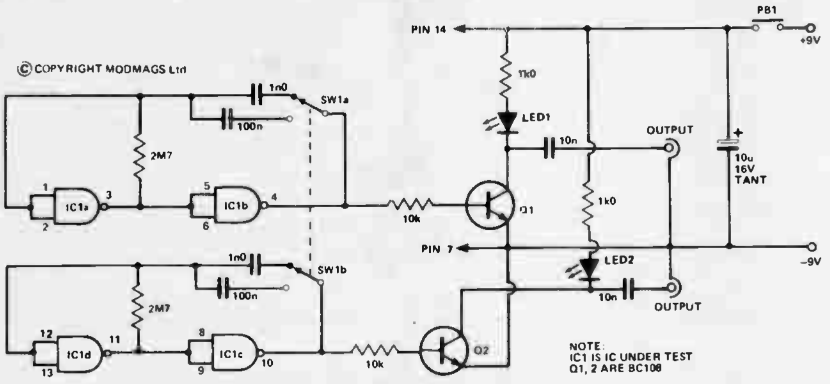
The control voltage, which ideally should be in the range 1.5 V to 3.5 V, is applied to the power supply connections. IC2 is used to square up and buffer the output.



CMOS tester

C. Jordan, Sompting

This circuit was designed to test 4001 and 4011 devices which were suspected of being damaged due to static from careless handling. Two gates on each side of the 14 pin DIL package are tested independently. Each pair is connected as an astable, the timing capacitor being switched to allow the device to oscillate at two different frequencies.



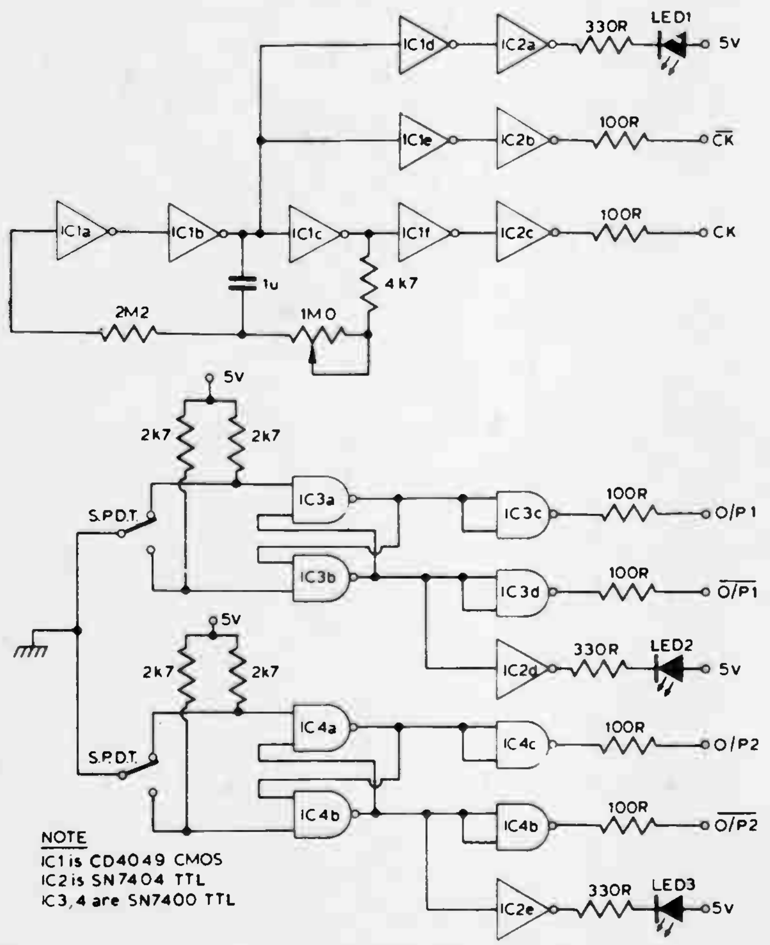
The output of the astable is fed to a transistor which acts as a buffer, driving the LED and providing an audio output to a crystal earpiece. PB1 should be a push-to-make type, so that it is impossible to insert or remove a device with the power on. Although intended to test 4001 and 4011 devices, it will also quite happily test 4030, 4071, 4077, 4081 and 4093.

Test unit for sequential logic

Any one testing a sequential logic circuit requires input pulses free of contact bounce. This unit does this, providing two switched, jitter-free outputs and a 'slow' variable speed clock. The complements of these signals are also provided.

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

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

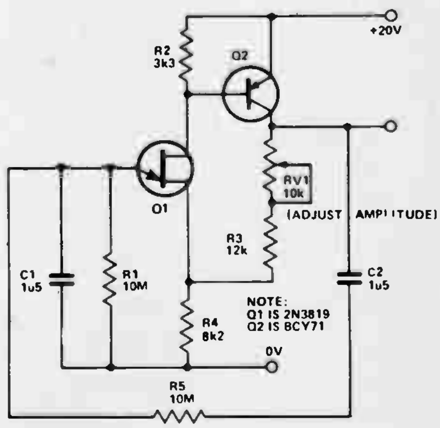


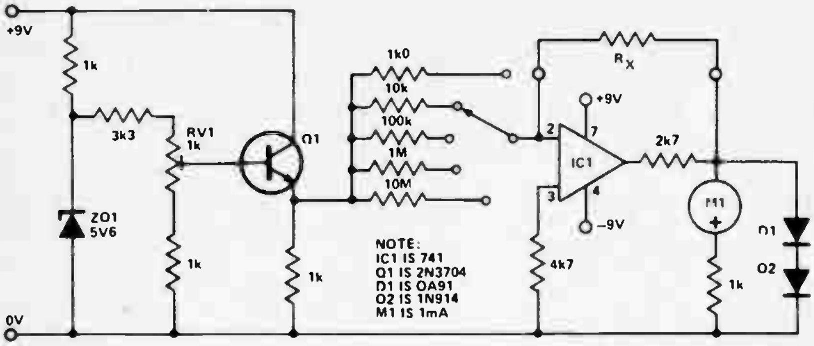
NOTE
IC1 is CD4049 CMOS
IC2 is SN7404 TTL
IC3,4 are SN7400 TTL

VLF sine generator

Generating very low frequency sine waves (i.e. less than 0.1 Hz) presents several problems, Timing capacitors usually have to be large valve 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.





Linear scale ohmmeter

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. The use of a FET 741 op-amp reduces any zero error and makes offsetting unnecessary.

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.

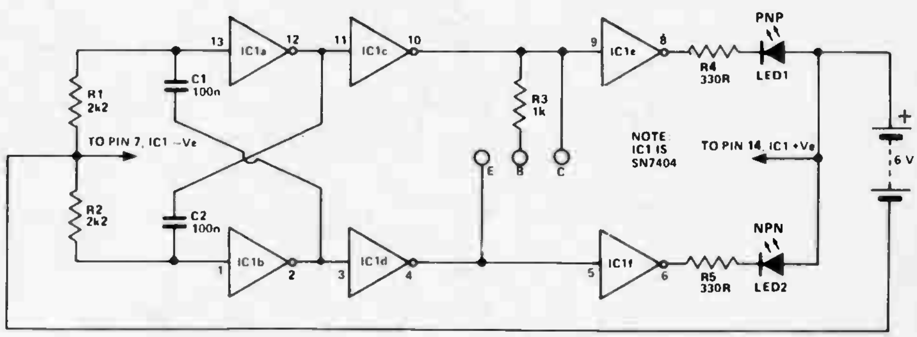
NPN-PNP indicator

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.

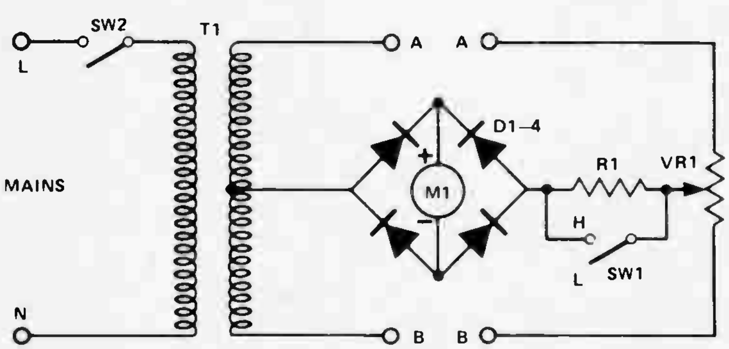
The signal applied to the base of the transistor is always in phase with the collector so the transistor, whether PNP of NPN, will always be turned fully on every half cycle.

When a 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.



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

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

Capacity checker

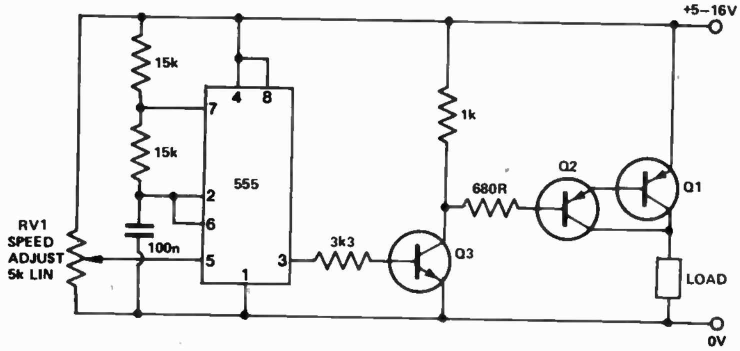
This bridge was originally designed to find values for odd, unmarked or undecipherable capacitors. While not being of great accuracy, it does give a very good indication as to the value of the capacitor.

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, i.e.: 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.

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.

Pulse width modulation controller



This novel idea, **from Donald** \ **of Bundaberg,** uses a 555 generate a variable width pulse t slot cars, model trains etc or the may be used as a light dimmer.

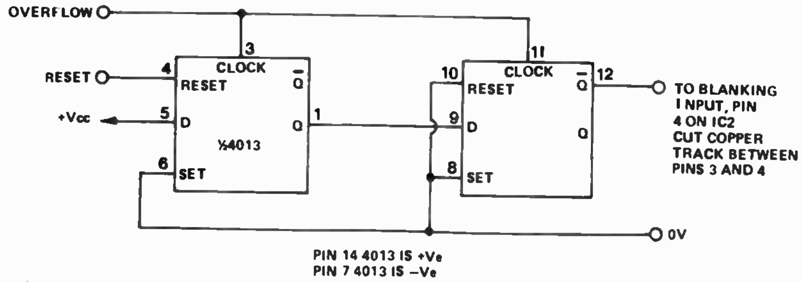
The pulse width is controlled by the voltage on pin 5, set by the potentiometer. The output transistor is switched on and off at several hundred hertz, the on to off ratio determining the speed of the motor, or brightness of the lamp.

The supply voltage may be 16 V maximum and the circuit can switch up to 10 A with an appropriate heatsink on the output transistor.

Overrange for ETI-117 digital voltmeter

After building our ETI 117 digital voltmeter, **S. Springett of Scarborough, WA,** decided to add an overrange facility. It is an inexpensive addition which does not interfere with the normal operation of the instrument. The display will flash when overrange occurs and reset to normal when the voltage is within range.

In normal operation there is an overflow pulse between the reset pulses. The first flip flop will be continuously clocked and reset. When overrange occurs there will be multiple pulses on the overflow line between the reset pulses, causing the second flip flop to change state, blanking the display. The display will re-appear after a reset pulse and the first overflow pulse. This produces a flashing display which can still be read.



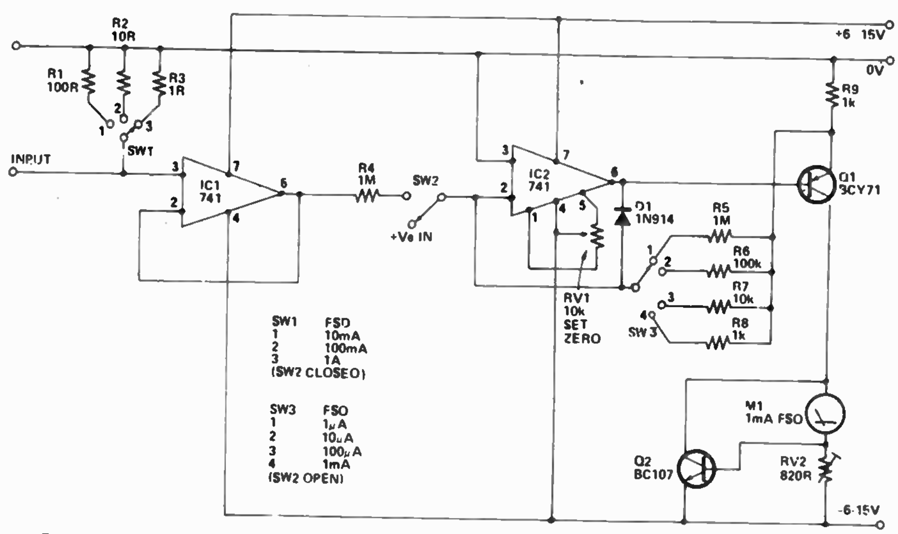
Wide range ammeter

The instrument shown will measure currents from 1μA to 1A F.S.D. in seven ranges.

IC1 is connected as a unity gain buffer and the input current flows through the resistor selected by SW1 to earth. In so doing a voltage proportional to the input current is developed across the resistor and this appears at the output, pin 6.

Small currents are measured by IC2. In this mode the current flows into the non-inverting input. Since this is a virtual earth, the output will generate a voltage proportional to the input current.

In practice, this voltage is developed across R9 and hence provides a proportional current through Q1 and M1.



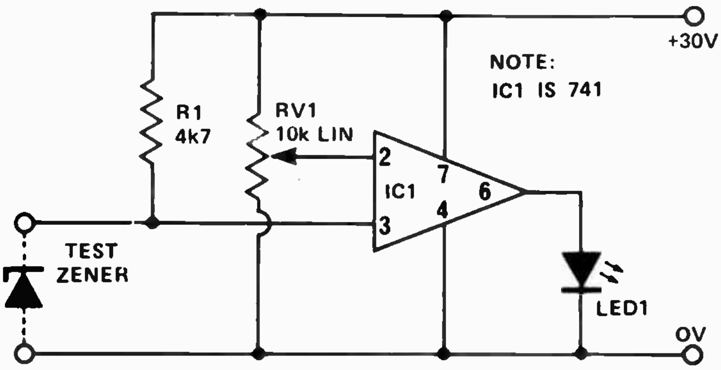
Q2 and RV1 form a meter protection circuit and the latter component should be adjusted so that Q2 starts to conduct at F.S.D. D1 is included to prevent damage to the base emitter junction of Q1 in the event of an input of wrong polarity.

Zener tester

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

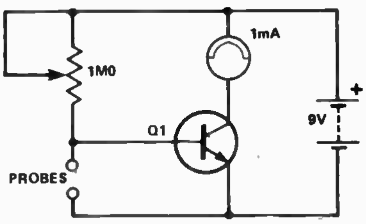
RV1 can be calibrated in volts, so that when LED 1 just lights, the voltage on pins 2 & 3 are nearly equal. Hence the zener voltage can be read directly from the setting of RV1.

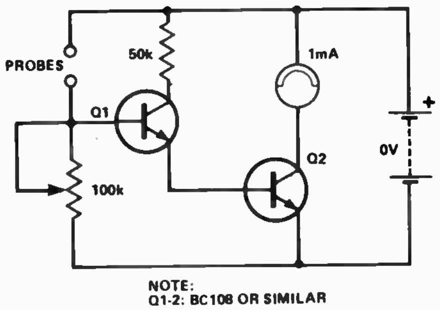
The supply need only be as high a value as the zener itself. For a more accurate measurement, a precision pot could be added and calibrated.



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.

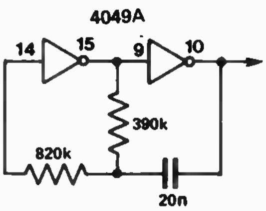
First experiments proved highly successful; the meter needle drifted at first and frequent use of the sensitivity control was required, but after a few minutes the needle stabilised.

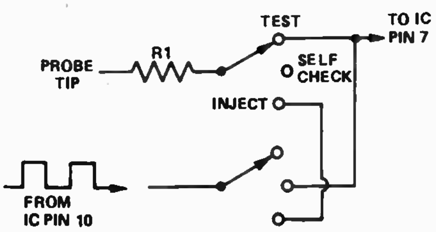
Since the needle responds to stress within the body or mind, it is easy to make it move; talking, thinking hard or biting a finger all cause the needle to move up, making it go back down by removing the factor causing the stress. Moving the needle below its mean value was far more difficult especially 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 NPN transistors, polarity of the meter and battery must be reversed.

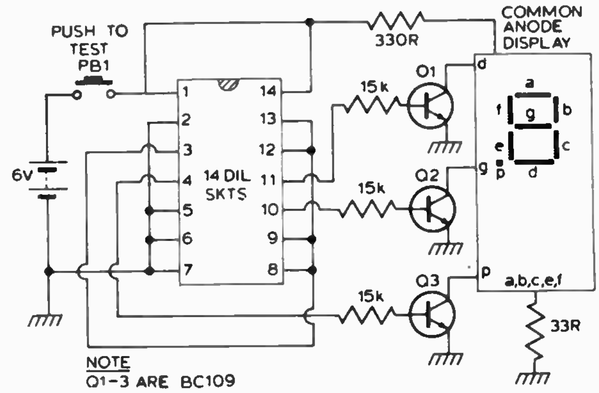
Signal injector for logic probe





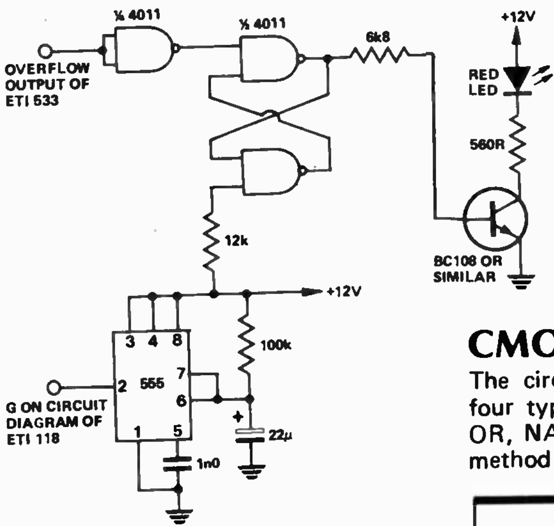
Ian Shearer of Darwin, NT, added a signal injector to his ETI-148 logic probe using two inverters and a two-pole, three-position switch. The centre position is a test function, which, when the oscillator and probe are working correctly, should light all LEDs on the probe.

The oscillator circuit uses two inverters in a 4049 IC and oscillates at about 50 Hz. The frequency can be varied by changing the values of the capacitor and the two resistors.



CMOS gate identifier

The 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.



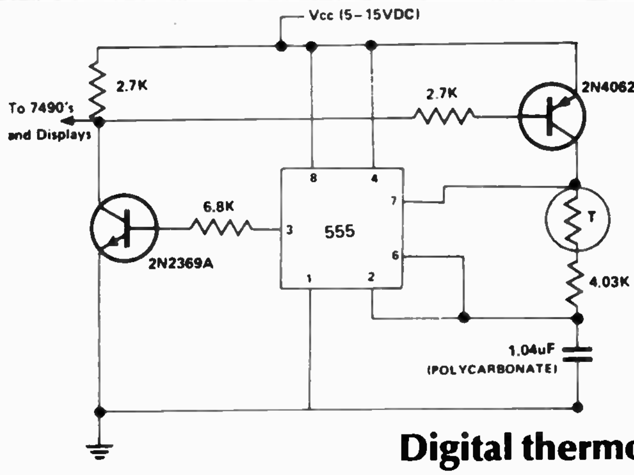
Frequency meter overflow indicator

After Gregory Freeman of Nairne had built the ETI 118 digital frequency meter, he found that the lack of an overflow indication was rather disconcerting. As a result, he built this little circuit, which latches the overflow output from the ETI 533 digital display module and resets it after a pre-determined period.

Although the circuit was originally intended for the ETI 118, it should be fairly easy to add it to any of the projects which use the 533 module.

Operation is fairly straightforward. When the overflow output of the 533 pulses high, it sets the latch formed by the 4011. This lights the LED via the transistor which will remain on until the 555 resets it.

The 555 is operating in the monostable mode, being triggered about every three seconds by the timebase output of the DFM (which is pin G on the board).

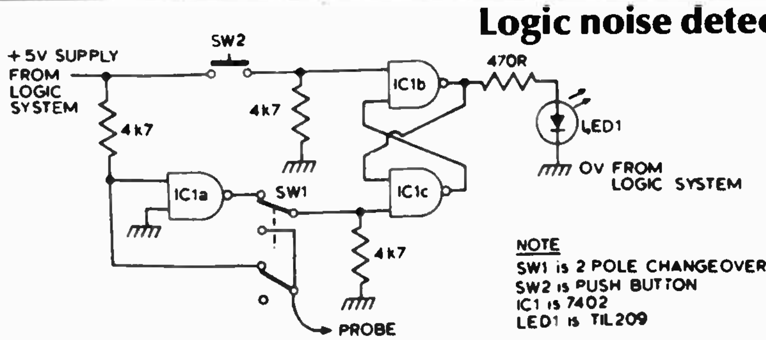


Digital thermometer

This circuit we haven't tried yet but it looks very good, anybody who tries it, let us know how you get on. The circuit's output frequency varies in a nearly linear manner from 38 to 114Hz as the temperature changes from 37°F to 115°F. The 555 is set up in the normal astable configuration with one resistor replaced by a thermistor/resistor network and other replaced by a transistor. The transistor's near zero on-resistance and very high off-resistance results in equal charge and discharge intervals that depend only on the thermistor/resistor network. The thermistor is one with a value of 5000 ohms at 25°C and a resistance ratio of 9.06:1 over the temperature range 0°C to 50°C. The capacitors need to be temperature stable and may need to be hand selected and added to give the best results. It would seem that a similar circuit for Centigrade might also be possible – any ideas?

Logic noise detector

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 I, any logic zero spikes occurring on a steady logic 'I' 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 'I' spikes.



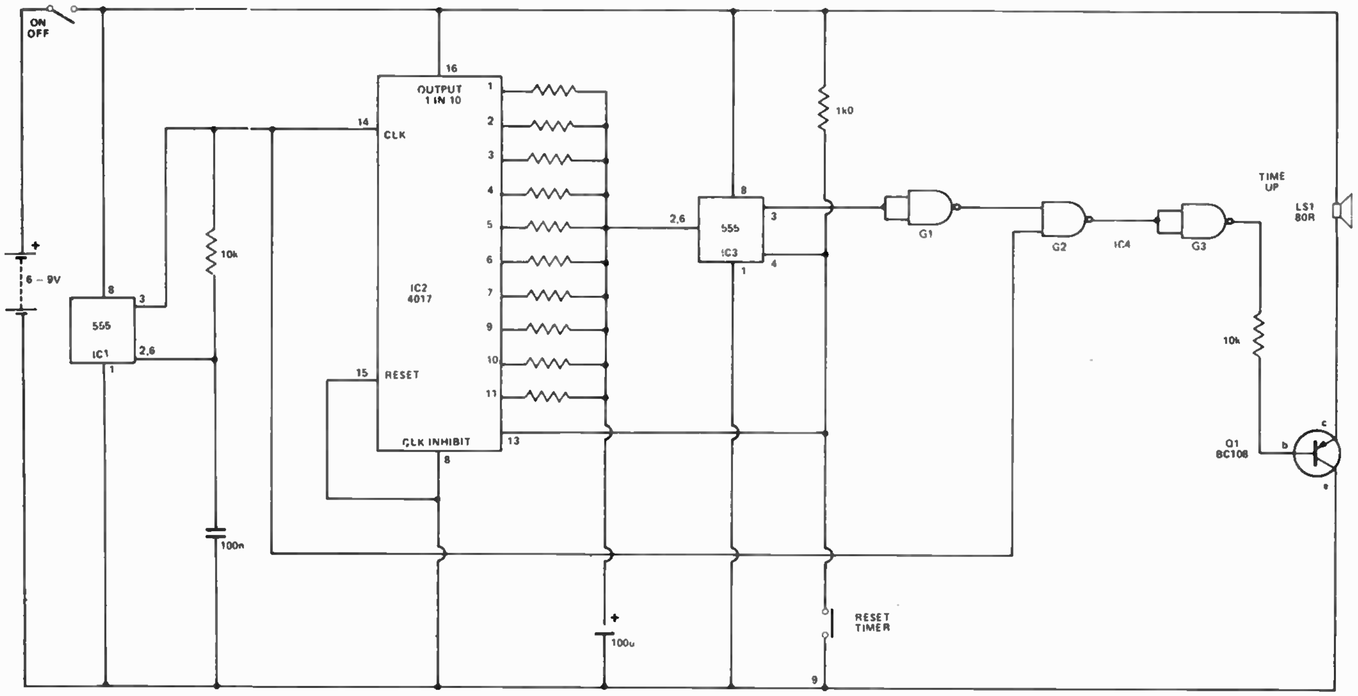
ıdom delay timer

S. D. Lang

ıis 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.



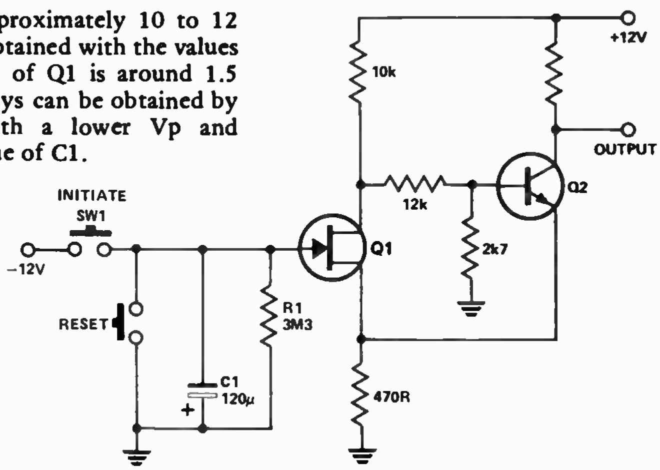
Ten-minute timer

Curiously, this one was sent in by Roger Harrison many years ago and has only just surfaced!

The circuit is a hybrid Schmitt trigger, using a FET and a bipolar transistor. Initially, Q1 will be on and Q2 will be off. The output will be high (+12V). The timer is initiated by pressing S1. C1 will rapidly charge to −12V and Q1 will be cut off. Q2 will then turn on.

When S1 is released, C1 discharges through R1 until the voltage across C1 equals Vp of Q1. The circuit will now change state and Q2 will turn off rapidly, providing a suitable output step which can be used to operate a relay driver or any external circuit.

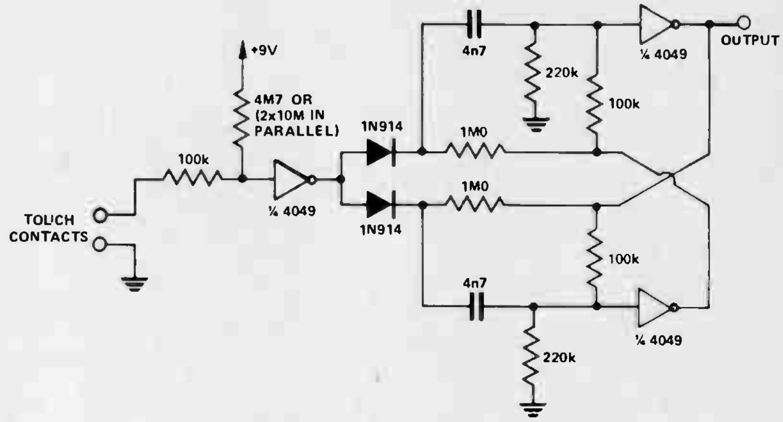
A delay of approximately 10 to 12 minutes can be obtained with the values shown if the Vp of Q1 is around 1.5 volts. Longer delays can be obtained by using a FET with a lower Vp and increasing the value of C1.



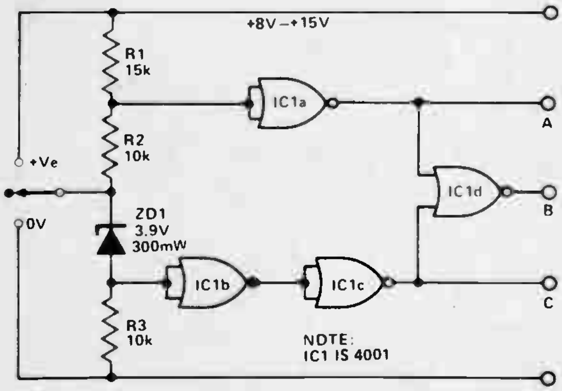
Touch switch

A nice simple little circuit from Paul Tannard of Brighton – a touch switch and flip-flop built from one CMOS IC.

The advantage of having a flip-flop on the output of a touch switch is that it then becomes touch-on, touch-off. A further gain is that, if you're inputting single pulses to some sort of counting circuit, it makes a very positive debounce circuit. Remember that if you are using it for this purpose and you wish to hang a LED off the end to show you what's happening at the output, you can drive the LED by using one of the unused gates in the package as a buffer and connecting it to the other output of the flip-flop. That is, unless you want to build two of the switches from one package!



3-way CMOS switch



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.

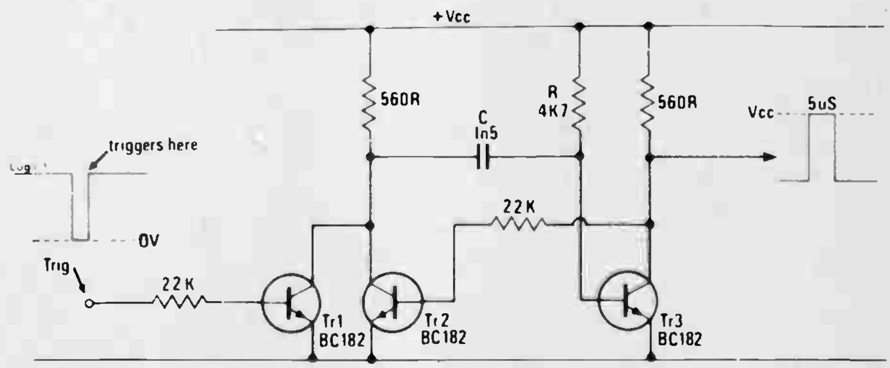
Connectin the input to OV causes output A to go high.

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.

Rising edge trigger

The diagram shows a method of triggering a conventional monostable on the rising edge of a short negative-going pulse. The additional transistor, TR1, provides good isolation between the output pulse and the triggering circuitry. The circuit shown gives a pulse of 5μsec duration, but of course the usual design formula $\tau = 0.65$ RC can be used to determine circuit values for other pulse widths.

One slight disadvantage of this circuit is that the collector of TR2 is held down by the triggering wave-form, so the switch-on of TR3 is not regenerative. For this reason the falling edge of the output pulse is not as fast as it might be, but is sufficient for most purposes.



Multi-flash trigger

This circuit provides a cheap and safe system for parallel connection for electronic flashguns and prevents damage to shutter sync. contacts.

Electronic flashguns used for photography usually have a voltage of between +200 V and +400 V present at the trigger input connector.

The flash unit operates when the trigger is grounded (by the shutter sync. contacts) and a current pulse of between 1 and 3 amps, lasting about 10 to 30 microseconds is carried by the sync. contacts.

Direct connection of electronic flashguns in parallel can cause two major problems:

(a) Different makes or powers of flashguns may have different operating voltages and may therefore be damaged by parallel connection.

(b) Shutter contacts could be damaged or burned by the excess current of multiple gun operation.

This circuit overcomes these two problems as follows:

(a) Diodes D2 to D5 effectively isolate the hot side of each flashgun from the next and also prevent the high voltage appearing on the unused flashgun contacts.

(b) The SCR trigger circuit operates as follows:

When one or more flashguns are connected to the unit, the cathodes of D2–D5 rise to a high positive value, say +200 V.

C1 is charged via R2, R1 and D1 in a time constant C1 x (R1 + R2) = 0.02 x 118 k = 2.36 mS.

SCR1 is non-conductive at this time as its cathode is slightly positive and its gate is grounded.

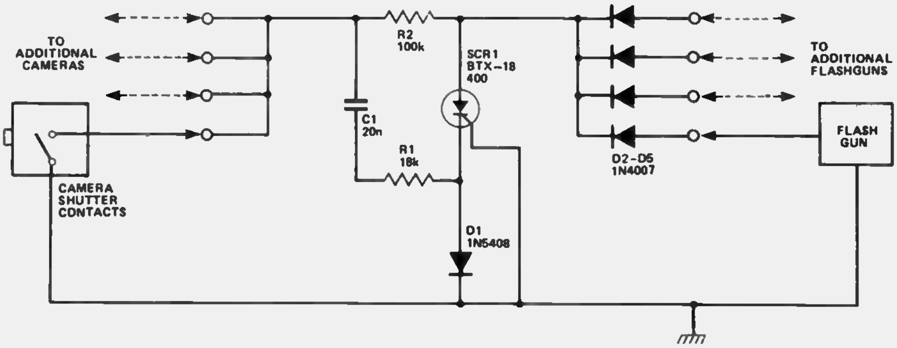
When the shutter contacts of a camera connected to the device are closed the R2 end of C1 is grounded and therefore the R1 end is driven negatively to –200 V. This enables a negative current pulse to be delivered to the cathode of SCR1 (D1 allows SCR cathode to go negative) of about 11 mA, for about 360 uS duration, this pulse turns on the SCR which then carries the trigger current of the flashguns.

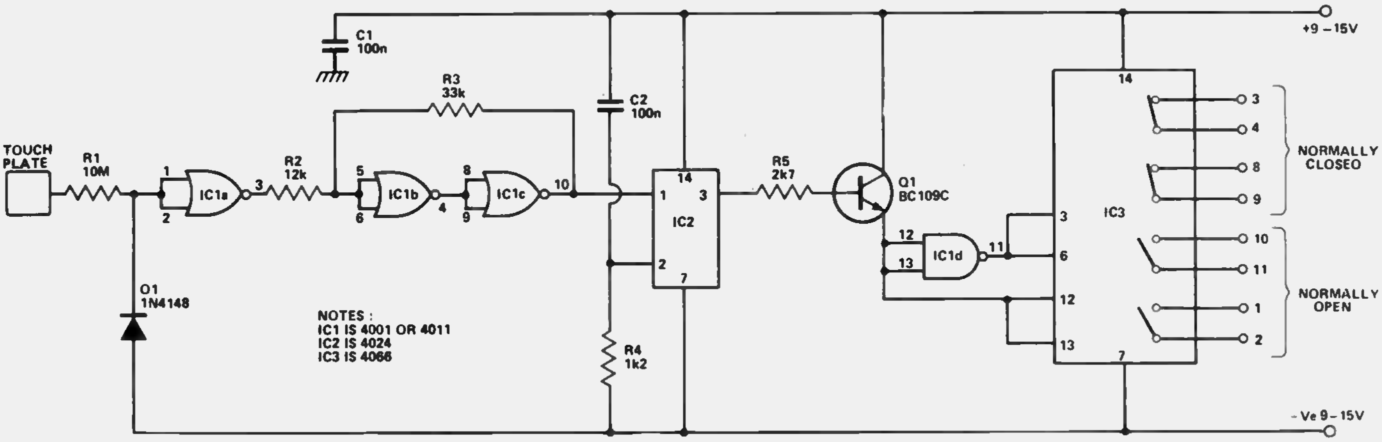
When the flashguns fire the trigger voltage drops to zero and the SCR turns off. C1 will recharge as the voltage of the flashguns recover ready for the next flash.

As can be seen, the maximum current through the camera contacts is thus reduced even with a flashgun voltage of 400 V, to only 22 mA.

When using more than one flashgun in a direct lighting system, allowance should be made for the increased guide number:–

Effective Guide Number = $\sqrt{a^2 + b^2 + c^2 \ldots}$





One contact touch switch

G.N. Durant

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

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

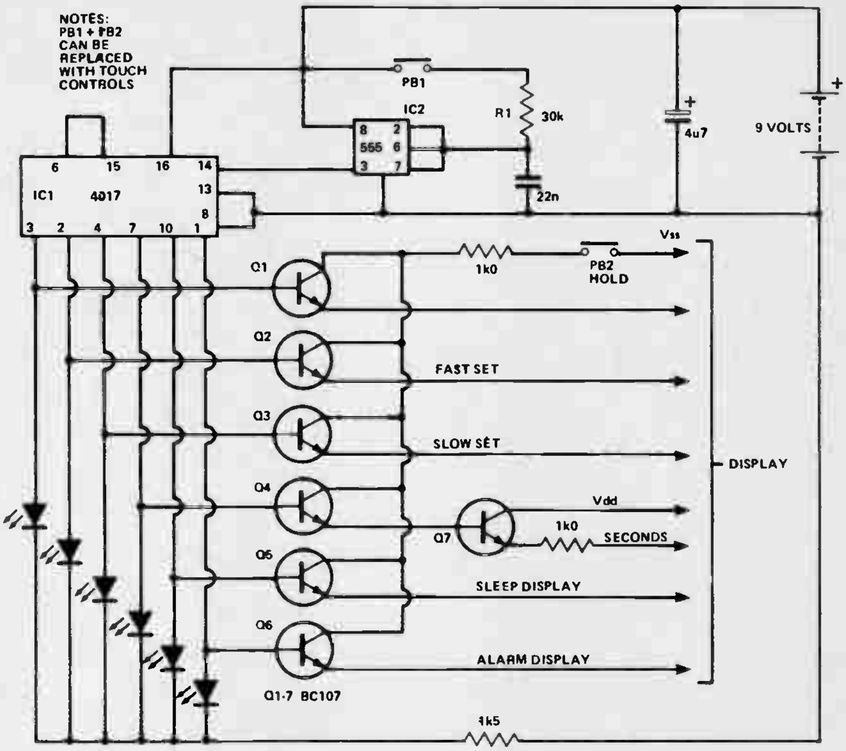
Q1 sends a pulse through to IC3, a solid state CMOS switch. This can be fed via an inverter if desired. The switch must not be used at more than its supply voltage -.up to 15 V. The 'off' switch resistance is about 10^{13} ohms and the 'on' resistance is about 80 ohms at 15 V V_{DD} (at 9 V V_{DD} it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

Clock switching unit

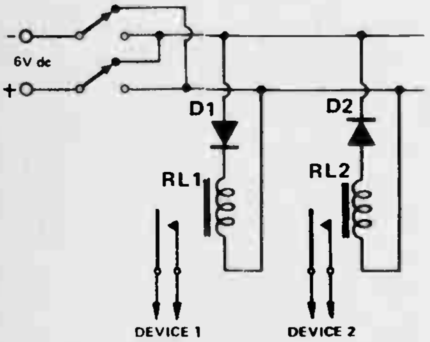
A. Claughan

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.



Two-wire relay control



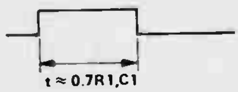
The problem of how to operate two relays independantly from just two wires always produces a lot of head scratching — and not just with beginners! This circuit, from the ETI files, shows how it's done.

The relays RL1 and RL2 are each connected to the two-wire line via a series diode. However, D1 is connected the opposite way round to D2. A reversing switch at the end of the line, before the dc voltage required to operate the relays, is used to set which relay will be activated. With the dc voltage connected in the polarity shown, and the reversing switch set as indicated, D1 will conduct and current will flow through RL1 which then operates Device 1 connected to its contacts. D2 will be reverse biased and will not conduct. When the reversing switch is set the opposite way D2 will conduct, D1 being reverse biased now, and RL2 will operate.

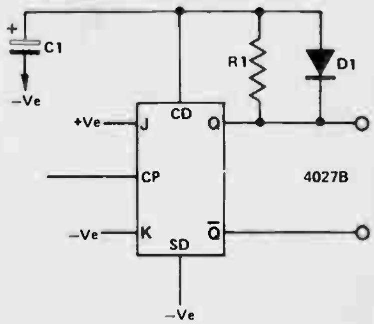
If you want both relays off for some purpose, the dc voltage will have to be disconnected. The simplest way to do this is to have a three-position two-pole toggle switch, the centre position being 'off'.

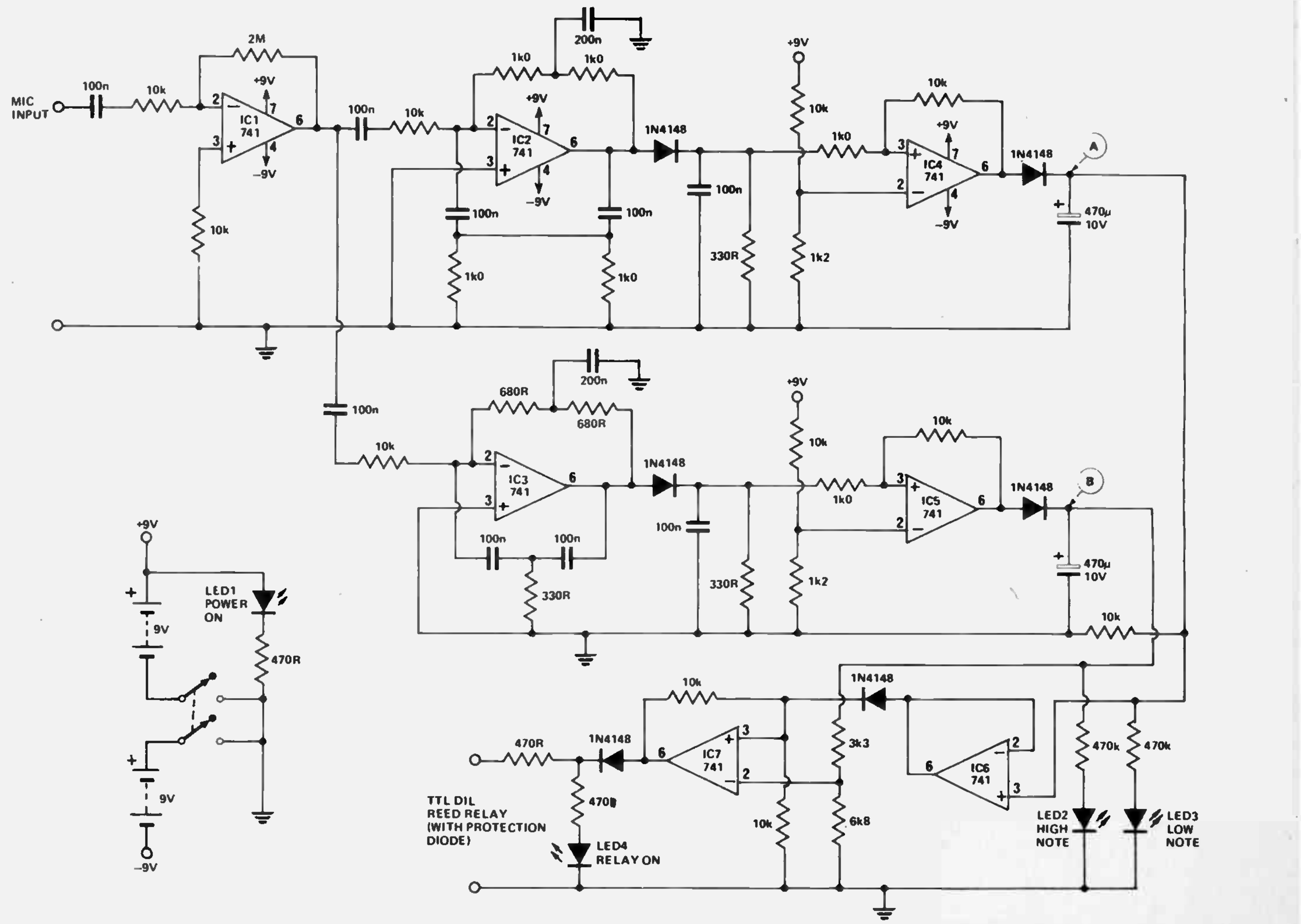
CMOS monostable

Barry Wilkinson (of Nebula Electronics) devised this mono using a 4027B CMOS JK flip-flop. The time constant is set by R1C1, and D1 speeds the discharge of C1.



OUTPUT PULSE OCCURS ON POSITIVE EDGE OF OUTPUT





"Whistle-up" switch

There are many applications – both 'novel' and useful – where one could use a switch that is activated by whistling. This circuit operates a relay when a high-pitched note is whistled, the relay latching on until a low-pitched note is whistled. The circuit comes from R.C.W. Gate of the UK.

The Schmitt trigger is 'set', activating the relay, when the high note is whistled and reset when the low note is whistled, the relay then dropping out.

Points A and B can be used to drive other logic functions. However, if high impedance (i.e: CMOS) logic is used a 10k resistor should be placed across the 470 u capacitor on the outputs of IC4 and IC5.

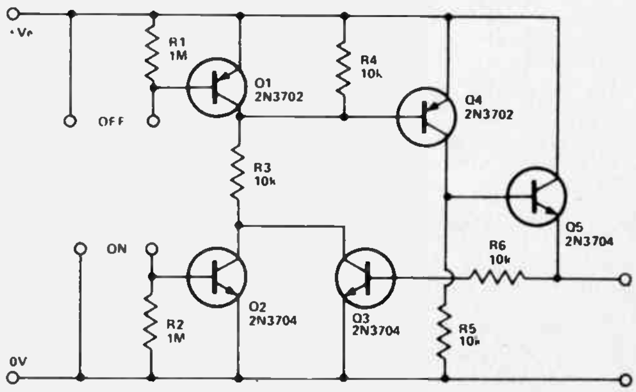
A concealed microphone picks up the note whistled. The mic output is amplified by a 741 op-amp (IC1), the output of which is filtered by two active peak filters. IC2 is the 'high' note filter and IC3 is the 'low' note filter. The output of each filter is rectified and smoothed then each is passed to the input of a Schmitt trigger – consisting of IC6 and IC7.

Solid state switch

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 off 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 contacts and again R6 and Q3 latch the circuit.



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