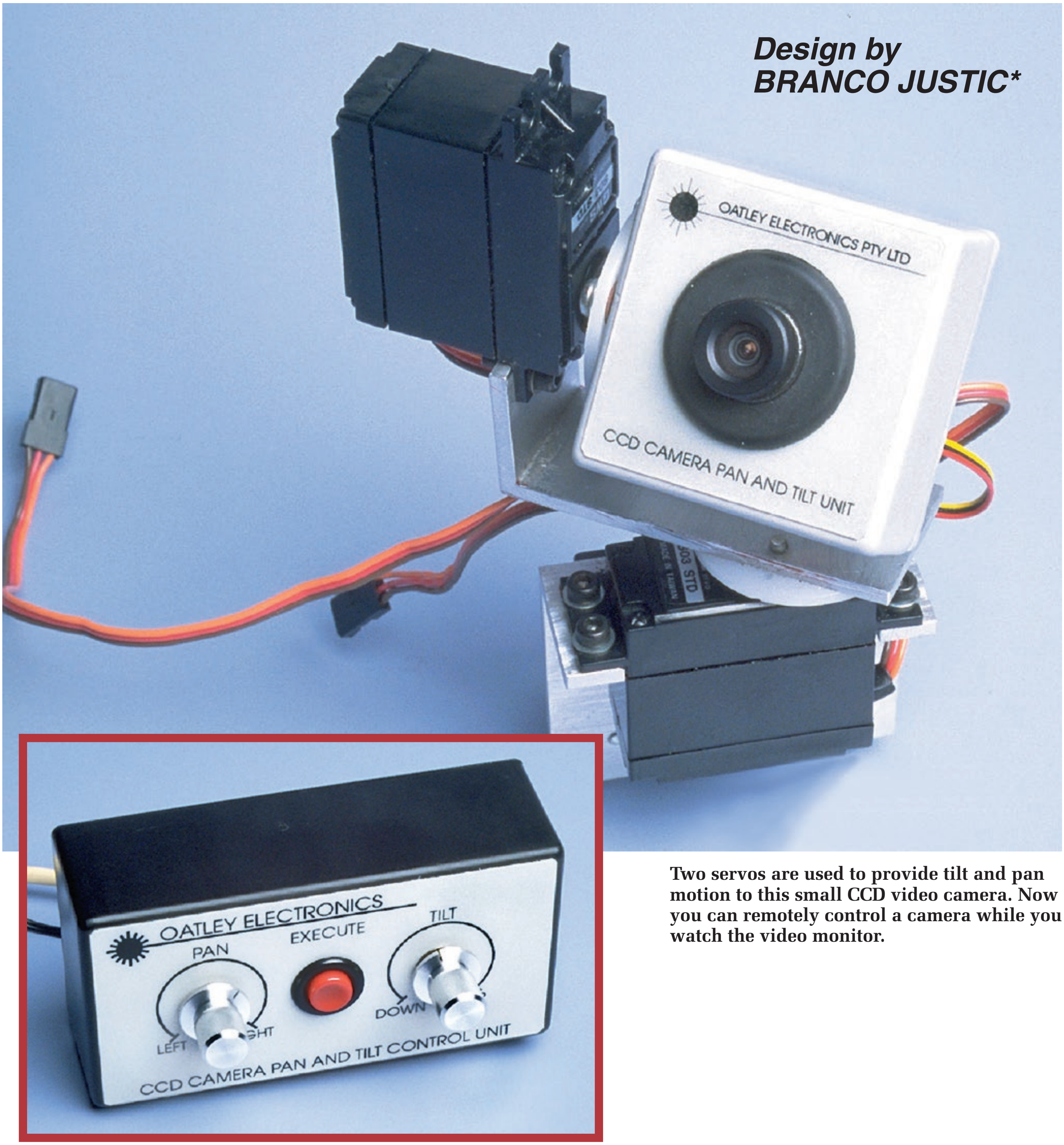
Design by
BRANCO JUSTIC*



Two servos are used to provide tilt and pan motion to this small CCD video camera. Now you can remotely control a camera while you watch the video monitor.

PAN your BY

CCD video camera REMOTE CONTROL

Do you have a video security system involving a miniature CCD camera? How would you like to be able to remotely pan it from side to side and up and down while you watch the video monitor? This circuit uses two servos to do the job and draws no current at all while the camera is stationary.

More and more people are finding uses for tiny CCD video cameras. They're not just being used in routine security applications but they are being used around the home for watching young children, especially around swimming pools, in hospitals and so on. But most of these cameras would be fixed installations, so the view on the screen is always of the same room or whatever. Now it is possible to remotely pan the camera while you watch the monitor.

In practice, the CCD camera is mounted as shown in our photos. These show a typical miniature CCD camera mounted in a small plastic case which is attached to a servo disc (ie; a round flange attached to the servo shaft). This first servo is then mounted on an angle bracket which is attached to a second servo disc. The first servo pans the camera up and down while the second servo pans it from side to side.

Servo driver

The servo control circuit is mounted in a plastic utility case with two knobs and a central button. Each knob controls a servo while the central button is labelled "Execute". This is not a form of punishment but merely means that nothing happens to the servos unless the button is pressed. This has the effect of minimising servo wear and tear but more importantly, if the button is not pressed, the circuit is completely dead and so the battery (if battery power is used) is conserved.

This approach to servo drive is quite novel but is practical in this application. After all, you don't want the servos drawing current while the camera remains pointed in a fixed direction. It might be left in this condition for hours or days at a time, so it makes sense to power the circuit only while the camera is actually being moved.

You could use the servo control circuit in one of two ways. First, you might rotate the pots to set a new camera position and then push the "execute" button. The camera will then move to the new position and stop. Second, you might hold the "execute" button down while you twiddle the pots so that the camera moves exactly in sympathy with rotation of the pots.

An ideal method would be to use a joystick potentiometer set from a radio control transmitter but at the time of writing we had not been able to access a suitable joystick at a reasonable price.

Circuit description

Fig.1 shows the circuit of the servo controller. It uses just one 74C14 CMOS hex Schmitt trigger inverter,

Parts List

1 plastic utility case, 130 x 67 x 42mm
1 PC board, 46 x 60mm
2 servos
2 servo discs
1 9V, 10V or 12V DC plugpack
1 momentary contact pushbutton switch (S1)
2 100kΩ potentiometers (VR1, VR2)

Semiconductors
1 74C14, 40106 hex Schmitt trigger (IC1)
1 TIP41C NPN power transistor (Q1)
3 BC548 NPN transistors (Q2, Q3,Q4)
1 6.2V 400mW zener diode (ZD1)
3 1N4148, 1N914 silicon diodes (D1,D2,D3)

Capacitors
3 10µF 16VW PC electrolytic
2 .012µF MKT or greencap polyester
2 .01µF MKT or greencap polyester

Resistors
2 1MΩ
2 68kΩ
4 10kΩ
3 2.2kΩ
2 1kΩ

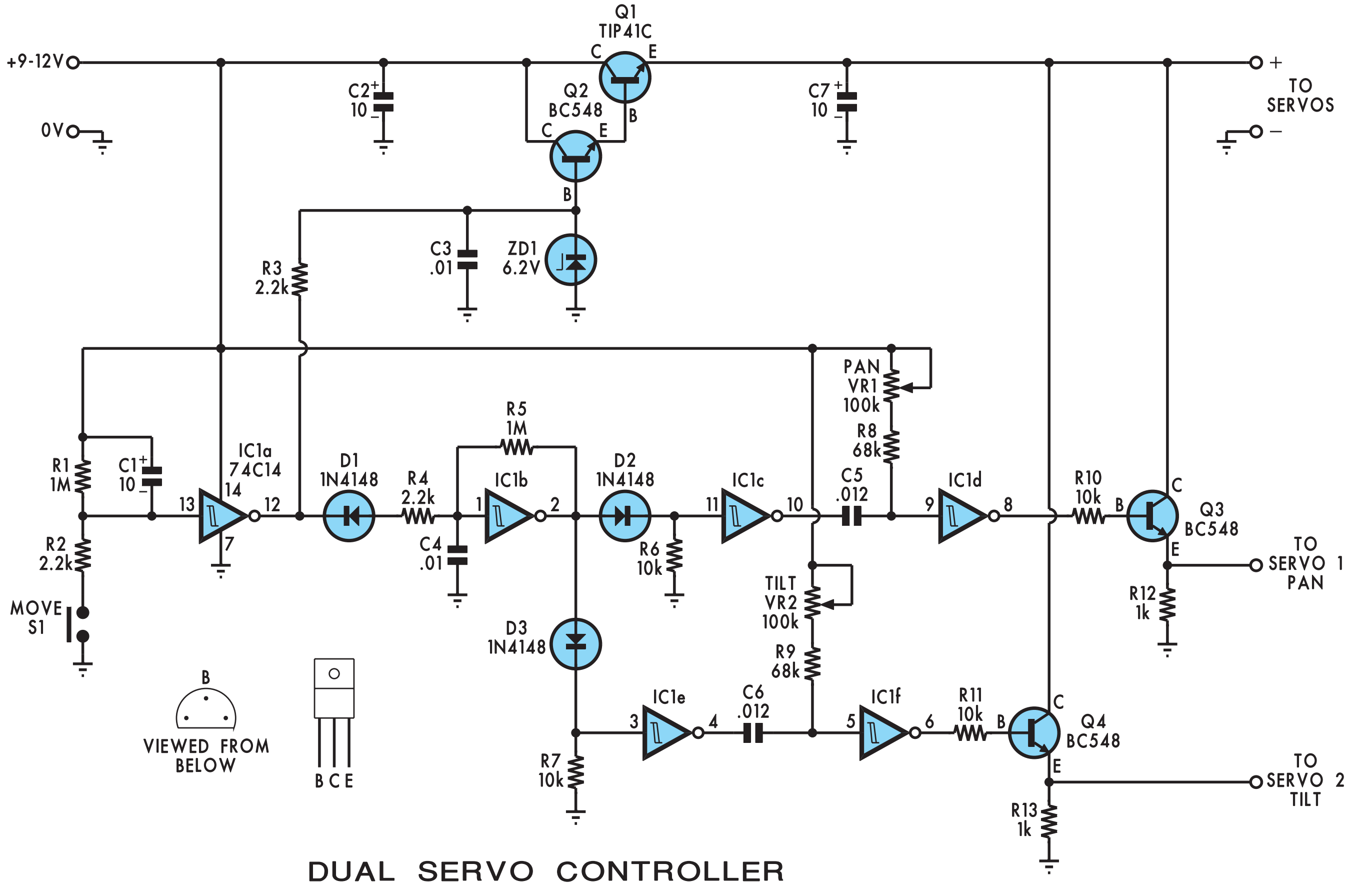


Fig.1: the circuit consists of two one-shot (monostable) pulse generators driven by oscillator IC1b. Most of the circuit is shut down until pushbutton S1 is pressed. The circuit and servos consume no power when not in use.

a few diodes and transistors and not much else.

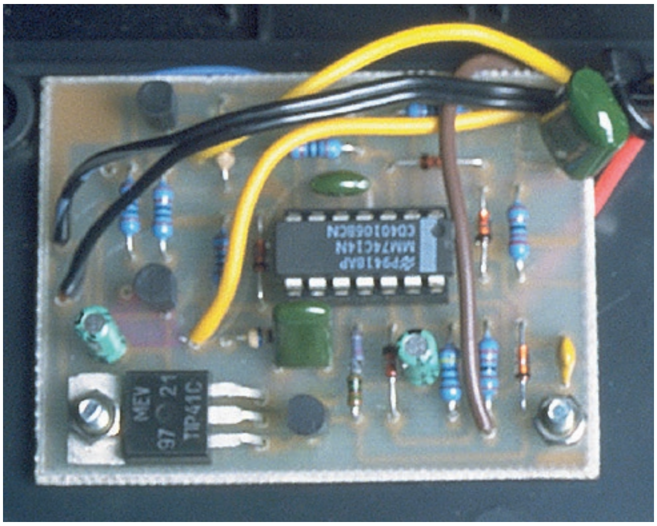
There are two separate servo pulse generators, the first involving IC1c & IC1d and the second involving IC1e & IC1f. These are both driven by IC1b which is a free-running oscillator. Before we get too far ahead of ourselves though, let's have a look at how the circuit starts itself.

When power is first applied to the circuit, nothing happens as far as the two servo outputs are concerned and the various Schmitt triggers do nothing. The output of the 5V regulator, comprising transistors Q1 & Q2, is also close to zero. Everything depends on IC1a and its output is close to zero because its input is held high due to the 1MΩ resistor and 10μF capacitor at pin 13.

When pushbutton S1 is pressed, pin 13 of IC1a is pulled low and the 10μF capacitor is charged via the 2.2kΩ resistor, R2. Pin 12 of IC1a goes high and this does two things. First, it feeds a bias current to the base of Q2 via a 2.2kΩ resistor, R3. This develops 6.2V across zener diode ZD1 and allows Q2 and Q1 to work as a 5V regulator to provide power to the two servos and to transistors Q3 & Q4.

At the same time, pin 12 of IC1a reverse-biases diode D1 and this allows IC1b to operate as a free-running oscillator, with its frequency set by the .01μF capacitor and 1MΩ resistor at its pin 1. It produces a square wave at about 60Hz.

Now let's look at the servo pulse generator involving IC1c & IC1d. This really operates as a one-shot to produce a single positive pulse with a duration set by the 100kΩ potentiometer VR1. Let's look at what happens, in slow motion. First, each time the output of IC1b goes high, it pulls the input of IC1c, pin 11, high. This causes pin 10 to go low and this low signal is fed via the .012μF capacitor to pin 9



This prototype board differs somewhat from the final version which has a screened parts overlay and solder masking.

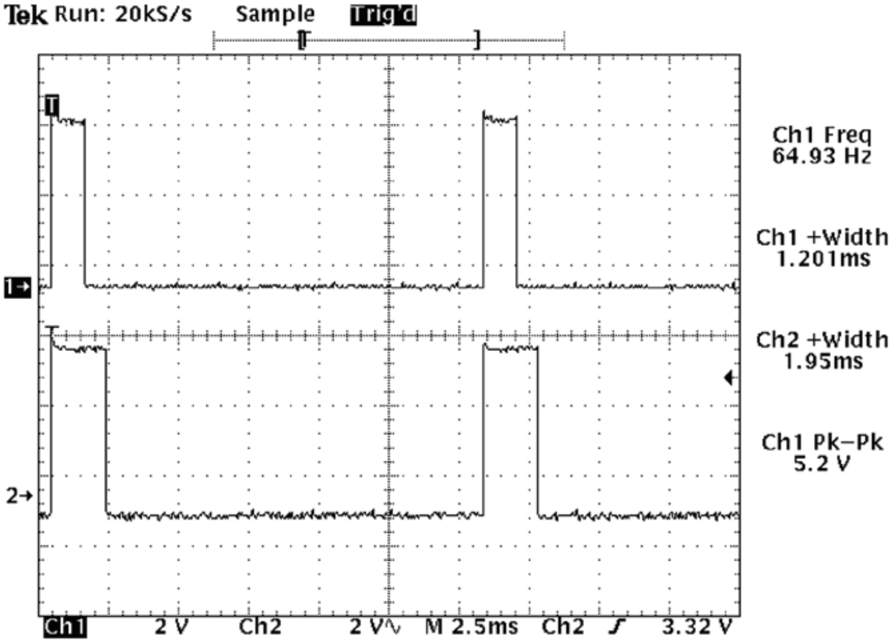


Fig.2: these scope waveforms show the servo signals from the emitters of Q3 & Q4. The pulse widths are varied by the potentiometers VR1 & VR2.

of IC1d. Pin 8 of IC1d then goes high and stays high until the capacitor at pin 9 is charged via VR1 and the series 68kΩ resistor. This causes pin 9 to be pulled high to the point where pin 8 must go low.

The result is a +12V pulse at pin 8 with a duration of between 1ms and 2ms (nominal), depending on the setting of VR1.

This pulse is fed to Q3 which acts as a voltage level translator and buffer, changing the +12V pulse at pin 8 to a pulse with a nominal amplitude of +5V which is compatible with the servos.

Exactly the same process happens with the other one-shot pulse generator comprising IC1e & IC1f. Each time the oscillator output of IC1b, pin 2, goes high, a positive pulse appears at pin 6 of IC1f and this is fed via transistor Q4 to the second servo.

So both pulse wavetrains are synchronised to each other, as can be seen from the two scope waveforms shown in Fig.2.

However, this whole process only lasts about 10 seconds which is more than enough for each servo to come to rest and stabilise at its new setting. After that time, the 10µF capacitor at pin 13 of IC1a will have discharged sufficiently via the shunt 1MΩ resistor to pull pin 13 high. This causes pin 12 to go low and this shuts down the 5V regulator and disables the oscillator involving IC1b via diode D1.

Thus, the +5V rail to the servos and the servo pulse signals are killed and so the servos are stuck at their last position. In this condition the circuit draws negligible current.

Note that as long as you hold

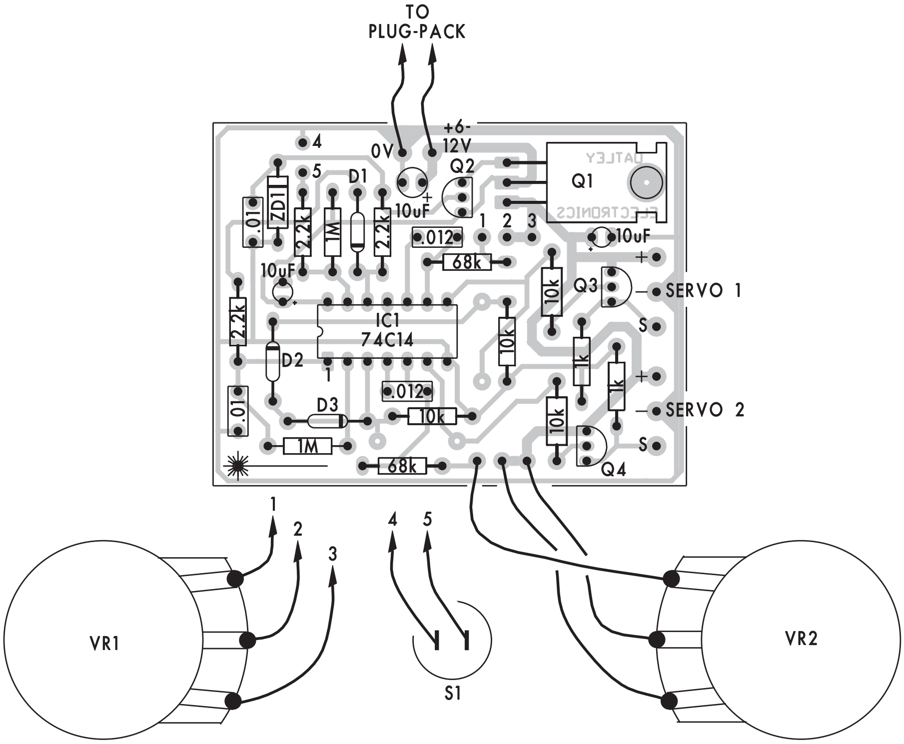
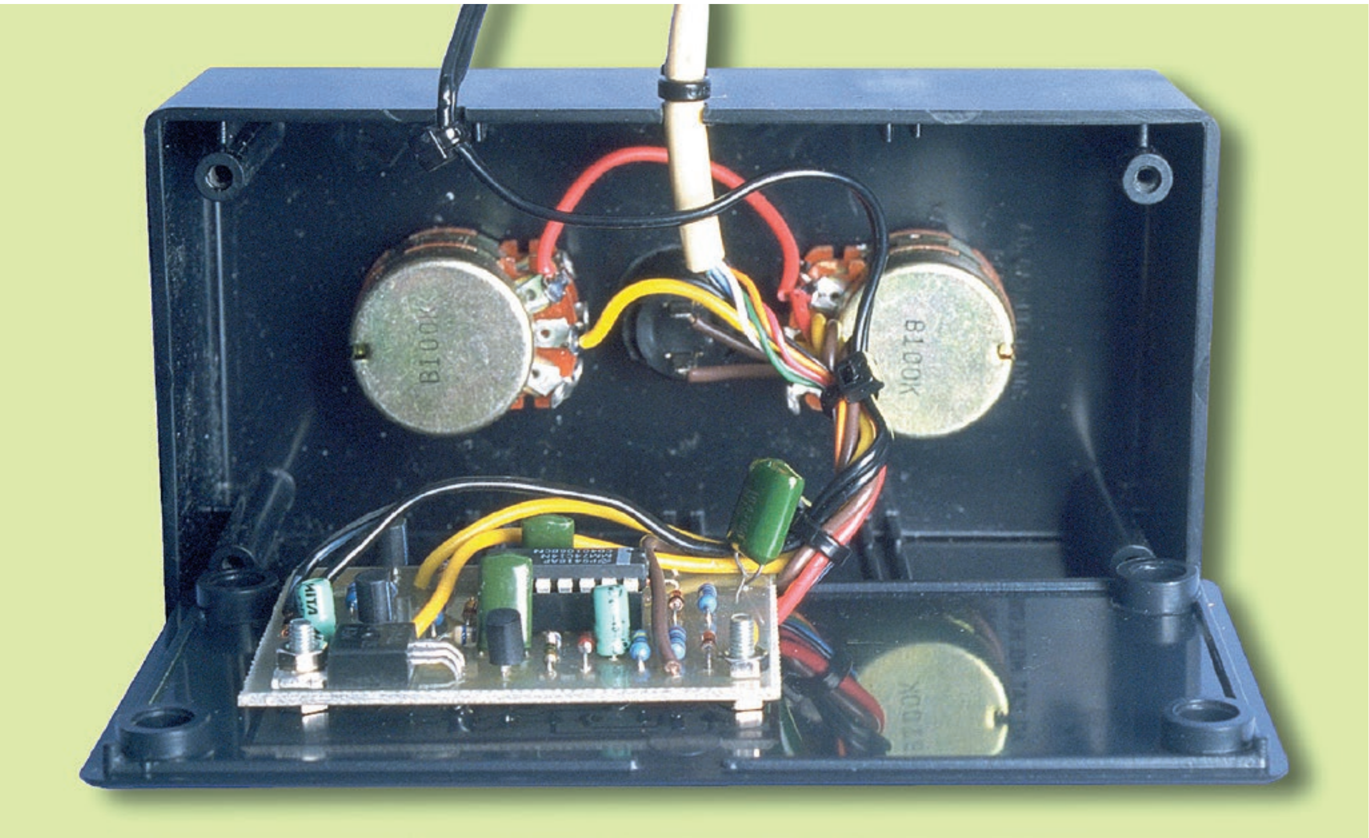


Fig.3 (left): the wiring diagram for the dual servo controller. If you do not wish to use the power-saving feature, the pushbutton switch could be replaced by a wire link.

Resistor Colour Codes

☐	No.	Value	4-Band Code (1%)	5-Band Code (1%)
☐	2	1MΩ	brown black green brown	brown black black yellow brown
☐	2	68kΩ	blue grey orange brown	blue grey black red brown
☐	4	10kΩ	brown black orange brown	brown black black red brown
☐	3	2.2kΩ	red red red brown	red red black brown brown
☐	2	1kΩ	brown black red brown	brown black black brown brown



The PC board is mounted on the lid of the case and connected to the Pan and Tilt potentiometers via flying leads. Power comes from a DC plugpack supply.

pushbutton S1 down the circuit will continue to work but it will stop about 10 seconds after the button is released.

If you want to have the circuit permanently powered, S1 could be a toggle switch or it could be linked across.

Note: readers wanting a detailed description of the operation of servo encoder and decoder circuitry should refer to the Radio Control articles by Bob Young in the November & December 1997 issues of SILICON CHIP.

Construction

All the components of the circuit, with the exception of the two potentiometers and the pushbutton switch, are mounted on a small PC board measuring 46 x 60mm. The component layout is shown in Fig.3.

Assembly is quite straightforward. Insert the PC pins first, followed by the resistors and diodes. Then insert the capacitors and the transistors. The CMOS IC should go in last.

Note: there are positions on the supplied PC board labelled D4 and D5 but these diodes are not required for the circuit to work.

The finished PC board is mounted in a plastic utility case and connected to the two potentiometers and pushbutton switch via flying leads.

When you have finished assembly, carefully check all your work against the circuit of Fig.1 and the wiring diagram of Fig.3.

If everything is OK, apply +12V to the supply input and check voltages around the circuit. You should find +12V at pin 14 of IC1 and at the collectors of Q1 & Q2. No voltage should be present at the collectors of Q3 & Q5. Furthermore, pins 2, 3, 5, 9, 11 & 13 of IC1 should be high (ie, close to 12V) while pins 1, 4, 6, 8, 10 & 12 should be low (ie, close to 0V).

When the pushbutton is pressed, pin 13 should go low, pin 12 will go high and the other pins of the IC will be at a voltage somewhere between high and low. The emitter of Q1 should be at +5V. The circuit will then revert to its original quiescent condition after about 10 seconds.

Now connect your two servos, press the button again and you should be able to move both servos with their respective potentiometers.

Having verified that the circuit works, you are ready to set up your camera and starting panning to your heart's content.

Where To Buy The Kit

All the parts for this kit are available from Oatley Electronics who own the design copyright. Their address is PO Box 89, Oatley, NSW 2223. Phone (02) 9584 3563; fax (02) 9584 3561. The prices are as follows:

Complete kit for dual servo controller	$19.00
Servo kits	$15.00 each
DC plugpack	$10.00
Pinhole or standard CCD video camera	$89.00
Camera box plus universal swivel bracket	$4.00

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*Branco Justic is the Managing Director of Oatley Electronics.

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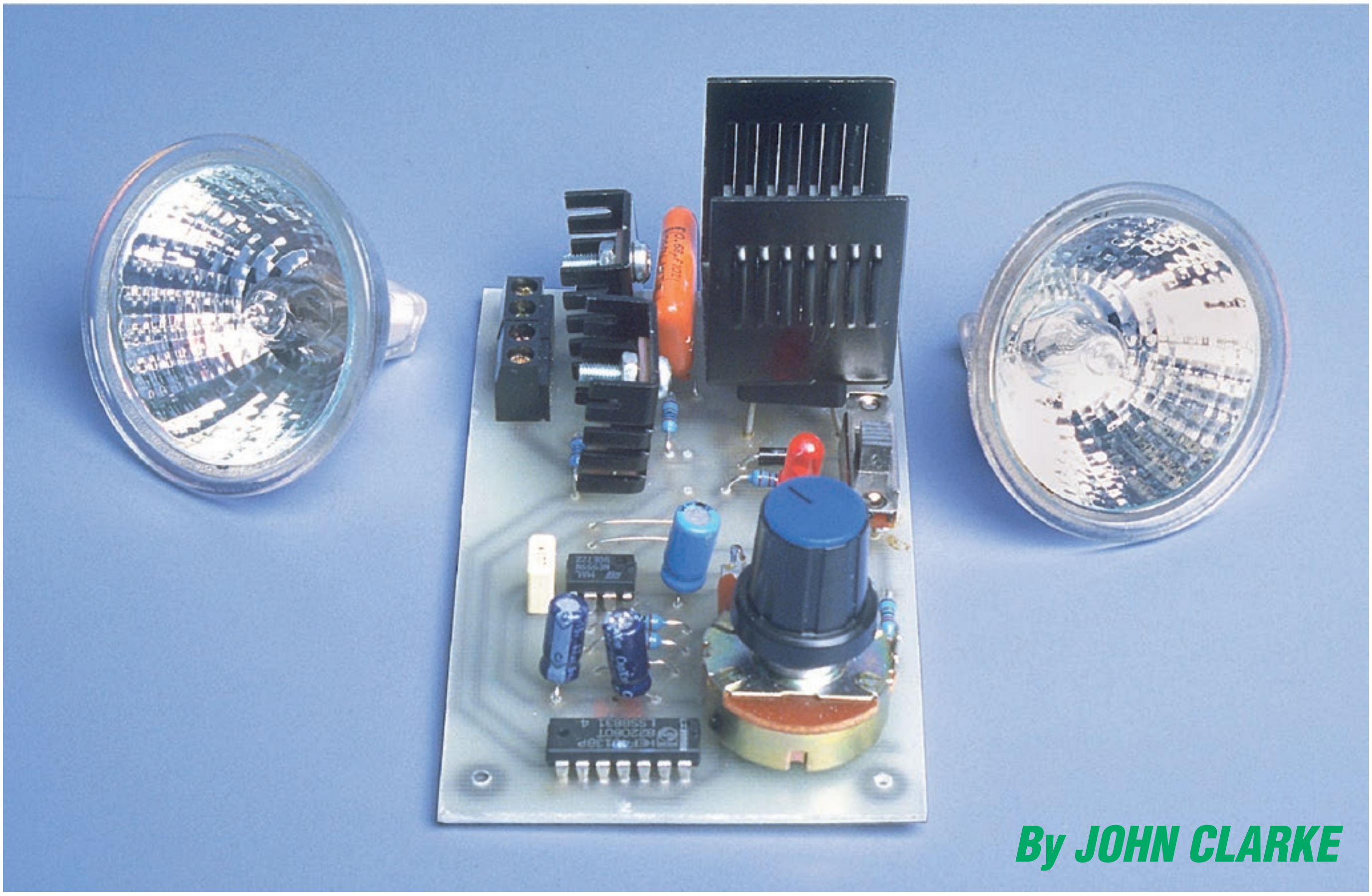


By JOHN CLARKE

Build a one or two-lamp flasher

This simple circuit lets you flash one halogen lamp at about twice a second to simulate a low frequency strobe or you can flash a pair of halogen lights alternately at rates from once a second to once every three seconds or so. You can use the flasher circuit to draw attention to a sign or wall display or simply just to liven up the atmosphere at a party.

Flashing lights are a good way of attracting peoples' attention. They are used to good effect on many advertising displays and at shows, particularly car & boat stands where the very latest high tech items are to be seen.

Flashing lights are also often used at parties and the best example of this is the Light Show presented elsewhere in this issue. If your budget doesn't run to a full-blown light show this project could give you at least some of the visual effect.

The circuit is quite simple and provides for two variations. In its simplest strobe form it uses just one 555 timer IC and one Mosfet. In its two-lamp form it uses the 555, a 4013

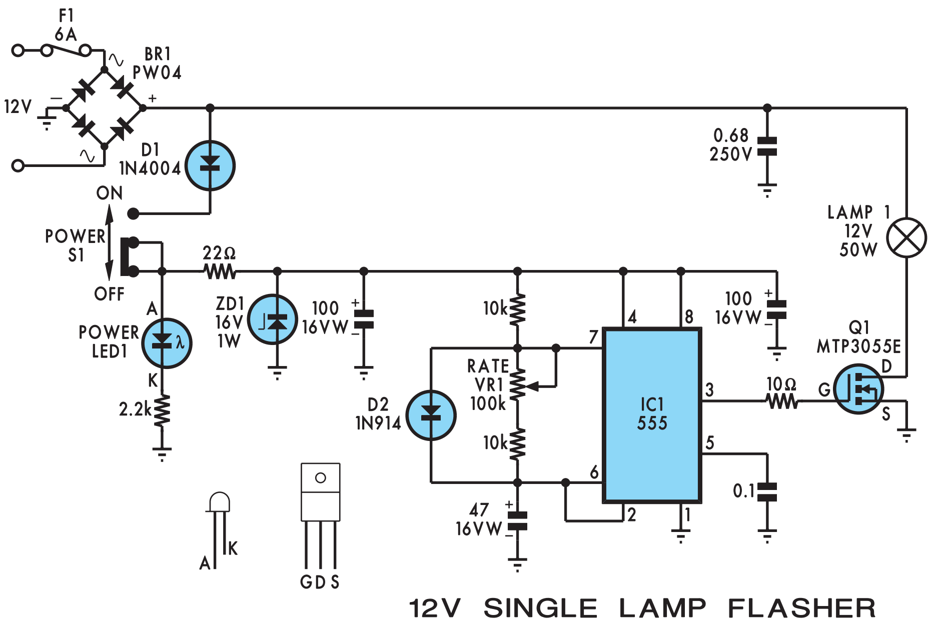


Fig.1: the single lamp version of the circuit uses a 555 timer to drive a Mosfet which flashes the lamp. Diode D2 ensures that the flash duration is fixed at about half a second while the flash repetition rate is varied by VR1.

flipflop IC and two Mosfets. It can run from 12V DC or 12V AC.

The strobe version simply flashes one lamp on and off with a fixed lamp on time of about 0.5s and a variable off duration from 0.5s to about 3.5s. The flasher version switches each lamp on at between 1s and 4s as set by the variable rate control. The flash rate is limited in practical terms by the thermal inertia of the halogen lamp's filament. If we were to flash the lamp too fast the filament would not have time to cool and the effect would be merely a flicker in the lamp brightness rather than flashing on and off.

Hence the strobe effect is not like that from an Xenon flash tube which can be driven at very fast rates to give the effect of stopped or jerky motion of moving objects.

Main Features

- Strobe (one lamp) or flasher (two lamp) operation
- Adjustable flash rate
- Operates from 12VAC or 12VDC supply
- Drives 20W or 50W halogen lights

Circuit description

Fig.1 shows the strobe version of the circuit, IC1 is a standard 555 timer which is connected to operate as an astable oscillator. Initially, when power is first applied, the 47µF capacitor at pins 2 and 6 is discharged and pin 3 is high. It is charged via diode D2 and the 10kΩ connecting to the positive supply. When the capacitor voltage reaches 2/3rds the supply, as detected by pin 6, pin 7 goes low to discharge the 47µF capacitor via potentiometer VR1 and the series 10kΩ resistor. At the same time as pin 7 goes low, so does pin 3.

When the 47µF capacitor is discharged to $^{1}/_{3}$rd the supply voltage, as detected at pin 2, pin 7 goes open circuit and pin 3 goes high again. Thus the capacitor charges again. Its voltage swings between $^{1}/_{3}$rd and $^{2}/_{3}$rds the supply while the voltage at pin 3 switches high and low at the same rate.

Diode D2 is included between pin 7 and 2 & 6 so that the capacitor charge

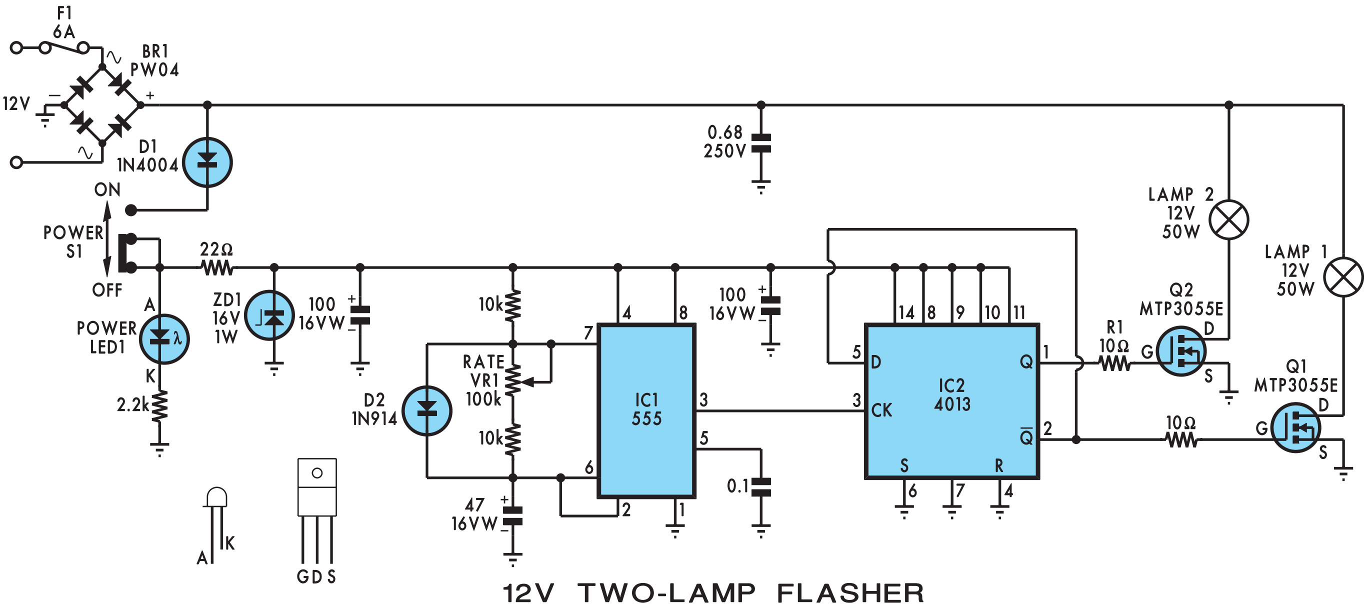


Fig.2: the two-lamp version of the circuit adds a flipflop and another Mosfet to drive the second lamp. The flipflop is used to ensure that each lamp is on for precisely half the time.

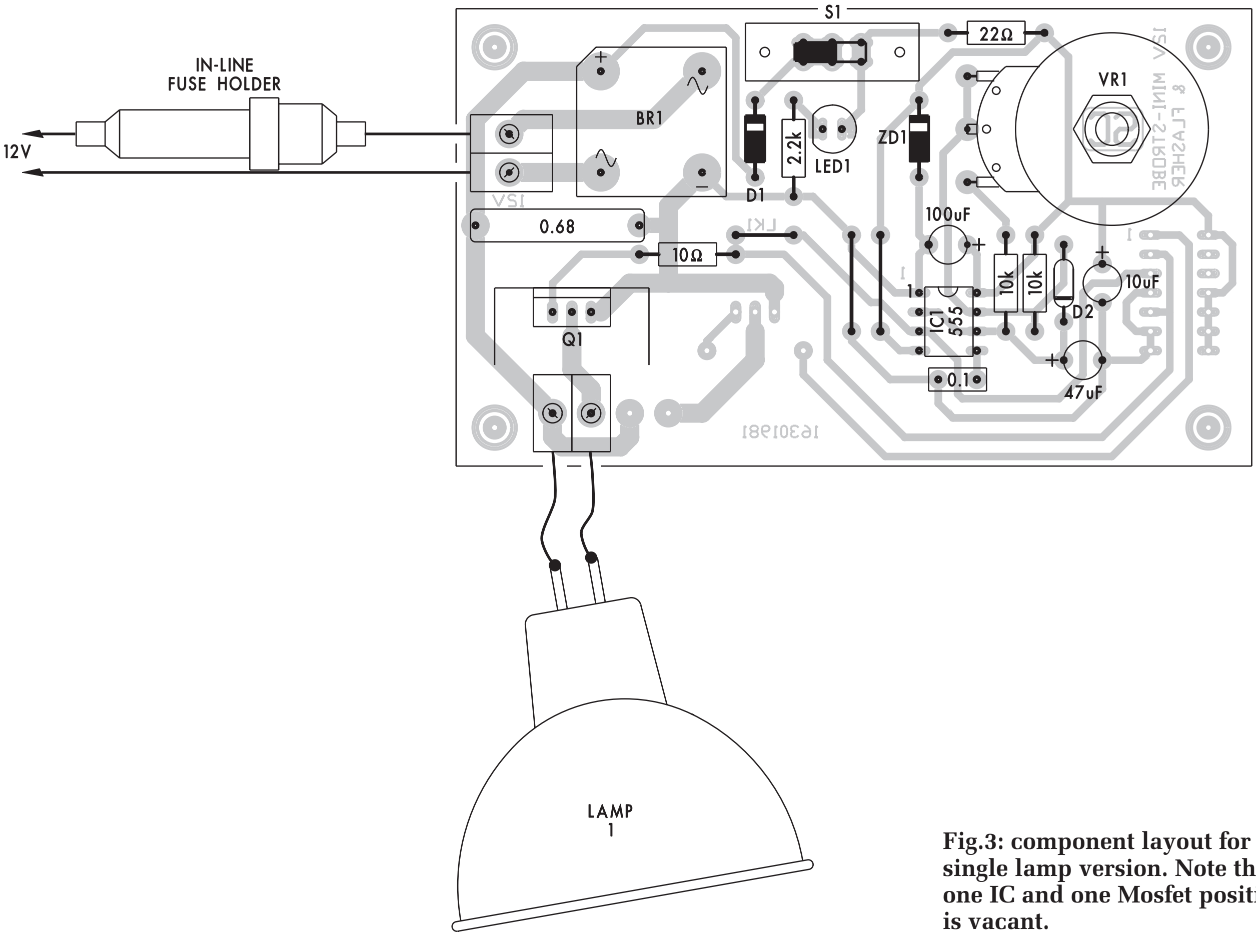


Fig.3: component layout for the single lamp version. Note that one IC and one Mosfet position is vacant.

rate is fixed and not dependent on the adjustment of VR1. This makes the duration of each flash constant while the time interval between flashes is adjustable.

The pulse waveform at pin 3 of IC1 drives the gate of Mosfet Q1 via a 10Ω resistor. The Mosfet then drives the halogen lamp.

Flasher circuit

Fig.2 shows the flasher version of the circuit. Instead of driving a Mosfet, pin 3 of IC1 drives one half of a 4013 dual D-type flipflop. So each time pin 3 of IC1 goes high, it causes the Q and Q-bar outputs of IC2 to change state; ie, change from low to high or from high to low.

The Q and Q-bar outputs of the flipflop then drive the gates of Mosfets Q1 and Q2 via 10Ω resistors. Each Mosfet then drives its own halogen lamp.

So far, so good but some readers will ask why we bothered to use the flipflop in order to drive two Mosfets for alternately flashing the lamps. Why not just drive the second Mosfet from the drain of the first Mosfet? That would work but it wouldn't look good, particularly if the flash rate was slow, say, once every three seconds. What you would find is that one lamp would be on for half a second, as set by D2, the 10kΩ resistor and the 47μF timing

Resistor Colour Codes

☐	No.	Value	4-Band Code (1%)	5-Band Code (1%)
☐	2	10kΩ	brown black orange brown	brown black black red brown
☐	1	2.2kΩ	red red red brown	red red black brown brown
☐	1	22Ω	red red black brown	red red black gold brown
☐	1	10Ω	brown black black brown	brown black black gold brown

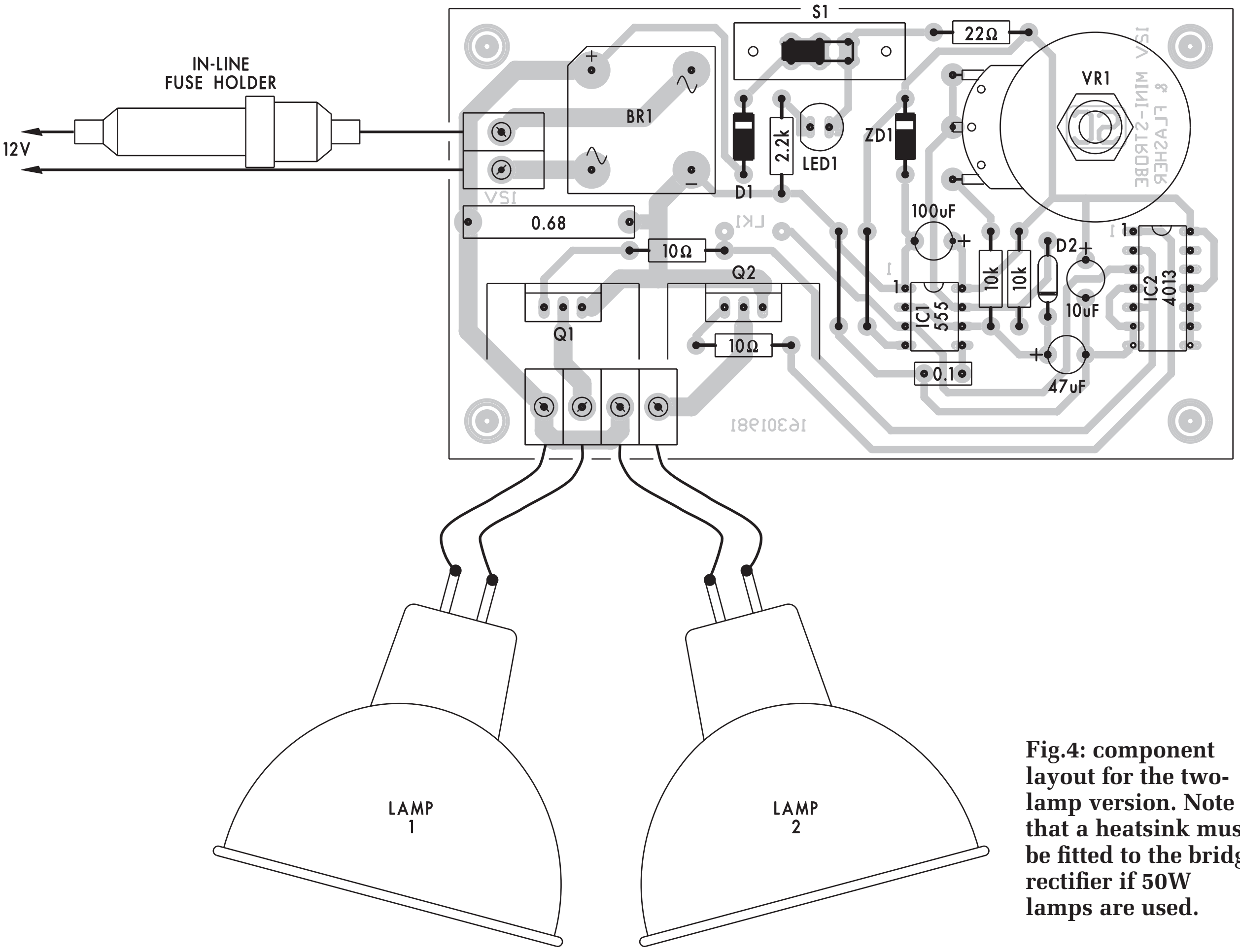


Fig.4: component layout for the two-lamp version. Note that a heatsink must be fitted to the bridge rectifier if 50W lamps are used.

capacitor. But the other lamp would then be on for three seconds before the circuit flicked back to the first lamp. That would mean that one lamp would be on for most of the time and so the display would not look good.

With the flipflop in circuit each lamp would be on for precisely the same amount of time, regardless of how the flashing rate potentiometer was set.

DC or AC

Both Fig.1 and Fig.2 show the supply input to the circuit via a bridge rectifier and that means that the circuit can run on 12V DC or 12V AC. A secondary benefit of the bridge rectifier is that if you are using a 12V DC battery or power supply, you can't accidentally damage the circuit by connecting the supply the wrong way around.

When you are using a 12V AC supply, diode D1 isolates the rectified but unfiltered lamp supply from the supply for the ICs which is filtered by a 100μF capacitor and protected from voltage transients with a 16V zener diode, ZD1.

The 0.68μF capacitor across the unfiltered DC supply prevents volt-

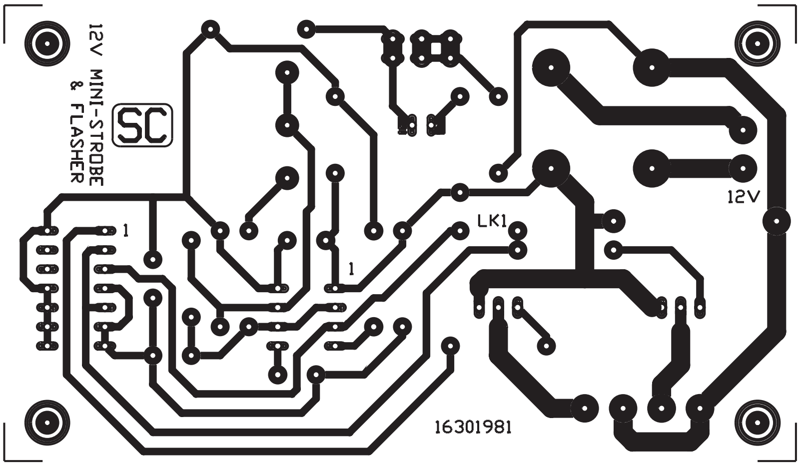


Fig.5: actual size artwork for the PC board. Check the board carefully before installing any of the parts.

age overshoot when the Mosfets turn off.

LED1 indicates when power is switched on via switch S1.

Construction

Both versions of the circuit can be built on a PC board coded 16301981 and measuring 105 x 60mm. Fig.3 shows the component layout for the single lamp (strobe) version. Note that the positions for IC2 and Q2 are vacant and there are three links to be inserted.

Fig.4 shows the component layout for the two-lamp version and this has both ICs present. Note that we have specified an in-line fuse for both versions.

All components apart from the in-line fuse and lamps mount on the PC board. Follow the appropriate component layout diagram to build either the strobe or flasher. Start by installing and soldering in all the resistors using the accompanying colour code table as an aid in finding the values. Then insert and solder the PC stakes located at the three locations for VR1's terminals.

When the ICs are inserted, make sure they are oriented with pin 1 in the position shown. Diodes D1 and D2 and ZD1 mount with their cathode stripes closest to the slide switch S1.

Make sure that the three electrolytic capacitors are oriented with the polarity shown. S1 is installed by inserting the switch pins into the PC board and soldering in place. If the pins are difficult to insert, crimp them with pliers first or use tinned copper wire through the switch pins which then insert into the PC board. LED1 mounts onto the PC board with the orientation shown.

The potentiometer VR1 mounts with the terminals soldered to the tops of three PC stakes. The Mosfets are mounted with small heatsinks bolted to their tabs.

Most important, a U-shaped heatsink must be bolted to the bridge rectifier if you are building the two-lamp version with 50W lamps. With two 50W lamps being driven, the bridge rectifier passes over 4A and dissipates over 6W so it is not surprising that it becomes a little red in the face if a heatsink is not fitted. On the other hand, if you are using 20W lamps, the heatsink should not be necessary.

The lamp and power supply con-

To make connecting the lamps easy, use the wired lamp bases. Trying to solder wires to the pins of the lamps is not really satisfactory.

Parts List

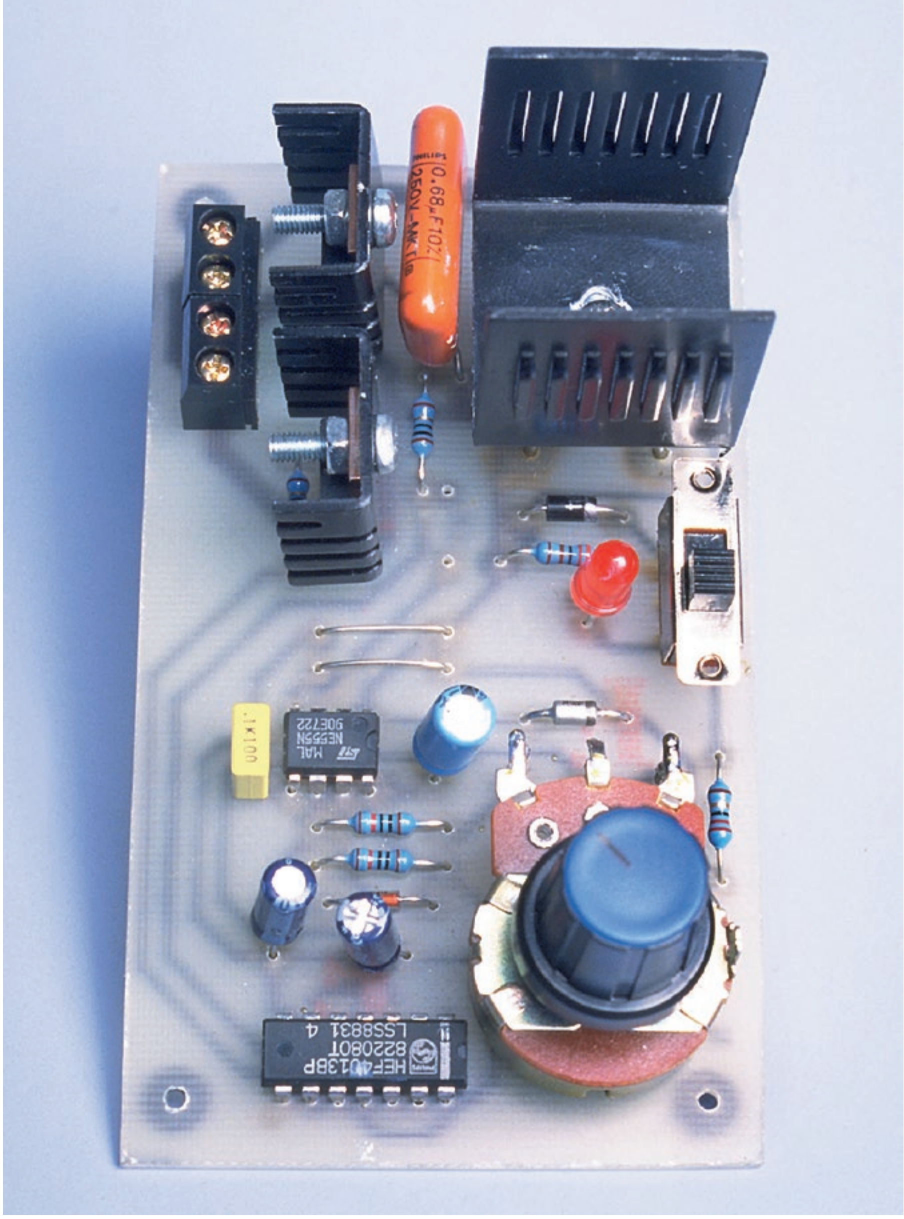
1 PC board, code 16301981, 105 x 60mm
2 2-way PC mount terminal strips
1 DPDT miniature slider switch (S1)
1 12V 50W or 20W halogen lamp
1 base to suit halogen lamp (Jaycar SI-2735 or equivalent)
1 mini heatsink, 20 x 20 x 10mm (Altronics H-0630 or equivalent)
1 mini U-shaped heatsink, 28 x 25 x 34mm (Altronics H-0625 or equivalent; for bridge rectifier)
2 3mm screws and nuts
1 100kΩ linear pot (VR1)
1 knob for VR1
1 3AG in-line fuse holder
1 3AG 6A fuse
1 5mm red LED (LED1)
3 PC stakes
1 60mm length of 0.8mm tinned copper wire

Semiconductors
1 555 timer (IC1)
1 PW04 10A 400V bridge rectifier (BR1)
1 1N4004 1A 400V diode (D1)
1 1N914, 1N4148 signal diode (D2)
1 16V 1W zener diode (ZD1)
1 MTP3055E 12A 60V avalanche protected Mosfet (Q1)

Capacitors
1 100μF 16VW PC electrolytic
1 47μF 16VW PC electrolytic
1 10μF 16VW PC electrolytic
1 0.68μF 250VDC MKT polyester
1 0.1μF MKT polyester

Resistors (0.25W, 1%)
2 10kΩ
1 2.2kΩ
1 22Ω
1 10Ω

Extra Parts required for flasher circuit
1 12V 50W or 20W halogen lamp
1 base to suit halogen lamp (Jaycar SI-2735 or equivalent)
1 2-way PC mounting terminal strip
1 mini heatsink, 20 x 20 x 10mm (Altronics H-0630 or equivalent)
1 3mm screw and nut
1 MTP3055E 12A 60V avalanche protected Mosfet (Q2)
1 4013 dual D flipflop (IC2)
1 10Ω 0.25W 1% resistor (R1)



This photo shows the board assembled for a two-lamp version of the circuit and with the bridge rectifier fitted with a heatsink. This is necessary if 50W lamps are used.

nections to the board are made via PC-mounting insulated terminal blocks. These enable connections to be made easily with a small screwdriver.

Connect up the lamp or lamps with the wired base connectors to the output terminals and apply power. Note that you will need a 12V battery or a DC power supply which can deliver about 2A for two 20W lamps and 4.2A for two 50W lamps. For AC operation the halogen lamp transformer from Jaycar (Cat MP-3050) would be suitable. This transformer includes a wired in mains lead and plug, making it safe from the mains voltage.

If the lamps fail to flash, check your board for faults including shorts between tracks and breaks. Also check that all the components are in their correct place with correct orientation. The DC supply to IC1 and IC2 should be about 11V between pins 1 and 8 of IC1 and pins 14 and 7 for IC2.

You can add colour to the flasher by placing a layer of tinted Cellophane over the halogen lamps but it should not touch the lens or lamp reflectors, as they become quite hot.

If you want to alter the flash rate from the presently available range with VR1, change the 47µF capacitor to a smaller value for faster rates and to a larger value for slower flashes. **SC**

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RADIO CONTROL

BY BOB YOUNG

Jet engines in model aircraft

This is the first in a series of articles covering the technical aspects of jet engines for model aircraft. In this coming series we will look at engine theory, engine management systems and fuel theory.

For too long, modellers in general have been locked out of modelling modern jet aircraft due to the lack of a suitable power plant. Today however, we stand at the dawn of a new and tremendously exciting era in R/C modelling with the recent introduction of the pure turbine engine. In my opinion, the jet engine will do for R/C modelling what proportional control did back in the early 1960s.

In the 1960s, we made do with reeds which did the job remarkably well and it would have been difficult for a bystander in those days to tell the difference between a well-flown reed system and a proportional system. However, this was more to do with the skill of the pilot than an attribute of the R/C system. Reeds really were the sort of system that only the truly dedicated modeller could warm to.

There is an exact parallel today with the ducted fan model and pure turbine. The ducted fan model has been developed to a remarkably high level and performs exceptionally well in the correct hands. But at no time can you ever forget that you are watching a model powered by a piston engine. In fact it is absolutely impossible to forget that fact for the simple reason that a ducted fan sounds like it is powered by the controlled fury of one thousand caged banshees.

After eight hours of sharing the pits with this incredible din, one's ears are begging for mercy. Again, the ducted fan system is the sort of system that only an absolutely dedicated modeller could develop a liking for.

This beautifully finished model of an F-20 Tigershark was built by Brett Davies. It is powered by an OS91 engined fitted with a Ramtec fan. It is 1.82 metres long and weighs just on 6kg.

Turbine engines

How delightful it is then to hear the soft pop of a turbine igniting and the gentle whine, or more correctly, whooshing of the turbine as the pilot runs it up prior to takeoff. And the differences do not end there. In flight the turbine pushes the model effortlessly and quietly (75dB) with that characteristic rumble that jets develop at a distance.

Most jet model pilots only run their engines at about 60% power as the thrust on some model turbines is absolutely staggering. The overall effect is to produce a flight with a rock solid, very smooth and realistic sounding characteristic.

In contrast the ducted fan model in flight is constantly screeching out a reminder that inside this machine is a very large reciprocating racing engine, worked up to the nth degree and being pushed to its limit at all times. Whilst there is little difference in the measured speed of both systems (at the moment, that is), the turbine engine produces an infinitely superior result.

By now you may have noticed, I am hooked on the turbine powered model, especially now that kerosene is replacing propane gas.

There is of course one proviso in all of this and that is the cost. The turbine at the moment is ferociously expensive ($5000-$10,000) and my bank manager was decidedly guarded in his response to my request for a loan of that magnitude, especially for an item that may disappear in a mushroom cloud at any moment!

Be that as it may, progress will follow rapidly now that the initial breakthrough has been made and prices will fall as more manufacturers enter the field and volumes and production techniques improve accordingly.

One other drawback will also succumb to the relentless march of progress and that is the question of fuel consumption. Turbines are notoriously thirsty and a typical fuel load currently is around 1.5 - 2kg for a 15-minute flight.

So how do these wonderful gadgets work and why has it taken so long for the turbine to finally make its appearance on the model scene?

Brief history

In the "Aeromodeller" annual published in 1954 there appeared the most wonderful article on turbine-powered jets. The author, Mr W. Ball, claimed he had flown turbine-powered deltas in England as early as 1947 and gave details of some of his early flights.

The lead photo in the article (p87) showed the author proudly posing beside a very modern looking delta model with his ground based transmitter at his side. Page 88 showed a cutaway drawing of a turbine engine featuring a 3-stage axial compressor with annular combustion chamber and a single stage turbine. The figures quoted are interesting and we will come back to these shortly – length 28 inches (711.2mm), diameter 6.5 inches (165mm), weight 3lb (1.36kg), static thrust 10.8lb at 26,000 rpm.

The article went on to give scanty details of high speed flight (100 mph) with rudder and trimmable wing tips combined with 3-speed motor control. Sadly, in common with a lot of precocious inventors, he suffered a terrible loss in the form of floods which swept away his entire workshop (and all evidence of his experiments).

Nowadays they usually have a fire in the workshop, a visit from the oil companies, the CIA or even the "men in black". Thus at the time of writing he was only flying a ducted fan delta which could be adapted to take a turbine "if required".

This Mirage was built from a Jet Hobbies Hanger kit. It is powered by a Golden West Models FD-3/67LS turbine and controlled by a Silvertone transmitter. It has a wing span of 1.09m, length of 1.56m and a weight of 5kg. It carries 1.75kg of kerosene.

Chris Mounkley built this Star Jet which is powered by a JPX-260 turbine. Note the maze of wiring in cockpit.

Did it exist?

So did this motor ever exist and did those models fly? Interestingly enough, I never forgot those articles for they had stirred my imagination and that of my friends and despite an intense search we could never find any evidence of those models being flown with turbines. Ever hopeful, I even asked David Boddington about this article on his recent visit to Australia but he could never find any evidence either.

Today the consensus is that the whole thing was a fabulous hoax. Upon re-reading that article for this column, I even discovered one of the photos of the delta in "flight" was upside down. But we were young and we lapped it up for it articulated the dream. And anyway, who could ever

Kevin Dodds of Tingalpa, Qld built this semi-scale A-10 "wart hog". Powered by a JPX-T-240 turbine, the model weighs 7kg empty and 8.5kg fuelled. Maximum engine speed is 122,000 rpm!

This is a closer view of the A-10 engine installation. The amount of plumbing in these models is amazing.

doubt such an eminent authority as "Aeromodeller" magazine?

The dream took a very long time to become a reality however and proved to be a fearsome task, taking even longer than the model helicopter to master. The engineering and metallurgy are quite demanding and the major difficulty facing the manufacturers of these engines is in matching components in one engine.

Quite often motors will not run successfully until all components are correctly matched and that is with components manufactured with modern machine tools. RPM can be down, tailpipe temperatures up and in the worst case, the turbine can drip out onto the tarmac if local hot spots develop. An even distribution of temperature inside the engine was one of the major difficulties and can still cause problems. We will examine these points in detail in coming articles.

More importantly, the successful engine relied upon a very sophisticated electronic engine management system for its safe operation. Finally however, somewhere around the late 1980s, model turbines began to make their appearance on flying fields. Kurt Schreckling is credited with being the first person to construct very small, lightweight turbines using amateur means.

To date there is no evidence to suggest that an axial flow turbine could run successfully at model sizes even today and all successful engines so far have used centrifugal compressors. This results in a shorter, more rotund engine than the axial flow engine but still of practical size. Kurt Schreck-ling's motor was 235mm long, 110mm in diameter, 1.14kg in weight and produced around 30 Newtons of thrust (about 8lb) at approximately 100,000 rpm.

At this thrust these engines will push models along at more than 320km/h. Compare this data to that of the Ball engine. Did those motors exist? I genuinely doubt it, especially when you consider that ceramic bearings give the best results at the RPM encountered in these engines.

Having suggested that turbine engines would make a good series for SILICON CHIP, Leo Simpson sent me off to Leeton (the premier jet gathering in Australia) to gather first-hand data for the series to follow. So let us look now at what I found there.

Leeton 1997

The Leeton Jet fly-in, hosted by the Leeton (NSW) Model Aircraft Club, is the longest running jet event in Australia and attracts fliers from all over Australia. Due to the increasing popularity of jet aircraft there are now many such events being staged in other localities and as a result numbers were down at Leeton this year. But Leeton was the first and is still considered by many as the premier event.

Certainly there was no lack of enthusiasm and the standard of models present staggered me – from electric ducted fans to swing-wing F111s fitted with turbines, they were all there. Fliers from as far afield as WA and Queensland were present in numbers and the sky was never clear of these daring young men and their flying machines.

Basically the models are now divided into two classes, the older ducted fan system and the newer turbine engines. As the name suggests, a "ducted fan" is a system whereby a reciprocating engine, usually a very highly developed racing motor, is used to drive a fan inside a close fitting, carefully designed duct. The ducted fan is still the predominant system and these were present in great numbers at Leeton. Turbines were not as well represented but there were at least six or seven in attendance. A striking feature of the models at Leeton was the amazing internal complexity. There were tubes, pipes and cables in vast numbers.

It has taken a long time from Charlie Peake's .15 powered, catapult-launched "Screaming Mimi" delta in the early 1960s to the .91 powered missiles of today but the ducted fan system has finally come of age. Capable of speeds in excess of 320km/h, these models are impressive performers indeed. Usually fitted with retractable undercarriages, these models can take off without the assistance of the catapults that were used in the early days of ducted fans.

Several examples of ducted fan models are shown in the accompanying photos and externally there is nothing to suggest any difference between the turbine and the ducted fan models. It is not until the motor is started that the real difference is apparent.

Starting a turbine

Whilst starting a ducted fan model is a fairly laid back affair, starting a turbine takes on a more serious air.

Compressed air is used to spin the compressor up to speed prior to ignition. This usually comes from a blower or compressed air bottles, while a helper stands by with a fire extinguisher. The propane gas used as fuel in the early turbines does present some element of risk and caution is the order of the day. The more modern turbines are gradually changing across to liquid fuels and this is where the future lies.

Once started, the turbine settles down to be just like other motors, with throttle control providing a complete range of thrust from idle to full power at will. In flight, the turbine-powered model presents a glorious sight and sound. The dream has finally become a reality and whilst Ball may have taken some poetic licence in his presentation of the facts, he provided the spur for it to finally become a reality. **SC**

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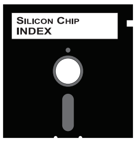

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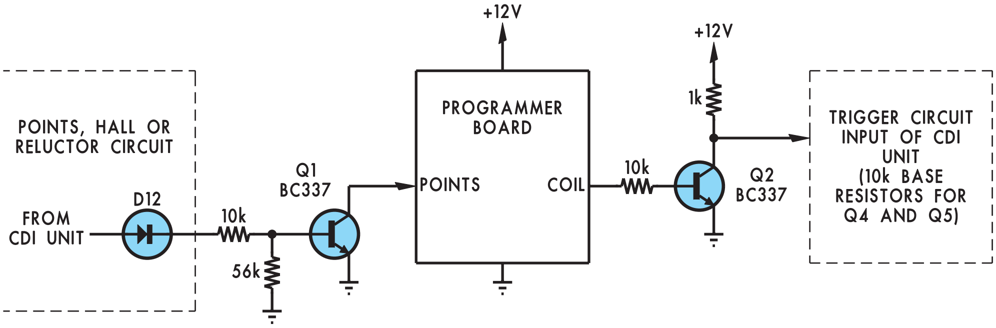
CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

Programmable multispark CDI

Using this simple circuit, the Multispark Capacitor Discharge Ignition published in the September 1997 issue of SILICON CHIP can be operated in conjunction with the Programmable Electronic Ignition described in the March 1996.



Q1 inverts the square wave signal from the points, Hall Effect or reluctor section of the CDI at diode D12 and feeds it to the points input to the Programmer board. The coil output signal from the Programmer is inverted by Q2 before it is applied to the 10kΩ base resistors for transistors Q4 and Q5 on the CDI board.

Q1 and Q2 and the four resistors can be mounted on a small piece of Veroboard. To make the board connections, disconnect the cathode of D12 and connect it to Q1.

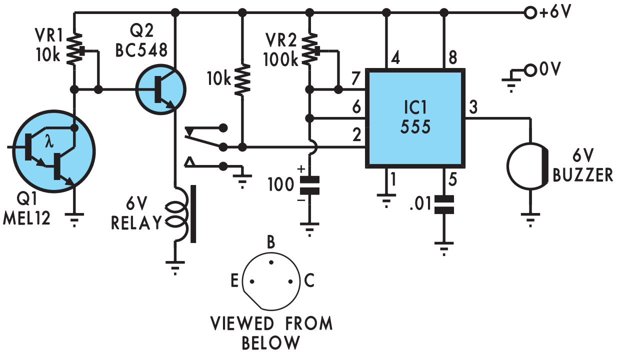
SILICON CHIP.

Versatile laser beam door minder

Now that solid state lasers and laser pointers are available, a laser door minder is a worthwhile proposition. The circuit is based on an MEL12 phototransistor (Q1) and a 555 timer IC (IC1). Q1 detects the laser beam and conducts during normal standby. The base of Q1 need not be connected and should be clipped off the transistor. Trimpot VR1 is used to adjust the sensitivity of Q1 and should be varied according to the ambient light.

When a person or object breaks the laser beam, Q1 switches off and Q2 is switched which then activates the relay. The relay's sole purpose is to enable the 555 timer which is connected in standard monostable mode and drives a buzzer.

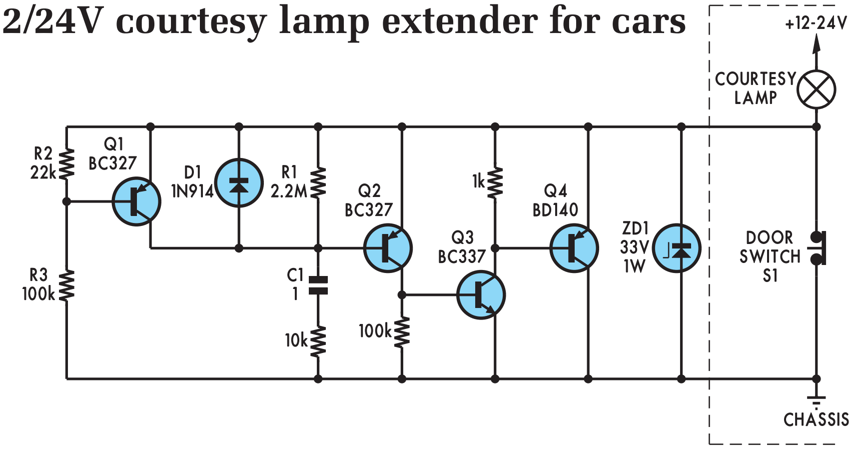
The buzzer sounds for a time set by the 100µF capacitor and trimpot VR2.



(Editor's note: a number of variations of this circuit are possible. For example, the relay could be used to drive the buzzer directly and the 555 could be omitted). Alternatively, Q2 could drive the buzzer directly, provided a diode was connected across the buzzer with its cathode to the collector of Q1).

A. Nguyen,
Bankstown, NSW. ($20)

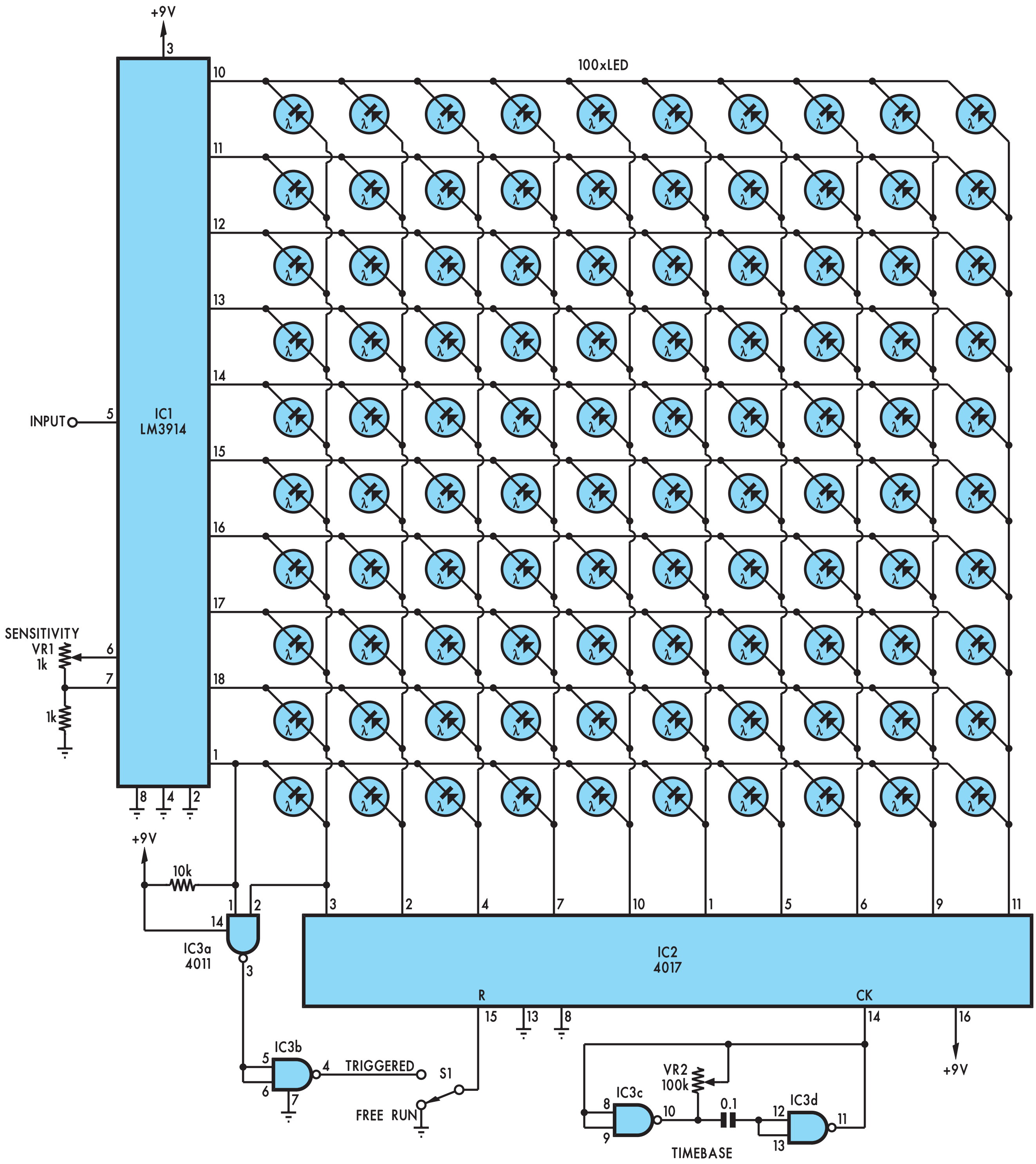
12/24V courtesy lamp extender for cars



This courtesy lamp delay circuit is suitable for 12V or 24V systems and is inherently short circuit protected.

Assuming S1 is closed initially, C1 has no charge and the lamp glows to full brilliance. Opening S1 activates the circuit with the lamp dimming slightly due to the voltage drop of about 0.9V. C1 supplies base drive to Q2 and turns on Q2, Q3 and Q4. As C1 slowly charges, the voltage drop across Q4 rises, gradually dimming the lamp until a threshold set by R2 & R3 turns the lamp off completely.

G. LaRooy, Christchurch, NZ. ($25)



This solid state LED oscilloscope uses an LM3914 display driver and a 4017 decade counter to drive a 100-LED array.

Solid state LED oscilloscope

This 100 LED array will give a rudimentary waveform display for frequencies set by the timebase generated by the oscillator formed with IC3c & IC3d. The oscillator drives a 4017 decade counter which provides the column drive to the LED grid.

The analog signal is fed to an LM3914 dot/bar display driver which then drives the rows of the LED grid. The timebase for the column driver can be synchronised via IC3b or left in free-running mode, depending on the setting of switch S1.

P. Melmoth,
Wyalong, NSW. ($30)