Project 1524

ELECTRONIC MOUSETRAP

With Auto Despatch and Reset

Ian Thomas

Furry freeloaders are generally not welcome in the home unless they're of the 'house-trained' variety. Commercial poisons (saturated in grain) act as an anti-coagulant and the beasts die by bleeding to death (slow and aesthetically unpopular). Other methods maim or kill slowly. This electronic mousetrap despatches them in milliseconds and automatically resets!

RECENTLY, relatives of mine reported that they had acquired some tiny furry freeloaders and couldn't find a mousetrap anywhere. This seemed a bit strange so I went to try and get some myself. Lo and behold, they were right — the mouse plague reportedly invading our three eastern states seemed to have taken all available supplies. I must have tried at least ten shops in both my local shopping centre and in the big smoke but there wasn't one mousetrap to be bought. OK then, perhaps it would be an idea to build my own. At least if the design turned out to be better, then I'd get a new path to my front door on the insurance!*

Given that the mousetrap was to be electronic (what else for an electronics engineer?), the first question was exactly how to despatch the miniscule marauders without a risk of doing the same to me. Suggestions from Roger for robot arms with hammers in their claws seemed a little too 'high tech' for me and perhaps not quite practical (I never suggested that . . . Ed). The easiest way seemed to be a simple *ZAP* at just the right time and place.

The simplest way to do this would be to take the mains lead, connect the neutral to a metal plate and the active to an insulated bolt in the centre of the plate with some cheese on the bolt. It would probably work just fine but would also probably clean up all the pets and small children in the area too! Things should be simple, but not *too* simple — to paraphrase Einstein.

The best idea seemed to use a high voltage pulse triggered by the mouse itself to despatch the little pest and try to arrange the triggering so it would be very hard for a person to get a potentially lethal belt through any part of their anatomy.

If the object of the exercise is to electrocute the rodents then it seemed a good idea, working on the "more is better" principle, to poke as much power as possible into the mouse. Clearly then, if we want to achieve optimum power transfer into the mouse then it is necessary to arrange for the output impedance of the high voltage generator to be the complex conjugate (opposite) of the mouse input impedance or:

$$Z_{out} = Z_{mouse}$$

where

$$Z_{mouse} = R_{mouse} + jX_{mouse}$$

and therefore

$$Z_{out} = R_{mouse} - jX_{mouse}$$

About this stage I started to get the feeling that technical niceties were starting to get the better of things (besides which, have you ever considered how to measure the complex input impedance of a mouse? Awkward to say the least!). Since it's a well known tenet that ". . . it's the volts that jolts but the mils that kills," I decided on generating one massive pulse of high voltage with a reasonably low output impedance to do the deed.

Generating this sort of high voltage pulse has been done for years now (perhaps in a rather extreme form). Capacitor discharge ignition systems in cars are a case in point. They are well understood, so I decided to use a similar method in my mouse-macerator.

The method requires that a capacitor be charged to a high dc voltage and then dumped into a coil which acts both as an inductance and a step-up transormer. The output voltage of the whole assemblage is equal to the capacitor dc voltage times the coil step-up turns ratio. Normal CDI systems deliver about 30 to 40 kV, *far* too much for this application. These voltages are hard to contain and tend to flash over everywhere. Also, the high step-up turns ratio in an automotive coil (usually about 100:1) means an equal step-down in current, all else being equal, which we don't want.

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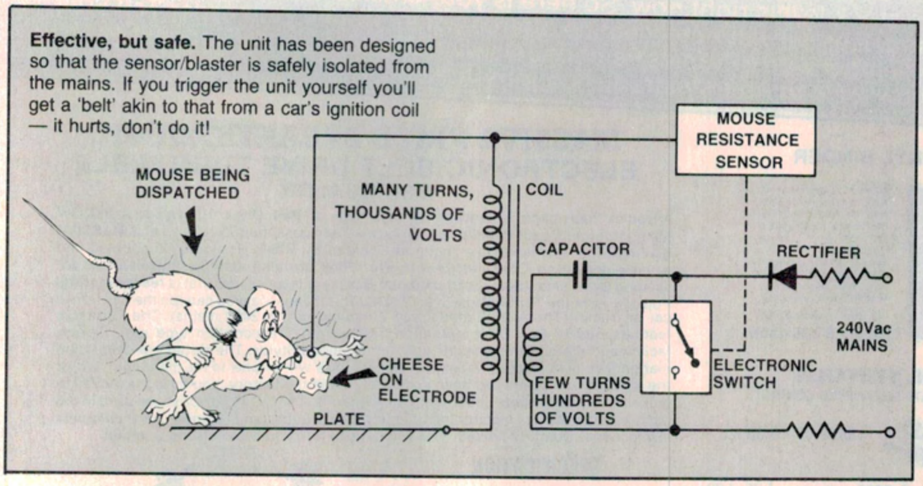
* On the theory that "build a better mousetrap and the world will beat a path to your door".



Effective, but safe. The unit has been designed so that the sensor/blaster is safely isolated from the mains. If you trigger the unit yourself you'll get a 'belt' akin to that from a car's ignition coil — it hurts, don't do it!

Design details

If we assume that the mousetrap will be mains powered then a simple diode and resistor combination will charge the storage capacitor to about 340 volts if left to itself and, with a 1M resistive bleed, it drops to about 280 V. This is still heaps (we want to terminate them — not blow them to pieces) and if the capacitor is followed by a 20:1 step-up coil the output voltage becomes about 6 kV — just nice!

The actual mechanism of the trap requires that the voltage not be continuously maintained but pulsed when the victim is nibbling on the bait. Even the most credulous mouse would probably be a bit wary of cheese that glows blue in the dark, buzzes and crackles a lot and stinks of ozone (although I have known limburgers with such characteristics!). This means that the sensing mechanism that detects the presence of the victim must also be able to tolerate 6 kV pulses. Another major problem to be aware of is that the trap is running off the mains and the output *must* be isolated to avoid any unfortunate mishaps.

The actual layout for the trap is a central disk, on which the cheese is placed, surrounded by a wide earth mat. The theory is that when our furry foe approaches the bait his back paws will be on the earth and its nose or front paws will touch the central electrode. When the trap triggers, all the goodness stored in the capacitor will flow through the whole body of the mouse causing instant discorporation and, hopefully, throwing it away from the trap ready for the next candidate for the big cheese factory in the sky. (See? — auto despatch and reset!).

The easiest way to isolate the trigger circuit from the output pulses is to use a large series resistor and in the actual design I used the largest I could get, namely 22M. Experimenting with a DVM I found that normal body resistance of a person (me) is of the order of 1M, most of which is skin resistance. The resistance of the interior of a body is very low as it's mostly salt water so I reasoned that a mouse would probably be about the same for the worst case and, if its mouth was actually on the cheese, probably a bit less. Therefore, compared to the 22M resistor, the mouse could be regarded as a short circuit.

The secondary winding of the coil is connected directly to the central electrode. To prevent it shorting out the resistance of the mouse the other end of the secondary is connected to two diodes which are reverse-biased by the trigger power supply. This nicely leaves the whole secondary floating when it has no voltage across it, but when the trap triggers one of the diodes will turn on and clamp the end of the coil effectively to earth (or +12 Volts which, compared to 6 kV, is the same thing) giving the mouse the full benefit of the voltage excursion.

As the secondary is *very* well insulated from everything else (it has to be to prevent flashover or punch-through), this arrangement ensures that mains voltages are completely isolated from the business end of the trap.

To further ensure that no mains could ever get near the output I powered the trigger circuit from a small transformer, even though only a few milliamps are needed, and coupled the trigger circuit to the dump SCR through an optocoupler. This nicely leaves the mains, dump capacitor and coil primary as the only parts of the trap that are connected directly to the 240 V mains.

The trigger circuit is a simple two-transistor amplifier with positive feedback around it to turn it into a monostable pulse generator. The most current that can flow through the 22M resistor is about ½µA so two transistors are needed to give sufficient gain to trigger the optocoupler. The optocoupler itself is a Motorola MOC3021 which has a triac type output and is normally used in triac power control circuits but it works just fine triggering SCR's too.

The dump capacitor is charged through two 220K resistors and a diode directly connected across the 240 Vac. Two resistors are used because there is no way of being sure which mains input is active and which is neutral. Using a resistor from each input ensures that, no matter how it's connected, a hapless project builder won't hang himself directly across 240 V when testing things out — he'll at least have 200k to ease the pain!

The coil primary has a diode across it so that after the SCR fires and dumps the capacitor's stored energy into the coil the diode turns on and prevents the coil-capacitor ringing and transferring the energy back into the capacitor again (see "How It Works"). The diode *must* be a rapid recovery type as things happen pretty fast when the SCR fires and 1N4006s are nowhwere near quick enough. Leaving the diode out reduces the effectiveness of the ZAP dramatically and without it I doubt that the pulse would do more than seriously annoy the mouse (and we don't want to annoy the mice do we?).

The coil itself posed me a few problems as I detest sitting for hours winding fine wire on formers and trying not to either drop it and have to start again or, worse, breaking the wire. For reasons I've already talked about, the coil has to have a 20:1 turns ratio so every turn on the primary means 20 more turns on the secondary. Clearly we want the fewest turns possible on the primary. *However* the coil primary must meet other requirements as well.

When the trap is triggered, the energy stored in the capacitor is transferred to the coil primary. Hanging just a few numbers around this we get:

$$\tfrac{1}{2} CV^2 = \tfrac{1}{2} LI^2$$

where V is the capacitor voltage and I is the peak coil current.

Rearranging things we get:

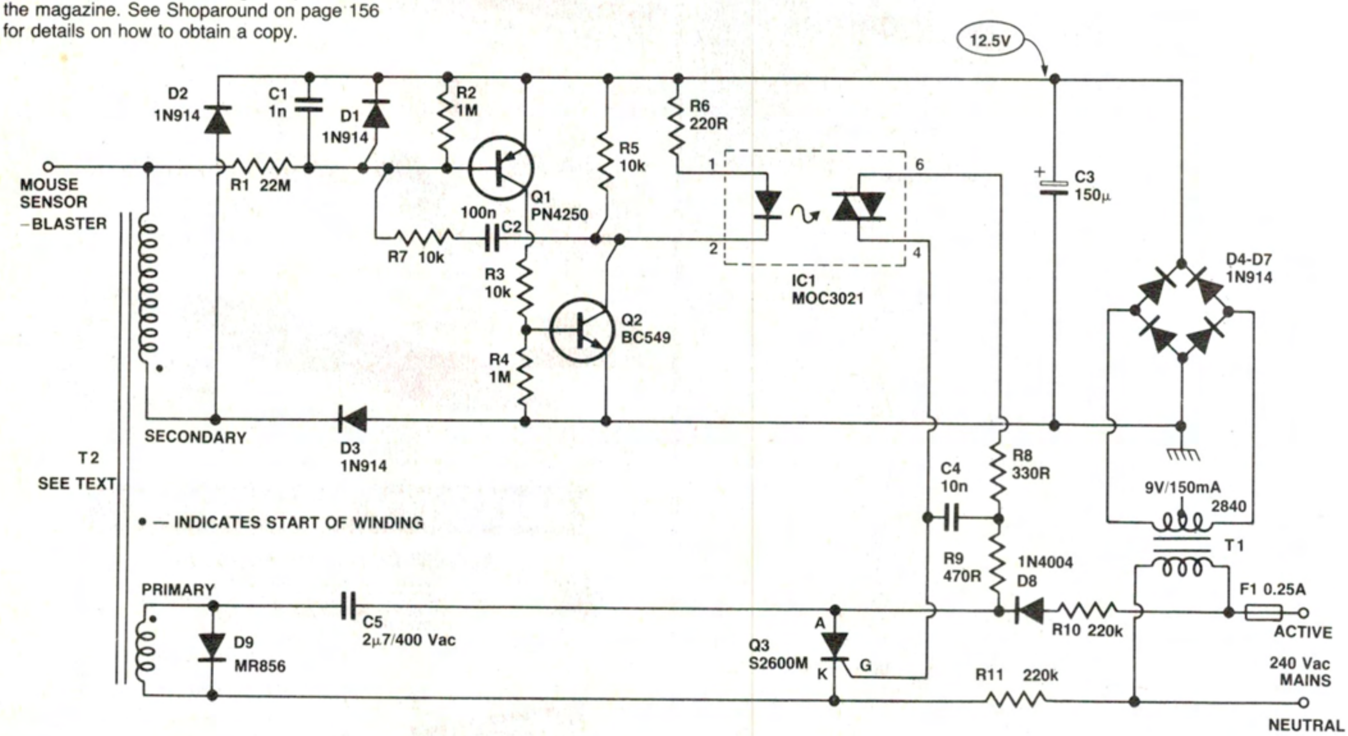
$$I = V\sqrt{\frac{C}{L}}$$

All this says is that, if the primary inductance is too small the peak current becomes impractically large. As this peak current has to flow through the SCR, and after that the clamping diode, the peak rating of these devices determines the smallest value inductor we can tolerate. As most diodes can tolerate high currents for microseconds I took the rating of the SCR as the determining value. This was given as 100 amps (no kidding — that's the peak current that flows!). Which, going through the numbers, gives an inductor value of about 20 microhenries. I did a bit of experimenting with various core materials and found that about twenty turns around a ferrite core gave the right value (see *Construction*) which gave me 400 turns of secondary to wind.

In the final coil these very high currents cause the core material to saturate which makes these values a bit dubious but the final thing still seems to work just fine!

The picture is actually a bit more complicated than these simple calculations show as current also flows in the secondary/mouse circuit which helps avoid the saturation problem. In order to ensure that saturation of the core doesn't cause problems I made sure that the coil would still work as a transformer by winding both the primary and secondary as simple, one-layer solenoids ▶

NOTE: The artwork is too big to reproduce in the magazine. See Shoparound on page 156 for details on how to obtain a copy.



HOW IT WORKS — ETI-1524

The mousetrap can be divided into three sections which are:

1. The sensing circuit
2. The trigger circuit
3. The high voltage pulse generator

THE SENSING CIRCUIT consists of the two transistors, Q1 and Q2, with their associated components. One end of R1, the 22M resistor, is connected to the trap centre electrode and coil secondary winding. The other end of the coil secondary is connected to the two diodes, D2 and D3. As the cathode of D2 is connected to the trigger positive rail (about +13 volts) and the anode of D3 is collected to ground, both diodes are reverse-biased and are effectively open circuit. This means that the electrode, when no mouse is near, is at the positive rail potential and no current flows through R1. Q1 is held off by R2 which in turn leaves Q2 off also as no collector current flows from Q1.

When a mouse makes contact with the centre electrode its body resistance to ground causes the electrode to go to ground potential and about 0.5µA to flow through R1. Resistors R1 and R2 form a potential divider such that for mouse body resistances greater than about 2M, Q1 will not be turned on, but for lower resistances, Q1 is turned on which then turns on Q2. Positive feedback is applied through R7 and C2 to then turn both transistors hard on and provide about 50 mA of current through the LED side of the optocoupler, IC1. After about a millisecond, C2 is discharged and removes the heavy drive from Q1's base causing it to turn off again.

The base of Q1 has a diode, D1, to the positive rail so voltage transients from the trap firing are clamped and do not destroy the transistor (R1 ensures that only about 0.25 mA can flow). Capacitor C1 forms a low pass filter with R1 to stop capacitive coupling of RF pickup from falsely triggering the trap.

Power is suplied to the trigger circuit via transformer TR1 and the fullwave rectifier D4 to D7. Capacitor C3 filters the dc and gives a stable supply.

THE TRIGGER CIRCUIT is formed by the optocoupler IC1, the SCR, Q3 and their associated components. When the sensing circuit fires a trigger current flows through the LED side of the optocoupler IC1. This causes the output triac side of the optocoupler to go low impedance. Before the circuit is triggered, C5 is charged to about 300 volts through D8, R10 and R11. This also gives 300 volts across the SCR, Q3, and the optocoupler output triac. After the optocoupler is triggered the end of R8 is connected to the gate of theSCR, Q3. This causes gate currents of almost an amp to flow and turn on the SCR. Resistors R8 and R9 limit the current that can flow through the optocoupler and C4 ensures that the optocoupler never sees an excessively fast change in voltage ($\frac{dV}{dt}$). After the dump cycle is complete resistors R10 and R11 aren't capable of providing sufficient current to hold the SCR on so it returns to the off state.

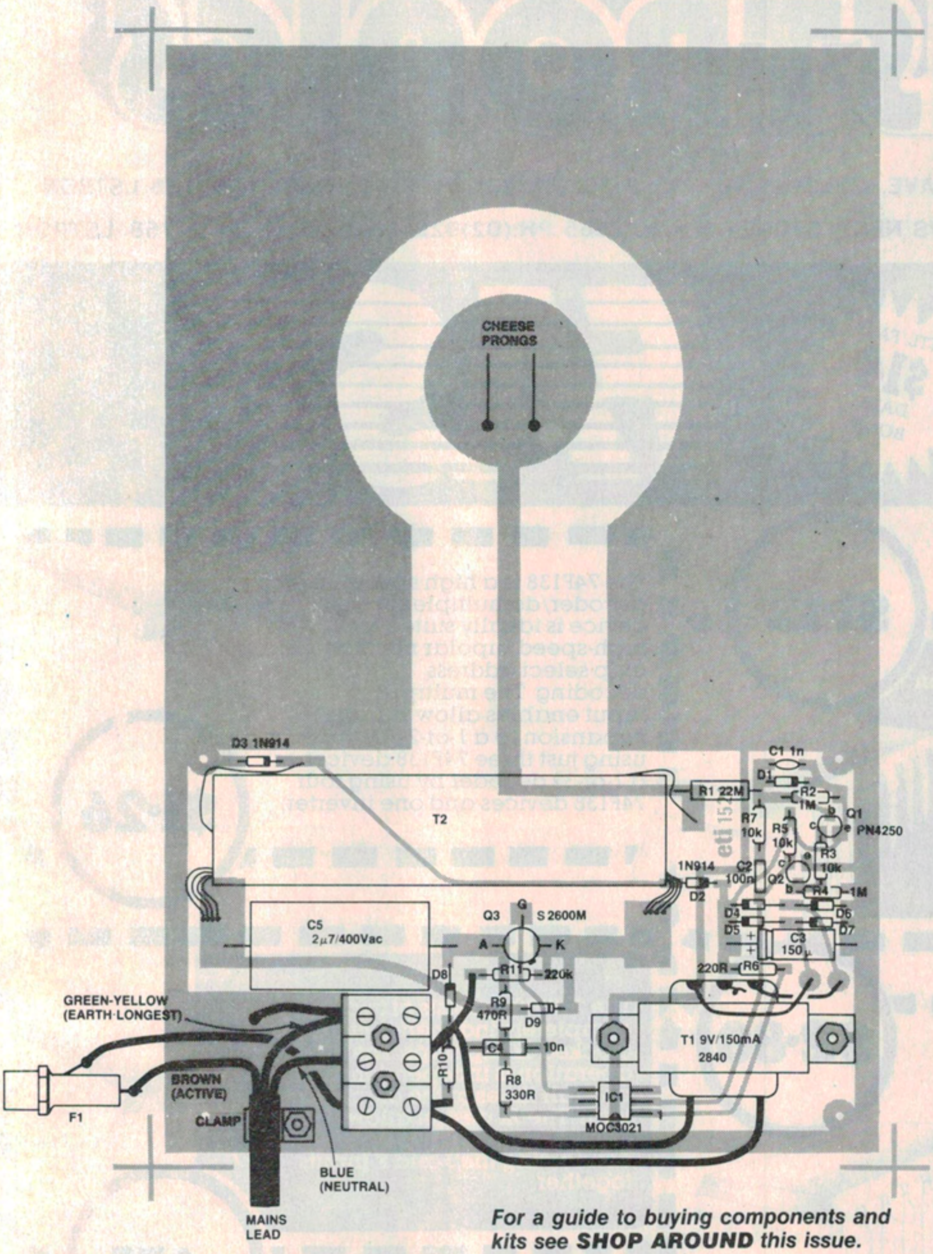
THE HIGH VOLTAGE PULSE GENERATOR is the deceptively simple circuit consisting of T2's primary, C5, Q3 and D9. In the steady state, Q3 has 300 volts across it with the anode positive and there is no voltage across T2 and D9. After the trigger, Q3, goes short circuit, and as there was 300 volts across C5, this energy cannot disappear so the node of the coil, D9's anode and C5 immediately goes 300 volts negative (in order to instantaneously change the voltage across a capacitor you must provide infinite current). Capacitor C5 then discharges through T2, and as the voltage across C5 decays (as a cosine function), the current through T2 rises as a sine function. At this time D9 is reverse biased.

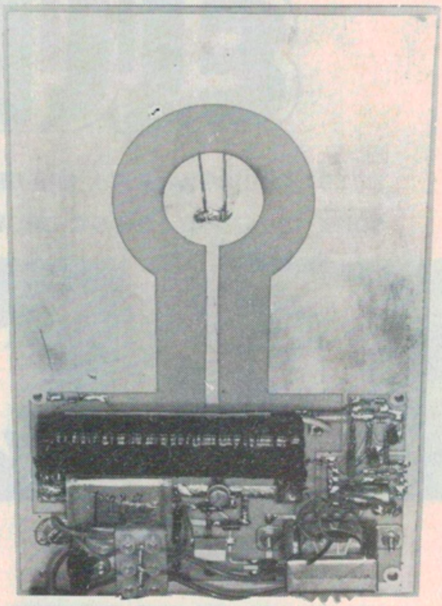
This process continues until all the energy has been removed from C5 and its voltage swings to −0.7 volts, the on state voltage of D9. At this instant, peak current is flowing in T2's primary of about 100 amps if the secondary winding is open circuit. However, as there must have been a resistance across the secondary to trigger the trap, some of this primary current is transferred to the secondary. As the turns ratio of the transformer is 10:1 it takes 20 amps of primary current to produce 1 amp of secondary current.

When the SCR first fires, the full 300 volts is imposed across the primary. As there is probably a secondary load of greater than a megohm (this is the resistance required to trigger the trap) the full 6 kV is imposed across the load mouse. This high voltage should cause the high skin resistance to break down and considerably lower the resistance presented by the victim. Thus, as the primary current runs up, the current in the secondary should run up also and take some of the load from the SCR (just how much of this actually occurs is hard to say as I didn't have a mouse to try it on and I didn't want to buy trouble with the RSPCA).

After the capacitor has completely discharged and peak current has been reached in both the primary and the mouse, diode D9 turns on and shorts the coil primary. This prevents the coil/capacitor (C5) combination from ringing and prevents the established peak currents to continue to flow until they run down exponentially.

Once the currents have completely decayed, D9 turns off and, as Q3 turned off when D9 turned on, capacitor C5 can commence recharging through D8, R10 and R11, completing the cycle.





Construction. The components are mounted on the copper side of the board, note. Two stiff wires soldered to the sensor/blaster pad hold the cheese. Four stick-on feet are attached beneath the board.

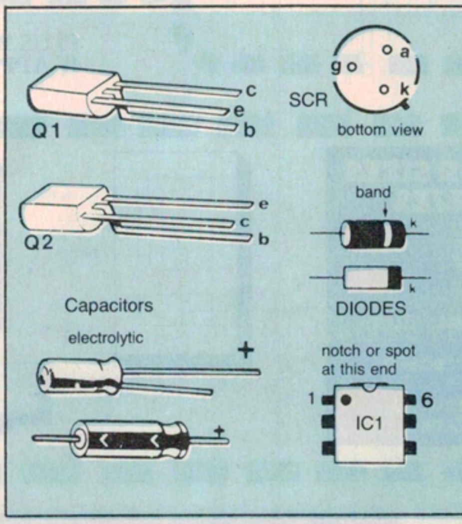
which would be close-coupled even without the core. The choice of ferrite as a core material was made purely because it is readily available; transformer iron would be much better and if you can get some, use it by all means.

To make the mousetrap easy and safe to build I chose to use a rather unusual construction method where the components are mounted on the same side as the copper. This enabled me to use only one board and at the same time keep all the nasty bitey voltages safely enclosed. It's a bit more tedious to assemble but means the final trap is cheaper to make. A plastic jiffy box covers all the works and gives the project a nice neat appearance.

Construction

The first and most tedious part of building the mousetrap is to wind the coil. First the core material must be prepared. I used a

*For a guide to buying components and kits see **SHOP AROUND** this issue.*



PARTS LIST — ETI-1524

Resistors	all ½W, 5% unless noted
R1	22M, 10% ½W or 1W Philips CR50 or similar
R2, R4	1M
R3, 5, 7	10k
R6	220R
R8	330R
R9	470R
R10, R11	220k
Semiconductors	
D1-7	1N914, 1N4148
D8	1N4004
D9	MR856 fast recovery diode
IC1	MOC3021
Q1	PN4250
Q2	BC549, BC109
Q3	S2600M (RCA) SCR, or C122E, TIC126E
Capacitors	
C1	1n disc ceramic
C2	100n metallised poly
C3	150μ/16 V axial electro.
C4	10n/400 V (250 Vac) mains-rated metal foil plastic cap.
C5	2μ7/400 V (250 Vac) mains-rated metallised cap (Siemens, type B32231 or similar self-healing type)
Transformers	
T1	240 V/9 V — ct, Dick Smith 2840 or similar
T2	see text

Miscellaneous

ETI-1524 pc board; 'UB-1' zippy box (157 x 95 x 50 mm); cable clamp; fuseholder; F1 — 0.25 amp 3AG fuse; mains cable and 3-pin plug, 3-way terminal block; Ferrite aerial rod 9 x 194 mm (approx.), e.g: DSE L-1401; 7-8 metres of 1 mm diameter enamelled copper wire; 30-odd metres of 0.16 mm enamelled copper wire; insulation tape; glue (see text); nuts, bolts, etc.

Price estimate: $28-$30

▶

ferrite rod stocked by Dick Smith (cat. no. L-1401) but, as mentioned, transformer iron would probably be better. If you want to stay with the ferrite it must first be cut in half. To do this, measure off *exactly* half way on the rod and score it with a three corner file. Score a nick all the way around the rod then, holding the rod firmly both sides of the score, tap the rod firmly against the edge of a table or somesuch so the rod is given a sharp blow on the score. It should break cleanly on the score.

Ferrite is very brittle stuff so don't smash it down — you'll break it into a trillion pieces. A firm rap is sufficient. Next, glue the two pieces together side by side to make a double thickness rod. Araldite or some form of superglue will do fine here.

If you want to use iron (or can get it!) use "I" laminations 100 mm long by 8 to 10 mm wide and the stack should be about 7 to 8 mm thick. Whatever core you use the next thing is to completely insulate it. As the primary winding goes directly over this insulation and the primary has 300 V imposed across it, it's a good idea to be sure about this layer.

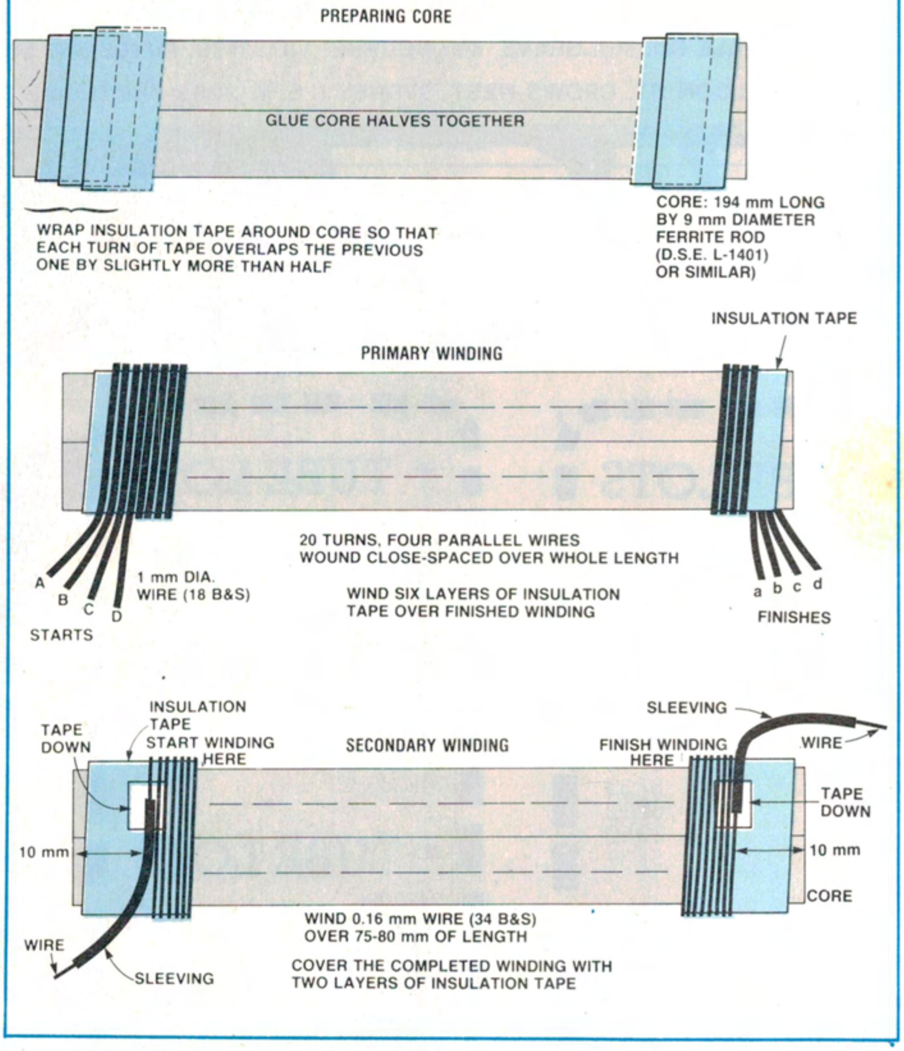
Using ordinary plastic insulating tape, wind a double thickness layer over the core. Wind it so each turn of tape overlaps the previous turn by slightly over half. In this way you have a double layer covering with no single layer gaps (but make sure that the turns do actually overlap by the bit more than half).

The primary winding is the next to go on and consists of four parallel windings of 1 mm diameter wire (say, 18 B&S). You will need about five metres of wire cut into four equal lengths. Four parallel windings are used for two reasons. Very high currents flow in the windings and you want the power to go into the mouse, not copper losses, and also using four wires gives a nice flat surface to build the secondary winding on.

Make sure that the four wires are straight then, holding all four side by side, start winding them around the insulated core. As the wire is nice and thick there is no need to tape down the start end of the winding — when you bend it around the core it should stay put. Wind twenty turns on so they're exactly close spaced with no gaps whatever between the wires. It's important that the wires lie flat as a secondary must later be built up over this layer and bumps become a damn nuisance. Both ends of this winding should come out to the one side of the core so they can be terminated easily on the board. If your're using the ferrite core they should come out along the narrow axis of the core.

Next, using fine, long-nosed pliers, bend the four wires sharply so they protrude out the ends of the core (see diagram). It doesn't particularly matter if you damage the insulation as there isn't any voltage between the turns and its more important to keep the coil neat. Do both ends the same then wind another layer of insulating tape over the completed primary winding the same as you did for the core insulation. You'll have to hold the ends of the winding down when the layer of tape is wound on. Take the tape right over the ends of the core then trim them back flush with the core. It's very important that the primary be properly insulated as it's connected (through resistors, but still connected) to the mains and we'd prefer not to have you hurt yourself!

The coil. Illustrating the steps in winding T2. Note that the secondary winding requires about 400 turns. Twenty turns either way doesn't matter.



As most tapes can only be relied on for about 500 V, and the secondary goes directly over this covering, one double layer is nowhere near enough to insulate it. Wind on another *five* layers using the same technique, so each layer gives a double thickness of tape, and winding each layer so it spirals in the opposite direction to the layer under it. This makes for a great lump of a coil but ensures that no flashovers occur. Each layer of tape should be taken right over the ends of the coil then trimmed back.

Now comes the fun bit — winding the secondary. I used 0.16 mm (say, 34 B&S) diameter wire. It is entirely too easy to break, so be warned! You'll need about 30 metres of wire, which works out at about seven grams weight, unless my calculator is in error. To protect and insulate the ends of the wire, cut two pieces of silicone rubber sleeving about 50 mm long and slip one piece over the end of the wire so about 100 mm protrudes.

Then, using a piece of insulating tape 10 mm long, tape the start of the wire down on one end of the coil so the tape covers half sleeving and half bare wire. The wire should be 10 mm in from the end of the coil and perpendicular to the long axis.

Now start winding on the secondary so each turn is tight (not too tight!) and laying hard up against the turn before. A very good idea here is to cut a piece of tape and, as you wind 7 or 8 mm of coil, tape the winding down. As the winding progresses, move the tape along so if you drop the coil you don't have to do the whole thing again! Each turn of the winding develops 15 V so you must be careful not to allow any windings to overlay other turns — if you get a shorted turn the coil is absolutely useless.

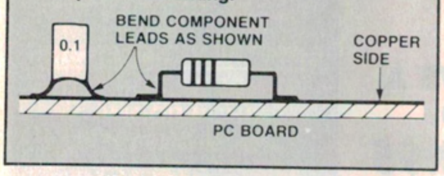
Keep on winding until you get to within 10 mm of the other end and you should have 75 to 80 mm of even, tight-spaced copper wire. If there are some narrow spaces between some of the windings it doesn't particularly matter but don't have too many — you're throwing away volts. Cut off the end of the wire so you have 100 mm of free end and slip the second piece of sleeving over it. Using another piece of tape terminate the free end the same as you did for the start. Then cover the whole secondary with a double layer tape winding and the coil is finished.

At this stage I checked out the coil in the following manner. Connect the 2.7 µF capacitor, used for C5 in the final circuit, in parallel with the coil primary and connect the two to your audio oscillator. Measure the ac volts across the parallel circuit and adjust the frequency until you find the resonance. For my coil it occurred at 19 kHz and was very sharp (3 dB down only a few hundred Herz either side of resonance. With the primary at resonance, measure the secondary voltage and you should find it 20 times the primary voltage. If you find the coil has a very poor Q you probably have a shorted turn somewhere so you'll have to find and fix it. I didn't try making an iron-cored coil so I can't give figures but I'd expect that the resonant frequency would be lower (maybe around 10 to 15 kHz) and the Q would probably be lower too due to iron losses.

The next step is to make the printed circuit board. If you've bought a kit, this is the easiest part as it's ready-made. But if not, use the layout given. As the components are not passed through holes in the board as normal, avoid using paper-phenolic board material as the copper tends to come off easily. Stick to the epoxy-glass-type where the copper bonding is better.

After you've made the board, assemble it according to the layout given. The component leads are formed by bending them down sharply as if you were going to solder them in a normal board with holes then, with pliers, bending the leads out flat again shown in the drawing above the component layout. Pre-tin all the pads that have components attached, then hold the components in place and solder them in. The power transformer centre tap is cut off short as it isn't needed. Use countersunk-head screws to mount the transformer and mains terminal block and mount them in place also. The two power transformer secondary leads go onto the two round pads.

Component mounting.



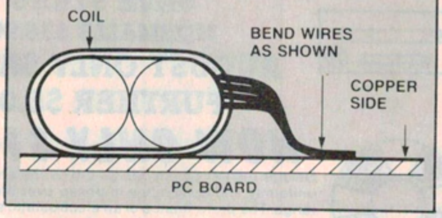
Before attempting to mount the coil, it's necessary to form the primary leads. Hold the coil in place and carefully bend the primary wires so they come down sharply onto the board then lie flat against the copper pads. If the wires are bent one at a time they shouldn't give any trouble. When you've made sure that the wires are just right and the coil is located correctly, cut off the eight wires so they have 5 or 6 mm actually in contact with the board.

Before attempting to tin the cut ends, hold the coil so the ends of the wires are resting on the edge of a table and scrape away all the enamel insulation where you want the solder. This enables the solder to "take" quickly and doesn't let things get too hot. The plastic insulating tape in the coil is not at all tolerant to heat and if you let things get too hot when tinning the leads the coil may flash over in use. When actually tinning the ends be as quick as possible and try to cool them as soon as they're done. I used a pressure pack cold spray to freeze them after they were tinned.

Attach the coil to the board using double-sided adhesive foam strip. This can be bought from any hardware store and solder the primary leads to their pads. Trim back the silicone sleeving to the right length so the secondary leads lie neatly on their pads. Being careful not to damage the wires inside, tin the leads (no worry here about excess heat) and solder them to the board.

Cut and bare back the two mains leads from the mains transformer so there's a bit of slack when they're inserted into the terminal block. You only need 6 or 7 mm of bare wire and I won't labour the point about having bare wire protruding from the terminal block being dangerous. Use the pieces of wire you cut off the transformer to connect to the resistors R10 and R11. Bare the same amount of wire as you did for the transformer, twist the transformer leads together with the pieces of wire and connect them to the terminal block. Solder the other ends of the pieces of wire to the pads on the board and assembly is almost complete.

Attaching the coil primary leads.



Strip back the outer insulation of the mains flex for about 250 mm then cut off all three (if you only have two you've got the wrong sort of flex!) leads 120 mm from the end of the outer insulation. Cut the active lead to 100 mm and bare 10 mm of the end. Trim the neutral lead (blue) so it protrudes 50 mm from the cable's outer insulation. Bare the neutral and earth lead ends from 10 mm and clamp the flex to the board with a cable clamp.

Take the piece of earth lead you originally cut off and cut it to 50 mm long. Bare 10 mm of wire at each end. Twist the end of this piece together with the bared end of the earth lead from the flex and solder them together then clamp the soldered end *in the terminal that is NOT connected to the transformer.* Solder the other end of the earth lead that's protruding from the terminal block to the ground on the board, using lots of solder and make absolutely sure that it has properly taken. The graveyards are full of people who thought "Yeah! yeah! I'll fix the earth up later" so make *absolutely and positively sure* that you can trace the earth from the flex to the terminal block then out again directly to the ground on the board. When you're quite satisfied that all is well, connect the neutral from the flex to the terminal block so blue wire goes to blue wire.

Finally, cut a hole in the plastic jiffy box where you are going to mount the fuse holder and clamp it in place. Loop the bared end of the active (brown) lead through the end terminal of the fuse holder and solder it in place. Bare the ends of the spare piece of active lead you have and solder one end of the wire to the side terminal of the fuse holder and tape up both soldered joints as best you can (or slip on heatshrink tubing beforehand). Connect the other free end of the active lead from the fuse holder and the mousetrap is wired up. Attach a three-pin plug to the end of the flex, paying attention to the active and neutral pins on the plug, and you're ready to start testing.

Testing it

Testing is quite straightforward. Plug in the trap and turn it on with the jiffy box cover off to one side. Watch to see that nothing bursts into flames. Then, using your DVM, check that the trigger circuit power supply is in fact generating about 13 V. Next, check that the main dump capacitor, C5, has in fact fully charged to about 300 V. Measure the voltage between the anode of the SCR and either end of the coil primary (the anode of the SCR is the case). Bear in mind that the energy stored in the capacitor here is *dangerous*.

If all is well, you can try triggering the trap by touching the base of Q1 with your multimeter probe while the other probe is earthed. There should be a clear, audible click when it fires. The final test is to actually trigger the trap with a 1M resistor. Earth one end of the resistor (I used a lead with alligator clips on either end) then gently touch the centre electrode with the other end. Once again you should hear the click. If you increase the resistor to 2.2 megohms, the trap may or may not trigger and higher values don't work at all. As a final test, try triggering the trap with a 2k resistor. This is just the right impedance to get the full benefit of the trap. When it fires, it will blow the side out of the resistor! If you get a satisfactory "splat" and a destroyed, open-circuit resistor, all you need to do is screw on the lid, bait your trap (when it's off!) then go hunting mice. ●