UNIBOARDS

SIMPLE TRANSISTOR DESIGNS

By A. R. Winstanley

4 TOUCH SWITCH

A TOUCH operated switch is a useful and popular example of the application of electronics and this article describes the construction of such a device.

In brief, a relay is made to switch on or off by simply touching the appropriate touch pads on the front panel of the Touch Switch unit. The circuit detects the resistance of the skin across the pads and then operates accordingly.

Any load, mains or otherwise, may be switched provided that the electrical specifications of the relay contacts are adhered to. The unit to be described here was designed to be powered from the *9 Volt Power Power* project described last month.

CIRCUIT DESCRIPTION

The circuit diagram of the Touch Switch appears in Fig. 1. Transistors TR1 and TR2 are special types of transistors called "Darlington transistors". They have the usual three terminals but internally they actually incorporate two individual transistors as the circuit symbol illustrates. The major advantage of the Darlington is the superior gain parameter obtained from the use of two transistors: gains of 5,000 to 25,000 are not uncommon. A "normal" bipolar transistor may have a gain of several hundred only.

The circuit operates as follows. When the ON contacts are bridged with a finger, the base of TR2 is connected to the positive supply line through R3, R4 and the resistance of the skin. Base current (although very small) therefore flows and TR2 conducts, causing RLA to energise (relay contacts close) and D1 to illuminate.

Without TR3, if the finger is removed from the ON pads then TR2 would switch off and the relay contacts open; TR3 has been incorporated to act as a latching transistor. When TR2 is conductive, TR3 is also biased into operation. Current therefore flows through R7 and supplies base current to TR2, thereby keeping this device switched on.

If the finger is removed from the ON contacts therefore, TR3 and TR2 will remain conductive, latching the circuit and ensuring that the relay remains energised (contacts closed).

If the OFF pads are now touched, base current for TR1 flows through the skin and R1. This switches TR1 fully on. The base current for TR2 is therefore diverted to ground. This cuts off both TR2 and TR3, and so the relay switches off. If the finger is removed from the OFF touch contacts then TR1 will cease to conduct with the relay remaining in the OFF state.

The circuit is so sensitive that even a resistor of 30 megohms placed across the pads will operate the circuit. (This implies a base current of less than one microamp!).

Any a.c. signal which the human body may present to the very sensitive base circuits when the pads are touched is removed by C1 and C2. They also remove the possibility of relay chatter if the pads are touched only very lightly. Capacitors C3 and C4 serve to decouple the power supply.

The reverse-connected diode D2 shorts away any back e.m.f. generated when the relay coil switches out quickly, which might otherwise damage TR2.

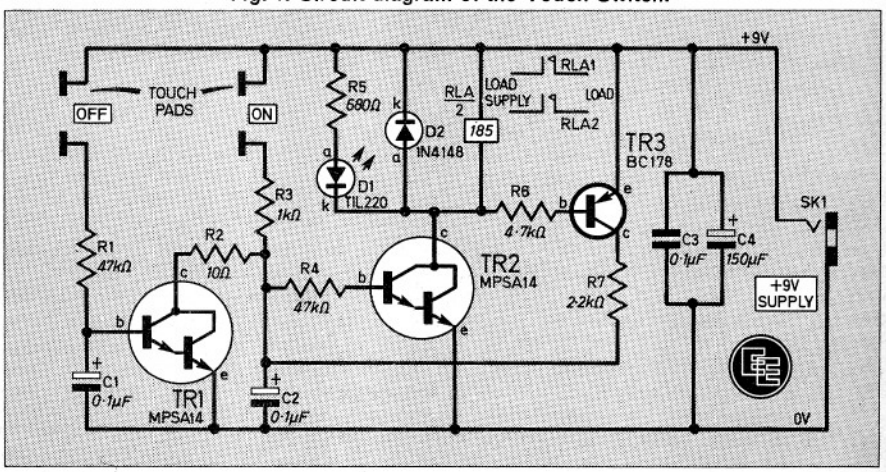
The desired load is controlled through both sets of relay contacts, RLA1 and RLA2. The circuit diagram supposes that a mains load will be driven. The relay chosen should have contacts suitable to comfortably handle the load connected.

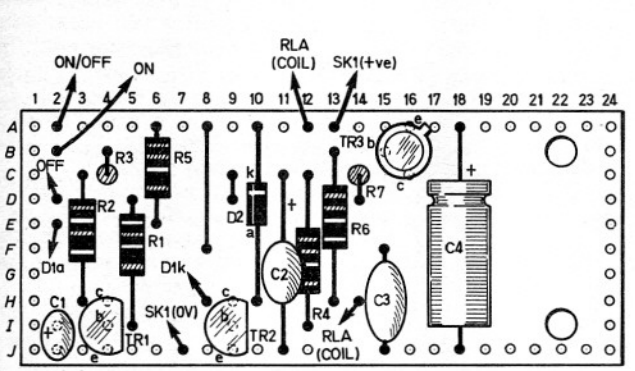
Finally, the *9 Volt Power Supply* is connected to the Touch Switch unit via SK1. The power supply requirements are 9 to 15V d.c. at approximately 50mA. As a suggested application, the touch switch could therefore be wired to operate successfully in the car as well as in the home.

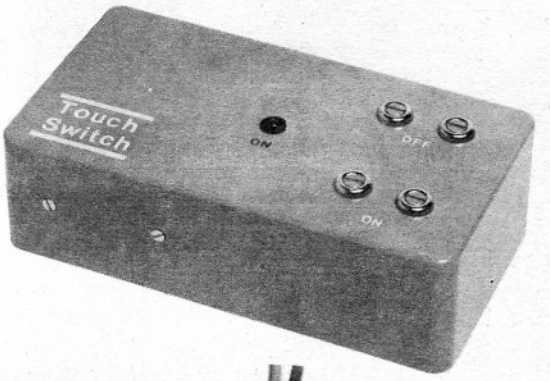
CONSTRUCTION starts here

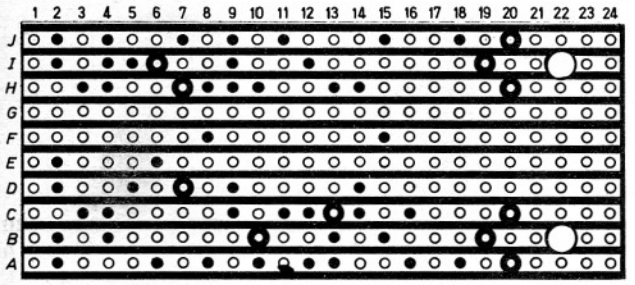
The complete Touch Switch is constructed on a piece of 0·1 inch matrix stripboard, 10 strips × 24 holes, as depicted in Figure 2. Two 6BA clearance holes are drilled in the locations shown. These holes will permit the support of the completed stripboard with the appropriate mounting hardware. Eleven breaks are required in the copper strips, and these can be

Fig. 1. Circuit diagram of the Touch Switch.









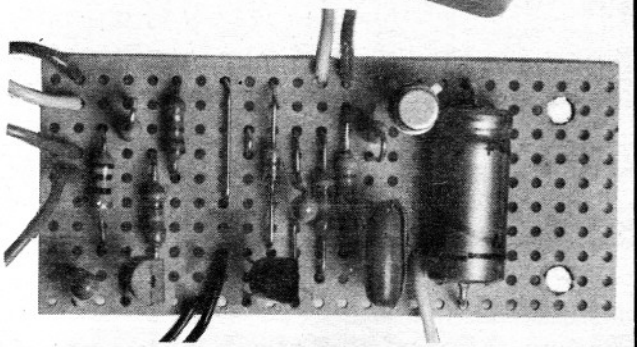


Fig. 2. Layout of the components on the topside of the board, showing wiring connections, and breaks necessary on the underside of the board

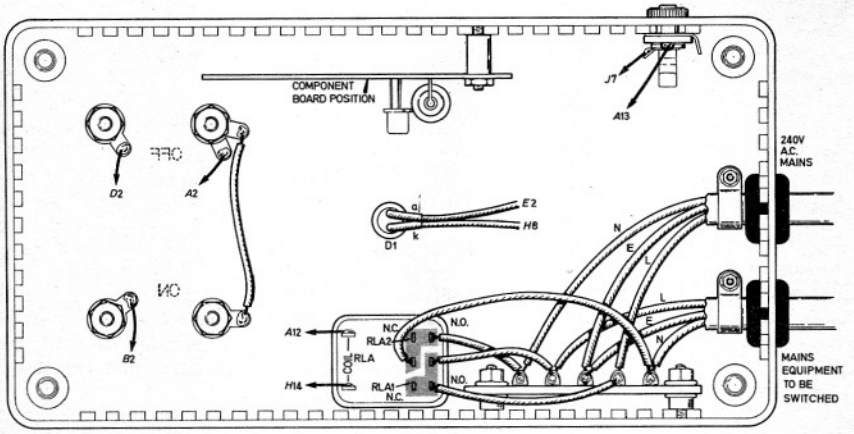
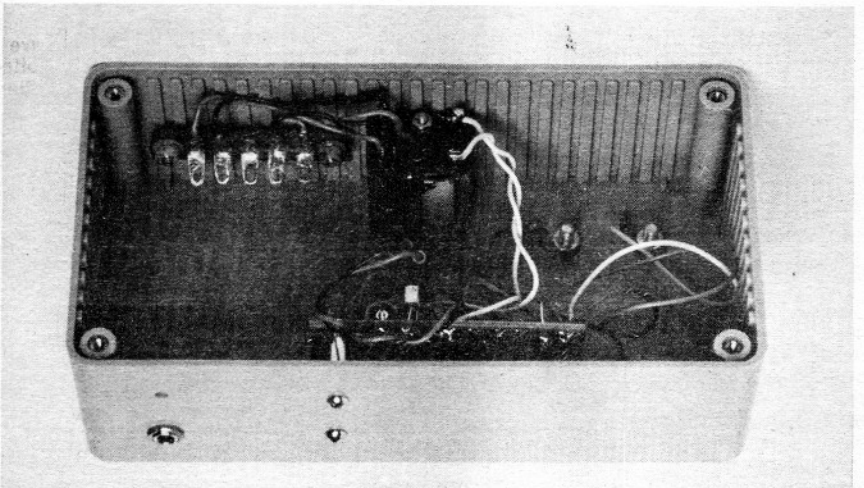


Fig. 3. Complete interwiring details between component board and case mounted components.



COMPONENTS

Resistors

R1 47kΩ
R2 10Ω
R3 1kΩ
R4 47kΩ
R5 680Ω
R6 4·7kΩ
R7 2·2kΩ
All ¼W carbon ± 5%

See **Shop Talk** page 167

Capacitors

C1,2 0·1μF 35V tantalum (2 off)
C3 0·1μF polyester type C280
C4 150μF 25 V elect.

Semiconductors

TR1, 2 MPSA14 Darlington silicon *npn* (2 off)
TR3 BC178 silicon *npn*
D1 TIL220 red light emitting diode
D2 1N4148 silicon small signal diode

Miscellaneous

RLA 185 ohm 12V coil and at least two sets of normally open contacts rated to suit applied load
SK1 3·5mm jack socket

Stripboard: 0·1 inch matrix size 10 strips × 24 holes; plastic case type BIM 2005/15 or similar (150 × 80 × 50mm); countersunk 4BA bolts/nuts/solder tags/cups for touch pads; 6BA mounting hardware, nuts/bolts/spacers; mounting clip for D1; mains cable rated to suit application; rubber grommets to suit mains cable; 5-way tag strip; cable grips for mains cable.

Approx. cost Guidance only
£6.00 excluding case

made with a "spot face cutter" or a hand-held twist drill.

It is important that miniature components are used in this design, for it will be seen that the component arrangement on the circuit board is very compact. In this respect, ¼watt resistors must be employed, and tantalum bead capacitors have been selected for C1 and C2 because of their small size.

Provided that the diagram is followed carefully there should be no problems, but, as usual, care should be exercised regarding the soldering of the semiconductors. In particular, the tantalum capacitors must be soldered in the right way, as must the diode D2. Note the orientation of the transistors.

ASSEMBLY

The prototype unit was housed in a grey Bimbox type 2005/15, measuring 150×80×50mm. In this instance it is necessary that a plastic or other non-conducting housing is chosen to encase the Touch Switch. The touch pads are mounted on the case and it is of course essential that these are insulated from each other.

The construction of the actual touch pads on the prototype consisted of a 4BA countersunk screw with a screw cup placed under the head to give a neater appearance. Connection to the touch contact is by means of a solder tag under the mounting nut.

WIRING-UP

The complete interwiring is shown in Fig. 3. Stranded lightweight interconnecting wire can be used throughout, with the exception that wiring at mains voltages should be suitably rated (3A minimum). All soldered joints which are at mains voltage must be of a good quality.

The mains (or other) supply enters and leaves the case via holes fitted with grommets in the case end. The cables should be fitted with grippers for safety reasons. A 5-way tag-strip was found to be a convenient interface between the cable and relay contact tags.

The l.e.d. can be mounted on the front panel using the special plastic clip normally provided with it; the relay can be stuck down with double-sided adhesive foam strip.

With construction complete, connect up the *9 Volt Power Supply*, or other suitable supply (9 volt to 15 volt) and then switch on. Touch the ON pads: the relay should be heard to click into operation and the l.e.d. should illuminate. Touching the OFF pads should cancel the relay and extinguish the l.e.d.

The Touch Switch is then complete and ready for use.

Next Month: Audio Tone Generator

BOOK REVIEWS

IBA TECHNICAL REVIEW NUMBER 12—TECHNIQUES FOR DIGITAL TV

Editor	C. W. B. Reis
Price	£1·50
Size	225 × 195mm 72 pages
Publisher	Independent Broadcasting Authority
ISBN	0 308 423 X

As the title suggests, this is a review of current practices and future trends in digital TV techniques within the IBA and as such requires a high level of understanding by the reader if he is going to be able to get anything out of the material presented. Chapter headings such as "Digital Sub-Nyquist Filters" and "A Low Bit-Rate System for Digital Video" give a good idea of the standard of knowledge assumed.

This publication is effectively intended for engineers and students directly involved in the field of broadcasting and as such is likely to have only limited appeal although presentation is clear and precise with a larger number of line drawings and photographs. S.E.D.

NEWNES BOOK OF AUDIO

Editor	K. G. Jackson
Price	£4·95 Limp
Size	250 × 185mm 144 pages
Publisher	Newnes Technical Books
ISBN	0 408 00429 0

Seven well-known specialists have contributed articles to this highly readable, well illustrated survey of techniques and equipments currently in vogue in sound reproduction systems. The names of the contributors will be familiar to all hi-fi magazine devotees; this fact should provide sufficient recommendation to others, especially those seeking to acquire their first hi-fi set-up or wishing to up-date an existing system. For them this book will prove a most valuable technical reference, and help them explore the jungle of the market place.

As the title suggests, the contents are not restricted to "hi-fi" as generally understood. Recording techniques are explained at length, aided and abetted by another section on microphones. The increasing importance of audio in the car is recognised by a section which helps the motorist to get the best from in-car entertainment equipment.

MECHANICAL WORLD ELECTRICAL YEAR BOOK 1979/80

Editor	R. Warring
Price	£3·95 Paperback
Size	155 × 105mm 383 pages
Publisher	Argus Books
ISBN	0 85242 679 8

The composition of this book reveals just how interwoven these two branches of engineering have become.

The purely electronic information is pretty well as comprehensive as you could wish for in a pocket book: colour codes, semiconductor theory, lists of current discrete and integrated devices, circuit theory and formulae, soldering, wire gauges—these are random samples.

The "electrical" information includes resistivities of metals, properties of plastics, insulating materials, electric lighting installation, cables, fuses, motors, thermostats, electroplating, metric/English threads, SI Units and much more.

In brief, a wealth of information clearly laid out in text, tables and diagrams, and always conveniently at hand.

One Armed Bandit
October 1979

PLEASE TAKE NOTE

We offer our apologies for three mistakes that appeared in the layout diagrams of the One Armed Bandit project.

In Fig. 2, underside view, a break is shown at location *O*35. This is not required and should be bridged with a short piece of wire.

Also in Fig. 2, the end of R14 located at *O*29 should be removed and connected to *A*26.

In Fig. 3 the two connections *P*64 and *E*64 from the diode "reels" should be transposed and annotations "D6-D12 and D20-D26" transposed to agree with the circuit diagram.