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Constructional Project

EASY-TYPIST TAPE CONTROLL

by **ANDY FLIND**

Improve keyboard skills, audio/visual presentations, and script prompter

This little project was devised to speed the task of typing text into a computer, though it will probably find plenty of other uses. It plays recorded speech a few words at a time, waiting for a prompt before continuing. This allows people who cannot type without looking at the screen or keyboard to type rapidly and continuously since it removes the need to refer frequently to the text being typed, which in the case of handwriting can be extremely tedious.

There are, of course, other ways to enter text into a computer. Printed matter of suitable quality can be scanned and read with optical character recognition, but this assumes that a reasonably powerful computer is available together with the software and a scanner, and it cannot be used with handwriting.

Voice recognition software is now available but this requires serious computing power and still has an error rate which many people find unacceptable. Also, it is difficult to see how this kind of software will ever be able to deal with words which sound the same, such as "to", "too" and "two" in the foreseeable future.

PAUSE FOR THOUGHT

The time-honored way to do the job is to dictate the text into a tape recorder and play it back whilst typing, but this normally

requires a "transcribing machine" as used by audio typists. The difference between these and ordinary tape players is that they can be started and stopped almost instantly and can "back-space" to play the last few words again, usually with a footswitch control. They are expensive though, and rarely found outside the office environment.

However, an ordinary cheap microcassette recorder can be used provided a couple of extra features are added. It should be prevented from stopping in the middle of a word so that every-

thing played is intelligible, to remove the need for back-spacing, and it should be possible to control it from a footswitch.

This is what the *Easy-Typist* does. The text is recorded in short "bursts" of as many words as the typist can reasonably remember, with brief silences of about a second between bursts.

This is much easier to do than it sounds and requires very little practice, certainly far less than the "training" required by most voice-recognition software products. It can then be played back with the recorder connected to this project which stops it automatically at each brief silence, allowing the pre-



Easy-Typist linked to a microcassette, earpiece, and the footswitch.

Constructional Project

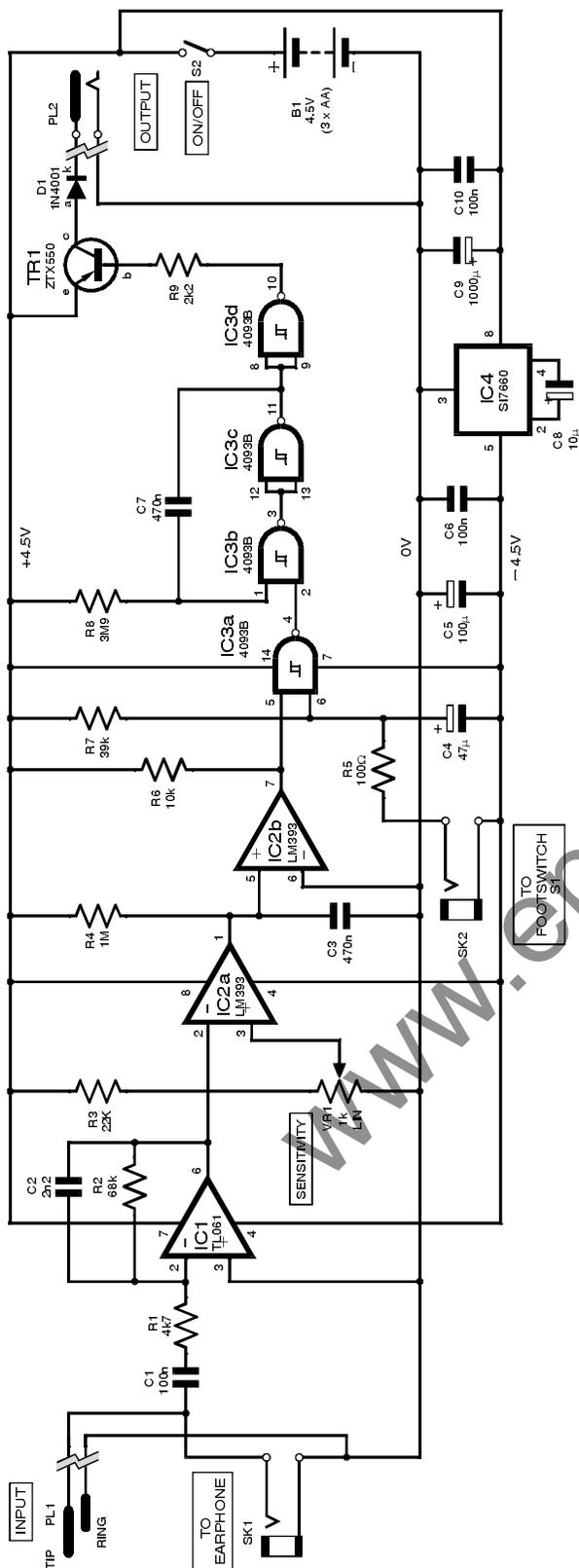


Fig.2. Complete circuit diagram for the Easy-Typist Tape Controller.

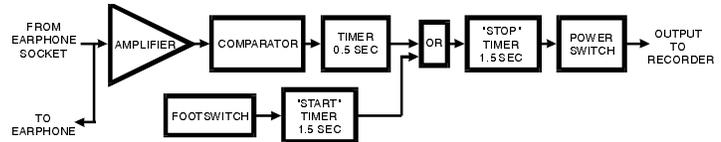


Fig.1. Simplified block diagram for the Easy-Typist.

ceding phrase to be typed before playback is resumed by a press of the footswitch.

The whole process is simple, rapid and inexpensive to implement since it will work with the cheapest of microcassette recorders. It can also be used with any old computer that will run a wordprocessor, or even with a typewriter.

OTHER APPLICATIONS

Although the intended use is easier typing, other applications for this project will include anything where audio information has to be dished out in discrete chunks with the user operating a switch of some kind to continue to the next section. Audio presentations and displays, operating instructions and perhaps drivers' navigation information would all be practical uses.

The direction lists generated by programs such as "Autoroute" would be ideal for it. Items such as instrument readings or test notes could be made directly to a recorder and written up easily later. No doubt readers will be able to think of many more applications.

As mentioned, microcassette dEasy-Typist linked to a microcassette, earpiece, and the footswitch.

ication recorders are now readily available and very cheap with some models costing under 20 UK Pounds. Provided the recorder has earphone and external power sockets and operates from a 3V supply (2 x AAA batteries is common) it can be used with this project. It is not necessary to modify it in any way, so any guarantee in force will not be affected.

HOW IT WORKS

A block diagram of the *Easy-Typist* is shown in Fig.1. The signal from the recorder's earphone socket passes straight through to the earphone, but is monitored by an amplifier with a voltage gain of about eleven.

The amplifier is used because at normal listening levels the voltage across an earphone is very small, typically only a few millivolts. It also allows some control of the frequency response, which improves circuit performance.

The amplifier drives a comparator. Each time the voltage of the amplifier's output waveform exceeds the reference set by the sensitivity control, the comparator

restarts a timer which runs for about half a second to deal with the natural gaps found even in continuous speech.

The output from this is combined with the input from the footswitch so that either will operate the output, again through a timer, which in this case operates only when the circuit switches off to ensure a positive turn-off action. The footswitch also has a timer, so that a quick press always operates the recorder for long enough to reach the next bit of speech.

Finally, there is an electronic switch to control power to the recorder itself. To avoid the need for modifications to the recorder it is started and stopped by using an external power supply and turning this on and off. Plugging an external supply into these recorders normally disconnects the internal batteries, so the *Easy-Typist* supplies power, in this case via a transistor.

CIRCUIT DESCRIPTION

The full circuit diagram for the *Easy-Typist* is shown in Fig.2. The input signal from plug PL1 is returned to the ear-phone socket SK1 but is also connected to the amplifier opamp, IC1 which has a voltage gain of eleven at 650Hz. An overall "speech" bandwidth of about 200Hz to 2kHz is set by capacitors C1 and C2.

Whenever the amplifier output exceeds the reference level set by Sensitivity control VR1, comparator IC2a discharges capacitor C3, causing the output of IC2b to go low. IC2a and IC2b have open collector outputs to which load resistors R4 and R6 are connected from the positive power supply. It takes

C3 about half a second to recharge via R4 to the point where IC2b's output returns to the high state, giving the "timer" action needed to keep running with normal speech.

Combination with the signal from the footswitch is performed by the Schmitt NAND gate IC3a. Taking either of the inputs of this gate low causes its output to go high.

When footswitch S1 is operated it discharges capacitor C4. The time taken for resistor R7 to recharge this capacitor guarantees around 1.5 seconds running time following switch operation.

The next two gates, IC3b and IC3c, ensure a positive switch-off action. When the input from IC3a goes low, the output of IC3b goes high and the output of IC3c goes low. This is fed back to the other input of IC3b through capacitor C7, ensuring that the "off" state is maintained for at least the 1.5 seconds it takes for this capacitor to charge through resistor R8.

POWER PLAY

Finally, IC3d inverts the signal to give the correct polarity of base drive to transistor TR1, which controls the power to the microcassette recorder. Diode D1 reduces the voltage slightly as a 4.5V supply with only the drop introduced by TR1 might damage a recorder intended to operate from 3V. In practice a single diode here gives about the right output voltage.

The supply for this circuit is taken from three "AA" cells giving 4.5V. The SI7660 "voltage converter" IC4 generates a *negative* supply for the opamp and the comparators, which gives them a more suitable working voltage and also allows the battery negative to be used as the circuit

"ground" (0V) to simplify the design.

Supply decoupling capacitors are provided, these are C5, C6, C9, and C10. The unusually large value of C9 is intended to absorb the start-up surges of the recorder's motor. Output to the recorder is from plug PL2, whilst switch S2 is provided to switch off the power when the unit is not in use.

CONSTRUCTION

Construction of this project is straightforward although it does call for a fine-tipped soldering iron. All the components are assembled on a piece of 0.1in. matrix stripboard, 14 strips by 33 holes. The topside component layout and details of breaks required in the underside copper tracks are shown in Fig.3.

The thirty-eight breaks should be made first. It's worth checking these carefully with a strong magnifying glass before continuing as an almost invisible strip of copper sometimes remains around the edge of a break and can be very difficult to find later.

Following this the 21 links should be fitted. These should be followed by the resistors, diode D1, the small capacitors, and transistor TR1. Finally, the sockets for the four ICs should be fitted, followed by the electrolytic capacitors.

It will be seen that some of the small ceramic capacitors have their leads bent outwards to accommodate a wider hole pitch; where this is necessary care is needed to avoid breaking them. There are seven external connection points on the board. The use of solder pins for these is highly recommended as they provide more

robust connections, which can be made from the component side.

COMPONENTS

Resistors

- R1 4k7
- R2 68k
- R3 22k
- R4 1M
- R5 100 ohms
- R6 10k
- R7 39k
- R8 3M9
- R9 2k2

All 0.6W 1% metal film

Potentiometer

- VR1 1k rotary carbon, linear

Capacitors

- C1, C6, C10 100n resin-dipped ceramic (3 off)
- C2 2n2 resin-dipped ceramic
- C3, C7 470n resin-dipped ceramic (2 off)
- C4 47u radial electrolytic, 10V
- C5 100u radial electrolytic, 10V
- C8 10u radial electrolytic, 63V
- C9 1000u radial electrolytic, 10V

Semiconductors

- D1 1N4001 1A 50V rectifier diode
- TR1 ZTX550 *pnp* silicon transistor
- IC1 TL061 opamp
- IC2 LM393 dual comparator
- IC3 4093B CMOS quad 2-input NAND Schmitt trigger
- IC4 SI7660 voltage converter

Miscellaneous

- PL1 3.5mm mono jack plug
- PL2 DC power plug (see text)
- SK1 3.5mm mono chassis socket
- SK2 6.35mm mono chassis socket
- S1 footswitch, momentary press-to-make type
- B1 4.5V battery pack (3 x AA cells in holder).

Stripboard 0.1in matrix, size 14 strips x 33 holes; plastic case, size 118mm x 98mm x 45mm approx; 8-pin DIL socket (3 off); 14-pin DIL socket; control knob; connecting wire, solder pins, solder, etc.

See also the
SHOP TALK Page!

Approx. Cost
Guidance Only **\$24**
(Excl. footswitch & batts)

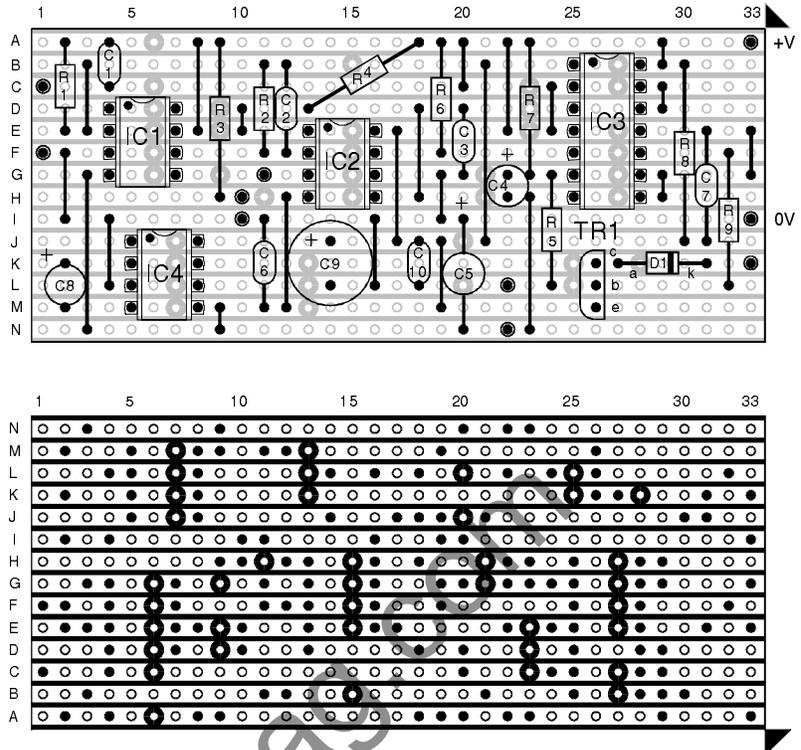
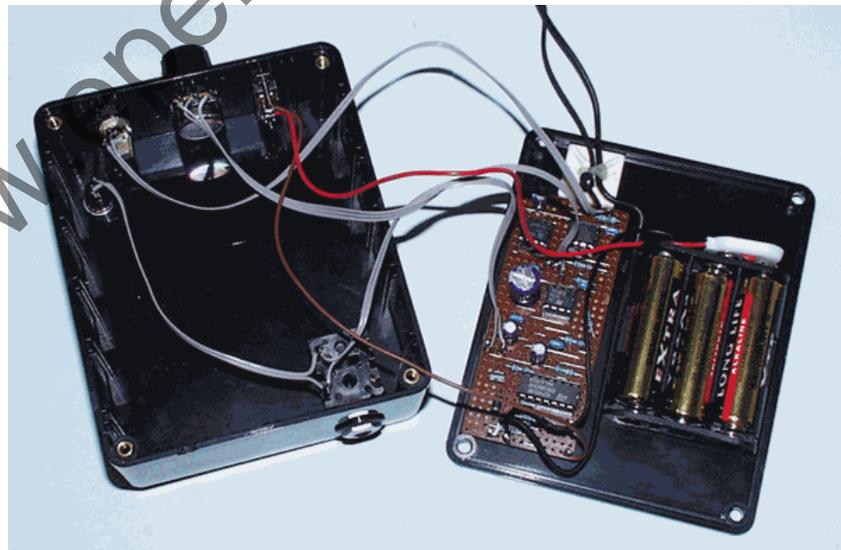


Fig.3. Easy-Typist stripboard component layout and details of breaks (38) required in the underside copper tracks.



Completed unit showing the circuit board and battery holder mounted on the lid.

FIRST TESTS

A useful initial test is to power the board without any of the ICs inserted, preferably from a current-limited bench supply.

Apart from a brief surge as the decoupling capacitors charge, there should be virtually no current drain. The reason for this test is to check there are no major short-circuits present without

risk to the ICs.

If all seems well IC4 can be inserted. When powered again with 4.5V, a 9V supply should appear across pin 4 and pin 7 of IC1's socket, pins 4 and 8 of IC2's socket and pins 7 and 14 of IC3's socket.

If this checks out, IC1 can be plugged in. With no input, output pin 6 should settle to around 0V (using the battery negative as the reference point). Next, IC3 can be inserted. Once capacitor C4 has had time to charge, both inputs (pins 5 and 6) to IC3a will be high, so IC3 pin 4 should be low, pin 3 should be high, pin 11 low and pin 10 high so transistor TR1 should be off. Shorting the connections for footswitch S1 should reverse all these polarities and cause the output to appear from TR1 collector (c) and diode D1.

SPEECH TEST

It should now be possible to test the stage around IC2 using a recorder with an earphone and some recorded speech. At this stage the recorder can operate from its internal batteries, there is no need to connect it to the supply from this project. The earphone must be connected though, since most recorders of this type use a series resistor to reduce power to the earphone

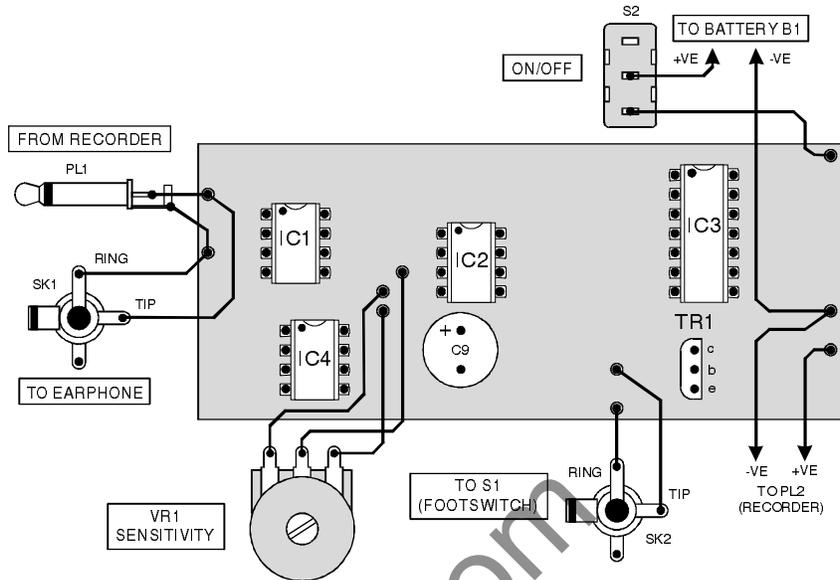


Fig.4. Interwiring from the circuit board to off-board components. The two plugs, PL1 and PL2, are wired on extended leads.

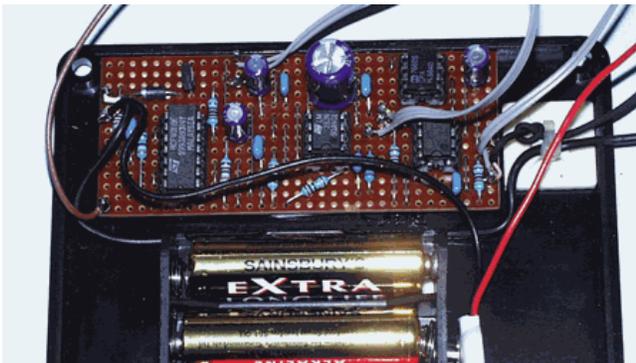
and if it is not present the output voltage will rise considerably.

The output of IC2b should be monitored with a meter and the recorder should be played at normal volume through the earphone. The output of IC2b, at pin 7, should be low whilst the speech is playing and go high when it stops. Some adjustment to Sensitivity control VR1 will probably be necessary to achieve this, although the setting of this control has not proved to be at all critical.

A recording of some speech with appropriate one-second silences will be

found useful for this test. Remember that, when the speech stops, it will take around half a second for the output of IC2b to go high. Checking the output of IC2a is not recommended unless an instrument with a very high input impedance is available.

A signal generator could be used in place of the recorder, of course. If this is available, it should be set to inject a level of 5mV RMS. (15mV peak-to-peak) at about 600Hz to 700Hz. If this works, the output from



Circuit board component layout and wiring.



Completed Easy-Typist showing the additional pause-switch button on top of the case.

transistor TR1 and diode D1 can be checked as operating correctly with the sound input present and absent.

BOXING-UP

With all tests completed and correct, the board can be fitted into a case of the user's own choice and connected as shown in Fig.4. In the prototype, the Input plug PL1 is a 3.5mm mono jack plug dangling on a short lead, whilst the Earphone socket SK1 is a 3.5mm mono chassis socket attached to the case. The power plug PL2 for the microcassette recorder is one of the miniature DC power plugs used with many items these days, the exact type and connection polarity will depend on the recorder it is to be used with.

The footswitch was purchased as an inexpensive ready-to-use item. It came with a standard 6.35mm mono jack plug so a socket for this was fitted to the case. Although not shown, a small pushbutton switch is fitted to the case and connected in parallel with the footswitch socket for applications where operation with this is more convenient.

MISSING LINK

A comment regarding the pitfalls of working with stripboard can be made here. Sharp-eyed readers may spot a link to the right of R6 at the top of the board which connects positive supply to a section of track with a break at either end, but going to nothing else.

Originally this link was not present. Neither was the right-hand track break so this section of track was connected to IC3 pin 2 and, more importantly, IC3 pin 4. This wouldn't be a problem since it didn't connect with anything else, right?

Wrong! The next track down connects to pin 1 and pin 5 of IC2, and capacitance between stripboard tracks can be astonishingly high. When IC2 pin 1 turns off, the connection to it becomes high-impedance, even though it is connected to ground by the 470nF capacitor C3.

The scenario, then, went as follows. IC2 output turned off and the voltage across C3 rose slowly as it charged from resistor R4. When it reached ground potential, IC2b changed state, causing IC3a output to go low.

A bit of this transition to the low state was fed back into C3 through the inter-track capacitance, pulling it down enough to cause IC2b to switch on again and the final result was a slow oscillation.

So, the circuit which had functioned perfectly as a breadboard "rats-nest" refused to behave as a neatly constructed stripboard unit! Worse, it worked fine without either IC2 or IC3, but not when both were present, so the immediate assumption was that there must be a short-circuit or a missed break between these two.

It took around three hours to figure out the true cause of the malfunction. The cure, of course, was to remove the feedback path by disconnecting the unused track section with an extra break, and to improve on this by tying it to the nearest supply rail. This is a good example of the type of problem that can befall the unwary stripboard user which may be helpful to others encountering similar troubles.

THE LAST WORD

To finish, here are a few more possible uses for this little gadget. It would make an ideal prompter for use when giving talks or speeches. It could be used for audio-visual training, or by actors learning their lines.

Finally, it might render its original purpose obsolete by helping to train the user in touch-typing!

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