

The Sudden Receiver

A simple-to-build receiver for 160-20M.

by Rev. George Dobbs G3RJV

It is sometimes said that the age of the amateur radio builder has gone. In the "great days," there was a huge electronic scrap yard left over from World War II, and hams could buy cheap parts and equipment just waiting to be modified for amateur radio use. They were good days; I remember well a local radio surplus store in my small home town in the north of England which had items that even a schoolboy could afford to buy. The store has now long since gone, and so have those bargain surplus items.

But my belief is that times have never been better for the ham who wants to build his own equipment. The world is full of electronics; from life-saving equipment to novelty junk, it is around us all the time. Smaller components, safer voltages and cleaner techniques mean that equipment can be built on a tray on the

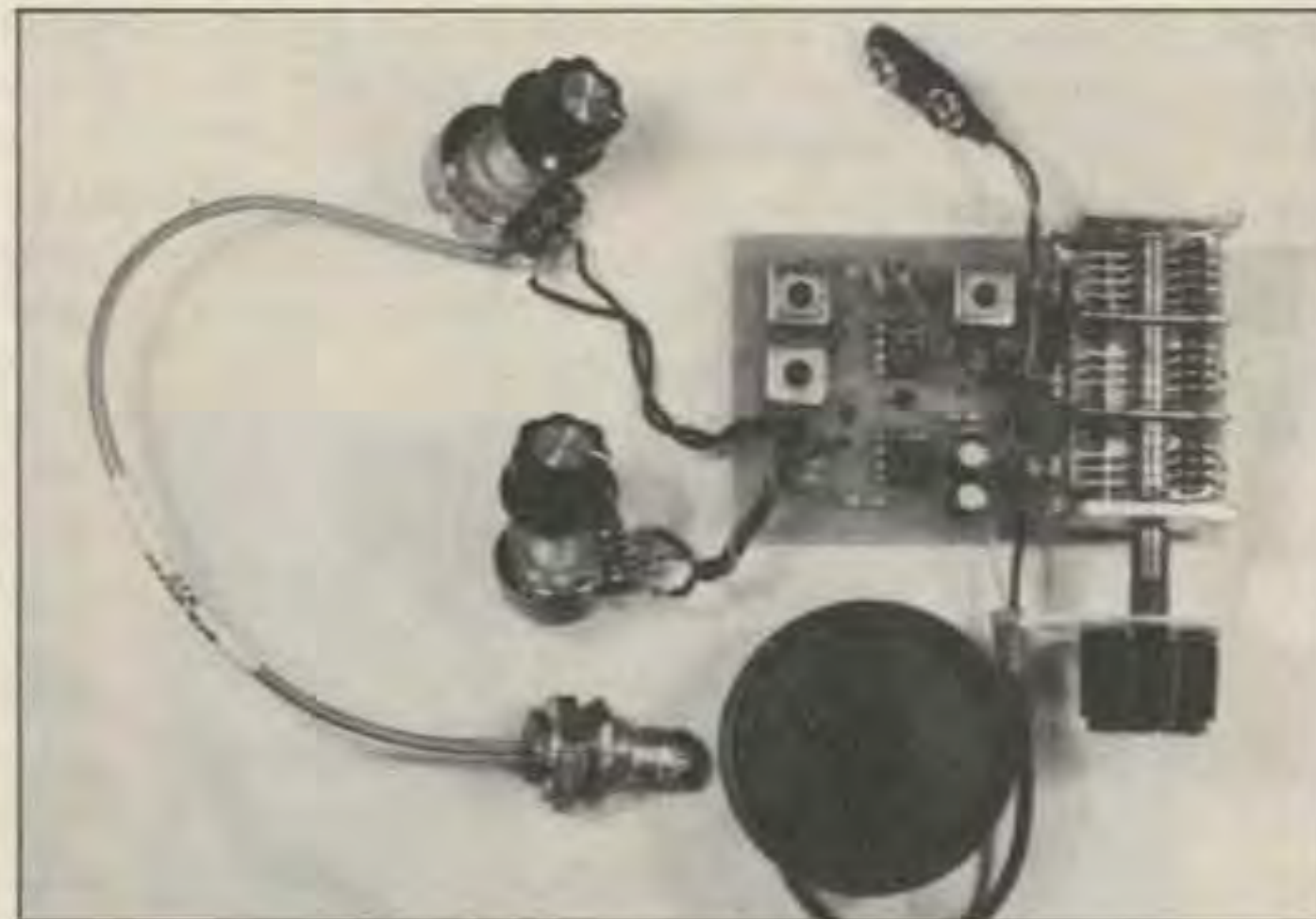


Photo. The Sudden receiver.

recent years of a revival in home construction among radio hams. This has been shown by the popularity of the G-QRP Club and its little journal, SPRAT. The club has always leaned heavily towards the use of home-built equipment, and SPRAT has grown into an informal constructor's magazine. Perhaps part of its popularity is due to the number of simple construction projects that have been published in SPRAT. Many amateur radio constructors in the UK have found their first radio project in its pages. I proffer all this cheerful information because I edit SPRAT, and for many years I have tried to include projects suitable for the beginner.

kitchen table—and cleared away after use. Components have never been cheaper; compare the price of electronic parts 30 years ago and now, and then compare average incomes. It is cheaper, easier and more convenient to build electronic equipment than ever before. I suspect that motivation, rather than means, is why more of it is not done.

There may not be the surplus items we used to find, but there is another kind of surplus these days. It is what I call the "scraps from the rich man's table." Modern technology has produced many specialized components and items for a particular job. If they are for consumer applications, the high sales volume often means that cheap, and sometimes clever, devices can be found. These may not be for applications directly related to amateur radio, but that is the joy of the new surplus market. The fun is taking cheaply produced devices designed for special applications, and making them fit what we want to build. That is real amateur radio in action!

In the UK there have been indications in

In the past, SPRAT has contained many simple HF bands transmitter circuits which can be built in an evening with a few parts. These give the experience of working on an amateur band with a few watts of home-generated RF. [Ed. Note: Those in the U.S. can join the G-QRP club and receive SPRAT for \$12/year from Luke Dodds W5HKA at 2852 Oak Forest, Grapevine TX 76051. Overseas readers can obtain more information directly from the author.]

Recently there have been requests to provide a very simple receiver circuit for the amateur bands capable of being built by a first-timer and yet able to yield reasonable results on the amateur bands. The Sudden Receiver was the result of this request.

The Sudden Conception

The name "Sudden" has nothing to do with the speed and ease of building this little radio (even though it is simple and easy to build); rather, it is the name of the town where it was conceived. I live in Rochdale, a

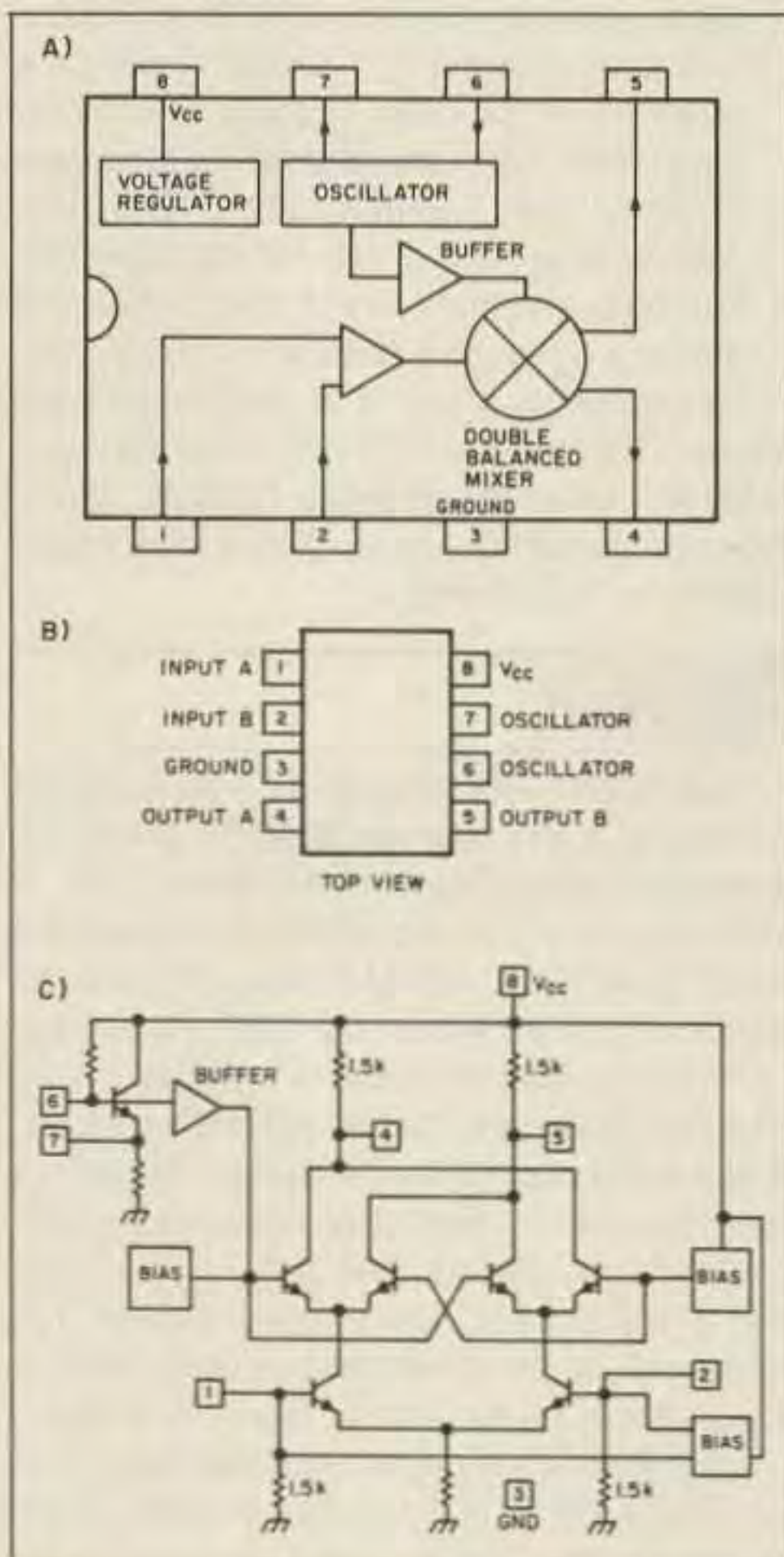


Figure 1. The Signetics NE602.

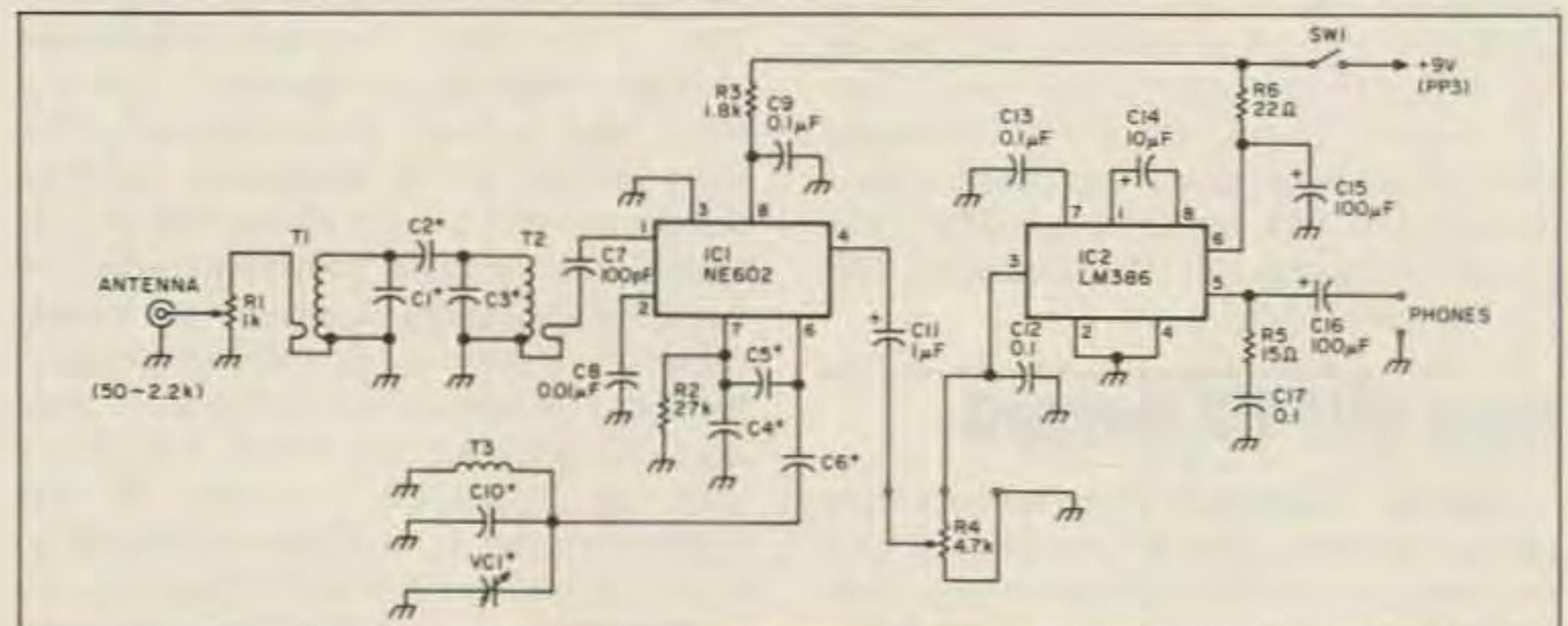


Figure 2. Schematic of the Sudden Receiver circuit.

Table. Component Values for Different Bands

| Band | C1 | C2 | C3 | T1 | T2 | VC1 + C10 C4 | C5 | C6 | T3 | |
|------|--------|--------|--------|-------------|-------------|-----------------------|---------------|---------------|--------|--------------|
| 160 | 220 pF | 10 pF | 220 pF | BKXN-K3333R | BKXN-K3333R | All Sections + 100 pF | 0.001 μ F | 0.001 μ F | 560 pF | BKXN-K3333R |
| 80 | 47 pF | 3 pF | 47 pF | BKXN-K3333R | BKXN-K3333R | All Sections + 100 pF | 0.001 μ F | 0.001 μ F | 560 pF | BKXN-K3334R |
| 40 | 100 pF | 8.2 pF | 100 pF | BKXN-K3334R | BKXN-K3334R | 1 Section + 47 pF | 560 pF | 560 pF | 270 pF | BKXN-K4173AO |
| 30 | 47 pF | 3 pF | 47 pF | BKXN-K3334R | BKXN-K3334R | 1 Section + 68 pF | 680 pF | 680 pF | 220 pF | BKXN-K3335R |
| 20 | 100 pF | 3 pF | 100 pF | BKXN-K3335R | BKXN-K3335R | 1 Section + 68 pF | 220 pF | 220 pF | 68 pF | BKXN-K3335R |

town in the northwest of England, in an area called Sudden. Sudden was once a village in its own right, and has a fine, stone-built Church of England church where I serve. I am the Vicar of Sudden, who just happened to design a simple radio receiver.

The Sudden could be described as a generic NE602 direct conversion receiver. It uses that fine and useful chip, plus the ever-popular LM386 audio chip. Another requirement of the design was to avoid the use of hand-wound coils, a common source of problems for beginners, and incorporate commercial inductors. The final design used a range of TOKO coils, given the UK designation KANK - - - - . [Ed. Note: In the U.S. the TOKO prefix is BKXN-K.] These have a range of inductance values useful for short-wave applications.

The NE602 is a fine example of the kind of "rich-man's scraps" we have today. It was

originally designed for cellular radio applications, but has found its way into many amateur radio circuits. The internal workings and pinouts are shown in Figure 1. It is indeed a useful device: a balanced mixer, RF oscillator, and voltage regulator all wrapped up in

one small, 8-pin DIP package. All the main workings of a direct conversion receiver under one roof!

Circuit Details

The circuit of the Sudden is shown in Figure 2. It is a simple receiver having only two active devices and three inductors. The input comes via a simple attenuator, the judicious use of which is essential, especially on the 40 meter version in the UK. T1/T2/C1,2,3 form a bandpass filter. The band chart table gives values for the appropriate TOKO coils. The values are calculated to give a flat response across each band. Once the filters have been peaked with the coil cores, there is no further need of adjustment during operation.

C7 couples the signal into one port of the NE602. The mixer is operated single-ended, which is a compromise in favor of simplicity. A similar design, the Neophyte (*QST*, February 1988), used a balanced configuration. In practice I have found that the results with this circuit did not warrant the extra complexity in obtaining a balanced input and output.

The oscillator portion of the NE602 is around pins 6 and 7. Looking at the circuit, if it is turned sideways, experienced constructors will recognize the popular parallel tuned Colpitts oscillator. Tuning is by means of T3 with VC1 and C10. The prototype receivers used a surplus variable capacitor which has three gangs of approximate values: 10 pF + 10 pF + 20 pF. It may be possible to find a similar capacitor (see the Parts List), or you can use a single section variable capacitor. It is essential to use a good quality air-spaced capacitor. The values on the band chart show the values for C10 when using the prototype variable capacitor. With other capacitors, some experimentation will be required. The kit version of the Sudden uses the values and the capacitor from the table.

The single-ended output is coupled via C11 to a volume control, then into the LM386 audio amplifier. The LM386 is configured in as a 200 times gain amplifier with a simple Zoebel filter R5/C17 on the output. The audio output will drive a small speaker, but is designed for headphone reception. A pair of Walkman-type headphones are adequate for the receiver (see Figure 3). It saves family arguments if you are using in-house teenager headphones on the receiver.

Figures 4(a) and (b) show the layout of the receiver. The receiver fits onto a printed circuit board measuring 2" x 2". The board shown here has been extended to mount the three-gang variable capacitor used in the prototype receivers. This portion can be cut away to give a smaller size with the variable capacitor mounted remotely from the board.

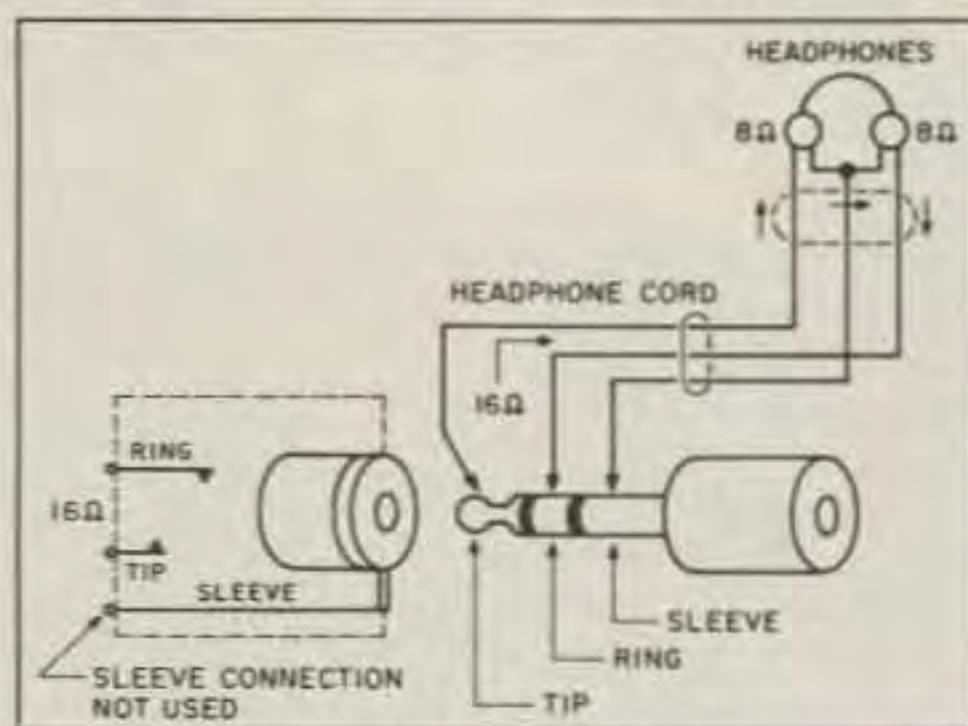


Figure 3. Walkman-type headphones can be used without changing the plug.

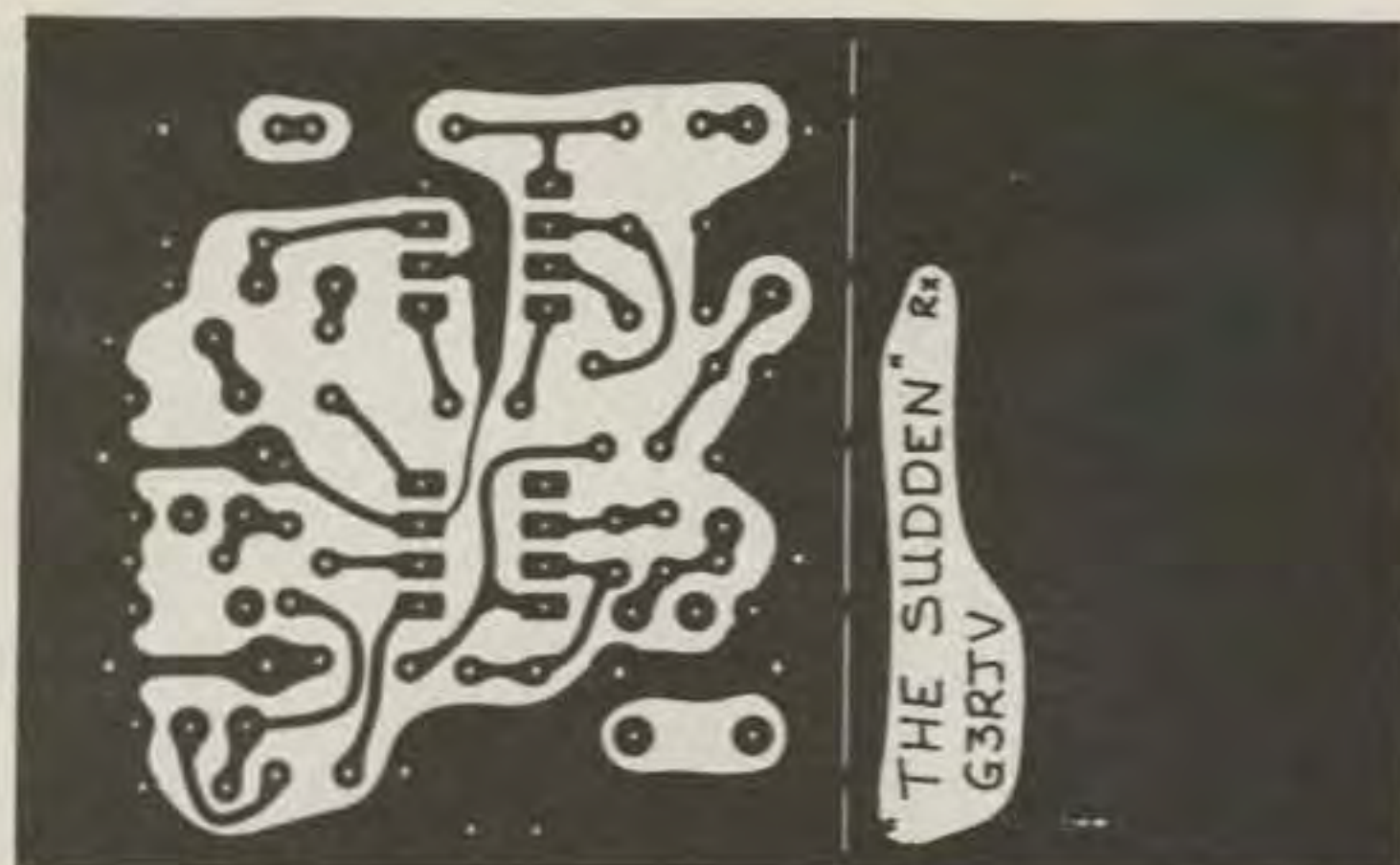
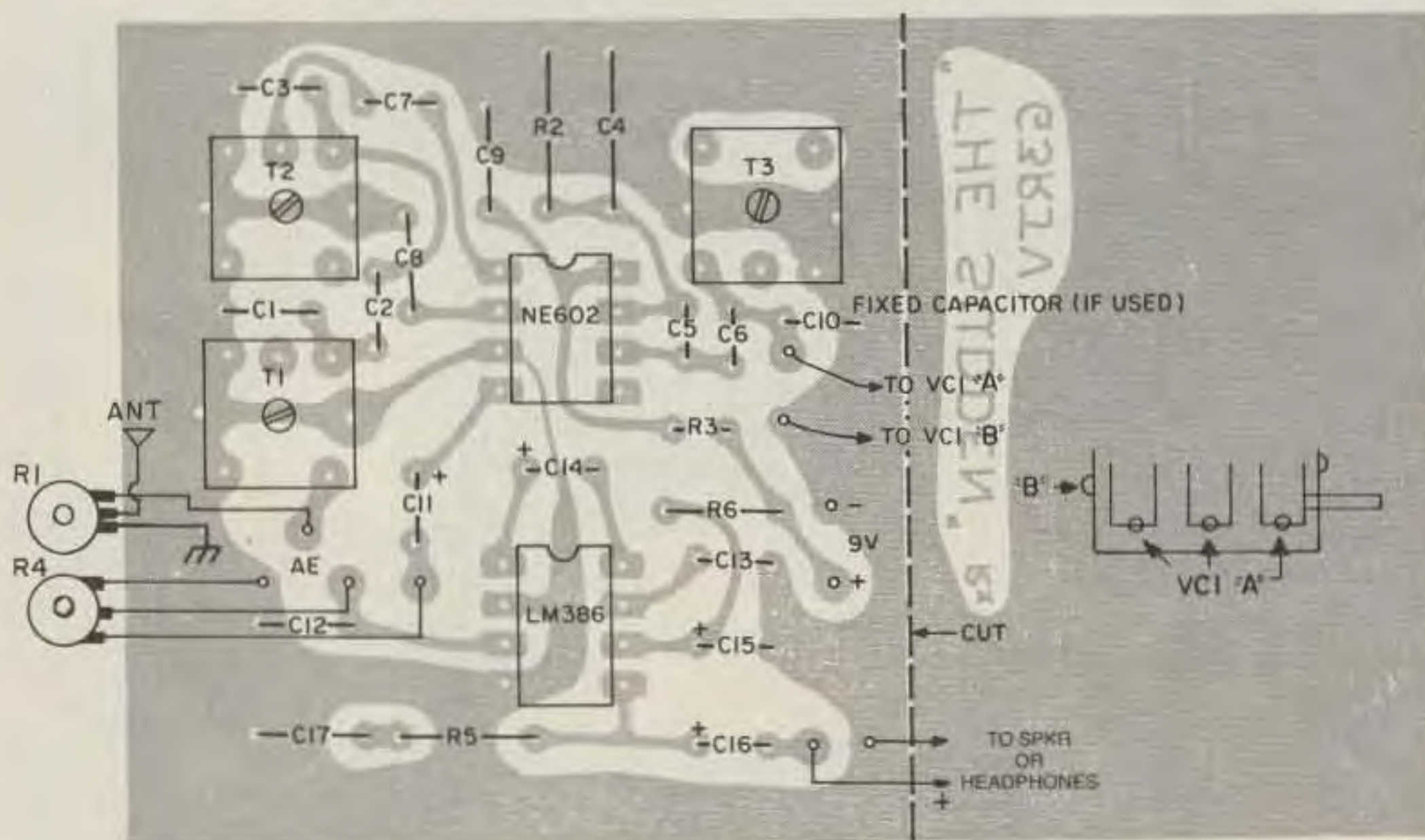


Figure 4. (a) Parts layout for the Sudden Receiver and (b) the foil diagram.

Parts List

Resistors

| | | |
|----|--------|---------------|
| R1 | 1k | potentiometer |
| R2 | 27k | resistor |
| R3 | 1.8k | resistor |
| R4 | 4.7k | potentiometer |
| R5 | 15 ohm | resistor |
| R6 | 22 ohm | resistor |

All resistors are ¼ Watt

Capacitors

| | |
|--------------------|-----------------------------------|
| C1-C6 | See the Table |
| C7 | 100 pF capacitor |
| C8 | 0.01 µF capacitor |
| C9,C12,C13,C16,C17 | 0.1 µF capacitor |
| C10 | See the Table |
| C11 | 1.0 µF/35V tantalum capacitor |
| C14 | 10 µF/16V tantalum capacitor |
| C15 | 100 µF/25V electrolytic capacitor |

Coils, ICs and Misc.

| | |
|----------|---|
| T1,T2,T3 | See the Table |
| IC1 | NE602 |
| IC2 | LM386 |
| SW1 | SPST switch |
| VC1 | Variable tuning capacitor (three sections: 10pF, 10pF and 20pF) see the Table and the note below. |

A kit of all parts including the PC board, the TOKO coils and the tuning capacitor is available in the U.S. for \$29.95 + \$3 shipping from Kanga US, c/o Bill Kelsey N8ET, 3521 Spring Lake Dr., Findlay OH 45840. Tel. (419) 423-5643, 7-11 p.m. Eastern. Kanga US will supply the blank PC board separately for \$6 + \$3 shipping. The complete kit is also available overseas from Kanga Products, 3 Limes Road, Folkestone, Kent CT19 4AU, Great Britain.

Variable tuning capacitor VC1 is also available as part # 2311007 from A.R.E. Surplus, 15272 S.R. 12E, Findlay OH 45840. Tel. (419) 422-1558.

The TOKO coils are also available from Penstock at (800) 736-7862.

Finishing Touches

The casing and hardware for the Sudden is a matter of individual taste. The main tuning capacitor does require a vernier drive for best results. The input attenuator potentiometer, R1, must have a linear track and can be in the value range of 50 to 2.2k ohms. Sturdy wiring is required for good mechanical stability between VC1 and the board.


Tuning up the receiver is very simple. A signal generator or other low level signal source is helpful, but it can be tuned up with band signals. The first step is to get the oscillator on to the band. This may be done by connecting a signal generator to C7 and adjusting the core on T3 until the signal is detected. It is also possible to listen for the signal on another receiver. A simple wire from the receiver antenna laid over the NE602 should be enough to pick up the signal. The core, T3, is adjusted to give the best coverage of the band in question using VC1.

The bandpass filter does re-

quire a little more work. I have obtained surprisingly good results by simply peaking T1 and T2 on signals in the band. The best method is to feed a signal source into R1 and adjust T1 and T2 several times. Begin in the center of the band and peak T1 and T2 for best output. Then repeat this operation at either end of the band, ending finally by again re-peaking in the center.

The receiver does have a conventional 50 ohms input impedance. It is advisable with such a simple receiver to attempt to match the antenna to the receiver. A good operating procedure is to turn up the audio gain control, R4, to the point where the internal noise of the LM386 just becomes a nuisance and then use the attenuator, R1, as the main gain control. This is a simple receiver, and hitting it with too much signal will bring out its worst traits.

The Sudden is capable of very surprising results for its simplicity. The morning that I am typing this text, a Sudden builder telephoned me to say he had been listening to VKs on SSB with a dipole and a Sudden on 20 meters. It is simple, it is inexpensive, and it is easy to build, but it certainly hears lots of stations. It makes a very good first receiver project or an ideal receiver for scouts or school groups.

Build the Sudden, and enjoy! 

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