The Heath/Kenwood Connection

—RIT for the 104

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How many times have I heard someone say, "I sure like Heathkits, but I don't know why they don't have RIT," or something similar? RIT, by the way, stands for receiver incremental tuning. (Sometimes it is called receiver-only tuning, or receiver offset, or simply offset.) This feature is found on many transceivers on the market today, and is a means of fine-tuning the receiver without affecting the frequency of the transmitter.

I am the proud owner of a Heathkit HW-104 and have in the past built and used SB-102s, HW-101s, and HW-7s and -8s. For the price, in my opinion, there is no better way to get on the air with state-of-the-art equipment. But no RIT!

Need for RIT

One of the main problems of not having RIT is what happens, for example, when I am talking with another ham who doesn't have RIT, and each of us is busy trying to improve reception of the other's voice. I will retune my transceiver to get a more "natural-sounding" voice; then he will retune his—and we both end up jumping around in frequency. This could end us up close to another station, causing some interference or being interfered with. Since the majority of hams on the air today appear to be using a transceiver, jumping around in frequency or being slightly off frequency are all too common events.

For a time, I used a Ten-Tec Argonaut for a bit of QRP work and became attached to using its offset feature. Upon completion of my HW-104, the first thing I considered doing was incorporating RIT and regaining some of the versatility of the Argonaut's offset control. After the "lids" were on the 104, however, and looking with some affection at my handiwork, I began to have second thoughts.

I've seen additions to equipment by others. Sometimes there is very professional work which doesn't detract from appearances, and in other cases you have to pretend you don't notice the additional switch, jack, meter, or whatever to keep from offending the obviously proud installer. (All the while you're fighting off an impulse to ask what brand of chewing gum was used to stick the little goodie on with.)

An Outboard Vfo

After weighing the pros and cons, I came to the conclusion that, if at all possible, RIT would have to be obtained without any modification to my new 104. Another factor is the ability of the 104 to go from one end of the band to the other without any peaking, tweaking, or anything save changing the vfo frequency (providing you did your antenna impedance design homework). Therefore, to be able to take full advantage of the broadband characteristics of the 104, it dawned on me that an outboard vfo would act as an RIT if proper switching or relay action were provided. In this case, not only would I get RIT, but I would be able also to make use of split operation—perfect for contests and DXing.

Once the decision was made to go to outboard or remote vfo, I began to look around for the best available remote vfo for the price, with ruggedness, durability, and stability, coupled with good eye-appeal. After using the 104, I knew the vfo in the rig was capable of meeting my ideals, but at the time, the engineers at Benton Harbor were on the verge of coming out with the SB-

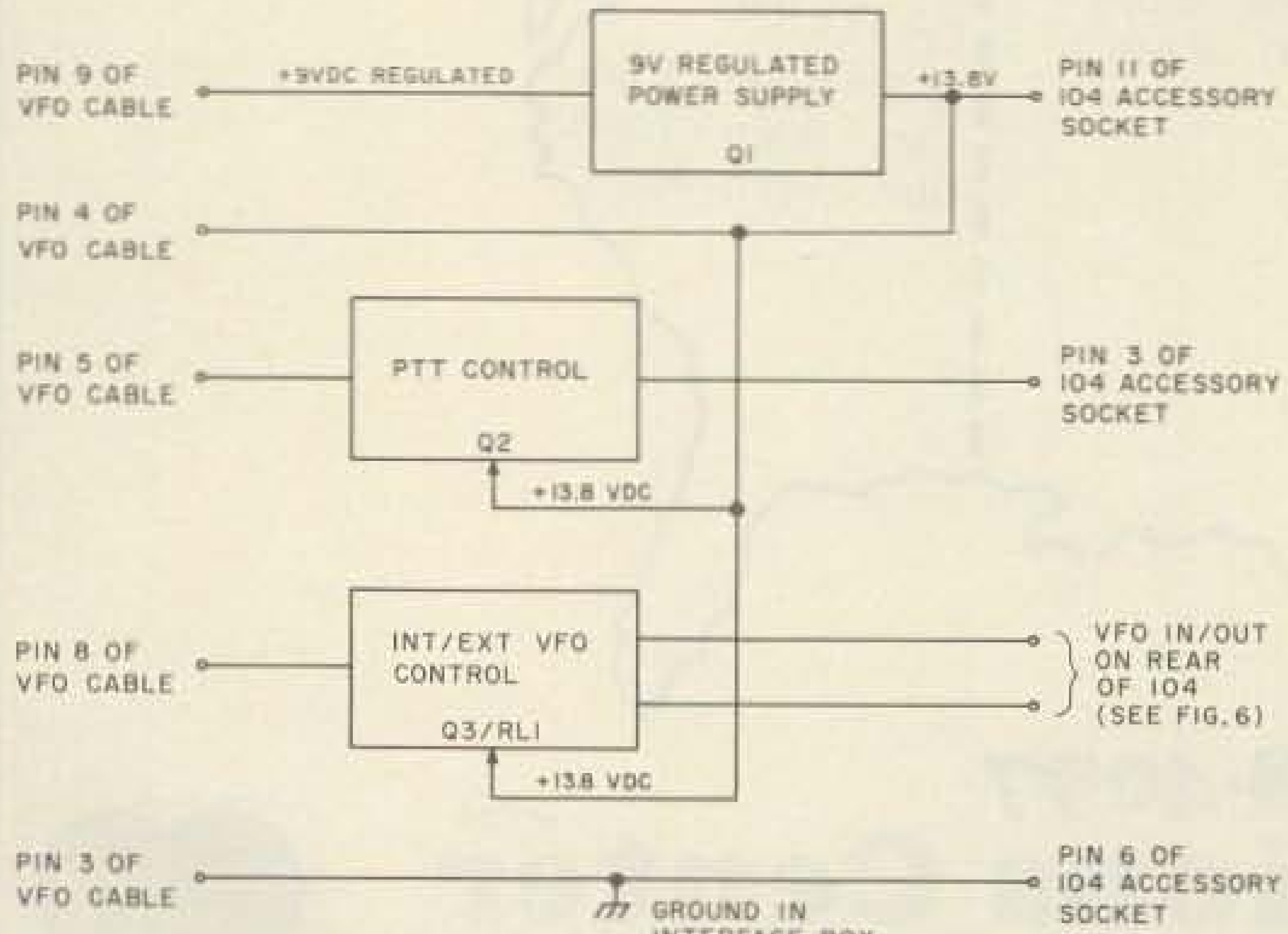

Fig. 1. Interconnection block diagram.

Pin No.	Function
1	Vfo signal
2	Shield for vfo signal
3	Ground
4	12.6 V ac (for lamps) (13.8 V dc used in this project)
5	Relay signal input (goes positive on transmit)
6	Calibrator supply source, 9 V dc (not used)
7	No connection
8	9 V dc for internal vfo
9	9 V dc for external vfo

Table 1.

104A. The remote vfo for the 104 wasn't listed in the catalog, and it would not have had RIT had I obtained one.

Looking around and considering what was still available on the market, I discovered that I could get a remote vfo and RIT in the same box for about the same price as the Heath remote vfo, had it been available. The only problem would be with the controls necessary to obtain selection of internal or external vfo and the push-to-talk (PTT) control for selecting the desired vfo on transmit.

My selection was Kenwood's model VFO-520 remote vfo, since it was readily obtainable and promised to do everything I needed. According to the stated specifications, it was compatible with the requirements of the 104.

The plan from the beginning was to utilize an outboard vfo with no modification either to the vfo or to the 104. This was accomplished by placing all interfacing components inside a miniature aluminum box which I placed out of sight behind the 104. Interconnection between the 104 and outboard vfo was neatly tucked away, and the interfacing was done silently and effectively.

A small cable from the interfacing box connects to the remote vfo. Two short pieces of RG-58 or RG-174 extend from the interfacing box to the rear of the 104, where Heath has provided convenient jacks for the vfo output from the internal vfo and for vfo signal input. Normally, if no external vfo is used, a simple jumper is installed between the two jacks. Only three other wires are necessary: 13.8 V dc, ground, and the PTT signal line. Two-conductor mike cable, with shield, may be used for these last three wires.

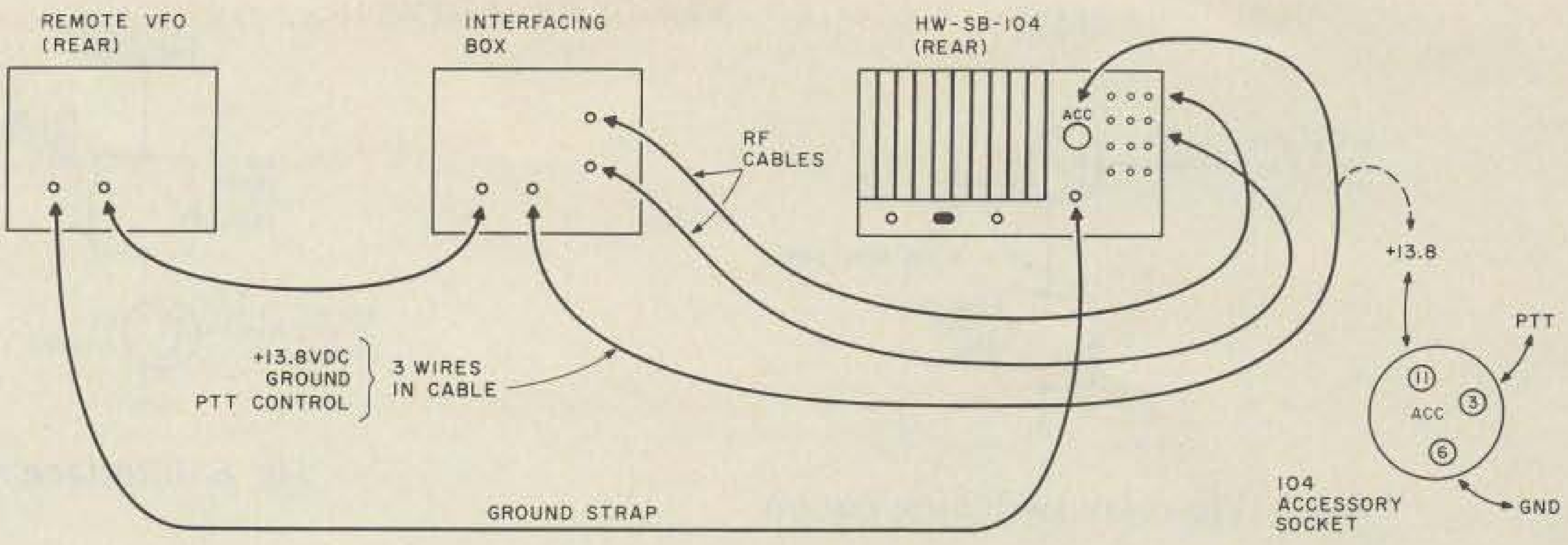

Fig. 2. Interfacing cable layout.

Kenwood has come out with a new design level since I purchased my VFO-520, but I imagine the new remote vfo and the old one are electrically equivalent. However, before buying the new one, in case the old one is hard to find, verification with a Kenwood dealer is recommended. Used equipment dealers should be eager to sell remote vfos if they have them in stock, because most hams don't need a remote vfo immediately when buying a new station, and this may leave the dealer with some extras.

The interfacing detailed in this article is what makes the combination work, so parts of the circuitry may be adaptable to other transceiver-to-remote hookups. Before planning to use combinations other than Kenwood to Heathkit, remember the two primary considerations: vfo frequency and which way the vfo is designed to tune. In this case, the Heathkit requires (a) that the vfo tunes from 5 to 5.5 MHz, and (b) that the vfo must tune backwards—which means that for a higher frequency of operation, the vfo will be producing a lower frequency, and vice versa.

The Circuit

A look at Table 1 will give an idea what the requirements of the vfo are and will aid in explaining what the interfacing connections accomplish. Block diagrams in Figs. 1 and 2 show how connections are made and demonstrate just how simple the project is. Figs. 3, 5, and 6 show the builder how few parts are required and may be followed as wiring diagrams. I will briefly discuss the various sections of the circuit, without details of the action of each electron, so that a better understanding of the circuit design and function can be achieved.

The power supply is the most complicated part of the interfacing box, but is actually a very basic circuit. For purposes of explanation, refer to Fig. 4 and notice that current flow is through zener diode D1 by way of resistor R1. Since a zener diode is designed to pass a large amount of current in the reverse direction when voltage across the diode reaches a certain level, it performs as a voltage reference device. In other words, as the voltage is raised across the diode, more current is passed by the diode at a certain voltage level, increasing the voltage drop across R1. In turn, this tends to stabilize the voltage across D1. The value of R1 is chosen to provide enough current for stable zener diode operation and to limit current through the diode to a safe value.

You may recognize transistor Q1 as operating in a standard emitter-follower amplifier circuit, but it is enough to remember that when Q1 is operating, a nearly constant voltage difference of a specific value is maintained between the base and emitter, mainly determined by the physical properties of the type of material used in making the transistor. For

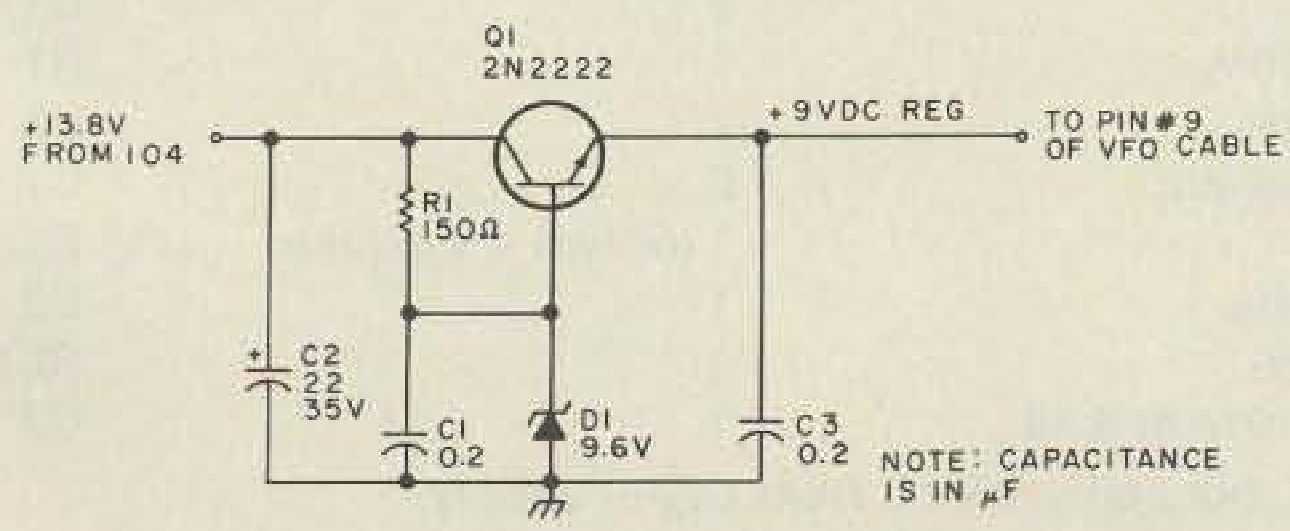

Fig. 3. 9 V dc regulated power supply.

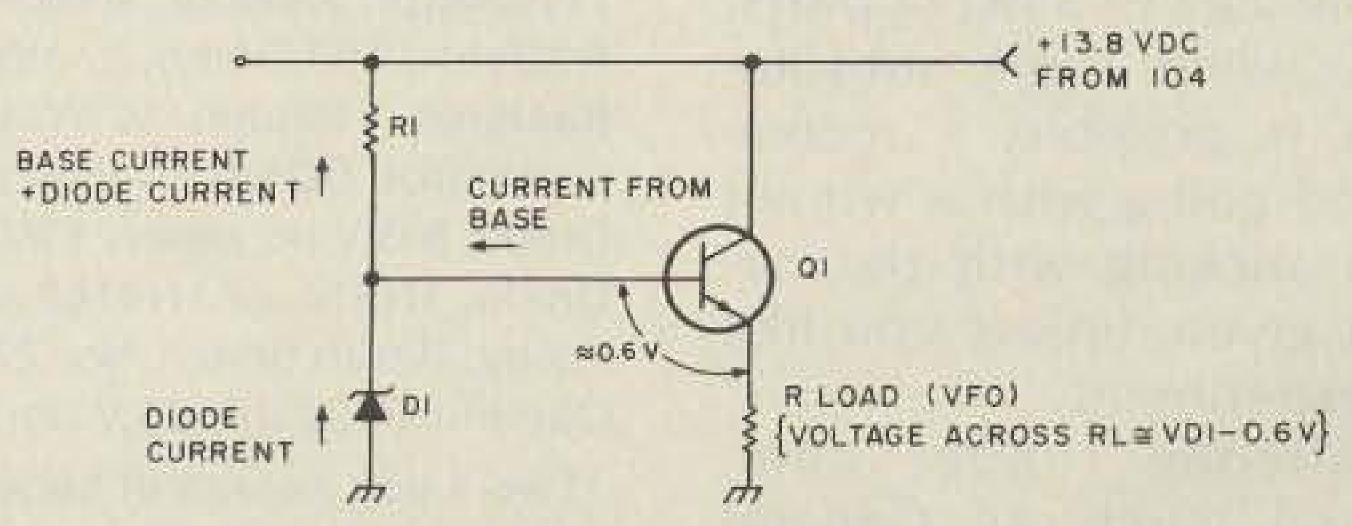

Fig. 4. Power supply simplified circuit.

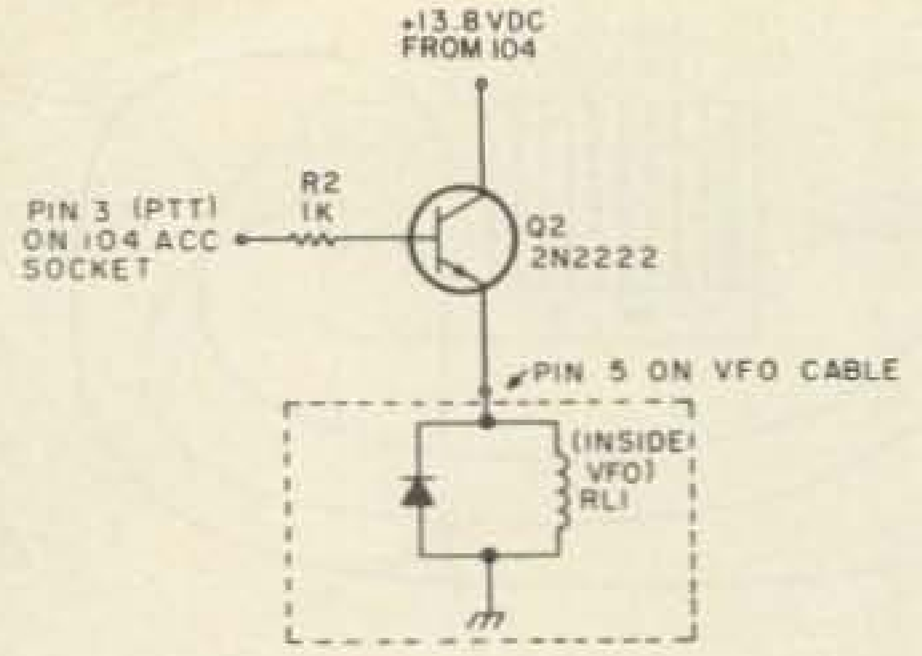

Fig. 5. Vfo relay switching circuit.

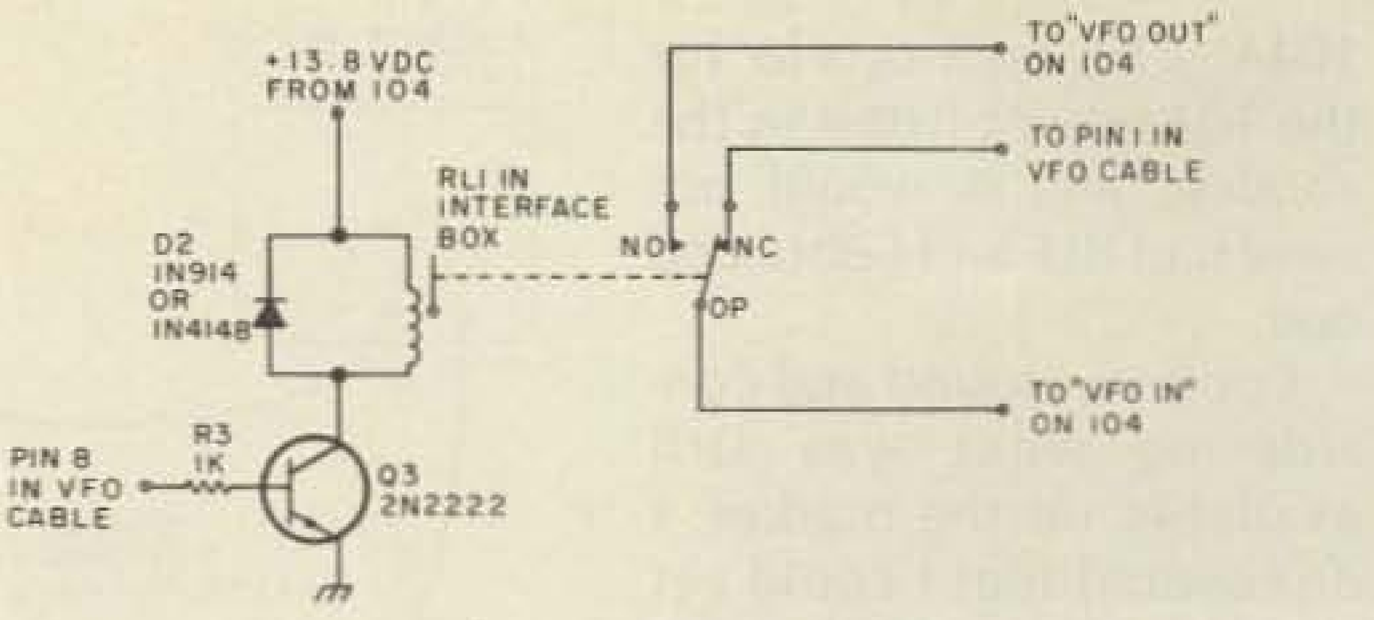

Fig. 6. Interface relay switching circuit.

silicon, which is used in the 2N2222, the voltage difference is about 0.6 V dc between base and emitter, and due to the clamping action of D1 on the base, the emitter circuit will supply current at a constant voltage. Capacitor C1 is used for insurance against the possible generation of white noise in the zener diode, due to random current paths in the silicon permitting "bumping," or friction, between groups of electrons, and resulting in a hissing sound.

Transistors Q2 and Q3 are used to operate relays, acting as current switches. R2 and R3 limit current in the base circuits to a safe value in the transistors and provide some isolation between the circuits. Diode D2 is used to limit to a safe value the "flyback" voltage generated as the relay winding is de-energized, since the inductive kickback voltage is usually high enough to jeopardize the switching transistor. Without this diode, the transistor could be "punctured" and destroyed.

Construction

All parts are common parts which either I had on hand or I bought at the local Radio Shack store. Table 2 gives a list of parts, and, while some substitution is possible, I recommend going with a winner and sticking with the circuit given, unless you like to experiment.

Silicone rubber compound, such as General Electric's RTV, would make mounting the relay a snap if you have it around. Perforated experimenter board can be used to mount the parts, but I soldered the parts to the pins on the 9-pin socket and rf connectors and experienced no mounting problems. Sockets for the rf cables between the interfacing box and transceiver may be considered unnecessary, but are recommended in order to keep everything grounded and shielded.

The VFO-520 comes with an interconnecting cable which has a 9-pin plug on each end. This cable is straight-through—that is, pin 1 goes to pin 1, etc., on each end of the cable. Also, pin numbering is standard, counting clockwise, starting from the large space between pins while looking at the bottom.

Remember to use the ground wire provided to strap the transceiver and vfo together, since depending on signal wire shields for grounding is poor practice. If the ground wire provided isn't long enough, one should be made up, since noise could be experienced later as connectors become dirty or oxidized.

Operation

Since placing the remote vfo in service, I have not had any problems whatsoever. Stability is as good as the 104 vfo, and that's pretty good. In fact, for almost all general operating, the Kenwood vfo is used exclusively. At first, one might think the price is pretty high just to get RIT, but not only do I now have RIT and the capability of comparing vfo operation, I also have the ability to set up operation on another band by verifying frequency availability and then moving with just a flick of the bandswitch. Actually, I now have the same capabilities as if I were using a separate receiver and transmitter, except for crossbanding.

I thought at one time I had a stability problem, but it turned out to be an oxidized bandswitch in the 104, and cleaning with a pencil eraser did the trick. (Take note, 104 owners.)

The function switch on the remote vfo gives total control over operating frequency. The four positions of the function switch are as follows, along with operating mode if the indicated position is selected:

OFF—Remote vfo is off. Transmit and receive frequencies are controlled by vfo in rig.

REC—Remote vfo controls receiver; rig's vfo controls transmitter.

REC/XMIT—Remote vfo has total control.

XMIT—Remote vfo controls transmitter; rig's vfo controls the receiver.

Summary

I don't expect any trouble from my vfo in the future because, upon inspection of the interior of the VFO-520 (I have a thing about looking inside every new thing I buy), I found good construction techniques were used, both electrical and mechanical. There was shielding where I didn't expect it, in fact. There is no reason why the VFO-520 cannot be used with other rigs with a little bit of homework, and I hope I've made it clear enough so others can duplicate the project without too much trouble. I also hope that those who do will get as much enjoyment out of the expanded operating capabilities as I have—all without modification to the rig or the vfo. ■

Component or Part	Quantity	
Transistor, 2N2222, silicon NPN	3	Q1, 2, 3
Resistor, 150 Ohms, ½ Watt, carbon, 10%	1	R1
Resistor, 1 kilohm, ¼ Watt, carbon, 10%	2	R2, 3
Capacitor, 0.2 uF 50 V dc min., disc ceramic	2	C1, 3
Diode, 9.6 V dc zener, 1 Watt*	1 (or two 4 V dc zen)	D1
Diode, 1N914, or 1N4148 switching diode	1	D2
Relay, Radio Shack No. 275-004 at $2.89	1	RL1
Capacitor, 22 uF, 35 V dc; RS No. 272-1014 at $.49	1	C2

*Two 4-volt zeners in series were used, but verify 9 V dc from power supply.

Table 2.