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Offset Tuning and Keying Modifications for the **HW-101**

Front-panel view of the HW-101, showing positions of the panel controls for the offset tuning, left, and the ON-OFF-ZERO switch, right.

BY GLEN CARLSON,* W6KVD

MOST HAMS are aware of the transceiver syndrome: on cw, rarely does a fellow ham come back to you exactly on your transmitting frequency. You may then tune him in, with a resulting change in your frequency. Under good conditions, your friend will retune for you, and no harm is done, but in the presence of severe interference this procedure can result in loss of contact. So, if you are interested in tuning in your off-frequency friends without losing them in the process, this information may be for you. It applies directly to the Heathkit HW-101, but the general procedure may be applied to other transceivers to provide receiver offset tuning.

Basically, the idea is to provide means for connecting a voltage-variable-capacitance diode in parallel with the VFO tuning capacitor in the HW-101, as shown in Fig. 1A, to offset the receiver frequency when the transceiver is in the cw mode. A stable source of negative voltage is supplied by the network in Fig. 1B. Control of the system is the function of the network 1C.

How It's Done

The locations for the offset control, R6, and the control switch, S1, are indicated on the front-panel photograph of the HW-101. This requires drilling two holes in the panel, but no trouble should be encountered if marking and drilling are done carefully. Balanced appearance of the transceiver is maintained, if a knob-operated wafer switch is used for S1. The mounting screw in the upper right corner of the panel makes a good place for attaching the two terminal strips used in wiring Network C.

Network A is wired on a 3-lug terminal strip, and mounted under the screw holding the VFO output transformer, T94. (Multidigit numbers used here are Heath designations for HW-101 parts.) The 1N649 was selected for CR1 because it was a fat little silicon diode, presumably with a lot of junction capacitance. Other small-signal silicon diodes should be usable, probably with somewhat different reverse-voltage vs junction-capacitance characteristics. Most such diodes should work as voltage-controlled capacitors well enough for this application.

Voltage applied to Point X will always be negative, so that the diode cannot conduct. The higher this voltage, the lower the capacitance exhibited by CR1. Thus we raise the VFO frequency by increasing the negative voltage at Point X, and lower the frequency by dropping the voltage.

The isolating resistor, R1, keeps rf out of the dc bias line. The input, Point X, is of high impedance, so the bias line must be shielded to prevent ac modulation of the diode. Small coax was used, but any well-shielded wire should serve equally well. The cable was pulled out of the top-front portion of the VFO assembly.

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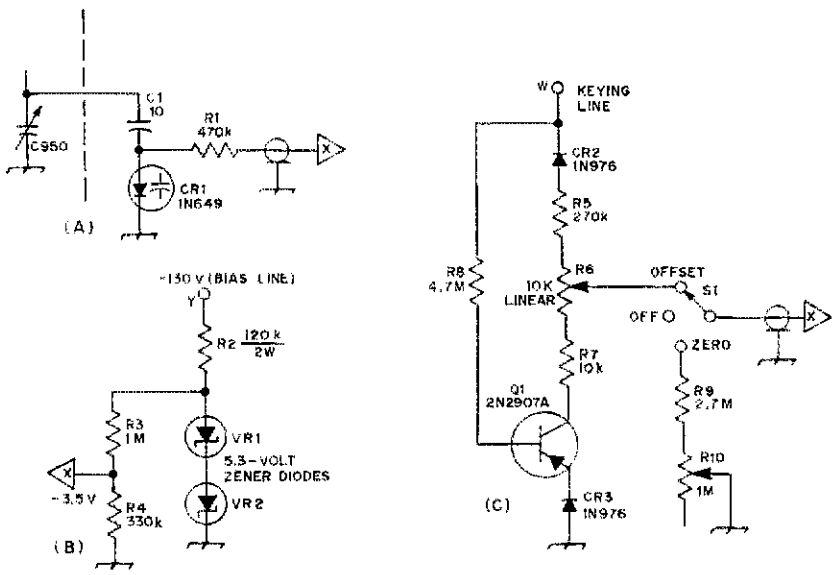

Fig. 1 — Three small networks are assembled on terminal strips, in modifying the HW-101 for offset tuning. Network B maintains the −3.5 bias for the tuning diode, CR1, when the transceiver is in the TRANSMIT mode. Network C selects the mode of operation, and provides for readjustment of the degree of receiver offset.

With Network A installed it is possible to check the tuning range and bias-voltage requirements of the diode used for CR1, using a temporary external bias source. The signal from the VFO should be monitored in an accurately calibrated receiver, or checked with a counter. The HW-101 tunes from 5.0 to 5.5 MHz. With Network A connected, but with zero voltage at Point X, set the VFO to its lower limit. Apply negative voltage at Point X, and check the frequency change resulting from increasing bias, in small increments, making curves similar to those in Fig. 2. Note at what voltage the curve begins to be nonlinear. Then repeat the process with the VFO set at the high end of its range. With a series capacitance, C1, of 10 pF, the 1N649 frequency change was linear up to about 6 volts, and the offset tuning available was more than enough for most operating purposes. To provide for tuning either way, a "center" bias voltage of −3.5 was selected, but in retrospect it was found that −3 or even −2 would have served equally well.

Network B was then installed, and the VFO was aligned according to the instruction manual. It and Network C serve two requirements: The voltage at Point X must be stable during transmitting periods, and it must be adjustable during receiving. Because the range of bias voltage desired was as yet undetermined, the system was designed as shown. A 3-lug terminal strip mounted on the control bracket, between the VOX DELAY and BIAS potentiometers is used for the components of Network B.

As the offset-tuning feature was to be used only on cw, the keying line was made the sense source. This line is at −55 volts when the key is up, and zero when it is down. The following conditions

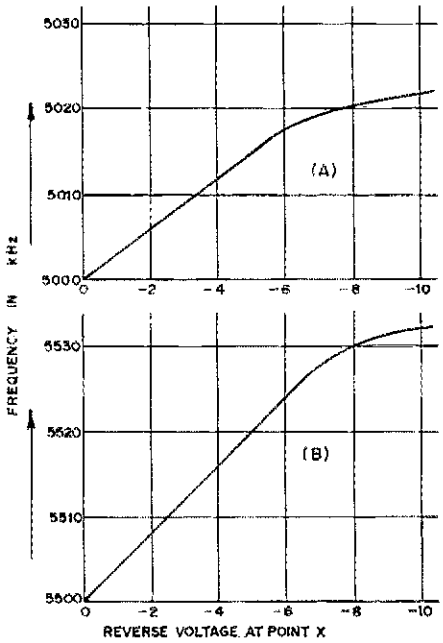

Fig. 2 — Typical curve of frequency shift for increasing values of bias voltage for the tuning diode, CR1. Only part of the linear portion of the curve is used in actual practice.

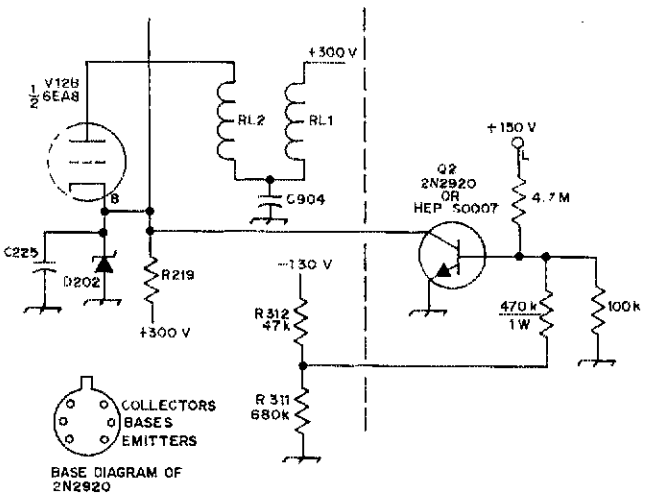

Fig. 3 — Modification details for reduced delay time in cw keying of the HW-101 to eliminate loss of first dot. Parts to the left of the broken line are in the original circuit. They are identified by the Heath numbers.

apply when the switch, S1 of Network C, is in the OFFSET position.

When the key is up, the −55 volts present at Point W biases the base of Q1 into conduction, through R8. Collector current from Point W flows through the collector load resistance (R5, R6, R7), and through the diode, CR3, to ground. Current flow through R6 causes the arm-to-ground voltage to be −3.5 when the arm is at its center of rotation. When the arm is at the top of the control range the voltage at Point X is −4.5, resulting in a change of about 3 kHz. At the bottom of the range it is about −2.5 volts. The total change in frequency is approximately plus-or-minus 3 kHz from the normal receiving frequency. Greater changes were experimented with, but tuning with the control became difficult.

When the key is down, Point W is grounded. Q1 is turned off for lack of bias, and the collector resistance is isolated from ground by Q1 and CR2. Network B assumes control of the voltage at Point X, and R6 has no effect on the transmitting frequency.

Using the Offset Tuning

With S1 in the OFF position, the transceiver works as originally designed. When the switch is in the ZERO position the receiving frequency is raised by an amount determined by the setting of R10. This feature was intended to make zero-beating of cw stations easier. It will be 100-percent accurate only at the dial setting where you make the adjustment. For example, if you adjust R10 to move the RECEIVE frequency up to the TRANSMIT frequency at 7050 kHz, your zero-beat adjustment will be accurate on 14,050, 21,050, etc. Within 50 kHz of this frequency you will be reasonably close.

Caution: The ZERO position is intended to zero-beat a station in the RECEIVE mode only; the receiving frequency is moved up 1 kHz to where your transmitting frequency normally is. If you transmit with S1 in the ZERO position, your transmitting frequency will also be moved up 1 kHz. So, use the ZERO position of S1 only in the RECEIVE mode.

With S1 in the OFFSET position, variation in the keying-line voltage (which is not regulated) can lead you to think that a station has drifted or jumped in frequency by a slight amount. So, keep S1 in the OFF position when checking for frequency stability.

The Case of the Missing Dot

With the HW-101 (and most other ssb transceivers) it is quite likely that, in transmissions starting with a dot, that first dot will not be heard on the air if the keying speed is 20 wpm or more. A starting W becomes M, R sounds like N, and so on. The fault may be unknown to the operator, because he hears the complete sequence in his sidetone monitor. In the HW-101 the trouble is the result of delay in operation of relays RL1 and RL2. It takes time for the voltage buildup on the grid of V12B to drive this triode into conduction, which will, in turn, operate the two relays.

The network at the right side of Fig. 3 reduces this delay time by lowering the bias on V12B (voltage on the cathode, Pin 8) when the key is down. When the transceiver is in the cw mode, the junction of R312 and R311 is tied to the keying line (−55 volts). The base of Q2 goes positive, causing the transistor to conduct, lowering the cathode voltage on V12B. The tube conducts much faster, and all dots are transmitted.

The case of the 2N2920 contains two transistors. Their elements are connected in parallel for this application, increasing the current-handling capability.

The circuit modifications have been in use in the author's HW-101 for several months, during which they have increased the enjoyment derived from use of the transceiver. QST