

HEATHKIT GR-78

General Coverage

Receiver Test/Review

When I first read the ad for Heath's GR-78, I was immediately enthusiastic about both its specifications and its very reasonable price. After all, it has many features not usually found in receivers costing less than \$200. I arranged to acquire one from Heath to give it the skeptic's "I'm from Missouri... show me!" test.

When my GR-78 arrived, the first thing I noticed was the way it had been packaged. Each component relating to a specific stage in construction was in a special box with a number keyed to a portion of the comprehensive instruction manual.

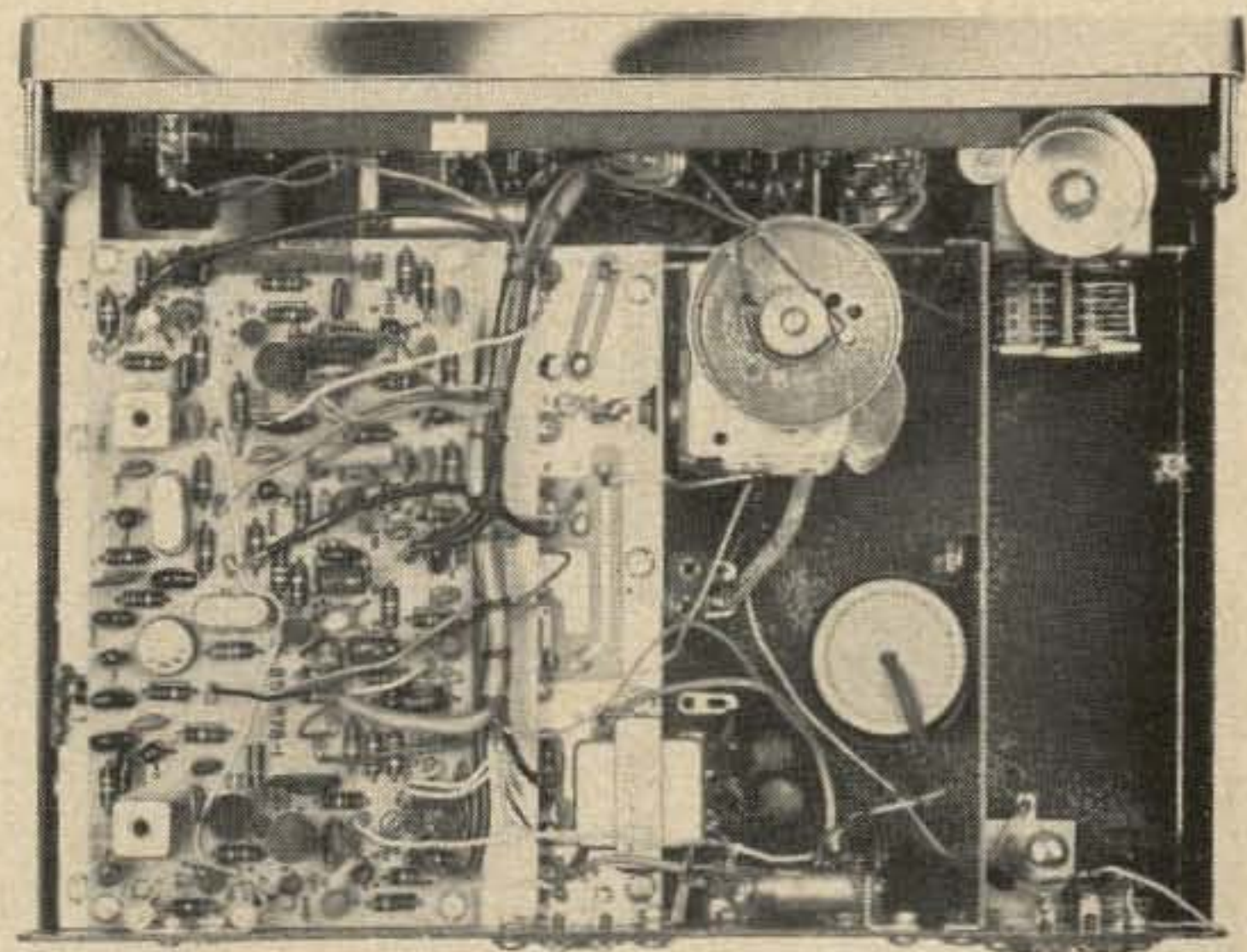
According to the specs, the GR-78 is a solid state portable (internal nicad battery) or home receiver operating on either 120/240V ac. Its coverage span is 200 kHz-30 MHz in six divisions. According to Heath, the receiver is designed primarily for amateur or shortwave listener use. A selection as to band spread coverage desired (ham or SWL) is made during construction and two calibrated band spread scales are included, one for ham use, the other for SWL'ers. The internal battery is "floated" across a unique charging circuit which insures that it will be fully charged providing the receiver is operated a few hours or so in the ac mode. This feature means that in case of power failure, you are still on the air as far as your receiver goes, and for field day, hurrah! no more generators, you just operate from the internal battery.

The receiver is designed to receive AM/CW/SSB transmissions with a front panel selector switch selecting the mode desired. A

built-in whip antenna will suffice for many applications, but provisions are incorporated into the rear panel for an external antenna.

That a great deal of thought went into the GR-78's development is evidenced by such features as a collapsible carrying handle, battery-saving switching for panel lamps, integral 500 kHz calibrator, ceramic i-f filters and an excellent noise limiter. Plug-in modulator circuit boards complete with single wafers of the main selector switch aid in simple, accurate assembly and cut the time required to wire this kit to around 35 hours, not counting calibration.

The all solid state circuitry includes 13 silicon transistors, five of which are FET's, two germanium transistors (audio stage), and a separate FET product detector to provide excellent CW and SSB reception. The audio circuit is novel (see schematic); its transformerless audio output circuitry combined with the all solid state receiver circuit



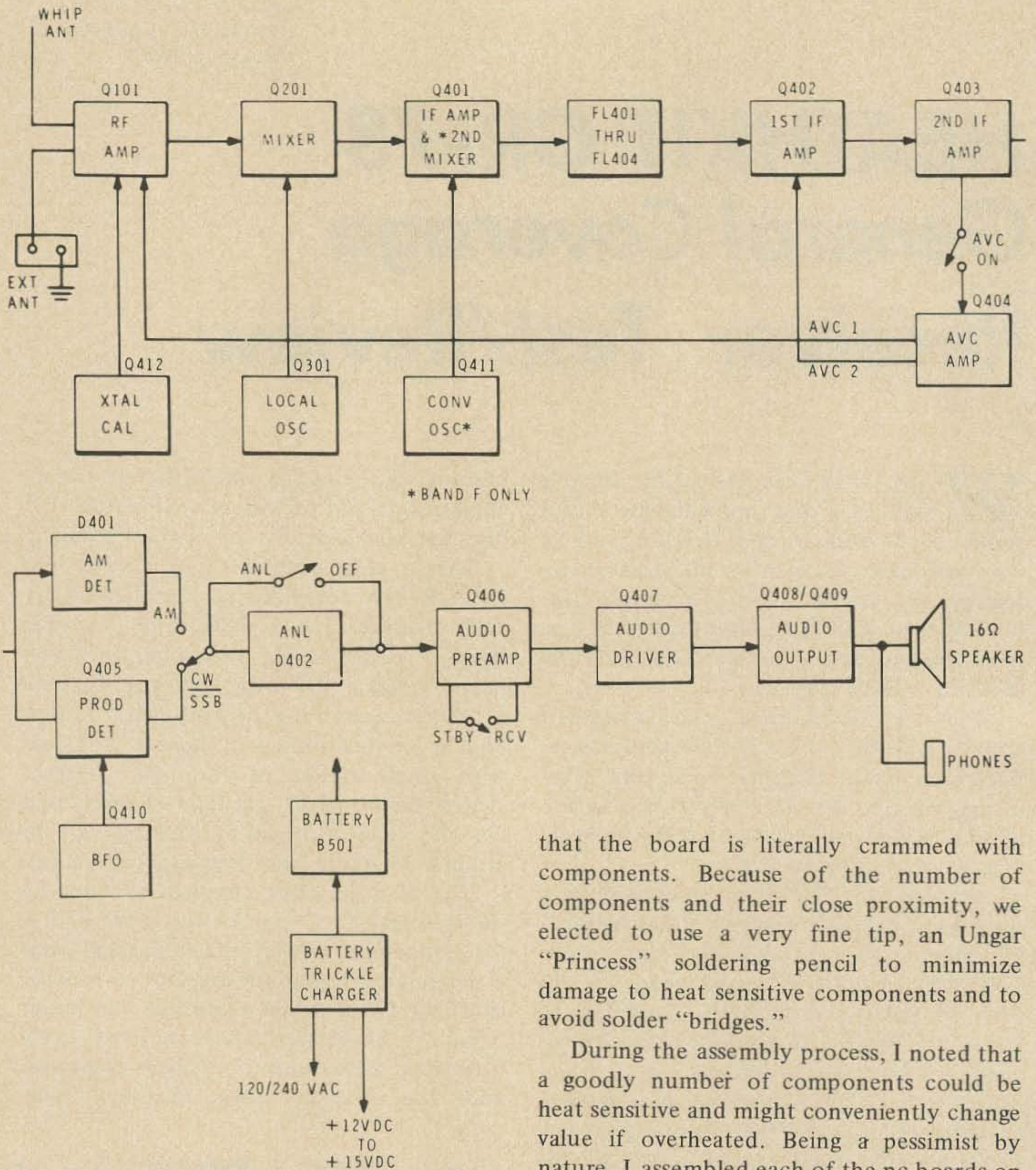


Fig. 1. Block diagram of GR-78.

provides excellent reproduction while conserving on power drain (most important when operating from the battery).

The majority of the components allied to the receiver including crystals, i-f filters, and the audio stage mount to the receiver circuit board. This board is wired first and contains a number of steps whereby the component density is increased gradually until you finish assembly, at which point you will note

that the board is literally crammed with components. Because of the number of components and their close proximity, we elected to use a very fine tip, an Ungar "Princess" soldering pencil to minimize damage to heat sensitive components and to avoid solder "bridges."

During the assembly process, I noted that a goodly number of components could be heat sensitive and might conveniently change value if overheated. Being a pessimist by nature, I assembled each of the pc boards on a large, common household sponge liberally moistened with water. The board was placed on the sponge component side down and soldering operations carried out. The sponge acted as a giant heatsink and conducted possibly damaging heat away from the components. The purist who never uses heat sinks might be made a believer by the sound of hissing emitting from that sponge. This hint might save a few hours of trouble shooting later. Besides, the sponge makes an excellent work surface and holder for the pc board.

Referring to the block diagram (Fig. 1) and the schematic (Fig. 2), we note that rf signals received from either the whip antenna or an external antenna are coupled to the input tuned circuit for Band A. The circuit consists of antenna coil L1, trimmer capacitor C1 and the first section of capacitor C501A. The signal is then coupled to gate 1 of FET Q101 via a tap on L1. Bias voltage for Q101 is obtained from the AVC amplifier and applied to gate 2. Source resistor R103 and rf gain control R501 provide the proper drain current for normal operation.

The amplified signal from Q1-1 is fed to a tap on rf coil L101 which together with trimmer capacitor C101 and capacitor C501b form the input tuned circuit of the first mixer stage Q201.

The first mixer, Q201 is a dual gate FET featuring excellent freedom from cross-modulation, overloading and the pulling effect on an oscillator that a strong signal frequently has. The amplified signal from Q101 is applied to gate 1 of Q202 through capacitor C111. The local oscillator signal from Q301 is applied to gate 2 of Q201 biased by resistors R203-204. The dc operating point is established by source resistor R205.

The incoming signal and the oscillator signal are heterodyned in Q201 resulting in an i-f frequency and mixer product. On bands A through E the output of Q201 is fed to a tap on coil L201 resonating with capacitor C201 to provide a 4.034 MHz output signal.

The output from Q201 is coupled through capacitor C205 to gate 1 of FET Q401, which operates as an i-f amplifier on Bands A-E and as a mixer (2d mixer) providing double conversion on Band F. Operating bias for gate 2 is provided by resistors R-401-402. When the band switch is in the Band F position, a 3.579 MHz injection signal from conversion oscillator Q411 is applied to gate 2 of Q401.

This signal combines with the 4.034 MHz signal from the 1st Mixer Q201 and results in an output of 455 kHz plus the mixer product frequencies. This output signal is then coupled through capacitor C410 to ceramic passband filters FL401 through

FL404. These filters serve to shape the bandpass and attenuate all frequencies except the i-f frequency of 455 kHz. This i-f signal is coupled to the base of the first i-f amplifier stage Q402.

Bias for Q402 is obtained from a voltage divider network comprised of resistors R415 and R418. Resistor R431 supplies an avc voltage from avc amplifier Q404 which will correspond in value to the changes in incoming signal strength.

I-f amplifier stage Q402 also contains the relative strength metering circuitry. The meter is connected between the emitter of Q402 and the meter's zero adjust control R408. The zero-adjust control is connected to a positive dc supply voltage and can be adjusted to give a zero indication on the meter. The meter also monitors avc action and provides a visual method of indicating the relative changes in avc voltage and therefore indicates relative signal strength.

The amplified signal from Q402 is coupled through capacitor C415 to the base of Q403 (i-f amplifier—2d stage). Bias for this stage is obtained via a voltage divider network made up of resistors R419 and R420. Transistor Q403 is also stabilized by emitter resistor R422 which is bypassed to ground by C416.

The receivers' local oscillator Q301 is a single-gate FET. The oscillator tuned circuit consists of coil L301, trimmer C301 and tuning capacitor C501C. Oscillator injection voltage is coupled through capacitor C308 to gate 2 of mixer Q201. This Hartley oscillator operates 455 kHz higher than the received signal on Bands A, B, C and D and the 455 kHz lower in frequency than signals on Band E and 4.034 MHz higher on Band F.

Detection is provided when a portion of the output signal from Q403 is applied to AM detector D401 for amplitude-modulated reception. The output signal is also applied through C429 to gate 1 of product detector Q405 for CW/SSB reception. Q405 is a dual gate FET with excellent isolation characteristics between gate 1 and 2 to eliminate BFO oscillator "pulling" or overloading on strong signals.

Injection voltage coming from BFO oscillator Q410 is applied to gate 2 of Q405 for CW/SSB reception. The i-f signal and the BFO signal are mixed, the resultant output is

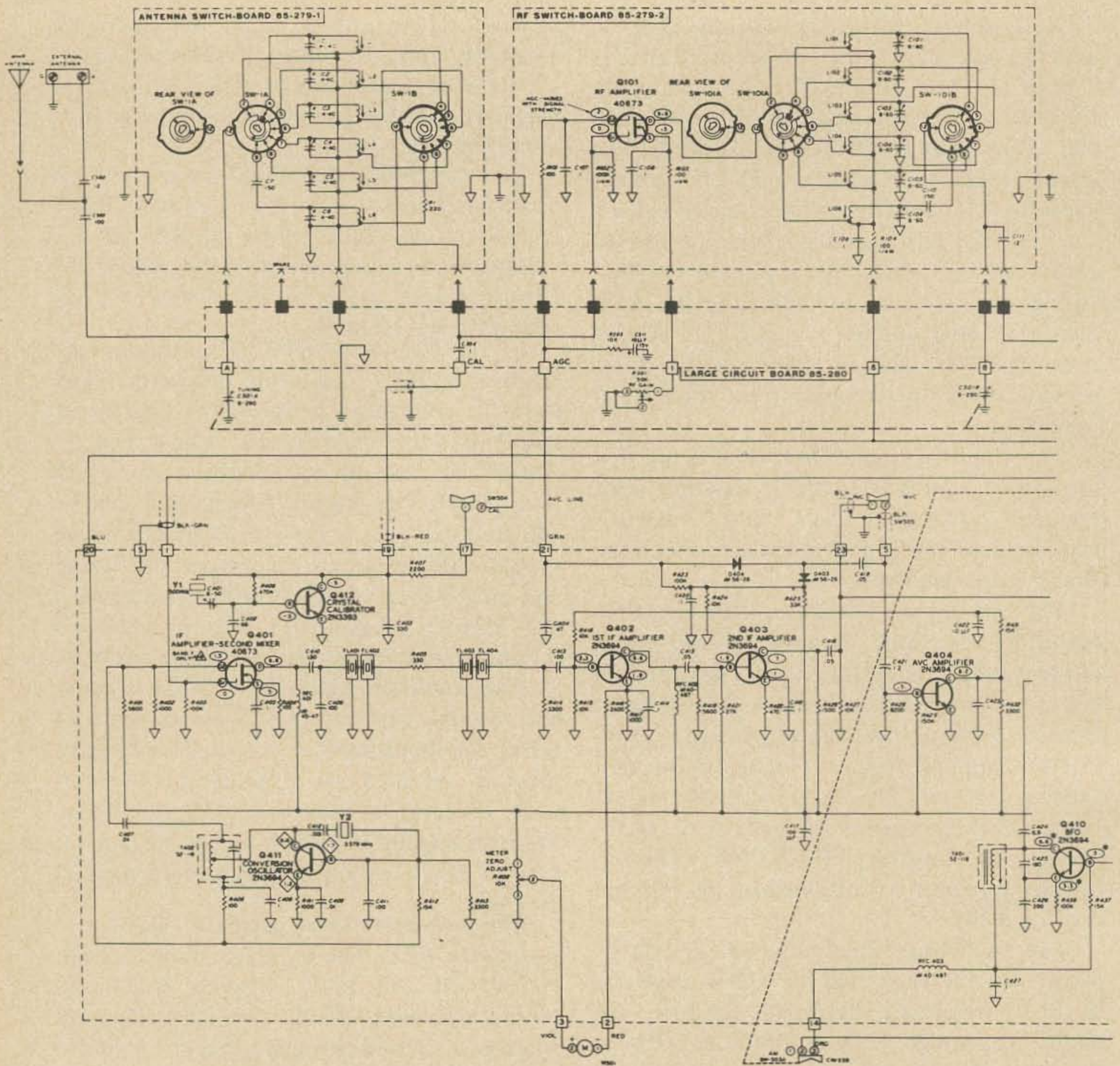


Fig. 2. Schematic, GR-78.

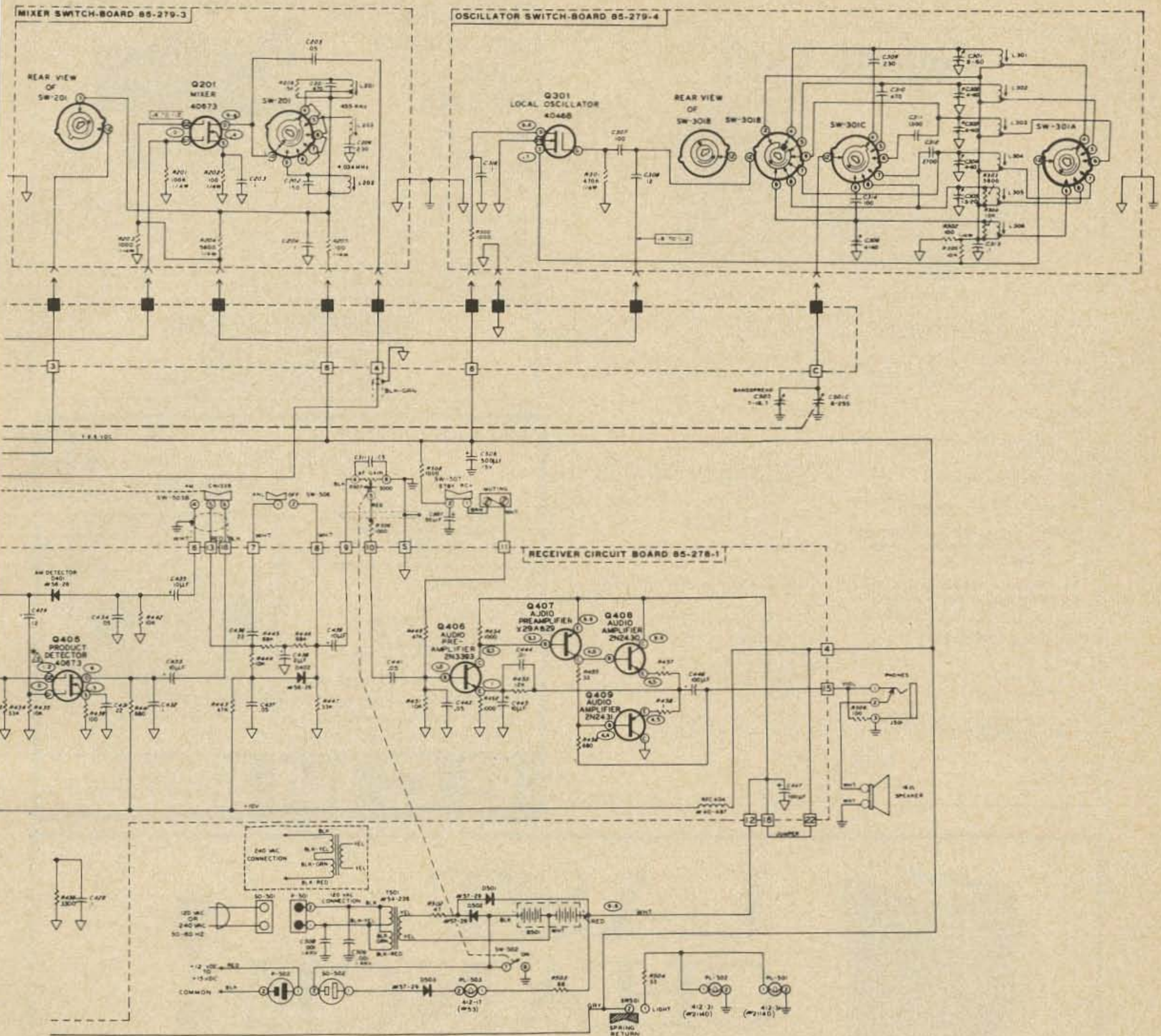
an audio signal developed across R441 and coupled through C433 to selector switch SW503B.

The BFO is a Colpitts oscillator made up of Q410, C425 and C426 to provide the proper feedback for oscillation and to form a tuned circuit with T401 to resonate at 455 kHz. Resistors R437-438 form a voltage divider and apply dc biasing to the base of Q410. Emitter resistor R436 provides temperature stabilization for the transistor. Injection voltage is coupled to gate 2 of Q405 through C424. The BFO is actuated by the AM/CW/SSB switch in the CW/SSB position which applied dc operating voltage through RFC403.

The audio signal coming from R505 is coupled through C441 to the base of audio-pre-amp Q406. The audio output is developed across the load resistor R454 and directly coupled to driver transistor Q407. The output of Q407 is directly coupled to a complementary pair of transistors Q408-409 with audio output coupled through C446 to either the 16Ω speaker or a headphone jack. A portion of the output is fed back to the emitter of Q406 to aid in stabilization of the stage and minimize distortion.

Miscellaneous Circuitry

Transistor Q412, crystal Y1 and associated circuitry form a 500 kHz calibration



oscillator which is switched on by the front panel calibration switch SW504. The oscillator provides very accurate calibration markings every 500 kHz for dial calibration and band edge marking.

The charging circuit requires that the battery be electrically divided in half for charging from ac. When the ac plug is inserted into a power outlet, the ac voltage from the secondary of T501 is applied through diode D501 on one-half cycles to charge one-half of the battery. The other half-cycle of the voltage is applied through D502 to charge the other half of the battery.

Comments

It would take many more pages to fully explore and expound upon the virtues and

the features of the GR-78, and for that reason several portions of the circuitry were left undescribed. It should suffice to say that with simple adherence to the manual, calibration per the manual and operation with a fairly decent antenna, this receiver will surpass many if not all of the receivers available today in its price class and probably a few of the higher priced models.

I would say that the receiver is not a kit to be wired by a novice, who has not yet wet his "teeth" so to speak on other kits, but, the GR-78 has returned countless hours of operating pleasure for those few enjoyable hours of construction. Like my musician buddies might say... "The GR-78, Man, it's a gas!"

... W9KXJ