CQ REVIEWS:

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THE TEN-TEC CORSAIR TRANSCEIVER

The Corsair sports some brand-new Ten-Tec equipment styling.

Have the boys at Tennessee Technology come up with another winner in their new Corsair transceiver? Well, only time will tell. However, they certainly have come up with a very interesting transceiver.

To start with, the Corsair has a bright, new styling as compared to some former Ten-Tec products. It is not that the basic color scheme used has changed much, but the dark-out plexiglass panel over the meter and digital frequency display, the placement and grouping of the controls and switches, the changed trim scheme, etc., all indicate that Ten-Tec took a hard look at the packaging of their new top-of-the-line transceiver. The result is a very "smartly" designed unit that really can only be appreciated by seeing it. It is also an amazingly light-weight and compact unit (14 lbs. in a 15" × 14" × 5" package).

General Characteristics

The Corsair is a 100 watt output class transceiver designed for c.w., s.s.b., RTTY, and SSTV operation on all existing and proposed amateur bands. Detailed specifications for the unit are shown in Table I. As one glances through the specifications, one will note quite a few interesting features, some of which will be covered in more detail later. For instance, on receive the r.f. preamplifier can be switched in or out, there is 2.4 kHz 12-pole crystal-ladder s.s.b. filtering, various optional s.s.b. and c.w. filters, passband tuning, selectable a.g.c., 6-digit frequency readout, notch filter, noise blanker with adjustable threshold, RIT, and a good dynamic-range specification.

On transmit, 85–100 watts of output power are available, full break-in operation is provided on c.w. with sidetone, the metering includes forward PEP power and s.w.r., and the power output can be varied over a wide range. Speech processing is not mentioned, but it is included. The 100% duty-cycle specification is quite interesting in that it is achieved without the use of any cooling fan! The controls, indicators, and connections available cover just about any imaginable operating requirement.

Circuit

The basic block diagram of the Corsair is shown in fig. 1. Basically it is a single conversion circuit using a 9 MHz i.f., but with an additional down/up frequency conversion to 6.3 MHz to provide a passband tuning feature.

The PTO feeds a variable 5.0 to 5.5 MHz signal into the "Osc./Mixer" board where that signal is mixed with the output of a crystal oscillator so the signal going into the "RF Mixer" board is correct to work with a 9 MHz i.f. For instance, for operation on 40 meters, 7.0–7.5 MHz, the PTO output frequency is translated to 16.0–16.5 MHz in the "Osc./Mixer" block. In this manner, full 500 kHz coverage is obtained on the 1.8, 3.5, 7.0, 10.0, 14.0, 18.0, 21.0, 24.5, and 28.0 to 30.0 MHz bands (the latter in four 500 kHz ranges). Crystals are included for the 10.0, 18.0, and 24.5 MHz bands, and the Corsair is ready to go on those bands. A few bonus features are that the PTO range actually has about a 30–40 kHz overrun on band edges so many MARS fre-

Although the Corsair has new styling, it fits in nicely with other Ten-Tec equipment in this station setup. (The Hercules solid-state linear is below it and the Model 229 tuner is to the right.)

*c/o CQ Magazine

quencies are covered, the 1.8 MHz band extends to 2.3 MHz to cover part of the Marine band, and the 10 MHz band includes, of course, WWV.

In the receive mode, incoming signals are routed through the lowpass filter assembly required for the PA stage (a five-pole filter on each band), via a PIN diode circuit for input signal switching to the bandpass filter board and then to a 2N3866 r.f. amplifier stage. This stage is shown in more detail in fig. 2. It is interesting in that it is completely broadband with no tuning required. In fact, the only "tuning" associated with the Corsair is the main tuning. After amplification, the signal is routed to a double-balanced diode quad mixer on the same board for translation to the 9 MHz i.f. The board also contains a low-noise i.f. preamplifier. The following noise-blanker stage is inserted in the i.f. path ahead of any high-selectivity crystal filter stages. The noise-blanker stage splits the incoming signal into two paths, one for gating and one for noise detection. Detection of fast-rise spike-type noise pulses causes the gating circuitry essentially to instantaneously interrupt the i.f. signal flow. The initial selectivity is provided by a standard 4-pole 2.4 kHz s.s.b. filter. If desired, this filter can be replaced by an optional 8-pole crystal filter.

The signal is next routed to a passband tuning board as shown in fig. 3. The feature is neatly executed. Q3 is the local oscillator, and its nominal 15.3 MHz crystal-controlled frequency can be shifted plus or minus a few kHz by controlling D17, an MV209 varactor diode. The incoming 9 MHz signal is translated to 6.3 MHz, goes through one of the crystal filter blocks (labeled 2.4, 1.8, .5, and .25), and then is retranslated to 9 MHz in the output stage Q2. By varying the frequency of the 15.3 MHz osciliator, the passband of the crystal filter on the board is moved across that of the preceding 2.4 kHz filter. The standard 2.4 kHz s.s.b.

General

Frequency Coverage: 1.8–2.3, 3.5–4.0, 7.0–7.5, 10.0–10.5, 14.0–14.5, 18.0–18.5, 21.0–21.5, 24.0–24.5, 28.0–30.0 MHz transceive. (V.F.O. provides approximately 40 kHz overrun on each band edge.)
V.F.O. Stability: Less than 15 Hz change per F° averaged over a 40° change from 70° to 110° F after 30 minutes of warmup. Less than 10 Hz change from 105 to 125 v.a.c. line voltage when using a Ten-Tec power supply.
Tuning Rate: Vernier, 18 kHz per revolution, typical.
Readout: 6 digit, 0.3" LED numerals.
Accuracy: ±100 Hz.
Semi-Conductors: 1 LSI, 20 IC's, 94 transistors, 107 diodes, 6 LED readouts.
PC Boards: 22 PC assemblies with plug-in cables.
Construction: Rigid aluminum chassis. Dark painted aluminum front and rear panels, textured top and bottom. Snap-up, steel bail.
Power Required: 12–14 v.d.c., 850 mA receive, 18.5 A max transmit.
Dimensions: HWD 5¼" × 15" × 14" (13 × 38 × 36 cm), bail retracted.
Net Weight: 14 lbs. (6.4 kg).

Receiver

Sensitivity: 0.25 μV for 10 dB S + N/N, all bands. 0.8 μV typical with r.f. amplifier off.
Selectivity: 12-pole crystal ladder filtering. 2.4 kHz bandwidth, 1.7 to 1 shape factor at 6/60 dB. Three-position switch selects standard s.s.b. filter, optional 1.8 kHz s.s.b. filter, 500 Hz c.w. filter, or 250 Hz c.w. filter.
Notch Filter: Greater than 50 dB notch tunable between 200 Hz and 3.5 kHz.
C.W. Spot: With 750 Hz reference tone.
I.F. Frequencies: 9 MHz and 6.3 MHz.
Antenna Input: Low impedance, unbalanced.
Audio Output: 1 watt @ 8 ohms with less than 2% distortion. Built-in speaker.
Spurious Responses: All below equivalent 10 dB S + N/N signal except 1.838 MHz (less than 15 dB S + N/N), 21.300 MHz (less than 20 dB S – N/N), and 28.980 MHz (which can be eliminated by using low end of 29.0–29.5 MHz band segment).
Noise Blanker: Built-in, adjustable blanking threshold.
I.F. Rejection: Greater than 60 dB.
S-Meter: Automatically switched on when receiving. Calibrated to 50 μV at S9, ±3 dB.
Dynamic Range: 90 dB, typical.
Offset Tuning: Dual range, max. ±4 kHz; min. ±500 Hz, typical.

Transmitter

D.C. Power Input: Maximum 200 watts @ 14 v.d.c. c.w. and s.s.b. 100% duty cycle for up to 20 minutes.
R.F. Power Output: 85–100 watts, typical.
Output Impedance: 50 ohms, unbalanced.
Microphone Input: High impedance. Accepts high- or low-impedance microphones with 5 mV output. Polarizing voltage available for electrets.
T/R Switching: VOX or PTT on s.s.b. Instant break-in or semi-break-in on c.w.
C.W. Sidetone: Internally generated. Adjustable tone and volume independent of a.f. gain control. Operates only in c.w. mode.
S.S.B. Generation: 9 MHz, 4-pole crystal ladder filter. Balanced modulator.
Carrier Suppression: 60 dB typical.
Unwanted Sideband Suppression: 45 dB typical at 1.5 kHz tone.
Spurious Output: Better than –45 dB relative to full output.
Meter: Forward power, collector current, s.w.r., processing level. Selectible 4-position switch.
C.W. Offset: 750 Hz, automatic.
A.L.C. Control: Front-panel adjustable. 30 to 100 watts output, LED indicator.

Front-Panel Connections and Controls

PBT; OFFSET; AF-RF AMP; RF-POWER; NOTCH; DRIVE; Bandswitch; Main Tuning Knob; MODE; METER switch; VOX GAIN; VOX DELAY; PROCESS level; N.B. LEVEL; ALC threshold; QSK/VOX switch; AGC switch; XTAL switch; OFFSET SELECT switches (2); SPOT push-button; PHONES; MIC.

Rear-Panel Connections and Controls

EXT. T/R jack; AUDIO IN jack, AUDIO OUT jack; AUX. 12 VDC jacks (2); KEY jack; PTT jack; VFO IN jack; VFO OUT jack; ACCESSORIES socket; LINEAR socket; GND terminal; EXT. SPKR. jack; POWER socket; 50 OHM ANTENNA connector (SO-239); RX ANTENNA jack; RX-TRX switch.

Table I– Corsair specifications.

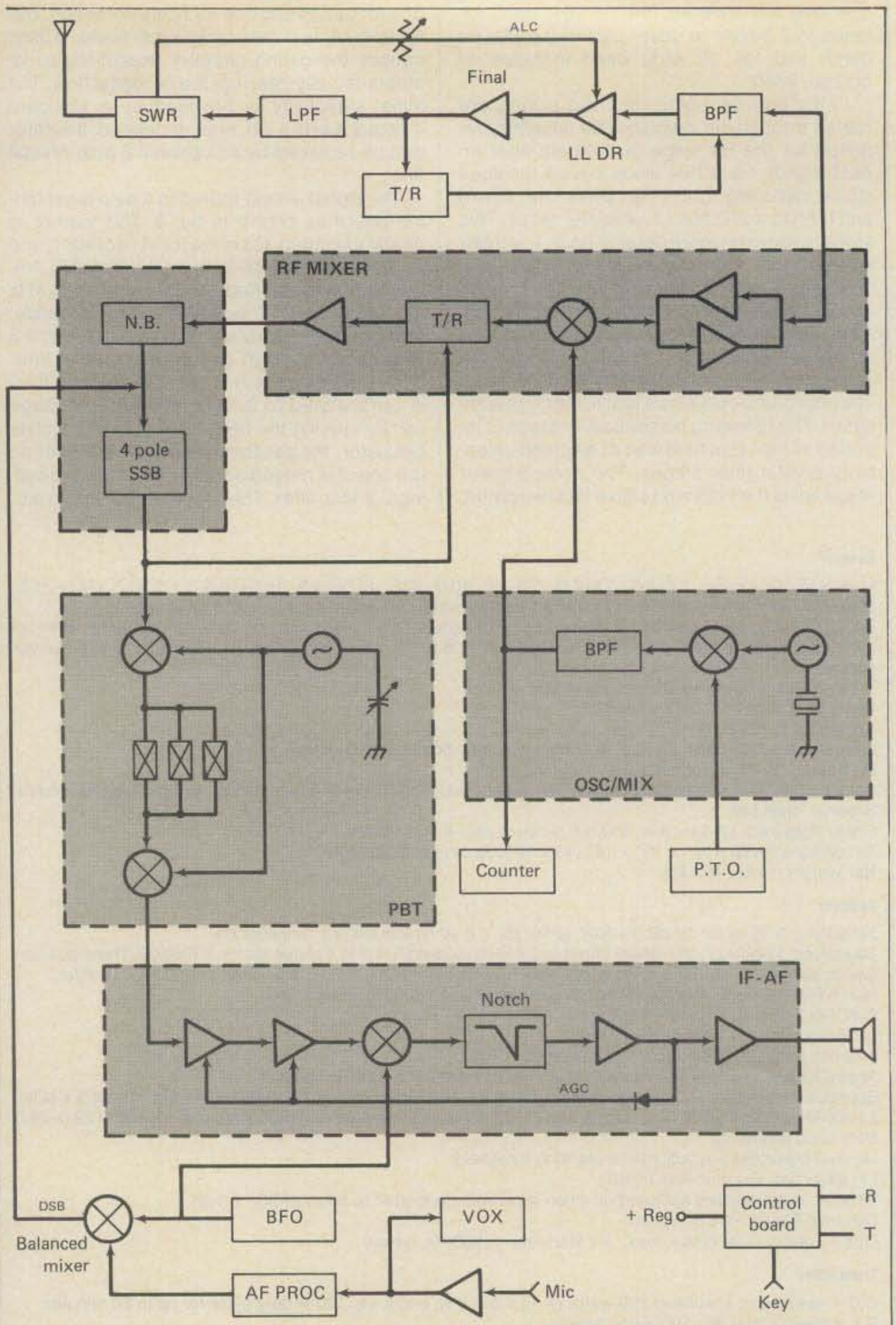


Fig. 1– Corsair block diagram

filter on the passband tuning board has 8 poles, and since it operates in series with the preceding, standard 4-pole filter, the overall result is 12 poles of i.f. filtering. The optional filters which can be placed on the passband tuning board are all diode switched and are preceded by resistor attenuator pads for overall gain equalization when switching between filters. (The .25 kHz filter does not have a pad, since its loss would be the highest that the others have to be equalized to match.)

After the passband tuning stage, the received signal goes through some i.f. amplifier stages and on to a dual-gate MOSFET product detector stage. The demodulated signal is then routed through a notch filter. The notch filter is tunable from 200 to 3500 Hz with a 50–60 dB notch depth. This is a particularly wide range for such a circuit, and details of it are shown in fig. 4. Final audio amplification is via a LM383 IC to produce about 1 watt output with less than 2% distortion to a built-in speaker. A.g.c., which is of the time delay or "hang" type, is audio derived, so it follows the setting of the audio notch control. The same board, fig. 4, also contains the sidetone oscillator with adjustable pitch and volume and a spotting oscillator. The latter is set at 750 kHz, the same as the i.f. offset on c.w., and can be activated by a front-panel pushbutton. Its tone can be beat against that of a desired c.w. signal for exact zero beat.

In the transmit mode, one can visualize the circuitry as working partially backwards. The microphone signal is amplified and then proceeds to the VOX and a.f. speech processor circuitry as shown in fig. 5. The a.f. processor is interesting in that it consists of a peak clipper and compressor. D11 and D12 perform the clipping function, while transistor Q3 is the shunt element for compression. The processing level can be set by a front-panel control.

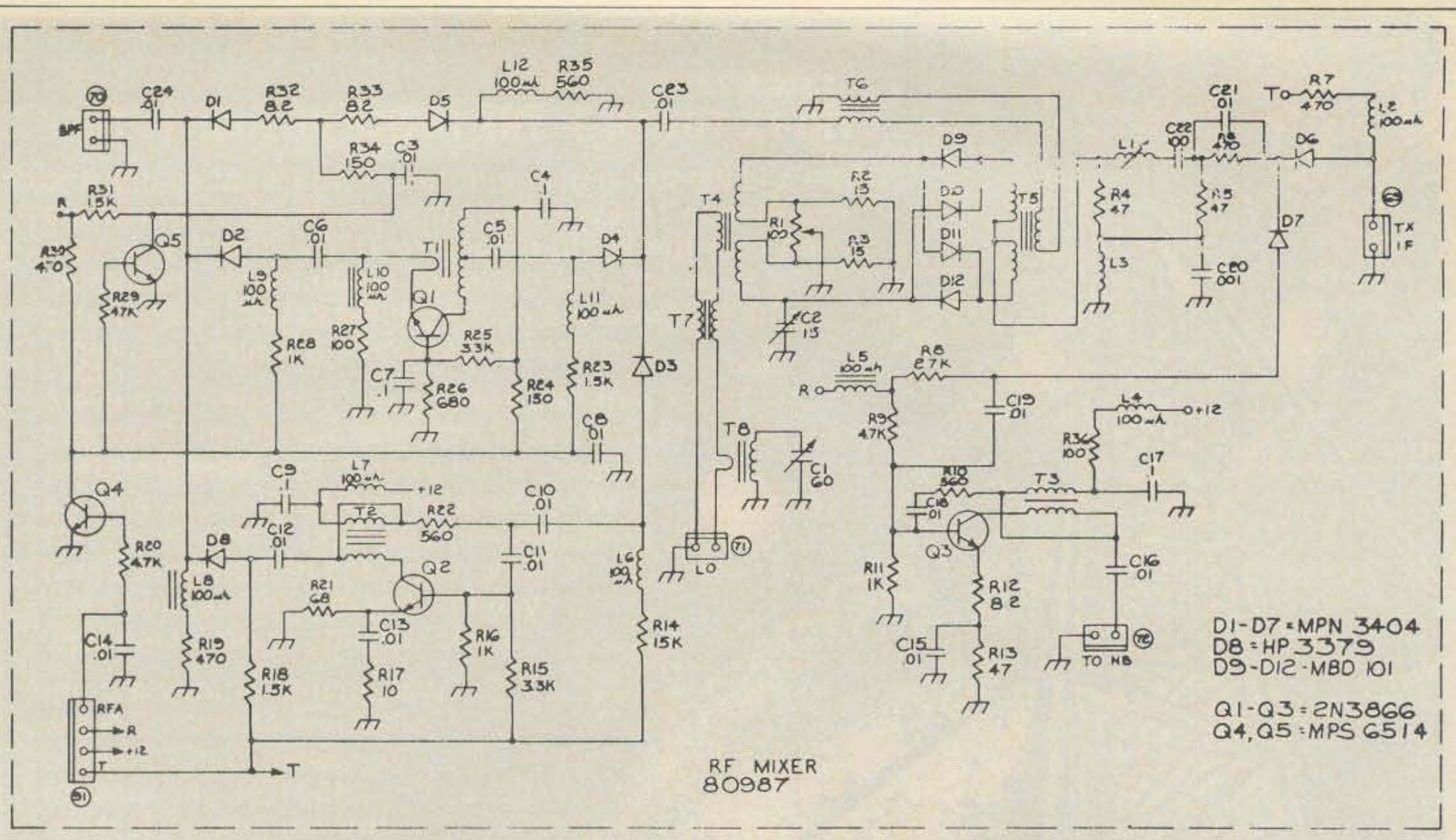


Fig. 2– The first active device in the "front-end" of the Corsair is the r.f. amplifier stage Q2, which is a broadband amplifier. After this stage the received signal goes through a double-balanced mixer and "exits" via Q3, another low-noise amplifier. Diode switching provides for using circuitry on the r.f. mixer board for the receive and transmit signal paths.

Fig. 5 also shows the VOX circuitry, which has front-panel controls for gain and delay.

After the circuitry of fig. 5, the a.f. signal is fed to a balanced modulator and a d.s.b. signal is generated. The d.s.b. signal goes through the standard 2.4 kHz s.s.b. filter and on to the "RF Mixer" block, where it is translated to the final output frequency. The signal is then amplified in various stages until it reaches a pair of MRF-458 transistors which operate in a push-pull arrangement at 200 watts d.c. input on all bands. The PA stage is completely broadband and followed by a lowpass filter assembly and an s.w.r. detection block. The front-panel meter automatically switches between being an "S" meter on receive and a multi-function meter on transmit. The s.w.r. reading function is unique in that there is none of the usual forward "set" adjustment necessary. Also, the forward power meter reading is of the peak-reading type, so it indicates PEP.

The s.w.r. bridge circuitry also supplies an a.l.c. feedback voltage and a control voltage which is used to drive an "ALC" LED which indicates relative output power.

Circuitry that is common to both the receive and transmit functions includes the frequency readout and control circuitry. The frequency readout circuitry basically revolves around an LSI IC, the MOSTEK type MK50398N. It accomplishes all of the counting, latching, multiplexing, output decoding, and driving functions on a single chip. The counter basically reads the "Osc./Mix" board output frequency, but it is fed preset information to convert its output to the actual transmitted or received frequency. It also follows and indicates any frequency offset set by the "Offset" (RIT) control in the receive mode. The actual readout is on large 0.3 inch LED displays with the six-digit display having five red readouts and one green readout for hundreds of Hertz. The control circuitry basically encompasses various transistor switches for controlling voltages that switch the transistor between the receive and transmit modes. Among other things, it provides for a slow/fast break-in feature on c.w.

Construction

The foregoing, frankly, may sound like a pretty bland description of any conventional, single-conversion 9 MHz transceiver. However, it was meant just to set the groundwork so one can visualize the basic makeup of the Corsair. So, what makes the Corsair different? In one sentence it could be expressed as "innovative and honest execution of a basically proven transceiver design concept using ex-

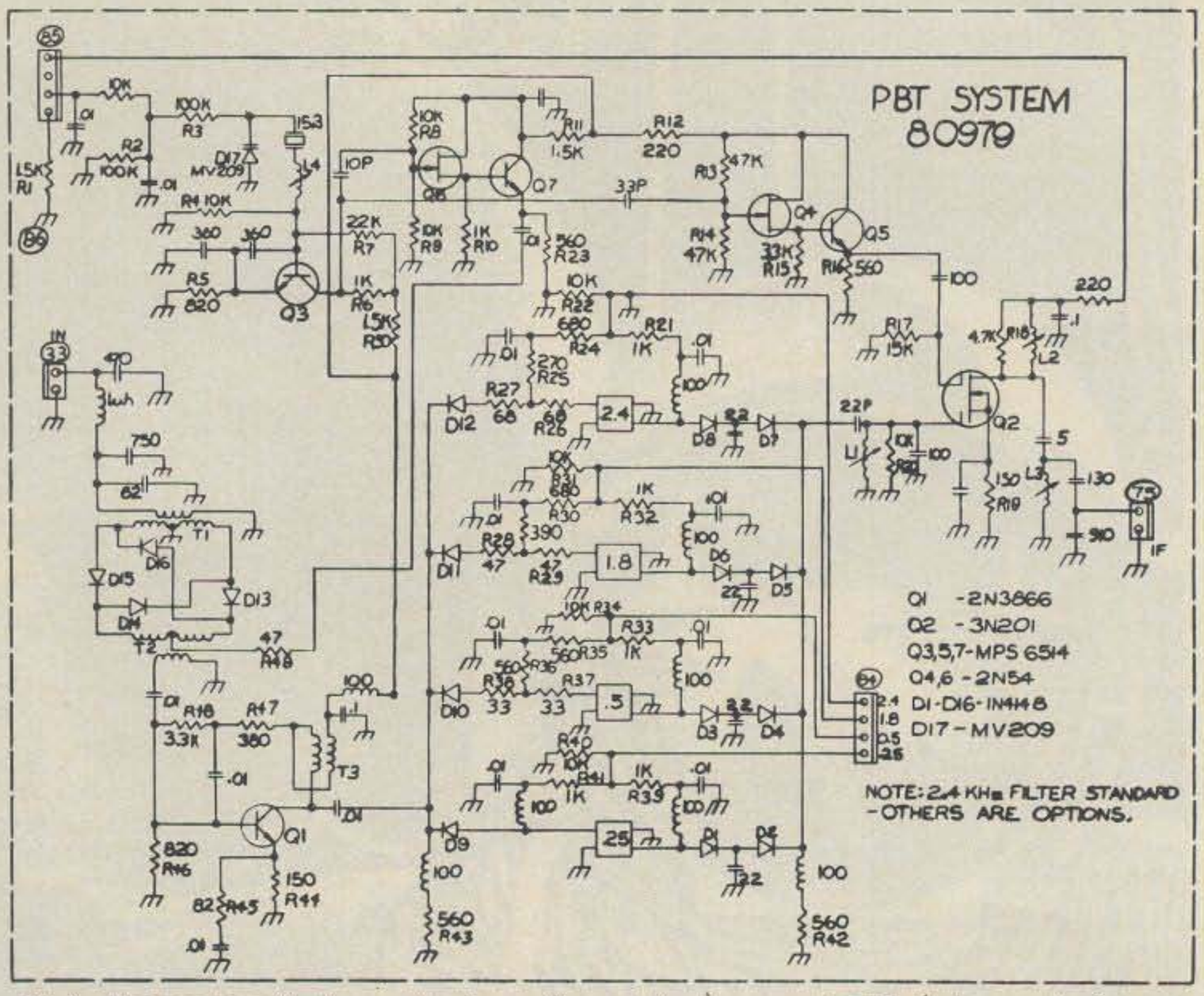


Fig. 3– The passband tuning system is neatly contained on one circuit board, except, of course, for the front-panel potentiometer which controls varactor diode D17 and the switches used to select different filters.

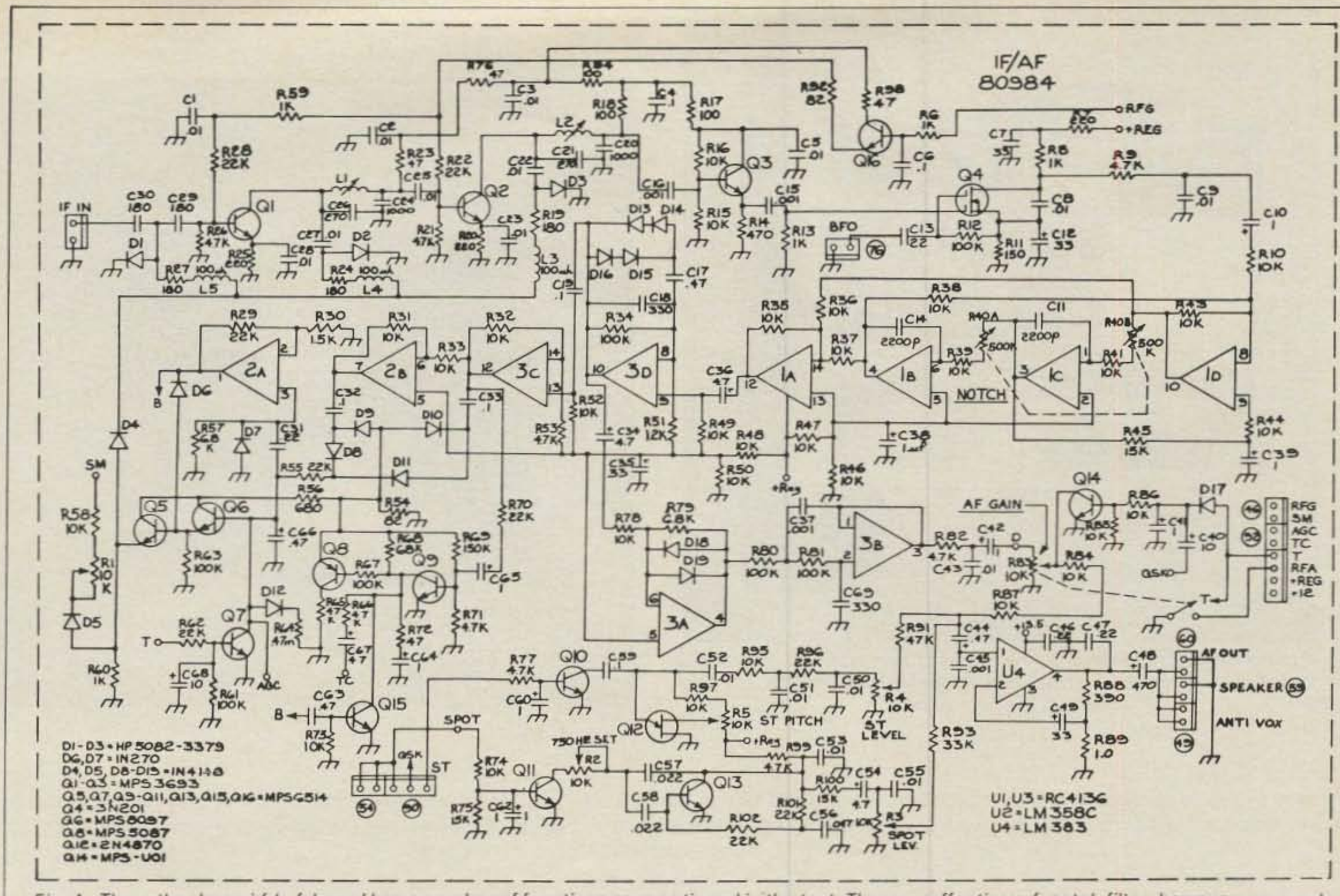


Fig. 4– The rather large i.f./a.f. board has a number of functions as men tioned in the text. The very effective a.f. notch filter, however, uses only one IC. It consists of the circuitry associated with U1A, 1B, 1C, and 1D.

cellent quality, conservatively rated components." There are not a lot of "bells and whistles" as found on some transceivers (although every needed feature is present). Overall, one receives the impression that the Corsair was designed by dedicated radio amateurs who actually use the equipment themselves.

Two photographs show the Corsair with its top and bottom covers removed. As one can see, Ten-Tec has taken the design approach of splitting the circuitry among a fairly large number of PC boards. In fact, there are some 22 PC boards. This type of approach requires a good amount of interconnection wiring, but it keeps various signal circuits isolated, and one does not have the problem of spikes and spurious signals running around a very large PC board. It is probably one reason why the Corsair has such a clean-sounding signal both in the receive and transmit modes.

One can see from the photographs that the PC boards are very neatly arranged, and a lot of care has been given to shielding of individual sections. For instance, the receive r.f. amplifier assembly is shown in the center of the photograph with the bottom cover removed, the shielded PTO assembly is below it, the output low-pass filters are to the left back in their enclosure, the r.f. power stages are in a completely shielded enclosure with heat sink mounted on the rear panel of the transceiver, etc. One can also see from the photograph of the top the space which is provided on the top-right PC board for the installation of the optional 1.8 kHz s.s.b. filter and the 500 Hz or 250 Hz c.w. filters. The bandswitching assembly (photograph of the bottom) looks rather imposing with all its sections, but it works quite smoothly. In fact, it feels like a single wafer switch when one actually uses it. Everything is switched directly by the bandswitch. There are no diode switching schemes used as far as the main r.f. circuits are concerned. The only significant diode r.f. switching that is done is in the circuitry which selects the optional s.s.b. or c.w. filters.

Measurements

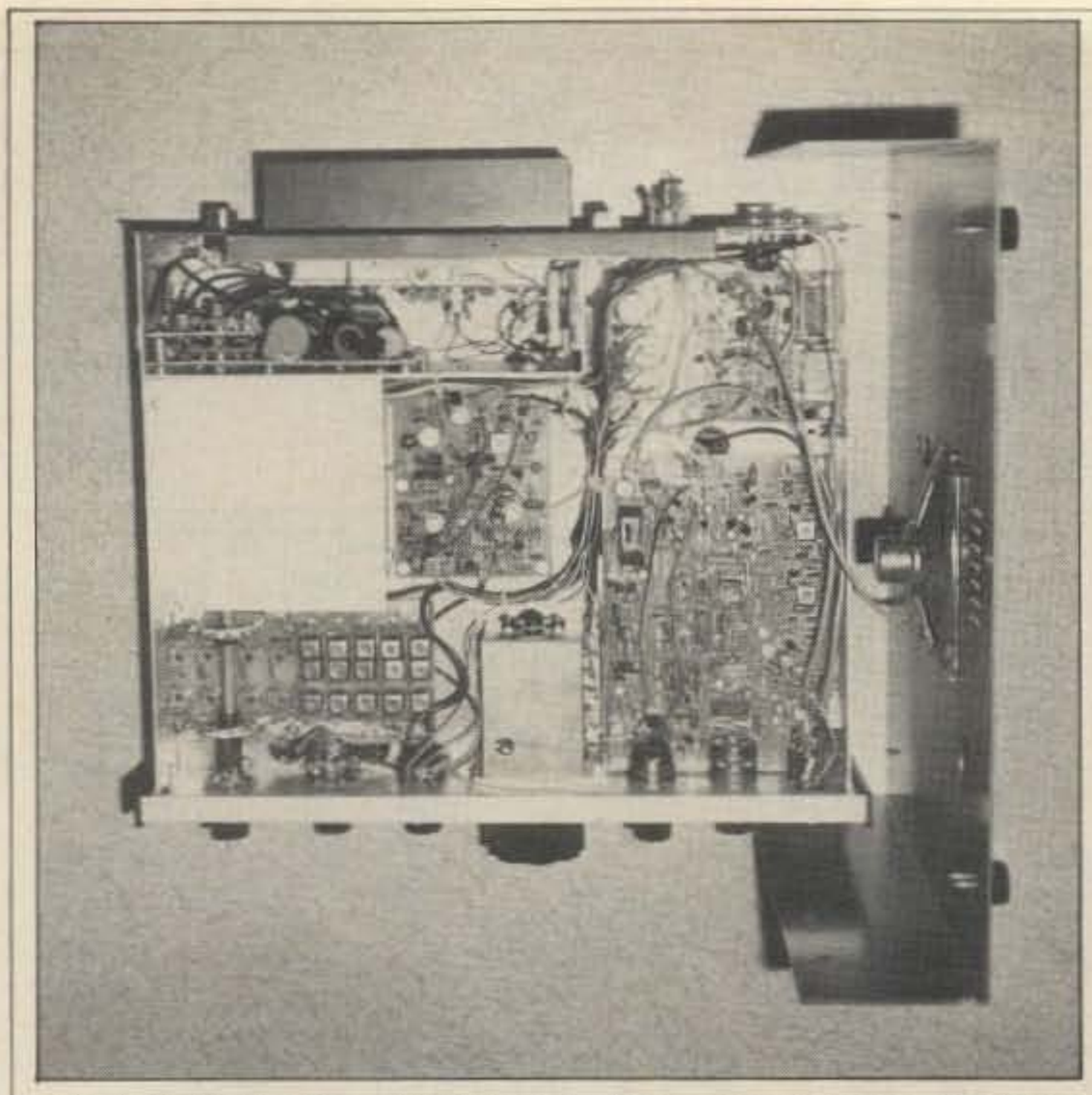
The "specs" measured on the Corsair are tabulated in Table I. It doesn't take too much perusal to see that it easily meets its advertised claims. The power output varies over an extremely narrow range from 98 to 99 watts as one goes from 10 down to 160 meters. It's interesting to note once again that although the Corsair PA has the usual thermal and other protective circuitry, it doesn't have an internal fan and it doesn't need one for extended s.s.b. or c.w. operation. Full power is available on RTTY and SSTV for 20 minutes key down, although Ten-Tec does recommend an external fan if these modes are to be used continuously. The third-order IMD products remain at a respectable −32 dB or better at full power output. Sideband rejection and carrier suppresion measured a respectable −43 to −54 dB. The c.w. keying waveshape is excellently "tailored" with 3 ms rise and fall times.

On the receive side, the s.s.b. sensitivity varies from about 0.15 μV on 10 meters to 0.3 μV on 160 meters for a 10 dB StN/N ratio with the r.f. amplifier in the circuit. The dynamic range measured out at a good 90 dB on 40 meters (s.s.b. bandwidth). The third-order intercept point measured a very good + 7 dBM, increasing almost 10 dB with r.f. amplifier switched out. Slight receive "birdies" were found at 6,999 and 18,165 kHz plus an S9 + one at 28,980 kHz. The latter is clearly recognized by Ten-Tec in the Corsair manual. In reality, it is not significant, since if one had to use that frequency, the transceiver could be set on 29.0–29.5 MHz and then the overrun tuning could be used below 29.0 MHz. In that case, the "birdie" completely disappears.

Operation

Operating the Corsair is easy, and, of course, that is where all the fun comes in as one appreciates the way the Corsair features and controls are arranged. The main tuning knob covers about 18–20 kHz per revolution. The "feel" is light and easy and probably will be most appreciated by the contest operator who operates long periods at a time. I would prefer to see a deeper finger well on the knob or a raised finger spinner, but that is strictly a personal preference. The digital readout is absolutely flicker-free and extremely pleasant compared to some of the miniature readouts found in other equipment.

The "S" meter is an honest one. It requires 45μV on 20 meters to get it to read S9. As one tunes through the bands, signals seem to come out of an almost quiet noise background. This sort of feature is hard to characterize even by noise base and other measurements. One finds it in very few pieces of equipment, and it really contributes to fatigue-free operating for the type of operator who doesn't mind spending hours searching for a select DX station. The Corsair performed remarkably well on the low end of 40 meters in the European area, where at least 50% of the "front-ends" of most transceivers completely



A look inside the Corsair with the bottom cover removed. The band-switch is on the left and can be seen extending from the front panel to almost the back panel.

A look inside with the top cover removed. All the crystal banks to the middle left are the optional s.s.b./c.w. filters.

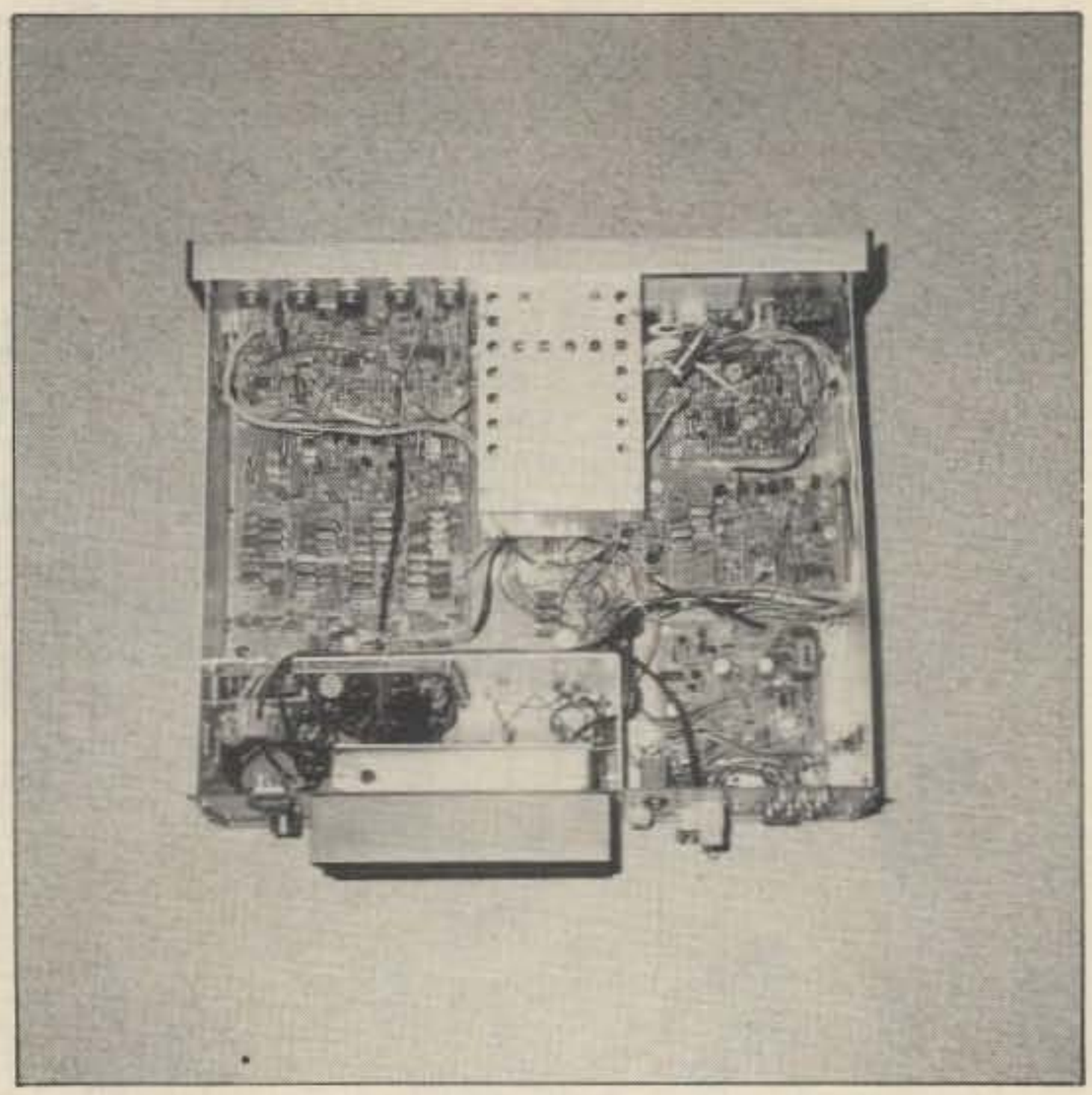
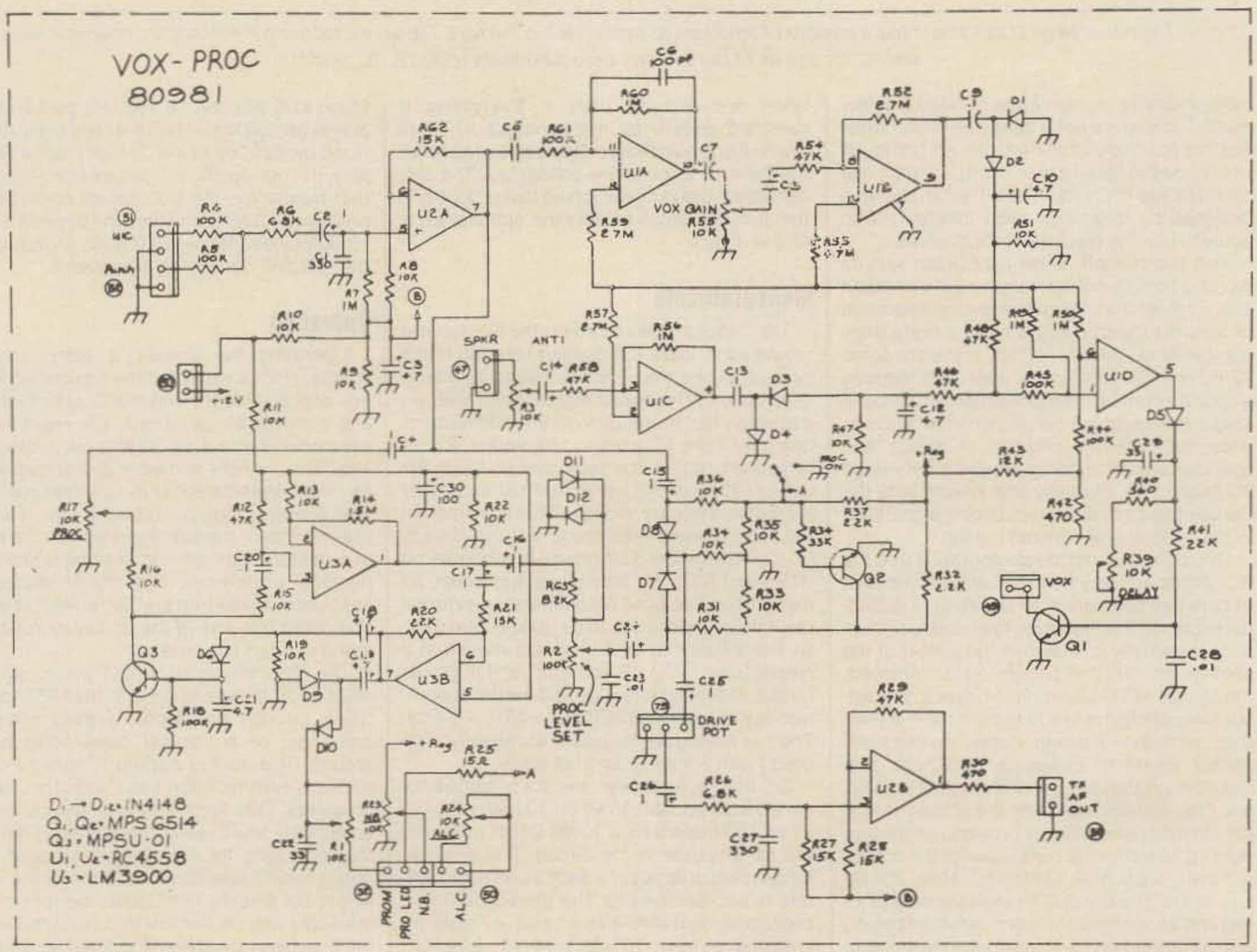


Fig. 5– Ten-Tec has come up with some interesting circuitry for the standard a.f.-type speech processor in the Corsair. The circuitry mainly centers around U3A, U3B, Q3, and diodes D11 and D12. The diodes perform a clipping function while Q3 performs a shunting function for speech compression.



fall apart in the face of broadcast QRM. The "hang" a.g.c. system is very effective, with an apparent discharge time of about 1 second on s.s.b.

The optional crystal filters, the standard notch filter, and bandpass tuning provide for about any reception problem one will encounter. The selection of optional filters is handily done by a separate toggle switch, with the selectivity increasing as one goes from the 3-2-1 switch sequence. It is handier to use than arrangements which couple filter selection with a mode selector switch. The fact that the offset tuning (RIT) provides for selectable shifts of either ±500 Hz or ±4 kHz makes this type of control ideally tailored for c.w. or s.s.b. operation. Both the optional s.s.b. and c.w. filters are highly recommended, but the optional 1.8 kHz s.s.b. filter deserves special mention for s.s.b. operators. It really has sharp skirts down to the −100 dB point. The use of the filter can easily make the difference between a solid QSO and a so-so QSO on s.s.b. especially during weekend QRM conditions.

The a.f. gain control has a pull-switch feature to insert or remove the r.f. amplifier from the receive r.f. line. With a beam and under extremely strong signal conditions, one might find a use for it. Normally, it probably will never be used. The noise blanker was not given a really thorough check, although it seemed to function extremely well by occasional automobile QRN at the test QTH. It seemed to help the situation somewhat when the Russian "woodpecker" would scan through one of the h.f. bands, the adjustable threshold control being very useful to tailor its response.

On the transmit side, one should first mention the easy tune-up procedure incorporated in the Corsair. On transmit, the panel meter can be set to automatically function as an s.w.r. meter and, as mentioned, there is no "set" control! The meter reads s.w.r. directly without any adjustment. To tune-up, one places the **Mode** switch in the **lock** position and advances the **Drive** control for increasing power output as one perhaps adjusts an antenna tuner for minimum s.w.r. reading on the panel meter. That's all there is to it.

When operating s.s.b., the mode switch is returned to a sideband position (normal or reverse) and the drive control readjusted so the **ALC LED** just lights on voice peaks. On c.w., no further readjustment of the drive control is required, but one can choose between fast and slow break-in operation by means of the panel switch marked **QSK/Fast** or **QSK/Slow.** Instant break-in is provided in the **QSK/Fast** position. That is, if one is transmitting a word such as TEST at 20 w.p.m., one can easily hear a break-in between sending individual letters. If one has the switch set in the **QSK/Slow** position, break-in's can be heard between the pause between words. In any case, c.w. operation is pure pleasure. Sidetone volume and pitch are easily adjusted by thumb-wheel controls accessed via an opening in the bottom cover. On s.s.b., consistent reports were received of good, clear modulation (a Ten-Tec electret-type microphone was used). In fact, several stations rated the audio as "superb," commenting that it was "sharp" but with just enough bass to make it pleasant to copy.

Many tests were made to evaluate the effectiveness of the Corsair's speech processor. The average result was that the Corsair's processor could increase the apparent received signal strength by 5–6 dB (about one honest "S" unit) without any noticeable audio distortion. That is rather remarkable performance for a purely a.f. type of speech processor. In fact, most stations who were asked preferred the audio with the processor in use! However, as is the case with almost any type processor, one must avoid the temptation to overdo the processing. The Corsair incorporates a very handy a.l.c. LED peak indicator. If one adjusts the processor so the a.l.c. LED just lights on voice peaks, effective speech processing will be assured.

Band	Sensitivity (μV)	Power Out (watts)	Harmonics (−dB)
160	.3	98	55
80	.3	99	45
40	.3	98	45
30	.24	98	50
20	.14	98	50
18	.14	99	55
15	.15	99	55
12	.15	99	55
10A	.14	99	52
10B	.14	98	60

S.S.B. sideband rejection at 1 kHz: −45 dB
Carrier Suppression: −54 dB
I.F. Rejection: −80 dB average
Dynamic Range (40 M): 90 dB
Third-Order Intercept: +7 dBm
Third-Order IMD: −30 dB or better
C.W. Waveshape Rise/Fall Times: 3 mS

Table II– Corsair test measurement summary.

Accessories

Besides the optional i.f. filters, the main accessories available for the Corsair are the Model 260 Power Supply and the Model 263 Remote V.F.O.

The power supply is designed to deliver a regulated 13.5 volts at 18 amperes nominal or 20 amperes maximum. The circuitry consists of a bridge rectifier, 26,000 mF of filtering, and two paralleled 2N5301 pass transistors. The pass transistors are controlled by an IC regulator and driver transistor. Regulation is better than 1% from no load to full load. An SCR "Crow-bar" circuit is incorporated which shorts the output if it should go over 16 volts. Another SCR is used in a latching circuit which turns off the circuitry when the output current drawn exceeds a preset value of 20 amperes. The latter circuitry really operates quickly if one should try to tune up too quickly such that the s.w.r. to the Corsair is great enough to exceed 20 amperes being drawn from the supply. It will trip out almost instantly. It offers excellent protection for the finals in the Corsair and quickly disciplines one to tune up properly. Resetting the circuit is easily done by rocking the front panel power switch back and forth. The power supply also contains an 8 ohm ceramic magnet speaker. There is only one main output line, but extra rear-panel connectors are provided, so one also has available two regulated 12 v.d.c. outputs for small accessory items.

The 263 remote v.f.o. covers all the same frequency ranges as the Corsair. It consists essentially of the same PTO subassembly as used in the Corsair, plus switching circuits, a crystal oscillator, and additional buffer/amplifier stages. Four crystal positions are provided which one can use in any desired combination within or among the amateur h.f. bands. If one does use crystal-controlled operation, the out-of-band limits that can be achieved are somewhat greater than when v.f.o. control is used. For instance, one can go up to 4.10 MHz on 80 meters and down to 6.9 MHz on 40 me-

The rear panel is clean and functional. There is no cooling fan, and none is needed for normal c.w./s.s.b. operation. Even after extended operating periods, the heatsink never got more than slightly warm to the touch.

ters. This may be an advantage for some specialized uses such as MARS operation. Otherwise, the operation of the 263 is basically the same as any second v.f.o., except that Ten-Tec has incorporated a few extra switching possibilities.

As a second v.f.o., the 263 can be used as just a temporary memory for a frequency of interest, as an actual operating v.f.o. for split-frequency operation, or as the main control v.f.o. for the Corsair. The mode selector switch allows the Corsair v.f.o. to control transmit/receive frequencies, the remote v.f.o. to control both frequencies, or the frequencies to be split between the v.f.o.'s. A "reverse" pushbutton temporarily exchanges the v.f.o.'s when they are set for split operation so one can quickly check that one is not accidentally set up to transmit on top of an out-of-band DX station. The mode switching also provides for both v.f.o.'s to be used on receive so one can zero beat them if desired.

All in all, the 263 proved to be just as stable as the basic Corsair v.f.o. and a very convenient operating accessory. Full break-in operation is maintained using it. As regards the optional i.f. filters, the usefulness of the 1.8 kHz filter for s.s.b. operation was already mentioned. However, I forgot to mention the optional 8-pole s.s.b. filter (Model 220), which can be used to replace the first, standard 4-pole filter in the i.f. chain. If one's pocketbook does not allow for too much leeway, the Model 220 filter probably should be considered as a primary purchase, since it works in conjunction with the passband tuning, and its use will improve both c.w. and s.s.b. selectivity until such time as one might consider an investment in specific optional s.s.b./c.w. filters.

Finally, a word about Ten-Tec's manuals and customer service. The manuals are not on glossy paper stock, but they do an excellent job. For instance, the Corsair manual writer rightly anticipated that most new owners would not first want a dissertation on transceiver theory, but rather would want to get their gear into operation. Therefore, the manual starts out with some condensed operating instructions (just enough to get the unit properly and safely hooked up and operating). It then goes on to detailed operating instructions and finally to alignment and service. Detailed diagrams, theory of operation, and alignment instructions are provided for every PC board. Detailed voltage check-point charts are included, as well as a generous use of photographs to show parts location. The manual is labeled an "Owner's Manual," and it's nice to know Ten-Tec still thinks amateur equipment "owners" are deserving of having complete technical details on their equipment. The manuals for the accessory items are, of course, smaller, but they cover just as much respective detail.

All of the equipment comes with the necessary interconnecting cables, so if one purchases the Ten-Tec line, it all simply interconnects in a few minutes' time. However, each piece of equipment also comes with extra accessory plugs (except for the totally standard ones such as the ¼ inch headphone type), so one can make up any necessary interconnecting cable for use with equipment of another manufacturer.

The Customer Service Dept. at Ten-Tec simply has to be rated as superb, and I'm not one to give out such acclaim lightly. The Corsair received got banged around a bit during initial Parcel Post shipment to an oversea's, military APO address. The receive function didn't work properly upon receipt, and the unit was shipped back for repair. Ten-Tec replaced a defective crystal on the PBT board, and the Corsair was received and in operation again two weeks later. Considering that the routing was Tennessee to New York to Germany to New York to Tennessee over a holiday season and via a complicated U.S. Postal Service/U.S. Army Post Office system, it would appear that the crew at Ten-Tec must have serviced the transceiver almost instantly. The returned Corsair even included a check to cover my mailing costs in returning the unit to them.

All in all, it is obvious that the Corsair is the culmination of many years of transceiver design and operating experience by the radio amateurs at Ten-Tec. Any amateur who invests in the Corsair and perhaps some of the accessory items should be more than well-satisfied by his purchase for years to come. CQ