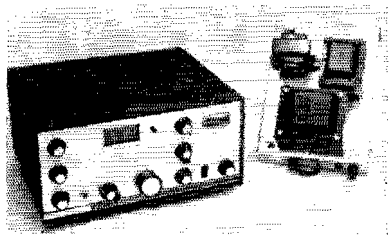
Recent Equipment

To acquaint you with the technical features of current amateur gear.

National 200 Transceiver



THIS latest product from National, in the competitive price class, covers the amateur bands from 10 to 80, inclusive in s.s.b., c.w., and a.m. modes. Nominal output ratings are 120 watts p.e.p. on s.s.b., 120 watts c.w., and 30 watts (carrier) on a.m. A pair of 6JB6 sweep tubes is used in the final amplifier.

Receiving Channel

The block diagram is shown in Fig. 1. The receiving channel (bottom portion of Fig. 1) is essentially an 8-tube single-conversion superhet with a 5.2-Mc. i.f. The line-up includes r.f. amplifier V_8, mixer V_9, crystal lattice filter, two stages of i.f. (V_{12} and V_{13}), detector V_{14A}, and audio (V_{14B} and V_{15}). A parallel-tuned trap in the cathode circuit of V_8 discourages 5-Mc. feed through. V_{14A} is switched to product detection for s.s.b. or c.w. operation, or to grid-leak detection for a.m. reception. The b.f.o. V_7 (which also serves as the carrier generator on transmit) is crystal-controlled.

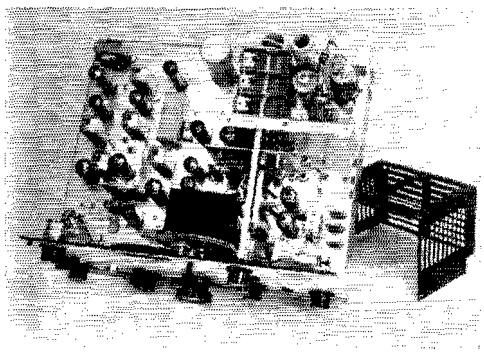
On 80 and 20, mixer local injection is the signal from V_{11}, the 8.7–9.3-Mc. v.f.o. (the only tunable element), amplified in V_{10B}. On the other bands (40, 15 and 10), the v.f.o. signal is combined in V_{10B} with a crystal-controlled signal from "band oscillator" V_{10A}, V_{10B} now operating as a "premixer," to yield the proper injection frequencies for these bands. The resulting ranges are 3.5 to 4.1 Mc., 7.6 to 7.0 Mc., 13.9 to 14.5 Mc., 21.6 to 21 Mc., and 28.5 to 29.1 Mc. Band-oscillator crystals for the ranges of 28.6 to 28 Mc. and 29.1 to 29.7 Mc. are not included, but are available as optional extras to be plugged in in place of the crystal furnished. (It is also necessary to unsolder a trimmer capacitor in the band-oscillator unit to operate in the 28.6-to-28-Mc. range.) The dial is calibrated for all ranges. It will be noticed that the particular heterodyne system used results in some bands tuning in a direction opposite to others.

All h.f. and i.f. circuits in the receiving channel are single-tuned, with capacitive coupling between stages.

The a.g.c. signal is taken from a capacitive divider across the output of V_{13}, rectified in a voltage-doubling rectifier, and applied to V_8, V_{12} and V_{13}. The manual r.f. gain control is also applied to these three stages. The a.g.c. system has fast-attack and slow-release characteristics.

The rectified a.g.c. signal is also applied to the grid of V_{6A}, which functions as an S-meter amplifier when receiving. The resulting variation in cathode voltage is used to drive the S meter. The screen voltage of V_{13} is used as the reference.

All oscillators are supplied with 150 volts, regulated by an 0A2.



Top chassis view. The v.f.o. is in the black box at bottom center. The assembly above and to the left contains the balanced modulator and transmitter i.f. amplifier (V_5). The carrier oscillator (V_7) is just below. The receiver audio output transformer is at the extreme upper left, and the rectangular gray box contains the crystal filter. To the right of the v.f.o. is the premixer with its band crystals. The final amplifier is in the upper righthand corner, normally covered by the black shield to the right of the chassis. The driver tube, V_3, is immediately in front of the amplifier compartment.

Transmitting Section

In this section, the carrier-oscillator signal from V_7 is combined with the microphone (high-impedance) audio signal from V_6 in a four-diode ring balanced modulator (1N542s), where the carrier is suppressed. The 5.2-Mc. d.s.b. output signal from the modulator is amplified in V_5, and fed to the crystal filter, which strips off one side band. The 5.2-Mc. s.s.b. output from the filter is amplified in V_{12}, and then fed to the transmitting mixer V_4. Here it is combined with the injection signal from V_{10B} to produce mixer output at the desired frequency. The signal from V_4 is fed to driver V_3, and thence to the final amplifier V_1V_2 (parallel neutralized AB_1 6JB6s)

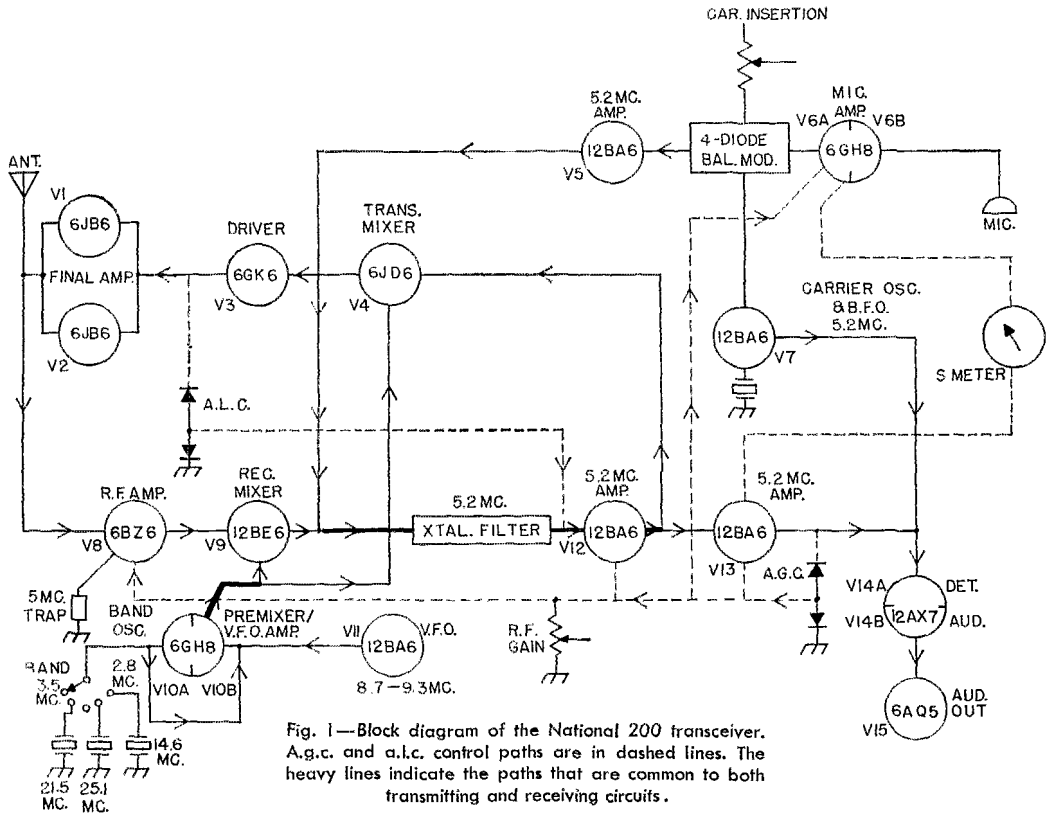


Fig. 1—Block diagram of the National 200 transceiver. A.g.c. and a.l.c. control paths are in dashed lines. The heavy lines indicate the paths that are common to both transmitting and receiving circuits.

with pi-network output. With the exception of the input and output circuits of V_5, all r.f. circuits in the transmitting channel are also single-tuned, and the stages are coupled capacitively. On transmit, the S meter is switched to read final-amplifier cathode current.

For the c.w. and a.m. modes, carrier is inserted by applying an adjustable d.c. voltage to unbalance the modulator.

The 200 is set up for l.s.b. on 80 and 40, and u.s.b. on the other bands, according to present customary usage. Sidebands are not changeable.

An a.l.c. circuit is included. The arrangement is more or less conventional in that it feeds any change in final-amplifier bias, as a result of overdrive into grid current, back to an exciter stage where it is applied as bias to reduce the gain of the stage. However, severe flat-topping resulted with the specified 10-mv. audio input signal as the microphone gain control was advanced toward maximum. A jack at the rear of the chassis permits connection of a linear amplifier into the a.l.c. line.

Control Switching

The change-over element is a 6-pole double-throw relay, actuated by either a push-to-talk switch at the microphone, or by a MOX switch on the panel. On receive, the relay performs the following operations:

1) Switches B voltage to V_8, V_9 and V_{13},
2) Removes protective bias from V_8, V_9 and V_{14},
3) Closes the cathode circuit of V_{14A},
4) Connects the meter for S-meter use,
5) Applies cut-off bias to V_3, V_4 and V_{6B} (except with the function switch in the c.w. position),
6) Removes screen voltage from V_1 and V_2,
7) Removes plate and screen voltage from V_5, and
8) Closes an external circuit (such as a linear-amplifier relay) connected to a pair of terminals at the rear of the chassis.

On transmit, the relay switches the meter to read final-amplifier cathode current, and grounds the a.g.c. bus to avoid accidental charging of this bus, in addition to the reverse (on or off as the case may be) switching of voltages mentioned above.

It will be noticed that there is no provision for switching the antenna. The grid of V_8 is coupled to the "hot" side of the transmitter pi network through a 22-pf. capacitor. Thus, the pi network serves as the tuned input circuit for the receiver r.f. amplifier. V_8 and other receiving tubes are protected on transmit, as described above.

On s.s.b., the function switch shifts V_{14A} to product operation, disconnects the key jack, increases the bias on V_5 to reduce gain, and disconnects the carrier-insertion control (available for adjustment at the rear of the chassis). On a.m., V_{14A} is shifted to grid-leak operation, the carrier-insertion control is switched in, the b.f.o. (V_7) is biased off, and the bias on V_5 is lowered for full gain. On c.w., the product detector and b.f.o. are in use, the key jack is connected, V_5 is

at full gain, the carrier-insertion control is operative, and the plate of V_{6B} is grounded to avoid accidental modulation. As mentioned earlier, with the function switch in the c.w. position, V_3 and V_4 are biased to cutoff. Operation of the key then removes this bias (grid-block keying). There is no provision for break-in operation, aside from that measure obtainable by a foot switch plugged into the p.t.t. microphone jack.

Performance

Specifications of particular interest are as follows:

Output: 120 watts p.e.p., s.s.b. and c.w.

Crystal filter: Bandwidth 2.8 kc. at 6 db. 6-50-db. shape factor 2.2 to 1.

Frequency stability: Nominal 1500 cycles in first 30 minutes after a 5-minute warm-up. Long-term stability 400 cycles for ordinary room ambient.

Suppression: Carrier −50 db., unwanted sideband − 40 db., third-order distortion products −30 db.

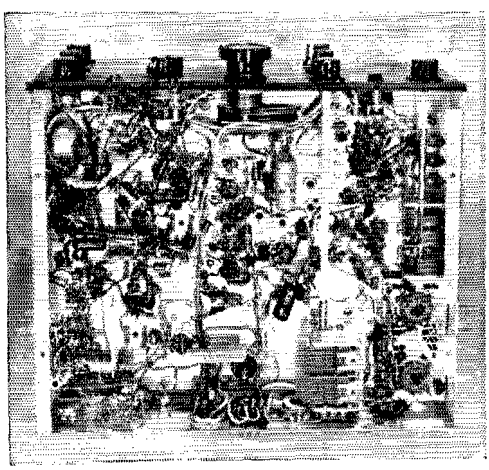
Receiver sensitivity: 0.5 μv. for 10 db. s/n (s.s.b.). Output impedance: 50–60 ohms.

These specifications were met or exceeded in laboratory tests made at A.R.R.L. on an off-the-shelf unit from a local dealer. It was noticed that third-order products could be reduced to well below the specification figure by careful adjustment of the driver tuning control, while maintaining essentially the same p.e.p. output. Second-harmonic output was down 45 db.

The range of load impedances into which the transmitter will work is limited, so the use of a transmatch is recommended for loads outside the range of 50 to 60 ohms. However, the instruction book contains information on simple modification of the pi network to accommodate reasonable departures from 50 ohms.

The v.h.f. shielding is not complete, but it will probably be found adequate for all but fringe TV areas.

Checks on i.f. feedthrough showed that the attenuation of a 5.2-Mc. signal was 50 to 70 db., depending on the band in use, after adjusting the 5.2-Mc. trap for maximum attenuation with the receiver tuned to the 20-meter band. However, the receiving channel appears to be quite susceptible to crossmodulation from nearby broadcast stations. The article by W1CER in this issue discusses this problem. At the test location, the stop-band filter described in the article proved to be a complete cure. However, if the filter is not to be switched out on transmit, the coils should be of heavier wire. Sections of Miniductor, Airdux, or Polycoil stock, cut to the same inductance values, should be suitable.



Components underneath the chassis include the exciter tuning capacitor at the right, and pi-network loading capacitor below.

National 200 Transceiver

Height: 6 3/16 inches.
Width: 13 3/8 inches.
Depth: 11 inches.
Weight: 15 lbs.
Power Requirements: 700 v.d.c. at 300 ma.: 280 v.d.c. at 200 ma.: — 80 v.d.c. at 10 ma.: 12.6 volts at 5 amperes.
Price Class: $360 less power supply and speaker; AC-200 power supply: $75.
Manufacturer: National Radio Company, 37 Washington St., Melrose, Mass. 02176.

Neither power supply nor speaker is included. The transceiver may be operated from the National NCX-A power-supply/speaker console, or from the AC-200 supply illustrated, which does not include a speaker. Speaker connections are available at the power receptacle, or they may be made by a plug in the headphone jack, since headphone connections are also taken from the output-transformer voice-coil winding. Thus the output is suitable for either high- or low-impedance headphones.

Physical Details

The unit appears to be well-built mechanically. The slate-blue cabinet is a perforated wrap-around type with open back and matching base plate. The panel is brushed-aluminum. Controls are black with chrome inserts. The tuning dial is combination pinch and planetary drive, with a ratio of 45 to 1. No backlash was discernible. A separate calibration scale is provided for each band, with marks at 5-kc. intervals. The position of the hair-line indicator is adjustable by a control on the panel to obtain an accurate setting against a calibration standard. A 100-kc. calibrator is not furnished, but is available as an optional extra (type XCU-27) that plugs into an accessory socket at the rear of the chassis. When so used, the calibrator is turned on and off by a push-pull type switch on the shaft of the microphone gain control.

The instruction book is very complete. In addition to the usual tuning data and tabulations of point voltages and resistances, it includes an explanation of the circuit operation, and complete instructions for alignment, with illustrative scope patterns. — *W1TS*