OPERATION and MAINTENANCE MANUAL

SB-34 SINGLE SIDEBAND TRANSCEIVER

SBE SIDEBAND ENGINEERS

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I. GENERAL DESCRIPTION

The Sideband Engineers Model SB-34 is a single-sideband, suppressed-carrier transceiver intended for operation in the A3 portions of the 80, 40, 20 and 15-meter amateur bands. The SB-34 operates either upper or lower sideband; selection is made by a front-panel switch. There is no carrier shift when emission is changed from one sideband to the other. Peak effective power output exceeds 60 watts on the 80, 40 and 20-meter bands, and 50 watts on the 15-meter band.

The SB-34 is self-contained, requiring only a microphone and an antenna for operation. The SB-34 will operate from either a 117-volt AC, or 12-volt DC (negative ground) power source; the two-way power supply is an integral part of the unit. Selection between the two power sources is automatically made when the proper line cord is connected.

Provisions are made for the use of a VOX unit and a 100-kc crystal calibrator which are available as accessory items. A front-panel switch is provided to control the calibrator unit. An accessory plug is also provided on the rear panel for control of the Sideband Engineers external Linear Amplifier companion unit.

All stages of the SB-34 except the transmitter driver and power amplifier are transistorized. The use of bilateral amplifiers and mixers, which amplify in one direction on transmit and in the other direction on receive, permits the use of a single bandpass circuit train. Duplication of circuitry is eliminated through use of common circuit elements for both receive and transmit functions.

The unique bandswitching and exciter tuning control permits adjustment of both functions with a single front-panel knob. Other controls and adjustments are held to a minimum for simplified operation. Exceptional receiver performance is obtained through the use of post-alloy diffused transistors and a 2.1-kc Collins mechanical filter. A pitch control is provided for tuning the receiver approximately 500 cycles either side of the transmitted frequency. The control may be disabled and the receiver locked to the transmitted frequency. A stand-by switch is also provided to turn off the transmitter-tube heaters and the high-voltage power supply during mobile operation. With this switch off, power drain from the car battery is reduced to 0.6 amps.

The entire transceiver package is less than one-half cubic foot in volume and weighs approximately 18 pounds. Construction of heavy-gauge steel and aluminum, and extensive use of printed circuit boards, provide an extremely rugged package, virtually immune to the effects of vibration and shock.

II. SPECIFICATIONS

Type of emission:	Single sideband, suppressed carrier, upper or lower sideband selectable from front panel
Frequency range:	3.775 - 4.025 mc, 7.05 - 7.3 mc, 14.1 - 14.35 mc, 21.25 - 21.45 mc
Power consumption:	117 VAC - receive 35 watts - transmit (single tone) 165 watts 12 VDC - standby 0.6 amps - receive 3.6 amps - transmit (single tone) 14 amps
Power output:	80, 40, 20 meters: 60 watts minimum 15 meters: 50 watts minimum
Carrier suppression:	50 db
Unwanted sideband suppression:	40 db at 300 cycles
Distortion products:	Down at least 25 db
Spurious responses:	Down at least 40 db
Antenna output impedance:	40 - 100 ohms, unbalanced. VSWR not to exceed 2:1
Sensitivity:	Less than 1 microvolt for 10 db signal-to-noise ratio
Selectivity:	2.1 kc down at 6 db, 4.5 kc at 60 db, both transmit and receive
Audio output:	2.0 watts at 10% distortion, 3 watts maximum
Dimensions:	5" high, 11-1/8" wide, 9-1/2" deep
Weight:	Approximately 18 pounds

III. INSTALLATION

A. GENERAL

The SB-34 transceiver is designed to provide a complete single-unit installation for fixed, portable, or mobile operation. No special precautions need be observed in the choice of location provided adequate ventilation space is available. A minimum of two inches of air space above the cabinet top and on all sides is recommended to allow proper air flow around the top and bottom of the cabinet. Do not place the unit on a car seat or similar surface which may block ventilation through the bottom. Never stack other units above or below the cabinet since the accumulated heat could cause permanent damage.

B. FIXED STATION

Plugging the 117-volt AC power cord into the receptacle at the rear of the transceiver connects all power circuits for 117 volt AC operation. The set should be connected to a good water-pipe ground. The ground may be connected either to the external speaker terminal labelled GND or to the braid of the antenna cable.

C. ANTENNA

Results both in receiving and transmitting will depend largely on the antenna; the receiver is particularly sensitive to the type of antenna used. Any of the common antenna systems designed for use on the high-frequency amateur bands may be used with SB-34 provided the input impedance of the antenna system is within the capability of the pi-output matching network (40 - 100 ohms resistive). If tuned open-wire transmission line is used, or if a long wire antenna is desired, a suitable antenna tuner must be used between the transceiver and the antenna to provide an impedance match between the unbalanced coaxial output and the balanced open-wire line or long wire.

D. LINEAR AMPLIFIER

The SB-34 Transceiver may be operated in conjunction with any conventional linear amplifier. A plug on the rear panel provides a 12-volt DC potential for actuating the control relays of the amplifier selected when the transceiver switches to transmit. If the linear amplifier relays are not intended to operate from such a voltage, an intermediary relay must be used. Any 12-volt relay may be used provided the coil resistance is 100 ohms or more. If in doubt as to the suitability of the amplifier to be used, contact Sideband Engineers, enclosing a copy of the schematic diagram.

E. MOBILE OPERATION

The SB-34 will operate satisfactorily from any 12-volt negative-ground battery source by connecting the DC power cord to the rear-panel receptacle. Due to the unusually small size of the SB-34, under-dash mounting is possible in many cars with limited available space.

When making connections to the car battery, be certain that the RED lead is connected to the positive (+) terminal and the BLACK lead to the chassis ground (-); reversed connections could permanently damage the transceiver. It is strongly recommended that the red lead be connected directly to the battery and not to the ammeter or an accessory terminal. If desired, a 15 amp fuse or circuit breaker may be inserted in the red lead for short-circuit protection.

Note: Prior to operating the SB-34 in a mobile installation, the automobile voltage regulator setting should be checked. Many times, even in new cars, the regulator is adjusted for an excessively high charging voltage. In addition to being injurious to the car battery, this high voltage could cause permanent damage to the SB-34. Make certain before operating that the voltage, when charging, does not exceed 14.6 volts.

Most of the commonly used mobile antennas will give excellent results with the SB-34. Make certain that the outer braid of the coaxial cable is securely grounded to the chassis at the antenna mount.

Noise generated by the ignition system, generator, etc., will usually interfere with weak-signal reception, especially on the higher-frequency bands. Since procedure for eliminating this noise varies with different makes and models of cars, no specific instructions for noise reduction can be given here. Valuable noise reduction information is given in the Amateur Mobile Manuals and these publications should be consulted or one of the several ignition noise suppression kits available, such as the Webster Model W-6200, should be considered.

If a mobile installation of higher power is desired, the Sideband Engineers companion Linear Amplifier is recommended for use with the SB-34. A special solid-state inverter is available for use with the amplifier to provide a practical 1000-watt mobile installation. Contact your dealer or Sideband Engineers for further particulars.

IV. OPERATION

NOTE: The SB-34 transceiver has been specifically designed to provide the utmost ease of operation and adjustment. All panel controls have been thoroughly tested before shipment from the factory. Several of the controls are unusual in operation, however, and improper adjustment may result in signals of poor quality, and even out-of-band operation. Read this section carefully before attempting to operate the transceiver.

A. CONTROL FUNCTIONS

The various front-panel controls and their functions are described in detail in the following paragraphs. Make certain that you understand the function of each control before attempting to operate the transceiver. Detailed instructions are given for tuning the transmitter. The design of the unit is such that when the transmitter is properly tuned, the receiving portion of the set is also properly aligned to the frequency in use.

1. Volume Control. The power ON/OFF switch and volume control functions are combined on a single control knob located at the lower left corner of the

front panel. Operating the knob clockwise beyond the click turns the unit on. Since the receiver portion of the unit is completely transistorized, no warm-up period is required.

A unique AGC system is incorporated in the SB-34. As the volume control is advanced, strong AGC action occurs as the set reaches normal room volume. From this point on, the volume remains substantially constant until the control is about three-quarters advanced. Beyond this point, the volume rises rapidly until full audio output is obtained with the control fully clockwise. For home use, the volume control is normally operated in the first half of its range. With mobile operation, where more audio output is usually required, the control is advanced into the second half of its range. Keeping the volume control at a low, but comfortable, level will reduce the "pumping" action that may occur on SSB signals.

2. Tuning Knob. The large knob directly below the dial window controls the actual frequency of operation after the desired band has been selected. A dual-speed reduction drive is incorporated to provide a slow tuning rate and, at the same time, to cover the entire band rapidly. In operation, the knob is turned to the desired portion of the frequency band and slightly past the desired frequency. When the knob rotation is reversed, the vernier action is increased by six for one complete revolution. Further rotation again engages the quick drive action. Since the tuning rate, in slow drive, is 14 kc per revolution, there is no critical "feel" to the dial. An additional feature of this mechanism is that the dial is positively locked to prevent mechanical frequency drift under vibration.

3. Microphone Connector. The microphone jack is located at the lower center of the panel. The jack accepts a type PL-68 (small diameter) plug with the microphone connected to the sleeve and the push-to-talk switch connected to the tip. The SB-34 transceiver is designed to operate with a medium or high-impedance dynamic microphone such as the Turner Model SR90D. Crystal or ceramic microphones will give poor results unless an auxiliary pre-amplifier is used, because of the very high impedance of the microphone and the low-impedance transistor microphone amplifier. In addition, the rising characteristic of this type of microphone combined with the narrow bandpass of the mechanical filter employed in the SB-34 produces a somewhat unpleasant sound to the average voice. Carbon microphones will operate only if external provisions are made for supplying them with operating current.

4. Bandswitch. The bandswitching and exciter tuning functions are combined in a single knob located just below the meter. With the knob indication fully clockwise, the transceiver is set for 80 meters, and the front end of the receiver is peaked by rotating the knob through the arc labelled "80". Correct tuning is indicated by a sharp rise in background noise similar to that obtained

with the "antenna tuning" control on a conventional receiver. To change to 40 meters, the knob is rotated counter-clockwise beyond the 80-meter arc. A click will be heard between the 80 and 40-meter arcs. This is the bandswitch operating to the 40-meter position. Tuning is again performed by rotating the knob within the 40-meter arc for a sharp rise in noise. This is progressively repeated for operation on the 20 and 15-meter bands. A stop is provided at the extreme counter-clockwise end of rotation past the 15-meter arc. Do not attempt to move the knob past this stop. No damage will result, but the knob may slip and cause loss of calibration. If this should happen, turn the bandswitch knob fully clockwise, loosen the set screws and set the knob index exactly on the clockwise stop mark on the panel. Tighten the set screws securely. Further adjustment of the bandswitch knob is covered in the TRANSMITTER TUNEUP section.

5. Pitch Control. The pitch control, located to the right of the volume control, provides a means for tuning the receiver frequency slightly to either side of the transmitting frequency. Thus, it is possible to set the pitch of the voice you are receiving to the most readable point without affecting your transmitting frequency. Its use is particularly valuable in "net" contacts where several of the participants may be transmitting slightly off frequency. The pitch control may be switched off and the receiver locked to the transmitting frequency by operating the PITCH switch (between the volume control and the pitch control) to the OFF position. Normally, you will want to keep the pitch control turned off until the initial contact is made. After accurately zeroed with the other station, the pitch control may be used to correct for any drift at the other end of the contact. This technique prevents the "leap-frogging" so prevalent with transceivers.

6. Dial Correct. The dial correct knob, located to the right of the dial window, is used to adjust for any error in dial calibration. The transceiver is aligned at the factory for correct dial readings with the correct knob index straight up. If an accurate calibration signal is not available, the correct knob should be left in this position. An accessory 100-kc calibrator unit is available for accurately setting the dial. Alternately, the dial can be corrected on a signal of known accuracy. The use of other amateur signals for this purpose is, in general, not advisable, however. The calibration of many amateur transmitters is subject to question.

6. USB/LSB Switch. This switch sets the transceiver to receive and transmit on either the upper sideband or the lower sideband. In general, it is common practice to use lower sideband on 80 and 40-meter band frequencies, and upper sideband on 20 and 15-meter frequencies. However, occasionally you will find exceptions. If the signal cannot be made intelligible by any amount of tuning, it is probably transmitting the sideband opposite to that which is selected on

the USB/LSB switch. Changing the position of this switch does not disturb the dial calibration and no retuning is required.

7. CAL Switch. This switch controls the 100-kc calibrator unit which is an accessory item. Moving the switch up to the ON position inserts a beat signal every 100 kc on all bands.

8. XMTR Switch. With this switch in the down position, the transmitter tube heaters and the high-voltage supply are turned off when the transceiver is operating mobile. This reduces battery drain to 0.6 amps and thus permits long periods of listening without fear of excessive battery drain. Operating the switch to the ON position actuates the high-voltage supply and the tube heaters. After a 30-second warm-up period, the transmitter is ready for operation. The XMTR switch operates only when the set is powered from a 12-volt DC battery; it does not function with 117-volt AC operation. With 117-volts AC, the heaters and high-voltage supply are energized at all times.

9. PA TUNE. The PA TUNE control is intended primarily for loading the transmitter to the antenna. However, for maximum receiver sensitivity, it must be set to the point which is correct for transmitting. If the transmitter section is not being operated, adjust the PA TUNE control for maximum receiver volume with the PA LOAD capacitor set at one turn back from maximum clockwise position. Otherwise, see TRANSMITTER TUNEUP section.

10. Transmitter Controls. The controls used exclusively in transmitting are: MIC GAIN, PA LOAD, METER Switch, and TUNE-OPER Switch. Their use is described in the TRANSMITTER TUNEUP section.

B. RECEIVER OPERATION

The SB-34 transceiver employs a 2.1 kc Collins mechanical filter to attain exceptional selectivity on both receive and transmit. The unit is designed to pass only that portion of the voice spectrum falling between 300 and 2400 cycles. Experience has shown that this bandwidth permits excellent intelligibility and still discriminates against interfering noise. Since the transceiver audio system and speaker is also carefully shaped to pass only 300 to 2400 cycles, the end result is reception similar to the quality of a conventional telephone. No adjustment of the transceiver will produce "high fidelity" reception in the normal sense. The SB-34 will, however, provide good communications under conditions of high noise and weak signals when conventional receivers with extended audio range and wide bandpass are completely unusable.

Considerable effort has been expended to prevent the receiver from overloading or blocking on strong signals. Since the volume control mainly affects the

RF section of the receiver rather than the audio circuits as is customary, the receiver is less likely to overload at low volume settings than at a high setting. Quite often interference from close-by stations can be completely eliminated by merely reducing the volume control setting. An automatic gain control system (AGC) is incorporated in the transceiver. It provides strong compression on signals when the audio output exceeds one-quarter watt (normal room volume). If more audio is required, as when operating mobile, turning the volume control into the upper half of its range increases the audio output to a maximum of three watts.

A few spurious responses (birdies) may be noted as the receiver is tuned through the various bands. With a normal antenna and in an average location, all of these responses will be below the level of a readable signal, with the exception of a single response at 7300.8 kc. Since this response is outside the amateur band, it should cause no inconvenience to the operator. It is, in fact, useful as a means of checking the dial accuracy, since it has the stability of the carrier oscillator and may be relied upon to be accurate as a frequency marker.

C. TRANSMITTER TUNEUP

NOTE

> Improper transmitter tuning can result in serious distortion and possibly operation outside the band. Improper adjustment of the MIC GAIN control can cause "flat-topping" and the generation of splatter and other spurious emissions. Make certain you understand the following instructions thoroughly before attempting to operate the transmitter.

Transmitter tuneup consists of adjusting the exciter, loading the power amplifier to the antenna, and setting the microphone gain control for optimum power output without distortion. The SB-34 has been carefully designed to minimize the possibility of improper operation due to faulty tuning procedures, and to make the tuneup process as simple and quick as possible.

The combination bandswitch and driver tuning, for instance, has been arranged to preclude the possibility of tuning up on incorrect frequencies. It is, however, possible to transmit a poor signal if the set is not correctly tuned. Take the time to memorize the following step-by-step procedure and your SB-34 will always transmit a clean, powerful signal that will be a credit to your station.

1. Exciter Tuning. With the transceiver turned on, allow 30 seconds for warm-up of the transmitter tubes. Set the bandswitch to the desired band,

Dial 7302.08
xtO 10475.00
VFO 5454.82
5020.18
11)(456.38) = 5020.18

make certain that an antenna resonant to that band is connected. Set the band-switch knob for maximum antenna noise, as outlined in the foregoing instructions. Set the MIC GAIN, PA LOAD, and PA TUNE controls fully counter-clockwise, and the METER switch in Ip position. Set the TUNE-OPER switch to TUNE position. The receiver will "quiet" and an indication will appear on the meter. Carefully adjust the bandswitch knob for maximum meter indication. This will occur at a setting very close to that which produced maximum receiver noise. One or more peaks may be evident if the bandswitch knob is tuned through the entire arc, but the correct setting will always be near the point of maximum receiver noise, and will always produce a much higher meter reading. This completes the exciter tuning.

2. Power Amplifier Tuning. Turn the PA TUNE control clockwise until a sharp dip in meter indication occurs. At this point, set the METER switch to OUTPUT position. Some meter indication will be evident. Turn the PA LOAD control clockwise to the point that produces maximum meter indication. Note that the PA LOAD control is a mica compression trimmer. The control rotates at least four full turns to obtain its effective range. Next, readjust the PA TUNE control for maximum meter reading. Repeat alternating adjustments of the PA TUNE and PA LOAD controls until the meter reads maximum possible, with final adjustment being the PA TUNE control. This completes the exciter and power amplifier tuneup.

3. MIC GAIN Adjustment. Turn the METER switch to Ip position and the TUNE-OPER switch to TUNE long enough to note the meter reading. With the transceiver properly tuned to a resonant antenna, the reading should be between 2.0 and 2.5. Return the TUNE-OPER switch to OPER, press the microphone button and speak a steady "AHHHH" into the microphone at the level and distance you intend to use when transmitting. Gradually turn the MIC GAIN control clockwise until the meter reading increases to approximately 1.5 if the maximum reading was 2.5; or 1.3 if the maximum reading was 2.0. This setting of the MIC GAIN control will ensure a strong transmitted signal without danger of overdriving.

NOTE

It is very important that the MIC GAIN control be correctly set. If it is too high, excessive distortion will be produced. On the other hand, too low a setting will result in low transmitter output. Experience is the best teacher of the optimum setting. On-the-air reports should be taken with caution since they are subject to many inaccuracies.

V. THEORY OF OPERATION

The SB-34 single sideband transceiver is essentially bilateral. With the exception of the receiver RF amplifier and the high-level transmitting stages, the signal stages may amplify in either direction. During the receive function they amplify in one direction, on transmit they amplify in the opposite direction. The same tuned circuits are used for both transmitting and receiving. The various injection oscillators operate continuously, supplying the local oscillator signals to the proper mixer stages.

All transistors in the transceiver operate in the common emitter configuration except the receiver RF amplifier Q11. This stage operates common base.

A typical bilateral stage may be understood by referring to the 456 kc amplifier Q5-Q6 in the schematic diagram. With the microphone button released, the base bias resistor of Q5 is returned to a line which carries a +12-volt potential. The transistor cannot conduct. The base bias resistor of Q6, however, is returned (through the volume control) to a line which is essentially ground potential with the microphone button released and Q6 is in conduction and able to amplify. Thus, with the microphone button up, a signal appearing at the mechanical filter will be amplified and delivered to IF transformer T2. With the microphone button pressed, the two bias-control lines are inverted in polarity so that Q6 is cut off and Q5 is able to conduct. Therefore, a signal appearing at T2 is amplified by Q5 and impressed on the filter. Similarly, the amplifying direction of the VFO mixer Q7-Q8, and the high-frequency mixer Q9-Q10 are controlled by the two bias control lines.

Unilateral stages that are required to operate only on receive or transmit are turned off when not needed by returning their base bias resistors to the appropriate bias control line. The transmitter tubes are disabled during receive by applying a high negative bias to their grids.

A. TRANSMIT FUNCTION

An audio signal from the microphone, controlled in amplitude by the MIC GAIN control, is amplified by the microphone amplifier Q4 and applied to the ring-balanced modulator CR3-7. Crystal oscillator Q12 operating at 456.38 kc, provides a carrier to the modulator. Carrier balance is obtained by a potentiometer and a trimmer capacitor. Double-sideband, suppressed-carrier output from the balanced modulator is amplified through T2 by the bilateral amplifier Q5-Q6. The amplified signal is then passed through the mechanical filter which suppresses the upper sideband.

Output from oscillator Q12 is also applied to frequency doubler CR8. The doubled carrier frequency from this stage is then either doubled again or tripled by Q13. With the mode selector switch set at USB, the frequency is tripled; with the switch on LSB the frequency is doubled. Thus, on USB, a 2738.2 kc (456.38 X 6) appears at the output of T5. On LSB an 1825.5 kc output appears at T5.

Doubler/tripler transformer T5 is connected in a ring with the mechanical filter, mixer CR9, and transformer T3 which is tuned to 2281.9 kc. With the mode selector in LSB, output from T5 is additively mixed with the lower side-band signal from the filter to produce a lower sideband signal at 2281.9 kc. With the mode selector set on USB, the T5 output is subtractively mixed with the filter output to generate an upper sideband signal, still at 2281.9 kc. Thus, the mode selector, by adjusting Q13 to either double or triple, determines the mode of the sideband signal. Since all of the frequencies involved are derived by a single oscillator, no shifting of carrier frequency can occur and no retun-ing is necessary when switching sidebands.

With the TUNE-OPER switch in TUNE position, a measured amount of carrier signal is inserted in the DC load resistor of mixer CR9 for transmitter tune-up purposes.

The 2281.9 kc upper or lower sideband output from T3 is applied to VFO mixer Q7-Q8. Also applied to this mixer is an injection signal which is tunable from 5456.9 kc to 5706.9 kc. This injection is generated by VFO Q15 and isolated from the load by VFO buffer Q14. Tunable IF transformer T6, connected to the output of VFO mixer Q7-Q8, tunes the frequency range 3175 through 3425 kc. This frequency range is the result of subtractively mixing the incoming 2281.9 kc sideband signal with the VFO injection. Transformer T6 is gang-tuned with the VFO and thus is always accurately tuned to the desired frequency.

The 3175 kc to 3425 kc sideband signal from Q7-Q8 is applied to high-frequency mixer Q9-Q10. Also applied to this mixer is an injection from high frequency crystal oscillator Q19. The frequency generated by this oscillator may be 7200, 10475, 17525, or 24625 kc depending upon the position of the bandswitch. Here again, the 3175-3425 kc incoming signal is subtractively mixed to produce the final output frequency. Output from mixer Q9-Q10 appears across tuner coil L2. The resonant frequency of L2 is controlled by a large variable capacitor and a special slug which penetrates into the coil an amount depending upon the setting of the bandswitch. The large variable capacitor is mechanically linked to the bandswitch through a Geneva movement so that rotating the capacitor shaft tunes the coil through a limited range bracketing the selected operating band. Changing the bandswitch to the next band tunes a limited range bracket-ing this band, etc. On 80 meters, the slug is almost fully penetrated into the coil and the capacitor is near maximum capacity. On 40 and 20 meters, the slug and capacitor are at near mid-range, and on 15 meters the slug is fully withdrawn and the capacitor is near minimum. By this unique method of tuning and bandswitching, the Q and inductance/capacitance ratio of L2 and the variable capacitor are near optimum on all bands, and the resonant impedance remains essentially constant across the entire tuning range. This tuning is ganged with, and duplicated in, antenna coil L3 and driver coil L7 which results in exciter train tuning with only one control.

The single-sideband suppressed-carrier final output signal from L2 is applied to the grid of transmitter driver V1 where it is amplified, and appears across L7. A low-impedance winding on L7 couples the signal to the paralleled grids of power amplifier V2 and V3. Neutralization of the power amplifier is accomplished by feeding back a small amount of the output through Cn to the top of L7 with the low-impedance winding providing the necessary phase reversal.

Final output from V2 and V3 is fed to a pi-section network consisting of L9 and the PA TUNE and PA LOAD capacitors. A section of the bandswitch adjusts the inductance of L9 to the correct value for each band, and also adds fixed amounts of capacity to both the PA LOAD and PA TUNE capacitors on 80 meters.

B. RECEIVE FUNCTION

With the microphone button released, a signal from the antenna is loosely coupled from the transmitter pi-section net to the top of L3. Diodes CR14 and CR15, across L3 conduct only when extremely strong signals are present and do not otherwise affect the circuit. The signal at L3 is coupled to the emitter of Q11 which operates as a common-base amplifier. The amplified signal from Q11 is applied to high-frequency mixer Q9-Q10 through L2. With injection from Q19, this stage converts the signal to a frequency within the range 3175-3425 kc. The converted signal is then mixed by Q7 and Q8 to 2281.9 kc with injection from the VFO Q14 and Q15. The converted signal is finally mixed by diode CR9 to the 456.38 reference frequency in a manner exactly opposite to that described for this stage during the transmit function. Output from the filter is then amplified by Q5 and Q6 and coupled through T2 to the ring modulator CR3-CR7.

With BFO injection from the carrier oscillator, the ring modulator now functions as a detector, and produces an audio output which is applied to the base of Q2. Output is taken from the collector and coupled to audio driver Q1. This stage, in turn, drives the audio power amplifier Q20 which increases the signal to speaker level.

The VOLUME control sets the gain of the high-frequency mixer, the 456 kc amplifier and, to a small extent, the first audio amplifier, Q2. Other signal stages operate at full gain except in the presence of AGC action.

RF amplifier Q11 and IF amplifier Q5-Q6 are gain controlled by AGC amplifier Q3. An audio signal appearing across the speaker terminal causes Q3 to conduct heavily. The voltage at its collector is normally close to that of the supply, +12 volts. When Q3 conducts, however, the collector potential falls rapidly and charges the 250-mfd capacitor (connected between collector and the 12-volt bus) to some value less than 12 volts. This AGC voltage is connected to the emitters of the RF amplifier and the 456 kc amplifier, and as the AGC voltage falls toward ground potential, the gains of these stages are reduced until the audio output is stabilized. The AGC action is proportioned such that the RF amplifier becomes largely cut off in the presence of even moderate signals so that following stages are protected from signal overload. If the signal fades, causing the audio output to drop, Q3 conducts less and the 250-mfd capacitor slowly discharges toward the +12-volt potential, causing the stages gains to be restored as necessary to maintain the audio level.

When the VOLUME control approaches the fully clockwise position, diode CR1, connected to the base of Q3, begins to limit the amount of audio applied for AGC action. With this occuring, more audio output is produced for a given amount of AGC. Finally, with the volume control fully clockwise, the base of Q3 is clamped off and full audio output is produced.

Diode CR2, in the collector of Q3, conducts when the unit is switched to transmit. This conduction charges the 250 mfd capacitor to the 12-volt potential so that when the set is switched back to receive, full receiver gain is instantly available.

C. KEYING CIRCUIT

Two transistors, Q16 and Q17, perform the functions necessary to switch the transceiver from receive to transmit, thus eliminating the conventional relay. The base of Q16 is coupled through a current limiting resistor to the cathode of driver tube V1. With the microphone button released, V1 draws no cathode current and its cathode is at ground potential. Q16, therefore, is cut off and the potential at its collector is +12 volts. This potential is supplied to the control line that requires +12 volts on receive. Also, the collector potential at Q16 is applied to the base of Q17 causing this transistor to conduct to saturation. Its collector potential, therefore, is essentially grounded. The control line requiring ground potential on receive is connected to the collector of Q17.

When the microphone button is pressed, the high negative bias on driver tube V1 is removed and the stage conducts. The cathode potential of V1 rises to approximately +6 volts and, with this voltage applied to the base, transistor Q16 conducts to saturation. The control line that was +12 volts on receive is now at ground potential. In addition, since the potential on the base of Q17 is removed, this stage cuts off and the control line that was grounded on receive is now +12 volts.

D. POWER SUPPLY

The SB-34 contains a power supply designed to operate from either 117-volts AC or 12-volts DC (negative ground). Inserting the appropriate power cord into the rear-panel receptacle makes the necessary connections to operate the supply in either mode.

With 12-volt DC operation, transistors Q21 and Q22 are connected as a common-emitter power oscillator. Starting bias for this oscillator is obtained from a small resistor and the heater current of driver tube V1. All of the transmitter-tube heaters and input voltage to the oscillator are applied through the XMTR switch so that the receiver portion of the transceiver may be operated with reduced power consumption. A high-voltage winding of T7 is connected to a voltage tripler circuit CR17, CR18 and CR19 to supply approximately +450 volts to the transmitter tubes and +150 volts to the screen grids of V2 and V3. Another small secondary winding is half-wave rectified by CR20 to supply negative bias to the transmitter tubes.

With 117-volt AC operation, T7 is energized by a second primary winding. The feedback and collector windings of the transformer are connected essentially in series and full-wave rectified by the collector-base diodes of Q21 and Q22 to provide a high-current +12 volts output. This voltage is used to operate the transistorized stages and operate the transmitter tube heaters. The high-voltage and bias systems operate as described above. The XMTR switch, in this mode of operation is not connected; the transmitter tube heaters are energized at all times.

A special regulator circuit is provided to stabilize the voltage to the VFO, Q14 and Q15. Regulator Q18 operates as a shunt regulator across the +12 volt bus to provide an output of +7.0 volts. The current to the base of Q18 is determined by the current flow through zener diode CR10, and since this zener diode in itself is not a perfect regulator, the output voltage from Q18 would normally vary slightly as the supply voltage changed. To overcome this variation, a small variable resistor is inserted in the series-dropping resistor line to the regulator transistor. The effect of this variable resistor is to insert an additional amount of base current to the transistor to offset the slight change that occurs in the zener diode due to supply-voltage changes. Thus, with proper adjustment of the resistor, regulation becomes perfect for input supply voltages of 11.5 to 15.0 volts.

E. PITCH CONTROL

The purpose of the PITCH control is to permit slight adjustment in receiver frequency with respect to the transmitting frequency. The control may be switched in or out as desired. A small silicon diode, CR11, is connected between the "hot" end of the VFO coil L5 and a voltage divider network which may be adjusted to a value between the regulated voltage (+7 volts) and ground. The diode is connected so that a reverse bias is applied and therefore appears as a small capacitor, the actual value of capacity being variable depending on the amount of reverse bias applied.

The voltage divider network supplying bias to the diode contains, in one leg, the DIAL CORRECT potentiometer. This leg is active on both transmit and receive. The other leg of the network is divided into two sections, one operating on transmit, the other on receive. On transmit, the leg consists of a 470-ohm resistor and diode CR12 which is arranged to conduct only on transmit. On receive, the leg consists of either an adjustable resistor (when the PITCH switch is OFF) or the PITCH control (when the PITCH switch is on) and diode CR13 which conducts only on receive.

The overall effect of the PITCH control network is to permit a slight variation in VFO frequency on both transmit and receive by the DIAL CORRECT control, and a variation on receive only by the PITCH control. The adjustable resistor, activated when the PITCH switch is off, is factory set so that the VFO frequency on receive is exactly the same as on transmit.

VI. TROUBLESHOOTING

The SB-34 transceiver has been carefully aligned and tested at the factory, and all adjustments that might become misaligned from the effects of vibration and temperature cycling have been securely locked in place.

Problems that might possibly arise, and their detection and correction, are included in the following paragraphs.

A. CARRIER BALANCE

The SB-34 is designed to maintain carrier suppression of at least 50 db below full output for extended periods of time. If for any reason excessive carrier is present, the carrier balance potentiometer on the rear panel should be re-adjusted. The most accurate method for doing this requires a fairly sensitive vacuum-tube RF voltmeter, such as the Hewlett-Packard HP-410B, or equivalent, connected across the antenna terminals. With the MIC GAIN control set fully counter-clockwise, and the microphone button pressed, the residual carrier, as measured by the voltmeter, should be nulled to a value of 0.2 volts rms, or less, by use of the carrier balance potentiometer. Check operation on both sidebands since there may be a slight difference in carrier between the two modes. Any difference should be averaged out by the potentiometer. If it is not possible to reduce the carrier to a reading of 0.2 volts with the potentiometer alone, remove the set from the cabinet, and readjust the carrier balance trimmer (see top-view layout chart). The trimmer and the potentiometer interact somewhat so that several cycles of adjustment may be required. Note: T2 adjustment can also affect carrier balance.

B. LOW TRANSMITTER OUTPUT

Low transmitter output generally indicates weak tubes. If the off-resonance plate current of the power amplifier stage becomes less than 200 ma, as indicated on the front-panel meter, either the driver or power amplifier tubes may require replacement. If the power amplifier tubes are replaced, re-neutralization may be necessary. The neutralizing capacitor (Cn) must be adjusted with an insulated alignment tool. Proper neutralization is indicated when maximum output and minimum plate current occur with the same setting of the PA TUNE control. The adjustment should be made with the set tuned for 15-meter operation.

C. LOW RECEIVER SENSITIVITY

Since the receive portion of the transceiver is fully transistorized, no loss in sensitivity should be experienced with age. If the receiver seems to be lacking in sensitivity, the RF trimmer and slug (see layout charts) may require touch-up. Make certain that the transmitter is properly tuned to the antenna before making the adjustment. The slug may be reached through the side of the chassis and requires a long screwdriver, completely non-metallic.

Low audio output or distortion may also be traced to leaky or shorted electrolytic capacitors in the audio portion of the receiver or transmitter. These will usually cause abnormal voltage readings at the various stages. Refer to the voltage chart.

VII. ALIGNMENT

WARNING

> Dangerous high voltage is present in the equipment whenever the unit is turned on. The high-voltage filter capacitors remain charged at all times and can cause fatal shock under certain conditions. Allow at least five minutes after the unit is turned off for the filter capacitors to discharge. Always remove the line plug from the outlet when servicing the set.

A. EQUIPMENT REQUIRED

For correct alignment, an accurate vacuum-tube RF voltmeter such as the Hewlett-Packard HP-410B, a calibrated audio voltmeter, and a well-calibrated

RF signal generator such as the Measurements Model 65B are required. Do not attempt alignment unless accurate equipment is available.

B. ALIGNMENT PROCEDURES

NOTE: Refer to layout charts for location of various components and test points. Use test probes with caution; an accidental short will usually cause permanent damage to transistors.

1. Carrier Oscillator. Connect the VTVM to the center arm of the carrier-balance potentiometer. A reading of 1 volt rms or more indicates correct oscillator operation.

2. Doubler and Doubler/Tripler Alignment. Connect a VTVM to the cathode of CR9. A reading of 0.4 to 0.5 volts indicates correct operation. Test with USB-LSB switch in both positions. If reading is low, align both slugs of T4 for maximum output. Switch to USB and align both slugs of T5 for best output. Switch to LSB and adjust the two X2 ADJUST trimmers for maximum. If readings are high, detune the bottom slug of T4 slightly until reading is correct. If only the LSB reading is high, detune one of the X2 ADJUST trimmers slightly.

3. VFO Alignment. Faulty VFO operation is indicated when dial readings cannot be corrected by the DIAL CORRECT knob, or no receiver operation is obtained on any band. Test for VFO oscillation by connecting the VTVM to the rear lug of the small 3-gang tuning capacitor. A reading of approximately 1.0 volt rms is normal. Test the VFO buffer by connecting the VTVM to the collector of Q14. Adjust the VFO buffer coil L4 for a reading of 1.0 volt rms.

To adjust the VFO frequency, set the DIAL CORRECT knob with pointer up and the PITCH switch to OFF. Tune the receiver to a signal of an accurate, known frequency (or use 100-kc calibrator) and adjust the VFO trimmer until the signal is zero beat at the correct dial reading.

4. Receiver Zero Adjustment. Loosely couple the antenna lead of a stable full-coverage receiver to L4. Tune the receiver in the range 5.50 - 5.75 mc until the VFO signal is heard. Press the microphone button and accurately zero beat the signal on the receiver. Release the microphone button and adjust the VFO ZERO potentiometer until the signal is again zero beat. Press the button several times and check to see that no detectable shift in VFO frequency occurs between receive and transmit.

5. Crystal Oscillator Alignment. Connect the VTVM to the emitter of either Q9 or Q10. Set the bandswitch to 15 meters. Adjust the slug of L6 for a meter

reading of 0.25 volts rms. If this reading cannot be obtained, a reading between 0.2 and 0.3 volts is satisfactory. Now set the bandswitch to 20 meters and adjust the rear crystal trimmer (next to bandswitch) for a meter reading of 0.25 volts. Next, set the bandswitch to 40 meters and adjust the center trimmer for 0.25 volts. Finally, set the bandswitch to 80 meters and adjust the forward trimmer for 0.25 volts.

6. Receive RF Amplifier Alignment. Set the bandswitch to 15 meters and adjust pointer to the center of the 15-meter arc. Connect a signal generator to the antenna jack and set for operation at 21.35 mc unmodulated. Reduce the attenuator as required so that an audio output signal of less than 0.25 volts (measured on the rear-panel speaker terminals) is obtained at full volume control setting. Adjust the PA TUNE and PA LOAD controls for maximum audio output. Then adjust the center trimmer of the large 3-gang capacitor for maximum audio output. Then set the transceiver to receive on 3.80 mc and adjust the signal generator to 3.80 mc. Reset PA TUNE and PA LOAD controls for maximum audio output. With the attenuator set for an audio output of less than 0.25 volts, set the bandswitch knob index to a point 1/4" from the clockwise edge of the 80-meter arc. Adjust the center slug (L3) on the slug rack for maximum audio output. Use a long, fully insulated screwdriver for this adjustment. Key transmitter with no drive, meter switch in Ip position. Adjust bias control, located in the upper right corner of the tube compartment, for a meter reading of ~~0.1.~~ This sets the final amplifier bias.
1. (100 ma.)

7. T2 Alignment. Set the transceiver to transmit on 3.80 mc. Connect a suitable 50-ohm dummy load to the antenna jack. Also connect the VTVM to the antenna jack. Connect a two-tone test signal into the microphone jack and with the microphone button pressed, tune the transmitter controls for maximum power output with MIC GAIN control advanced slightly. Then reduce the MIC GAIN setting until the output is about 30 volts. Adjust T2 (one slug) for maximum output.

8. T3 Alignment. With the conditions set up for Step 7, adjust both slugs of T3 for maximum output.

9. T6 Alignment. With the conditions set up for Step 7, tune the transceiver to 3.90 mc. Repeak the bandswitch knob, the PA TUNE control and the PA LOAD control for maximum output. Then adjust both slugs of T6 for maximum output.

10. High-Frequency Mixer Alignment. With the conditions set up as in Step 7, set the transceiver to transmit at 21.35 mc and adjust the transmitter controls for maximum output. Set the bandswitch knob to the center of the 15-meter arc. With the MIC GAIN control set for an output of about 20 volts, adjust the forward trimmer of the large 3-gang capacitor for maximum output. Also

adjust the rear trimmer for maximum output. If a large change in this trimmer is noted, it may be necessary to re-neutralize the power amplifier. To adjust the neutralizer, advance the MIC GAIN control until flat-topping occurs. Adjust the neutralizer until maximum output and minimum plate current occur at the same setting of the PA TUNE control. The neutralizer and the driver trimmer (rear trimmer) interact somewhat. Before checking for proper neutralization, make certain that the driver trimmer is set for maximum output.

Now set the transceiver to transmit at 3.80 mc and adjust controls for maximum output. Set the MIC GAIN control for about 30-volts output. Set the bandswitch knob index at a point 1/4" from the clockwise edge of the 80-meter arc. Adjust the front slug (L2) of the slug rack for maximum output. Also adjust the rear slug for maximum output.

Finally, set the transceiver to transmit at 7.20 mc and adjust controls for maximum output, release the microphone button and see that maximum receiver noise occurs at the same setting of the bandswitch knob as transmitter maximum output. If not, adjust the rear slug (L7) very slightly until the two settings are very nearly the same. Check 80-meter operation again and see that the bandswitch knob settings for maximum receiver noise and transmitter output are very nearly the same.

11. Driver Alignment. See Step 10.

12. L10 Alignment. This adjustment reduces the spurious radiation of a signal at 24.625 kc, the frequency of the crystal oscillator when operating on 15 meters. Set for transmit on 21.35 mc and adjust for maximum transmitter output. Then set the MIC GAIN control fully counter-clockwise and adjust the VTVM to read the residual output signal. Slowly turn the PA TUNE control clockwise until a small peak shows on the VTVM. Adjust the slug of L10 for minimum reading. The final reading should be less than 1.0 volt rms. Return the PA TUNE control to the setting for maximum 15-meter output.

13. Carrier Balance. After completing Step 12, again reduce the MIC GAIN setting to zero. Alternately, adjust the Carrier Balance potentiometer and the Carrier Balance trimmer for minimum output. It should be possible to null the carrier to a VTVM reading of less than 0.2 volt with the USB-LSB switch in either position. This completes the alignment procedure. Incorrect adjustment of T2 can affect carrier balance.

SEMICONDUCTOR CHARACTERISTICS AND VOLTAGE CHART

*	No.	Type	Mfr.	Description	Voltages			Measured in
					Base	Emitter	Collec-tor	
	Q1	2N2431		PNP Alloy	9.9	10.0	0	Receive
2N3638	Q2	2N1305		PNP Alloy	9.6	9.9	4.4	Receive
2N3642	Q3	2N2926	GE	NPN Silicon	0	0	10.5	Receive
2N3638	Q4	2N1305		PNP Alloy	10.0	10.2	4.5	Transmit
	Q5	2N2672	Amperex	PADT	11.1	12.4	0	Transmit
	Q6	2N2672	Amperex	PADT	10.2	10.5	0	Receive
	Q7	2N2672	Amperex	PADT	10.5	10.9	0	Transmit
	Q8	2N2672	Amperex	PADT	9.7	10.0	0	Receive
	Q9	2N2672	Amperex	PADT	11.1	11.4	0	Transmit
GE-9	Q10	2N2495	Amperex	PADT	10.6	10.9	0	Receive
	Q11	2N2672	Amperex	PADT	10.6	10.9	0	Receive
2N2596	Q12	2N2672	Amperex	PADT	9.9	9.3	0	Receive
2N2596	Q13	2N2672	Amperex	PADT	11.6	11.4	0	Receive
	Q14	2N2672	Amperex	PADT	5.3	5.7	0	Receive
2N3564	Q15	2N706	RCA	NPN Silicon	1.0	0.4	5.0	Receive
2N3642	Q16	2N1302		NPN Alloy	0	0	11.4	Receive
2N3642	Q17	2N1302		NPN Alloy	0.3	0	0.08	Receive
	Q18	2N2926	GE	NPN Silicon	0.5	0	7.0	Receive
2N3638	Q19	2N2672	Amperex	PADT	7.4	6.9	0	Receive
2N2869/	Q20	2N301		PNP Power	9.6	10.0	0.5	Receive
	Q21	2N443		PNP Power	13.0	11.4	10.0*	Receive
	Q22	2N443		PNP Power	13.0	11.4	10.0*	Receive
2N/2923	Q23	2N2926	GE	NPN Silicon	11.4	11.0	11.4	Transmit

Measurements taken with 20,000-ohm per volt meter, VOLUME control fully clockwise, no signal input, set powered from 117-volt AC.

* AC

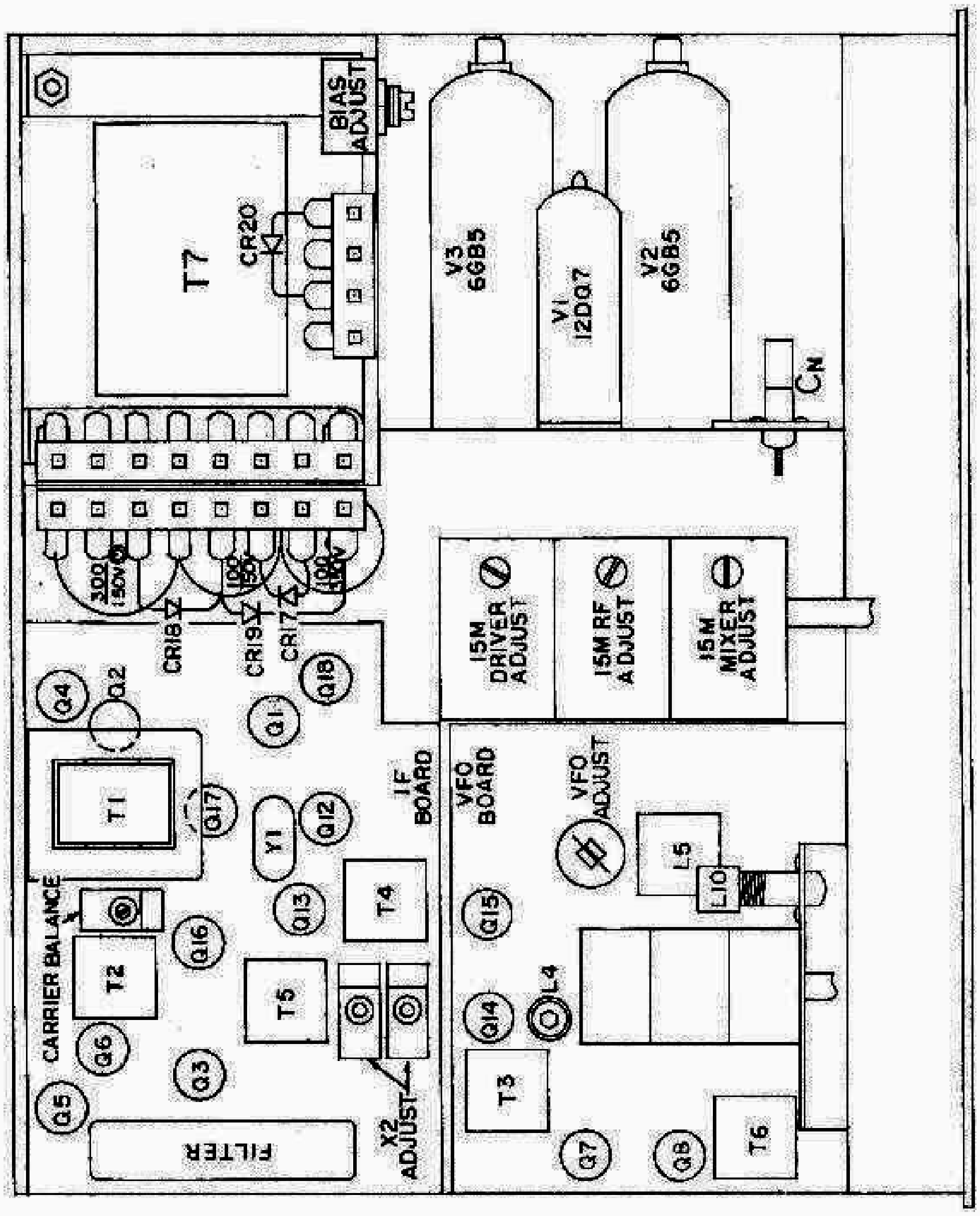
* Used in later models.

Note: 2N2672 can be replaced by GE-9

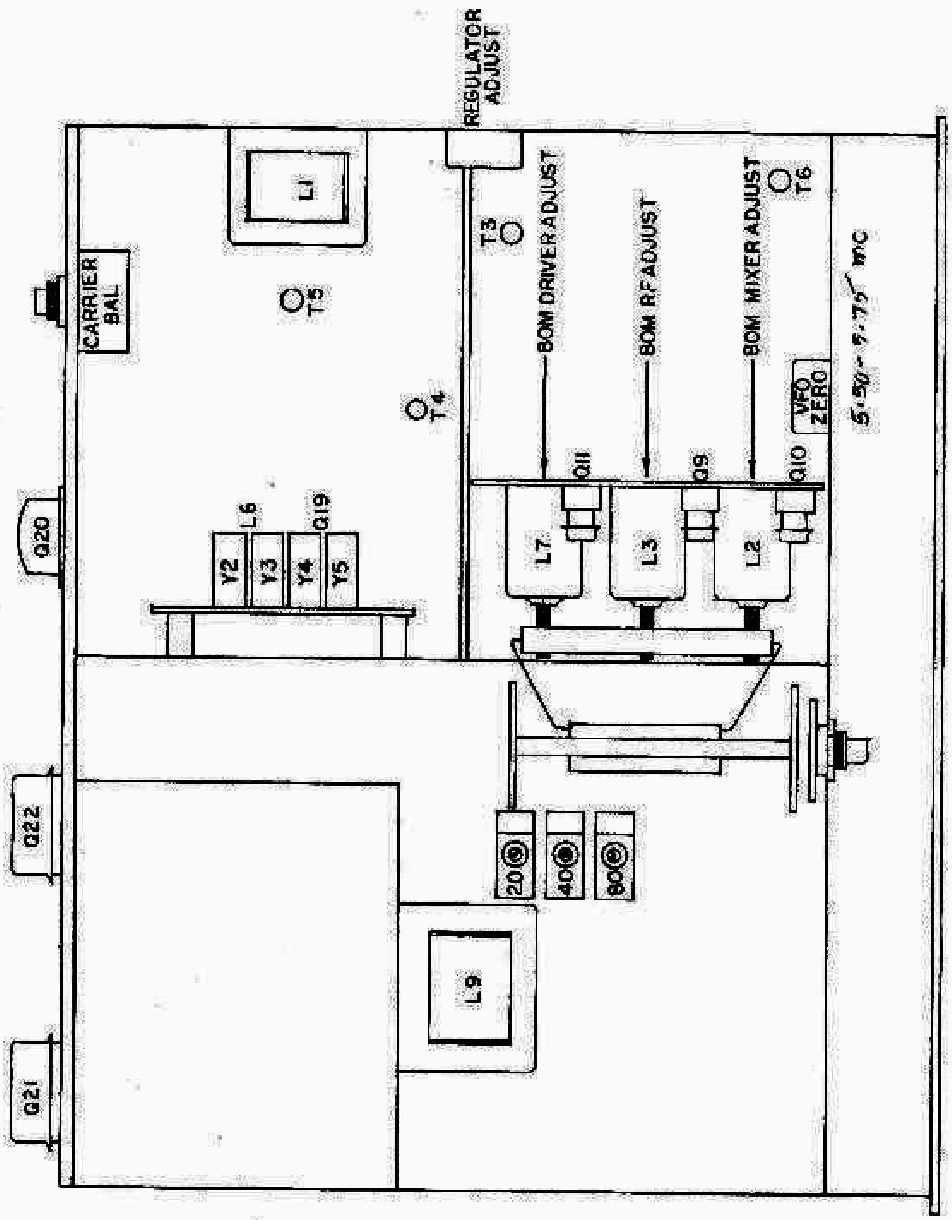
DIODE TYPES

Symbol	Type	Description
CR1	S262 (Amperex)	Point Germanium
CR2	S262 (Amperex)	Point Germanium
CR3	S262 (Amperex)	Point Germanium
CR4	S262 (Amperex)	Point Germanium
CR5	S262 (Amperex)	Point Germanium
CR6	S262 (Amperex)	Point Germanium
CR7	S262 (Amperex)	Point Germanium
CR8	S262 (Amperex)	Point Germanium
CR9	1N87A	Point Germanium
CR10	1N754	Zener, 6.8 volts
CR11	1N625 (Hughes)	Point Silicon
CR12	S262 (Amperex)	Point Germanium
CR13	S262 (Amperex)	Point Germanium
CR14	HE9010 (Hughes)	Planar Silicon
CR15	HE9010 (Hughes)	Planar Silicon
CR16	Not used	
CR17	1N2071	Silicon Rectifier
CR18	1N2071	Silicon Rectifier
CR19	1N2071	Silicon Rectifier
CR20	1N2071	Silicon Rectifier
CR21	S262 (Amperex)	Point Germanium

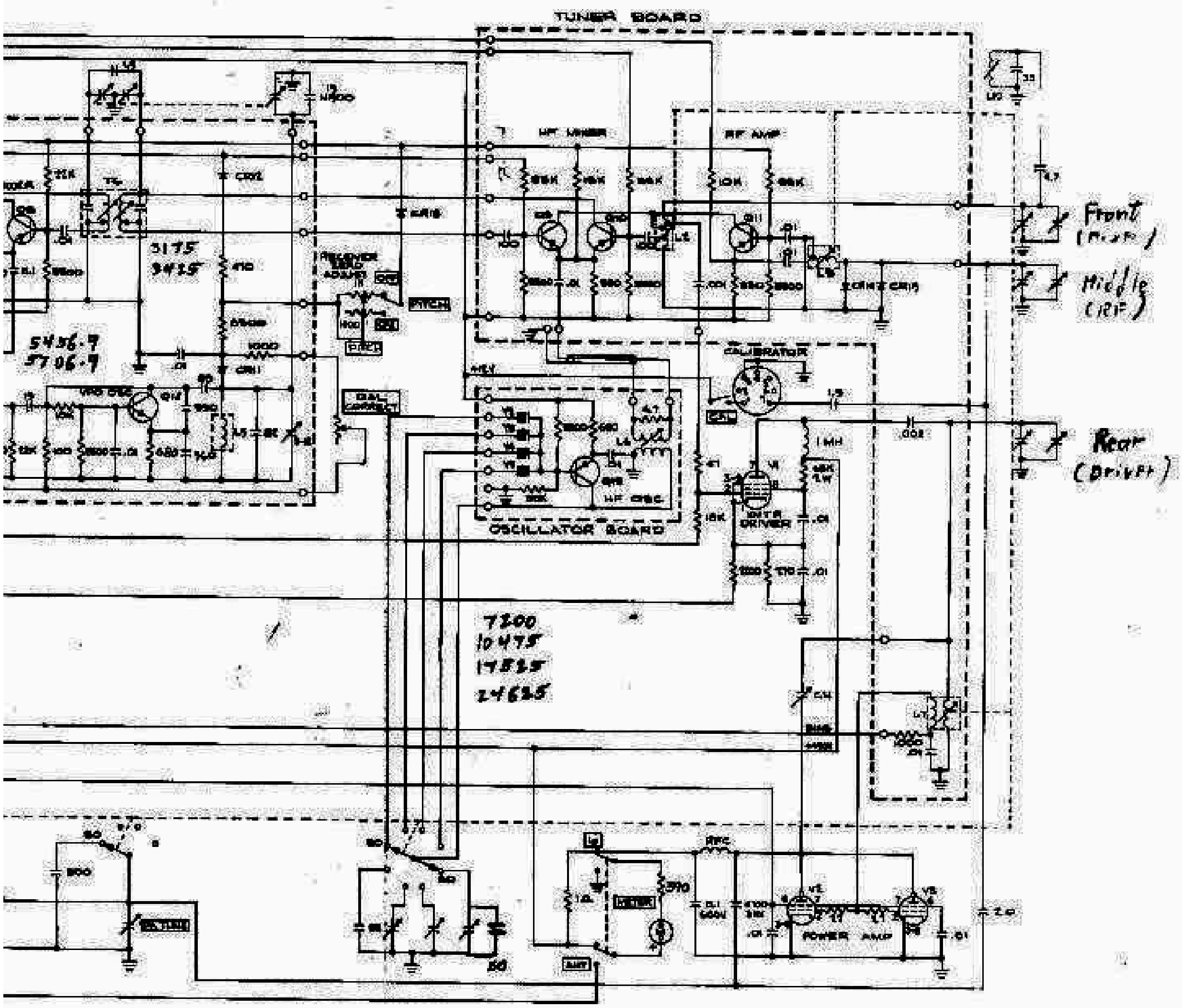
2N2926



CHASSIS, TOP VIEW

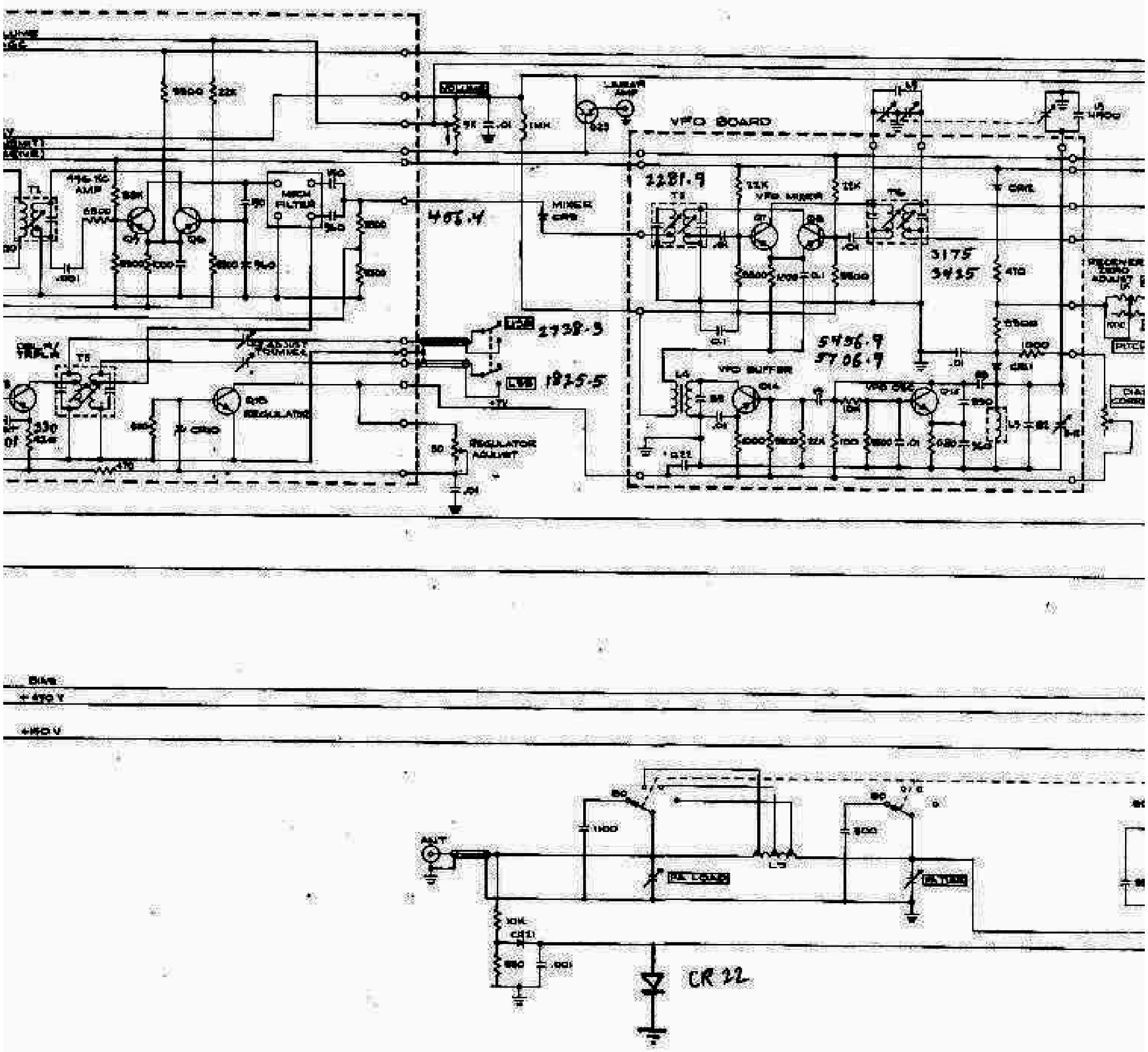


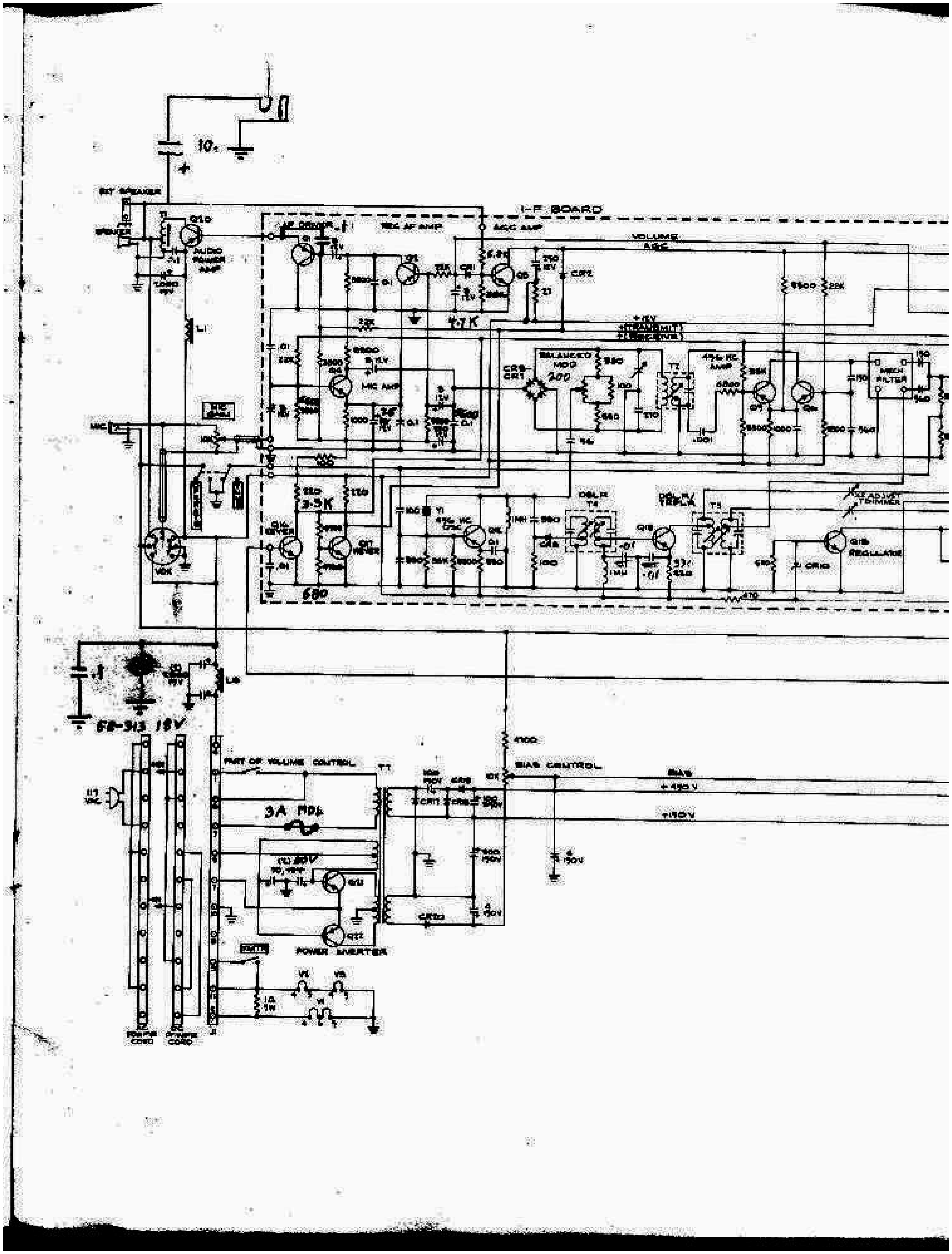
CHASSIS, BOTTOM VIEW



SCHEMATIC DIAGRAM SB-34

7267-8001
11-64


VFO BOARD
2281.9
VFO MIXER
VFO BUFFER
VFO OSC
3175
3415
5456.9
5706.9
496.4
2738.5
1825.5
MECH FILTER
MIXER
REGULATOR ADJUST
REGULATOR
ANT
PA LOAD
FILTER
CR 22
+470 V
+150 V



10
EXT SPEAKER
SPEAKER
AUDIO POWER AMP
I-F BOARD
AF DRIVER
REC AF AMP
AGC AMP
VOLUME
AGC
4.7K
+(TRANSMIT)
+(RECEIVE)
BALANCED MOD
200
MIC AMP
MIC GAIN
MIC
MECH FILTER
3.5K
680
VOX
REGULATOR
68-313 18V
PART OF VOLUME CONTROL
BIAS CONTROL
BIAS
3A MDL
POWER INVERTER