

PHONE PATCH switch, S2, is set to ON and the STATION CONTROL switch, S1, is turned to VOX OPERATE, audio output voltage from the 32RS-1 passes through an attenuating pad (R13, R14, and R15) to the primary of T2. The secondary of T2 is connected across a bridge circuit. Output from the bridge circuit is passed through a resistive pad and an r-f filter to the telephone line. Audio input voltage from the telephone line is passed through an r-f filter and the resistive pad to the bridge circuit, impressed across T1, and coupled through the STATION CONTROL switch, S1, to the microphone input of the 32RS-1.

Resistors R6, R7, R8, R9, and R10 along with capacitors C6 and C7 form a balancing circuit that operates with the 32RS-1 VOX GAIN control to prevent transceiver audio output voltages from operating the transceiver audio input circuits. The VOX GAIN control on Transceiver 32RS-1 and the 152J-1 balance adjustments, C7 and R10, are adjusted so that with normal receiver output voltages, the voltage appearing across T2 secondary is not strong enough to couple to the microphone input and trip the vox relays in the 32RS-1.

The TRANSMIT and RECEIVE positions of the STATION CONTROL switch, S1, allow transceiver operation when telephone input voltages will not permit normal vox operation or when it is desired to override the vox circuits. The TRANSMIT position of S1 grounds the grid and cathode of vox amplifier V8 in the 32RS-1 and couples audio input signals from T1 of the 152J-1 bridge circuit to the microphone input of the 32RS-1. The RECEIVE position of S1 grounds the grid of vox amplifier V8 in the 32RS-1 and shorts microphone input signals from the 152J-1.

The STATION MUTE position of the PHONE PATCH switch, S2, grounds the 32RS-1 microphone input, disconnects the received input signals from the 32RS-1, and disconnects the phone line. The OFF position of the PHONE PATCH switch, S2, disconnects the phone line and returns a ground to the 32RS-1 speaker. The 32RS-1 may be keyed, however, by turning the STATION CONTROL switch to TRANSMIT. The 152J-1 exerts no control on the 32RS-1 when the STATION CONTROL switch is in VOX OPERATE position and the PHONE PATCH switch is in the OFF position.

SECTION V MAINTENANCE

5.1 GENERAL.

This section contains trouble-shooting procedures, alignment instructions, and performance tests for Transceiver 32RS-1.

5.1.1 TEST EQUIPMENT.

The following test equipment items (or equivalents) are suggested for testing Transceiver 32RS-1.

- a. R-f signal generator, capable of 1.0 volt output.
- b. Audio signal generator, Heathkit AG-9.
- c. Vacuum-tube voltmeter, Hewlett-Packard 410B.
- d. 52-ohm load, Bird Model 820.
- e. Communications receiver - general coverage with S-meter, 51J-4.
- f. One 600-ohm, 4-watt resistor (two 270-ohm, 2-watt resistors in series).

5.2 INSPECTION AND LUBRICATION.

5.2.1 GENERAL.

It is suggested that at the beginning of station operation that the operator make a log of meter readings and output power level and that the operator continue keeping this log up to date. A comparative check of meter indications and output power level over a period of time will give an indication of over-all transceiver operation. Also, trading log information with other stations within the radio net helps in determining over-all equipment operation.

5.2.2 VISUAL INSPECTION.

Remove the covers from the 32RS-1, and make a visual inspection of circuit components and relay and

switch contacts. Remove any dust or dirt that may have accumulated.

5.2.3 PA CATHODE CURRENT CHECK.

Check power amplifier cathode current periodically by turning the meter selector to PA CATH MA. The meter should indicate S-1.5 to S-2 when unit is keyed and kick up to S-9 when talking into the handset. Abnormal meter readings indicate aging PA tubes, incorrect bias or plate voltage, possible alc circuit malfunction, PA screen or high-voltage fuses blown, or antenna changes.

5.2.4 LUBRICATION.

Lubricate blower motor and band-switch bushings, link, and detent every 2,000 hours. Use any good quality of motor oil.

5.3 TROUBLE ANALYSIS.

5.3.1 GENERAL.

Trouble analysis of Transceiver 32RS-1 is accomplished easily by measuring stage gain, checking for normal voltage and resistance readings, and other common trouble-shooting methods. Stage gain and voltage and resistance readings are incorporated on the 32RS-1 schematic diagram, figure 7-1. The following text provides trouble-shooting procedures for faults that could be encountered in the 32RS-1. It should be noted that voltage and resistance readings given in this section are nominal and may vary slightly from equipment to equipment.

5.3.2 WEAK TRANSMIT SIGNAL.

a. Attach a 52-ohm load (Bird model 820) to J5 of the 32RS-1, and check power output during transmit. If power output is near normal (100 watts PEP), check antenna feed-line system to see that an swr of 2.5 to 1 or less exists. If power output is less than normal, proceed to next step.

b. Key transmitter and measure the 455 kilocycles and channel injection oscillator voltages. Voltage at the wiper arm of R8 (455 kc) should be about 1.1 volts a-c. Voltage at either of the cathodes of V2 (channel injection) should be about 0.75 volt a-c. If either or both indications are abnormal, trouble-shoot oscillator circuits, and then proceed to paragraphs 5.4.9 and 5.4.10 for oscillator alignment procedures. If oscillator voltages are normal, proceed to next step.

c. Refer to paragraph 2.4, steps e through n, for tuning adjustments of the 32RS-1.

NOTE

Be careful that the transmitter is not tuned to the injection frequency. Transmitter is tuned to the injection frequency if the TRANSMIT AUDIO gain control has no effect on the amplitude of the output signal.

5.3.3 SPURIOUS SIGNAL RADIATION.

a. Spurious signal radiation may be caused by oscillations in the driver or power amplifier stages. Refer to paragraphs 5.4.2, 5.4.3, 5.4.4, and 5.4.5 for neutralization procedures.

b. Channel injection voltages will not hold when channels are changed. (These may vary over a 2-to-1 range due to normal crystal activity variations.)

c. If diode CR1 malfunctions, injection voltage for receive operation will not be at the proper level.

5.3.4 UNWANTED RECEIVER RESPONSE DURING TRANSMIT.

Any receiver response during transmit operation indicates that receive circuits are not being disabled. Check relay K2 and other vox circuits.

5.3.5 FREQUENCY DRIFTING.

- Check oven power circuits.
- Check ovens.

5.3.6 EQUIPMENT OFF FREQUENCY.

a. Check oven circuits.

b. Check crystal trimmers according to tuning instructions given in paragraph 2.4. If the crystal is off trim on any one channel, check the channel trimmer. If this is all right, the crystal has probably aged beyond its frequency tolerances.

5.3.7 POOR TRANSMIT AUDIO QUALITY.

a. Turn the meter selector to the ALC-S position. Talk into handset while observing alc action. If alc action is abnormal, check V18 and associated alc circuits.

b. Key unit and check for an indication of S-1.5 to S-2 when the meter is in the PA CATH MA position. If the bias voltage is too low, the PA tubes will be

driven into nonlinear operation. If the PA bias is too high, the life of the PA tubes is impaired.

c. Check r-f amplifier tubes.

d. Check crystal trim and tuning and loading adjustments on the driver and power amplifier according to instructions in paragraph 2.4.

5.3.8 SIGNAL DROPOUT DURING TRANSMIT.

a. Refer to paragraph 3.2, steps f and g for VOX GAIN and ANTI-TRIP adjustments.

b. Check vox circuits including V7B, V8B, V9, and relays K1, K2, and K3.

5.3.9 CONTINUAL RECEIVER SQUEAL.

a. Check filter components between the product detector, V14, and the audio amplifier, V15. Also check components between the product detector and V11 and V12.

b. Check i-f amplifier circuits for oscillations.

5.3.10 RECEIVER WEAK.

a. Check avc action according to paragraph 5.4.7.

b. If avc voltage is normal and signal is still weak, check the a-f stages and the product detector.

c. Check channel injection voltage at pin 2 of V11 for about 0.75 volt.

d. Check alignment of r-f stage according to paragraph 2.4.

NOTE

If it is noted that the receiver is weak immediately after tuning procedures have been completed, it is possible that the receiver is tuned to an image frequency. Repeat tuning adjustments. Be very careful that equipment is not tuned to the injection frequencies.

5.3.11 TRANSCEIVER 32RS-1 FAILS TO TUNE.

Check the physical alignment of switches S1 through S6 and S11 to see that one or more switches have not become misaligned.

WARNING

The plate amplifier shield should be securely in place for the following adjustments.

5.4 NEUTRALIZATION AND ALIGNMENT.

5.4.1 PRELIMINARY NEUTRALIZATION PROCEDURE.

Set the r-f driver and neutralizing capacitor (C47, figure 6-1) 45 degrees from minimum capacity, and set the feedback neutralizing capacitor (C48, figure 6-1) at one half capacity. Connect the 52-ohm load at antenna jack J1. Apply low and high voltage; then put the TUNE-OPERATE switch in the TUNE position and adjust the tuneup signal (transmit audio-gain control) for approximately five volts across this load, as read on a 410B or equivalent meter. Carefully peak all coils (antenna, r-f and PA tank) for maximum output, keeping the load power below five watts. If the equipment becomes unstable, as evidenced by a jump in

output voltage, adjust the feedback neutralizing capacitor slightly to re-establish stability.

5.4.2 R-F AMPLIFIER NEUTRALIZATION.

Open the feedback circuit by disconnecting the lead from the above chassis end of C50. Remove the plate and screen voltages from V3, and turn on the high and low voltages. With the 52-ohm load still in place, but with the 410B replaced by a 51J-4 or receiver of equivalent range, perform the following operations:

- a. Select a 12-mc channel using the tuneup oscillator for a forward signal.
- b. Using an insulated alignment tool, adjust C155 for a minimum S-meter reading.
- c. Repeak the r-f plate coil and repeat step b.

5.4.3 DRIVER NEUTRALIZATION.

a. Remove the plate and screen voltages from V4, apply plate and screen voltages to V3, and turn on the low and high voltages. The 52-ohm load and 51J-4 are connected as in paragraph 5.4.2. Again select a 12-mc channel.

- b. Using an insulated alignment tool, adjust C47 for a minimum S-meter indication.
- c. Repeak driver plate coil and repeat step b.

5.4.4 PA NEUTRALIZATION.

Remove plate and screen voltages from V5 and V6. Apply plate and screen voltages to both V3 and V4. The load and 51J-4 are connected as in paragraph 5.4.2. The transceiver is tuned to a 12-mc channel.

- a. Using an insulated alignment tool, adjust C114 (see figure 6-2) for a minimum S-meter indication.
- b. Repeak the PA tank circuit and repeat step a.
- c. Replace the 51J-4 with the 410B or equivalent. Apply high voltage, and set the tuneup signal for approximately five volts across the 52-ohm load. Repeak all coils for a maximum output indication.

5.4.5 FEEDBACK NEUTRALIZATION.

a. With the 32RS-1 tuned to the 12-mc channel, couple the antenna of a 51J-4 receiver to the plate of V3 through a 10-uuf capacitor. Connect a 22-uuf capacitor between the signal generator and the above chassis end of C50 (figure 6-1), the feedback-feedthrough capacitor. Leads should be short and the coax should be grounded securely.

- b. Key the transmitter. With the tuneup oscillator turned off and the channel crystal oven removed, tune the signal generator for a zero beat on the 51J-4 at 12 mc. Adjust the signal generator output until the 51J-4 S-meter rests at midscale or less. Using an insulated alignment tool, adjust C48 for a minimum change in S-meter indication as the driver grid coil is varied back and forth through resonance.
- c. Reconnect feedback lead to C50.

5.4.6 METER ADJUSTMENT.

- a. Turn OVENS and low-voltage (L.V.) switches on.
- b. After the warmup period, adjust the meter zero-adjust potentiometer (R16) for a zero reading on the meter, with the antenna shorted to ground.
- c. Turn the high-voltage (H.V.) switch on. Rotate the meter function selector through the +275 and -75 VDC positions. Meter should indicate S-9 $\pm 5\%$ on each position.
- d. Rotate the meter function selector to +800 VDC position. Meter should indicate between 59 and 20 db over S-9 when the 32RS-1 is unkeyed. Key the 32RS-1 and adjust the bias potentiometer (2R3) for a meter indication of between S-1.5 and S-2 when the meter selector is in the PA CATH MA position. The +800 VDC reading should then drop to near S-9 when the 32RS-1 is keyed.

5.4.7 RECEIVER I-F ALIGNMENT.

a. Inject a 453.5-kc unmodulated signal at the junction of C15-C16. This tie point is located just below pin 9 on V11.

b. Turn meter selector to the ALC-S position, and adjust T1 and both slugs of T2 for maximum indication on the meter.

c. Check gain through the receiver i-f stages by adjusting signal generator input until the meter indicates S-0. If signal generator input level is between 150 and 500 uv, the receiver i-f stages are operating properly. If an input signal of greater than 350 uv is required for S-0 indication, check V12, V13, and associated circuit components. The S-0 indication is at avc threshold.

d. Check avc action by adjusting signal generator input level until meter indicates S-9. If signal generator input level for S-9 indication is between 5000 and 35000 uv, the avc circuits are operating properly. If less than 5000 uv is required for an S-9 indication, avc circuits are malfunctioning; check V17 and associated circuit components.

e. Disconnect signal generator input, and check that the S-meter drops smoothly to zero with a time constant of about one-fifth second.

5.4.8 AUDIO AMPLIFIER AND 455-KC OSCILLATOR CHECKS.

a. With the signal generator still connected at the junction of C15-C16 and the injection level at avc threshold (S-0), turn up RECEIVER AUDIO GAIN, R84. A beat note between the 455-kc crystal oscillator and the 453.5-kc signal should be heard in the handset.

b. Turn SPEAKER on to check its operation.

c. Connect two 270-ohm, 2-watt resistors in series from C142 to ground. Connect a vtvm from C142 to ground. Capacitor C142 is located on the rear filter plate.

d. Sweep the signal generator across the "audio spectrum" (450 to 455 kc), then return the signal generator to the frequency setting that gives maximum output voltage.

e. With the SPEAKER off, increase the RECEIVER AUDIO GAIN to maximum. Output voltage should be not less than 27.4 volts. If the audio gain is low, check V14, V15, V16 and associated circuits.

5.4.9 CHANNEL INJECTION BALANCE.

a. Terminate the 32RS-1 with a 52-ohm load (Bird model 820). Remove the 455-kc crystal oven. Select the highest frequency channel being used. Turn the TRANSMIT AUDIO control to minimum, and select OPERATE at the TUNE-OPERATE switch.

b. Couple a general coverage communications receiver to the 32RS-1 output, and tune to the 32RS-1 frequency. Figure 5-1 is the suggested method of coupling the communications receiver to protect the receiver.

c. Adjust R14 and C25 for a minimum signal as heard on the communications receiver.

d. Select TUNE at the TUNE-OPERATE switch, and increase the TRANSMIT AUDIO control until 100 watts is indicated at the output load. When tuned to the channel frequency, the communications receiver S-meter should indicate an increased reading of at least 65 db over the transmitted signal level at the channel crystal frequency. If there is less than 65 db signal increase, channel injection balance adjustments should be repeated.



DO NOT run the 32RS-1 at full CW output power for more than 15 seconds at a time or the PA tubes may be damaged.

5.4.10 CARRIER BALANCE AND NOISE.

a. Terminate 32RS-1 with a 52-ohm load (Bird model 820). Couple the input of a communications receiver to the 32RS-1 output. Select a frequency on the communications receiver corresponding to the frequency selected at the CHANNEL SELECTOR. One channel is as good as another for this adjustment. Select OPERATE with the TUNE-OPERATE switch, and key transmitter by means of the handset push-button. Hold down the cradle switch, S10, to eliminate ambient noise pickup.

b. With no signal input and the TRANSMIT AUDIO control to minimum, balance R8 and C11 for minimum residual carrier.

c. Decrease coupling to the communications receiver until its S-meter indicates near the low end of the scale. Record S-meter indication.

d. Increase the gain setting of the TRANSMIT AUDIO control to maximum. Record communications receiver S-meter indication.

e. Return TRANSMIT AUDIO to minimum, and select TUNE at the TUNE-OPERATE switch.

f. Increase TRANSMIT AUDIO to a point where the 32RS-1 output is 100 watts PEP. Record communications receiver S-meter indication.

g. If residual carrier and noise levels (as measured in steps c and d) are not at least 50 db down from full power output operation (as measured in step f), repeat carrier balance adjustments, and check a-f input circuits for stray noise inputs.

5.4.11 TRANSMIT AUDIO AND VOX OPERATION.

a. Turn TRANSMIT AUDIO control to maximum (cw stop). Place TUNE-OPERATE switch in TUNE position.

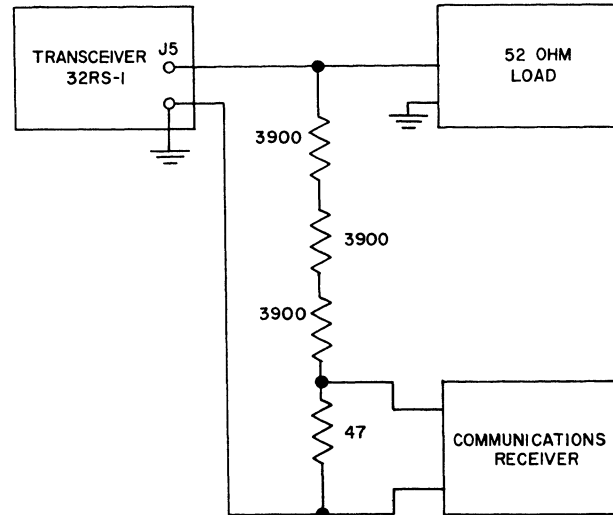


Figure 5-1. Test Equipment Connections During Balance Adjustments

b. Turn VOX GAIN clockwise, and check that vox relays operate before the knob pointer passes nine o'clock position. If operation is not normal, check V7, V8, and V9 tubes and circuitry.

5.5 PERFORMANCE TESTS AND ADJUSTMENTS.

5.5.1 GENERAL.

To determine that the 32RS-1 is operating properly, conduct the tests outlined in the following paragraphs. If test results indicate that corrective action is necessary, the last step of each test procedure gives instructions for corrective action or references this information elsewhere in this section. It is assumed that prior to testing, the tuning procedures outlined in paragraph 2.4 have been performed.

5.5.2 OVER-ALL GAIN, ALC, AND POWER OUTPUT CHECKS.

a. Terminate the 32RS-1 at J5 with a 52-ohm load. (Bird model 820). Select OPERATE at the TUNE-OPERATE switch. Attach an audio signal generator to the microphone input on the rear of the 32RS-1 (C146), and set frequency output to 1500 cps. Turn TRANSMIT AUDIO control, R35, to maximum.

b. Increase audio oscillator input until the meter reads S-3 in the ALC-S position.



DO NOT overheat the PA tubes.

c. Using an r-f voltmeter, measure the 32RS-1 output voltage. Output voltage should be not less than 72 volts. Input voltage required to produce 72 volts output should not exceed 0.1 volt.

d. Increase input voltage 6 db, and measure the 32RS-1 output voltage. Output voltage with the increased input level should not exceed two volts more than voltage measured in step c. The ALC-S meter reading for the increased signal level input should be between S-4 and S-8.

e. If power output does not meet specifications, proceed to paragraph 5.3.2 for trouble-analysis procedures.

5.5.3 RECEIVER OVER-ALL GAIN.

a. Turn RECEIVE RF gain R91 and RECEIVER AUDIO GAIN R83 to maximum. Turn SPEAKER to OFF. Terminate C142 with two 270-ohm, 2-watt resistors in series to ground.

b. For any channel selected, use a signal generator to inject a 1.0-uv signal at J5 of the 32RS-1. Vary the signal generator frequency to obtain maximum audio output voltage as measured with a vtvm at the load. Output voltage should be not less than 5.5 volts.



Be careful that the high-voltage switch is off while the signal generator is connected to J5 so that if the transmitter is keyed accidentally severe damage would not result to the signal generator.

c. If receiver gain is low, refer to paragraph 5.3.10 for trouble analysis.

5.5.4 RECEIVER SENSITIVITY.

a. TURN RECEIVE RF gain R91 and RECEIVER AUDIO GAIN R84 to maximum. Turn SPEAKER off. Terminate C142 with two 270-ohm, 2-watt resistors in series to ground.

b. For any channel selection, use a signal generator to inject a 1.0-uv signal at J5 of the 32RS-1. Vary the signal generator frequency to obtain maximum audio output voltage as measured with a vtvm across the load. Record this voltage.

c. Detune the signal generator input, and again measure the load voltage. The signal-plus-noise to noise ratio should be not less than 10 db. If the signal-plus-noise to noise ratio is too low, check alignment of r-f stages (refer to par. 2.4) or try changing r-f tubes.

5.5.5 MAXIMUM AUDIO POWER OUTPUT AND AVC ACTION.

a. Turn RECEIVE RF gain R91 and RECEIVER AUDIO GAIN R84 to maximum. Turn SPEAKER off. Terminate C142 with two 270-ohm, 2-watt resistors in series to ground.

b. For any channel selection, use a signal generator to inject a signal at J5 of the 32RS-1. Vary the signal generator frequency until output load voltage is maximum.

c. Increase signal generator input voltage until output load voltage is 13.8 volts. The ALC-S meter should read not more than S-6 and antenna input voltage should be from 1 to 7 uv.

d. If power output is low, refer to paragraph 5.3.10 for corrective action.

5.5.6 TALKOUT, VOX, ALC, AND ROUGH GAIN CHECKS.

a. Set the TUNE-OPERATE switch to OPERATE. Select any channel with the CHANNEL SELECTOR. Set the TRANSMIT AUDIO gain, R35, so alc kicks on voice peaks. Increase the VOX GAIN, R47, setting until normal vox operation is obtained, that is transmitter keys when operator speaks into handset.

b. Hold the handset about one foot in front of the speaker. Adjust the ANTI-TRIP control, R88, until no feedback occurs.

c. Speak into the handset, and check for normal vox operation. Repeat adjustments outlined in steps a and b.

d. Check that send-receive operation is smooth and quiet.

e. Check for alc action on all four channels, resetting the TRANSMIT AUDIO gain control as required. If no indication is obtained on a channel, repeat tuning procedures according to paragraph 2.4.

f. Listen to transmitter on a separate receiver.

5.6 TROUBLE ANALYSIS OF DIRECTIONAL WATT-METER 302E-2.

Unusual readings for forward and reflected power do not necessarily indicate a faulty instrument. The wattmeter may be reading the true conditions resulting from a faulty transmission line, antenna, or transmitter. If a fault in the instrument is suspected, connect the output to a nonreactive 52-ohm load such as a Bird model 820. When r-f energy is fed into the load from the 32RS-1, the forward power reading should be consistent with 32RS-1 power output (100 watts PEP) and the reflected power reading should be quite small or zero. Wattmeter calibration and accuracy can be checked by reversing the 302E-2 in the line and comparing the power readings on corresponding direction settings. The 302E-2 is reversed by switching the TRANS. and ANT. connectors. Under these conditions, forward power will be read when the switch is set to the REVERSE position and vice versa. Corresponding readings in the normal and reversed positions should be within $\pm 10\%$ of one another.

The value and placement of most of the parts in the coupler are critical. Replacement components must have the same tolerance, be of the same type, and be in exactly the same position as the original parts. Accuracy and calibration will be impaired if improper parts and placement are used. The types of parts and their tolerances are specified in section VI, Parts List. If any one of the selected resistors must be replaced, use the same value ($\pm 1\%$) of the original resistor. Faulty instruments can be returned to the factory for service, calibration, and adjustment at any time. If diodes are changed, rebalancing is necessary.



When packing the 302E-2 for shipment, pad the shipping container with abundant packing material to avoid shipping damage.

5.7 TROUBLE ANALYSIS OF PHONE PATCH 152J-1.

If the phone patch unit is not functioning properly, carefully check all adjustments as outlined in section III. Check all connections, plugs, etc., for open or shorted conditions. If the BALANCE controls, C7 and R10, do not yield sufficient isolation, check to make sure the telephone line is properly connected. Replacement components can be ordered from the factory by part number, as listed in section VI.