

Service Bulletin 11

For alignment new rules.

The minimum test equipment besides test cables.
are:

Any A.C voltmeter that can do audio, in Rms A.C . most can, all can today,
Most meters can do DC volts, any DMM sold can. really.
total cost \$20 on the walmart high end, pegs. in electric department.
The meter needs 1meg ohm input z or better, all do. so.... move on.

A scope if best, as it means you can even skip the above. A 1986 or newer scope is best!
and one calibrated, 10x best.

1 extender card.

1 external speaker 4- 8ohms. Z.

1 100 watt dummy , max out is 125watts on CW. I use a cantenna so never have to worry burning up a
gutless dummy sold seems everywhere.

1 antenna good for HF bands.

A PTT microphone, high z or better any Elecret MIC, and your rig wired for phantom power. easy.
A RCA phone plug, so you can test the CW key jack at he rear of the rig.

April 11, 1975

SB-104

Solid State Transceiver

Bulletin No:

SB-104-11

Check Out And Alignment Procedures

TEST EQUIPMENT REQUIREMENTS:

None of this is in the original book !
what they ment is needed for repairs..!

Oscilloscope: 15 Mhz vertical bandpass; triggered [IO-4510 or
better.]

best is a scope yes.
but most don't have
one.
best is your first buy!

RF Generator: Calibrated output attenuator; Frequency Range
3 to 30 Mhz [Radiometer MS-27G or equivalent.]

Audio Generator: 100 to 3000 Hz sine wave output; adjustable
output level [IG-18 or equivalent.]

100 Khz Crystal Calibrator: Harmonic output 100 Khz to 30 Mhz
[HD-20 or equivalent.]

VTVM: High input impedance [IM-18 or equivalent.]

the counter in the
radio has this.

AC VTVM: Calibrated in decibels [IM-38 or equivalent.]

Bench Supply: 13.8 VDC; less than 2% regulation, no load to 20 amps
[HP-1144 or equivalent.]

DC Voltage Supply: 0 to 11 V. at 1 amp [IP-28 or equivalent.]

Wattmeter: 150 watts at 50 ohms [HM-102 or equivalent.]

100w or more

Dummy load: 150 watts; 50 ohms resistive load [HN-31 or equivalent.]

PTT Microphone: High impedance, approximately 25K ohms
[HDP-21A or equivalent.]

any PTT , even a
electret mic

2 ea. Speaker: 8 ohms impedance [HS-24 or equivalent.]

Probes: 10:1 LC Probe [PKW-101 or equivalent.]

RF Probe [PK-3 or equivalent.]

VTVM Probe [PKW-4 or equivalent.]

Receiver: Monitor [SB-303 or equivalent.]

Monitor Scope: SB-614 ((Do not use SB-610)).

Assorted cables: See attached sheet for cables and test lead needed
for interconnecting test equipment and UUT.

SB-104 TRANSCEIVER AND TEST EQUIPMENT INTERCONNECTING CABLES

Part numbers of connectors, wire and cables needed to make the test cables
are listed at each part. the 134- part numbers are cable assemblies and it
is only necessary to add the specified connector to one end of complete
these cables.

Make about 6 "jumper leads" of various lengths to use for temporarily connecting circuit points together during troubleshooting. Install an insulator on each alligator clip.

Cable Assembly No: 134-237 'REC Jack to RF Generator'
[other end of cable has PN 438-4]

Cable Assembly No: 134-36 (2ea) 1. AC VTVM to Patch Out Jack
2. Audio Gen. to Patch in Jack
[other end of these cables has PN 438-30]

Cable Assembly No: 134-36 'HD-20 Xtal Cal. to REC Jack'
[other end of cable has PN 438-47/70-11 (on center conductor) & PN 260-16 with 73-34 insulator (on braid)]

Piece of cable [PN 343-2] 4' long 'Ant Jack to Wattmeter'
One end with connector 438-9 & insert 438-12, the other end with connector PN 438-4]

Piece of cable [PN 343-2] less than 5' 'Wattmeter to Dummy Load'
Both ends with connector 438-9 & insert 438-12.

Piece of red wire [PN 341-2] 4' long & black wire [PN 341-1] 4' long (IP-27 leads) one end of the wires has alligator clips [PN 260-16/insulator 73-34] and the other ends are crossed into a (dual banana plug) [PN 438-30].

SB-104 ALIGNMENT PROCEDURE

The following checks and alignment of the SB-104 transceiver is made with all circuit boards plugged in. Always turn the unit off when you remove or insert a circuit board.

INITIAL CHECKS

1. Depress the on button. Release all other buttons.
 - Pilot lamp lights.
 - Display lights.
2. Check for 4.5 volts DC [plus or minus .5 volts] at terminal B4 and 10.5 volts DC [plus or minus .5 volts] at B1.

Contradicts org. book telling you add boards and check voltages first to avoid damage. wise that is.

The 5vdc supply must be 4.75 to 5.25v or the TTL chips will fail. TTL does not run on 4v, sorry !

power off,

3. Set bandswitch to 3.5: Lift COUNTER Board [A] from connector pins.

power on...

- Display reads F FFF.F

4. Switch BAND switch through all positions, starting at 3.5. First digit should light in the following sequence:

BANDSWITCH	FIRST DIGIT
3.5	Blank
7.	Blank
14.	1
21.	2
WWV	1
28.	2
28.5	2
29	2
29.5	2

5. Depress the 100 Hz button.

- Digit on the right end of display extinguishes.

6. Plug in COUNTER board [A] and set BAND switch to 3.5. Lift the HFO/PRE-MIXER board [D] from connector pins.

- Release all pushbuttons except ON.

- Display reads 6600.0

- Depress USB switch; display reads 6603.6.

- Depress LSB switch; display reads 6606.4.

- Depress CW switch; display reads 6604.3.

- Plug in HFO/PRE-MIXER board [D].

7. Lift TX IF/PRE-DRIVER board [C] from connector pins.

- Check that the tips of choke L-311 on board C are not shorting against the shield.

8. Connect a microphone and depress the PTT switch.

- Receiver mutes.
9. Depress PTT switch on microphone and depress HI button.
 - T/R relay pulls in.
 - T/R relay drops out with PTT switch released.
 10. Depress VOX and HI buttons; speak into microphone and turn VOX GAIN control slowly CW.
 - T/R relay pulls in when speaking and drops out when you cease talking.
 11. Turn VOX DELAY CW and speak in microphone.
 - T/R relay holds for a length of time after you cease talking. The hold-in time will decrease as DELAY control is turned CCW.
 12. Release VOX button and check the voltage on the foils at L-952 and L-953 on the PA board.
 - The voltage on these foils is zero.
 13. Depress the TUNE button.
 - T/R relay pulls in; approximately .6 volts should be measured at the indicated foil patterns on the PA board.
 14. Release TUNE button.

HFO COIL ADJUSTMENTS

- Install HFO/PRE-MIXER board [D] on extender board.
- Set VTVM to +DC; 1.5V range.
- Connect the positive lead of the voltmeter to TP [free lead of 2200 ohm near Q402; and the negative lead to chassis.
- Adjust each HFO coil as described in the following chart. Each coil may peak at two points throughout its tuning range. Use the peak that occurs at the bottom of each coil. After the bottom peak is found, turn the slug CCW to zero volts. Now, turn the slug CW for peak voltage; typically .1V DC to .5V DC.

I just solder a wire to the 2.2k free standing resistor and avoid using the extender.

readout may appear at two positions of the coil slug. The correct position is where CCW rotation of the slug causes a lower frequency to be displayed.

- Reinstall and tune MAIN TUNING knob for display of 3800 KHZ.
- Remove MAIN TUNING knob.
- Depress USB button and record frequency display.
- Depress LSB button and adjust VFO SHIFT ADJUSTMENT (C1211) at hole ES with a small screwdriver. Remove the screwdriver after each adjustment and check the frequency. Adjust C1211 until the LSB frequency is the same as the USB frequency. Check 3500 KHZ and 4000 KHZ. The side band shift should be less than plus or minus .5 KHZ at each point.
- Reinstall customer's black tape over holes ES and ET; reinstall MAIN TUNING knob and tighten the two set screws.
- Check stability of frequency display at all positions of the bandswitch. Turn the VFO LEVEL ADJUST slight CCW to stabilize the display as necessary. Adjusting this control beyond the point necessary for a stable display will increase noise and birdies.

RECEIVER ALIGNMENT

Preselector BPF And 8.65 BPF Alignment

- Set transceiver controls as follows:

Bandswitch - 3.5
RF Gain - FCW ← max noise
ALC Button - IN
USB Button - IN
AGC - OFF
ANT Switch - SEP ← there is no antenna here
LEVEL - FCCW

- Install RECEIVER FRONT END board (G) on an extender board.
- Connect 100 KHZ crystal calibrator to REC antenna jack.
- Connect AC VTVM to PATCH OUT jack.

a \$60 tool ,oops!

Any scope or a.c. voltmeter works here. this is low z speaker driver so there is no worrisome loading effects, only needs to know what -10dBm means? next.

URL

- Set AC VTVM range switch to .1 V.
- Adjust AF gain control for a -10 dB reading on the meter scale (noise output).
- Turn transceiver to calibrator harmonic at 3800 KHZ. Turn to the high side of receiver bandpass (high pitched beat note) until AC VTVM indicates -5 dB.
- Adjust the three PRESELECTOR BPF trimmers for maximum indication on AC VTVM.
- Tune transceiver to calibrator harmonic at 3500 KHZ and adjust LOW END trimmer for maximum output.
- Adjust trimmers at coils L725 and L726 (8.65 BPF) for maximum output. Adjust these trimmers for the most uniform response across the 80 meter band.
- Follow the same procedure and adjust the PRESELECTOR BPF's for the 40 through 10 meter bands. Refer to the chart below for the location of the trimmers and the three frequencies used for the adjustment of each filter. Do not adjust the trimmers at coils L725 and L726.

-10dBm is easy to see using rms volts. on any meter. it's 0.25v rms on meter or 1.414 times more on scope for peak. easy no? be sure to use 600ohm rules, not RF 50.

Here is dBm list
 0dbm = 0.77v rms
 -5 dBm= .44v
 -10dBm= .25v rms
 on any scope, multiply rms times 1.414 for peak. I use a scope for all this. its 10x more easy to use.

[[Looking at component side of Board G, where coils L725 and L726 are in the upper left-hand corner of the board, there is shown (5) rows of 3-trimmers on the right 2/3 of the board. Trimmer L704 is shown at the extreme lower left corner of the board. Again looking at the board - component side - the 3 trimmers are, reading from top to bottom::

MATCHING TRIMMER	HIGH END TRIMMER	LOW END TRIMMER	BAND SWITCH
	29.0-29.5		
	28.0-28.5		
	21.0		
	14.0		
	7.0		
	3.5]]		

[[The next chart shows mid-band adjustments for the 3 trimmers:

| F R E Q U E N C I E S

BAND	MID-BAND (ADJ. 3 TRIMMERS)	LOW END	HIGH END
29.0			
29.5	29400	29000	29700

28.0			
28.5	28400	28000	29000

21.0	21100	21000	21400

14.0	14200	14000	14400

7.0	7100	7000	7300

3.5	3800	3500	4000

[[Hope this can be followed, please advise if not]]

3.395 MHZ Receiver Trap Adjustment

- Connect RF generator to REC antenna jack and AC VTVM to PATCH OUT jack.
- Tune generator to 3.395 MHZ and tune transceiver to 3.5 MHZ.
- Adjust trimmer capacitor at L704 of RECEIVER FRONT END board (G) for minimum output.

NOTE: Due to the location of the 3.395 trimmer, this adjustment is hard to get at. The board (G) will have to be removed and the trimmer adjusted in increments until the correct setting is reached. The position of the trimmer of L704 will be changed in future runs for easier access to the adjustment.

- Reinstall FRONT END board (G).

S Meter Adjustment

Amazing at it is, the org. book page 245 shows using no SIG_GEN and card D removed and signal nulled. Using the S-meter in the panel. now this SB11 needs a \$4000 signal Gen. are they kidding? and no longer sold VTVM. wow!

Amazing #1 the first step in this procedure tells us its extended on a extender card. so in fact is super easy to reach. if \$60 tool is owned.

- Set the generator and transceiver to 3800 KHZ.
- Set AGC switch to FAST.
- Set the generator output for 50 uV and tune the receiver for maximum output.
- Adjust the S Meter LEVEL ADJUST on the RECEIVER IF/AUDIO board (F) for an S-9 reading on the S meter.

Receiver Sensitivity Measurement

The receiver sensitivity is specified at less than 1 uV for 10 dB signal plus noise-to-noise ratio.

- Set the controls of the transceiver as follows:

Bandswitch - 3.5
 RF Gain - FCW
 USB Switch - IN
 AGC - OFF
 ON Switch - IN

- Connect AC VTVM to PATCH OUT jack.
- Connect generator to REC Antenna jack.
- Set generator for unmodulated RF to 50 uV output.
- Tune generator and transceiver to center of band [3800 KHZ].
- Reduce generator output to zero.
- Set AC VTVM range switch to .1 V.
- Adjust AF GAIN control for a -10 dB reading on the meter scale [noise output].
- Increase generator output and tune the receiver for a maximum indication of 0 dB on the AC VTVM [signal plus noise output].
- If the output of the generator is 1 uV or less, the receiver is within specifications.
- Check the sensitivity of the remaining bands.

using my URL above we do the math. +10dBm is what? but is now 50ohm rules 0.707vrms, or 1.0v peak on any scope. This is NOT alignment it is just an random check of MDS. so skip this and the \$4000 Sig-gen, now. Best is to jump past here if your have good DX, now. you do . I bet.

NOTE: The sensitivity of the receiver on the 20 meter band can be improved by a slight toughup adjustment of HFO coil L405. This is the only band that a noticeable increase in sensitivity is achieved by a touch of the HFO coils.

8.64 MHZ IF Rejection Check

The IF rejection is specified at -60 dB.

- Set bandswitch to 7.
- Connect RF generator to REC antenna jack and AC VTVM to PATCH OUT jack.
- Tune receiver and generator to 7.25 MHZ.
- Make sensitivity measurements and note generator output reading for a 10 dB S+N/N.
- Tune generator to 8.65 MHZ and increase generator output until the VTVM reading is the same as obtained in the sensitivity measurement.
- If the generator output was increased 60 dB or more to obtain the same VTVM reading, the IF rejection of the receiver is within specifications.

Again, this is NOT and alignment step. jump past all this. and save a fortune on signal generators, real.

10dBm = 0.7v rms

-60dBm= 0.0002236v-rms

NOTE: If on 50 dB of rejection is obtained during this test, check that coils L1 or L3 are not shorted to the chassis or across the lugs of terminal strip AE. To prevent a short at these points, dress the coils away from the lugs of the terminal strip and place a piece of fish paper between each coil and chassis.

COUNTER CLOCK CALIBRATION

- Connect antenna to REC antenna jack.
- Set bandswitch to WWV (15000 KHZ) or 7 (CHU, Canada, 7335 KHZ).
- Tune to zero beat station selected.
- Adjust the MAIN TUNING until the voice announcements sound natural.
- Adjust the TIME BASE TRIMMER capacitor on the upper right hand corner of COUNTER board (A) for a readout of 15000.0 or 7335.0.

wow back on topic, ALIGNMEMNT or aka, CALIBRATION. Look , ma, no tools just 1 antenna.

needs no tools at all...well a dummy load.
Once past the "G" card its smooth sailing

TRANSMITTER ALIGNMENT

Low Power Transmitter Check

- Check that the coil slug of L321 on the TX IF/PREDRIVER board (C) is flush with the bottom of the coil form and reinstall this board.
- Connect a wattmeter and a 100 watt dummy load to ANT jack.
- Set controls as follows:

BANDSWITCH - 3.5
LEVEL - FCCW
SIDETONE - FCCW
ANTI-VOX - FCCW
PWR, TUNE and ON button - IN
All Other Buttons - OUT

CAUTION: Never change bands when the TUNE button is IN.

- Advance LEVEL control and check for power output at the middle of the band and within 25 KHZ of the lower and upper band edges. Panel meter will read about 1 on the relative power scale; 1 watt or greater on the wattmeter. The meter should not deflect when the band-switch is set to WWV.
- Release TUNE button and set the bandswitch to the next higher band. Check the output at the middle and each edge of all bands.
- Depress the ALC button and advance the MIC/CW LEVEL control. The ALC meter should show a full scale indication as the LEVEL control is advanced on all bands.
- Turn AF GAIN control to 9 o'clock and advance SIDETONE control for a comfortable listening level.

10 Meter IF/PREDRIVER Filters Adjustments

- Set transceiver controls as follows:

BANDSWITCH - 28
ALC BUTTON - IN

- Connect dummy load to ANT jack.

- Tune the transceiver to 28.1 MHZ.
- During the following coil adjustments, the ALC indication will vary with the setting of the LEVEL control. Keep the meter reading at mid-range.
- After each coil is adjusted, turn the LEVEL control FCCW. The ALC meter indication must drop to zero.
- Refer to the pictorial below for the location of each coil on the TRANSMITTER IF/PREDRIVER board (C).

[[[Looking down at the this board, the 3.395 MHZ coil (L321) is at the top of the board, far righthand side. The other coils are [reading from left to right:

L309 [29.6], L310 [28.1], L320 [29.6], L319 [29.1] and then and the extreme right edge, L321 [3.395 MHZ]]]]

- Depress TUNE button and peak coil L310 [28.1 MHZ].
- Release TUNE button.
- Set bandswitch to 29 and tune to 29.1 MHZ.
- Depress TUNE button and peak coil L319 [29.1 MHZ].
- Release TUNE button.
- Set bandswitch to 29.5 and tune to 29.6 MHZ.
- Depress TUNE button and peak coils L309 and L320 [29.6 MHZ].
- Repeat the preceding steps until maximum output is obtained across the 10 meter band.
- Release TUNE button.

CW Check

- Connect wattmeter and dummy load to ANT jack.
- Connect speaker to SPKR jack.
- Plug key into KEY jack. A positive voltage is present at this jack so

the leads of any "grid block keyer" must be reversed.

- Set the controls as follows:

BANDSWITCH - 7
LEVEL - FCCW
PWR, VOX, CW and ON BUTTON - Depressed.
All Other Buttons - Released.

- Tune to 7000 KHZ.
- Close the key. The panel meter should read between 1/2 and 1 as the LEVEL control is advanced.
- Adjust SIDETONE Control for a comfortable volume level.

P. A. Circuit Board Check

CAUTIONS:

1. Check that all five cables in the P.A. compartment are properly connected. If an error is made at this point, you may have to replace the four power transistors.
2. Whenever the transceiver is operated in both HI power and TUNE, the duty cycle requires an OFF period [receive mode] of five times the TUNE time. [Example: 10 seconds TUNED followed by 50 seconds with TUNE button released]. This must be carefully observed in the following steps. Complete duty cycle information is given in the "Operations" section of the SB-104 Operations Manual, Page 261.
3. Do not exceed 30 seconds in the HI power and TUNE modes.
4. Read the following nine steps before proceeding to make the P.A. circuit board check.

- Set front panel controls as follows:

LEVEL - FCCW
BANDSWITCH - 7
VOX DELAY - FCCW
PWR, USB, HI and ON BUTTONS - Depressed
All Other Buttons - Released

- Connect a wattmeter and dummy load to the Ant Jack.

- Depress the TUNE button.
- In the following steps, turn the LEVEL control FCW only when making a check. Return the LEVEL control to the FCCW position after a check is made.
- Advance the LEVEL control. The panel meter should read above 12 on the upper scale. The wattmeter should read 80 to 125 watts.
- Depress the ALC button. The panel meter should read not less than full scale.
- Rotate LEVEL control FCCW; ALC meter should read between no deflection and 3.
- Release the TUNE button.
- Perform the preceding five steps at 20 through 10 meter positions of the band switch, being careful to observe the duty cycle. There should be no output at the WWV position.
- Perform the following 3.395 trap adjustment. Then, repeat the last five steps of the P.A. check at the 80M position.

3.395 Trap Adjustment

- Set the bandswitch to 3.5 and tune transceiver to 3500 KHZ.
- Depress PWR, HI and TUNE buttons.
- Turn the MIC/CW LEVEL FCW.
- Adjust coil L321 on the right side of the TRANSMITTER IF/PREDRIVER board (C) for a dip in the power output. Then adjust the coil CCW until the power output is 80 watts.

SWR "Power Down" Check

- Turn unit off.
- Interchange the IN and OUT plugs on the ALC/FILTER board (K).
- Depress the TUNE and ON buttons.
- Turn the LEVEL control CW.

- Output should be "powered down" considerably (Wattmeter should indicate approximately 15 watts output).
- Reinstall the IN and OUT plugs in their proper jacks.

Carrier Suppression

Transceiver carrier suppression specification is 50 dB down from 100 Watts.

- Connect the wattmeter and dummy load to the ANT jack.
- Connect the microphone.
- Turn the bandswitch to 7.
- Turn the MIC/CW LEVEL FCCW.
- Depress the PWR, USB, HI and ON buttons. Other buttons released.
- Connect an RF probe to the OUT jack of the ALC/FILTER board (K).
- Key the transmitter with the PTT switch for short periods and alternately adjust R666 and C649 on the CARRIER GENERATOR/XTAL FILTER board (E) for the best possible null as indicated on the VTVM. Carrier suppression is within specifications if this voltage is 2/10 volts or less when the power output in the HI power mode is 100 watts.
- Depress the LSB button. If the meter indication is any higher, make the best possible compromise adjustment between USB and LSB.

ALC Metering Check

The operator of the transceiver is instructed to adjust the ALC meter for a total change of 6 units on voice peaks. Either low power output or sideband 'splatter' will result if 100% modulation does not occur at the 6 unit difference point.

- Connect monitor scope [SB-614] and dummy load to the ANT jack of transceiver.
- Depress the PWR, VOX, CW and ON buttons.
- Depress the HI button and advance the LEVEL control only to the point where the meter reading ceases to increase. Note the height of the CW

pattern on the monitor scope.

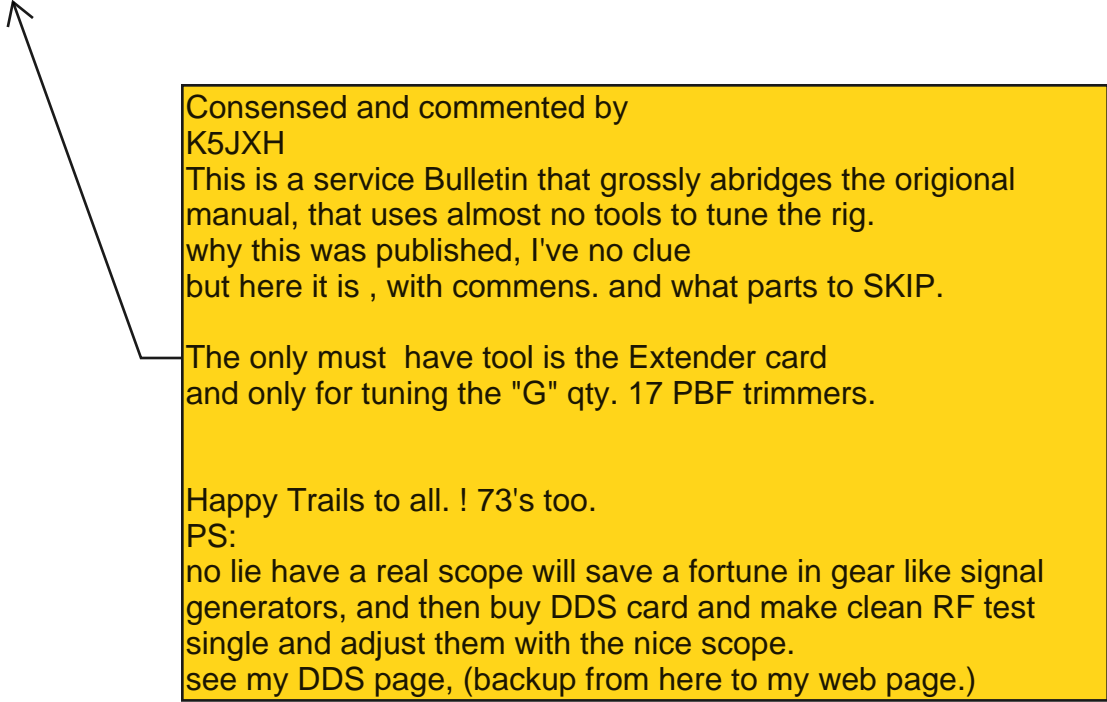
- Turn LEVEL control FCCW.
- Depress the HI, ALC, USB and ON buttons.
- Depress PTT switch on microphone.
- Speak into the microphone and advance LEVEL control until voice peaks obtain the same height as the CW signal. The peaks of the signal should be sharp, [giving a 100% Modulation Voice Pattern].
- The panel meter should indicate the total change of approximately 6 units on voice peaks. Advancing the LEVEL control beyond this point should result in overmodulation [as indicated on the monitor scope].

SERVICE HINTS

1. When connecting probes to a circuit for tests, connect the ground lead of the probe as close as possible to the point of measurement. This will minimize the signal pickup in a ground loop.
2. Check all coax cables used in the unit for proper grounding of the shields. Tighten the hardware used to mount solder lugs on the chassis and check the solder connection of each coax shield.
3. If the second harmonic content of the output signal in the high power mode exceeds specifications, check for interchanged 100 ohm and 10 ohm resistors on the P.A. circuit board.
4. To eliminate or confirm the ALC circuit as a cause of low power output, connect a jumper wire between pin 5 of the transmitter IF board and the 5 volt line. This will allow the transmitter amplifier stages to operate at maximum gain, causing the output power to increase to 175 watts. If a problem exists in the amplifier stages, the power output will remain low. If the power output increases to 175 watts, this would indicate a problem exists in the ALC circuits.
5. If power output is normal on the 10 through 40 meter bands, but low on the 80 meter band, with the power output decreasing as you tune from the high to the low end of this band, check for and remove a jumper wire between lugs 2 and 3 of bandswitch S1C. This wiring error will also cause C957 and C963 [25 uF electrolytics] on the P.A. board (H) to overheat.
6. Each "S" unit on the S-Meter is approximately equal to 3 dB.

7. If the VFO frequency shifts when transmitting, check the 11 volt line for proper regulation (10.75 VDC; +/- .5V] and zener diode ZD1201 for proper type [PN 56-19; 9.1V].
8. The VFO output voltage on 80 meters can be measured directly with an IM-28 VTVM set to 1.5 VAC range. Approximately .5 RMS can be measured at PL201, pin 1 (coax center lead).

END all Alignmentts and CALIBRATIONS.



Consensed and commented by
K5JXH

This is a service Bulletin that grossly abridges the original manual, that uses almost no tools to tune the rig. why this was published, I've no clue but here it is , with commens. and what parts to SKIP.

The only must have tool is the Extender card and only for tuning the "G" qty. 17 PBF trimmers.

Happy Trails to all. ! 73's too.

PS:

no lie have a real scope will save a fortune in gear like signal generators, and then buy DDS card and make clean RF test single and adjust them with the nice scope. see my DDS page, (backup from here to my web page.)