TUNE-UP OF PCL-303

Power Amp.

The following procedures should be carefully adhered to, to achieve optimum performance of the power amplifier cavities. As a preliminary check, it is advisable that the AFC of the transmitter is locked and that the output of the multiplier stage is clean and free from spurs. This can be done by removing the coaxial cable connecting the output of the multiplier stage, J202, from the power amplifier cavity input, J301, and installing in its place a 50Ω load with a sampling device such that the output of the multiplier stage may be observed on a spectrum analyzer. If the multiplier output is free of spurs at this time, it may be reconnected to the input of the power amplifier and the adjustment procedure of the amplifier begun.

Prior to the actual tuning, the special BNC adaptor should be constructed so that it may be installed in place of the varactor, CR301.

The first requirement in the procedure will be to remove the RF power amplifier cavity from the chassis frame. This may be done by disconnecting the coaxial cable from J301. Then, remove the five screws which hold the power amplifier cavity base plate to the mounting frame. The only thing now attaching the cavity to the chassis will be the wiring to the 28 volt input of the power amplifier cavity. This may be left attached and the cavity swung free from the rest of the chassis. Next, remove the screws that secure the base plate to the cavity itself and remove the base plate. You now have access to the adjustments inside the power amplifier cavity. The next step will be the removal of the varactor and the mount that holds it in place. By means of the access hole on the side of the cavity assembly, loosen the 4/40 Allen screw holding the tip of the varactor in place. This will require a 0.050 wrench. Next, loosen the two 4/40 screws which are holding the varactor mount through the upper portion of the power amplifier cavity. As these screws are removed, the varactor will come loose from the crosspiece in the cavity holding it. As you remove the varactor fixture, be very careful not to exert excessive side force on the varactor. The body of the varactor is ceramic and is very easily broken. Next, place the special BNC adaptor in place of the varactor fixture and secure it with the two screws used to mount the varactor fixture. Tighten the 4/40 Allen screw to secure the wire coming from the bottom of the special adaptor into the varactor crosspiece. Next, connect a wattmeter and the RF load to the special BNC adaptor on the power amplifier chassis. Insert a 15 watt 200 to 500 megacycle element in the wattmeter. If available, a 10 watt 400 to 1,000 megacycle element may be used in the 300 megacycle region with only minor inaccuracy. Set the variable capacitors in the power amplifier as closely as possible to the position shown in the power amplifier component location diagram. With a voltmeter connected to the 28 volt supply as a monitor, turn the transmitter on and adjust the supply voltage for 20 volts DC. Using the front-panel multimeter of your PCL-303 Transmitter, select the IPA CURRENT position. With a completely non-metallic screwdriver, adjust C301 and C304 until some output is observed. Adjust C304 for a maximum reading on the front-panel meter. When adjusting C304 through a peak in IPA CURRENT notice that the current will change more rapidly when adjusting from one direction than when adjusting from the other direction. Set the capacitor near the peak IPA CURRENT slightly on the slow side. Now adjust C306 for the first peak in collector current which occurs when increasing the mesh between the capacitor plates from the open position. Adjust

C305 for maximum IPA collector current. Adjust C307 for maximum IPA collector current without deviating appreciably from the capacitor setting shown in the power amplifier component location drawing. Next, adjust C310 for the first increase in power output when tuning from minimum capacity. Keep the capacitor slightly on the mesh side for the peak in power output. Adjust C311 for an increase of power output as shown on the wattmeter staying on the meshed side of the peak. Set the transmitter front-panel meter switch to final current. In this position of the meter switch, 100 on the meter is equal to 1 ampere. Adjust C314 for maximum power output and minimum IPA collector current leaving the capacitor on the meshed side of the peak in the output power. Adjust C315 for maximum power output. Increase loading on the power amplifier by adjusting C316 for an increase in power output while staying on the meshed side of the peak. At this point the power output should be between 3 watts and 6 watts. Next, remove transistor Q203 from its socket in the multiplier strip. The reading on the wattmeter should go to zero. If it does not, the amplifier is oscillating and the above procedure should be reinitiated by resetting the variable capacitors to the position shown on the power amplifier component location diagram. Replace Q203. If the power amplifier is not oscillating, readjust the power supply now for 26 volts. With the front-panel switch in the FINAL CURRENT position, as the supply voltage is being brought up, observe that the final current does not exceed 800 milliamperes for any extended period. Adjust C314 for maximum power output and minimum collector current. Keep the capacitor on the closed or meshed side of the first peak in power output when tuning from minimum capacity toward an increase in capacity. Adjust C315 for maximum power output. Increase the loading on the power amplifier by adjusting C316 for an increase in power while staying slightly on the meshed side of the peak in power output. Readjust C310 and C311 in that order remembering to keep on the closed or meshed side of the first peak in power output when tuning from minimum toward maximum capacity. Readjust C306, C305, and C307 in that order remembering to keep C306 and C307 on the closed or meshed side of the peak in power output. Readjust C304 for maximum power output. The proper setting of C304 is a compromise between maximum power output and greater temperature stability which results from leaving the capacitors slightly on the slow side of the peak in power output. From this point on, further increases in power output at the proper frequency can be accomplished only by a careful trade-off between the settings in each matching network. The object, of course, is to increase the coupling or matching between each stage of amplification while maintaining resonance and stability. In general, capacitors C307, C311, and C316 act as loading controls with an increase in loading coinciding with a decrease in capacitance. If the loading on any stage is too heavy for the degree of resonance and matching achieved, the circulating currents in the network will be excessive and lead to unstable operation or oscillation. Capacitors C306, C310, and C314 form a reactive combination with their associated series inductors which can be either capacitive or inductive. In the properly tuned state, these combinations should be an inductive reactance. For this reason, the settings of these capacitors should be kept at the greatest capacitance consistent with the desired on frequency power output. When operating power has been achieved, the settings of all the capacitors should not vary more than slightly from those pictured in the power amplifier component location diagram. In summary, when tuning the power amplifier, keep in mind that each of the capacitors in a compartment form a matching network designed to couple the relatively high output impedance of the previous amplifier to a lower input impedance of the succeeding amplifier. It is impossible to achieve a perfect match in one network and then proceed to the next network since impedances are reflected back through the amplifier. For this reason, the proper match between each stage must be approached in ever decreasing increments until an overall match between all of the stages is achieved. If, for example, the adjustment of a capacitor will produce a maximum increase in power output of 2 watts in any stage in the tuning, that capacitor should be set for an increase of approximately 1 watt on the side of the 2 watt peak where the capacitance is relatively greater. This approach of ever decreasing increments of improvement in power output will avoid the instability problems resulting from overcoupling and excessive circulating currents in the matching network. When properly tuned, the power amplifier is capable of developing a power output of 13 to 15 watts in the 315 megacycle region. A considerable increase in reliability may be achieved however by reducing the power output somewhat. To accomplish this, decrease the power output approximately $\frac{1}{2}$ watt by adjusting C304 more on the slow or soft side of the peak power output. Increase the capacitance of C314 slightly. Observe that the power output drops slowly while the IPA collector current drops at a faster rate. We are now ready for the installation of the tripler diode. When proper power output of the power amplifier has been achieved, turn off the transmitter and disconnect the wattmeter and load. Set capacitor C314 and C316 to the varactor settings shown in the RF power amplifier tripler component location diagram. Remove the special BNC adaptor and replace the varactor fixture and mounting screws.

CAUTION: Do not overtighten the 4/40 Allen screws securing the varactor diode. Replace the power amplifier bottom plate. Connect the wattmeter and RF load to the antenna connection on the rear of the transmitter cavity. Insert a 400 to 1,000 megacycle 10 or 25 watt element in the wattmeter. Set the adjustment screws of C317, C319, C320, and C321 flush with the top of the capacitor. Turn each of these capacitors two turns clockwise. Turn the transmitter power on and set the power supply voltage once again for 20 volts. Turn the meter switch to FINAL CURRENT. If the power amplifier current is greater than 800 milliamperes, adjust C314 slightly clockwise for less PA current. Adjust C317, C319, C320, and C321 in sequence for maximum power output. These adjustments should not vary more than 1 quarter turn in either direction from their previous setting. Repeat the above adjustments. Adjust C314 for maximum power output consistent with minimum power amplifier collector current. Adjust C316 and C314 alternately and repetitively for an increase in power output. Retune C317, C319, C320. and C321. When the power output is above 4.5 watts and not until it is above this value, carefully tune C310 and C311 and then C306, C305, and C307 in that order for maximum power output. Readjustment of these capacitors should not vary more than 5 degrees from their previous settings. Careful adjustment, however, can increase the output power by as much as 1 watt. It is not necessary to readjust C301 and C304. Readjust the output cavity capacitors once more. At this point, the output power should exceed 5 watts. Watching the power amplifier current, adjust C314 clockwise until the power drops slightly and the power amplifier collector current is around 750 milliamperes as read directly on the front-panel meter. Now, readjust the power supply for approximately 26 volts and repeat the above procedure. At this time the peak power should be approximately 8 watts with a power amplifier current of 750 milliamperes. Observing the power output sample with a spectrum analyzer, determine that there are no miscellaneous spurs present on the power output. If there are, these may be reduced by careful tuning of capacitors C321, C320, C319, and C317. Any spurs present should be 60 dB or less. Note that all of the capacitor adjustments operate smoothly through a peak and do not act as a switch. Once you have achieved maximum power output from the cavity, it may be reinstalled in the main frame. Adjust R310, the RF output indicator, to correspond with the output level calibration curve. This completes the field adjustment tune-up procedure for the PCL-303 power amplifier cavity.

VM/br
12/72

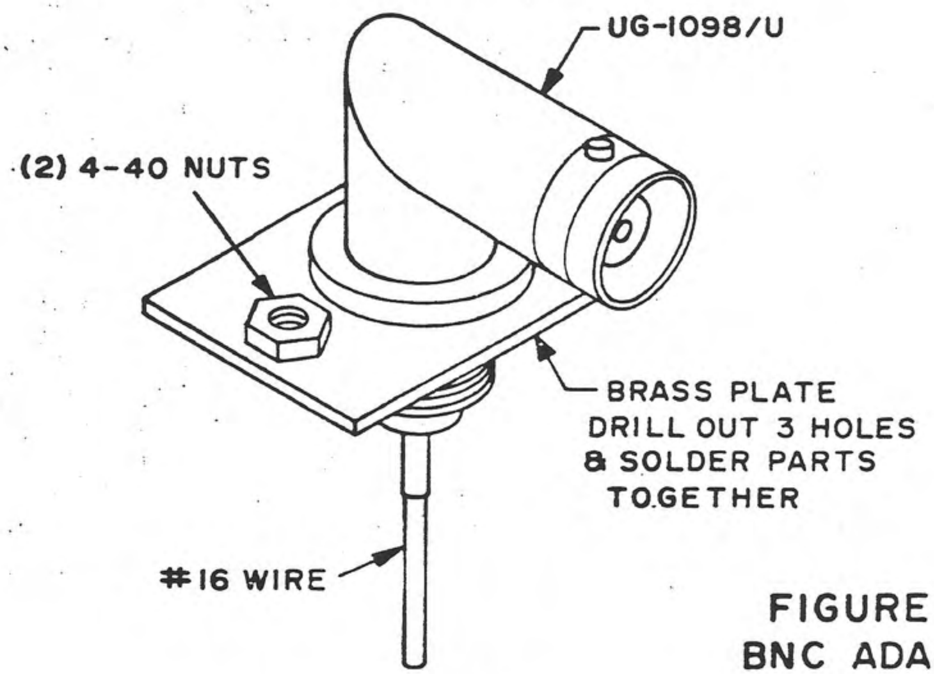
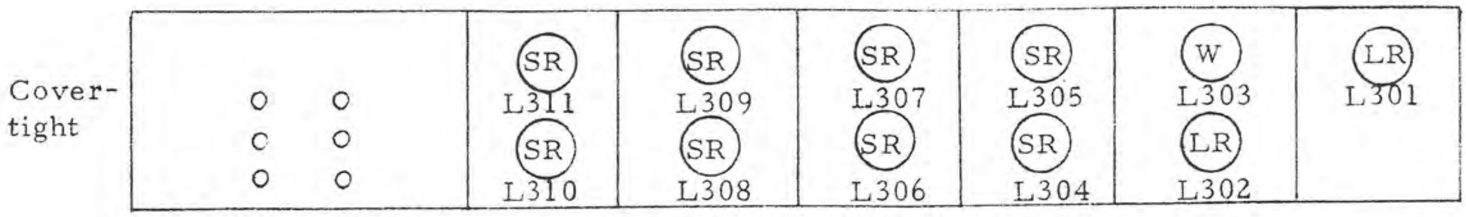


FIGURE 4-1
BNC ADAPTER

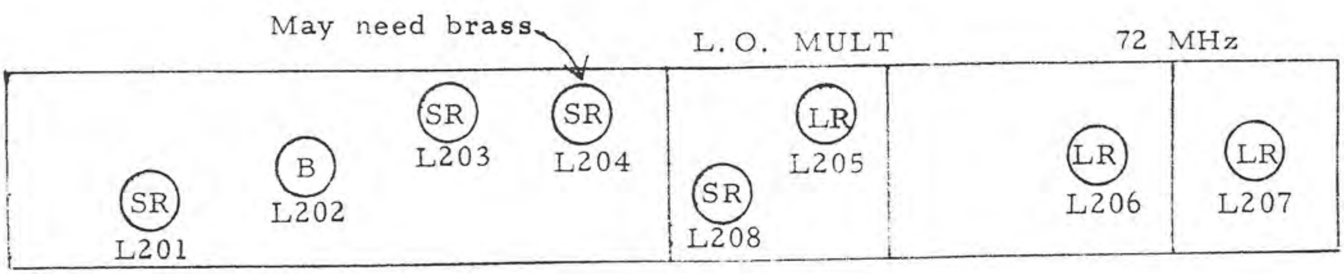
MOSELEY ASSOCIATES, INC.

CHECKOUT PROCEDURE FOR PCL-303/C RECEIVER

1. Install proper slugs in tuned circuits of 10.7 and 72 MHz IF's.



BOTTOM VIEW

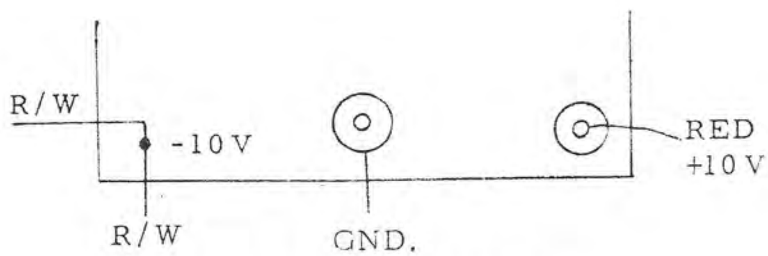


2. Install I.F. covers.

3. Check $\frac{1}{2}$ amp S.B. fuse.

4. Verify P.S.

   A. Monitor ±10 VDC



POWER SUPPLY

5. Install 61.3 MHz crystal in Y-301.

   A. Monitor 2nd osc. and lock all coils after peaking.

   B. Preset L301 and L302 to $\frac{1}{2}$" and peak on front panel meter.

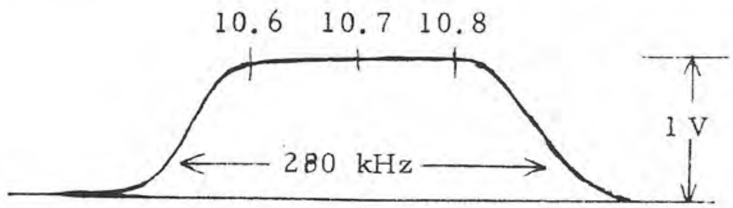
   C. Adjust L303 for $\frac{1}{2}$" and lock.

D. Preset remaining 10.7 coils to approximately ½". Don't lock.

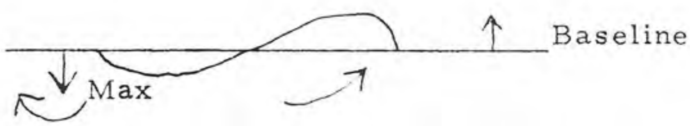
E. Set EICO sweep generator as follows: band SW "D", RF attenuation X-1, and RF level at "2". Connect RF out of sweep generator to J301.

F. Set scope to ext. input. Select ch. "B" and position marker at center of scope. Switch (on) 10.7 marker on crystal osc. Connect demodulator between limiter T.P. and ground. Set sweep to center of 10.7 marker. NOTE: Approximately 1 V P-P = 60 dB gain.

G. Set L304-L311 coils for proper sweep. 100 kc at 3 dB points.



H. Remove cable and monitor J302 with demod in line. Adjust primary T301 for crossover at 10.7. Adjust secondary for max. gain. Reconnect cable and monitor limiter.



I. Readjust coils for bell shape curve above. Check 100 kHz points by switching crystals, reconnect J301 to J203. Tighten lock nuts.

6. 72 MHz

A. Set sweep generator as follows: RF attenuator to X-1, RF level to zero, band switch to "B" and frequency to 72 MHz. Connect RF output to J201.

B. Preset L207, 6, 5, and 8 to approximately ½". Peak coils for maximum gain - limiting. Tighten, lock and disconnect T.E. (marker and scope).

7. Audio

A. Remove squelch relay. Connect 400 Hz audio osc. to audio input and connect dist. meter VTVM across output.

B. Set VTVM to +10 dBm.

C. Set audio osc. to 0.3 V P-P with scope.

D. Set audio gain pot to +5 dBm and lock. NOTE: 0.3 V P-P on input of audio board and +5 dBm on output indicates 60 kHz system deviation.

8. Multiplier adjustment

A. Install 54.875 crystal in Y201.

B. Switch front panel to 1st osc.

C. Peak L201 for maximum and lock.

D. Preset L204 for 1/8" and L203 for $\frac{1}{2}$". Switch to mixer drive and tune L202 for maximum. Readjust L203 if no deflect. Then readjust L203 and L204 for maximum and lock.

9. Preselector

A. Preset C101-C107 to approximately $1\frac{1}{2}$ turns from top.

B. Set RF signal generator for 950 MHz at 500 μvolts. Connect preselector to signal generator with coax. Monitor VTVM output with scope. NOTE: There are 2 peaks on C107.

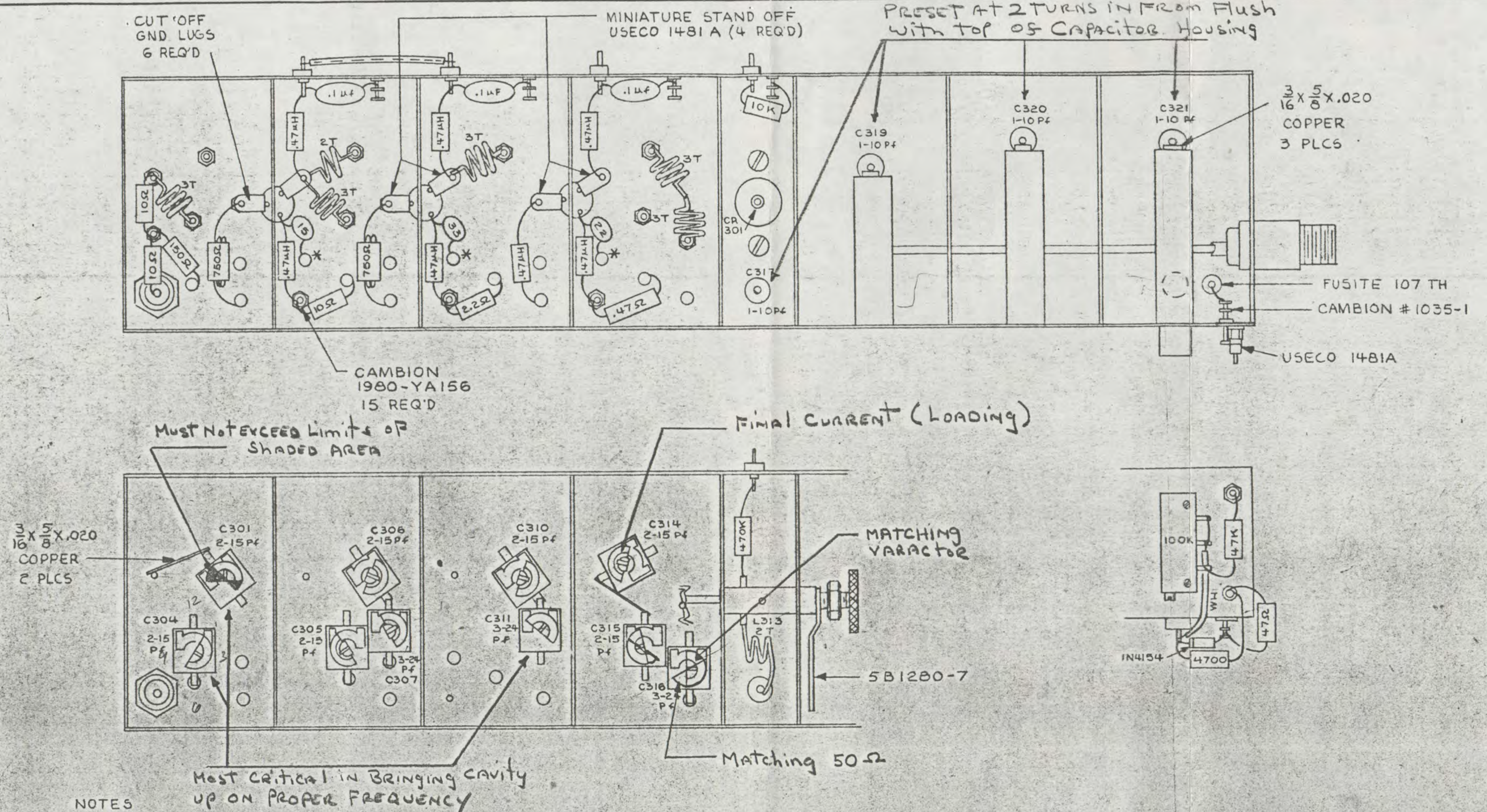
C. Set front-panel switch to discrim. Set front-panel meter to zero by rocking frequency on signal generator.

D. Set VTVM for -45 from +5 dBm and reset signal generator.

E. Adjust receiver preselector to achieve maximum quieting. Reset the signal out of signal generator at each position to prevent saturation. Sensitivity should be 50 μvolts. Also adjust capacitor bottom side.

10. Reinstall squelch relay and increase signal to 50 μvolts. Adjust squelch pot for threshold. Check by varying signal generator output below 50 μvolts. Lock nut.

11. Check AGC by monitoring sig 2. Remove Q207 and observe meter deflection from approximately 20 to over-range.



NOTES

1 * SOLDER FLOW ON THESE TERMINALS MUST BE SMOOTH TO GROUND PLANE →

2 COILS WOUND ON 1/4" DIA. MANDREL WITH AWG 16 BUS (TINNED).
L313 (2T) WOUND WITH AWG 14 BUS (TINNED)

C	ECO 68	10-67
B	REMOVE STAND-OFFS (2), ADD 5B1280-7	9/67
A	ADD NOTES	8/67

MOSELEY ASSOCIATES, INC.
SANTA BARBARA, CALIFORNIA

ASSEMBLY PICTORIAL
R F POWER AMP - PCL-303 XMTR

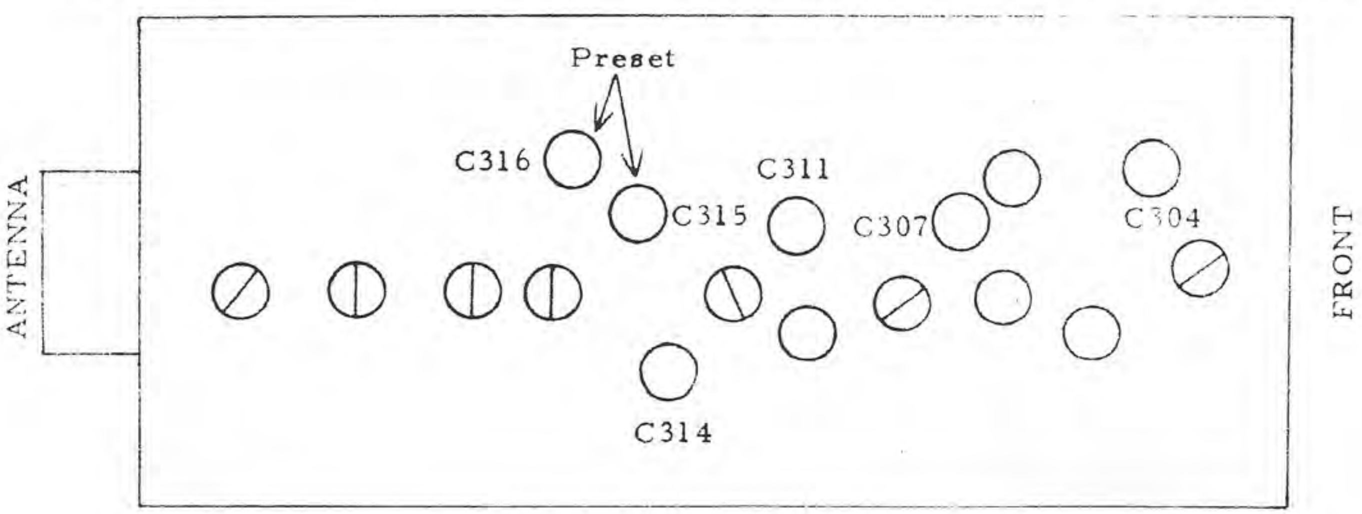
DWN FXY 8-67
ENG FL 8/67

21 B 2110 C

CHECKOUT PROCEDURE FOR PCL-303 /C TRANSMITTER

INITIAL PROCEDURE

1. Check line fuse.
2. Turn R408 fully CCW.
3. With VOM on 50 VDC range, monitor PS from "B+" fuse to ground.
4. Adjust R408 for 28 VDC.
5. Install brass slugs in L201 and L202 and brass slug with one wrap of mylar tape in L101.
6. Install crystal in 40 volt oven and oven in socket.
7. Monitor pin 3 of crystal socket with VOM to verify oven cycling.
8. Observe basic oscillator position on front panel S/B between 16 and 30. Adjust C104 to approximately ½" above chassis.
9. Switch to Reference OSC. reading between 58 and 66.
10. Switch to Binary Output Position, reading between 56 and 62.
11. Switch to AFC unlock position. Tune L101 for positive DC voltage ≅ 20. Tune L101 for zero D.C. in AFC unlock position.
12. Switch to AFC position. Tune C104 for 50.
13. Preset L201-L203 to ½".
14. Switch to IPA Drive. Connect coax from wattmeter to J202 and install 275-450 MHz 1 watt slug in wattmeter. Tune L201 for maximum reading, then tune L202 for maximum, then L203. IPA Drive ≅ 200 mw minimum. IPA Drive meter reading S/B 50 to 90.
15. Switch to IPA CURRENT. Reconnect coax jumper from J301 to J202 and connect wattmeter to J302 with 10 watt 400 to 1 GHz slug. Tune C304 for maximum IPA Current. Then, tune C307 for max, switch to final current. Tune C-311 for max on wattmeter then tune C314 for ≅ 70 (700 ma) final current. Observe wattmeter, tune C319 through C321 for maximum power out. Then tune C317 for maximum power out. Nominal output with 28 VDC B+ is 8 watts minimum is 6 w. Sample output on spectrum analyzer.



FINAL CHECKOUT PROCEDURE FOR PCL-303/C system

REQUIRED TEST EQUIPMENT

1. Spectrum analyzer
2. Distortion analyzer with VTVM
3. Dummy load
4. Wattmeter with 10 W 900 MHz slug
5. Sampling unit
6. Audio oscillator
7. 950 MHz RF generator
8. Oscilloscope
9. Attenuator box
10. Belar FM stereo monitor
11. SCG-3T or similar stereo generator
12. Audio matrix box.

SYSTEM CHECK

1. Check fuses and mechanically zero all meters.
2. Install proper crystals in receiver and transmitter.
3. Set transmitter on frequency with counter. Allow 5 minutes for oven to warm up.
4. Check spectrum with analyzer.
5. Connect transmitter to wattmeter, sampler and load.
6. Connect sampler output through 20 dB attenuator to receiver.
7. Connect audio oscillator to audio input of transmitter and set the audio oscillator to 15 kHz at 3.5 V P-P.

8. Connect receiver output (wideband) to input of VTVM. Set to +10 dB scale. Adjust the deviation control on the transmitter for 3.5 V P-P or 5 dBm output.

9. Install 15 K and 150 pF for pre-emphasis at C_{105} and R_{101}. In some cases this step is done at assembly.

10. Check 15 kHz and 1.5 kHz distortion. Both should be below 0.5%.

11. Set the receiver meter switch to "DISC +." Adjust the secondary (bottom) of the ratio detector CCW for minimum distortion on distortion analyzer. If discriminator increases from zero, adjust the primary for a zero reading.

12. Adjust slightly the 10.7 MHz IF, L_{304}-L_{311}, for minimum distortion.

13. Check the SNR. Should have -60 dB from +5 dB reference.

14. Check frequency response. Set audio oscillator to 1 kHz. Adjust for zero dB out of receiver. Response should be ±0.5 dB from 35 Hz to 15 kHz.

15. Record the specified distortion levels.

16. Record the -2 dB frequency with the reference adjusted to +5 dB (100% modulation) at 50 kHz. Use distortion analyzer - VTVM.

17. Inject 110 kHz. Adjust the level for 0.5 Vrms at the wideband output. Measure the required input and record it as "Mux Tx Sens." Also record 0.5 Vrms at "Mux Rx Out."

18. Install resistors in the metering circuitry to prevent off scale readings.

19. Record all Signal 1 and Signal 2 readings (with and without AGC).

20. Set the squelch for 50 µV threshold. Make sure the transmitter is off.

21. Check wideband quieting (45 dB SNR). It should be 70 µV or better.

22. Check wideband SNR. Use 1 kHz at 100% modulation. Do not record this value. Final SNR is taken with the covers on.

STEREO CHECK

1. Plug Belar monitor, SCG-3T, transmitter, and receiver into the same 110 VAC line.

2. Connect the SCG-3T stereo generator output to the wideband input of the STL transmitter.

3. Connect the composite output of the receiver to "Stereo In" on the Belar monitor.

4. Connect, in phase, the matrix box L and R channels to the SCG-3T input.

5. Connect the input of the matrix box to an audio oscillator set at 1.5 kHz.

6. Connect the oscillator to the external trigger of the oscilloscope. Switch the scope to external triggering.

7. Connect the scope to the Belar composite output. Use the standoff at the extreme right of the control panel.

8. Set matrix box to "right" channel.

9. Make sure the slide switch is not at the "flat" position.

10. Press the stereo button "S" on the SCG+3T.

11. Move the meter switch to "total" on the SCG-3T.

12. Adjust the audio oscillator for zero on the SCG-3T meter. It should take about 13 VP-P.

13. Calibrate the Belar monitor.

    a. Verify 3.5 VP-P from receiver to monitor.

    b. Switch the monitor to "Pilot." Adjust R_{323} in the SCG-3T for "90" on the upper modulation meter of the Belar.

    c. Switch the monitor to "Total" and "Mod."

    d. Adjust the "Internal" pot for 100% modulation on upper meter.

14. Trim the pre-empahsis, C_{105}, for best separation (flattest baseline on scope trace).

15. Read the separation by switching the Belar to "left" channel. It should be -35 dB or better. Repeat with the Belar on "right" and the matrix box on "left."

16. Check the separation at 15 kHz and 1.5 kHz. There should be only a small change in the scope indication.

17. Set the oscillator to 1.5 kHz.

18. Switch the Belar to -30 dB.

19. Check left and right separation again and record the best case at the specified frequencies.

20. Switch the oscillator to 15 kHz. If the separation at this frequency is not close to that of the SCG-3T (given on SCG-3T data sheet) add or remove capacitance from C_{419} in receiver. This is not usually required.

CROSSTALK CHECK

1. Switch the matrix box to L+R.

2. Switch the oscilliscope the 15 kHz.

3. Switch the monitor to L-R.

4. Read the crosstalk in dB on the upper meter. It should be below -45 dB.

5. Switch to L-R on the matrix box and L+R on the monitor. Again, it should be below -45 dB.

6. Record the worst case (L+R or L-R) at the specified frequencies. Note: Most crosstalk problems originate in the IF section.

7. Install transmitter bottom cover.

8. Connect the multiplier output of the transmitter to the receiver through a KAY attenuator box. Remove receiver squelch relay.

60 dB L+R MONO

1. Verify 100% modulation with the matrix box in "L+R" and the monitor in "Total" and "Mod."

2. Change the SCG to "Mono."

3. Turn the matrix box to "Off."

4. Change the monitor to "FM Noise" and "-50 dB."

5. Insert the KAY attenuator progressively until the modulation meter reads -60 dB.

6. Note the Signal 1 receiver meter reading.

7. Disconnect the attenuator. Connect an RF generator and duplicate the Signal 1 reading.

8. Record the indicated strength, in microvolts, as read on the generator.

60 dB L(or R) STEREO

1. Press the "S" button on the SCG-3T.

2. Move the matrix box to "Left."

3. Connect a cord from "Left" on the monitor control panel to the VTVM input.

4. Switch all attenuation out.

5. Verify +10 dB on VTVM.

6. Switch the matrix box to "Off."

7. Insert attenuation until 60 dB below +10 dB (-50 dB) is indicated on the VTVM.

8. Note Signal 1 reading on the receiver.

9. Duplicate the Signal 1 reading with the RF signal generator and record the indicated strength in microvolts.

SATURATED L+R MONO SNR

1. Remove the attenuation.

2. Switch the SCG to "Mono."

3. Switch the monitor and the matrix box to L+R and verify 100% modulation indication on the monitor meter.

4. Switch the monitor to "FM noise" and "-50 dB."

5. Switch the matrix box to "Off."

6. Record the SNR in dB as read on the monitor meter.