

Updating Invader and Invader 2000 Transmitters  
February 19, 1962

Some Invader owners have asked to be advised of changes in Invader circuitry, which might improve the performance of their equipments. Several circuit and component changes made in the Invader since the first production run but most of these have been made to permit better bracketing of tolerances, facilities test procedures, etc., and are of minor nature not affecting equipment performance.

Following is a list of changes considered worthwhile and the reason for each change. Some changes are recommended and others are at the option of the Invader owner.

1. C62, pin 2 of V5A to ground, changed to 330 pF, mica. A few of the early units used a smaller value. The larger value reduces the possibility of RF feedback in cases where the microphone shield is not properly grounded or transmitter ground is ineffectual. Optional change
2. C146, .005 uF disk capacitor, added in series with microphone lead, from pin 1 of J6 to R34. This is to prevent possible damage to microphone in case of DC voltage application to crystal microphone due to internal tube short. Optional change due to remote possibility of plate to grid short in triode tube.
3. L2 choke in Key Jack, J1, replacing by 47 ohm, ½ W resistor. This resistor is designated as new R25. This reduces current through key contacts and essentially eliminates arcing at key and VOX relay contacts. Recommended change
4. C138, 12 uF keying wave shaping capacitor, lead moved from connection on terminal 12 of SW2B, rear (operating switch) to terminal 10, SW3A, rear (mode switch). The ungrounded capacitor lead, which is connected, to SW2B is unsoldered, the capacitor is shifted around toward SW3A and the lead soldered to terminal 10 of SW3A (terminal 10 has a white, orange, blue wire connected to it). C138 will be found between the Operate and Mode switches, under the chassis. This change prevents discharge of the capacitor through either the Operate or Mode switch contacts and will lead to greatly extended switch life. Recommended change.
5. R180, 1000 ohm, 10W resistor added. This resistor is placed between pin 6 of V102 and pin 7 of V103 in the Invader power supply. This resistor limits the maximum current the bias rectifier. Recommended change.
6. R175, R176, R177, bleeder resistors across 60 mF high voltage filter capacitors, changed from 100K to 20K 10W. With high line voltage and dust and moisture on 5R4 rectifier socket, the socket can arc to ground. This change reduces the Standby voltage and improves the high voltage regulation in addition to preventing arc over. Recommended change.
7. R12 changed to 100K. R12 is the resistor in the grid bias of V2. The end of R12 previously connected to R15 should be moved to the junction of R14 and R15.

After changing R12, make new Audio Drive Adjustment, Section J, Alignment and Maintenance, using -5.8 volts at R11/R12 junction in place of -4 volts previously used. This change improves the stability of the RF Level setting on AM and when using the Invader as an exciter at low output level. Change in RF Level is caused by changing 6AH6, V2, characteristics due to gas and grid emissions. Reducing the grid return resistance reduces the effect. Changing this tube usually solves the problem. Optional change

8. R11, 1.5 ohm, 1/2W resistor added from pin 4 of V2 (pin 4 was grounded) to ground. This resistor reduces the filament voltage of V2 with resultant reduction of control grid temperature thus further improving RF Level stability.  
Recommended change
9. If for any reason (tampering, transportation, etc.) the balanced modulator becomes unbalanced thus degrading the carrier suppression, a simple method of rebalancing may be employed. After 15 minute warm up, tune transmitter to full power level and switch to one of the sideband positions (audio at zero). Turn Output control (meter sensitivity) clockwise to maximum sensitivity. Adjust balanced modulator controls R8 and C13 (Figure 5) for minimum meter reading by making small incremental adjustment of C13 and then nulling with R8 after each C13 adjustment. Switch between USB and LSB to verify that both sidebands are nulled. This will provide upwards of 4db carrier suppression. Greater carrier suppression can be achieved by loosely coupling the transmitter to a receiver (which provides more sensitivity than the output meter) and adjusting C13 and R8 for minimum receiver S meter reading. This should provide more than 55 db of carrier suppression when careful adjustment is made.

Other undocumented changes from schematics. These changes may or may not have been carried out depending upon when your transmitter was manufactured

1. **Make sure you have a copy of the schematic dated 11-15-64.** To my knowledge this is the final version of the Invader 200 schematic.
2. Add C149, 4 uF 450V electrolytic capacitor, from junction R47 and R48 to ground.
3. Remove R39, 1200 ohm, and C65, 100 uF 25V, from pin 8 of V6A and ground pin 8 directly.
4. Change R40 on pin 6 V6A to a 6800 ohm 2W resistor. Connect to the "hot" side of R47 not the side connected to C67.
5. Change C39 from 10pF to 15pF
6. Remove R25, 470 ohm, from the circuit.
7. Change designations of R24 to R26 and R26 to R24.
8. Change R24 (formerly R26) from a 120 ohm to a 220 ohm.

9. Remove R27, 47 ohm, from the circuit and connect the crystals directly to ground.
10. Add a 100 ohm resistor, designated as R27, from terminal 1 of SW1A, front, band switch to ground.
11. Add a parallel resonate trap, T5, in series with the lead from T2 to C31. Tune trap for minimum signal at 6.994 MHz.
12. Add 1800 ohm resistor, R41, across C79.

#### Other changes for better operation

1. Add 5.5 MHz series resonate trap in the plate of V8, second mixer, to remove VFO feed through signal. 80 uH coil and series 8-25 pF trimmer connected between pin 5 V8 and ground. Tune for minimum with the VFO at 5.5 MHz. This eliminates a spur at the low end of the 40M CW band.
2. Add 10-11 MHz parallel resonate trap in plate of VFO to remove 2<sup>nd</sup> harmonic of VFO signal. Break lead from pin 5 of V4 to T3. Insert 6 uF coil shunted with 8-50 trimmer. Tune for minimum 10.5 MHz signal with the VFO at 5.25 MHz. This eliminates a spur at the low end of the 20M CW band.
3. I like to change resistor R105, 1000 ohm 10W, to a 2000 10W. This is the VFO heater resistor, which keeps the VFO at temperature when the transmitter is off. This resistor runs so hot you cannot touch it. I think it needlessly cooks the VFO. A 2000 ohm resistor keeps the VFO warm.
4. The Invader has an undeserved reputation for VFO drift. Early Invaders, which I believe can be identified by the lack of a vernier and reduction gear on the VFO knob, perform well after the factory prescribed modifications to the VFO.
5. Another reason for VFO drift is due to failure of the AC contacts on SW3D, rear, Operate switch. Since this wafer is difficult to replace, many owners simply put a switch in the AC line cord. With the AC turned off in the manner, the VFO heater is no longer maintains the temperature of the VFO compartment when the transmitter is turned off.