QUALIFIER BOARD TEST 03-22-2002

Test Setup

I. **Test Equipment Required**

A. Power supply, 12 VDC 0.5 Amps, current limiting.
B. Power supply, 10-18 VDC 15 Amps, current limiting.
C. Oscilloscope, Tektronix TDS 220 or equivalent.
D. Spectrum Analyzer, HP 8594E or equivalent.
E. Digital Voltmeter, Fluke 75 or equivalent.
F. Dummy Load 50 ohm, 20 watts minimum, Cantenna or equivalent.
G. 20 dB pad with tap.
H. Test receiver assembly.
I. Heatsink extrusion fixture.
J. Bird Watt Meter model 43P with a 5A and 25A slug.

II. Test Cables Required

A. Qualifier power cable.
B. BNC/BNC 50 ohm coax cable.
C. DB9 female to DB9 female serial cable. Wire straight except switch pins 2 and 3.
D. Qualifier interface in-circuit programming.
E. RF test cable.

III. Test Computer

A. 286 PC minimum, with 2 serial ports (9pins) and 1 parallel port.
B. DOS version 6.2 or higher.
C. Software, see Randy Smith.

QUALIFIER BOARD TEST

TEST PROCEDURE

I. Initial Power on Test Procedure

A. Adjust power supply for the following voltage and current limit value
   +14 VDC @ 10 A maximum.
B. Connect power leads to power supply, red lead to positive, black lead to negative and make sure supply is plug in.
C. Connect the Power Plug to P2 on the Qualifier circuit board. Install 15 Amp fuse in place of Qualifier's power switch if testing with PCB only.
D. Connect Qualifier to the computer with the special modified serial cable via the DB9 connectors. A regular serial straight serial cable will not work without switching pins 2 and 3.
E. Make sure bench area is free of material that may cause the board to short.
F. Visually inspect the circuit board for all connections. Especially check for solder bridges.

G. Check current on the power supply, 325 mA typical.
H. Verify that only the Green LED is emitting photons. If the Green LED is not illuminated it is an indication that another problem or problems exist. The Green LED needs to be on before going to the next step.
   1. Make sure that the on board uP has been programmed.
   2. If the Green LED is off and the Red LED right beside it is on, adjust RX15 counter clock wise until the Red LED goes out and the Green LED goes on. This LED is connected to a temperature sensor on the Final transistor. When this Red LED is on power to the output stages are turned off to protect the unit. If this Red LED is on the yellow LED on the PLL should be on also. The unit will not transmit.
   3. If the Red LED on the far left is on check for voltage on pin 1 of IC5. If there is little or no voltage at this point, adjust RX4C until 5 volts appears on pin 1. Turn power off and wait for voltage to drop to almost zero. Turn power back on, the far left Red LED should now be out. If this LED comes on during transmit, RX5C needs to be turned counter clockwise until this does not occur under a normal antenna load condition. This LED when illuminated under normal operations indicates a high VSWR and shuts down the transmitter.
I. Turn the power supply on. Yellow LED (D4) should Flash and go off. If yellow LED is on PLL is unlocked. As a preliminary adjustment set unit to channel 2 via computer. With a DVM measure the voltage from the junction of R19 and R26 to ground. Adjust L19 until this voltage is 2.8 volts. The Yellow LED should go out. This indicates the PLL is locked. This will be covered in more detail later.
J. Measure voltage regulator output, U1 – pin 1, should be +5 VDC out.
K. Measure voltage regulator output, U3 – pin 1, should be +5 VDC out.
L. Measure GMSK encoder crystal oscillator of Y1, should be 4.9152 MHz.
M. Measure uP crystal oscillator frequency of Y2, should be 22.11684 MHz.
N. Measure the voltage controlled crystal oscillator, (VCXO) frequency, 15.36 MHz.

II. Carrier Synthesizer Test

A. Load proper test software on the test computer
B. Verify oscillator's level at TP15, the level should be -6 dBm, +/- 1 dB.
C. Set channel 1's frequency by typing 1 <enter>, verify CH1's frequency is 27.45 MHz.
D. Set channel 2's frequency by typing 2 <enter>, verify CH2's frequency is 27.47 MHz.
E. Set channel 3's frequency by typing 3 <enter>, verify CH3's frequency is 27.49 MHz.
F. Verify that the PLL unlock LED is off while tuned to the above channels.
G. Verify oscillator's output at TP15. Use spectrum analyzer and make sure signal is clean and stable. Also make sure harmonics are low.

III. RF Power Amp Alignment

A. Place temporary jumper across C45. Warning, this allows the unit to be operated in CW mode for test and alignment and care should be taken to make transmissions as short as possible with a very low duty cycle to keep from damaging output transistors or collector resistors. A duty cycle of a ½ second on with 10 seconds off is a good place to start.
B. Preset pots R103, R45, and R51. See example.
C. Set unit with computer to the highest power level by typing C <enter>.
D. Starting with the variable capacitors located toward the output port adjust each capacitor for maximum RF output. C118, C117 , C11 and then C19. L6,L8 and L9 may need to be spread slightly to bring the circuits to resonance. It may be necessary to go back and forth to get each pole aligned properly. 20 watts should be an achievable at 14 volts VCC.
E. After 20 watts out is achieved, check the output for spectrum purity with the Spectrum Analyzer at a safe spot after the 20 dB Pad and before the dummy load. The harmonics should be greater than 50 dBs below the fundamental frequency. If not make it so!

IV. Power Level Adjustment

A. R45 controls the Intercept Range. R51 controls the slope. R103 controls the offset. Use these controls to make the following adjustments.
B. Set power level A, by typing A <enter>, = +27 dBm, or ½ Watt.
C. Adjust attenuator control (R103) to be in control range.
D. Check power level B, by typing B <enter>, = +37 dBm +/- 0.5dB, or 5 Watts = ~/-0.5 watt.
E. Check power level C, by typing C <enter>, = +43 dBm, or 20 Watts
F. Check RF power level average and peak current.
G. Remove jumper across C45.
H. Check TX EN fail safe time, (less than 250 mS typical).

V. VSWR Shutdown Adjustment

A. Measure the voltage on Pin 1 of IC5. If not already adjusted, turn Pot RX4C until Pin 1 of IC5 is high. Turn RX4C clockwise just enough to make pin 1 go low.
B. Turn pot RX5C until the flat side of the pot is parallel with the top of the board.
C. With 50-ohm dummy load connected and power set at B power level, Pulse transmitter. Green LED should still be illuminated and red VSWR LED should be off.
D. Remove dummy load.
E. Pulse Transmitter. If red VSWR LED is illuminated and Green LED is off, go to next step. If not, turn RX5C counter clockwise (CCW) just a hair and pulse transmitter. Repeat until Red VSWR LED is illuminated.
F. Turn power to unit off and back on to reset VSWR LED. It should be off at this time. Connect dummy load. Pulse Transmitter at power setting C. VSWR LED should not light.

VI. Temperature Shutdown Adjustment

A. Adjust RX15 until 3.4 volts is measured on pin 5 of IC5B. This trip point is about 170 degrees F on the output transistors heat sink.

VII. GMSK Deviation Adjustment

A. Adjust GMSK Deviation for +/- 7.5 KHz, use R107 and R108.
B. Hook trigger of scope to TX clock Pin 22 of U5
C. Hook signal input of scope to TP3.
D. Check for I pattern.

VIII. 433.92 MHz Receiver Link

A. For safety reasons unsolder one end of L2.
B. Check voltage between LX3 and RX30, Voltage should be 3.6 Volts.
C. Use a signal generator and inject a 433.92 MHz signal with a level of 0 dBmV into J1.
D. Use a Spectrum Analyzer and take a measurement at the center pin of J1. Then measure the signal at pin 20 of IC9. There should be a gain of 25 dBs if everything is working properly.
E. Check voltage on pin 16 of IC9, it should be between 3 and 3.4 volts.