Troubleshooting the Phaser Transceiver

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For REV C Kits only

Uh-oh! You've built the Phaser and something's not working. Now what??

General guidelines that cover nearly all assembly issues:

1. **Tests after each assembly Group –** For starters, did you follow the step-by-step instructions and perform the tests after each assembly group? If so, it worked until you got to that stage. That means that the problem is localized to just the components you added most recently. The five Assembly Group Tests are reproduced below this section, for reference and augmented guidance.
2. **Missing or cold solder joint –** This is single most frequently encountered problem. You want good lighting and plenty of magnification to inspect all solder joints. Don't kid yourself! It's surprisingly easy to overlook this.
3. **Misplaced components –** This type of problem is less common, but it does happen on occasion. A careful visual inspection of the color-bands on axial components (resistors and RF chokes) will reveal these issues.
4. **IC socket pins in okay? –** Do the leads on all pins of the **IC sockets** protrude through to the underside of the board? We added a caution to the instructions about this issue as they're often a bear to fix afterwards.
5. **Toroids –** Do you measure DC continuity through the windings? (This is an in-circuit test.) If not, the leads haven't been adequately prepared. Insulation remaining on the leads may prevent proper operation.
6. **Low Power output –** The most likely culprit is an extra turn on L5 or L6. Output power will fall off rather rapidly if the inductance values are too high. If possible, count the turns without removing the toroids. Use a pointed object (e.g., toothpick) to 'bump' over each turn to count them.
7. **Semiconductors –** Integrated circuits in particular can seem mysterious. Even so, resist the temptation to assume they're bad until you've exhausted all the other candidates. Before making that assumption, be sure the ICs are firmly seated in their sockets- sometimes that'll bring them to life.
8. **Receivers –** Receivers in particular are often difficult to troubleshoot without test equipment. That's because the signals involved are so small. Here are a few suggestions:

a. Placing a fingertip on R1's wire lead should increase the signal strength indication on the WSJT-X display. If it doesn't, suspect the two audio amp stages (U1). The 'downstream' side of R7 should be at 2.5V.

b. With DC power removed make sure there's DC continuity through RF chokes L1 and L2.

c. Is the receiver 'numb' (hard of hearing)? If checking the FT8 frequency with another rig shows plenty of activity, here's a test you can try:

   i. Connect a clip lead to ground at one end and touch the other (free) end to the center conductor of J1, or alternately, to the left side of C1.

   ii. If the reception improves, contact Dave K1SWL for further no-cost assistance. The culprit is likely a strong AM broadcast station near you, and it's blocking reception by overloading the NE602 mixer. The corrective action involves adding two components on the underside of the board. This addition requires no cuts or jumpers.

9. **Check Voltages –** The two schematic pages which follow show measurements taken for both DC and AC voltages. The AC measurements will generally require the use of an oscilloscope. The AC measurements are in millivolts (mV) or Volts **peak-to-peak**. Comparing the readings you get with those on the troubleshoot schematics will often turn up an issue that needs further investigation.

10. **Get someone to look over your handiwork work –** An extra pair of eyes sometimes reveals something you've missed. Don't be shy about turning over your handiwork to a friend to have them look it over. If you're stumped, don't be afraid to ask for assistance on the CWTD reflector. Other folks may have encountered the same issue or have good suggestions. Both George (N2APB) and Dave (K1SWL) are subscribers and will assist as needed. If hands-on troubleshooting/repair becomes necessary, K1SWL charges a flat fee for the work. Contact Dave (davek1swl@gmail.com) for particulars before shipping the unit.

The 5 Assembly Group Tests

These test sections have been reproduced from the Instructions document and some additional guidance is provided in each. An additional section "Test 6: Transmitter" has been added as well. If you suspect that Phaser board is not operating properly, follow these steps (again) to determine where or how yours is behaving differently and explore possible causes on CWTD reflector or in emails with Dave or George.

TEST #1: Basic Power

1. Apply 12V power through jack J2. (The center pin is positive.) The current draw from the power supply should be very small (e.g., less than 10 ma).
2. With your multimeter ground clip attached to any of the board mounting holes, measure for 5V at pin 8 of the U1 pin socket.
3. Then measure for 3.3V at pin 1 of the U10 IC socket.

TEST #2: T-R Switching

1. Connect the 12V power source again to J2 and a cable from your computer audio output at J3.
2. Launch the WSJT-X software on your computer and command it to 'TUNE'. (See "Quick Start" in Appendix 4.)
3. Measure the voltage 'Vsw' (at the top pad of L3, near C34) and see it change from 0V DC to a nominal 12V DC. Verify that the voltage drops when canceling 'Tune'.

4. If you do NOT see this voltage change when toggling 'Tune' on and off, work backwards in the signal chain (per Schematic 2, below), starting at the R35/R36 junction. If you DO start seeing the voltage transitions shown in red when going to 'Tune' mode, then the problem is between there and the point you did NOT see the transitions.
5. Check to ensure that you have the Vb voltage at 3.0V on U9 pin 2. If this is not correct then nothing will switch, and your problem is likely at the R6/R6 junction on Schematic 1.
6. Check to ensure that you have about 3.27V on U9 pin 3. If this is not correct, then nothing will switch when toggling 'Tune'. Check for proper placement of R30 and R31.
7. Check that you have sufficient audio level coming to the Phaser board by moving the 'Pwr' slidebar up to at least 75% on the WSJT-X screen.
8. Check that you have the proper audio cable coming from the computer's audio output/headphone jack to the Phaser's audio input jack J3.

Test #3: Measure the Carrier

1. Connect a 12V power source to J2, then connect a clip lead to one of the pins on J6. The clip lead serves as an antenna to radiate to clock frequency present on J6. You should be able to hear this steady carrier on your 'big rig' at 3573.0 kHz (Phaser-80), 7074.0 kHz (Phaser-40), 10,136.0 kHz (Phaser-30), or 14,074.0 kHz (Phaser-20).
2. If you do NOT hear or see the carrier at the specified frequency for your Phaser board, use a magnifying loupe to very carefully check that the pads at U11 and U12 do not have any obvious solder shorts. (Although these are attached at the factory, bits of solder or wire snips may cause problems if they get lodged on some of the pads.
3. Using an oscilloscope, check to see that U11 is generating the square wave clock at the points noted around U11 and U12. It is not necessary to measure these signals, but just ensure they are present. (You'll have to crank up your scope timebase to see these HF signals.)
4. If still no signals are seen, use your scope to look at the I2C signals coming from the PIC controller on U10 pins 12 and 13. Fast (short) pulse streams will be seen if things are working right. If not seen, check to ensure proper placement of R39/R40.
5. If still no good, then check to ensure that U10 is properly plugged in and oriented with its pin 1 in the lower-left corner of the socket.
6. If STILL no good, check to ensure that the green 'FT8' LED turns on when the left pushbutton S1 is pressed, and that the yellow 'ALT' LED turns toggles on when the right pushbutton S2 is pressed. If not, check to ensure proper placement of R37/R38 and that the LEDs were inserted properly by noting a very subtle 'flat' edge on the lower side of the LED (i.e., the sides closer to the resistors R37/R38.)
7. If you get to this point, your PIC may be malfunctioning or unprogrammed. Contact Dave or George.

Test 4: Receiving FT8 Signals

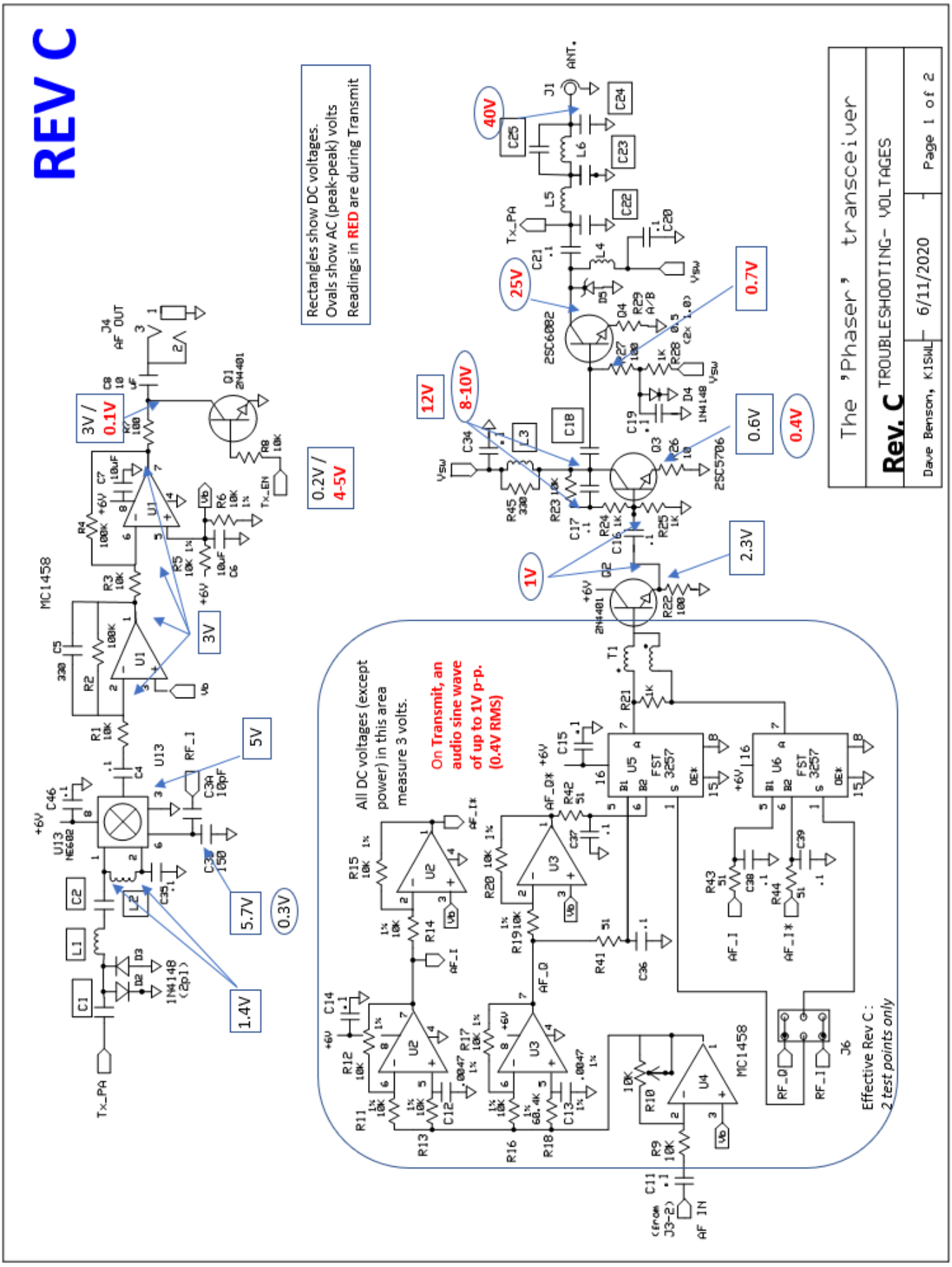
1. When this assembly group is complete, the Phaser receiver should be operational and you should be able to decode FT8 signals in the WSJT-X application on your PC. Refer to the Quick-Start section of these instructions for hookup and operating guidance.
2. Ensure that the settings in the 'Radio' and 'Audio' tabs in the File➔Configuration menu tabs of WSJT-X are set properly. Carefully follow the guidance in the "FT8 HinsonTips" document, as doing so will ensure that you get your computer set up properly for using the Phaser Transceiver.

Test 5: Listening for the Carrier

1. Connect a clip lead to R22. Leave the other end free. Apply 12V power via J2 and audio via J3. Command WSJT-X to "Tune". (See 'Quick-Start'.)
2. As you tune across the operating frequency with your 'big rig' you will encounter the loudest signal (the upper sideband), and then the much lower carrier and lower sideband, in this order. Toggle the 'Tune' control to ensure you identify these three signals being produced by the Phaser. The opposite sideband at 2400 Hz is down ~35 dB, and noise is ~20 mV pp at this point.

Test 6: Transmitter

1. We'll assume that you have carefully followed the guidance in Appendix 5 of the Instructions document, called "Adjustment/Calibration".
2. You can measure the signals in the Tx chain shown to the right of Q2 on Schematic 1. While in 'Tune' mode, you should see the RED signal values indicated on the schematic, and when you toggle 'Tune' off, you should see the signal levels noted in BLACK.
3. When transmitting, the Power Amplifier (PA) transistor Q4 and its silver heatsink should get quite warm to the touch after a few seconds of this continuous duty cycle operation. If you do NOT have a hot PA, then something is wrong and you should identify the point at which you "lose" the Tx signal, starting the Q2 and progressing toward the right on the schematic.
4. Once you find a point at which you DO have a valid signal, and the next measurement point that does NOT have the signal, you know that the components between must be incorrectly placed or be malfunctioning. If you cannot locate the cause for the problem in this area, post to the CWTD reflector or email Dave or George explaining the symptoms.
5. NOTE: Be careful not to leave the Phaser board in 'Tune' (transmit) mode for more than necessary. This will help protect the PA transistor Q4 from overheating and self-destructing. (NOTE: The transmitter normally operates for 13 seconds at a time in FT8 mode.)


REV C
Rectangles show DC voltages.
Ovals show AC (peak-peak) volts
Readings in RED are during Transmit
The 'Phaser' transceiver
Rev. C TROUBLESHOOTING- VOLTAGES
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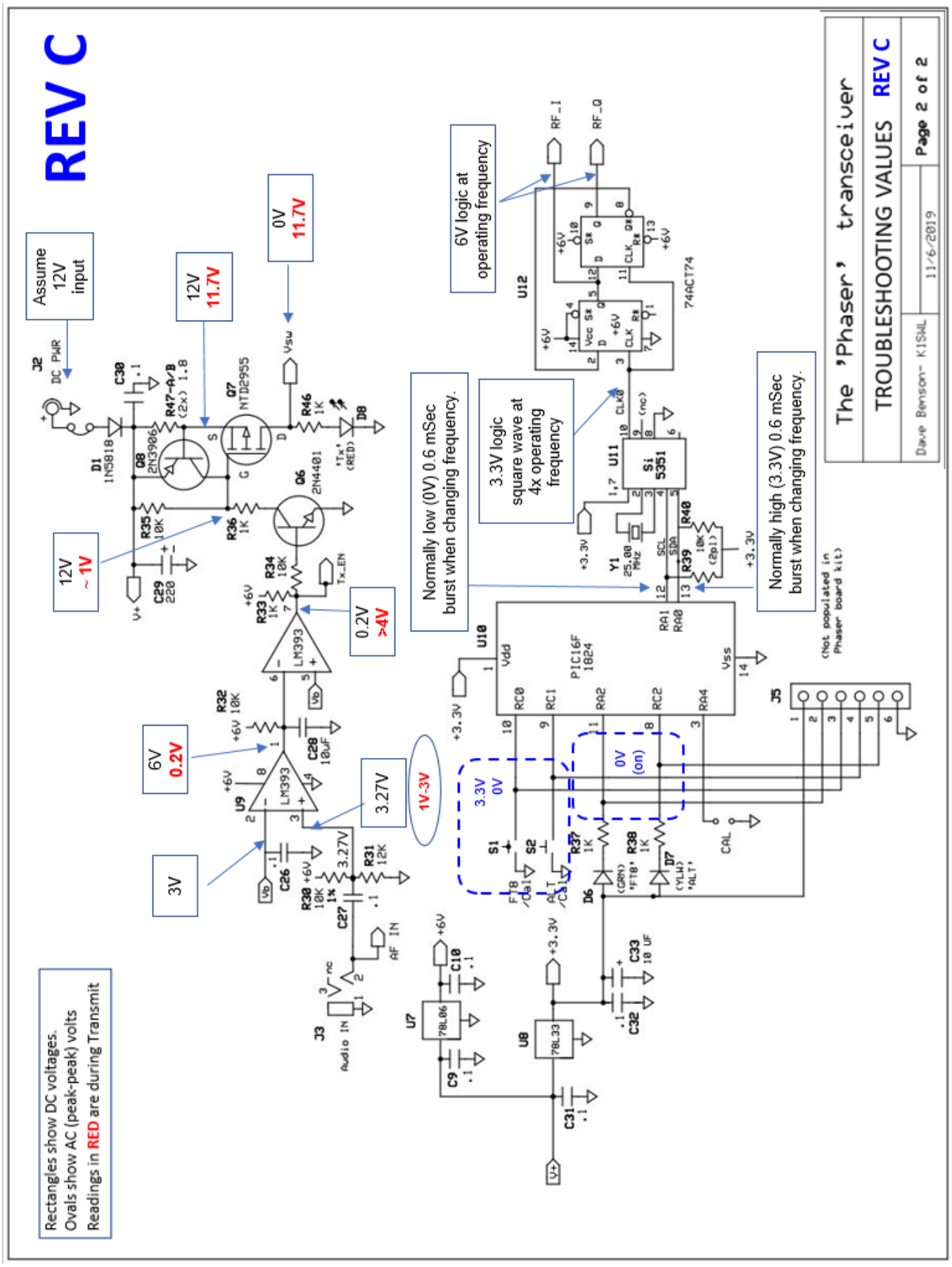
All DC voltages (except power) in this area measure 3 volts.
On Transmit, an audio sine wave of up to 1V p-p. (0.4V RMS)
Effective Rev C : 2 test points only
MC1458
3V / 0.1V
0.2V / 4-5V
12V
8-10V
40V
25V
0.7V
0.6V
0.4V
2.3V
1V
5V
3V
5.7V
0.3V
1.4V


REV C
Assume 12V input
12V 11.7V
0V 11.7V
6V logic at operating frequency
12V ~1V
0.2V >4V
Normally low (0V) 0.6 mSec burst when changing frequency.
3.3V logic square wave at 4x operating frequency
Normally high (3.3V) 0.6 mSec burst when changing frequency.
6V 0.2V
3V
3.27V
1V-3V
Rectangles show DC voltages.
Ovals show AC (peak-peak) volts
Readings in RED are during Transmit
The 'Phaser' transceiver
TROUBLESHOOTING VALUES REV C
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