NHRC-2 Repeater Controller
Troubleshooting Guide

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Power-related problems

Check all of your solder joints carefully. A poorly soldered or an unsoldered joint can cause all sorts of problems. Solder joints should appear bright and shiny, and the solder should taper from the end of the pin to the pad on the board; there should not be a "blob" of solder on the pin. Make sure that there are no solder "bridges" between pads or traces. It is very easy to create solder bridges between the IC pins, these pins are only 1/10 of an inch apart.

Apply power with all the chips removed from their sockets and an ammeter in series with the +13.8 (pin 2 on the controller). There should be an extremely small amount of current flowing into the board with the ICs removed, typically less than 5 mA. If there is more current, check component placement, and ensure that there are no solder bridges on the board. Remove the ammeter, and re-apply power. With all of the chips still removed, check for 5 volts at pin 3 of U4, pin 14 of U1, pin 28 of U2, and pin 18 of U3. If any of the power supply voltages are not right **do not insert the chips** until this problem is found and corrected.

Make sure the PIC 16C84 is in the middle socket on the board. The M8870 sits in the socket next to the crystal. Make sure the chips are plugged in correctly, with pin 1 toward the DB-9 connector. Improper installation of the chips can destroy them! If you had the chips in backward they may be nuked.

CAS Signal problems

The easiest way to verify correct operation of the CAS signal is to remove ISO1 (4N39) from its socket, and plug a LED in instead. The LED's anode(?) (the + leg, usually longer) goes into pin 1, and the cathode(?) (the - leg, usually shorter)

goes to pin 2 of the socket. If you are unsure of which leg of the LED is which, test it with 12 volts and a 1K ohm resistor in series with the LED. When the CAS signal is correctly applied, the LED should glow. A dim glow is probably OK. If the LED lights up very brightly, or explodes, it is likely that the CAS signal's voltage is too high. In this case, ISO1 has probably been destroyed. Replace R30 (1.5K) with a higher value, calculated to allow approximately 10 mA to flow through the LED in the opto-isolator. We do not recommend CAS signal voltages of more than 30 volts.

If the LED will not glow, make sure that there is at least +3 volts on pin 6 of the DB-9 connector, measured against pin 7, when the CAS signal is present. The LED must glow when the CAS signal is present.

If the LED glows when CAS is applied, but the controller never seems to "see" that the signal is there, you can test the entire CAS path in the controller by using a DVM to measure the voltage on pin 13 of U1 (the PIC16C84). Pin 13 should be near 5 volts when the CAS signal is not present, and should fall to near 0 volts when the signal is present.

PTT Signal problems

If the power is not good, or the CAS signal is not good, you will never get PTT (push-to-talk). These sections should be verified before worrying about the PTT circuit.

Pin 7 of U1 (the PIC16C84) should normally be around 0 volts, and should rise to about 5 volts when the controller turns PTT on. If not, verify the CAS signal is working, then examine the section in this document on a completely dead controller. When PTT is turned on, the gate (pin 1) of Q6 should rise to about 5 volts. If not, then either Q6 is bad (shorted) or R29 is open or incorrectly installed.

The controller supplies PTT as a closure to ground. If the controller is interfaced to the repeater correctly, there should be some positive voltage on the drain (pin 2) of Q6. When the controller turns PTT on, this positive voltage should drop to near 0 volts. If there is no positive voltage on pin 2 of Q6, then check the interface to the transmitter's PTT line.

Completely Dead Controller

If the controller appears completely dead, and none of the power, CAS, or PTT symptoms are found, then the problem may be related to the microprocesor. Measure the DC voltage on Pin 4 of U1 (the PIC 16C84) with a DVM. This pin should hava around 5 volts on it. If it does not, check R17, R18, R19, Q5, and D1. Make sure that D1 is installed correctly, with the banded end of the diode towards the junction of R17 and R19. Make sure that Q5 is oriented correctly, and verify the values of R17, R18, and R19.

If U1 pin 4 has about 5 volts on it, make sure that the 3.58 MHz clock is running. Use an oscilloscope to look at U1 pin 15. This pin should have a nice square wave on it, at the 3.58 MHz clock frequency. If the clock is not found at pin 15, look for

it at U3 (the M8870) pin 8. If the clock is present on U3 pin 8, but not on U1 pin 15, verify the installation of C20, a 33pF capacitor. If the clock is not present on U3 pin 8, verify that power is applied to the U3, and that the crystal Y1 is properly installed.

Audio problems

First, note that the controller should pass audio through to the transmitter only when the CAS signal is present. If the audio passes through when the CAS signal is not present, and unsquelched audio is transmitted during the hang time, then it is likely that either you have forgotten to remove the init jumper (S1), or are overdriving the audio gate FET. Remove the jumper or reduce the signal applied with VR1.

The next common problem to cause the audio path to malfunction is the failure to use dipped tantalum caps for c2, c7, c8, c9, c10, c11, c14 and c17. The tantalum caps have a very low ESR (effective series resistance). The use of any other type of cap will cause the output of the op amp to sit at the rail (13v). Voltages around U5 measured with a DVM should be as follows . Pin3=6.5v, pin 1=6.5v , pin 7=6.5v. If pin 1 or 7 is reading higher (about 12 volts or more) you have a leaky cap or an open in the feedback path. If pin 3 isn't reading around 6.5v check the values of r1 and r2, should be 10k. Also note that you have installed the tantalum caps in the board with the proper polarity. The square pad indicates the positive side of the cap (except C7 and C8 where the square pad indicates the negative side.) Tantalum caps are easily destroyed by reverse voltages, if you put it in backwards, throw it away and use a new one.

If the audio out of the controller is low, check to make sure that VR2 is a 500k pot and R15 is 10k.

DTMF decoding problems

If DTMF tones do not mute completely or not at all, try lowering the main RX level at VR1. You may be over driving the audio muting gate FET (Q1) and it is starting to turn on. Verify the installation of all the components in the muting circuit: R6, R7, R8, Q1, and Q2.

If DTMF tones do not mute and the controller doesn't respond to commands, can' t load password, make certain that VR1 isn't adjusted to low. You should have around 2v P-P at u5 pin 1, ignoring the dc level. Check the audio circuit for malfunctions as above. If the audio through the controller is good check that C1, a .1uf cap is soldered in. R5 and R23 should be 100k. Look with a scope at pin 2 on u3 the M8870. You should see audio here. It should look similar to the signal at U5 (op-amp) pin 1 EXCEPT the signal should not be biased at the 6.5v dc level. If you have audio at a dc level at the decoder pin2 then c1 is probably bad. If the audio looks good at the decoder be certain R22 is 300k and C19 is .1uf. Probe pin 15 of U3 (STD) with a dvm or scope, you should see this pin go high when you send DTMF to the controller. If the STD signal is working check pin 6 of U1 (the PIC16C84) and see if the signal is getting to the PIC.

Check the section on audio problems if this section does not help with your DTMF decoding problem.

Voice messages are distorted or noisy

The leading cause of noise on recorded messages is improper bypass caps on the power supply leads around the 7805 and the ISD1420. Be certain that C13 is installed properly and is a minimum of 220uf @16v. The ISD1420 draws large bursts of current while recording. If the caps are not properly installed the voltage to the chip sags during record and noise is recorded with the audio.

If your messages are distorted you are probably either overdriving the ISD1420, or the ISD1420 is overdriving the repeater controller's mixer or your transmitter's microphone preamp. Place the controller in the simplex repeater mode and adjust VR-3 (record level) and VR-5 (play level) until the audio sounds natural.

Also check the values of R21 470k, c12 4.7 uf tantalum cap, c10 .1uf . Check R9 22k, R10 10k and c5 .1uf . Check C9 1uf tantalum, R13 22k.

The last resort

If these hints don't get you going or don't address your problem, then send a detailed, clearly written question to hardware-support@nhrc.net hardware-support@nhrc.net . Also, please email if you discover a problem, hint, or solution that is not documented in this page.

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