Distribution: Quality, EL Assembly, Manufacturing (1)

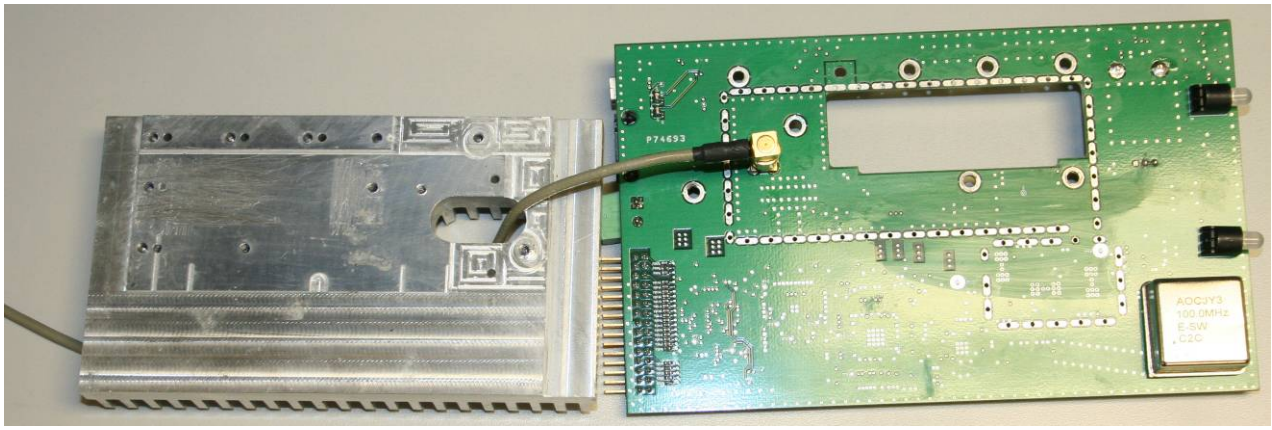
- The following document is a procedure to assemble, test, and calibrate a Wakeup TX Module for the EA_MOBILE Gas/Water/Electric Interrogator, FCC ID G8JEAMOBILE1.
- MUST assemble in an ESD safe environment and must wear an ESD wrist strap.
- It's recommended that this document be printed in color.
- Reference 5D26056G01 Assembly, Wakeup TX and gather materials list on GKS.

Procedures

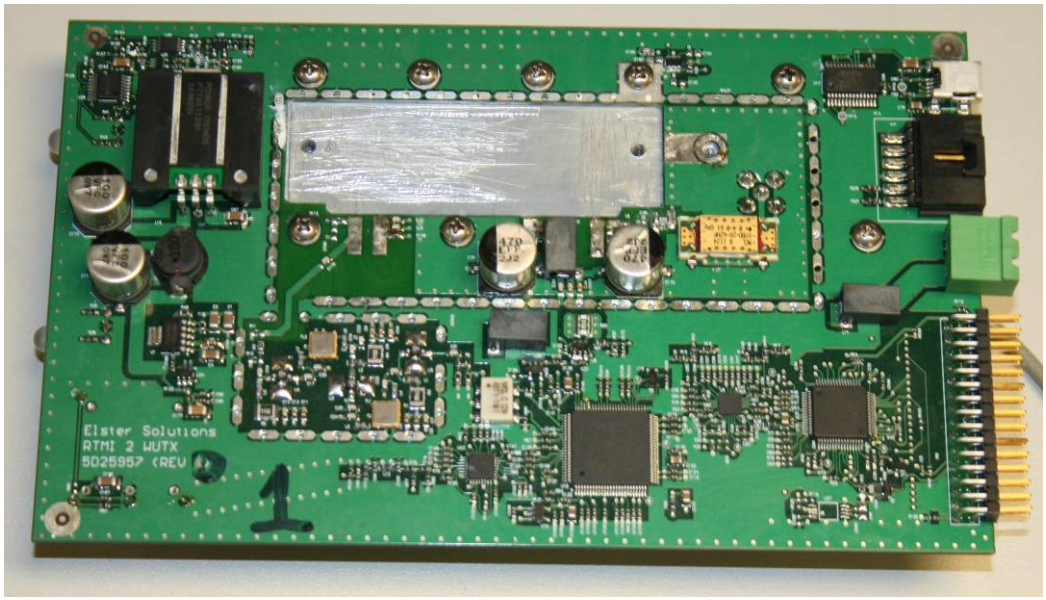
For Assembly of Assembly of Wakeup TX Module.

1 Assembly

1. Connect cable (7S1939H002) to the right angle SMA conttection on the back of the Wakeup TX PCBA (5D25958G01). Torque to 4 ± 1 in-lb with 5/16" pre-calibrated SMA torque wrench, such as Fairview Microwave 74Z-0-0-79 or Mountz 06003B-106. Note that the wrench is only calibrated in ONE DIRECTION, and the wrench must be applied accordingly. Also, grab the torque wrench only at the "load point line" (notch around end of handle) or you will apply more torque than rated.
2. Feed cable through slot in the heat sink, as shown below.



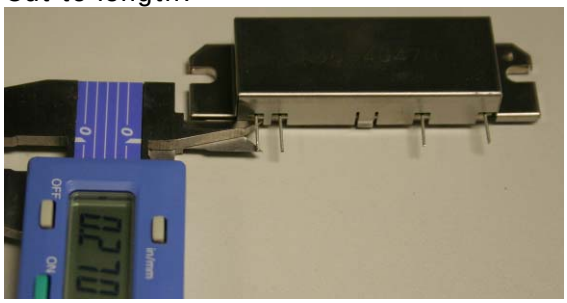
3. Attach the heat sink to the PCB with (8) #4-40 truss-head screws, ¼" long (52807P050). Torque all the screws to 3 ± 1 in-lb. The resulting assembly is shown below (ignore scratches on the heatsink; picture taken of prototype):



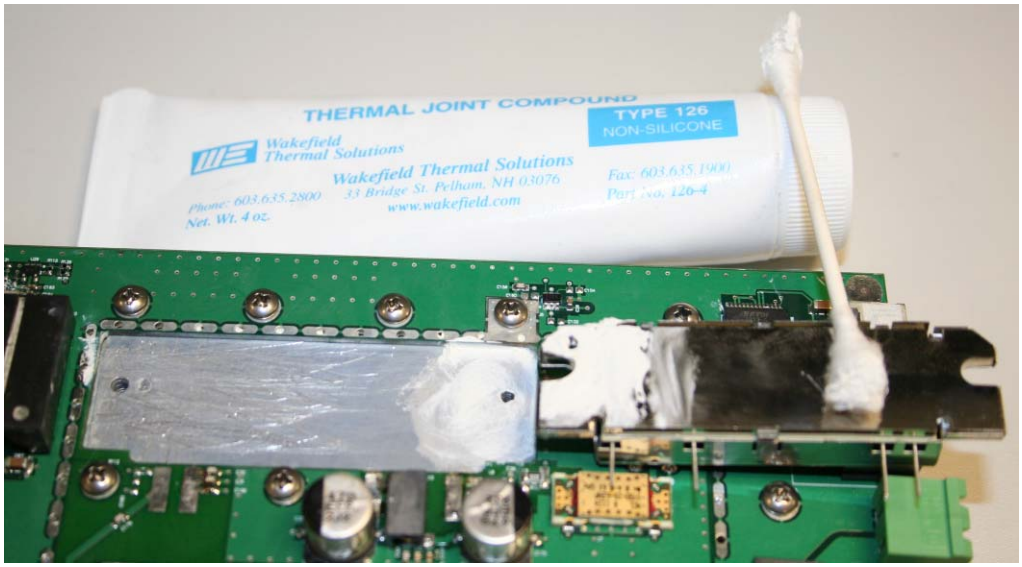
4. Using best ESD control practices, retrieve an RA30H4047M1 Power Amplifier (PA) module, and cut the 4 pins of the PA to a length of 0.270”, as shown below.

Uncut:

Cut to length:



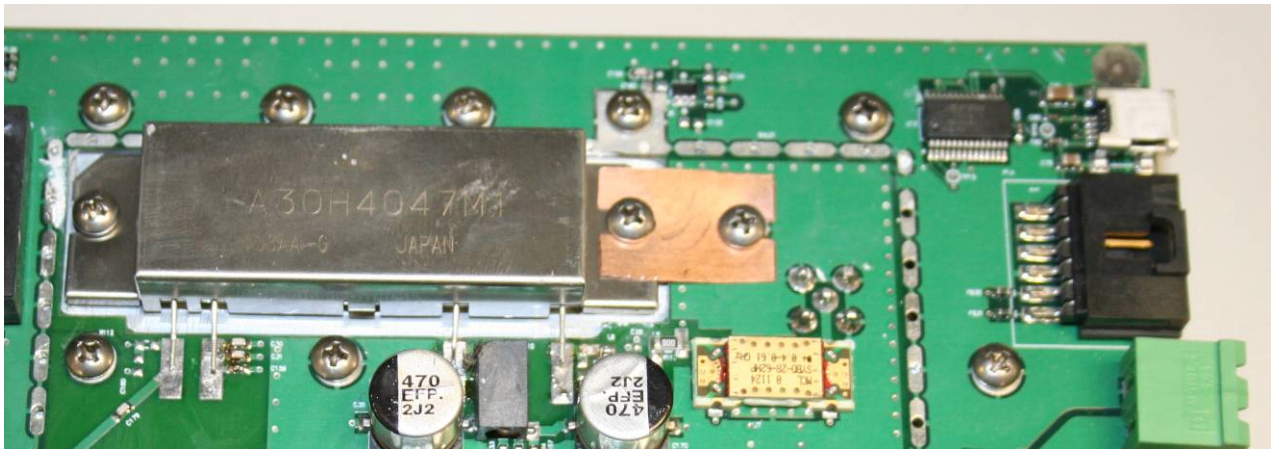
5. Using Wakefield Type 126 Non-Silicone Thermal Joint Compound, coat both the heat sink and PA areas shown below with a thin layer, using a Q-tip or similar spreader. DO NOT COAT the entire PA and heatsink area! The PA must make electrical contact with the heatsink on the left end.



6. Align the PA such that its 4 pins are centered laterally on the PCB pads.

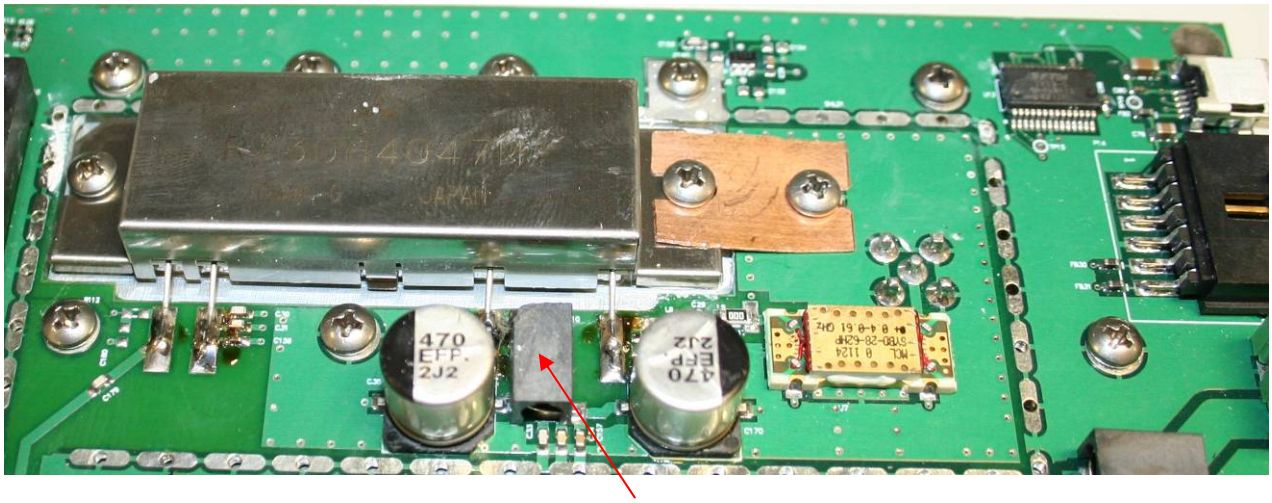
7. Position a PA Ground Strap (1B11997H01) on top of the PA and the PCBA so that one notch lines up with the right-side PA heat sink hole, and the other notch lines up with the hole to the right of the PA.

8. Fasten the PA and ground strap using three (3) #4-40 truss-head screws, ¼" long (52807P050). Torque all three screws to 3 ± 1 in-lb. A close-up of the resulting assembly is shown below:



9. Using a flat-blade screwdriver or spudger, gently bend the 4 PA leads so that they rest on the pads on the PCB.

10. Solder all 4 PA leads to the PCB. The resulting assembly is shown below:

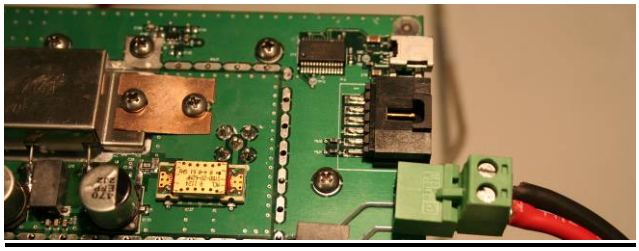


11. Clean all flux residue from around the pads using flux remover or IPA. Be careful not to bend the leads of the inductor between the two large capacitors.

2 Test

2.1 Power Up

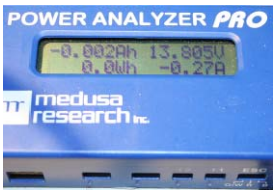
1. Set power supply to 13.6V at 5A current limit. Attach power supply cable with an ammeter or power analyzer in line to the green connector.



2.2 Voltage, Current and Signal Checks

1. Check that PCBA doesn't pull over 500 mA at 13.6V initially. A power analyzer in line with the power supply is useful for this purpose (example below shows the board pulling 270 mA), or an ammeter can be used.

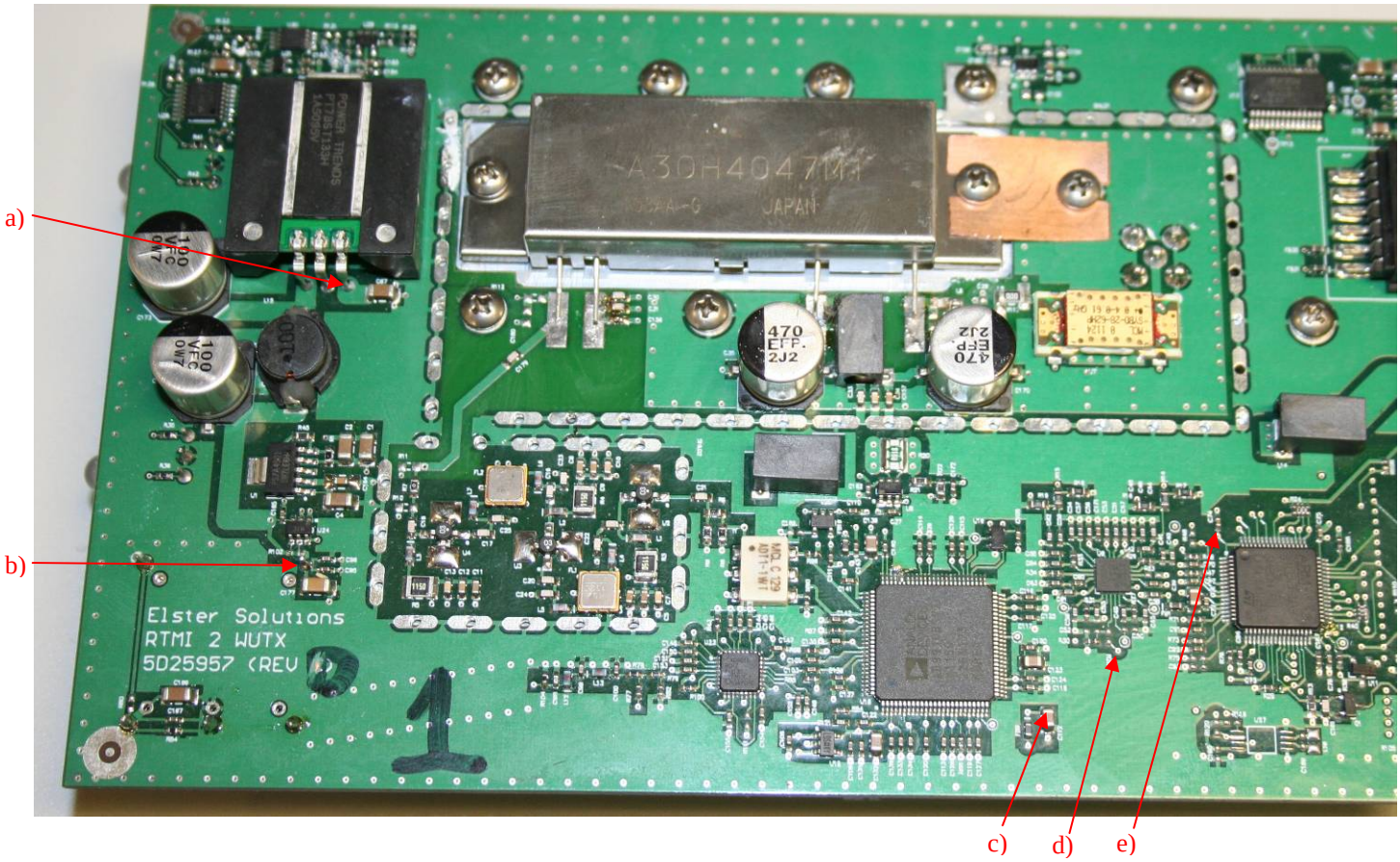
   It is normal for the board to pull less current as it warms up. After a 2-minute warmup, values under 300 mA are typical.



   If the PCBA pulls more than 500 mA, there is a short somewhere on the board, and the board should be given to Engineering to follow up with the contract manufacturer.

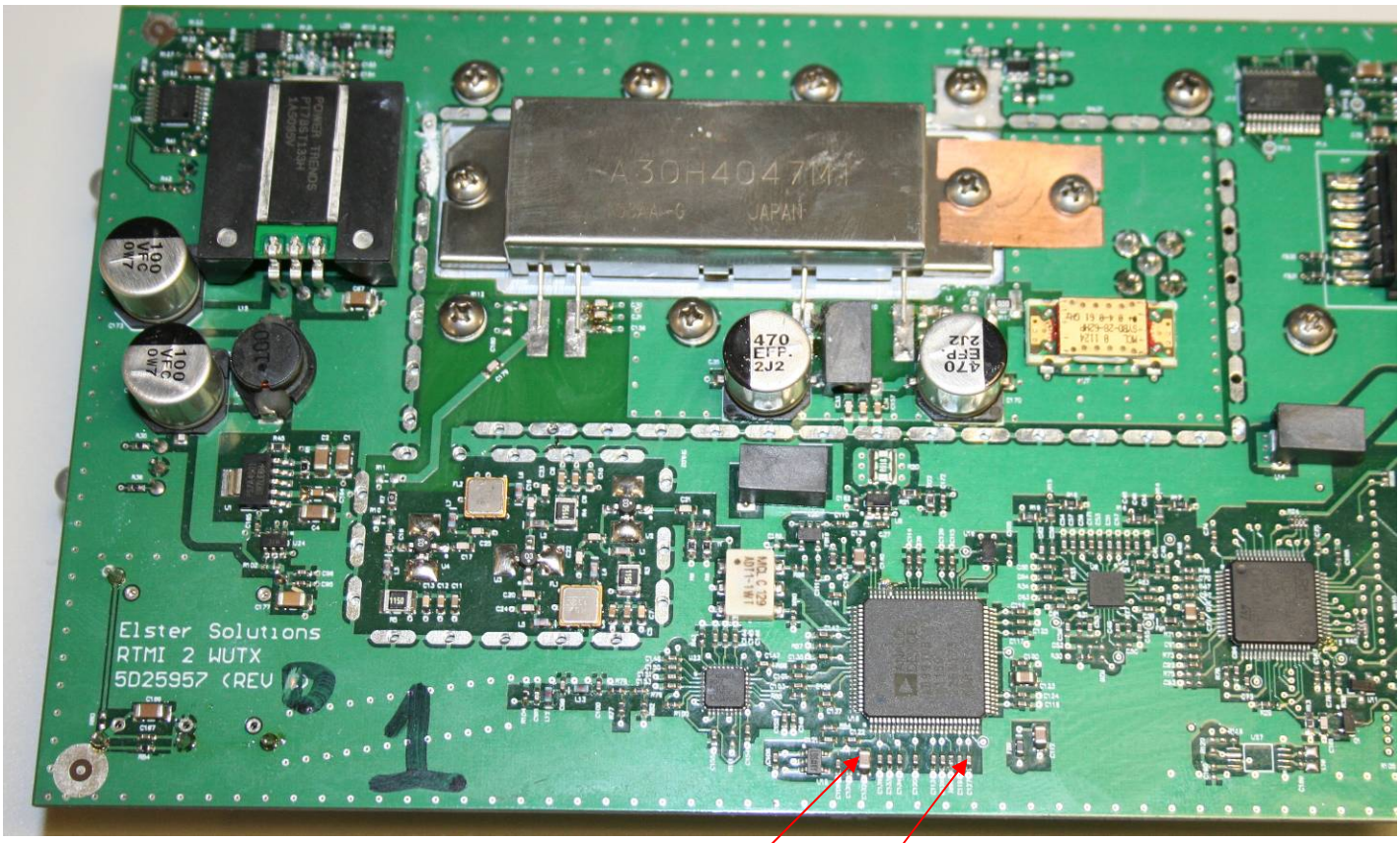
2. Using a DMM, check for 3.3V ± 0.2V with respect to GND (attaching at power input is OK) at the following places:

   a) U10 (switching regulator) pin 3;
   b) OSC1 pin 5;
   c) “North” end of C112 (next to U18, DDS);
   d) U9 (RF detector) via just “southwest” of R28;
   e) “South” end of C74 (“northwest” of U12, Microcontroller).



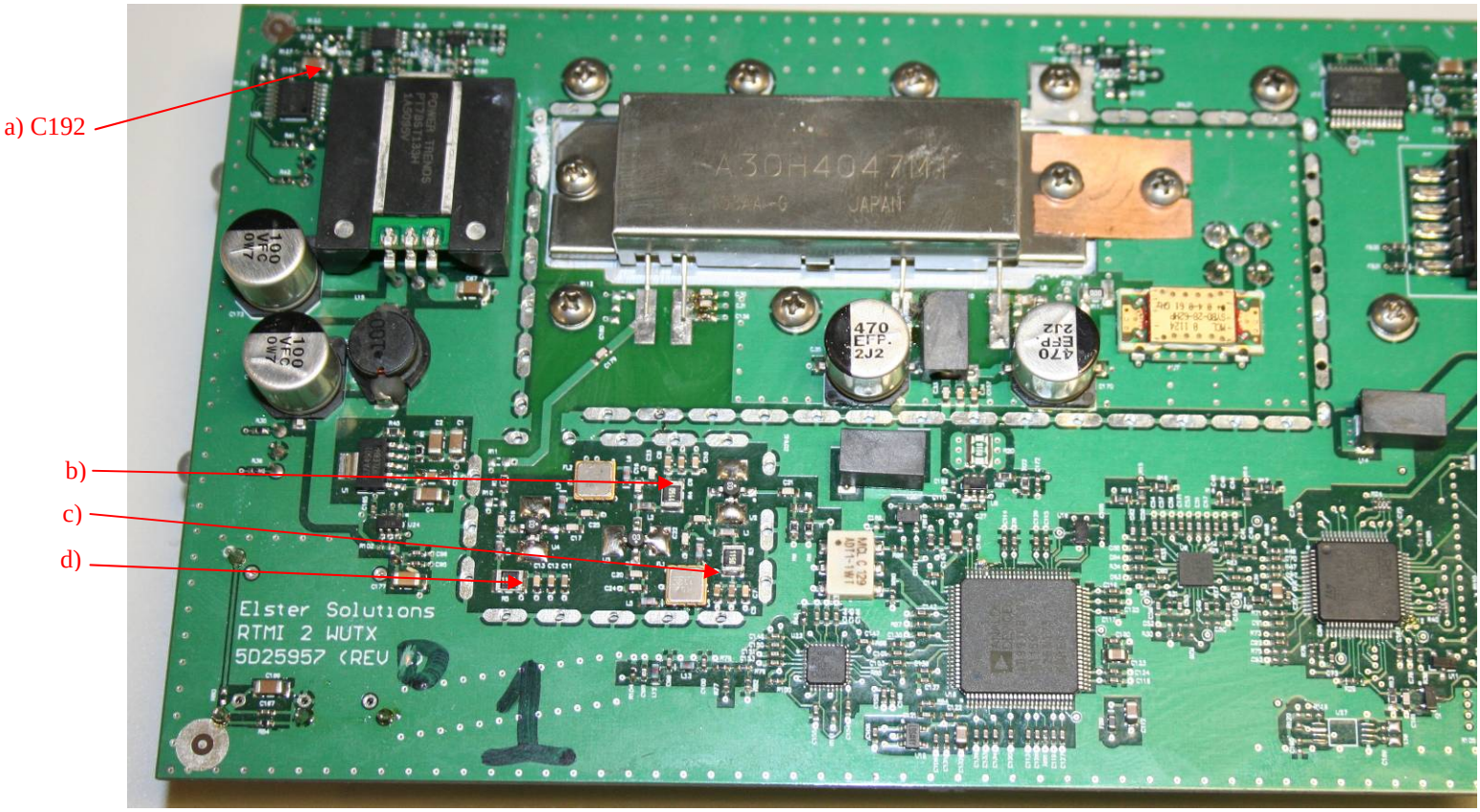
3. Using a DMM, check for 1.8V ± 0.1V w/r/t GND at following places:

   a) At the “north” end of C127 (“south” of U18), an 0402-size capacitor (DVDD_1.8V)
   b) At the “north” end of C132 (“south” of U18), a larger 2012-size capacitor (AVDD_1.8V)



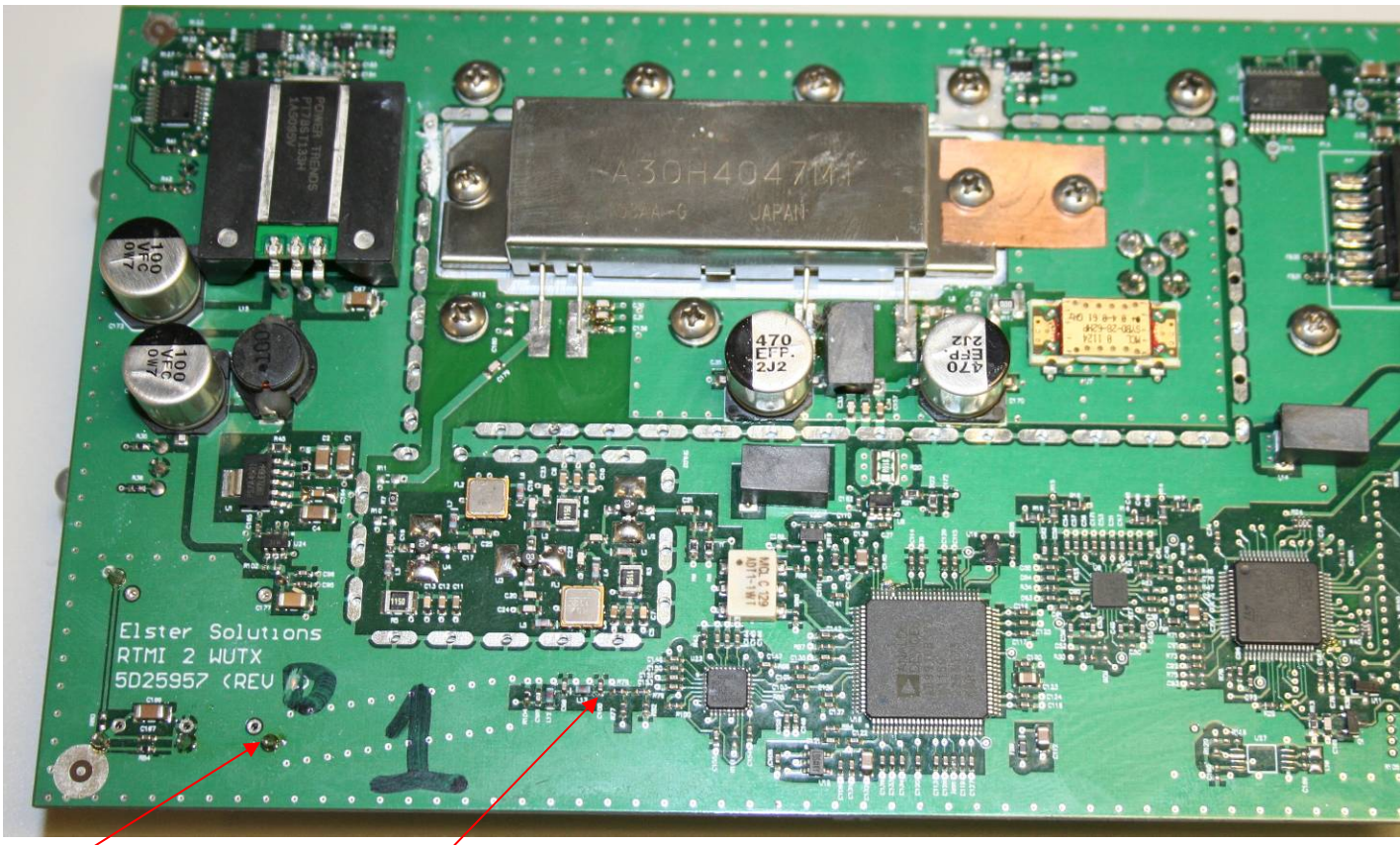
4. Check for 9V ± 0.3V w/r/t GND at the following places:

   a) "East" end of C192 ("Northeast" of large regulator);
   b) R4/C8 junction near amplifier U3;
   c) R3/C5 junction near amplifier U2;
   d) R5/C11 junction near amplifier U4.



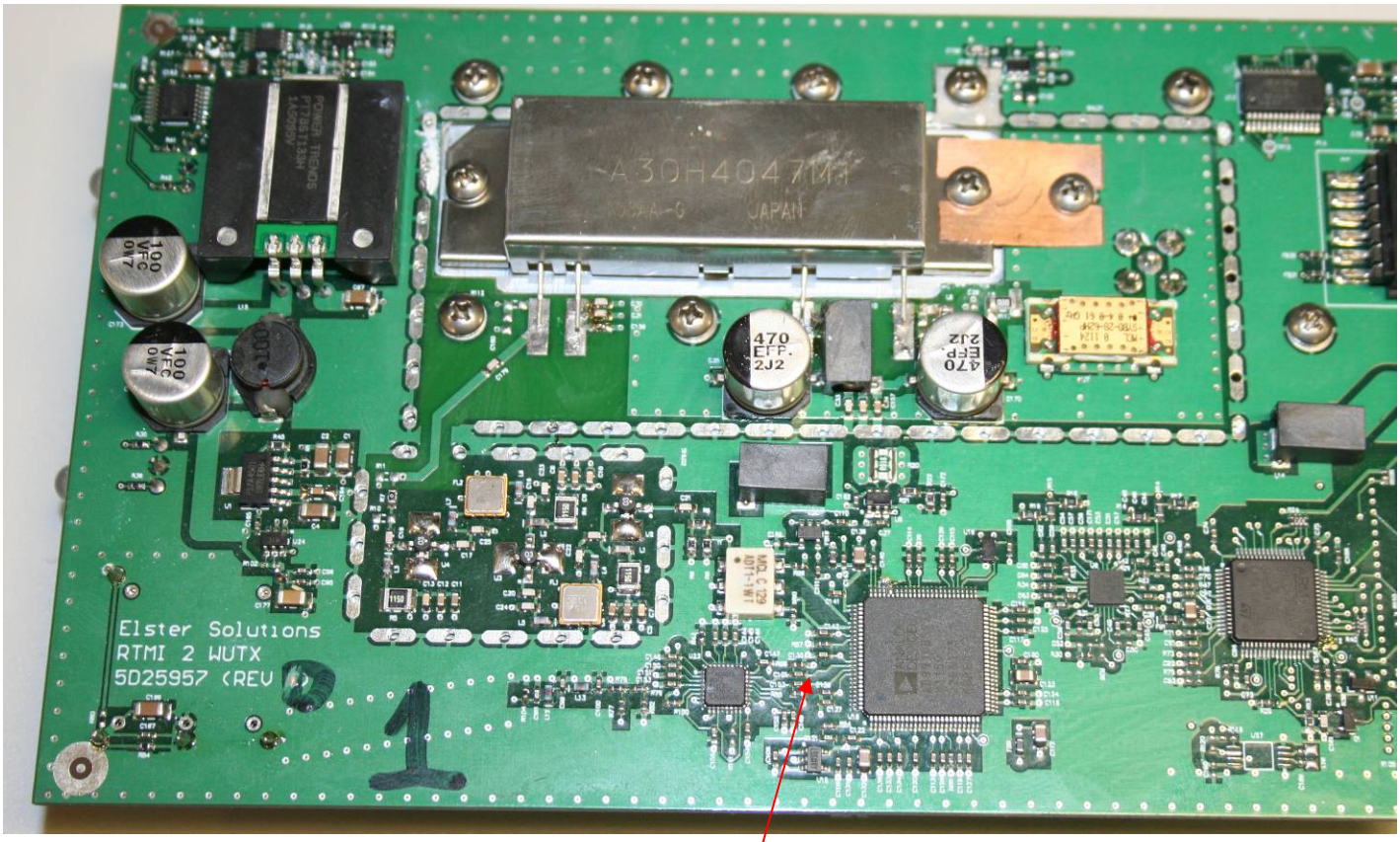
5. Using an oscilloscope with frequency measurement, check for 100 MHz +/- 200 Hz at the following places:

   a) Pin 1 of OSC1; sine wave >= 1.2V p-p
   b) L13/C100 junction, sine wave of >= 500 mV p-p
   (this checks for correct values for L12 & L13)



6. Using an oscilloscope with frequency measurement:

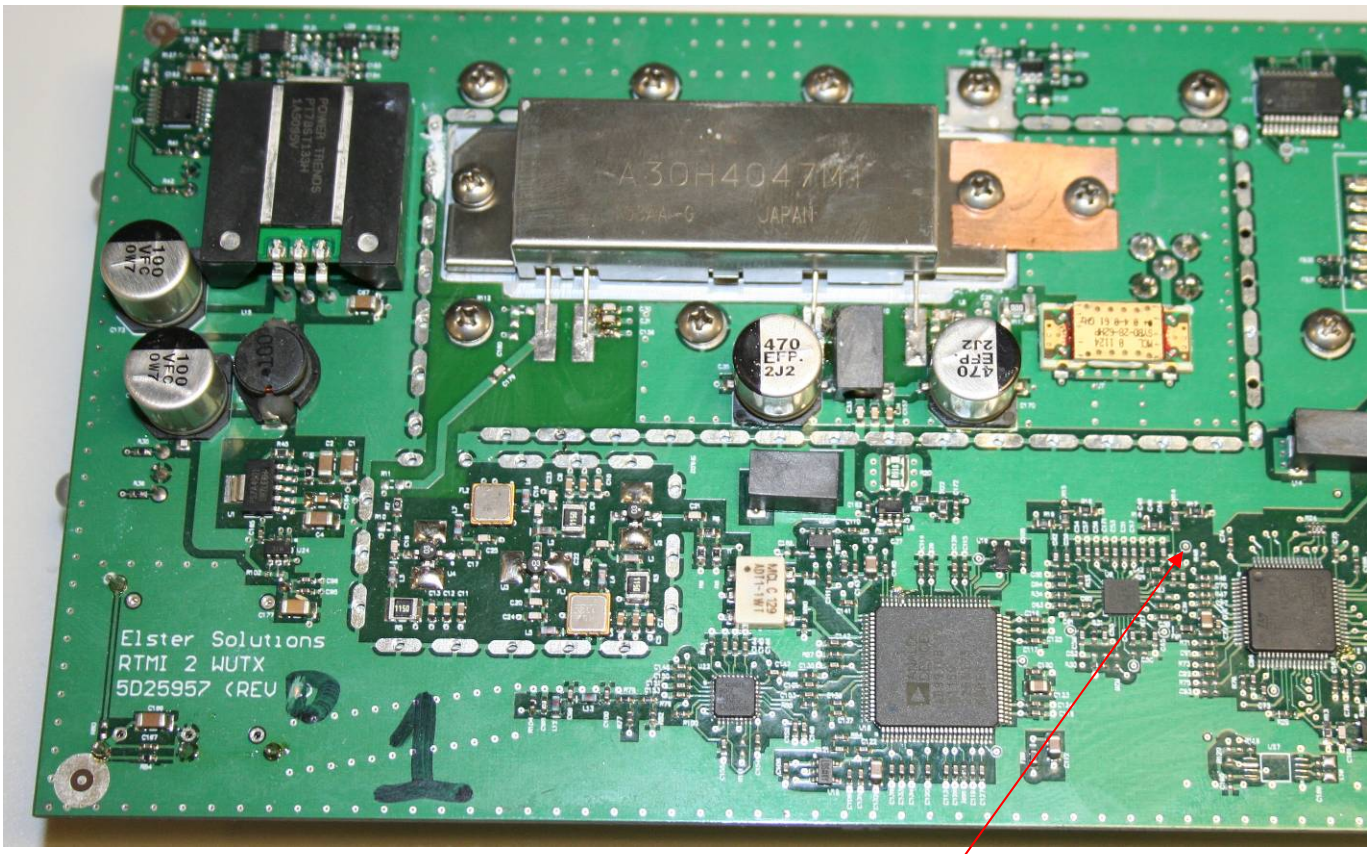
   a) check for 50 MHz square wave, >= 880 mV p-p, swinging about 1.15V DC level at “East” end of C101. (50 MHz because it’s one side of a differential output)



a) C101

7. Using an oscilloscope with frequency measurement:

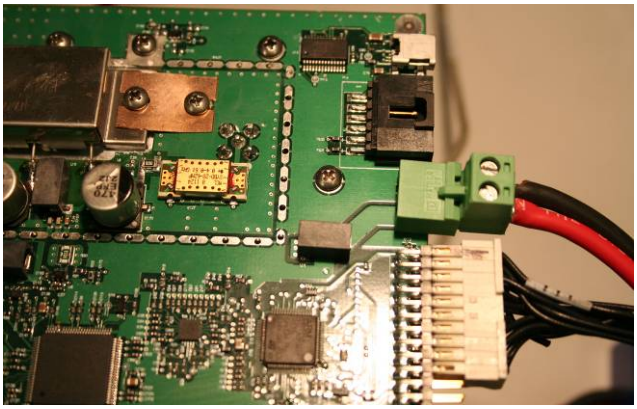
   a) check for 10 MHz +/- 100 Hz square wave at 3.3V ± 0.2V p-p at TP12.



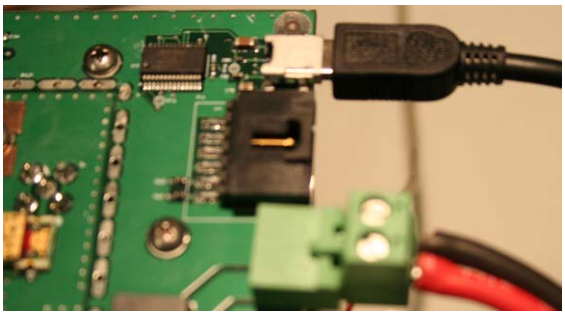
8. If tests have been successful to this point, continue to next section, JTAG Programming.

2.3 Firmware Programming via JTAG

1. Connect the 20-pin JTAG connector from the ARM-USB-OCD device to the 30-pin connector P0 as shown below. Note that 10 of the pins of P0 are not involved in JTAG programming.

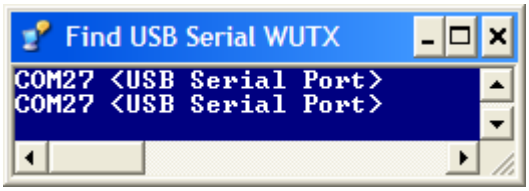


2. Connect mini-B USB cable to the PCBA, and be sure the other end (A type connector) is plugged into the test PC.



If the computer beeps, the board's USB device probably attached correctly (enumerated). Even if the beep does not occur, go to the next step.

3. On the PC, double-click the **Find USB Serial WUTX** script's icon to find COM port number. If a "COM" number is listed in the resulting window, this confirms that the board was enumerated correctly on the USB bus. The example below shows COM port number 27. If enumeration does not occur (no COM number listed), try rebooting the PC and trying again. If that fails, set the PCBA aside and contact Engineering.

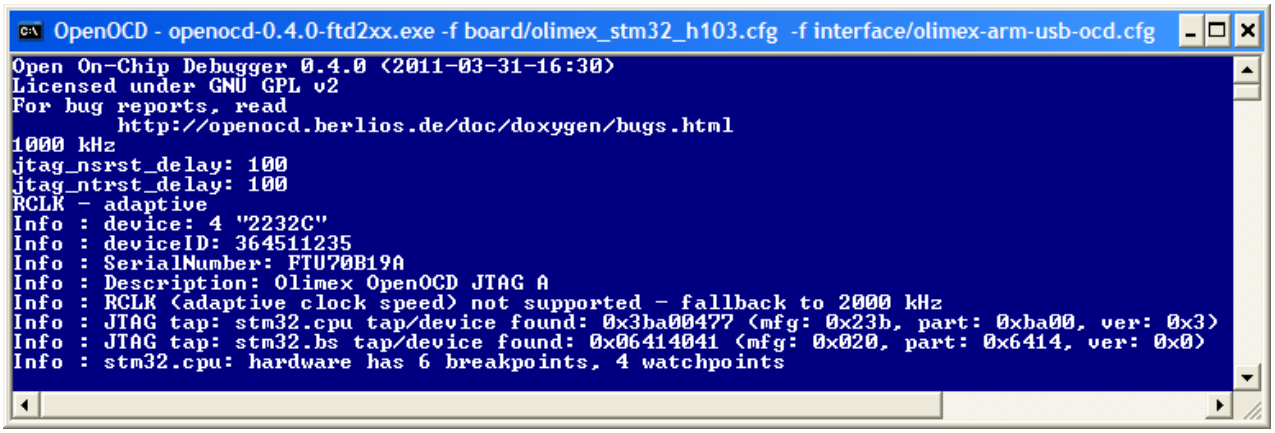


4. The software that controls the JTAG programmer, OpenOCD, may continue running through the programming and checkout of multiple Wakeup TX PCBA's. Skip this step if OpenOCD is running.

   If OpenOCD is not running, do the following.

   First, double-click the OpenOCD icon.

   OpenOCD will open a status window like the following:



   The last line, containing the phrase

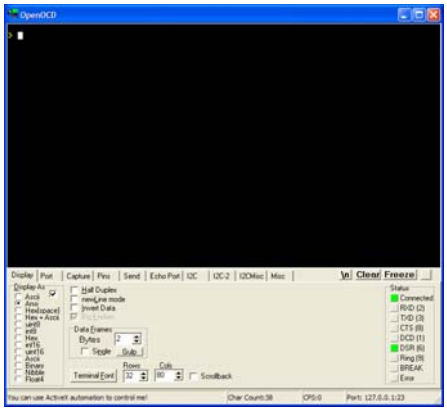
   `stm32.cpu: hardware has 6 breakpoints, 4 watchpoints`

   …is the key indicator that the JTAG programmer has made contact with the CPU on the PCBA. If this phrase is not seen, disconnect the ARM-USB-OCD device both from the Wakeup TX PCA, as well as the ARM-USB-OCD's USB connection, and reconnect them, with USB being connected first. Close the OpenOCD status window and repeat this step. Contact Engineering if reconnecting does not help.

You may now minimize the OpenOCD status window.

Now, double-click the OpenOCD RealTerm icon.

This will bring up OpenOCD's terminal window, so that commands can be sent to it. Press <ENTER> after the cursor starts flashing. The > prompt should appear:

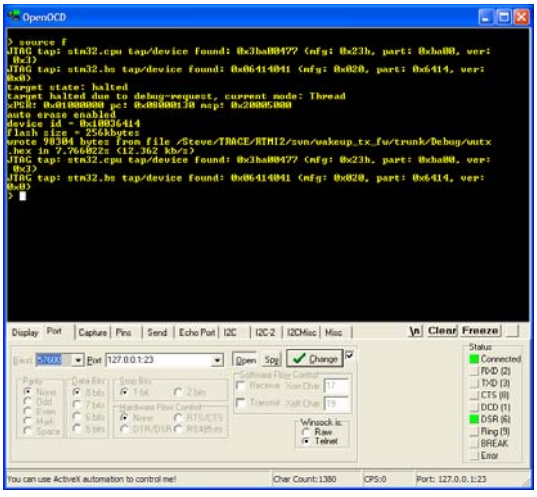


The > prompt indicates that connection with OpenOCD has been made. If this does not happen, click the Port tab, and click Open, then click Open again (this cycles the port connection). Press Enter again. If no prompt appears, seek help from Engineering.

5. Flash the microcontroller with firmware by using the

   source f

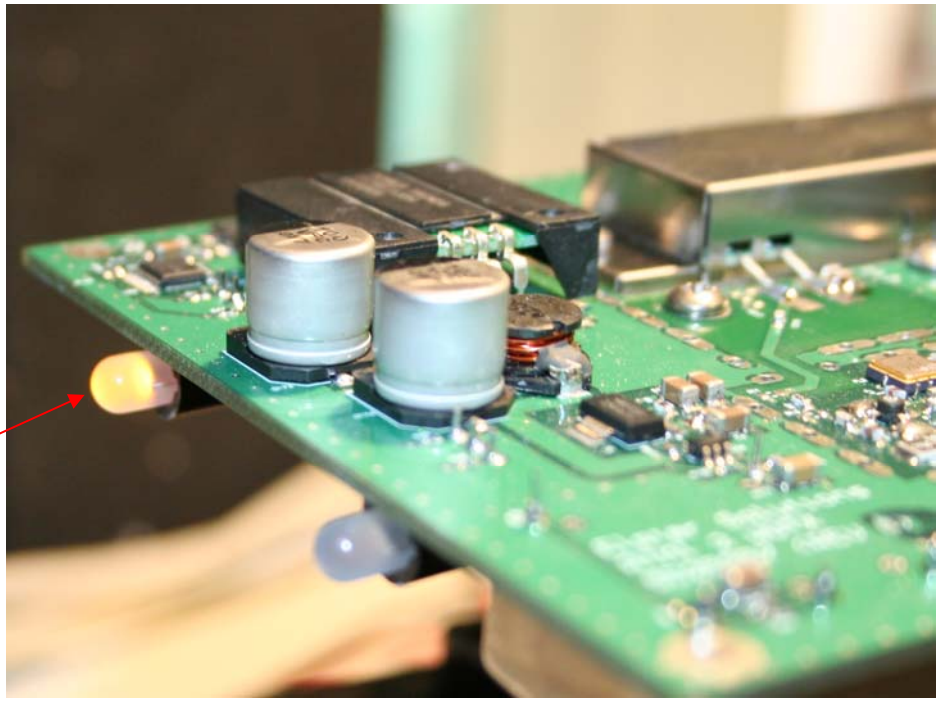
   command in the OpenOCD terminal window, and press <ENTER>. See below.



The phrase “wrote xxxxx bytes from file” is the important part. The other particulars may be different, but this phrase indicates the firmware was written successfully.

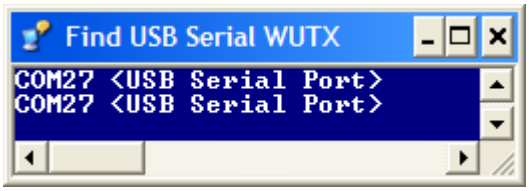
Another indication that the firmware was programmed correctly are the state of the two LEDs on the PCBA.

The “north” LED should be RED or blinking RED/YELLOW, and the other LED should be OFF, as shown below:

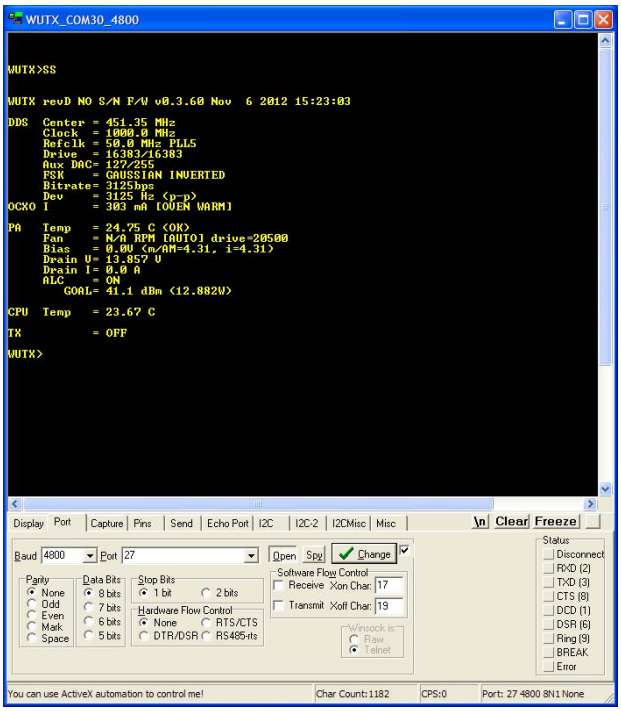


2.4 Post-Firmware Configuration and Checks

1. If you did not remember the COM port number from the last section, double-click the **Find USB Serial WUTX** script to find the PCBA’s COM port number. The example below shows COM port number 27.



2. Start RealTerm or other ANSI terminal emulator, select COM port at 4800 baud, and open the port number from the step above. Hit <ENTER> and make sure that you get the WUTX> prompt. Type **SS** and hit <ENTER> you should see something like the following:

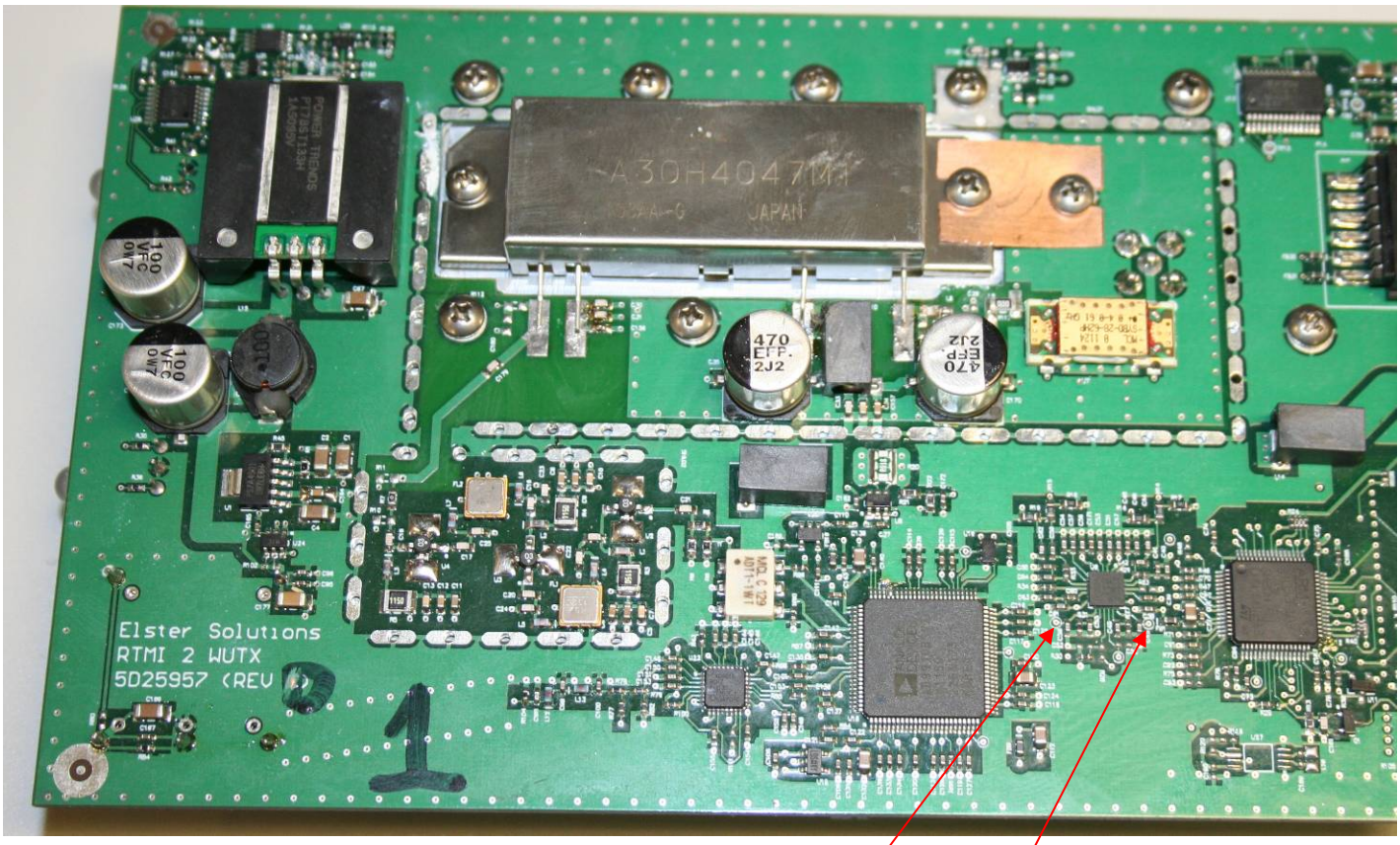


3. Check voltage across R102; should be 1/10th of OXCO current as listed above. For example, for 303 mA as shown above, the voltage across R102 should be 30 ±10 mV.

4. Now that the firmware is running, the RF detector can be checked:

    a. Check for <0.5V on TP4, lower left of U9 (RF detector). If the voltage is higher, the board is faulty. Contact Engineering for repair advice.

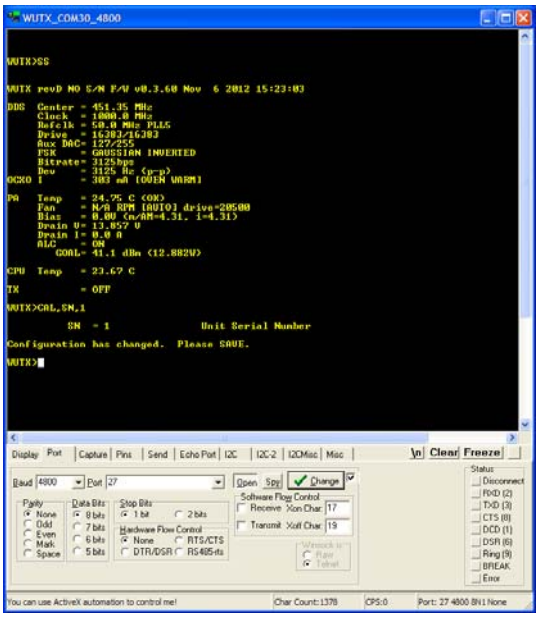
    b. Check for <0.5V on TP2, lower right of U9 (RF detector). If the voltage is higher, the board is faulty. Contact Engineering for repair advice.


Elster Solutions
RTMI 2 WUTX
5D25957 (REV
a) TP4
b) TP2

5. On the terminal emulator, type the command

   `CAL,SN,`*`n`*

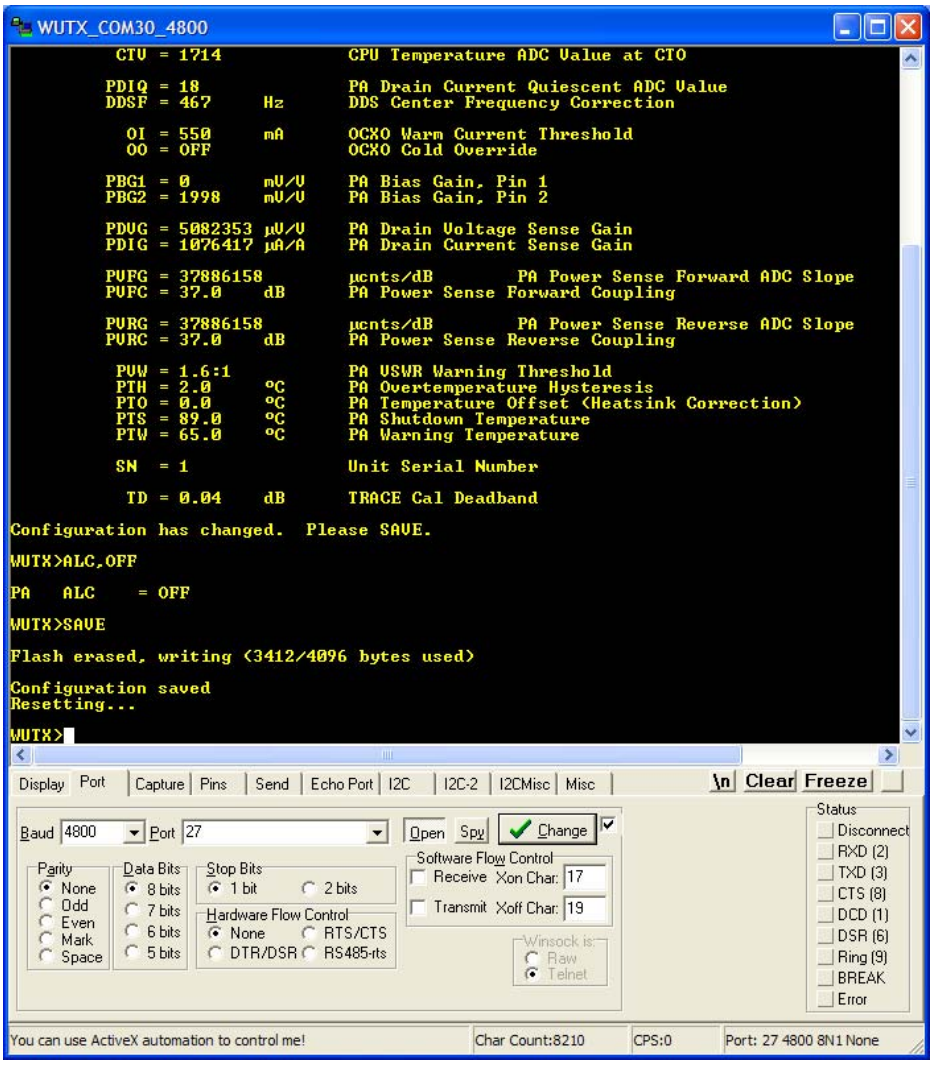
   where ***n*** is the serial number of the board. Serial numbers should be kept in a spreadsheet so they are unique. The result will look like the following:



6. On the terminal emulator, type the following commands, pressing <ENTER> after each line:

CAL,AUTOT
ALC,OFF
SAVE

The result should look like:



7. Now type **SS** and press <ENTER>.

8. Check that PA & CPU temperatures are within ±2 degrees C of each other, and are within ±3 degrees C of ambient temperature

9. Command: **BIAS,4**
check for 4±0.01V on PA pin 2 with respect to the case of the PA; no oscillation on bias rising, fall, or stable

10. Command: **BIAS,0**

11. Connect the Wakeup TX PCBA's SMA cable through a power attenuator or coupler to a spectrum analyzer. Be sure the attenuator or coupler can withstand up to 15 Watts of RF power at 451 MHz.

12. Configure the the spectrum analyzer:

    a. Center Frequency: 451.35 MHz
    b. Span: 12.5 kHz
    c. Resolution bandwidth (RBW) and video bandwidth (VBW): 300 Hz.

       1 kHz is OK for RBW and VBW if the analyzer does not support 300 Hz, but all screen shots below are based on 300 Hz RBW & VBW.

    d. Reference level: 45 dBm. Set the reference offset to account for the attenuation of the attenuator and/or the coupling loss of the coupler.

13. Command: **CW**

    Check for 451.35 MHz ± 1kHz, > 11.5 dBm, with NO MEASURABLE SPURS from 12.5 kHz span to 400 MHz span. Using 10 Hz bandwidth at 12.5 kHz span and freq counter, measure carrier frequency. e.g., 451.349985

14. Command: ***CAL,AUTOF,***freq from above. This calibrates the transmitter center frequency.
    e.g., ***CAL,AUTOF, 451.349985M***

15. Command: ***SAVE***

16. Disconnect all cables from board. Trim leads of 3.3V regulator.
    Install SMA cable and heat sink. Solder on PA. Re-connect cables.

17. Command: ***CAL,AUTOP*** This command calibrates the RF output power curve for the transmitter.

    The unit will transmit a signal. Read the dBm from the power meter, type it into the terminal window, and press <ENTER>.

    Repeat for all of the points requested. Below is an example session:

```
WUTX>CAL,AUTOPWR

Automatic RF power detector calibration

1 of 6; Enter power meter reading in dBm: 44.6
2 of 6; Enter power meter reading in dBm: 42.6
3 of 6; Enter power meter reading in dBm: 39.9
4 of 6; Enter power meter reading in dBm: 35.6
5 of 6; Enter power meter reading in dBm: 31.5
6 of 6; Enter power meter reading in dBm: 25.8
     TX     =  OFF

PRESENT:
      PVFG = 37281063  µcnts/dB
      PVFC = 36.5      dB


PROPOSED:
      PVFG = 37930218  µcnts/dB
      PVFC = 35.4      dB

Accept? (Y/N):Y

PVFG, PVFC, PVRG, PVRC changed, please SAVE.
```

```
WUTX>SAVE

Flash erased, writing (3412/4096 bytes used)

Configuration saved
Resetting...

WUTX>
```

The Wakeup Transmitter unit is now fully assembled, calibrated, and tested.

Rev	DCN	Author	Reviewer	Date	Description
1	103-225	S. Bragg	M.Holman	12/10/12	Draft 0
1	103-225	S. Bragg	M.Holman	12/17/12	Draft 1

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