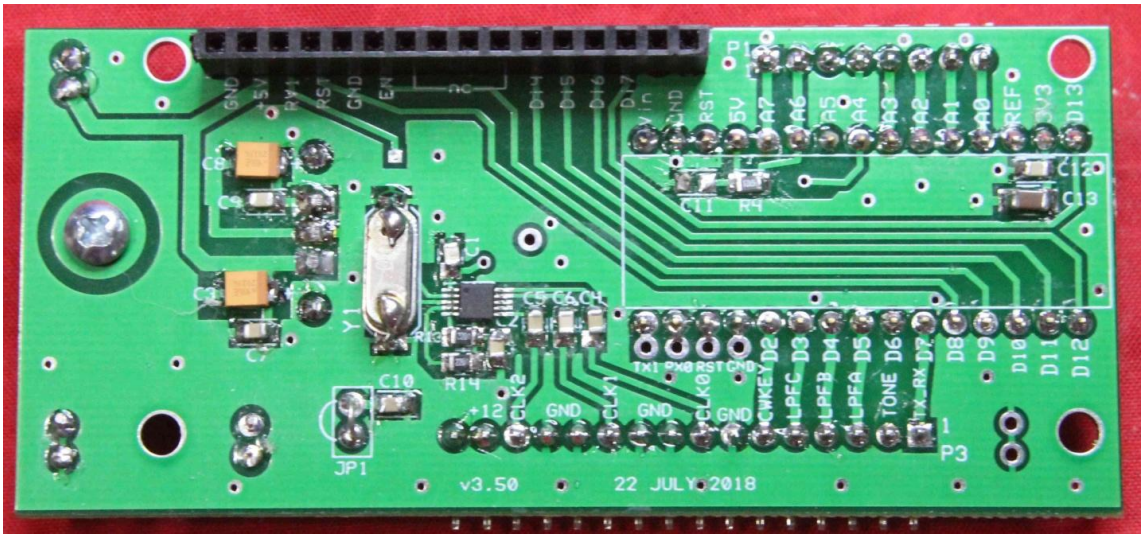
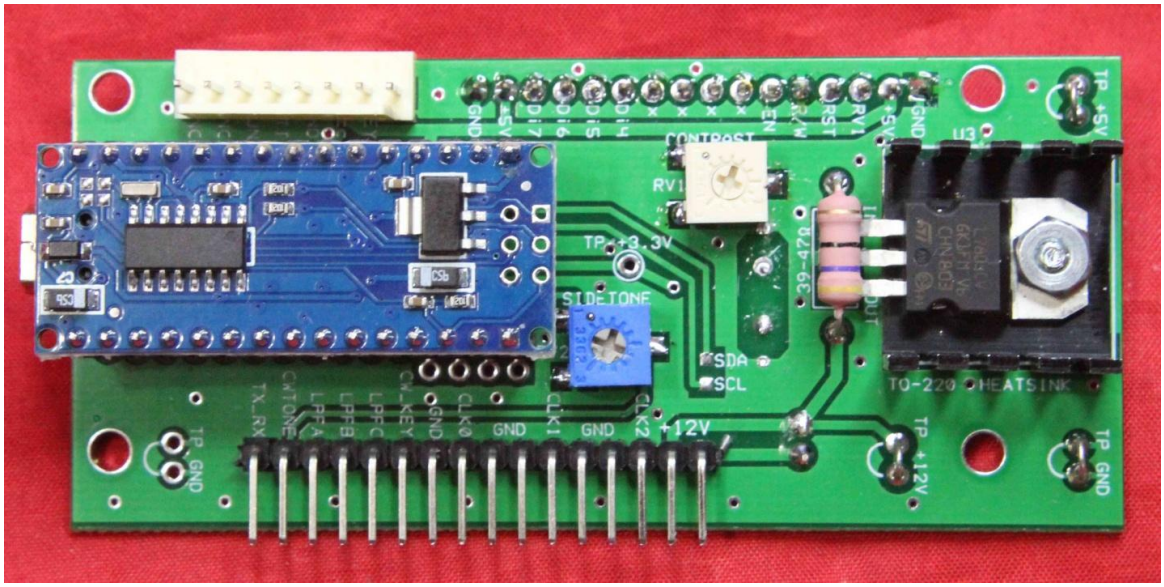
Construction Manual for the W0EB/N5IB New uBITX Raduino Clone

Version 1.5, January 09, 2019



Completed W0EB-N5IB Raduino Clone Card Front Side View



Completed W0EB-N5IB Raduino Clone Card Rear Side View

Overview:

The W0EB/N5IB Raduino Clone board was originally intended for use in just the uBITX but it will also work in a BITX40 if you omit the installation of R4 on page 5 of this manual and install the proper 5 pin header at P3 (may be supplied on request in place of the 16pin right angle header the uBITX requires)and the wire-up pictorial is included as Appendix D to this manual.

This kit uses small surface mount components and you must use caution when installing these. Be especially careful you don't short adjacent pins of the tiny Si5351a clock chip. Also, when installing resistors and capacitors, be careful to position them properly and don't use too much solder. NOTE: A very helpful item is Chip Quik™ "Tack" flux, especially for soldering the Si5351a clock chip.

If you are not completely familiar with the techniques for soldering the tiny, fine pitch IC pins to extremely close-spaced pads on a PC board, we suggest you proceed very cautiously or maybe even enlist an experienced friend to at least solder the 10 pin clock chip.

Very small diameter 63/37 low temperature, flux core solder is recommended for installing all components. For the header pins, slightly larger 0.8mm 63/37 flux core solder can be used if desired.

Unless you have really good eyes, you will also need a good magnifying glass or better yet one of those headbands with several different powers of magnifying lenses. A fairly bright light to illuminate your work is also a necessity. For most people, it's very difficult to accurately solder the Si5351 in place without these.

Refer to the BOM (Bill of Materials) in Appendix A for component values and ordering information if you are building from the bare board or ordering replacements for accidentally lost parts during construction (it happens).

All the solder pads on the board have been "pre-tinned" by the PC fabricating house and have a very thin layer of solder already applied to them. If you use a flux similar to Chip Quik™ "Tack Flux", there is usually enough solder already on

the pads that the pins of the Si5351a clock chip will bond to them with only the application of heat from a very fine tipped soldering iron.

With the surface mount resistors and capacitors it's a good idea to apply a small amount of solder to one pad, and while holding the component in place with tweezers, heat that end again until the solder melts and anchors the capacitor or resistor in place. Soldering the other end completes the job.

Constructing your Raduino clone:

Let's get the really hard stuff out of the way first. There is only one tiny 10 pin integrated circuit, U2. This is the Silicon Labs Si5351a clock generator chip which creates the various RF oscillator signals used in the uBITX.

This is the most difficult part to install correctly so we tackle it first.

Apply a thin layer of flux across all the PC board pads for U2, the Si5351a clock IC.

Carefully observe the pin 1 indicator dot on the 5351 chip and place that pin over the indicated pin 1 pad on the board. (The Pin 1 designation may be hard to see but it is the upper left pin of the pad pattern when viewed from the front of the board with the upper edge horizontal.)

Using a tweezers or a pointed wooden toothpick, carefully position U2 so each pin on both sides is in the center of its pad on the board.

Now, using a very fine point soldering iron, carefully "tack" pin 1 in place.

Next "tack" pin 5 and check to make sure all pins are still square and over their pads.

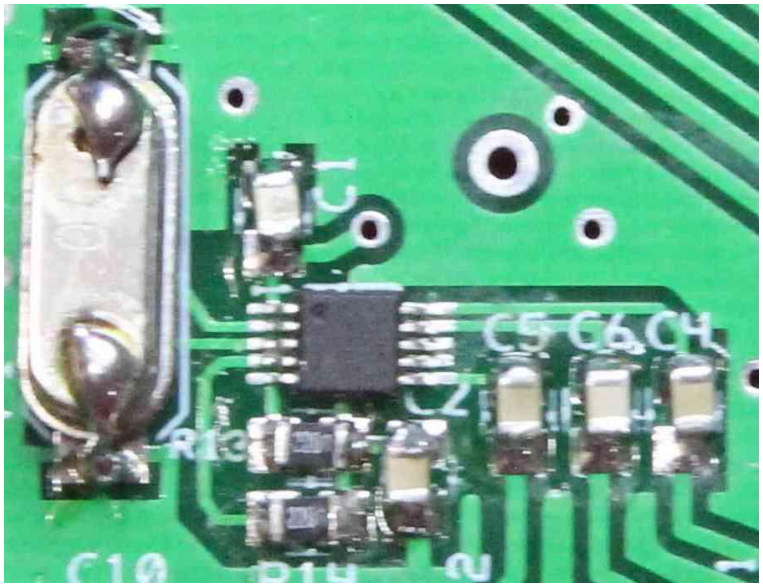
If necessary apply a little heat to pin 1 or pin 5 while applying a very GENTLE twisting motion to the IC with a pair of tweezers until the pins are all properly centered on their pads.

Now carefully "tack" pins 10 and 6. Inspect for shorts and if there are none, carefully tack the rest of the pins until they are all adhered to their respective pads.

Before proceeding to the next step, using your DMM's continuity check and referring to the trace and pad pattern in Appendix A of this manual, perform a continuity check between the actual pins on U2 (not the trace or pad) and the capacitor or resistor pad they connect to.

Use minimal pressure on U2's pins so you don't push one down and have it make contact in case the solder didn't take as this will give a false idea that the pin was actually soldered. Clear any shorts with a little flux and solder braid. Once you are satisfied all pins are firmly attached to their pads and there are no shorts between them proceed to the next step.

It is NOT a good idea to use an older "analog" meter's "Ohms" ranges to make these checks as some of them had fairly high voltage (22.5V or sometimes higher) batteries in them to power the resistance checks and if accidentally applied between the wrong point(s) and ground on the Si5351a, it could be enough to actually destroy the chip as the 5351a can tolerate no more than about 3.5 volts. A DMM usually has a high limiting resistance so its 9V battery doesn't produce enough current through the probes to create a problem.



Install the discrete 25.000 MHz crystal at Y1. Make sure it sits a tiny bit off of the PC board so the case does not short to the solder pads. Trim the leads on the back side and using one of the cut leads (or both if you like.) solder a ground wire

to the crystal case and to the ground pad(s) on either end of the crystal as shown above. Only one ground is needed though it doesn't hurt to install both.

Continuing, solder the 2.2K 0805 SMD Resistors R13 and R14 near the bottom of the Si5351 chip.
If the Raduino clone is to be installed in a uBITX that has already been completely wired up for CW, OR if you intend to use it in a BITX40, skip the installation of R4 and continue with installing the capacitors.

Install the 4.7K CW pull-up resistor at R4.

(NOTE: R1, R4 R13 and R14 are the only fixed resistors used. This numbering scheme was used to match the silkscreen designations on the board.)

Next, carefully solder the .1uF 50 volt, 0805 ceramic chip capacitors in place at locations C1, C2,C4, C5 C6, C7, C9, C10, C11, and C12, on the front side of the board.

Now, install 10 uF 25V 1206, non-polarized ceramic chip capacitor C13. Installing a 10 uF cap here helps cut down on the tuning click RFI generated by the Si5351 clock chip.

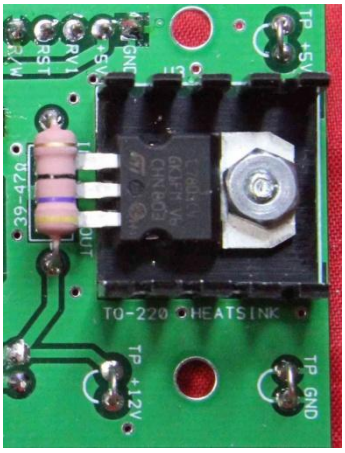
The pads for C13 are shown as being polarized and if desired you could use a 10uF Tantalum capacitor here. If you do, be sure and connect the + side of the Tantalum capacitor to the + indicated pad on the board. A non polarized 10uF ceramic chip capacitor is supplied in the kit.

Install 10uF, size 1206 or 1210 (either may be supplied) Tantalum capacitors at C3 and C8, carefully observing the polarity marked on the board. **The colored line on the capacitors is the + terminal and must be soldered to the pad marked + on the board.** Size 1210 components are slightly larger than 1206 so if you have the larger ones, be careful that their terminals don't accidentally short to the ground plane when soldering.

Make sure the terminals on both ends of these capacitors are properly soldered to their respective pads or U3 could break into oscillation with the possibility of a catastrophic failure that might destroy your NANO and subsequently the Si5351a.

Install the 7805 Regulator IC and its heatsink at U3. Carefully bend the leads of U3 so they clear the edge of the heat sink and the hole in the regulator's tab is centered over the hole in the heat sink. You can, if you like, use thermal compound (not supplied) between the 7805 and the heatsink but this is probably not necessary. The tab of the 7805 is grounded so use a short 4-40 screw and nut to secure the regulator and heatsink to the board using the available hole.

NOTE: The heatsink for U3 can have taller fins than the one called out, but the base of it can't be bigger than a .75" x .75" footprint or it could short to the 5 volt test point near the top of the board.



Install R1, an axial lead, 47 ohm 2 watt resistor in the 2 outer holes over the 7805 regulator's leads. Position the resistor so it sits slightly above the 3 regulator leads and make sure neither leg of R1 shorts to the regulator terminals. Positioning it slightly above the leads to the regulator will insure that R1 sits in "open air" and heat from it will be easily dissipated.

Next install the 10K SMD trimmer potentiometer RV1, labeled "CONTRAST" just to the left of the 7805. Match its pin pattern to that on the PC board. It's virtually impossible to install it wrong if you center the pins over the pads as they will fit only one way. CAREFULLY solder these pins to the pads without touching the soldering iron tip to the plastic case as it's easily melted. RV1 is used to set the display contrast when a standard, parallel display is used.

Install the 5K SMD trimmer potentiometer RV2, labeled “SIDETONE” located just to the right of the bottom row of the NANO socket pins. Use the same techniques you used for installing RV1.

Jumper JP1 (optional) connects the normally unconnected terminal on the 16 pin right angle header P3 to +12 volts which may be used as a 12 volt pick-off on the main board if necessary. Use a small diameter, solid wire (one of the clipped leads from R1 would work).

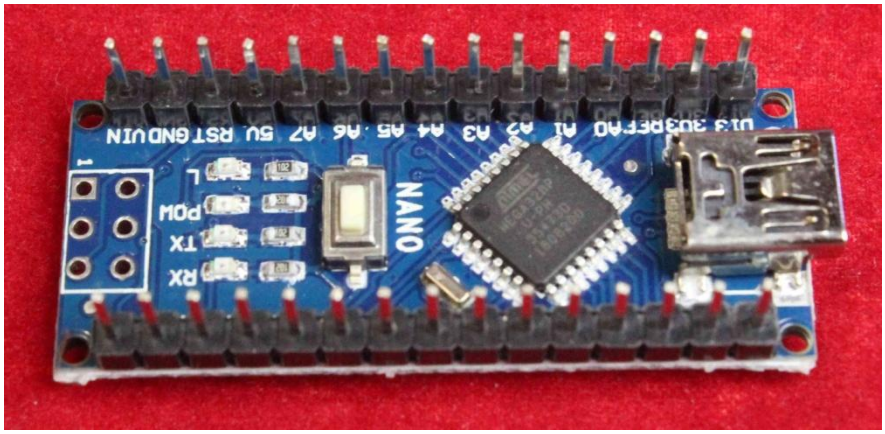
There are 5 test points configured and silk screened on the board. 4 of these can be made by soldering a small wire loop into TP +5V, TP +12V and the two TP GND points. There is one additional test point TP +3.3V that can be left as-is or a single pin header could be soldered in place. Either side of the board is fine for them. Now, it’s time to decide whether or not you are going to install U2, the NANO MPU on the front or back of the board.

The later model Factory Raduinos have the NANO socketed and on the back of the board to keep it from interfering with the 16 x 2 line standard parallel display they include. To keep costs down, we are not supplying a display as most users will have one already.

Supplied are two 15 pin female socket strips and they should be soldered into the NANO’s hole pattern on the board on whichever side you have chosen. Carefully insure that both strips are parallel and perpendicular to the board before soldering all the pins so a NANO with installed pins will easily fit the socket you just created.

Also, remember if you chose to install the NANO on the back side of the board, the LONG ENDS of the male header pins soldered onto the NANO will have to

protrude from the TOP of the NANO.



Pins shown properly installed for “back side” mounted NANO.

The pre-programmed (uBITX code version 4.3) NANO is supplied as a bare board with the pins not soldered in place to allow the user to chose which side of the Raduino clone they want to put the NANO. WE recommend putting it on the back side of the board.

Install 16 pin right angle male header P3 on the BACK side of the board (this matches a factory supplied original Raduino). Solder 1 pin near the middle first. Check the alignment and if necessary, carefully heat that pin while adjusting the orientation of the header so the long pins are parallel to the edge of the PC board and it will fit properly into the socket on the main uBITX PCB. Once you have it correct, solder the remaining pins and make sure there are no unsoldered pins or solder shorts between them.

If you are constructing this Raduino Clone for a BITX40, install the supplied 5 pin “Wafer” (Molex type) connector in the left most 5 holes of P3. The 16 pin right angle header won’t be used (and if ordered for a BITX40, the 5 pin Wafer connector will be substituted for the 16 pin right angle header. See the BITX40 wireup graphic included as Appendix

Install the 8 pin, polarized “Digital” connector at P1 on the back side of the board with the flat, polarizing tab toward the bottom of the board. Solder 1 pin on the front side, check to see the base is flat against the board and if necessary reheat

the pin while adjusting it. Now, solder all the remaining pins and make sure there are no shorts between them.

Finally, install J2, the 16 pin female display socket on the front side of the board. Insure that it's fully seated and perpendicular to the board. Solder 1 pin first and readjust the position if necessary. Once you are satisfied with the orientation, solder all the remaining pins and inspect for unsoldered pins or shorts.

Using the photos on Page 1 you can see what a correctly assembled Raduino clone should look like.

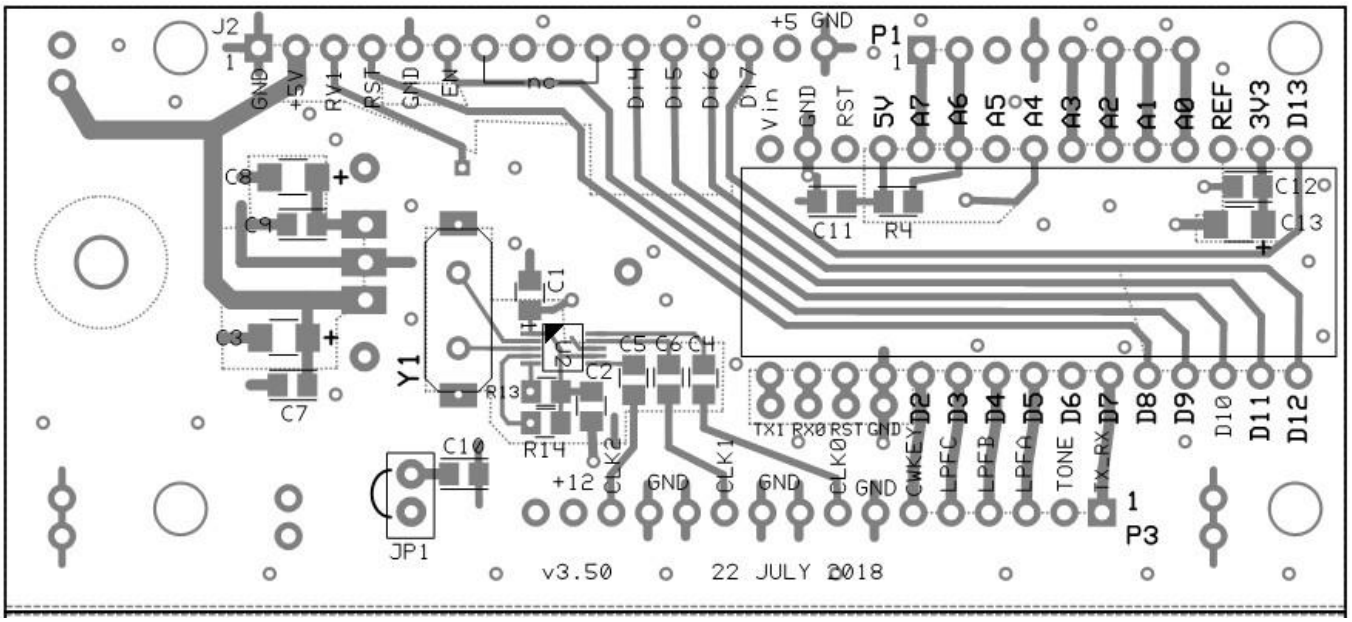
Once you have installed your Raduino Clone in the uBITX, do not forget to adjust the "CONTRAST" control potentiometer on the back of the board. If you forget this adjustment you will most likely see nothing on the display. When adjusted, this control will be almost completely rotated "CLOCKWISE" and it somewhat touchy near the clockwise end of it's adjustment.

Jim Sheldon, W0EB
Jim Giammanco, N5IB

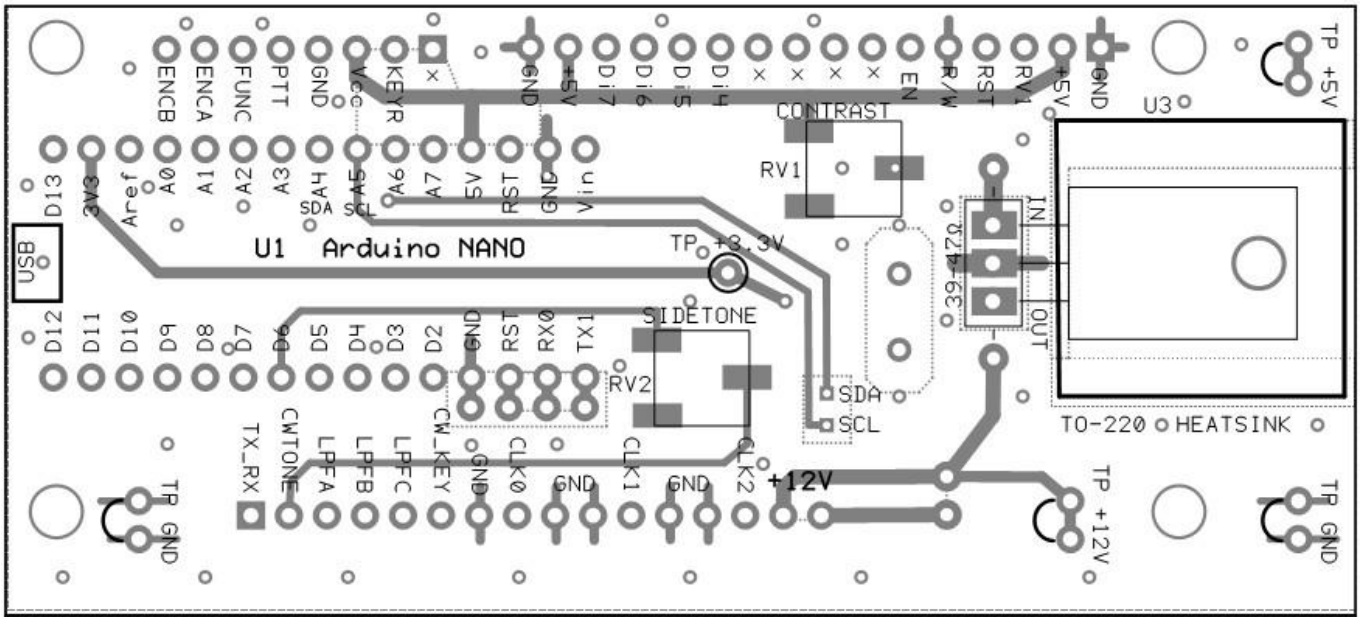
Appendix A:

NOTE: The ground plane patterns in the front/back images have been omitted to make the traces more visible for easier troubleshooting.

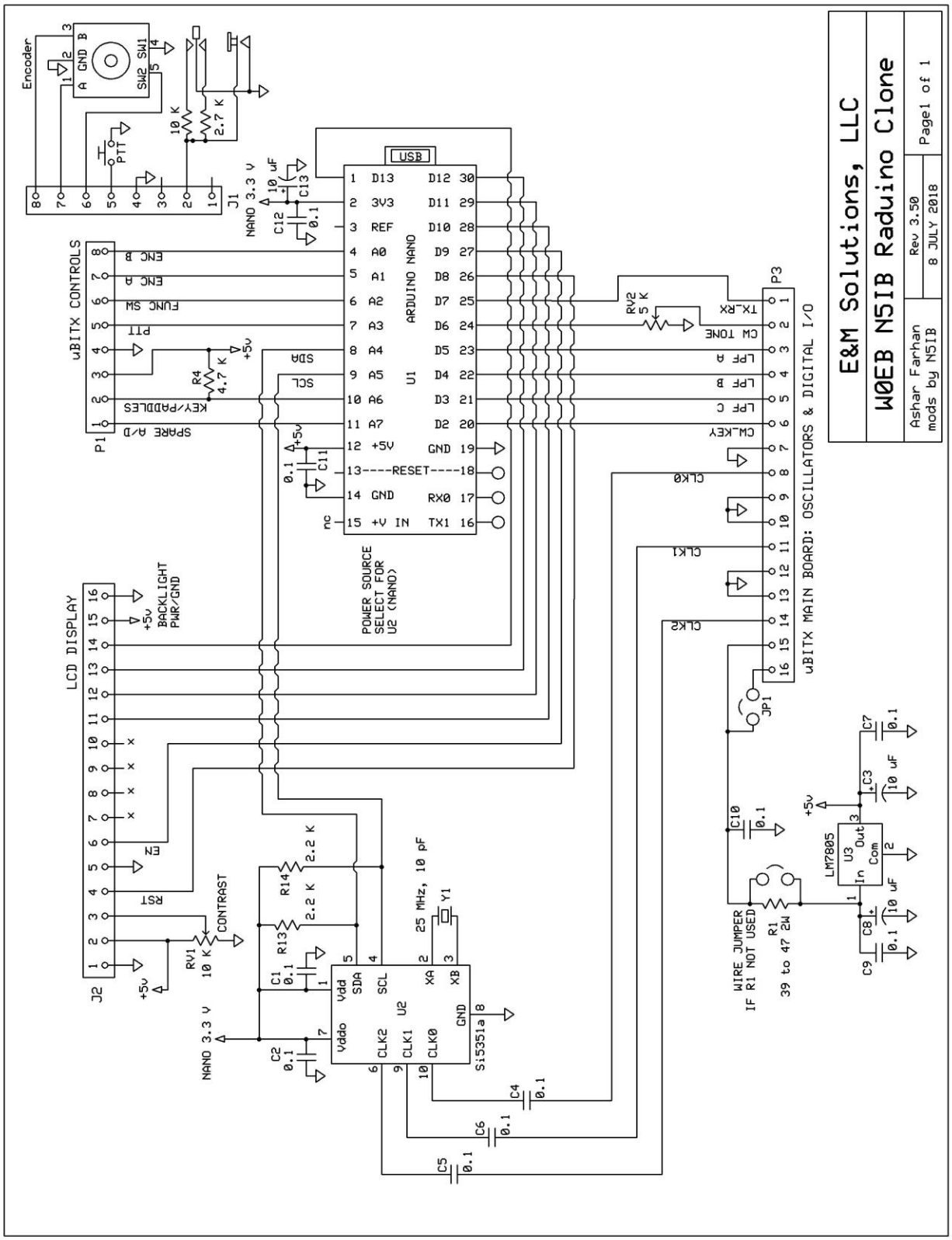
Board Pattern Front View:



Board Pattern Rear View:



Appendix B: Schematic:



Appendix C, Bill of Materials (BOM):

C3, C8 10 uF Tantalum Electrolytic SMD 1206 or 1210 size
Mouser 581-TCJA106M025R0150 (for size 1206)
Digi-Key 478-9408-1-ND (for size 1210)

C1, C2,C4, C5 C6, C7, C9, C10, C11, C12
0.1 uF 50V MLCC SMD 0805
Mouser 77-VJ0805Y104KXAAT or Tayda A-3511

C13 10 uF 25V MLCC SMD 1206
Mouser 963-TMK316BJ106KL-T

P1 8-pin polarized “wafer” connector
Tayda SKU: A-810

J2 16 pin female header strip
Tayda SKU: A-196 (cut from 40 pin female strips)

P3 16 pin, right angle, male header strip
Tayda SKU-A-199 (20 pin break apart strip)
If the kit was ordered to go with a BITX40, a 5 pin male Wafer (MOLEX)type connector (Tayda SKU A-807) will be supplied instead of the 16 pin right angle male header strip.

R1 47 ohm, 2 Watt 10% Metal Film Resistor, Non-Inductive
Digi-Key 47ZCT-ND

R13, R14 2.2K 0805 5% 1/8 W SMD
Tayda A-3073

R4 4.7K 0805 5% 1/8W SMD
Mouser 603-AC0805JR-074K7L

RV1 10K SMD Trimmer Potentiometer
Tayda SKU A-604 (bend leads at right angles to body to make SMD)

RV2	5K trimmer potentiometer Tayda SKU A-610 (bend leads at right angles to body to make SMD)
U1	NANO MPU (pre programmed) Various sources to numerous to name here.
SKT for U1	Two 15 pin female socket strips Tayda SKU: A-96 (cut from 40 pin strips)
U2	Si5351a clock generator Mouser 634-SI5351A-B-GT
U3	LM7805 5V series regulator, TO-220 Mouser 512-LM7805CT
Y1	25 MHz crystal, parallel mode, 10-18 pF, Tayda SKU A-215
HS1	Heat sink, TO-220 .75" x .75" x .3" Mouser 532-507302B00
PCB	N5IB printed circuit board V3.50 (design copyright©, N5IB, 22 JULY 2018)
Hardware	#4-40 x 1/2" machine screw and nut Available from most hardware stores

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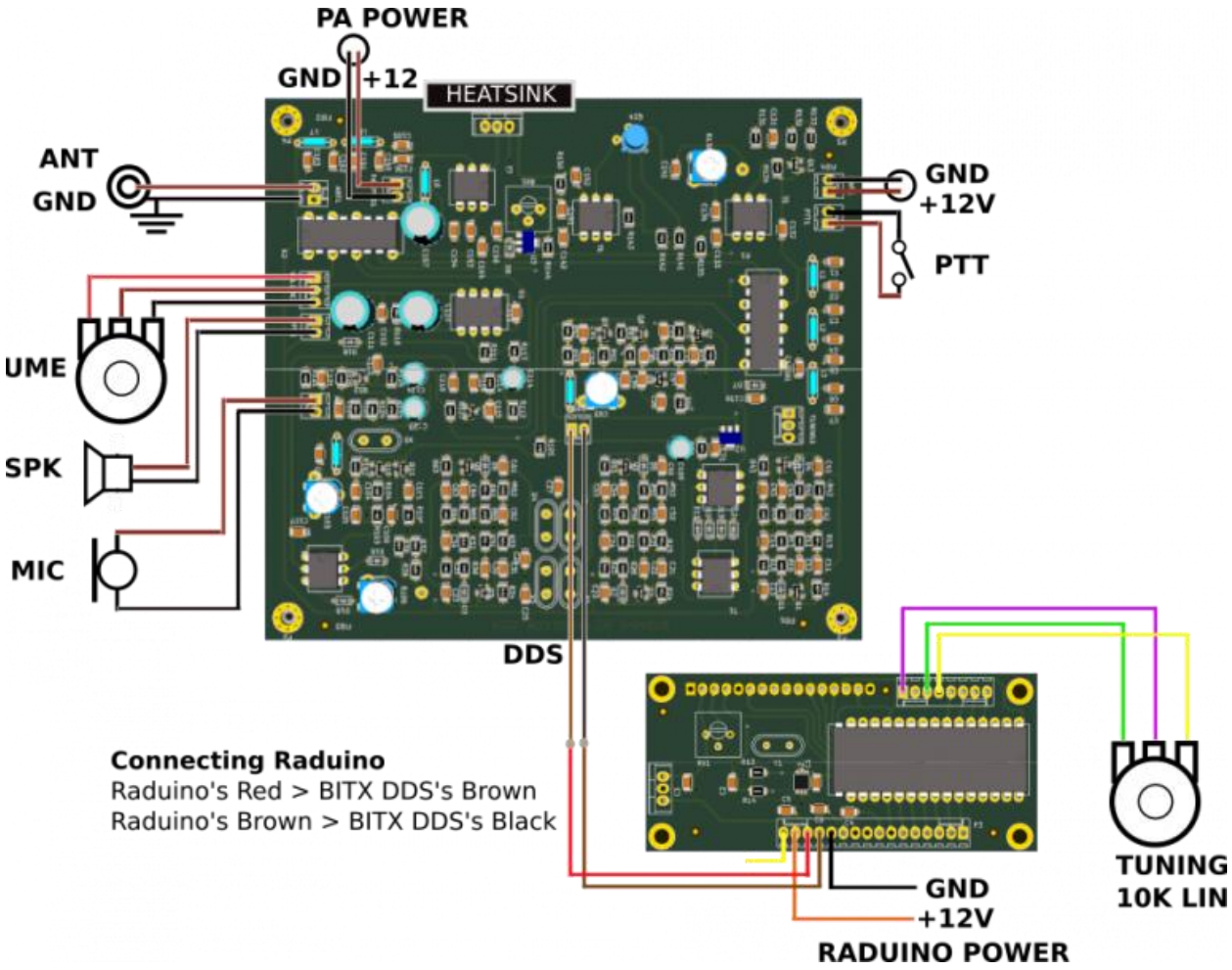
Mouser Electronics URL: https://www.mouser.com
Digi-Key Electronics URL: https://www.digikey.com
Tayda Electronics URL: https://www.taydaelectronics.com

Appendix D: BITX40 wire-up showing the Raduino connections:



Design & testing, N5IB/W0EB

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