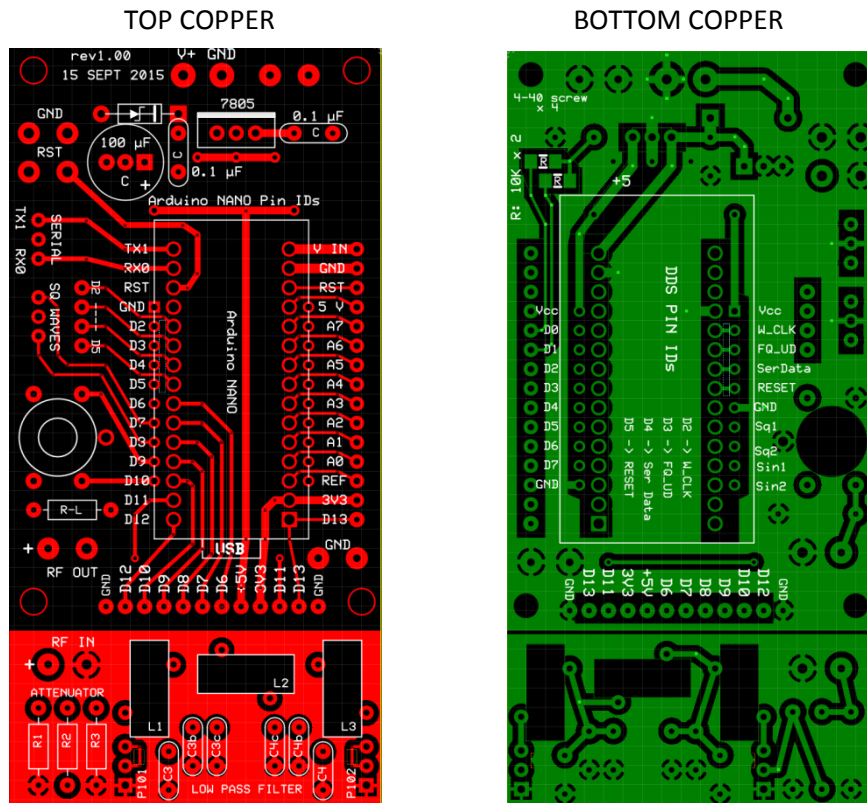


DDS Type II and Arduino NANO Experimenter Board (revised 01 Dec 2015)

Approximately actual size (3.925" x 1.95")



Features:

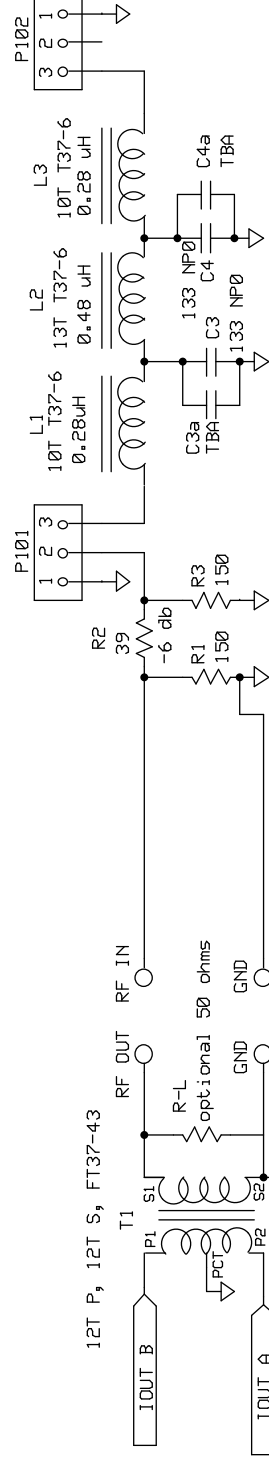
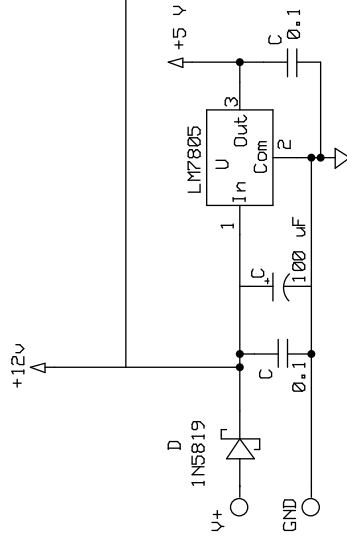
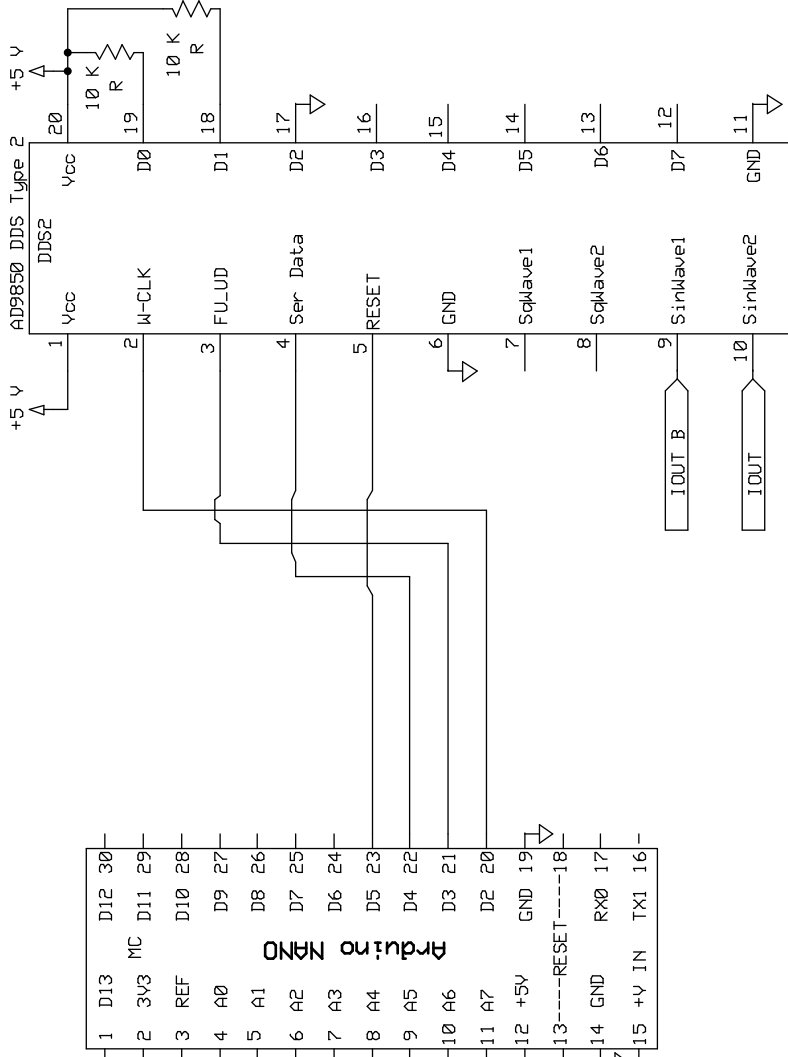
- Accepts a Type II DDS module and an Arduino NANO processor board
- USB connector of NANO is accessible for programming or serial communications
- Connections are already made for controlling the DDS with the NANO (NANO D2 – D5)
 - PHSNA software will need to be modified to change the pin assignment(see **Software Modifications**)*
- 5 V regulator footprint on board, will run on supply of 8 to 14 V
- All digital pins not connected to the DDS are brought out to the lower row of 0.1" spaced pads
- Analog and other miscellaneous pins are brought out to the right side column of 0.1" pads
- DDS pins D0 and D1 have pads available for optional pull-ups (1206 SMT on bottom side)
- NANO pins D2 through D5 (used for DDS) are also brought out to a pad set
- Traces can be cut to isolate NANO pins D2 through D5 if desired
- Serial Rx/Tx, and RST from the NANO are brought out to pads on the left side
- Square wave outputs from DDS are brought out to pads on the left side
- Sinewave outputs from DDS are connected to pads for a center-tapped transformer (FT37-43)
- Transformer output brought out to pads for RF out
- Attenuator circuit layout at bottom
- Low pass filter circuit (same as Type II PHSNA) layout at bottom
 - LPF can be used in place, or separated from the main board if desired*
- Pads provided for installing grounding loops to connect instrument commons

New, just discovered (by Dick, K9IVB) feature:

The pinout and spacing on the board that are designed to accept the Type II DDS modules turns out to be compatible (with some wiring care and attention to software) with the QRP-Labs synthesizer module that utilizes the popular Silicon Labs Si5351A clock generator chip <http://www.qrp-labs.com/synth.html> See the following schematics for more information.

ONLY THE DEDICATED CONNECTIONS ARE SHOWN
 MANY OTHER PINS OF THE NANO
 AND SEVERAL OF THE DDS MODULE
 ARE BROKEN OUT TO PCB PADS

THE TWO PULLUP RESISTORS ARE OTIONAL



USE C3a AND C4a AS NEEDED TO OBTAIN PRECISE VALUES

THIS IS THE SAME LPF CIRCUIT USED ON THE TYPE I AND TYPE II PHSNA
 VALUES SHOWN ARE FOR 32 MHZ CUTOFF

E&M Solutions, LLC

Type II DDS / NANO Experimenter Board

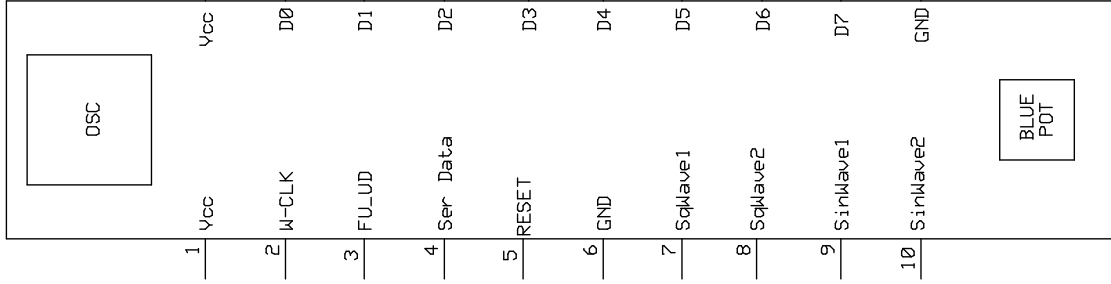
Rev 1.00
 12 Sept 2015

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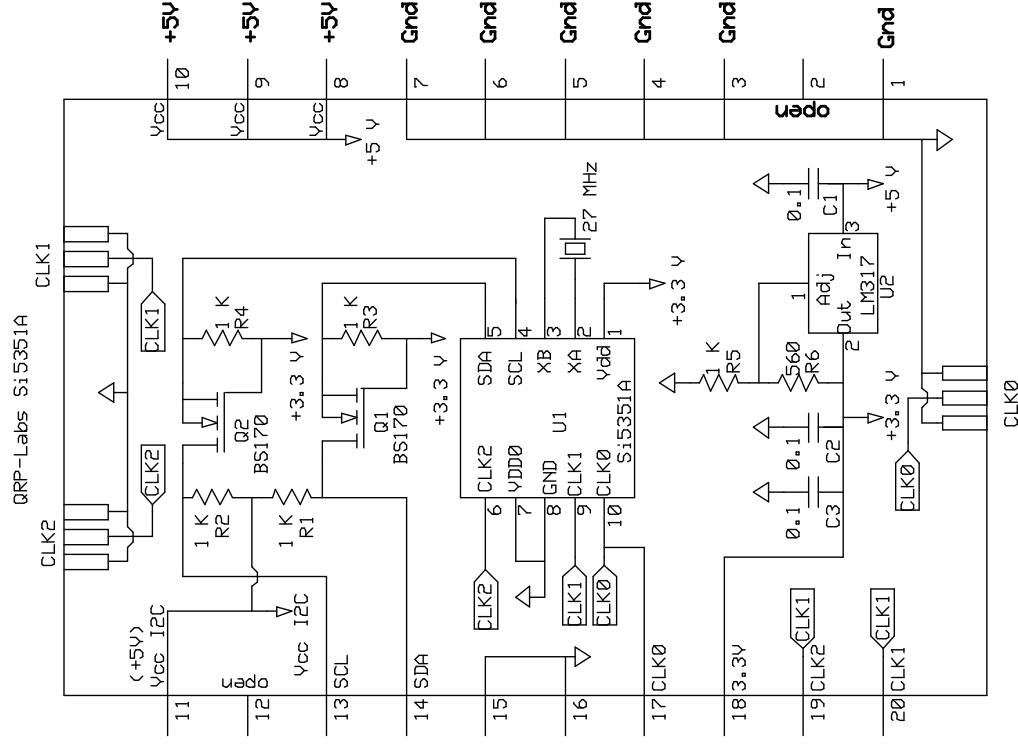
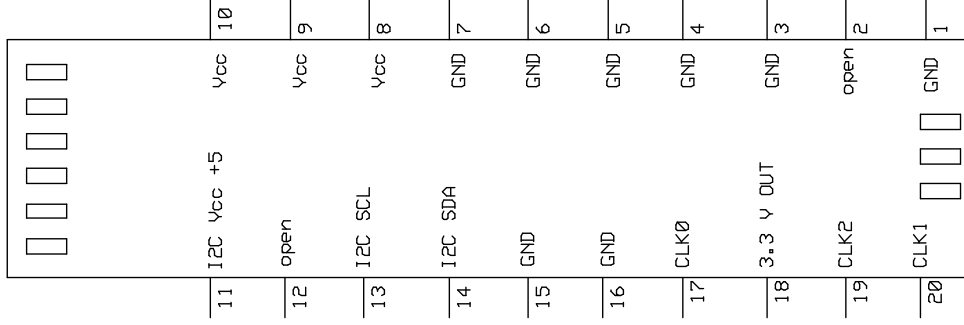
FOR THE NANO AND THE DDS THE PHYSICAL PIN NUMBERS ARE AN ARBITRARY ASSIGNMENT
 BUT THE LOGICAL PIN IDS CONFORM TO GENERALLY ACCEPTED NOMENCLATURE

NOT TO BE DISTRIBUTED OR REPRODUCED FOR COMMERCIAL PURPOSES

AD9850 DDS Type II

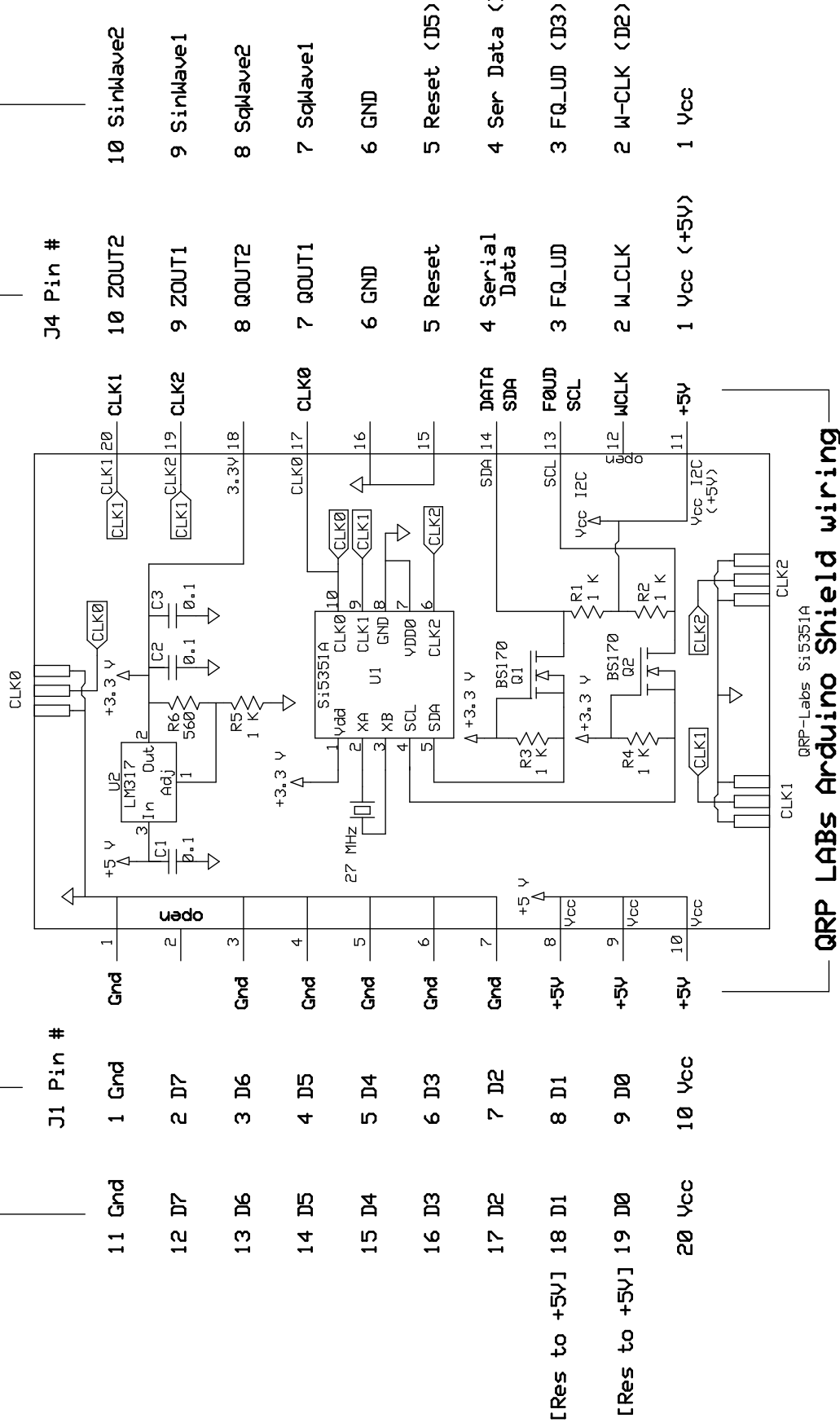


QRP-Labs Si5351A



Arduino NANO Connections

AD9850 Type II DDS Connections



QRP LABS Arduino Shield wiring

Redrawn QRP LABS Si5351 Circuit
More like physical representation

AD9850 DDS Type 2 & QRP LABS Si5351A	
Compatibility Pinouts	
K91VB	Rev 1.0 9/17/2015
	Page 3 of 3

Building and Application notes (more to come)

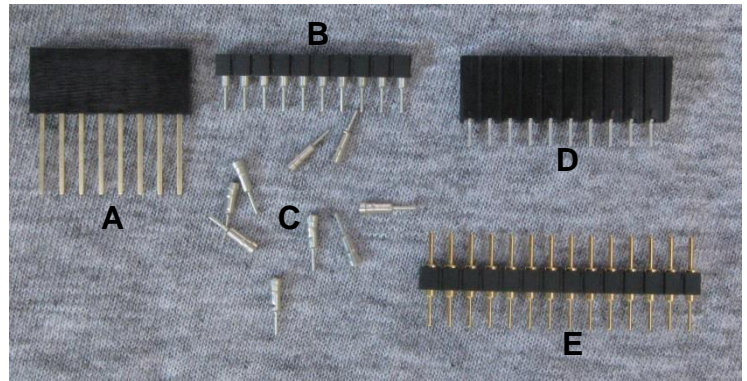
The key to getting the Arduino NANO and a Type II DDS module to “piggyback” is the selection of pins and sockets for connecting the three circuit boards.

A DRY FIT TEST IS AN ABSOLUTE NECESSITY TO MAKE SURE THERE WILL BE ENOUGH CLEARANCE. **DO THE DRY FIT BEFORE SOLDERING ANYTHING.**

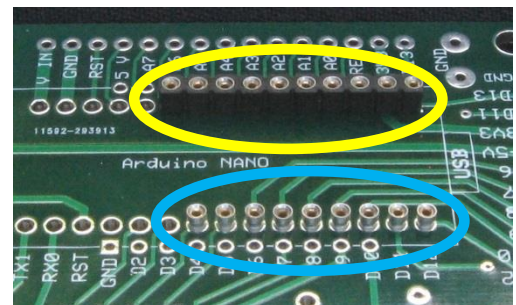
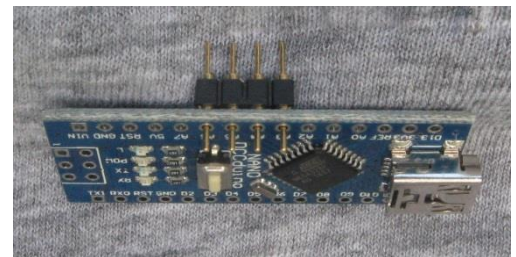
Many NANOs come with the header pins supplied, but not yet installed. That’s the kind you want to obtain, since you will want to use a different type of pin strip than the one supplied. Most of the Type II DDS modules already have the pin header strips installed. We have to work with what we have.

First we’ll deal with the NANO. The goal is to cozy it up as close to the top surface of the PC board as possible, without touching. To do this we’ll use those breakaway strips of machined pins and sockets. They are available at the usual parts houses, or from eBay vendors. The tinned ones are fine – no need to splurge on the gold plated ones.

At **E** in the photo at right is a breakaway strip of machined pins. Notice that the pins are slightly larger in diameter on one side of the strip. The row of larger pins will be inserted into the holes on the Arduino NANO board as in the next photo. Of course, you’ll be using a strip of 15 pins on each side. The short strip shown here is just for illustration. Be sure to insert the pins from the bottom of the board (the USB connector and reset switch are on the top). Remember – **NO SOLDERING** until the dry fit test is passed.



Two sets of 15-pin sockets will be installed on the main carrier board into the inner two rows of pads. As usual, there is a quick easy way, and there is a better way. You’ll notice that the holes in these pads are larger than normal. That is to allow the body of the pins to nestle down close to the board, gaining you an extra mm or so of clearance. The quick easy way is circled in yellow in the photo at right, The sockets – as shown at **B**, still in their plastic carrier strip – are installed so that the plastic is flush down against the board. The plastic carrier strip should sit down flush against the PC board’s top surface.



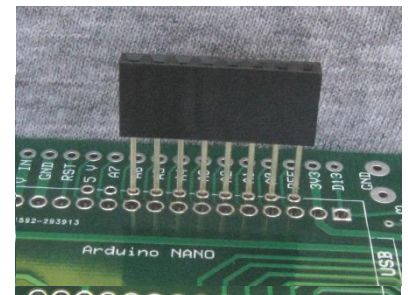
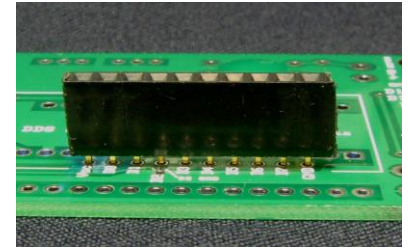
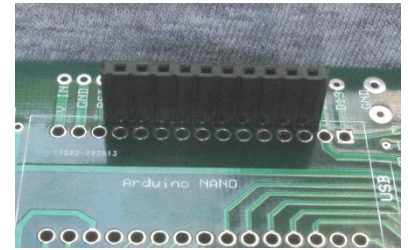
The better way is circled in blue. The individual sockets (**C** in the photo) have been removed from the plastic carrier strip by cracking the plastic with wire nippers and carefully pulling out the sockets. They fit down into the holes and form a much lower profile than if left in the plastic.

Now for the DDS Type II module. It has to sit high enough off the main board so that its underside will not touch the metal housing of the USB connector on the NANO. To accept the header pins from the DDS module we’ll use a pair of 10-pin strips of socket pins designed to fit the 0.025” square posts. There are two possible choices for the socket strips. Pictured at **A** in the top photo, is a **stacking header**. It’s commonly used when building *Arduino shields*, since the long tail pins plug into a lower board, while an upper board can plug into the sockets. The conventional header socket strip is pictured at **D**.

Now is the time when the choices you made for the NANO's sockets will come into play. If you chose to do the better (blue circled) arrangement, you should be able to use the conventional pin header for the DDS module, and install it either in the normal fashion as shown in the top photo at right, or spaced above the board as in the second photo. You can let the pins be just flush with the bottom surface of the board, which will elevate the header a mm or so.

I found that spacing the header was necessary if I wanted to be able to fully seat the NANO into its socket. Remember, these holes are plated through. So when you do solder them the plating will carry the connection from the top to bottom of the main board. Depending on your particular header, you may, or may not, be quite able to seat the DDS fully into the socket, but it will still be a solid connection.

If you took the easy way out (yellow circled), there will not be enough clearance between the bottom of the DDS and the top of the NANO. You will need to use a stacking header strip and stand off the header above the board an amount sufficient to clear the USB connector shell, as shown in the third photo. Remember if you chose the stacking header for the DDS connection, it really doesn't matter how you mounted the NANO, the long tail pins will allow you to raise the DDS module as much as needed. You can cut off any excess protruding beneath the board.

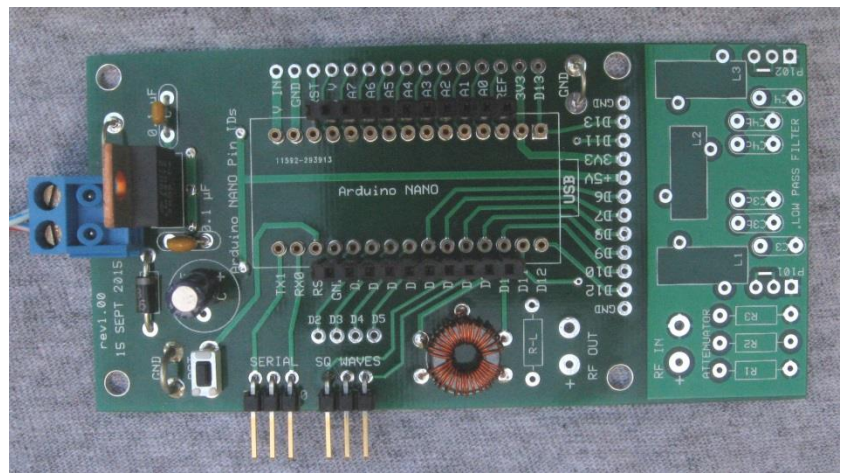


ONE MORE WARNING – DRY FIT BEFORE SOLDERING.

Once you're satisfied with the fit and clearance, go ahead and solder in the pins and sockets. It's usually better to have all the mating parts assembled together and solder the pins while they are assembled. This maintains the spacing and alignment of the pins even if soldering heat softens plastic carrier strips.

Now you can continue with the remaining assembly of the board. Remember – this is an *Experimenter's* board, so the choice of how to make connections to off board devices and circuits is up to you. Plain hookup wire is an obvious option. But there are a couple of things to watch out for if you want to use header pins or sockets.

You can't use a straight (vertical) header in the row of pads next to the low pass filter. It would block access to the USB connector on the NANO. A right-angled header can work, but not if the low pass filter section stays attached to the main board – but a header, either straight or right-angled, will work if mounted on the **BOTTOM** of the main board. Just build the low pass filter **BEFORE** installing a right-angled header strip there. You could sever the low pass filter section from the main board if you wished. Notice that the bottom side ground plane is interrupted between the main board and the filter section. So the circuit grounds are **NOT** connected, and a jumper (at the RF IN / RF OUT pads) is required to establish an overall circuit common.



Software modifications

See the PHSNA Yahoo Group for more information about software

<https://groups.yahoo.com/neo/groups/PHSNA/info>

If you wish to construct a version of the Poor Ham's Scalar Network Analyzer (PHSNA) using the Experimenter Board, you can use either the Terminal or Windows Versions of Nick's (WA5BDU) software that's posted on the Yahoo Group, but it will be necessary to change the four lines of code that assign Arduino pin numbers to the DDS control lines.

In either *PHSNA_standard_rev_3r02.ino* (the Terminal Version) or *PHSNA_VB.ino* (the Windows Version)

Locate these lines of code – the lines to be changed are in **BOLDFACE**:

```
#define NICK 0 // Special compile modes just for me -- set to zero for general distribution 1r10

#if NICK
#define DATA 11 // ***** NRK ONLY BAD PIN 8 USE 11 *****
#else
#define DATA 8 // for the rest of the world: Pin 8 - connect to serial data load pin (DATA or D7)
#endif

#define W_CLK 9 // Pin 9 - connect to AD9850 module word load clock pin (CLK)
#define FQ_UD 10 // Pin 10 - connect to freq update pin (FQ)
#define RESET 11 // Pin 11 - connect to reset pin (RST)
#define LEDpin 13 // Pin 13 - on board LED to be used as "heartbeat"
```

Edit the code to as shown below (the changed lines are, again, in **BOLDFACE**)

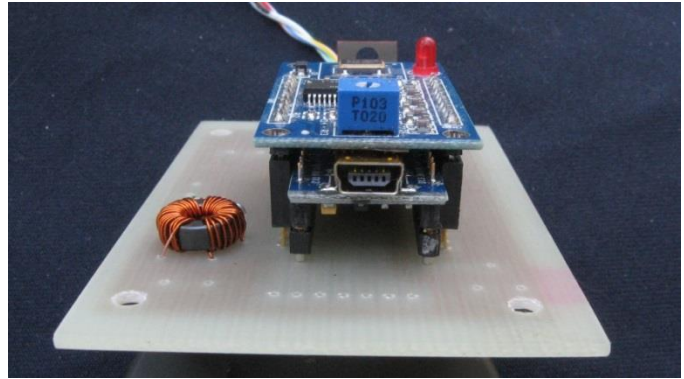
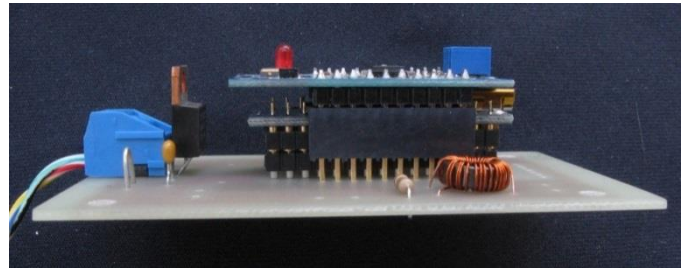
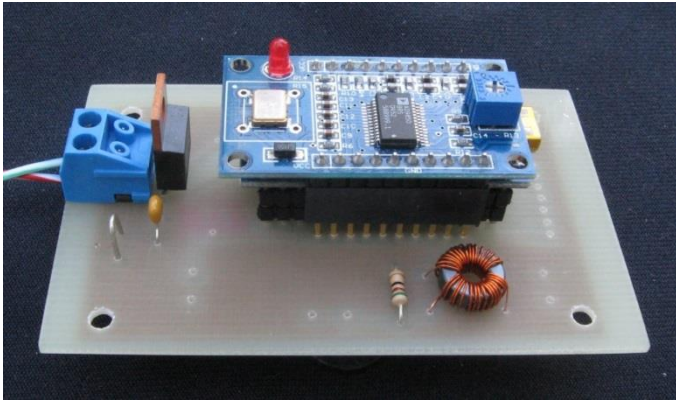
```
#define NICK 0 // Special compile modes just for me -- set to zero for general distribution 1r10

#if NICK
#define DATA 11 // ***** NRK ONLY BAD PIN 8 USE 11 *****
#else
#define DATA 4 // for the rest of the world: Pin 4 - connect to serial data load pin (DATA or D7)
#endif

#define W_CLK 2 // Pin 2 - connect to AD9850 module word load clock pin (CLK)
#define FQ_UD 3 // Pin 3 - connect to freq update pin (FQ)
#define RESET 5 // Pin 5 - connect to reset pin (RST)
#define LEDpin 13 // Pin 13 - on board LED to be used as "heartbeat"
```

No other software changes are needed.

Photos of first prototype (homebrew etched) PC board with Type II DDS and Arduino NANO installed. Right-angled socket strips, whose pins had been straightened, were used to accept the DDS module pins.



Photos of the production board, with NANO installed, and with DDS Type II installed. Note that the DDS is not fully seated, to be sure there is no contact with the metal shell of the USB connector. Insulating tape could be place on top of the USB connector and beneath the pins of the potentiometer.

