Manual for the N3ZI DDS2 2016
WWW.PONGRANCE.COM
Version 7.10 Nov 21, 2019
For DDS2 kits with PCBs dated 2016 and later.

The above photo is of the Jan 2016 PCB, Later PCBs have different mounting holes and the Output jack was turned 90 degrees. Identical electrical schematic though.

ATTENTION
STATIC SENSITIVE DEVICES
HANDLE ONLY AT STATIC SAFE WORK STATIONS

Assembly

This kit is intended for qualified individuals with extensive, from scratch, home brew experience, not just with other simple kits. Please read this manual in it entirety prior to starting construction. If you then feel that you cannot assemble this kit please return it to us for a refund.

Verify Parts: Verify that you have all the correct parts for your kit by checking the parts against the **printed packing list included with your kit**. Although there is a list of materials further down in this manual, The packing list included with your kit is the most up to date. Many of the parts are static sensitive, and you should use industry standard techniques for proper handling of all parts. The above photo should only be used as a general guide. Parts shipped with your kit may be of a different color or size, and not all the items shown in the photo are included in all kits.

Test Equipment Needed: You will need a Digital Voltmeter to measure Resistance, DC voltage and current, and a low current 12v power source. The maximum current draw for a properly assembled kit is 100mA so you should limit you source current to 100mA during the assembly process, that way the damage from any errors or faults will be minimized. You will also need some circuit board cleaner.

PCB Check: Before you solder any parts in, I recommend a check of the microprocessor pins. There have been instances were one of the micro pins were inadvertently shorted to the PCB ground plane. This is very rare, but difficult to debug and repair after the board has been built. Check the continuity to ground for each of the 28 pins of U2. Only pins 8 and 22 should show a continuity to ground, the rest should show open circuit. There is a thin fusible link on the back of the PCB under the power connector. This fuse will blow at ~1 Amp. If you do blow this, correct the problem that caused the fault, then replace that connection with a piece of 40ga wire. However, keep in mind that any fault with a semiconductor device will likely incur damage in a few nanoseconds, long before any copper wire fuse will heat up an blow.
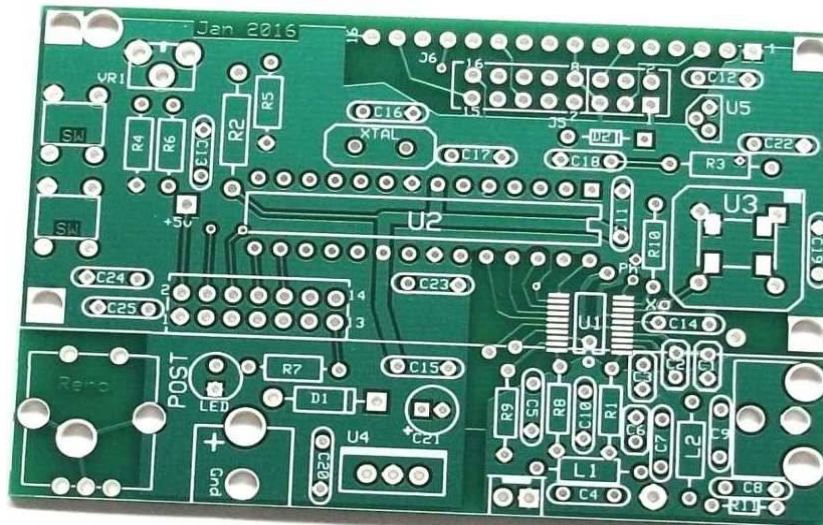
Soldering: All the holes on the PCB are plated through. Component leads should be soldered from the back side of the board, with a minimal amount of solder.
Start by soldering in the power supply components. D1, U4, C15, C20, C21 The PCB is laid out to accept a 2.1mm power connector, but it isn't really needed. This is a 2.1 mm coaxial power connector, +12v inside, ground outside. These connectors usually have 3 pins, there is no PCB hole for the side pin, just break it off.   If you don't have a power connector, just solder your power wires directly into the PCB holes. This connector can be soldered to either side of the board. Double check the polarity on D1, C21, the LED (short lead is Gnd) and the orientation of U4.

Power supply current Check#1: Apply 12VDC power using a power supply with a current limit set to 100mA. Check to see if 5VDC is present at U2 pin 7. Measure and record the current draw, it should be less than 10mA at this point.
Assuming your DDS Chip has been previously soldered to the PCB, Next install the 4 capacitors next to the DDS chip, C1, C2, C3, C14 be careful with these to avoid any solder shorts, and trim the leads neatly.

Power supply current Check#2: At this point you should check the 5v power supply and current draw. Apply 12VDC power using a power supply with a current limit set to 100mA. Check to see if 5VDC is present at U2 pin 7. Measure and record the current draw, it should be less than 15mA at this point. Also check and record the voltage across C14, it should be 2.5V.

The photos show a Yellow RCA jack soldered to the PCB. In general it is better, not ot use this jack, and to simply solder coax into those holes. The connection into the yellow jack is not reliable. Later kits do not include and RCA jack.

The push-buttons are simple SPST switches, and you can remotely mount another switch in parallel if you like. You could use a single SPDT switch to replace both SPDT switches. One that is momentary with a center off position is a very nice setup.

Encoder and Switches: The SPDT Switches and the connections for the Encoder all are routed to the 14 pin connector if you want to mount them remotely. It's ok to use the pushbutton switches on the PCB and have another set remoted. But you can only have one encoder connected. The encoder can be mounted remotely or soldered to the PCB. If soldered to the PCB it can be soldered on either side of the PCB. You should consider this carefully before you solder it in, because it's very difficult to unsolder without damage. Also there is no need to solder the side tabs to the PCB. Just solder the 5 signal pins (3 on one side 2 on the other) There are also spaces to capacitors to filter the remote Encoder signal if needed (C24, C25)

Finish Soldering: Solder in the rest of the components. Kits normally include a socket for the micro. Solder in the remaining components except the 80MHz oscillator can, and the encoder. Note the polarity of the LED, the short lead is ground. The ground hole, is the next to the power connector. Completely clean the PCB using appropriate solvent.

Power supply current Check#3(a,b,c):
(a)At this point, with everything installed except the following: Micro, 80MHz Oscillator can, LCD. Apply 12v power and check and record current draw. It should be less than 15mA.
(b) Remove power and put the micro in, now current draw should be less than 35mA. At this point the POST (power on self test) LED will function. Normal LED operation is as follows, after power is applied, it's off for short period of time while micro boots up, generally less than 0.2 seconds, then goes dim for while running the self test for 1-2 seconds, then switches to full on indicating everything OK. If test fails it will turn off.
(c) Remove power and solder in the 80MHz oscillator can. Apply power current draw should be, between 40 and 80mA

**LCD:** The next step is to connect the LCD. LCDs supplied have a 16 pin connector, but only 12 of the connections are used, you can skip connection for pins 7-10. R2, 200 ohms, sets the current to the LCD backlight at 7mA.   You can decrease this resistor to increase the brightness of your backlight, but do not use a resistor less than 100 ohms (10mA). Kits are shipped with a 4.7K pot for contrast adjustment, which works well with

all supplied LCDs. There are other component holes in the area for use with different LCDs
There are matching holes on the PCB to mount the main PCB and LCD together if you wish. This makes it a little easier to solder the connections, since they are all straight through. The above picture shows solid pins making the connection. Although very easy to solder, it's very difficult to access for service, because they don't bend and are difficult to unsolder, if you need to get to the back of the PCB or correct some soldering error. Consequently I recommend using individual wires for each connection. This takes a bit more time, but it will allow you to bend the LCD out of the way if you need to get access. The mounting hardware shown in the photos is not included in the kit, but many hardware stores (e.g Lowes and Home Depot) stock 4-40 hardware that will fit.
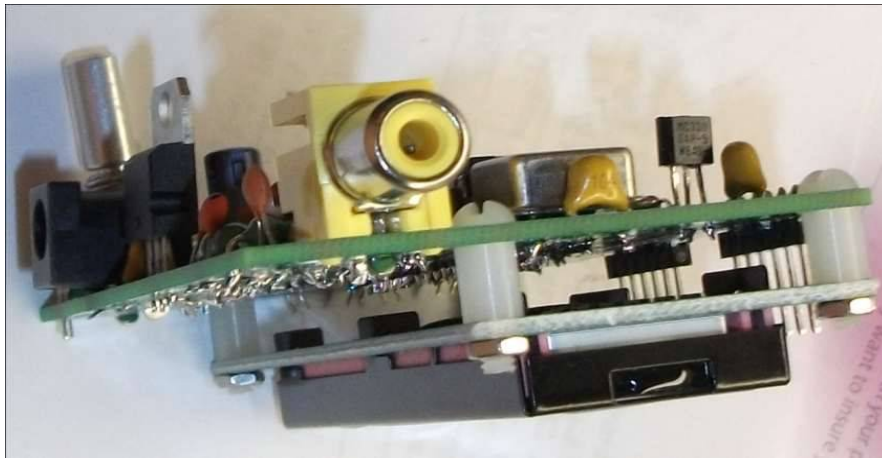
Another option for LCD mounting is remote, as shown in the picture below. You will need 4 6 pin strips, and two 6 pin jumper cables. Pre made jumper cables are sold by many suppliers on ebay. Pins are soldered on both the DDS PCB and the LCD, then they are connected using jumper cables. Generally you can get 40pin breakaway pin strips, and just break off 6 pin sections
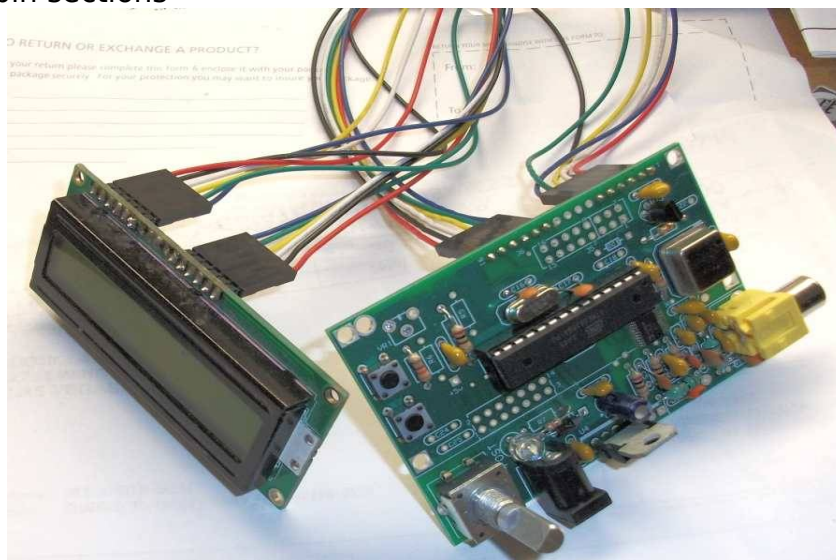
Final Current check: With the LCD connected and all parts installed, check and record the current draw, it should be less than 100mA. No parts should be getting hot, except the 80MHz oscillator can may get slightly warm but not hot. The 7805 may get slightly warm, but not hot. If the power on self test LED is working properly, but the LCD is not on check the bias voltage (LCD Pin 3) and wiring to the LCD.

Operation

FACTORY RESET: Note that if you get into difficulty with the Memory and IF settings you can do an EEPROM Reformat, to reset everything back to factory defaults. The settings are not range checked so it is possible to enter something out of range that will cause unexpected behavior. The details in doing a Factory Reset, are described below on page 10 ("Function Switch Operation") under the paragraph "EEPROM FORMAT" It's a good idea, to start off by doing this once when you start. This will erase all memory and IF settings.

Memories: There are a total of 12 memories each memory holds a Frequency and an IF. In many cases all the IF's will be set the same. You can set any or all IF's to 0.00. Memories 0 though 9 are selected using the two pushbuttons (up/down) and are tunable. That is, if you turn the dial while at that memory the frequency will change. When you switch to the next memory, the last used frequency will be saved for the prior memory location.

The other two memories, are VFO A and B. These are different in that a separate control line (PB5) selects between the two. You can program a different IF in for VFO A and B, but I doubt you will want to.

With the standard serial LCD a single character on the left side of the display indicates the memory number (0 to 9) or A, b for the VFO's With the character based 44780 LCD's the display will be slightly different.

Dial speedup. The default frequency increment is usually 25Hz per tick. As you turn the dial continuously, the tuning rate will start to increase automatically. You can also increase the rate by tapping the encoder push switch. This will sequence through 1,10,25,100,1000Hz steps. Automatic acceleration is indicated with an "F" on the display. If you continue to turn the dial, the rate will continue to accelerate up to a maximum of 100KHz per tick. If you stop turning the dial for a few seconds the rate will return to the default rate and the "F" will disappear from the display. Entry into the "F" mode is based on the time the dial is continuously rotated, not the number of turns, so turning faster does not trigger that mode faster. Note that many parameters associated with tuning can be changed using the rs232 port, including default tune step and trigger points for acceleration. Refer to rs232 manual for details.

Setting IF's If's offset can be set in 3 different ways. You can use the serial port (refer to the serial port manual) You can set the current IF using the push switch, see the **"IF SET"** in the **"Function Switch Operation"** section below, that's the preferred method. There is also a special IF set mode similar to the method used in my older DDS. To enter this mode, remove power, hold either SW1 or SW2 and apply power. It will then come up in a mode, which will allow you to set the IF's. "IF" will be indicated on the LCD display. The DDS will output the IF frequency in this mode, which can be used to zero beat with your BFO if applicable. Then when complete, toggle through all memories, to make sure they are all ok, then remove power. This method may erase the operating frequency in memory, so it's best to set the IF's before anything else.

Additive IF: This VFO supports 3 different IF modes. The simplest is the additive, and example of this is the one used on the BITX20. The IF is 11MHz and the VFO tunes 3.0 to 3.35, resulting in an operating frequency of 14.0 to 14.35. For this type of operation enter the IF as a positive number, and enter the operating frequency as a positive

number. It will compute the proper VFO frequency to generate. Note that this type of radio can never operate below the IF.

Subtractive IF: With subtractive IF schemes, there are two options for the VFO, high side, and low side VFO injection. For example, many 40m QRP radios have a 11MHz IF, with a VFO ranging from 4.0 to 3.7MHz. Tuning is backwards, so the higher the VFO the lower the operating frequency. To program you DDS VFO to work this way, enter the IF frequency as a negative number, i.e. –11.000.0 in this case, and also enter your operating frequency as a negative number, to indicate low side injection. i.e –7.000.0, the DDS micro-controller will computer the proper VFO frequency to use, 4.000.0 in this case. Note that if you are using the serial port, you can turn on the debug mode, and it will display the IF, VFO, and operating frequency every time. Note that most radios will also work with high side injection without modification. For example you can charge the operating frequency to +7.000.0 and you will be on the same frequency, but with high side VFO at 18MHz. Usually when you do this, the opposite sideband is selected.

Dial Direction: The dial direction may be reversed because of the use of negative IF's and/or high vs. low VFO injection. Reversing the sign will reverse the direction. For example if you have 0.0 IF and are tuned to 7.000.000 and you want to reverse the direction of tuning, tune down in frequency towards 0.000 then keep turning the encoder (in the same direction) and the frequency will start to increase, when you get back to 7.000.000 the tuning direction will be reversed. If you have an IF set, then you will also need to change the sign of that. The dial direction can be reversed by changing the sign of parameter 9, (tick_div) via the serial port. 0.02 or –0.02 are values to try for this parameters. If your encoder is remotely mounted, you can also interchange the A & B connections to reverse direction.

Output: The output signal is not amplified, and the level is approx. 250mV peak to peak which works well with SA612 or similar mixers. Output impedance is 200 ohms. It does not need to be matched, but the output filter is flatter if the output is matched. With vintage radios, or other applications, you may need a separate buffer amplifier.

Output filer: This DDS uses a D/A converter to generate the sine wave output. This D/A converter is clocked at 80Mhz. The theoretical maximum output frequency is 40Mhz, this is refereed to the Nyquist rate. All D/A converters have an image output above the Nyquist frequency. (If you go to wikipedia, and search for Nyquist you will find a nice article describing the theory) So if you generate a 39Mhz signal, which is 1 MHz below the Nyquist frequency, there will be a mirror image exactly 1 MHz above the Nyquist rate, at 41Mhz. If you generate a signal at 25Mhz the mirror will be at 55Mhz. Normally an output filter is used to filter out this signal. The output filter included in your kit, will allow operation up to 34MHz, with about 40db of attenuation of the 46MHz mirror.

Calibration: It is normally not necessary to calibrate your DDS-VFO. The 80MHz reference oscillator is specified at 100ppm accuracy, but they are normally much more accurate than this.   Calibration is done in software, it is an extremely fine adjustment, much finer than the fundamental step size. The oscillation frequency of the 80Mhz timebase will not change, but the mathematics will be adjusted. 64 bit math is used in computing operating frequency to be certain, that no error would be introduced by rounding. A change of +0.20 in this parameter is approx. a 10 Hz change of operating frequency at 20MHz. Keep in mind that it is a multiplicative correction factor, so a 10Hz change at 20MHz, will result in a 5Hz change at 10MHz. The calibration factor can be set via the serial port, or using one of the push switch modes, see below.

RIT: The RIT function on this DDS operates differently than some radios and can be used for a wide variety of functions. The default setting is 500Hz. When RIT control line is grounded the VFO's output frequency will shift up by 500Hz. This might be used for transceivers in CW mode, typically on transmit you want to shift the transmit frequency up by 500Hz. Unlike most RIT functions, there is no limit to the value used for RIT, any positive or negative number can be used. If a negative number is used the frequency will shift down, rather than up. For example. Lets say you have a vintage transmitter (e.g. DX-20) with a simple design, where the VFO is equal to the transmit frequency . And for a receiver you are using a vintage super heterodyne receiver (e.g. HQ-110) with a 3.045MHz IF. You can use one DDS as the VFO for both. Set the RIT to -3.045.000 and ground the control line when receiving. So if you want to operate CW on 40M, you would tune your DDS to 7.050.000. With the control line grounded while in receiver, the VFO would actually put out 4.005MHz which is the required VFO frequency for the HQ-110 to receive 7.050MHz. When you go to transmit, unground (open) the control line and the DDS VFO frequency will instantly move to 7.050MHz, the proper frequency for your Vintage transmitter. So that way just one DDS can be used for separate transmitter and receiver, but you will probably need a buffer amp for each to drive the tube circuits.

FSK & PSK: This DDS can send FSK and PSK directly, without first generating Audio FSK & PSK. FSK (RTTY) is sent by using the RIT function. Connect your RTTY signal (0-5v) to the RIT control line (3) pin 7 open. Set the RIT value (see below) to your RTTY shift (typ 170Hz). If your RTTY signal is coming from a computer serial port you will need to convert it to a 0-5v signal (R10 is a pull-up for this signal). You can invert the RTTY signal, by changing the negating the RIT offset i.e -170Hz.

To send PSK directly, you need to connect to the PH test point on the PCB (adjacent to R10). There is a fine trace on the back of the PCB grounding this signal, so you will need to cut that. Feed a 0-5v PSK signal into this point. The amount of phase shift is set by EEPROM parameter #10, the default is 180 degrees. Note that most computer sound card PSK programs generate Audio PSK only, not base-band digital PSK, and thus cannot properly drive this. (RTTY programs typically generate both, AFSK and base-band Digital FSK) This should only be used by advanced users. Very advanced users might notice that it is possible to set a phase shift of 90 degrees and generate I & Q using two DDS's locked together.

Serial Port: There is a serial port available for debug and parameter changes. The full manual is on my web site. TTL level Serial data I/O lines are accessible though the 14 pin aux connector. There is no RS-232 level converter because RS-232 ports are so rare these days, though you could build one using 2 transistors and a few resistors. However, you can also purchase a USB to TTL converter on ebay for about $1 which is a better option.

Function Switch operation

The function switch can be either a push switch on the encoder, or a separate push button switch. A short tap on this sequences through the 5 standard tuning step sizes, 1,10,25,100,1000Hz. This switch also is used to bring up special parameter setting modes for RIT, Tuning Step, Calibration, IF, EEPROM format, and Text Edit. Press and hold the switch, then press one of the up/down buttons you will toggle through the 6 different parameters that can be set. Each parameter is indicated as :x: on the second line of the display as shown below. Simply release the switch when you get to the one you want. Each of these settings is described below

> **:R: RIT Adjust:** Use the tuning knob to adjust the RIT offset.   When you are finished, simply stop tuning for a while and it will return to normal. This will set the frequency shift when the RIT control line is grounded.

> **:S: Tuning Step:** Use the dial to set the tuning step if you want something other than the standard 1,10,25,100, or 1000Hz. As above simply stop turning the knob when you get to the value you want, and it will return to normal after a few seconds. Do not set to anything greater than 10,000Hz. Using the short tap for standard rates will override this setting.

> **:C: Calibration** This adjustment if very fine. You will be making an adjustment to the main calibration factor, and only the delta will be displayed. First, in normal operation, set the DDS output to a reference frequency, such as 10.000.000MHz. Use the push switch to get into the calibration mode, then use the dial to zero beat the DDS signal to your reference, be it WWV or some other source. The adjustment is extremely fine. Once you are satisfied, stop tuning and after a few seconds the value will be saved, and the master calibration factor will be adjusted.   When setting it via the knob only the change from the current setting is displayed, so it always starts out at 0.000 and changes are cumulative.

> **:I: IF SET:** The current IF is set by turning the dial. If you want to change the IF for a different memory, you need to return to the normal operating mode, then change the memory number, and then change the IF again.

> **:E: EEPROM format:** This function causes the EEPROM to be loaded with factory default values. You will loose any IF's or frequencies you have set in, and any parameters you may have changed. Turn the encoder until you get to a reading of 73 (:E:0.073) on the second line of the LCD. Stop turning and wait, it will take a few seconds to initialize the EEPROM, and then the LCD should display a flashing message. At this point, remove power and re-apply power to reboot. The DDS will now start up with fresh factory default parameters. All the IF's are set to 0.0, and the memories are set to a MHZ value equal to their memory number (ie memory 5 is set to 5.000.000) If you set the LCD to anything other than 73, nothing will happen and the reformat will be canceled.

> **:T: TEXT EDIT:** This allows you to edit 12 characters in unused areas of the display, 4 on line 1, and 8 on line 2. Use the encoder dial to select digit, up/down buttons to navigate char position, press the Renc Push Button to go to next line. ASCII characters from 32 to 126 are available which includes numbers, upper and lower case alphabet, plus some special characters. Edits are saved in EEPROM.

14 pin Aux Connector

This is a 14 pin connector located between U2 and the power connector. Carefully note the pin numbering. Pin numbers are on the front silk screen and back copper.

Pin #	Name	Type	Function
1	Gnd (D)	Ground	Digital Ground
2	+5v	Power	+5v test line
3	RIT-b	Digital Input	RIT Control line: LOW Causes RF output to shift in frequency by the RIT value (Normally tie pin 3 and 7 together)
7	RIT-a	Digital Input	LOW causes LCD to display Freq + RIT (Micro pin 23) (Normally tie pin 3 and 7 together)
4,8	SW1,2	Inputs	Upper, Lower Switch, Used to connect remote switch
5	Reset	Digital Out	Active low, reset output
6, 12	ENC-A, B	Inputs	For remote encoder connection, interchange ENC-A and B to reverse the direction of the encoder.
10	ENC-Push	Input	Remote Function Switch (Encoder push switch)
9	Data	Digital Input	Serial Data input (Micro pin 2)
13	Data	Digital Out	Serial Data out (Micro pin 3) Also used for POST LED
11	PC0	Digital Out	Band output, (Micro 23) not used
14	A/B VFO	Digital Input	A/B VFO select, gnd for A, open B (micro pin 19)

Use reasonable caution when connecting to the input control pins (3,4,7,8,9,10,13,14). All inputs have on chip pullups to +5v, so only a contact to ground is needed. You can connect a switch, relay, open collector, but any voltage over 5v, or negative, will likely damage the microprocessor. Use an opto isolator to connect to protect against any possible ground differences, or voltages over 5v. Pins 6 and 12 are input lines, but should only be driven if the encoder is not mounted on the PCB. C24 and C25 can be used for filtering of the remote encoder lines if needed.

Pins 5, 11,13 are outputs that swing from 0 to 5v, and can drive or sink no more than 2 mA. Use care when connecting to these signals.

Pins 7 and 3 control RIT. Pin 3 causes to DDS to actually shift by the RIT frequency. Pin 7 causes the LCD to display that frequency. Normally you would tie these together. But you could keep them separate and it would give you the ability to look at the RIT frequency is without actually changing the frequency.

RIT is an offset to the main frequency. So for example if the RIT is set to 1.000KHz, and the main frequency is set at 7050.000, when you lower the RIT control line (Pin 3) the frequency will shift to 7051.000 and if you also low control line #7, the LCD will display that new frequency. If you then change the main frequency, to, for example, 10,110.00, then lower the RIT control line the output frequency will move up to 10,111.00. You do not have to set the RIT offset again after you change the main frequency. The RIT can be set to pretty much anything, positive or negative.

Using Pin 3 alone the RIT frequency shift is fast and phase continuous, there are no glitches, and it could be used for FSK (Rtty) or QSK. This pin connects directly to the DDS chip, so it's action is very fast.

There are three other test points that might be of interest. 1) One is the axillary unfiltered output below R9 (labeled out(b) on the back) paired with an analog ground. 2) "Ph" located between U1, U2 and U3 On the back there is a thin trace connecting it to ground. This controls a phase shift for the DDS chip. If you cut this grounding trace then a logic signal will select between normal and phase shifted output. The default phase shift is 180 degrees, which would allow you to transmit BPSK31 directly. This parameter is #10, and can be set via the serial port to other interesting values, e.g. 90 degrees. 3) Another is Labeled "+5v" located near the left end of U2 which outputs a 10Gb/s stream equal to the square root of the time of day on the Klingon home world. (I just want to see if anyone actually reads the manual.)

DDS Chip Solder

Most kits are shipped with the DDS chip soldered to the PCB, If not then you will have to solder it. It's a tiny 20 pin chip AD9834CRUZ. It will be easier to solder it down if the rest of the board is nearly empty. The best method I have found for this chip is the use a 15 watt soldering iron, with a fine tip. Carefully align the chip in the right location. Make note of the direction.   Pin 1 goes in the lower right. Pin1 on the chip has a dot indent in the plastic package. I normally use tape to temporarily hold the chip in place while I'm soldering it. Under no circumstances should you glue the chip to the PCB. Carefully align the chip to make sure it's centered, both left/right and up/down then hold the chip down with a piece of tape leaving one side of the chip exposed. Solder down one of the exposed corner pins. Remove the tape, re-align the chip, and solder the opposite corner. Then solder all the remaining pins, use plenty of solder and don't worry about solder bridging. After you are done use solder wick to remove excess solder and any solder bridges. (Flux will help the solder wick.) If the solder wick becomes frozen (soldered) to the board, don't rip it off, heat it up with your iron and pull it up carefully. Inspect it carefully by eye under a magnifying glass. Clean it with flux remover, and make sure there is no debris under the chip or elsewhere. Use a DVM or continuity tester all the connections are made by testing right as the lead exits the package, then on the PCB at the appropriate point. Also make sure there are no pin to pin shorts and no shorts to power or ground. Note than pins 4 and 5 will show as shorted because they are both connected to +5v. And pins 7, 10, 12, and 18 are hardwired to ground, so all should show continuity to ground. Pin to pin solder shorts are fairly common, frequently they appear OK visually, but show up shorted on the continuity check. Just lay some wick down apply heat, and you should wick up the excess solder causing the short. I that doesn't work, you can try running the blade of an exacto knife between the leads to clear out any short. If that doesn't work apply some more solder, then wick it up again.

Other LCD Types

This DDS can work with other LCD types. I included that info in earlier version of the manuals, but it was very confusing to the reader, and since 99% of kits are sold with the standard LCD, I left it out of this manual. But the DDS will work with the 10 pin serial LCD, and many 14 or 16 pin LCDs with a 2 row connector. If you are trying to fit a display in a small area, there are some very small LCDs sold on ebay that might be of interest. If they are 44780 compatible they will likely work, but you will have to fiddle with the backlight drive (R2) and the LCD Bias, VR1, R2, R4, R5, R6

Other Encoder Connections

The standard kit includes a mechanical encoder that mounts to the PCB, with an integrated push switch (5 pins). If you want to use an optical encoder, such as the EM14 series from Bournes. Mount it remotely, the pushbutton switch can be a push switch on the encoder, or a separate pushbutton. C24 and C25 can be used to filter the encoder lines, if you pick up noise or RF on the remote wireing.

Most Optical Encoders have 4 pins usually Pwr, Gnd, A, B , if there are 6 pins, the two extra are for the push switch.
- Connect Encoder Power pin +5v on the PCB Aux Connector Pin 2
- Connect Encoder pins A, B to Aux connector pins 6 & 12 Note: Reversing these will reverse tuning dial direction
- Connect the encoder ground pin to Aux Connector pin 1
- Connect a SPST-NO pushbutton from Aux connector pin 10 to ground(1)

You will want to connect the serial port and change some parameters in the micro. (No programming is required) The "DDS 2 RS-232 interface Spec" is located on my web site here: http://www.pongrance.com/manuals.html There serial I/O lines are pins 9 &13 of the 14 pin connector. They are TTL level signals, to use them with an RS232 connection, you will need a RS232 level shifter. Or if you want to use with a USB port, you will need a USB to RS232 TTL Converter, widely sold on ebay for $1.

- Change parameter #4 to 0.001 (Step size)
- Change parameter #5 to 0.003 (for encoders with >200ppr, use 0.001)
- Change parameter #6 to 0.200 (Loop delay)
- Change parameter #7 to 1.100 (Acceleration)
- Change parameter #8 to 0.000 (Debounce)
- Change parameter #9 to 0.001 (Tick Divider)

Your optical encoder will function if you do not make these changes, but it will operate much like the mechanical encoder.

Some kits may include a PCB mounted encoder with only 3 pins. This type does not have an integral push switch. With this encoder, you will have to add an external pushbutton switch, wired as above. No parameter changes are needed with this encoder.

Bill of Materials

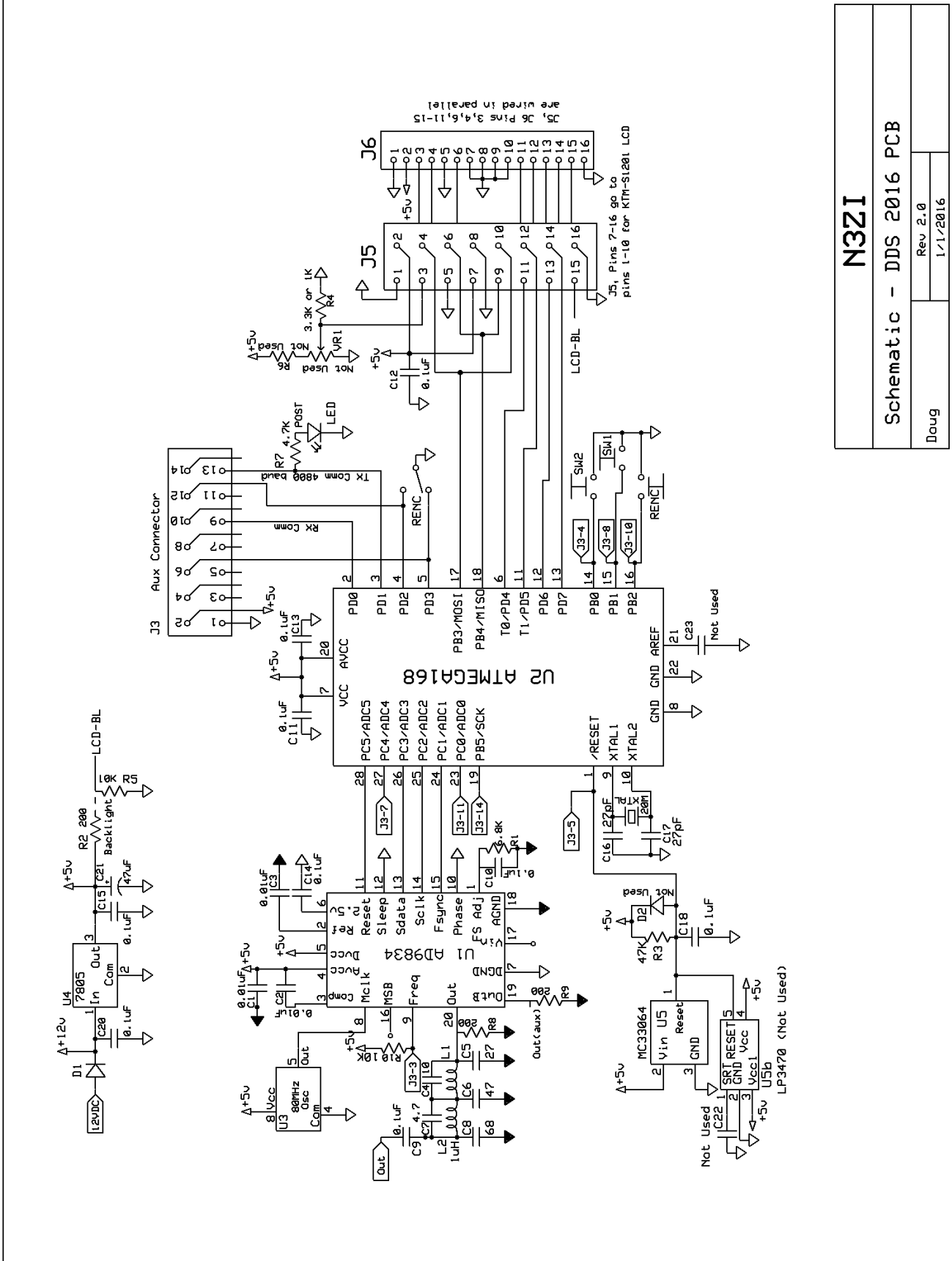(Note: The packing list included with your kit supersedes this list)

Designator	Part	Qty	Description / Appearance
PCB	Circuit Board	1	N3ZI DDS
J6	LCD Module	1	Varies
U1	DDS Chip AD9834	1	Tiny 20 pin TSSOP (normally soldered to PCB)
U2	Micro ATMEGA168	1	28 Pin Dip
U2	Socket for Above	1	28 Pin DIP socket
U3	Oscillator	1	Metal can 80MHz
U4	Volt Reg	1	7805
U5	MCP100 or Equiv	1	TO-92
D1	Diode	1	Black epoxy
LED	LED	1	POST LED (Polarity: Short lead is Ground)
L1,L2	1.0uH Inductor	2	Brown, Black, Gold
XTAL	20 MHz XTAL	1	Short Can 20.000
C1,C2,C3	0.01uF Capacitor	3	Yellow 103
C4	10pF Capacitor	1	Brown/Orange 10
C5, C16, C17	27pF Capacitor	3	Brown 27
C6	47pF Capacitor	1	Brown/Orange 47
C7	4.7pF Capacitor	1	Brown/Orange 4.7
C8	68pF Capacitor	1	Brown/Orange 68
C9, C10, C11, C12, C13, C14, C15, C19, C20	0.10uF Capacitor	8	Yellow 104
C21	Electrolytic Cap	1	Black Radial
R1	6.8K Resistor	1	Blue, Grey, Red
R2, R8, R9	200 Ohm	3	Red, Black Brown
R7	4.7K Resistor	1	Yellow, Purple, Red
R10	10K Resistor	1	Brown, Black, Orange
VR1	4.7K Vari Resistor	1	White
R-ENC	Encoder	1	
SW1,SW2	Push button Switch	2	
J1	Solder holes	for	Output Signal
J2	Power 12v	1	2.1 mm power

Note: the appearance color and value of some parts change from time to time with differences from various suppliers. You should receive a packing list with your kit, which should have a current description for the parts in your kit, and it supersedes this list.

The following PCB locations are not used: R3, R4, R5, R6, R11, D2, C18, C22, C23, C24, C25
Explanation:

- VR1, R2, R4, R5, and R6 control the bias and backlight of the LCD. With the LCD type I am currently shipping, only VR1 and R2 are used. If you want to use a different type of LCD, the others may be helpful.
- D2,C18,C22, and R3 are related to the microprocessor power up reset. With the reset chip I am currently including in the KIT (U5, MCP100) none of these are needed. But they may be useful If you want to operate at a lower voltage or have an external reset.
- C24, and C25 are filter caps on the encoder lines. If you remote the encoder and are concerned about picking up noise or RF, you might want to use ~1000pF filter caps in these locations.
- C23 is a filter cap for the analog section of the micro, the current programming does not use this section of the chip so it's not needed.
- R11 is an optional output load resistor. Not normally needed.
- U3A and VR-1A are under U3, in the 2018 PCB. and Can be used to replace the normal U3, with a SMT Oscillator and Trimmer, (Digikey part numbers 631-1463-ND OSC VCXO 80.000MHZ, A105870-ND 10K trimmer) to provide a manually trimmable Oscillator. Additionally J7 can be used for on off control.

N3ZI

Schematic – DDS 2016 PCB

Rev 2.0
1/1/2016
Doug

J6
J5

J5, J6 Pins 3,4,5,11-15 are wired in parallel

J5, Pins 7-16 go to pins 1-10 for KTM-S1201 LCD

+5v
LCD-BL

R4 3.3K or 1K
R6 10K Not Used
VR1 10K Not Used
C12 0.1uF
+5v

R7 4.7K
POST LED
Tx Comm 4800 baud
RX Comm
RENC

J3 Aux Connector

SW2
SW1
J3-4
J3-8
J3-10
RENC

U2 ATMEGA168

- PD0 2
- PD1 3
- PD2 4
- PD3 5
- PB3/MOSI 17
- PB4/MISO 18
- T0/PD4 6
- T1/PD5 11
- PD6 12
- PD7 13
- PB0 14
- PB1 15
- PB2 16
- AVCC 20
- VCC 7
- GND 22
- GND 8
- AREF 21
- GND
- PC5/ADC5 28
- PC4/ADC4 27
- PC3/ADC3 26
- PC2/ADC2 25
- PC1/ADC1 24
- PC0/ADC0 23
- PB5/SCK 19
- /RESET 1
- XTAL1 9
- XTAL2 10

C13 0.1uF +5v
C11 0.1uF
C23 Not Used

J3-7
J3-11
J3-14
R1 6.8K
J3-5
C16 27pF
C17 27pF
20M

+12v U4 7805
In 1 Out 3 Com 2
D1
12VDC
R2 200
R5 10K Backlight
LCD-BL
C21 47uF
C15 0.1uF
C20 0.1uF
+5v

U1 AD9834

- Reset 11
- Sleep 12
- Sdata 13
- Sclk 14
- Fsync 15
- Phase 1
- FS Adj 18
- AGND 17
- DGND 19
- DVdd 2
- Ref 3
- AVdd 4
- Comp 5
- MSB 16
- Freq 9
- Out 20
- Mclk 8
- Iout 6
- Ioutb 7

C3 0.01uF
C14 0.1uF
C10 0.1uF
R9 200
Out(aux)
C1 0.01uF +5v
C2 0.1uF +5v
R10 10K
J3-3
R8 200
C5 27
C4 10 L1
C6 47
C8 68
C9 0.1uF
C7 4.7 L2 1uH
Out

U3 80MHz Osc
Vcc 8 Out 5 Com 4

D2
R3 47K
C18 0.1uF
+5v Not Used

MC33064 U5
Vin 2 Reset 1 GND 3
+5v

U5b LP3470 (Not Used)
SRT RESET 5 GND 4 Vcc
Vcc1 3
C22 0.1uF
Not Used
+5v