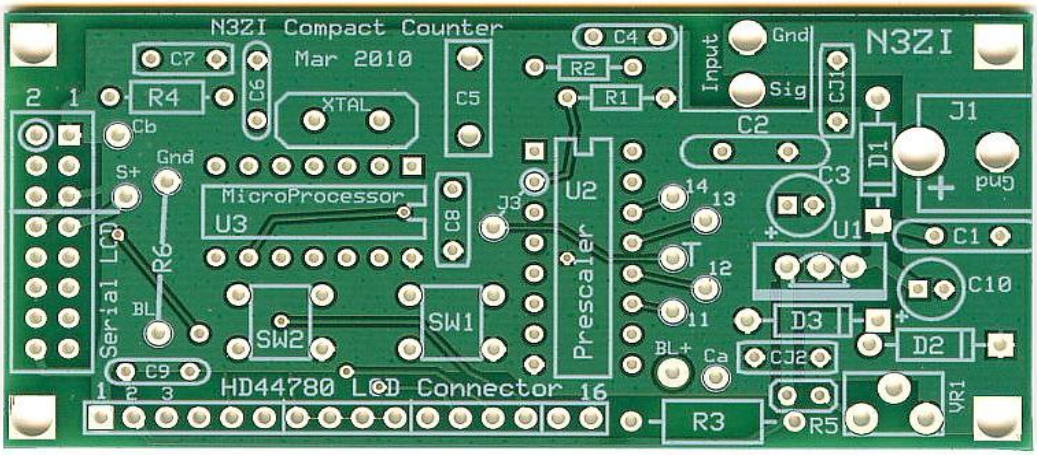
N3ZI Digital Dial

Vintage Kit Manual

Rev 1.6 26 JUL 2010



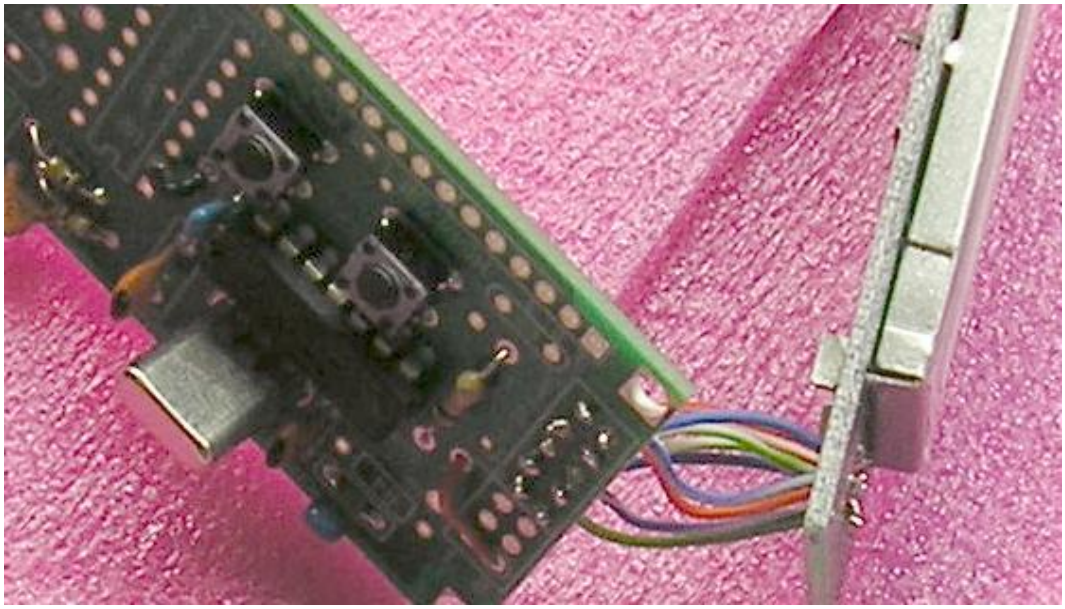
Vintage Kit Components			
Item	**Qty**	**Designator**	**Part Color/Marking**
PCB	1		
LCD Display	1		
Volt Regulator	1	U1	78L05, Black TO-92
Prescaler	1	U2 Prescaler	16 Pin Dip, 74HC161/3
Microprocessor	1	U3 Microprocessor	14 Pin Dip, ATTINY44
XTAL	1	XTAL	ECXR3392
Caps	4	C1, C2, C7, C8	Yellow 104
Electrolytic Cap.	2	C3, C10	Black Electrolytic
Caps, 27pF	2	C5,C6	Orange - 27
Cap, 1000pF	1	C4	Box
Diode	1	D1	Black Epoxy
Resistors, 100K	2	R1,R2	Brown-Black-Yellow
Resistor, 10K	1	R6	Brown-Black-Orange
Switch	2	SW1, SW2	
Power Jack	1	J1	Black 2.1mm Jack
Input Jack	1	Input	RCA Jack

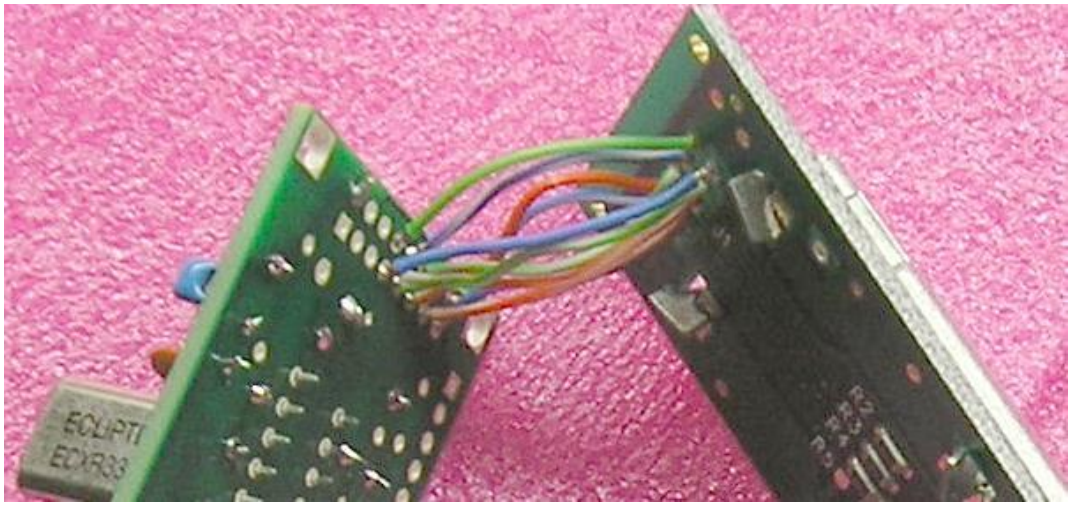
You should start by soldering all of the passive components in the circuit board. Leave the U2, U3 and the LCD module uninstalled for the time being. Solder in U1. There are 4 jumpers that must be soldered in. CJ1, CJ2, are marked on the silkscreen. But you also need a jumper for LCD power from S+ to +5v, and a prescaler jumper. A good starting point for the prescaler is jumper "T" to "12" this will give you a Div/8 prescaler. J3 is left open.

You can connect your power wires to J1 holes. Any voltage from 9 to 14 volts will work. Double check your work, and apply power. Check the voltage at pin 1 of the microprocessor, you should your +5v there. As long as that is ok, disconnect power, and

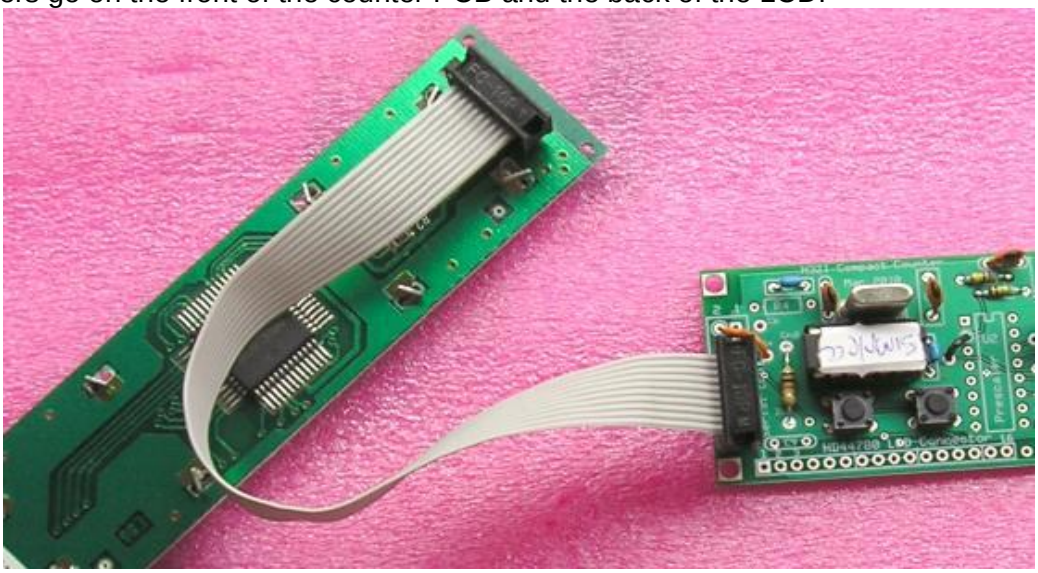
solder the two remaining ICs, U2 and U3. You can use sockets, but my experience is that IC sockets can cause problems, so I recommend that you solder the IC directly into the PCB.

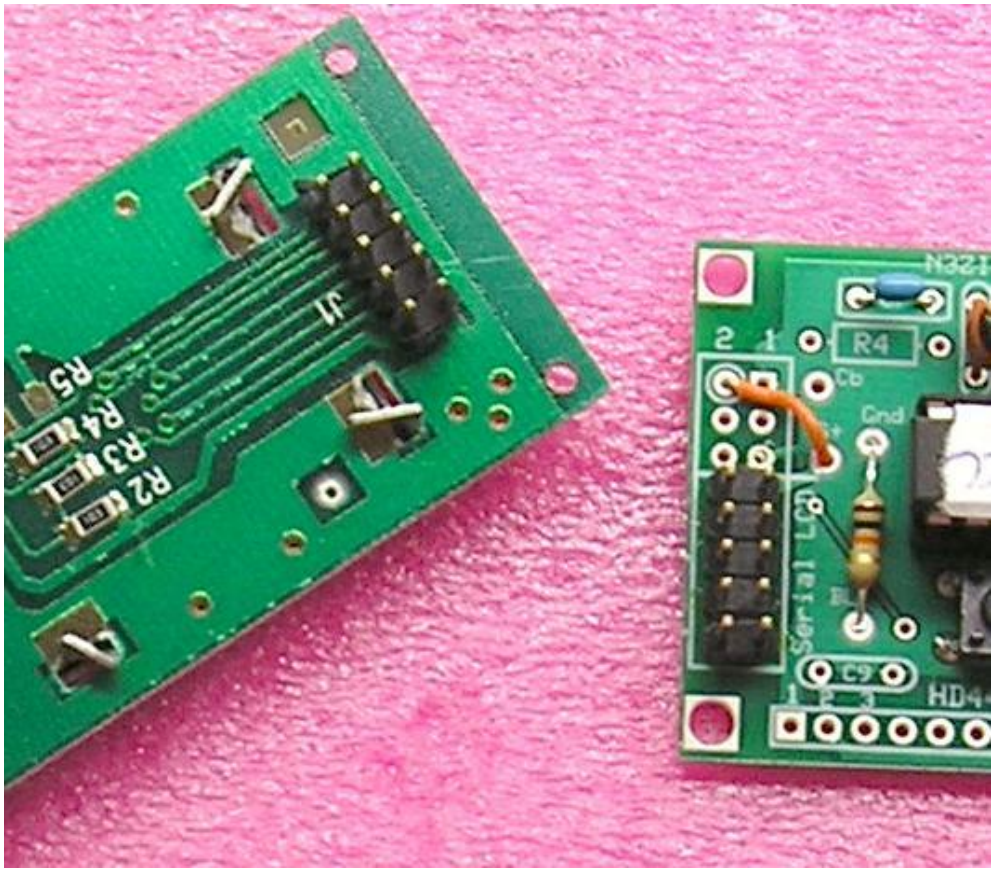
Lastly solder the LCD module in place. Solder insulated wires from each position in the 10 pin area from the PCB to the LCD module. Note that on the PCB you will be using the lower 10 pins in the 16 pin connector, see photo. Use about 1-2 inches of wire, and this will allow you to fold the two boards apart to get to the back of the PCB if you need to make changes. The wiring is straight through if you align the board back to back, see photos. There is a drawing of the LCD module at the end of this manual. If you are using stranded wire, twist and tin each end of the wire first.

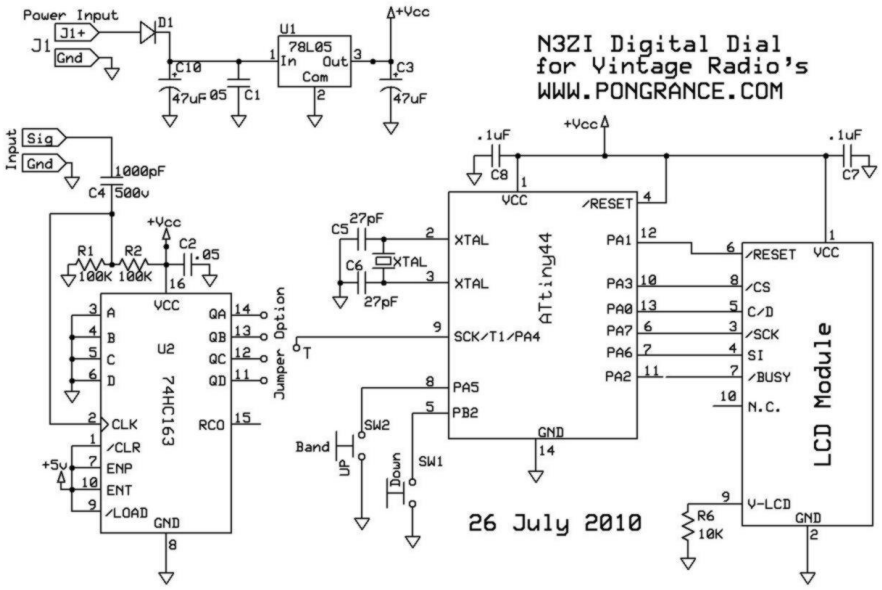




You can also use a removable cable as shown in the photo below. The the 10 pin headers go on the front of the counter PCB and the back of the LCD.







Just a note about the switches, if you want to use different, or remotely mounted switches. There are 4 holes on the PCB for each switch, the upper left is the active signal, the lower right is grounded, the other 2 are not connected.

With this kit you will end up with a PCB with some unused component positions.

Prescaler chip:

Your kit is supplied with a 74HC163 or equivalent Prescaler chip, although others can be used. Jumpers are provided for a number of different Divide by rations, but in general a Div by 8 setting should be used. This will give you a counter that will work from 1MHz to 45MHz. You will need to solder in a jumper from "Tb" to "12" During the setup routine you should set the timebase factor to 8. Your counter will refresh approximately 6 times per second.

If you need a faster update rate, or want to operate above 45MHz, or below 1MHz, please refer to the appendix entitled "advanced prescaler options."

Initial Set Up:

When you first power up the counter, a date code should appear for about 2 seconds, then the frequency reading will show. If there is no input, then the IF frequency will be displayed.

If that all looks ok, turn it off, hold one of the push buttons down, and apply power. The date code will appear and stay there until you release the pushbutton.

The first set up item is the calibration factor for the crystal used, in general you don't have to change this, unless you have a real fascination with precision. This value equals the actual oscillating frequency of the microprocessor crystal, in hertz, divided by 100, minus a few depending on the timebase factor.

CAL 134326

Just do nothing to keep the default, it will move to the next step in 5 seconds.

The next step is setting the timebase factor. The default is 1.

/n 1

The slash is a tad crooked, the best I could do with a seven segment display, but you'll get the idea. Just do nothing to keep the default, and it will move to the next step in 5 seconds.

The way the setup works, is the buttons increase and decrease the number displayed. Once you've gotten to the value you want. Simply release all the buttons and after about 5 seconds it will proceed to the next step. If you've installed the prescaler chip as above and soldered the appropriate jumpers for divide by 2 operation. Then change this setting to "2" This factor simply slows the timebase down by that factor. When you set it to 2 it causes the counter to count the input 2 times over, thus canceling out the effect of your input divider. Of course this also slows the update rate by the same factor. Decrementing beyond 0 will make it negative, be careful not to accidentally enter a negative value for the timebase factor.

The next step is the number of IF's. The default is usually 2

IFn 2

But if you are just using one IF offset, change this to "1".

The next step is for setting the decimal point position.

dp 12.345.6

Pressing either button sequences the decimal points through the possible positions. The default is with the decimal point between the 1st and second digits. You can also turn them off. The position is strictly cosmetic, but the readout can be quite confusing if they are set wrong. Stick with the default, except for some special cases, see table below.

The next parameters are the IF frequencies. You will be promoted for as many IF's as you specified in step 3.

IF1 -5.172.0

Simply use the up down buttons to change the IF, for a large change, holding a button down continuously will change the value at an accelerating rate. If the value is negative, a minus sign will appear. If you have to change from a positive IF to a negative number just keep reducing the IF value by holding the button down, eventually it will go to zero and the minus sign comes on, and you keep going. If your radio uses a subtractive frequency plan, you need to enter the IF as a negative number. For example, many swan radios use a 5500 or 5173 KHz IF. You should set one IF to –5.500.0 and one to 5.500.0, for 40m and 80m the SWANs use a subtractive IF, for the higher bands they use an additive IF.

It takes about 90 seconds to go from +10.000.0, to –10.000.0 MHz. Once you are close, release the button, and use the buttons to tweak it in. The change speed slows the instant the button is released. After your satisfied, just release both buttons, and after 5 seconds of no buttons being pressed, it will move to the next IF. After they are all in the values will be saved in EEPROM. Next time you power up these values will be used.

If you want to use it as a frequency counter, just set one of the IF's to 0. If you are not sure of your IF frequency, set it to zero, then use the device as a frequency counter to measure your radio's BFO frequency. Then go through the setup again using that value for the IF.

Calibration:

With the 74HC163 prescaler the input sensitivity is 100mV RMS (~300mV peak to peak) meaning your VFO signal must be above this level. The maximum input signal level is equal to your power supply voltage. The maximum is 5v peak to peak (1.8v RMS) There are clamp diodes on the input of the microprocessor which will absorb some excess voltage, but if you overdrive it too much, such as directly with a transmitter, it will be permanently damaged. Even a 1 watt QRP rig puts out 20v peak to peak, which will cause damage.

Once you get it hooked up to your radio's VFO, you may want a fine tweak of the IF, to compensate for a variety of errors, including the frequency error in the crystal. Generally these are less than 1 Khz.

During normal operation, the buttons are used to switch IF's. Pushing SW2 switches to the next IF and displays that value. Pushing SW1 goes to the previous IF. Holding either switch down runs through all the IF's, just stop at the one you want. They both wrap around, so only one is really needed unless you program in a bunch of IF's. These switches are SPST NO switches, so you can add another switch in parallel if you want to be able to toggle through the IF's without reaching around to the back of the counter. If you are going to put the counter in an enclosure, I suggest you put a pushbutton on the front connected to SW1.

Tune your radio to a known frequency, observe the readout, and compute the error by subtracting the readout value from the expected frequency. Then go through the set-up again, and change your IF setting by exactly that amount. Calibrating this way eliminates the need for a trimmer capacitor in the xtal oscillator circuit. If you are going to use the counter over a wide frequency range then it is better to calibrate it using the "CAL" parameter in the set up. If you want you could use a 50pf trimmer in place of one of the 27pf capacitors, and using that to tweak unit you get exactly the reading you want.

Other Considerations

The maximum VFO frequency that this counter can measure is 45MHz with the prescaler included and set to Div/8. For other options refer to the section on advanced prescaler options.

Anti jitter logic. The s/w designed so that the last digit will not jitter between two values. Even if you purposely set your VFO on the edge of two readings, it won't jitter. Now if your VFO is very unstable, then you may see some jitter. In essence you have 1 LSD (100hz) of hysteresis in the counter.

The readout may show a negative sign, which can be ignored under normal operation. But basically if your radio has a frequency plan that causes the VFO frequency to move in the opposite direction of the operating frequency a minus sign will be shown.

Your kit included a serial LCD, and this version of the kit does not support other types of LCDs

Advanced Prescaler Options

This design supports a number of different prescaler (divider) chips. If you VFO is at 5.5MHz or below you do not need a preselector and this counter will work better without one. If your VFO is between 5 and 45MHz, you should use a 74HC161 prescaler. If your VFO is above 25Mhz, then you can use a 74AC161 prescaler. But do not use the 74AC161 prescaler with a VFO below 20 MHz. I should note that the 74xC163 counters are identical in this application and can be substituted.

Maximum VFO Frequency	Recommended prescaler Chip	Timebase Factor	Div/ by mode	Jumpers
5.5 MHz	NONE	1 or 10	NONE	J3
11 MHz	74HC161	2 or 20	Div/2	Jumper T to 14
25Mhz	74HC161	4 or 40	Div/4	Jumper T to 13
45 MHz	74HC161, or 74AC161	8 or 80	Div .8	Jumper T to 12
100 MHz	74AC161	16	Div /16	Jumper T to 11

At first glance you might just select the highest setting, Div/16. This will work over the widest frequency range, but the counter update will be rather slow. And the 74AC parts are a little touchy at low frequencies, so they should be preceded by an external Schmidt trigger if you want to use the counter over a very wide frequency range. When using the higher of the two stated "timebase" factors, you will need to move the decimal point over one place, and your resolution will be 10Hz. Note that the higher the timebase factor the slower the counter update. With a timebase factor of 1 the counter will update 50 times a second. With a factor of 16 it updates 3 times a second, 80 gets you one update every 2 seconds.