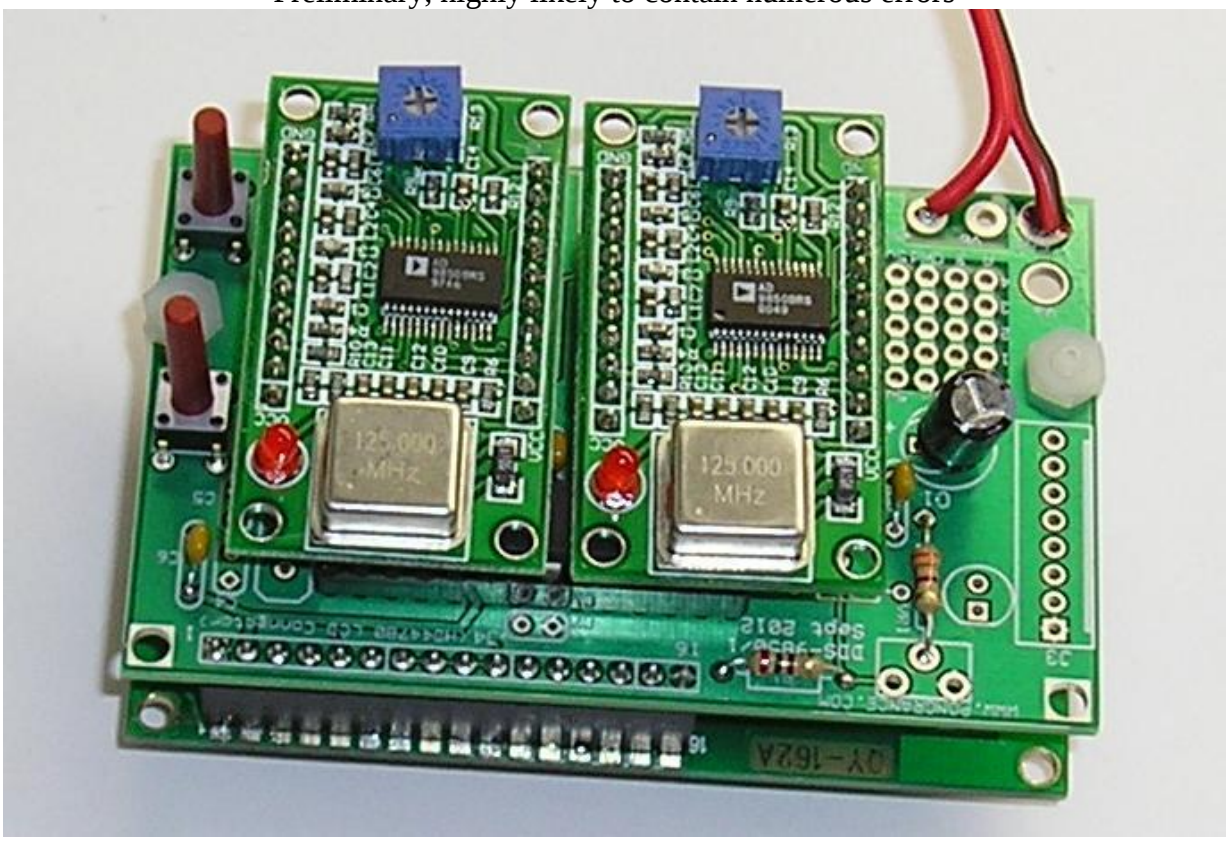
XTAL Bank DDS

Version 0.02 Sept 7 2012

Preliminary, highly likely to contain numerous errors



The photo above shows the fully assembled Xtal Bank DDS with 2 DDS modules installed
(The kit is normally only supplied with 1 module)

Specifications

- Power requirements:
  - 5VDC, regulated, filtered, and stable +/- .2V
  - Current 20mA, Control board plus LCD
  - DDS Modules, 125 to 175mA each.
  - Recommended supply capability, 500 to 1000 mA
- Outputs
  - 2 Sine wave, approx 1v p-p @7MHz, no load.
  - 2 Square wave, approx 5v p-p @ 7MHz.
- Frequency range 100KHz to 40MHz.
  - Expandable to 50MHz with additional filter (provision on PCB)
- Step Size , 0.5Hz.
- DDS Type AD9850
- PCB Size 3.15 in x 2.00 inch
- Thickness, 1.75 inch, including DDS Modules, LCD
- LCD Type, HD44780 compatible
  - 16 Characters, 2 lines, with 16 pin single row connector, and 5mA backlight.
- Microprocessor type, Atmel AVR ATMEGA168.

XTAL BANK DDS Components			
Item	**Qty**	**Designator**	**Part Color/Marking**
PCB	1	Sept 2012	DDS-9850/1
DDS-9850		J1	Module
Microprocessor	1	U2 Microprocessor	28 Pin, ATMega168
Socket	1	U2	Socket
LED	1	LED	LED
Cap, 470uF	1	C1	Black Electrolytic
Caps, 0.1uF	4	C2,C3,C6, C8	Yellow – 104
Jumper	0	C10	Jumper
Resistor, 200	1	R1	Red, Black, Brown
Resistor, 1K	1	R2	Brown,Black,Red
Resistor, 4.7K	1	R3	Yellow,Purple,Red
Resistor, 3.3K	1	VR1 (See Manual)	Orange,Orange,Red
Switch	2	SW1, SW2	
RCA Jack	1	J1 (Back Mount, see text)	
Header Female	1	40 pin (10,10,16)	

Your kit includes a single DDS module which should be mounted in the position over J1. C8 and C10 (jumper) are underneath the module The RCA jack is soldered on the back of the PCB (in doesn't' fit under the DDS Module), and you have to cut off the small plastic nubs to get a nice fit.

Normally shipped with a 40 Pin female header. So you will need to cut it into 10, 10 and 16 pins. Some kits may ship with the connecter already cut. To cut the 40 pin one, pull out the 11th pin, then cut there. do that again for another 10 pin connector. That will leave 18 pins left, just pull out two on then end, and cut that off

This DDS emulates two separate oscillators, each with a bank of 32 crystals. Frequencies can be set easily by the user with the push buttons.

The table below the factory default frequencies.

Channel	Frequency Left	Frequency Right
0	1.0MHz	1.5MHz
1	2.0MHz	2.5MHz
2	3.0MHz	3.5 MHz
	. . .	. . .
30	31.0MHz	31.5MHz
31	32.0MHz	32.5MHz

The user can easily change any of these frequencies using the pushbuttons. All frequencies are saved in non-volatile memory, i.e. remembered even when power is off. You can return the device to this factory original state using a special Factory Reset mode, see below.

The output level is unbuffered, and ranges from 1v P-P at 1MHz to about 200mV peak to peak at 40MHz. It will not drive 50 ohms.

A regulated and filtered 5VDC power source is needed. Total current draw is with 1 DDS module is approx 250mA, so a 500mA power source is sufficient. If two modules are used, and current will increase to as much as 500mA, so a 1 Amp power supply is recommended.

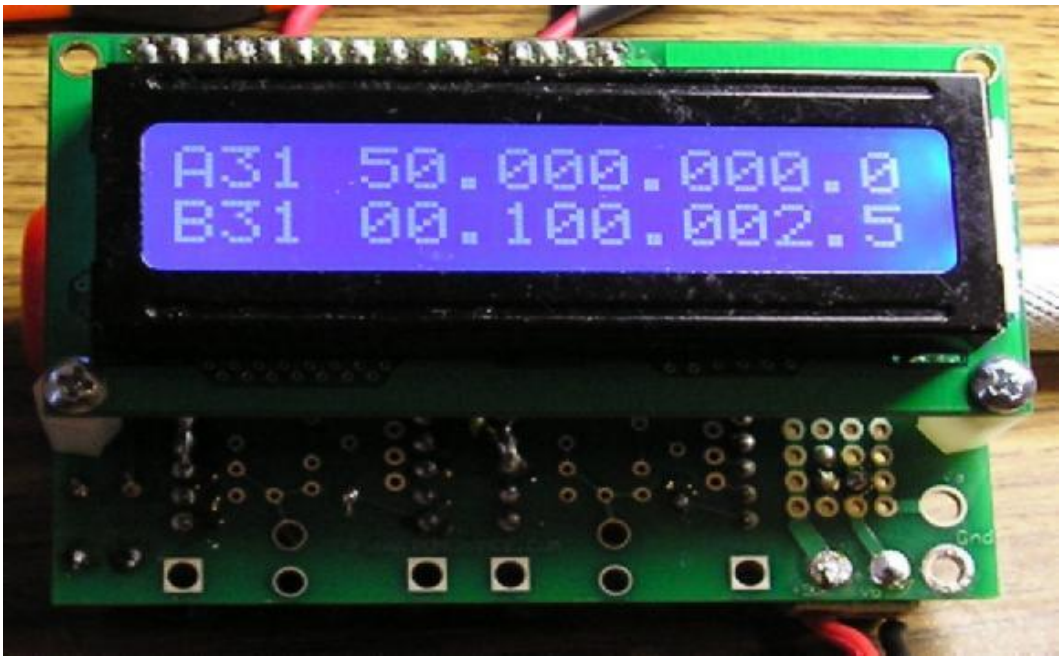
The channel is selected using the 5 but input code on J3. These lines have pull up resistors so an open circuit represents a "1' Driving the signal to ground, represents a "0". So if all inputs are left open (disconnected), channel #31 is selected (all 1's). If all inputs are grounded, channel #0 is selected. There is a separate strobe signal, which can be wired to ground, or pulsed when a valid code is present. If it's wired to ground then the channel will change immediately when any of the 5 input lines changes state. So for example if you are changing from channel # 7 to channel #8 the input code must go from 00111 to 01000 It may momentarily be picked up as any intermediate code, e.g. 01111 (15) or 0000(0) or anything in between. However if the strobe line is used, changes to the input code are only recognized when strobed in. Pin assignments for these signals are shown in the table below

J3	**Pin function**	**Electrical Use**
Pin 1	Ground (note square pad)	Ground
Pin 2	Select Code (Bit 4, MSB)	Contact closure to ground or 0-5v digital signal
Pin 3	Fast slow switch input (see text)	Contact closure to ground only, Do not apply any voltage.
Pin 4	Strobe (can be grounded)	Contact closure to ground or 0-5v digital signal
Pin 5	Select Code (Bit 1)	Contact closure to ground or 0-5v digital signal
Pin 6	Select Code (Bit 0, LSB)	Contact closure to ground or 0-5v digital signal
Pin 7	Select Code (Bit 2)	Contact closure to ground or 0-5v digital signal
Pin 8	Select Code (Bit 3)	Contact closure to ground or 0-5v digital signal

The two buttons on the right side of the board are up/down buttons for setting frequencies. When powered up normally these buttons don't do anything. If you want to set the frequency in the left DDS module, hold the upper button down while applying power. Keep the button down for at least 10 seconds. The LED will cycle blinking quickly once or twice depending on which module you have selected to set. Release the button at this point. Now DDS will operate normally but the buttons will change the frequency selected by the 5 bit code. When the Fast/Slow line is open, changes occur initially at 0.5Hz steps, gradually increasing in speed. When the Fast/Slow line is grounded, changes occur at 100KHz steps. Do not change the 5 bit code while changing a frequency. Once your are done, wait a few seconds to make sure all values are saved, then cycle power. The unit will than power up in locked mode.

There is an optional LCD display that will ease setup, the frequency of both oscillators is displayed at all time. However this is not necessary, one could use a separate frequency counter for setup. No display is needed once the frequencies are set, channels will change per the input code, and as long as you do not power the unit up with one of the buttons pressed, all frequencies will be locked.
The photo below shows the LCD display during normal operation A/B indicates the Left/Right DDS module, 31 represents to channel number, and the remaining digits represent to frequency with 0.5Hz

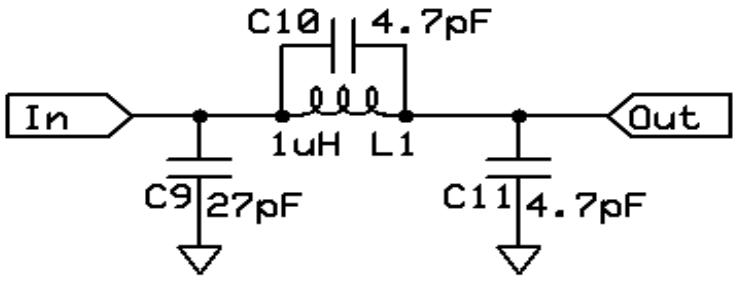
precision. 50MHz and 100.0025KHz are shown.



The normal operating range for this device is 100KHz to 40MHz in 1/2 Hz steps.
It however can be pushed to DC to 50MHz with some minor changes/accommodations.

Low frequency (Audio) operation. Kits are normally shipped with a 0.1uF output coupling capacitor. This will limit the usefulness at very low frequencies (below 100KHz) but one could easily change this to a larger value, or use the DDS output directly without a coupling capacitor. Just keep in mind the direct DDS output sine-wave rides on a DC voltage. There is no lower limit to the DDS operation it will work down to 0.5Hz.

Higher frequency operation. As supplied the kit will work to 40MHz. To operate in the 40-50 MHz range an supplemental out put filter is needed, see schematic below. Holes for these components are on the PCB under each DDS module. This filter corrects the poorly (or incorrectly) designed filter on the DDS chip module. However, the output level is greatly reduced. Don't count on more that 50mV peak to peak at 50MHz.There is an LED which can be usefull when a LCD display is not used. It is on a line shared with the fast/slow line. Primarily it is helpful in setup without an LCD, when initializing to factory defaults, and selecting which module to set a frequency for.



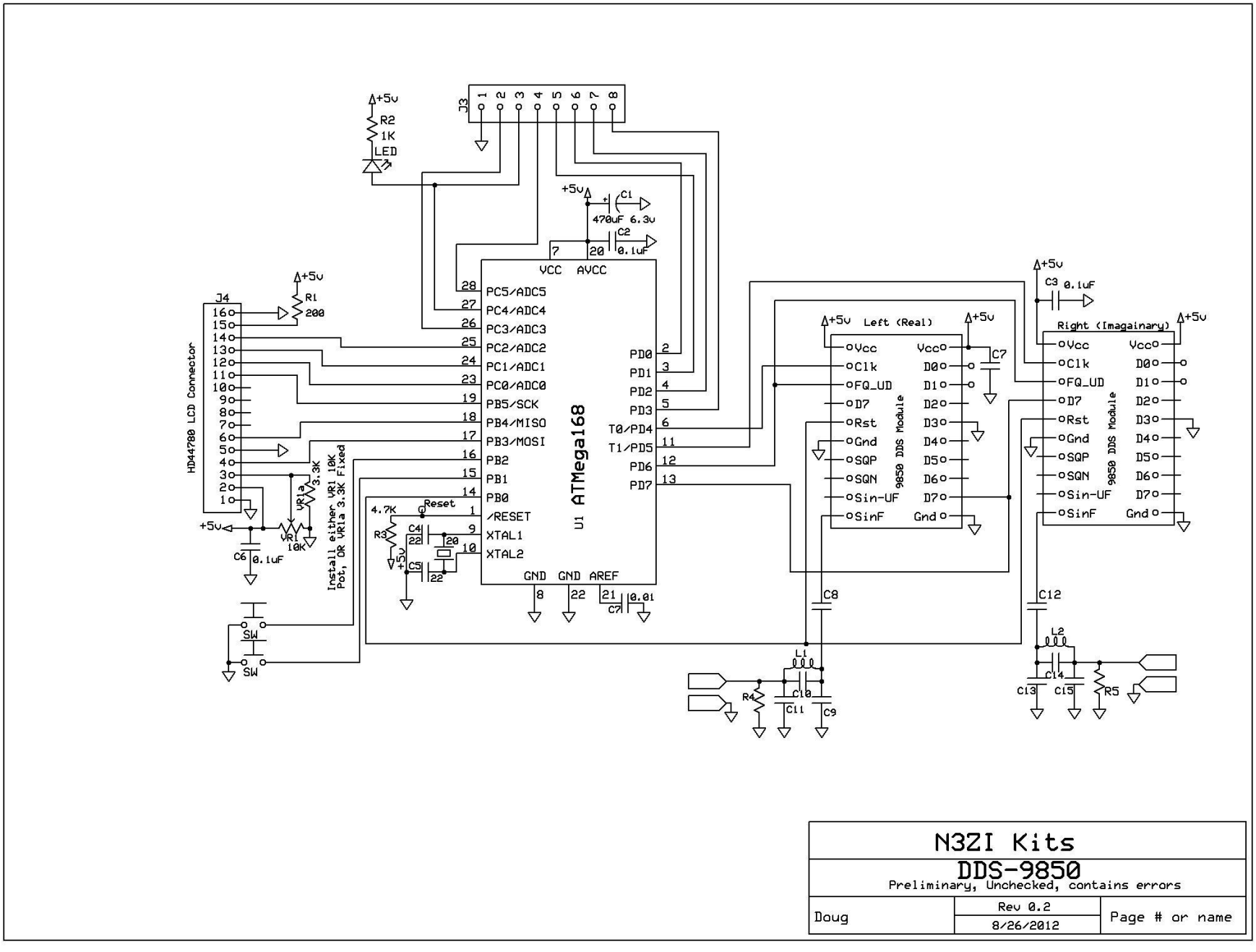
Simple Applications: For very simple applications, which involve the replacement of a 5 or less crystals The individual channels can be selected with a contact to ground on one of the 5 control lines. You will be utilizing channels 15,23,27,29, and 30.

Factory reset can be performed by holding both buttons down while power is applied, hold both buttons for at least 10 seconds, until the LSD blinks a few times then stops blinking, then release. Then wait 1 few minutes for the processor to initialize all memories, the LED will blink while this is happening, once the LED stops blinking, wait a few seconds and cycle power. If you have the LCD connected there will be English instructions

Calibration: Calibration is rarely needed. And is only necessary when using the attached LCD, if you are using an external frequency counter, you should calibrate that instead. There are two calibration factors one for each of the two DDS modules. For each module, you should use the channel with the highest frequency to do the calibration. To enter calibration mode, power up with the pushbutton corresponding to the DDS module you wish to calibrate, hold the button down until the LCD prompt indicating Setup. Continue to hold that button and press the other button until "calibrate" shows on the LCD, then release both buttons. Wait, until the normal mode starts up. there will be a lower case 's' on one line of the LCD. The buttons will change the calibration factor, but the LCD readout will remain the same. Occasionally the Calibration factors will pop up on the display, you should ignore this except perhaps to not that it is changing. Adjust the calibration until the actual DDS output frequency matches the frequency on the display using some other frequency reference. Once you are satisfied the the frequency is OK, wait at least 20 seconds, then power the unit down.

The calibration factor is applied to the 125MHz Xtal, thus affects all channels proportionally. Note that the 125MHz Xtals are nothing magic. They are simple quartz crystal oscillators. They obey the laws of physics regarding the oscillation of quartz. And will be affected by temperature and aging, just as any quartz crystal will. There is much literature on this, as hams have been using quartz crystals for nearly 100 years. Some manufactures will offer 'better' quartz crystal oscillators, but frequently they are only better in terms of initial calibration, but since you calibrate any initial calibration error with this DDS that does not matter. If you keep your DDS outdoors, or do not have heat in your ham shack, then you may find the frequency change due to temperature bothersome. I suggest you use the DDS in a normally heated room. There will be some warm up drift, perhaps a few 10's of Hz, so you should probably do your calibration after the DDS is fully warmed up.

A factory reset (above) will set the calibration back to the factory settings.



N3ZI Kits		
DDS-9850 Preliminary, Unchecked, contains errors		
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