<u>An Arduino Uno DDS AF / RF signal generator</u>: - by Alastair GW0AJU

A signal generator designed for both audio and RF, an design improvement has been made by replacing the variable resistance pot for fine frequency adjustment, by a rotary encoder device, sourced and purchased from "eBay". The AD9850 DDS VFO used can be also sourced from eBay, as well as the Arduino Uno micro controller board. The Arduino IDE is a free download from the Arduino website.

The Arduino Uno program has been written to provide HF band coverage from 136 KHz up to the 4metre metre band to an upper limit of 75MHz. A general coverage setting for **"RF 20KHz to 75MHz"** mode is provided from the selection of the band change buttons. The use of a "general coverage" is envisaged to provide a test signal for say an "I.F." frequency measurement or test, such as 9MHz "I.F." requirement or perhaps a 455KHz "I.F." need, or as an 1st I.F. of 35MHz. In any regard, the wide range of the general coverage principle for RF needs would provide any RF test signal from 20KHz to 75MHz, while the AF mode would provide an audio test signal of **"AF 1Hz to 20KHz"**, both the AF and RF signals to align perhaps a radio transmitter system or a receiver design.

The dial step setting for the increment and decrement of the VFO is programmed to facilitate many hopefully useful selections. An example of a selection choice is for CW side tones. A CW side tone audio tones of 500Hz, 600Hz and 700Hz is given as a frequency step change. When used as a frequency step dial change, a CW audio side tone would be produced within the receiver. For RTTY operational use, a 45 or 50 baud space test tone of a 1275Hz and 2125Hz for RTTY decoder filter checks, but when used as a RF frequency step selection choice, the carrier is offset by 170Hz, up or downward increments.is provided. Three RTTY frequency shift variations are programmed, the 170Hz, 475Hz, and the 625Hz tone variations.

Other audio tones are also provided, audio tone for a NBFM 2400Hz signal for NBFM deviation tests, and a SSB audio tone of 3300Hz to test the upper AF limit of the audio and SSB filtering systems. By using a dial step change of 3KHz, a step down to 3000Hz for the SSB use would test the lower limit response of 300Hz for either SSB or FM.

The "general coverage" program mode has a minimum frequency setting of the signal generator of 10Hz of audio, and a maximum of 75MHz of R.F., both within the range of an AD9850 DDS VFO. This has the added advantage of generating test signal audio tones in addition to a source R.F. signal of up to 75MHz. This means that the Radio amateur bands from VLF 136KHz to the 4metre band are included. Only the 60m band of 5MHz is included as a Ham Radio NoV selection.

The Arduino Uno data port interface pins D0 – D13 are connected with an AD9850 DDS VFO via port pins D10 - D13. The dial information LCD display a LCD 16*2 line display, has been connected via the port pins D4 – D9. The analog ports are again used for a simplified keyboard control with A2 and A3.

The Rotary encoder is connected to the Arduino data pins D2 and D3. The general convention is a clockwise rotation for an increment within the dial frequency displayed, while an anti-clockwise rotation would decrease the dial frequency. If while testing one finds the opposite change in frequency happening to a rotational rotary encoder twist direction, the problem can be overcome by re-arranging the rotary encoder connections to an opposite way around connection.

The AF and RF signal generator can used as the source test signal for an Antenna analyser project, signal amplification may be required for the antenna balance measurements detection circuit, the measurement of the unknown impedance of the antenna under test.

Below is a list of the data connection ports of D0 - D13, and analog ports A0 - A5.

AD9850 DDS VFO:-
RESET=13; // Pin 13 - D13 - Arduino Uno port connect to reset pin (RST).
DATA=12; //   Pin 12 - D12 - Arduino Uno port connect to serial data load pin (D7 of AD9850)
FQ_UD=11; // Pin 11 - D11 - Arduino Uno port connect to freq update pin (FQ_UD)
W_CLK=10; // Pin 10 - D10 – Arduino Uno port to AD9850 module word load clock pin (CLK)

Liquid Crystal Display "16*2 line" unit suitable for Arduino Uno micro-controller:
Arduino Uno port D9 = LCD Db7 data input
Arduino Uno port D8 = LCD Db6 data input
Arduino Uno port D7 = LCD Db5 data input
Arduino Uno port D6 = LCD Db4 data input
Arduino Uno port D5 = LCD "Enable pin"
Arduino Uno port D4 = LCD "reset pin"

The Rotary encoder connection:
 Arduino data pins D2 and D3.

The rotary encoder used was sourced from eBay, the encoder connections where marked as "GND", "DT" "CLK". The data port connections of D2 and D3, connect to "DT" and "CLK" individually, while "GND" is connected to zero volts (Vss GND).

Analog port A0 – A5 input connections:
A0 = not connected
A1 = not connected
A2 = "band selection", reference half voltage +VDD, up button holds high at +VDD, while down button ties low at zero VGND
A3 = "dial frequency step", reference half voltage +VDD, up button holds high at +VDD, while down button ties low at zero VGND
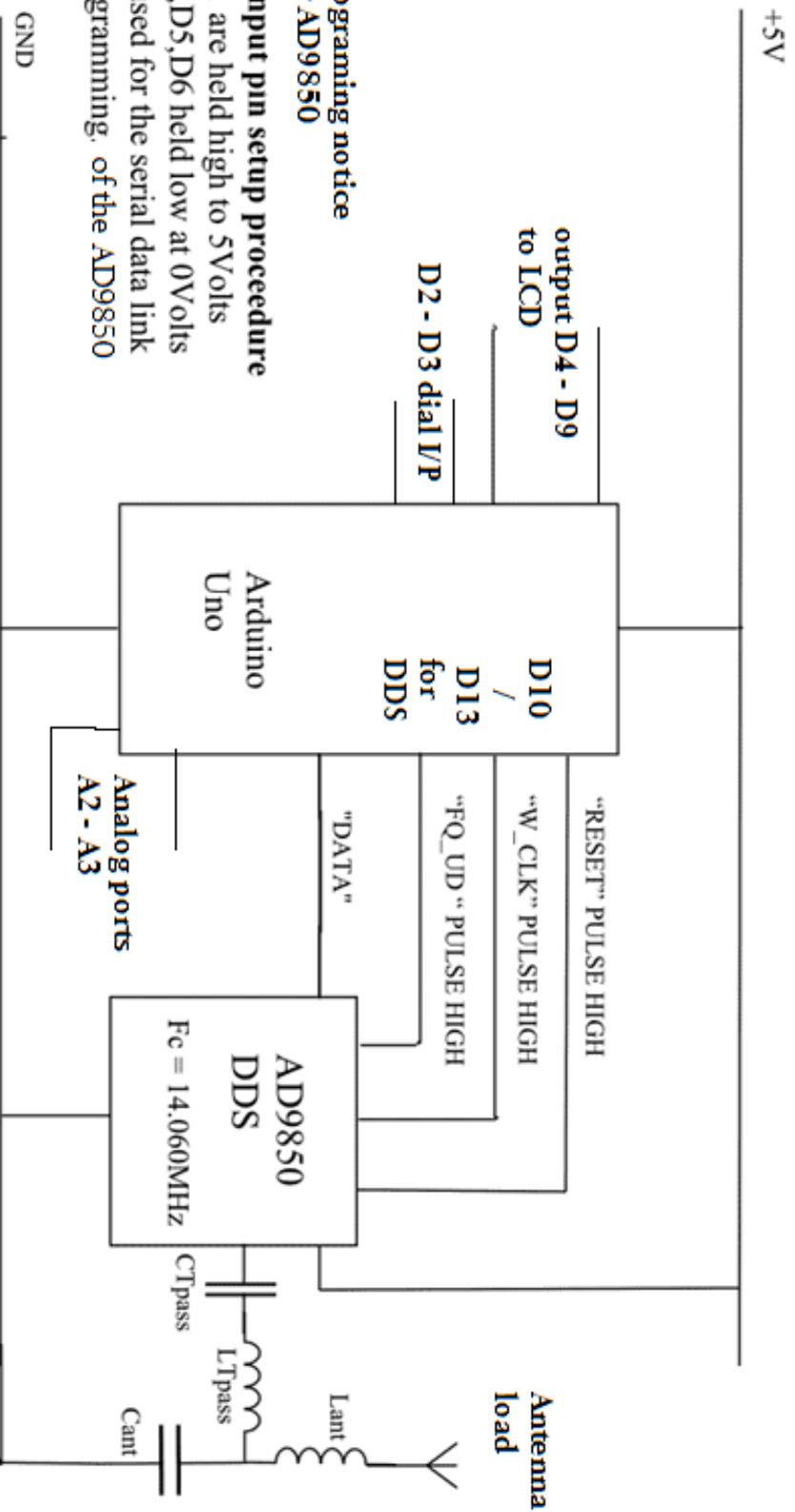A4 = not connected
A5 = not connected

Connection circuit diagram for the analog ports is illustrated below:
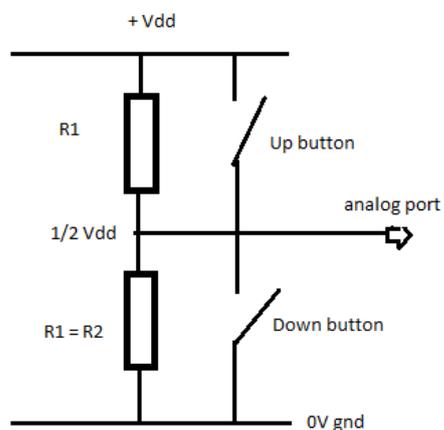
Below illustrates the circuit diagram for the Arduino Uno to DDS AD9850 VFO electrical connections.

Arduino Uno to DDS AD9850 signal generator VFO for Ham Radio : by Alastair GW0AJU

+5V

output D4 - D9
to LCD

D2 - D3 dial I/P

**Programing notice
for AD9850**

Note: Data input pin setup proceedure

D0 ,D1 are held high to 5Volts
D3,D4,D5,D6 held low at 0Volts
D7 is used for the serial data link
for programming, of the AD9850

GND

**Arduino
Uno**

D10
/
D13
for
DDS

"RESET" PULSE HIGH

"W_CLK" PULSE HIGH

"FQ_UD " PULSE HIGH

"DATA"

Analog ports
A2 - A3

**AD9850
DDS**

Fc = 14.060MHz

Antenna
load

Lant

CTpass

LTpass

Cant

The "Lant" and the "Cant" are the lumped component values for a physically short antenna.
The "CTpass" and the "LTpass" are the BPF components for the harmonic suppression of the RF output.