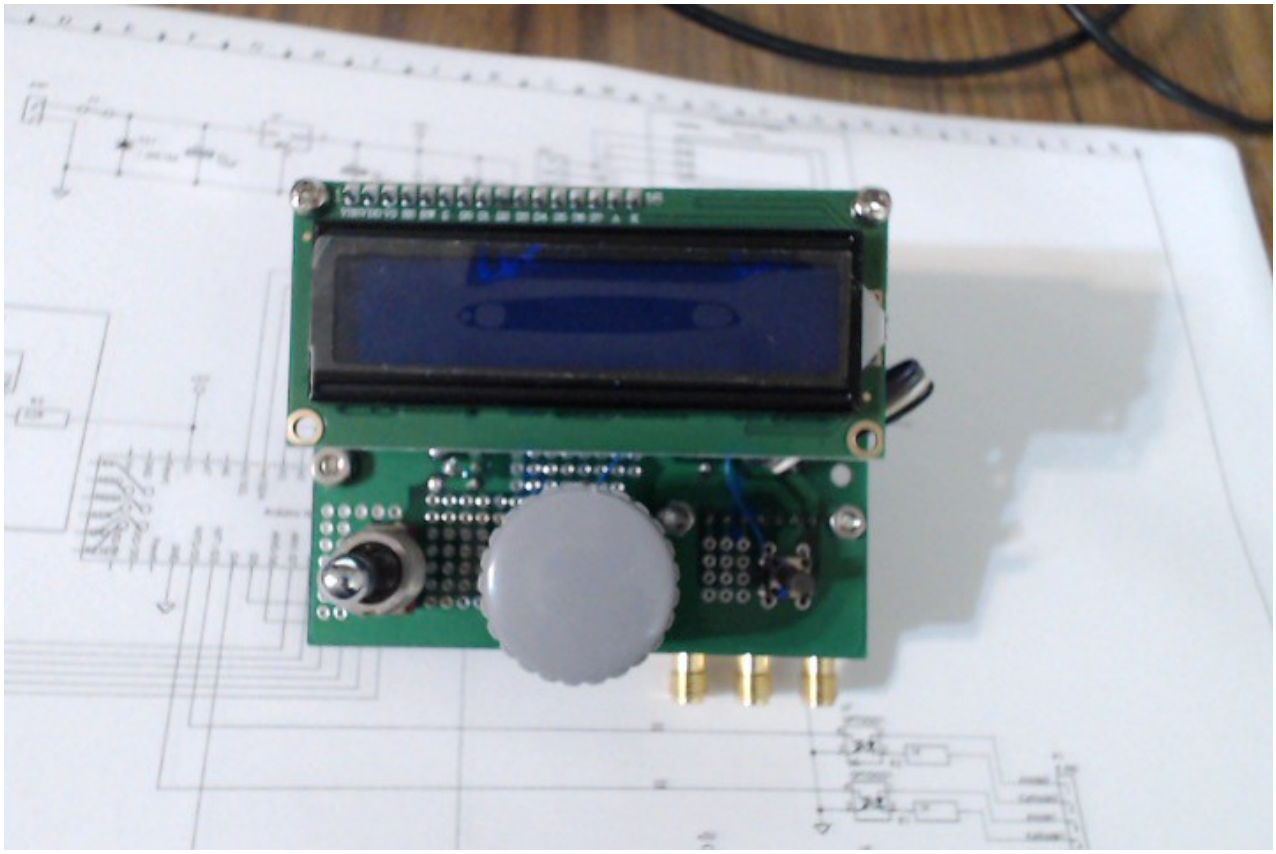
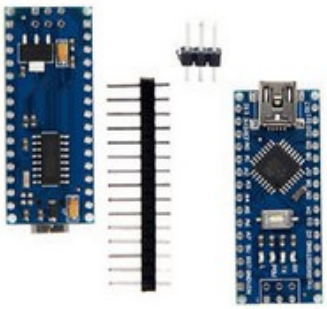


VK3ZYZ Arduino VFO Version 1.

This is the first run of an Arduino driven 3 signal capable VFO based around the Arduino nano and the Si5351 VFO board.



The Arduino Nano is available on Ebay for around $4.00 and the Si5351 for about $6.00 so this is a pretty cost effective project.

Tuning is via rotary encoder, one again an Ebay item, available for $1.00 or less. In fact, the knob will cost you more!



All these add up to a small few dollars.

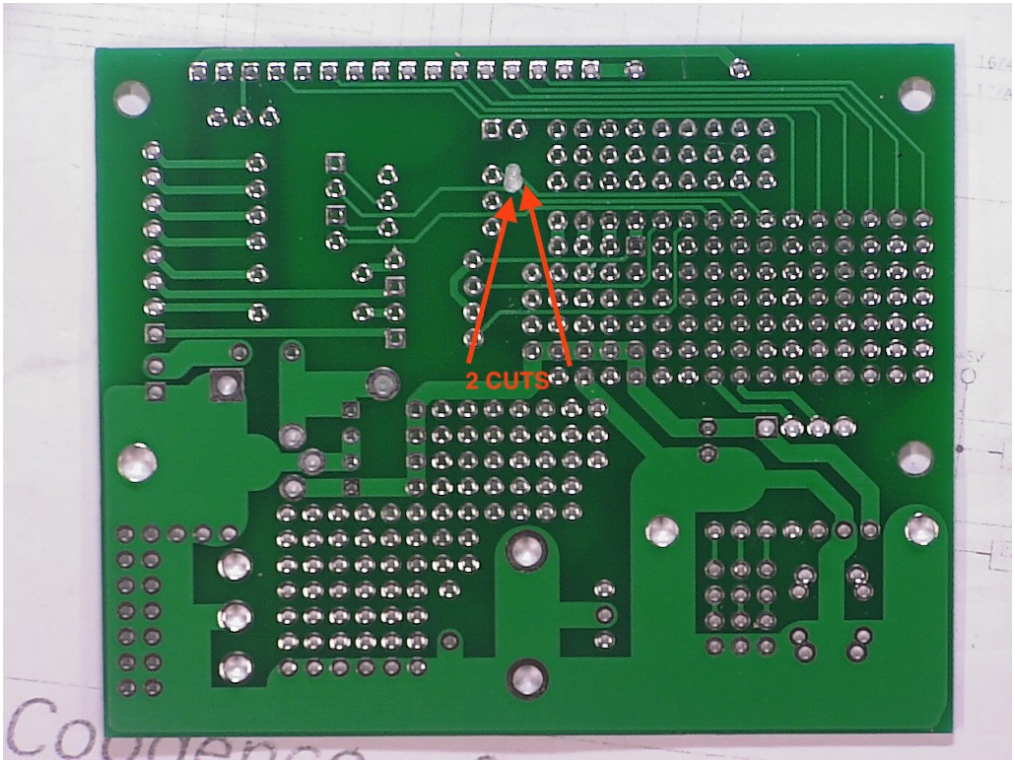
Then, the display. The board has provision for a parallel 4bit mode LCD and an I2C version. The latter is the one I use.

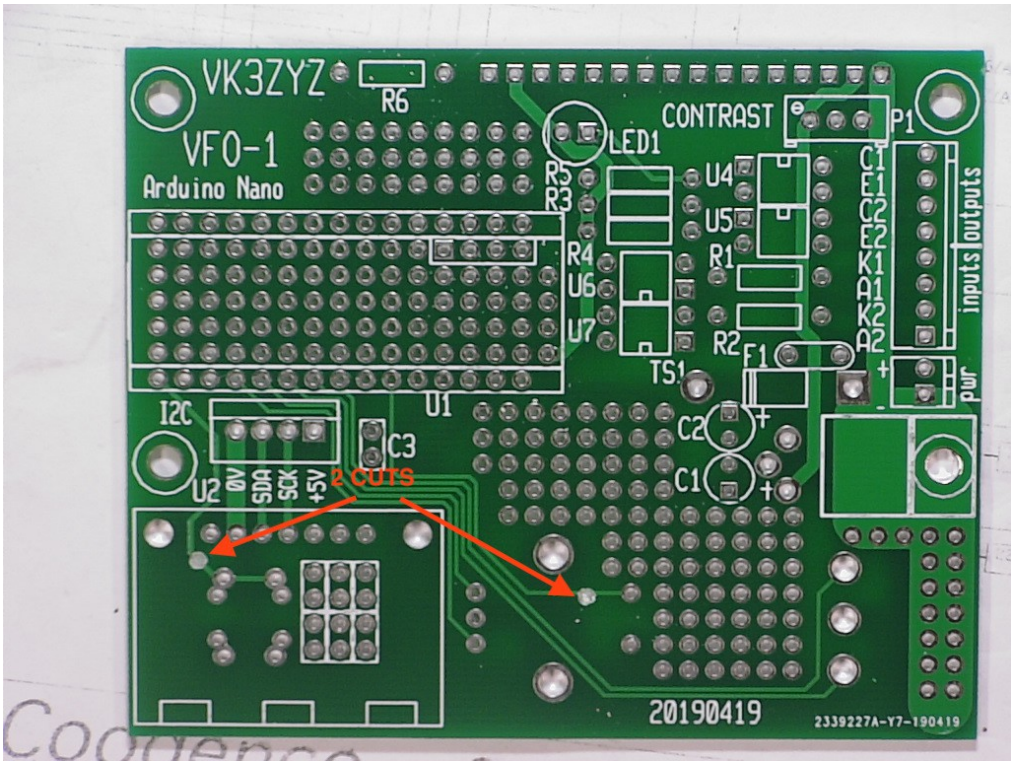

This can display is a 16 character x 2 lines version but bigger displays can easily be incorporated as required.

A 7805 regulator, polyswitch, tranzorb and a couple of capacitors are the 5V power supply.
2 x optically isolated inputs and 2 optically isolated outputs are for whatever use needed, like PTT input and relay drive output.
The programming is with the free Arduino Integrated Development Environment (IDE) that is freely downloaded from..
https://www.arduino.cc/
A sample program will be provided

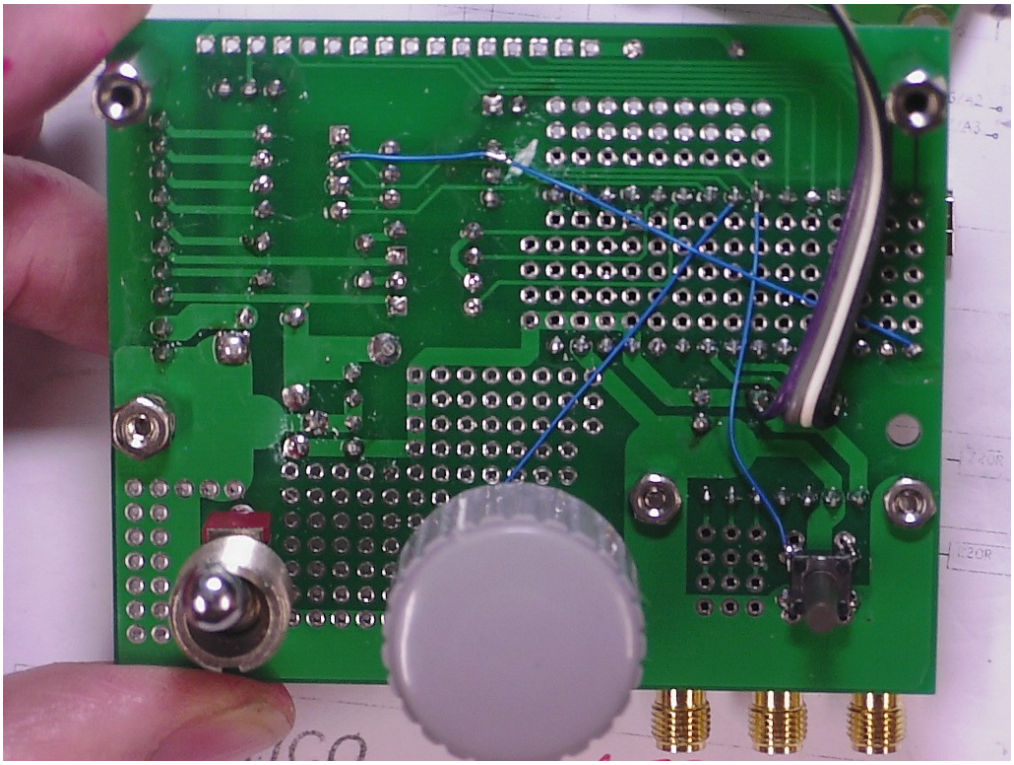
Denys VK3ZYZ.

Version1 board needs some mods!
This was a design error, not a layout error.

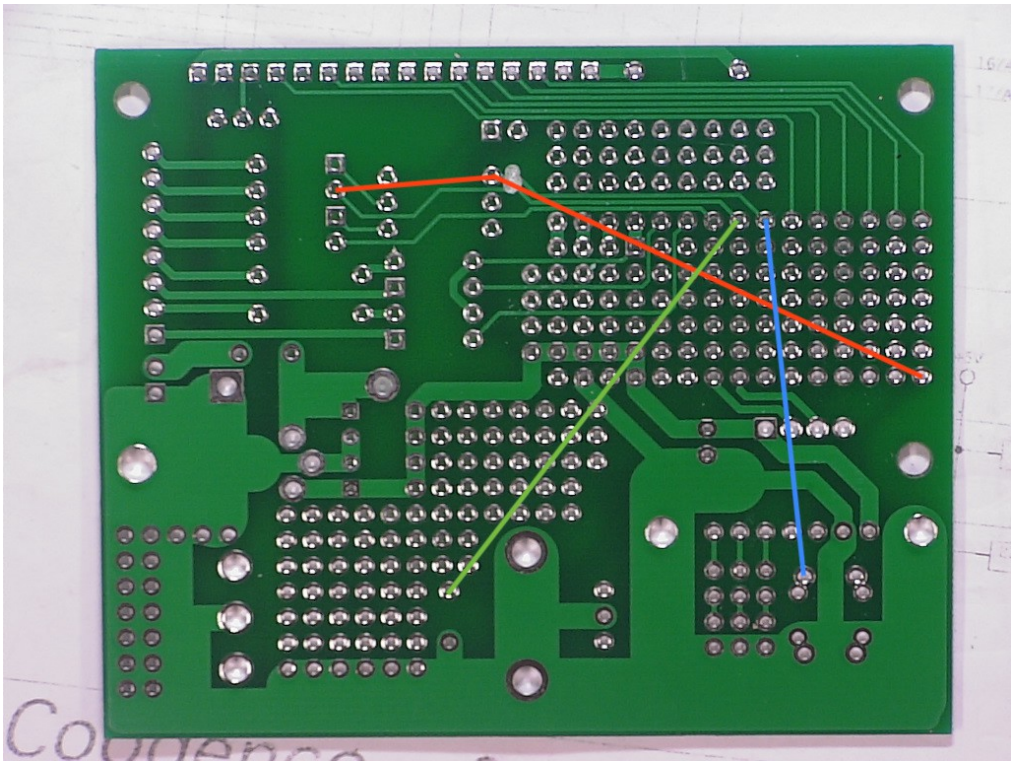


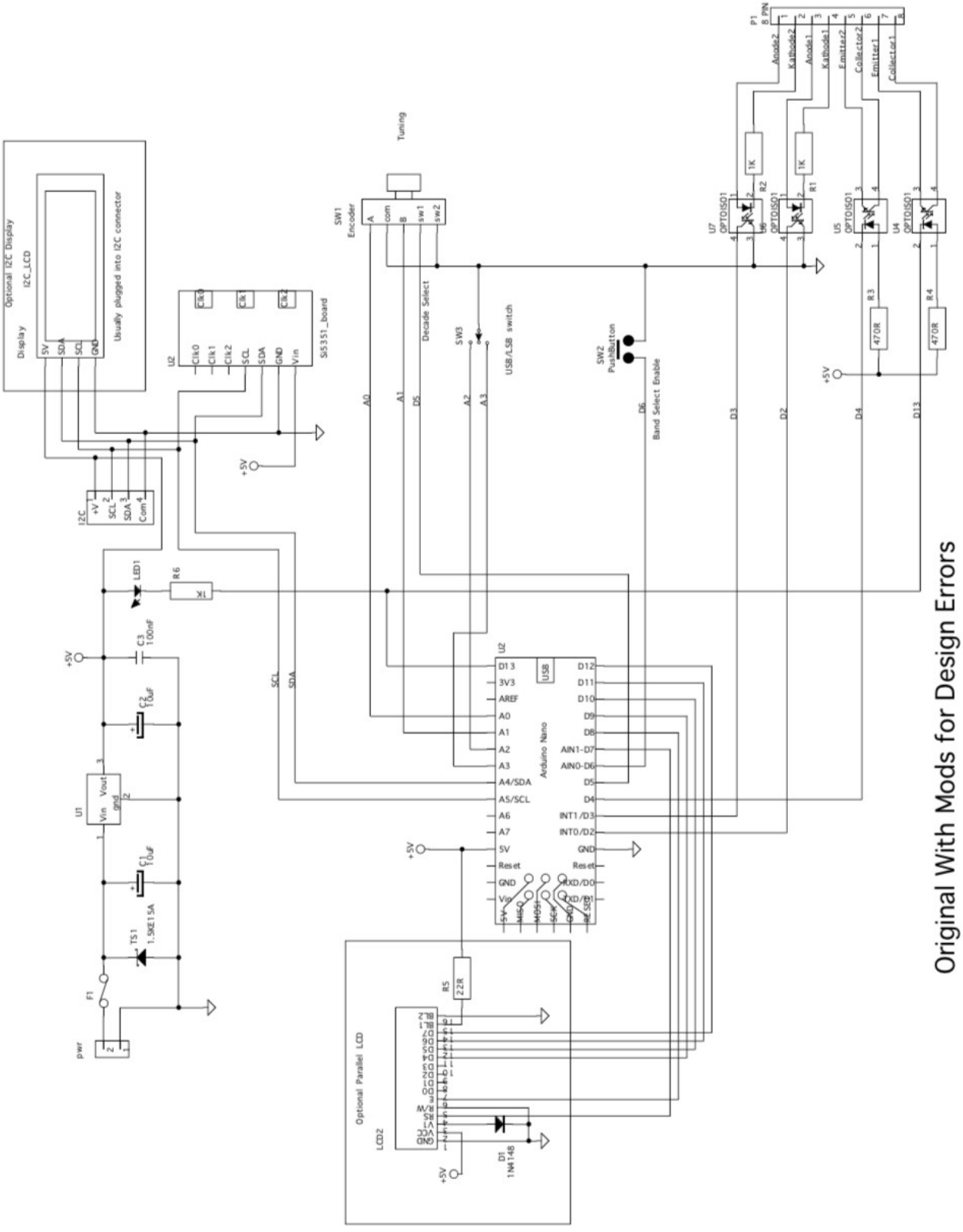


2 cuts on each side.



Here are the link locations that need to be fitted.




Original With Mods for Design Errors
Optional I2C Display
I2C_LCD
Display
Usually plugged into I2C connector
SI5351_board
Tuning
Encoder
Decode Select
USB/LSB switch
Push button
Band Select Enable
Arduino Nano
Optional Parallel LCD
LCD2
1N4148
1.5KE15A
P1
8 PIN
OPTOISO1
470R
1K
22R
100nF
10uF

Sample code is as follows...

```
/*
 Frequ systh for hawk 102-12 radio.
 DCP 20190416
 Libs as loaded from Etherkit Si5351 examples
 Try to add USB/LSB switch
 It looks like it works :)
 Try to add band limits. :)
 next, make 1Hz res.
 Add band memory.
 */

#define Version "ArduinoVFO_DCP_5"

#define LCD_I2C // comment out fopr 4 bits LCD

#include "si5351.h"
#include "Wire.h"

#ifdef LCD_I2C  // use this if it is an I2C LCD
#include <LCD.h>
#include <LiquidCrystal_I2C.h>
#else
#include <LiquidCrystal.h>    // use this if it is an 4bit LCD
#endif

// synthesiser default settings on start up.
unsigned long frequency =   3630000;          // 4 bytes required for frequency

unsigned long frequency0 =  1810000;          // 4 bytes required for frequency
unsigned long frequency1 =  3525000;          // 4 bytes required for frequency
unsigned long frequency2 =  7000000;          // 4 bytes required for frequency
unsigned long frequency3 = 10100000;          // 4 bytes required for frequency
unsigned long frequency4 = 14100000;          // 4 bytes required for frequency
unsigned long frequency5 = 18068000;          // 4 bytes required for frequency
unsigned long frequency6 = 21000000;          // 4 bytes required for frequency
unsigned long frequency7 = 24000000;          // 4 bytes required for frequency
unsigned long frequency8 = 28000000;          // 4 bytes required for frequency

unsigned long step_size = 1000;             // default tuning increment (Hz)
unsigned long offset = 1650000;             // IF offset for clockgen when driving Kestral/Hawk RFDS Radio
static signed char ham_band_index = 1;      // start on 3.5Mhz

long encoder;                         // encoder direction: CCW=-1; NC=0; CW=1
Si5351 clockgen;                        // initalize clockgen

// encoder definitions
#define ENCODER_A  A0
#define ENCODER_B  A1
#define SSB_SWITCH A2                     // HIGH = LSB, LOW = USB.
#define AM_SWITCH  A3                     // not used yet
// A4 = SDA
// A5 = SCL
#define BAND_SENSE     A6                 // not used yet
#define AnalogIn       A7                // not used yet

#define Input1   2                      // not used yet
#define Input2   3                      // not used yet
#define Output2  4                       // not used yet
#define ENCODER_BUTTON 5                  // selects tuning decade
#define BAND_SWITCH    6                 // When held down, encoder selects band
#define Output1  13                      // not used yet

#define ENCODER_INPUT_PORT PINC
int sideband = 0;
```

```
int last_sideband = 1;

/* HF Ham bands
Band       UK Allocation         USA Allocation    Australia Allocation
(metres)       Mhz                 Mhz                Mhz
 160       1.810 -  2.000       1.800 -  2.000       1.800 -  1.875
  80       3.500 -  3.800       3.500 -  4.000       3.500 -  3.800
  40       7.000 -  7.200       7.000 -  7.300       7.000 -  7.300
  30      10.100 - 10.150      10.100 - 10.150      10.100 - 10.150
  20      14.100 - 14.350      14.100 - 14.350      14.100 - 14.350
  17      18.068 - 18.168      18.068 - 18.168      18.068 - 18.168
  15      21.000 - 21.450      21.000 - 21.450      21.000 - 21.450
  12      24.890 - 24.990      24.890 - 24.990      24.890 - 24.990
  10      28.000 - 29.700      28.000 - 29.700      28.000 - 29.700
 */

#ifdef LCD_I2C  // use this if it is an I2C LCD

//LiquidCrystal_I2C  lcd(0x20,4,5,6,0,1,2,3); // <<<<<<Works wih he GY-IICLCD board. "bl and blpol" not used.
//LiquidCrystal_I2C  lcd(0x3f,2,1,0,4,5,6,7,3,POSITIVE); // 0x3f is the I2C bus address for PCF8574AT HM Board
LiquidCrystal_I2C  lcd(0x27,2,1,0,4,5,6,7,3,POSITIVE); // 0x27 is the I2C bus address for PCF8574T HM Boar

#else   // use this if it is an 4bit LCD
/*
 The circuit:
 * LCD RS pin to digital pin 7
 * LCD Enable pin to digital pin 8
 * LCD D4 pin to digital pin  9
 * LCD D5 pin to digital pin 10
 * LCD D6 pin to digital pin 11
 * LCD D7 pin to digital pin 12
 * LCD R/W pin to ground
 * LCD VSS pin to ground
 * LCD VCC pin to 5V
 * initialize the library with the numbers of the interface pins
*/
//              RS, E, D4, D5, D6, D7
LiquidCrystal lcd(7, 8,  9, 10, 11, 22);
#endif

void setup() {

  lcd.begin(16,2);                        // 16 char x 2 line LCD display
  lcd.print(Version);
  delay(1000);
  lcd.clear();

  bool i2c_found;

  // Start serial and initialize the Si5351
  Serial.begin(57600);
  i2c_found = clockgen.init(SI5351_CRYSTAL_LOAD_8PF, 0, 0);
  if(!i2c_found)
  {
    lcd.print("Device not found on I2C bus!");
  }

  // configure rotary encoder & push-button
  pinMode(ENCODER_A, INPUT_PULLUP);     // encoder leads
  pinMode(ENCODER_B, INPUT_PULLUP);
  pinMode(ENCODER_BUTTON, INPUT_PULLUP);
  pinMode(BAND_SWITCH, INPUT_PULLUP);
  pinMode(SSB_SWITCH, INPUT_PULLUP);    // Hi = LSB, LOW =  USB
  pinMode(AM_SWITCH, INPUT_PULLUP);
  pinMode(Input1, INPUT_PULLUP);
  pinMode(Input2, INPUT_PULLUP);
  pinMode(Output1,OUTPUT);
```

```
  pinMode(Output2,OUTPUT);
  digitalWrite(Output1,HIGH);     // output1 off
  digitalWrite(Output2,HIGH);     // output2 off

  display_freq_step();           // display frequency & step-size
  set_synth();
}

/*******************************
 main loop
*******************************/
void loop() {
  check_band();
  check_step_size();

if (digitalRead(SSB_SWITCH)!=last_sideband)
    { set_synth();
      display_freq_step();                    // display frequency & step-size
    }
  // check the frequency
  encoder = read_encoder();                    // returns +1/0/-1 (cw/nc/ccw)
  if (encoder != 0) {
    frequency = frequency + (encoder * step_size);

   set_synth();
    display_freq_step();                      // display frequency & step-size
  }
}

/*******************************
 read encoder direction
*******************************/
char read_encoder() {
  // definitions
  #define DELAY 100                          // number of polling-loops
  static unsigned short integrator;           // encoder debounce

  /* the array values are determined by combining the previous and current A1,A0
  Gray Code bit-patterns to form an array-index. +1 is assigned to all clockwise
  (CW) indexes; -1 is assigned to all counter-clockwise (CCW) indexes; and 0 is
  assigned to the remaining positions to indicate no movement*/
  static char encoder[] = {0,-1,1,0,1,0,0,-1,-1,0,0,1,0,1,-1,0}; // SWAPPED PHASES
  //   static char encoder[] = {0,1,-1,0,-1,0,0,1,1,0,0,-1,0,-1,1,0};
  static unsigned char encoder_index = 0;

  static long count = 0;                     // CW rotation = +1; CCW rotation = -1
  static long this_reading;
  static long last_reading;
  char value;                                // return value

  /* check for encoder rotation. The absolute "count" value changes as the encoder rotates.
  Typically there are four states (counts) per click, but often more due to contact bounce.
  Bounce doesn't matter so long as the "count" decreases" for CCW rotation; remains constant
  when there is no rotation; and increases with CW rotation. Bounce can be completely
  eliminated if we look for the "detent" code and integrate as shown below. */
  encoder_index <<= 2;                       // shift previous bit-pattern left two places
  encoder_index |= (ENCODER_INPUT_PORT & 0x03);  // get current bit-pattern and combine with previous
  count += encoder[( encoder_index & 0x0f )];

  // debounce encoder
  if ((ENCODER_INPUT_PORT & 0x03) == 3) {        // encoder on an indent (3 decimal == 00000011 binary)
    if (integrator < DELAY) {
      integrator++;
    }
  } else {                                   // encoder not resting on indent
     if (integrator > 0) {
       integrator--;
```

```
    }
  }

  // prepare the "return" value
  if (integrator >= DELAY) {                  // encoder deemed to be stationary
    this_reading = count;
    if (this_reading < last_reading) value = -1;
    if (this_reading == last_reading) value = 0;
    if (this_reading > last_reading) value = 1;
    last_reading = this_reading;              // both readings now hold current "count"
    integrator = 0;                           // reset integrator
  } else {
    value = 0;
  }
  return(value);
}

/*****************************
 check frequency band
*****************************/
void check_band() {
  #define DELAY 100                           // number of polling-loops
  static unsigned short integrator;           // encoder debounce

  static char encoder[] = {0,-1,1,0,1,0,0,-1,-1,0,0,1,0,1,-1,0}; // SWAPPED PHASES
  //   static char encoder[] = {0,1,-1,0,-1,0,0,1,1,0,0,-1,0,-1,1,0};
  static unsigned char encoder_index = 0;
  static long count = 0;                      // CW rotation = +1; CCW rotation = -1
  static long this_reading;
  static long last_reading;

  long ham_band[] = {frequency0,frequency1,frequency2,frequency3,frequency4,frequency5,frequency6,frequency7,frequency8};

  while (digitalRead(BAND_SWITCH) == LOW) {
    // check for encoder rotation
    encoder_index <<= 2;
    encoder_index |= (ENCODER_INPUT_PORT & 0x03);
    count += encoder[( encoder_index & 0x0f )];

    if ((ENCODER_INPUT_PORT & 0x03) == 3) {     // encoder on indent = B00000011
      if (integrator < DELAY) {
        integrator++;
      }
    } else {                                    // encoder not resting on indent
      if (integrator > 0) {
  integrator--;
      }
    }

    if (integrator >= DELAY) {                  // encoder stationary
      this_reading = count;
      if (this_reading != last_reading) {
        if (this_reading > last_reading) {
          ham_band_index++;
          if (ham_band_index > 8) {
            ham_band_index =0;                  // wrap around
          }
        }
        if (this_reading < last_reading) {
          ham_band_index--;
          if (ham_band_index < 0) {
            ham_band_index = 8;
          }
        }
        last_reading = this_reading;            // both now hold current count
        integrator = 0;                         // reset integrator
```

```
      frequency = ham_band[ham_band_index];     // change frequency band
      set_synth ();                          // set the new frequ ****** added 20190502
      display_freq_step();
     }
    }
   }
}

/*****************************
 check the step size
*****************************/
void check_step_size() {
  // delay definitions
  #define DELAY 3000                        // DELAY = debounce(mS)*loops/second
  #define LONG_PUSH 15000                       // number of loops considered "long"

  // variables
  static boolean transition = false;            // valid during button push
  static unsigned short integrator;             // varies from 0 to MAXIMUM
  static unsigned short push_duration;          // determines step size/direction

  // look for first high-to-low transition
  if (!transition && (digitalRead(ENCODER_BUTTON) == LOW)) {
    transition = true;
    integrator = 0;
    push_duration = 0;
  }

  // look for last low-to-high transition
  if (transition) {
    if (push_duration < (LONG_PUSH*2)) {        // track push duration
      push_duration++;
    }
    if (digitalRead(ENCODER_BUTTON) == HIGH) {   // ENCODER_BUTTON is HIGH
      if (integrator < DELAY) {
        integrator++;
      } else {                              // ENCODER_BUTTON is LOW
        if (integrator > 0) {
    integrator--;
  }
      }
    }

    // update the step_size
    if (integrator >= DELAY) {
      transition = false;
      if (push_duration > LONG_PUSH) {          // LONG PUSH: decrease step size
        step_size = step_size/10;
        if (step_size < 1) {                  // was 10
          step_size = 100000;                 // wrap around
        }
      } else {                              // SHORT PUSH: increase step size
        step_size = step_size*10;
        if (step_size > 100000) {
          step_size = 1;                    // wrap around Was 10
        }
      }

      display_freq_step();                    // update step-size
    }
  }
}


/*****************************
set the Si5351 CLK0 frequency
 *****************************/
```

```
void set_synth ()
{
switch (ham_band_index) {       // limit to SSB part of bands
    case 0:
  frequency = constrain(frequency, 1840000, 1875000);
  frequency0 = frequency;
  break;

    case 1:
  frequency = constrain(frequency, 3525000, 3700000);
  frequency1 = frequency;
  break;

    case 2:
  frequency = constrain(frequency, 7040000, 7300000);
  frequency2 = frequency;
  break;

    case 3:
  frequency = constrain(frequency, 10115000, 10140000);
  frequency3 = frequency;
  break;

    case 4:
  frequency = constrain(frequency, 14112000, 14350000);
  frequency4 = frequency;
  break;

    case 5:
  frequency = constrain(frequency, 18110000, 18168000);
  frequency5 = frequency;
  break;

    case 6:
  frequency = constrain(frequency, 21150000, 21450000);
  frequency6 = frequency;
  break;

    case 7:
  frequency = constrain(frequency, 24930000, 24990000);
  frequency7 = frequency;
  break;

    case 8:
  frequency = constrain(frequency, 28300000, 29100000);
  frequency8 = frequency;
  break;
}

    if (digitalRead(SSB_SWITCH)==LOW)
    {
    clockgen.set_freq(((frequency+offset)*100), SI5351_CLK0);
    last_sideband=0;
    }
  else
    {
    clockgen.set_freq(((frequency-offset)*100), SI5351_CLK0);
    last_sideband=1;
    }
}


/*******************************
 update frequency and step-size
*******************************/
void display_freq_step() {
  long MHz = frequency/1000000;
```

```
  // convert frequency to floating point
  // adding 0.0000001 fixes a rounding error
  double freq = (double) frequency/1000000+0.0000001;

  // display frequency
  lcd.clear();
     if (digitalRead(SSB_SWITCH)==HIGH)
     { lcd.print("L");
     }
     else
     { lcd.print("U");
     }

  if (MHz < 10) {
    lcd.setCursor(3,0);                    // start at char 1, line 1
    lcd.print(freq, 6);                   // 6 digit resolution
    lcd.print(" MHz ");
  } else {
    lcd.setCursor(2,0);                    // start at char 1, line 1
    lcd.print(freq, 6);
    lcd.print(" MHz ");
  }

  // commented out to set 1x Hz.
  // last digit always zero                 // digit sometimes showed a 1
//  lcd.setCursor(10,0);
//  lcd.print("0");

  // display step size
  switch (step_size) {

      case 1:                     // added for 1xHz.
      lcd.setCursor(10,1);
      lcd.print("*");
      break;

    case 10:
      lcd.setCursor(9,1);
      lcd.print("*");
      break;
    case 100:
      lcd.setCursor(8,1);
      lcd.print("*");
      break;
    case 1000:
      lcd.setCursor(7,1);
      lcd.print("*");
      break;
    case 10000:
      lcd.setCursor(6,1);
      lcd.print("*");
      break;
    case 100000:
      lcd.setCursor(5,1);
      lcd.print("*");
      break;
    default:
      break;
  }
}
```