

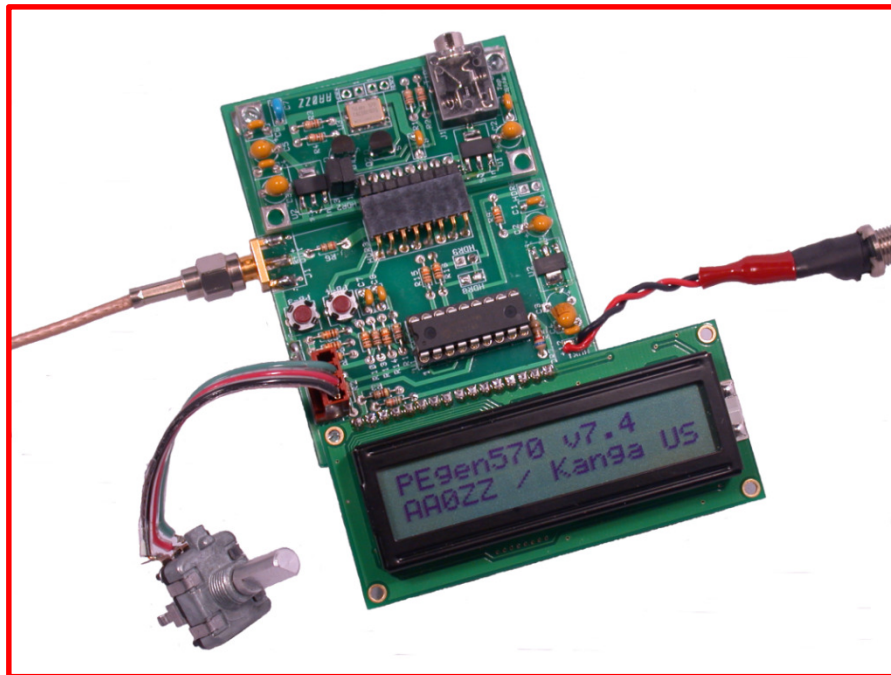
# AAØZZ Control Board for Si570 Daughtercard

Complete Signal Generator for 10 to 157 MHz

By Craig Johnson, AAØZZ

[AAØZZ@CBJOHN.COM](mailto:AAØZZ@CBJOHN.COM)

[www.cbjohn.com/AAØZZ](http://www.cbjohn.com/AAØZZ)



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## 1 Introduction

This Control Board is intended to be used with the Si570 Daughtercard. The Daughtercard uses the Silicon Labs Si570 DSPLL and software to generate RF signals in the continuous range of 10 to 157 MHz. Since many amateurs use divide-by-four mechanisms in Quadrature Sampling Detectors (QSD) – i.e., “Tayloe” mixers - for their receivers and also in Quadrature Sampling Exciters (QSE) for their transmitters, the Si570 Daughtercard can provide the local oscillator signal for receivers and transmitters which operate on the 80 through 10 meter amateur bands.

## 2 Hardware Description

Details of the Si570 DSPLL are in the Daughtercard manual

The schematic of this Control Board is in Appendix A. For reference, the Daughtercard schematic is in Appendix B.

The picture of the Control Board shows the LCD directly attached to the Control Board header. This, of course, is for testing only. It is intended that the user will install the LCD on the front panel and use a wiring harness to connect the LCD to the Control Board header.

The encoder shown in the picture is a very high quality mechanical encoder and supplied with the kit. An optical encoder (for example, Clarostat 600128CBL, DigiKey part number 600CS-ND ) could be used for highest performance (more frequency updates per revolution and less “backlash”) but this mechanical encoder gives good performance. The optical encoder is much more expensive and can be substituted if higher performance is needed.

### 2.1 Circuit Description

See the schematic in Appendix A.

Header HDR2 on the Daughtercard is a 2x2 connector block that is used when the Daughtercard is used in the Control Board. Two jumpers can be installed in this header block (1 to 2 and 3 to 4) to route the I2C communications through the 8-pin interface connector.

Headers HDR5 and HDR6 are intended to be used in the PEGen570 for controlling a sideband select latching relay. A suggested relay (not supplied) is Panasonic TQ2-L-5V (DigiKey part number 255-1004-5-ND).

Header HDR7 is used for controlling the frequency shift for a CW sidetone or FSK (RTTY). When in CW mode, HDR7 is intended to be connected to the Transmit/Receive circuitry. The HDR7 pin should be HIGH (+5v nominal) when the CW transmitter is active and LOW when the receiver is active. When FSK mode is selected in the menu, HDR7 is used for the shift modulation and should be connected to the FSK circuitry.

## 3 Si570 Control Board Assembly

### 3.1 Parts Identification

The builder should first identify all the parts in the kit. The parts are listed and described in Appendix B. Every effort is made to include all parts in the kit; however, mistakes do happen. If you are missing a part,

notify Bill Kelsey at Kanga and he will send the missing parts to you. It may be faster to get common components from your own “junk box” or at your local Radio Shack store.

### **3.2 Assembly**

The silk-screen part names on the board will be your guide. The order in which you place the parts is not critical but I would suggest that you install the PIC last for static-protection reasons.

Here is a possible assembly order that works well for the Control Board.

1. Install the voltage regulator, U2.
2. Install the resistors and capacitors.
3. Install the header connectors.

HDR1, HDR5, HDR6 and HDR7 are 2-pin connectors.

HDR 2 is the 4-pin locking header. It is installed with the tab near the board edge.

HDR 3 is an 8-pin right-angle connector which holds the daughtercard. It should be soldered into the control board with the connector sockets elevated by 1/4” from the board. Solder one end pin, measure the elevation, adjust as needed, solder the other end pin, measure and adjust as needed, and then solder the remaining pins.

HDR4 is the 16 pin connector for the LCD. The 16-pin socket strip should be installed on the board and the matching 16-pin plug strip should be installed on the back side of the LCD.

4. Install the DIP socket for U1 (the PIC).
5. Test the voltages.
  - a) Apply 12v to HDR1 and power up.
  - b) Use a Volt meter to check:
    - 12v coming into HDR1 pin 1.
    - 5v out of U2. Check at the point where the regulator connects to C1 or C2.
    - 5v at Pin 4 of U1 (PIC) socket.
    - **IF ANY OF THESE VOLTAGES ARE NOT CORRECT, YOU MUST RESOLVE THE PROBLEM BEFORE PROCEEDING!**
6. Install the pushbuttons.
7. Install the SMA connector.
5. Power down.
6. Plug the Daughtercard into the HDR3 socket.
7. Plug in the LCD to the HDR4 socket.
8. Assemble rotary encoder wiring harness and plug in the rotary encoder. This picture shows the wiring harness connections.

**Pin 1 (Unused with this encoder)**



9. Header HDR2 of the Daughtercard is a 2x2 connector block that is not used when the Daughtercard is used in a PIC-EL. However, when the Daughtercard is used in a different platform, two jumpers can be installed in this header block (1 to 4 and 2 to 3) to route the I2C communications through the 8-pin interface connector. This eliminates the need for the external wires from the stereo jack to the PIC-EL board.
10. Put the programmed 16F88 PIC in 18-pin DIP socket.
11. Power up. You should have RF coming from J1, the RF output jack.

## **4 PEGen570 Software Application**

My sample application software for the AAØZZ Si570 Daughtercard is called PEGen570. It runs on a simple, inexpensive 16F88 PIC in the Control Board.

### **4.1 User Interface**

The user interface for the PEGen570 application is very simple. It uses two pushbuttons, the encoder, and the 2-line by 16-character LCD.

There is no operational “RESET” pushbutton for the PIC. The pushbutton attached to PIC Pin 4 is configured (via the CONFIG statement in the source code) such that it does not perform a microprocessor reset when pressed but to operate as a normal I/O pin instead. This made the pushbutton available for operation and it is needed.

The Pushbutton 3 and Pushbutton 4 are the two operational pushbuttons. When running the Si570, each time Pushbutton 3 is pressed and released the tuning digit that is currently being modified by turning the encoder to be increased by one digit. It can be advanced up to the 1 MHz position. Similarly, each time Pushbutton 4 is pressed and released, the tuning digit that is currently being modified by turning the encoder to be decreased by one digit. The digit that is currently being modified by the encoder is underlined.

When the daughtercard is running, pressing and holding Pushbutton 3 for longer than 2 seconds stores the current frequency in EEPROM. This frequency is used as the start-up frequency on subsequent power-ups.

### **4.2 Menu**

A simple menu is used for changing 3 items in the operation.

- 1) Sideband selection
- 2) Frequency division for LCD display
- 3) FSK enable (if FSK is enabled via compile option in source code)

The menu is activated by holding Pushbutton 4 while pushing Pushbutton 3 and then releasing them both. The current mode is shown in character position 1 of line 1 of the LCD. Now the user can update the current selection of each of the three items. Tapping Pushbutton 3 allows the user to cycle through the

available options for the current item. Tapping Pushbutton 4 leaves the current item at its last value and advances to the next item in the menu. After the last item has been selected, pressing Pushbutton 4 exits the menu.

### **4.2.1 Sideband Selection**

The first menu item that may be selected in the menu is the sideband selection. The user may select one of four sideband modes, USB, LSB, CW+ or CW- .

An external latching relay is engaged or disengaged as the sideband is changed in the menu. PIC output ports RA6 and RA7 attach to HDR5 and HDR6 (pins 15 and 16) respectively. As the sideband is changed in the menu, either RA6 or RA7 is driven high with an 8 mS pulse (with the opposite side being held low) to engage or disengage the external latching relay. The recommended latching relay (TQ2-L-5V – DigiKey part 255-1004-5-ND) requires 14 mA at 5v for 3 mS plus contact bounce time. The latching relay is intended to enable the proper I and Q phases of the transmitter and/or receiver to set the proper sideband.

### **4.2.2 CW Sidetone During Receive**

If the mode is CW+ or CW- , Header HDR7, attached to PIC input port PB7, is monitored by the software to determine whether or not to shift the frequency by the sidetone amount. HDR7 is expected to be set to a low state by external Transmit/Receive circuitry during Receive operations and to a high state during Transmit operations. The software continually monitors the signal at HDR7 and, when is detected to be low while in CW- mode, shifts the frequency down by 600 Hz from the nominal, displayed frequency. If the mode is CW+ and HDR7 is LOW (Receive), the frequency is shifted up by 600 Hz from the nominal, displayed frequency. In either case, whenever HDR7 is detected to be HIGH, indicating Transmit operation, the frequency will be set back to the nominal frequency that is displayed on the LCD.

How fast does it switch? The software looks at the signal on HDR7 often enough to detect and change the frequency within 1.6 mS of HDR7 changing state. That's fast enough for QSK.

### **4.2.3 Frequency Division for LCD Display**

The PEGen570 application can be configured to display the current Si570 generated frequency or it can be configured to display the Si570 frequency divided by two or four. The divide-by-four option is useful when the signal generator is being used as a signal source for a QSD/QSE (“Tayloe”) mixer. The circuitry for these mixers usually divides the input frequency by four so this software option allows the LCD to display the mixer’s operating frequency.

Tapping PB3 while in this portion of the menu allows the divide-by-x factor to be changed. When the correct factor is selected, press PB4 to advance to the next menu item selection.

### **4.2.4 FSK Frequency Shift**

This menu item is only available and displayed only if the FSK option is enabled via a #DEFINE statement in the source code. The default software does not have FSK enabled.

Tapping PB3 while in this portion of the menu allows the FSK option to be enabled or disabled. When the correct factor is selected, press PB4 to advance to the next menu item selection.

If FSK is enabled, the FSK shift size will be used, even if CW+ or CW- is also selected in the menu. FSK takes precedence.

When FSK is active, Header HDR7, attached to PIC input port PB7, is monitored by the software to determine whether or not to shift the frequency by the FSK shift size. The frequency is set to the displayed frequency when the signal on HDR7 is HIGH (the MARK frequency) and is shifted down by 170 Hz when the signal on HDR7 is LOW (the SPACE frequency).

The software looks at the signal on HDR7 often enough to detect and change the frequency within 1.6 mS of HDR7 changing state.

### **4.3 LCD Display**

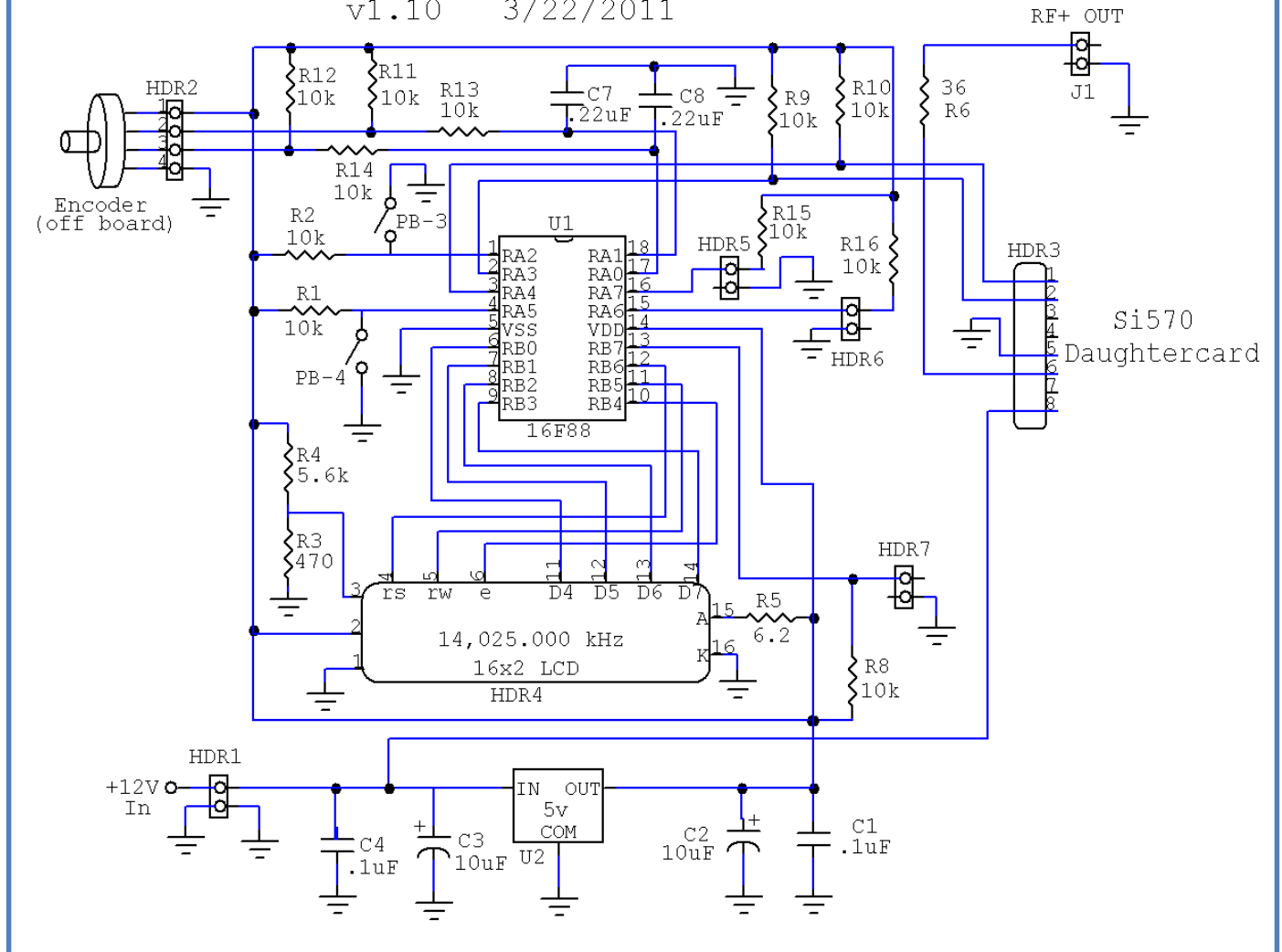
The first line of the LCD displays the current frequency. The second line is for debug purposes and shows the hex digits for the 6 Si570 register parameter (SiReg7 through SiReg12) starting at LCD position 1. The current band number is displayed in positions 15 and 16 of line 2.

As explained in the Menu section regarding the frequency division selection option, the PEgen570 application can be configured to display the current Si570 frequency or it can be configured to display the Si570 frequency divided by two or four. The divide-by-four option is useful when the signal generator is being used as a signal source for a QSD/QSE (“Tayloe”) mixer. The circuitry for these mixers usually divides the input frequency by four so this software option allows the LCD to display the mixer’s operating frequency.

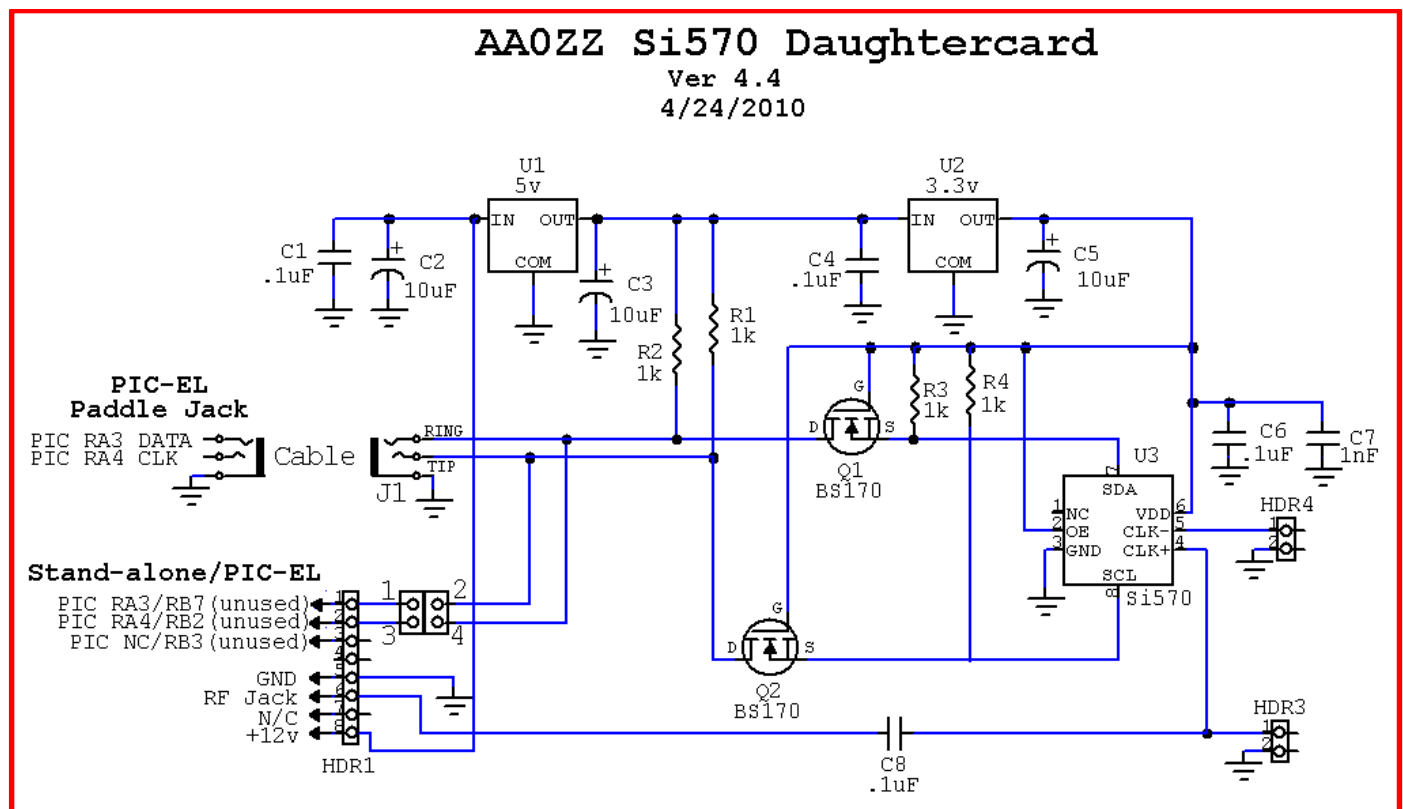
# Appendix A – Control Board Schematic

## AA0ZZ Si570 Control Board

v1.10 3/22/2011



# Appendix B – Daughtercard Schematic



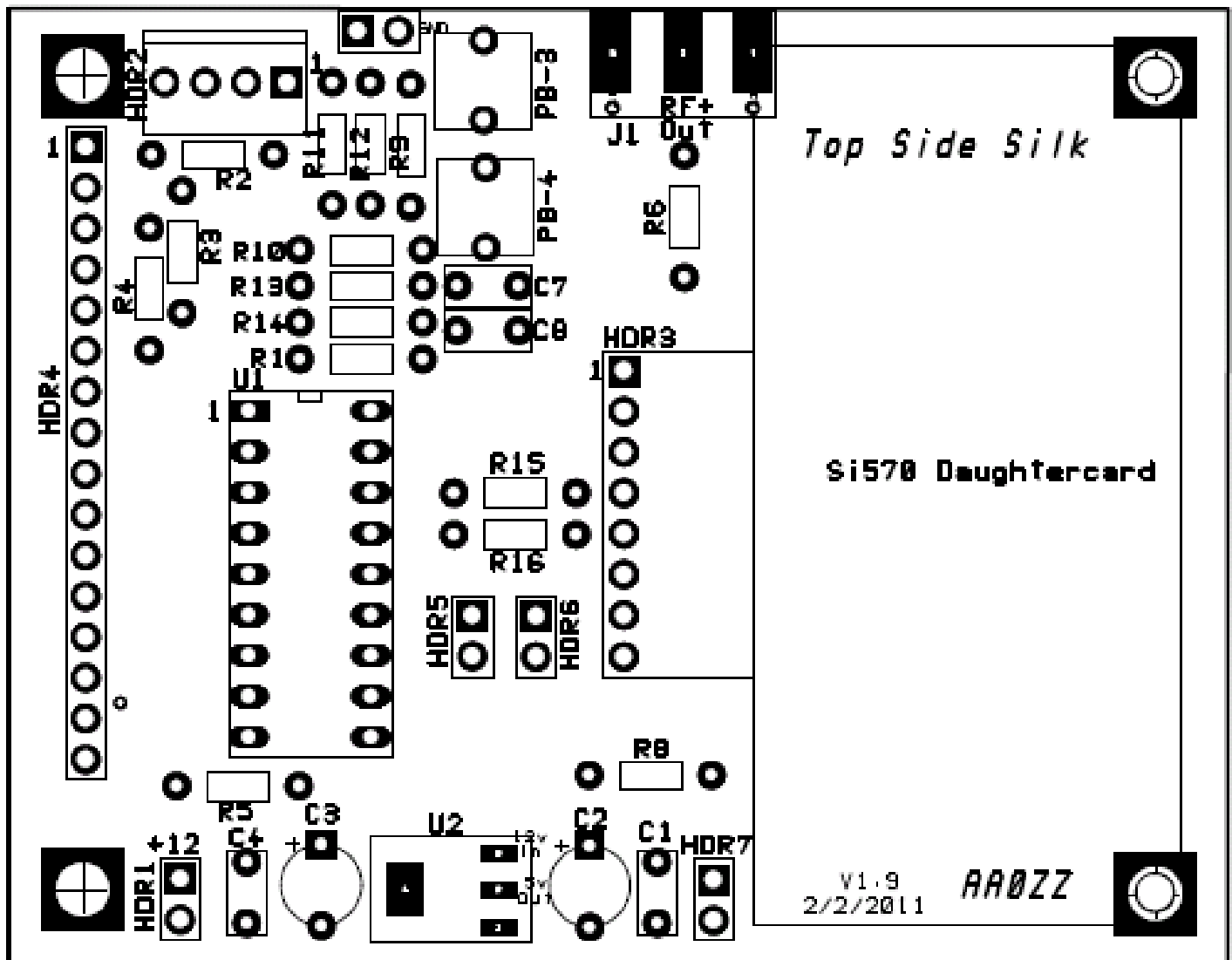


## Appendix C – Control Board Parts List

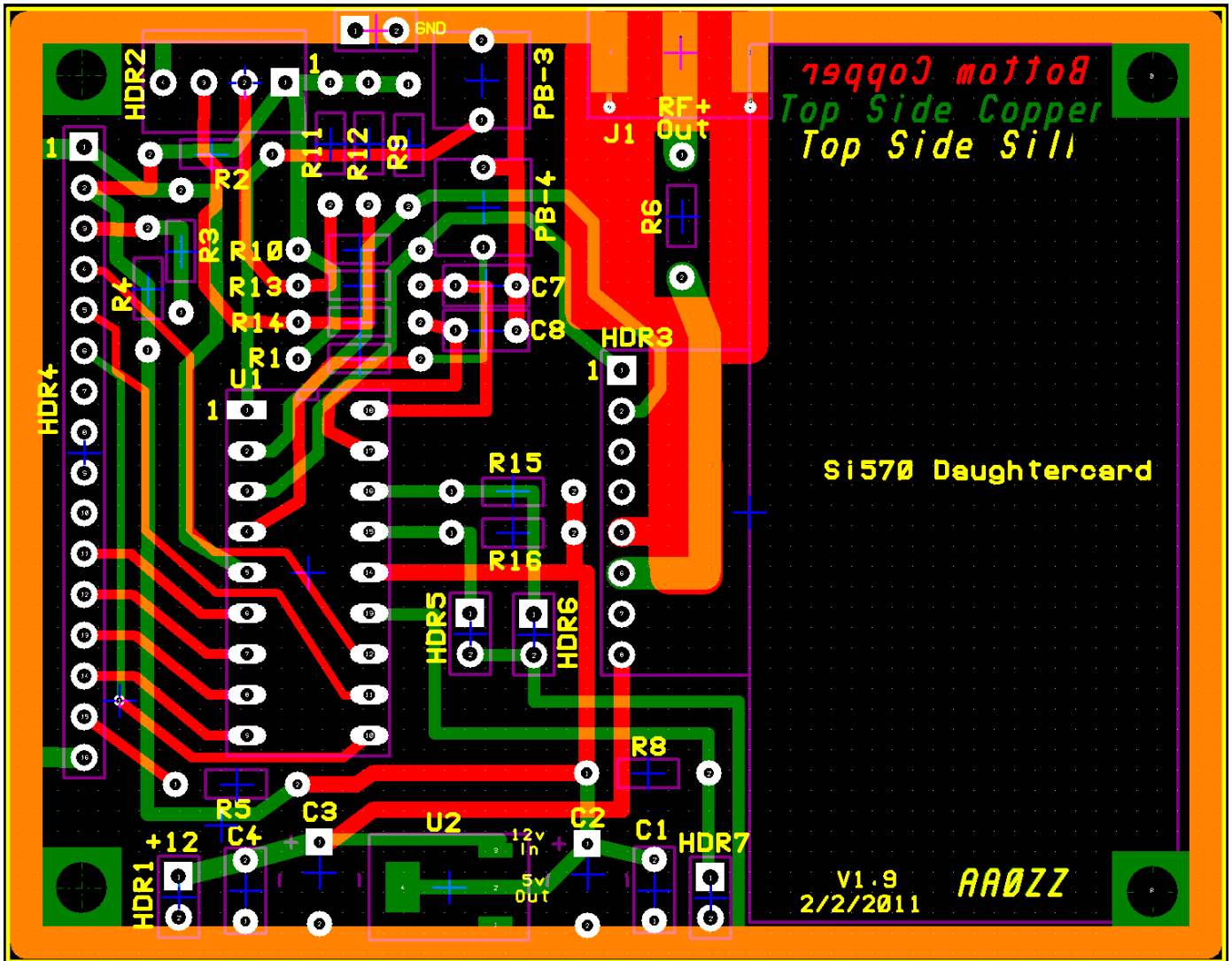
Si570 Control Board Parts					Ver 1.3	2/7/2011
Quantity	Designator	Description	Part number	Single Price	Total Price	
1	HDR3	8-pin RA Socket	(Samtec) SSQ-108-04-G-S-RA	\$0.77	\$0.77	
1	HDR4	SIP socket, 16-pos'n. .1" (on PCB for LCD)	(D) ED7150-ND (M) 517-974-01-16	\$1.69	\$1.69	
1	(on LCD)	SIP header, 16-pos'n .1"	(M) 571-16404526	\$1.10	\$1.10	
1	for U1	DIP socket, 18-position .1" (for PIC)	(D) ED3118-ND	\$1.01	\$1.01	
1	HDR-2	Locking Header (.1" spacing) (4-pins)	(D) WM4202-ND	\$0.42	\$0.42	
1	For HDR-2	Locking Socket (.100" spacing) (4-pins)	(D) WM2002-ND	\$0.29	\$0.29	
4	For HDR-2	Pins for locking sockets	(D) WM1114-ND	\$0.12	\$0.48	
4	HDR1, HDR5-HDR7	pin header, 0.1", 1x2 pos'n	(M) 571-1032392	\$0.20	\$0.80	
2	C1, C4	0.1 uF, monolithic, ("104") – usually yellow	(D) 478-4855-ND	\$0.19	\$0.38	
2	C7, C8	.22 uF, monolithic ("224")	(D) 445-2849-ND	\$0.21	\$0.21	
2	C2,C3	10 uF tantalum cap	(D) 399-3638-ND	\$0.79	\$1.58	
1	R5	6.2 ohm resistor 1/4w	(D) 6.2QBK-ND	\$0.06	\$0.06	
1	R6	36 ohm resistor 1/4w 5%	(D) 36QBK-ND	\$0.06	\$0.06	
1	R3	470 ohm resistor 1/4w 5%	(D) 470QBK-ND	\$0.06	\$0.06	
1	R4	5.6k ohm resistor 1/4w 5%	(D) 10KQBK-ND	\$0.06	\$0.06	
11	R1,R2, R8-R16	10K resistor 1/4w 5%	(D) 10KQBK-ND	\$0.06	\$0.70	
1	U2	REG LDO 1A 5.0V SOT223-3	(D) ZLDO1117G50DICT-ND	\$0.62	\$0.62	
1	LCD	Liquid Crystal Display with B/L, 2x16 char	08LCD9 from ElectronixExpress.com	\$8.95	\$8.95	
2	PB-3, PB-4	SPST pushbutton, momentary	(D) P8079SCT-ND	\$0.38	\$0.76	
1	J1	SMA connector, edge mount	(D) J502-ND	\$5.10	\$5.10	
1	ENC1	Mechanical Encoder(Quadrature)	Kanga	\$9.00	\$9.00	
1	For ENC1	Three 6" Wires	Kanga	\$0.25	\$0.25	
1		PCB	AA0ZZ supplied	\$8.00	\$8.00	
					=====	
					\$42.36	

\*\*\*\* NOTE Programmed PIC supplied with Daughtercard

# Appendix D – Si570 Control Board Parts Placement



# Appendix E – Si570 Control Board PCB



Board dimensions: 2.5" by 3"