



the
Workbench
Podcast

Antenna Analyzer Assembly Guide

Rev 1.1

Introduction

The Workbench antenna analyzer project was designed by Beric Dunn, K6BEZ. This assembly guide explains how to build the antenna analyzer. The theory of operation is documented elsewhere. For all the latest documents go to www.360workbench.com

General Assembly Instructions

We recommend assembling the antenna analyzer in the following order.

Install all low profile components first.

- ☐ Install all resistors

If you have a **version 6** board read the page "**Alert ! Rev 6 Board Changes**" page in this document to see the four silkscreen changes to the board.

If you have a **version 7** or later board, install the resistors as marked on the board.

- ☐ Install all capacitors
- ☐ Install the two glass germanium diodes
- ☐ Install the 8 pin IC socket
- ☐ Install the 3 tactile switches

Install connectors

- ☐ Install the two 10 pin female header sockets for the DDS module
- ☐ Install the one 16 pin male header connector for the LCD display
- ☐ Install the two 12 pin male header connectors for the Arduino module
- ☐ Install the DC coaxial power jack
- ☐ Install the BNC coax jack

Install the voltage regulator

- ☐ Install the voltage regulator module.

At this point, check to make sure the DC voltages are correct. See the DC Test Point page.

Install standoffs

- ☐ Install the 4 ¼" hex standoffs to the LCD module using 4 of the ½" 4-40 screws
- ☐ Install the 4 ¼" hex standoffs to the main PCB in the corners using 4-40 screws

Mount the LCD

- ☐ Place the ½" screws that are part of the LCD module through the holes on the PCB and attach with 4-40 nuts on the bottom of the board

Install Arduino

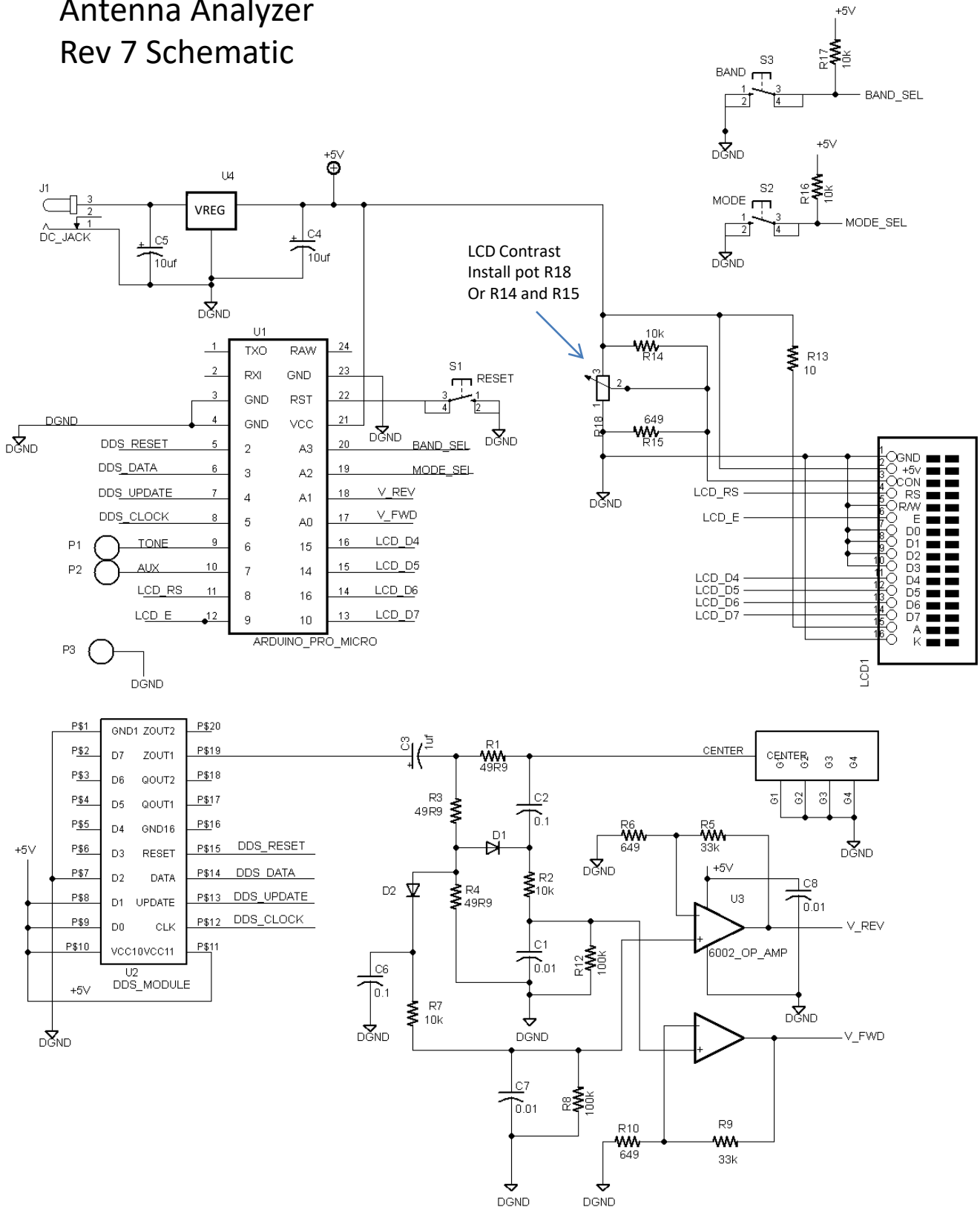
- ☐ Place the Arduino module on the male headers and solder. Make sure the micro USB jack is pointing to the edge of the board.

Install the DDS module

- ☐ Plug the DDS module on to the main PCB.

Antenna Analyzer

Rev 7 Schematic



Bill of Materials

Type	Part	Description	Value	Digikey Part #
Connector	CON1	Right angle BNC connector		A97569-ND
Connector	J1	DC power jack 2.1mm		CP-102AH-ND
Capacitor	C1	0.1" spaced dipped mono 10%	0.01	399-4260-ND
Capacitor	C2	0.1" spaced dipped mono 10%	0.1	BC1084CT-ND
Capacitor	C3	Electrolytic capacitor 25v	1uf	493-10461-1-ND
Capacitor	C4	Electrolytic capacitor 25v	10uf	P980-ND
Capacitor	C5	Electrolytic capacitor 25v	10uf	P980-ND
Capacitor	C6	0.1" spaced dipped mono 10%	0.1	BC1084CT-ND
Capacitor	C7	0.1" spaced dipped mono 10%	0.01	399-4260-ND
Capacitor	C8	0.1" spaced dipped mono 10%	0.01	399-4260-ND
Resistor	R1	1/4 Watt 5%	49.9	49.9XBK-ND
Resistor	R2	1/4 Watt 5%	10k	10KQBK-ND
Resistor	R3	1/4 Watt 5%	49.9	49.9XBK-ND
Resistor	R4	1/4 Watt 5%	49.9	49.9XBK-ND
Resistor	R5	1/4 Watt 5%	649	649XBK-ND
Resistor	R6	1/4 Watt 5%	33k	33KQBK-ND
Resistor	R7	1/4 Watt 5%	10k	10KQBK-ND
Resistor	R8	1/4 Watt 5%	100k	100KQBK-ND
Resistor	R9	1/4 Watt 5%	649	649XBK-ND
Resistor	R10	1/4 Watt 5%	33k	33KQBK-ND
Resistor	R12	1/4 Watt 5%	100k	100KQBK-ND
Resistor	R13	1/4 Watt 5%	10	10QBK-ND
Resistor	R14	1/4 Watt 5%	10k	10KQBK-ND
Resistor	R15	1/4 Watt 5%	649	649XBK-ND
Resistor	R16	1/4 Watt 5%	10k	10KQBK-ND
Resistor	R17	1/4 Watt 5%	10k	10KQBK-ND
Switch	S1	Tactile pushbutton switch		450-1650-ND
Switch	S2	Tactile pushbutton switch		450-1650-ND
Switch	S3	Tactile pushbutton switch		450-1650-ND
Integrated Circuit	U3	MCP 6002 Dual OpAmp		MCP6002-E/P-ND
Integrated Circuit	U4	5v DC / DC converter OKI-78SR-5/1.5-W36H-C		811-2692-ND

Bill of Materials

Mechanical	X1	10 pin female header	S7043-ND
Mechanical	X2	10 pin female header	S7043-ND
Mechanical	X3	16 pin male header 0.1" pitch	S1011EC-16-ND
Mechanical	X4	4-40 Hex standoff 1/4" long, 3/16" diameter	36-1891-ND
Mechanical	X5	4-40 Hex standoff 1/4" long, 3/16" diameter	36-1891-ND
Mechanical	X6	4-40 Hex standoff 1/4" long, 3/16" diameter	36-1891-ND
Mechanical	X7	4-40 Hex standoff 1/4" long, 3/16" diameter	36-1891-ND
Mechanical	X8	4-40 Hex standoff 1/4" long, 3/16" diameter	36-1891-ND
Mechanical	X9	4-40 Hex standoff 1/4" long, 3/16" diameter	36-1891-ND
Mechanical	X10	4-40 Hex standoff 1/4" long, 3/16" diameter	36-1891-ND
Mechanical	X11	4-40 Hex standoff 1/4" long, 3/16" diameter	36-1891-ND
Mechanical	X12	4-40 1/4" pan head philips screw	36-9900-ND
Mechanical	X13	4-40 1/4" pan head philips screw	36-9900-ND
Mechanical	X14	4-40 1/4" pan head philips screw	36-9900-ND
Mechanical	X15	4-40 1/4" pan head philips screw	36-9900-ND
Mechanical	X16	4-40 hex nut	36-4694-ND
Mechanical	X17	4-40 hex nut	36-4694-ND
Mechanical	X18	4-40 hex nut	36-4694-ND
Mechanical	X19	4-40 hex nut	36-4694-ND
Mechanical	X20	4-40 1/2" pan head philips screw	36-9902-ND
Mechanical	X21	4-40 1/2" pan head philips screw	36-9902-ND
Mechanical	X22	4-40 1/2" pan head philips screw	36-9902-ND
Mechanical	X23	4-40 1/2" pan head philips screw	36-9902-ND
Mechanical	X24	8 pin DIP socket	AE9986-ND

Components from Other Internet Sources

Item	Part	Description
Integrated Circuit	U1	Arduino Pro Micro
Integrated Circuit	U2	AD9850 DDS Module
LCD	LCD1	2x16 LCD Display

Components from PackTenna

Item	Part	Description
Antenna Analyzer Parts Kit includes...		
	PCB	Printed circuit board
	D1	AA143 Germanium diode
	D2	AA143 Germanium diode

Arduino Pro Micro 5v Example

<http://www.dx.com/p/pro-micro-atmega-32u4-5v-16mhz-development-board-module-for-arduino-deep-blue-320958#.WAtHJOArIdU>

DDS Module example on Ebay

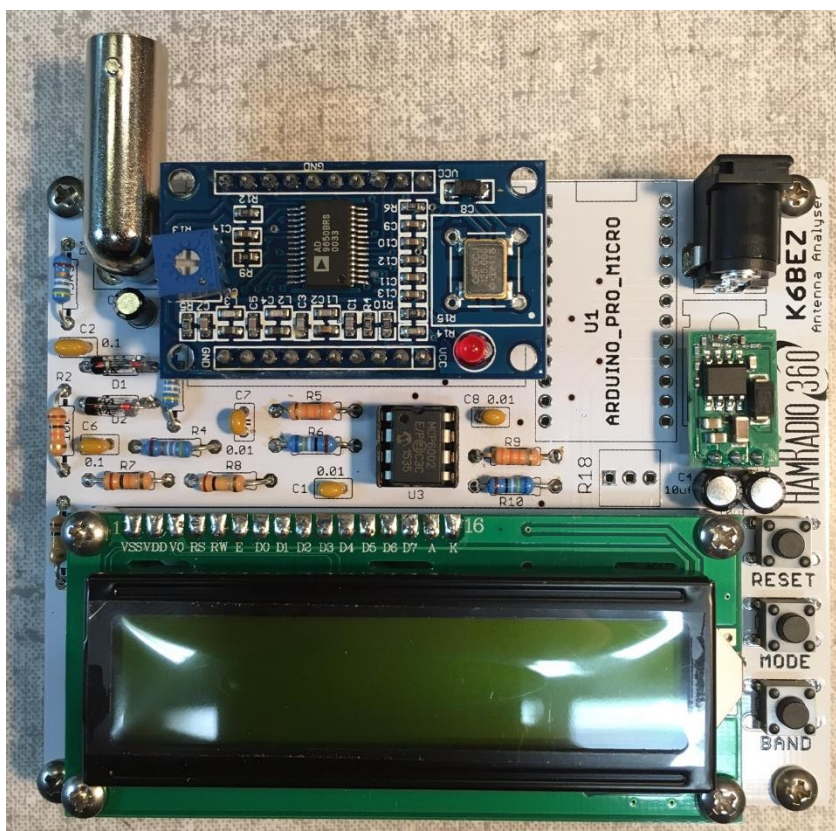
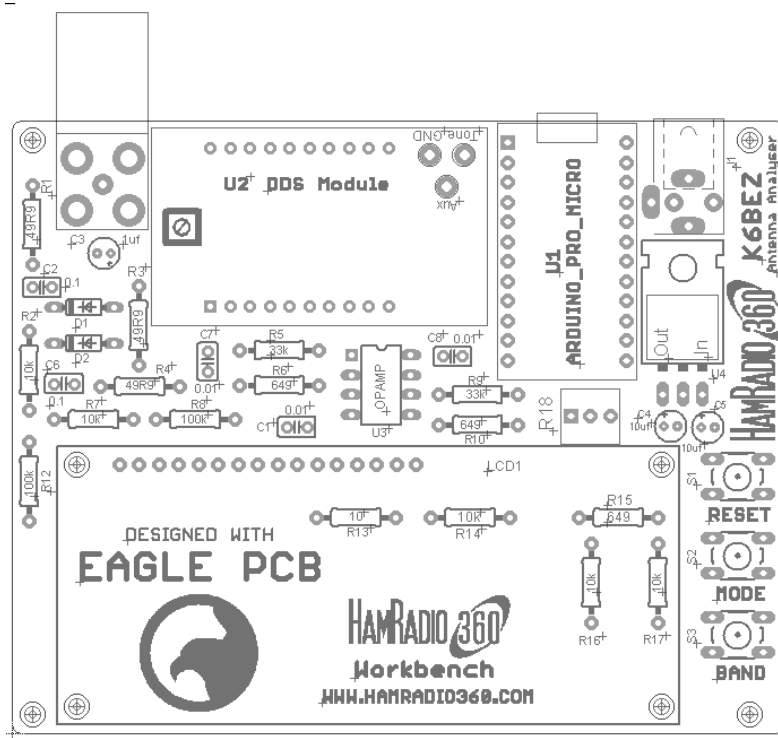
<http://www.ebay.com/itm/AD9850-DDS-Signal-Generator-Module-0-40MHz-2-Sine-Wave-And-2-Square-Wave-Output-/170910337597>

LCD example on Ebay

<http://www.ebay.com/itm/1602-162-16x2-Character-LCD-Display-Module-HD44780-Controller-Yellow-Blacklight-/400436751565?hash=item5d3be3eccd:g:u iMAAOSwZVIXkHXi>

The Workbench – Antenna Analyzer

Parts Placement Diagram



Install all low profile components first.

- ☐ Install all resistors
- ☐ Install all capacitors
- ☐ Install the two glass germanium diodes
- ☐ Install the 8 pin IC socket
- ☐ Install the 3 tactile switches

**If you have a rev 6 board,
look at the builder's alert on
the next page.**

Install connectors

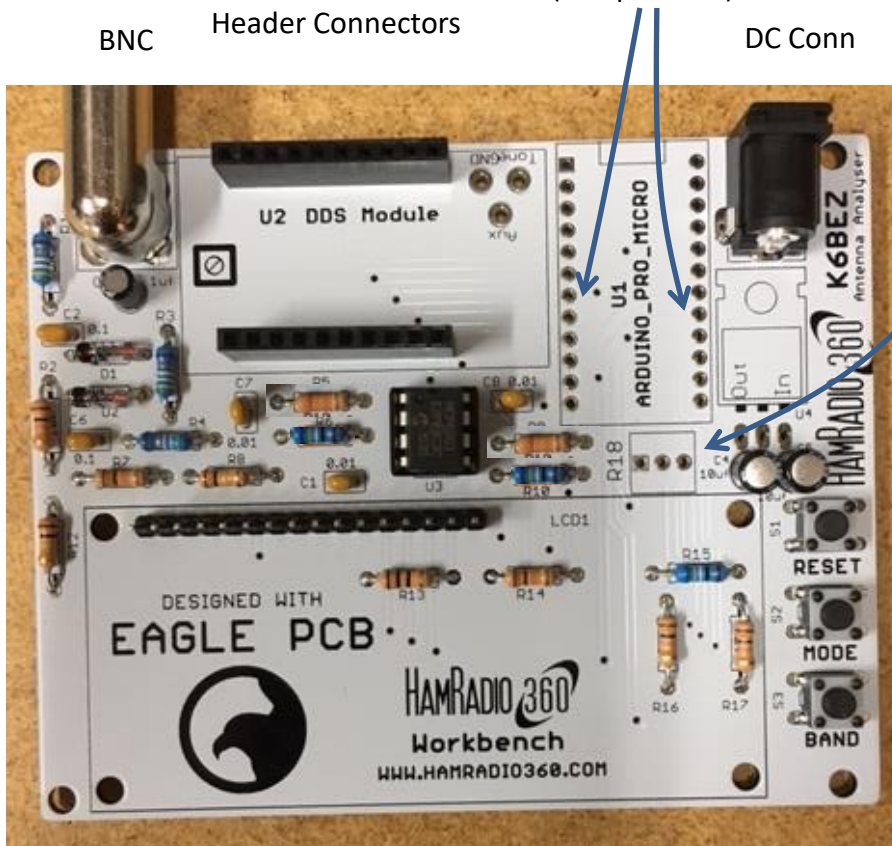
- ☐ Install the two 10 pin female header sockets for the DDS module
- ☐ Install the one 16 pin male header connector for the LCD display
- ☐ Install the two 12 pin male header connectors for the Arduino module
- ☐ Install the DC coaxial power jack
- ☐ Install the BNC coax jack

Install the voltage regulator

- ☐ Install the voltage regulator module.

Install male header pins
for the Arduino module.
(Not pictured)

Resistors
Capacitors
Diodes
IC socket



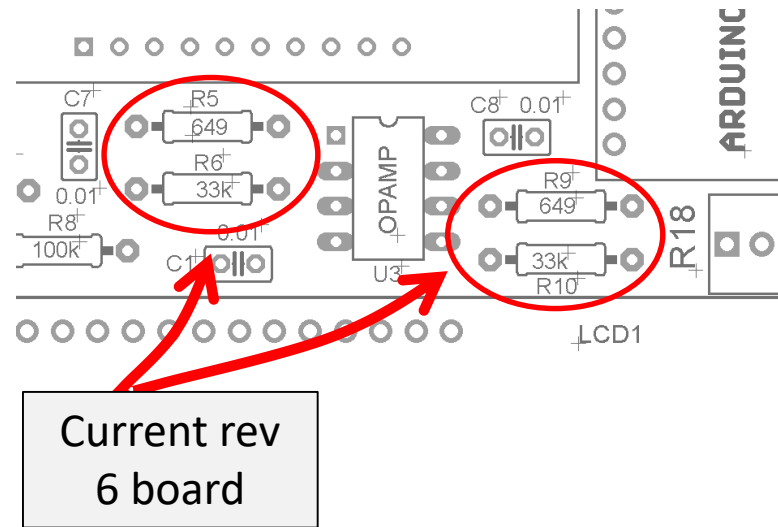
Do not install
contrast pot

Voltage Regulator

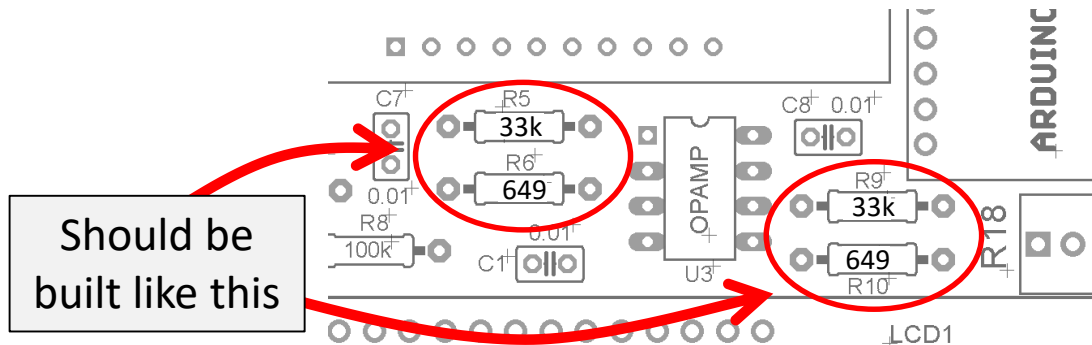
Tactile buttons

Alert ! Rev 6 Board Changes

There is a mistake on the rev 6 board silkscreen. Look on the back of the board for the text like “Rev 6” on the back. If it says “Rev 6” there is a mistake on the text for four of the resistors. The parts list has all the right components, they just need to be put in different places. All boards rev 7 and beyond are labeled correctly on the board.



- ☐ R5 says 649 ohms it should be 33k
 - ☐ R6 says 33k ohms it should be 649
 - ☐ R9 says 649 ohms it should be 33k
 - ☐ R10 says 33k ohms it should be 649
- Swap pairs of resistors. Swap R5 and R6 and then swap R9 and R10.



Voltage Regulator

The antenna analyzer's voltage regulator is a three terminal switching power supply module. We recommend the OKI-78SR-5/1.5-W36H-C made by MuRata. When you look at the solder pads of the component outline, it is similar to a 7805 linear regulator *except* that the pins are backwards.

The board is designed to have the switching regulator module mounted upside down to allow the pins to pass through the main PCB. The big advantage of the switching regulator is that you can run the device as high as 14 VDC and not generate excessive heat.

You can use a good old linear regulator (7805) if you mount it upside down. Be aware that we only advise doing this if you are running on a low input voltage round 7 volts.



Assemble LCD Module



Install a ½" machine screw in each corner of the LCD module. The screw is held in place with a ¼" 4-40 hex standoff.



Mount the LCD module to the main PCB. Secure the module in place with a 4-40 nut.



Make sure the 16 holes of the LCD module line up with the 16 pin male header. Solder each pin to the solder pads.



Arduino Module

The brains of the board is the Arduino processor module. This board is called an Arduino Pro Micro 5v version. This tells you the shape, configuration and voltage of the board.

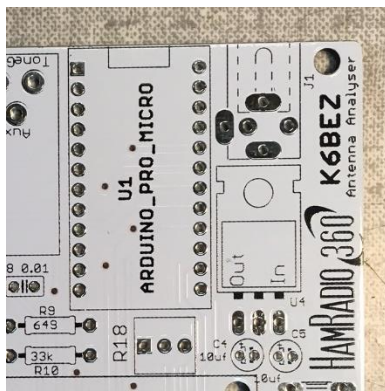
When installing the Arduino module, first solder the two 12 pin male headers that came with the Arduino. Solder them to the top of the board like you would normally do. This means the black plastic part that holds all the pins together is touching the surface of the antenna analyzer board.

After the headers are soldered in place, drop the Arduino module onto the pins.

Make sure the micro USB socket is pointing to the edge of the board.

Now that you have confirmed the board is placed in the right direction, solder the 24 pins of the header on the top of the Arduino board module.

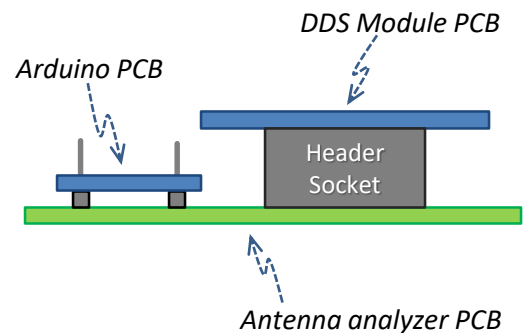
Rear board edge



Rear board edge



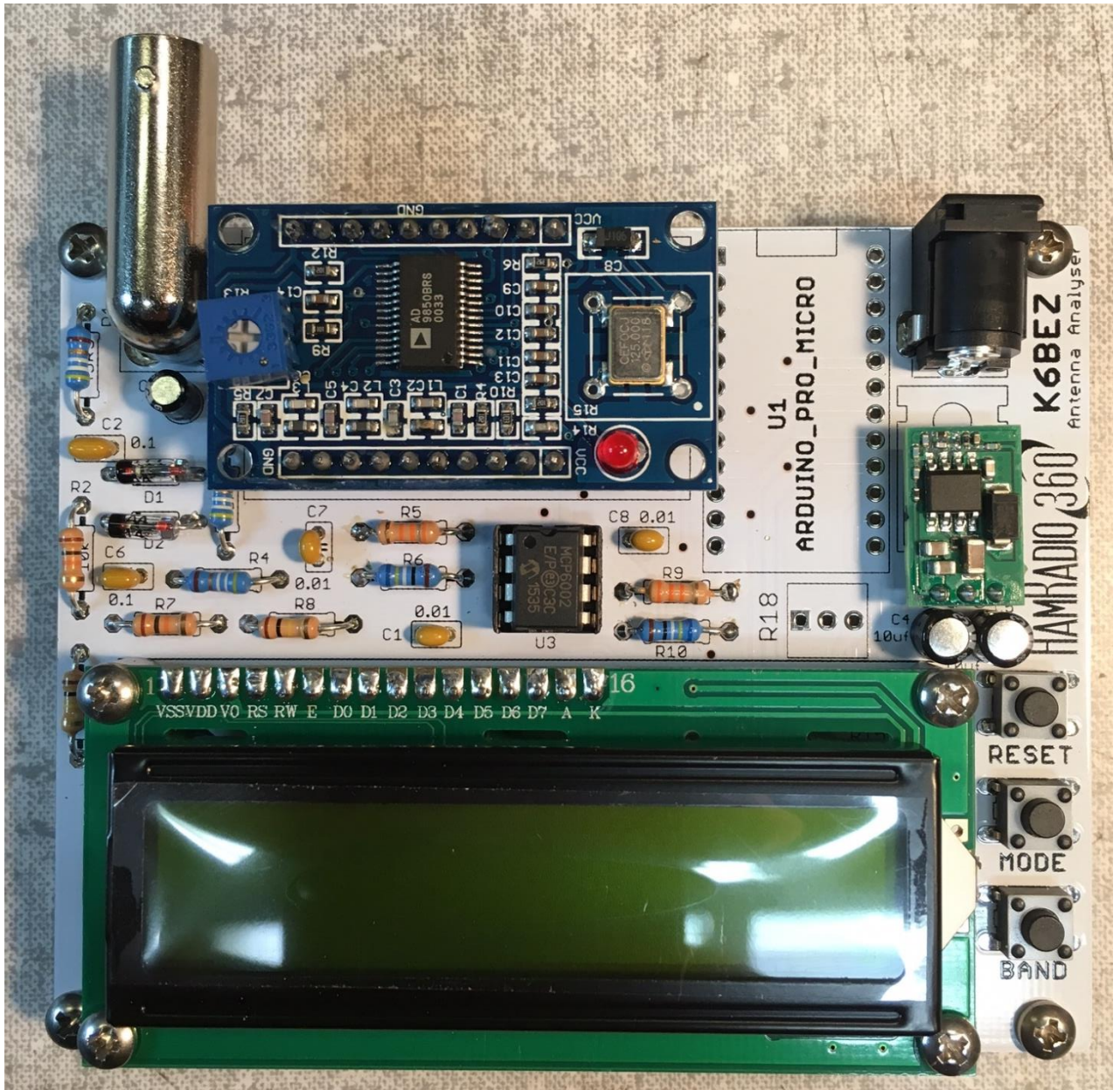
View from the rear



The DDS synthesis module will be significantly higher than the Arduino board.

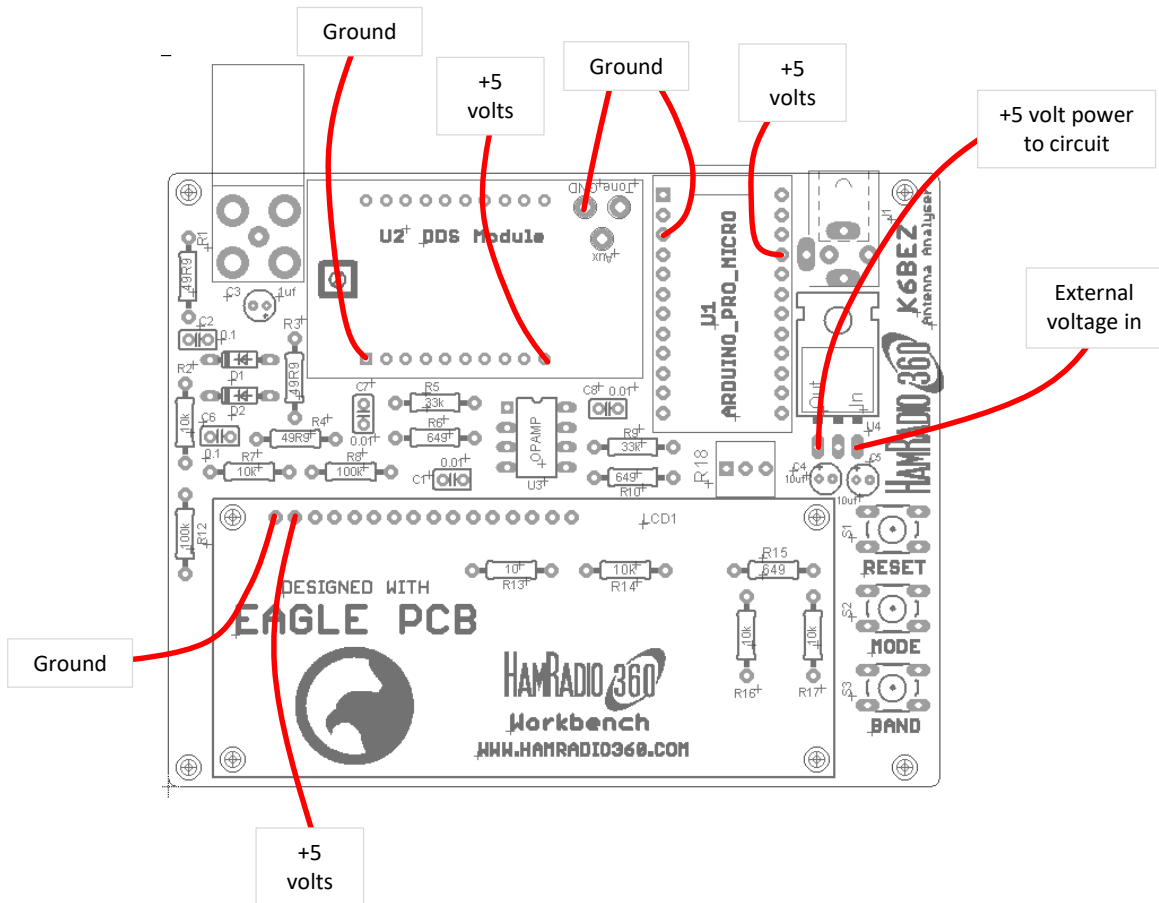
Assembled Unit

Arduino module not shown in this picture.



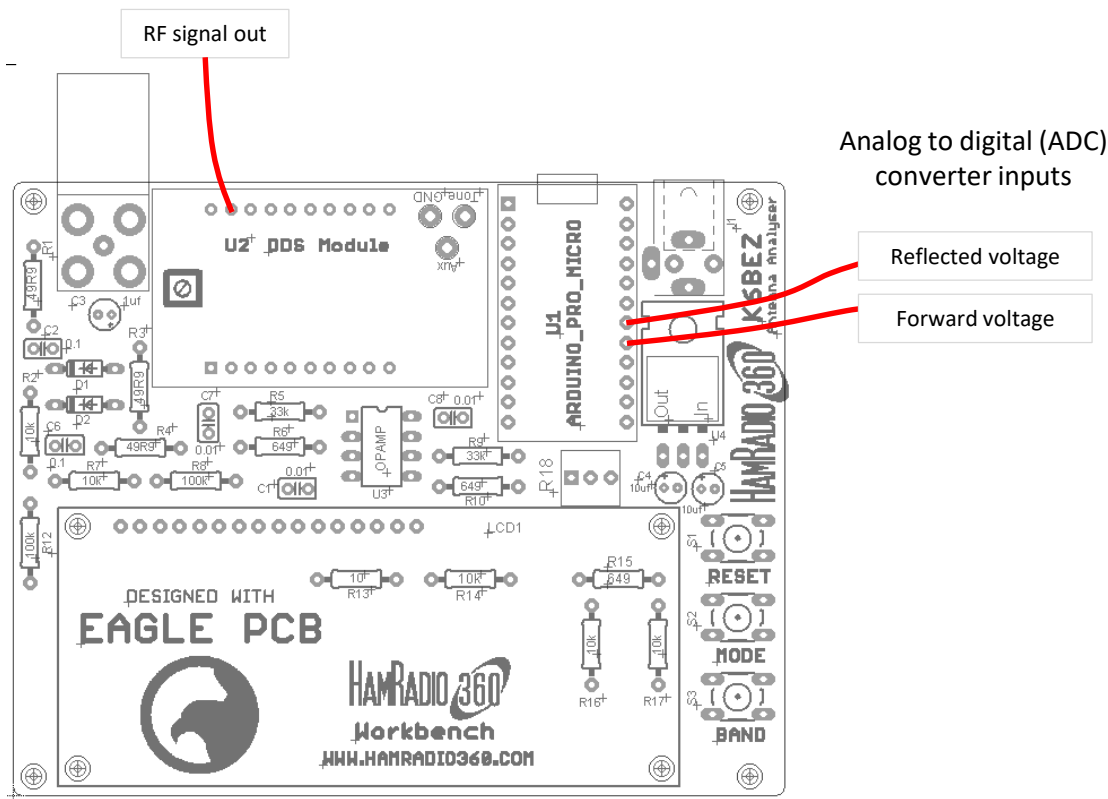
DC Test Points

Before you install the Arduino, DDS module and LCD, you should power up the board to make sure power is properly going to each of the key test points.



RF Test Points

These are the critical signal test points if you want to measure the RF Signal path.



Digital Test Points

These are digital connections from the Arduino to the DDS module and the LCD.

