Introduction

This document will describe how to assemble and checkout a K42 Keyboard/Reader Kit. The assembly of the K42 is not difficult, but probably not a good "first kit". Before you start working on the kit you will need to gather the following items

1) A low wattage (40W) soldering iron or pencil or temperature controller solder station.
2) Good grade of Rosin core solder, Please do not use ACID CORE Solder !!
3) A few pieces of hook up wire
4) Good pair of wire cutters, small pliers, assorted screwdrivers, and a 5/64" Allen wrench
5) A Volt Ohmmeter or DVM is required for several assembly steps
6) A magnifying glass is very helpful
7) Power supply providing a voltage between 8 to 13 VDC (9VDC is optimum) at about 250 ma.
8) Audio signal generator or radio receiver with a calibrate function.

It is very important to take your time and to carefully follow the instructions and assembly photos. These instructions will take you through a step by step process that will test portions as you go. This will make debugging much easier since if a problem arises you will be able to locate the source and repair it right away. Please don't assemble the kit in a manner other than as described, the order of the steps is very important from a mechanical perspective and if you don't follow them you can end up with a kit that can't be completed.

These instructions assume you have basic electronic kit building experience and can identify different types of electronic components. Photos are provided which will greatly aid in assembling the kit correctly. Additional info is provided in RED. The biggest enemy of kit success is poor soldering, so please take care with each solder joint, and use just enough heat to get a good connection. A good joint should be both shiny and smooth.

Bill of Materials

The bill of materials is listed below. The first step is to inventory and identify all parts ahead of time. This will allow the assembly to proceed smoothly. The parts are packed in separate compartments; try not to mix the resistors in different compartments together, the precision resistors are packed by themselves. You might want to verify resistor values with an ohmmeter if you are color impaired like I am. We try to do a good job putting the kits together but sometimes we make mistakes, let us know if you are missing any parts.

Reference Des.	Qty	Part Description	Package	Other Info	Check Off
C1,C2,C3,C4 C16,C17	6	.001uF Capacitor	Ceramic Disk	.2″ spacing	_____
C11	1	.01uF,Capacitor	Ceramic Disk	.2″ spacing	_____
C2A,C10,C12,C18 C19,C20,C21,C22	8	.1uF,Capacitor	Ceramic	.2″ spacing	_____
C6	1	.1uF,Capacitor	Dipped Mylar	.2″ spacing	_____
C7,C8,C14,C15	4	.012uF Mylar Capacitor	Yellow Box	.2″ spacing	_____
C5	1	4.7uF Electrolytic Cap	Radial	.1″ Spacing	_____
C9,C13	2	33uF Electrolytic Cap	Radial	.1″ Spacing	_____
R1	1	10K Ohm Trimmer	Potentiometer		_____
R16	1	68 Ohm Resistor	1/4 Watt	Blu Gray Blk	_____
R10,R11,R23,R24,R25	5	470 Ohm Resistor	1/8 Watt	Yel Violet Brn	_____
R2,R3,R4,R6,R15, R19,R20,R21,R22	9	4.7K Ohm Resistor	1/8 Watt	Yel Violet Red	_____
R5,R12	2	10K Ohm Resistor	1/8 Watt	Brn Blk Org	_____
R9	1	4.64K Ohm 1% Resistor	1/8 Watt	Blue Axial	_____
R17	1	9.76K Ohm 1% Resistor	1/8 Watt	Blue Axial	_____
R8,R13	2	33.2K Ohm 1% Resistor	1/8 Watt	Blue Axial	_____
R7,R18	2	66.5K Ohm 1% Resistor	1/8 Watt	Blue Axial	_____

U1	1	Solid State Relay	8 pin DIP	AQW210EH	_____
U2	1	16F688 Keyer PIC	14 pin DIP	red dot, skt'd	_____
U3	1	CY8C27143 PSoC	8 pin DIP	silver, skt'd	_____
U4	1	LMC6482 Dual Op Amp or TS922	8 pin DIP	no socket	_____
U5	1	16F688 Console PIC	14 pin DIP	µP, socket	_____
U6	1	24LC32A Serial EEPROM	8 pin DIP	no socket	_____
U7		12F508 LED Driver PIC	8 pin DIP	µP, no socket	_____
L1,L2	2	1uH,Inductor	Ferrite Bead		_____
Q1	1	2N2222 Transistor	TO-9		_____
D1,D2,D3,D4,D5,D6	6	CWR Tuning LED	Right Angle	Red or Green	_____
D7	1	1N4001 Diode	DO-41		_____
VR1	1	LM7805 5 Volt Regulator	TO220		_____
DP1	1	Lumex LCMS01602DTR/M	LCD Display	PCB Module	_____
SP1	1	Mini Speaker			_____
J1,J3,J4	3	Stereo Phone Jack	1/8 Inch Jack	AF, Key, Pdl	_____
J2	1	Keyboard Connector	PS2 6 Pin DIN		_____
J5	1	Power Connector	2.5 mm female receptacle		_____
P1	1	Power Connector	2.5 mm male plug		_____
ENC1	1	Rotary Encoder	Panel Mount		_____
MISC	1	K42 Enclosure			_____
MISC	1	Control Knob	Plastic 1/4" shaft		_____
MISC	4	Rubber Feet	Press on		_____
MISC	1	14 pin Header	Right Angle	Tin solder	_____
MISC	2	3/16" plastic spacers	LCD Mounting		_____
MISC	2	4-40 Hex Nuts	" " " "		_____
MISC	4	4-40 Star Washers	" " " "		_____
MISC	4	Rubber Feet			_____
MISC	4	4-40 1/4" Screws	Black for enclosure cover		_____
MISC	4	4-40 1/4" Screws	Silver for PCB mounting		_____
MISC	1	Hex Nut for Rotary Encoder			_____
MISC	1	Flat Washer for Rotary Encoder			_____
MISC	2	14 pin DIP socket for U2 and U5 (Keyer & Console PICs)			_____
MISC	2	8 pin DIP socket for U3 (PSoC) and U1 (Opto SSR)			_____
MISC	2	1/8" Plugs for AF input and key output			_____
MISC	1	10" length of hook up wire			_____
R14	1	Not included, not used in this version			

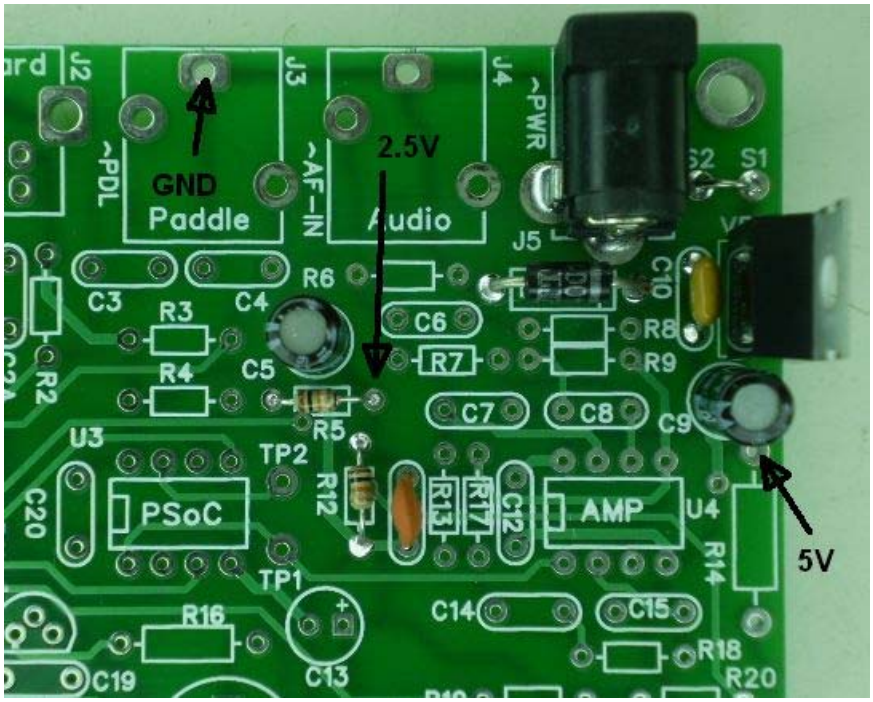
Step By Step Assembly Instructions

1) After inventory, carefully inspect the PCB for defects such as solder shorts or breaks due to over etching. We buy high quality boards and rarely have any problems but it's easier to find one now before we solder anything to the board. Use the PCB layer pictures on pages 24 and 25 as a reference. There is also a *Placement by Part Value* picture on Page 26 which is very helpful.
2) We will start with the power supply, install and solder:

___ Power Connector J5
___ Voltage Regulator VR1 LM7805 TO-220
___ Resistors R5 and R12 (10K) Brown Black Orange

Capacitors:
___ C5 (4.7uF electrolytic) may be black or grey in color
___ C9 (33uF electrolytic)
___ C11 (.01uF) 103 Disc
___ C10 (.1uF) 104 Orange
___ D7 (1N4001)
___ Solder and trim leads

The long lead of the electrolytic caps (C5 and C9) is positive and must go into the square pad (reference the the picture of C13 in the picture below). If you are not going to use an on/off switch (optional) solder a jumper between pads S1 and S2. You can always remove the jumper and add a switch later. Observe the band on D7 and line it up to match the silkscreen.



3) Once these parts are soldered in place, trim the component leads and then make up a power supply connector plug to test the board. A mate to J5 (P1) is included in the kit. Solder two wires to the connector the plus lead will go to the center pin. Wire for this cable is not provided in the kit.

Connect the other two ends of this cable assembly to a power supply, positive lead to the plus side of the power supply. Don't plug the cable into the K42 yet, instead turn on the supply and use your meter to measure to be sure that the plus side is connected to the center pin of the connector. The K42 does have a polarity protection diode but it's worth the extra step to make sure the cable is right. Now turn off the supply and plug the power connector into J5 on the K42 board. Turn on the supply and with a voltmeter you should see +5V on the R14 pad closest to C9 and then see 2.5V on the right pad of R5, which is also the junction of R5 and R12. The picture on page 3 shows where to place the meter leads for both voltages.
Now Disconnect Power.

4) Next step is to install parts to test the keyer portion of the K42.

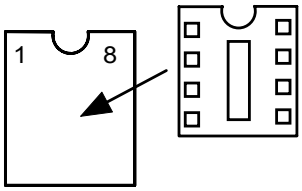
___ Install two 1/8 inch jacks J1 and J3 READ BELOW BEFORE SOLDERING!!

Tack solder the rectangular hole first making sure the connector is aligned correctly. Use the silkscreen guide on the top of the board to center the connector as close as you can. Also insure the front of the connector is flush with the PC board edge. Solder the remaining two holes. It's important to align these connectors correctly so that they will fit properly in the metal enclosure.

After installing both connectors

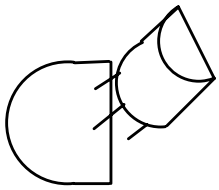
___ Install and solder three IC sockets at sites: U1, U2, and U5.

Be sure to align the dimple in the socket with the silkscreen as illustrated :



Now install and solder the following resistors and transistor:

___ R10 and R11 (470) Yellow Violet Brown
___ R2, R3, R15, R19, R20, R21, R22 (4.7K) Yellow Violet Red
___ R16 (68 ohm) Blue Gray Black
___ Q1 2N2222 transistor (TO92) Align flat side with silkscreen as shown:

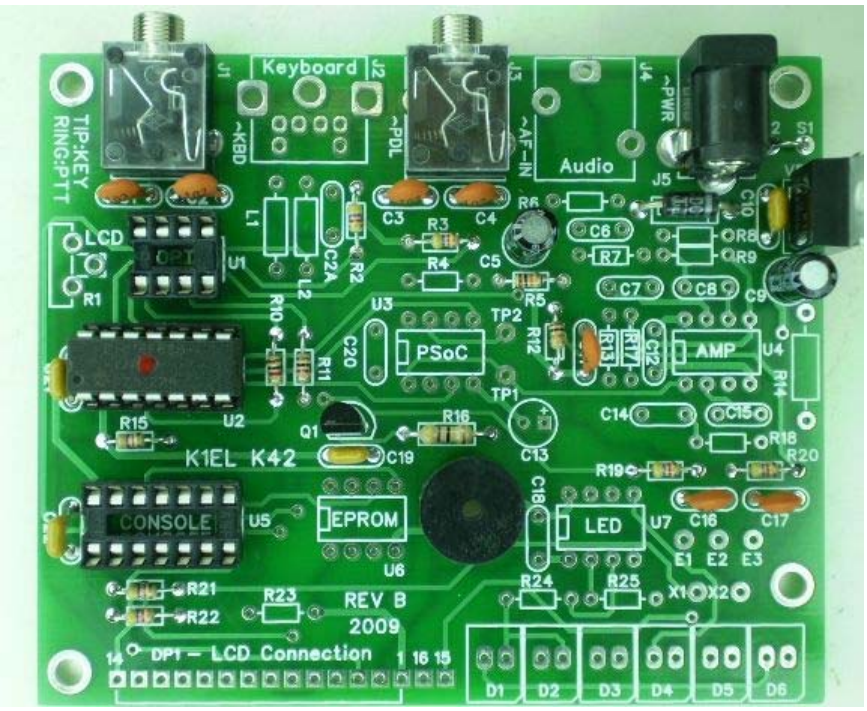


Now install and solder capacitors and trim all component leads:

___ C1, C2, C3, C4, C16, C17 (.001uF) 102 Disc
___ C19, C21, C22 (.1uF) 104 Orange

Install mini speaker SP1, observe polarity marker on the side of the part, and place the plus side pin into one of the square pads. There are four holes, pick the pair with spacing that matches your speaker.

___ SP1



5) We can now test the keyer logic.

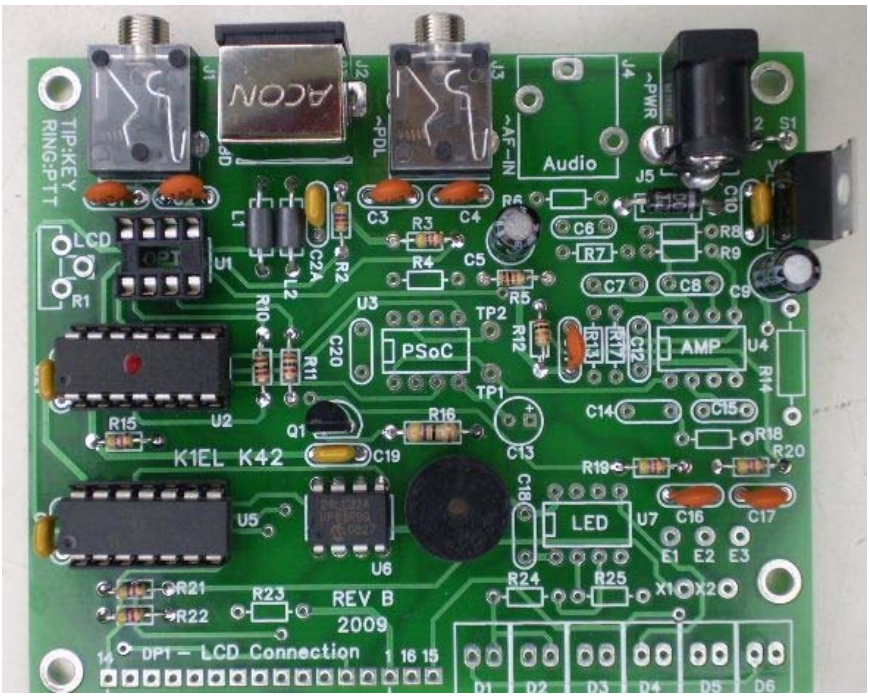
___ Install U2 (the 14 pin DIP IC with the red dot. This is the keyer PIC.

For all IC installs please observe the pin 1 dimple on the IC and orient it to match the silkscreen and socket. Look ahead at the picture above. To get an IC to fit into its socket you will have to bend the leads to a 90 angle by laying the IC on its side on a flat surface and folding the pins in slightly.

Plug your keyer paddle into J3, it's assumed that your paddle set cable has an 1/8" stereo plug. Turn on power and when you press the paddles you should hear dits one way, dahs the other, and alternating dits/dahs when both are pressed. Note: you may need to install the console PIC to get this step to work properly. When the console PIC is not installed, the serial input on the keyer PIC floats and is susceptible to noise. When in doubt, install U5, the console PIC.
REMOVE POWER and disconnect the paddles.

6) Next step is to install and test the Console logic.

___ Install and solder Keyboard connector J2
___ Install the two leaded Ferrite Beads L1 and L2
___ Install Cap C2A (.1 uF) 104 Orange
___ Install Serial EEPROM U6 (no socket), solder and trim component leads
___ Install Console PIC U5 in its socket if you have not already done so.



7) We can now test the keyboard and Console PIC. Plug a PS/2 keyboard into J2. Re-attach power and when power is turned on you will now hear an “R” in sidetone. When you type letters on the keyboard you will hear them sent in sidetone.

___ Turn off power, install solid state relay (AQW210E) in 8 pin DIP socket position U1, then reapply power.

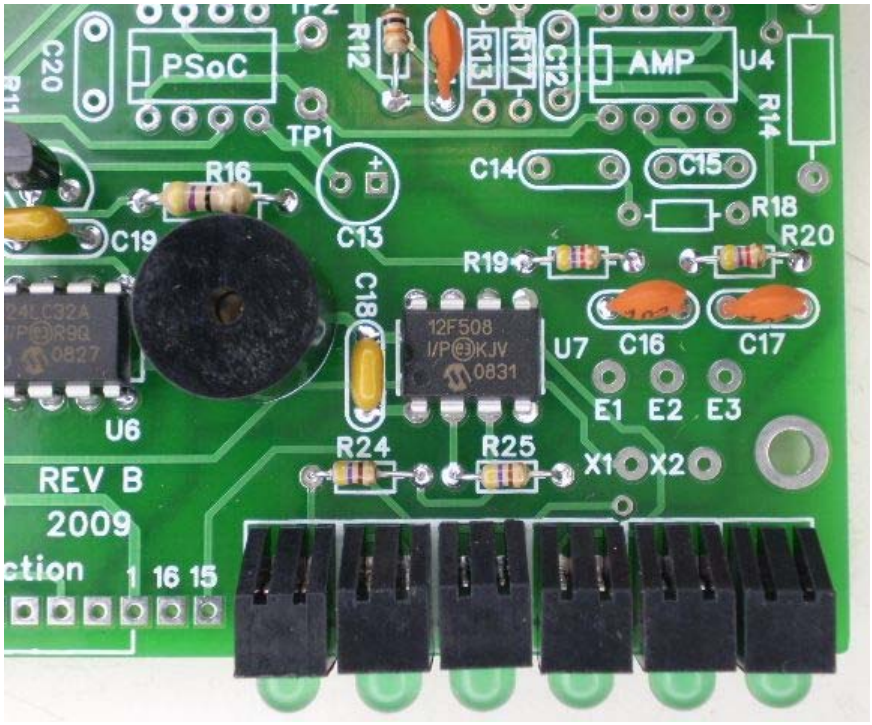
While keying, measure the resistance across the tip and shield of connector J1. An 1/8” mating connector plug is provided for your convenience. At key down you will see a low resistance, at key up you will see an open circuit. Polarity doesn’t matter since U1 acts as a true relay contact. Remove power when done.

8) Now we will install the CWR interface and run a few basic tests. We install the LCD display last to reduce the risk of damage due to mishandling

We’ll start with the CWR LED tuning array:

___ Install Resistors R24 and R25 (470 ohm) Yellow Violet Brown
___ Install Cap C18 (.1uF) 104 Orange
___ Install IC U7 (follow precautions called out in Step 6)
___ Install six LEDs D1-D6 read below for details. Solder and trim component leads

We want to install the LEDs so that they are all even with the front edge of the board and there is equal space between them. The best thing to do is start in the middle and work your way right and left. Put in D3 first, tack solder one lead and tweak the placement to get the front edge aligned right. Then install D4 the same way and space it so that D3 and D4 are not touching and there is about 1/32” gap between them. Go back and forth D3, D4, D5, D2, D6, and D1. It should look at least as good as the picture below when you are done. Please spend extra time with this because you will see the bodies of the LEDs through the front panel and the better they look, the better the whole assembly will look.



9) Check out of the display is pretty easy. Just attach power, turn it on, and the LEDs will run a self test pattern. D1->D2->D3->D4->D5->D6 then in reverse. One LED will remain on when the test is complete.

10) The next step is a big one, we will install the AF active filter of the CWR

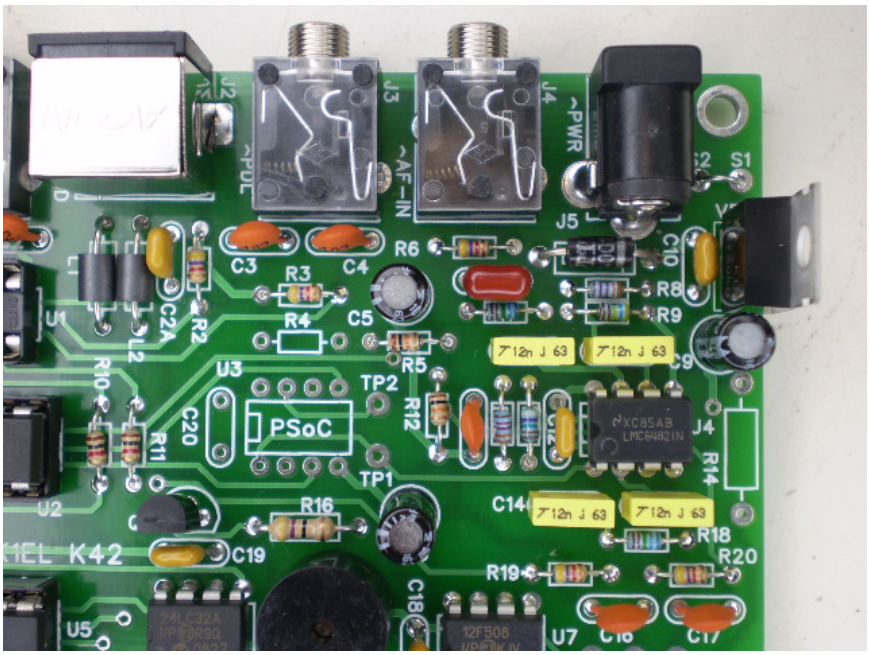
___ Install and solder 1/8 inch connector J4 (observe precautions in Step 4 !!)
___ Install resistor R6 (4.7K) Yellow Violet Red

Note about precision resistor installation. These are the six blue colored resistors. The color code is very hard to read on these, I insist that you use either a DVM or multimeter to sort them out. They are far enough apart in value so it's pretty easy. Note that depending on your meter's calibration and the tolerance of the resistors, you probably will not read the exact value but all we are trying to do is sort them into four bins: 4.64K, 9.76K, 33.2K, and 66.5K

___ Install precision resistor R9 (4.64K)
___ Install precision resistor R17 (9.76K)
___ Install precision resistors R8, R13 (33.2K)
___ Install precision resistors R7,R18 (66.5K)
___ Install capacitor C12 (.1uF) 104 Orange

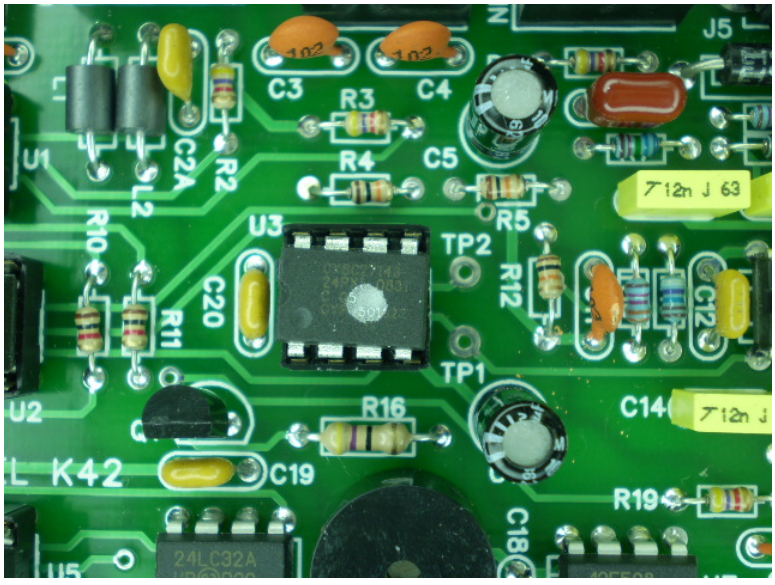
___ Install U4 LMC6482 or TS922 op amp, then solder and trim leads

___ Install C6 (.1uF) 104 Mylar cap (this is a brown cap, see picture)
___ Install Capacitors C7, C8, C14, and C15 (.012 uF) 12n yellow box style
___ Install C13 (33uF electrolytic) the long lead is plus which goes in the square pad
___ Solder carefully (it's easy to bridge pads here) and trim component leads



11) We can't test the AF filter until the PSoC processor is installed, we will do that now

___ Install resistor R4 (4.7K) Yellow Violet Orange
___ Install Cap C20 (.1uF) 104 Orange
___ Solder and trim component leads
___ Install and solder 8 pin socket at U3
___ Install PSoC microprocessor, 8 pin DIP (silver dot) at U3

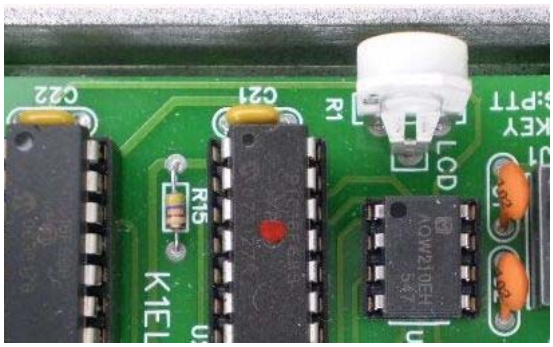


12) Now it's time to check out the CWR tone filters. Connect an audio frequency generator or receiver audio output to the AF input on the K42 board. An 1/8" mating connector plug is provided for your convenience. The level should be around .5V peak to peak, preferably a high impedance output (600Ω). You can use speaker audio output but be careful to start with a low volume setting. If you are using a receiver, turn on calibrate or tune in a carrier signal to get a beat note. If you are using a signal generator set it close to 690 Hz. You will need to attach your keyboard. Power up the K42 and enter ALT-F1 to enable CWR mode. Adjust the receiver or signal generator frequency up and down slowly until you see some activity on the LED display. You may have to adjust the audio level. As you tune you will first see LEDs light on the left side

and then peak to the right as you tune through 690 Hz. The maximum swing should be at 690 Hz. If your audio level is too low you may not see a full LED swing. If the level is too high you may see a very broad tuning peak. If you are having problems, read through the theory of operations and check the signal path through the filter. TP1 and TP2 are useful for this (see schematic) TP1 is the output of the on board active bandpass filter while TP2 is the output of the PSoC's internal active bandpass filter. If you see two very distinct peaks when sweeping the frequency this may indicate that the on board active filter has resistors misplaced. The PSoC filter is hard coded to respond at 690 Hz so you should always see that peak. When the filter is working properly the peak that you measure at TP1 will be very close to the peak you measure at TP2, both at 690Hz.

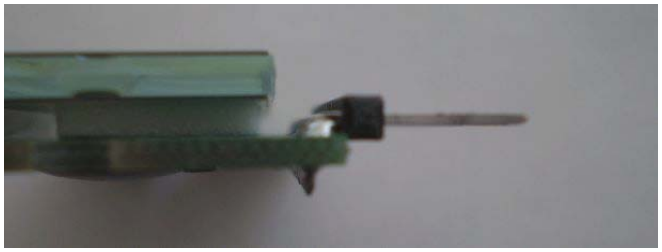
13) Next step is to install the LCD display and associated components:

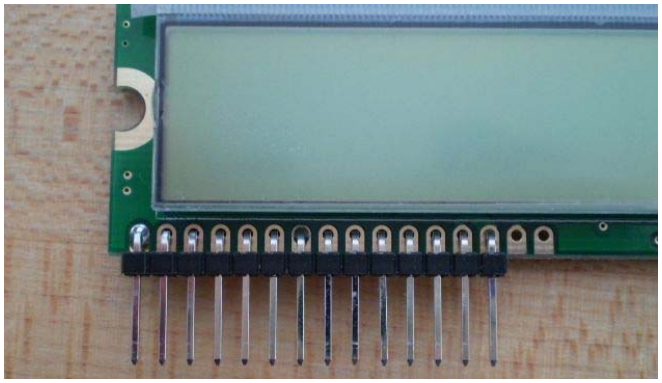
___ Install and solder resistor R23 (470 ohms) Yellow Violet Brown
___ Install and solder trim pot resistor R1 (10K ohms) Brown Black Orange



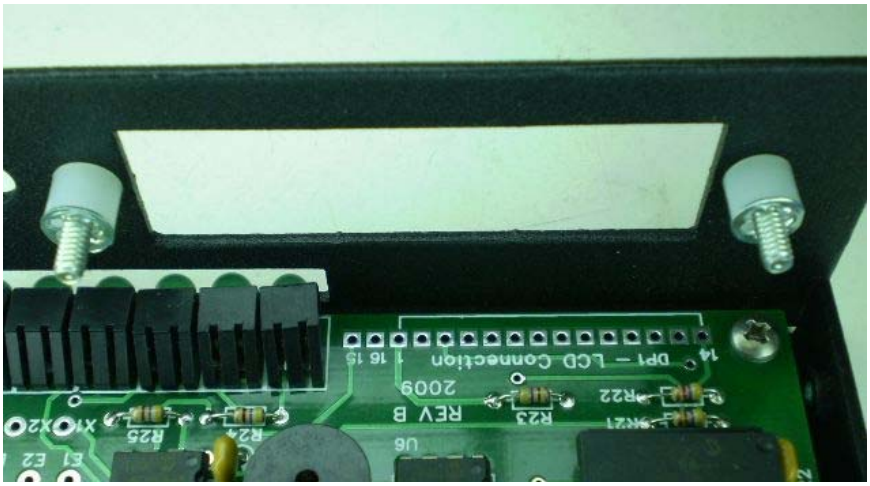
NOTE: the LCD module uses a delicate paper film ribbon cable which can be easily torn or damaged, when picking the display up try to hold it by the sides avoiding contact with the ribbon cable.

These next steps are a little tricky and you have to take your time on this. First of all attach the right angle 14 position header to the LCD module EXACTLY as shown in the following pictures. Try to align it so the connector seats evenly on the display PCB and make sure you put it on the correct side.

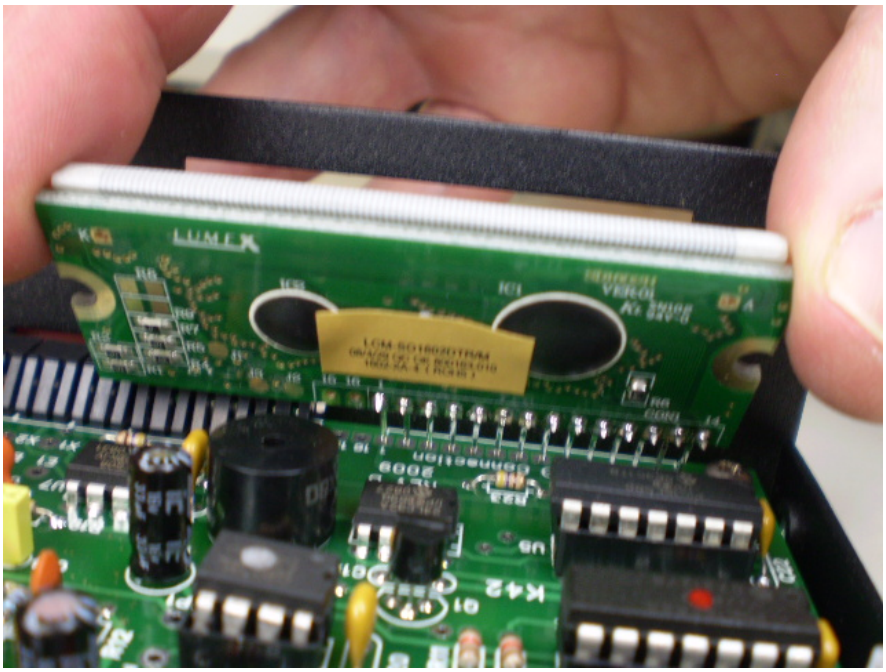




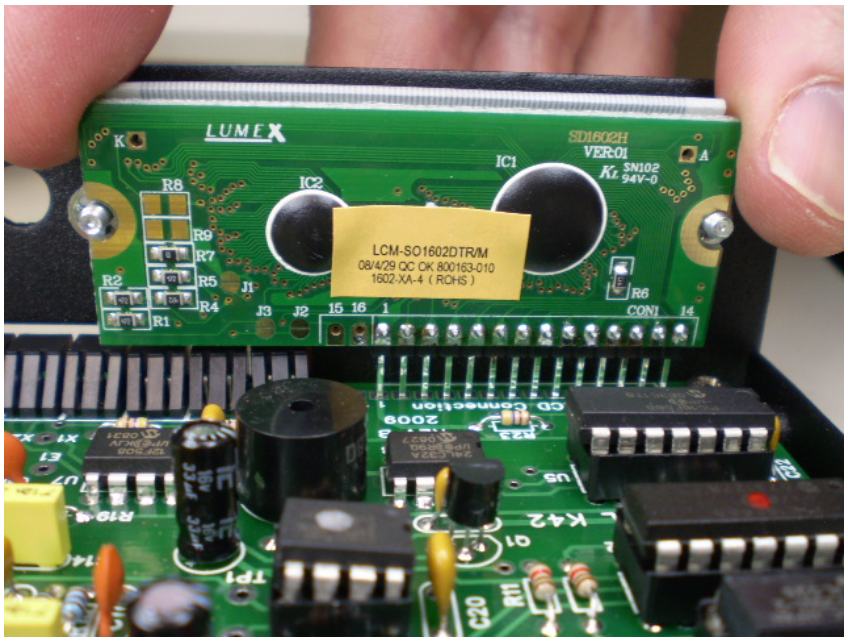
Next mount the K42 PC board into the enclosure with all four screws. Then place a 3/16" white plastic spacer and star washer on each of the threaded studs on the front panel.



Now carefully install the display so that the header pins fit into the K42 board and the LCD mounting ears fit in place on the threaded studs. This will take a little coaxing to get into place. Please remember to handle the display on its sides so as not to damage the display's wire film ribbon cable (looks like paper).

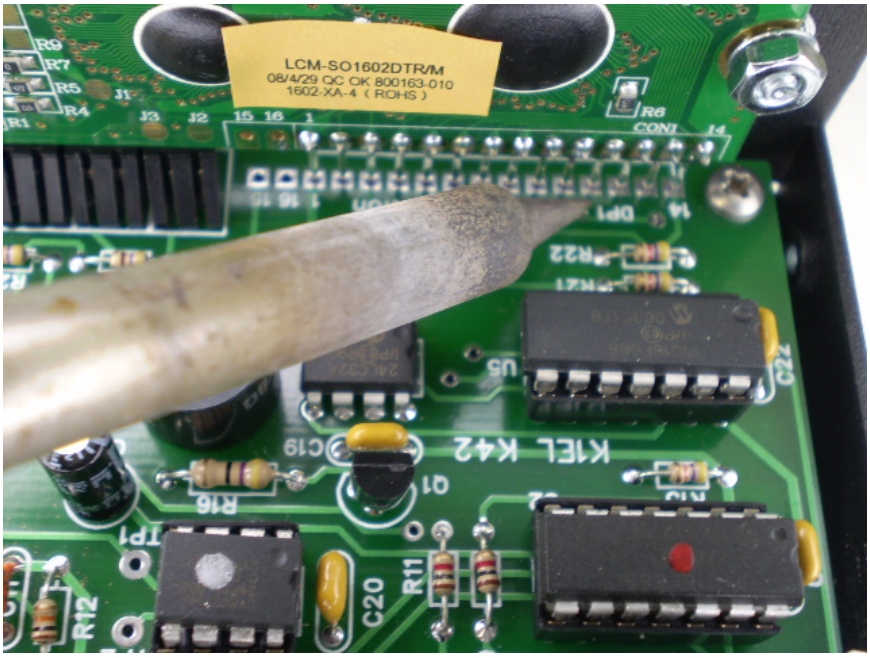


Start the pins in their holes first



Then fold the display up into place on the threaded studs

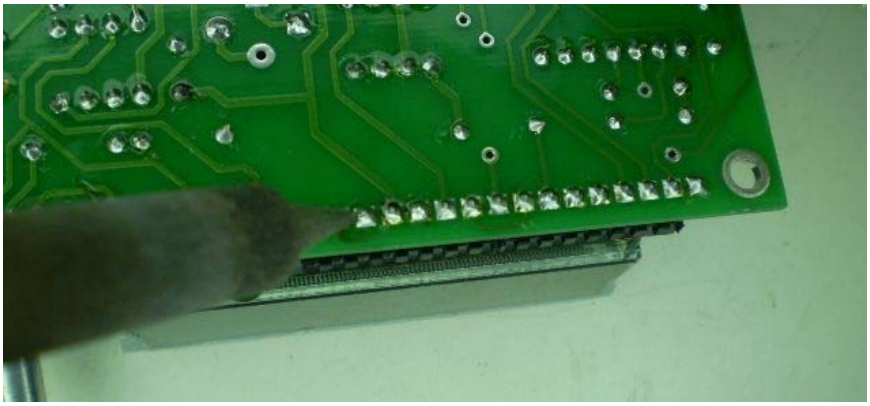
Adjust the display so the threaded studs are centered in the display's mounting holes as shown. Then place a star washer one each side followed by 4-40 nuts then tighten just enough to hold the display in place.



Make sure the K42 PC board is firmly seated on the enclosure standoffs and that the display is held firmly in place by the 4-40 nuts. Now very carefully sneak in with your soldering iron and tack solder two pins on the header to the K42 main board as shown. Solder the fourth pin in from each end, being careful that the barrel of your soldering iron does not come in contact with anything.

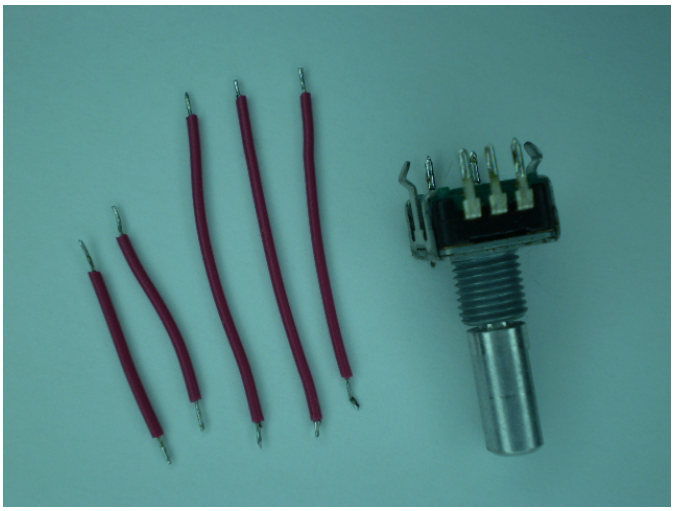
This fixes the display to the K42 main PC board

Now carefully remove the LCD display/K42 PCB assembly and solder the remaining header pins from the bottom of the K42 board. **SOLDER THE TACKED JOINTS LAST** to preserve your alignment.

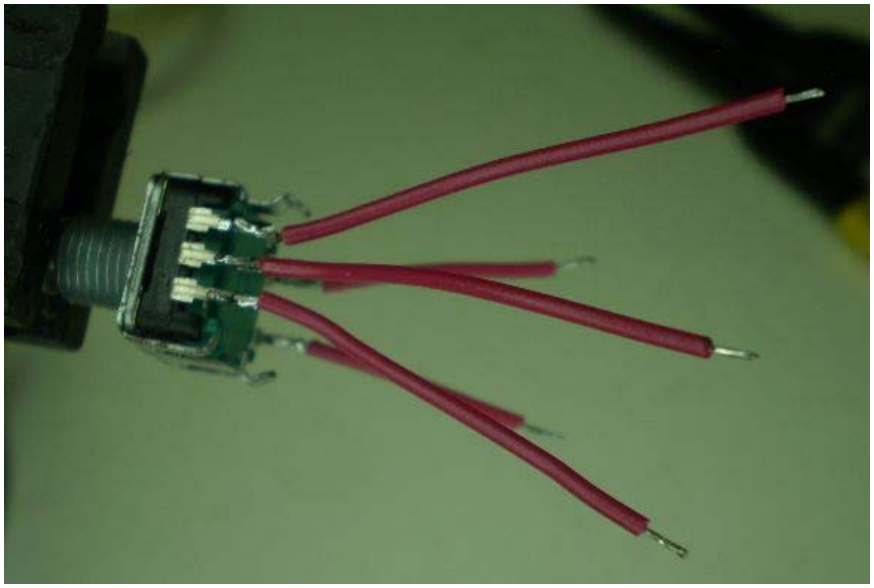


To test the LCD simply apply power and you should see the sign on message displayed. You may see an 'N' between PvA and CW. If the display is blank adjust the LCD contrast trimmer until the display appears. Adjust the trimmer to get the best display appearance. The sign on display automatically clears after a few seconds so you may need to cycle power a few times to complete the contrast adjustment procedure. This display does not have a backlight, it works on the reflected light principle, so it is not possible to see the display in a darkly lit room.

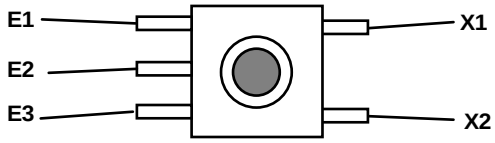
14) It's time to attach the rotary encoder. Before doing so, make sure the encoder shaft fits into its mounting hole in the chassis. You may need to remove the paint on the inside of the hole to get a good fit, I use large screw driver blade and carefully ream the hole to clear the extra paint. An Xacto knife blade will also work but be careful that metal shards do not get into the electronics.



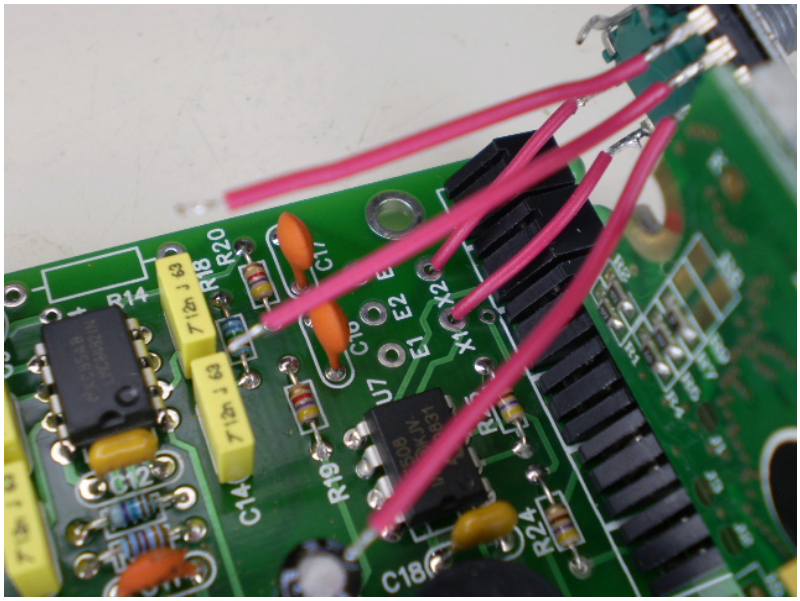
Prepare five wires, two are 1 inch long the remaining three are 2 inches long. Strip and tin both ends as shown in the picture.



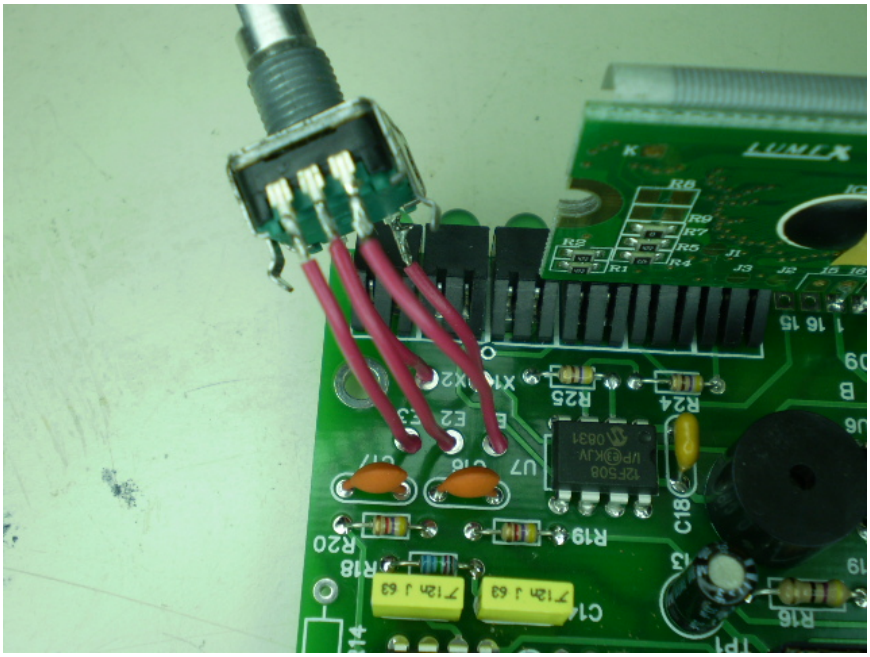
Next tin the five leads on the encoder and attach the five wires, short ones to the side with two lugs (X1 and X2) and the three long wires to the side with three lugs. (E1, E2, and E3).



The drawing above shows how the wires should be connected to pads on the K42 PCB board. E1, E2 and E3 are the encoder outputs while X1 and X2 are the encoder's pushbutton switch connections



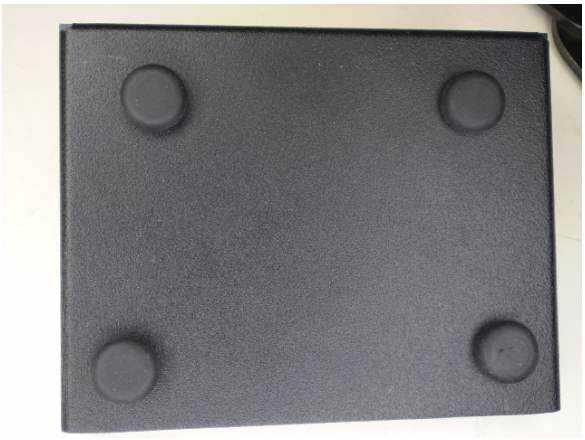
Solder in the X1 and X2 wires first



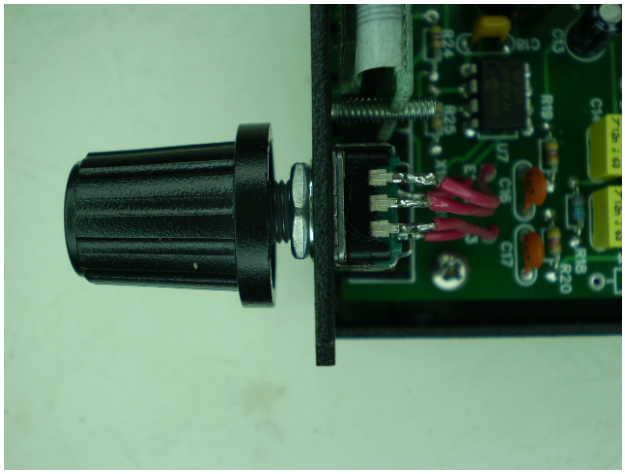
Then solder the remaining three wires: E1, E2, and E3

It's easy to test the encoder, power up the K42 and turn the encoder, you should see the current WPM value displayed on the upper left side of the display. The display will blank a few seconds after you stop turning the encoder.

15) Now install the four rubber feet into the bottom of the chassis. They can be uncooperative but they will fit, just twist and push in at the same time.



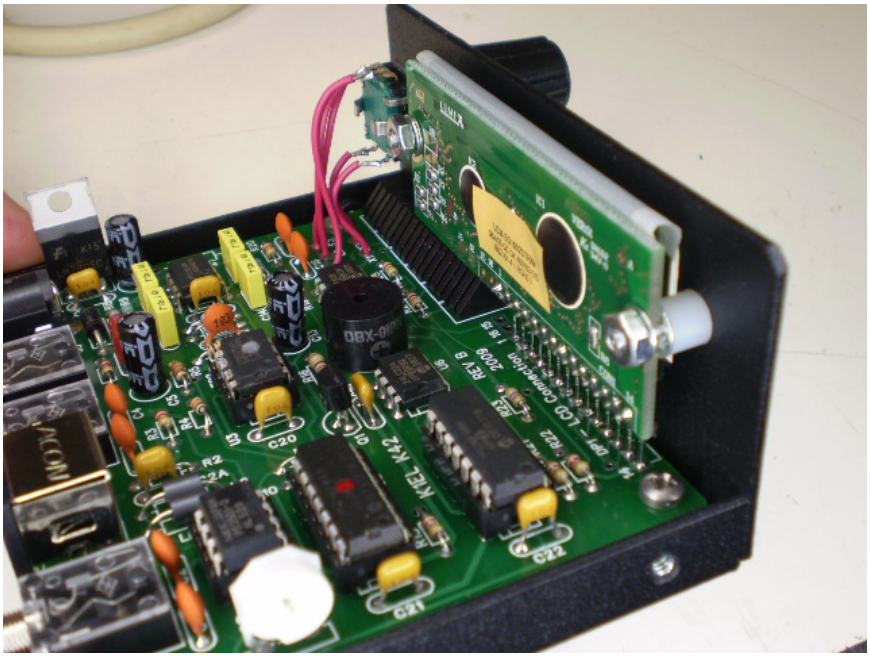
16) Re-install the PC board assembly into the chassis. First make sure the display spacers and washers are installed as per step 13. Then carefully fold the board back into the chassis front side first on to the display studs then second align the board with the base mounting studs. Install and tighten the four silver 4-40 board mounting screws. Then install two lock washers and 4-40 nuts to hold the display in place, don't over tighten these.



17) The encoder is mounted with one hex nut and one flat washer. The washer and nut both go on the front of the unit. Reference the picture above to see how this is done. You might want to put a spacer on the inside so the control knob will rest closer to the enclosure but that's up to you. Be careful when tightening the nut, it's easy to slip and scratch the front panel. Now attach the rotary encoder knob using a 5/64 inch Allen wrench.

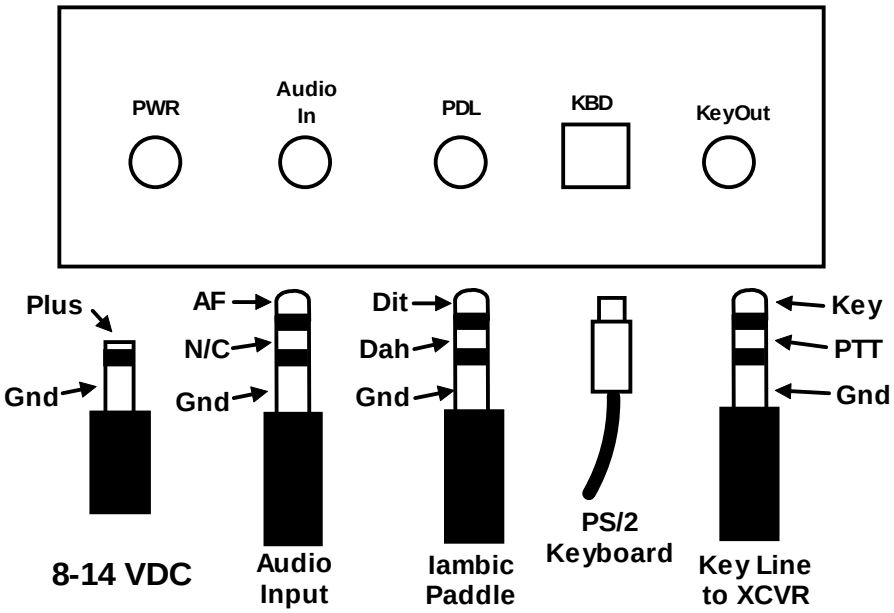
Completed base assembly

Completed base assembly front view



LCD Display Mounted in proper position

18) Now is the time to give the K42 a good workout, go through the Quick Start section of the K42 manual and then try out all of the commands and message features. You might want to take some time now to make up any interconnecting cables you may need, The following diagram shows the connector layout on the K42 rear panel. A mating power supply connector is included with the kit, as well as two mono 1/8 plugs. Note that stereo plugs are shown in the drawing below. A stereo plug is only required if you want to use PTT or two keying ports on the KeyOut jack.



19) To install the top cover, reference the following picture. Angle the top cover and get the rear connectors to start to go into the cover. Then fold the cover down to meet the front panel and push it forward so the three 1/8 inch connectors poke out the back evenly. Install the four black 4-40 screws to hold the cover in place.

Completed Unit Front View

Completed Unit Rear View

CW Keyboard Theory of Operation

This section will cover the CW keyboard portion of the K42. It can be helpful to read through this to get familiar with the circuitry if you are debugging the K42.

As shown in the block diagram below, two PIC processors share the task of converting keystrokes to Morse code. U5, the console PIC, is responsible for retrieving keystrokes from the keyboard and determining what to do with them. U2 is the Keyer PIC which is controlled by the console PIC, its main task is to generate Morse code and monitor the keyer paddle inputs. The two PICs communicate over a serial interface running at 9600 baud. The Keyer PIC throttles the Console PIC via in-band flow control. A 4-kilobyte EEPROM memory, connected to the Console PIC's SPI interface, stores up to 12 messages, system settings, and holds the keyboard type ahead and LCD display buffers.

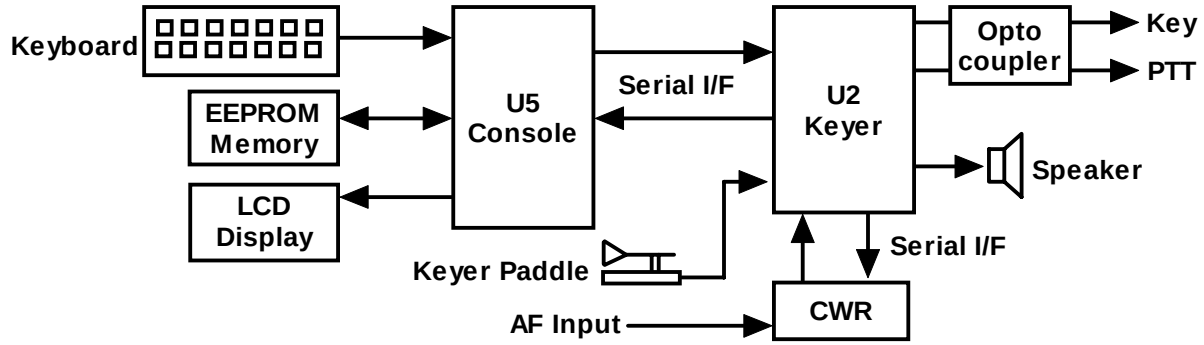


Figure 1 - K42 CW Keyboard Block Diagram

There are two types of data sent from the Console to the Keyer: Commands and Data. Commands modify the K42's operation in some way; changing operating speed, turning off sidetone, recording a message, etc. Data are letters, numbers, or prosigns that are to be sent in Morse. Data is processed differently than commands. Data is put into a type ahead buffer that allows the user to type faster than the Morse is being sent. The size of this buffer is about 200 characters and is a FIFO buffer (First In First Out) meaning that characters are taken out in the order they were put in. Since there can be a considerable delay from keyboard input to Morse output, commands bypass the input FIFO and are sent to the Keyer PIC immediately. This allows changes to be made while sending is underway.

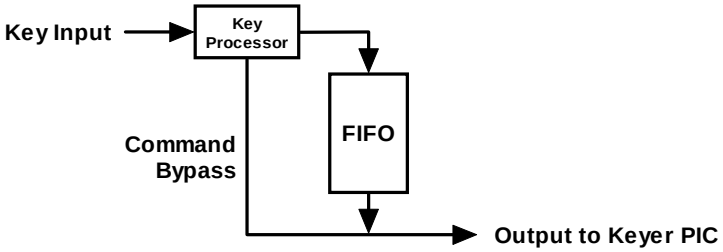


Figure 2 – Output FIFO Block Diagram

Since there are cases when you don't want commands to take effect immediately, the K42 buffers certain commands. This means that the command is placed in the typeahead buffer and won't be acted on until it comes out. An example of the use of a buffered command would be to send two words at two different speeds, the first at 15 WPM and the second at 20 WPM. By placing a buffered speed command between the words the speed will not be changed until the first word is completely sent. Not all, but many of the immediate commands can be entered as buffered commands. Most often, buffered commands are used in messages.

Getting back to the block diagram, the paddle inputs are connected to the Keyer PIC, the paddle takes priority over data coming in from the keyboard. A paddle press will cause the FIFO buffer to be cleared. This allows you to cancel a message and start sending by paddle right away. As mentioned before, the keyboard is connected to the Console PIC since its input generally has to be buffered in the EEPROM. The LCD is also connected to the Console to allow keyboard data and command prompts to be displayed. The K42 keeps two separate display buffers in EEPROM, one that tracks keystrokes as they are entered and a second which shows data as it is being sent by the Keyer PIC.

The Keyer PIC has three outputs, KEY, PTT, and sidetone. Both the KEY and PTT outputs are optically isolated from K42 power and ground and are open collector, in most cases these can switch the transmitter inputs directly. Full control over PTT is provided to compensate for transmit changeover delay and hold keying between letters and words. The optocoupler may be replaced by a solid state relay which allows the K42 to key practically any transmitter, vacuum tube or solid state. Sidetone, generated by the Keyer PIC, is buffered by a 2N2222 buffer transistor which drives an on-board mini-speaker, the volume is set by the on-board resistor R16.

A rotary digital encoder is connected to the Keyer PIC, this control is used primarily for speed control but it is also used for real time control of CW Reader settings such as gain and noise filtering.

The K42's LCD interface is a fixed format at 16 characters by 2 lines. The interface is compatible with most, if not all, LCD displays based on the Hitachi HD44780 controller I.C. So if you prefer to use your own enclosure and display you can. The display allows the user to see what is being typed in while sending and also do basic editing. It is also possible to scroll back to view the last 14 lines typed in. The outgoing viewport can be selected by hitting the TAB key which allows the user to see outgoing Morse as it is being sent. The outgoing buffer is much larger at 125 lines. A cursor is shown when viewing the edit buffer, the cursor is not shown when viewing the outgoing buffer.

K42 CW Reader Theory of Operation

The following block diagram, Figure 3, shows the main sections of the K42 CW Reader. Audio from a receiver is filtered through an initial four pole, two op amp, active bandpass filter stage. The bandwidth of this stage is approx. 400 Hz which provides coarse out of band signal rejection. This stage also isolates and protects the PSoC processor from large input levels. The LMC6482 (or TS922) op amp handles large input amplitudes well and clips very cleanly. After filtering, audio is fed directly to the PSoC processor. This is a mixed signal device containing both analog and digital function blocks. These blocks, as well as the connections between the blocks, are programmable. This allows a very sophisticated design to be implemented in a tiny package. The clock that runs the PSoC is contained within the device and is set at 24 MHz. The signal chain inside the PSoC is described next. First the signal is passed through an adjustable gain amplifier to provide a boost for low level signals. Next, the signal is fed through a two stage 4 pole bandpass filter that is implemented with an SCAF filter. The center frequency of this filter is set to 690 Hz with a bandwidth of about 200 Hz. The filtered signal is then fed to a tone detector which is implemented with a quadrature correlator. This decoder essentially compares the period of the incoming waveform to a reference 690 Hz waveform if they match then the signal is deemed in band. The recovered dit and dah intervals are then timed and translated into ASCII letters which are sent to the Keyer PIC which in turn passes it directly to the Console PIC for display on the LCD. As part of the detection process, the amplitude of the filtered CW signal is determined in the PSoC. This amplitude information is formatted into a PWM waveform which is fed to the display PIC U7 which decodes the PWM input and represents the amplitude by lighting a six LED bar graph display.

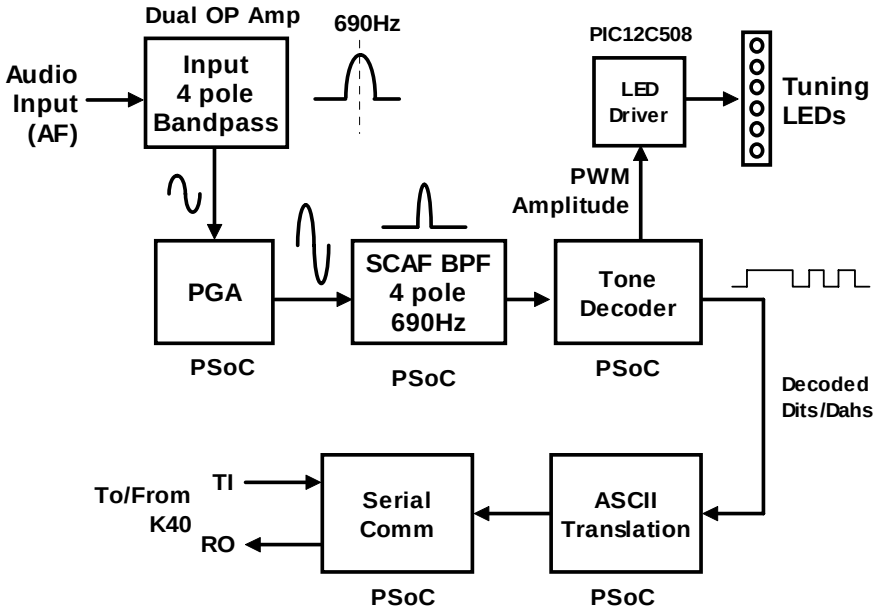


Figure 3 - K42 CW Reader Block Diagram

K42 PCB Silkscreen, Checkplot, and top bottom layers

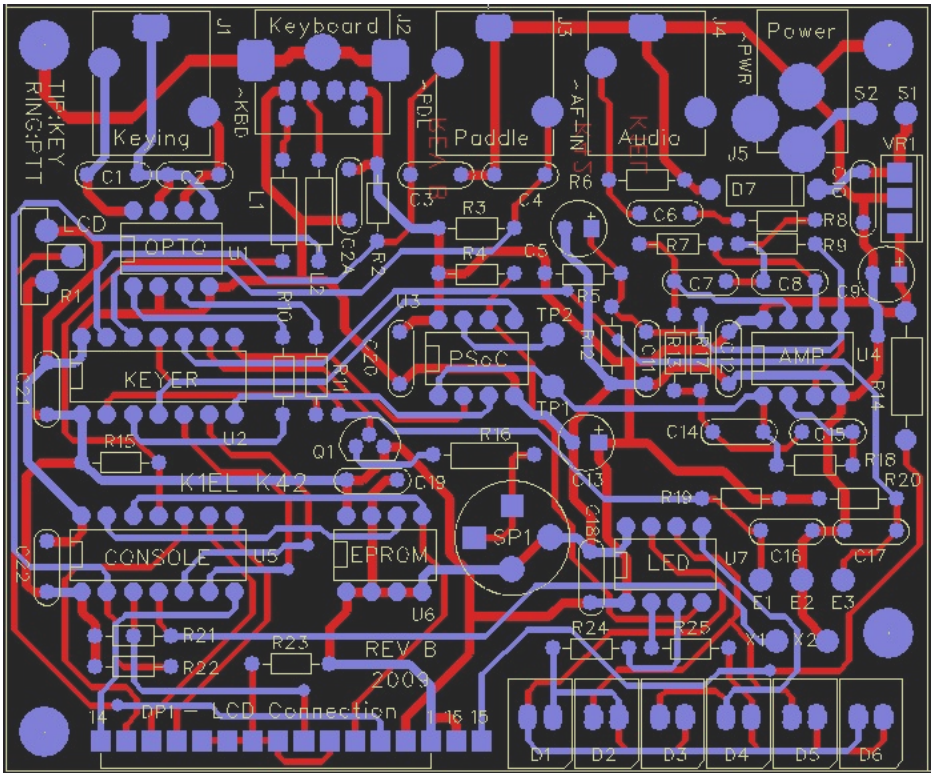


Figure 4 - K42 Composite Checkplot, Red=Bottom, Blue=Top

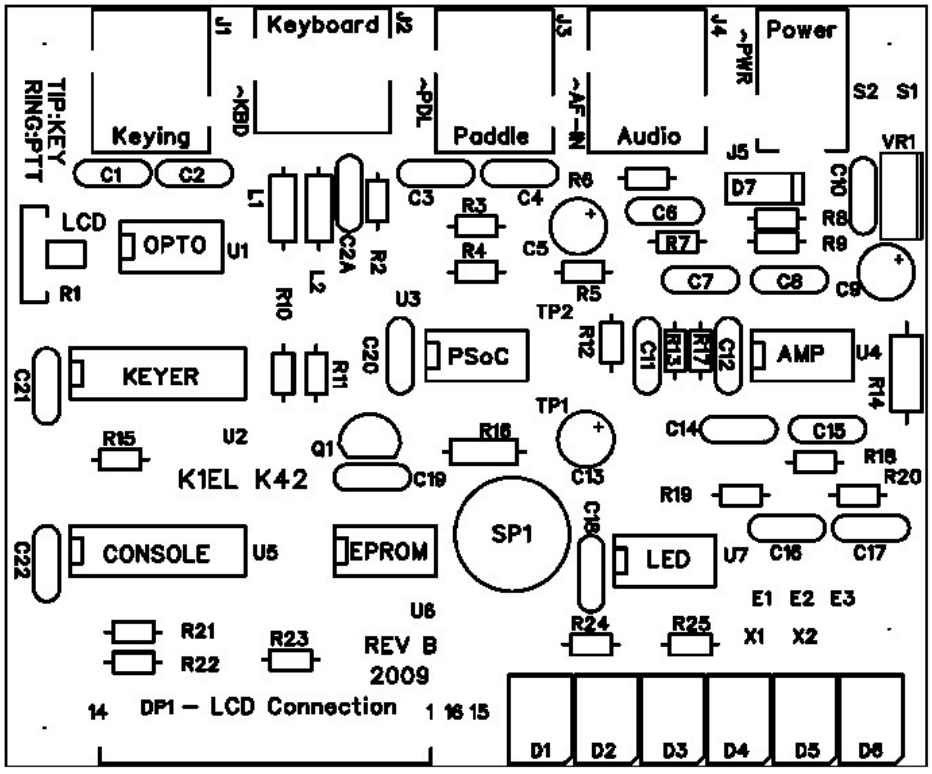


Figure 5 – K42 Silkscreen

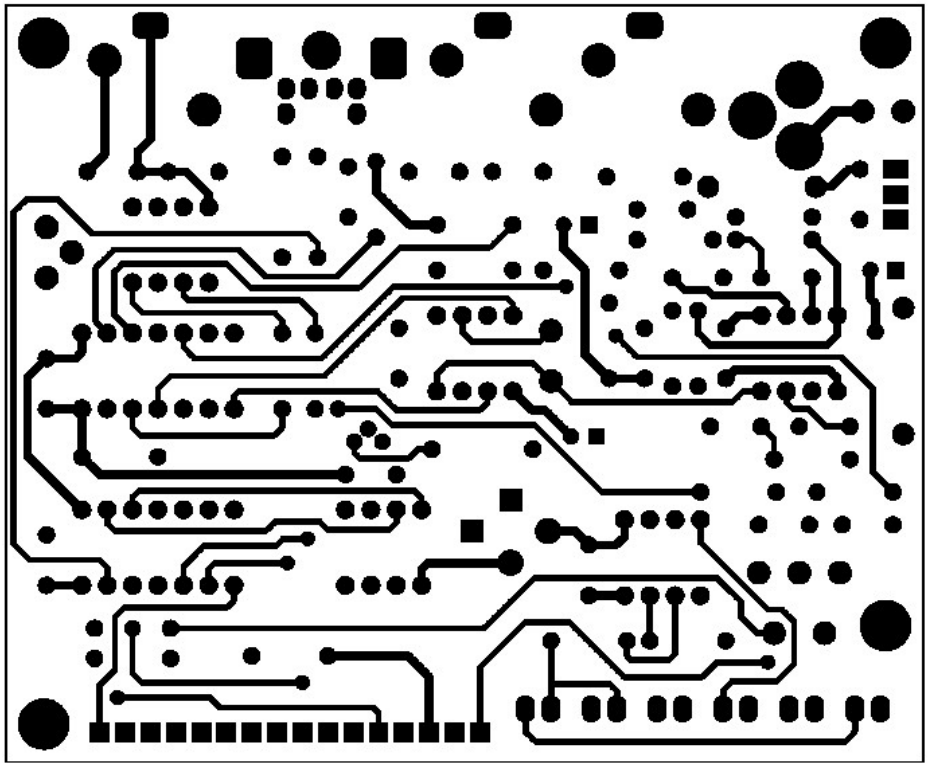


Figure 6 - K42 Top Copper

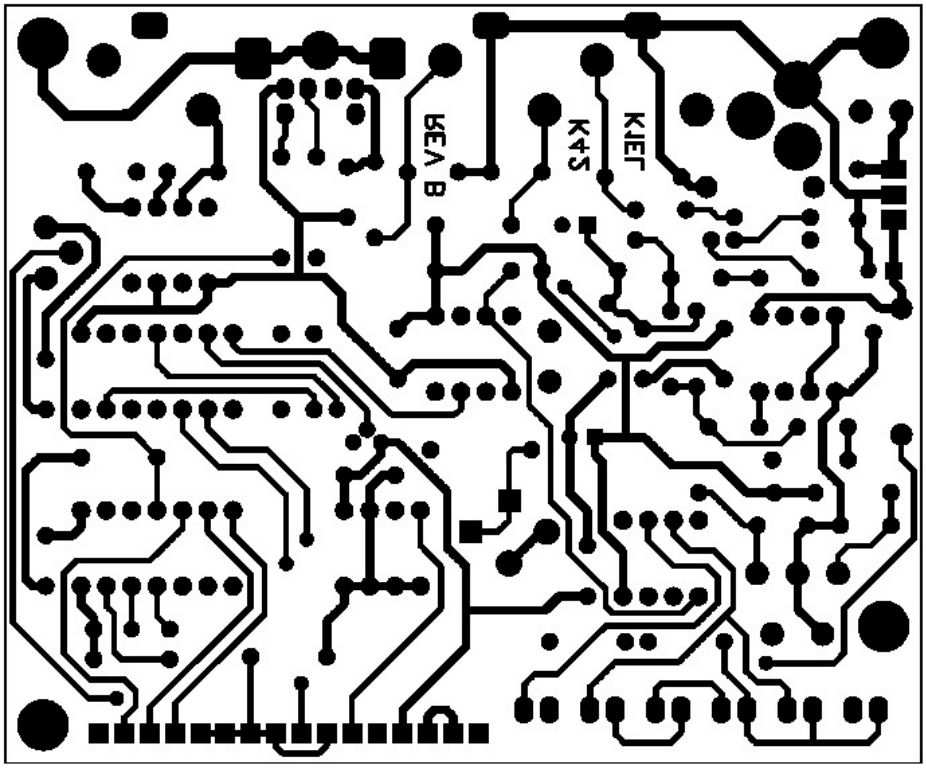


Figure 7 - K42 CW Bottom Copper

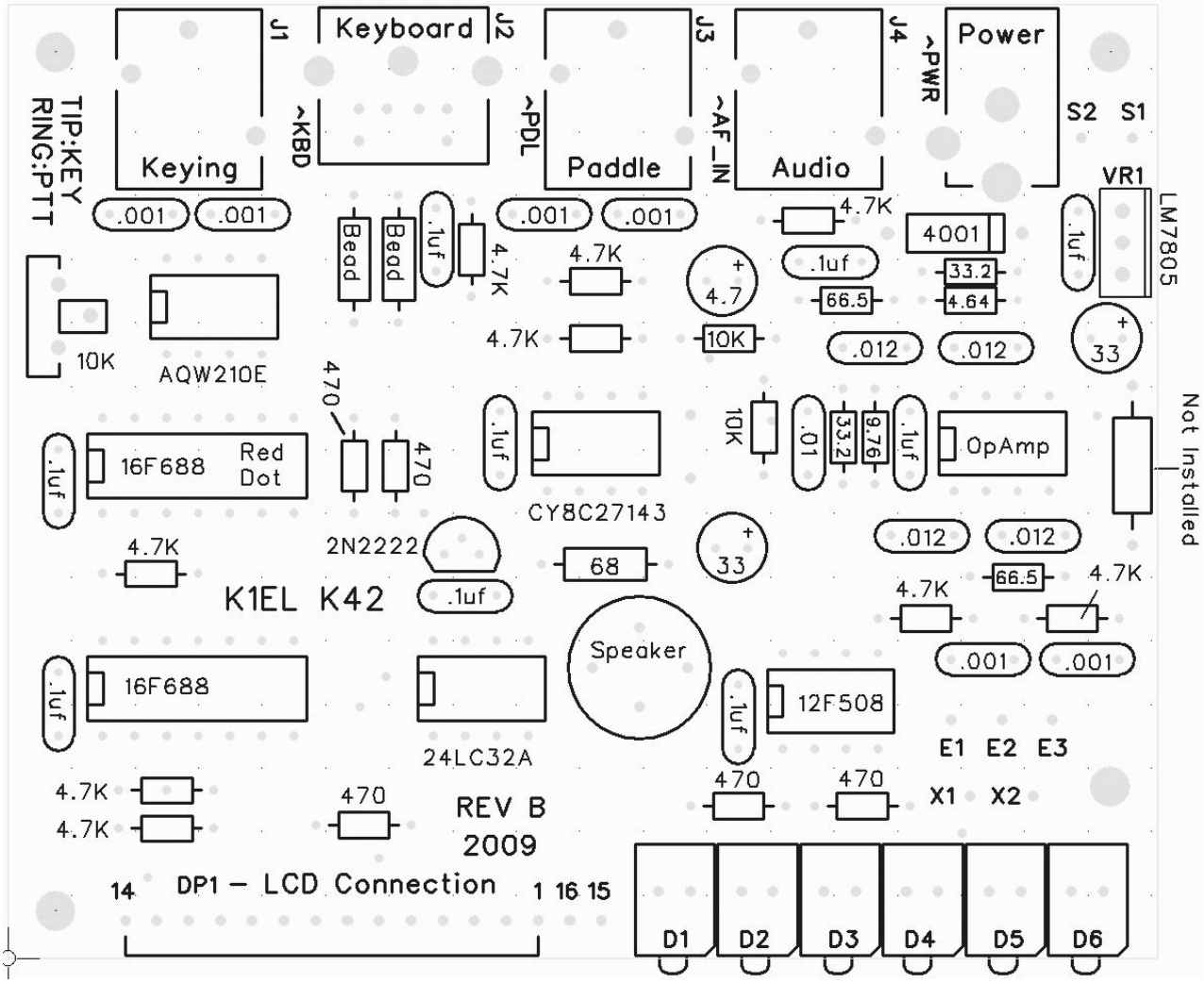
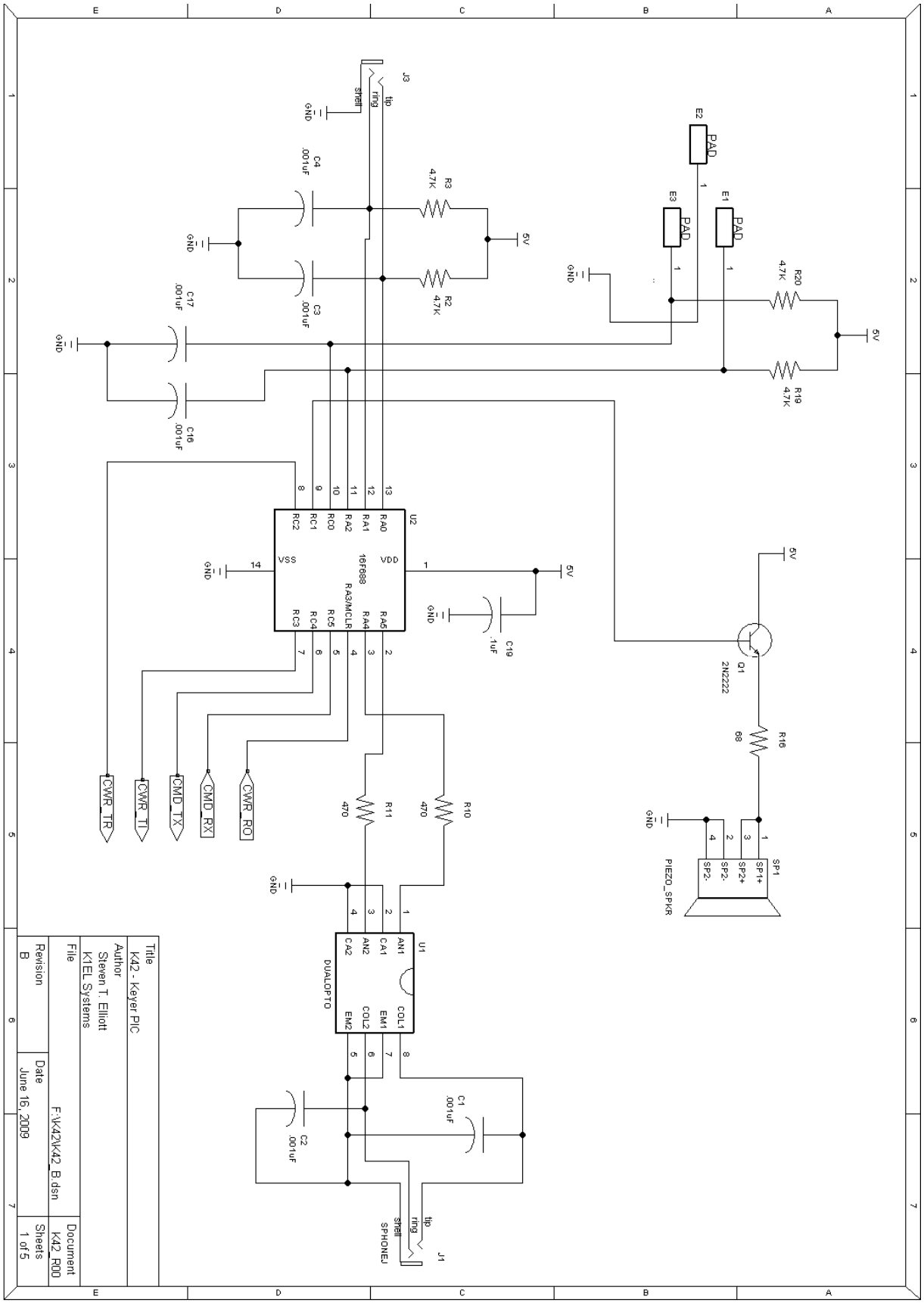


Figure 8 - K42 Placement by Part Value


J3
shell
ring
tip
GND
C4 .001uF
R3 4.7K
5V
C3 .001uF
R2 4.7K
C17 .001uF
C16 .001uF
E2 PAD
E3 PAD
E1 PAD
R20 4.7K
R19 4.7K
U2
16F688
VSS
VDD
RA3/MCLR
RC2
RC1
RC0
RA2
RA1
RA0
RC3
RC4
RC5
RA4
RA5
C19 .1uF
Q1 2N2222
R16 68
SP1
SP1+
SP2+
SP2-
PIEZO_SPKR
CWR_TR
CWR_TT
CMD_TX
CMD_RX
CWR_RO
R11 470
R10 470
U1
DUALOPTO
AN1
CA1
AN2
CA2
COL1
EM1
COL2
EM2
C1 .001uF
C2 .001uF
J1
SPHONEJ
Title
K42 - Keyer PIC
Author
Steven T. Elliott
K1EL Systems
File
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Revision
B
Date
June 16, 2009
Document
K42_R00
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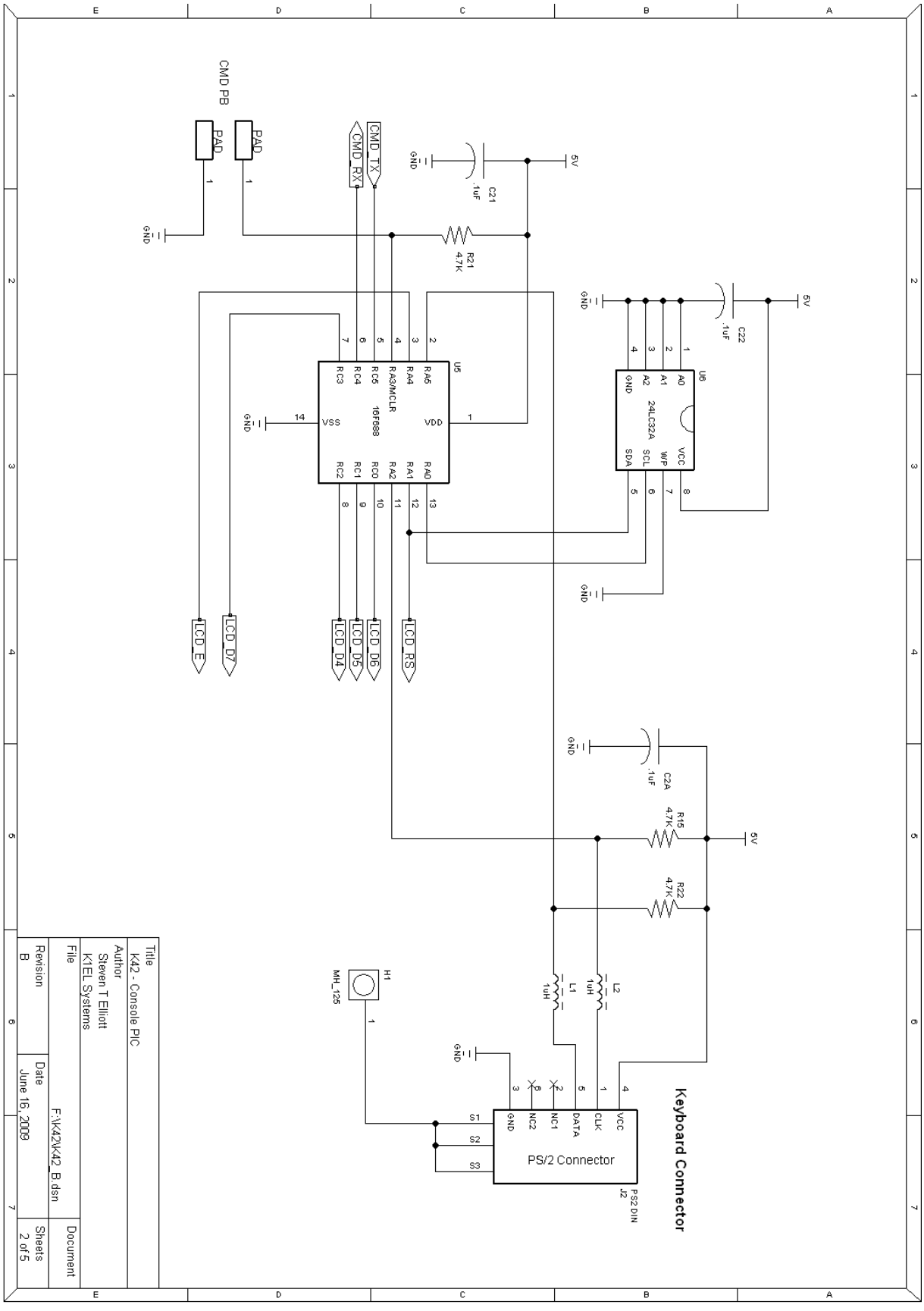
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PAD
PAD
CMD_TX
CMD_RX
C21
.1uF
5V
GND
R21
4.7K
C22
U5
16F688
RA3/MCLR
VSS
VDD
U6
24LC32A
A0
A1
A2
SCL
SDA
WP
VCC
LCD_E
LCD_D7
LCD_D4
LCD_D5
LCD_D6
LCD_RS
C2A
R15
4.7K
R22
4.7K
L1
1uH
L2
1uH
H1
MH_125
S1
S2
S3
GND
NC2
NC1
DATA
CLK
VCC
PS/2 Connector
PS2 DIN
J2
Keyboard Connector
Title
K42 - Console PIC
Author
Steven T Elliott
K1EL Systems
File
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Revision
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Date
June 16, 2009
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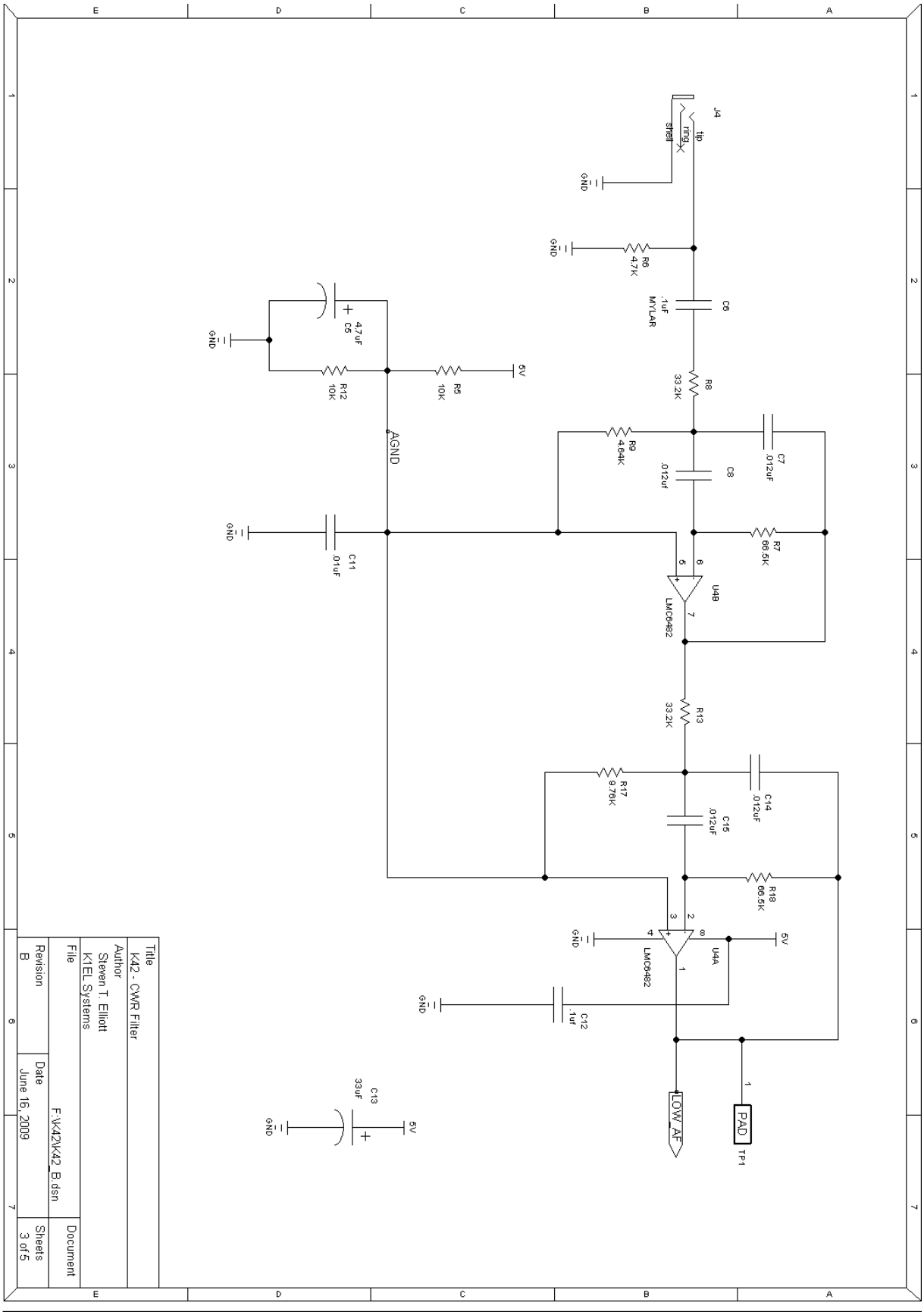
J4
shell
ring
tip
GND
R6
4.7K
C6
.1uF
MYLAR
C5
4.7uF
R12
10K
R5
10K
5V
R8
33.2K
AGND
R9
4.64K
C8
.012uf
C7
.012uF
C11
.01uF
R7
66.5K
U4B
LM6482
R13
33.2K
R17
9.76K
C14
.012uF
C15
.012uF
R18
66.5K
U4A
LM6482
C12
.1uf
C13
33uF
LOW_AF
PAD
TP1
Title
K42 - CWR Filter
Author
Steven T. Elliott
K1EL Systems
File
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B
Date
June 16, 2009
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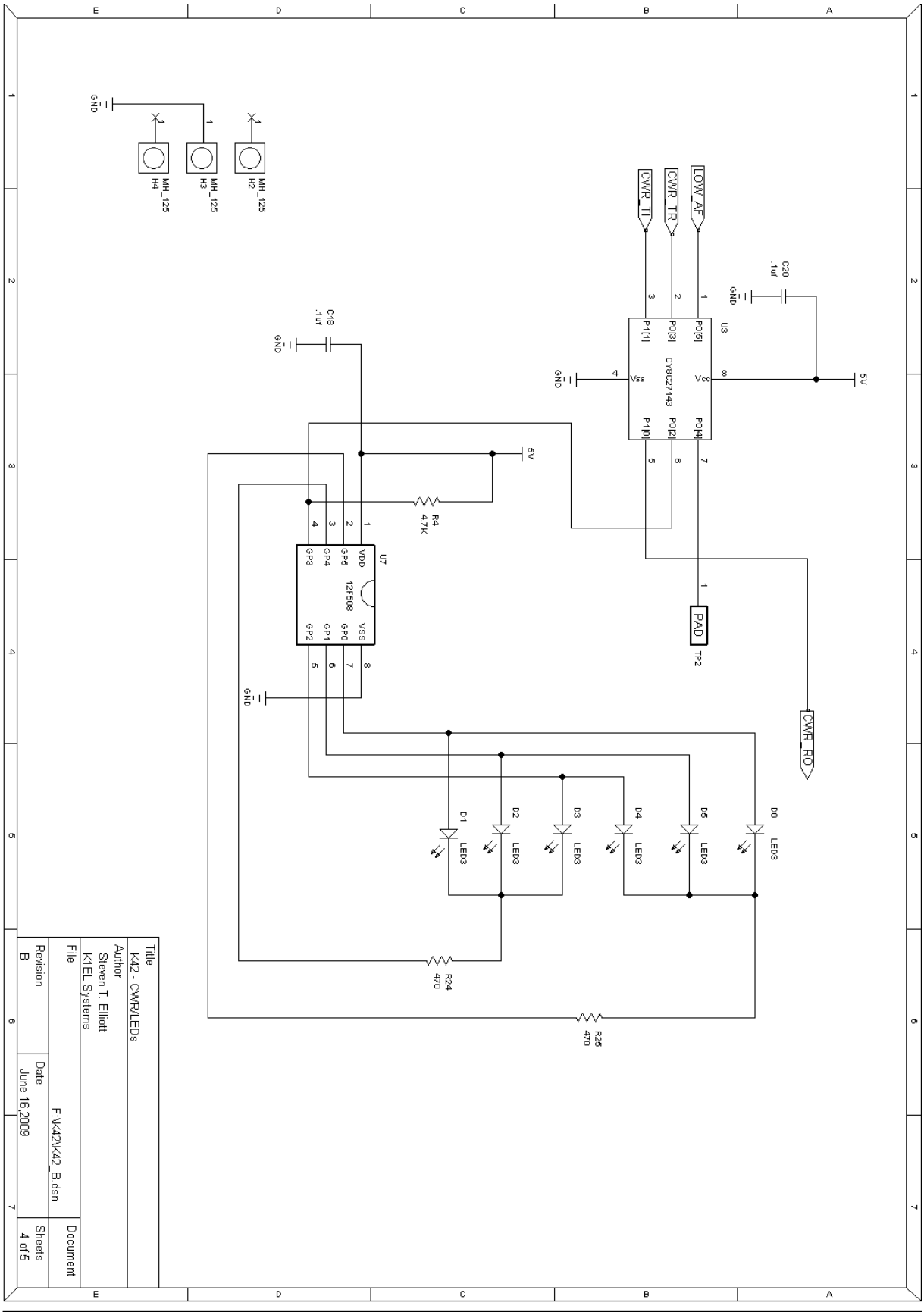
MH_125
H4
MH_125
H3
MH_125
H2
GND
CWR_TI
CWR_TR
LOW_AF
C20
.1uf
C18
.1uf
U3
CY8C27143
P1[1]
P0[3]
P0[5]
P1[0]
P0[2]
P0[4]
Vss
Vcc
5V
R4
4.7K
U7
12F508
GP3
GP4
GP5
VDD
GP2
GP1
GP0
VSS
PAD
TP2
CWR_RO
D1
D2
D3
D4
D5
D6
LED3
R24
470
R25
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Title
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Author
Steven T. Elliott
K1EL Systems
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Date
June 16, 2009
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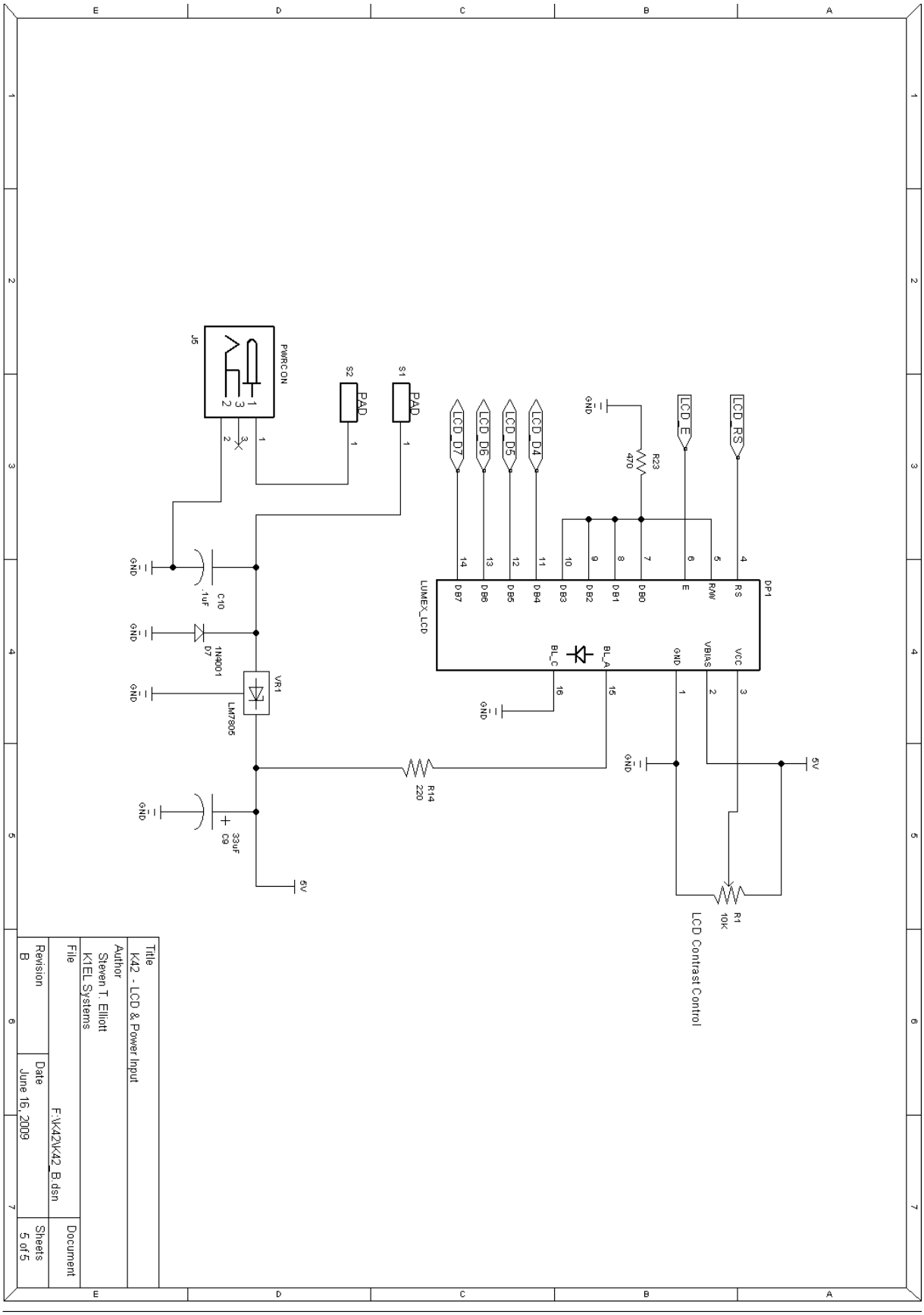
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PWRCON
S2
PAD
S1
PAD
LCD_D7
LCD_D6
LCD_D5
LCD_D4
LCD_E
LCD_RS
R23
470
GND
C10
.1uF
D7
1N4001
VR1
LM7805
C9
33uF
5V
R14
220
LUMEX_LCD
DB7
DB6
DB5
DB4
DB3
DB2
DB1
DB0
E
R/W
RS
BL_C
BL_A
GND
VBIAS
VCC
DP1
R1
10K
LCD Contrast Control
Title
K42 - LCD & Power Input
Author
Steven T. Elliott
K1EL Systems
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