Introduction

This document will describe how to assemble and test the K44 Keyboard/Reader Kit. The assembly of a K44 is not very difficult, but is probably not a good "first kit" since there many challenging assembly steps. 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 good pair of wire cutters, small pliers, assorted screwdrivers, and a 5/64" Allen wrench
4) A Volt Ohmmeter or DVM is required for several assembly steps
5) A magnifying glass is very helpful
6) Power supply providing a voltage between 8 to 13 VDC (9VDC is optimum) at about 250 ma.
7) Optional: An audio signal generator or radio receiver with a calibrate function.

It is very important to take your time and carefully follow the instructions and assembly photos.
The main tasks are 1) Identify components, install them in the correct board location and then do a good job soldering them in place. Experienced builders will have no problem with the process but others will have to take their time and carefully examine the board photos and refer to the bill of materials often. 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.

As mentioned, 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. The instructions don't provide component by component instruction but more of a general section by section flow. 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. Even experienced builders can benefit from reading Appendices A, B & C at the end of this document.

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. Let us know if you are missing any parts.

Reference Des.	Qty	Part Description	Package	Other Info	Check Off
R10	1	100 ohm Resistor	1/8 Watt	Brn Blk Brn	_____
R18,R12	2	10K ohm Resistor	1/8 Watt	Brn Blk Org	_____
R16	1	47 Ohm Resistor	**1/8** Watt	Yel Violet Blk	_____
R13,R14,R11,R20 R21,R23	6	470 Ohm Resistor	1/8 Watt	Yel Violet Brn	_____
R15,R17,R18,R19,R22, R3,R4,R1,R7	9	4.7K Ohm Resistor	1/8 Watt	Yel Violet Red	_____
R9	1	47 ohm	**1/2** Watt	Yel Violet Blk	_____
R6	1	5.76K Ohm 1% Resistor	1/8 Watt	Blue Axial	_____
R2	1	33.2K Ohm 1% Resistor	1/8 Watt	Blue Axial	_____
R5	1	66.5K Ohm 1% Resistor	1/8 Watt	Blue Axial	_____
C3,C4	2	.001uF Capacitor (102)	Ceramic Disk	.2" spacing	_____
C1,C16,C19,C2,C21 C14,C15,C20	8	.1uF,Capacitor (104)	Ceramic Disk	.2" spacing	_____
C22,C23,C5,C6	4	.01uF,Capacitor (103)	Ceramic	.2" spacing	_____
C13	1	.01uF,Capacitor (103)	Mylar (brown)	.2" spacing	_____
C7	1	.1uF Capacitor (104)	Mylar (brown)	.2" spacing	_____
C11,C12	2	.012uF Mylar Cap (123)	Mylar (brown)	.2" spacing	_____
C9	1	.47uF Capacitor (474)	Ceramic	.1" spacing	_____

C17,C18,C8	3	33uF Electrolytic Cap	Radial	.1″ Spacing	_____
C10	1	100uF Electrolytic Cap	Radial	.1″ Spacing	_____
L1,L2	2	1uH,Inductor	Leaded Ferrite	leaded	_____
U1	1	AQW280EH SS Relay	8 pin DIP	no socket	_____
U4 (two red dots)	1	16F1825 Keyer PIC	14 pin DIP	socketed, dot	_____
U2 (two red dots)	1	CY8C27143 PSoC	8 pin DIP	socketed	_____
U3	1	MCP6002 Dual Op Amp	8 pin DIP	no socket	_____
U6 (one silver dot)	1	16F1825 Console PIC	14 pin DIP	socketed	_____
U7	1	24LC32A Serial EEPROM	8 pin DIP	no socket	_____
U5 (one silver dot)	1	12F508 LED Driver PIC	8 pin DIP	no socket	_____
Q1	1	PN2222A Transistor	TO-92		_____
D3,D4,D5,D6,D7	5	CWR Tuning LED	Right Angle	Green	_____
D2`	1	CWR Tuning LED	Right Angle	Red	_____
D1	1	1N4001 Diode	DO-41		_____
VR1	1	LM7805 5 Volt Regulator	TO220		_____
DP1	1	Sunlike SD1602H	LCD Display	PCB Module	_____
SP1	1	Mini Speaker			_____
J1,J2,J3	3	Stereo Phone Jack	1/8 Inch Jack	AF, Key, Pdl	_____
J4	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		_____
ENC-BKO	1	Encoder Breakout Board	Small PCB		_____
MISC	1	K44 Enclosure			_____
MISC	1	Control Knob	Plastic 1/4″ shaft		_____
MISC	4	Rubber Feet	Press in		_____
MISC	1	16 pin Header	Right Angle	Tinned leads	_____
MISC	3	4-40 Hex Nuts	w/lock washers		_____
MISC	1	K44-KIT Rev A PC Board			_____
MISC	4	4-40 1/4″ Screws	Black for enclosure cover		_____
MISC	5	4-40 1/4″ Screws	For PCB & heatsink mounting		_____
MISC	2	14 pin DIP socket for U4 and U6 (Keyer & Console PICs)			_____
MISC	2	8 pin DIP socket for U2 (PSoC)			_____
MISC	1	10″ length of hook up wire			_____
MISC	1	Heatsink			_____

K44 Kit Assembly Instructions

First task is to assemble the K44 PC board. It will progress in sections, a picture will accompany each section.

We will start with the resistors, the color codes are listed in the parts list. We recommend verifying values with an ohmmeter. 1/8 watt resistors can be difficult to read and it is difficult to unsolder them. Use Figure 1 below as a guide. Note that there are two 47 ohm resistors, a large one (1/2W) and a small one (1/8W). The large one goes in R9 and small one in R16.

Note about precision resistor installation. These are the three blue colored resistors. The color code is very hard to read on these, Please use either an ohmmeter 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 three values: 5.76K, 33.2K, and 66.5K.

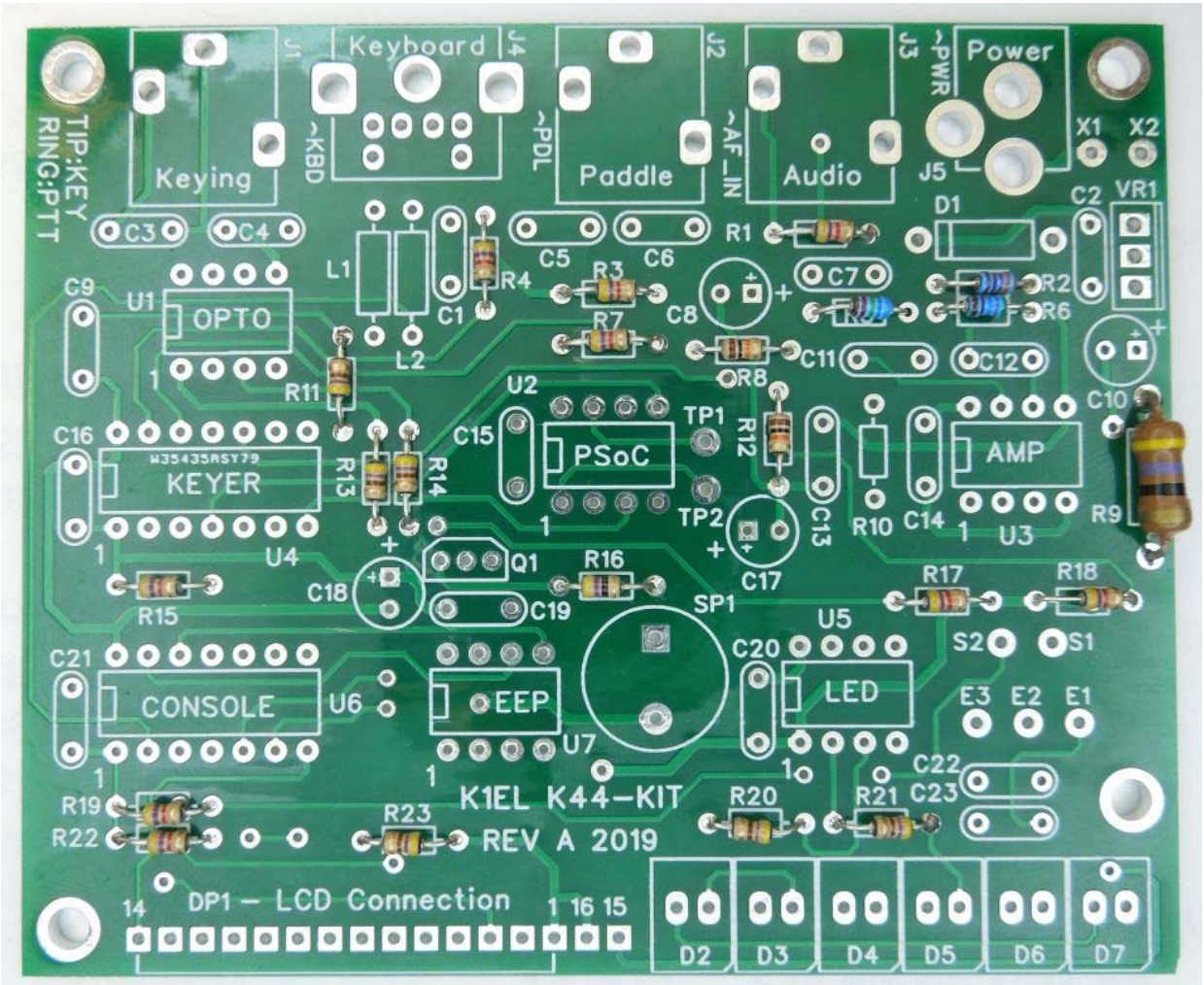


Figure 1 – Section 1: Resistor Installation

Continue with the ceramic capacitors, followed by three mylar capacitors. Next install the leaded ferrite beads L1 & L2 and three IC sockets. Final installation in this section is diode D1 with the polarity marker on the left as shown.

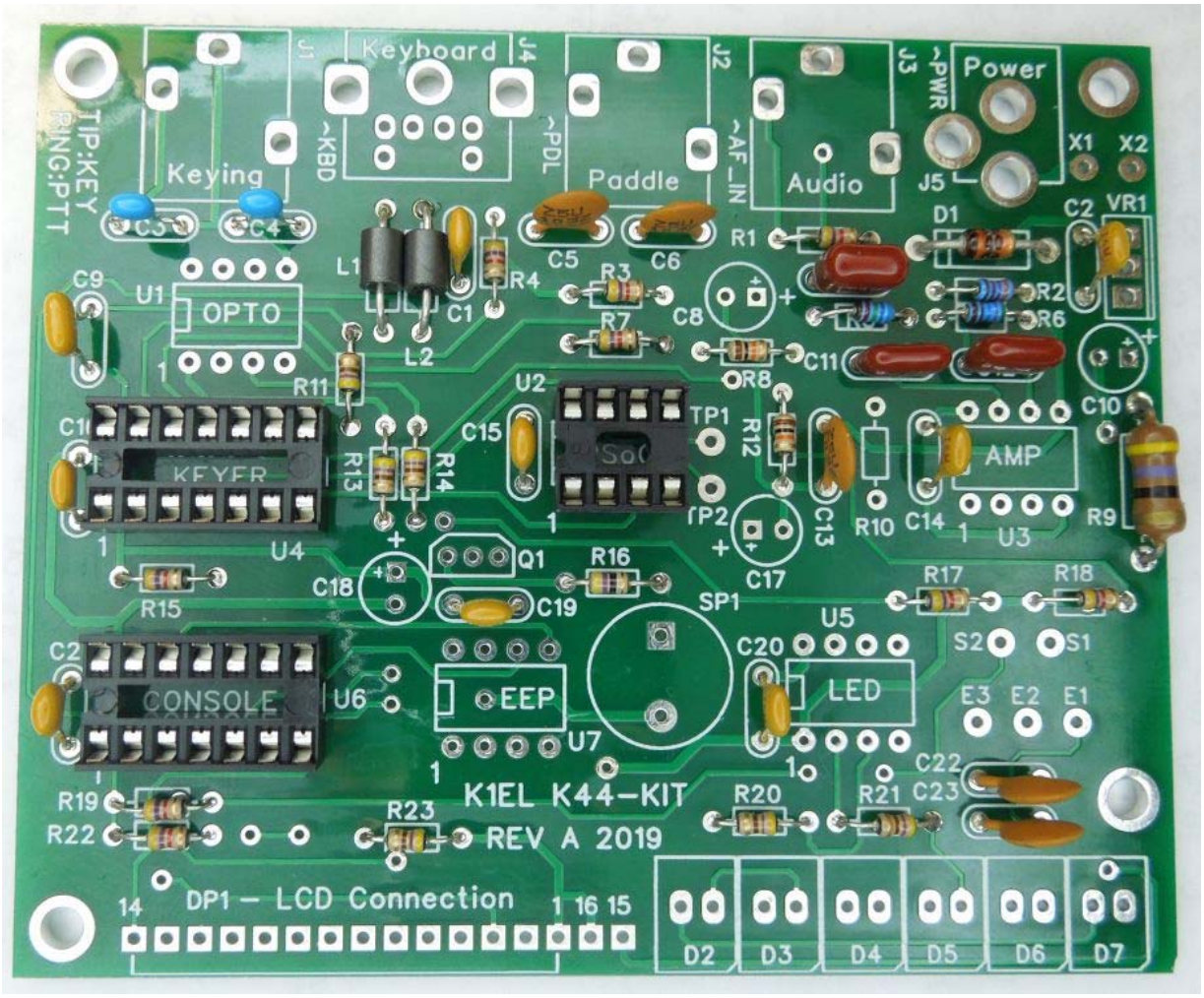
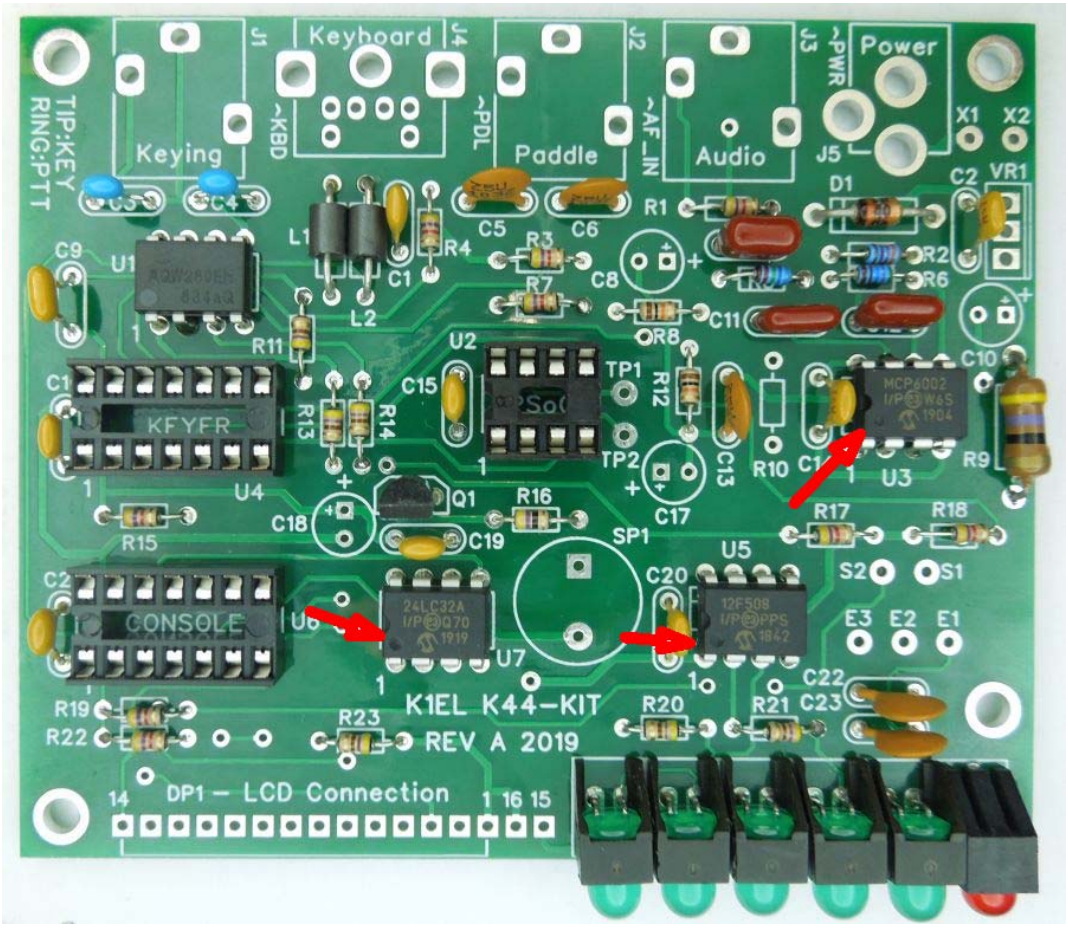
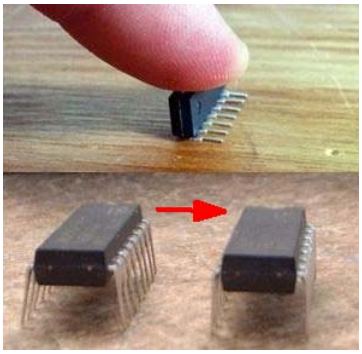


Figure 2 – Section 2: Capacitor, Sockets, Ferrite, and D1 Installation

This section starts with the LEDs D2-D7. Install them so that they are all even with the front edge of the board and there is equal space between them. Save the Red LED for last at position D7. The best thing to do is start in the middle and work your way right and left. Put in D4 first, tack solder one lead and tweak the placement to get the front edge aligned right. Then install D5 the same way and space it so that D4 and D5 are not touching and there is about 1/32" gap between them. Go back and forth D4, D5, D3, D6, D2, and D7. 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.

Now install ICs: U1, U3, U5, and U7 which don't require sockets. Be sure that the dimple on the top of the IC aligns with the silkscreen number 1. You will have to carefully bend the IC pins in to get them to insert into PC board. See picture below. Complete this section with Q1, flat side aligned with the silkscreen. (U5 has one silver dot)





Carefully bend IC leads

Figure 3 – Section 3: LED, IC, and Q1 Installation

Start section 4 with the connectors J1, J2, J3, and J4. Make sure that each one is fully seated in the board before soldering. It's best to do them one at a time. It's important to align these connectors correctly and neatly with the silkscreen so that they will fit properly in the metal enclosure.

The electrolytic capacitors are installed with the polarity bands facing as shown (long lead into square hole). Install the mini speaker with the plus side facing R16. After soldering remove the protection sticker. Solder VR1 in place, tab away from C2. If you are not going to use the optional on/off switch, solder a jumper between pads X1 and X2. If undecided, you can cut or remove the jumper and add the switch later.

Before installing the socketed ICs, make up a power supply cable to test the board. A mate to J5 is included in the kit. Solder two wires to the connector, with the plus lead on the center pin. If you have a 9 to 13VDC wall wart supply with a 2.5mm connector, center pin positive, that will work fine. Current rating must be greater than 100 mA. Double check that the center pin of the power connector is positive with respect to the shell and then plug it into J5. The K44 does have a polarity protection diode but it's worth the extra step to make sure the cable is right.

Apply voltage to the board and you should measure 5 volts between the R9 and the tab on VR1 (GND). If you don't see 5 volts you will need to do some detective work. First of all, verify that your cable is wired correctly. Then make sure that VR1 is installed correctly and that all the electrolytics are installed as shown in the picture. If that's ok you will need to examine your solder workmanship to be sure there are not solder shorts or missed solder connections.

Once this is verified you can install U2, U4, and U6. You will need to bend the IC pins in order to get them to fit in the sockets (see Fig 3). Note that pin one of each IC (dimple) must align with the 1 on the silkscreen. Note U4 has two red dots, U2 has two red dots, and U6 has one silver dot.

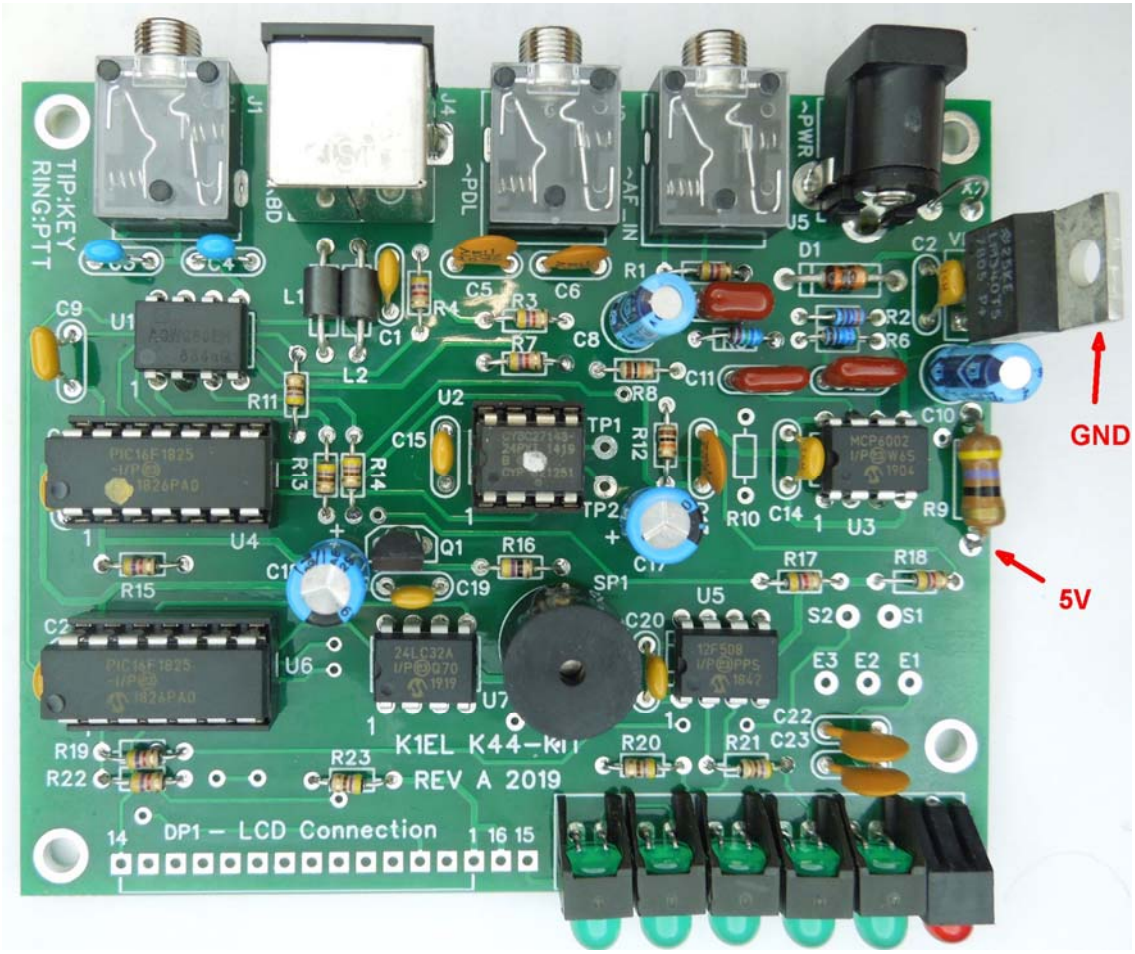
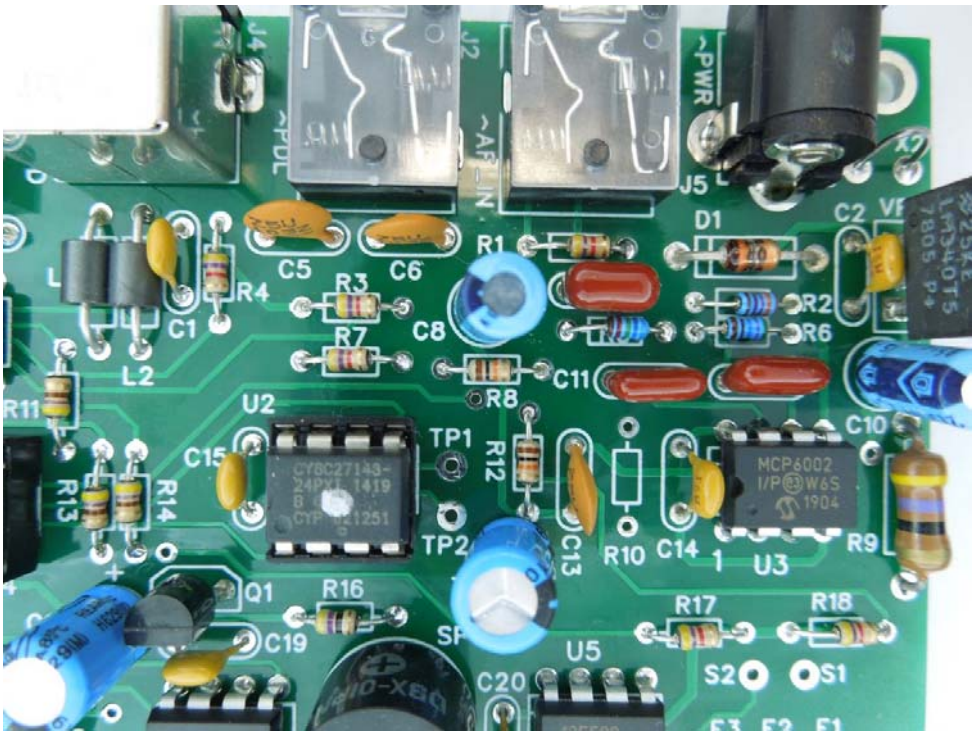
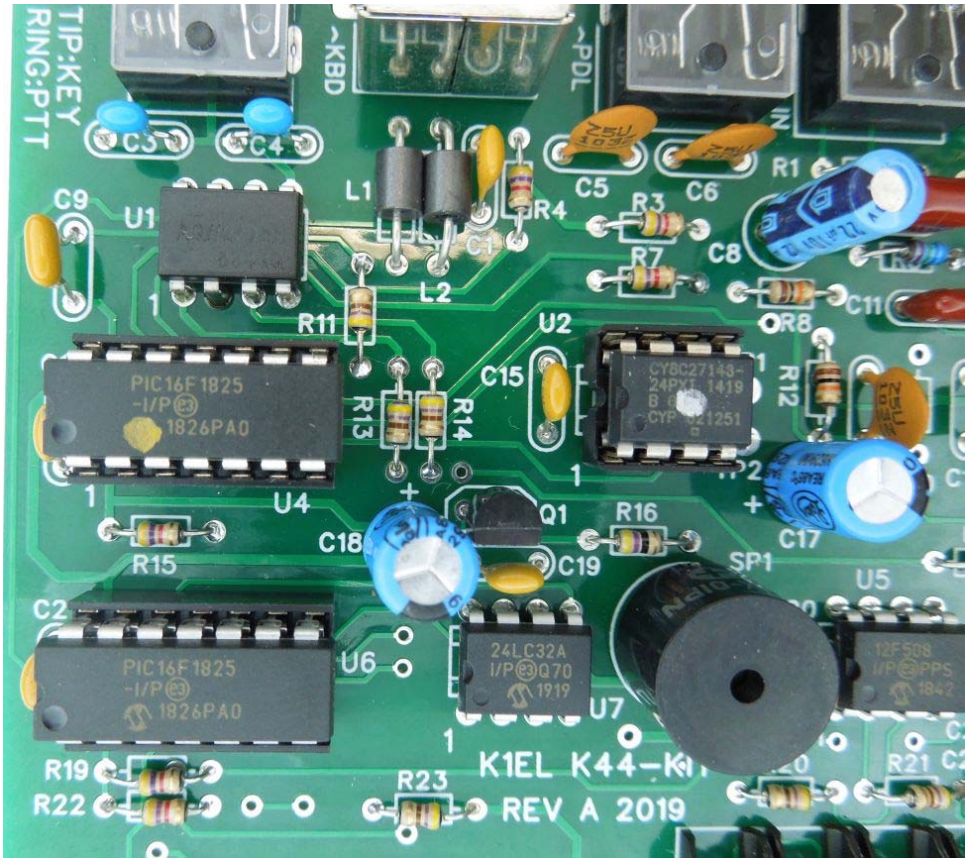


Figure 4 – Section 4: Connector, Electrolytic, VR, and IC Installation

Following are some close ups of the board to help verify part placement, Note that R10 is not installed:





Figures 5 & 6 – Close Up Views

LCD Installation

This is the most challenging step in assembling a K44. Please read through the entire procedure so that you fully understand how it is done. If you make a mistake here, it will be very difficult to fix it so go slowly and follow each step closely. **Some assembly pictures were taken with a previous revision of the K44 pcb board, but the display assembly procedure is exactly the same.**

NOTE: the LCD module uses a delicate film ribbon interconnect which can be easily torn or damaged by soldering iron. When picking the display up try to hold it by the sides avoiding contact with the ribbon.

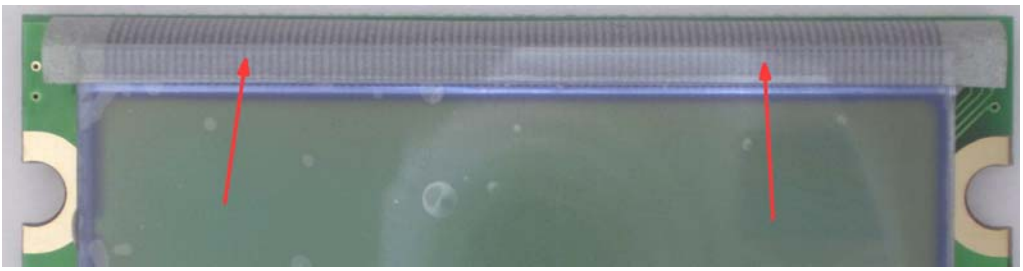


Figure 7 – Caution, do not damage ribbon film interconnect

Begin by installing four rubber feet into the bottom of the enclosure base and set it aside for now.

Figure 8 - Rubber feet in place on bottom half of enclosure

Insert the 16 pin header into the LCD module as shown in figure 5. The plastic bracket on the display module may make this a bit difficult. If you start with the header at an angle it will help. Once in place, make sure the header is fully seated and on the correct side, but **do not solder this yet** !

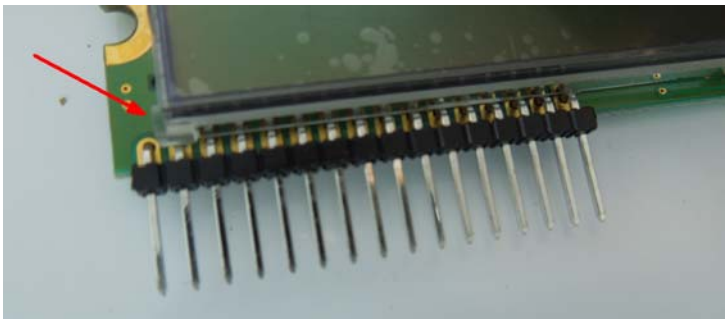


Figure 9 – Insert header into display module – **DO NOT SOLDER THE PINS YET !!**

Now fit the unsoldered LCD/Header sub-assembly into the K44 PC board as shown in figure 10.

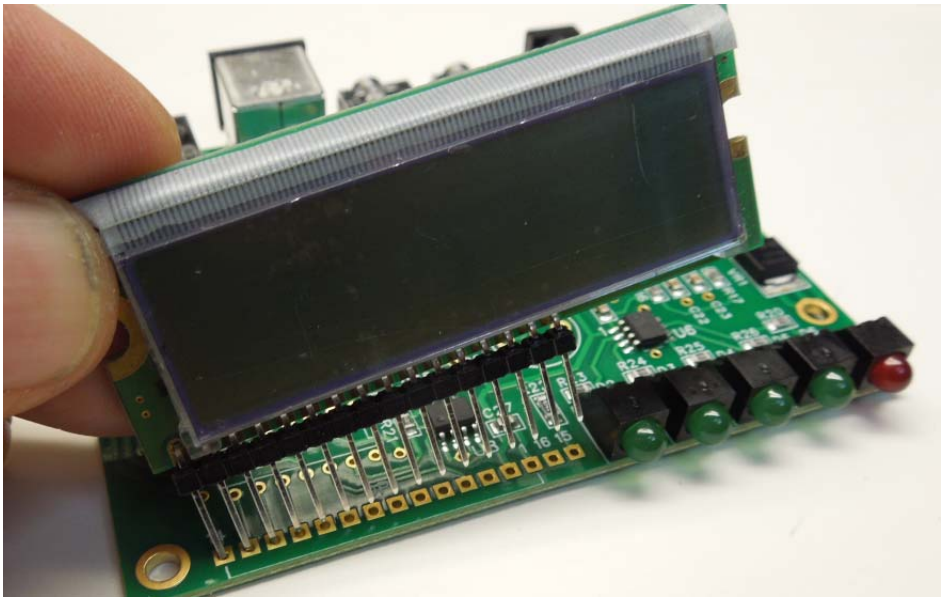


Figure 10 – Insert subassembly into K44 PC board

Now slide this loose sub-assembly in place into the enclosure base. Carefully fit the display notches over the threaded studs on the front panel. Note that the header should naturally seat into both the LCD module and K44 board, if you find yourself forcing anything you probably have something misaligned.

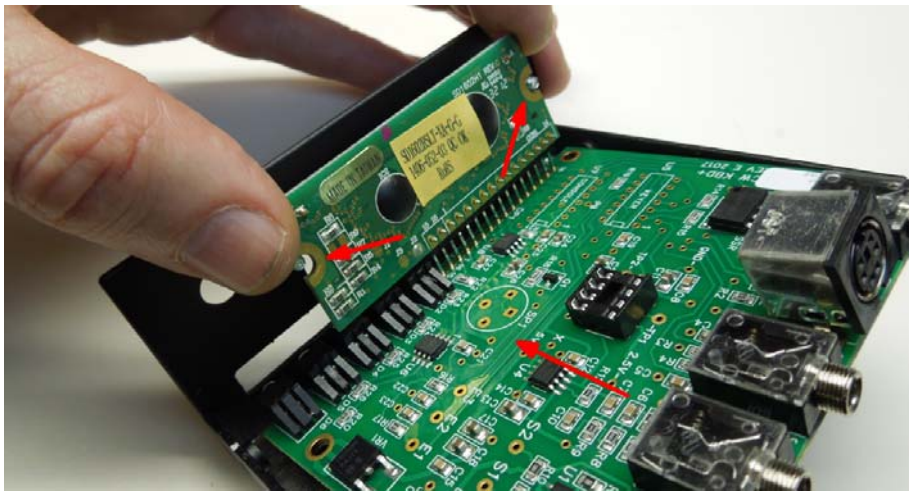


Figure 11 – Slide subassembly into K44 enclosure base on threaded studs

Attach the K44 PC board to the base with two 4-40 screws. Then fix the LCD display to the front bezel with two 4-40 nuts. Use just enough force to hold the display in place so it is nearly flat against the front panel and centered in the enclosure display window. **DO NOT USE A NUT DRIVER**, tighten by finger force only !!!

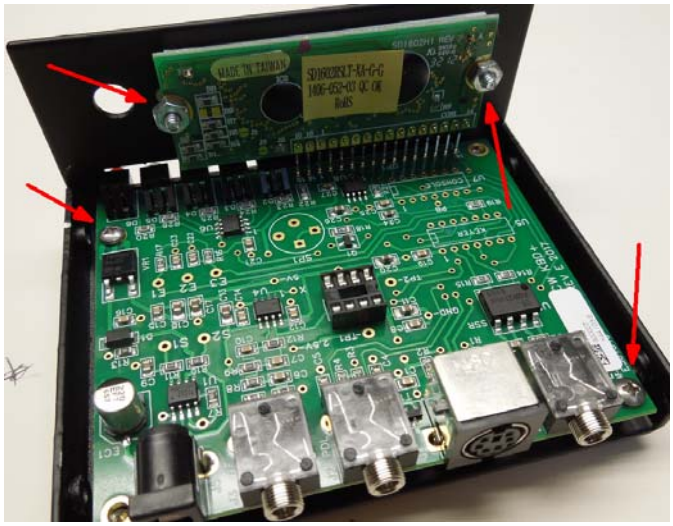


Figure 12 – Add 4-40 nuts and screws to hold subassembly in place

Figure 13 – Close up of display fixed to front panel **(DO NOT OVER-TIGHTEN DISPLAY NUTS !!)**

Double and triple check the alignment and make sure the header is fully seated into the LCD display module. Loosen the display nuts if necessary to get a good centered display alignment then re-tighten

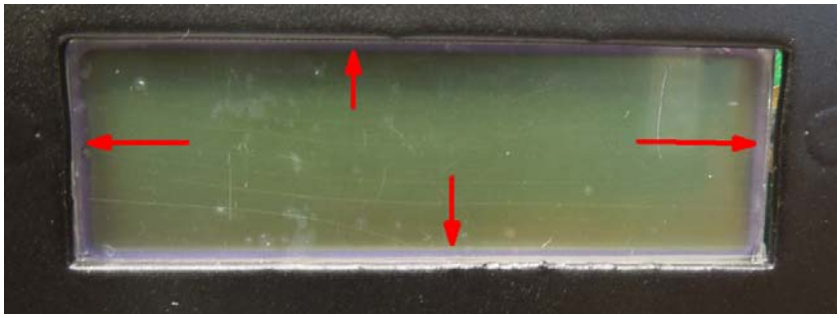


Figure 14 – Center the display window in the enclosure opening

Sometimes during handling, the header will slip out of the LCD display module. Before soldering, you may have to very gently pull the header back into the LCD module with thin long nose pliers or tweezers. We want all of the header pins to stick out roughly the same on each end.

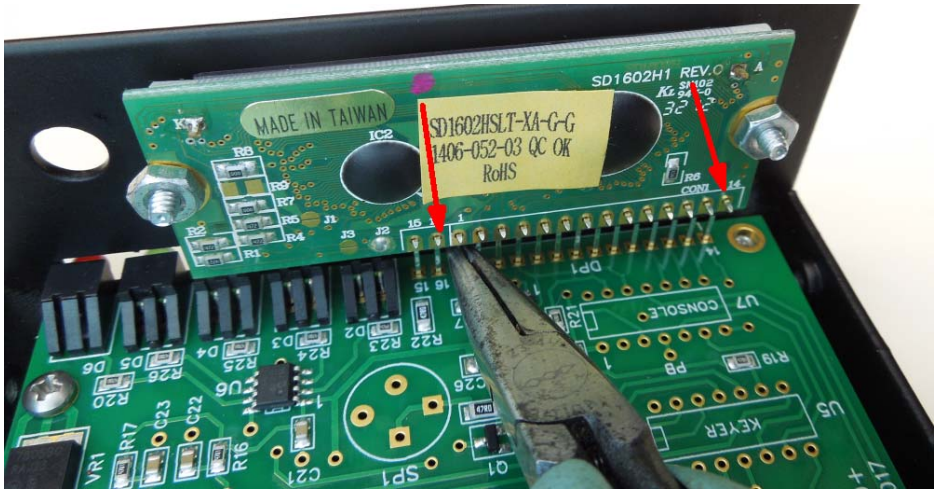


Figure 15 – Gently adjust header for equal pin alignment

Now carefully solder the two end pins on the LCD module and then two end pins of the header to the K44 board. It's easier to get at pin16 on the K44 board since it is further away from D2's LED housing.

Figure 16 – Solder four places to fix display alignment

Remove the two 4-40 nuts, and two 4-40 screws. Then extract the assembly from the enclosure base. Solder the unsoldered pins on both sides of the header. Be sure to NOT start with the end pins you soldered in the previous step because that will spoil the display alignment.

Figure 17 – Solder remaining connections on display

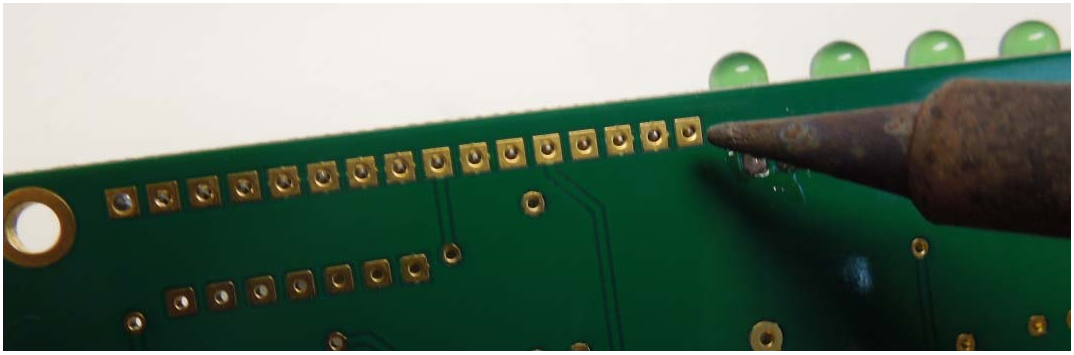


Figure 18 – Solder remaining connections on bottom of K44 board

Display assembly is now complete !

Now it's time to work with the rotary encoder. Locate the rotary encoder and encoder PCB seen below. Make sure the threaded encoder shaft fits into its mounting hole on the K44 enclosure's front panel. You may need to remove some paint on the inside of the enclosure hole to get it to fit.

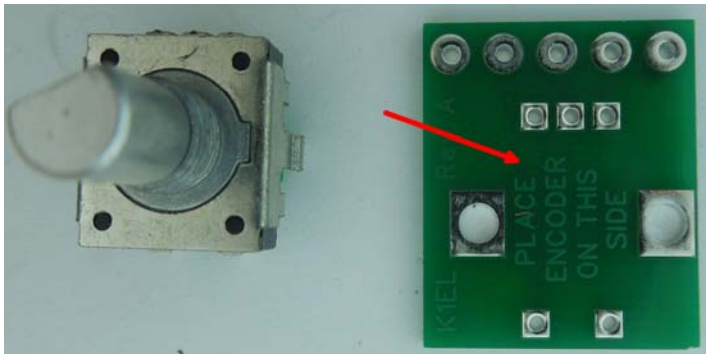


Figure 19 - Encoder and encoder PCB

Prepare five wires, two are 2.5 inches long and three are 1.5 inches long. Strip and tin both ends. Solder wires to PCB as shown in figure 17. This step is much easier if you use a board vice or clamp to hold the encoder board steady while you solder wires to it.

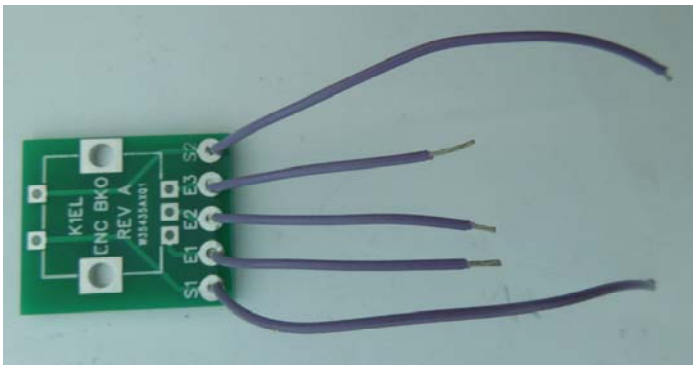


Figure 20 - Wires attached to encoder board

Mount the encoder on the correct side of the PCB per text on PCB. It's not necessary to completely fill the bracket mounting holes with solder.

Figure 21 - Encoder on encoder PCB

Solder the 5 wires from the encoder PCB to the K44 PCB as shown, starting with E1 to E1, then E2 to E2, E3 to E3, S1 to S1, and finally S2 to S2. Avoid hitting the plastic wire insulation with your soldering iron.

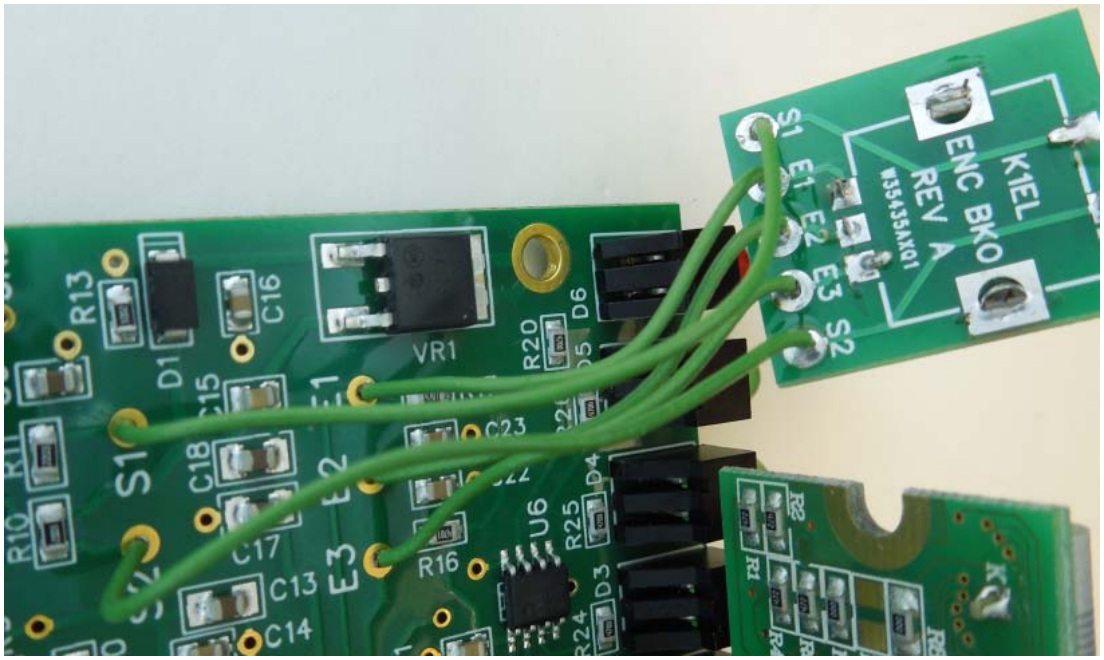


Figure 22 - Encoder PCB attached to main K44 PCB

Peel off the thin protective film from the front of the LCD display.

Figure 23 - Don't forget this step or the display will appear foggy !

Re-install the PC board assembly into the chassis by carefully folding the board back in place first on to the threaded studs then on to base mounting studs. Install and tighten the four silver 4-40 board mounting screws. **Please do not reinstall the two display hold down nuts.** The soldered header is mechanically strong and is all that is needed to support the display. More often than not, builders will over tighten the nuts and damage the LCD display or under tighten them so they work their way loose and fall on the board causing a damaging short circuit. ***Bottom line, do not install the display holding nuts !!***

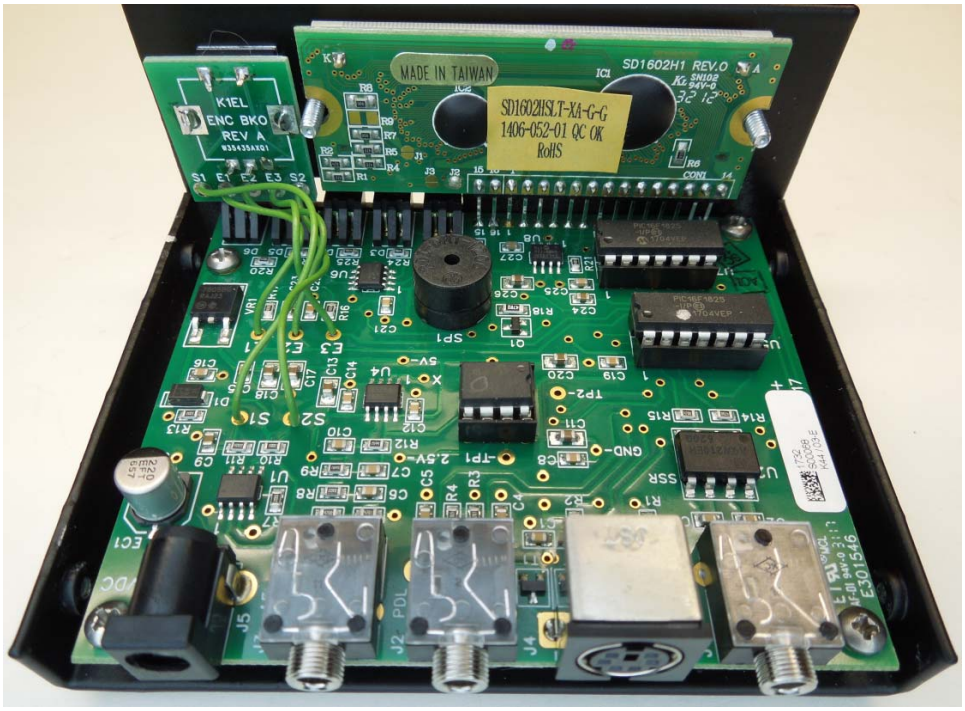


Figure 24 – Rear view with encoder and display in place

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. Be careful when tightening the nut, it's easy to slip and scratch the front panel. Now attach the rotary encoder knob using a small Allen wrench.

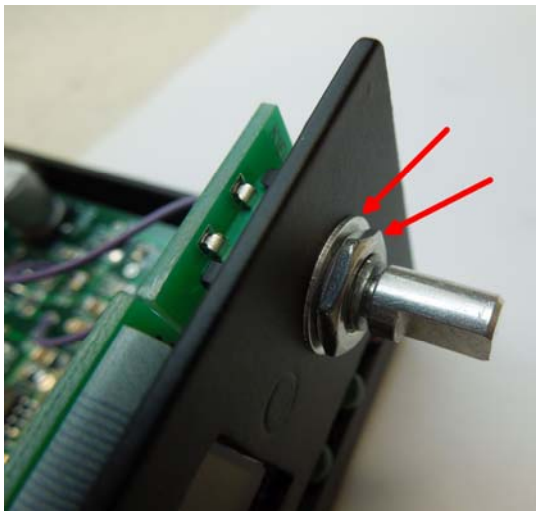


Figure 25 – Placement of encoder flat washer and hex nut

Attach heatsink to 5 volt regulator as shown:

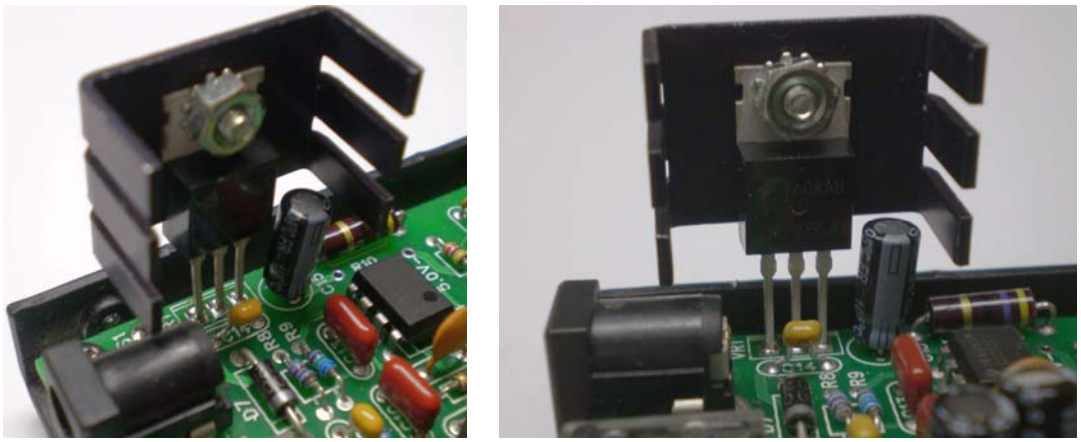


Figure 26 – Heatsink Installation

We will leave the top cover off until we have completed the K44 Test Procedure.

K44 Test Procedure

1) First thing to do is attach the K44 to power. The K44 accepts a 2.1 mm power connector with center pin positive. The supply voltage should be in the range between 7 to 13.5 VDC at 150 mA. As soon as power is applied, the LEDs will run a self test pattern. D1->D2->D3->D4->D5 then in reverse. This is followed by two alternating LED patterns. All LEDs will turn off after the test is complete.

2) During the LED test, the LCD backlight will turn on followed by a start up message. This message will display the PIC and PSoC versions along with other status as indicated in the figure below. If the display contrast is not satisfactory, we will show how to adjust it in step 3. After the LED test completes, the K44 will send an 'R' in sidetone, and the start up display will automatically clear leaving an underline cursor.

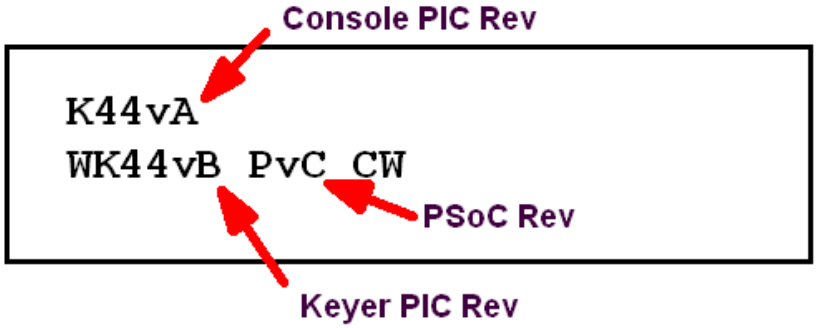


Figure 27 – Start Up Display with revision locations A, B, and C

3) Console PIC Test: Turn K44 power off by disconnecting power. Now attach a PS/2 keyboard and turn the power back on. We need to load a default keyboard table before we proceed. Simply press the Scroll Lock key and you will see FCR? displayed. Respond by hitting Scroll Lock again and the K44 will restart, load a keyboard table, and display QWERT. Now when you type on the keyboard you will hear CW sent in sidetone and also see letters displayed on the LCD display. If you want to change the keyboard mapping press CTL-ALT-INS and you can toggle between QWERT and AZERT layouts. Now that we have a keyboard attached we can adjust the display contrast. Press ALT-LEFT and ALT-RIGHT to change contrast.

4) Keyer PIC Test: Plug a keyer paddle into J3, it's assumed that your paddle set cable has an 1/8" stereo plug with left paddle connected to the tip. When you press the paddles you should hear dits when the left paddle is pressed, dahs when the right paddle is pressed, and alternating dits/dahs when both are pressed.

5) Keying Output Test: Make up a keying cable that has an 1/8" stereo connector on one end (K44) and an appropriate key connector on the other side that will plug into your transceiver keying input. This is usually a 1/4" phone plug. Before plugging into your radio, it's a good idea to verify keyer output by measuring the resistance across the tip and sleeve of the key connector. When you key either by paddle or keyboard, you will see the resistance vary with keying. If you measure between ring and sleeve, you will see the PTT resistance go low as long as keying is active. Meter lead polarity doesn't matter since the output acts like a switch contact.

Figure 28 – Key Output Connector

6) PSoC IC Test: During power up two LED test patterns are displayed. The second test shows two alternating LED patterns (two and three LEDs) which test the path between the PSoC and the LED controller. To test the PIC to PSoC path enter ALT-F2 and the default CWR speed will be displayed.

7) Rotary Encoder Test: Simply turn the encoder and you should see the current WPM value updated on the upper left side of the LCD display. The WPM value will increase when you turn clockwise and decrease when you turn counter-clockwise. The WPM readout will disappear a few seconds after you stop turning the encoder.

8) This is an optional test; if you have an audio frequency generator you can run a quick test. First of all, power up the K44 and hit the ALT and then F1 keys and you should see **CWR On** displayed.

   Now in order to feed audio into the K44 you will need to make up an audio cable. This will consist of an 1/8" mono or stereo plug on one end and bare leads on the other. Audio will be applied between the tip and sleeve of the connector. On your signal generator, select a frequency range that will cover a sub range close to 500Hz through 1000Hz. Set the output lever to minimum and connect the K44 audio cable leads to the signal generator output. Now plug the other end of the cable into the K44. Set the frequency to 725 Hz and slowly increase the signal level until you see the LEDs start to light. Stop when you see the rightmost red LED turn on. Now adjust the frequency back and forth around 725 Hz and you should see a definite peak close to 725Hz. It may not be exact due to signal generator calibration or allowable error in the K44. As long as it's close and there is a definite peak we are done. If you don't see this, the first thing to check is the placement of the three precision resistors followed by C11 and C12.

9) Using a receiver as an audio source brings up several issues. If you simply plug into a receiver's external speaker output you will not be able to hear anything because you are replacing the speaker output with the K44 which only consumes audio and does not have its own internal speaker. The ideal place to take receiver audio from an audio line out connector. Every radio is different, some put this on a connector labeled RTTY, Packet, Data, or if you are really lucky, and RCA jack marked Line Out. Odds are the line out connection is on a DIN connector which might be labeled AUX, AUX1, or AUX2. The beauty of using Line Out is that it is a fixed level not influenced by the AF gain control.

   If you want to skip line out, you can do a quick connection by using an external speaker connection and connecting that to an external speaker. Then tap K44 audio across the speaker. Be sure to connect the speaker's ground side to the K44 cable ground.

10) Now is the time to give the K44 a good workout, go through the K44 User Guide and try out some of the commands and message features. It will take some time to get through everything. If you have not done it, take some time to make up any interconnecting cables you may need, the following diagram shows the connector layout on the K44 rear panel. 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 Key Out jack.

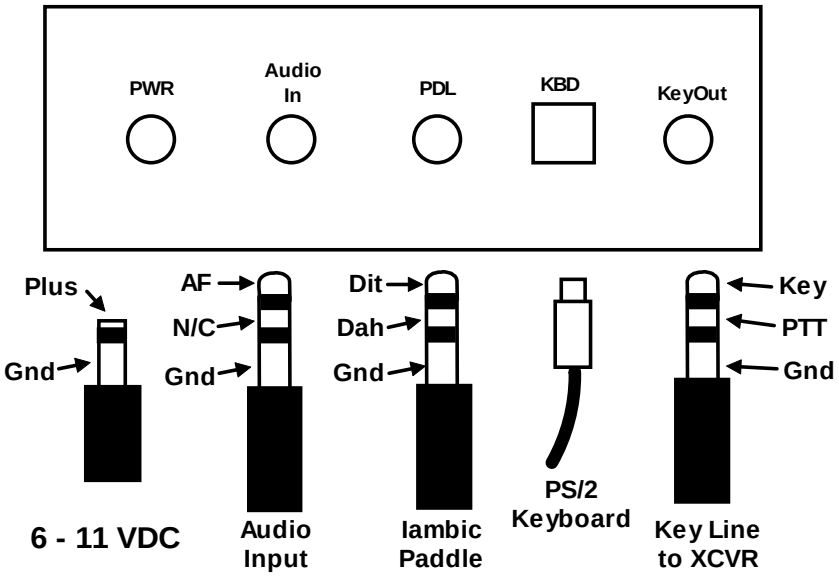


Figure 29 – K44 Back Panel Connections

Final Assembly

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.

Figure 30 – Fold top cover into place

Fig 31 - Completed Unit Front View

Fig. 32 - Completed Unit Rear View

R10 Information

This is an optional install and is not required for normal operation of the K44. R10 routes post filter audio to the ring of Audio In jack on the back panel. The intent was to provide a way for the user to extract in band audio from the K44 and feed it to an audio amplifier. This allows the user to hear peaked CW at the K44 decode frequency making it slightly easier to tune and decode a CW station. In practice it is not much of an advantage due to the extra cabling, shielding, and the necessity of an external audio amplifier. Unless you have a definite plan to use this feature we recommend leaving R10 out.

Rev A.1 Manual Changes
Corrected switch pads to X1 & X2 (not S1 & S2)
C13 is a mylar .01 uF cap
Clarified IC dot descriptions (page 2)

CW Keyboard Theory of Operation

This section will cover the CW keyboard portion of the K44. It can be helpful to read through this to get familiar with the circuitry if you are debugging the K44.

As shown in the block diagram below, two PIC processors share the task of converting keystrokes to Morse code. U6, the console PIC, is responsible for retrieving keystrokes from the keyboard and determining what to do with them. U4 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.

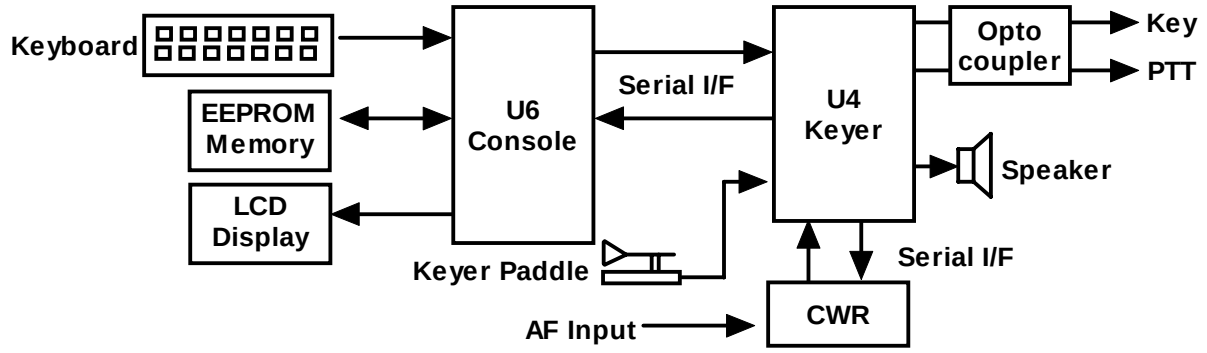


Figure 33 - K44 CW Keyboard Block Diagram

There are two types of data sent from the Console to the Keyer: Commands and Data. Commands modify the K44'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.

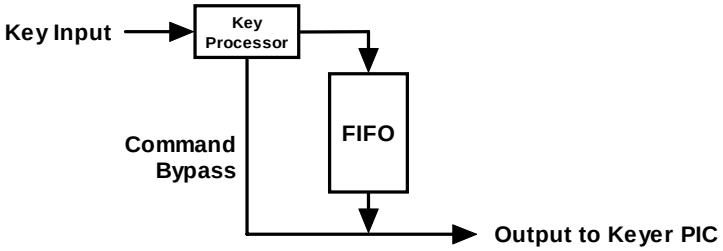


Figure 34 – Output FIFO Block Diagram

Since there are cases when you don't want commands to take effect immediately, the K44 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 K44 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 K44 power and ground and are open drain, 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 opto-coupler may be replaced by a solid state relay which allows the K44 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 resistor R16. Increasing R16 will lower the volume, decreasing it will raise the volume.

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 K44'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.

K44 CW Reader Theory of Operation

The following block diagram, Figure 28?, shows the main sections of the K44 CW Reader. Audio from a receiver is filtered through an initial four pole, 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 MCP6002 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 U5 which decodes the PWM input and represents the amplitude by lighting a six LED bar graph display.

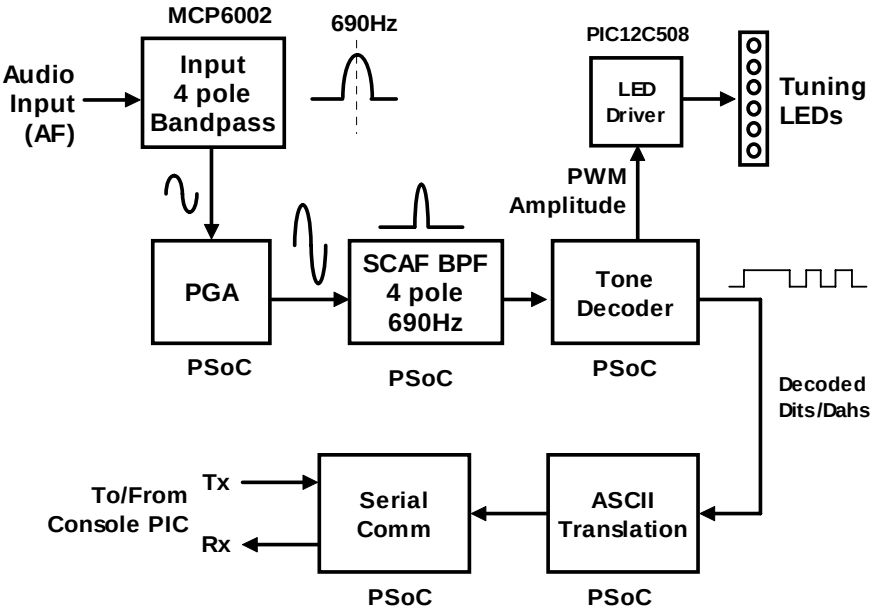
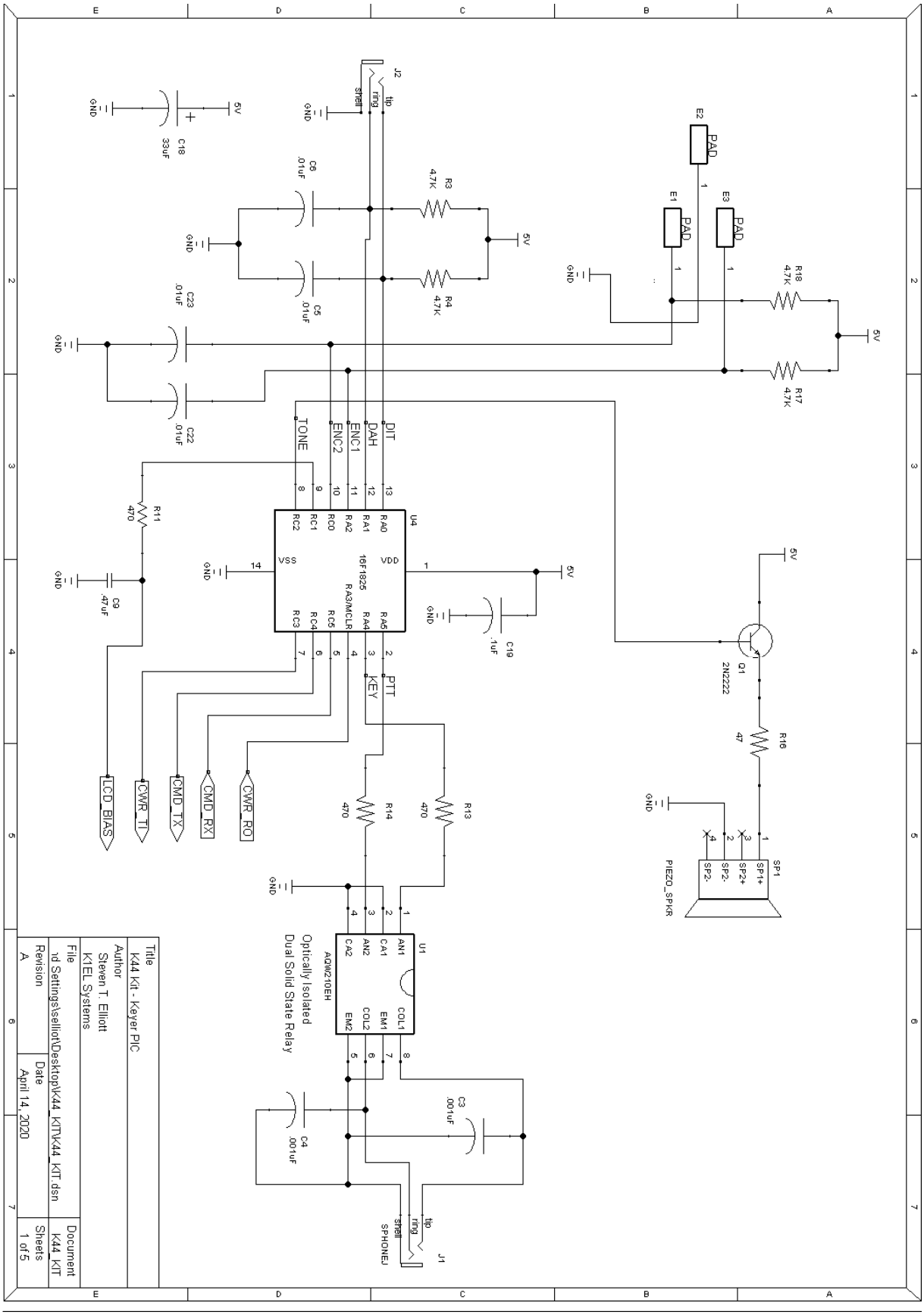


Figure 35 - K44 CW Reader Block Diagram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Author
Steven T. Elliott
K1EL Systems
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Revision
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Date
April 14, 2020
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1 of 5
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16F1825
U1
ADW210EH
Optically Isolated
Dual Solid State Relay
Q1
2N2222
PIEZO_SPKR
SPHONEJ
TONE
DIT
DAH
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ENC2
PTT
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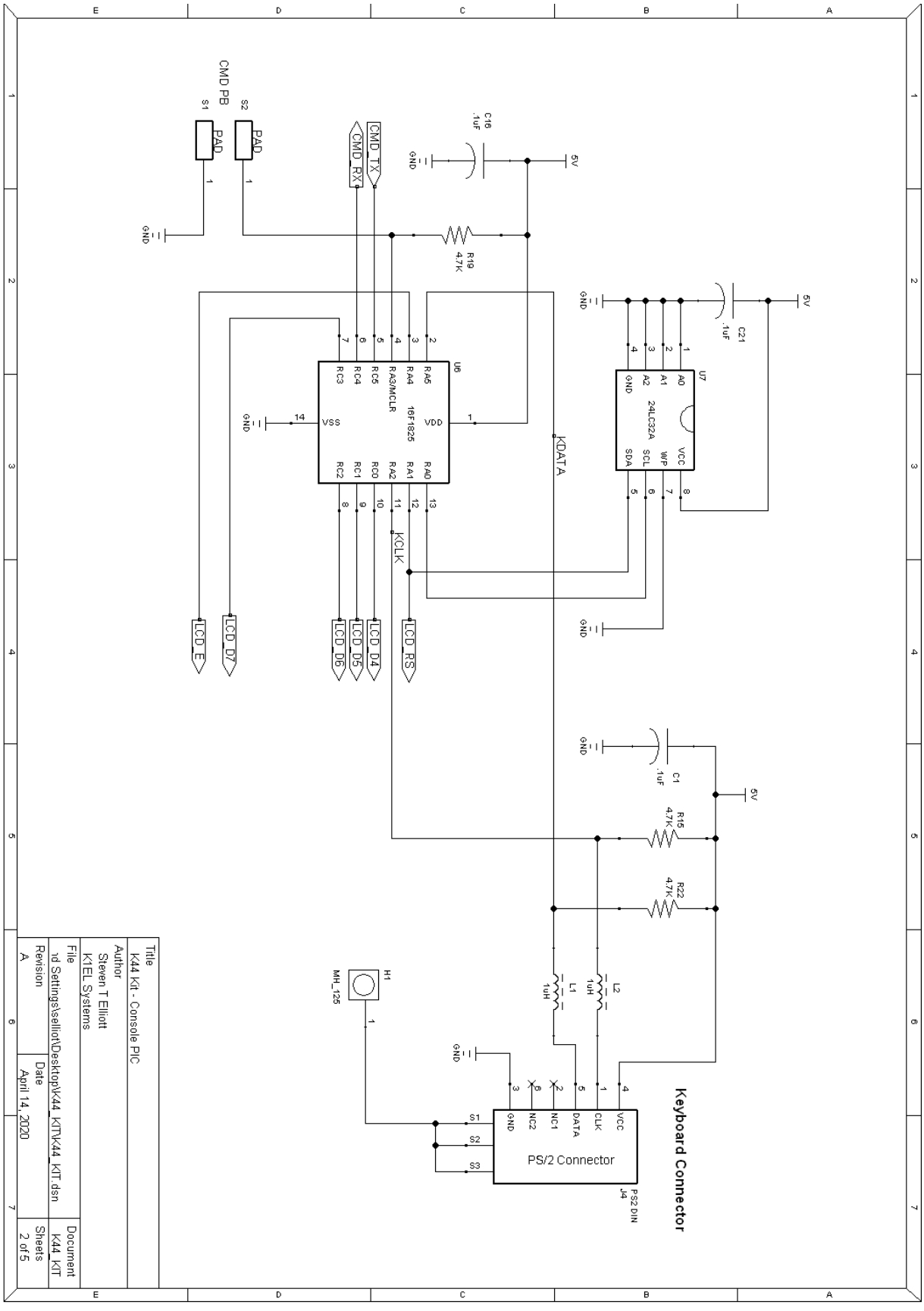
LCD_BIAS
CWR_TI
CMD_TX
CMD_RX
CWR_RO
5V
GND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S1
S2
PAD
PAD
CMD_TX
CMD_RX
C16
.1uF
5V
GND
R19
4.7K
U6
16F1825
RC3
RC4
RC5
RA3/MCLR
RA4
RA5
VSS
VDD
RC2
RC1
RC0
RA2
RA1
RA0
U7
24LC32A
A0
A1
A2
GND
SCL
SDA
WP
VCC
C21
KDATA
KCLK
LCD_E
LCD_D7
LCD_D6
LCD_D5
LCD_D4
LCD_RS
C1
R15
4.7K
R22
4.7K
L1
1uH
L2
1uH
H1
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S2
S3
PS/2 Connector
GND
NC2
NC1
DATA
CLK
VCC
PS2 DIN
J4
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Author
Steven T Elliott
K1EL Systems
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April 14, 2020
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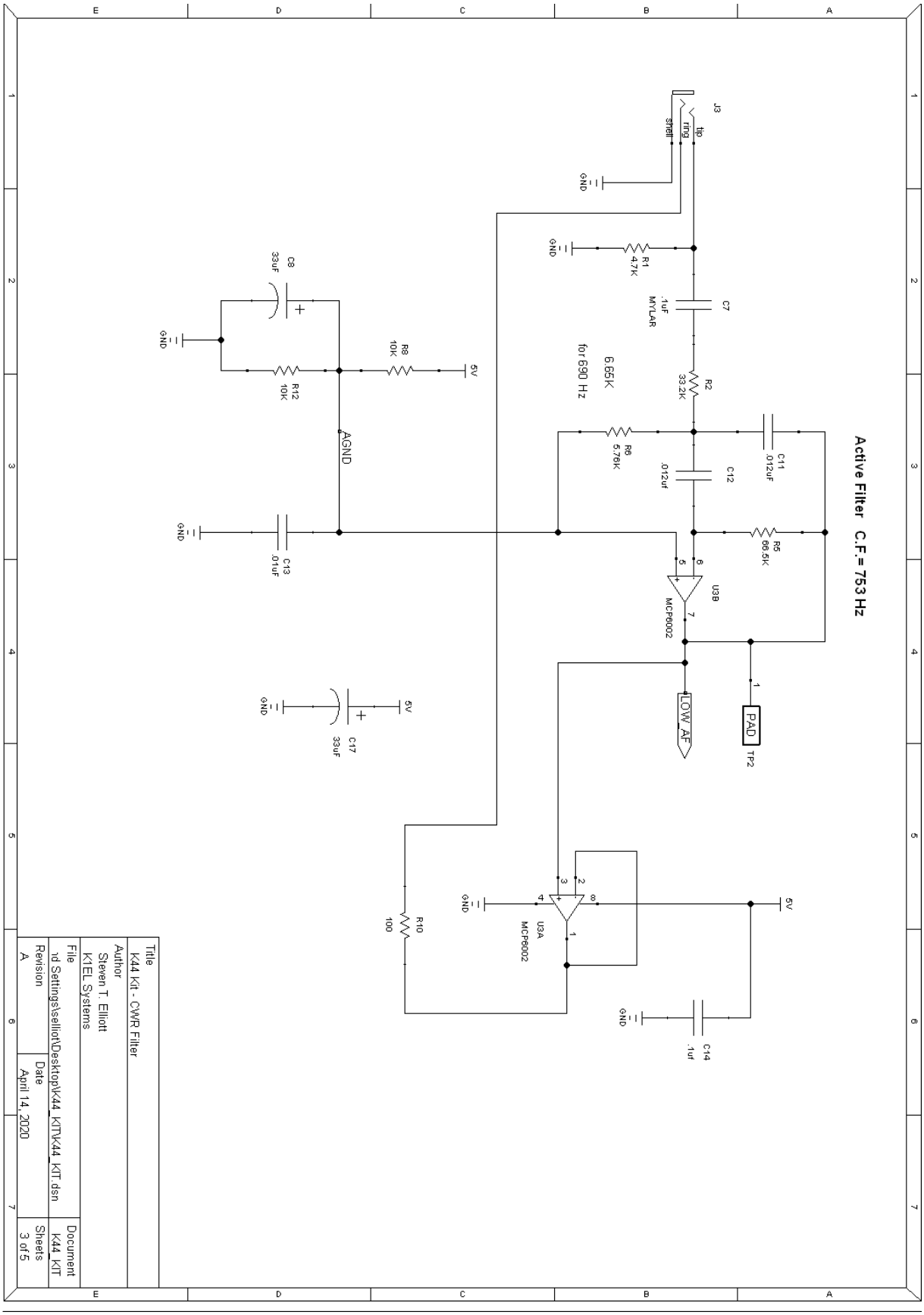
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J3
shell
ring
tip
GND
R1
4.7K
C7
.1uF
MYLAR
R2
33.2K
6.65K
for 690 Hz
R6
5.76K
C11
.012uF
C12
.012uf
R5
66.5K
U3B
MCP6002
LOW AF
PAD
TP2
C8
33uF
R8
10K
R12
10K
5V
AGND
C13
.01uF
C17
33uF
R10
100
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MCP6002
C14
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Author
Steven T. Elliott
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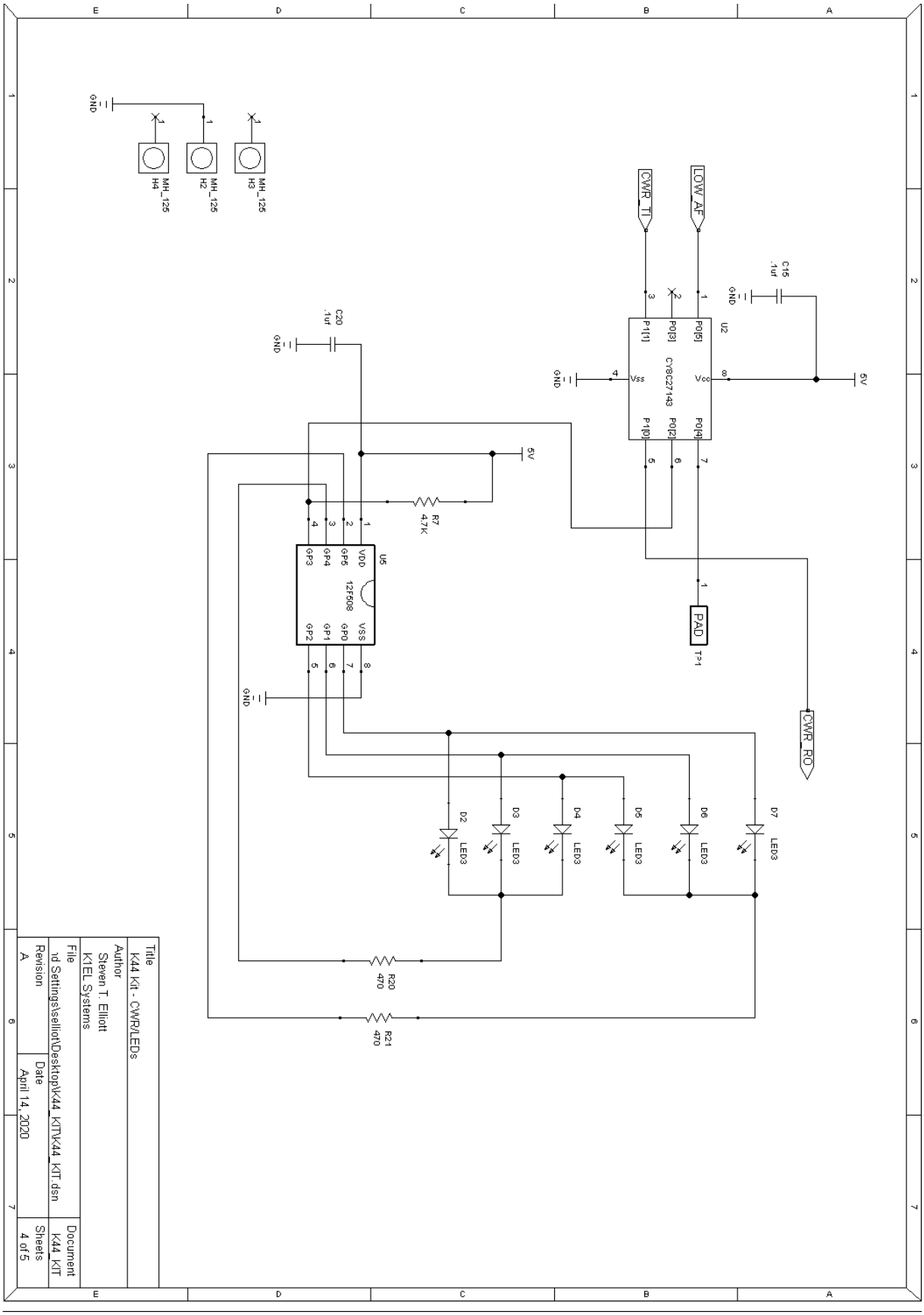
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H4
MH_125
H2
MH_125
H3
GND
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C20
.1uf
U2
CY8C27143
P1[1]
P0[3]
P0[5]
P1[0]
P0[2]
P0[4]
Vss
Vcc
5V
R7
4.7K
U5
12F508
GP3
GP4
GP5
GP0
GP1
GP2
VDD
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TP1
CWR_RO
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D3
D4
D5
D6
D7
LED3
R20
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R21
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K44 Kit - CWR/LEDs
Author
Steven T. Elliott
K1EL Systems
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April 14, 2020
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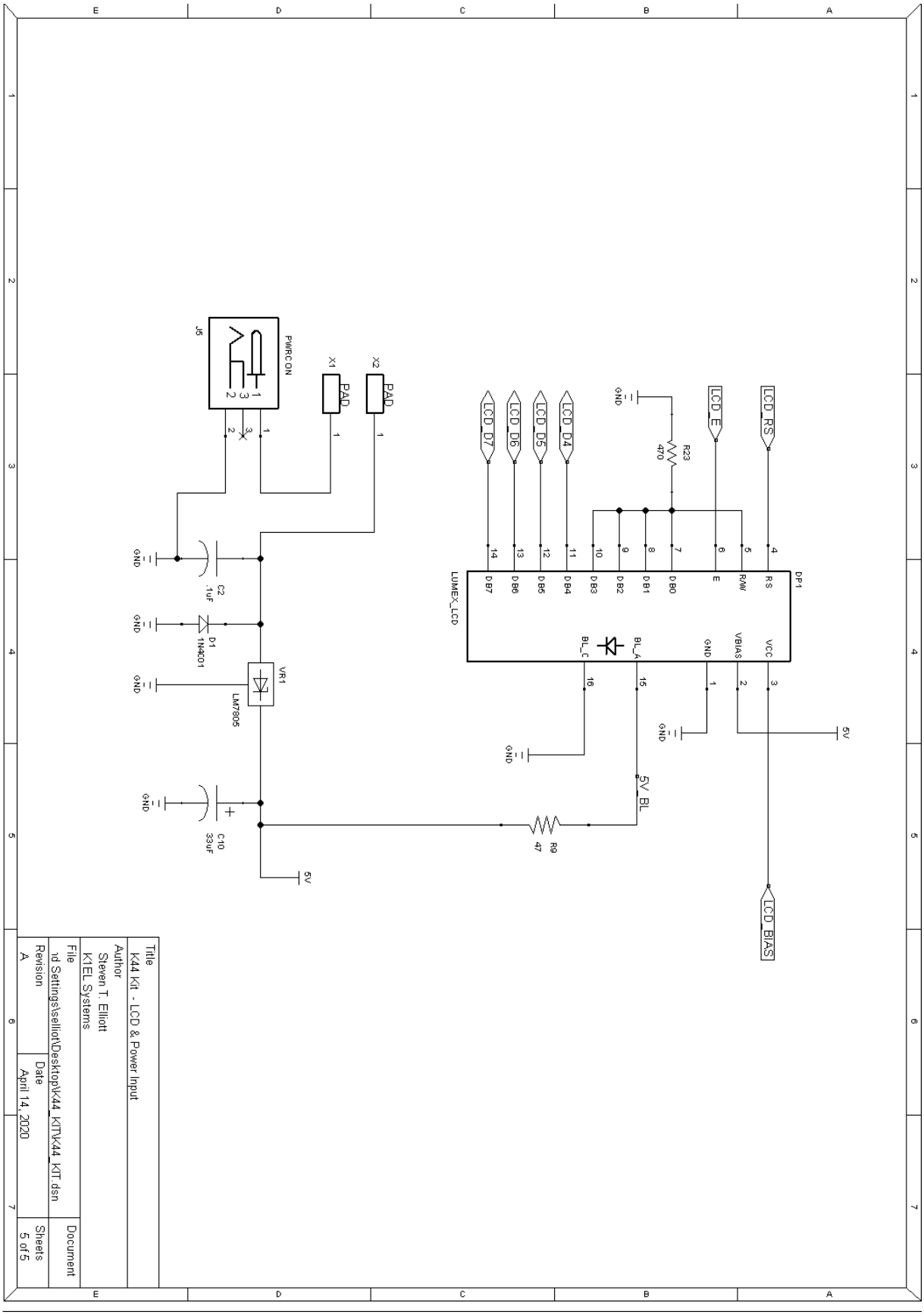
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X2
PAD
C2
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D1
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VR1
LM7805
C10
33uF
R9
47
R23
470
LCD_D7
LCD_D6
LCD_D5
LCD_D4
LCD_E
LCD_RS
LCD_BIAS
5V
5V_BL
GND
DP1
LUMEX_LCD
DB7
DB6
DB5
DB4
DB3
DB2
DB1
DB0
E
RW
RS
VBIAS
VCC
BL_C
BL_A
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K44 Kit - LCD & Power Input
Author
Steven T. Elliott
K1EL Systems
File
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Revision
A
Date
April 14, 2020
Document
Sheets
5 of 5

Appendix A - Kit Construction Hints

1. Find a good workspace.

It is essential that you have a good place to work on your kit, You will need room to spread out your parts and have access to tools. Good lighting and ventilation is essential. A magnifying glass or hood is highly recommended.

2. Have the proper tools.

At a bare minimum you will need:

Small side cutters, flush cutters are a plus.
Small needle nosed pliers
Small flat blade & Philips head screw drivers

A good quality, 40-60Watt, temperature controlled Soldering Iron. The price has come down on these; you can buy a Weller WLC100 40W adjustable soldering station for $40 on Amazon.

3. Read the Instructions First.

Read through the assembly instructions completely and have everything on hand before you start. Carefully inventory the kit parts, make sure you have everything.

4. Follow the assembly instructions in order.

Although not always obvious, the order in which parts are installed is important and should be followed. Sometimes individual sections are completed and tested in order or there may be mechanical clearance considerations.

5. Keep your Workplace Clean and Orderly.

Nothing spoils a kit building experience more than lost parts. Second to that are stray bits of dirt and metal that get on a printed circuit board assembly. Our PC boards are nicely plating and accept solder easily. There is no need to use solder flux or to clean the board with steel wool before starting.

6. Take your time.

There is no need to rush, enjoy the process and the difference will show in the end result. Moving too quickly or working when you are tired often leads to big mistakes which could be difficult if not impossible to fix.

Appendix B - Note About Safety

Burns to your skin can be very painful and can lead to serious injury.

Burns to your eyes can be catastrophic.

Toxic fumes can cause serious harm.

Flying objects such as wire ends etc. can cause painful and serious injuries.

When building your kit please remember that Soldering Irons and Solder are used at High Temperatures!

Soldering Irons can remain hot for many minutes after being turned off. Never touch the tip to see if it is hot. Place the tip on a wet pad to test for temperature.

Wear safety glasses to protect your eyes from flying objects.

Appendix C - Soldering Basics

1. Insert component leads into PCB holes and bend them back slightly to hold the part in place. You can either trim the lead now or wait till after the joint is soldered. I usually install several parts at one time and then solder and trim multiple leads in groups.

2. Place a hot and clean iron tip against both the lead and pad as in Fig. C1.

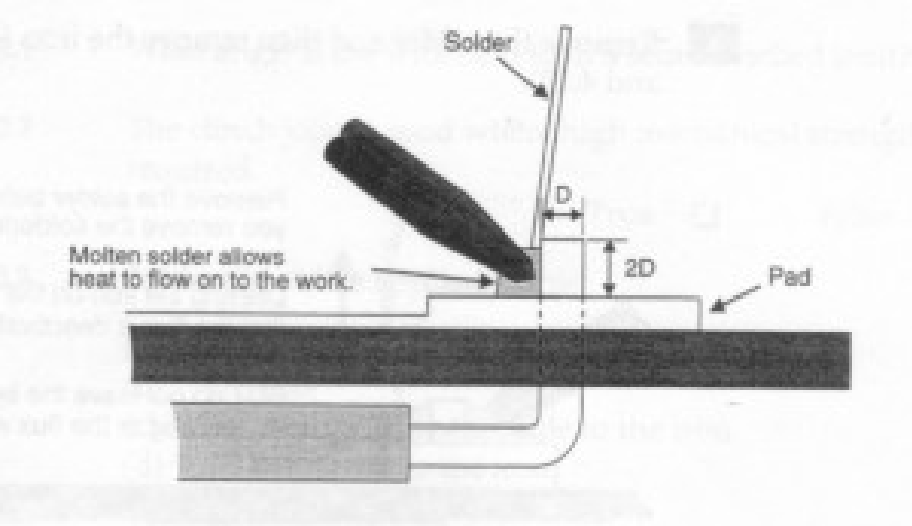

Figure C1 - Form a heat bridge

3. Create a heat bridge between the lead, the PCB pad and the iron by placing a small amount of solder on the tip.

4. Apply solder around the outside edge of the pad as in Fig. C2. If the pad and lead are at the correct temperature, the solder will flow around the connection.

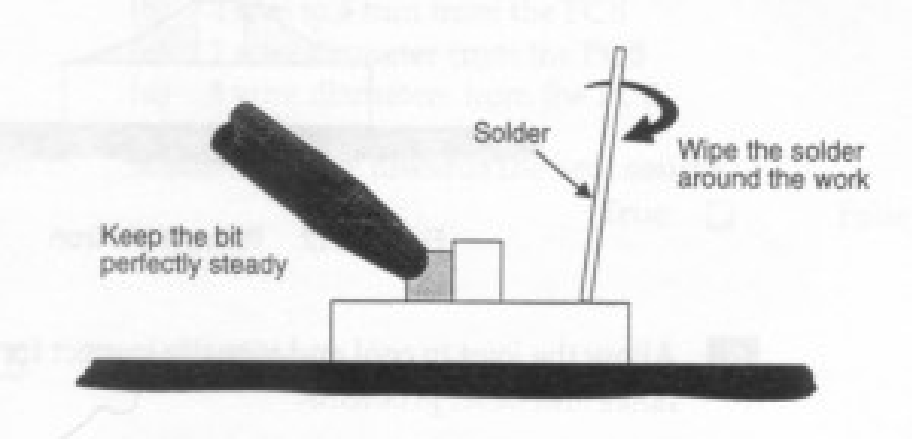

Figure C2 - Spread solder around the work

5. Remove the solder and then remove the iron:

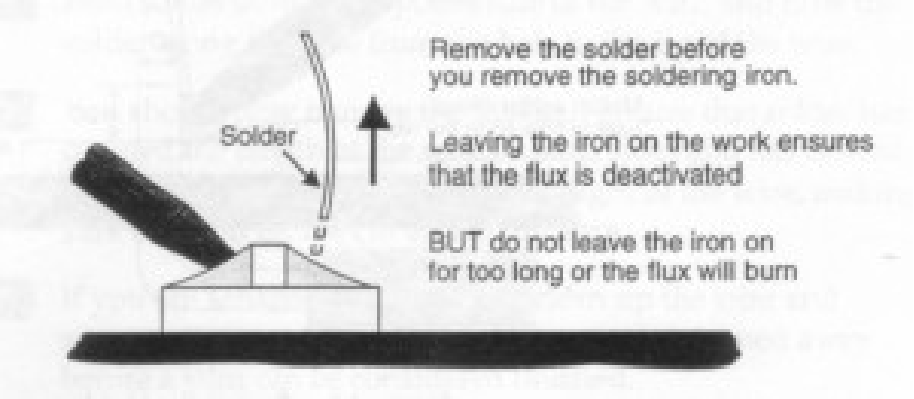

Fig C3 - Remove the solder

6. Allow the joint to cool and visually inspect for defects or other problems. You should have a solder joint with a bright shiny finish and a profile like that shown in Fig. C4.

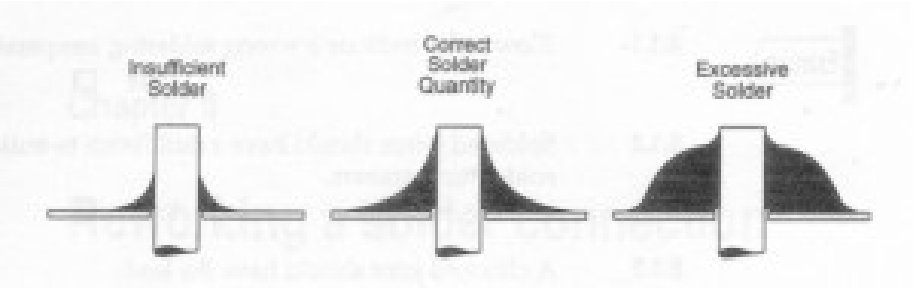

Figure C4 - Solder quantity comparison