1. PACKAGE INSPECTION AND COMPONENT IDENTIFICATION

The project kit comes in one package as shown in Fig.1. Unpack the bag and identify its content using parts list enclosed. Verify that parts are correct and free of damage, and that they correspond to parts list. Always keep unused parts in the very same bag with your name on it. Report immediately if you find that some parts are missing or that part numbers are wrong. Handle parts and boards with extreme care to minimize damage due to electrostatic discharge, mechanical abuse or dirt and sweat which causes oxidation of soldering surfaces.

Figure 1-1: Oscilloscope project 06204KP package bag

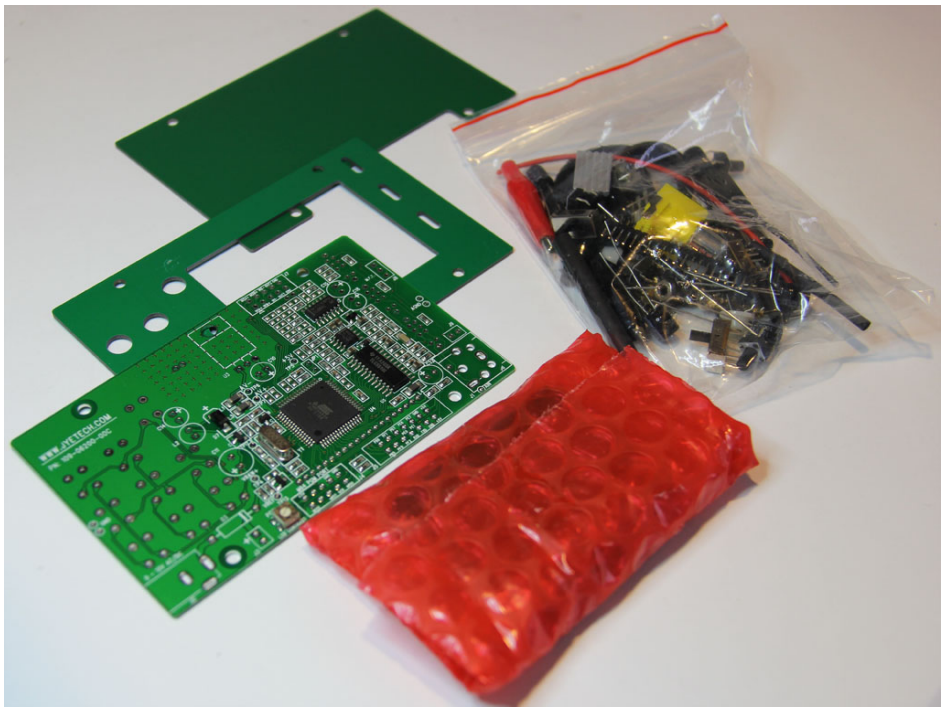
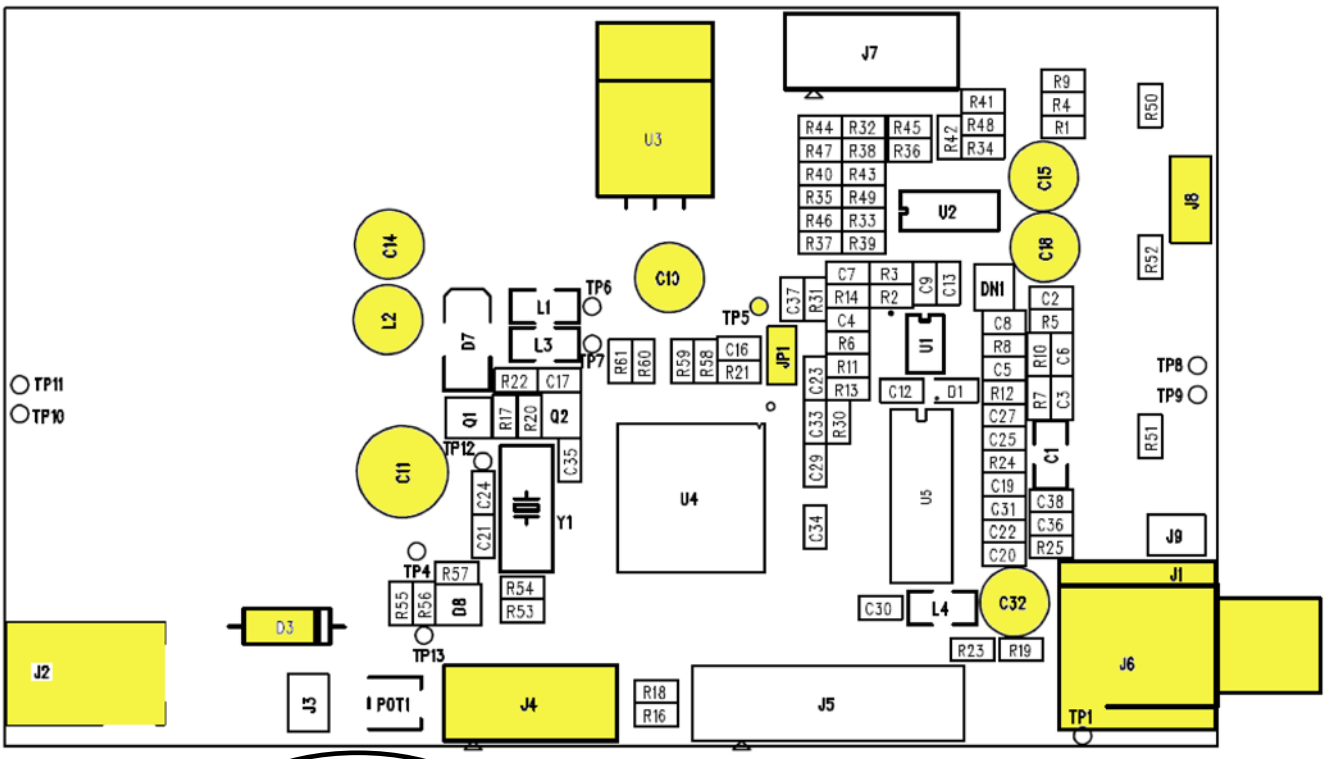
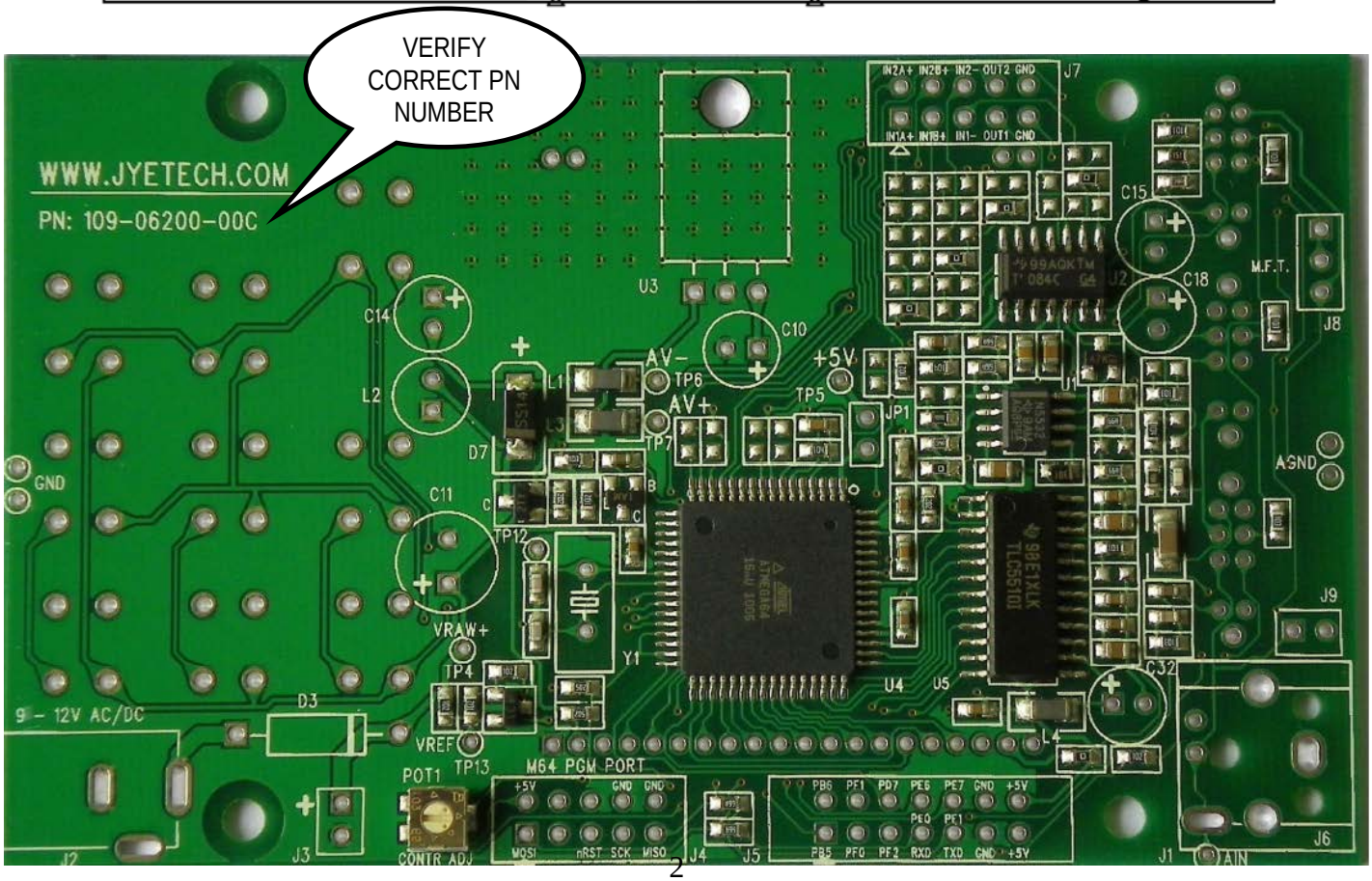


Figure 1-2: Oscilloscope project 06204KP package bag content

Figure 1-3: Identification of components layout and soldering points





2. TOOLS

In figures below you can recognize some but not necessarily all of the tools required for assembly of this oscilloscope kit. For the purpose of successfully soldering I recommend very sharp iron tip with at least two-three different diameters of soldering wires. All soldering illustrated in this instructions has been performed using a 40-watt soldering iron shown in figure (compared to a LED, size-wise). Do not forget de-soldering wick, cleaning sponge and screwdrivers. Be careful when using de-soldering pump especially if it is as powerful as the one shown; multiple suction operations usually end up lifting the whole pad from the board. In many cases this means only one thing - good bye project! When handling the PCB or components, use edges or non-soldering parts. Clean the components' leads if you notice traces of corrosion on them: almost all components from a sample kit used for the purpose of this instructions, have required some cleaning to be done; I have used a long-nose pliers (see diode bending figure further down in text) to strip away dirt along the leads around soldering or cutting points.

Make sure your hand is not shaking while soldering by providing at least one fixing point of the arm. The tip approaching angle should be convenient for easy lead touch and safe solder flow. Do not apply soldering iron to thin soldering pads for longer than 5 sec! If you fail to finish soldering in first attempt, repeat again after cooling down the pads and solder for 5-10 sec.

A solid board stand (holder) is crucial in having a steady and safe soldiering conditions. Magnifying glass is optional but very useful when checking the quality of your work and inspecting for solder bridges or metallic debris on PCB.

DO NOT ATTEMPT TO COMPLETE THE TASK WITHOUT PROPER SOLDERING IRON OR TOOLS-IT IS VERY LIKELY THAT YOU WILL DAMAGE THE DEVICE!

There should be no improvisation of any kind! This is an example of an electronic device of a high PCB complexity with heavy trace density; it has some very thin and therefore brittle traces which are sensitive to mechanical or heat damage. As with any other kit assembly, there is no guarantee that device will work fine at the end, unless you follow the instructions thoroughly and apply yourself as a dedicated professional! If you don't do that - you will fail, no question!

3. THROUGH-HOLE COMPONENT SOLDERING

It is recommended to start soldering TH component in the following order:

3.1 Diode D3

A diode is a polarized device with clear distinction between the positive terminal (anode) made of p-type material, and the negative terminal (cathode) made of n-type doped material. By now, you should be able to determine diode polarity easily, using a DMM with diode-checking feature. However, most of the diodes have a white (or black, or silver) strip imprinted on diode body to simplify cathode identification. The anode terminal must be mounted into the hole (pad) marked as white square. Simply follow the silkscreen graphics of the diode on the PCB. This diode has protective function in case the applied voltage from an AC adaptor has reverse polarity. Before soldering, clean the leads and bend them to the length to fit the predrilled holes. After cleaning, avoid touching the leads and save lead off-cuts for further installation.

NOTE: Do not follow the instruction in manufacturer's original manual-it is opposite!

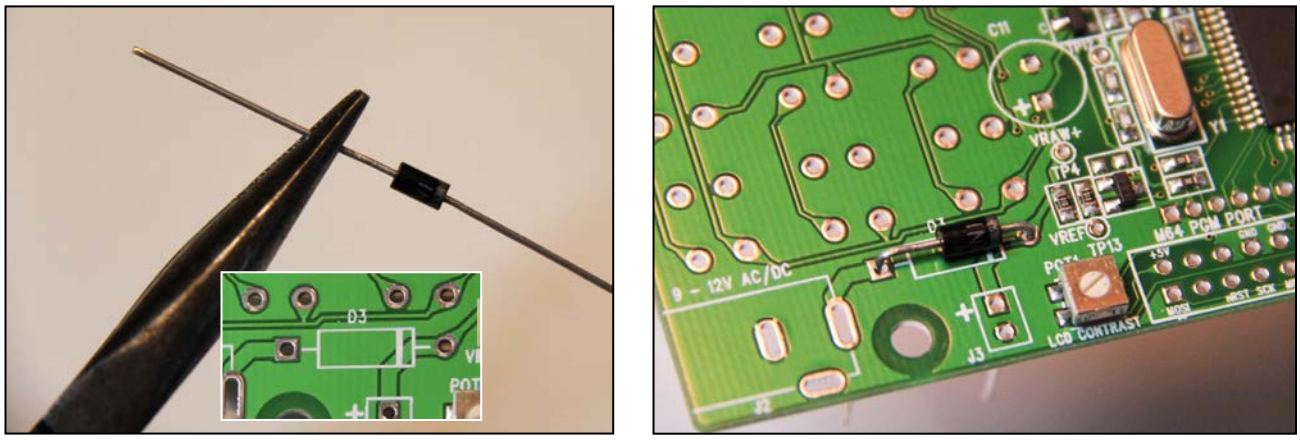


Figure 3.1-1: Diode D3 Installation

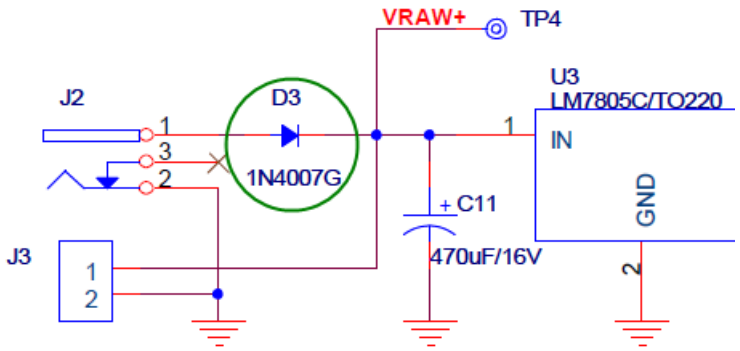
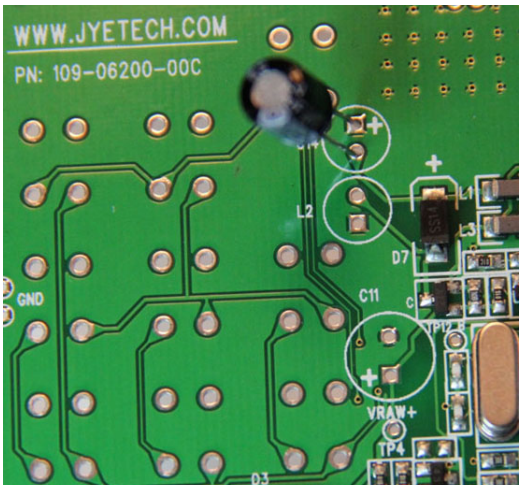


Figure 3.1-2: Diode D3 Schematic Detail of the Regulator Circuit

3.2 Electrolytic Capacitors C10, C11, C14, C15, C18 and C32

All electrolytic capacitors are polarized devices and should be installed properly. The negative pole is connected either to a shorter lead (if the two are not equal in length) or/and the negative mark may be imprinted on the body beside the corresponding terminal. Therefore, the positive terminal must go into a hole with white square or often designated as "+". Select proper location of the capacitor C11=470 µF because it is used as a major rectifying filter unlike others which are all 100 µF. In addition, when mounting C10, cut the leads flash to PCB to avoid possible contacts and shorts with the LCD module which will be installed on top of it.



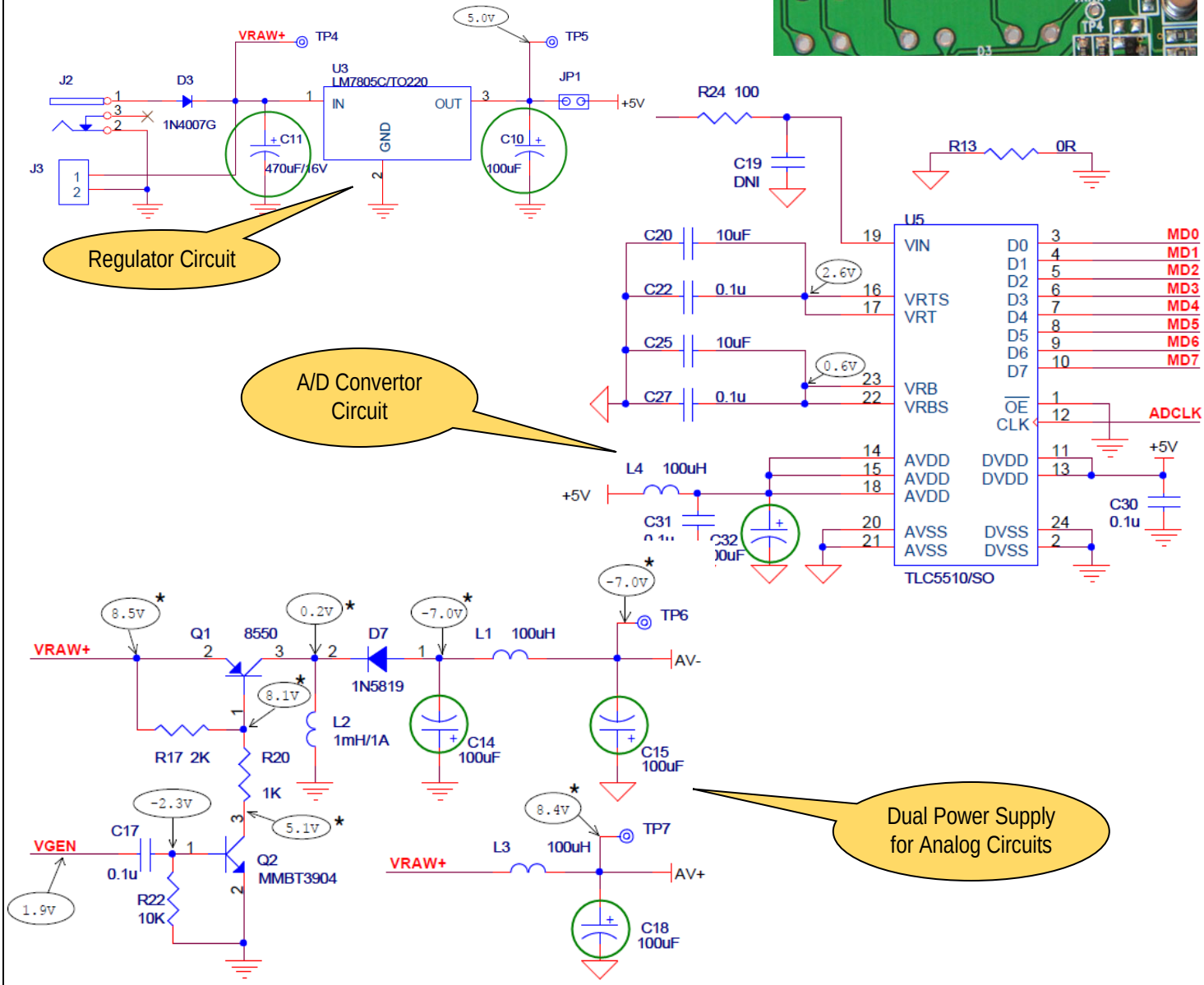
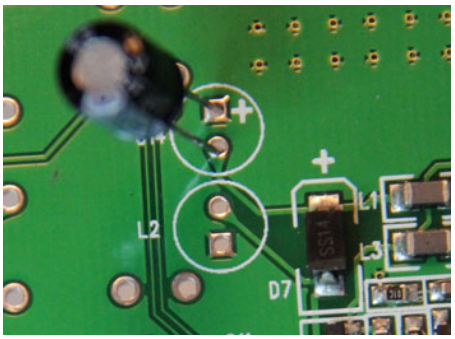
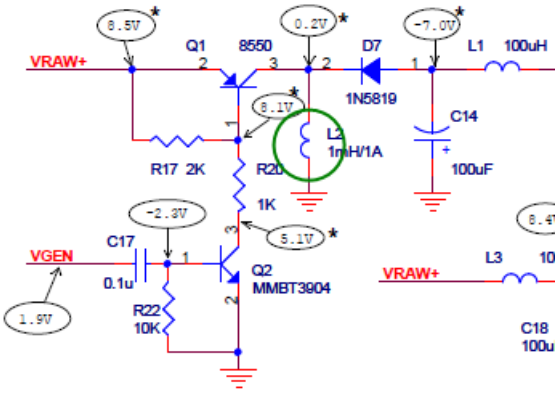


Figure 3.2-1: Respective Capacitors' Locations in Schematic Drawing

3.3 Inductor L2

Inductor is NOT a polarized component; therefore you don't have to worry about terminal orientation. However, be careful when handling this fragile device because of extremely tiny coil wire; do not apply any force on soldering terminals (bending, twisting, dropping, etc.) which may cause wire to break. From schematic drawing you can identify the function of the inductor L2 in switching regulator circuit; when BJT Q1 conducts, it charges this inductor in short pulses (D7 is OFF); when Q1 is off, induced voltage across inductor charges capacitor C14 and D7 which is forward-biased now. This is a standard method of creating reverse polarity of the voltage required for the dual supply voltage used in amplifier stages.





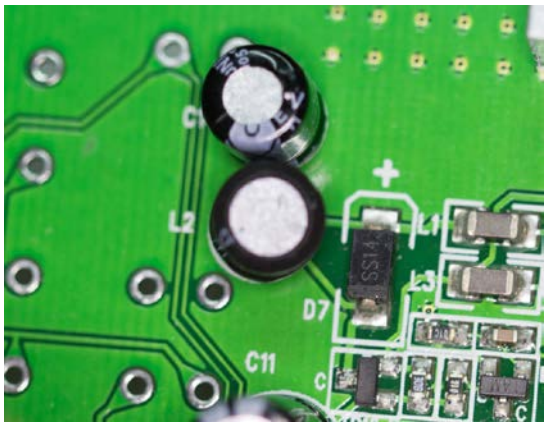
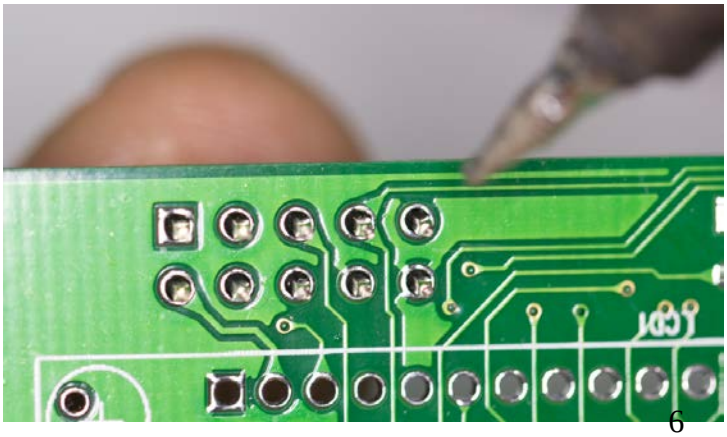
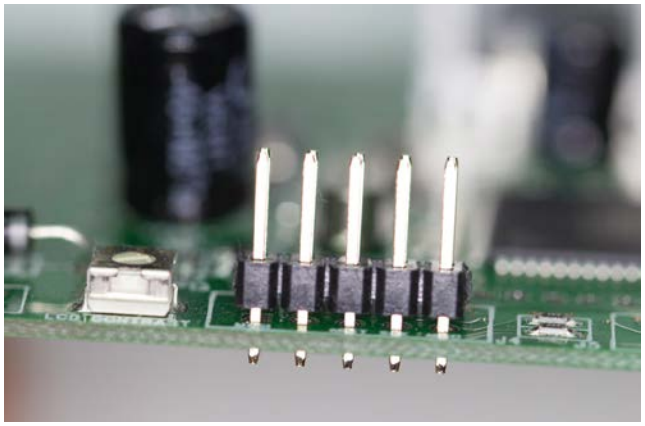


Figure 3.3-1: Inductor L2 must be mounted between capacitor C11 and C14 - polarity is irrelevant

3.4 Header Connector J4

J4 connector is a header 10-pin connector for programming the Atmel microcontroller ATmega64. It is not crucial for oscilloscope application which already resides in CPU memory. However, it may be a very useful tool if students decide to modify the functionality of the scope at later times. This option offers numerous possibilities in processing, analyzing or displaying different signals. Figure 3.4-1 illustrate correct header position. It is very likely that you will have to push the header against the PCB for soldering; because connector's metal pins provide excellent heat transfer, you should protect your fingers from burning (use piece of cloth, paper or alike). Connector should sit well and straight on PCB.





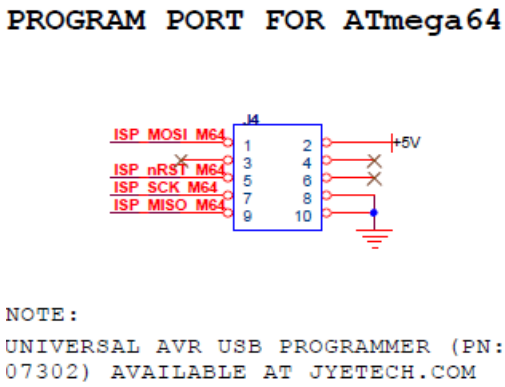


Figure 3.4-1: Header Connector J4 is used for optional programming of µC ATmega64

3.5 Power Connector J2

J2 is a RCA connector for connecting power supply adaptor to the scope. It has 3 terminals: one common and another two which make a contact (normally closed contacts, when RCA female connector of the power cable is not plugged in), or break, when power cable with RCA female connector is plugged in). This terminals have larger sizes and require more heat (wider soldering tip or more powerful soldering iron), and thicker soldering wire when soldering. If the same soldering tip is used for all soldering (like I have done in this manual), apply wider portion of the soldering tip cone to allow better heat transfer. To keep the connector in place, I had to bend one terminal before soldering the other two (see picture below), and then I straighten back the bent one before finishing the job. If terminals appear to be dirty, clean them thoroughly and apply flux generously, before soldering.

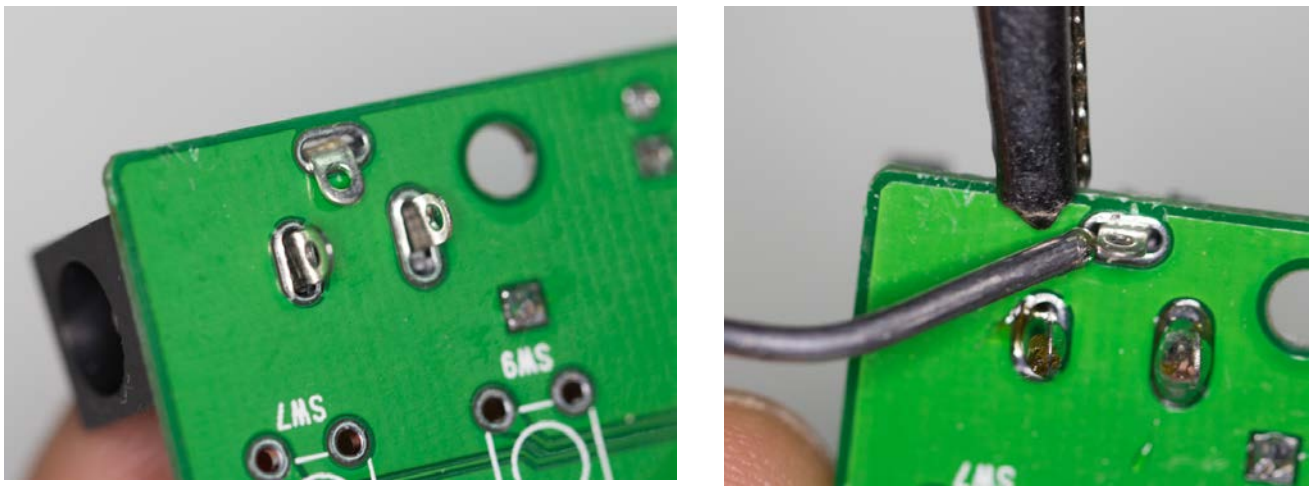


Figure 3.5-1: Power Connector J2; use more heat and thicker soldering wire (with flux core)

3.6 Signal Connector J6 (J1)

J6 is an RCA connector for connecting measured signal to the scope via special probe cable assembled later in this manual. It has 2 terminals: one common and one signal terminal (hot).

For easy assembling, it has additional 3 plastic fixing pins (**do not solder them**!). Again, just like in step 5, because of large sizes, the solder cools downs faster thus requiring more heat. Make sure the connector sits flush and straight on the PCB.

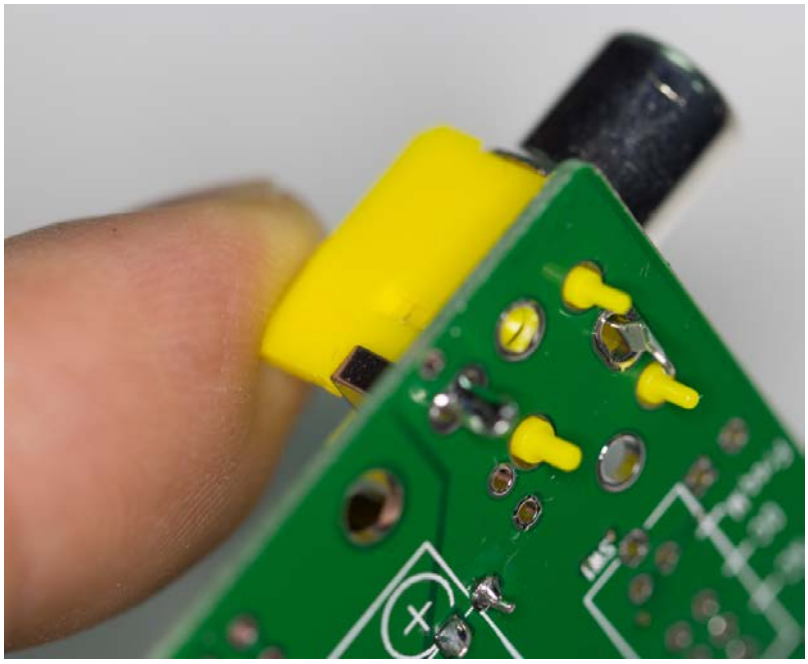


Figure 3.6-1: Signal Connector J6 Assembly

3.7 Test Signal Terminal J8

J8 is a self-made terminal for connecting oscilloscope probe to an internal test signal, equivalent to a calibration test point on our lab oscilloscopes, which provides a reference or test square-wave waveform for adjusting probe performance. You should make this test point in a form of a small U-shaped loop using left-overs of the diode lead off-cuts. Use convenient object (like a screwdriver, or a similar round object) to bend it outwards and make a U-shaped half-loop as shown in Fig.6.7-1. The height of the loop should be around 0.3 inches. Solder this terminal to the top 2 pads of the terminal J8 designated as M.F.T.

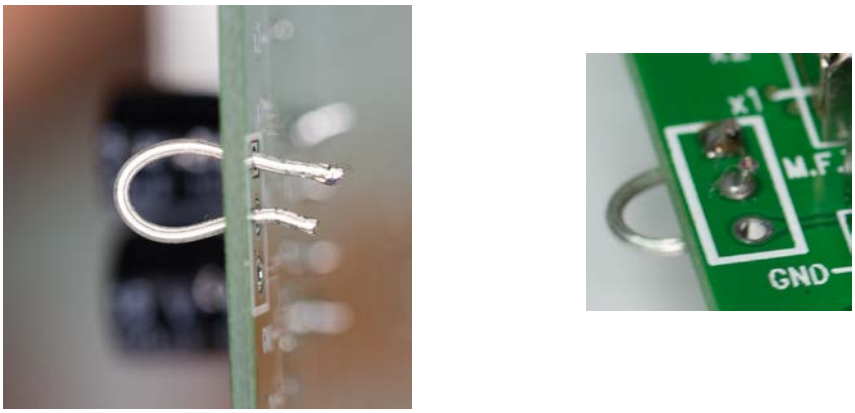


Figure 3.7-1: Test Signal Terminal J8 (M.F.T.)

3.8 Voltage Regulator U3 with Heat Sink

A fixed 5V-regulator U3 in TO-220 casing must be mounted on a heat sink. Because of the horizontal positioning of this chip, its leads has to be bent 90 degrees at an appropriate distance to fit both: the mounting hole and the terminal pads. Therefore we should make heat sink assembly prior to soldering (see Fig. 3.8-1A), just to be able to estimate better bending point. When you are satisfied with positioning, disassemble the heat sink again, and mount it to the PCB using pan head screw M3x10mm (see Fig.3.8-1B). Then place the U3 regulator into the correct position and tighten the assembly with the nut using long-nose pliers. After the soldering, cut the excessive terminals flush with the PCB.

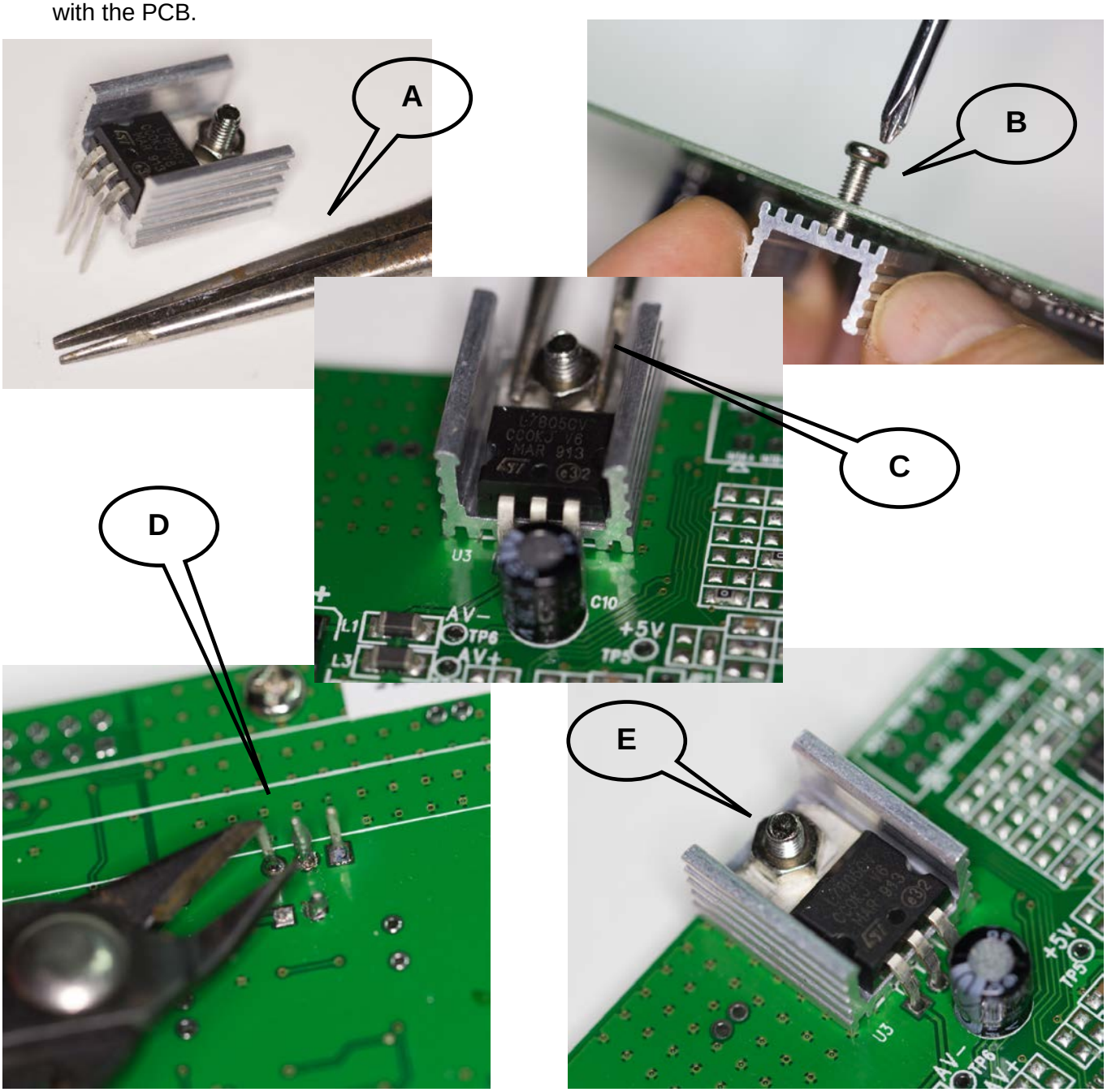


Figure 3.8-1: Voltage Regulator Assembly

3.9 Testing 5V Power Supply and Installing Safe-Guard Jumper

Upon installation of the voltage regulator, our basic board is ready for power check-up. Use original AC/DC adaptor SM-0222 available from the same supplier of the oscilloscope kit 06204KP, that provides nominal DC output voltage of approximately 9V. Other AC/DC adaptors are suitable as long as they provide similar output voltage within a range 9-12V DC, and have central pin of the power connector attached to + polarity (note the label on enclosed photo). It is not necessary to provide 1000mA consumption current (300 mA will do the job). At this point, voltage regulator circuit is not connected to other electronics on the board so it is safe to plug in the AC/DC adaptor's connector into J2.

NOTE: Whenever you power on electronic circuitry for the first time, look for signs of excessive heat or smoke and disconnect power immediately!

If your board survives power on, using DC voltmeter measure the voltage at test point TP5 (+5V); it should read 5V±0.2V! Fig. 3.9-1 shows a voltage measurement between TP5 and common for which I used a tab of TO-220 case of U3 (or heat sink itself). If the value is far off, check again D3, C10, C11 and U3 soldering points and galvanic connections between them using schematic drawing.

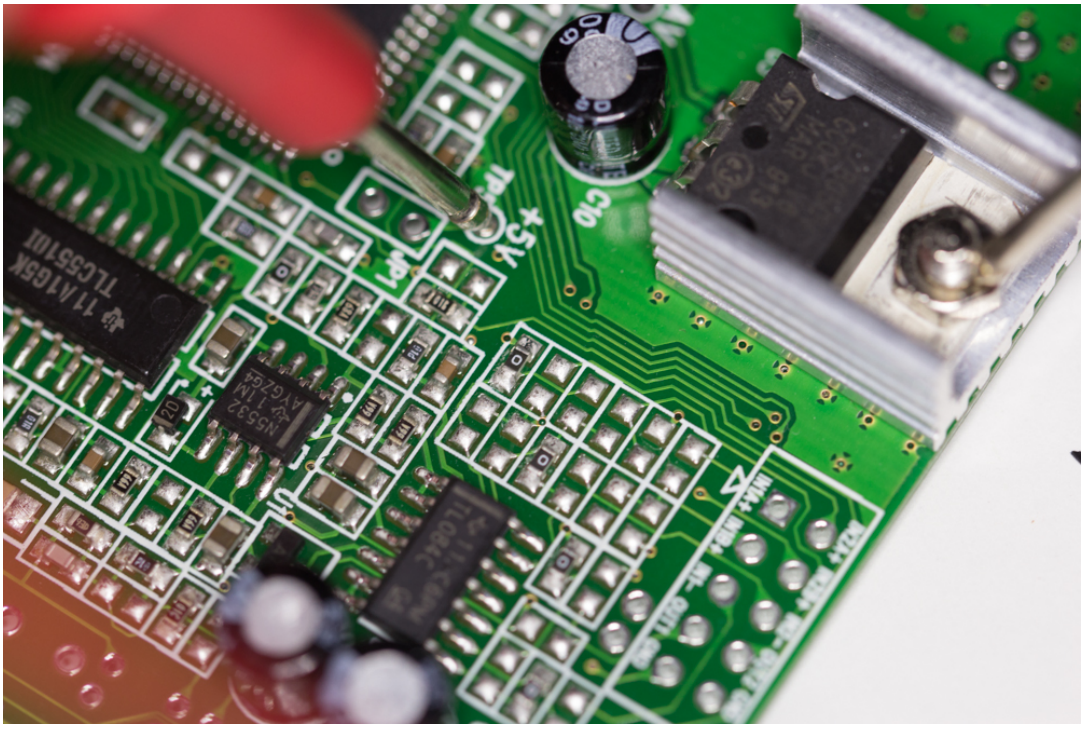


Figure 3.9-1: Power-On Voltage Measurements (TP5)

Power off the board. If the voltage was correct, we can now connect power to all circuitry on the PCB by installing the jumper JP1. Locate this point near the test point TP5 (see Fig.3.9-2). The jumper can be made of capacitors' lead offcuts. Make sure, that you cut jumper leads flush with the board to avoid interference with the LCD module which will be mounted on top of it.

After soldering repeat the measurement once again! The voltage must be the same. If not, check your soldering of the JP1 and/or ask your instructor for help!

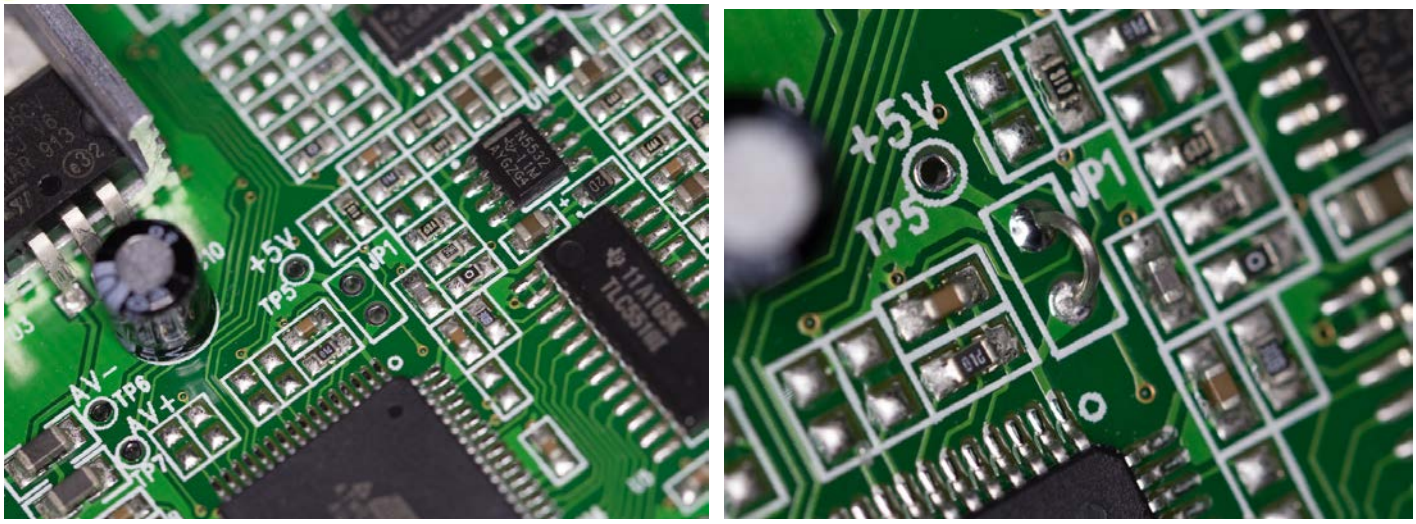
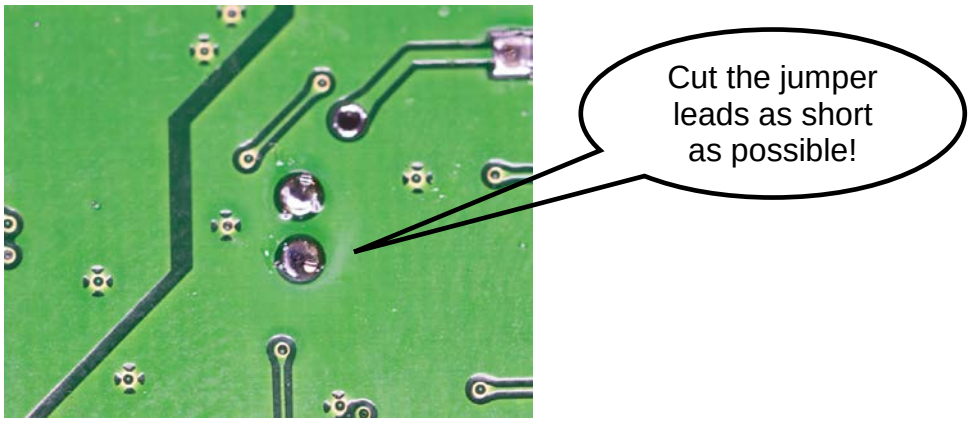


Figure 3.9-2: Powering the PCB Electronics via Jumper JP1



4. INSTALLING PCB PUSH-BUTTONS AND SLIDE SWITCHES

4.1 The PCB Push-button Switches

The push-button switches (or tact switches) provide basic oscilloscope functionality and settings that are indicated by corresponding switch silkscreen labels. When soldering, make sure that switches are sitting upright (not tilted) and evenly on PCB. Otherwise it will be impossible to mount correctly the front panel which sits on top of them. Solder one leg only to keep the switch in place, and if necessary level the position by pushing it slightly down while melting the solder on the pad. Then proceed with other legs in diagonal pattern. Finish the soldering carefully not to damage nearby components. The different horizontal and vertical pitch between switch legs provides proper switch orientation so you do not have to worry about rotating the parts to match contact functionality. If you notice leg corrosion, clean them thoroughly before soldering.

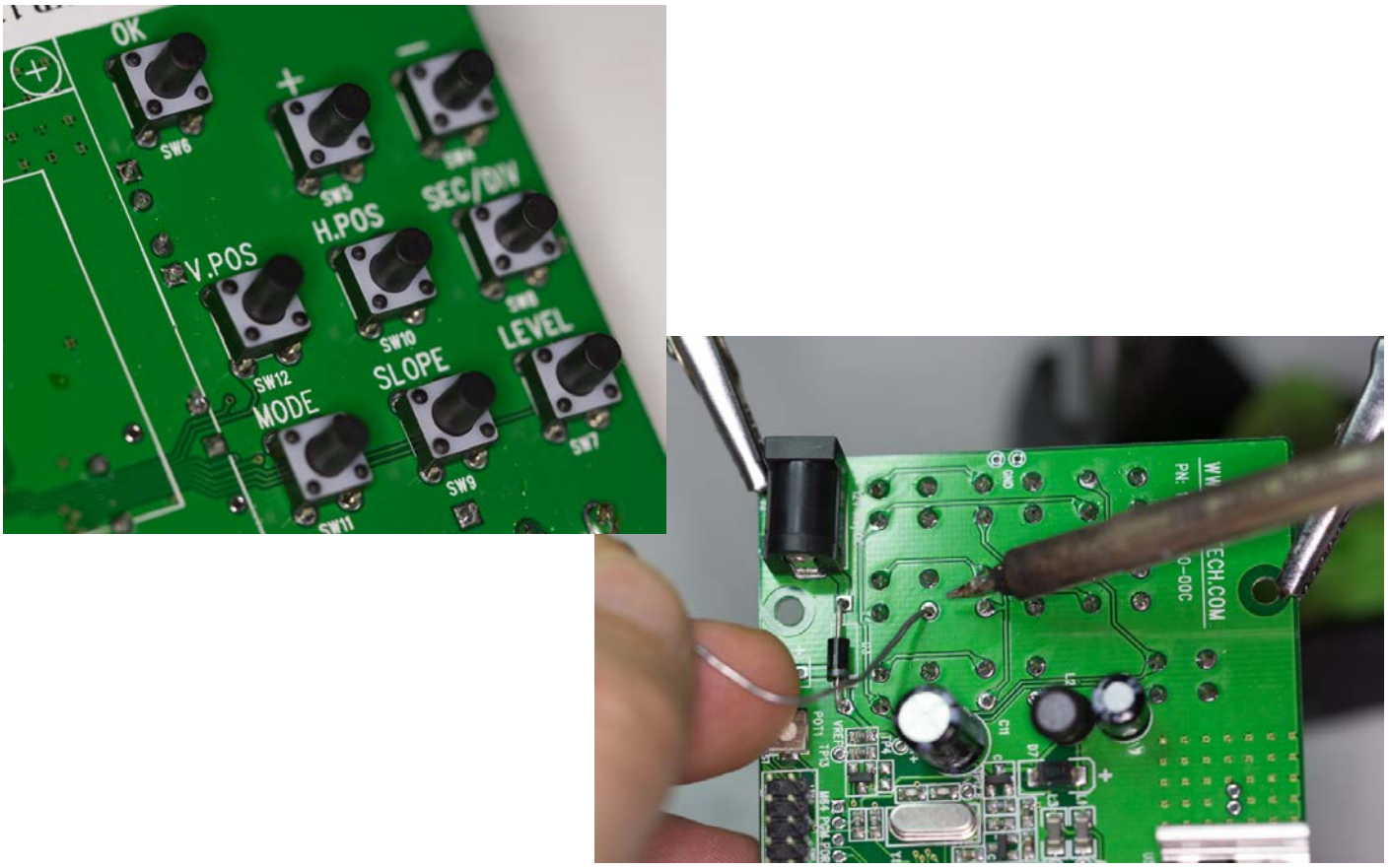


Figure 4.1-1: Installing PCB Push-buttons Switches

4.2 Slide Switches

The sliding switches are selectors for additional functionality of the scope indicated by the silkscreen labels (range selection, coupling, etc.). I found their installation to be quite challenging due to the facts that
a) Soldering pads are very small for the size of switch terminals
b) Typically, you can expect switch pins to be dirty (corroded)
c) High density of switch pins (limited access to do the soldering)
d) Large metal areas of the switches allow for easy heat dissipation thus decreasing the temperature of the soldering tip and causing premature cooling down of the solder.
You must be very patient when doing this part!

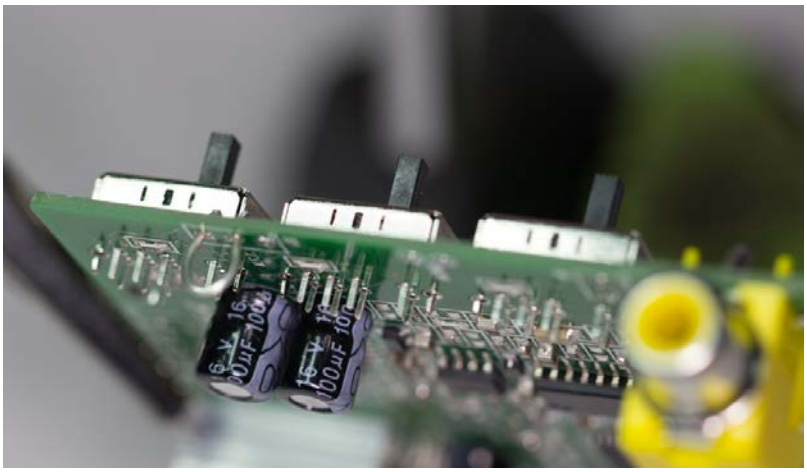


Figure 4.2-1: Installing slide switches can be very challenging

5. INSTALLING LCD MODULE

5.1 SIP Connector

The connection between the main microcontroller PCB and the LCD module is provided via 20-pin SIP strip connector. Identify the row of pads with labels on the LCD module - this is where the strip connector should be soldered (see Fig. 5.1-1). Insert SIP connector into the module board facing long pins out (short pins into the board), using the side of the module board opposite to the LCD glass display.

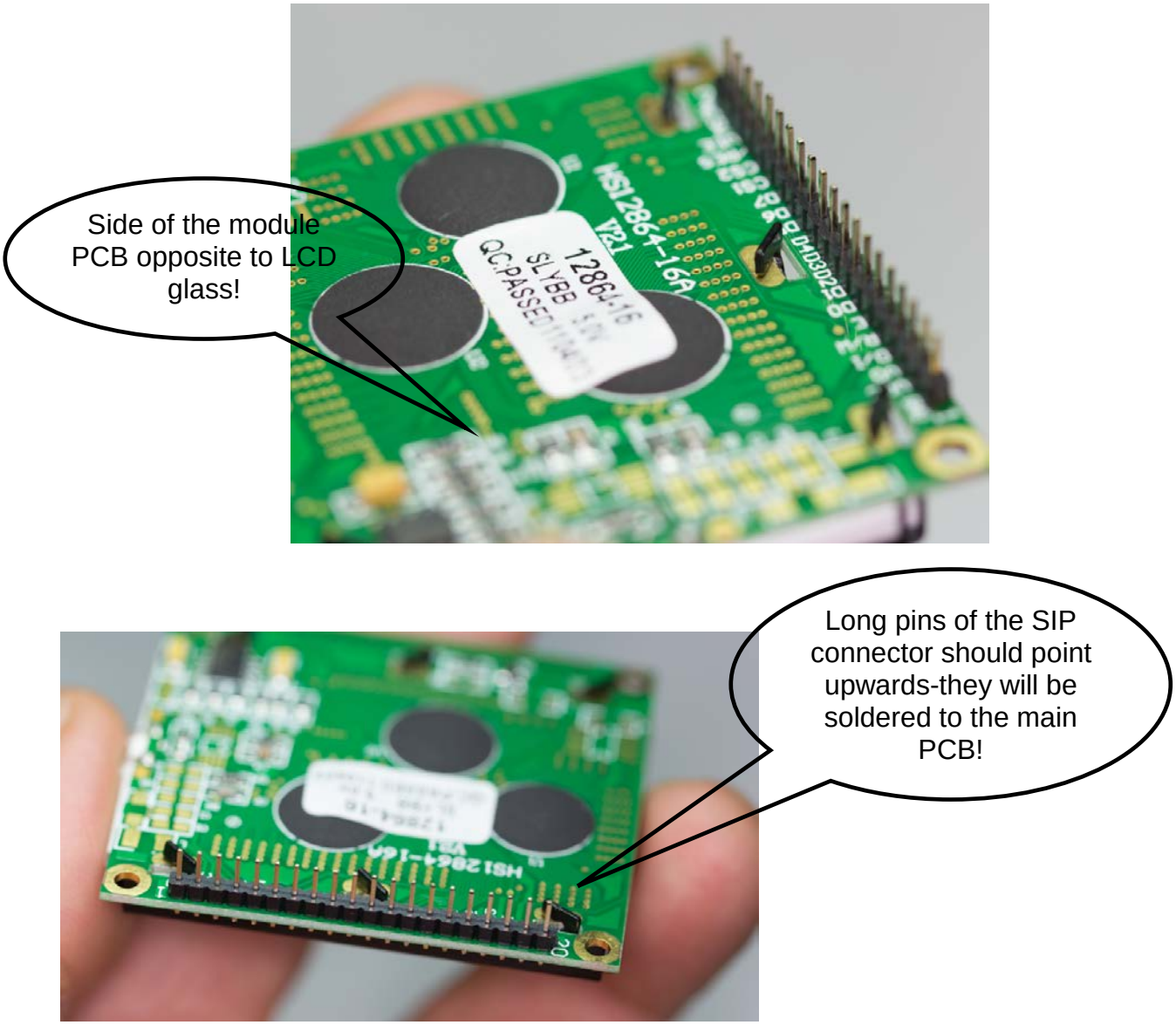


Figure 5.1-1: Plug in the short pins of the SIP connector into the LCD module PCB along the row of labelled pads

You will have to push SIP connector against the PCB while soldering, to keep the pins all away down and vertically aligned. Again, use thermal protection for your finders because metal pins are good heat conductor and they will heat up quickly to very high temperatures. Although it cannot be seen in Fig. 5.1-3, a plastic piece has been used for hand protection. There are some extremely narrow copper traces on the soldering side, so be very careful not to overheat them (they could break easily).

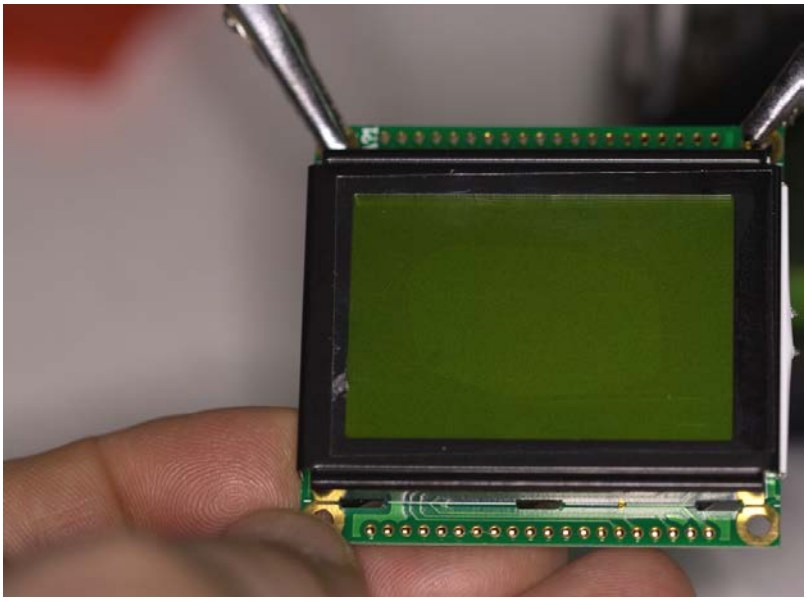
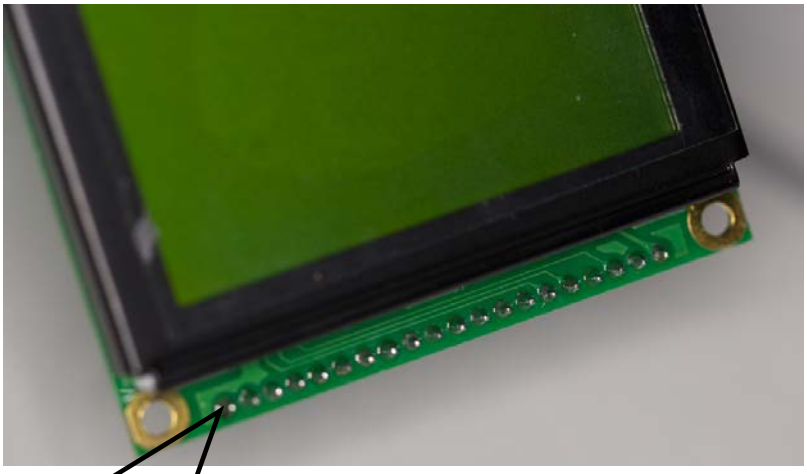


Figure 5.1-3: Push gently SIP strip against LCD module while soldering; connector will get very hot! Use soldering holder (stand) and skin protection



Solder end pins first, then verify whether SIP is perpendicular to the LCD board before soldering other pins! If not, melt the soldering point and correct the position.

If SIP pins are not perpendicular to the LCD module board it will not fit into the main PCB and when all pins are soldered it will be hard to correct the position. However, corrections are easy to make if only one or two end pins are soldered first.

When 20-pin SIP connector is in place, solder two 2-pin SIP connectors along the opposite edge of the LCD module (the same side of the board though). These are not functional connections but rather mechanical support for LCD module as shown in Fig. 15.1-4. Again, they have to be perpendicular to the LCD module board.

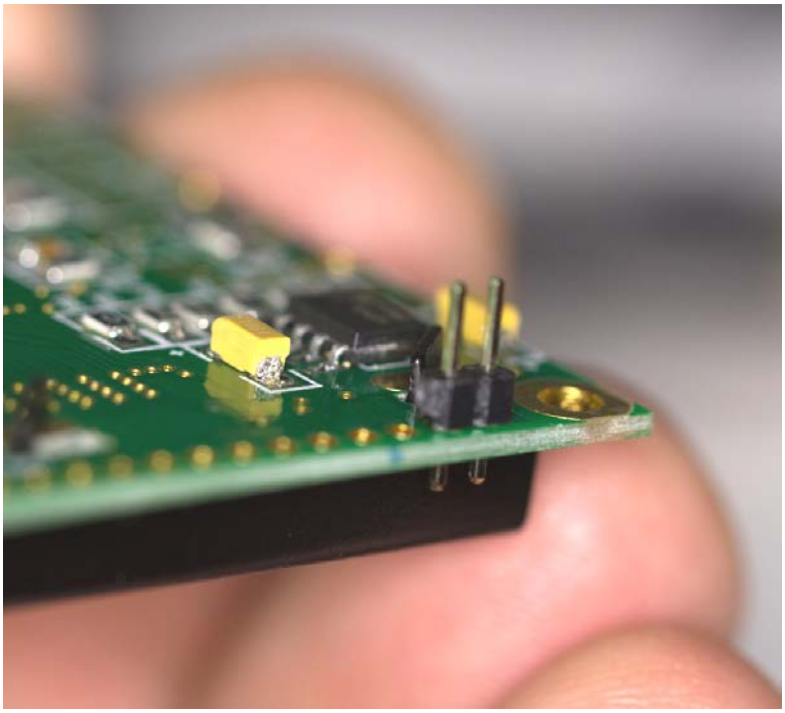
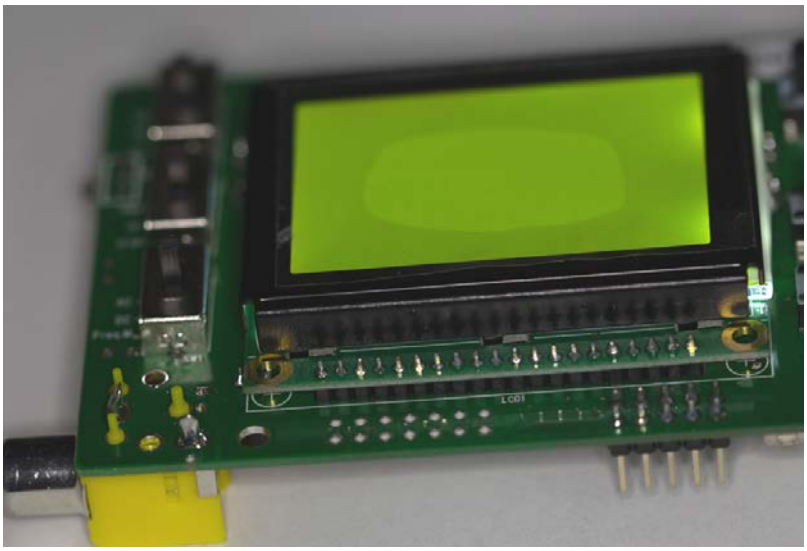


Figure 5.1-4: Two 2-pin SIP strips are not part of the circuitry; they are mechanical support to hold the LCD module to the main PCB.

We are ready now to place the LCD module on the main PCB and to do final soldering. Solder four corner pins first, check the LCD alignment and how well and deep it sits into the main PCB. If the module is misaligned, heat one by one, corner pins to realign the LCD module. When satisfied, complete the soldering of all other pins.



5.2 Power-Up Verification

With all components soldered as illustrated in Figure 5.2-1, you are ready to power on the device and verify LCD connection.

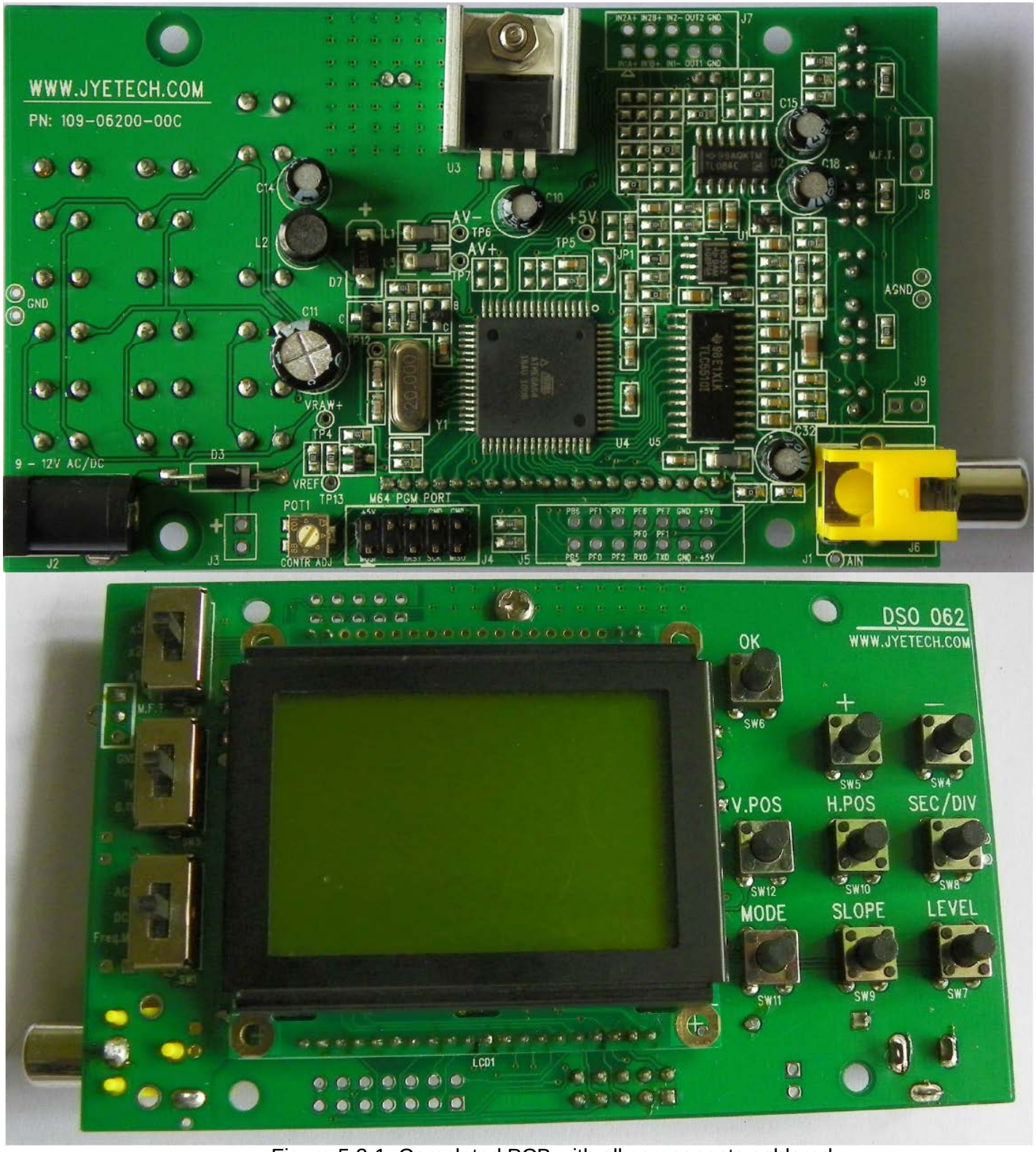


Figure 5.2-1: Completed PCB with all components soldered

However, before doing it, make sure that there are no extra leads sticking or touching other components. Now, plug in a suitable AC/DC adaptor and carefully (without touching any of the components), observe the LCD behavior. At least, you should have LCD backlight working, which may have been set too bright, so that the messages or traces/settings of the scope are not visible yet! **But do not panic!** Beside the programming header connector, there is a small trim potentiometer POT1 labelled "LCD CONTRAST" for controlling the brightness of the backlight; reduce the brightness until the trace is visible. You will need tiny screwdriver for that- do not improvise, because the brittle pot can break easily! If you see the trace, your LCD module is connected properly and you should proceed with mechanical assembly. If not, power of the device and check one by one (preferably with the magnifying glass), all pads of the 20-in pin SIP connector and re-solder them if necessary.

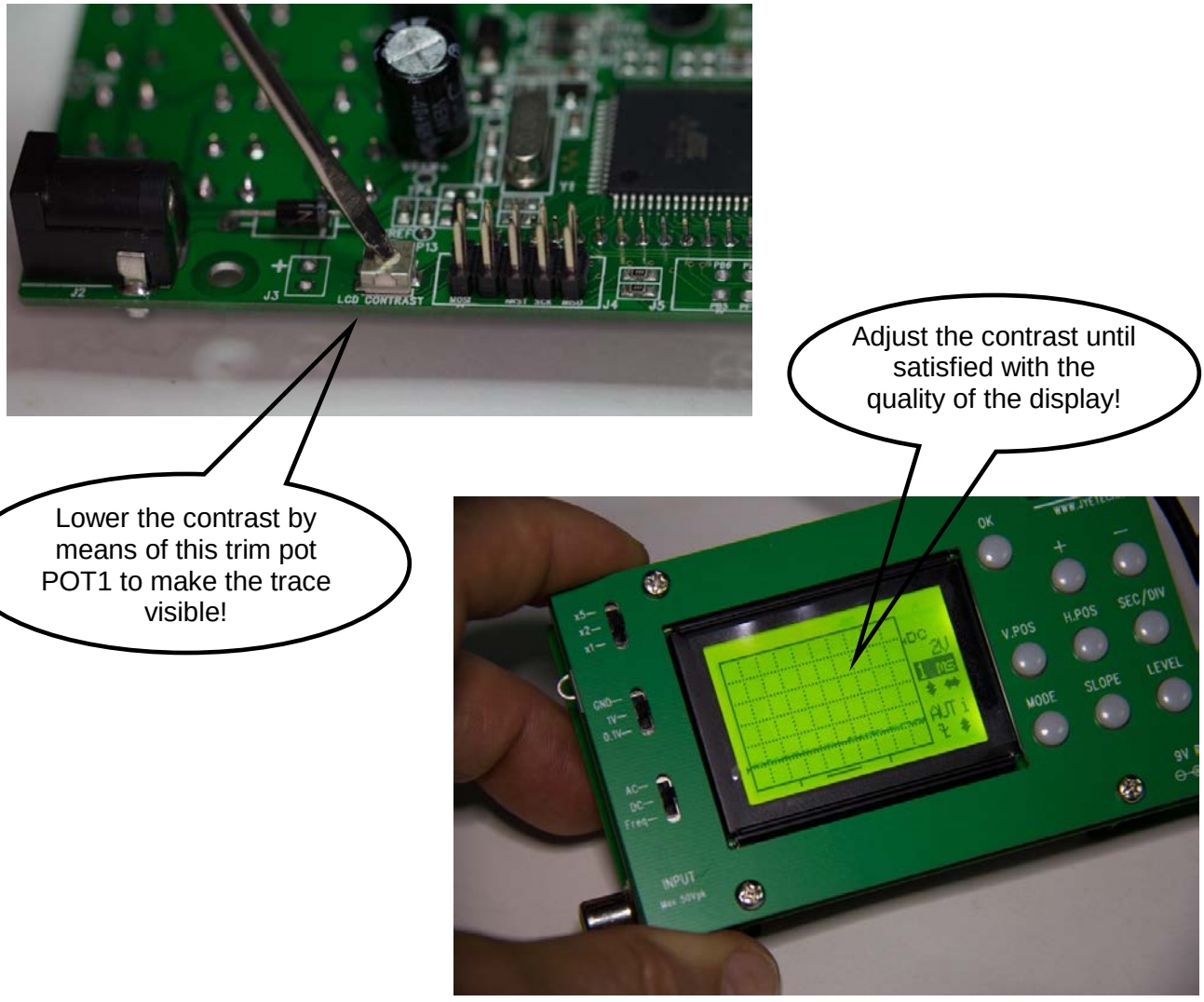


Figure 5.2-2: Adjusting LCD contrast

Your oscilloscope is now ready for final front and back panel assembly!

5.3 Mechanical Assembly

First install 4 longer standoffs to the back plate as shown in Fig. 5.3-1.

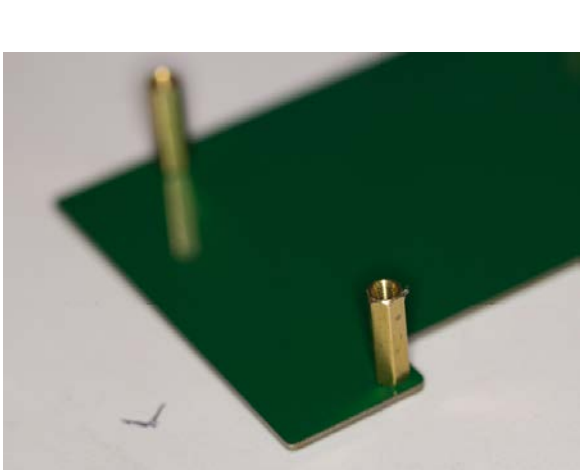


Figure 5.3-1: Start assembly from the back plate and 4 long standoffs

Secondly, place the main PCB on top of these 4 standoffs and fix them to the back plate with set of 4 shorter standoffs, which are having threaded holes for screws. Then, place the caps on push-button switches and position the front panel on top of the assembly, as shown in Fig.5.3-2. Tighten the front plate with available 4 screws. Check whether all keys are working without obstructions and whether the sliders switches operate without resistance.

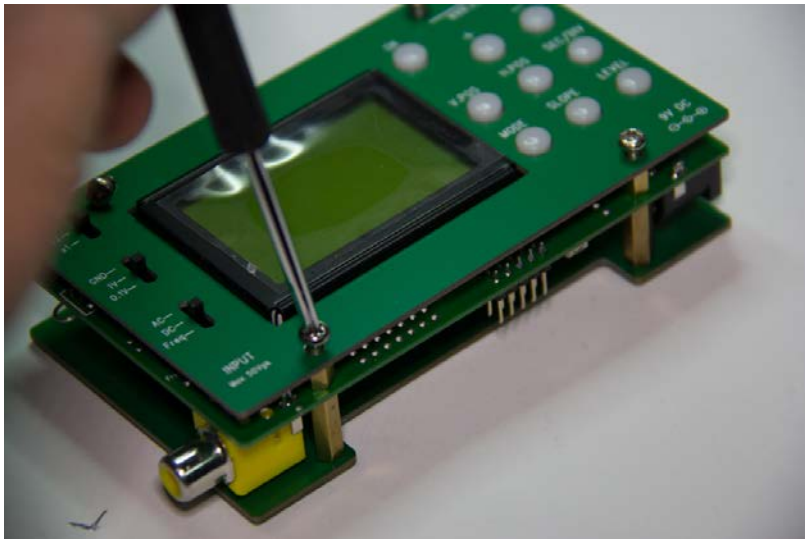


Figure 5.3-2: Finishing mechanical assembly by mounting the front panel plate

6. PROBE ASSEMBLY

6.1 Probe Cable

This assembly shouldn't be too challenging - just make sure you have more powerful soldering iron and clean alligator clips and RCA connector terminals before applying solder. Use shrinking tubes and a heat gun to finish the connections nicely.

Figure 6.1-1: Probe cable assembly details

7. TROUBLESHOOTING (TBD)

8. SPECIFICATIONS

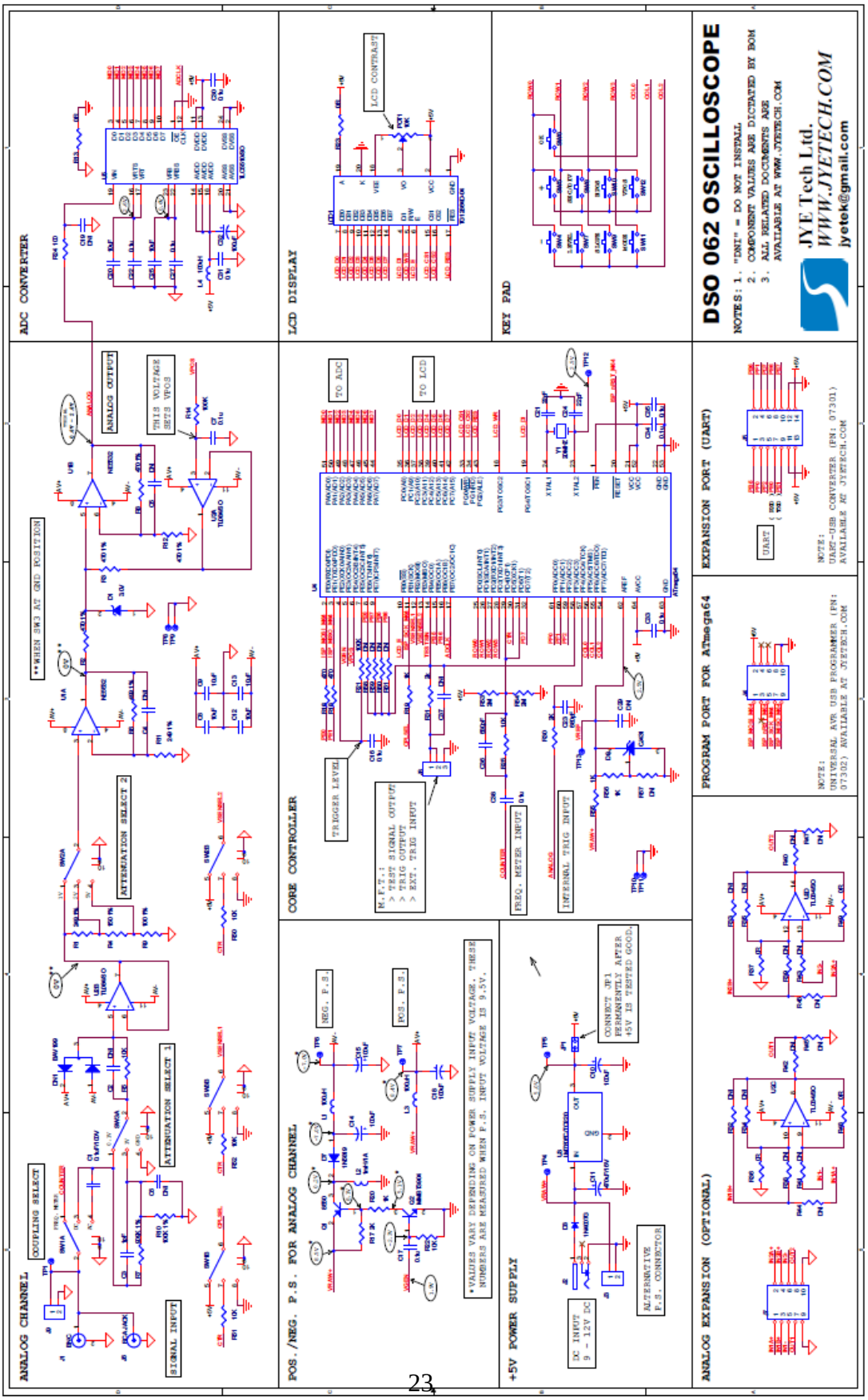
Oscilloscope	Max Equivalent-Time Sample Rate	20MSa/s
	Max Real-time Sample Rate	2M samples/second
	Time-base Range	0.2us/Div – 10minute/Div
	Resolution	8 bits
	Sample Memory Depth	256 bytes
	Analog Bandwidth	1MHz
	Vertical Sensitivity	100mV/Div – 5V/Div
	Input Impedance	1MΩ
	Max Input Voltage	50Vpp
	Coupling	DC/AC
	Trigger Modes	Auto, Normal, and Single
	Trigger Polarity	Rising/Falling
	Trig position	1/4 of sample buffer (fixed)
	External Trig Input Range	0 – 15V
	Trig output amplitude	5V
	Trig output polarity	Falling edge
	Save up to 6 captures to EEPROM	
	Display saved captures	
	Transfer screen as bitmap file to PC via serial port	
	Backlit LCD display	
	Power Supply Voltage	9 DC
	Power Supply Current	< 200mA
Frequency Meter	Frequency Range	5MHz
	Sensitivity	3Vpp
	Max Input Voltage	15Vpp
FFT	FFT Size	256 points and 512 points selectable
	FFT Sampling Rate	1Ksps – 2Msps (in 1 – 2 – 5 style)
	Window	Hamming
Overall	Dimension	110mm X 65mm X 25mm
	Weight	70 grams (board & probe)

Specification, Parts List and Schematic are copied from original JYE TECH documentation

Bill Of Materials - 062 Kit
P/N: 103-06203-01 **ECR#:** **Last Modification Date: 2010.04.03**

Category	Type/Value	Qty/Board	Designator/PCB Location	Footprint
Capacitor	0.1uF/100V	1	C1	[1206/0805]
Capacitor	1pF	1	C3	[0805]
Capacitor	0.1u	12	C7, C16, C17, C22, C27, C29, C30, C31, C33, C34, C35,	[0805]
Capacitor	100uF	5	C10, C14, C15, C18, C32	[CAPPR_025X060]
Capacitor	470uF/16V	1	C11	[CAPPR_035X080]
Capacitor	10uF	2	C8, C9, C12, C13, C20, C25	[0805]
Capacitor	22pF	2	C21, C24	[0805]
Capacitor	680pF	2	C23, C36	[0805]
Diode	BAV199	1	DN1	[SOT23]
Zener	3.0V	1	D1	[0603/0805LED]
Diode	1N4007G	1	D3	[DO41]
Diode	1N5819	1	D7	[DO_SMB]
Regulator	CJ431	1	D8	[SOT23]
Jumper	(Use by a piece of wire)	1	JP1	[HD1002X1]
Connector	POWERJACK-3.5	1	J2	[POWERJACK-3.5]
Header	HEADER 5X2, 0.1"	1	J4	[HD1002X5A]
Connector	RCA JACK	1	J6	[RCA-114]
LCD	TG12864D-04	1	LCD1	[TG12864D-04]
Inductor	100uH	3	L1, L3, L4	[1206/0805]
Inductor	1mH/0.5A, Φ6 X 7	1	L2	[CAPPR_025X060]
Trimmer	10K, Bourns 3314	1	POT1	[TRIMMER_Bourns_3314J]
Transistor	8550	1	Q1	[SOT23]
Transistor	MMBT3904	1	Q2	[SOT23]
Resistor	249 1%	2	R1, R11	[0805]
Resistor	475 1%	6	R2, R3, R8, R12, R16, R18	[0805]
Resistor	150 1%	1	R4	[0805]
Resistor	10K	6	R5, R22, R25, R50, R51, R52	[0805]
Resistor	499 1%	1	R6	[0805]
Resistor	909K 1%	1	R7	[0805]
Resistor	100 1%	2	R9, R24	[0805]
Resistor	100K 1%	1	R10, R14, R21	[0805]
Resistor	0R	6	R13, R23, R36, R37, R48, R49	[0805]
Resistor	2K	2	R17, R30	[0805]
Resistor	1K	6	R19, R20, R31, R55, R56, R57	[0805]
Resistor	2M	2	R53, R54	[0805]
Switch	SW_2P3T, SS-23D07	3	SW1, SW2, SW3	[SW_2P3T]
Switch	Tact, 6X6X9mm	9	SW4, SW5, SW6, SW7, SW8, SW9, SW10, SW11, SW12	[SW_TACT_4X6]
IC	NE5532	1	U1	[SOP127X_0600-8]
IC	TL084/SO	1	U2	[SOP127X_0600-14]
IC	LM7805C/TO220	1	U3	[TO220]
IC	ATmega64AU	1	U4	[QFP080-64]
IC	TLC5510/SO	1	U5	[SOP127X_0800-24]
Crystal	20MHZ	1	Y1	[XTAL_HCM49]
PCB	109-06200-00C	1	PCB1	
Connector	1 X 20Pin, 2mm	1	ASSY1	
Connector	1 X 2Pin, 2mm	2	ASSY2	
Screw	Pan head, M3 x 8	1	ASSY3	
Nut	M3	1	ASSY4	
Clip	Red, small size	1	ASSY5	
Clip	Black, small size	1	ASSY6	
Wire	Single core, shielded, AWG24, 400mm length (1185 or similar)	1	ASSY7	
Plug	RCA	1	ASSY8	
Wire	AWG24, stranded, 100mm len, red	1	ASSY9	
Wire	AWG24, stranded, 100mm len, black	1	ASSY10	
Heat shrink tube	Φ2mm，40mm	2	ASSY11	
Heat shrink tube	Φ4mm，40mm	1	ASSY12	
Heat sink	KF-032_16	1	ASSY13	
Panel	702-06202, front and back	1	ASSY14	
Standoff	M3 x 6 + 6	4	ASSY16	
Standoff	M3 x 15	4	ASSY17	
Screw	Screw，pan head, M3 x 6	8	ASSY18	
Switch Cap	KM1-A06	9	ASSY19	
Firmware	113-06208-020 (or later)	1	FW1	
Document	Schematic	1	DOC1	
Document	Quick Reference	1	DOC2	

Notes:
1. Only install components listed in this BOM. Ignore those presented in schematic and PCB but not included in this list.
2. Use component values as specified in this BOM only. These values may be different from those shown in schematic.


DSO 062 OSCILLOSCOPE
NOTES: 1. "DNI" = DO NOT INSTALL
2. COMPONENT VALUES ARE DICTATED BY BOM
3. ALL RELATED DOCUMENTS ARE AVAILABLE AT WWW.JYETECH.COM
JYE Tech Ltd.
WWW.JYETECH.COM
jyetek@gmail.com
ADC CONVERTER
LCD DISPLAY
KEY PAD
ANALOG CHANNEL
CORE CONTROLLER
EXPANSION PORT (UART)
PROGRAM PORT FOR ATmega64
POS./NEG. P.S. FOR ANALOG CHANNEL
+5V POWER SUPPLY
ANALOG EXPANSION (OPTIONAL)
ANALOG OUTPUT
COUPLING SELECT
ATTENUATION SELECT 1
ATTENUATION SELECT 2
SIGNAL INPUT
TRIGGER LEVEL
INTERNAL TRIG INPUT
FREQ. METER INPUT
DC INPUT 9 - 12V DC
ALTERNATIVE P.S. CONNECTOR