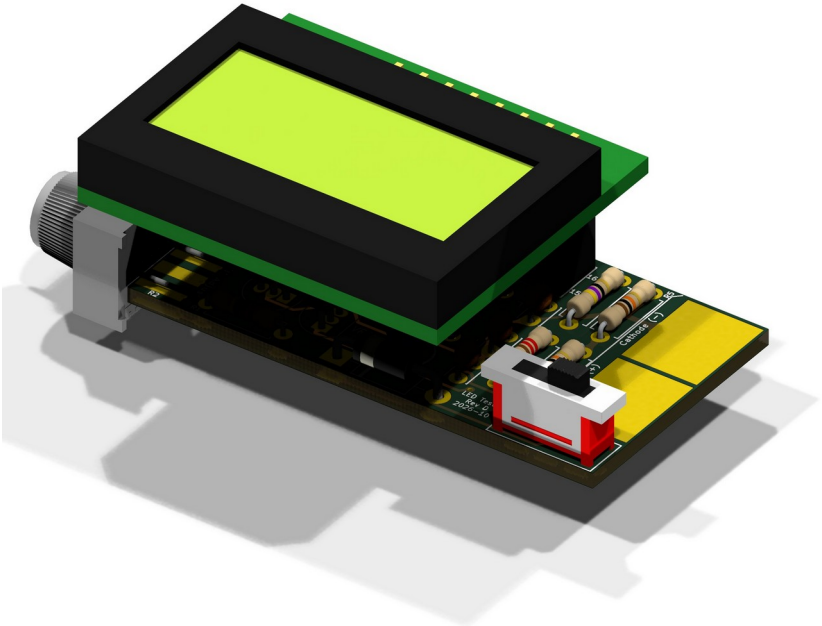
KIT ASSEMBLY MANUAL

LED TESTER

Constant-Current LED Tester with Display

Version 2.0 · LCD 0802 · Rev D



Somerled Design

somerled.design

Welcome

Thank you for choosing the Somerled Design **LED Tester** kit. In an evening or two you will build a small bench instrument that lights any ordinary LED safely at a current you choose. Its display shows the LED's **forward voltage** and **current**, and works out the **series resistor** you would need to run that LED, at that current, from your own supply voltage.

This manual is written in the tradition of the classic kit manuals many of us grew up with. Every step has a check box, ( ). When you finish a step, mark the box. If you are interrupted, you will know exactly where to pick up again. Read each step all the way through before you do it, and do the steps in order.

Do not hurry. Kit building is meant to be enjoyed, and careful work the first time is much faster than finding a mistake later.

What the kit does

An LED must never be connected straight to a battery. It needs its **current** limited. The LED Tester uses an **LM317L** adjustable regulator wired as a **constant-current source**. Whatever LED you touch to the test pads, the tester pushes a steady current through it, set by trimmer R2. An **ATtiny84A** microcontroller measures the LED and drives a backlit **8-character × 2-line LCD** display.

- Turn **R2** to set the LED current, from about **2.3 mA to 27 mA**.
- Read the LED's **forward voltage** and **current** on the display. No meter is needed.
- Turn **R3** to dial in the **supply voltage** your project will use (0 to about 9.4 V).
- The display then shows the **series resistor** for that LED, current and supply.

The power switch

Unlike the simple v1 tester, this one has a microcontroller and a backlit display that draw current all the time it is on. Slide switch **SW1** turns the tester on and off. Switch it **OFF** when you have finished, or the battery will run down.

About this manual

The pictures are 3D renderings of the circuit board made from the actual design files. Each group of steps shows the board with only the parts installed so far. Your parts may look slightly different from the pictures (body colours, markings and shapes vary between makers), but the values and placements will be the same.

An interactive placement guide (iBOM) for this kit is on the support page, **shop.somerled.design/support/**. It shows where every part goes on the board.

Tools You Will Need

( )	Tool	Notes
( )	Soldering iron	25–40 W pencil iron, or a temperature-controlled station set to about 650–700 °F (340–370 °C). Fine conical or small chisel tip.
( )	Solder	Rosin-core electronics solder, 0.020–0.031 in (0.5–0.8 mm) diameter. Never use acid-core solder.
( )	Iron stand and tip cleaner	A damp sponge or brass wool.
( )	Diagonal cutters	Small flush cutters for trimming leads.
( )	Long-nose pliers	For bending leads.
( )	Tweezers	For placing the small surface-mount contrast trimmer R8.
( )	Small screwdriver	A jeweller's flat blade, for setting the contrast trimmer.
( )	Safety glasses	Clipped leads fly. Solder can spit.
( )	Good light and a magnifier	For inspecting solder joints.
( )	Optional	Multimeter, for checking parts and troubleshooting. Desoldering braid or a solder sucker, in case you need to correct a mistake.

CAUTION: Work in a ventilated area, keep your fingers away from the hot tip, and wash your hands after handling solder. Most kit solder contains lead.

Static electricity

The microcontroller U1 and the display module can be damaged by static electricity, the same kind of spark you feel from a doorknob in dry weather. You may not feel a discharge that is large enough to harm them.

- Leave U1 in its protective tube or foam until the step that installs it.
- Before you pick up U1 or the display, touch a large grounded metal object (a metal desk frame, or the screw on a grounded outlet cover) to discharge yourself. An anti-static wrist strap is even better.
- Work on a bare wooden or laminate surface, not on carpet or plastic sheeting. Avoid wool sweaters.
- Hold U1 by the ends of its body and the display by the edges of its circuit board. Do not touch the pins, and do not press on the glass.

Soldering

A good solder joint is the single most important thing in a kit. Almost every kit that does not work on the first try has a poor solder joint somewhere. Take the time to learn the method below and you will have few problems.

How to make a good solder joint

( ) Keep the tip clean and **tinned**: wipe it on the sponge and melt a little fresh solder onto it.

( ) Touch the tip so it heats **both** the component lead **and** the copper pad at the same time.

( ) After one or two seconds, feed solder into the joint, **not onto the iron tip**. The solder should flow smoothly around the lead and over the pad.

( ) Remove the solder first, then the iron. Do not move the part while the solder cools (a few seconds).

( ) Trim the lead just above the top of the solder joint with diagonal cutters. Hold the lead end so it does not fly.

What to look for

Good joint	Poor joint
Smooth, shiny (or satin with lead-free) and shaped like a small volcano or tent around the lead.	Dull, grainy, lumpy, or a ball of solder sitting on the pad.
Solder wets the whole pad and climbs the lead.	Solder only on the lead, not the pad (or the reverse). A dark ring around the lead means a cold joint.
Nothing touches the next pad.	A bridge of solder joins two pads that should be separate.

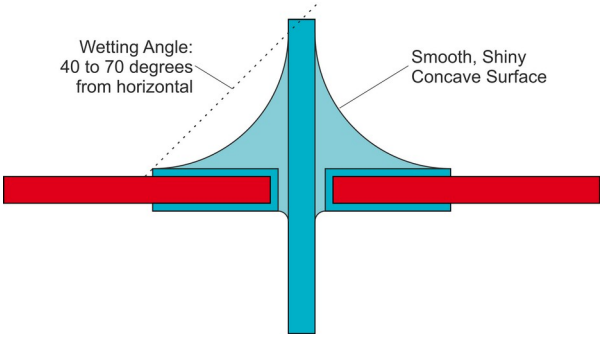


Figure 1. *An ideal solder joint in cross-section. Image: "Solder Joint en.svg" by SLUB Dresden / Carsten Pietzsch, based on an Adafruit diagram by Bill Earl. CC BY-SA 4.0 (creativecommons.org/licenses/by-sa/4.0), via Wikimedia Commons. Converted to PNG.*

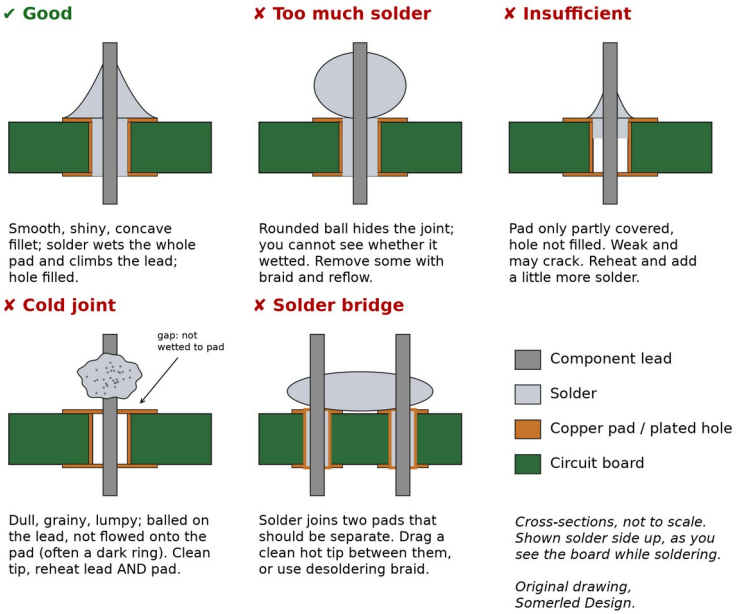


Figure 2. *A good joint and the four most common faults.*

To fix a poor joint, reheat it and add a small amount of fresh solder. To remove a bridge, drag a clean, hot tip between the pads, or use desoldering braid.

NOTE: Heat is the enemy of semiconductors. Do not hold the iron on a diode or regulator lead for more than a few seconds. If a joint is not right, let it cool, then try again.

Soldering a surface-mount part

One part, the contrast trimmer **R8**, is a tiny surface-mount part that sits **on** its pads instead of passing through holes. It is easy with this method:

( ) Melt a small amount of solder onto **one** pad only.

( ) Hold the part in place with tweezers, reheat that pad, and let the part sink into the solder. Remove the iron and hold the part still for a few seconds.

( ) Check that the part is square on all its pads. If not, reheat and nudge it. Then solder the other pads, touching the iron to the pad and the end of the part together. Finally reflow the first pad with a touch of fresh solder.

Unpacking and Parts Inventory

Open the kit over a tray or a light-coloured towel so small parts cannot roll away. Check each part against the list below and mark its box. The **Ref** column gives the reference designator printed on the circuit board.

( )	Qty	Ref	Description
( )	1	—	LED Tester circuit board, v2.0 LCD 0802 Rev D, 1.850 × 1.000 in (47.0 × 25.4 mm)
( )	2	R1, R6	47 Ω resistor, ⅛ W, ±5% (yellow-violet-black-gold)
( )	2	R4, R5	10 kΩ resistor, ⅛ W, ±5% (brown-black-orange-gold)
( )	1	R7	220 Ω resistor, ⅛ W, ±5% (red-red-brown-gold)
( )	1	R8	5 kΩ contrast trimmer, surface-mount, Bourns TC33 (about 1/8 in square)
( )	1	D1	1N5817 Schottky diode, black body with a band at one end
( )	4	C1, C3, C4, C5	0.1 µF (100 nF) ceramic capacitor, marked “104”: disc, or axial mounted hairpin
( )	1	C2	47 µF 6.3 V aluminium electrolytic, 4 mm can (Panasonic ECE-A0JKA470B), polarized (stripe marks −). Leads come pre-formed to a 5 mm spread; straighten them to fit the 2.0 mm pads.
( )	1	VR1	LM317L adjustable regulator, TO-92, marked “LM317L” (or “317L”)
( )	1	VR2	LM2931AZ-5.0 5 V regulator, TO-92, marked “2931”
( )	1	R2	500 Ω trimmer with knob, Bourns 3386F (marked “501”)
( )	1	R3	10 kΩ trimmer with knob, Bourns 3386F (marked “103”)
( )	1	XU1	14-pin DIP IC socket
( )	1	U1	ATtiny84A microcontroller, 14-pin DIP, **pre-programmed; copper dot ● on top (firmware mark)**
( )	1	SW1	Slide switch, 3 pins
( )	1	J1	2×8 female header (16-way socket, two rows), 0.100 in (2.54 mm) pitch
( )	1	—	2×8 male pin header (16 pins), for the display
( )	1	—	LCD display module, 8 characters × 2 lines, with backlight: Newhaven NHD-0208AZ or Surenoo 0802A1
( )	1	B1	9 V battery snap with red and black leads

The two large gold squares marked **Cathode (−)** and **Anode (+)** are the LED test pads. They are part of the board and need no parts.

NOTE: A 9 V battery is **not** included. If a part is missing, check the packing material again, then email **support@somerled.design** with your kit version and the missing part.

Identifying the Parts

Resistors: the 4-band colour code

Resistor values are shown by coloured bands. Hold the resistor with the **tolerance band** on the right. It is gold or silver, and often set a little apart from the others. Then read from the left: the first two bands are digits, and the third band is the multiplier (the number of zeros).

The **fourth band is the tolerance**: how far the actual resistance may be from the marked value. **Gold** means within ±5%. **Silver** means within ±10%. A resistor with no fourth band is ±20%. Brown (±1%) and red (±2%) tolerance bands are found on 5-band precision resistors. Resistors are made in standard series of values. The ±10% series, called **E12**, has twelve values per decade: 10, 12, 15, 18, 22, 27, 33, 39, **47**, 56, 68, 82. The ±5% series, **E24**, adds twelve more in between. 47, 10 and 22 are in both series. All the resistors in this kit are ±5%.

Colour		Digit	Multiplier	Tolerance
Black		0	×1	
Brown		1	×10	±1%
Red		2	×100	±2%
Orange		3	×1 k	
Yellow		4	×10 k	
Green		5	×100 k	
Blue		6	×1 M	
Violet		7	×10 M	
Gray		8	—	
White		9	—	
Gold		—	×0.1	±5%
Silver		—	×0.01	±10%

Ref	Value	Bands	Reading
R1, R6	47 Ω ±5%	yellow-violet-black-gold	4, 7, ×1 = 47 Ω
R4, R5	10 kΩ ±5%	brown-black-orange-gold	1, 0, ×1 k = 10 000 Ω
R7	220 Ω ±5%	red-red-brown-gold	2, 2, ×10 = 220 Ω

R4 and R5 are the same value, so they cannot be swapped by mistake. Take care not to mix up R7 (220 Ω, **red**-red-brown) with the 47 Ω resistors (**yellow**-violet-black).

Capacitors

C1, C3, C4 and C5 are small ceramic capacitors marked **104** (10 followed by 4 zeros = 100 000 pF = 0.1 µF). They can go in either way round. Your kit may have ceramic discs or small axial capacitors (a body with one lead out of each end). Both work. Mount an axial one hairpin style: stand it upright over one hole and bend its top lead down into the other hole. Keep the bend tight so it doesn't touch nearby parts.

C2 is a small **aluminium electrolytic** capacitor: a metal can in a plastic sleeve, 4 mm across. It is **polarized**. A stripe of − signs down the sleeve marks the **negative** lead, and the positive lead is the longer one. The board marks the positive hole with a + and shades the negative half of the outline. An electrolytic capacitor installed backwards can fail.

Diode D1

A diode lets current flow in one direction only. One end of the body has a painted **band**. That end is the **cathode**. On the board, the D1 outline shows the band, and the cathode hole is the square pad marked **K**. D1 protects the tester if the battery snap is ever touched the wrong way round.

Regulators VR1 and VR2

VR1 and VR2 look the same: a black plastic body with three leads and one **flat** face that carries the printing. **Read the markings.** VR1 is the **LM317L**. VR2 is the **LM2931AZ-5.0** (marked 2931). Swapping them will stop the tester working and may damage U1 or the display. On the board, each outline is a circle with one flat side. The flat face of the part goes against the flat side of the outline.

Trimmers R2, R3 and R8

R2 and R3 are square Bourns 3386F trimmers with a finger knob. Their three pins form a triangle: two outer pins on one side and the centre pin on the other. Both mount on the **left edge** of the board, knob outward: R3 at the top and R2 at the bottom. **R2** is marked **501** (500 Ω) and sets the LED current. **R3** is marked **103** (10 kΩ) and sets the supply voltage used for the resistor calculation.

R8 is the tiny square surface-mount trimmer that sets the display **contrast**. It mounts on the **bottom** of the board, and you turn it with a small screwdriver.

U1, its socket, and the display

U1 is a 14-pin chip. A **notch** (or a small dot) at one end marks **pin 1**. The socket XU1 has a matching notch. U1 comes **pre-programmed**. It cannot be replaced with a blank ATtiny84A.

U1 is marked on top with a copper dot ● (firmware mark).

The display is an 8-character, 2-line LCD module with a backlight. Its circuit board has 16 contact holes in **two rows of eight** at one edge. In the kit you solder the 2×8 male header to the display, and it plugs into the 2×8 female socket **J1** on the main board. The display is held by the header alone: it has no mounting screws or spacers. The kit uses either the **Newhaven NHD-0208AZ** or the **Surenoo 0802A1**. They have the same pinout and header and are fitted the same way. The Surenoo module is larger, and overhangs the bottom edge of the board by about 3/8 in (10 mm).

Switch, socket strip and snap

SW1 is a small slide switch with three pins. J1 is a black plastic socket with two rows of eight sockets. B1 is the 9 V battery snap with a red (+) and a black (−) lead.

Circuit Board Assembly

Look over the bare circuit board (Figure 3). All parts except the trimmers and R8 mount on the **top** (printed) side and are soldered on the bottom. R8 goes on the bottom, and is fitted first while the board can lie flat. The trimmers R2 and R3 straddle the **left** edge. The two large gold squares on the right are the LED **test pads**, marked **Cathode (−)** at the top and **Anode (+)** below it. The other parts go in from the lowest to the tallest, so the board rests flat on the bench while you solder.

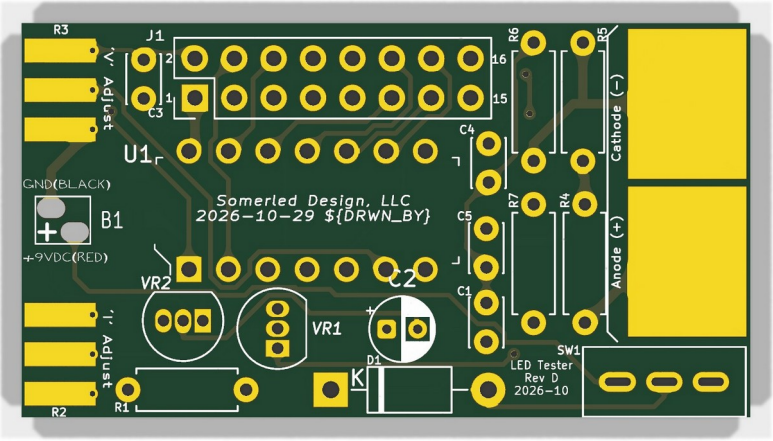


Figure 3. *The bare v2.0 LCD 0802 Rev D board, top view.*

NOTE: Install each part flat against the board (or at the height given in the step), solder all of its leads, then trim the leads. Mark the ( ) box as you go.

Contrast trimmer R8 (bottom side)

( ) Turn the board over. Find the **R8** outline beside the label **Contrast**, at the end of the U1 pin rows nearest the trimmer edge (seen from the bottom, it is on the right). It has **three** pads: two side by side and one on its own.

( ) **R8**: 5 kΩ surface-mount trimmer. Its three terminals match the three pads, so it fits only one way. Using the method in **Soldering a surface-mount part**, tack one terminal, check that the part is square, then solder the other two. Do not let solder run into the slot of the adjuster.

( ) Set R8 to about the **middle** of its travel with a small screwdriver. You will adjust it when the display is working.

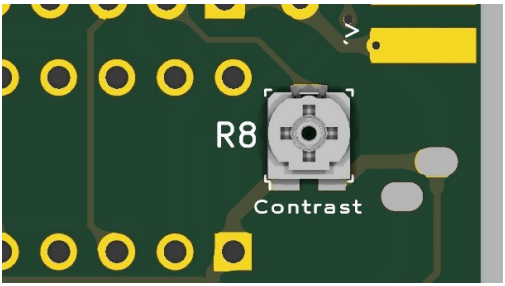


Figure 4. *R8 on the bottom of the board, beside the Contrast label.*

Resistors

Four of the resistors stand in a block of two rows between the U1 area and the test pads, lying flat with their bodies running up and down the board. R1 lies along the bottom edge.

( ) **R1**: 47 Ω (yellow-violet-black-gold). Bend the leads at right angles close to the body to fit the hole spacing. Insert R1 at **R1**, along the bottom edge between the R2 pads and D1, lying flat. Either direction is fine, but for a neat look keep all the tolerance bands the same way.

( ) **R6**: 47 Ω (yellow-violet-black-gold), at **R6**, the left resistor of the upper pair, just right of J1's pins 15 and 16.

( ) **R5**: 10 kΩ (brown-black-orange-gold), at **R5**, right of R6, beside the **Cathode (−)** pad.

( ) **R4**: 10 kΩ (brown-black-orange-gold), at **R4**, below R5, beside the **Anode (+)** pad.

( ) **R7**: 220 Ω (**red**-red-brown-gold), at **R7**, below R6. R7 sets the brightness of the display backlight.

( ) Bend the leads slightly outward on the bottom so the parts cannot fall out. Solder all ten leads and trim them. Do not let the leads or solder touch R8 underneath.

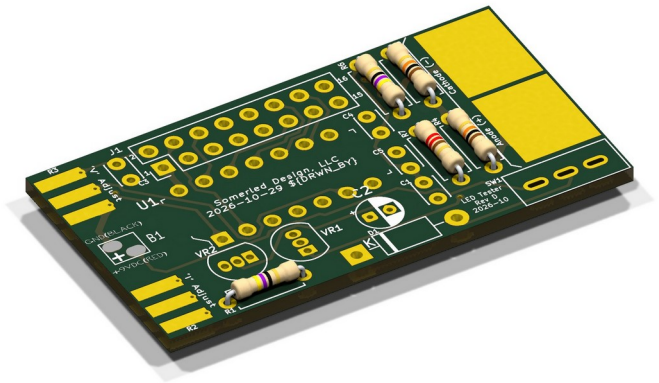


Figure 5. *R1, R4, R5, R6 and R7 installed.*

Diode

( ) **D1**: 1N5817 Schottky diode. Bend the leads close to the body to fit the hole spacing. Insert D1 at **D1**, along the bottom edge right of R1, with the **band toward the square pad marked K** (the left end).

( ) Solder both leads and trim them.

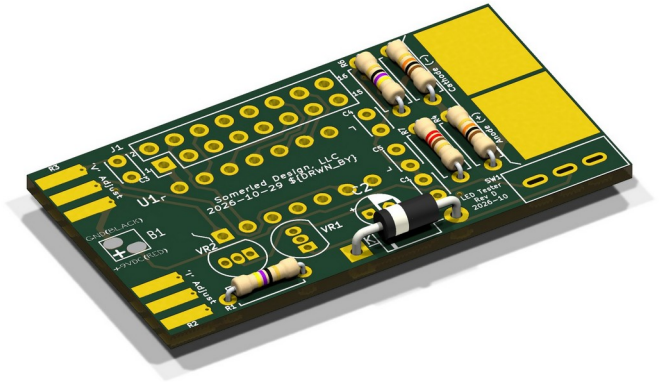


Figure 6. *D1 installed. The band faces the K pad, to the left.*

IC socket

( ) **XU1**: 14-pin socket, at **U1** in the middle of the board. Turn it so its **notch points left**, toward the trimmer edge. The square pad is pin 1, at the lower left. The socket's pins fit either way, so check the notch now.

( ) Hold the socket flat and solder **two opposite corner pins** only. Check that the socket sits flat. If it does not, reheat a corner and press it down. Then solder the other twelve pins. Do not plug U1 in yet.

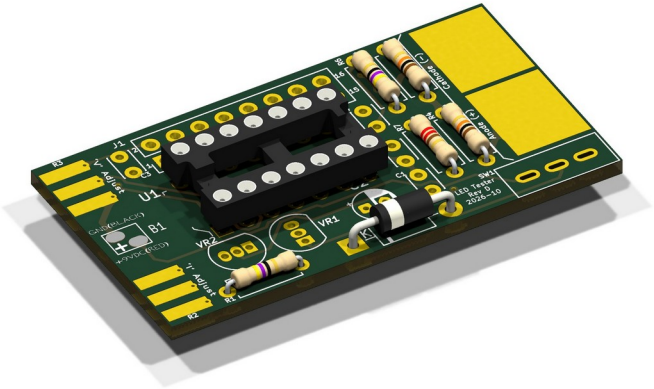


Figure 7. *XU1 installed, notch toward the left edge.*

Capacitors

( ) **C3**: 0.1 µF ceramic (104), at **C3**, at the top left between the R3 pads and J1. Either way round. Disc or axial (hairpin).

( ) **C4**: 0.1 µF (104), at **C4**, right of the U1 socket, the top one of a column of three.

( ) **C5**: 0.1 µF (104), at **C5**, below C4.

( ) **C1**: 0.1 µF (104), at **C1**, below C5.

( ) Solder and trim the eight leads.

( ) **C2**: 47 µF electrolytic. Find the **negative** stripe and the longer **+** lead. Insert C2 at **C2**, below the right-hand end of the socket, with the **+ lead in the hole marked +** (the left hole) and the stripe toward the shaded half of the outline.

NOTE: C2's leads come pre-formed to a 5 mm spread. Straighten them so they fit the 2.0 mm pads, then push C2 down until it rests on the board. Solder and trim.

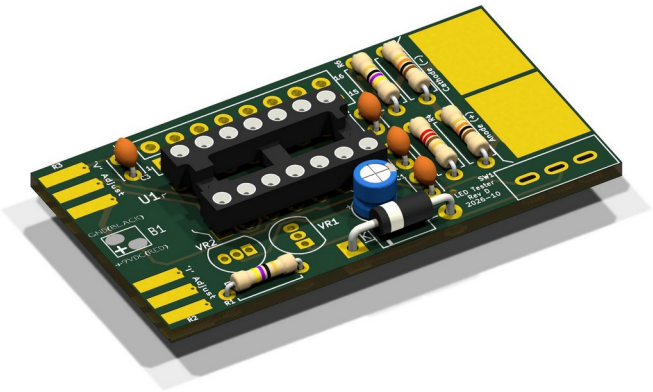


Figure 8. *Capacitors installed.*

Regulators

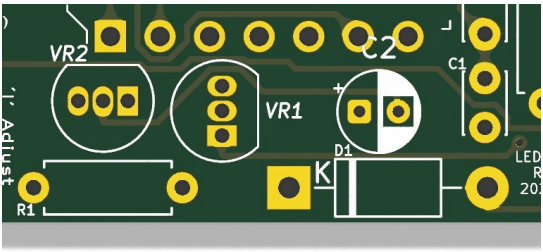


Figure 9. *VR2 (flat side at the top) and VR1 (flat side to the right) outlines, C2 with its + hole, and D1 with its K pad.*

( ) **VR1**: the part marked **LM317L**. Hold it over the VR1 outline with its **flat face toward the right** (toward C2), matching the flat side of the outline. Insert the three leads and push the part down until its body is about 1/8 in (3 mm) above the board. The display will sit above it later, so keep it low.

( ) Check the marking (LM317L) and the flat, then solder the three leads. Work quickly: about two seconds per lead. Check for solder bridges between the closely spaced pads, then trim.

( ) **VR2**: the part marked **2931**. Install it at **VR2**, left of VR1, with its **flat face toward the top** (toward the socket), about 1/8 in (3 mm) above the board. Solder and trim.

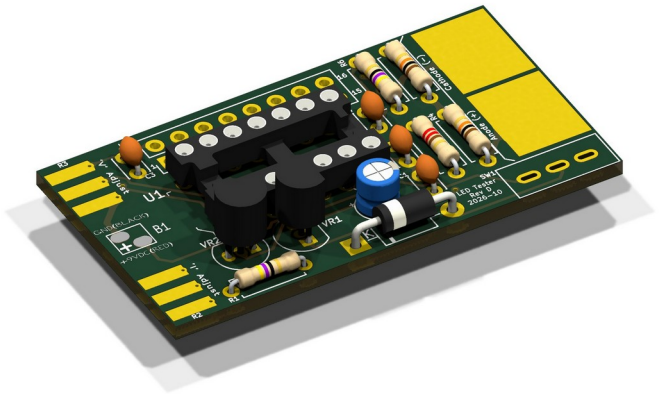


Figure 10. *VR1 and VR2 installed.*

Trimmers

The trimmers R2 and R3 mount on the left edge of the board with the knob pointing outward, like a small thumbwheel. Each one has a set of three pads on the top of the board and a matching set underneath.

( ) **R2**: 500 Ω trimmer (**501**). Slide it onto the board edge at **R2** (the lower position, beside the label **'I' Adjust**) so the board fits **between its pins**: the **two outer pins** lie on the outer pads on the **top**, and the **centre pin** lies on the centre pad **underneath**. Push it on until the body touches the board edge. The knob points away from the board.

( ) Check that each pin lies flat on its pad. Solder the two top pins, then turn the board over and solder the centre pin underneath. Use enough solder to form a fillet along each pin.

( ) **R3**: 10 kΩ trimmer (**103**). Install it at **R3** (the upper position, beside the label **'V' Adjust**) in the same way: outer pins on top, centre pin underneath. Solder all three pins.

( ) Turn both knobs to the **middle** of their travel. R2 at mid-travel gives a moderate current (about 4 mA), which is safe for any LED.

The board labels say what each trimmer does: **'I' Adjust** for R2 (the LED current) and **'V' Adjust** for R3 (the target supply voltage).

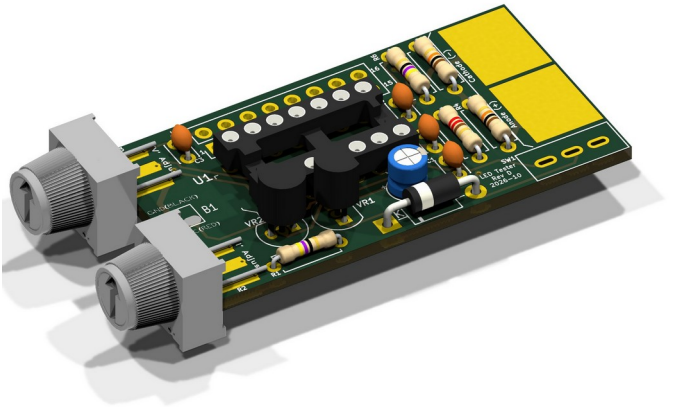


Figure 11. *R2 and R3 installed on the left edge.*

Power switch

( ) **SW1**: slide switch, at **SW1** (bottom right corner). It fits either way round. Hold it flat against the board, solder one pin, check that it is straight, then solder the other two.

( ) The board has no ON/OFF marking. **ON** is toward the **centre** of the board (to the left, toward D1). **OFF** is toward the right edge. Slide the switch to **OFF** now.

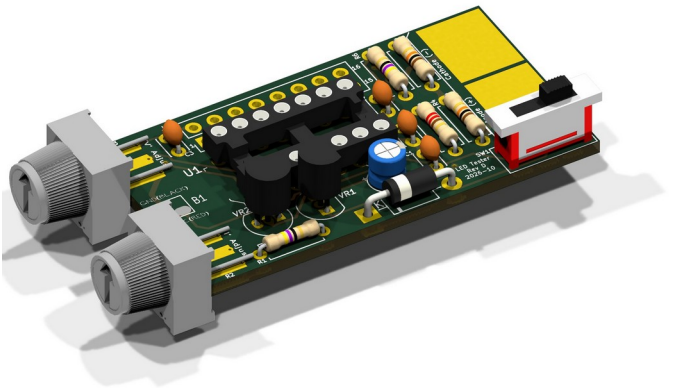


Figure 12. *SW1 installed.*

Display socket

( ) **J1**: 2×8 female socket, at **J1** (along the top edge, between C3 and R6, where the board is marked 1, 2, 15 and 16). Insert it from the top, open side up.

( ) Solder **one** corner pin only. Check that the socket stands straight up and sits flat. If it does not, reheat the joint and adjust it. Then solder the other fifteen pins, and check for bridges between them.

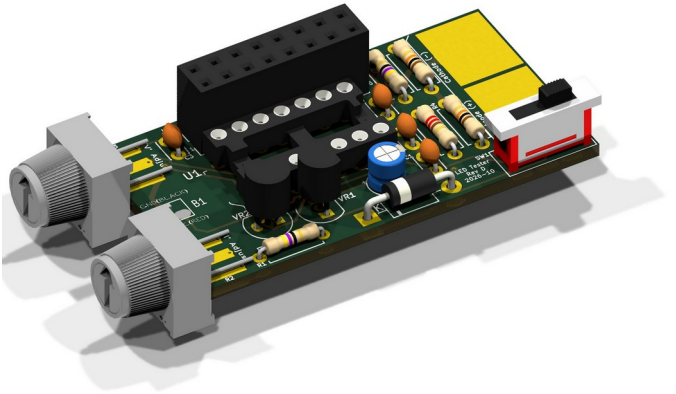


Figure 13. *J1 installed.*

Battery snap

B1 is at the left edge, between the two trimmers. Its two small holes are marked with arrows: **GND(BLACK)** for the upper hole and **+9VDC(RED)** for the lower one. The holes are small, so twist the strands of each lead tightly and tin the tip with a little solder first.

( ) **B1**: 9 V battery snap. Push the **red** lead through the hole marked **+9VDC(RED)** from the top of the board, and the **black** lead through the hole marked **GND(BLACK)**.

( ) Solder both leads on the bottom and trim the excess wire.

( ) For strain relief you may put a small dab of hot-melt glue over the two wires on the top of the board (optional). Keep it low: the display covers this area.

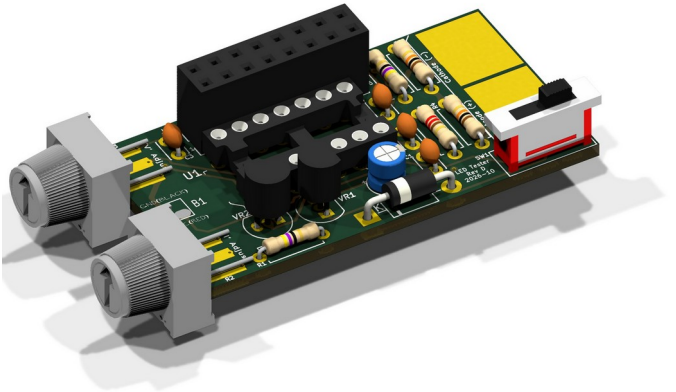


Figure 14. *Board assembly complete (battery snap leads not shown).*

Installing U1 and the Display

If you prefer, do the **Final Inspection** (it follows this section) before you fit U1 and the display. The solder joints are easier to see without the display in place.

Microcontroller U1

( ) Discharge yourself (see **Static electricity**). Take U1 out of its packing.

( ) **Check the firmware mark.** U1 is the 14-pin ATtiny84A, marked on top with a copper dot ●. The OLED boards use 8-pin ATtiny85 chips (copper dot ● for 128×64, silver dot ● for 128×32), so a chip with 8 pins is not yours. If the dot on your chip is missing or the wrong colour, do not fit it: email support@somerled.design and we will send the right one. Each chip is programmed with the firmware for one board only, so never swap chips between board types.

( ) New chips have their two rows of pins spread a little wider than the socket. If they do not line up with the socket, rest one row of pins flat on the bench and roll the chip gently to bend the whole row in slightly. Do the other row the same way.

( ) Line up U1's **notch with the notch of the socket**, pointing **left** toward the trimmers. Make sure every pin is over its socket hole, then press U1 straight down with even pressure until it is fully seated.

( ) Check that no pin has folded under the chip or outside the socket.

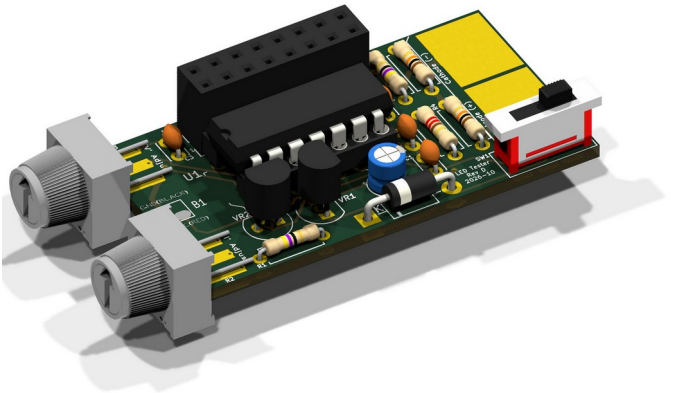


Figure 15. *U1 in its socket, notch toward the left edge.*

Display header

The 2×8 male header is soldered to the display module. The easiest way to get it straight is to use J1 as a jig.

( ) Push the **long** ends of the 2×8 male header fully into J1 on the main board. The short ends point up.

( ) Hold the display module **glass side up**, with its row of 16 contact holes at the **top** edge, over J1. The module must lie **over the main board** (over U1 and the regulators), not hanging off the top edge. In this position the module's pin 1 (usually marked 1, or a square pad) is above J1's pin 1, the square pad at the left, marked **1**.

( ) Lower the module onto the short ends of the header so they pass through its 16 holes. Rest it level. It should not touch any part on the main board.

( ) Solder **one** corner pin on the top of the module, check that the module is level and square, then solder the other fifteen pins. Work quickly and do not let the iron touch the glass or its metal frame. Check for bridges.

( ) Lift the display, with its header, straight up out of J1. Look at the J1 joints on the main board again: they must not have been disturbed.

Fitting the display

( ) Plug the display back into **J1** the same way round: glass up, lying over the main board. Push it fully home, pressing on the module's circuit board near the header, **not** on the glass.

( ) Look along the side of the board. The display should be level, and nothing on the main board should touch the back of the module. If a part does touch, unplug the display and bend that part over slightly.

NOTE: The display is held only by the header. There are no mounting holes or spacers. Hold the tester by the main board, not by the display, and to remove the display, rock it gently straight up. The NHD-0208AZ overhangs the bottom edge of the board a little, and the Surenoo 0802A1 about 3/8 in (10 mm). That is normal.

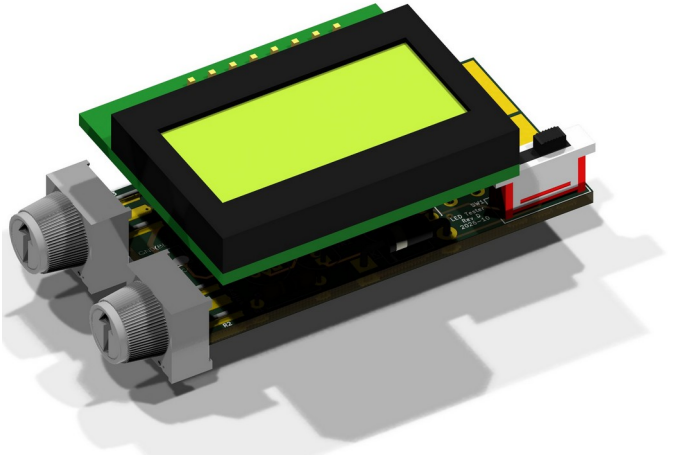


Figure 16. *The completed LED Tester with the display fitted (NHD-0208AZ shown).*

Final Inspection

Before you connect a battery, go over the board carefully with a magnifier and good light. Most problems are caught here.

( ) Every lead is soldered. Count them: R8 (3, bottom), R1, R4, R5, R6, R7 (10), D1 (2), XU1 (14), C1–C5 (10), VR1 and VR2 (6), R2 and R3 (6), SW1 (3), J1 (16), B1 (2): **72 joints** on the main board, plus **16** on the display header.

( ) No solder bridges, especially between the VR1 and VR2 pads, the socket pins, the J1 pins, the trimmer pins and the R8 pads.

( ) D1 band toward the K pad (left). C2 + lead in the + hole, stripe toward the shaded half.

( ) VR1 is the LM317L, flat to the right. VR2 is the LM2931 (2931), flat toward the socket.

( ) R7 (red-red-brown) below R6, and the two 47 Ω resistors at R1 and R6.

( ) U1 notch toward the left edge, all fourteen pins in the socket.

( ) Display plugged in glass up, lying over the main board.

( ) B1: red lead at **+9VDC(RED)**, black lead at **GND(BLACK)**.

( ) No clipped leads or solder splashes are stuck to the board. Brush the board off, especially between the test pads.

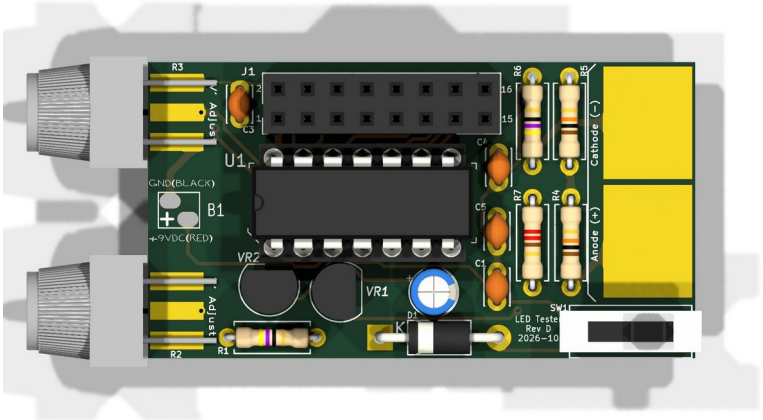


Figure 17. *Finished board, top view, display removed.*

Using the LED Tester

First power-up

( ) With SW1 at **OFF** (toward the right edge), snap a 9 V battery onto B1.

( ) Slide SW1 to **ON**, toward the centre of the board. The backlight turns on automatically at power-up.

( ) The display shows three start-up screens, each for about two seconds (see the table below): **LED TESTER**, then **Pro Vers** with the firmware version, then **Vcc:** with the supply voltage, about **5.0 V**, and a lightning-bolt symbol. Then it shows **TOUCH LED**.

( ) If the characters are faint, or the display shows rows of dark boxes, turn the contrast trimmer **R8** (on the bottom, reach it with a small screwdriver) until the characters are dark and the background is clear.

Screen	Top line	Bottom line
Start-up 1	LED	TESTER
Start-up 2	Pro Vers	version, e.g. 0.9D
Start-up 3	Vcc:5.0 and a bolt	--------
Waiting for an LED	TOUCH	LED
Testing an LED	2.0V 15mA	5.0 200Ω

NOTE: The Vcc reading uses the chip's own internal reference, so anything from about 4.6 V to 5.4 V is normal. If the screen stays blank, switch off and see Troubleshooting.

NOTE: If your kit has the yellow-green LCD, turn the contrast pot (R8) toward the GND end (clockwise, as seen from the screwdriver side on the bottom of the board), so pin 3 sits near 0 V. If the screen looks blank, adjust R8 before suspecting a fault.

Testing an LED

( ) Hold the LED's leads against the two large test pads: the **anode** (the longer lead) on **Anode (+)**, and the **cathode** (the shorter lead, on the flat side of the LED rim) on **Cathode (−)**. The LED lights,

and the display shows its readings. They are updated about once a second.

( ) Watch the current on the display and turn **R2** to set the current you want. Do not exceed the current rating of the LED (many standard 5 mm LEDs are rated about 20 mA).

NOTE: An LED placed backwards will not light, and the display stays at TOUCH LED. Turn it around and try again.

Reading the display

Position	Shows	Example
Top left	LED forward voltage, in 0.1 V steps	2.0V
Top right	LED current, in mA (“mA” is one small symbol)	15mA
Bottom left	Your supply voltage, set with R3 (no unit shown)	5.0
Bottom right	Series resistor for that supply and current	200Ω, 1.4K or 10K

Turn **R3** until the bottom-left figure shows the supply voltage of your project, from 0 to about 9.4 V. The bottom-right figure is then the series resistor that would give the same current from that supply: (supply voltage − LED voltage) ÷ current. It is the **calculated** value, not a standard value. Values under 1000 Ω are shown in ohms with an **Ω** symbol. Values from 1000 Ω up are shown in kilohms with a **K** and one decimal place (for example 1.4K). Anything from 9.95 kΩ up shows as **10K**. If the supply voltage is no higher than the LED voltage, the display shows **0Ω**: that supply cannot drive the LED through a resistor.

Choose the nearest standard value **at or above** the figure shown. The readings are good to a few percent, plenty for choosing a resistor.

Example. A red LED reads 2.0 V at 15 mA. With R3 set to 5.0 V, the resistor is (5.0 − 2.0) ÷ 0.015 = 200 Ω, and the display shows **200Ω**. 200 Ω is a standard E24 value.

Check the resistor’s power rating too. Power = current × current × resistance: 0.015 × 0.015 × 200 = 0.045 W, well within an ⅛ W resistor.

Battery life

The display, its backlight and the microcontroller draw current whenever the tester is switched on, whether or not an LED is on the pads. Switch it **OFF** after use. Replace the battery when the display dims or flickers, or when blue and white LEDs (which need a higher voltage) no longer reach the current you set.

Troubleshooting

Most problems are caused by solder joints or by parts installed the wrong way round. Recheck the Final Inspection list first.

Symptom	Check
Display completely dark, no backlight	SW1 at ON (toward the centre of the board)? Battery good, snap firm, red lead at +9VDC? D1 band toward K? VR2 (2931) in the VR2 place, flat toward the socket? U1 notch to the left and all pins in the socket? With a meter, J1 pin 2 to pin 1 (the square pad) should read about 5 V.
Backlight on, but no characters	Turn R8 (contrast) through its range. Check the three R8 joints and the J1 pin 3 joint.
Backlight on, top line shows a row of dark boxes	The display is powered but not receiving data. Check that U1 is fully seated, notch left. Check the display header joints, the J1 joints, and the U1 socket joints for pins 2, 3 and 9 to 13.
Characters garbled	Check the display header and J1 joints (pins 4 to 6 and 11 to 14) and the U1 socket pins 9 to 12 for bridges or poor joints.
Characters visible but no backlight	Check R7 (220 Ω) and its joints, the J1 pin 15 and 16 joints, and the U1 pin 5 socket joint.
LED does not light; display shows TOUCH LED	LED the right way round (long lead on +)? VR1 (LM317L) in the VR1 place, flat to the right? Check the R1, R2, R6 and VR1 joints.
LED lights but display still shows TOUCH LED	Look for a solder bridge across C4. Check that R6 is 47 Ω (yellow-violet-black), and check the U1 pin 8 socket joint.
Voltage reading clearly wrong	Check that R4 and R5 are both 10 kΩ (brown-black-orange). Look for a bridge across C5. Check the R4, R5 and U1 pin 7 joints.
Supply-voltage figure will not change, or jumps	Check the three R3 joints and the U1 pin 6 socket joint.
Current cannot be turned down, or is very high	Look for bridges between the VR1 pads or the R2 pins. Check that R1 is 47 Ω, not 4.7 Ω or 470 Ω.
Blue or white LED dim or will not reach the set current	The battery may be low. These LEDs need more voltage. Try a fresh battery.
A regulator gets hot	Switch off at once. VR1 and VR2 swapped, or one is in backwards, or there is a bridge.

Still stuck? Email **support@somerled.design** with your kit version (v2.0 LCD 0802, Rev D), which display you have, what you see and, if you can, clear photos of both sides of the board.

How It Works

The current source

The LM317L (VR1) always tries to hold **1.25 V** between its OUT and ADJ pins. OUT feeds the wiper of trimmer R2. The part of R2 in use is in series with R1 (47 Ω) back to ADJ, and the LED is connected from ADJ to the test pads. To hold 1.25 V across R1 plus R2, the regulator must pass a current of

$$I \approx 1.25\ \text{V} \div (47\ \Omega + \text{R2 setting})$$

and that same current flows through the LED. With R2 at 0 Ω the current is about 1.25 / 47 ≈ **27 mA**. With R2 at its full 500 Ω it is about 1.25 / 547 ≈ **2.3 mA**. The regulator adjusts its own voltage drop, so the current stays the same whatever the LED's forward voltage.

The measurements

From the Cathode (−) pad the LED current flows through **R6**, a 47 Ω sense resistor, to ground. U1 measures the voltage across R6 on pin 8 and divides it by 47 Ω to get the current.

R4 and R5 (10 kΩ each) form a divider across the LED. U1 measures the divider's midpoint on pin 7. The difference between the two readings is half the LED voltage, so U1 multiplies it by 2. C4 and C5 filter noise on the two measuring points.

R3 is wired between 5 V and ground. U1 reads its wiper on pin 6 and scales it to 0–9.4 V for the supply-voltage figure.

The display

The LCD module has its own controller. U1 sends it characters four bits at a time: data on pins 9 to 12, control on pins 2, 3 and 13. R8 sets the voltage on the display's contrast pin. U1 also switches the backlight on from pin 5, through R7 (220 Ω), which limits the backlight current.

Power

SW1 switches the battery. D1, a Schottky diode with a low voltage drop, blocks current if the battery is ever connected backwards. VR2, an LM2931 low-dropout regulator, makes a steady 5 V for U1 and the display. C1, C2 and C3 keep the supplies stable. The 5 V supply is also U1's measuring reference.

Schematic

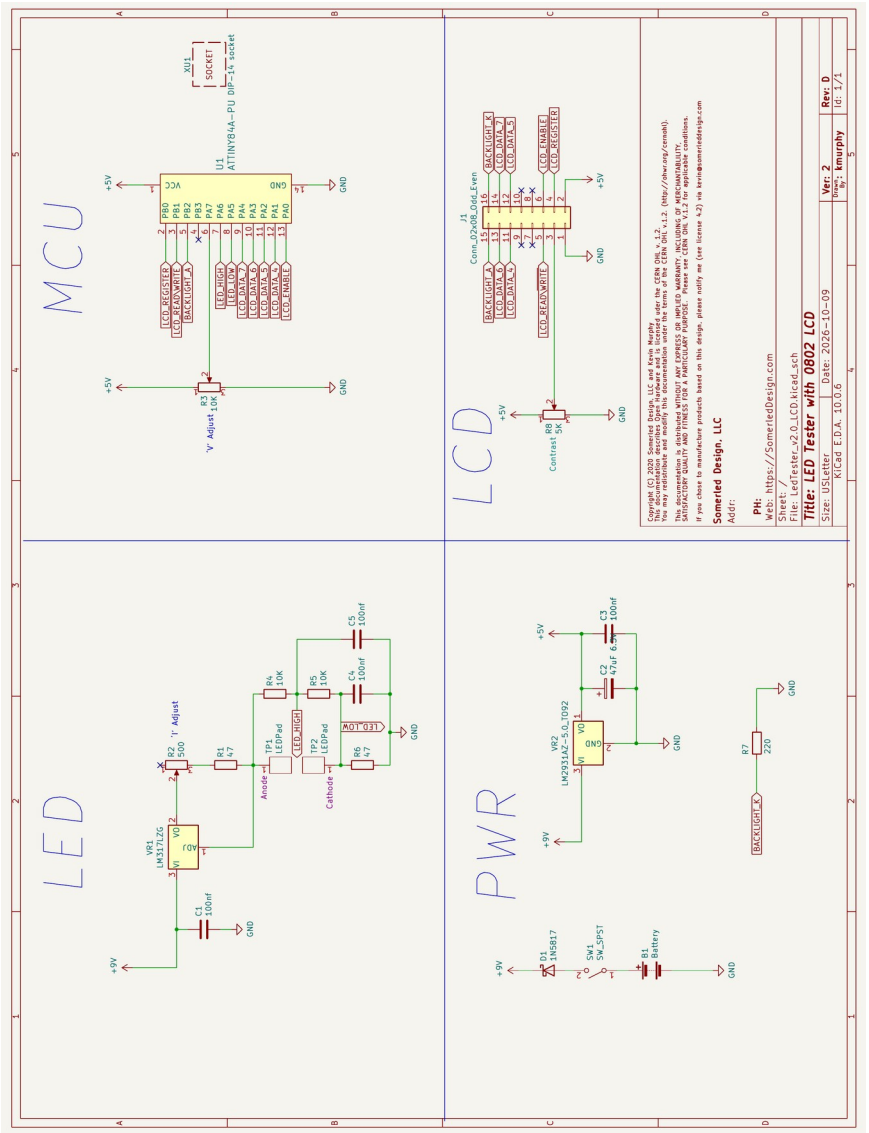


Figure 18. *LED Tester v2.0 LCD 0802 Rev D schematic (from LedTester_v2.0_LCD.kicad_sch). Turn the page to read it.*

Specifications

Item	Value
Circuit	LM317L constant-current source; ATtiny84A measurement; 8×2 backlit character LCD (NHD-0208AZ or Surenoo 0802A1)
LED current	Adjustable with R2, about 2.3 mA to 27 mA (1.25 V ÷ (47 Ω + 0–500 Ω))
Displayed values	LED voltage (0.1 V steps), LED current (1 mA steps), supply voltage (0–9.4 V, set with R3), calculated series resistor (ohms below 1 kΩ, 0.1 kΩ steps to 9.9 kΩ, then 10K)
Display adjustments	Contrast: R8. Backlight: on whenever the tester is on
Power	One 9 V battery (not included), via snap; slide switch SW1
Logic supply	5 V from an LM2931AZ-5.0 (VR2)
Reverse-battery protection	D1, 1N5817 Schottky diode
Board size	1.850 × 1.000 in (47.0 × 25.4 mm); the display overhangs the bottom edge
Board version	v2.0 LCD 0802, Rev D (2026-10)
Firmware	Somerled Design (proprietary), pre-programmed in U1; version shown at start-up

Credits

Based on the LED tester design by **David Cook** of **Robot Room** (robotroom.com). The LED voltage divider and the choice of trimmers also follow his work. Many thanks to David for sharing his designs.

Kit design, board, firmware and manual: **Somerled Design, LLC** (Kevin Murphy).

Firmware © 2026 Somerled Design, LLC. All rights reserved. The firmware in U1 is proprietary, an original Somerled Design program, and is supplied pre-programmed. It may not be copied, read out or redistributed without permission.

Support

Email **support@somerled.design**. Support page, with the iBOM placement guide and updates: **shop.somerled.design/support/**

Illustrations: 3D images rendered from the KiCad design files. Good/faulty joint drawing: original, Somerled Design. Ideal joint diagram: “Solder Joint en.svg”, SLUB Dresden / Carsten Pietzsch after Bill Earl (Adafruit), CC BY-SA 4.0, commons.wikimedia.org/wiki/File:Solder_Joint_en.svg (converted to PNG).

Manual revision: October 2026, board v2.0 LCD 0802 Rev D.