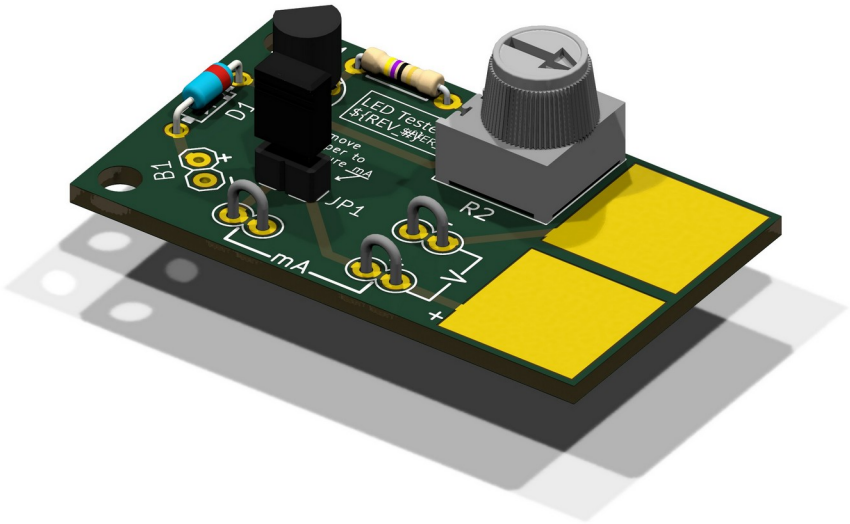
KIT ASSEMBLY MANUAL

LED TESTER

Constant-Current LED Tester Kit

Version 1.1A



Somerled Design

somerled.design

Welcome

Thank you for choosing the Somerled Design **LED Tester** kit. In an evening or less you will build a small, useful bench instrument that lets you light any ordinary LED safely, set exactly how much current it receives, and measure both the current and the LED's forward voltage with your multimeter.

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 place on the test pads, the tester pushes a steady current through it, set by the trimmer potentiometer R2.

- Turn R2 to choose the LED current, from about **2.3 mA to 27 mA** (clockwise raises the current).
- Read the LED's **forward voltage** at the **V** test loops with a voltmeter.
- Remove jumper JP1 and read the **actual LED current** at the **mA** test loops with an ammeter.
- Check LED brightness and colour at a known current before you choose a series resistor for your own project.

Why there is no power switch

You will notice the LED Tester has no on/off switch. That is deliberate, and it is a feature. The circuit only has a path for current when an LED is across the test pads. With nothing connected, the tester draws practically nothing from the battery, so there is nothing to switch off. Leave the battery connected and the tester is always ready. The designer has had the same 9 V battery in his tester for about ten years.

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 and forming the test loops.
( )	Multimeter	Needed to use the tester and helpful for checking parts.
( )	Safety glasses	Clipped leads fly. Solder can spit.
( )	Good light and a magnifier	For inspecting solder joints.
( )	Optional	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.

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.

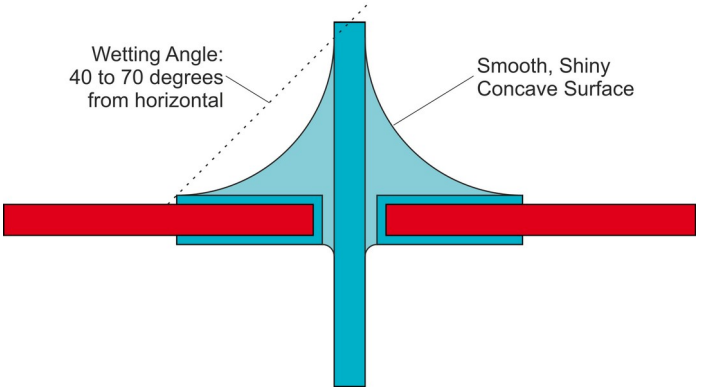


Figure 1. *An ideal solder joint in cross-section. Image: "Solder Joint en.svg" by SLUB Dresden / Carsten Pietzsch, based on an Adafruit diagram by Bill Earl. CC BY-SA 4.0 (creativecommons.org/licenses/by-sa/4.0), via Wikimedia Commons. Converted to PNG.*

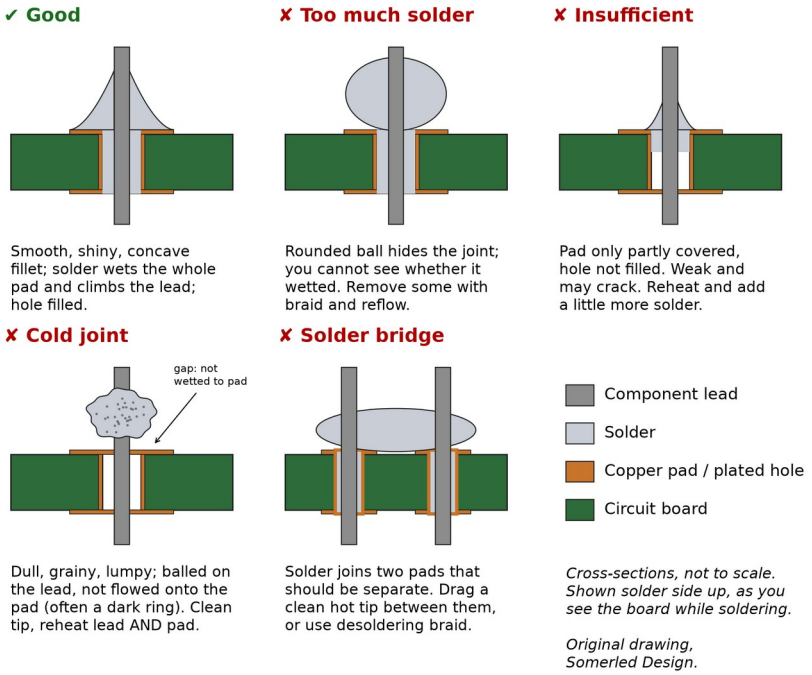


Figure 2. *A good joint and the four most common faults.*

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.

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, v1.1A, 1.700 × 1.000 in (43.2 × 25.4 mm)
( )	1	R1	47 Ω resistor, ⅛ W, ±5%, 4-band (yellow-violet-black-gold)
( )	1	D1	1N5817 Schottky diode, black body with a band at one end
( )	1	IC1	LM317LZ adjustable regulator, TO-92 (three leads, one flat face)
( )	1	R2	500 Ω trimmer potentiometer, Bourns 3386F-1-501TLF (marked “501”)
( )	1	JP1	2-pin header, 0.100 in (2.54 mm) pitch
( )	1	JP1	Shorting jumper (shunt) for the header
( )	1	B1	9 V battery snap with red and black leads

The three test loops (TP1, TP2 and TP3) have no separate parts. You will make them from the leads you cut off diode D1.

NOTE: A 9 V battery is **not** included. Any ordinary 9 V alkaline battery will work.

MISSING PARTS? If a part is missing, check the packing material again first. 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 is in both series, so 47 Ω resistors are made in both tolerances. The one in this kit is ±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%

Example. R1, 47 Ω ±5%: yellow (4), violet (7), black (×1) = 47 Ω, then **gold** (±5%). Its actual value may be anywhere from about 44.7 Ω to 49.4 Ω, which is fine for this circuit.

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**. The circuit board shows the same band in the D1 outline. The band on the diode must line up with the band

on the board. D1 protects the tester if the battery snap is ever touched the wrong way round.

Regulator IC1

The LM317LZ looks like a small transistor: a black plastic body with three leads. One side of the body is **flat** and carries the printing. The board outline for IC1 is a “D” shape with one flat side. The flat face of the part must match the flat side of the outline.

Trimmer potentiometer R2

R2 is a square trimmer with an adjustment knob and three pins in a triangle. The pins only fit the board one way. It may be marked “501” (50 followed by 1 zero = 500 Ω).

Header and shunt JP1

The 2-pin header is a pair of square pins in a black plastic strip. The shunt (jumper) is a small plastic cap with a metal clip inside. It slides over the two pins to connect them.

Circuit Board Assembly

Look over the bare circuit board (Figure 3). All parts mount on the **top** (printed) side and are soldered on the bottom. The large gold squares at the right end are the LED **test pads**. The upper pad is marked "−" and the lower pad is marked "+".

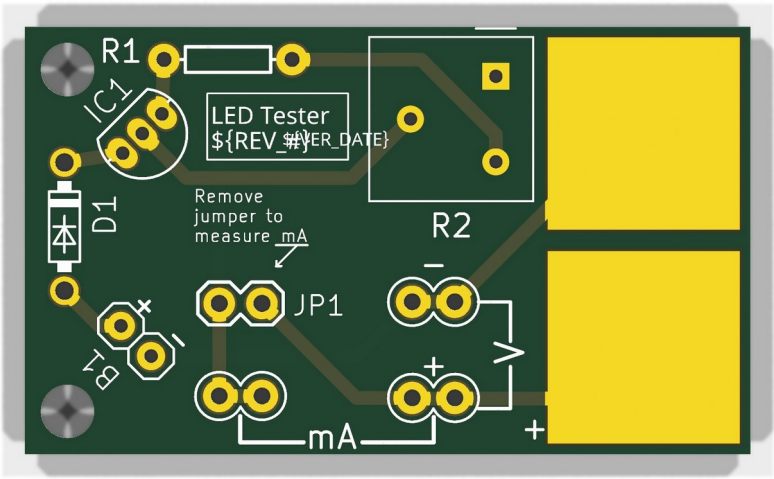


Figure 3. *The bare v1.1A circuit board, top view.*

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.

Resistor

( ) **R1**: 47 Ω (yellow-violet-black-gold). R1 is a small ⅛ W resistor and its holes are 0.3 in (7.62 mm) apart, so bend each lead at a right angle about 5/64 in (2 mm) from the body to match the hole spacing. Insert the resistor at **R1**, at the top edge of the board. Either direction is fine, but for a neat look keep the gold band to the right. Push it flat against the board.

( ) Bend the leads slightly outward on the bottom so the part cannot fall out. Solder both leads and trim them.

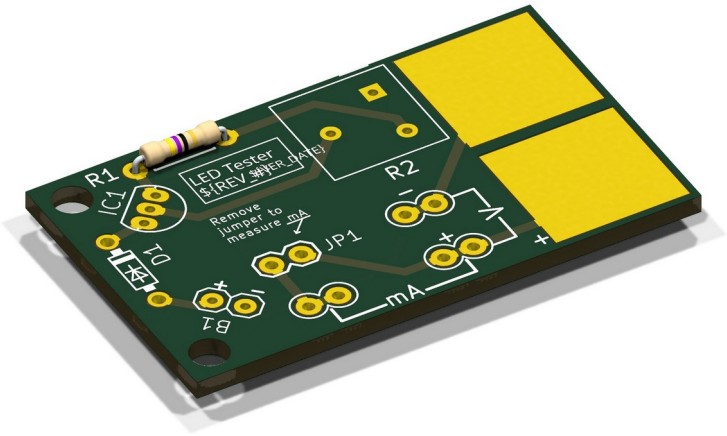


Figure 4. *R1 installed.*

Diode

( ) **D1**: 1N5817 Schottky diode. Bend the leads close to the body to match the hole spacing. Insert D1 at **D1** with the **band toward IC1** (toward the top of the board), matching the band printed on the board.

( ) Solder both leads.

( ) Trim the leads, and **save both cut-off leads**. You will use them in the next group of steps to make the test loops. Put them somewhere you will not lose them.

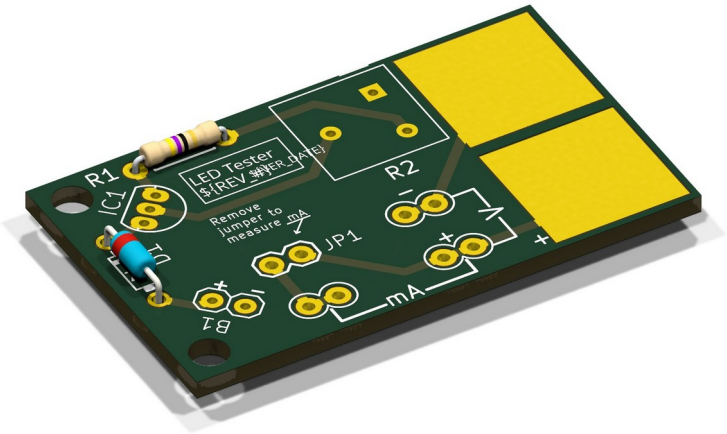


Figure 5. *D1 installed. The band faces IC1.*

Test loops

The three test loops give your meter probes or clip leads something solid to grab. Each loop is a small staple of wire, formed from the D1 offcuts, soldered into a pair of holes.

Each D1 offcut makes two loops if you are careful, so your two offcuts make up to four. You need three, which leaves one spare in case a loop does not come out the way you want. To get two loops from one offcut, form the first loop at one end, keep it low, and use no more wire than you need. Then cut it off and form the second loop from what is left.

( ) Using long-nose pliers, bend one end of a saved D1 lead into a small **U** whose legs are 0.100 in (2.54 mm) apart, to fit a pair of test-loop holes. Keep the loop low, about 1/8 in (3 mm) above the board: high enough to hook a clip lead on, but no more. Cut the U from the rest of the lead, leaving legs just long enough to pass through the board. Save the rest of the lead for the next loop.

( ) **TP1** (the "−" loop of the **V** pair): insert the loop, push it down to the height you want, and solder both legs on the bottom. Trim the excess.

( ) **TP2** (the "+" loop, shared by the **V** and **mA** pairs): form, insert, solder and trim the second loop in the same way.

( ) **TP3** (the left-hand loop of the **mA** pair, next to JP1): form, insert, solder and trim the third loop in the same way.

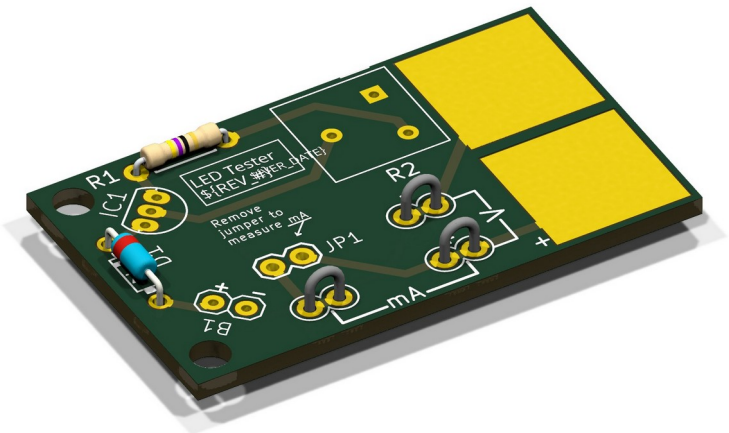


Figure 6. *Test loops TP1, TP2 and TP3 installed.*

Regulator

( ) **IC1**: LM317LZ. Find the flat face of the part. Hold it over the IC1 outline so its **flat face lines up with the flat side of the "D"** printed on the board (Figure 7).

( ) Insert the three leads into the three holes. Do not force the part flat. Leave about 1/8 to 1/4 in (3–6 mm) of lead between the body and the board.

( ) Double-check that the flat matches the outline, then solder the three leads. Work quickly: about two seconds per lead. Check that no solder bridges the closely spaced pads, then trim the leads.

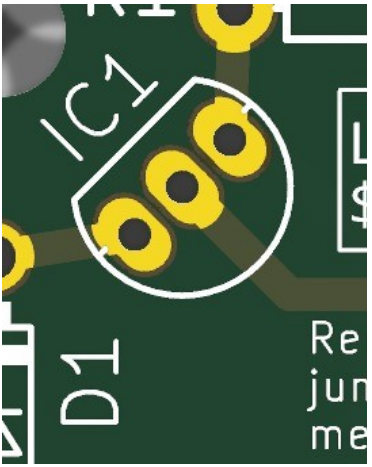


Figure 7. *IC1 outline. The flat side of the part goes against the flat side of the "D".*

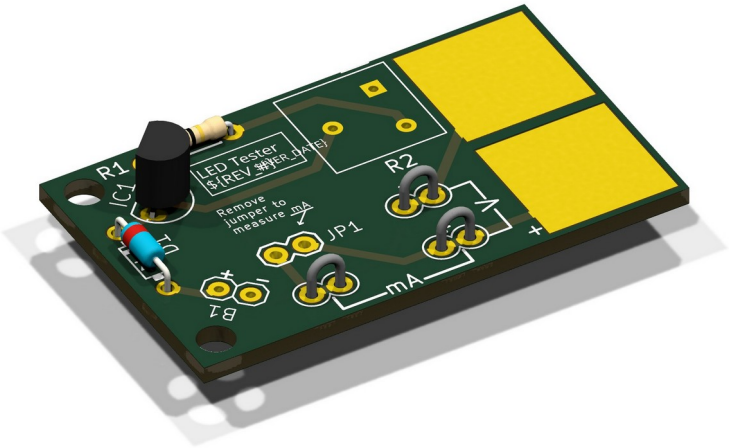


Figure 8. *IC1 installed.*

Trimmer potentiometer

( ) **R2**: 500 Ω trimmer, Bourns 3386F. Insert it at **R2** so its three pins drop into the three holes. It fits only one way. Hold it flat against the board.

( ) Solder the three pins and trim them if they are long.

( ) Set R2 to **minimum current**: turn the adjustment fully **counter-clockwise**. Turning R2 clockwise moves its wiper (pin 2) from pin 1 toward pin 3. Only pins 2 and 3 are in the circuit, so the resistance in series with R1 falls and the LED current **rises**. Counter-clockwise lowers it.

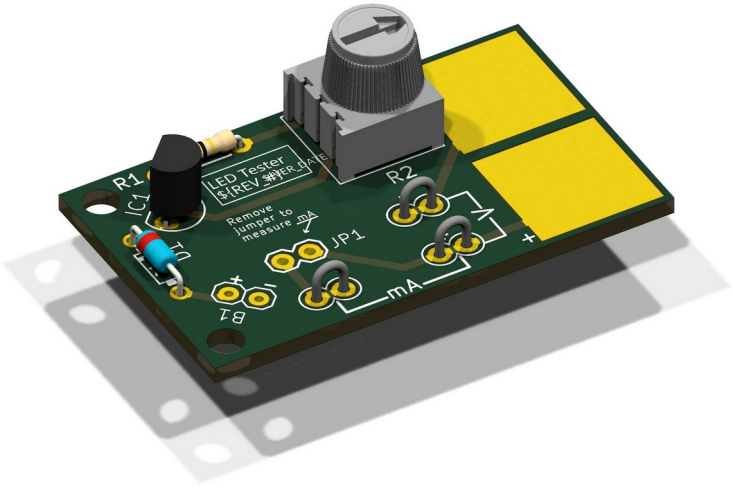


Figure 9. *R2 installed.*

Jumper JP1

( ) **JP1**: 2-pin header. Insert the **short** ends of the pins into the JP1 holes from the top, with the long pins standing up.

( ) Solder **one** pin only. Check that the header stands straight and flat. If it does not, reheat the joint and adjust it. Then solder the second pin.

( ) Press the **shunt** onto the two JP1 pins. The shunt must be in place whenever you are **not** measuring current.

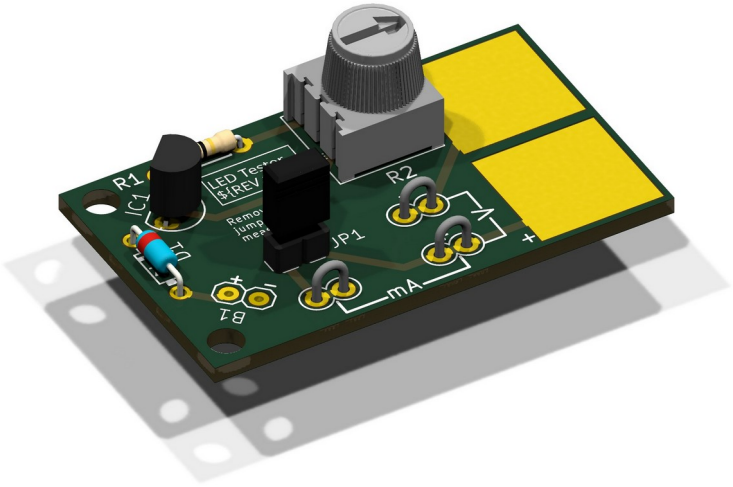


Figure 10. *JP1 with its shunt in place.*

Battery snap

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

( ) 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).

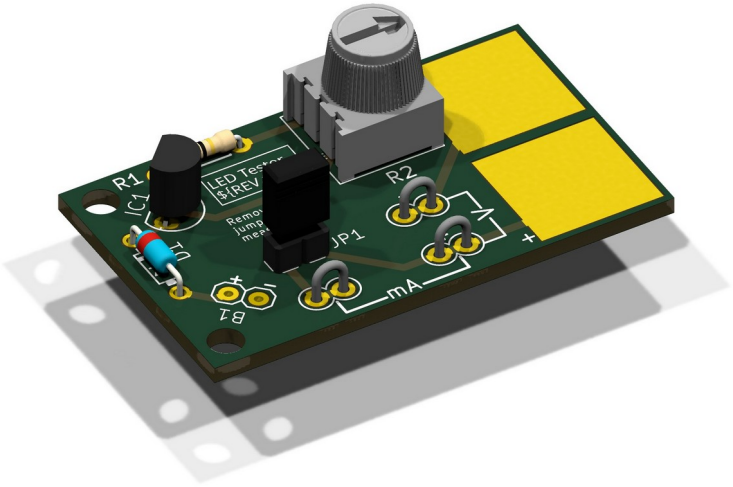


Figure 11. *The completed LED Tester (battery snap pads at the left; snap leads not shown).*

NOTE: The 3D pictures show the B1 pads only. The snap wires are not drawn.

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: R1 (2), D1 (2), TP1–TP3 (6), IC1 (3), R2 (3), JP1 (2), B1 (2): **20 joints**.
- ( ) No solder bridges, especially between the three IC1 pads and the three R2 pins.
- ( ) D1 band faces IC1.
- ( ) IC1 flat face matches the flat of the printed outline.
- ( ) B1: red lead at +, black lead at −.
- ( ) The JP1 shunt is in place.
- ( ) No clipped leads or solder splashes are stuck to the board. Brush the board off.

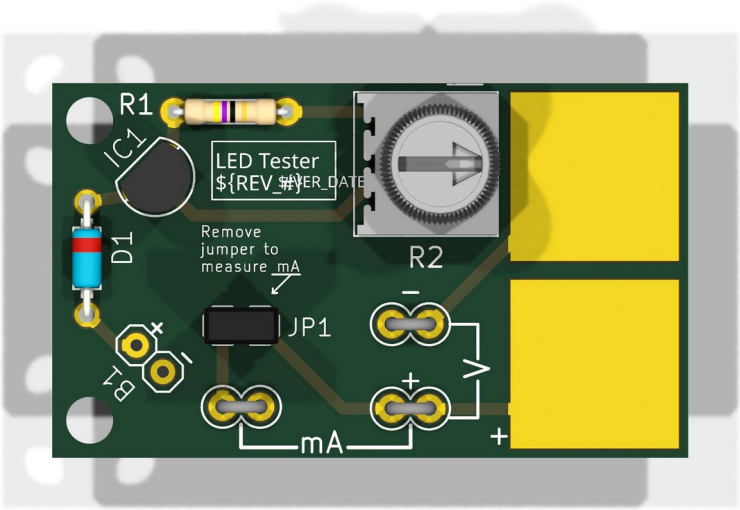


Figure 12. *Finished board, top view.*

Using the LED Tester

Connecting the battery

( ) Snap a 9 V battery onto B1. Nothing will happen yet. That is normal: with no LED in place, the tester draws almost no current.

Testing an LED

( ) Turn R2 fully counter-clockwise (lowest current).

( ) Hold the LED's leads against the two large test pads: the **anode** (the longer lead) on the pad marked **+**, and the **cathode** (the shorter lead, on the flat side of the LED rim) on the pad marked **−**. The LED should light dimly.

( ) Slowly turn R2 clockwise to raise the current until you reach the brightness 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. Turn it around and try again.

Measuring forward voltage

( ) Set your meter to DC volts. Connect the red probe to the **+** loop (TP2) and the black probe to the **−** loop (TP1): the pair bracketed **V** on the board. With an LED lit on the pads, the meter shows the LED's forward voltage at the present current.

Measuring LED current

( ) Remove the JP1 shunt. (The LED goes out: the current now has to flow through your meter.)

( ) Set your meter to DC milliamps (mA range). Connect the **red** probe to the **mA** loop (TP3, beside JP1) and the **black** probe to the **+** loop (TP2): the pair bracketed **mA** on the board.

( ) With an LED on the pads, the meter reads the LED current. Adjust R2 to the current you want.

( ) Disconnect the meter and **replace the JP1 shunt**.

CAUTION: Never connect a meter set to a current range across the **V** loops or across a battery. Most meters' current fuse would blow.

Battery life

Because the tester draws current only while an LED is on the pads, a battery lasts a very long time. Replace it when bright LEDs (especially blue and white ones, 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
No LED lights at any setting	Battery good and snap firmly connected? JP1 shunt in place? LED the right way round (long lead on +)? D1 band toward IC1? IC1 flat matching the outline? Reflow all IC1 and B1 joints.
LED lights but R2 has no effect	Check the three R2 joints and the two R1 joints for cold joints or bridges.
Current cannot be turned down low, or is very high	Look for a solder bridge between IC1 pads or between R2 pins. Check that R1 is 47 Ω (yellow-violet-black), not 4.7 Ω or 470 Ω.
V reading is zero	Meter probes on TP2 (+) and TP1 (−)? LED lit? Check the TP loop joints.
mA reading is zero	Is the JP1 shunt removed and the meter on a mA range? Is the meter's current fuse good? Are the probes on TP3 and TP2?
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.
IC1 gets hot	Turn R2 down. If it is hot with no LED in place, IC1 is in backwards or has a bridge: disconnect the battery and inspect.

Still stuck? Email **support@somerled.design**. Include your kit version (v1.1A), what you see, and, if you can, clear photos of both sides of the board. The support page, **shop.somerled.design/support/**, has the interactive placement guide (iBOM) and updates.

How It Works

The LM317L always tries to hold **1.25 V** between its OUT and ADJ pins. In the LED Tester, OUT feeds the wiper of trimmer R2. R2 is in series with R1 (47 Ω) back to ADJ. The LED is connected from ADJ, through jumper JP1, to battery negative.

To hold 1.25 V across R1 plus the part of R2 in use, the regulator must pass a current of

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

and that same current must flow through the LED. With R2 at 0 Ω (fully clockwise: wiper at pin 3) the current is about 1.25 / 47 ≈ **27 mA**. With R2 at its full 500 Ω (fully counter-clockwise: wiper at pin 1, which is unconnected) it is about 1.25 / 547 ≈ **2.3 mA**. The regulator adjusts its own voltage drop automatically, so the current stays the same whatever the LED's forward voltage (as long as the battery has enough voltage left).

D1, a Schottky diode with a low voltage drop, blocks current if the battery is ever connected backwards. JP1 sits in the LED current path. Remove it and connect an ammeter across TP3–TP2 to read the current directly. TP1 and TP2 sit across the LED, so a voltmeter there reads its forward voltage.

> **NOTE:** The range of about 2.3–27 mA has been confirmed on a built tester. Individual units vary slightly with resistor and regulator tolerances.

Schematic

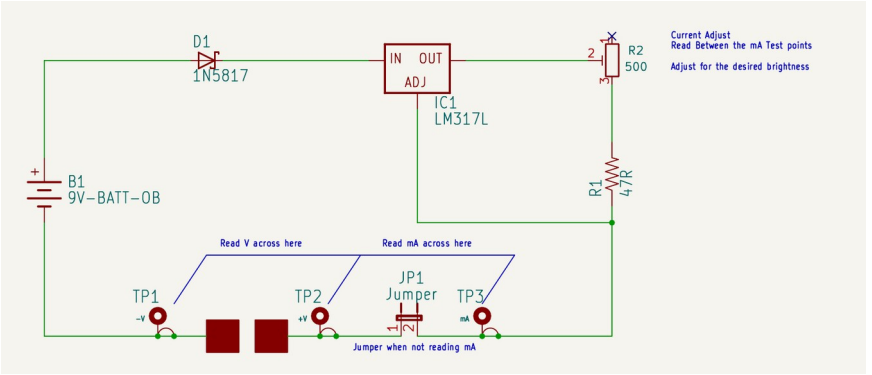


Figure 13. *LED Tester v1.1 schematic (from LEDTEST-11.kicad_sch).*

Specifications

Item	Value
Circuit	LM317L constant-current source
LED current	Adjustable, about 2.3 mA to 27 mA (1.25 V ÷ (47 Ω + 0–500 Ω)); clockwise = more current
Current adjust	R2, 500 Ω trimmer (Bourns 3386F-1-501TLF)
Measurements	LED forward voltage (V loops TP1/TP2); LED current (mA loops TP3/TP2 with JP1 removed)
Power	One 9 V battery (not included), via snap
Reverse-battery protection	D1, 1N5817 Schottky diode
Standby current	Practically zero with no LED on the pads; no power switch needed
Board size	1.700 × 1.000 in (43.18 × 25.40 mm)
Board version	v1.1A (silkscreen date 1-1-20)

Credits

The LED Tester circuit is based on the original LED tester design by **David Cook** of **Robot Room** (robotroom.com). The choice of trimmer potentiometer also follows his Robot Room work (robotroom.com/Trimpots.html). Many thanks to David for sharing his designs.

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

Hardware design © 2020 Somerled Design, LLC and Kevin Murphy, licensed under the CERN Open Hardware Licence v1.2 (as stated on the schematic).

Support

Email: **support@somerled.design**

Support page, with the interactive placement guide (iBOM) 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, for board v1.1A.