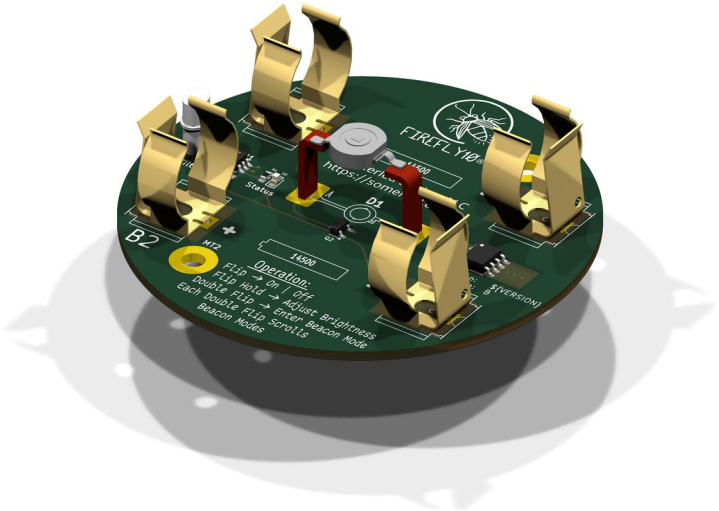
KIT ASSEMBLY MANUAL

FIREFLY10®

LED Camp Light for a Wide-Mount Jar

ATtiny10 · Surface-Mount · v1.0 Rev B



Somerled Design

somerled.design

Welcome

Thank you for choosing the Somerled Design **FireFly10** kit. In an evening you will build a small LED light engine that lives in a wide-mouth jar: a camp light, an emergency light, or a lantern for the patio. It has no buttons. You control it by turning the jar **upside down and back**.

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

A pre-programmed **ATtiny10** microcontroller watches a small **tilt switch**. When you flip the light, it switches the 1 W LED on or off through a power MOSFET, **Q1**, and sets its brightness. A small **status LED** shows what the light is doing. Two 14500 lithium-ion cells power the light.

The controls are printed on the board itself:

- **Flip** (upside down and back): on or off.
- **Flip and hold** upside down: adjust the brightness.
- **Double flip**: enter beacon mode. Each further double flip scrolls to the next beacon mode.

You will need a WIDE-MOUTH jar

IMPORTANT: The board is a circle **2.70 in (68.6 mm)** across. It needs a **wide-mouth** mason jar, or a wide-mouth pickle jar. **Regular-mouth jars are too small: the board will not go through the opening.** Measure the inside of the mouth of your jar before you start. It must be at least 2.70 in (68.6 mm).

What you supply

- A **wide-mouth** jar with its lid (see above).
- Two **14500** size 3.7 V lithium-ion rechargeable cells, and a charger for them.

- Mounting supplies for fixing the board in the jar (for example screws and standoffs through the two mounting holes, MT1 and MT2).

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 at **shop.somerled.design/support/ibom/firefly10-ibom.html**. 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 tip for the surface-mount parts; a larger chisel tip helps on the battery clips and lofts.
( )	Solder	Rosin-core electronics solder, 0.015–0.020 in (0.4–0.5 mm) for the small parts, 0.031 in (0.8 mm) for the clips and lofts. 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 lofts.
( )	Fine tweezers	For placing the surface-mount parts.
( )	Liquid or pen flux	Strongly recommended for the surface-mount parts.
( )	Magnifier	A 5–10× loupe or a magnifying lamp. The smallest parts are 0.06 × 0.03 in (1.6 × 0.8 mm).
( )	Safety glasses	Clipped leads fly. Solder can spit.
( )	Good light	For inspecting solder joints.
( )	Multimeter	Helpful for checking the battery clips, the LED and the 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.

Static electricity

The microcontroller U1 and the MOSFETs Q1 and Q2 can be damaged by static electricity, the same kind of spark you feel from a doorknob in dry weather.

- Leave them in their packing until the step that installs them.
- Before you pick them up, touch a large grounded metal object 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.

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.

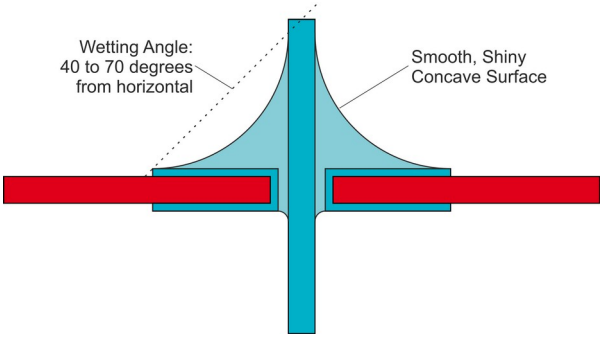


Figure 1. *An ideal solder joint in cross-section. Image: "Solder Joint en.svg" by SLUB Dresden / Carsten Pietzsch, based on an Adafruit diagram by Bill Earl. CC BY-SA 4.0 (creativecommons.org/licenses/by-sa/4.0), via Wikimedia Commons. Converted to PNG.*

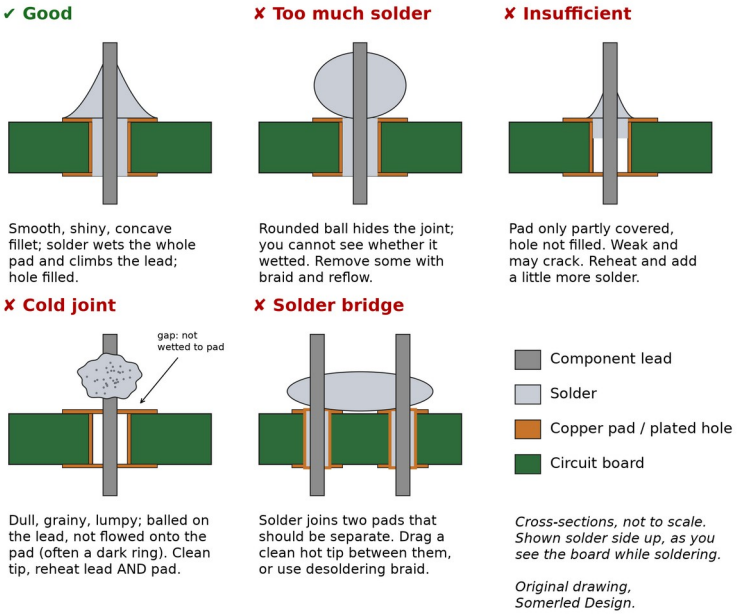


Figure 2. *A good joint and the four most common faults.*

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.

Large joints: battery clips and lofts

The battery clips and the copper lofts are big pieces of metal on large copper pads. They soak up heat. Use a larger tip, or turn the iron up a little, and hold it on the joint until the solder flows freely all round. A

joint that sets the moment the solder touches it is cold. Let these parts cool before you touch them: copper and brass stay hot for a long time.

Soldering a surface-mount part

Most of the FireFly10 parts are surface-mount: they sit **on** their pads instead of passing through holes. They are small, but easy with this method and a little patience:

( ) Brush a little flux on the pads. 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 under the magnifier that the part is square, and that every lead sits on its own pad. If not, reheat the one joint and nudge it. Then solder the other leads, touching the iron to the pad and the end of the lead together. Finally reflow the first joint with a touch of fresh solder.

A bridge between two leads of a chip is easy to remove: add flux, then drag a clean tip, or a piece of desoldering braid, across the leads.

NOTE: Heat is the enemy of semiconductors. Do not hold the iron on a chip or MOSFET 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	—	FireFly10 circuit board, v1.0 Rev B, round, 2.70 in (68.6 mm) diameter
( )	1	U1	ATtiny10 microcontroller (ATtiny10-TSHR), SOT-23-6, 6 leads, **pre-programmed**
( )	1	Q1	FDS6680A N-channel MOSFET, SO-8 (8 leads)
( )	1	Q2	AO3401A P-channel MOSFET, SOT-23 (3 leads)
( )	2	R1, R2	220 Ω resistor, 0603 surface-mount, 0.06 × 0.03 in (1.6 × 0.8 mm)
( )	1	D2	Status LED, 0603 surface-mount
( )	1	SW1	Tilt switch with wire leads
( )	4	B1, B2	Keystone 92 battery clip (two per cell)
( )	1	D1	1 W high-power LED
( )	2	—	Copper LED lofts (pre-formed copper straps that hold D1)

NOTE: On the iBOM and in the design files, Q1 is still listed as **SI4410DY**, an older part that is no longer made. The kit ships with the **FDS6680A**, which fits the same SO-8 pads and is fitted the same way. If your board's silkscreen says SI4410DY at Q1, fit the FDS6680A there.

There is no programming header on this board, and none is needed: U1 comes **pre-programmed**. It cannot be replaced with a blank ATtiny10.

NOTE: Not included: the two 14500 cells, the wide-mouth jar, and mounting supplies. If a part is missing, check the packing material again, then email **support@somerled.design** with your kit name and the missing part.

Identifying the Parts

U1, the microcontroller

U1 is a tiny black chip with **six** leads, three on each side. A dot, or the start of the printing, marks **pin 1**. On the board, a small **triangle** beside the U1 outline marks the pin 1 pad (top left).

Q1 and Q2, the MOSFETs

Q1 (FDS6680A) is the larger chip with **eight** leads, four on each side. A dot or a bevelled edge marks **pin 1**. On the board, a triangle marks the pin 1 pad of Q1 (top left). **Q2** (AO3401A) is a three-lead SOT-23: two leads on one side, one on the other, so it fits only one way.

R1, R2 and D2

R1 and R2 are tiny 220 Ω chip resistors. They are not polarized. Small chip resistors are often unmarked, so keep them in their tape until you fit them. D2 is a chip LED of the same size, and **is** polarized: the cathode end is marked, usually with a green line, dot or “T” on the underside. On the board, the D2 outline is closed at the **cathode** end (the lower pad).

SW1, the tilt switch

The tilt switch is a small sealed cylinder with two wire leads. Inside, a contact closes when the switch is upright and opens when it is turned over. That is how the light knows it has been flipped. It is not polarized: either lead can go in either hole.

Battery clips

The four **Keystone 92** clips hold the two cells. Each cell, B1 and B2, sits in two clips, one at each end. The clips are not polarized; the cell’s direction is set by the + and − printed on the board.

D1, the 1 W LED, and the lofts

D1 is a 1 W high-power LED with two solder tabs, an **anode (+)** and a **cathode (−)**. Find the + mark on the LED or on its seller’s drawing, or check it with a multimeter on the diode range: the LED glows faintly when the red probe is on the anode. The LED is not soldered to the board

directly. It sits on top of two copper **lofts**, which carry the current and hold the LED up in the jar.

The Copper LED Lofts

The kit includes two copper **lofts**, made by hand at Somerled Design from copper strap. Each loft has a straight leg at the bottom that goes through one of the two large slotted pads marked D1, a vertical post, and a short top that supports one tab of the 1 W LED. The two lofts are the same; either can go in either pad.

Item	From the board design
Slot in each D1 pad	0.031 × 0.118 in (0.8 × 3.0 mm)
D1 pads	0.16 × 0.24 in (4 × 6 mm) copper pads, 0.71 in (18 mm) apart, centre to centre
LED height in the design	About 0.41 in (10.5 mm) above the board

( ) Find the two lofts in the kit and compare them with Figure 11. Check that they are straight and the same height, so the LED will sit level. If one has been bent in the post, straighten it gently with long-nose pliers.

( ) Try each leg in its slot before you solder. It should slip through without force.

NOTE: Copper is soft. Handle the lofts gently. If they are tarnished, clean the leg and the top with fine abrasive or a fibreglass pen so the solder will flow.

Circuit Board Assembly

Look over the bare circuit board (Figure 3). All the parts mount on the **top** side, the side with the FireFly10 logo. The small surface-mount parts are on the left (U1, R1, R2, D2), on the centre line (Q2) and on the right (Q1). Fit the surface-mount parts first, while the board can lie flat, then the tilt switch, the battery clips and finally the lofts and LED.

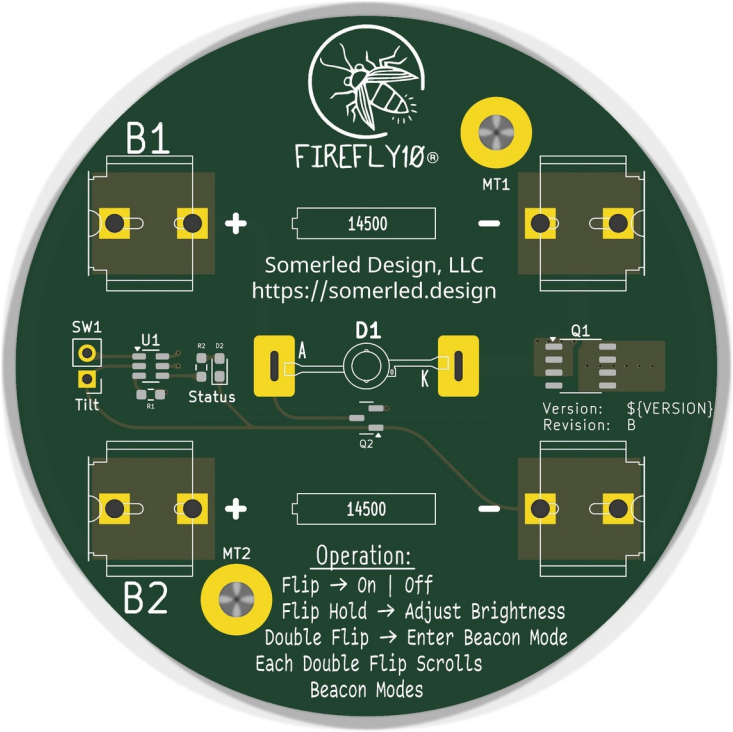


Figure 3. *The bare FireFly10 v1.0 Rev B board, top view.*

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.

Microcontroller U1

( ) Find the U1 outline on the left, between **SW1** and **Status**. The small triangle at its top left marks pin 1.

( ) **U1**: ATtiny10, pre-programmed. Put it on its pads with the **pin 1 dot at the triangle** (top left). Tack one corner lead, check that all six leads sit on their pads, then solder the rest.

( ) Inspect with the magnifier for bridges between the leads.

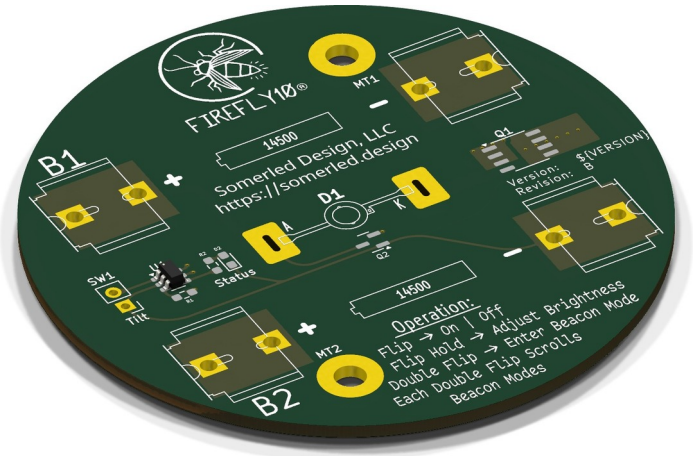


Figure 4. *U1 installed.*

MOSFET Q2

( ) **Q2**: AO3401A, SOT-23. Its outline is on the centre line, below D1. Place it with its **single** lead on the single pad. Tack one lead, check, then solder the other two.

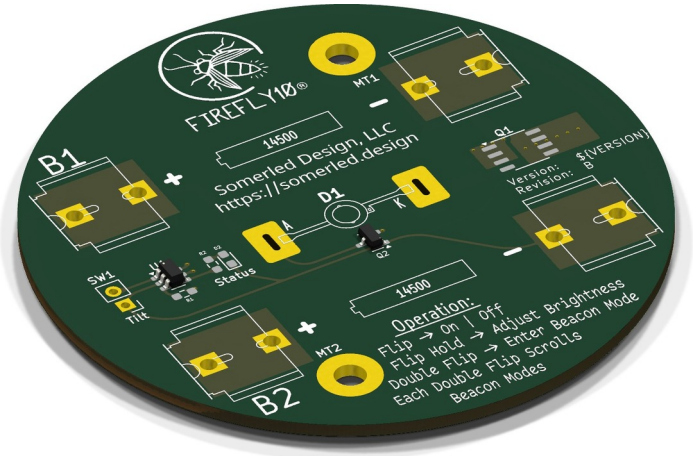


Figure 5. *Q2 installed.*

MOSFET Q1

( ) **Q1**: FDS6680A, SO-8, on the right of the board. Place it with the **pin 1 dot at the triangle** (top left of the outline). Tack one corner lead, check that all eight leads are on their pads, then tack the opposite corner and solder the rest.

( ) Pins 1, 2 and 3 are joined on the board, and so are pins 5 to 8, so a bridge within those groups does no harm. A bridge from pin 4 to pin 3 or from pin 4 to pin 5 **must** be removed.

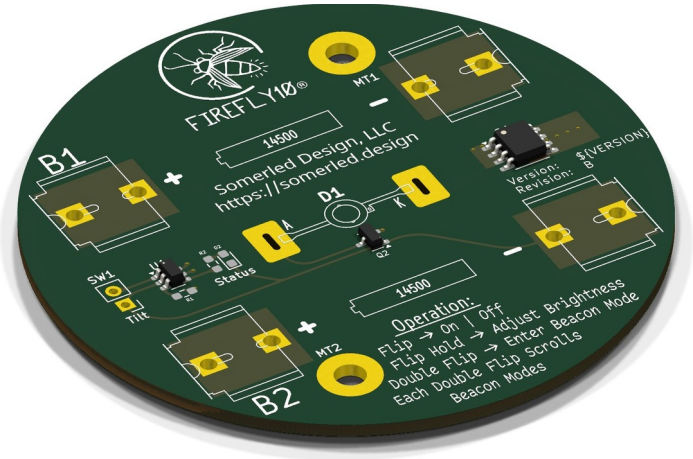


Figure 6. *Q1 installed.*

Resistors and status LED

( ) **R1**: 220 Ω, the pads just below U1. Either way round.

( ) **R2**: 220 Ω, the left pair of pads in the **Status** group (R2 is printed above them). Either way round.

( ) **D2**: status LED, the right pair of pads in the **Status** group. The **cathode** mark goes to the **lower** pad, at the closed end of the outline.

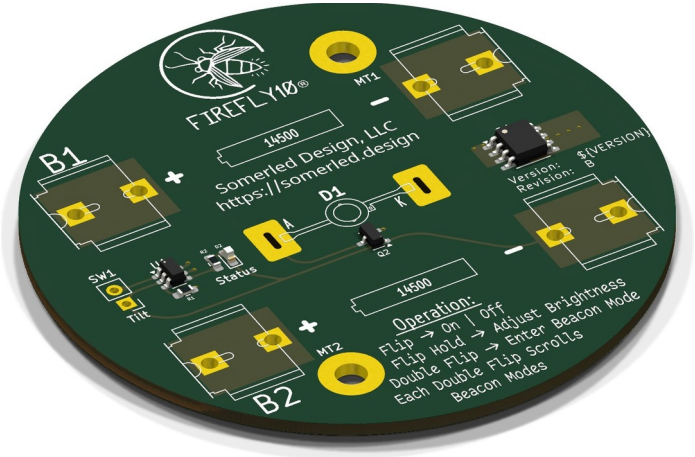


Figure 7. *R1, R2 and D2 installed.*

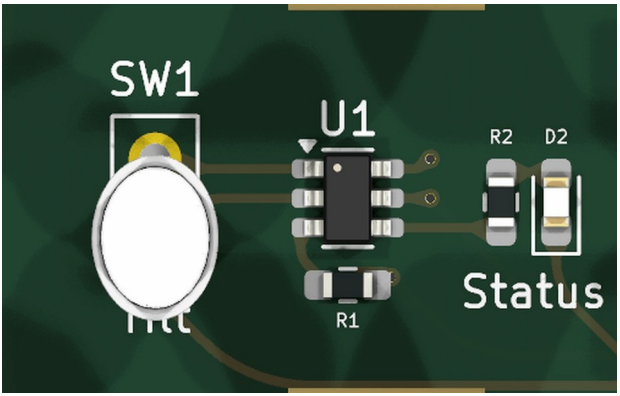


Figure 8. *The left-hand group, top view: SW1, U1 (pin 1 at the triangle), R1, R2 and D2.*

Tilt switch

( ) **SW1**: tilt switch, beside the label **Tilt**. The two holes are 0.100 in (2.54 mm) apart and 0.039 in (1.0 mm) across. Bend the wire leads gently so they drop into the holes.

( ) Stand the switch **upright**, square to the board, with its leads at the bottom, as in the picture. The light reads “upright” and “upside down” from this switch, so do not leave it leaning. Solder quickly (the switch is sealed) and trim.

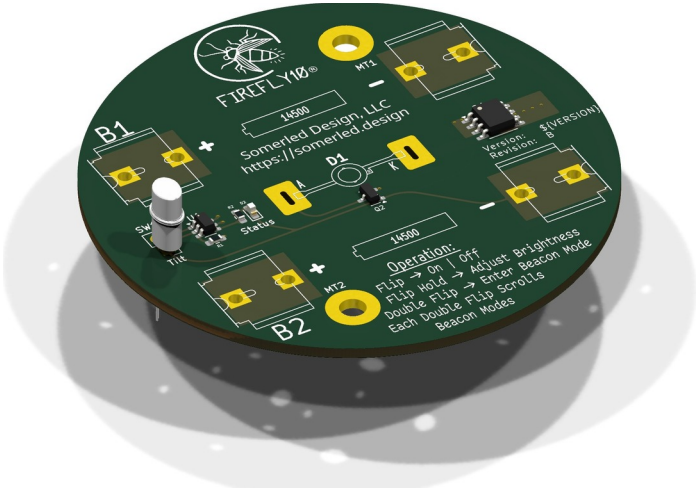


Figure 9. *SW1 installed, standing upright.*

Battery clips

( ) **B1**: two Keystone 92 clips, one at each end of the B1 outline (top). Each clip goes in the two holes at its end of the outline, over the printed clip shape. Hold the clip square and flat, solder both of its pins, and check it has not tilted.

( ) **B2**: two more clips at the B2 outline (bottom), in the same way.

( ) Check that each pair of clips lines up so a cell will sit straight, and that every clip is solid.

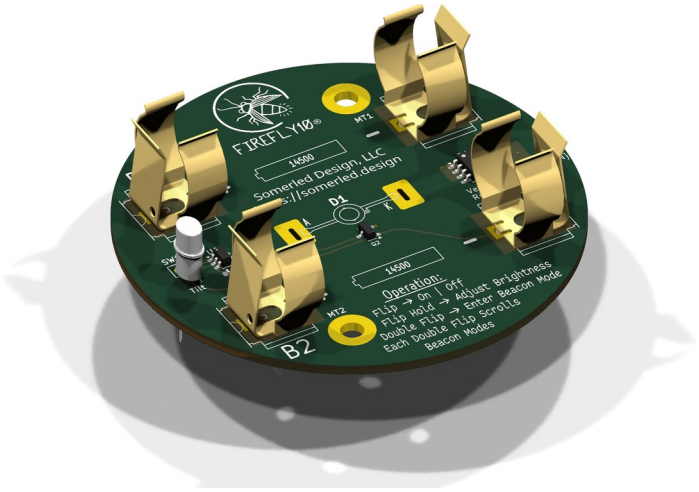


Figure 10. *The four battery clips installed.*

Lofts and the 1 W LED

( ) Push one loft through each of the two large slotted **D1** pads, from the top, so the posts stand straight up and the tops turn in toward each other. Solder each loft to its pad from the bottom and the top, with plenty of heat.

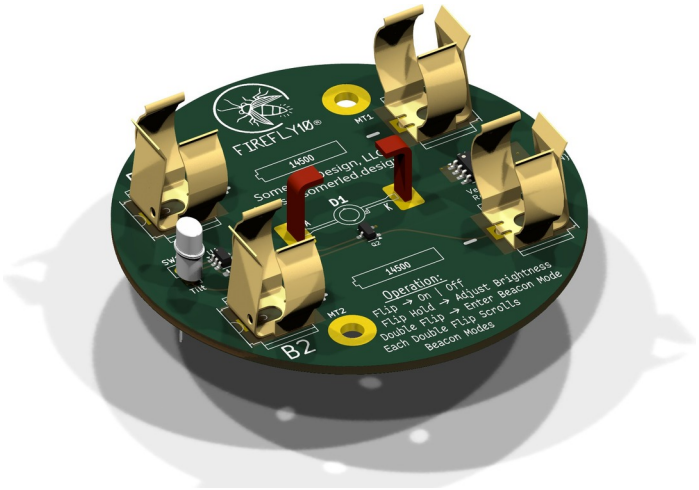


Figure 11. *The two copper lofts installed.*

( ) Find the + (anode) tab of the 1 W LED. The anode goes on the **left-hand** loft as the board is shown in Figure 3 (the pad marked **A**). The cathode goes on the right-hand loft (marked **K**).

( ) Set the LED on top of the lofts, LED face up. Tin each tab and the top of each loft, then solder them together. Work quickly so the LED does not overheat.

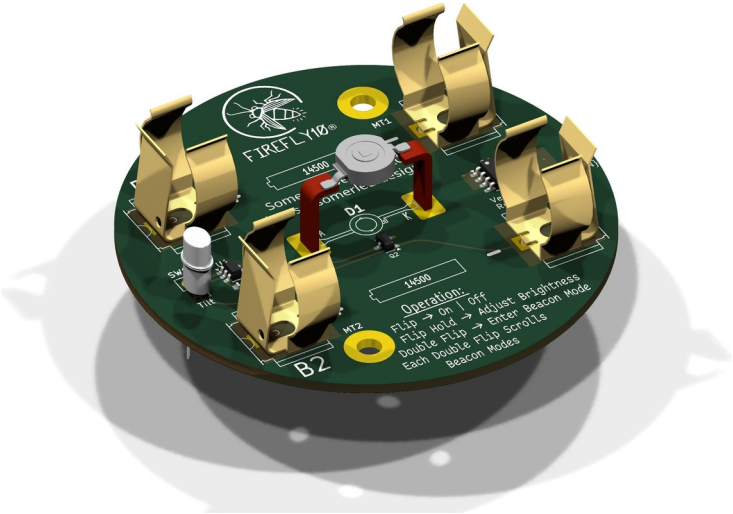


Figure 12. *The finished FireFly10 board.*

Final Inspection

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

( ) Every lead is soldered: U1 (6), Q1 (8), Q2 (3), R1, R2, D2 (6), SW1 (2), clips (8), lofts (2), and the two LED tabs.

( ) No solder bridges between the U1 leads, or from Q1 pin 4 to its neighbours.

( ) U1 and Q1 pin 1 at their triangles. D2 cathode at the lower pad.

( ) Tilt switch upright. LED anode on the **A** loft.

( ) No clipped leads or solder splashes on the board. Brush it off.

( ) With a multimeter on resistance, check from a + clip to a − clip. It must **not** read a dead short (0 Ω).

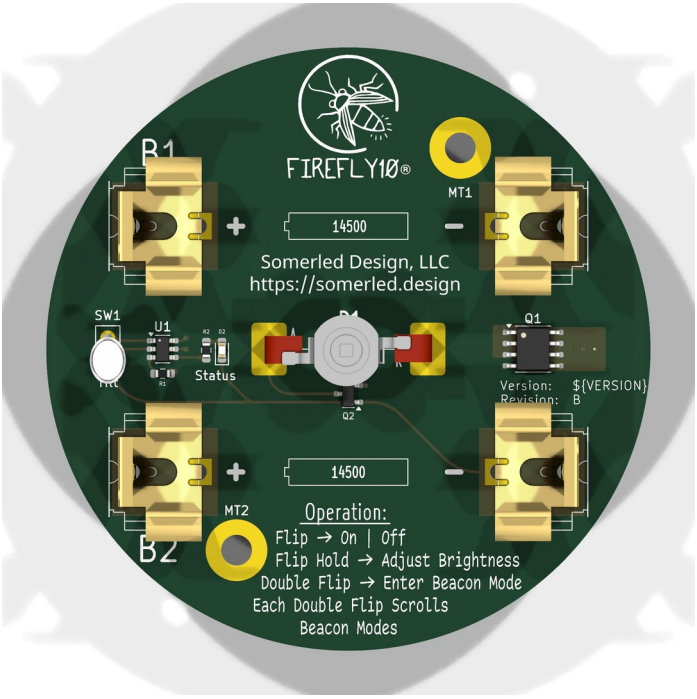


Figure 13. *Finished board, top view.*

Using the FireFly10

Batteries

WARNING: Use only **14500 size 3.7 V lithium-ion** cells. Ordinary AA cells are the same size but only 1.5 V, and the light will not work properly on them. The two cells are connected **in parallel**: each cell must go in with its **+** end at the **+** printed on the board. **A cell put in backwards is shorted by the other cell.** Lithium-ion cells can get very hot, vent or catch fire if they are shorted. Check both cells every time you put them in.

( ) Charge both cells fully before first use, in the charger made for them.

( ) Put one cell in B1 and one in B2, **+ end at the +** on the board.

First power-up

( ) Stand the board upright on the bench (LED up). Then turn it **upside down and back**. The LED should come on.

( ) Turn it over and **hold** it upside down. The brightness changes. Turn it back upright when you have the level you like.

( ) Flip it again to turn it off.

( ) Try a **double flip** to enter beacon mode, and further double flips to scroll through the beacon modes.

CAUTION: The 1 W LED is very bright. Do not look straight into it.

Into the jar

Mount the board in the jar using the two mounting holes, MT1 and MT2, which are 0.138 in (3.5 mm) across. How you mount it is up to you; the mounting supplies are not part of the kit. Make sure nothing metal can touch the battery clips or the lofts.

REMEMBER: Once more: only a **wide-mouth** jar will do. The board is 2.70 in (68.6 mm) across. Regular-mouth jars are too small.

Troubleshooting

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

Symptom	Check
Nothing happens when flipped	Both cells charged, + at the + mark? Check the clip joints. Check U1 orientation (pin 1 at the triangle) and its six joints, and Q2 and its three joints (Q2 feeds U1).
Status LED works but the 1 W LED does not	LED anode on the A loft? Check the loft and LED tab joints, the Q1 joints (especially pin 4), and R1.
LED on all the time, cannot be turned off	Look for a bridge from Q1 pin 4 to pins 5–8. Check the U1 joints.
Does not respond to flips	Is SW1 upright and both leads soldered? Check the U1 pin 1 joint.
Status LED never lights	D2 cathode at the lower pad? Check R2 and D2 joints.
A cell or clip gets hot	Remove the cells at once. A cell is in backwards, or there is a short between the + and − clips.

Still stuck? Email **support@somerled.design** with your kit name (FireFly10, v1.0 Rev B), what you see and, if you can, clear photos of both sides of the board.

How It Works

The two cells, B1 and B2, are in parallel and supply about 3.7 V. The 1 W LED, D1, runs from the cells through **Q1**, an N-channel MOSFET that acts as a switch in the LED's negative lead. U1 drives Q1's gate through R1 and switches it on and off rapidly to set the brightness.

Q2, a P-channel MOSFET, feeds U1 from the cells. Its gate is tied to negative, so it is on whenever the cells are the right way round, and it blocks U1's supply if they are not.

The tilt switch SW1 connects one of U1's inputs to negative when the light is upright. U1 times the flips and holds and decides what to do. The status LED D2 is driven from another U1 pin through R2.

Specifications

Item	Value
Controller	ATtiny10, pre-programmed; no programming header
LED switch	Q1, FDS6680A N-channel MOSFET (SO-8); listed as SI4410DY on the iBOM
U1 supply	Through Q2, AO3401A P-channel MOSFET (SOT-23)
Light	1 W high-power LED on the supplied copper lofts
Control	Tilt switch: flip, flip-and-hold, double flip
Power	Two 14500 3.7 V lithium-ion cells in parallel (not included), in four Keystone 92 clips
Board	Round, 2.70 in (68.6 mm) diameter; two 0.138 in (3.5 mm) mounting holes
Enclosure	Wide-mouth mason jar or wide-mouth pickle jar (not included). Regular-mouth jars are too small.
Board version	v1.0 Rev B
Firmware	Somerled Design (proprietary), pre-programmed in U1

Credits

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**. Interactive placement guide: **shop.somerled.design/support/ibom/firefly10-ibom.html**

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 FireFly10 v1.0 Rev B.