DATASHEET · GEN 1 (REV P1) BOARD

LED-STROBE-XXL

A stand-alone 72-LED white strobe on one board. Set the flash rate, flash length and brightness with three trimmers, solder pads or logic pins. Just add 12 V: no code and no computer.

Datasheet **rev B**
2026-11-12
Board **P1 (gen 1)** · Firmware **1.01**

72 LEDs	**4.32 A**	**1–1,000 Hz**	**0.1–12.7 %**
6500 K white, about 5,800 lm peak (calculated)	Peak LED current from two constant-current drivers	Flash rate, 60–60,000 flashes a minute	Duty in 0.1 % steps: flashes from 5 µs to 127 ms

Overview

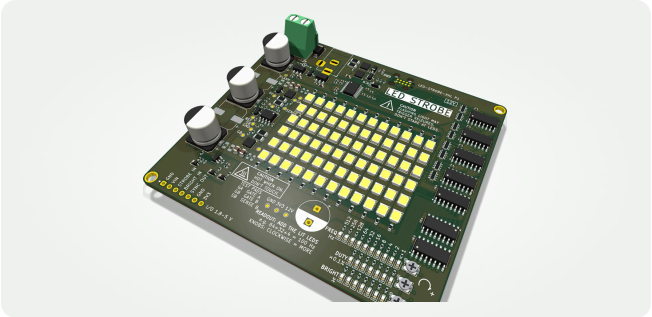
LED-STROBE-XXL has 72 white LEDs, two op-amp constant-current drivers and a small microcontroller whose timer makes every flash in hardware. It needs only a 12 V supply.

This datasheet covers **gen 1 (rev P1)** boards, a small prototype run, with **firmware 1.01**. Each board has one hand rework and its own temperature calibration. Read **section 12, Known issues on gen 1**, before you use one.

Features

- **72 white LEDs**, 6500 K, in 24 strings of 3, each string with its own ballast resistor.
- **4.32 A peak LED current** (180 mA a string), held steady by two op-amp constant-current drivers as the 12 V droops.
- **1–1,000 flashes a second**, with a log-curve rate trimmer so both ends are easy to set.
- **Duty 0.1–12.7 %** in 0.1 % steps; **brightness in 128 steps**.
- **Three sources for each setting:** trimmer, solder pads or header pin, chosen per setting.
- **STROBE IN** (a contact to GND or 1.8–5 V logic): one flash per trigger, light on while held, or PWM duty.
- **Binary readout:** 24 red LEDs show the settings in use. No display needed.
- **SYNC OUT:** 3.3 V logic, low during every flash, for a camera, a scope or a second board.
- **Protection:** reverse polarity, over-voltage cut-off at about 14.9 V, 24 V surge diode, ESD diodes on the header signals, a temperature sensor beside the driver MOSFET, and firmware limits for heat and a sagging supply.
- **14 labelled test pads** and a Tag-Connect TC2050 programming footprint.
- **96.5 × 86.4 mm**, four M3 mounting holes, flat back.

> ⚠ **Flashing light can trigger seizures. The board gets hot.**
> Read **section 9, Heat and safety**, before you power it.



Main parts	PY32F002B microcontroller, TLV9062 op-amp, 2 × AON7400A MOSFETs, 72 × Everlight 67-21S white LEDs
Power	12 V DC on a 2-pin screw terminal
Interface	7-pin 0.1" header: STROBE IN, BRIGHT IN, SYNC OUT, VIN, 3V3, 2 × GND
Programming	SWD on a Tag-Connect TC2050 footprint
Size	96.52 × 86.36 mm (3.80 × 3.40 in)
In the box	1 × board, assembled and tested; 1 × 7-pin 0.1" male header, loose. No supply or heatsink.

Typical applications (section 8)

- Stroboscope and RPM
- Freezing motion
- Physics demos
- Multi-exposure photos
- Machine vision
- Testing light sensors
- Time fountains
- POV and zoetropes
- Camera flash
- High-speed photos
- Chained boards
- Light on while held

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2 SPECIFICATIONS

At 25 °C room temperature with a 12 V supply, unless a note says otherwise. The **Basis** column says where each figure comes from: Meas. measured on P1 boards on the bench · Calc. calculated from the design, not yet measured · Part from the part's datasheet · FW a limit set by the firmware · Design fixed by the circuit · TBD not yet measured.

Power

Parameter	Min	Typ	Max	Unit	Basis	Notes
Supply voltage	10.5	12.0	14.0	V	FW	The firmware pauses flashing outside 10.5–14 V (fault lasting 50 ms)
Over-voltage cut-off		14.9		V	Meas.	The input switch turns off and the board goes dark
Average supply current			0.30	A	Calc.	From the firmware's 3.39 W heat budget
Peak supply current			4.5	A	Calc.	Long flashes only. Flashes of a few ms or less come from the board's 3 × 1,000 µF capacitors
Idle current, not flashing		—		mA	TBD	Not yet measured

> **Which supply?**
> A 12 V, 1 A adapter is enough for short flashes, which is most strobe use. For long flashes at high brightness (over about 5 ms each) or a held light, use a 12 V supply rated for 5 A on short, thick leads. If the 12 V sags under 11 V during a flash, the firmware dims the flashes instead of stopping. It holds them dimmed for a minute, then raises the brightness again slowly.

Light

Parameter	Min	Typ	Max	Unit	Basis	Notes
LEDs		72			Design	Everlight 67-21S/KK7C-H657034Z15/DT, 2835 package, 0.5 W
Colour temperature		6500		K	Part	Cool white, CRI 80
Wiring					Design	24 strings of 3 LEDs, each with a 1 Ω ballast resistor; 12 strings on each driver
Current a string, full brightness		180		mA	Calc.	From the sense resistors (2 × 0.1 Ω a driver)
Total LED current, full brightness		4.32		A	Calc.	2.16 A a driver
Peak light output		5,800		lm	Calc.	From the LED datasheet's lowest brightness grade. Not yet measured
Brightness steps	0		127		FW	Linear in current, about 1.4 mA a string a step
Beam angle		120		°	Part	Each LED, bare with no lens. The LED field is about 51 × 35 mm

Timing

Parameter	Min	Typ	Max	Unit	Basis	Notes
Flash rate, free-running	1		1,000	Hz	FW	60–60,000 flashes a minute. The rate trimmer follows a log curve
Flash rate, triggered			1,100	Hz	FW	From STROBE IN. Flashes are at least 0.9 ms apart; a trigger that comes sooner is skipped
Duty cycle	0.1		12.7	%	FW	0.1 % steps. Triggered flashes: 12.3 % at most. Follow mode has no duty limit; the heat limits dim it instead (section 9)
Flash length	5 µs		127 ms		FW	Duty divided by rate. A setting that works out under 5 µs is raised to 5 µs, and the readout shows the raised duty. 127 ms = 12.7 % at 1 Hz

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Parameter	Min	Typ	Max	Unit	Basis	Notes
Driver turn-on		3		µs	Meas.	On the MOSFET gates. This is why the shortest flash is 5 µs
Trigger delay			3	µs	Meas.	STROBE IN going low to SYNC OUT going low, timed by a Pico (which adds 1–2 µs of its own). Not yet checked on a scope
Trigger debounce		2		ms	FW	The rest STROBE IN needs after a triggered flash, so a bouncing contact gives one flash. A steady signal needs only an eighth of its period
Timing source					Design	The microcontroller's internal 24 MHz oscillator, no crystal. Fine for strobing; check RPM against a tachometer if you need it exact

Header signals (J1)

Parameter	Min	Typ	Max	Unit	Basis	Notes
Logic level, STROBE IN and BRIGHT IN	1.8		5.0	V	Design	Works with 1.8 V, 3.3 V and 5 V hosts
STROBE IN switching point		1.2		V	Calc.	10 kΩ pull-up to 3.3 V and an NPN buffer. Below it the pin is active; above it, or left open, it is at rest
STROBE IN current when pulled low		0.33		mA	Calc.	A switch, a camera contact or an open-collector output works
STROBE IN PWM, duty mode	0.1		100	kHz	Meas.	The active time reads about 0.3 µs short. That is nothing below 20 kHz, but at 100 kHz a 10 % input reads 7.2 %. Above 10 kHz a change takes about 0.5 s to show
BRIGHT IN input resistance		14.7		kΩ	Design	4.7 kΩ in series, 10 kΩ to GND
BRIGHT IN range	0		3.3	V	Design	0–3.3 V sets 0–100 %. Higher voltages read as 100 %
BRIGHT IN PWM	0.1		100	kHz	Meas.	At any logic level from 1.8 to 5 V: the board measures the duty. It reads within about 3 steps (of 127) in tests at 1 kHz and 10 kHz. At 100 Hz one test read well off, so use 1 kHz or more. At 100 kHz a duty under about 3 % or over 97 % reads as a steady level
SYNC OUT logic level		3.3		V	Design	Push-pull with 100 Ω in series. High at rest, low for the whole flash
SYNC OUT load	1			kΩ	Design	Logic inputs, camera trigger inputs and scopes
3V3 pin, current you can draw			30	mA	Design	From the board's 3.3 V regulator
VIN pin current			1	A	Design	The supply input itself, before the reverse-polarity switch

Board

Size	96.52 × 86.36 mm (3.80 × 3.40 in)
Mounting holes	4 × Ø3.2 mm, for M3 or #4 screws, on a 91.44 × 81.28 mm grid
PCB	FR-4, 1.6 mm, 2 layers, 1 oz copper, ENIG (gold) finish
Tallest parts	The screw terminal and the 10.5 mm electrolytic capacitors, both on the front
Back	Flat: pads, copper and print only
Weight	TBD Not yet measured
Use	Indoors, at room temperature. Not tested hot or cold

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3 ABSOLUTE MAXIMUM RATINGS

Going past any of these can damage the board. They are limits, not working conditions: run it inside **section 2, Specifications**. The figures come from the part ratings and the circuit (calculated). P1 boards have been tested up to 15 V on the input.

Parameter	Min	Max	Unit	Notes
Supply voltage, terminal or VIN pin	−24	24	V	Reverse polarity is blocked and the board stays dark above 14.9 V. The limit is the 24 V surge diode, which heats up if held above 24 V
STROBE IN, BRIGHT IN	−0.5	5.5	V	Each has an ESD diode and a series resistor
SYNC OUT	−0.3	3.6	V	An output. Don't drive it from another output
3V3 pin		30	mA	An output. Don't feed power into it
VIN pin current		1	A	Power the board through the screw terminal, not the header
Duty cycle		12.7	%	Free-running and triggered flashes, whatever the source. Set by the firmware. Follow mode is limited by heat instead
Board temperature at the temperature sensor		60	°C	The firmware dims from 50 °C and stops flashing at 60 °C

Static

The header signals have ESD diodes. The rest of the board doesn't, so handle it by the edges and touch something grounded first.

Short circuits

SYNC OUT has 100 Ω in series, which limits a short to GND to about 33 mA. That is above the microcontroller pin's rating, so don't leave it shorted. The 3V3 and VIN pins are not short-circuit protected.

4 BOARD LAYOUT

Power comes in at the top left and the LEDs fill the middle. Everything you touch sits along the bottom edge: the header, the trimmers and the readout. The back holds the solder pads for fixed settings. Positions are as seen from the front, with the screw terminal at the top left.

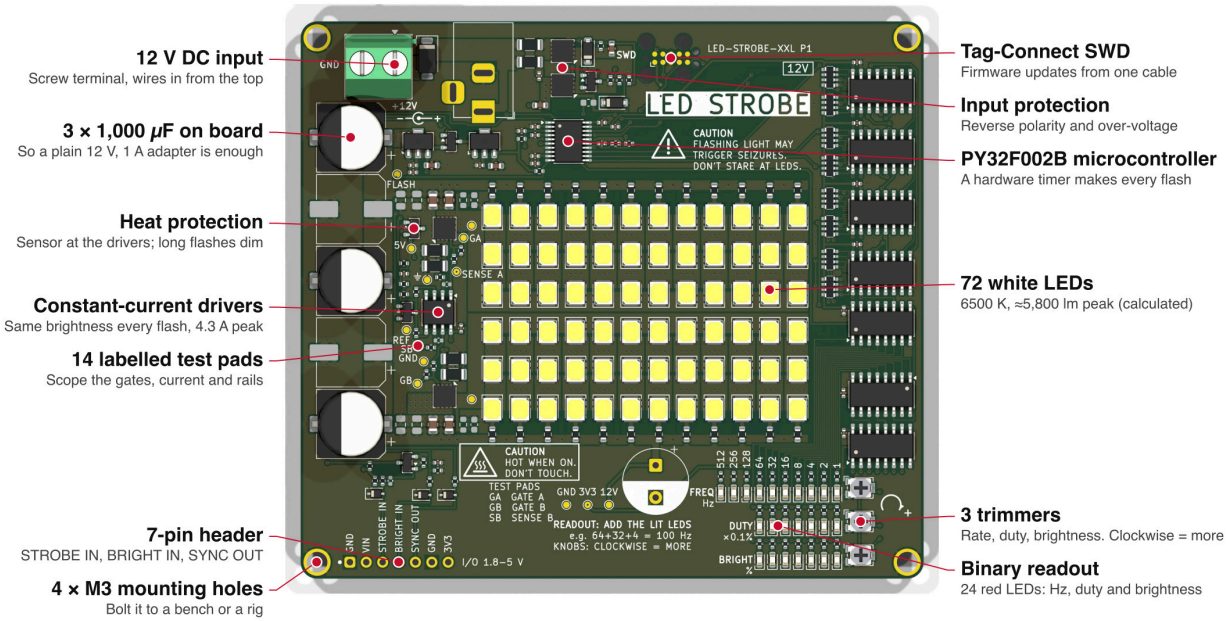


Figure 1. Front, labelled. Render of the P1 design.

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Front

Where	What	Notes
Top left	**12 V screw terminal (J2)**	5.08 mm pitch. GND (left) and +12V (right) are printed beside it; the wires enter from the top edge. The barrel-jack footprint next to it (J3) is not fitted
Top left	**Input protection**	Reverse-polarity and over-voltage switch (two P-MOSFETs), soft start, 24 V surge diode
Top left	**Regulators and microcontroller**	5 V for the op-amp, 3.3 V for the logic, PY32F002B
Top edge, middle	**Programming footprint (J4)**	Tag-Connect TC2050, marked SWD. See section 11
Left edge	**3 × 1,000 µF capacitors**	Supply the current for each flash
Left of the LEDs	**Constant-current drivers**	2 MOSFETs, the op-amp, 4 sense resistors and the temperature sensor, with 11 test pads beside them
Middle	**72 white LEDs**	12 × 6 grid, about 51 × 35 mm, with a ballast resistor at the end of each string
Below the LEDs	**Hot-surface sign**	The MOSFETs beside the LED field get hot during long flashes
Top right	**Name and warnings**	Seizure and don't-stare warnings
Bottom left	**7-pin header (J1)**	Pin names and "I/O 1.8-5 V" printed beside it. See section 5
Bottom middle	**Rail test pads**	3V3, 12V and GND
Bottom right	**Readout and trimmers**	Three rows of red LEDs with bit values and a legend; the RATE, DUTY and BRIGHT trimmers (RV1–RV3), clockwise = more
Corners	**4 × M3 holes**	Joined to GND

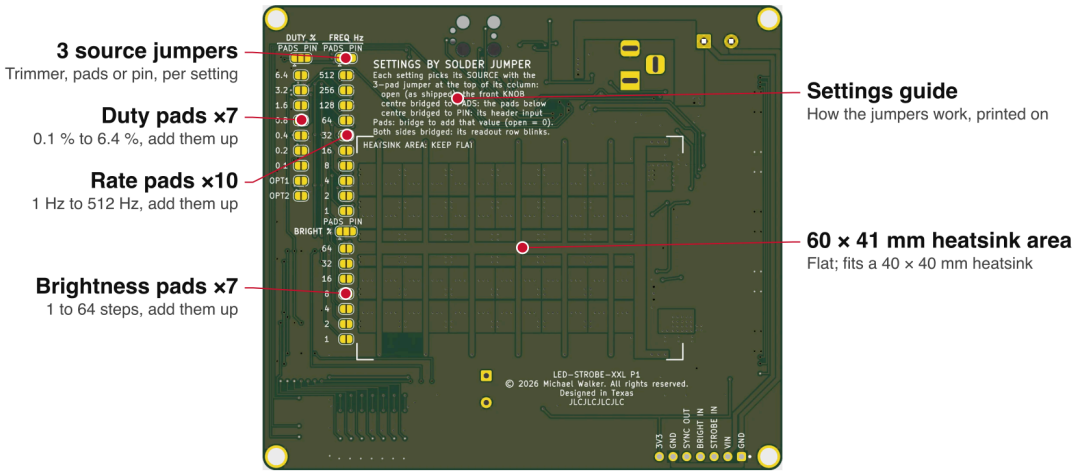


Figure 2. Back, seen from behind, so it is mirrored left to right compared with the front. Render of the P1 design.

Back

Nothing is fitted on the back: it is all pads, copper and print.

What	Notes
Rate pads ×10	1, 2, 4 … 512 Hz
Duty pads ×7	0.1, 0.2, 0.4 … 6.4 %
Brightness pads ×7	Binary, 1 to 64 steps (the board prints "BRIGHT %"; the values are steps of 127)
3 source jumpers	One for each setting: PADS · GND · PIN
Settings guide	Short how-to beside the pads
Heatsink area	A flat 60 × 41 mm area behind the LEDs and the drivers, corners marked "HEATSINK AREA: KEEP FLAT". Fits a 40 × 40 mm heatsink

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Test pads

All 14 are on the front, with their names in a key printed by the rail pads.

Pad	Signal	Pad	Signal
TP1	3V3	TP8	Gate, driver B
TP2	12 V (after the input switch)	TP9	REF (current set point)
TP3	5 V	TP10	FLASH_N (low during a flash)
TP4, TP13, TP14	GND for probe grounds	TP11	Drain, driver A
TP5	Sense, driver A	TP12	Drain, driver B
TP6	Sense, driver B		
TP7	Gate, driver A		

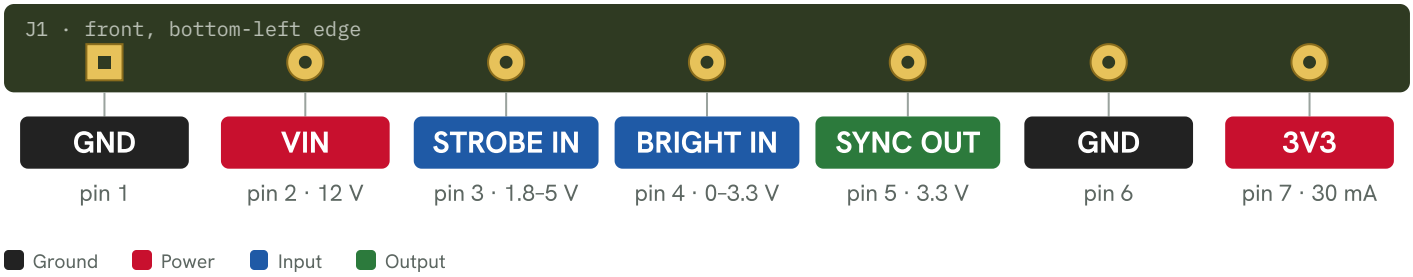
5 CONNECTIONS

Power: J2 screw terminal

- **Left screw GND, right screw +12V**, as printed on the board. The wires go in from the top edge. 5.08 mm pitch.
- 22 AWG wire is fine for short flashes. Use 18 AWG for long flashes at high brightness, which pull up to about 4.5 A.
- Wired backwards, the board stays dark and isn't damaged.
- The barrel-jack footprint beside it (J3) is not fitted on gen 1.

J1: 7-pin header, 0.1" (2.54 mm)

The header ships loose. Solder it on the front, or solder wires straight into the holes. Pin 1 has the square pad, at the end nearest the bottom-left mounting hole.



Pin	Name	Type	What it does
1	GND	Ground	Ground for the header signals
2	VIN	Power	The supply input, the same as J2's +12V, before the reverse-polarity switch. Up to 1 A for an add-on
3	STROBE IN	Input	Fires flashes from a contact or a logic signal. Active when pulled low; open or high is rest. 10 kΩ pull-up to 3.3 V, NPN buffer, ESD diode
4	BRIGHT IN	Input	Sets the brightness: 0–3.3 V, or PWM at any logic level. 14.7 kΩ to GND, ESD diode
5	SYNC OUT	Output	3.3 V logic: high at rest, low for the whole of every flash. 100 Ω in series, ESD diode
6	GND	Ground	Second ground pin
7	3V3	Power out	The board's 3.3 V logic supply, up to 30 mA

The header's GND pins join the board's ground only at the power terminal, so current in your wiring doesn't disturb the LED current.

What STROBE IN does

STROBE IN is active when it is pulled low: by a switch or contact to GND, an open-collector output or a logic low. Open or high is rest, so an unplugged pin keeps the board dark. What it does depends on which settings have their source jumper on **PIN** (section 6).

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Settings on PIN	Mode	What happens
Rate	Trigger	Each time the pin goes low, the board fires one flash, started in hardware. Its length is the duty setting × the signal's own period, or × the rate trimmer's period if that is shorter or the trigger comes alone. So a camera gets the same flash at any shot rate. For a sensor on a spinning part, turn the rate trimmer down to 1 Hz. Up to about 1,100 flashes a second; a bouncing contact gives one flash
Rate and duty	Follow	The LEDs are on for as long as the pin is held low, with no duty limit. A light held longer than about 20 ms dims as the driver MOSFETs heat (section 9). For holds and for patterns up to 10 kHz
Duty only	Duty	The board flashes at its own rate, at the duty measured on the pin: PWM from 100 Hz to 100 kHz, low = on. The duty is used as it is, up to 12.7 %

> **A signal that rests low is upside down**
>
> If your signal rests low and pulses high, the LEDs light while it rests (follow) or the triggers may not fire. Invert it, or use an open-collector or open-drain output. In duty mode, the duty is the share of the time the pin is low.

Wiring examples

To do this	Connect
Trigger a camera or a scope on each flash	SYNC OUT to the trigger input, GND to GND. Trigger on the falling edge: SYNC OUT goes low as the flash starts. It is a 3.3 V logic signal, so a camera that wants a contact closure needs an optocoupler
Fire flashes from a microcontroller	A GPIO pin (1.8–5 V logic) to STROBE IN, GND to GND. Rest high and pulse low. Rate jumper on PIN
Fire flashes from a switch or a sound-sensor contact	The contact between STROBE IN and GND. The pull-up is on the board. Rate jumper on PIN
Light on while a switch is held	The switch between STROBE IN and GND. Rate and duty jumpers on PIN
Run two boards in step	Board A's SYNC OUT to board B's STROBE IN, and join their GNDs. On board B, put the rate and duty jumpers on PIN. Power both boards together. Not yet tested with two boards (section 12)
Set brightness with your own knob	A 10 kΩ pot between 3V3 and GND, its wiper to BRIGHT IN. Brightness jumper on PIN

6 CONTROLS AND READOUT

Each of the three settings (rate, duty, brightness) has three possible sources: its trimmer, its solder pads on the back, or a header pin. Each setting picks its own source, so you can mix them, for example the rate from STROBE IN, the duty from pads and the brightness from its trimmer.

Trimmers

Trimmer	Sets	Range	Curve
RV1 (top)	Rate	1–1,000 Hz	Log: the same percentage change for every degree, so 1 Hz and 1,000 Hz are both easy to land on
RV2 (middle)	Duty	0–12.7 %	Straight. 0 gives the shortest flash, 5 µs
RV3 (bottom)	Brightness	0–127 steps	Straight. 0 is dark: no flashes

- **Clockwise = more**, as printed on the board. Use a small screwdriver.
- These are trimmers (Bourns TC33X), made for setting, not for turning all day. Bourns rates them for about 20 cycles. Turn them gently and stop at the end stops. For a control you change often, wire your own pot to BRIGHT IN, or use the pads.

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Source jumpers (back)

One 3-pad jumper for each setting, marked **PADS · GND · PIN**. Bridge the middle pad to one side with a blob of solder.

Jumper	Setting comes from
Open (as shipped)	The trimmer. Every board ships this way and is tested on its trimmers
GND to PADS	That setting's solder pads on the back
GND to PIN	That setting's header pin (STROBE IN for rate and duty, BRIGHT IN for brightness)
Both sides bridged	Error: its readout row blinks and the trimmer stays in charge

Value pads (back)

A bridged pad counts its value. Add up the bridged pads to get the setting. A fixed setting can't drift or get knocked.

Setting	Pads	Values
Rate	10	1, 2, 4, 8, 16, 32, 64, 128, 256, 512 Hz. Example: 64 + 32 + 4 = 100 Hz. Over 1,000 counts as 1,000. None bridged = no flashes
Duty	7	0.1, 0.2, 0.4, 0.8, 1.6, 3.2, 6.4 %. None bridged = the shortest flash, 5 µs
Brightness	7	1, 2, 4, 8, 16, 32, 64 steps (127 = full). None bridged = no flashes

Readout

Three rows of red LEDs at the bottom right show, in binary, the settings as flashed, whatever their source. The value of each LED is printed above its column, and a short legend sits beside the rows. **Add up the lit LEDs.**

Row	LEDs	Shows
FREQ	10	Flash rate in Hz. With the rate on PIN, the rate measured on STROBE IN
DUTY	7	Duty in 0.1 % steps (lit 64 + 32 + 4 = 10.0 %), after any raise to 5 µs
BRIGHT	7	Brightness, 0–127, after any dimming by the heat or supply limits. If it reads less than you set, the board is protecting itself

You see	It means
One row blinking	Both sides of that setting's source jumper are bridged
The brightness row blinking	Flashing is paused by a check, for example the supply is outside 10.5–14 V
Duty and brightness rows blinking together	Paused because the board is too hot, or a temperature reading is faulty. It restarts by itself once it cools
Every row blinking fast	The pad reader failed its self-check. Every setting uses its trimmer

At power-up the readout lights each LED in turn and then all of them (about 3.5 s), which is a quick check that every LED works. The strobe starts about 1 s later.

7 GETTING STARTED

You need the board, a 12 V DC supply (1 A or more) and a small screwdriver.

1. **Read section 9, Heat and safety.** Flashing light can trigger seizures, and the board gets hot.
2. **Set it down on something that doesn't conduct**, or mount it on M3 standoffs. Keep the back flat and clear.
3. **Turn the brightness trimmer (RV3, bottom) fully anticlockwise**, and the rate trimmer (RV1, top) to about the middle.
4. **Wire the supply to J2:** GND to the left screw, +12V to the right one. A bench supply set to 12 V with a 1 A current limit is ideal for the first power-up.
5. **Switch on.** The readout lights each LED in turn, then all of them. About a second later the board is ready. With RV3 at zero the LEDs stay dark.
6. **Turn RV3 clockwise** for more light, **RV1** for the rate and **RV2** (middle) for the flash length. The readout follows.
7. **To switch off, unplug the supply.** Gen 1 has no power switch.

> **If the BRIGHT row reads less than you set**
> The firmware has dimmed the flashes to keep the board inside its heat or supply limits (section 9). Shorter flashes, a lower rate or a stronger supply bring the brightness back.

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8 TYPICAL APPLICATIONS

Settings to start from for common jobs. The first eight need only the trimmers, and SYNC OUT if you want it. The last four use STROBE IN, with the source jumpers on the back set as shown (section 6).

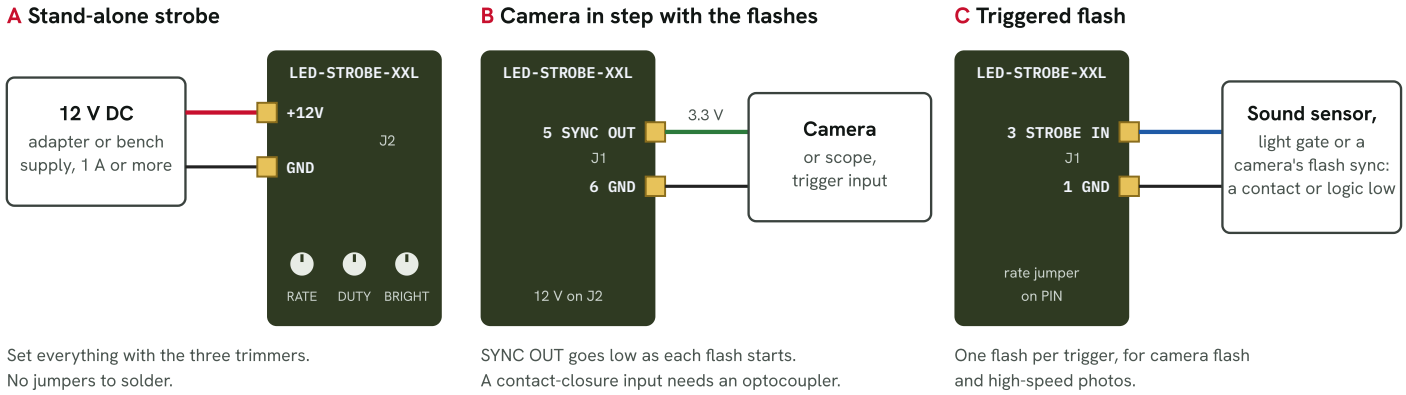


Figure 3. Typical application wiring. All three need 12 V on J2; B and C use the 7-pin header J1 (section 5).

Use	Start from	How
Stroboscope: measure RPM	Rate high, duty 0.5 %	Come down from a high rate until a single mark stands still. RPM = Hz × 60. Method below
Freeze or slow down motion	Rate at the motion's rate, duty 0.5 %	Fans, gears, belts, vibrating strings, speaker cones, water jets. Exactly on the rate freezes it; a little off shows it in slow motion
Physics demos	The motion's rate, or 20 Hz for frames	A guitar string's standing wave, a swinging pendulum or a falling ball, frozen or in frames. No laptop needed
Multi-exposure photo	20 Hz, duty 0.5 %	Dark room, camera on a tripod, 1–2 s exposure: a thrown or bouncing ball shows up once for each flash. Mind the seizure warning below
Camera in step with the flashes	Rate at or below the camera's frame rate	SYNC OUT to the camera's trigger input, so each frame gets one flash. For machine vision, inspection and high-speed video
Testing light sensors	Any rate, short duty	SYNC OUT on scope channel 1 (low = light on) and the sensor on channel 2. The delay between them is the sensor's response time, less the board's few µs
Time fountain, hovering drops	The drip or pump rate	Drops lit at the same point each time hang still. A little above or below the drip rate makes them crawl up or down
Zoetrope or POV display	Frames a turn × turns a second	12 frames at 4 turns a second (240 RPM) = 48 Hz. A steady motor works with the trimmer. To lock to a sensor on the platter, use STROBE IN in trigger mode
Camera flash	Rate 1,000 Hz, duty 2–10 %	Rate jumper on PIN, and the camera's flash-sync contact (PC sync, or a hot-shoe adapter) between STROBE IN and GND: one flash per shot. Flash length = duty × the rate trimmer's period, here 20–100 µs
High-speed photo of a splash, pop or break	Rate 1,000 Hz, duty 2–10 %	Dark room, camera on a long exposure. A sound sensor or light gate on STROBE IN fires one short flash at the right moment, and that flash freezes the action
Several boards together	Set the rate on board A	Board A's SYNC OUT to board B's STROBE IN, GNDs joined. Board B's rate and duty jumpers on PIN, so it lights for as long as board A does. Not yet tested with two boards
Light on while held	Brightness as you like	Rate and duty jumpers on PIN, and a switch between STROBE IN and GND. Full brightness lasts about 20 ms, then the light dims as the drivers heat: about 10 % after 2 s and 3 % if held for minutes (section 9)

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Measure how fast something spins

1. Mark one spot on the part (a dot of tape or paint helps).
2. Shine the strobe on it and start with the rate high.
3. Turn the rate down slowly. **The first rate where you see a single, still mark is the speed.** Below that the mark also stands still at half, a third and so on of the real speed, so always come down from above.
4. Speed in RPM = rate in Hz × 60. For example, 25 Hz = 1,500 RPM.

The rate comes from the microcontroller's own oscillator, so treat it as a close reading, not a calibrated one.

Sharp or bright?

The part keeps moving during each flash. A fan-blade tip at 20 m/s moves 0.1 mm in a 5 µs flash but 2 mm in a 100 µs one. Use the shortest flash that is still bright enough. Flash length = duty ÷ rate, so at low rates even 0.1 % is long: 100 µs at 10 Hz. The shortest flash is 5 µs, which is 0.5 % at 1,000 Hz.

⚠ 3–30 flashes a second

Multi-exposure photos and slow zoetropes often land in the 3–30 Hz range that carries the most seizure risk. Tell everyone in the room first, and see section 9.

9 HEAT AND SAFETY

⚠ Warnings (also printed on the board)

- **Seizures.** Flashing light can trigger seizures in people with photosensitive epilepsy. Rates of about 3–30 flashes a second carry the most risk. Tell people nearby before you start it, and don't use it where someone at risk may see it.
- **Eyes.** Don't stare into the LEDs at high brightness or point them at anyone's eyes. The peak light is about 5,800 lm from a small area.
- **Hot surface.** The driver MOSFETs beside the LED field get hot during long flashes. Don't touch the board while it's on or just after.

How hot it gets

Measured on a P1 board with firmware 1.01 on 2026-11-12: 12 V bench supply on short, thick leads, still air, no heatsink, room about 24 °C, brightness set to full. The four free-running steps ran one after another, each until the temperature levelled. The firmware never paused.

Settings	Brightness held (of 127)	Why it was held there	Temperature sensor	Driver MOSFET, firmware's estimate	Board power, firmware's estimate
1,000 Hz, 7.5 %	127 (full)	—	41 °C, levelled	44 °C	3.1 W
1,000 Hz, 12.7 %	81	Board heat budget	44 °C, levelled	48 °C	3.35 W
10 Hz, 7.5 %	127 (full)	—	39 °C	80 °C	3.1 W
1 Hz, 5 %	113	MOSFET temperature target	36 °C	125 °C	1.8 W
Triggered at 1,000 Hz, 12.3 %, 10 min	84	Board heat budget	48 °C, levelled	53 °C	3.4 W

The supply leads matter in the slow steps: the 12 V dipped to 11.3 V in the 50 ms flashes at 1 Hz. On longer leads (2026-11-05, an earlier firmware) it sagged further and the firmware held those two steps at 76–124 and 68 of 127 instead.

The temperature sensor sits 4.7 mm from driver A's MOSFET, so the MOSFET itself runs hotter, most of all in long flashes. Short, fast flashes spread the heat out; long, slow flashes heat the MOSFET in bursts even when the average power is low.

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How long a held light stays bright (follow mode)

Measured on a P1 board on 2026-11-09 and 2026-11-10 (firmware 1.00): 12.0 V on short leads, from cold, STROBE IN held low, brightness set to full. The light never went out and dimmed in single steps with no flicker. A 60 s hold on firmware 1.01 on 2026-11-12 came within 3 steps of these.

Held for	20 ms	50 ms	0.1 s	0.2 s	0.5 s	1 s	2 s	5 s	10 s	20 s	60 s	90 s on
Brightness (of 127)	127	76	53	31	16	14	13	11	10	7	5	4
Share of full	100 %	60 %	42 %	24 %	13 %	11 %	10 %	9 %	8 %	6 %	4 %	3 %

These figures are the firmware's own choice from a cautious model of the driver MOSFETs, so they are a floor for this firmware, not a measurement of the parts' limits. A higher supply voltage dims sooner, because the MOSFETs take the extra volts. After a 60 s hold, full brightness is available again about 2 minutes after you let go. The 90 s figure was measured from a start at 13 of 127.

How the firmware protects the board

- **Every flash ends in hardware:** the timer turns the LEDs off itself, so a stuck program can't leave them on. A held light (follow mode) is renewed every millisecond and ends within 1 ms if the program stops.
- **Heat budget:** it holds the average power at or below 3.39 W, the most the board can shed in still air without a heatsink. Ask for more and it dims the flashes instead.
- **MOSFET limit:** it works out each driver MOSFET's temperature from every flash and dims long flashes to keep it under 125 °C. The MOSFETs are rated to 150 °C.
- **Temperature sensor:** from 50 °C it lowers the brightness limit in a straight line, from full to zero at 60 °C, so a hot board settles dimmer. At 60 °C it stops flashing, and it restarts by itself once the board is back under 50 °C. It also stops if the microcontroller passes 75 °C or a temperature reading is faulty.
- **Supply:** it stops flashing outside 10.5–14 V. If the 12 V sags under 11 V during flashes, it dims them until the supply keeps up, holds that for a minute, then raises the brightness again a step every 2 s.
- **Restart back-off:** after a pause it restarts 1 s later. After 3 pauses close together it waits longer before each restart: 10 s, 60 s, then 5 min.
- **Self-checks:** a watchdog restarts the microcontroller if it hangs (2 s), and the flash timer is checked against its settings all the time.

Heatsink (optional)

The back has a flat 60 × 41 mm area behind the LEDs and the drivers, marked HEATSINK AREA: KEEP FLAT. A 40 × 40 mm heatsink fits, stuck on with electrically insulating thermal tape. It keeps the board cooler, but firmware 1.01 still uses the no-heatsink budget, so it doesn't allow more power.

Use

- Indoors and dry, at room temperature, with air around it.
- Keep loose wires, tools and metal off the board while it's on.
- Don't leave it running unattended.
- Not for emergency or safety lighting, or for medical use.
- Gen 1 is a prototype. It has not been tested for FCC or CE compliance.

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10 DIMENSIONS

All in millimetres, read from the KiCad design. Positions are measured from the **top-left corner of the board seen from the front** (screw terminal at the top left), x to the right and y down. Board outline ±0.2 mm.

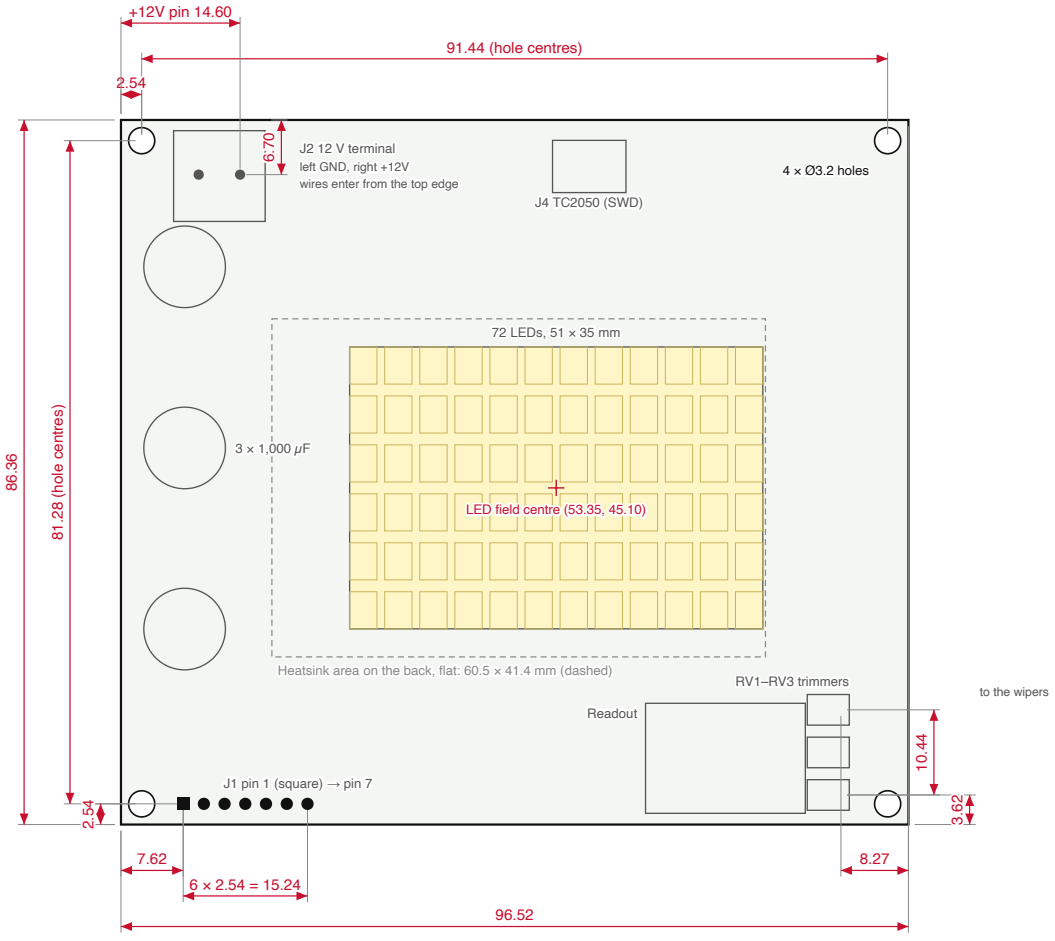


Figure 4. Dimension drawing, millimetres, seen from the front. The dashed box is the heatsink area on the back.

Feature	Position or size
Board	96.52 × 86.36 (3.80 × 3.40 in), 1.6 thick
Mounting holes	4 × Ø3.2, centres 2.54 in from each edge, on a 91.44 × 81.28 grid (3.6 × 3.2 in). Joined to GND
J1 header, pin 1	(7.62, 83.82). Pins 1–7 run to the right at 2.54 pitch, so pin 7 is at (22.86, 83.82)
J2 screw terminal	GND (9.52, 6.70), +12V (14.60, 6.70). Wires enter from the top edge
J4 Tag-Connect TC2050	Centre (57.40, 5.70)
Trimmer adjusters, RV1 / RV2 / RV3	x 88.25; y 72.30 / 77.52 / 82.74
LED field	50.7 × 34.6 over the LED bodies, centre (53.35, 45.10). LED pitch 4.3 across, 6.0 down
Readout	64.3–83.9 across, 71.5–85.0 down
Heatsink area, back	18.5–79.0 across, 24.4–65.8 down (as seen from the front): 60.5 × 41.4
Height above the board	Electrolytic capacitors 10.5. The screw terminal is the tallest part; its height is TBD on a real board
Back	Flat, nothing fitted

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11 PROGRAMMING AND FIRMWARE

The board works out of the box. You only need this section to load firmware of your own.

Microcontroller

Puya **PY32F002B**: Arm Cortex-M0+ at 24 MHz, 24 KB flash, 3 KB RAM. It programs over **SWD only**: it has no serial bootloader, so a USB-serial adapter can't program it.

J4: Tag-Connect TC2050 (front, top edge)

A 10-pad footprint for the legged **TC2050-IDC** cable, which clips into the board's holes. The no-legs cable (TC2050-IDC-NL) also works if you hold it in place.

Pad	Signal	Pad	Signal
1	3V3 (the board's logic supply)	6	Not connected
2	`SWDIO`	7	Not connected
3	GND	8	Not connected
4	`SWCLK`	9	Not connected
5	`PROG_PWR`: power from the programmer	10	`NRST` (reset)

`PROG_PWR` feeds the 3.3 V regulator through a diode, so the board can be programmed with only the cable plugged in and no 12 V. Pad 1 is the board's own 3.3 V, for a probe that senses the target voltage.

Probes

Any SWD probe that supports the PY32F002B works. We use a Raspberry Pi Pico running the debugprobe firmware, with pyOCD and the PY32 device pack.

Firmware on gen 1 boards

Gen 1 boards ship with **firmware 1.01 (2026-11-10)**, which does everything in this datasheet. Datasheet rev A described an earlier bring-up firmware, with a 10 % brightness cap and header inputs that were read but not used. That no longer applies.

Calibration record

Each board's temperature sensor is calibrated on a cold board before it ships. The record is stored in the last 128 bytes of the chip's flash and is tied to that chip. Without a valid record the firmware caps the brightness at 13 of 127 (10 %). Loading your own firmware replaces ours, and a full chip erase removes the record too. The firmware file is not published, so think before you erase the chip.

The firmware is closed source. © 2026 Michael Walker. All rights reserved.

12 KNOWN ISSUES ON GEN 1

Gen 1 is a prototype run, and these are the things we know about. None of them is a safety problem.

Hardware

Issue	What you see	Cause	Workaround	Fixed in
Glow between flashes: fixed by hand	As made, half the LEDs glowed dimly when they should be off. Each board sold has two small 1 MΩ resistors added by hand beside the op-amp and glued in place. With them the LEDs are fully dark between flashes	The op-amp has a small input offset, so a driver MOSFET passed a little current instead of switching fully off	None needed. Leave the two resistors alone	Rev 2 (the resistors are on the PCB)
No power switch	The board runs whenever the supply is connected	Not in the gen 1 design	Unplug the supply, or use a switched supply	Rev 2 (push-on, push-off switch)

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Issue	What you see	Cause	Workaround	Fixed in
Trimmers are delicate	On one P1 board the brightness trimmer's end stop broke, so it turns all the way round	Small screwdriver trimmers, rated for about 20 cycles	Turn gently and stop at the ends	Rev 2 (finger knobs that stick out past the board edge)
Shortest flash is 5 µs	A rate and duty that work out shorter flash for 5 µs, and the DUTY row shows the raised duty	The drivers take about 3 µs to turn on	None needed	—
Barrel jack not fitted	Empty footprint beside the screw terminal	Left off gen 1	Use the screw terminal	—

Firmware 1.01

Limit	What you see	What to do
STROBE IN has one polarity	Pulled low is active. A signal that rests low and pulses high lights the LEDs while it rests (follow) or may not fire (trigger)	Invert the signal, or use an open-collector output
The start of a trigger stream	The first trigger after a rest fires a flash of the duty setting × the rate trimmer's period. If that is longer than the stream's own flashes, the triggers that follow it are skipped for about 8 times its length. Measured: trimmers at 8 Hz and 12.7 %, a 1 kHz stream lost its first 0.12 s, then flashed on every trigger for 10 minutes	Set the rate trimmer at or above the fastest rate you trigger at
A held light is dim	In follow mode a held light is down to about 10 % of full after 2 s and 3 % after 90 s (section 9)	The heat model is cautious for long holds. For bright light, use flashes
Follow mode above 10 kHz	The LEDs stay on for 1–2 ms at a time, several times longer than the pin is low. The heat limits still hold	Use duty mode for fast PWM
Duty mode reads short at high frequency	The pin's low time reads about 0.3 µs short: 10 % at 100 kHz reads 7.2 %, 5 % reads 2.2 %	Use 20 kHz or less, where it doesn't matter
A supply that steps down and stays down	A drop of about 1 V that isn't caused by the flashes is taken for a sag: dark for about a minute, back to full after about five	Use a steady supply
Follow mode straight after heavy flashing	After minutes of bright flashing in another mode, a held light stays dark for 10 s or so. A press in that time can light briefly and go out again. Then the light comes on dim, stays on, and brightens over the next half minute	None needed. It is the heat model catching up
Follow mode after a long pause	For a couple of minutes after a pause, a held light is dimmer than it needs to be	None needed
Rate is approximate	The rate is a little off a calibrated tachometer	It uses the microcontroller's own oscillator, no crystal. Not planned to change

Not yet measured or tested

- Light output in lumens and lux. The 5,800 lm figure is calculated from the LED datasheet.
- Idle current, weight, and the screw terminal's height.
- The LED current's rise and fall on a scope (the gate timing is measured).
- The driver MOSFETs' case temperature in long flashes (the firmware estimates it).
- With firmware 1.01: the value pads and source jumpers bridged with solder (their logic is tested on a computer, and the bench tests chose the sources over the programming port); two boards chained.

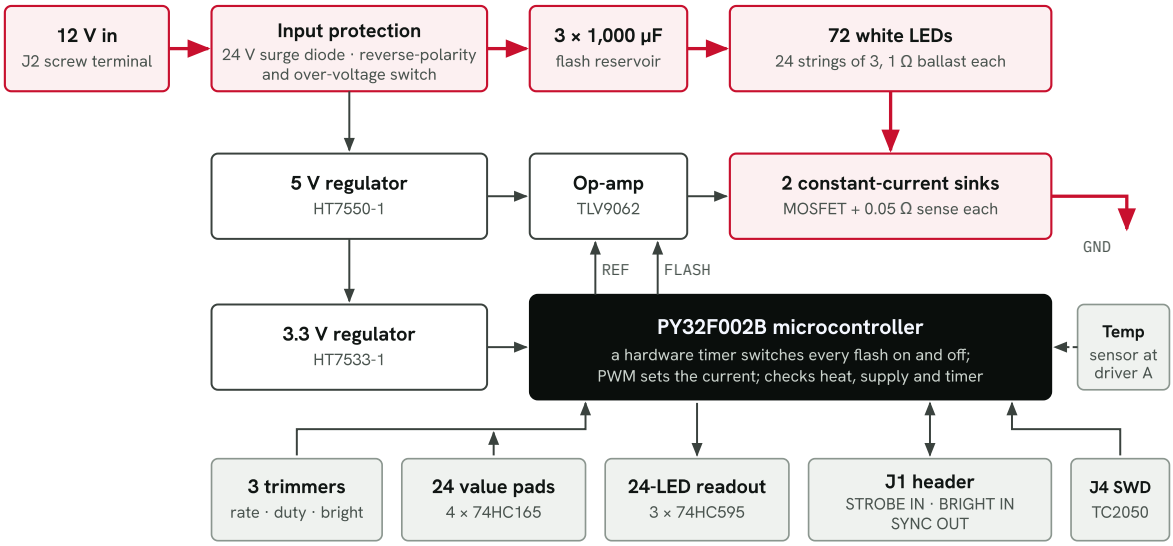
Other changes planned for rev 2

- The FREQ row's printed labels change to a log scale to match the rate knob, instead of 1, 2, 4 … 512 Hz.

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13 REVISIONS AND DOCUMENTS

How it works



The microcontroller's timer switches the flash on and off in hardware, so the timing doesn't depend on the code being busy. The op-amp holds each sink's current at the set point for the whole flash, so the brightness stays the same as the 12 V droops. The full schematic is published as a separate 10-page PDF, **LED-STROBE-XXL_P1_schematic.pdf**, on the product page. The PCB design files are not published.

Board revisions

Revision	Date	Notes
P1 (gen 1)	Made October 2026, tested November 2026	First run. This datasheet. "LED-STROBE-XXL P1" is printed on the front. Sold with the glow rework and firmware 1.01
Rev 2	Planned	Glow fix on the PCB, power switch, finger knobs, log-scale FREQ labels. See section 12

Datasheet revisions

Version	Date	Changes
A	2026-11-06	First release, for gen 1 (P1) boards with the bring-up firmware
B	2026-11-12	Firmware 1.01: header inputs, pads and full brightness. STROBE IN is active low and SYNC OUT is low during a flash (rev A said high). Shortest flash 5 µs. Glow fixed by rework. Held-light table added, heat table measured again

Main parts

Part	Maker	Number	LCSC
Microcontroller	Puya	PY32F002B	C7469098
Op-amp, dual, 10 MHz	Texas Instruments	TLV9062IDR	C398355
Driver MOSFETs, 30 V	Alpha & Omega	AON7400A	C85734
White LEDs, 2835, 6500 K	Everlight	67-21S/KK7C-H657034Z15/DT	C385305
3.3 V and 5 V regulators	Holtek	HT7533-1, HT7550-1	C14289, C16106
Trimmers, 10 kΩ	Bourns	TC33X-2-103E	C719176
Input switch MOSFETs	—	DOZ30P03	C36499166
Surge diode, 24 V	—	SMAJ24CA	C19077542

Product page: led-strobe.vercel.app. This datasheet and the schematic can be downloaded there. Specifications come from the P1 prototype and its design files, and may change in later revisions.

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