STONE TECHNOLOGIES

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Galena

User Guide

Find out where a sick logic board stops

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Requires	macOS 14 Sonoma or later, Apple silicon or Intel; Linux with GTK 3
From	Stone Technologies

Galena is a free tool for board techs. It walks a repair one question at a time, keeps every board's story in a log that follows the board, reads beep codes, POST displays and debug lights, compares diode-mode readings with a known-good board, and holds what is known about each board with where it came from. The Galena hub, which talks to a board directly, is still being built.

Contents

1 Getting started
2 The repair walk
3 The Board screen
4 Capture and the Board Log
5 The Schematic screen
6 Listen, Lights and Diode
7 Sharing
8 Settings
9 Reference

Getting started

What Galena is

A logic board that will not start leaves you guessing: is it power, the clock, the ROM, RAM, a chip, or a trace eaten by a leaking capacitor? Galena turns the guessing into steps. It asks what the board does, tells you what to measure and where, and narrows it down until it points at the part. Every fact it shows says where it came from and how far it is trusted, so you know what is proven and what is only reported.

It works the way a bench tech works: with a meter, a logic probe, a scope, a phone camera and ears. The Galena hub, still being built, will add a diagnostic ROM and probes that report straight from the board. Galena is free.

What works now, and what waits on the hub

Works now, on any board	Waits on the hub
The repair walk, with your own measurements	Galena ROM's tests reporting by themselves
The Board screen, photos, parts and replacements	Reports and the Start-up screen
Capture and the Board Log	Cards on the hub's port
The Schematic screen and its exports	Signature probing (the Whisker)
Listen (beep codes), Lights (POST codes and debug lights), Diode	Bus watch and boot traces
Share: what would be sent, saved to a folder	Sending to the shared library

Install on a Mac

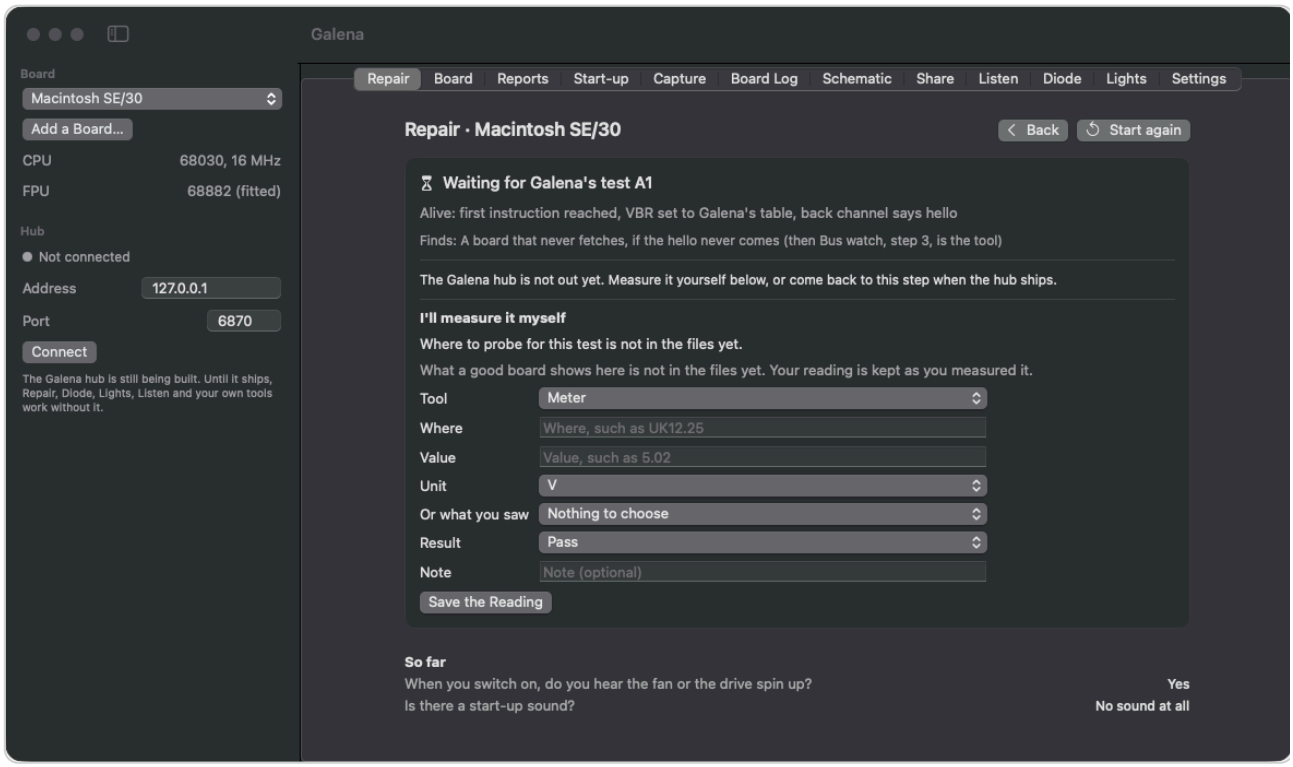
1. Download **Galena.dmg** from maketokeep.com/galena.
2. Open the disk image and drag **Galena** to the **Applications** folder.
3. Open Galena from Applications.

> **Tip** This preview is not yet signed by Apple, so the first time macOS says it cannot check Galena. Click **Done**, open **System Settings › Privacy & Security**, and click **Open Anyway** beside Galena's name, then **Open**. On macOS 14 you can instead Control-click Galena in Applications and choose **Open**. You do this once.

Install on Linux

The Linux download is a folder with the **galena** program in it. Unpack it anywhere and run **./galena** from that folder. It needs GTK 3, which most desktops have; on Debian, Ubuntu and Mint it is the package gir1.2-gtk-3.0. The Linux copy has the same screens and words as the Mac's. Where the two differ, this guide says so.

The window



Galena on the Repair screen, with the Macintosh SE/30 chosen in the sidebar.

- **The sidebar:** the board you are working on, Add a Board…, its processor, and the hub. Until the hub ships it says so.
- **The screens:** Repair, Board, Reports, Start-up, Capture, Board Log, Schematic, Share, Listen, Diode and Lights, then Settings. Their order and colours are yours to change in Settings.
- **The reminder:** a band across the top while your work is not in a file. **Save…** (⌘S) makes a folder for it, and Galena keeps writing that folder from then on.

Boards

Galena comes with four boards in its library: the **Macintosh SE/30**, the **Macintosh IIci**, the **Macintosh Quadra 605 / LC 475** and the **Power Macintosh 7200/90**. Each has its parts, its connections, the faults owners report, and a repair walk. The SE/30 also has a full schematic, from an open redraw of Apple's board.

Choose a board in the sidebar. **Settings › Your Work** narrows the list to the kind of work you do (below).

Adding a board

1. Click **Add a Board…** under the board list.
2. Type its **Name** (such as ASUS P5Q, or Amiga 500 rev 6A), and the **Board number** as printed on the board, if any.
3. Type the **CPU** and the **Clock** in whole MHz, if you know them.
4. Choose the **Kind of work**: Motherboards › Amiga, for instance. Then click **Add**.

The new board is chosen at once. It is kept on this computer and starts with your words only: no chips, no repair walk, nothing checked. Capture, the schematic builder, Diode, Lights, Listen and your readings all work on it, and fill it in as you learn the board. **Remove** appears beside Add a Board… for boards you added, never for the library's; it asks first, and the board's readings, diode sets and logs stay.

The repair walk

How the walk goes

Repair asks one question at a time: does the fan spin, is there a start-up sound, what does the screen show. Each answer leads to the next step. **So far**, under the step, lists what you have answered. **Back** goes back one step; **Start again** clears the answers.

A step can be advice: what the answers point to, with **Suspects** named on the board. Some advice ends the walk; where it can go on, **Carry on** takes the next step.

Test steps, and I'll measure it myself

Some steps wait for one of Galena ROM's tests. Until the hub ships, answer them yourself with **I'll measure it myself**. It shows where to probe (the parts the board file ties to that test), or says so when the files do not know yet, and records what you saw.

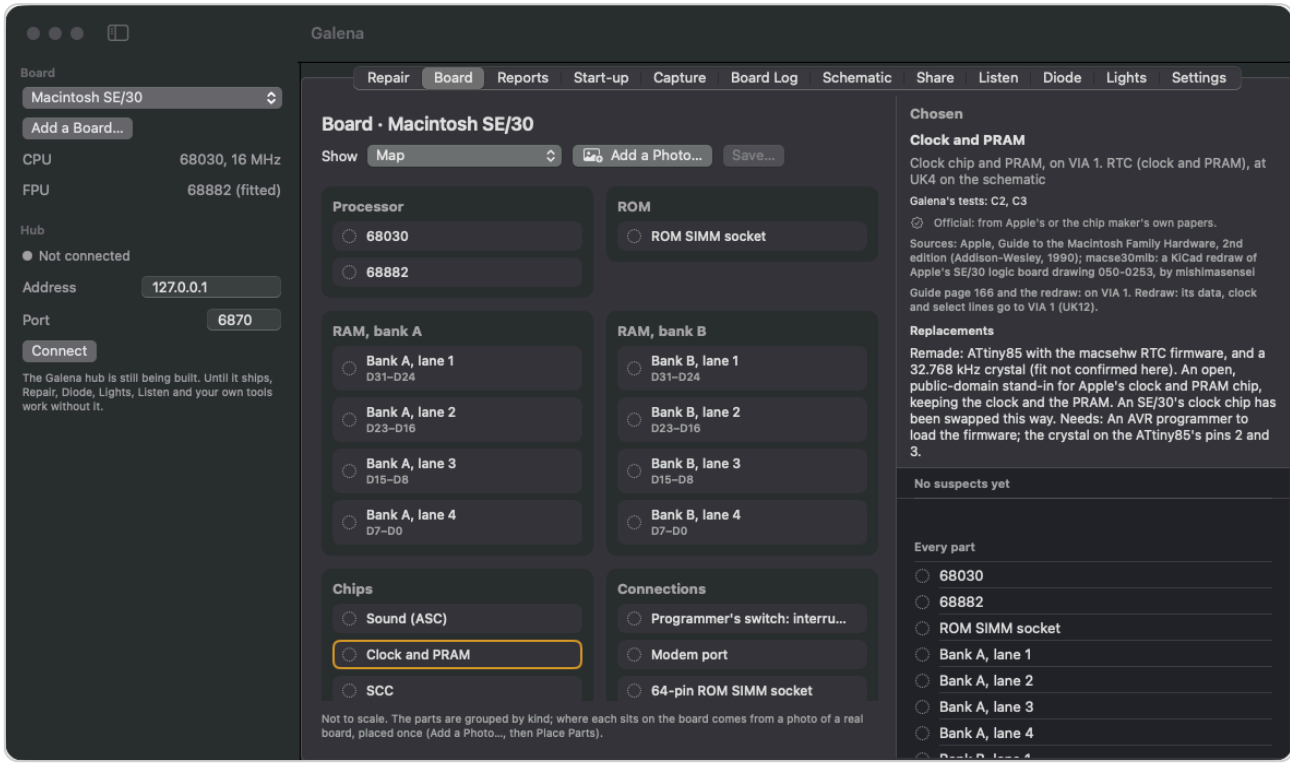
Field	What goes in
Tool	Meter, Logic probe, Oscilloscope, Logic analyser, Serial terminal, Bench supply, Eyes and ears, Galena card, or Other
Where	The part and pin, such as UK12.25, or a test point
Value	A number, such as 5.02, with its Unit: V, mV, A, mA, ohm, kohm, Hz, kHz, MHz, s, degC or count
Or what you saw	High, Low, Pulsing, Beeps, or Open, no beep
Result	Pass, Fail or Not sure
Note	Anything else, up to 200 letters

Save the Reading. Pass or Fail moves the walk on, and So far says so: "A5 passed, by hand (logic probe)". Not sure keeps the reading and the walk waits. A value is checked as you save it: 5,02 is refused, and asks for 5.02. Readings are kept for the board, show on the Share screen, and go into the board's log as a Tested entry when a log for the board is open on Board Log.

> **Tip** When the hub ships, a test it runs takes the place of your hand result for that step.

The Board screen

Parts and the map



The SE/30's map, with its clock chip chosen: its tests, sources and a replacement.

Board shows every part of the board grouped by kind: processor, ROM, RAM by bank and byte lane, chips, connections and known trouble spots. The map is not to scale. Where each part sits comes from a photo of a real board, placed once (below). A part the walk suspects is lit; a part whose tests passed is green.

Choose a part to see it in **Chosen**: what it does, its reference and part number, the tests that look at it, how far the facts are trusted and where they came from, and its history in the board's log.

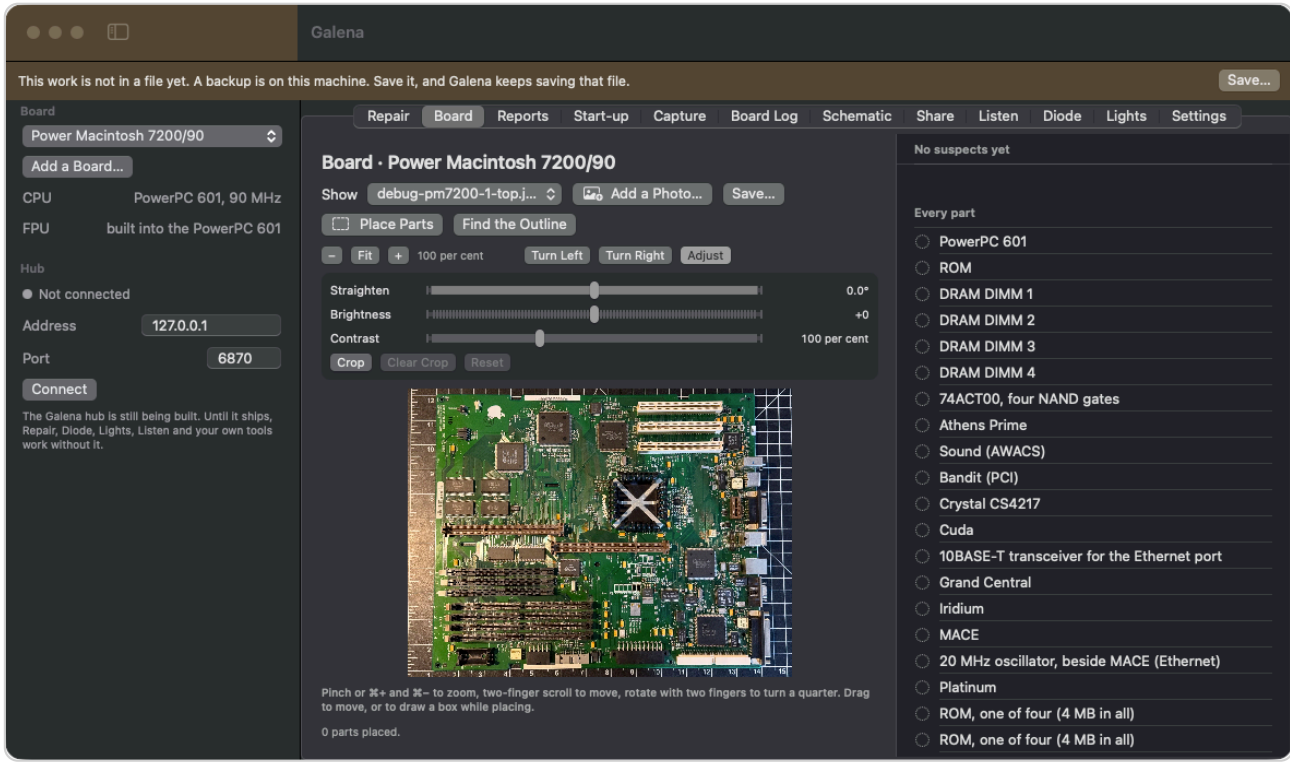
Replacements

For each chip and the ROM, Chosen lists what can stand in for it, each with its trust and sources:

Kind	Means
Made today	A part still made, such as WDC's W65C22 for a 6522 VIA
Old stock	New old stock, or a part no longer made
From a donor board	Apple's own chips with nothing made to replace them, such as the SE/30's sound chip
Remade	A microcontroller or logic chip doing the old chip's job, such as an ATtiny85 in place of the clock chip
Reprogrammable	A part you write, such as a flash ROM SIMM, with the programmer it needs
On this board	A note about this board, such as how a chip's pin is wired

Each line also says whether it fits as it stands, fits with changes, is not pin-compatible, or is not confirmed here, and what the job needs. A part with none says "Replacements: not in the files."

Photos, and placing parts



A Power Macintosh 7200 board photo with Adjust open.

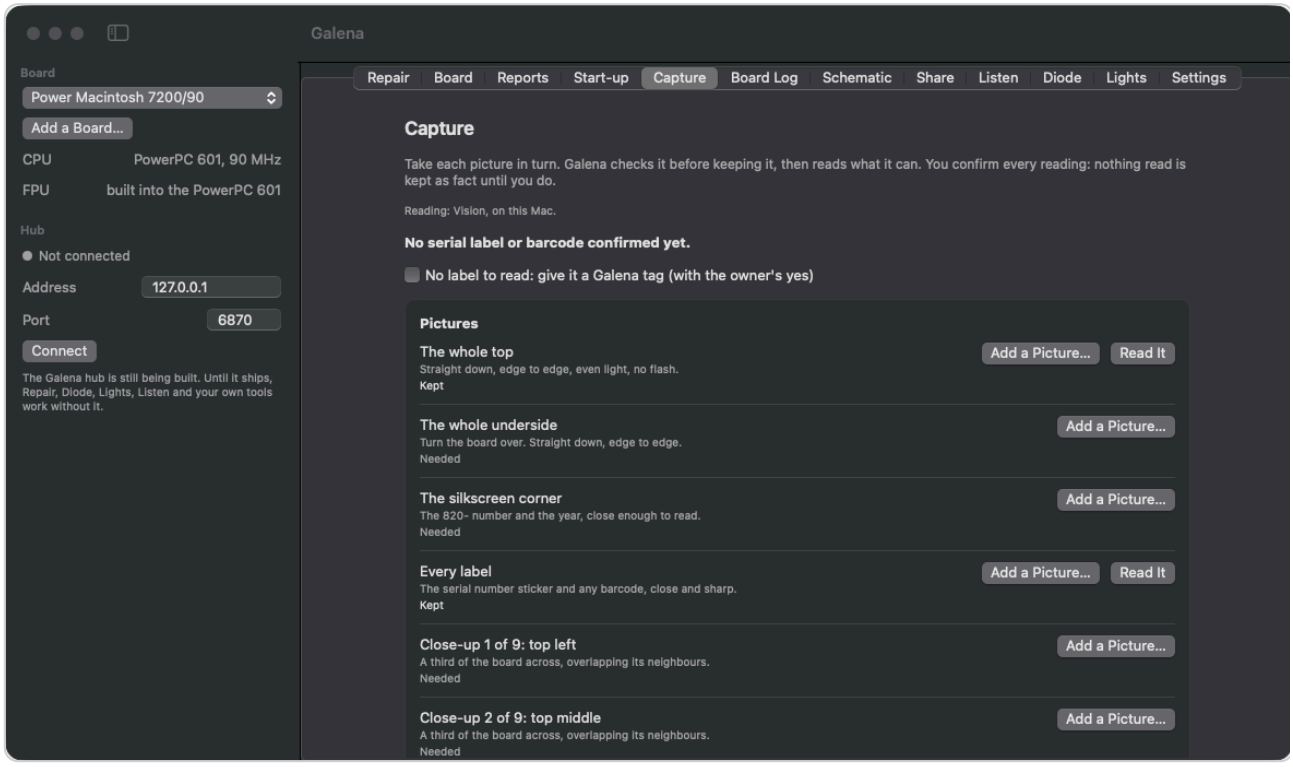
1. Click **Add a Photo…** and choose a photo of the board taken straight down (JPEG, PNG or HEIC on the Mac; JPEG or PNG on Linux).
2. Click **Place Parts**, choose a part in the list, and drag a box round it on the photo.
3. Do the same for each part you want on the map. Boxes are kept on this computer, marked not checked.

To	Do this
Zoom	Pinch, ⌘+ and ⌘−, ⌘ with scroll, or −, Fit and + above the photo; up to 1000 per cent. ⌘0 fits it
Move	Scroll with two fingers, or drag. While placing a part, a drag draws its box instead
Turn	Rotate with two fingers; it settles on the nearest quarter turn. Or Turn Left and Turn Right
Adjust	Straighten (−15° to +15°), Brightness, Contrast, Crop and Clear Crop, Reset. The photo file is never changed

Find the Outline, on a whole-board photo, finds the board's four corners. Then **Show › Layout** draws the board straightened, with every placed part where it sits. Type the long edge in mm to see its size.

Capture and the Board Log

Capture



Capture for the 7200: the whole top and a label kept, the rest still needed.

Capture lists the pictures to take of the chosen board: the whole top and underside, the silkscreen corner, every label, nine close-ups, and one for each part whose printing could not be read before. **Add a Picture…** takes a phone photo or a scan. Each picture is checked before it is kept:

Check	Must be
Size	3000 pixels on the long side for the whole board, 1500 for a close-up
Sharp	Sharp enough to read printing, measured on its sharpest part
Glare	No more than 4 per cent of the picture burnt out

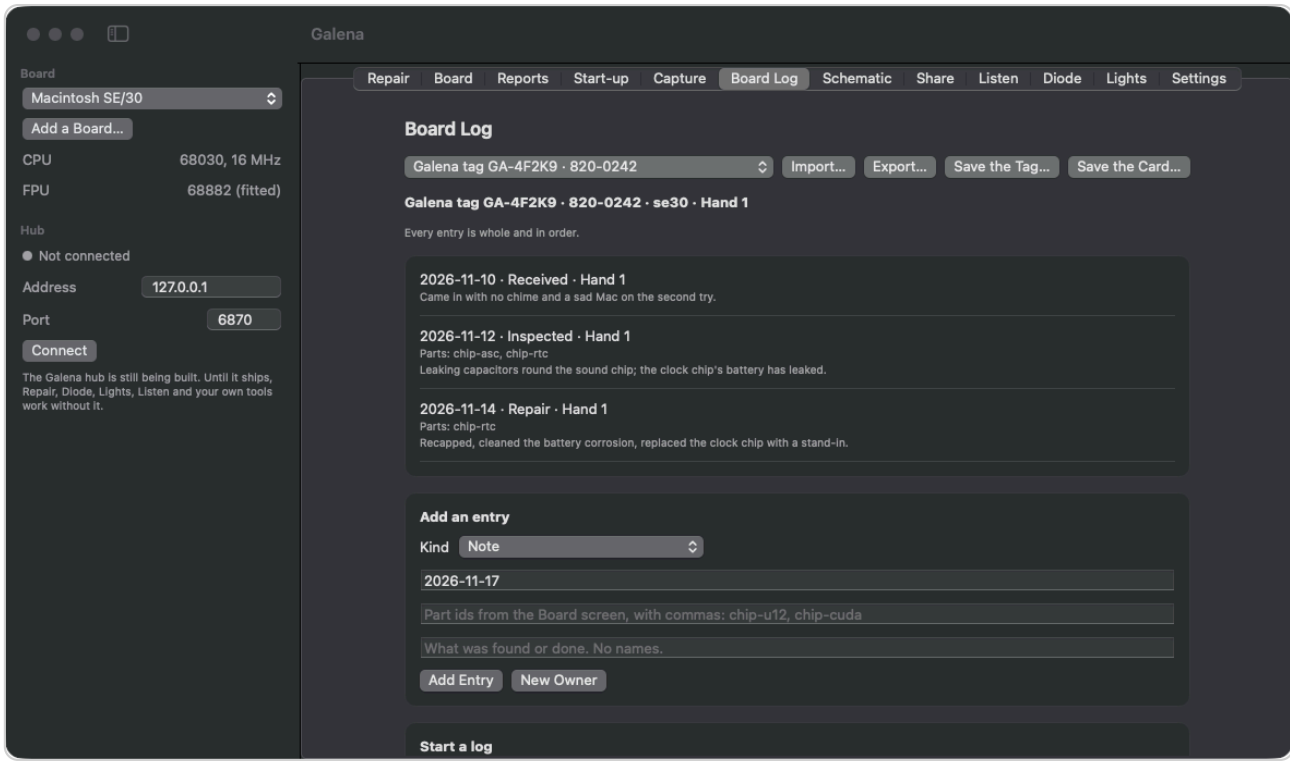
A refused picture is not kept, and its row says why, such as "Too soft. Hold the camera still, or move back a little." For the whole top and underside Galena also asks whether the whole board is in the picture, taken straight down.

Reading what is printed

Read It reads a kept picture on this computer: Apple's Vision on the Mac, and Tesseract on Linux when it is installed (otherwise you type what is printed). Each reading is sorted as a serial label, barcode, board number, Apple part number, reference, date code or printing, and waits for you: **Confirm**, **Correct…**, **Can't read**, or **Remove** for a line that is not printing at all. Nothing read is kept as fact until you confirm it.

Finish writes an Inspected entry into the board's log, keyed by the serial label if you confirmed one, then the barcode, otherwise a Galena tag with your yes. With Keep photos off (the default), the pictures are deleted.

The Board Log



A board's log: Received, Inspected and Repair, every entry whole and in order.

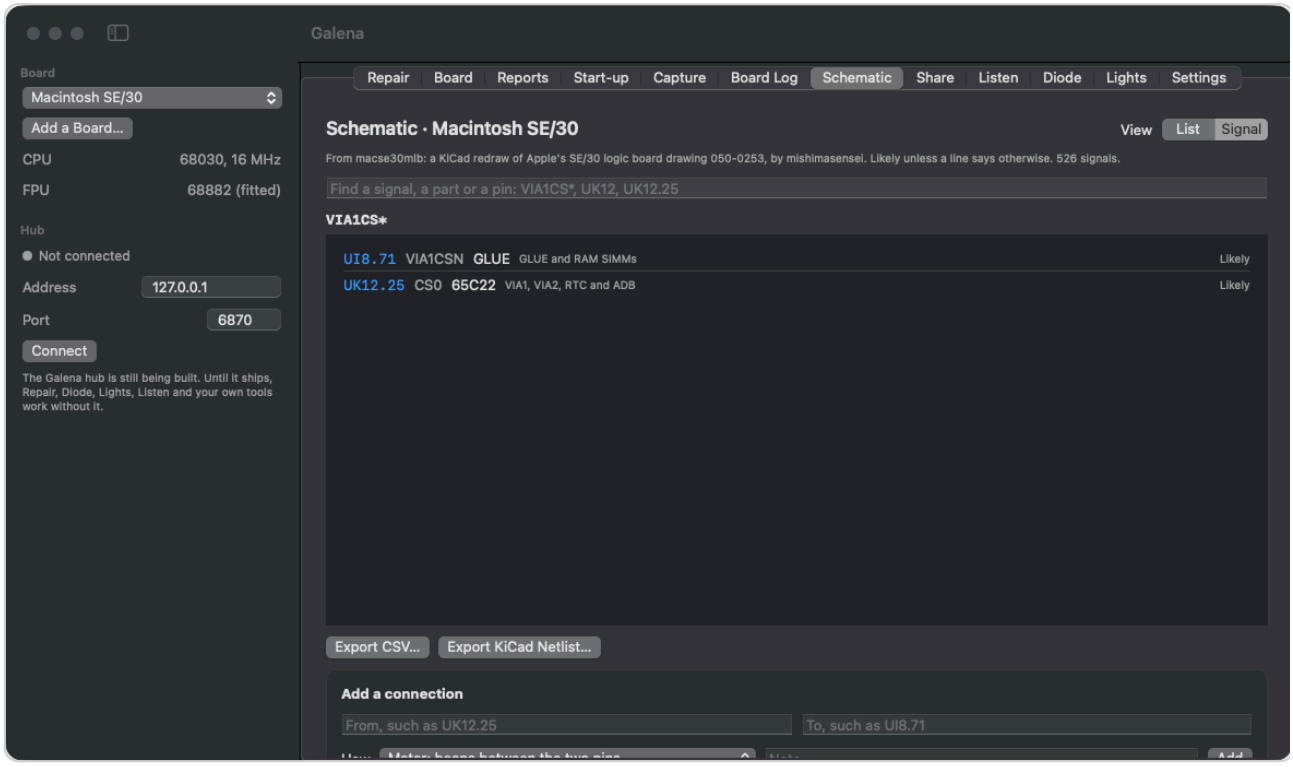
Board Log shows one board's story, entry by entry: the date, the kind, the hand (owner) it was in, the parts and what was found or done. Each entry carries a fingerprint of the one before, so a changed or missing entry shows at once.

Kind	For
Received	The board arrived, and how
Inspected	What was looked at and seen
Fault found	What is wrong
Repair	What was done
Tested	A test or a reading, and its result
Passed on	The board left
Note	Anything else

- **Add an entry:** choose its kind, the date and the parts, and say what was found or done. No names.
- **New Owner:** the board changed hands. The next hand starts; no name is asked for or kept.
- **Start a log:** for a board with none, keyed by its serial label, barcode or a Galena tag.
- **Export… and Import…:** one file that travels with the board. Import refuses a file that was changed, is for another board, or parts ways with the log here.
- **Save the Tag… and Save the Card…:** files to print, a 30 by 12 mm tag and an 85 by 55 mm card, each with a QR code that holds the board's key, never a name.

The Schematic screen

Following a signal



The SE/30's VIA1CS signal: GLUE's pin 71 to VIA 1's pin 25.*

Schematic holds the board's netlist, when it has one. The SE/30's comes from an open redraw of Apple's board: 186 parts and 526 signals, marked Likely until checked on a real board.

- **List:** every signal, with its pin count and trust. Search by signal, part or pin: VIA1CS*, UK12, UK12.25.
- **Signal:** every pin on a signal, with the pin's name, the part, the drawing's sheet and the trust. Choose a pin to see every pin of its part; choose a signal there to follow it on.

Adding connections

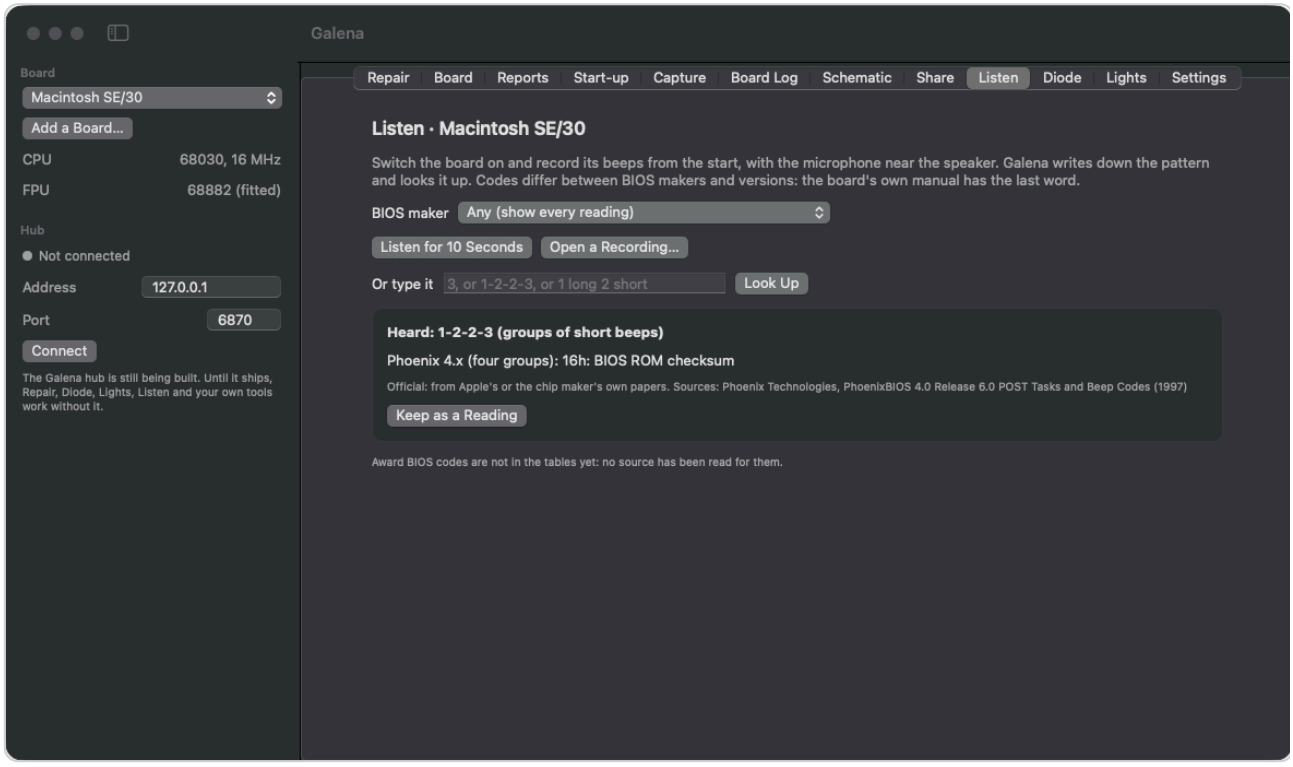
Add a connection builds a schematic one wire at a time, for boards with none and to add to those that have one: two pins, and how you found the connection.

How	Trusted as
A meter beeps between the two pins	Proven
A trace seen on the board	Proven
The chip maker's datasheet	Official
Other, said in the note	Reported

A connection the board file puts on two different signals is shown as a problem, not merged. **Export CSV…** and **Export KiCad Netlist…** write every signal and pin with its sources and trust, for KiCad or a spreadsheet.

Listen, Lights and Diode

Listen: beep codes



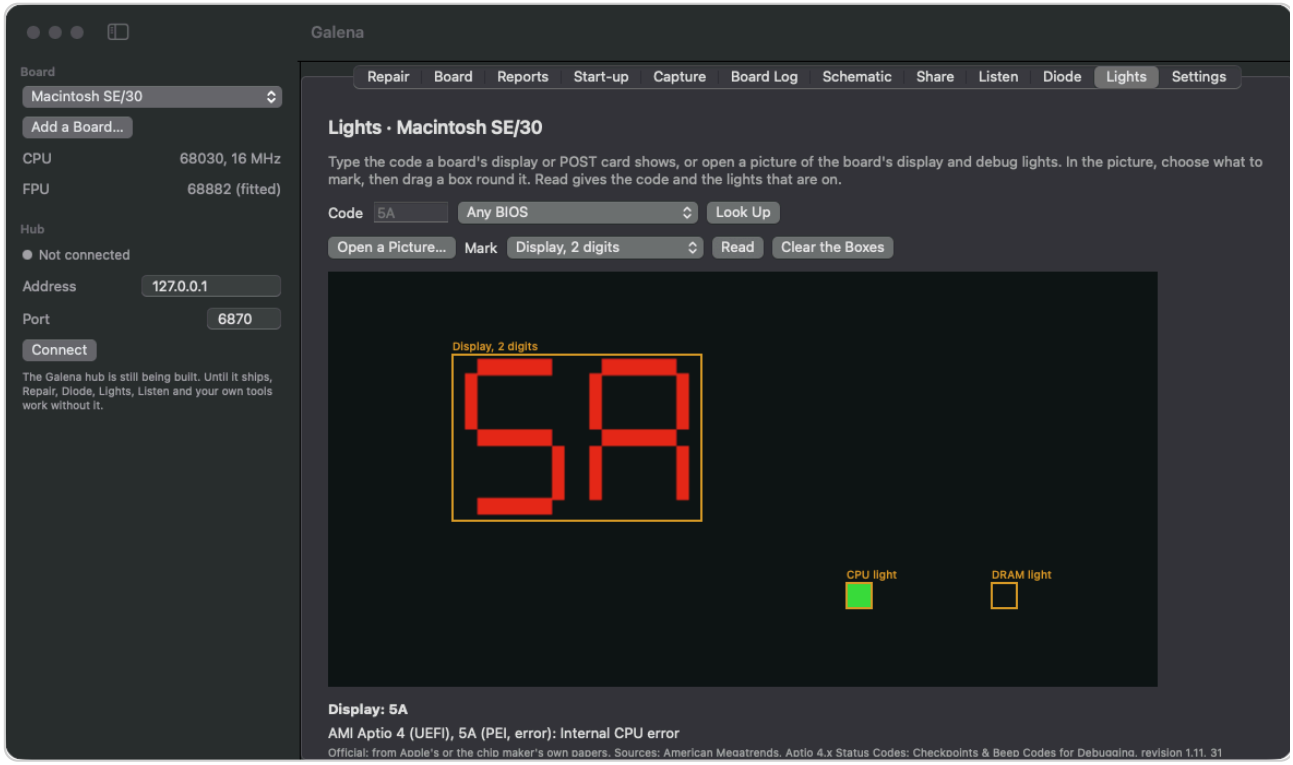
A recording heard as 1-2-2-3: Phoenix 16h, BIOS ROM checksum.

A PC board that fails before its video starts says why in beeps. **Listen** has three ways in: **Listen for 10 Seconds** from the microphone (switch the board on and hold the microphone near its speaker), **Open a Recording…**, or type the pattern in **Or type it**: 3, 1-2-2-3, or 1 long 2 short.

Galena writes down what it heard and every BIOS maker's reading of it, each with its source. The **BIOS maker** picker narrows the list. The codes come from the makers' own papers: AMI's AMIBIOS8 list (2002), AMI's Aptio 4 status codes (2009) and Phoenix's PhoenixBIOS 4.0 Release 6.0 sheet (1997), with older three-group Phoenix codes from a third-party copy, marked Reported. Phoenix's own rule turns any four-group code into its POST code, so 2-2-4-1 still names 5Ch. Award BIOS codes are not in yet.

> **Tip** The Mac asks once for the microphone. On Linux, recording needs arecord (alsa-utils), and Open a Recording… takes WAV files only.

Lights: POST codes and debug lights



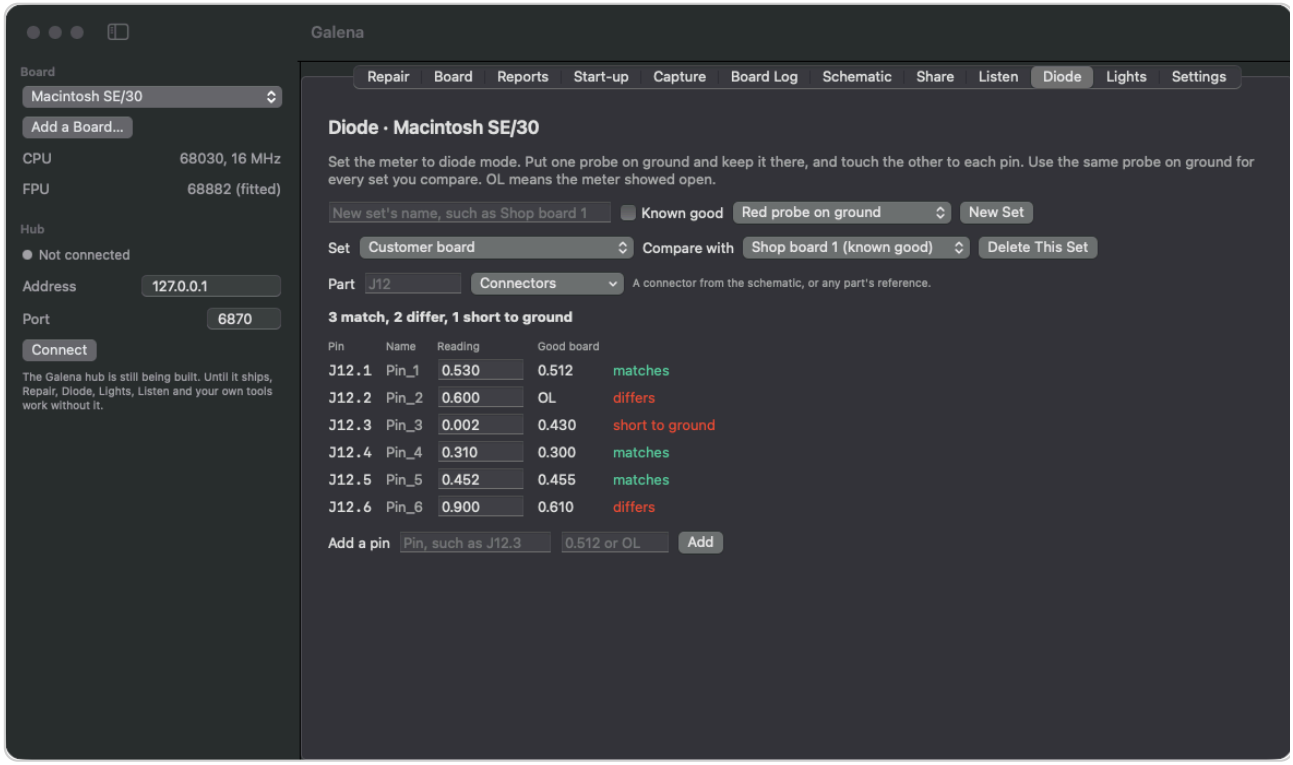
A display read as 5A from a photo, with the CPU light on.

Type the two digits a board's display or POST card shows in **Code** and **Look Up**: 5A, 0x5A or 5Ah. Galena lists each BIOS's meaning, from AMI's Aptio 4 list and Phoenix 4.0's test points. Board makers change these lists for their own boards, so the board's manual has the last word.

1. Click **Open a Picture…** and choose a photo of the board's display and debug lights.
2. Choose what to mark in **Mark**: Display, 2 digits or 4 digits, or the CPU, DRAM, VGA, BOOT or another light.
3. Drag a box round it on the picture. Do the same for each light.
4. Click **Read**. Galena gives the code, looked up at once, and which lights are on.

Galena reads the display's segments itself, so draw the box tight round the digits. A ? is a digit it could not read. **Keep as a Reading** keeps the code and the lights for the board.

Diode: compare with a good board



A customer board against a known-good set: two differ and one is short to ground.

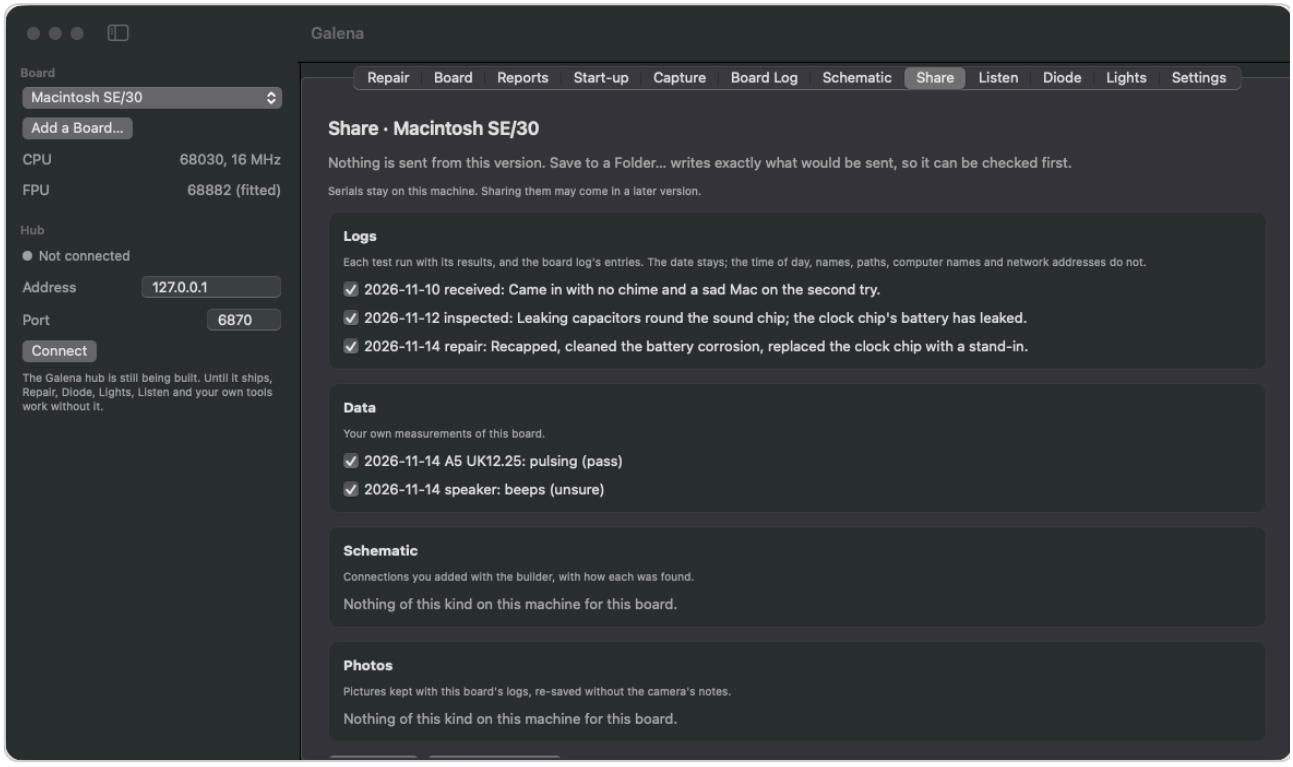
Diode-mode readings, from a pin to ground, tell a sick board from a good one without powering it. Set the meter to diode mode, keep one probe on ground, and touch the other to each pin.

1. Type a name for the set, tick **Known good** if the board works, choose which probe is on ground, and click **New Set**.
2. Type a part such as J12 in **Part**, or choose one under **Connectors**: its pins are listed with their names, where the board has a schematic. Otherwise add each pin with **Add a pin**, such as J12.3.
3. Type each reading: 0.512, or OL for open. A number above 3 is taken as millivolts.
4. Choose a known-good set in **Compare with**.

Each pin then says **matches**, **differs** or **short to ground**, with a count at the top. A reading matches within 0.05 V or 10 per cent of the good board's, whichever is wider; 0.05 V or less, where the good board reads more, is a short. Sets taken with different probes on ground are not compared.

Sharing

The Share screen



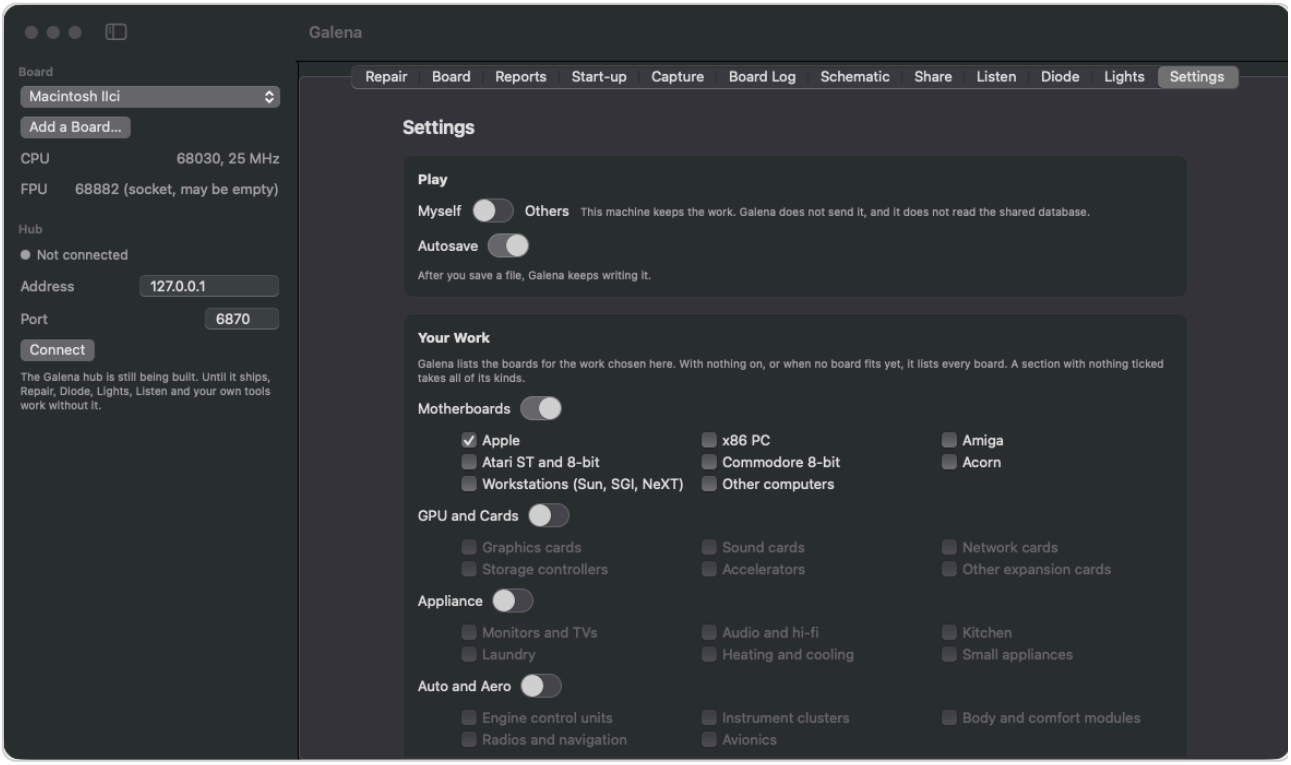
What would be shared for the SE/30: log entries and two readings.

Galena's library grows from what techs find. **Share** lists what could be sent for the board, item by item: Logs (test runs and log entries), Data (your measurements), Schematic (connections you added) and Photos (kept with the board's logs). Untick anything to leave it out.

- **Taken out first:** file paths, network addresses, the time of day, and this computer's names.
- **Marked and unticked:** a note that looks like it holds an email address, a phone number or a street address.
- Photos are saved again without the camera's notes: no place, no camera, no date.
- Serials stay on this computer.

Nothing is sent from this version. Save to a Folder… writes exactly what would be sent, so you can look at it first. Each kind can be set to Never in Settings.

Settings



Settings: Play, Autosave and Your Work.

Setting	What it does
Play: Myself or Others	Myself keeps the work on this computer and reads nothing shared. Others is for the shared library, when it is connected
Autosave	After you save a file with Save…, Galena keeps writing it
Your Work	A switch for each kind of work (Motherboards, GPU and Cards, Appliance, Auto and Aero, Consoles, Custom), with boxes to narrow it. The board list shows the boards that fit; with nothing on, or nothing fitting, it shows them all
Keep photos with the board's log	Off: Capture deletes its pictures when you finish. On: they are kept
Share photos, logs, data, schematic	Ask each time, or Never
Icon colours	One colour, Rainbow or By section; Back to Brass, Back to the Matched Set
Screen order	Up and Down move a screen; Back to the Standard Order

Reference

How far a fact is trusted

Word	Means
Proven	Checked on the shop's own board, with the date and how
Official	From Apple's or the chip maker's own papers
Likely	From a careful schematic redraw or an emulator; not yet checked on a real board
Reported	From community reports only, not checked

Where your work is kept

What	Mac	Linux
Settings	~/Library/Application Support/Galena/ui.json	~/.config/galena/ui.json
Logs, readings, diode sets, boards you added	~/Library/Application Support/Galena/	~/.local/share/galena/
A saved work folder	Where you chose with Save…	Where you chose with Save…

Keys

Mac	Linux	Does
⌘S	Ctrl+S	Save…
⌘K	Ctrl+K	Connect to the hub, once it ships
⌘ with scroll	Ctrl with scroll	Zoom a photo
⌘+ ⌘− ⌘0	−, Fit and + above the photo	Zoom a photo in, out, and to fit

The hub, and what is coming

The Galena hub is still being built. It connects to a board through the places it already has, with no soldering: a diagnostic ROM in the ROM SIMM socket of the SE/30 and the Mac II family that tests the board with no working RAM and reports back through the socket, Apple's own Test Manager through the modem port, a probe for signature analysis compared with a shared library of known-good boards, a card that watches the processor-direct slot, and a clip on a PC board's BIOS chip. When it ships, the Reports and Start-up screens come alive, and the walk's test steps answer themselves.

Also planned: the shared library, through Share; more boards, classic and modern; Award BIOS codes; reading logs from Memtest86+ and a live Linux system; and logic analyser captures.

This version

0.12.1, a preview. It is not yet signed by Apple. Nothing leaves your computer: Share saves to a folder only. All rights reserved until Galena's licence is chosen.