Liminal Chess

User Manual

The electronic chessboard that reads your real pieces, plays online on Lichess, and analyzes your games.

Firmware version 4.26

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1. Welcome to Liminal Chess

Liminal Chess is an electronic chessboard you play with real, physical pieces. Magnetic sensors under every square read your moves as you make them, a small color display keeps you informed, and a Wi-Fi connection lets you play opponents around the world through Lichess.

There is no app to learn and no screen to stare at while you play. You simply move the pieces. The board does the rest: it tracks the game, talks to Lichess, plays distinctive sounds for every event, and can even email you a computer analysis of each finished game.

This manual is your complete reference. If you want to get playing, start with the one-page Quick Start guide instead, then come back here when you want the full picture.

What you can do with it

- Play online against people or the computer through your Lichess account, using real pieces.
- Play head-to-head games against a friend on the physical board, with optional chess clocks.
- Practice with built-in training drills that sharpen your board and coordinate vision.
- Receive an emailed computer analysis of your finished games.

2. Your Board at a Glance

Liminal Chess is built around an ESP32-S3 microcontroller (an Adafruit Feather ESP32-S3 Reverse TFT). Here is what is inside and what each part does.

Component	What it does
Magnetic sensor grid	One hall-effect sensor sits under each of the 64 squares, reading where pieces are placed and lifted.
Magnetic pieces	Every piece holds a magnet. White and black use opposite magnetic polarity, which is how the board tells the colors apart and detects which way the board is facing.
Color display	A 240 by 135 pixel TFT screen shows menus, game status, the move list, and clocks.
Three buttons	Used for all navigation on the board itself.
Buzzer	Plays distinct tones for moves, captures, castling, game start and end, alerts, and more. Sound can be turned off.
Battery and USB-C	Runs from USB-C power or the onboard rechargeable battery, with a fuel gauge for an accurate charge readout.
Wi-Fi	Connects the board for Lichess play, the built-in web settings page, game analysis, and firmware updates.

3. The Three Buttons

All on-device navigation happens with three buttons. They map as follows.

Button	Action
D2	Up: navigate up, or to the previous item.
D0	Down: navigate down, or to the next item.
D1	Select: confirm or enter.
Hold D0 for about 3 seconds	Power off. Works from anywhere.
Press D0	Power on, or wake from sleep.
Hold D1 in the main menu for about 3 seconds	Reset Wi-Fi credentials and reopen the setup portal.

During a game, the bottom of the screen shows button hints for the current context, such as Pause, Draw, or Resign.

> **Note:** The physical labels and orientation of the buttons on your production unit may differ. If the on-screen hints do not match what you expect, follow the hints on the display, which always reflect the current buttons.

4. First-Time Setup

Setting up takes only a few minutes. You will need your home Wi-Fi name and password, and (for online play) a Lichess account.

1. Power on. Connect USB-C power, or use a charged battery, and press D0. A welcome screen appears, and the board looks for Wi-Fi.
2. Connect to Wi-Fi. On first use, with no saved network, the board creates its own temporary Wi-Fi network (a configuration portal). Join it from your phone or computer, then enter your home Wi-Fi name and password. The board reboots and connects.
3. Open the web settings page. Once the board is on your Wi-Fi, choose Settings on the board. It displays a QR code and a web address for the board's own settings page, served on your local network. Use this page for anything that requires typing.
4. Add your Lichess token (for online play). On the web page, paste a Lichess API token so the board can play on your account. See Appendix A for a preconfigured link that creates one with the right permissions.
5. Set your analysis email (optional). On the web page, under Game Analysis, enter the email address where post-game analysis should be sent.
6. Set up the pieces in the standard starting position and start a game.

5. Turning the Board On and Off

There is no mechanical on/off switch. Power is managed in software, using a low-power deep-sleep mode.

To do this	Do this
Turn off	Hold D0 for about 3 seconds. The screen shows “Powering off” and goes dark, drawing very little power.
Turn on	Press D0.

Automatic power-off

After a period of inactivity in the menus, the board sleeps on its own to save power. The default is 15 minutes, and you can change it on the web settings page to Never, 5, 10, 15, 30, or 60 minutes. The board will not sleep on its own during an active game.

> **Note:** While the board is asleep, its USB connection drops, so a connected computer will not see it until you wake it with D0. This is normal.

6. The Main Menu and Modes

The main menu is a grid of four icons. Each one opens a different mode.

Play Online (Lichess)

Requires Wi-Fi and a saved Lichess token. From here you can:

- Play the computer at a difficulty you choose.
- Start a new game, or continue one already in progress.
- Accept incoming challenges, or challenge your friends.

The board first checks that the pieces are set up correctly, then tracks your moves on the physical board and relays them to Lichess. When your opponent moves, the board plays a sound and prompts you to make that move on the board. Time controls and color selection are offered when you start a challenge.

Local Game (two players, head-to-head)

Two people play on the same physical board, and the board records the game in standard notation.

- Optional chess clock: Unlimited, 5, 10, 15, 30, or 60 minutes.
- On screen, you see a large turn banner (“WHITE” or “BLACK”), the clock if enabled, and a running move list.
- **In-game buttons:** Pause (which opens Resume, Undo last move, or Quit), Draw, and Resign.

Finished games are saved automatically. They appear in the web Games tab, where you can download them as PGN or send them for analysis.

Training

Built-in drills, including Coordinate Vision and Move Vision, help you practice recognizing squares and coordinates. Your best scores are saved.

Settings

On the board, this screen shows the QR code and address for the full web settings page, and lets you check for a firmware update on demand—most configuration lives on the web page, covered in Section 9.

7. Pieces, Setup, and Auto-Orientation

Starting position

New games begin from the standard chess starting position. The board runs a setup check and prompts you if any pieces are missing or misplaced.

Auto-orientation: sit on either side

Because the white and black pieces have opposite magnetic polarities, the board can detect which side of the board White is on at the start of each game. You do not have to sit on one fixed side. The player nearest the display can be Black, for example. On standard boards, this works out of the box.

> **If your board was built with reversed polarity:** There is a one-time Calibrate action on the web settings page. Set up White nearest the screen, then click Calibrate.

The board tells colors apart by polarity, but it cannot distinguish two pieces of the same color from each other. When a move would otherwise be ambiguous, it relies on legality checking, described next.

8. How Moves Register, and Recovery

To make a move, lift a piece and place it on its destination square. The board detects the change, records the move, and confirms with a sound. Captures and castling are recognized automatically.

The board validates every move: it checks that the piece moved legally, that captures are valid, that you are not leaving your own king in check, and that it is the correct side to move.

Recovery

If a move cannot be made sense of, for example, because a piece was bumped or a move was missed, the board enters a Recovery prompt. It asks you to re-place the pieces and resync, rather than recording a bad move. Simply follow the on-screen prompts to restore the position.

> **Castling tip:** You can move the king first or the rook first; both work. Complete the castle by moving the second piece.

9. The Web Settings Page

The board hosts its own web page on your local network. The address and a QR code appear on the Settings screen. The page is organized into the following sections.

Settings

- Sound on or off.
- Automatic Updates on or off.
- Auto power-off timeout.
- Auto Orientation on or off, plus Calibrate.
- Display brightness.
- Sensor detection threshold.
- Lichess computer (AI) level.
- Lichess API token.

- Game Analysis email, with an Advanced section for backend and device fields that normally do not need changing.

Games

A list of your saved head-to-head games, newest first. Send any of them to analysis, or download them as PGN.

About

Battery status, firmware version, and device information.

Update

The over-the-air firmware update page.

10. Game Analysis

After a game, the board can send it to a cloud service that returns Stockfish and Claude analyses via email. Enter your email address on the web page to enable this, or leave it blank to turn it off. Online Lichess games are the primary path for analysis.

11. Sound

The buzzer plays distinct tones for many events, including a move, a capture, castling, the start of a game, a win, a loss, or a draw, an opponent's move, an incoming challenge, low time, recovery alerts, startup, and power-off.

Sound can be turned off in Settings. The board works with either a SparkFun Qwiic Buzzer or an Arduino Modulino Buzzer, and detects which is attached at startup. The Modulino buzzer has no volume control.

12. Battery and Power Management

An onboard fuel gauge reports the battery voltage, percentage, and charge rate. A battery icon appears in the title bars and on the About tab on the web.

- A low-battery warning appears at about 15 percent.
- A critical warning appears at about 5 percent, as a brief on-screen alert.

To save power, the display dims automatically in the menus and runs at full brightness during games.

> **Why the battery can drain while plugged in:** With Wi-Fi, sensors, and the display all active, the board can draw more power than USB supplies. The battery may slowly drain even while plugged in, shown as “USB (draining)”. This is expected.

13. Firmware Updates

If Automatic Updates is on, the board checks for new firmware and offers to install it on screen. You can also check on demand from the Settings screen or the web Update page.

A battery guard prevents updates when the battery is low to avoid a failed flash. After installing, the board reboots into the new version.

14. Troubleshooting

Symptom	What to do
Sensor errors, or some squares not detected	This is usually a wiring or connection issue in the sensor chain, such as a loose connector, cable, or solder joint, rather than a software problem. If the first few files work and the rest show errors, suspect a broken power or data line at a chain junction.
A move went to Recovery	Re-place the pieces as prompted. This protects your game from recording a mis-read move.
The board will not connect to Wi-Fi	Re-open the configuration portal by holding D1 in the main menu, then re-enter your network credentials.
Online play says “No API Key”	Add your Lichess token on the web settings page.
No sound	Check that Sound is enabled and that a buzzer is attached and detected.
The USB device disappears	The board is asleep. Press D0 to wake it.

Appendix A: Getting a Lichess API Token

To play online, you need a personal API token from your Lichess account. The board doesn't paste anything on your behalf; you create the token on the Lichess website and copy it into the board's web settings page.

The quickest way is to use the preconfigured link below, which opens Lichess with the correct permissions (scopes) already selected for Liminal Chess. Sign in to Lichess if prompted, review the request, and create the token. Then copy it and paste it into the Lichess API token field on the board's web settings page.

Create your token:
https://lichess.org/account/oauth/token/create?scopes[]=board:play&scopes[]=challenge:read&scopes[]=challenge:write&description=LiminalChess

Keep your token private: Your token grants access to your Lichess account. Do not share it. If you ever need to revoke it, you can do so from your Lichess account security settings.

Appendix B: Serial Diagnostic Commands

These commands are primarily for assembly and diagnostics, not everyday use. Over a USB serial connection at 115200 baud, the board accepts diagnostic commands.

Command	Purpose
scan	Scan the I²C bus.
board	Perform a full sensor read.
cal	Calibrate sensor baselines.

Command	Purpose
orient	Show or calibrate board orientation.
buzzer	Report the attached buzzer type.
battery	Report battery status.
i2cclock	Report or set the I²C clock.
help	List all available commands.