Lutra documentation

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1 Lutra documentation

This is the technical documentation for Lutra Pool: the Lutra Lite gateway and its firmware, the installation on site, the Lutra Insight portal for partners, the view for pool owners, and the Lutra API for integrations.

On this page: where to start, what each product does, and where to find each topic.

New to Lutra? Start here: from a partner account to the first pool with readings, in five steps.

Get started

1.1 Products in one minute

Product	What it is	Where it runs
Lutra Lite	A small DIN-rail box in the plant room. It reads the pool equipment (water treatment, pump, contacts) over RS485/ Modbus and sends the readings to the Lutra cloud. One build only reads; a separate build can switch outputs with interlocks.	ESP32-S3 boards from Waveshare, see Boards
Lutra Insight	The web portal for partners (pool builders, service companies and their technicians): pools, readings, alerts, visits, boxes and remote actions.	app.lutrapool.com
Owner view	A simple view for the pool owner, invited by the partner: water quality in plain words, temperature, charts and, where allowed, on/off controls.	Same portal, owner role, see Pool owners
Lutra API	The REST API behind the portal, the MQTT interface for Lutra boxes, and a write-only interface for third-party measuring devices.	`api.lutrapool.com`, `iot.lutrapool.com`, see API and integrations

How these parts connect is described in How Lutra fits together.

1.2 Find a topic

- **Becoming a partner** How a company gets access to Lutra Insight, and the first sign-in. Become a Lutra partner
- **Choosing hardware for a pool** Monitor only, switching, or dosing: which board and which firmware build. Choose hardware and build
- **Installing a box** Safety first, then wiring, setup and commissioning on site. Installation

- **Flashing and configuring firmware** Web flasher, setup page, network, updates and troubleshooting. Firmware
- **Working in the portal** What an administrator and a technician see and do. Lutra Insight
- **Connecting your own device** Send readings from a controller or PLC that Lutra firmware does not support. External devices
- **Looking up a term** Quantities, units and the words used in this documentation. Reference

1.3 Ground rules that apply everywhere

- **The pool always works without Lutra.** Lutra Lite reads; the read build never switches anything. The existing controllers keep their own safety functions.
- **No open ports at the pool.** A Lutra box only makes outgoing connections. The only local web page is the setup page on the box's own temporary Wi-Fi network, opened by physical access to the box. See Setup page.
- **Changes on site win.** The cloud may only change a box setting on the basis of the box's current state; anything changed on site is never overwritten from a distance. See Remote commands and settings.
- **Mains work is for a licensed electrician.** Lutra supplies low-voltage control electronics. See Electrical installation and safety.

1.4 For AI assistants and search

The full text of this documentation is also available as plain Markdown: `llms.txt` (index) and `llms-full.txt` (all pages in navigation order) at the root of the site. See About this documentation.

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2 Get started

On this page: the path from nothing to the first pool with readings in Lutra Insight, in five steps. Each step links to the page that has the details. Read them in this order the first time.

2.1 Before you begin

Lutra works through partners: pool builders and service companies that look after pools for their clients. You need a partner account in Lutra Insight to activate boxes and see readings. If your company does not have one yet, start with Become a Lutra partner.

To get a picture of the whole system first, read How Lutra fits together.

2.2 Five steps to the first readings

1. **Get access to Lutra Insight.** Lutra creates the partner account and invites the first administrator, who signs in at app.lutrapool.com. See Become a Lutra partner.

2. **Choose hardware and build for the pool.** Monitor only, switching, or an external device; which board and which firmware build. See Choose hardware and build.
3. **Prepare the box.** Flash Lutra firmware before connecting anything to the outputs; a new board runs the manufacturer's demo firmware. See Web flasher.
4. **Install the box on site.** Safety first, then wiring, the setup page (devices first, network last). See Installation and the Commissioning checklist.
5. **Pair the box with the pool.** Create the client and the pool in Lutra Insight and activate the box with its pairing code. The first readings arrive within minutes (every 5 minutes by default). See Clients, pools and boxes.

After the first box, the "Getting started" checklist in the portal guides the administrator through the remaining set-up: alert limits, inviting colleagues and email alerts. See Lutra Insight.

2.3 No Lutra box needed?

If the pool already has a controller or PLC that can send its own readings over the network, it can deliver them to Lutra directly. See External devices.

2.4 Related pages

- Become a Lutra partner
- Choose hardware and build
- Commissioning checklist
- Glossary

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3 Become a Lutra partner

On this page: how a company becomes a Lutra partner, what the invitation looks like, the first sign-in, and the first steps in Lutra Insight. Prices and billing rules are in Subscription and pricing; commercial conditions are on lutrapool.com.

3.1 Who can be a partner

Partners are pool builders and service companies that install and look after pools for their clients. The partner has the agreement with Lutra and can invite the pool owner to a simple owner view. See Pool owners.

3.2 1. Request access

There is no self-service sign-up. Contact Lutra through lutrapool.com (arrange an introduction, or request access to the demo of Lutra Insight). Lutra then creates the partner account.

To be confirmed

- The steps between the first contact and the account being created (agreement, lead time).

- Whether new partners get a test account before working with real pools.

3.3 2. The invitation

When Lutra creates the partner, it sets the partner's country and the defaults for time zone, language and units, and enters the email address of the **first administrator**. That person receives an email "Your invitation to the Lutra portal" with:

- the portal address, app.lutrapool.com;
- the user name;
- a temporary password, valid for **7 days**.

The invitation text is in English. An email address that already has a Lutra account cannot be invited again; use a different address.

To be confirmed

What to do when the temporary password has expired before the first sign-in (a new invitation from Lutra is the expected route), and the sender address of the invitation email.

3.4 3. First sign-in

The first sign-in always uses the password route:

1. Open app.lutrapool.com and choose **Sign in with password and code**.
2. Enter the email address and the temporary password.
3. Choose your own password: at least 12 characters, with lower case, upper case and a digit.
4. Link an authenticator app (scan the QR code) and enter the code it shows. A second step is required for every account.
5. The portal then offers to create a **passkey**. With a passkey you sign in without password or code next time. You can postpone it; the portal asks again after each password sign-in.

Keep the password and the authenticator app as your backup, also after creating a passkey. Passkeys work only on app.lutrapool.com. See Lutra Insight.

3.5 4. First steps in Lutra Insight

After signing in, the administrator sees a "Getting started" checklist on the overview. Each step ticks itself off when it is really done:

Step	Details
Add a client	Clients, pools and boxes
Add a pool to the client	Clients, pools and boxes
Flash the box and activate it with the pairing code	Web flasher, Pairing a box, Commissioning checklist
Check and save the alert limits	Alerts and visits
Invite a colleague	Team and administration
Switch on email alerts	Alerts and visits

When a box is activated but has not sent a reading yet, the checklist shows that it is waiting for the first measurement (every 5 minutes by default).

3.6 Inviting your team

On the **Team** page the administrator invites colleagues by email, with a role (technician or administrator) and, for a technician, a scope (all pools or a selection). Each colleague receives the same invitation email and follows the same first sign-in. See Roles.

3.7 Related pages

- Get started
- Lutra Insight
- Roles
- Choose hardware and build

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4 Subscription and pricing

On this page: what a pool costs in Lutra Insight, how remote monitoring is added per pool, how changes are billed, the trial month, and what a pool without remote monitoring can still do.

The partner (the pool builder or service company) has the subscription with Lutra. Pool owners never pay Lutra directly.

4.1 Prices

Per pool, in EUR, excluding VAT.

Per pool	Per month	Per year (paid in advance)
Basis: client overview, planning, routes, manual and LabCOM readings, team	0.50	5
Remote monitoring (includes basis): box online, history, alerts, remote control, also for the owner	5	50
Minimum per partner, over the total	25	250

- Every pool in the portal counts. A pool is either basis or remote monitoring, never both.
- Deleted pools do not count.
- When the total of your pools is below the minimum, the invoice has a separate line “Minimum top-up” for the difference.
- Yearly is about 17% cheaper than monthly (two months free).

4.2 Monthly or yearly

You choose one interval for the whole subscription, in **Settings**, **Subscription**.

- The subscription renews one month or one year after it started (not on a fixed calendar date).
- **Monthly to yearly** takes effect immediately; the unused part of the current month is credited.
- **Yearly to monthly** takes effect at the next renewal.

4.3 Adding and removing

Change	When it is billed
New pool, or remote monitoring switched on	Immediately, prorated until the next renewal
Pool deleted, or remote monitoring switched off	From the next renewal; no refund for the current period

4.4 Switching remote monitoring on or off

On the pool page, tab **Devices**, the administrator switches **Remote monitoring** on or off. Technicians and Lutra (when reading along) cannot.

- **On**: the portal first shows what changes, calculated by the payment provider: the amount per period, the prorated amount charged now and the new total. Nothing changes until you confirm with **Increase subscription**.
- **Off**: the subscription decreases at the end of the current period. Remote monitoring keeps working until that date.

Every change is recorded in the audit log.

4.5 Trial month

Each partner gets one trial month, not one per pool. During the trial, remote monitoring works on every pool the administrator switches on, at no cost. After the trial the subscription continues with the pools as they are.

4.6 Local only

A pool without remote monitoring shows **Local only** on the pool page and in the owner app.

- The box stays connected to Lutra for firmware updates and a sign of life.
- Lutra keeps no history of its readings, sends no alerts for it, and refuses remote commands and remote switching.
- Operating the pool on site through the box itself (its local page and buttons) stays free.

4.7 Firmware downloads

Firmware for the web flasher is only available inside Lutra Insight, to partners with an active subscription or in their trial month. Remote updates of boxes are not affected. In the demo account the flasher shows a simulated flash and does not write real firmware.

4.8 Free accounts

The demo account, Lutra's own pools and partners with a separate agreement do not pay.

4.9 Related pages

- Team and administration
- Clients, pools and boxes
- Remote panel
- Commercial conditions: lutrapool.com

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5 How Lutra fits together

On this page: the path of a reading from the pool equipment to the portal, the main building blocks in the cloud, how data is kept, and the security principles behind the design. Details are on the linked pages.

5.1 From plant room to portal

Diagram: Data path: pool equipment is read over RS485 Modbus by the Lutra Lite box, which sends MQTT over mutual TLS to AWS IoT Core and the ingest. A third-party device sends to the same ingest over MQTT or HTTPS, write only. Topics: telemetry goes to the raw archive and database, events to alerts and the log, the shadow carries box settings both ways, cmd carries signed commands. Lutra Insight and the owner view read the stored data through the REST API. From plant room to portal: readings go up over outgoing connections only; remote actions return to the box through the shadow and signed commands.

1. The box reads the equipment on the bus every few seconds and sends a compact telemetry message to the cloud, by default every 300 seconds and immediately when a state changes (at most once per 30 seconds). See Device messages.
2. Without a connection the box stores messages in a flash buffer and sends them later, in order. Measuring never waits for the cloud. See Network.
3. In the cloud every message is archived unchanged; the current state and history are derived from that archive. See Data and storage.
4. The portal and the owner view read through the REST API. Remote actions go back to the box as signed commands or as settings through the device shadow. See Remote commands and settings.
5. Devices that do not run Lutra firmware can send readings through the external devices interface. They are write only: Lutra never sends anything to them.

5.2 Building blocks

Part	Role	Documented in
Lutra Lite box	Reads the bus and inputs; in the switching build also drives outputs with interlocks	Firmware
Setup page	Local configuration on the box's temporary Wi-Fi network	Setup page
AWS IoT Core	Device connections (MQTT, mTLS, one certificate per box)	Device messages
Ingest	Normalises readings into quantities, removes duplicates, assigns them to a pool	API overview
REST API	One API for the portal, the owner view and integrations	REST API
Lutra Insight	Partner portal	Lutra Insight
Web flasher	Flashing and updating boxes over USB from the portal	Web flasher
Release pipeline	Builds, signs and publishes firmware per board, build and channel	Updates and channels

5.3 Organisations and ownership

Diagram: Ownership tree: Lutra, the platform, has partners. A partner is a pool builder or service company with a team of administrators and technicians. A partner has clients, the pool owners such as households, hotels and campsites. A client has pools. A pool has sources: Lutra boxes and external devices. Each level belongs to exactly one level above it; partners are strictly separated from each other.

- A box does not know whom it belongs to. It only sends its own name; the cloud links it to a pool when the partner activates it with its pairing code. See Clients, pools and boxes.
- If a box moves to another pool, the old data stays with the old pool.
- Partners are strictly separated from each other (multi-tenant). See Authentication and access.

- The contract runs through the partner: the partner has the subscription with Lutra and can invite the pool owner. See Pool owners.

5.4 Data and storage

What	Where	How long
Raw messages, unchanged	Archive (S3)	Kept; this is the source from which everything else can be rebuilt
Detailed readings	Database (DynamoDB)	90 days
Hourly averages	Database	Kept
Current state per pool	Database	Overwritten with each update

The cloud runs in the AWS region eu-central-1 (Frankfurt). When a client leaves, their data is erased (GDPR); the partner's administrator can export or erase a client's data in the portal. See Team and administration.

To be confirmed

Retention periods for the test environment and for archived raw data after a client leaves are not yet published as policy.

5.5 Security principles

- **One identity per box.** Each box has its own key pair and certificate; certificates can be revoked individually. Private keys never leave the device or the key store.
- **Only outgoing connections.** No open ports and no tunnel at the pool.
- **Signed firmware and signed commands.** A box only installs firmware signed by Lutra and only executes commands from a fixed list, signed by the command service. See Updates and channels and Remote commands and settings.
- **Limits live in the firmware.** The server can make limits stricter, never looser.
- **Physical access for the sensitive things.** Changing the network, enabling "changes from the cloud" and assigning output functions can only be done on site.
- **The pool keeps working.** If Lutra or the internet is unavailable, the pool equipment runs as before.

5.6 Related pages

- Choose hardware and build
- Glossary

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6 Choose hardware and build

On this page: a step-by-step decision for one pool, a summary table, and what is not available yet. Decide per pool; a partner can use different boards and builds for different pools. An interactive version of this guide will follow.

6.1 Step 1: what should Lutra do at this pool?

What does the pool maintainer want? Pick the card that fits.

Goal

Only see readings and alerts (monitor).

Read build

- Either board
- Continue with step 2

Goal

Also switch equipment from Lutra: pump speed, filter pump, backwash valve, heating enable, refill valve, light, aux.

Switching build

- 8DI-8DO board only
- Interposing relays or contactors
- An electrician, see step 4

Goal

Dose chemicals (pH, chlorine).

Not available yet

- Monitor now with the read build

Situation

The equipment is not supported by Lutra firmware, or the pool already has its own controller or PLC with network access.

External devices API

- No Lutra box needed
- PLC: see Connecting a PLC
- **Read build**: reads the bus and the inputs, sends readings, never switches an output. It contains no code that can switch an output. See Builds.
- **Switching build**: everything the read build does, plus outputs with interlocks, schedules and limits in the firmware. Only for the 8DI-8DO board. See Switching build.
- **External devices API**: your own device sends readings over MQTT or HTTPS. See External devices; for a pool that already runs its own PLC, see Connecting a PLC.

To be confirmed

Dosing (pH and chlorine) is being explored as a separate build with hardware interlocks and is not available. The switching build deliberately excludes dosing and pool cover movement. Do not use the switching build to drive dosing pumps.

6.2 Step 2: how does the box reach the internet?

Situation	Board
Network cable available, or PoE wanted (one cable for data and power)	ESP32-S3-POE-ETH-8DI-8DO
Only Wi-Fi in the plant room	Either board; the RS485-CAN board is Wi-Fi only
No usable network at all	A 4G/5G router next to the box (neither board has a modem)

See Boards and Network. Another ESP32-S3 board in mind? Lutra is open to adding boards; see New boards.

6.3 Step 3: what has to be read?

What	Needs	Notes
Controllers, chlorinators, pumps, heat pumps with Modbus RTU	RS485 on either board	Check the supported devices. All devices on one bus need the same baud rate, parity and stop bits.
A bus that already has a master (PLC, panel)	Listen-only mode	Lutra must never be a second master on such a bus. See Bus devices and inputs.
Contacts: flow switch, pump running, level floats, leak, plant room door	Digital inputs (DI)	Only the 8DI-8DO board has inputs.
Wireless sensors: pool thermometer, plant room temperature and humidity, leak, door	Bluetooth, BTHome v2, unencrypted, fixed address; firmware 0.5.0 or later, either board	Passive, read only. Not yet tested with a real sensor. See Bluetooth sensors.
Own pH/ORP probes	A Modbus pH/ORP transmitter and a flow cell with flow switch	See Own probes and flow cell.
Equipment only reachable through the manufacturer's cloud	Not on the box	Cloud connectors in the backend are being designed.

To be confirmed

How a flow switch is read on the RS485-CAN board (it has no digital inputs) is an open question.

6.4 Step 4: who installs what?

Choice	Lutra box wiring (low voltage)	Electrician needed
Read build, bus only	Installer or technician	For the box's power supply if it is mains-fed. See Electrical installation and safety.
Read build with DI contacts	Installer or technician	If a contact comes from a contactor or device that also carries mains, the auxiliary contact wiring must be done safely; see the safety chapter.
Switching build	Installer for the low-voltage side	**Yes**: interposing relays, contactors, all mains wiring and the hardware interlocks.

6.5 Summary

The pool maintainer wants	Board	Build	Extra hardware
Monitor, network by cable or PoE	8DI-8DO	Read	none
Monitor, Wi-Fi only, no contacts	8DI-8DO or RS485-CAN	Read	none
Monitor plus contacts (flow, pump running, levels)	8DI-8DO	Read	contacts on DI
Monitor with own probes	8DI-8DO	Read	pH/ORP transmitter, flow cell, flow switch
Switch pump, valves, heating, light	8DI-8DO	Switching	interposing relays or contactors, hardware interlocks, electrician
Dosing	(not available)	(not available)	
Unsupported device or own controller	none	none	device with TLS client certificate support

Changing the build later is possible, but only by a complete reflash over USB on site, never by a remote update. See Converting to another build.

6.6 Related pages

- Boards
- Builds
- Connecting a PLC
- Commissioning checklist

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.5.0.

7 Lutra Lite firmware

On this page: what the firmware does, the design rules behind it, and a map of the firmware chapter. The current beta version is **0.5.5**; the current stable version is **0.4.0**. See Updates and channels.

7.1 What the firmware does

Lutra Lite is firmware in C on ESP-IDF for ESP32-S3 boards. It is closed source and free to use with Lutra; Lutra builds and signs every image. A box with Lutra Lite:

- reads pool equipment over RS485 (Modbus RTU as master, or listen-only next to an existing master), and optionally local network devices over HTTP;
- reads contacts on its digital inputs (8DI-8DO board): flow switch, pump running, level floats, leak, door;
- listens passively for wireless Bluetooth sensors in the BTHome v2 format (firmware 0.5.0 and later);
- sends readings, events and its state to the Lutra cloud over MQTT with mutual TLS;
- buffers readings in flash when offline and sends them later, in order;
- accepts a fixed list of signed commands and a small set of settings from the cloud;
- installs only firmware signed by Lutra, with automatic rollback if the new version fails its self-test;
- in the switching build only: drives outputs through interposing relays, with interlocks in the firmware.

7.2 Design rules

Rule	Consequence
The box may be unreachable at any time	Every update must be safe to fail: A/B partitions, self-test, rollback, watchdog. Remotely you can only read data, change a few settings and request an update.
The read build never switches	The read build contains no code that can set an output. The CI checks the source and the compiled binary.
No open ports at the pool	Only outgoing connections. The setup page runs only on the box's own temporary network.
On site wins	A change made on site is never overwritten by an older wish from the cloud.
Physical access for sensitive actions	Network, "changes from the cloud" and output functions are set on site only.

7.3 Chapter map

Task	Page
Which boards are supported, pins and power	Boards
Read build or switching build	Builds
Flash or update from the browser	Web flasher
Flash or update from the command line	USB and command line
Change a box from read to switching (or back)	Converting to another build
Configure devices, network and inputs on site	Setup page, Network, Bus devices and inputs
Read wireless Bluetooth (BTHome) sensors	Bluetooth sensors
Read the LED, use the BOOT button	LED and BOOT button
Updates, beta and stable channels	Updates and channels
Outputs and interlocks	Switching build
Which equipment can be read	Supported devices
Something does not work	Troubleshooting

7.4 Related pages

- Choose hardware and build
- Commissioning checklist
- Device messages (MQTT)

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.5.0.

8 Boards

On this page: the supported boards and where to buy them, adding new boards, what each board has and lacks, power options and the pin assignments the firmware uses. For choosing between them, see Choose hardware and build.

8.1 Supported boards

The firmware currently works on the boards below, both from Waveshare. Buy them from the manufacturer:

- **ESP32-S3-POE-ETH-8DI-8DO**: product page at Waveshare
- **ESP32-S3-RS485-CAN**: product page at Waveshare

The firmware is built separately for each board; a box refuses firmware for the other board. See Builds.

8.2 New boards

Lutra is open to adding new boards. Boards with an ESP32-S3 and PSRAM are preferred, because the firmware is built for that chip. If you find a board you would like to use with Lutra, let us know through lutrapool.com. We would like to receive two units of the board to test it and adapt the firmware.

8.3 Comparison

	ESP32-S3-POE-ETH-8DI-8DO	ESP32-S3-RS485-CAN
Firmware board name	`poe_8di8do`	`rs485_can`
Role	Pilot board, the only board for the switching build	Series candidate, read build only
MCU	ESP32-S3 (module ESP32-S3-WROOM-1U-N16R8), 16 MB flash, 8 MB PSRAM, external antenna (U.FL)	ESP32-S3R8, 16 MB flash, 8 MB PSRAM
Network	Ethernet (W5500, 10/100) and Wi-Fi	Wi-Fi only
Power	7 to 36 V on the screw terminal, or PoE (802.3af), or 5 V via USB-C	7 to 36 V; do not power via USB at the same time
RS485	Isolated, 120 ohm termination jumper	Isolated
CAN	Isolated (not used by Lutra)	Isolated (not used by Lutra)
Digital inputs	8, optically isolated, passive and active	none
Digital outputs	8, Darlington open collector, optically isolated, max 500 mA sink, flyback diode	none
Real-time clock	PCF85063	PCF85063
Status LED	RGB LED driven by the firmware, see LED and BOOT button	No LED the firmware can drive (only PWR, RS485 and CAN hardware LEDs)
BOOT button	Accessible	Inside the enclosure
Enclosure	DIN rail	DIN rail, 23 mm wide

Two SKUs exist of the RS485-CAN board; they differ only in the antenna: SKU 32154 with the antenna on the board, SKU 34781 (-U) with an external antenna.

Never connect a load directly to the DO terminals

The DO outputs of the 8DI-8DO board are Darlington open-collector (sink) outputs, rated at most 500 mA, with a flyback diode. They may only drive the coil of an interposing relay or a contactor coil on a low-voltage supply, never a pump, valve, heater or any mains load directly.

The board's **factory firmware switches the outputs** (all outputs on at start-up, inputs mirrored to outputs). Until Lutra firmware is on the board, connect nothing to the DO terminals. The Lutra read build never switches an output.

8.4 Pins used by the firmware

8DI-8DO board:

Function	Pins
Ethernet W5500 (SPI)	INT 12, MOSI 13, MISO 14, SCLK 15, CS 16, RST 39
RS485	TX 17, RX 18, RTS 21 (direction via UART RTS)
CAN	TX 2, RX 3
DI1 to DI8	GPIO 4 to 11
DO1 to DO8	Via I/O expander TCA9554 (I2C address 0x20), bits 0 to 7; bit low (0) = output on
RTC PCF85063	I2C address 0x51, SCL 41, SDA 42, INT 40
SD card (1-bit)	D0 45, CMD 47, SCK 48
RGB LED	38
Buzzer	46
BOOT button	0 (strapping pin: held at reset = download mode)
Pin header	IO1, IO0, RXD, TXD, SDA, SCL, GND, VCC; IO1 is free

RS485-CAN board:

Function	Pins
RS485	TX 17, RX 18, RTS 21 (same as the 8DI-8DO board)
CAN	TX 15, RX 16
RTC PCF85063	I2C address 0x51, SCL 38, SDA 39, INT 40
Free on the SH1.0 connector	GPIO 1, 2

The SDA/SCL bus carries the RTC and the output expander. Never connect external devices to it.

8.5 Inputs (8DI-8DO)

The inputs are optocoupler inputs for contacts. An open input reads `1` (pull-up); a contact closed to the GND of the input block reads `0`. They are not suitable for data signals (for example a DS18B20 sensor).

> **To be confirmed**
>
> The voltage range for active (powered) input signals has not been measured yet. Until it is, use potential-free contacts between DIx and the input block's GND.

8.6 Factory state of new boards

A new board from Waveshare runs the factory demo firmware. That firmware sets all outputs on at start-up and lets the inputs drive the outputs directly. Flash Lutra firmware before connecting anything to the outputs. See Web flasher.

8.7 Related pages

- Wiring the box
- Builds
- Network

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

9 Builds

On this page: the two firmware builds, the build identity in every image, the three update channels that follow from it, and how to choose. The version number is the same for both builds (for example 0.4.1).

9.1 Read build

The default build. It reads, it never switches.

- Reads Modbus devices on RS485, local HTTP devices and the digital inputs; sends readings, events and state.
- At start-up all outputs are set off and to input (high impedance). After that the firmware never writes to the output expander again.
- Contains no code that can set an output. A check in CI fails the build if anything writes to the output registers outside the safe start-up routine, and a second check proves on the compiled binary that no switching code is present.
- The remote command `set_output` exists only by name: the read build always answers `not_supported`.
- Runs on both boards.

9.2 Switching build

A separate build for the 8DI-8DO board only. It does everything the read build does, plus:

- drives the DO outputs through interposing relays or contactors;
- output functions (pump speeds, filter pump, backwash, heating enable, refill, light, aux) assigned on site;
- interlocks, minimum on and off times, daily limits and break-before-make in the firmware;
- local schedules per output;
- remote on and off through the portal, within the rules above.

See Switching build for the full behaviour.

> **Status of the switching build**
>
> The switching build has been built and its logic is tested on the host, but the hardware-in-the-loop tests and a 7-day endurance test must pass before it is used at a real pool.

9.3 Build identity

Every image carries a build identity: build (`read` or `switching`) and board (`poe_8di8do` or `rs485_can`). It is part of the signed image.

- A box refuses an image of another build or another board, both for remote updates and over USB. The reasons it reports are `other build`, `other board`, or `no build id` (an image from before build identities existed).
- The box reports its build and board in its status line on the USB console (`..., build read, board poe_8di8do`) and in its device shadow (`reported.build`, `reported.board`).
- The switching build is also recognisable by the start-up line in the log (`Start: firmware x.y.z (switching build)`) and on the setup page.

9.4 Channels per board and build

Each combination of board and build has its own update channels:

Board	Build	Channels
`poe_8di8do`	`read`	beta, stable
`rs485_can`	`read`	beta, stable
`poe_8di8do`	`switching`	beta, stable

See Updates and channels.

9.5 Choosing

If	Choose
You only need readings and alerts	Read build
You use the RS485-CAN board	Read build (the only option)
Lutra should switch equipment and an electrician installs the relays and interlocks	Switching build
You are not sure	Read build; changing later is possible with a full reflash

Changing build is never done by an update. See Converting to another build.

9.6 Related pages

- Choose hardware and build
- Boards
- Electrical installation and safety

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

10 Web flasher

On this page: when to use the web flasher, what you need, the two modes (update and full flash), and what to do when it fails. The web flasher is part of Lutra Insight, menu **Flash a box**.

Partners and their technicians may flash boxes at a client's pool themselves with the web flasher.

Firmware is not published as public files. The flasher asks Lutra Insight for download links that are valid for five minutes, only for partners with an active subscription or in their trial month. In the demo account the flasher runs a simulated flash and ends with "In the demo no real firmware is flashed". See Subscription and pricing.

10.1 When you need it

Situation	Use
Box runs Lutra firmware and has internet	Not needed: updates arrive remotely. See Updates and channels.
Box runs Lutra firmware, no internet on site	Web flasher, mode **update**
New board (factory firmware), empty or broken box	Web flasher, mode **full flash**
Change from read build to switching build or back	Web flasher, mode **full flash**. See Converting to another build.

10.2 What you need

- A computer with Windows, macOS, Linux or ChromeOS.
- Chrome, Edge or Opera. Safari, Firefox and browsers on phones and tablets do not support Web Serial.
- A USB-C data cable.
- A Lutra Insight account of a partner with an active subscription or trial month.

10.3 Mode a: update a box that runs Lutra firmware

1. Connect the box to the computer with the USB-C cable.
2. Open **Flash a box** in the portal and click **Connect**. Choose the box in the browser's port list.
3. The flasher reads the running version, board and build from the box. It only offers firmware from the channel of exactly that board and build.
4. Choose the version and click **Update to**. You can also choose your own signed file (`.bin`); it must be signed by Lutra and be for the same board and build.
5. The box checks the signature and the version, writes the new firmware to its other firmware slot and restarts.
6. After the restart the box tests itself. If the test fails, it returns to the previous version by itself. The flasher reconnects and shows the running version.

The box accepts only a newer version that was not rolled back earlier on that box.

Opening the USB port restarts the box

Opening the serial port resets the board. After an update, the flasher waits about 45 seconds before it opens the port again, so the self-test is not interrupted. Do not unplug the cable during that time.

10.4 Mode b: full flash of an empty or broken box

A full flash erases everything

Settings, the log, buffered readings, and the box's identity with its key and certificate are erased. Afterwards the box must be registered again. Only use this for an empty or broken box, or to change build.

1. Connect the box and click **Connect**. If the box does not answer as Lutra Lite, the flasher offers the full flash.
2. Choose board and build. An empty box reports nothing; choose exactly the board you have. The switching build is marked clearly. See Builds.
3. The flasher downloads all files of that firmware and checks them (sha256).
4. **Read chip**: the flasher checks that the chip is an ESP32-S3, shows the MAC address and the flash size, and checks the security state. Compare the MAC address with the box's sticker or earlier registration.
5. Tick "I understand that everything on this box is erased" and click **Erase and write**.

6. The flasher erases the whole flash, writes bootloader, partition table, OTA data and application, verifies each with MD5 and restarts the box.

The flasher refuses to write if the chip is not an ESP32-S3, if secure boot or flash encryption is enabled, if the security state cannot be read, or if the flash is too small. The web flasher never touches eFuses.

To be confirmed

How a box is registered again after a full flash (by Lutra or by the partner) is not decided yet.

10.5 When it fails

Message or symptom	What to do
"The USB port is busy"	Close other programs using the box (serial monitor, esptool, another browser tab).
"Could not put the chip into flash mode"	Hold BOOT, plug in the cable, release BOOT, click **Connect** again.
"This browser cannot talk to USB devices"	Use Chrome, Edge or Opera on a computer.
"The box refused the update"	Read the reason. `other build` or `other board`: the file is for another channel. A lower or rolled-back version is refused.
"This file is not signed"	Only firmware signed by Lutra is accepted.
No firmware offered, subscription needed	Firmware downloads need an active subscription or trial month. See Subscription and pricing.
Download fails after a long wait	Download links expire after five minutes. Choose the version again; the flasher asks for new links.
Box not found after the restart	Keep the cable in; click **Connect** again to see the version.
Version unchanged after the restart	The new version was rolled back after a failed self-test. Check the box's log.
Flashing failed halfway	The box may be empty now, but the chip cannot break. Try again, holding BOOT while plugging in.

More in Troubleshooting.

10.6 Related pages

- USB and command line
- Updates and channels
- Setup page

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

11 USB and command line

On this page: the other ways to put firmware on a box. For most partners the web flasher is the right tool; this page covers updating through the setup page, the USB update tool, and full flashing with esptool for development boards.

11.1 Always a signed image

A box only accepts firmware signed by Lutra, of the same board and build, with a newer version than the one running. This holds for every route below. A full flash with esptool bypasses the running firmware, but the signed image matters there too: the firmware expects its own signature block at start-up, and an unsigned application ends up in a start-up loop. (It can start by accident when an old signature block of an image of exactly the same size is still in the flash; never rely on that.) Never flash an unsigned application.

11.2 Update through the setup page (no computer needed)

For a site without internet, with a phone or laptop:

1. Open the setup page (see Setup page).
2. In **Update firmware**, choose the update file (`.bin`) from Lutra.
3. The box checks the file (signature, version, board and build) and restarts. After the restart it runs its self-test and returns to the previous version if that fails.

To be confirmed

Where partners download signed update files for offline use is not published yet. Firmware is not available as public files; use the web flasher, which fetches the files itself with short-lived links (active subscription or trial month needed).

11.3 USB update tool (running firmware)

The USB update tool `lutra_usb_update.py` talks to the running firmware over the USB console, with the same protocol as the web flasher:

```
python3 lutra_usb_update.py <signed.bin> --port /dev/cu.usbmodem2101
```

The tool sends the image in chunks; the box confirms progress, checks version and signature at the end and restarts. Opening the USB port restarts the box, so the tool waits until the box has been up for a while.

To be confirmed

How partners obtain the USB update tool and signed images for it. Until that is published, use the web flasher.

11.4 Full flash with esptool (development)

Only for development boards. Partners use mode b of the web flasher instead, which does the same with the files of the right build. A full flash erases the box's identity. With esptool, write the four files of one build to these offsets:

File	Offset
Bootloader	`0x0`
Partition table	`0x8000`
OTA data (initial)	`0xf000`
Signed application	`0x20000`

```
esptool.py --chip esp32s3 -p <port> write_flash --flash_mode dio --flash_freq
80m --flash_size keep \
  0x0 bootloader.bin 0x8000 partition-table.bin 0xf000 ota_data_initial.bin
0x20000 lutra_lite.signed.bin
```

Use any serial monitor to watch the log. Never write an unsigned application.

To put the chip in download mode manually: hold BOOT while plugging in the USB cable (or while resetting).

11.5 How the firmware is made available

Lutra Lite firmware is closed source and free to use with Lutra. Lutra builds, tests and signs every image; partners do not build firmware themselves. What a partner needs:

- a supported board;
- a USB-C data cable and a browser with Web Serial, for the web flasher;
- a Lutra Insight account; the web flasher fetches the signed image for the board and build.

Updates after that arrive remotely through the update channels. See Updates and channels.

11.6 Related pages

- Web flasher
- Updates and channels
- Converting to another build

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

12 Converting to another build

On this page: why a build change is never an update, the procedure on site, and what to check afterwards.

12.1 Why only by a full reflash

A box refuses any update of another build or another board, remotely and over USB (`other build`, `other board`). There is no exception, also not with a forced or downgrade update. This guarantees that:

- a read box can never receive or install switching firmware by accident;
- a switching box never silently falls back to read firmware through an update;
- firmware for one board never lands on the other.

The only way to change build is a complete reflash over USB on site, with an explicit choice of board and build.

From	To	Possible
`poe_8di8do` read	`poe_8di8do` switching	Yes, full flash on site
`poe_8di8do` switching	`poe_8di8do` read	Yes, full flash on site
`rs485_can` read	switching	No: the RS485-CAN board has no outputs
Any board	Other board	No: different hardware

12.2 Procedure

1. **Before you start**: for read to switching, the electrical installation (interposing relays or contactors, hardware interlocks) must be done and checked by a licensed electrician. See Electrical installation and safety. Disconnect the DO wiring until the new firmware runs and the outputs are configured.
2. Note the box's current settings that you want to keep (bus devices, input roles, network).
3. Run a **full flash** with the web flasher and choose the target board and build explicitly.
4. Register the box again (the full flash erases its identity).
5. Configure it again on the setup page: bus devices, inputs, network. For the switching build also the output functions. See Switching build.
6. Check the build on the setup page or the USB console status line (`build switching, board poe_8di8do`).
7. Reconnect the DO wiring and test each output function with the electrician present.
8. In the portal, the Remote panel shows the box as switching build.

To be confirmed

How re-registration after a full flash is done (by Lutra or by the partner), and whether the pairing code stays the same, is not decided yet.

12.3 Boxes with firmware older than build identities

Firmware up to 0.2.x does not check the build identity and does not report its board. When updating such a box, choose the correct channel yourself (the web flasher asks explicitly). From the first version with build identity onwards the box checks it itself.

12.4 Related pages

- Builds
- Web flasher
- Commissioning checklist

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

13 Setup page

On this page: how to open the setup page, the order to set up a box, what each part of the page does, and when the temporary network closes. The setup page is in English and works in the browser of a phone or laptop.

13.1 Opening the setup page

The box opens its own temporary Wi-Fi network `Lutra-XXXXXX` (the last six characters of its MAC address). This network is **open** (no password) and exists only during the setup window.

How the window opens	When
Automatically	A box without network settings opens it at start-up. On the RS485-CAN board this is the normal route, because its BOOT button is inside the enclosure.
BOOT button, 3 seconds	Hold BOOT for 3 to 10 seconds and release. The LED turns blue at 3 seconds (8DI-8DO). See LED and BOOT button.

1. Connect your phone to `Lutra-XXXXXX`.
2. The setup page usually opens by itself. If it does not, open `http://192.168.4.1` in the browser.
3. On a phone, the captive portal window closes when you switch apps. The page points you to `http://192.168.4.1` in the normal browser; use that for longer work.

Every unknown address is redirected to the setup page, and the box's own name server points every name to `192.168.4.1`.

13.2 When the window closes

- after 10 minutes without activity;
- after 2 hours at most, even with activity;
- immediately after a successful connection to the network you chose.

After that the temporary network is switched off. The setup page is never reachable on the client's network: the box has no open ports there.

13.3 Order of setup

Devices first, network last. Saving the network ends the setup window, so do everything else first.

1. **Devices**: add the bus devices and check that each one answers. See Bus devices and inputs.
2. **Inputs**: assign a role to each digital input that is connected (8DI-8DO). See Bus devices and inputs.
3. **Outputs** (switching build only): assign output functions. See Switching build.
4. **Network**: choose Wi-Fi or network cable and press **Save & Connect**. See Network.
5. Watch the LED. The page shows the LED legend while the box connects.

13.4 Parts of the page

Part	What you see and do
Status	Network and connection state with the reason if not connected (password refused, network not found, no address, connection lost), firmware version, build, MAC address, cloud connection, time and time zone, buffered and dropped messages, last restarts
Devices	Modbus devices (mode, list with live readings and status, add by make and model, **Check**, scan) and network devices
Inputs	“What is connected”: role per digital input, NO or NC, current state
Bluetooth	Bound Bluetooth sensors with status and **Remove**, and “Heard nearby” with **Add** (firmware 0.5.0 and later). See Bluetooth sensors
Outputs	Read build: a notice that all outputs are off and cannot be switched. Switching build: output configuration
Device	**Changes from the cloud** (allow remote changes), time zone (read only), **Update firmware** from a signed file
Network	**Change network**: Wi-Fi list from a scan, hidden network, password, or network cable
Logs	The last 32 events since start-up, newest first, in English. Lines from before the last restart are marked. Passwords are never logged.
Trend	A chosen value since you opened the page, one point every 5 seconds, for up to an hour. The box does not store this history.

13.4.1 Changes from the cloud

When **Changes from the cloud** is on, the Lutra cloud may change a few settings and send signed write commands, always within fixed limits. Switching it **on** is only

possible on this page or on the USB console, so only someone at the box can allow it. Switching it **off** is also possible remotely. Every change is logged. See Remote commands and settings.

13.5 Security limits

Open temporary network

The temporary network has no password. Anyone within Wi-Fi range during the setup window could read the Wi-Fi password that is entered on the page. This risk is accepted by design because the window can only be opened with physical access to the box and closes by itself. Keep the window short and close it by finishing the setup.

- The pairing code is never entered on the box. It is entered in the portal. See Clients, pools and boxes.
- The setup page uses no external resources; it is built into the firmware.

13.6 Related pages

- Network
- Bus devices and inputs
- Commissioning checklist

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.5.0.

14 Network

On this page: cable and Wi-Fi, what happens when a connection fails, which connections the box makes, how it keeps time, and how it buffers readings when offline.

14.1 Cable or Wi-Fi

A network cable is preferred. With PoE (802.3af) one cable carries data and power.

	8DI-8DO board	RS485-CAN board
Network cable (Ethernet, DHCP)	yes	no
Wi-Fi	yes	yes
4G/5G	via an external router	via an external router

On the 8DI-8DO board Ethernet is always on. When the cable has an address, the cable is used; when the cable is unplugged, Wi-Fi takes over (if Wi-Fi is configured). The setup page shows “Cable detected” or “no network cable”.

14.2 Setting the network

On the setup page, as the last step:

1. Choose **Wi-Fi** (from a scan list, or **Join hidden network**) and enter the password, or choose **Network cable** (8DI-8DO only, selectable only when the Ethernet link is up).
2. Press **Save & Connect**. The box saves the settings and the page shows the LED legend.
3. After a few seconds the temporary network switches off and the box connects, without a restart.
4. If it cannot connect within 60 seconds, the temporary network opens again for 10 minutes and the page shows the reason: password refused, network not found, or no internet.

The network can always be changed on site with 3 seconds on BOOT, without the pairing code. It can never be changed remotely.

Wi-Fi rules: SSID up to 32 bytes; password empty (open network) or 8 to 63 printable ASCII characters. Passwords are case sensitive and never appear in a log.

14.3 Connections the box makes

The box only makes outgoing connections. It needs:

Purpose	Destination	Protocol
Cloud (readings, events, settings, commands)	`iot.lutrapool.com`	MQTT over TLS with client certificate, port 8883
Firmware updates	`fw.lutrapool.com`	HTTPS
Time	`pool.ntp.org`, `time.cloudflare.com`	SNTP (UDP 123)
Name resolution and address	the local network	DNS, DHCP

To be confirmed

A complete firewall list (ports and host names for strict networks) has not been published as a reference yet. Firmware older than 0.2.10 connects to the AWS IoT endpoint directly instead of `iot.lutrapool.com`.

14.4 Time

The box keeps time in UTC. At start-up it reads the battery-backed real-time clock, then corrects it through SNTP (and sets the RTC again every 6 hours or when it drifts more than 2 seconds). Local time, used for the night window of updates and for schedules in the switching build, comes from the time zone setting `tz`, which the cloud sets from the pool's location. Default `UTC0` on a new box. See Remote commands and settings.

14.5 Offline buffer

Measuring and buffering never wait for the network.

- Every message is first written to a flash buffer of about 9.7 MB and marked as sent only after the cloud acknowledges it. The buffer survives restarts and power loss.
- After the connection returns, messages are sent one at a time, in order.
- When the buffer is full, the oldest messages are dropped and counted (`cloud_dropped` on the status page).
- How long the buffer lasts depends on the message size: about 60 days for a box without bus devices, about 8 days with one device of around twenty values (at one message per minute).

To be confirmed

The buffer durations above were calculated for one message per minute. Since 21 November 2026 the default interval is 300 seconds, which lengthens them; updated figures have not been published.

14.6 Related pages

- Setup page
- LED and BOOT button
- Troubleshooting

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

15 Bus devices and inputs

On this page: how a box learns which equipment to read, the rules for one RS485 bus, the bus scan, listen-only mode, network (HTTP) devices, and the roles of the digital inputs including the flow switch.

15.1 How a box knows a device

Every supported device has a **profile**: a description of how to read it (registers, scaling, units, bus parameters). All profiles are built into the firmware, so a box can add or replace a device on site without internet. The installer chooses **make and model**; nobody types register addresses. See Supported devices.

A box holds up to **8 devices**. Each gets a fixed id (`d1` to `d8`) that is used in its telemetry.

15.2 Adding a Modbus device

On the setup page, **Devices**:

1. Choose **Make** and **Model**. The page shows the profile's hint: default address, baud rate, parity, stop bits and A/B wiring, and fills in the default address.
2. Correct the address if the device uses another one.
3. Press **Check**. The box reads that one device once with the bus parameters from its profile and shows the values.
4. Press **Add to list**, then **Save**.

Check is limited to one device at a time and at most every 3 seconds; it is not available in listen-only mode or during a scan.

15.2.1 One bus, one set of parameters

All devices on one RS485 bus must use the same baud rate, parity and stop bits. A device on 8N1 and a device on 8E1 cannot share a bus. Where a device's parameters are adjustable, set it to match the others:

Device	Bus parameters	Adjustable
AstralPool Control Basic Plus	9600 8E1 from factory	yes, menu "rs485 settings": set to No parity (8N1)
Eletechsup R4DCB08	9600 8N1	yes, baud 1200 to 19200
Elecro PLUS	19200 odd parity from factory	yes, 9600/19200, parity odd/even/none
Speck BADU	19200 8N1	yes, 9600 to 115200
NeoPool platform (AquaRite+, Sugar Valley)	19200 8N1	not documented: assume fixed
Elite Connect, Aquagem, PHNIX, Fairland, Autodos	9600 8N1	not documented

A NeoPool device together with a fixed 9600 device is a real conflict on one bus. A second RS485 port is being prepared but is not available in the firmware yet.

To be confirmed

Support for a second RS485 bus (through an isolated TTL-to-RS485 module on the pin header, or a Modbus TCP gateway) is designed but not built.

15.2.2 Bus scan

The scan helps to find unknown addresses; it is not the main route. It only reads (one register per address), tries 9600, 19200 and 4800 baud, and suggests a make and model when address and baud rate match a profile. On site a scan can be repeated every 2 minutes; remotely at most once per hour. Not available in listen-only mode.

15.2.3 Listen-only mode

If the bus already has a master (a PLC, a control panel, a heat pump's main board talking to its display), Lutra must never transmit on it: two masters on one bus collide. In **Listen only** mode the box only listens and decodes the traffic it sees between the master and the devices.

To be confirmed

The decoding logic for listen-only mode is built and tested on the host, but the connection to the serial port is not finished. Until it is, do not rely on listen-only readings.

15.3 Network (HTTP) devices

Some devices offer a local HTTP/JSON interface. The box can read them as a client on the client's network (only GET requests). The installer enters the IP address, the port, the security mode and, if the profile needs it, a user name and password.

Security mode	Meaning
Encrypted, trusted certificate	Normal HTTPS
Encrypted, remember this device	Self-signed certificate; the box remembers its fingerprint after a successful check and sends no password before that
Not encrypted	For devices without HTTPS

Basic authentication over unencrypted HTTP is refused by default. The installer can explicitly allow it per device ("Lower security"); the portal then shows a warning. Passwords are stored only on the box, never in the device list, the cloud, telemetry or logs. Create a separate read-only account on the device where possible.

To be confirmed

No HTTP device profile is released yet, so the network part of the device wizard does not appear in practice. Host names ending in `.local` are not supported yet.

15.4 Digital inputs

8DI-8DO board only. Each input can get one role from a fixed list, NO or NC, with 1 second debounce. A role can be used on one input only.

Role	Meaning when active
`pump_running`	Filter pump runs (auxiliary contact)
`heater_on`	Heating on
`backwash`	Backwash in progress
`fill_valve`	Refill valve open
`light`	Light on
`cover_state`	Cover closed or open
`plantroom_door`	Plant room door closed (inactive = open)
`level_low`, `level_fill`, `level_high`	Level floats
`leak`	Leak detected

Set roles on the setup page (**Inputs**, “What is connected”) or on the USB console, for example `di set 2=cover_state,5=plantroom_door,7=level_low:nc`. A change of state is logged (“Input DI2 cover_state: closed”) and sent with the telemetry. A factory reset clears the roles.

Prefer NC (normally closed) contacts for safety-related signals such as `level_low` and flow, so a broken wire reads as an alarm.

15.4.1 Flow switch

Readings that need flow through the measuring cell (pH, ORP and similar) are marked invalid when there is no flow; they are kept, not discarded.

Flow switch on a DI	Device reports flow itself	Status of flow-dependent readings
configured	(ignored)	`ok` with flow, otherwise `no_flow`
not configured	yes, flow	`ok`
not configured	yes, no flow	`no_flow`
not configured	nothing	`unknown`

After flow returns, the DI flow switch has a 60 second run-in before readings count again.

To be confirmed

The flow switch input is currently a build option (`CONFIG_LUTRA_FLOW_DI`, off by default; DI1 in the installation guide). How it is selected per box in the field is not settled yet.

15.5 Related pages

- Supported devices
- Wiring the box
- Quantities

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

16 Bluetooth sensors

On this page: what Bluetooth does in Lutra Lite, which sensor values map to which Lutra quantities, how to bind a sensor on site, the status of a sensor, what is not supported, and how the box protects itself when memory is short. Available from firmware **0.5.0**, in the read build and in the switching build.

To be confirmed

Bluetooth has run on a development board (stack started, telemetry and a firmware update with Bluetooth active). It has **not yet been tested with a real sensor**. Everything about receiving, binding and reporting sensor values on this page is built and tested in software, but not yet confirmed with real hardware.

16.1 What it does

The box listens for wireless sensors that broadcast their readings in the open BTHome v2 format. For example a floating pool thermometer or a temperature and humidity sensor in the plant room.

- **Passive only.** The box only listens to advertisements. It never connects to a sensor, never advertises itself, never pairs, and does not even send scan requests.
- **Read only.** Bluetooth never switches anything, also not in the switching build.
- **Not for phones.** Bluetooth is not used to set up the box or to talk to a phone; setup stays on the setup page over the box's temporary Wi-Fi network.
- **Unencrypted BTHome v2 only.** Other Bluetooth protocols (for example those of some chlorinators and heat pumps) are not read. See What is not supported.

A sensor is **bound** by its MAC address to one Lutra quantity and gets a short id `b1` to `b8`. In the cloud its source is `ble/<id>`, for example `ble/b1` (compare `d1` for a device on the bus). A sensor that measures two things, such as temperature and humidity, is bound twice, once per quantity.

Limit	Value
Bound sensors (bindings)	at most 8
"Heard nearby" list	the last 16 BTHome devices the box heard

16.2 Quantities and BTHome objects

A BTHome message contains objects, each with an id. The box maps these objects to Lutra quantities:

Quantity	Unit	BTHome objects (id, factor)
`water_temp`, `outdoor_temp`, `air_temp`, `heatpump_water_in`, `heatpump_water_out`	°C	temperature `0x02` (0.01), `0x45` (0.1), `0x57` (1), `0x58` (0.35)
`air_humidity`	%	humidity `0x03` (0.01), `0x2E` (1)
`pump_power`, `heatpump_power`	W	power `0x0B` (0.01), `0x5C` (0.01, signed)
`pump_energy`, `heat_energy`	kWh	energy `0x0A` (0.001), `0x4D` (0.001)
`flow_rate`	m3/h	volume flow rate `0x49` (0.001)
`leak`	bool	moisture (binary) `0x20`: 1 = wet = `true`
`plantroom_door`	`open` / `closed`	door `0x1A`, opening `0x11`, window `0x2D` (binary): 1 = `open`

Rules:

- Per binding the **first** object of the matching kind in a message counts. Objects are ordered by id, so `0x02` wins over `0x45`.
- Battery (`0x01`) and signal strength are sent along as diagnostics (`bat`, `rssi`), not as a quantity.
- The box decodes all objects of the BTHome object table (for example pressure, voltage, CO2, illuminance), but only the objects above can be bound. Everything else still shows in “Heard nearby” and on the USB console.
- Events (button, dimmer), text and raw objects and device information objects are skipped.
- A message with a BTHome version other than 2 is ignored. An unknown object id ends reading of that message (values before it still count). A message with an object that runs past its end is dropped entirely.

16.3 Binding a sensor

Sensors are bound **on site only**, like the device list. Prepare the sensor first: set it to BTHome v2, **unencrypted**, with a fixed MAC address.

16.3.1 On the setup page

1. Open the setup page and choose the **Bluetooth** tab.
2. Under **Heard nearby** every BTHome device within reach appears with its address, signal and last values. The list refreshes every few seconds while the page is open.

3. For the sensor you want, choose what it measures and press **Add**. It appears under **Bluetooth sensors** with its id and status.
4. To bind a second value of the same sensor (for example humidity), add it again with the other quantity.
5. To unbind, press **Remove** next to the sensor.

The page uses `GET /api/ble`, `POST /api/ble/add` (`mac=<12 hex>&q=<quantity>`) and `POST /api/ble/remove` (`id=b1`) on the box's temporary network.

16.3.2 On the USB console

Command	What it does
`ble`	Bluetooth state, bound sensors with status, and what is heard nearby
`ble add mac=A4:C1:38:0A:0B:0C&q=water_temp`	Bind the sensor with this MAC address to a quantity
`ble rm b1`	Remove binding `b1`

16.3.3 Not from the cloud

Bindings cannot be changed remotely. The settings `ble` and `ble_sensors` in the shadow are refused with "only on site", like `devices` and `busplan`. The box does report its bound sensors in `reported.devices`, as `{"id":"b1","type":"bthome","via":"ble","ok":true}`.

Bindings are stored in the box's settings and survive restarts and updates. A factory reset removes them. If the stored list is damaged or unknown, the box starts with no sensors rather than guessing.

16.4 Status per sensor

Status	Meaning
`ok`	A value of the bound kind was received within the stale time (default 10 minutes)
`stale`	There was a value, but nothing new for longer than the stale time. The old value is no longer sent.
`invalid`	The sensor is heard, but does not send this kind of value (wrong quantity chosen, or the sensor is encrypted)
`no_answer`	Nothing heard from this address since the box started

In the cloud, `stale` is shown as `no_answer`.

16.5 Telemetry

Only when at least one sensor is bound, telemetry gets an extra member `ble`; otherwise the message is the same as in 0.4.x:

```
"ble":[{"id":"b1","q":"water_temp","s":"ok","v":27.53,"bat":88,"rssi":-71},
       {"id":"b2","q":"leak","s":"stale"}]
```

`v` is present only with `"s":"ok"`. A change of status (for example `ok` to `stale`) or of a state (leak, door) sends a message straight away, at most once every 30 seconds. A slowly changing temperature waits for the normal interval, as with bus devices. See Device messages (MQTT).

16.6 What is not supported

Not supported	What to do
Encrypted BTHome messages	Not decrypted in this version. The sensor shows in “Heard nearby” marked “encrypted”; a bound encrypted sensor has status `invalid`. Switch encryption off in the sensor.
Sensors with a changing (privacy) address	Binding is by fixed MAC address. Use a sensor with a fixed address.
Other Bluetooth protocols (chlorinators, heat pumps, apps)	Not read; these protocols are undocumented.
Connecting, pairing, phones	Never; the box only listens.
Setting up sensors remotely	On site only.

16.7 Compatible sensors

Any sensor that sends unencrypted BTHome v2 advertisements from a fixed address should work.

> **To be confirmed**
>
> No sensor has been tested with Lutra yet. Planned first tests are a Xiaomi LYWSD03MMC with pvvx firmware in BTHome mode, and a Shelly BLU H&T. Until those tests are done, no sensor is listed as verified.

16.8 Radio, memory and safety

Bluetooth is designed so that it can never make the box unreachable or stop it from updating.

- **Wi-Fi first.** The box scans passively for 50 ms in every 200 ms (25 %), so Wi-Fi has the radio most of the time. A sensor that advertises every 10 seconds is heard on average about every 40 seconds.

- **Scans only when needed**: when sensors are bound or the setup page is open. Without sensors the radio stays with Wi-Fi.
- **Starts only when needed** (from 0.5.2). Without bound sensors Bluetooth does not start at all (status `standby`), so the box keeps about 31 KB of internal RAM free. It starts as soon as the setup page opens or the first sensor is bound, and then stays on until the next restart.
- **Starts last**, after the bus, the cloud connection and the update path.
- **Not in safe mode.** A box that keeps crashing in Bluetooth ends up in safe mode after 5 restarts, without Bluetooth, and stays reachable.
- **Stops itself when memory is short.** If less than 64 KB of internal RAM is free after Bluetooth starts, Bluetooth is stopped again, because a firmware update must always fit.
- **The box keeps running.** If Bluetooth cannot start, the log gets one line `Bluetooth: not started (<reason>)`, the LED shows no error, and the box works on without Bluetooth. Reasons: `safe mode`, `no memory`, `controller error`, `low memory`. The setup page shows the same reason on the Bluetooth tab.
- On success the log shows `Bluetooth: started (internal RAM <n> KB used, <m> KB free)`. The same figure is shown by `status` and `ble` on the USB console.

16.9 Related pages

- Setup page
- Bus devices and inputs
- Supported devices
- Quantities
- Device messages (MQTT)

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.5.0.

17 LED and BOOT button

On this page: the LED language of the 8DI-8DO board, the BOOT button actions, what a factory reset clears, and safe mode after a start-up loop.

17.1 LED language (8DI-8DO board)

Each state has its own rhythm, so it can be recognised without relying on colour. When several states apply, the one higher in the table wins.

State	LED
Factory reset in progress	red, steady
BOOT held: 3 s reached / 10 s reached	blue / red, steady
Setup window open after a failed attempt	red, fast blink (200 ms on, 200 ms off)
Setup window open	blue, slow blink (1 s on, 1 s off)
Connecting to the client's network	yellow, double blink (2 x 200 ms, period 1.6 s)
Nothing set up yet (no network choice saved)	green, short flash (200 ms) every 2 s
Network or cloud gone, or the pool equipment does not answer	orange, slow blink
Online, pairing code not yet entered in the portal	green, breathing (period 3 s)
Online and activated	green, steady: bright for 1 minute, then dimmed

The normal state is **dimmed green, steady**. The LED is never fully off in normal operation, so a dark box means no power. A short press on BOOT makes the LED bright for 10 seconds.

To be confirmed

A dedicated LED pattern during a firmware update (proposed: purple, slow blink) is part of the design but not confirmed as built.

The RS485-CAN board has no LED the firmware can drive. There, the temporary network `Lutra-XXXXXX` appearing on your phone is the feedback that the setup window is open.

17.2 BOOT button

The action happens when you **release** the button.

Hold for	Action
Less than 3 s	Status line in the log; LED bright for 10 s
3 to 10 s	Open the setup window (LED turns blue at 3 s)
10 to 30 s	Factory reset of network and settings, then restart (LED turns red at 10 s)
30 s or more	No action (treated as a stuck button)

A button that is already pressed at start-up only counts after it has been released once, so a stuck button never causes a reset loop. Holding BOOT while the board resets or powers up starts the chip's download mode (used for a full flash); that is not firmware behaviour.

17.3 What a factory reset clears

Cleared	Kept
Network settings (Wi-Fi, cable choice)	Identity: device key, certificate, pairing code
Box settings (interval, changes from the cloud, time zone)	Firmware version
Bus devices and device list, stored device passwords	
Digital input roles	
Switching build: output configuration and schedules (not the counters for daily limits)	

After a factory reset the box starts as "nothing set up yet" and opens its setup window.

17.4 Safe mode

If the box restarts abnormally (crash, watchdog) 5 times in a row without running stably for 10 minutes in between, it starts in **safe mode**: network, log, setup page and updates work, but the bus is not started and, in the switching build, all outputs stay off. This keeps a repair update possible. Power-on, USB connection, a deliberate restart and a power dip do not count and break the series.

17.5 Related pages

- Setup page
- Troubleshooting
- Network

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

18 Updates and channels

On this page: release channels, what a box checks before it installs an update, the self-test and automatic rollback, how a remote update is started today, and the planned fleet roll-out.

18.1 Channels

Every combination of board and build has two channels:

Channel	Meaning
beta	Every tagged release lands here first, after the full test suite and a manual approval
stable	A beta version that has been promoted deliberately, per board and build

So there are six channels: `poe_8di8do/read`, `rs485_can/read` and `poe_8di8do/switching`, each with beta and stable. A switching build can be promoted to stable independently of the read build. See Builds.

Rules per channel:

- A version lower than the one in the channel is refused (except with an explicit rollback option at promotion).
- The same version with different files is always refused: a fix needs a new patch version.
- A mistake in beta is fixed with a new patch version, not by rolling back: a box that already has the newer version refuses an older one anyway.

To be confirmed

Which channel the web flasher offers by default (beta or stable) per board and build, and when the first stable versions are promoted.

18.2 Release path

1. The version is raised in the source and merged to the main branch.
2. A release tag `lite-vX.Y.Z` on that commit starts the release workflow.
3. The workflow checks that tag and version match, runs all tests and builds all three builds.
4. After approval, each build is signed in AWS KMS (the private key never leaves KMS), its manifest is published in its beta channel, and the signed image is stored for remote updates.
5. Promotion to stable is a separate, approved step per board and build. It verifies files, build identity and signature, and cannot sign anything itself.

18.3 What a box checks

Before an update is activated, the box checks:

Check	Rule
Signature	Signed with the same Lutra key as the running firmware
Version	Strictly `MAJOR.MINOR.PATCH`, newer than the running version; older only with an explicit downgrade in a signed command; versions that were rolled back on this box are refused forever
Build and board	Same build and board as the running firmware, checked before anything is written and again before activation
Source	For remote updates, only the Lutra firmware download host
Night window	Remote updates install between 02:00 and 05:00 local time, and only with a valid clock

18.4 Self-test and rollback

1. The box writes the new firmware to the other of its two firmware slots (A/B).
2. In the switching build all outputs are switched off before the restart (event `stopped_for_update`).
3. After the restart the new version runs on probation. Its self-test requires what worked just before the update (network, cloud) and at least 20 seconds of stable running.
4. Passed: the version becomes permanent (event `ota_ok`).
5. Failed, or a restart during the self-test: the bootloader returns to the previous version (event `ota_rollback`), and the box puts the failed version on its block list.

Because the self-test only requires what worked before, an update on site at a pool without internet does not roll back for lack of a cloud connection.

18.5 Starting a remote update today

A remote update is always a command from outside; a box does not poll a channel by itself. Today an update is sent as the signed command `ota_check` with a temporary download link. In the portal, administrators and technicians can send “check for update” from the Remote panel.

Remote updates do not depend on remote monitoring or on the subscription: a box without remote monitoring (**Local only**) stays connected for updates.

18.6 Planned fleet roll-out

To be confirmed

The design foresees automatic updates per channel in waves (own development board, then 5 %, 25 %, 100 %), with an automatic stop when more than 2 % fail, an option for the partner to postpone updates per pool (at most one season), emergency fixes by Lutra with a reason in the audit log, and short release notes for the owner. This roll-out service does not exist yet.

18.7 Related pages

- Web flasher
- Remote commands and settings
- Troubleshooting

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

19 Switching build

On this page: what the switching build may switch, the rules that always apply, how requests are prioritised, the interlocks per function, behaviour on failures, the hardware it requires, and how outputs are configured.

Not yet released for real pools

The switching build is built and its logic is tested on the host. The hardware-in-the-loop tests and a 7-day endurance test without unrequested switching must pass before it is used at a real pool.

Mains work only by a licensed electrician

Any work on mains voltage (230/400 V), on the supply of pumps, heaters, heat pumps and lighting, on contactors and interposing relays switching those loads, and on earthing and equipotential bonding of the pool installation must be done by a licensed electrician under local regulations (for example NEN 1010 in the Netherlands, IEC 60364 generally). See Electrical installation and safety.

19.1 What must never happen

1. An output turns on without a request, not even briefly at start-up.
2. A request from the cloud does something that was not set up or allowed on site.
3. An interlock is relaxed remotely. Limits in the firmware are the maximum; settings can only make them stricter.
4. Two outputs of one exclusion group (pump speeds) are on at the same time, not even during a change.
5. A failure (I2C, settings, clock, network, crash) leaves an output on that would otherwise be off.

When in doubt: **off**. Off is the safe state for every function in this build. Functions for which off is not safe (moving a pool cover, dosing) are deliberately not included.

19.2 Functions

Each DO is **unassigned, and therefore always off**, until it gets a function on site. Functions and channels can never be changed through the cloud.

Function	Class	Channels	Notes
`pump_speed`	B	1 to 3, one group	Speeds 1, 2, 3 of a variable-speed pump with digital inputs; the group is mutually exclusive
`pump_run`	B	1	Pump without speeds (on/off through a contactor)
`backwash`	B	1	Backwash valve
`heat_enable`	B	1	Enable signal for heat pump or heater
`fill`	B	1	Refill valve
`light`	A	1	
`aux`	A	1	Free name, class A rules only

Inputs get a function on site too: `level_low`, `level_fill`, `level_high` (level floats), `flow`, `pump_feedback` (auxiliary contact of pump or contactor), `button` (local control per output) and `cover` (read only). Prefer NC contacts for `level_low` and `flow`, so a broken wire reads as an alarm.

19.3 Request priorities

A request is (output or function, state, source, expiry). Highest priority first:

Priority	Source	May	Expires
1	Interlock	Only off (forces off)	When the condition is gone, after its recovery time
2	Local (button on a DI, setup on site)	On and off	Button: next press or the maximum on-time
3	Schedule on the box	On and off	End of the time slot
4	Cloud (`set_output`)	On only with "changes from the cloud" enabled; **off always**	`for_s`, default and at most the function's maximum on-time

- Interlocks always win.
- Network lost: local and schedule continue; cloud requests expire on time and are not extended.
- After a restart (power, crash, update) no request returns except the schedule. Light stays off; backwash and refill are not resumed.
- Schedules only run with a valid clock. They follow wall-clock time in the box's time zone: a slot in the hour that does not exist at the spring clock change does not run that night; a slot in the hour that occurs twice in autumn runs twice.

19.4 Interlocks per function

Values are **default / hard limit in the firmware**. Settings may choose between the two, never beyond the hard limit.

19.4.1 Pump (`pump_speed`, `pump_run`)

- Off when `level_low` is active (after 5 s debounce); free again only after `level_low` has been inactive for 60 s.
- Minimum on-time 120 s / 30 s; minimum off-time 60 s / 30 s.
- At most 6 starts per hour / 12 per hour; beyond that the pump stays off until the hour is over.
- Speed change: break-before-make, old speed off, wait 500 ms / 200 ms, new speed on.
- With `pump_feedback` configured: no feedback 10 s after on, or feedback without an on command for longer than 10 s, gives alarm `pump_feedback`, pump off, and a retry only after confirmation.

19.4.2 Backwash

- Only with the pump on and running stably for at least 30 s.

- Sequence: valve on at the current pump speed, wait for the valve (5 s / 2 s), pump to the highest speed, run for the maximum duration (180 s / 600 s), pump back to its previous speed, wait again, valve off.
- At most 1 per 24 hours / 2 per 24 hours, at least 12 hours apart.
- Never with `level_low` active; if it becomes active during backwash, everything stops immediately with an alarm.
- During backwash `heat_enable` and `fill` are off, and the pump cannot be switched off or change speed by a request (only by an interlock).

19.4.3 Heating enable (`heat_enable`)

- Only with confirmed flow (2 s debounce, 60 s run-in); flow lost means off immediately.
- Only with the pump on (if a pump function is configured).
- Minimum on-time and off-time 300 s / 120 s.
- **Hardware required**: the flow contact in series with the coil of the enable relay. Without confirming this during setup, `heat_enable` cannot be assigned.

19.4.4 Refill (`fill`)

- On only after `level_fill` has been active for more than 60 s; off when `level_fill` is inactive or `level_high` is active.
- At most 30 min per fill / 120 min; at most 120 min per 24 hours / 240 min.
- Alarm `fill_no_rise` if the level does not change after 20 minutes: off, and no new fill until confirmed.
- `fill` can never be switched on from the cloud.

19.4.5 Light and aux (class A)

- Maximum on-time 6 hours / 12 hours per request.

19.4.6 Inconsistent inputs

- `level_high` and `level_low` active at the same time, or `level_low` active while `level_fill` is not: treated as `level_low` (pump and refill off) plus alarm `level_inconsistent`.
- An input changing more than 10 times per minute is treated as active (safe side) plus alarm `input_flapping`.

19.5 Failures

Failure	Result
I2C write or read fails (3 attempts), read-back does not match, expander missing	All outputs off and blocked until restart, alarm `io_fault`
Settings invalid	All outputs unassigned (off), alarm `config_invalid`
Clock invalid	Schedules do nothing; interlock timers keep running on the internal monotonic clock
Network lost	No effect on local control and schedules; cloud requests expire
Watchdog or crash	Restart; all outputs off at start-up
Start-up loop (safe mode)	Outputs are not started; all stay off
Firmware update	All outputs off before the restart; after the update 10 s of stable running before outputs are free
Power loss	The expander starts with all outputs off; nothing resumes except the schedule

Alarms are sent to the cloud immediately (through the buffer, so also kept offline) and written to the log in flash.

19.6 Required hardware

- DO outputs drive only relay or contactor coils (at most 500 mA). Never a load directly. See Electrical installation and safety.
- Required hardware interlocks:
  - `heat_enable`: flow contact in series with the coil.
  - `pump_*`: dry-run contact (`level_low`) in series with the pump start, if the pump allows it.
  - `fill`: preferably a float valve or `level_high` in series with the valve.
- Recommended: `pump_feedback` from an auxiliary contact, so the firmware sees whether the pump really runs.

To be confirmed

Wiring diagrams for these interlocks are planned but not published. They must be reviewed by a qualified electrician.

19.7 Configuring outputs

Output functions, input functions, pool type and numbers are set on site as one **installation profile**, validated as a whole against the hard limits (all or nothing).

To be confirmed

The setup page does not have the output wizard yet. Until it does, the installation profile is posted as JSON from a laptop on the box's temporary network. Preloading an installation profile from the web flasher and a short local test per output are designed but not built.

19.8 Remote control

- `set_output` from the portal: off is always allowed; on only with "changes from the cloud" enabled on site, and for class B functions only with an explicit confirmation by the user. See Remote commands and settings.
- The box reports each assigned output with its state, source of the last change and the reason when it does not do what was requested (for example `interlock:level_low`).

19.9 Related pages

- Builds
- Converting to another build
- Remote panel

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

20 Supported devices

On this page: the device profiles in the firmware and their status, the ways Lutra can reach equipment, and how a new device gets added.

20.1 Profile status

Status	Meaning
verified	Works in practice
draft	Register map known from documentation or research, not yet tested on hardware
pending	Waiting for information; cannot be read yet

Draft profiles

Whether a draft profile may be used at a client's pool, or only on test boxes, is not decided. Ask Lutra before relying on a draft profile.

20.2 Profiles

Make	Model	Connection	Status
AstralPool (Fluidra)	Elite Connect salt chlorinator	Modbus RTU	verified
Aquagem (Hyper Pool Group)	InverCaptain inverter pump	Modbus RTU	verified
AstralPool (Fluidra)	Control Basic Plus pH or Rx (dosing pump with control)	Modbus RTU	draft
Sugar Valley (Hayward)	NeoPool platform: Hidrolife, Oxilife, Aquascenic, Bionet and others; OEM Hayward AquaRite+ (SV), AquaRite HC LS, Bayrol, Brilix, Kripsol and others	Modbus RTU	draft
Pahlén	Autodos M1/M2/M3 measuring and dosing controller with Modbus board	Modbus RTU	draft
Fairland (OEM)	Inverter heat pump with board MWH216/MWH298 (IPS Pro, IPS 170, InverX, IPHCR)	Modbus RTU	draft
PHNIX (OEM)	Heat pump controller PC1004, port CN13 (for example Gullberg & Jansson MELIUS 90)	Modbus RTU	draft
PHNIX (OEM)	Heat pump controller PC1002, display bus (for example Gullberg & Jansson S series)	Modbus RTU, listen only	draft
[illegible] (Fluidra)	[illegible]	Modbus RTU	draft (drafting in design)

The list is generated from the profiles in `packages/devices/profiles` of the Lutra repository; the firmware contains all profiles of the moment it was built.

20.3 Ways Lutra reaches equipment

Class	Example	Status
Modbus RTU, Lutra is master	Most profiles above	Built
Modbus RTU, listen only next to an existing master	PLC, PHNIX PC1002	Decoding built; serial connection not finished
Fixed binary frames	Aseko v7	Decoder built; transport not built
Own RS485 protocols (not Modbus)	Pentair, Jandy/AquaLink, Hayward pump bus	Later, per protocol
Modbus TCP, Lutra is client	Devices with Ethernet Modbus	Later
Local HTTP/JSON, Lutra is client	Heat pumps and controllers with a local API	Built, not tested on hardware
Contacts on DI	Pump running, flow, alarms, levels	Built
Contacts driven by DO	Pump speeds, valves, enable signals	Switching build only
Manufacturer clouds	Fluidra Pool, iAquaLink and others	Not on the box: cloud connectors in the backend, in design
Bluetooth (BLE), BTHome v2 sensors, passive	Pool thermometers, temperature and humidity, leak and door sensors	Built in 0.5.0, not yet tested with a real sensor. See Bluetooth sensors
Bluetooth (BLE), manufacturer protocols	Some chlorinators and heat pumps	Not supported (protocols undocumented)

20.4 Adding a new device

A device is added as a profile (data, not code) with automated tests. Installers cannot add profiles on site. If equipment is missing, ask Lutra. For equipment that can send its own readings, the external devices API is an alternative that works today.

To be confirmed

Delivering a single new or corrected profile to a box without a firmware update (a signed profile supplement) is decided in principle but not built.

20.5 Related pages

- Bus devices and inputs
- Bluetooth sensors
- Quantities
- Choose hardware and build

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.5.0.

21 Troubleshooting

On this page: symptoms and what to check, grouped by area, plus the diagnosis tools you can use on site and remotely.

21.1 First look

1. Look at the LED (8DI-8DO). See LED and BOOT button.
2. Open the setup page (BOOT 3 seconds) and read **Status** and **Logs**. See Setup page.
3. In the portal, open the pool and check “last seen” for the box. See Remote panel.

21.2 No network

Symptom	Check
LED yellow, double blink for a long time	The box keeps trying to connect. Open the setup page; the status shows the reason.
“Password refused”	Re-enter the Wi-Fi password (case sensitive; tap the eye to check).
“Network not found”	Wi-Fi out of range or hidden network name mistyped. Check the antenna (U.FL on the 8DI-8DO). Consider a network cable.
“No address”	The router gave no DHCP address. Check the router or cable.
“No internet” / LED orange	Network works but the cloud is unreachable. Check that outgoing connections are allowed; see Network.
Network cable not used	Setup page shows “no network cable”: check the cable and the switch port. Cable is available on the 8DI-8DO board only.

If nothing helps: factory reset (BOOT 10 to 30 seconds). Network and settings are cleared; identity and pairing code stay. See What a factory reset clears.

21.3 No readings

Symptom	Check
Device status “no answer”	A and B wiring, device address, baud rate and parity, termination. See Wiring the box.
Check on the setup page shows nothing	Use the bus scan to find the address. Make sure the device’s bus parameters match its profile.
Some devices answer, others not	All devices on one bus need the same baud rate, parity and stop bits. See Bus devices and inputs.
Readings marked `no_flow`	No flow through the measuring cell; expected when the pump is off.
Readings marked `unknown`	No flow switch and the device does not report flow; flow-dependent values are not counted.
The bus is silent	No device list saved, mode set to “Off”, or the box is in safe mode.
Tiles in the portal show “old”	No new reading for more than one hour.
Alert “box no longer reporting”	No message for 30 minutes. Check power and internet.

To be confirmed

A fixed checklist for bus faults (A and B swapped, wrong address, termination) and the exact meaning of the status “communication error” are still to be written.

21.4 Updates

Symptom	Meaning
`other build` / `other board`	The image is for another channel. See Builds.
`no build id`	The image is from before build identities existed. Use a current image.
Version refused	Only newer versions; a version that rolled back on this box is refused permanently.
Signature refused	The image is not signed by Lutra or was damaged.
Same version after the update	The new version failed its self-test and rolled back. Read the log.
Remote update does not start	Remote updates install between 02:00 and 05:00 local time and need a valid clock.

21.5 Safe mode

After 5 abnormal restarts in a row the box starts in safe mode: network, setup page and updates work, the bus does not run. The status page shows **Safe mode** and the list of last restarts. Install a fixed version; a deliberate restart resets the series. See LED and BOOT button.

21.6 Diagnosis tools

Tool	Where	Who
Status and log on the setup page	On site, temporary network	Anyone with physical access
USB console (`status`, `di`, `tz`, `interval`, `remote on`)	On site, USB-C cable	Technician
`get_diag` (diagnosis)	Remote, Remote panel	Administrator, technician
`get_logs` (last log lines, firmware 0.2.5 and later)	Remote	Administrator, technician
`busscan`	Remote, at most once per hour	Administrator, technician

The log never contains passwords, keys, tokens, certificates or download links.

21.7 Related pages

- Commissioning checklist
- Web flasher

- Network

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

22 Installation

On this page: the order in which to read and do the installation chapters, and the rules that apply on site.

22.1 Order of work

1. **Choose** the board and build for this pool: Choose hardware and build.
2. **Unpack** and check the box: What is in the box.
3. **Safety first**: Electrical installation and safety. Decide which work needs a licensed electrician.
4. **Wire** power, network, bus and inputs: Wiring the box.
5. **Own probes** if the pool has none that can be read: Own probes and flow cell.
6. **Commission** on site, step by step: Commissioning checklist.

22.2 Rules on site

- Lutra reads; the pool's own controllers keep control and keep their safety functions.
- Nothing on the DO terminals before Lutra firmware is on the board, and never a load directly.
- If the bus already has a master, Lutra only listens.
- The network and "changes from the cloud" are only set on site; take your time to finish the setup before the temporary network closes.

22.3 Related pages

- Setup page
- Clients, pools and boxes

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

23 What is in the box

On this page: what a Lutra Lite box is, the boards it is built on, and what to check when you unpack it.

23.1 The box

Lutra Lite is a box on the DIN rail in the plant room. It reads the pool equipment over RS485 (Modbus) and sends the measurements to Lutra Insight. The read build only measures; it never switches an output. See Builds.

23.2 Boards

A box is built on one of two Waveshare boards. The Boards page has the full comparison.

Board	Network	Power
ESP32-S3-POE-ETH-8DI-8DO (pilot board)	Network cable (Ethernet) or Wi-Fi	7 to 36 V DC on the screw terminal, or PoE (802.3af), or 5 V via USB-C
ESP32-S3-RS485-CAN (possible series version)	Wi-Fi only	7 to 36 V DC; do not power it via USB-C at the same time

The 8DI-8DO board has an external Wi-Fi antenna (U.FL). The RS485-CAN board exists with the antenna on the board (SKU 32154) or with an external antenna (SKU 34781).

23.3 Check when you unpack

- ☐ The board matches the one chosen for this pool. See Choose hardware and build.
- ☐ The box runs Lutra firmware. A board straight from Waveshare runs factory firmware that switches its outputs: flash it first with the web flasher, before anything is connected to the DO terminals.
- ☐ The sticker with the pairing code (`LP-XXXX-XXXX`) is on the box. You need it to pair the box.
- ☐ For Wi-Fi on the 8DI-8DO board: the antenna is at hand.

To be confirmed

What exactly ships in the box (which board, power supply, enclosure, antenna, sticker with the pairing code) is not fixed yet.

23.4 Related pages

- Wiring the box
- Commissioning checklist
- Boards

Last reviewed: 2026-11-25. Applies to Lutra Lite 0.5.0.

24 Electrical installation and safety

Draft: review by a qualified electrician required before publication

This chapter states structure and general, conservative principles only. **It must be reviewed and signed off by a qualified electrician before it is published or used for an installation.**

All work on mains voltage must be done by a **licensed electrician** under local regulations, for example **NEN 1010** in the Netherlands and **IEC 60364** generally (including its part on swimming pools).

Lutra supplies low-voltage control electronics. Lutra is not responsible for mains wiring, earthing/bonding of the pool installation, or the selection of contactors/relays for loads.

On this page: the responsibility boundary, who does which work, the voltage zones in a plant room, how outputs must be connected through interposing relays, inputs, earthing and isolation, and a checklist before energising. Values that depend on local regulations (cable cross-sections, RCD ratings, clearances, protection classes, zones) are deliberately not given here.

24.1 Responsibility boundary

Lutra supplies and is responsible for	Lutra is not responsible for
The Lutra Lite firmware and its documented behaviour	Mains wiring of any kind
Documentation of the box's low-voltage interfaces (RS485, digital inputs, digital outputs, power input)	Earthing and equipotential bonding of the pool installation
The safety logic in the firmware of the switching build, as documented	Selection, rating and installation of contactors, interposing relays, motor protection, fuses and RCDs
	The power supply that feeds the box, its installation and its protection
	Compliance of the complete installation with local regulations and the manufacturer instructions of the pool equipment
	Hardware interlocks in the installation (they are required for the switching build, but designing and wiring them is the electrician's work)

The pool equipment (controllers, chlorinators, pumps, heat pumps) remains responsible for its own safety functions. Lutra never takes over or bypasses them.

24.2 Who does what

Work	Who
Mounting the box on the DIN rail, network cable, RS485 bus cable, potential-free contacts on DI	Installer or technician, provided no mains voltage is involved
Power supply for the box, if fed from mains	Licensed electrician
Interposing relays and contactors for loads, their supply and protection	Licensed electrician
Hardware interlocks (flow contact, dry-run contact, level contacts in series)	Licensed electrician
Earthing and equipotential bonding	Licensed electrician
Testing and documenting the installation before use	Licensed electrician, according to local regulations

24.3 Voltage zones

Think of the installation as two zones that must stay separated:

Zone	Contains
Low-voltage control	The Lutra box (7 to 36 V DC, PoE or 5 V USB-C), RS485 bus, digital inputs, the DO outputs and the relay coils they drive, Lutra measuring modules
Mains and power	Supply of the box's power supply, pumps, heat pumps, heaters, lighting transformers, valves on mains voltage, contactor main contacts

- Interposing relays and contactors form the boundary: their coil is in the low-voltage zone, their switching contacts in the mains zone.
- Lutra's own pH/ORP module is designed to be fully SELV: fed from a certified SELV supply of 12 to 24 V DC, with nothing on the module touching mains voltage.

To be confirmed by electrician

- Required class of the power supply for the box (SELV or PELV) and its protection.
- Separation between low-voltage and mains wiring in the same cabinet (routing, separate ducts, clearances, insulation ratings).

- Requirements for the enclosure (IP rating, location relative to the pool zones). The retrofit measuring kit design uses an IP65 enclosure, optionally with conformal coating on the electronics.

24.4 Outputs and interposing relays

This section applies only to the switching build. The read build never switches.

Never connect a load directly to the DO terminals

The DO outputs of the 8DI-8DO board are Darlington open-collector (sink) outputs, rated at most 500 mA, with a flyback diode. They may only drive the coil of an interposing relay or a contactor coil on a low-voltage supply, never a pump, valve, heater or any mains load directly.

The board's **factory firmware switches the outputs** (all outputs on at start-up, inputs mirrored to outputs). Until Lutra firmware is on the board, connect nothing to the DO terminals. The Lutra read build never switches an output.

Principles from the board's specification:

- The DO outputs are open-collector sink outputs (Darlington with optocoupler), at most 500 mA, with a flyback diode. The COM terminal goes to the plus of the coil supply, so the flyback diode works.
- Each output drives **only** the coil of an interposing relay or a DC contactor coil. The relay's contacts, or a contactor driven by it, switch the load.
- Hardware interlocks are required in addition to the firmware interlocks:
  - heating enable: the flow contact in series with the coil of the enable relay;
  - pump: the dry-run contact (`level_low`) in series with the pump start, where the pump allows it;
  - refill: preferably a float valve or the `level_high` contact in series with the valve.
- Recommended: an auxiliary contact of the pump contactor back to a digital input (`pump_feedback`), so the firmware sees whether the pump really runs.
- Dosing pumps are not supported by any Lutra build. Where peristaltic pumps are switched in a future build, they must go through a contactor or interposing relay, never directly on a DO.

To be confirmed by electrician

- Types of interposing relays (coil voltage, contact rating, utilisation category for motor and inductive loads, relay modules with or without built-in diode).
- When an interposing relay is enough and when a contactor with motor protection is required.
- Behaviour of variable-speed pumps with digital speed inputs: whether those inputs are potential-free and can be driven by relay contacts directly.
- Wiring diagrams for each output function and each hardware interlock.

24.5 Digital inputs

- The inputs are optically isolated and intended for contacts. A contact closed between DIx and the GND of the input block reads as active.
- Use potential-free contacts (auxiliary contacts, float switches, flow switches).
- Never connect mains voltage to an input.

To be confirmed by electrician

- Whether active (powered) input signals may be used, and within which voltage range (not yet measured).
- How to bring an auxiliary contact from a contactor in the mains zone to the input safely.

24.6 Earthing and isolation

What the sources establish:

- The RS485 and CAN interfaces of both boards are isolated. The digital inputs and outputs of the 8DI-8DO board are optically isolated.
- Lutra's pH/ORP module isolates the probe side from the host side (power and data). That isolation is functional, with both sides SELV: the water side and the 24 V side must not share an earth or reference. A leaking temperature sensor on the probe side would create a second path to the measuring reference, which is why its sensor sits on the host side.
- On a Jandy/AquaLink bus, connect only A, B and 0V, never POS (the panel's supply).

To be confirmed by electrician

Must be earthed or bonded: which parts of the pool installation require equipotential bonding and protective earth, and whether any part of the Lutra installation (enclosure, DIN rail, power supply) must be connected to it.

Must not be earthed: whether the 0 V of the box, the RS485 0 V, the probe reference of measuring modules or the shield of the bus cable may be connected to protective earth, and where a cable shield is terminated.

RCD protection and other protective devices for the supply circuits.

24.7 Before energising

- ? Mains work done and tested by a licensed electrician, with documentation according to local regulations.
- ? Lutra firmware is on the board before anything is connected to the DO terminals.
- ? No load connected directly to a DO terminal; only relay or contactor coils within 500 mA.
- ? Hardware interlocks wired as required for every assigned switching function.

- ? Low-voltage and mains wiring separated as decided by the electrician.
- ? Only potential-free contacts on the digital inputs.
- ? On a Jandy bus, POS not connected.

Continue with the Commissioning checklist.

24.8 Related pages

- Wiring the box
- Switching build
- Boards

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

25 Wiring the box

On this page: mounting, power, network, the RS485 bus, digital inputs and the outputs. Read Electrical installation and safety first.

> **Mains work only by a licensed electrician**
>
> Any work on mains voltage (230/400 V), on the supply of pumps, heaters, heat pumps and lighting, on contactors and interposing relays switching those loads, and on earthing and equipotential bonding of the pool installation must be done by a licensed electrician under local regulations (for example NEN 1010 in the Netherlands, IEC 60364 generally). See Electrical installation and safety.

25.1 Overview

The schematic shows the low-voltage connections of an 8DI-8DO box. The RS485-CAN board has only the power and RS485 connections. The sections below give the rules for each connection.

Diagram: Wiring schematic of a Lutra Lite box on the 8DI-8DO board. Power: V+ and 0V from a 7 to 36 V DC supply, or PoE; the mains feed of the supply is electrician work. RS485: A, B and 0V to the equipment bus, 120 ohm termination only at the last device, on a Jandy or AquaLink bus never connect POS. Digital input: a potential-free contact between DI1 and the GND of the input block, closed reads as active. Digital output, switching build only: COM to the plus of a low-voltage coil supply, the coil of an interposing relay between that plus and DO1; hardware interlocks in series with the coil; the relay contact switches the load in the mains zone, which is work for a licensed electrician only. Schematic only; terminal positions and the 0V of the coil supply are to be confirmed. Low-voltage connections of the box. Outputs are used only with the switching build; with the read build leave DO and COM unconnected.

25.2 Mounting

Mount the box on the DIN rail in the plant room. On the 8DI-8DO board, connect the external Wi-Fi antenna (U.FL) if Wi-Fi is used.

25.3 Power

Board	Options
8DI-8DO	7 to 36 V DC on the screw terminal, or PoE (802.3af) over the network cable, or 5 V via USB-C
RS485-CAN	7 to 36 V DC; do not power it via USB-C at the same time

25.4 Network

A network cable is preferred (8DI-8DO only); with PoE one cable carries data and power. Wi-Fi is the fallback. See Network.

25.5 RS485 bus

1. Connect RS485 **A** and **B**, and **0V** (GND), to the bus of the pool equipment.
2. All devices on one bus must use the same baud rate, parity and stop bits. See Bus devices and inputs.
3. Termination resistor (120 ohm) only on the last device of the bus.
4. **Jandy/AquaLink bus**: connect only A, B and 0V, never POS (the panel's supply). Wire colours on that bus: A black, B yellow or white, 0V green, POS red.
5. If the bus already has a master (PLC, control panel), Lutra may only listen. See Listen-only mode.

To be confirmed

- Terminal layout of the boards (where A, B and GND are).
- Whether the 120 ohm jumper on the Lutra box must be set (depends on its position on the bus).
- Cable type and maximum cable length.

25.6 Digital inputs (8DI-8DO)

- Connect potential-free contacts between an input DI1 to DI8 and the GND of the input block. A closed contact reads as active.
- Typical uses: flow switch, pump running (auxiliary contact), level floats, leak sensor, fault contact of a heat pump or chlorinator, plant room door.
- Prefer NC contacts for flow and low level, so a broken wire reads as an alarm.
- The flow switch goes on DI1 in the current installation guide. See Flow switch.

Assign the role of each input on the setup page. See Digital inputs.

25.7 Digital outputs (8DI-8DO)

Never connect a load directly to the DO terminals

The DO outputs of the 8DI-8DO board are Darlington open-collector (sink) outputs, rated at most 500 mA, with a flyback diode. They may only drive the coil of an interposing relay or a contactor coil on a low-voltage supply, never a pump, valve, heater or any mains load directly.

The board's **factory firmware switches the outputs** (all outputs on at start-up, inputs mirrored to outputs). Until Lutra firmware is on the board, connect nothing to the DO terminals. The Lutra read build never switches an output.

With the read build: leave the DO terminals unconnected. With the switching build: see Outputs and interposing relays.

25.8 Pin header

The pin header has IO1, IO0, RXD, TXD, SDA, SCL, GND and VCC. Do not connect anything to SDA/SCL (they carry the clock and the output expander) or IO0 (a strapping pin).

To be confirmed

A second RS485 port through an isolated TTL-to-RS485 module on RXD/TXD is designed but not supported by the firmware yet. A DS18B20 temperature sensor on the free IO1 is a possibility, not a supported feature.

25.9 Related pages

- Commissioning checklist
- Own probes and flow cell
- Boards

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

26 Own probes and flow cell

On this page: the measuring kit for pools whose equipment cannot be read or lacks sensors, the hydraulic installation of the flow cell, temperature options, and calibration. The measuring kit only measures; dosing is not available.

26.1 The measuring kit

Part	What
Controller	Lutra Lite on the 8DI-8DO board, Modbus master on RS485
pH and ORP	Two isolated pH/ORP transmitters with RS485 Modbus, each with its own address
Temperature	Preferably a PT1000 in the flow cell on the temperature (ATC) input of the pH transmitter, read over Modbus. Alternatives: a probe with built-in PT1000/NTC10K, or a DS18B20 sensor (not on a DI)
Flow	A flow switch in the flow cell, on a digital input
Enclosure	IP65, optionally with conformal coating

Supported transmitter profiles are listed in Supported devices (ComWinTop pH and ORP transmitters, and Lutra's own pH/ORP module, all as draft).

To be confirmed

- Lutra's own pH/ORP module is in design and not available yet.
- The choice of probe and transmitter suppliers is still being tested for drift over 1 to 2 months.
- What exactly is supplied in a kit is not fixed.

26.2 Hydraulic installation

- Flow cell mounted on the wall, on a **bypass**: two tapping saddles, ball valves and the flow switch.
- Probes **after the filter and before the heating**, mounted upright.
- Injection points (for future dosing) **after the heating**.
- Saddles for 50 mm pipe as standard, 63 mm as an option.

26.3 Flow and validity

Without flow through the cell, probe readings are marked invalid (kept, not discarded). After flow returns there is a 60 second run-in. See Flow switch.

26.4 Calibration

- pH is calibrated at two points with buffer solutions; ORP gets an offset.
- Calibration is done on site only, never through the cloud.

To be confirmed

The calibration procedure for installers (on which device, which buffers, via the setup page or the USB console) is not fixed yet.

26.5 Chlorine with stabiliser

If the pool uses trichlor (with stabiliser, CYA), ORP says little about free chlorine. Rely mainly on pH and a measured free chlorine value.

26.6 Related pages

- Wiring the box
- Commissioning checklist
- Bus devices and inputs

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

27 Commissioning checklist

On this page: a checklist for commissioning one box at one pool. Work through it in order; each step links to the page with the details. Print it or keep it open on your phone.

27.1 1. Before you go

- ☐ Board and build chosen for this pool. See Choose hardware and build.
- ☐ The pool equipment is in the supported devices list; you know its Modbus address and bus parameters, or plan to use the bus scan.
- ☐ Client and pool exist in Lutra Insight, or you have the rights to create them on site.
- ☐ The box runs Lutra firmware of the right board and build. A new board runs factory firmware that switches its outputs: flash it first with the web flasher.
- ☐ The box's pairing code (`LP-XXXX-XXXX`) is at hand.
- ☐ For the switching build: a licensed electrician is booked for the relays, interlocks and mains work.
- ☐ You carry a phone, a laptop with Chrome, Edge or Opera, and a USB-C data cable.

27.2 2. Safety

- ☐ Read Electrical installation and safety. Mains work only by a licensed electrician.
- ☐ Nothing connected to the DO terminals (read build), or only relay coils through the electrician's installation (switching build).
- ☐ If the bus already has a master (PLC, control panel), Lutra will only listen. Never add a second master.

27.3 3. Mount and wire

- ☐ Box on the DIN rail; antenna connected if Wi-Fi is used. See Wiring the box.

- ☐ RS485 A, B and 0V connected; termination only on the last device of the bus.
- ☐ On a Jandy bus: POS not connected.
- ☐ Contacts on the digital inputs (flow switch, pump running, levels), NC where possible.
- ☐ Network cable or PoE connected, or Wi-Fi signal checked at the box's location.
- ☐ Power connected.

27.4 4. Power on

- ☐ LED (8DI-8DO): green short flash every 2 s (nothing set up yet) or blue slow blink (setup window open). See LED and BOOT button.
- ☐ Temporary network `Lutra-XXXXXX` visible on your phone. If not: hold BOOT for 3 seconds.

27.5 5. Setup page: devices first

- ☐ Join `Lutra-XXXXXX` and open the setup page (`http://192.168.4.1` if it does not open by itself). See Setup page.
- ☐ Status shows the expected firmware version and build.
- ☐ For each bus device: make and model, address, **Check** shows plausible values, **Add to list**.
- ☐ **Save** the device list. Readings appear live on the page.
- ☐ Roles assigned to the connected digital inputs; open and close each contact once and watch the state change. See Digital inputs.
- ☐ Switching build only: outputs configured and each function tested with the electrician present. See Switching build.
- ☐ **Changes from the cloud** set as agreed with the partner and the owner (off unless agreed).

27.6 6. Setup page: network last

- ☐ Network chosen (cable, or Wi-Fi with password) and **Save & Connect** pressed.
- ☐ LED yellow double blink, then green. If the page reports a failure, correct it in the window that opens again. See Network.

27.7 7. Pair in the portal

- ☐ In Lutra Insight: open the pool, **Boxes**, **Add box with pairing code**, enter the code, **Activate**. See Pairing a box.
- ☐ LED changes from green breathing to green steady.

27.8 8. First readings

- ☐ The pool page shows tiles with values and "last seen" for the box. The box sends every 5 minutes by default, and immediately when a state changes.
- ☐ Values are plausible compared with the equipment's own display.
- ☐ If the pool uses trichlor (with CYA): rely on pH and free chlorine rather than ORP.

- ? Alert limits checked for this pool, email alerts on. See Alerts and visits.

To be confirmed

How soon after activation the first reading appears in the portal.

27.9 9. Handover

- ? Note in the portal or your records: MAC address, firmware version, board and build, bus devices with addresses, input roles.
- ? Owner invited to the owner view if agreed. See Pool owners.
- ? Setup window closed (it closes by itself after a successful connection).
- ? The owner knows that the pool works as before without Lutra, and whom to call.

27.10 Related pages

- Troubleshooting
- Installation

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

28 Lutra Insight

On this page: what Lutra Insight is, how to sign in, the main areas of the portal and the getting-started checklist for a new partner.

The portal is being redesigned

Menu structure and page layout of Lutra Insight are being reworked. This chapter describes concepts and functions, not exact screens or button positions.

28.1 What it is

Lutra Insight is the web portal for partners: pool builders and service companies, their administrators and technicians. It runs at app.lutrapool.com and works on desktop and phone. A partner sees only its own clients, pools and boxes.

28.2 Signing in

- Accounts are personal; there are no shared accounts.
- Sign-in requires a second step: an authenticator app code (TOTP) or a passkey.
- The portal is available in several languages; the language is a personal setting.

28.3 Main areas

Area	What you do there	More
Overview	Pools that need attention first, a card per pool with status and key values	Clients, pools and boxes
Clients and pools	Clients on a map or in a list, their pools, adding pools and boxes	Clients, pools and boxes
Alerts	Active and resolved alerts, acknowledge, plan a visit, call the client	Alerts and visits
Visits	Service visits per day and week, route per technician, navigation	Alerts and visits
Remote panel (per box)	Box state, settings, safe commands, switching where available	Remote panel
Flash a box	Update or flash a box over USB	Web flasher
Installation guide	Short on-site guide inside the portal	Commissioning checklist
API and integration	External devices for a pool	External devices
Team, audit log, billing, settings	Administration of the partner account	Team and administration

28.4 Getting started

A new partner sees a “Getting started” checklist on the overview until all steps are done:

1. Create a client.
2. Add a pool.
3. Add a box (flash it if needed, then pair it).
4. Check alert limits.
5. Invite a colleague.
6. Switch on alerts.

When a box is activated but has not sent readings yet, the checklist says so. Each member can hide the checklist.

28.5 Related pages

- Roles

- Pool owners
- REST API

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

29 Roles

On this page: the roles in the portal, the scope of a technician, and a table of what each role may do. The rules are enforced by the API on every request, not only hidden in the interface. See Authentication and access.

29.1 The roles

Role	Who	In short
Administrator (beheerder)	Owner or manager at the partner	Everything for the partner: team, clients, pools, boxes, alerts settings, remote settings and switching, privacy, billing, external devices
Technician (monteur)	Field staff of the partner	Daily work on pools: readings, alerts, visits, pairing boxes, safe remote commands. No team, billing or privacy actions
Owner (eigenaar)	The pool owner, invited by the partner	Only their own pools, in a simple view. See Pool owners
Lutra admin	Lutra staff	Support: views a partner's data with a stated reason (read only), manages partners, releases boxes

29.2 Scope of a technician

A technician has a scope:

- **all**: all pools and clients of the partner;
- **selection**: only selected pools. Clients without any selected pool are invisible; for a visible client only the selected pools are shown. A technician with a selection does not manage clients.

29.3 What each role may do

Action	Administrator	Technician	Owner	Lutra admin
See pools and readings	yes	yes (scope)	own pools	read along
Create and edit pools	yes	yes		
Create and edit clients	yes	yes (scope all)		
Activate (pair) a box	yes	yes		
Release a box	yes			yes
Acknowledge alerts, set limits per pool	yes	yes		
Partner-wide alert settings	yes	read		read
Subscribe to alerts for yourself	yes	yes	yes	
Plan visits, optimise own route	yes	yes (own visits)		read
Depot and visit defaults	yes			
Safe remote commands (diagnosis, logs, bus scan, update check)	yes	yes (scope)		yes
Remote box settings (interval, turning off remote changes, time zone)	yes			yes
Write commands to the equipment (setpoints)				yes, only with remote changes enabled on site
Switch outputs remotely (switching, build)	yes		if allowed per pool	yes
[illegible]	yes			read along

Remote switching and write commands are additionally checked by the box itself. See Remote commands and settings.

To be confirmed

Write commands to the pool equipment (setpoints, production) are limited to Lutra admin for now, and the read build refuses them anyway. Whether partners will get this right is not decided.

29.4 Related pages

- Team and administration
- Authentication and access

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

30 Clients, pools and boxes

On this page: how clients, pools and boxes relate, what the overview and the pool page show, and how to pair, move and release a box.

30.1 Clients and pools

- A **client** is the owner of one or more pools (a household, hotel, campsite). A client has a name, optional contact details and an address. The address is placed on a map; you can drag the pin if the position is inaccurate.
- A **pool** belongs to at most one client; a client can have several pools.
- A pool's **sources** are the Lutra boxes and external devices that deliver readings for it. Two sources may deliver the same quantity; the chart draws a line per source.
- A client can only be deleted when no pools are linked to it.

Contact details and addresses are personal data. They are kept only in the partner's register and never written to logs; the audit log records which fields changed, not their values.

30.2 Overview

The overview shows what needs attention first, then a card per pool with its status, water temperature, pH, ORP, free chlorine and a 24-hour sparkline.

30.3 Pool page

The pool page has four tabs:

- **Now**: active alerts, a **tile** per quantity (label, value, unit and status; only quantities the pool has ever measured, older than one hour shown as old), the last 24 hours and the water profile.
- **History**: charts per quantity over a chosen period.
- **Settings**: everything about the pool and its water: **Limits**, **Manual tests** (enter test results, alerts and reminder), **Water profile** and **Delete pool**.
- **Devices**: everything connected to the pool. The **Lutra box** with its settings (reading interval, time zone, remote changes) and the Remote panel, external devices,

and **cloud connections** such as PoolLab via LabCOM with the code to enter there. A pool without a box shows its other devices and **Add a Lutra box**. The administrator switches **Remote monitoring** on or off here; see Subscription and pricing.

A pool without remote monitoring shows **Local only**: the box stays connected for updates, but there is no history, no alerts and no remote control for it.

Statuses of a reading follow the quantity statuses, for example `no_flow` when there is no flow through the measuring cell.

30.4 Pairing a box

The **pairing code** has the form `LP-XXXX-XXXX`. It belongs to the box, not to the client: it is printed on the box's sticker and stored in the box's identity, and survives a factory reset.

1. Create the client and add a pool (or open an existing pool).
2. Open the pool, go to **Devices** and choose **Add a Lutra box** (or **Add measuring device**, **Lutra box**).
3. Type the code and press **Activate**. Lower case, spaces and hyphens are fine, with or without `LP`. Nothing is guessed: an O is not turned into a 0.

The box's LED changes from green breathing to green steady once it is activated (8DI-8DO).

Message	Meaning
Unknown pairing code	Check the code. The alphabet has no 0, 1, I, L or O.
Already activated	The box is linked elsewhere; it must be released first.

The number of attempts is limited.

To be confirmed

Whether boxes delivered today already carry a sticker with the pairing code, and how the pairing code is shown on the box's status page.

30.5 Moving or releasing a box

A pairing code works once. To move a box to another pool (relocation, sale, replacement), an administrator first **releases** it; then it can be activated again with the same code. Readings from before the move stay with the old pool.

30.6 Related pages

- Commissioning checklist
- Remote panel
- Alerts and visits

Last reviewed: 2026-11-25. Applies to Lutra Lite 0.5.5.

31 Alerts and visits

On this page: when an alert starts and ends, default limits and how to change them, how alerts reach people, how the water profile affects ORP alerts, manual test values, and planning service visits.

31.1 When an alert starts and ends

- **Out of range**: a value must stay outside its limit for at least **2 hours** (adjustable) before the alert becomes active. A short dip back inside does not reset the timer.
- **Resolved**: after 15 minutes continuously inside the limit.
- **Box not reporting**: a box that has sent nothing for **30 minutes** (it normally sends every 5 minutes) gives an offline alert. It resolves when messages arrive again or when the box is released.
- A value that is missing, or whose status is not `ok` (for example `no_flow`), neither starts nor resolves an alert.
- Late messages from a box's offline buffer are stored in the history but do not count for alerts.

31.2 Default limits

Quantity	Default range	Critical
pH	7.00 to 7.60	below 6.8 or above 8.0
ORP	650 to 800 mV	below 550 mV
Free chlorine	0.30 to 2.00 mg/l	below 0.1 or above 5.0 mg/l
Water temperature	10 to 31 °C	
Filter pressure	max 150 kPa, only while the pump runs	

Limits are layered: built-in defaults, then the partner's defaults (administrator, Settings, Alerts), then the pool's own values. Each limit can be switched off.

On the pool page (**Settings > Limits**) a yellow dot marks a limit with a value of its own for that pool; without the dot the partner default applies. **Default** next to a limit removes the pool's own value again.

31.3 Water profile and ORP

If a pool's water profile has cyanuric acid (CYA) above 30 mg/l, or uses trichlor without a CYA measurement, ORP limits do not raise alerts: the stabiliser lowers ORP while there is enough free chlorine. An administrator can still switch ORP alerts on for that pool.

31.4 How alerts reach people

- **In the portal**: the alerts page with active, resolved and all alerts; a red badge for active, unacknowledged alerts. Each alert can be **acknowledged**, used to **plan a visit**, or to **call** the client's contact.
- **Email** at the start of an alert, to members who may see the pool and have email alerts on, in their own language and units.
- **Push notifications** to the member's devices (also as an installed web app on a phone).
- **Quiet hours** (default 22:00 to 07:00, pool's time zone): non-critical alerts wait until after the quiet hours. Critical alerts that are not delivered by push within 10 minutes are also sent by email.
- Owners can receive alerts for their pool if the administrator enables this. See Pool owners.

31.5 Manual test values

Values from manual water tests (strip, drops, photometer, lab) are entered on the pool page under **Settings > Manual tests**, or with a service visit. Tests from a cloud connection such as PoolLab arrive the same way. Cyanuric acid, total alkalinity and calcium hardness from a test also update the water profile. They have their own limits and raise an alert directly when outside them; the next test inside the limit resolves it. An optional reminder alerts when no manual test has been entered for a number of days.

31.6 Visits

- Visits per day and per week, per technician.
- A visit has a pool, date, optional time window, reason, technician and status (planned, done, cancelled), and can be linked to an alert.
- **Optimise route** computes the order of the day's stops for a technician, starting and ending at the depot, with traffic, time windows and service duration, and estimated arrival times.
- Stops can be moved earlier or later by hand; changes mark the stored route as outdated.
- **Navigate** opens all stops in Google Maps (at most 9 intermediate stops) or each stop in Apple Maps.
- The administrator sets the depot, departure time and default service duration.
- A technician plans and edits only his own visits and optimises only his own route.

To be confirmed

Emailing the pool owner about a planned visit is built but needs a sending address before it is active.

31.7 Related pages

- Clients, pools and boxes
- Roles

- Quantities

Last reviewed: 2026-11-25. Applies to Lutra Lite 0.5.5.

32 Water profile

The water profile holds the slow-changing chemistry of a pool: values you test every few weeks, not every few minutes. Lutra uses them to interpret the live readings from the box. You find it on the pool page under **Settings > Water profile**; a summary is shown on the **Now** tab.

32.1 What is in the profile

Value	Unit	Used for
Disinfection		Recommended free chlorine, ORP alerts, bromine pools
Cyanuric acid (CYA, stabiliser)	mg/l	Recommended free chlorine, ORP alerts, scale balance
Total alkalinity	mg/l as CaCO3	Scale balance
Calcium hardness	mg/l as CaCO3	Scale balance
Volume	m^3	Shown with the pool; not used in calculations yet

Without a disinfection of its own, a pool follows the partner default (administrator, **Settings > Alerts > Water treatment**).

32.2 Where the values come from

Each value in the profile shows its source and the date of the test:

- **Manual test**: entered under **Settings > Manual tests** on the pool page.
- **Visit**: a test entered with a service visit.
- **PoolLab via LabCOM** (or another cloud connection): a photometer test fetched from the cloud.
- **Entered by hand**: typed directly into the profile with **Edit**.

A new test of cyanuric acid, total alkalinity or calcium hardness updates the profile automatically, whatever its source. A test with an older date never replaces a newer value. Free chlorine, combined chlorine, pH and salt from a manual test are not part of the profile: they appear in the chart and the test list, and have their own manual test limits.

A value older than 60 days is marked as old: retest it.

32.3 What Lutra calculates with it

32.3.1 ORP alerts

Cyanuric acid lowers the ORP reading while there is still enough free chlorine. If CYA is above 30 mg/l, or the pool uses trichlor without a CYA test, ORP limits do not raise alerts. An administrator can switch them on anyway for that pool. See Alerts and visits.

32.3.2 Recommended free chlorine

With a known CYA, the recommended minimum free chlorine is 7.5 % of the CYA (5 % for salt chlorination). The free chlorine tile shows this minimum and marks a reading below it. The manual test limits for free chlorine follow the same rule, up to 20 % of the CYA as the upper limit.

32.3.3 Scale balance (LSI)

The Langelier saturation index tells whether water tends to dissolve (aggressive) or deposit (scale forming) calcium. Lutra calculates it from the live pH and water temperature of the box and the profile's total alkalinity and calcium hardness. Alkalinity is corrected for cyanuric acid (carbonate alkalinity = total alkalinity minus CYA / 3). Dissolved solids are taken from the salt reading, or assumed (3500 mg/l for a salt pool, 1000 mg/l otherwise). Between −0.3 and +0.3 the water is balanced.

All of this is an indication, not dosing or health advice.

32.4 Related pages

- Alerts and visits
- PoolLab via LabCOM
- Quantities

Last reviewed: 2026-11-25. Applies to Lutra Lite 0.5.5.

33 Remote panel

On this page: what the remote panel of a box shows, which settings and commands are available to whom, what the command statuses mean, and how switching works for switching-build boxes. The technical rules are in Remote commands and settings. Commands need remote monitoring on the pool (or the partner's trial month); see Subscription and pricing.

33.1 What it shows

- Firmware version, build (read or switching) and board, and the update channel that fits the box.
- Whether **changes from the cloud** is enabled on site.
- The telemetry interval and time zone.
- For switching builds: each assigned output with its state, the source of the last change and, if it does not do what was asked, the reason.
- The list of recent commands with their status.

33.2 Settings

Setting	Values	Who
Telemetry interval	30 to 3600 seconds (default 300)	Administrator, Lutra admin
Changes from the cloud	Can only be switched **off** remotely	Administrator, Lutra admin
Time zone	Chosen from the pool's location; firmware 0.2.8 and later	Administrator, Lutra admin

A change waits until the box confirms it ("waiting for box"). The portal refuses to send a change when:

- the box has not reported recently, so its current state is not known;
- the box changed the setting on site since you loaded the page (the setting's revision differs);
- another change is still waiting;
- the box's firmware does not support revisions (then the portal never writes);
- the new value equals the current one.

The box itself refuses a change that is based on an outdated revision (`stale`). On site always wins.

33.3 Commands

Safe commands, for administrators and technicians (technicians with a selection only on their pools):

Command	What it does
Diagnosis (`get_diag`)	Returns diagnostic information
Logs (`get_logs`)	Returns the last 1 to 200 log lines from a minimum level; firmware 0.2.5 and later
Bus scan (`busscan`)	Scans the RS485 bus for devices; at most once per hour remotely
Check for update (`ota_check`)	Asks the box to fetch and install a signed update. See Updates and channels

At most 10 commands per box per hour.

Status	Meaning
sent	Sent; waiting for the box
executed	The box carried it out, with details
refused	The box refused it, with its reason (for example `not_supported`, `not_allowed`, `stale`, `replay`, `signature`)
no answer	No answer within 60 seconds
failed	Signing or sending failed

33.4 Switching outputs

Only for boxes running the switching build that report assigned outputs.

- **Off** is always allowed.
- **On** requires “changes from the cloud” enabled on site, and the function must allow remote on (refill never does).
- Pump, backwash and heating enable (class B) require an explicit confirmation that you are responsible.
- At most 30 switching commands per box per hour.
- The box applies its interlocks; the reported state shows whether the output really changed and why not.

Administrators and Lutra admin may switch. Technicians switch on site, not through the portal. Owners may switch from their own view only if the administrator allows it for that pool. See Pool owners.

33.5 Related pages

- Remote commands and settings
- Troubleshooting
- Roles

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

34 Team and administration

On this page: managing the team, the audit log, settings, inviting owners, external devices, billing and the privacy (GDPR) functions. Most of these are for the administrator role. See Roles.

34.1 Team

- Invite members, set their role (administrator or technician) and the technician’s scope (all pools or a selection), remove members.
- The last administrator of a partner cannot delete their own account.

34.2 Audit log

Every write action is recorded in an append-only audit log: who did what, when, on which pool or box. Personal data such as phone numbers are not written to it; only the names of changed fields. Administrators and Lutra admin can read it.

34.3 Settings

Tab	Contents
Account	Language, passkeys, account
Preferences	Units (temperature, pressure, flow), number and time format, first day of the week, theme, start page, navigation app
Alerts	Default limits and alert delay (partner), alert channels and quiet hours, your own email alerts, a test email
Visits	Depot, departure time and service duration (administrator)

34.4 Owners

Administrators can invite the owner of a client's pools to the owner view, and revoke that access. Per pool they decide whether the owner may operate outputs and whether the owner receives alerts. At most 5 owners per client. See Pool owners.

34.5 External devices

Administrators can add measuring devices that do not run Lutra firmware to a pool, sign their certificate from a certificate signing request, and revoke them. See External devices.

34.6 Billing

In **Settings**, **Subscription**, the administrator sees the pools that count (basis and remote monitoring), the prices for the chosen interval, the total per period, the trial month, the invoices, and the pools per month. The administrator also chooses monthly or yearly billing there. Remote monitoring is switched on or off per pool on the pool page, tab **Devices**.

Prices and billing rules: Subscription and pricing. Commercial conditions: lutrapool.com.

34.7 Privacy: export and erasure

The partner is the controller towards the pool owner; Lutra processes the data on the partner's behalf.

- **Export** all data of a client.
- **Erase** a client, or a single pool, with all personal data.
- **Delete your own account** (any member except the last administrator).

These actions are reserved for the administrator. Lutra admin cannot perform them through read-along access.

34.8 Related pages

- Roles
- Authentication and access

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

35 Pool owners

On this page: how you get access as a pool owner, what you see, what you can operate, and what Lutra does and does not do at your pool.

35.1 How you get access

Your installer or pool service company (the Lutra partner) invites you. You receive an email with a temporary password and then set up a second sign-in step (an app code or a passkey). The partner maintains your pool and has the Lutra subscription; there is nothing to buy or install yourself.

If your pool shows **Local only**, your installer has not switched on remote monitoring for it: the app shows no history and sends no alerts, and remote switching is not available. Operating the equipment on site through the box stays possible.

Your access can be revoked by the partner's administrator; you can be invited again later.

35.2 What you see

- **My pools**: the pools of your account. With more than one pool, choose a pool first.
- **Water quality in plain words**: good or needs attention.
- **Water temperature** and a **chart** of recent values.
- The **tiles** your installer has switched on for your pool (for example pump, lights, cover).
- Who maintains your pool.

You do not see settings, boxes or other clients.

35.3 What you can do

- **Receive alerts** for your pool, if your installer enabled this.
- **Operate equipment** (on and off), only if all of the following are true:
  - your pool has a Lutra box running the switching build;
  - your installer allowed you to operate it for this pool;
  - remote control is enabled at the box on site.

When a switch is held back, the app says why in plain words, for example "the water level is too low", "no water is flowing through the pipe" or "held back by a safety check". Safety checks in the box always win.

- Set your own preferences: language, units, theme.

To be confirmed

The owner app is a prototype. Which tiles and controls are offered, and how it looks on a phone, may change.

35.4 What Lutra does not do

- Your pool works as before without Lutra or without internet. Lutra reads and reports; your pool's own controllers keep their safety functions.
- Lutra never changes water treatment settings without the safeguards described in Remote commands and settings.
- Your installer, not Lutra, is your contact for the pool.

35.5 Your data

Your installer is responsible for your data and can export or erase it on request. See Team and administration.

35.6 Related pages

- Lutra Insight
- Alerts and visits

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

36 API and integrations

On this page: the three interfaces of the Lutra backend, who uses which, how readings flow through the ingest, and the versioning rules. This chapter describes the public behaviour only; it contains no keys or internal configuration.

36.1 Three interfaces

Interface	For	Transport	Page
Device interface	Lutra Lite boxes	MQTT over TLS with a client certificate per box, `iot.lutrapool.com:8883`	Device messages (MQTT)
External devices	Measuring devices that do not run Lutra firmware	MQTT (8883) or HTTPS (8443) with a client certificate, write only	External devices
REST API `/v1`	Lutra Insight, the owner view, and later third-party applications	HTTPS with JSON, signed-in users	REST API

A PLC that already controls the pool sends its readings as an external device; see Connecting a PLC.

Remote actions towards a box (settings and signed commands) are described in Remote commands and settings.

36.2 The data path

Diagram: Ingest data path: a Lutra box sends over MQTT and an external device over MQTT or HTTPS, both on the topic lutra/v1/{thing}/telemetry. Every message is first archived raw and unchanged. The ingest then 1. finds the source, 2. finds the pool it was assigned to at the time of the reading, 3. maps device values to quantities, 4. drops duplicates, 5. writes current state, history and aggregates, 6. evaluates alerts. All sources arrive on the same path; after the ingest nothing depends on where a value came from.

- Everything after the ingest (storage, alerts, API, apps) does not know where a value came from: all sources deliver the same quantities with fixed units.
- **Assignment with validity**: a source delivers to a pool from a start date to an end date. A source without assignment (in stock, not yet activated) is archived but shown to nobody.
- Duplicates (for example a resent message from a box's buffer) are removed, so resending is always safe.

36.3 Platform

The backend is serverless on AWS in eu-central-1 (Frankfurt): AWS IoT Core for device connections, AWS Lambda behind API Gateway for the REST API, DynamoDB and S3 for storage, Cognito for sign-in, and AWS KMS for signing keys. There are separate test and production environments; a box belongs to one environment.

36.4 Stability of `/v1`

- A field never disappears within `/v1`; new behaviour comes as a new field or as `/v2`.
- Device topics are versioned too (`lutra/v1/...`); message formats carry a version field `v`.

To be confirmed

- A published OpenAPI description of the REST API.
- Access for third-party applications with machine credentials (OAuth2 client credentials with scopes such as `pools:read`, `measurements:read`) and webhooks are designed but not available.
- Cloud connectors for manufacturer clouds (Fluidra Pool first) are designed but not available.

36.5 Related pages

- Authentication and access
- How Lutra fits together

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

37 Authentication and access

On this page: the identities in Lutra (people, boxes, external devices), how each authenticates, how partners are kept apart, and the order of checks on every request.

37.1 People

- People sign in through Amazon Cognito with a second factor (authenticator app code or passkey). The REST API accepts the resulting JSON Web Token (JWT) on every request.
- The partner (tenant) a person belongs to comes from the token and cannot be changed by the user. Role, scope and pool selection come from the person's membership record.
- No membership means no access.

Roles and what they may do: Roles.

37.2 Lutra boxes

- Each box has its own key pair and an X.509 certificate; it connects to AWS IoT Core with mutual TLS.
- The device policy only allows the box its own topics (`lutra/v1/{thingName}/...`) and its own device shadow.
- Certificates can be revoked per box.
- Commands to a box are additionally signed by the Lutra command service with a key in AWS KMS; the box checks the signature with a public key built into the firmware. Access to MQTT alone is therefore not enough to send a box a command. See Remote commands and settings.

To be confirmed

Production provisioning (key generated in the device's protected hardware, certificate through a signing request, pairing code written at production) and hardware security features (secure boot, flash encryption) are designed. Enabling them on field boxes is decided per board and not yet done.

37.3 External devices

- One certificate per device, from a key made on the device itself and a signing request pasted in the portal.
- The certificate only allows connecting as itself and publishing to its own telemetry topic. It cannot subscribe or receive anything.

See External devices.

37.4 Separation between partners

- Every database key starts with the partner (tenant). For every request the API works with temporary rights that only allow keys of that tenant. A mistake in a query therefore results in a refusal, never in data of another partner.

- Separation between clients of the same partner (for example an owner who may only see their own pools, or a technician with a selection) is enforced in the API.

37.5 Order of checks

For every request:

1. Is the action known?
2. Lutra admin: read along only, with a stated reason.
3. Does the tenant in the token match the requested data?
4. Does the role allow this action?
5. Technician with a selection: is the pool in the selection? Owner: is it the owner's own pool?

Then the request runs with tenant-bound rights, and every write is written to the audit log.

37.6 Related pages

- REST API
- Roles

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

38 REST API

On this page: conventions, then the endpoints of `/v1` grouped by resource. The API is used by Lutra Insight and the owner view; each group names the permission it needs (see Roles).

To be confirmed

- Public base URL (planned: `https://api.lutrapool.com/v1`).
- The API is not yet open to third-party applications; request and response schemas will be published as an OpenAPI description. Until then this page lists endpoints only.

38.1 Conventions

- JSON over HTTPS; every request carries the user's JWT (see Authentication and access).
- Field names, enum values, query parameters and error codes are English. A request with an unknown (for example Dutch) field name or value is refused with `400 invalid_input`.
- Lutra admin reads along with `?tenant=<tenant id>&reason=<reason>`.
- IDs are opaque with a prefix: `ten_` (partner), `cus_` (client), `pool_` (pool), `bzk_` (visit).
- Errors use HTTP status codes with a JSON body `{"error": "<code>", "message": "<text>"}`: a short machine-readable code (for example `404 not_found`, `429`

`too_many_requests`, or `409 stale` when a box setting changed meanwhile) and a human-readable message.

Example:

```
POST /v1/pools
{"name": "Villa Rosa", "timezone": "Europe/Paris", "volume_m3": 45}
```

```
{"pool": "pool_3f9a1c2b7d", "name": "Villa Rosa", "timezone": "Europe/Paris",
"volume_m3": 45,
 "created": 1795242969, "customer": null, "modules": {}, "owner":
{"can_switch": false, "alerts": false}}
```

38.2 Account and partner

Method and path	What
`GET /v1/me`	Current user, role, preferences
`GET, PATCH /v1/me/preferences`	Own display preferences (units, time format, first weekday, theme, start page, navigation app)
`DELETE /v1/me`	Delete own account (not the last administrator)
`GET, POST /v1/members; PATCH, DELETE /v1/members/{sub}`	Team members (administrator)
`GET /v1/audit`	Audit log (administrator, Lutra admin)
`GET, PATCH /v1/getting-started`	Getting-started checklist
`GET, PATCH /v1/billing`	Subscription: pools that count, prices, interval (monthly or yearly), pools per month (administrator; changing the interval only by the administrator, not when reading along)
`GET, POST /v1/partners; GET /v1/partners/billing`	Partners (Lutra admin)

38.3 Clients and owners

Method and path	What
`GET, POST /v1/customers`	List and create clients
`GET, PATCH, DELETE /v1/customers/{id}`	One client; delete only without pools
`POST /v1/customers/{id}/pools; DELETE /v1/customers/{id}/pools/{pool}`	Link or unlink a pool
`GET /v1/customers/{id}/export; POST /v1/customers/{id}/erase`	Privacy export and erasure (administrator)
`GET, POST /v1/customers/{id}/owners; DELETE /v1/customers/{id}/owners/{sub}`	Invite and revoke owners (administrator)

38.4 Pools, readings and sources

Method and path	What
`GET, POST /v1/pools`	List and create pools
`GET, PATCH /v1/pools/{id}`	One pool, including owner options per pool
`GET /v1/pools/{id}/state`	Current state per quantity
`GET /v1/pools/{id}/measurements?from=&to=&q=`	History; points as `[ts, value, status, thing]`
`GET, POST /v1/pools/{id}/sources; DELETE /v1/pools/{id}/sources/{thing}`	Activate a box with its pairing code; release it
`POST /v1/pools/{id}/erase`	Erase a pool with its data (administrator)
`POST /v1/pools/{id}/remote/preview; PUT /v1/pools/{id}/remote`	Preview and switch remote monitoring for a pool (administrator; switching on needs `confirmation: true`)
`GET /v1/firmware; GET /v1/firmware/{board}/{build}/{channel}`	Firmware versions per channel; manifest with download links valid for five minutes (active subscription or trial month; not in the demo)
`GET, POST /v1/pools/{id}/external-devices`	External devices of a pool (administrator)
`GET, DELETE /v1/pools/{id}/external-devices/{thing}`	One external device; revoke
`POST /v1/pools/{id}/external-devices/{thing}/certificate`	Sign a certificate from `{csr}`

38.5 Alerts

Method and path	What
`GET /v1/alerts?status=&pool=&days=`	Alerts
`POST /v1/alerts/{id}/ack`	Acknowledge
`GET, PATCH /v1/alert-settings`	Partner defaults
`GET, PATCH /v1/pools/{id}/alert-limits`	Limits per pool
`GET, PATCH /v1/me/alert-mail`; `POST /v1/me/alert-mail/test`	Own email alerts; test email (at most once per 5 minutes)

38.6 Visits

Method and path	What
`GET, POST /v1/visits`	Visits (range at most 62 days; filter by technician, pool, status)
`GET, PATCH, DELETE /v1/visits/{id}`	One visit
`GET, POST /v1/visit-routes`	Optimised route per technician per day
`GET, PATCH /v1/visit-settings`	Depot and defaults (administrator)

38.7 Boxes: commands, settings and control

Method and path	What
`GET, POST /v1/pools/{pool}/boxes/{thing}/commands`	Send a command and list recent commands with status
`GET, PATCH /v1/pools/{pool}/boxes/{thing}/settings`	Box settings through the device shadow, with revision check
`GET, POST /v1/pools/{id}/control`	Owner and partner controls (switch outputs on switching builds)

Rules, limits and statuses: Remote commands and settings.

38.8 Related pages

- Authentication and access
- Device messages (MQTT)

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

39 Device messages (MQTT)

On this page: the MQTT topics of a Lutra box, when it sends what, the common envelope, telemetry versions, events and the device shadow. External devices use a subset; see External devices.

39.1 Topics

Topic	Direction	Contents
`lutra/v1/{thingName}/telemetry`	box to cloud	Readings, every `interval_s` (default 300 s) and on a state change
`lutra/v1/{thingName}/events`	box to cloud	Immediately: alarms, DI changes, bus errors, start-up, updates, crash summaries
`lutra/v1/{thingName}/cmd`	cloud to box	Signed commands from the fixed list
`lutra/v1/{thingName}/cmd/result`	box to cloud	Result of a command, with old and new value
`$aws/things/{thingName}/shadow/...`	both	Settings: desired by the cloud, reported by the box

The device policy allows a box only its own topics. Messages are published with QoS 1.

39.2 When a box sends

- Telemetry every `interval_s` seconds (30 to 3600, default 300) and immediately when a state changes (points, device reachable, status, on/off and mode; not ordinary measured numbers), at most once per 30 seconds.
- Events immediately.
- A box only connects with a complete identity, a valid clock and a network. It creates messages as soon as it has an identity and a valid clock, also without network; they wait in the offline buffer.

39.3 Envelope and duplicates

- Every message carries a start-up counter `boot` and a sequence number `seq`; the pair is unique per box. The cloud drops duplicates, so resending is always safe.
- Only values with status `ok` count as a reading. Values that are not valid (no flow, no answer, unknown) travel separately, so the cloud can show why a value is missing.

39.4 Telemetry versions

Version	Adds
`"v": 2`	Readings per device with the device's fixed `id` (`d1` to `d8`), so the cloud links readings to the device, not to a position in a list
`"v": 3`	`pts`: the box's own points as quantities, for example digital input roles (`cover_state`, `pump_running`)

Device readings use the profile's own point names; the cloud maps them to quantities through the profile. Each resulting row has a status: `ok`, `out_of_range`, `invalid`, `no_flow`, `comm_error`, `no_answer` or `unknown`.

> **To be confirmed**
>
> A complete field-by-field schema of box telemetry and events is not published yet. External devices use the simpler, documented `"v": 3` format in External devices.

39.5 Events

Examples of events a box sends: start-up, input changes, `ota_restart`, `ota_ok`, `ota_failed`, `ota_rollback`, and in the switching build `output_change`, `output_refused`, `alarm_on`, `alarm_off`, `backwash_done`, `aborted_by_restart`, `stopped_for_update`.

39.6 Device shadow

The shadow carries ordinary settings both ways.

- `reported` (box): firmware version, `build` (`read` or `switching`), `board`, settings with their revision (`"rev": {"cfg": N}`), refused wishes in `rejected`, and in the switching build the list of `outputs`.
- `desired` (cloud): a wish, which must carry the base revision it was made on (`"base_rev": {"cfg": N}`).
- The box processes a wish, then clears everything it saw from `desired`: `desired` works as a mailbox.

Details of the revision rule: Remote commands and settings.

39.7 Related pages

- Remote commands and settings
- Authentication and access
- Quantities

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

40 Remote commands and settings

On this page: the two ways the cloud can act on a box (signed commands and shadow settings), the rules the firmware enforces, the revision rule that makes “on site wins” work, and remote switching for switching builds. The portal side is described in Remote panel.

40.1 Principles

- Remotely you can only read data, change a few settings and request an update.
- Limits are compiled into the firmware. The server can only make them stricter.
- The network, “changes from the cloud” (switching it on), output functions and calibration are only changed on site.
- Every change is logged with old value, new value, who and the owner’s consent ID, on the box and in the cloud.
- Commands through the API (except `ota_check`) and switching need remote monitoring on the pool, or the partner’s trial month. Without it the API answers `402` with error `remote_monitoring_required`. See Subscription and pricing.

40.2 Command list

Only these commands exist; the firmware refuses anything else.

Command	Purpose	Notes
`get_diag`	Diagnosis	Read only
`get_logs`	Last log lines	Optional `lines` 1 to 200 (default 50), `level` `E`, `W`, `I`, `D` or `V` (minimum level). Firmware 0.2.5 and later; the answer is at most 4096 characters, oldest lines dropped first (`truncated`)
`busscan`	Scan the RS485 bus	At most once per hour remotely
`ota_check`	Fetch and install a signed update	See Updates and channels
`set_ph_setpoint`	pH target of the equipment	Proposed limits 7.0 to 7.6, at most 0.2 per command
`set_orp_setpoint`	ORP target	Proposed 650 to 780 mV, at most 50 mV per command
`set_ppm_setpoint`	Free chlorine target	Proposed 0.5 to 2.0 ppm
`set_production`	Cell production	Proposed 10 to 100 %, at most 30 percentage points per command
`revert_last`	Undo the last change	
`set_output`	Switch an output	Switching build only; the read build always answers `not_supported`

To be confirmed

The limits of the write commands are proposals and must be fixed per setting and per brand. The read build answers `not_supported` to all write commands, so they have no effect today.

40.3 Rules enforced by the firmware

1. Every command carries a command ID, a timestamp (at most 5 minutes old), the owner's consent ID and a signature of the Lutra command service (ECDSA P-256, key in AWS KMS). The box verifies it with the public key in its firmware. A repeated command is refused (`replay`), a tampered one is not executed.

2. Write commands require “changes from the cloud” (`remote_ok`) to be on. It is switched on only on site; it can be switched off remotely.
3. Rate limits on the box: at most 20 commands per hour in general, 40 per hour for `set_output`, and at most 4 changes per hour per setting.
4. After a write the box reads the value back; a mismatch is reported as an error without a second attempt.

The API adds its own limits: at most 10 commands per box per hour, and 30 switching commands per box per hour.

40.4 Command statuses

Status	Meaning
`sent`	Published to the box
`executed`	Done, with `detail`
`rejected`	With the firmware’s reason, for example `not_allowed`, `stale`, `replay`, `signature`, `not_supported`, `limit:for_s`
`no_response`	No result within 60 seconds
`failed`	Signing or publishing failed

40.5 Settings through the device shadow

Ordinary settings travel through the device shadow:

Setting	Values	Remote
`interval_s`	30 to 3600 seconds, default 300	Yes
`remote_ok`	true or false	Only to false
`tz`	POSIX time zone string, for example `CET-1CEST,M3.5.0,M10.5.0/3`, `IST-5:30`, `AST4`; default `UTC0`	Yes, firmware 0.2.8 and later; the portal picks an IANA zone and the API converts it
Bus devices, network, input roles		No: on site only (`only on site`)

40.5.1 The revision rule

Rule: the cloud may never change something on the box that was changed on site and that the cloud did not yet know. Settings are therefore only changed on the basis of current data.

1. Each group of settings has a revision `rev` (a random start value, plus one for every change, on site or remote). The box reports it as `"rev": {"cfg": N}`.

2. A wish in `desired` must carry `"base_rev": {"cfg": N}` equal to the current revision. Missing or different: the change is refused as `stale` and nothing is applied.
3. A key with the same value as now is not a change and is never refused, so duplicate delivery is harmless.
4. After every processed wish the box clears `desired`.
5. A change on site clears pending wishes and raises the revision, so a wish that was still on its way becomes `stale`.

The API checks the same before writing: it reads the shadow fresh and refuses with `409` when the revision differs (`stale`), when the firmware reports no revision (`no_rev`; older firmware would apply a wish without checking), when the box has not reported recently (`not_current`: last telemetry older than 2 x `interval_s` + 60 s), when a wish is already pending (`already_pending`), or when the value is unchanged (`no_change`). A conflict between two portal users gives `409 conflict`.

40.6 Switching outputs

`set_output` (switching build only):

Argument	Value
`fn`	`pump`, `backwash`, `heat_enable`, `fill`, `light` or `aux`
`state`	`on` or `off`; for `pump` also `1`, `2`, `3`
`for_s`	Optional, 0 to 86400 seconds; omitted or 0 means the function's maximum
`confirm`	Optional boolean; `true` is required to switch on `pump`, `backwash` or `heat_enable`

- Off is always allowed, also without `remote_ok`. On requires `remote_ok`. `fill` can only be switched off.
- The API offers switching only when the shadow reports `"build": "switching"` with a list of `outputs`.
- `ok` means "request accepted"; whether the output really changes is decided by the interlocks in the next cycle and shown in `reported.outputs`. See Switching build.

40.7 Related pages

- Remote panel
- Device messages (MQTT)
- Switching build

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

41 External devices

Integration guide for partners and device makers: how to send readings from your own device to Lutra. In the portal, **Settings > API and integrations** links here, also to the sample clients; you add the devices themselves per pool, under **Devices**.

On this page: what you need, registering the device, the message format, sending over HTTPS and MQTT, the sample clients and a security summary.

Lutra can log readings from measuring equipment that is not a Lutra box: your own controller, a PLC, a probe with a network connection. Running your own PLC? See Connecting a PLC for a PLC-specific outline. Once connected, the readings show up in the pool in the Lutra portal with history, charts, alerts, the water profile and the owner view, marked as “Own device (logging only)”.

Write only. Your device can only send readings. Lutra never sends anything to it: no commands, no settings, no updates. The device’s certificate does not allow it to subscribe or receive, so even a mistake on our side cannot reach your equipment.

41.1 1. What you need

- A device that can make a TLS 1.2 connection with a client certificate (mTLS) to port 8883 (MQTT) or 8443 (HTTPS).
- OpenSSL (or any tool that can make an EC P-256 key and a certificate signing request, CSR) on that device.
- An administrator of your Lutra partner account who adds the device to a pool in the portal. See Team and administration.

41.2 2. Register the device

1. In the portal, open the pool, go to **Devices** > **Own devices** and choose **Add own device**. Give it a name and, optionally, the make or model. The portal shows a device ID such as `lutra-ext-0a1b2c3d4e5f`.
2. On the device itself, create a key and a CSR whose common name (CN) is exactly that device ID:

   ```
   openssl ecparam -name prime256v1 -genkey -noout -out lutra.key
   openssl req -new -key lutra.key -subj "/CN=lutra-ext-0a1b2c3d4e5f" -out
   lutra.csr
   ```

   The key (`lutra.key`) never leaves the device. Do not paste it anywhere, do not email it.
3. Paste the contents of `lutra.csr` in the portal and choose **Create certificate**. Download the certificate (`lutra.crt`) and the settings file (`lutra-extern.json`: endpoint, device ID, topic).
4. Download the AWS root CA: https://www.amazontrust.com/repository/AmazonRootCA1.pem.

Lost the key, or replacing the device? Revoke it in the portal and add a new one. A revoked certificate stops working: new connections and HTTPS requests are refused. The history of the pool stays.

41.3 3. Message format

One JSON object per message, UTF-8, at most 4 KB:

```
{"v": 3, "ts": 1795242969, "seq": 42, "pts": {"ph": 7.2, "orp": 720,
"water_temp": 27.5, "pump_running": true}}
```

Field	Required	Meaning
`v`	yes	always `3`
`ts`	yes	time of the reading, whole seconds since 1970 (UTC). At most 7 days old and at most 2 minutes in the future
`pts`	yes	readings: `{quantity: value}`, 1 to 40 entries
`seq`	no	your own message counter (whole number), helps us spot gaps
`boot`	no	your own restart counter (whole number)
`units`	no	`{quantity: unit}` as a check; must be the Lutra unit (see below). Lutra never converts
`fw`	no	your software version (text)

Anything else in the message, or a field `thing`, makes Lutra drop the message.

Quantities and units (selection; the full list is in Quantities):

Quantity	Unit	Range	Type
`ph`	pH	0 to 14	number
`orp`	mV	−1500 to 1500	number
`free_cl`, `combined_cl`	mg/l	0 to 20	number
`salt`	g/l	0 to 60	number
`water_temp`	°C (or `C`)	−5 to 60	number
`air_temp`, `outdoor_temp`	°C	−40 to 70 (`outdoor_temp` −40 to 60)	number
`flow_rate`	m3/h	0 to 500	number
`filter_pressure`	kPa	0 to 1000	number
`pump_speed`	%	0 to 100	number
`pump_running`, `flow`, `heater_on`, `light`			true or false
`cover_state`			`open`, `closed`, `moving`, `unknown`

A reading with an unknown quantity, the wrong type, or a value outside the range is dropped; the rest of the message is kept. Need a quantity that is not in the list? Ask us; we add it for everyone rather than allowing free names.

Rate: at most 12 messages per minute per device; more are dropped. Every 1 to 5 minutes, plus on a clear change, is plenty.

Keep sending when there is nothing to measure: after 30 minutes without a message Lutra reports the device offline. Many installations only measure water with the pump running (no flow, no valid pH or temperature), so a planned pump pause would look like a dead device. Send the pump state as well (`pump_running`, `flow`, and where known `pump_speed` and `flow_rate`); those are valid during a pause, so every message still has at least one reading. Silence then really means the device, its source, or the network is down.

41.4 4. Sending over HTTPS (port 8443)

Endpoint for all devices: `iot.lutrapool.com` (HTTPS 8443, MQTT 8883). The settings file from the portal has it too.

The topic goes URL-encoded in the path (`/` becomes `%2F`):

```
curl --tlsv1.2 --cacert AmazonRootCA1.pem --cert lutra.crt --key lutra.key \
  -H 'content-type: application/json' \
  --data '{"v":3,"ts":1795242969,"pts":{"ph":7.2,"water_temp":27.5}}' \
```

```
  'https://iot.lutrapool.com:8443/topics/lutra%2Fv1%2Flutra-ext-0a1b2c3d4e5f%2
Ftelemetry?qos=1'
```

HTTP 200 means AWS IoT accepted the message. It does not mean every reading was valid (see Message format). HTTP 403 means the certificate is not (or no longer) allowed to publish to this topic: check the device ID in the URL and that the device was not revoked.

Python without extra libraries:

```
import http.client, json, ssl, time, urllib.parse

THING = "lutra-ext-0a1b2c3d4e5f"
ctx = ssl.create_default_context(cafile="AmazonRootCA1.pem")
ctx.load_cert_chain("lutra.crt", "lutra.key")
c = http.client.HTTPSConnection("iot.lutrapool.com", 8443, context=ctx,
timeout=10)
path = "/topics/" + urllib.parse.quote(f"lutra/v1/{THING}/telemetry", safe="")
+ "?qos=1"
body = json.dumps({"v": 3, "ts": int(time.time()), "pts": {"ph": 7.2}})
c.request("POST", path, body=body, headers={"content-type": "application/
json"})
print(c.getresponse().status)
```

41.5 5. Sending over MQTT (port 8883)

The MQTT client ID must be exactly the device ID. Publish with QoS 1 to `lutra/v1/<device ID>/telemetry`. Do not subscribe to anything: it is refused.

```
import json, time
import paho.mqtt.client as mqtt  # paho-mqtt 2.x

THING = "lutra-ext-0a1b2c3d4e5f"
c = mqtt.Client(mqtt.CallbackAPIVersion.VERSION2, client_id=THING)
c.tls_set(ca_certs="AmazonRootCA1.pem", certfile="lutra.crt",
keyfile="lutra.key")
c.connect("iot.lutrapool.com", 8883)
c.loop_start()
msg = {"v": 3, "ts": int(time.time()), "pts": {"ph": 7.2, "water_temp": 27.5}}
c.publish(f"lutra/v1/{THING}/telemetry", json.dumps(msg),
qos=1).wait_for_publish()
c.disconnect()
```

41.6 6. Sample clients

The snippets in sections 4 and 5 are the smallest working clients: an HTTPS request with `curl` or plain Python, and an MQTT publish with Python and paho-mqtt. For a device that should keep sending, there is a complete reference client in Python.

Reference client. Download `lutra_extern.py` (Python 3, standard library only for HTTPS; paho-mqtt 2.x only if you send over MQTT). Start from the settings file `lutra-extern.json` from step 2 and add where the readings come from (`source`) and how they map to Lutra quantities (`fields`); the full list of settings is at the top of the

script. Use it as it is, or as an example for a client in another language: the message format is all a client needs to follow.

`lutra_extern.py` reads a status file or a local status URL of your controller (read only: one file read or one HTTP GET per round; a local API token can be read from a file with `"token_file"` and is sent as `X-Api-Token`, never logged), maps fields to Lutra quantities and sends them over HTTPS (or MQTT with paho-mqtt). A failure on either side is logged and skipped; it never touches your controller.

Stale values. Many controllers keep the last reading in their status after a sensor or bus failure. Sent on, that looks like a fresh measurement, which is worse than no value. A field in `fields` can therefore be an object instead of a path, with conditions; if one fails, that quantity is left out of the message (the rest is sent):

```
"fields": {
  "water_temp": "devices.pool_water_temp.values.temp_C",
  "ph": {"path": "devices.elite.values.ph",
         "only_if": "devices.elite.values.online",
         "time": "devices.elite.values.last_ok", "max_age_s": 120}
}
```

Key	Meaning
`path`	path to the value (required)
`only_if`	path to a flag that must be exactly `true` (not 1, not `"true"`); missing counts as false
`time` + `max_age_s`	path to the time of the last good reading (seconds since 1970) and the maximum age in seconds; missing, not a number, too old or more than 2 minutes in the future counts as stale. Always together

```
python3 lutra_extern.py --config /etc/lutra-extern/config.json --once --dry-
run   # print one message
python3 lutra_extern.py --config /etc/lutra-extern/config.json
# run
```

Example systemd unit (`/etc/systemd/system/lutra-extern.service`), as its own user with read access to the status file only:

```
[Unit]
Description=Send pool readings to Lutra (write only)
After=network-online.target

[Service]
User=lutra-extern
ExecStart=/usr/bin/python3 /opt/lutra-extern/lutra_extern.py --config /etc/
lutra-extern/config.json
Restart=always
RestartSec=30
```

```
NoNewPrivileges=true
ProtectSystem=strict
ReadOnlyPaths=/

[Install]
WantedBy=multi-user.target
```

41.7 7. Security summary

Identity	one X.509 certificate per device, key made on the device, signed by AWS IoT Core
Allowed	connect as itself; publish to its own `lutra/v1/<device ID>/telemetry`
Not allowed	subscribe, receive, device shadow, jobs, retained messages, any other topic
Where the data goes	only to the pool the device was added to, from the moment its certificate was created
Revoking	in the portal (administrator); the certificate is deactivated at AWS IoT and detached from the device, and readings no longer reach the pool

41.8 Related pages

- Connecting a PLC
- Quantities
- Authentication and access
- Choose hardware and build

Last reviewed: 2026-11-25. Applies to Lutra Lite 0.4.1.

42 Connecting a PLC

On this page: when a PLC should send its readings to Lutra directly, the integration path, an outline for Phoenix Contact PLCnext, a worked message for an overflow pool with a buffer tank, why Lutra sends no commands to a PLC, a testing checklist and troubleshooting.

This page is for installers and system integrators who already control the pool plant with their own PLC, for example a Phoenix Contact PLCnext controller, Siemens, Beckhoff, Wago or a Codesys-based controller, and who want the readings in Lutra Insight with history, charts, alerts and the owner view.

42.1 When to use this

- **The PLC keeps control.** Pumps, valves, refill, backwash and heating stay in your PLC program, with your own interlocks. Lutra only receives readings.

- **No Lutra box next to the PLC.** The PLC sends its readings itself, through the external devices API. With no second controller in the plant room there is never doubt about who switches what.
- **Write only.** The device certificate only allows the PLC to publish its own readings. Lutra cannot send anything to the PLC. See Commands from Lutra to the PLC.

If the PLC is the master of a Modbus bus and you still want a Lutra box to read that bus, the box must run in listen-only mode; see Bus devices and inputs. For a PLC with network access, sending directly as described here is the simpler path.

42.2 The integration path

The PLC is an external device. Everything below is documented in External devices; this is a summary, not a replacement.

1. **Register**: an administrator adds an own device to the pool in Lutra Insight and gets a device ID such as `lutra-ext-0a1b2c3d4e5f`. See Register the device.
2. **Certificate**: a key pair is made on the PLC, a CSR with the common name (CN) exactly equal to the device ID is pasted in the portal, and the signed certificate is installed on the PLC together with the Amazon root CA.
3. **Connect** with TLS 1.2 and that client certificate to `iot.lutrapool.com`:
   - MQTT on port 8883: client ID exactly the device ID, publish with QoS 1 to `lutra/v1/<device ID>/telemetry`, no subscriptions, see Sending over MQTT; or
   - HTTPS POST on port 8443 to the same topic, URL-encoded in the path, see Sending over HTTPS.
4. **Message**: one JSON object with `v` (always `3`), `ts` (UTC seconds since 1970) and `pts` (`{quantity: value}`, 1 to 40 entries), at most 4 KB. Optional: `seq`, `boot`, `units`, `fw`. Any other field makes Lutra drop the whole message. See Message format.
5. **Quantities**: only keys from the Quantities catalogue, in the Lutra unit and range. Lutra never converts units. A reading with an unknown key, the wrong type or a value out of range is dropped; the rest of the message is kept.
6. **Rate**: at most 12 messages per minute per device. Every 1 to 5 minutes, plus on a clear change, is enough. After 30 minutes without a message the device shows as offline.

The same path works for any PLC brand. Before you start, check that the controller's MQTT or HTTPS client supports all of the following; a client that misses one of them will not work with Lutra:

- TLS 1.2 with a client certificate and private key (mutual TLS), not only a username and password;
- a CA you choose (the Amazon root CA);
- for MQTT: a client ID you set freely, a topic you set freely, QoS 1, and no retained messages;
- a payload you build yourself as a JSON text;
- a clock synchronised to NTP, so that `ts` is correct.

42.3 PLCnext: what is available

This section summarises Phoenix Contact's public documentation as checked on 2026-11-24. Lutra has not tested a PLCnext controller yet. Names of menus and function blocks change between firmware versions: always check the PLCnext Info Center for your controller and firmware.

Option	What Phoenix Contact documents	Fit for Lutra
Built-in MQTT client (firmware 2024.0 LTS and later)	Publishes OUT ports marked for Proficloud to a broker set as "Other MQTT Broker" in Web-based Management (WBM); publish only; TLS with an Identity Store and a Trust Store; QoS currently fixed at 0 ("at most once"); the client ID is combined with the device UUID [1] [2]	Probably not: the payload is not a message you define, the client ID is not exactly the device ID, and QoS 1 is not available. Not tested
MQTT Client function block in the IIoT library, free in the PLCnext Store [1]	An MQTT client inside your PLCnext Engineer project; Phoenix Contact recommends it for connecting to more than one broker [1]	The preferred route to check. Whether it takes a client certificate and key (not only a server CA) is not verified: check the library documentation
An app on the controller's Linux system	PLCnext controllers run Linux; the admin user has a matching Linux user [3]. PLCnext Store apps include Function Extensions, which can be "an extension of a runtime, a container or a command line tool" [4]	Possible for HTTPS POST (or MQTT) from your own program or container. Which languages and tools are available depends on the controller and firmware: check the Info Center

Libraries from the PLCnext Store ("PLCnext Engineer Library") are imported into PLCnext Engineer; apps are installed online from the Store or offline through WBM [4] [5].

Certificates on PLCnext. WBM keeps your own identities (an X.509 certificate with its private key) in an **Identity Store** and the certificates of trusted partners in a **Trust Store** [6]. From firmware 2025.0, WBM can generate a key pair in an Identity Store, generate a CSR for download, and upload the signed certificate as PEM [7]. That

matches the Lutra flow: the key is made on the PLC and never leaves it. AWS IoT Core, which signs the certificate, accepts RSA keys of at least 2048 bits and ECC keys on the NIST P-256, P-384 or P-521 curves [8]; choose one of those as the key type.

To be confirmed

For PLCnext firmware older than 2025.0 the Info Center documents importing a key pair and certificate into an Identity Store, but not generating a CSR on the controller [6]. Making the key on a computer and uploading it breaks the rule that the key never leaves the device. Whether Lutra accepts that for older firmware is not decided; ask Lutra first.

42.3.1 Step outline for PLCnext

1. **Check the firmware version** of the controller in WBM. It decides which MQTT client options and which certificate pages you have.
2. **Register the device** in Lutra Insight: open the pool, **Own devices**, **Add own device**. Note the device ID. See Team and administration.
3. **Create the identity on the controller**: in WBM, under certificate management, add an Identity Store, generate a key pair (EC P-256, or RSA 2048 or larger), and generate a CSR with the common name exactly equal to the device ID. Download the CSR.
4. **Get the certificate**: paste the CSR in the portal, choose **Create certificate**, download `lutra.crt` and upload it as the certificate of that Identity Store.
5. **Trust the server**: add `AmazonRootCA1.pem` (https://www.amazontrust.com/repository/AmazonRootCA1.pem) to a Trust Store.
6. **Install the MQTT client**: import the IIoT library from the PLCnext Store into your PLCnext Engineer project, or install your own app for HTTPS. For the inputs of the MQTT client (broker, port, client ID, TLS identity, QoS, topic) check the library documentation; Lutra does not document vendor function blocks.
7. **Map PLC variables to the message**: build the JSON text in the program from your variables, in Lutra units (see the example). Leave out a quantity when the PLC knows its value is not valid (sensor fault, no flow through the measuring cell) instead of sending the last value.
8. **Publish every 60 to 300 seconds**, plus on a clear change (pump starts or stops, refill valve opens). Never more than 12 messages per minute.
9. **Run the testing checklist.**

42.4 Example: overflow pool with buffer tank

An overflow pool where the PLC runs the filter pump with a variable-speed drive, controls refill from float switches in the buffer tank, reads pH, ORP and free chlorine in a flow cell, and starts a heat pump. One message, built by the PLC every two minutes:

```
{
  "v": 3,
  "ts": 1795242969,
```

```
  "seq": 1842,
  "boot": 7,
  "fw": "pool-plc 2.1",
  "pts": {
    "ph": 7.25,
    "orp": 735,
    "free_cl": 0.8,
    "water_temp": 28.4,
    "flow": true,
    "flow_rate": 42.5,
    "pump_running": true,
    "pump_speed": 80,
    "filter_pressure": 85,
    "level_low": false,
    "level_fill": false,
    "level_high": false,
    "fill_valve": false,
    "backwash": false,
    "heatpump_on": true,
    "outdoor_temp": 14.2
  }
}
```

Quantity	From the PLC	Note
`ph`, `orp`, `free_cl`	measuring cell transmitters	Leave out when there is no flow through the cell or the transmitter reports a fault
`water_temp`	temperature sensor in the return line	°C
`flow`	flow switch on the measuring cell	`true` or `false`, never `1` or `0`
`flow_rate`	flow meter	m3/h
`pump_running`, `pump_speed`	drive status and speed	`pump_speed` in % of maximum
`filter_pressure`	pressure sensor before the filter	**kPa**: a value in bar times 100 (0.85 bar is `85`)
`level_low`, `level_fill`, `level_high`	float switches in the buffer tank	The catalogue does not say which vessel; in an overflow pool these are the buffer tank switches that drive refill
`fill_valve`, `backwash`	output states	`true` while the valve is open or backwash runs
`heatpump_on`	output or feedback contact	
`outdoor_temp`	outdoor sensor	°C

All keys are in the Quantities catalogue. Sending the pump state in every message keeps the device online during a planned pump pause, when the water readings are left out.

To be confirmed

Quantities for an overflow pool with analogue level and pressure measurement are planned but not in the catalogue yet: **buffer tank level**, **pressure vessel pressure** and **overflow level** (as a height in cm or m). Their keys, units and ranges are not decided. Until they are added, do not send them: an unknown key is dropped. Lutra adds new quantities to the catalogue for everyone; ask Lutra if you need one.

42.5 Commands from Lutra to the PLC

Not available. The external devices API is write only: the device certificate cannot subscribe or receive, so nothing from Lutra can reach the PLC. Setpoints, schedules and switching stay in the PLC program and its own HMI.

> **To be confirmed**
>
> Sending commands from Lutra to a PLC (for example starting a backwash) is a possible future option, and only for installations where the PLC itself enforces all interlocks, so that a command from Lutra can never bypass them. There is no design or date for it.

42.6 Testing checklist

- ☐ The device appears in Lutra Insight under **Own devices** of the right pool, with a certificate created.
- ☐ The PLC clock is synchronised to NTP, and `ts` is UTC seconds since 1970, not local time.
- ☐ One test message sent by hand (for example with the `curl` command in External devices from a laptop with a test device, or a single publish from the PLC) shows up in the pool.
- ☐ Every value is in the Lutra unit (kPa, m3/h, °C, mg/l, mV) and in range; booleans are `true` or `false`.
- ☐ The message contains only `v`, `ts`, `pts` and the optional fields; no `NaN` or `Infinity` (not valid JSON).
- ☐ The interval is 60 to 300 seconds; never more than 12 messages per minute, also after a restart or a reconnect with a backlog.
- ☐ During a planned pump pause the PLC keeps sending (pump state), and the device stays online.
- ☐ A sensor fault or no flow leaves that quantity out instead of repeating the last value.
- ☐ Unplugging the network for longer than 30 minutes shows the device offline, and it recovers on its own.
- ☐ The private key cannot be read from outside the PLC, and no copy exists elsewhere.

42.7 Troubleshooting

Symptom	Likely cause	Check
TLS handshake fails	Wrong CA, certificate not matching the key, or TLS older than 1.2	Trust Store holds `AmazonRootCA1.pem`; the certificate uploaded to the Identity Store is the one signed for this CSR; host is `iot.lutrapool.com`
No connection at all	Outbound port blocked	Firewall allows outbound TCP 8883 (MQTT) or 8443 (HTTPS); DNS works on the PLC
TLS fails right after commissioning, or after a battery change	PLC clock wrong, so the certificate looks not yet valid or expired	Set NTP; check date and time in WBM or the PLC
MQTT connects and is closed at once	Client ID is not exactly the device ID, a subscription was attempted, the topic is wrong, the retained flag is set, or the device was revoked	Client ID and topic `lutra/v1/<device ID>/telemetry`; no subscriptions; retain off; device status in the portal
HTTPS returns 403	Device ID in the URL is wrong, or the device was revoked	URL-encoded topic in the path; device status in the portal
Accepted, but nothing appears	`ts` more than 7 days old or more than 2 minutes in the future (often local time instead of UTC); a field outside the envelope; `v` not `3`; message larger than 4 KB	Compare `ts` with the current UTC time; remove extra fields
Some readings missing	Unknown key, wrong type (`"7.2"` as text, `1` for a boolean) or value out of range	Keys and ranges in Quantities
A value is a factor 100 off	Wrong unit, for example pressure in bar instead of kPa	Convert in the PLC; Lutra never converts
Gaps in the history	More than 12 messages per minute (extra ones dropped), or no message for 30 minutes	Publish interval; `seq` helps find gaps

42.8 Sources

Checked on 2026-11-24.

1. Phoenix Contact, PLCnext Info Center, “Communication via MQTT broker”: https://plcnext.help/te/Communication_interfaces/Communication_via_MQTT.htm
2. Phoenix Contact, PLCnext Info Center, WBM “Configuration: Proficloud services” (MQTT broker and time series data settings): https://plcnext.help/te/WBM/Configuration_Proficloud_Services.htm
3. Phoenix Contact, PLCnext Info Center, “User rights”: https://plcnext.help/te/Operating_System/Root_rights.htm
4. Phoenix Contact, PLCnext Store Info Center, “App types”: https://store.plcnext.help/st/App_types.htm
5. Phoenix Contact, PLCnext Info Center, “PLCnext Store resources”: https://plcnext.help/te/Functions_and_applications/PLCnext_Store_resources.htm
6. Phoenix Contact, PLCnext Info Center, WBM “Certificate authentication” (firmware up to 2024.6): https://plcnext.help/te/WBM/Security_Certificate_authentication.htm
7. Phoenix Contact, PLCnext Info Center, WBM 2 “Certificate management” (firmware 2025.0 and later): https://www.plcnext.help/te/WBM2/WBM2_Security_Certificate-management.htm
8. AWS IoT Core API reference, “CreateCertificateFromCsr”: https://docs.aws.amazon.com/iot/latest/apireference/API_CreateCertificateFromCsr.html

42.9 Related pages

- External devices
- Quantities
- Choose hardware and build
- Team and administration

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

43 Cloud connections

A cloud connection lets Lutra fetch measurements from a vendor’s cloud and file them under the right pool, next to what a Lutra box measures and what a technician enters by hand. You set it up once for your whole company: one connection covers all your customers in that vendor’s cloud.

In the portal: **Settings > API and integrations > Cloud connections**. Only an administrator of your partner account sees this section; technicians and pool owners only see the results (the measurements on the pool, with their source).

43.1 Available connections

Connection	Vendor	What comes in	Status	Guide
LabCOM (PoolLab)	Water-i.d. GmbH	Photometer tests (pH, free and combined chlorine, cyanuric acid, alkalinity) as manual tests	Beta	PoolLab via LabCOM

Beta means the vendor does not publish an official API for this. Lutra only reads, never writes, and shows an error on the connection if the vendor changes something.

43.2 How every connection works

1. **Connect.** Paste the access key (an API token) that the vendor gives you. Lutra stores it encrypted, never shows it again and only uses it to read.
2. **Link sampling points to pools.** Lutra lists the vendor's sampling points (locations, customers) with their latest measurements. Per point you choose an existing pool, create a new pool from it, or skip it. One **Apply** saves all choices.
3. **Done.** Every 15 minutes Lutra checks for anything new. Points that appear later at the vendor show up at the top as new, ready to link.

Removing a connection deletes the stored token and all links to pools. Measurements that came in stay on the pools unless you choose to delete them as well. Revoke the token at the vendor too; Lutra cannot do that for you.

43.3 Is your system not listed?

- Your own controller, PLC or probe can send readings directly: see External devices and Device messages (MQTT).
- Your software can read and write through the REST API.
- Want a vendor cloud added? Mail info@lutrapool.com with the system and, if you have it, a link to the vendor's API documentation.

Last reviewed: 2026-11-25. Applies to Lutra Lite 0.5.5.

44 PoolLab via LabCOM

PoolLab and PrimeLab photometers from Water-i.d. sync their tests to the LabCOM cloud. With this connection Lutra fetches those tests and files them under the right pool as manual tests, marked PoolLab via LabCOM. They show up in the pool's chart and test list, and cyanuric acid and alkalinity update the water profile.

The connection is **beta**: Water-i.d. does not publish official API documentation. Lutra only reads.

44.1 1. Get the API token

1. Log in at labcom.cloud.
2. Go to **Profile > Settings > GraphQL API** (direct link).
3. Copy the token.

The token gives access to everything in that LabCOM account, including writing. Lutra never writes, but it is good practice to use a separate LabCOM account for Lutra and share your sampling points with it, if your LabCOM setup allows that. If the token was ever shared by mistake, renew it in LabCOM and replace it in Lutra.

44.2 2. Connect in Lutra

1. In the portal go to **Settings > API and integrations > Cloud connections**.
2. On **LabCOM (PoolLab)** choose **Connect**, paste the token and save.

Lutra stores the token encrypted and never shows it again. The card then shows when and by whom it was set, with **Replace** and **Remove**. Within 15 minutes the sampling points appear.

44.3 3. Link sampling points to pools

Lutra lists every LabCOM sampling point with its name, Identifier, place, volume and its most recent measurements. For each point choose:

- **an existing pool**: Lutra suggests one when the point's Identifier matches the pool code (see below) or, less certain, when the names look alike;
- **New pool**: Lutra creates a pool with the point's name and volume (no customer is created; link the pool to a customer yourself if you want);
- **Skip**: leave the point out; you can still link it later.

Then choose **Apply**. For every linked point Lutra fetches the tests of the last 90 days, and from then on every new test.

44.3.1 Automatic matching with the Identifier

Each pool in Lutra has a short pool code: open the pool, **Devices > Cloud connections**. Enter that code in LabCOM in the **Identifier** field of the sampling point. Lutra then suggests that pool with certainty; you confirm with one click. Upper and lower case and spaces do not matter.

44.4 New customers later

1. Create the sampling point in LabCOM itself (in the LabCOM app or on labcom.cloud; see LabCOM's own help for how). Lutra cannot create sampling points.
2. Do a test with the PoolLab and let it sync.
3. Within 15 minutes the point appears at the top of the list in Lutra as new, with that test. Link it to a pool or create a new pool from it, and choose **Apply**.

Tests of a point that is not linked are only shown in this list; they are filed under a pool once you link it.

44.5 What Lutra reads

Reads	Does not read
Sampling points: name, Identifier, place, pool text, volume	Street, postal code, phone, email, GPS, notes
Tests: parameter, value, unit, time, device serial number	Name of the person who measured, comments

Tests Lutra does not recognise yet are skipped (not guessed) and counted, so we can add them. Lutra never writes to LabCOM.

44.6 Times and time zones

LabCOM stores the clock time of the photometer, not UTC. Lutra therefore reads test times as local time in the pool's time zone (the pool's **Settings**), including summer and winter time. If tests on a pool appear one or two hours off, switch **Times are the pool's local time** on the connection card.

44.7 Status and errors

- **Active**: everything works; the card shows when Lutra last fetched.
- **Error**: LabCOM did not answer or answered unexpectedly; Lutra retries with growing pauses.
- **Token refused**: the token was revoked or renewed in LabCOM. Lutra stops and mails the administrators once. Choose **Replace** and paste the new token.

44.8 Unlinking and removing

- **Unlink** a point: new tests no longer go to that pool. You choose whether tests already imported stay (default) or are deleted.
- **Remove** the connection: Lutra deletes the token and all links. Imported tests stay on the pools unless you choose to delete them. Revoke the token in LabCOM as well; Lutra cannot do that.

Last reviewed: 2026-11-25. Applies to Lutra Lite 0.5.5.

45 Reference

On this page: an index of the reference material.

Page	Contents
Quantities	Every quantity with unit and range, and the statuses of a reading
Glossary	Terms in English with the Dutch words used in the portal and the code
About this documentation	Versions, formats (HTML, PDF, EPUB), plain-text files for AI tools, conventions

45.1 Related pages

- Supported devices
- REST API

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

46 Quantities

On this page: the fixed list of quantities that every source (Lutra boxes, external devices) delivers, and the statuses of a reading. Lutra never converts units on input: a value must be in the unit listed here.

A **quantity** is what a value means (for example `orp`), with a fixed unit. Devices deliver their own **points** (for example `orp_mv`); the cloud maps points to quantities through the device profile. The portal, alerts and reports work with quantities only, never with brands.

46.1 Catalogue

Generated from `packages/devices/quantities.json` in the Lutra repository.

Key	Label	Group	Type	Unit	Range or values
`ph`	pH	water	number	pH	0 to 14
`orp`	Redox (ORP)	water	number	mV	−1500 to 1500
`free_cl`	Free chlorine	water	number	mg/l	0 to 20
`combined_cl`	Combined chlorine	water	number	mg/l	0 to 20
`salt`	Salt	water	number	g/l	0 to 60
`cya`	Cyanuric acid (stabiliser)	water	number	mg/l	0 to 300
`total_alkalinity`	Total alkalinity	water	number	mg/l	0 to 500
`calcium_hardness`	Calcium hardness	water	number	mg/l	0 to 2000
`water_temp`	Water temperature	water	number	°C	−5 to 60
`flow`	Flow	water	bool		
`flow_rate`	Flow rate	water	number	m3/h	0 to 500
`level_low`	Level low	water	bool		
`level_fill`	Level refill	water	bool		
`level_high`	Level high	water	bool		
`ph_setpoint`	pH setpoint	water	number	pH	0 to 14
`orp_setpoint`	ORP setpoint	water	number	mV	−1500 to 1500
`free_cl_setpoint`	Chlorine setpoint	water	number	mg/l	0 to 20
`water_temp_setpoint`	Water temperature setpoint	water	number	°C	0 to 60
`air_temp`	Air temperature	air	number	°C	−40 to 70
`air_humidity`	Air humidity	air	number	%	0 to 100
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible], closed, moving, unknown

Some quantities accept an equivalent unit through a fixed factor in the catalogue (for example `ppm` for `mg/l`). A key is never renamed or reused. New quantities are added to the catalogue for everyone; ask Lutra.

46.2 Reading statuses

Status	Meaning
`ok`	Valid reading
`out_of_range`	Outside the catalogue range; value kept
`invalid`	The device reported a value that is not a valid measurement
`no_flow`	No flow through the measuring cell; value not counted
`comm_error`	Communication error with the device
`no_answer`	The device did not answer
`unknown`	Flow state unknown (no flow switch and the device does not report flow); value not counted

Two sources may deliver the same quantity for one pool; both are kept, and the cloud chooses per pool which one is shown first.

46.3 Related pages

- External devices
- Device messages (MQTT)
- Supported devices

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

47 Glossary

On this page: the terms used throughout this documentation, with the Dutch word where the portal or the API still uses it.

Term	Dutch	Meaning
Administrator	beheerder	Partner role with full rights for the partner. See Roles.
Box	kastje	A Lutra Lite device at a pool.
Build	build	Firmware variant: read build or switching build. See Builds.
Bus plan, device list	busplan, apparatenlijst	The devices a box reads, with address and profile. See Bus devices and inputs.
Changes from the cloud	aanpassen op afstand (`remote_ok`)	Permission, set on site, for the cloud to change settings and send write commands.
Channel	kanaal	Update stream per board and build: beta or stable. See Updates and channels.
Client	klant	The owner of one or more pools, as registered by the partner.
Device shadow	shadow	AWS IoT document with desired and reported settings of a box. See Device messages.
External device	extern apparaat	A measuring device that sends readings to Lutra without Lutra firmware. See External devices.
Factory reset	fabrieksreset	Clears network and settings, keeps identity. See LED and BOOT button.
Interlock	interlock	A condition that forces an output off. See Switching build.
Interposing relay	tussenrelais	Relay whose coil is driven by a DO output and
[illegible]	[illegible]	[illegible] commands and settings.

47.1 Related pages

- Quantities
- How Lutra fits together

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.

48 About this documentation

On this page: versions, formats, the meaning of the notes on each page, and the conventions used.

48.1 Versions

The documentation is versioned with the firmware. The version selector at the top shows which documentation version you read; `latest` follows the newest release. Each page ends with a "Last reviewed" line with the date and the Lutra Lite firmware version it applies to.

48.2 Formats

Download the whole documentation as one file: PDF or EPUB. They are generated from the same pages on every deploy, with numbered chapters.

Format	Where
HTML with search	This site
PDF and EPUB	Exported from the same Markdown source
`llms.txt`	Index of all pages with a one-line description, at the root of the site, for AI tools
`llms-full.txt`	All pages as Markdown in navigation order, in one file

48.3 Notes on the pages

Note	Meaning
To be confirmed	Not decided, not built, or not verified yet. Do not rely on it.
To be confirmed by electrician	Depends on local regulations and the specific installation; a qualified electrician decides.
Danger and warning boxes	Safety information. Read them before acting.

48.4 Conventions

- Technical English first; translations follow from the same source.

- Each topic is written once and linked from other pages.
- Product names: Lutra Lite (the gateway firmware and box), Lutra Insight (the partner portal).
- Commands, keys, topics and field names are shown as `code`. Where the API or portal still uses a Dutch name, it is shown as it is, with the English meaning.
- No keys, certificates, tokens or real client data appear in this documentation.

48.5 Related pages

- Glossary
- Lutra documentation

Last reviewed: 2026-11-24. Applies to Lutra Lite 0.4.1.