

User guide.

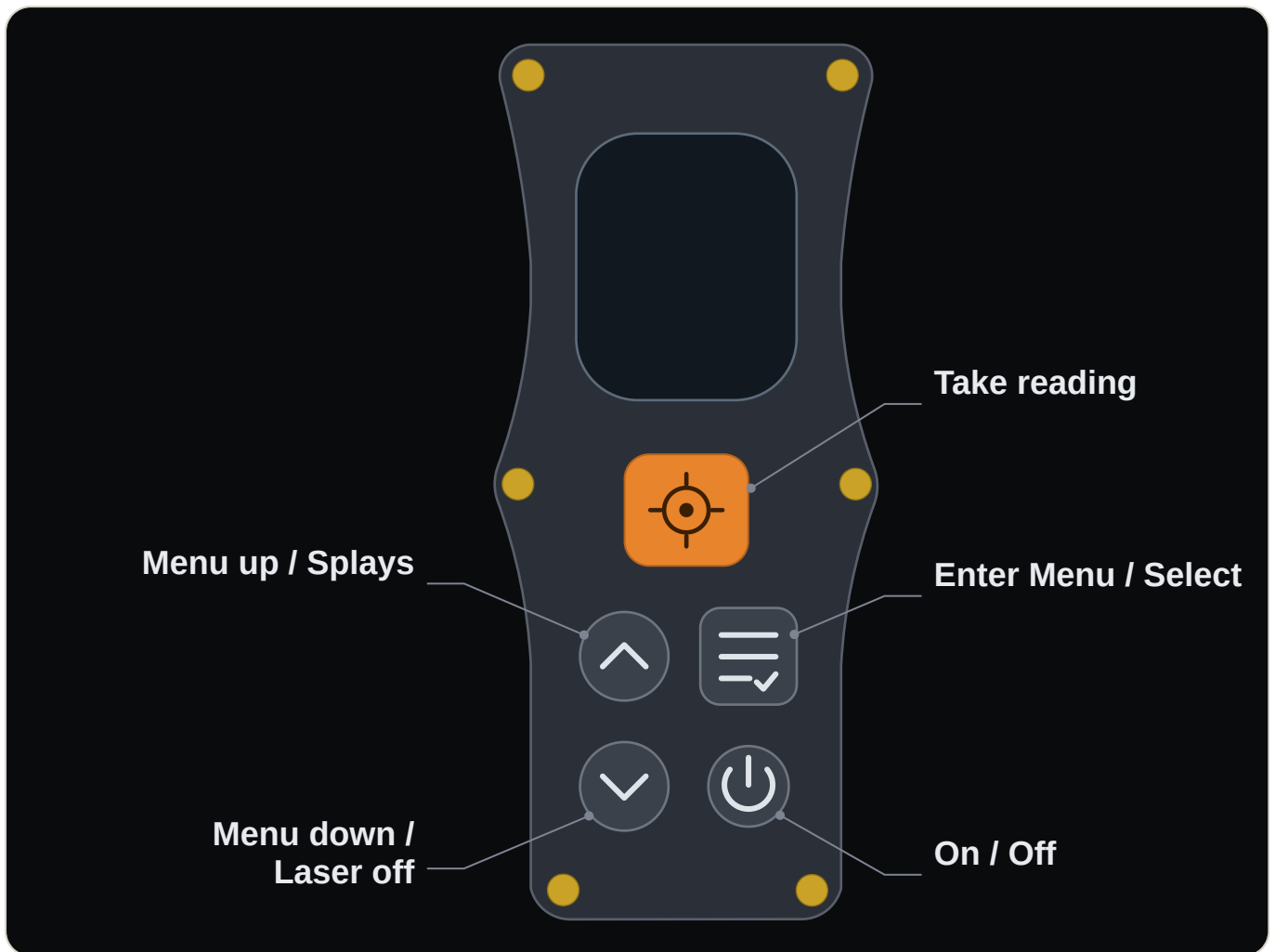
A comprehensive guide to using your DiscoX survey device, if anythings missing let me know and I'll get it updated.

Showing the new device – the one with the large orange trigger button.

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Buttons



In normal mode

- **Orange trigger** — high-accuracy shots. The first press wakes the laser so you can aim; the second takes the shot.
- **Up** — short press: take a splay shot. Hold for ~1.5s: toggle Disco mode.
- **Down** — turn the laser off between shots to save battery. The trigger brings it back.
- **Menu** — open the settings menu.
- **Power** — press to turn the device on or off.

In **menu mode**, Up and Down scroll and either the **orange trigger** or **Menu** selects. The power button still turns the device off.



HINT • THE POWER BUTTON IS ALSO THE RESET BUTTON

If the device software ever crashes, **hold the power button down for 3 seconds**. That cuts power in hardware, no matter what the firmware is doing — press it again to start back up.

Hold at power-on

Holding a button while the device starts up gets you to the recovery routes:

- **Down** — boot straight into USB drive mode, even if the settings file is unreadable.
- **Down + Menu** — storage factory reset. You're asked to confirm; hold the trigger for 3s to erase. This wipes settings, calibration and any unsent shots, so it's the last resort.

Taking readings

Once set up the DiscoX is a simple point-and-shoot device. The **large orange button** triggers high-accuracy shots: press it once to wake the laser and aim, then press again to shoot. The device checks it is being held steady (LED turns **red**) before taking the shot (LED turns **green**) — so hold it still until the shot lands.

To save battery, and to show you the shot worked, **the laser turns off after every high-accuracy shot**. The next press of the trigger turns it back on for aiming.

LED states



RED

Checking you're steady — hold the device still.



GREEN

Shot taken and saved.



PURPLE

Station recognised — three shots agreed.

Splay shots

The **up button** takes splay shots. These skip the stability check, so they are not as precise as shots taken with the orange button, but they are much faster to take — and the laser stays on afterwards so you can fire off the next one straight away.

Splays don't count towards station detection, so a run of splays between stations never interferes with your legs.

Turning the laser off

To turn the laser off between shots press the **down button**. It only ever turns the beam off — a stray press underground can cost you a re-press, but it will never light the laser unasked. The orange trigger brings it back. The laser also switches itself off after the laser timeout (2 minutes by default).

Stations

If 3 shots are taken at the same target 3 times in a row, the device registers this as a station: it flashes white, plays a rising fanfare, blinks the laser, and then **lights up purple**. Shots count as the same target when their end points fall within the leg tolerance of each other (10 cm by default — **Menu → Settings → Leg tol**).

The display stays frozen on the reading until you take the next shot.

Sounds

The buzzer has a different sound for each event, so you can survey without looking at the device:

- **Click** — shot started.
- **Bleep** — reading taken and saved.
- **Rising fanfare** — station recognised.
- **Falling womp** — something went wrong, check the screen.



REJECTED SHOTS

Very dark or shiny targets can bounce back too little light for the laser to trust the distance it measured. Rather than record a plausible-but-wrong number the DiscoX rejects the shot and plays the error tone — re-sight onto a better target, or put something matt where you're aiming.

Display

The OLED display shows three values from your most recent stable shot:

- **Distance** (top) — in metres, to two decimal places.
- **Azimuth** (middle) — compass bearing, in degrees.
- **Inclination** (bottom) — clino angle, in degrees.

The **top-left** shows  when Bluetooth is connected, with a count of pending (unsent) readings beside it. The **top-right** shows a proportional battery bar. If the device is set to measure from the front this is indicated at the top of the display as well.

Disco mode

Hold the **up button** for about 1.5 seconds to toggle disco/rave mode. The laser shuts off and the LED cycles through colours. **Shake the device** for faster colour cycling and full brightness.

To get back to surveying, press the **orange trigger** — or hold the up button again to switch disco off where it stands.

Bluetooth & memory

The DiscoX works with current versions of **SexyTopo** and **TopoDroid** via a long-range C++ implementation of the SAP6 BLE protocol. The device advertises continuously, so nearby phones and tablets can discover it, unpair and repair it from the Bluetooth settings on your phone.

Once connected, the device flashes blue, a **BT** label appears in the top-left of the screen, and live readings are pushed directly to your survey app.

Shots are saved in the device's memory until a Bluetooth device is connected and they are transferred to the surveying app. A reading is only struck off the device once the app has confirmed it arrived, so dropping the connection mid-survey — or surveying with the phone switched off entirely — can't lose readings. The number beside **BT** is how many are still waiting to go.



NOTE • BLE NAMING

Each DiscoX ships with a unique Bluetooth name, this can be changed from within the **settings.json** config file by changing the **ble_name** config item. Change it via the settings file, or request a specific name before assembly. Note the name has a limit of 20 characters.

Calibration

Calibrate whenever you survey in a new area or if readings seem off. Run a **Mag Field Check** before each trip to quickly verify accuracy at your survey site.

To start: press **Menu** → **Enter Calibration**. The two stages are separate menu entries — **Part 1 (Ellipsoid)** and **Part 2 (Alignment)** — so you can re-run either one on its own.

Calibration is performed in two stages. **Stage 1** corrects for sensor bias; **Stage 2** corrects for the alignment between the sensors and the laser. Together they take 80 readings.

TAKE IT UNDERGROUND

PRINTABLE CALIBRATION CARD

Both stages, the field check and the on-screen warnings on one sheet. Print A4 landscape at 100%, double-sided, and fold down the middle for a pocket-sized A5 card.

[Download PDF](#)

Stage 1 — Sensor bias

With perfect sensors under perfect conditions, taking survey readings in every orientation would trace out a sphere. In practice, manufacturing variance between sensors and the presence of metal components mean an uncalibrated device traces something closer to a rugby ball.

The fix is to take readings across a well-distributed set of orientations, then compute a correction matrix that can be applied to the raw sensor readings to give a less biased output.

56 READINGS

Taking the readings

You could take readings in random directions and still get a decent result, but a recommended set usually does better. For the DiscoX, aim roughly at every face and corner of an imaginary cube — 14 positions — rolling the device 90° four times at each one.

This is similar to the DistoX, but with no need to worry about where exactly the laser is pointing.

Do try to keep the device still as you take each reading. Rest your arms on a non-magnetic surface while moving it, or use a jig — this helps ensure the accelerometer readings are correct.

Trigger record • Down undo
Up+Down hold save • Down hold discard

Stage 2 — Sensor alignment

When the sensors are mounted in the device it is very difficult to get them perfectly aligned with the laser, so an alignment function is needed to correct for the residual error.

24 READINGS

Taking the readings

Point the device at a target and barrel-roll it, taking **8 readings** evenly distributed around the same axis as the laser. Repeat this twice more, aiming at targets in completely different directions.

Trigger record • Down undo
Up+Down hold save • Down hold discard

! HOLD IT STEADY

For this stage it is very important that the readings are on point and the device is steady. The best way I have found is to sit down with your head and back supported, rest the back of the device against your nose, then lock your arms to your sides and take the readings as described above. This gives the most stable base, because there are very few degrees of freedom between you and the device.

Mag field check

Verifies calibration accuracy without re-running a full calibration.

FIELD CHECK

How it works

Shoot a fixed target, walk to it, shoot back. Repeat for **3+ pairs** in different directions. The device records each pair's bearing error and calculates an overall correction amplitude.

A consistently high amplitude means it's time to run a full calibration.

Trigger take shot
Up finish (after 2+ pairs) • **Down hold** exit

Quality metrics

After calibration the screen shows three quality scores. **Lower is better** in all cases. View them any time via **Menu** → **Enter Calibration** → **View Last Cal.**

- **Mag** — magnetometer ellipsoid fit uniformity.
- **Grav** — accelerometer ellipsoid fit uniformity.
- **Acc** — final accuracy in degrees (the most important number).

EXCELLENT < 0.25°  ACCEPTABLE < 0.5°

TIP

For best results, calibrate in the same magnetic environment as your survey — i.e. away from bolts, helmet lights, and SRT kit. Anomaly detection will warn you if your calibration is being contaminated.

Firmware update

Plug the DiscoX into your computer first, then go to **Menu** → **Update Firmware** → **Yes**. The device enters the UF2 bootloader and appears as a removable drive. Drag and drop the new `.uf2` file onto it — the DiscoX reboots when flashing is complete. Your settings, calibration and any unsent shots survive the update.

The device has to be connected before you pick Yes: the bootloader only waits a few seconds for the USB connection before dropping back into the normal firmware.

Settings

All common settings are accessible from the onboard menu — press **Menu** to open it, **Up/Down** to scroll, and the **orange trigger** or **Menu** to select.

Onboard menu

- **Exit** — back to surveying.
- **Enter Calibration** — run Part 1 (Ellipsoid) or Part 2 (Alignment), perform a Mag Field Check, or view the last results.
- **Measure from:** — measure from the back of the device (its length is added on) or the front (raw laser distance).
- **Settings** — the submenu below.
- **Play Snake** — hidden bonus for when you're waiting around.
- **Update Firmware** — reboot into the bootloader to flash a new `.uf2`.
- **Delete saved shots** — wipe any pending readings stored in flash.

SETTINGS SUBMENU

- **Laser off** — 30s · 60s · 2m · 5m · 15m · 30m of inactivity before the laser shuts down.
- **Anomaly Detec** — toggle warnings for nearby metallic objects (helmet lights, SRT kit, bolts).
- **Shutdown** — 5 · 10 · 15 · 30 · 60 min · 2 hr auto power-off.
- **Brightness** — screen contrast, 1% to 100%.
- **Leg tol** — how close three shots must land to count as a station, 4 cm to 30 cm.
- **USB Drive Mode** — mount the device on a computer to edit its settings and calibration files.
- **Reformat Storage** — erase and rebuild the device's filesystem. Only needed if storage is corrupt.

Advanced: `config.json`

Go to **Menu** → **Settings** → **USB Drive Mode**. The DiscoX reboots and appears as a drive called `MRZAPPY` holding `CONFIG.JSON`, `CALIBRATION.JSON`, `READINGS.CSV` (your unsent shots, export only) and a `README.TXT`. Edit the values you want, save, eject the drive on your computer,

then press **Menu** on the device to import and restart. Any setting you omit uses its default, and a file that doesn't parse is rejected — the device keeps the old one rather than starting up misconfigured.

If the device ever won't boot far enough to reach the menu, **hold Down while turning it on** to get to the same drive.

MEASUREMENT & STABILITY

stability_tolerance default 0.5	Degrees the sensors must converge within before a high-accuracy shot is accepted. Lower = stricter.
stability_buffer_length default 5	Consecutive stable samples required before accepting a reading.
ema_alpha_stable default 0.15	Smoothing applied while the device is held still. Lower = smoother but slower-reacting.
ema_alpha_moving default 0.6	Smoothing applied while the device is moving, so the display keeps up as you swing onto a target.
laser_distance_offset default 0.12	Device length in metres, added to the laser distance when measuring from the back so readings are station-to-station.
measure_from_front default false	☒ true uses the raw laser distance instead (same as Menu → Measure from).
splays_enabled default true	Whether a short press of the up button takes a splay shot.

STATION DETECTION

cartesian_tolerance default 10.0	Centimetres. Three shots count as the same station when their end points all fall this close together — one number covering bearing, clino and distance at once. Same as Menu → Settings → Leg tol.
laser_wobble default true	Blink the laser on/off in quick succession when a station is detected.
leg_angle_tolerance default 1.7	Degrees. Used by the Mag Field Check to decide that a foresight and backsight are a matching pair.

LASER SHOT VALIDATION

laser_shots

default 1

Shots taken per measurement. Above 1 the median of the surviving shots is used — slower, but steadier on awkward targets.

laser_sq_limit

default 50

Minimum signal quality for a shot to be trusted. Raise it to reject more dark/shiny targets, set to 0 to accept everything.

laser_spread_limit_mm

default 25

How far apart multiple shots may land and still be averaged. Only relevant when `laser_shots` is above 1.

ANOMALY DETECTION

anomaly_detection

default false

Enable warnings when nearby metallic objects may be distorting the magnetic field. Turn this on once the device has been calibrated in your own environment.

mag_tolerance

default 10.0

Magnetometer field-strength tolerance in degrees from the expected local field.

grav_tolerance

default 10.0

Accelerometer magnitude tolerance in degrees.

dip_tolerance

default 10.0

Magnetic dip-angle tolerance in degrees.

CALIBRATION

cal_mag_consistency

default 0.5

Angular consistency window in degrees for the magnetometer during calibration.

cal_grav_consistency

default 0.4

Angular consistency window in degrees for the accelerometer during calibration.

cal_buffer_length

default 5

Samples in the calibration consistency window.

cal_settle_ms

default 250

Milliseconds the device must remain stable before a cal point is accepted.

cal_ema_alpha

default 0.3

EMA smoothing used during calibration.

cal_timeout_ms

default 4000

Max ms to wait for stability before a cal point is force-accepted.

TIMERS & DISPLAY

auto_shutdown_timeout

default 1800

Seconds of inactivity before automatic power-off (1800 = 30 min).

laser_timeout

default 120

Seconds of inactivity before the laser turns off to save power.

screen_brightness

default 255

OLED contrast level, 0–255.

BLUETOOTH

ble_name

default "SAP6_DiscoX"

Bluetooth device name advertised to survey apps. Max 20 characters; the **SAP6_** prefix is added for you if you leave it out.