

Multiplexing and Energy

Training — Discover

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Discover — this session

MUXEN training is built in **four levels**. Each level adds **one tool**, and you are trained and authorised for that tool before you touch it.

Discover is the first, and it runs **entirely from this call**: you watch, you listen, you ask. Everything you need is on the screen in front of you.

- One to two hours, remote
- What multiplexing is, and why the boat is built this way
- The boxes you will see on board, and what each one does
- What the on-board screen shows
- The vocabulary that every level above this one uses

Today is about **understanding** the boat. Configuring it starts at the next level — and that is the whole difference between the two.

The three levels above

Basic — the screen on board.
Diagnose the bus, replace a Bloc or a gateway, add a switch, use the local panel, bring the boat online for remote support.

Medium — Raken.
The configuration web application, **served by the Brain itself** — a browser on the boat's own network reaches it. eFuse values and response times, spare outputs, tank calibration, multiplexing rules, commissioning a new Bloc or gateway.

Expert — VPN and Eagle.
Reaching the boat from shore, Brain and firmware updates, reading the recorded history.

The levels are defined by the **tool**, not by how difficult the task feels. A five-minute job can sit in Expert, because of what it can break.

Why?

Less copper, more diagnostics

The traditional boat

In a conventional installation, every function has its own wire, running all the way from the switch panel to the device — and back.

- A switch panel is a bundle of wires
- Each circuit is switched by a relay or a switch, and protected by a fuse
- More options means more wires, more weight, more connections
- Every connection, every relay and every fuse is a failure point
- Finding a fault means physically following a wire

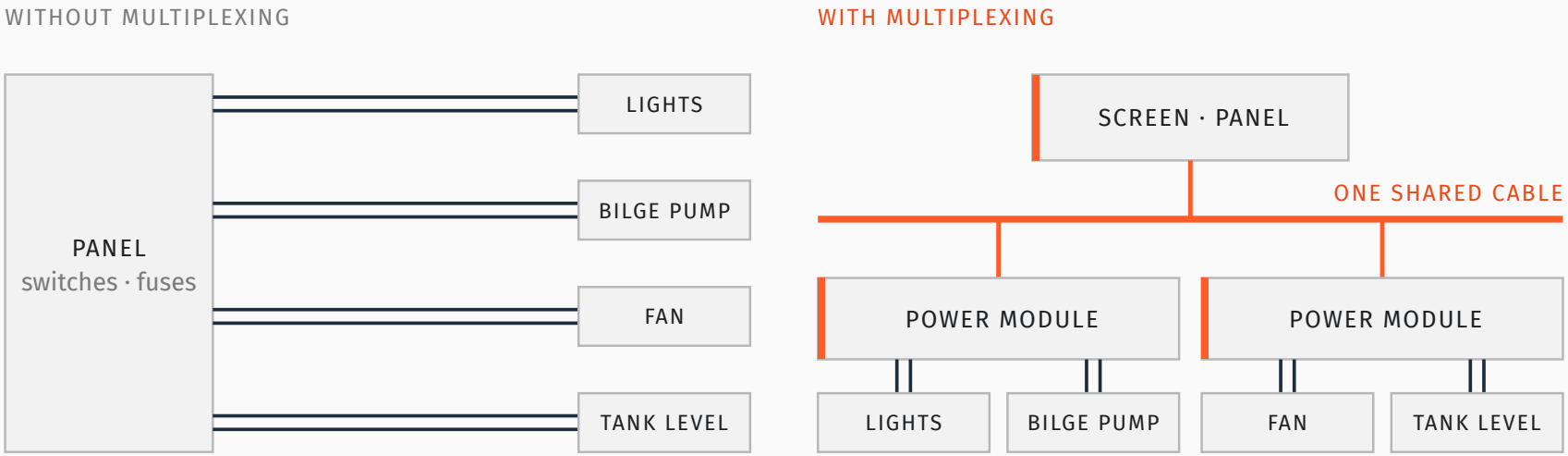
The wiring is the product. Changing the boat means changing the wiring.

The multiplexed boat

A single **communication network** runs through the boat. Power is distributed by boxes placed close to the loads.

- A switch no longer carries the power — it **sends a message**
- The **Bloc** near the device does the switching and the protection
- Adding a function becomes a **configuration**, not a new cable
- Every device **reports its own state** — diagnostics become quick

Without and with multiplexing



Without: every load has its own long wire pair, all the way from the central panel, with a switch and a fuse at the panel end.

With: one shared cable crosses the boat. Power modules sit next to the loads, so the power runs are short. On a MUXEN boat, the power module is the **Bloc**.

Less copper on board

This is the argument that carries the rest.

In a conventional installation, every load is fed **from a central panel**: a long, thick pair of wires out to the device and back, sized for its current. Those long high-current runs are the **heaviest part of the harness**.

On a multiplexed boat the Blocs sit **next to the loads**. The high-current runs become short. What crosses the boat from end to end is a **light network cable**.

On a catamaran, weight is not a detail — it is payload, fuel consumption and waterline. Every kilo of copper removed is a kilo the customer can use.

And it grows with the boat: **the longer the boat, the longer every run**, so **every loop multiplexing removes saves more**. The saving is not one fixed figure — it scales with the size of the boat.

This is not new — it comes from the car industry

MUXEN's decentralised technology comes from proven automotive know-how. The same move happened in cars twenty years ago, for the same two reasons: weight and reliability.

A modern car has no central switch panel either. Each function is switched close to where it sits, and one network carries the commands and the measurements from one end of the vehicle to the other. Two decades of production have made that architecture ordinary.

The car industry also replaced its relays and fuses with eFuses. So does MUXEN, in its power distribution modules — we will come back to it.

What that move gave the car plants and their drivers is exactly what it gives the yard and the customer.

What it changes, on both sides

For the yard

- **Less copper** to buy, to route and to carry
- **Faster harness installation**
- **Easier quality control** — the network reports what is connected and what works
- **Traceability** of the equipment fitted in each boat
- Options handled by configuration, not by dedicated looms
- Fault diagnosis from shore, without sending someone to the boat

For the customer

- **Weight saved** — turned into payload, speed or range
- **Fewer things that break** — no relay contacts, no fuses to replace
- Real-time monitoring of consumption and battery charge
- Every electrical device controlled **from the chart table** — or from a smartphone, ashore
- Confirmation that the watermaker, the HVAC or a pump is really running
- Alarms, protection and **load shedding**

A multiplexed boat is not a set of independent circuits.

It is a network that knows its own state.

The Network

One cable, many messages

One cable, many messages

Multiplexing means several sources sharing one medium. MUXEN uses a CAN bus: a single pair of wires that every device on board is connected to.

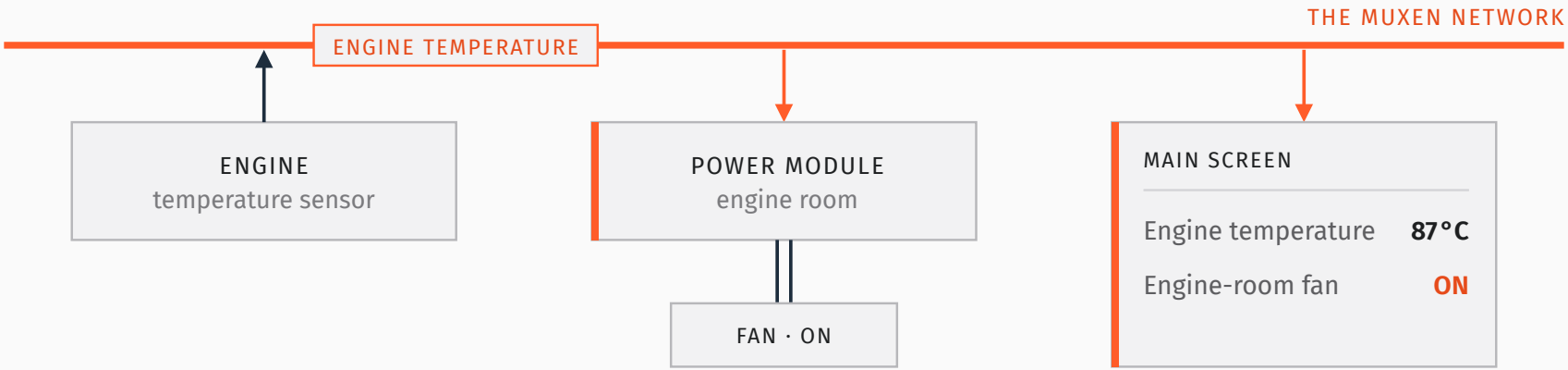
- Each device speaks in turn — messages never overlap
- Every message is labelled, so each device picks out what concerns it
- The same cable carries commands, measurements, alarms and configuration

You do not need to understand CAN to work on a multiplexed boat. You do need to respect its rules, and there are three:

- Connect only MUXEN equipment to it
- Tap into it with a distributor, never by cutting it
- Close it with a terminator at each end

How it works

EXAMPLE — THE ENGINE-ROOM FAN



01 — The engine reports

The engine's temperature is put on the network. It is sent once, and every device on board can read it.

02 — The Bloc acts

In the engine room, a Bloc sees that temperature reach the value set for it, and switches the fan on.

03 — The screen shows it

At the chart table, the screen shows the engine temperature, and the fan's indicator lights up.

No wire runs from the sensor to the fan: **the network carries the reading to everyone**.

No central brain that runs the boat

Every MUXEN device is autonomous in deciding how it behaves. There is no central computer that everything depends on — no single point of failure.

The boat adapts in real time to the state of the network. For example:

- Loss of a battery: the maximum engine power is adapted
- Battery overload: the generator starts automatically
- Loss of the screen: the light switches keep working

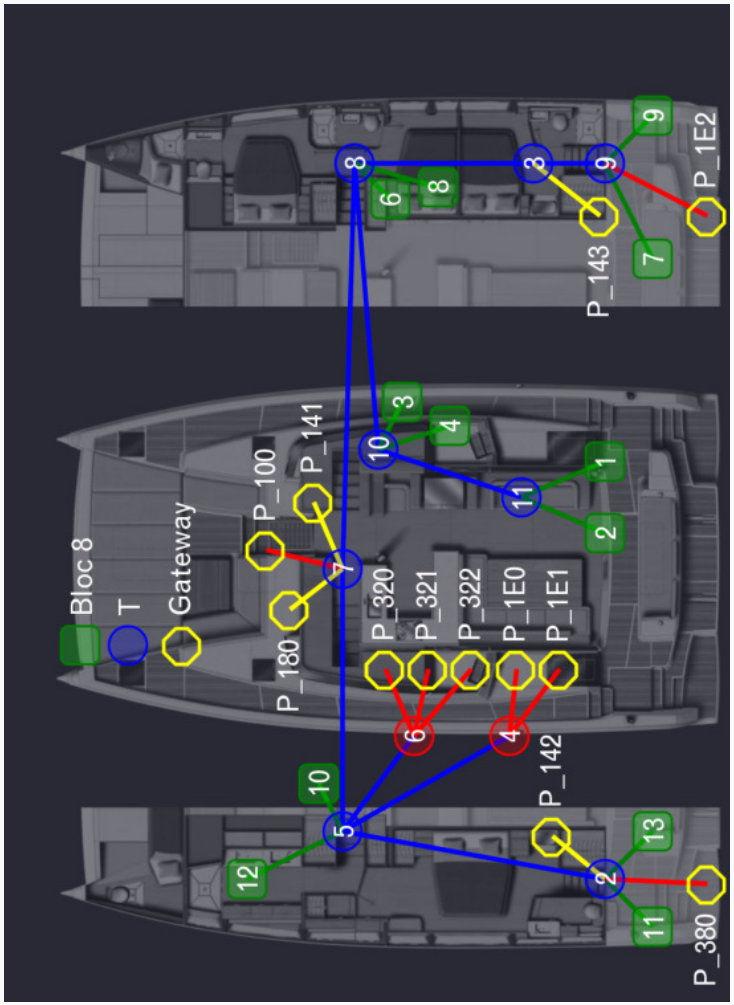
The on-board screen displays and commands the network — but the boat keeps working without it.

The words you need

Backbone	The main network cable running through the boat
Distributor (T)	Where a device taps into the backbone
Terminator	The plug that closes each end of the backbone
Node	Any device connected to the network
Bloc 8	A node that distributes and protects DC power
Gateway	A node that integrates third-party equipment into MUXEN
SFSP	Battery-free wireless switch (*sans fil, sans pile*)
Brain	The on-board computer running the screen
Configuration	What this particular boat has, and how it must behave

This is the vocabulary used by every level above this one, and by whoever you call for support. Naming a part the same way on both ends of the line is half the diagnosis.

The same words, on a real boat



The boat's own network diagram, drawn on its own deck plan.

- **Green squares** are the Blocs, numbered
- **Blue circles** are the distributors (T), where devices tap into the backbone
- **Yellow octagons** are gateways, named by their address (P_180, P_320, …)
- **Blue lines** are the backbone running through the boat
- **Red** marks a link that is not answering

This one screen is why the vocabulary matters. Once you can name what you are looking at, you can say *where* a problem is — and that is most of the job.

The golden rule: orange is MUXEN

MUXEN uses orange M12 connectors for one reason: so that they cannot be confused with anything else on board. The colour code is being extended: orange distributors and cables arrive at the end of 2027, so a MUXEN run will be recognisable along its whole length, not only at its ends.

Never connect the NMEA 2000 navigation network to the MUXEN network.

- Incompatible speed (250 kbps vs 500 kbps)
- Incompatible data format (J1939 + NMEA vs MUXEN)

They are both CAN networks and the connectors look similar. They are not compatible. Nothing is destroyed by mixing them — but both networks stop communicating, the MUXEN one and the navigation one.

A network has two ends

The backbone must be **closed by a terminator at each end**. Both of them. Always.



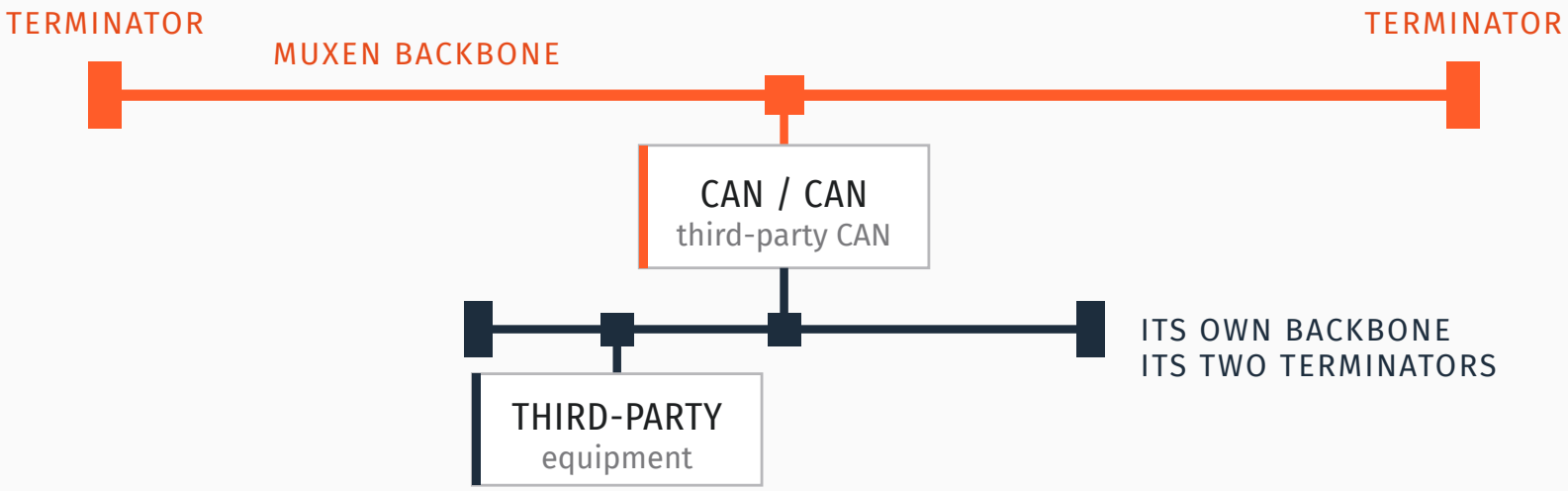
A missing terminator does not stop the network cleanly — it makes it **unreliable**:

- Devices that appear and disappear
- Values that freeze or jump
- Faults that move when you touch a cable

Intermittent faults are the most expensive kind to chase. Checking the terminators costs thirty seconds.

Count the ends per network, not per boat

A **CAN / CAN gateway sits on two backbones at once** — the MUXEN one and the equipment's own bus — and **each of them needs its own two terminators**.



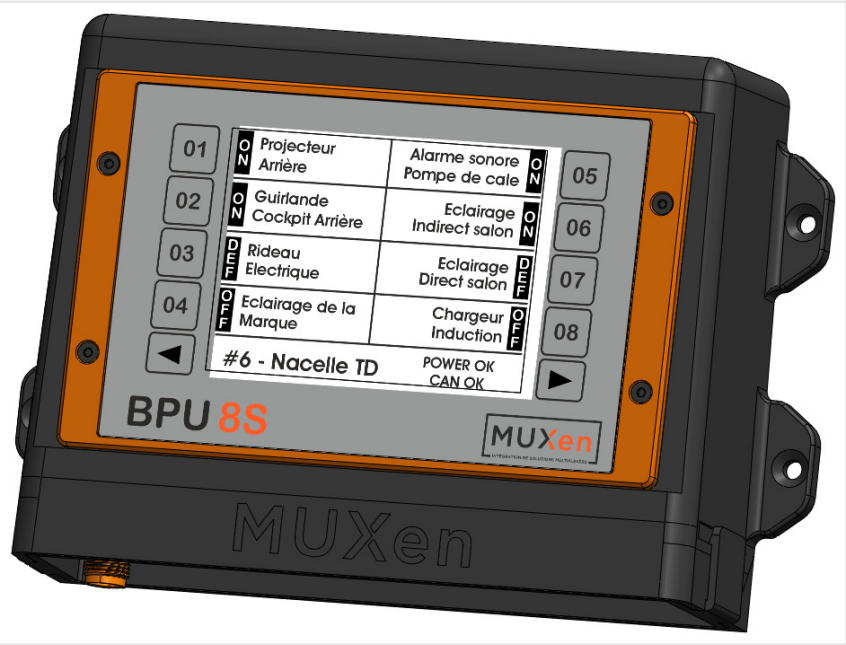
Terminating the MUXEN side and forgetting the equipment side gives the same intermittent behaviour, on a bus you were not looking at.

The same arithmetic applies the day you **split the backbone**: you have just made two networks, and both need closing. Either terminate both halves, or put the backbone back together before you leave.

The Products

What you will actually see on board

The Bloc 8



Bloc 8 — power distribution and protection, placed close to the loads

- 8 outputs, 30 A each
- 9 inputs: 6 digital, 3 analog
- Tank senders and switches wire directly into it
- Injects 12 V onto the CAN network

Because it sits next to the loads, the long high-current runs disappear.

Inside, there is no relay and no fuse.

No relay, no fuse — the eFuse

A conventional circuit needs two mechanical parts: a relay to switch it and a fuse to protect it. Both are things that fail.

- Relay contacts wear, arc, chatter with vibration — and can weld shut
- A fuse is single use: someone has to find it, and fit the right rating back

The Bloc 8 uses an eFuse on every output — the solution the car industry adopted for exactly this reason. Solid state: it switches and protects with no moving part.

- Nothing to wear out, nothing to weld, nothing to replace
- Trip current and response time are programmable, not fixed by a part number
- It resets from the screen instead of from a spares box
- Each output reports its own state — you know which one tripped, and why

Fewer hardware faults — and the faults that remain announce themselves.

Over and under voltage — the Bloc protects what is behind it

Besides the eFuse on every output, the Bloc 8 watches the **voltage at its own power input**. Outside the limits, it **switches its outputs off** — to protect the equipment behind it, not itself.

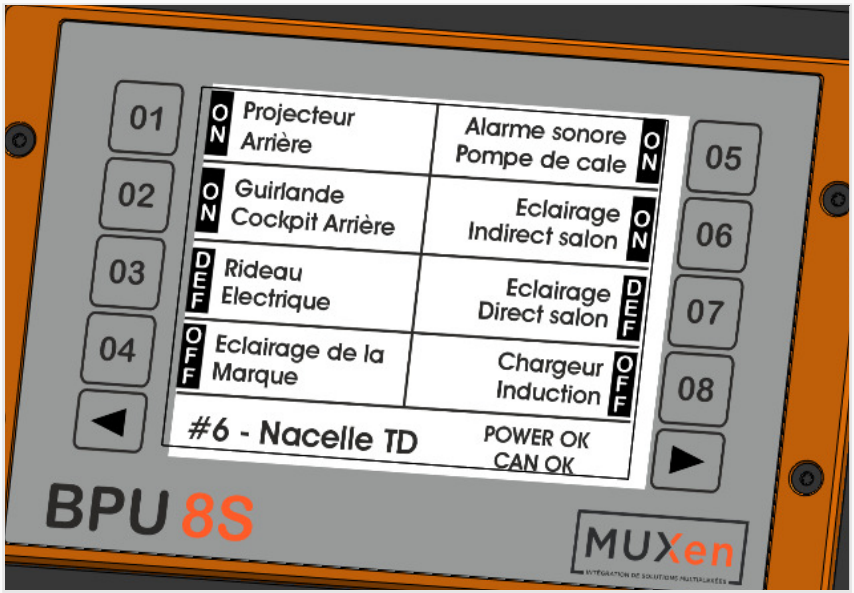
- **Over voltage** — an alternator load dump, lightning. The energy is absorbed inside the Bloc, by its **Transil**
- **Under voltage** — a battery that is very low

When the voltage comes back inside the limits, the outputs restart by themselves, after the Bloc's startup delay.

On the Bloc itself, this is the **supply fault**: **all LEDs blinking red**. The Bloc is protecting, not broken — look at the supply, not at the loads.

The two limits are **configured in Raken**, Bloc by Bloc: a 12 V boat and a 24 V boat do not need the same ones. That is taught at Medium.

The local panel



The same box you have just seen, from the front: the 8-key local panel gives local control of a Bloc, at the Bloc.

Its keys are labelled on e-paper, so each one shows the function it actually commands — nothing engraved, nothing to redo when a function changes.

It matters most when something else is not working: it lets you operate the boat without the screen and without the network.

Together with the bypass fuses, it is the boat's fallback mode — which is exactly why it is taught early, at Basic level.

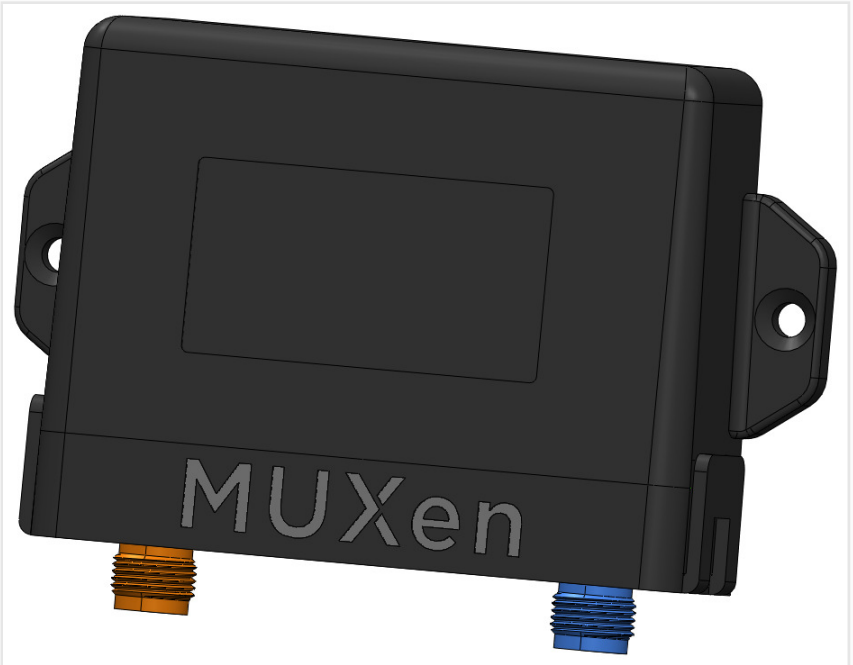
Gateways — the principle

Equipment from other manufacturers does not speak MUXEN. A gateway is a small protocol converter that puts that equipment's data onto the MUXEN bus.

Typical cases: Victron inverters and chargers, solar MPPT controllers, air conditioning, generators, watermakers, battery sensors.

On every gateway, whatever the model, the orange connector is always the MUXEN side. The other connectors go to the equipment.

On the photos that follow, the M12s still wear their yellow protective caps — fitted for the yard's logistics, to keep the dust out until the box is connected.



CAN / CAN Basic



CAN / CAN Basic

- Protocol conversion between two CAN networks
- MUXEN CAN bus on one side — the orange connector
- Manufacturer CAN bus on the other: J1939, CANopen, NMEA, ...
- Each of the two buses is terminated at its own two ends

One box can be several products

Every MUXEN device is identified by **three numbers**, and all three are needed to know what it really is:

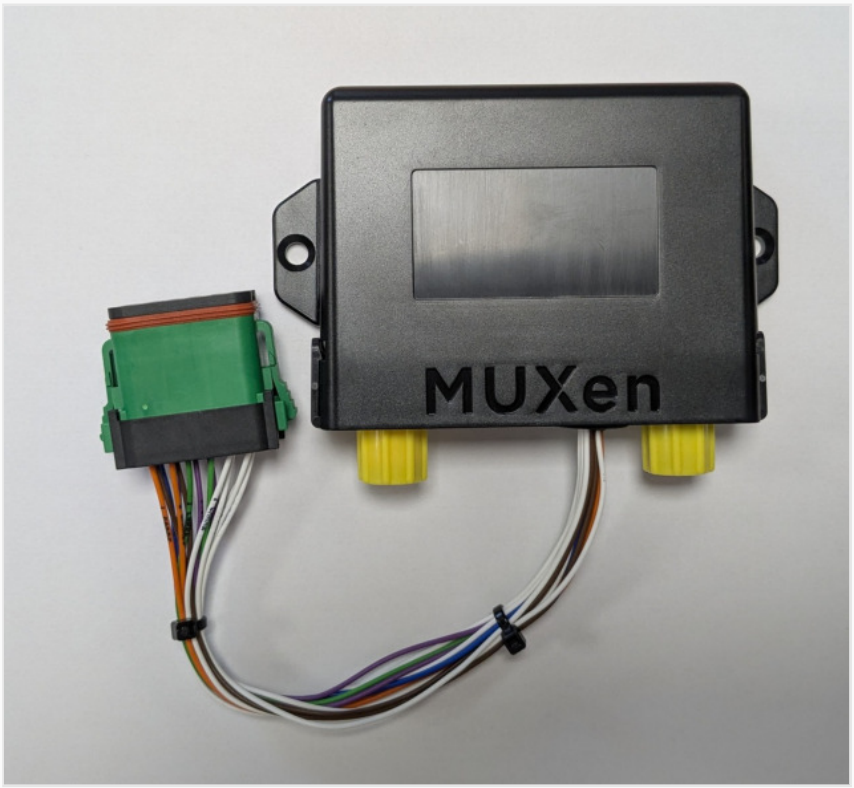
- **Product ID** — what it is, commercially
- **Hardware ID** — the electronic board inside
- **Software ID** — the application loaded on it

The same hardware becomes a **different product** depending on the software. One CAN/CAN Basic board can be an NMEA 2000 gateway, a J1939 engine gateway or a CANopen watermaker gateway.

This is why **you cannot identify a device by looking at it**. Read the label.



CAN / CAN Full

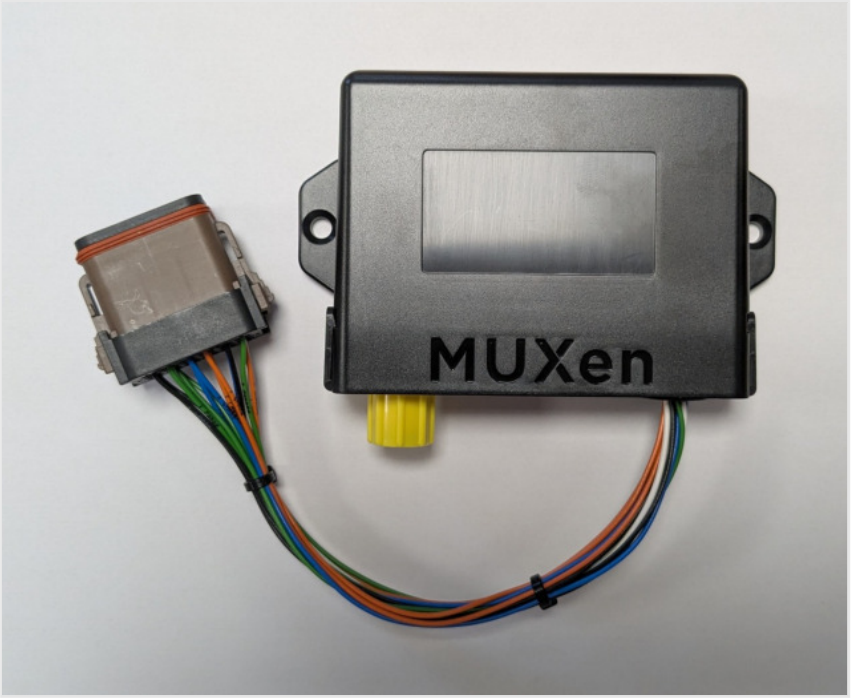


CAN / CAN Full

- Everything a Basic does
- Two relays (NO / NC)
- Two isolated digital inputs
- Two analog inputs (0–5 V)

Recognised by its extra green connector.

CAN / SERIAL — VE.Direct

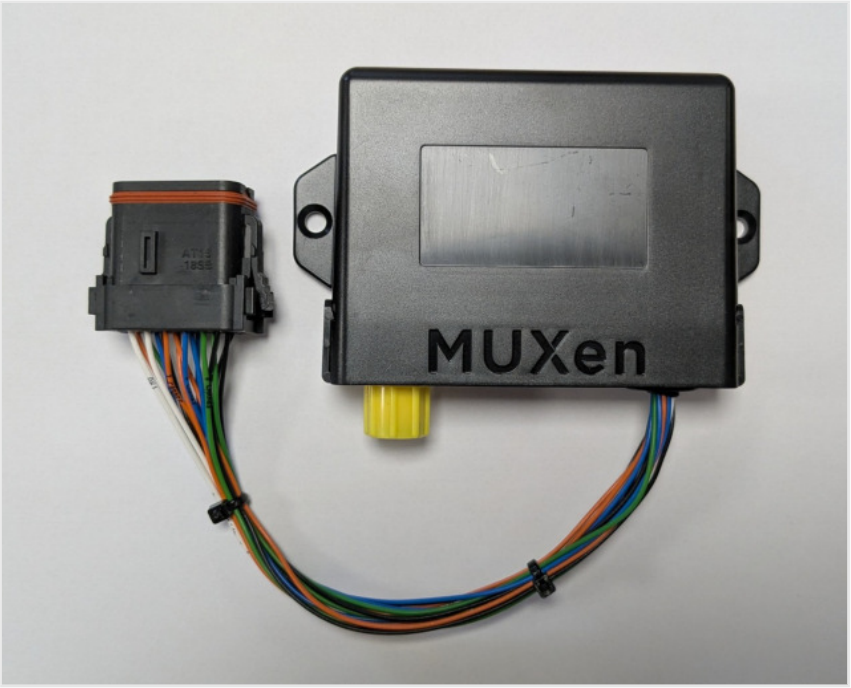


CAN / SERIAL — VE.Direct

- 4 serial ports
- VE.Direct — a plain TTL-level UART at 5 V, not RS-232
- Typical use: Victron solar MPPT controllers, chargers and shunts

One M12 on the MUXEN side; the harness carries the serial ports out to the equipment.

CAN / SERIAL — Modbus



CAN / SERIAL — Modbus

- The **same box**, the same four ports
- **Modbus** over RS-485
- Typical use: the **air conditioning**

Two boxes that look alike, two different gateways — which is exactly why you **read the label**.

The gateway family is large

MUXEN is manufacturer agnostic: the boat is not tied to one supplier's ecosystem. Whatever equipment the yard chooses, a gateway is written for it — Victron, NMEA 2000, Scheiber, Fisher Panda, Nanni, Frigomar, Aquabase, Mabru, EcoSistems, BlueAirco, MagicTrim, RV-C, battery sensors, ...

The family grows with the catalogue: a new supplier means a new gateway, not a new boat architecture.

You are not expected to know them all.

You are expected to know that:

- Two identical-looking boxes can be two different gateways
- The label on the box tells you which one it is
- A gateway is assigned its role during production, not on the boat

The Brain



The Brain is the on-board computer. It runs the screen, stores the boat's configuration, records what happens and provides remote access for support.

- Displays the boat's dashboard on the chart table screen
- Same interface available on a tablet, over Ethernet or Wi-Fi
- Keeps the history of measurements and error codes
- Provides access for remote assistance

It is the window onto the network — not the master of it. The boat keeps working without it.

The Boat-Assist screen

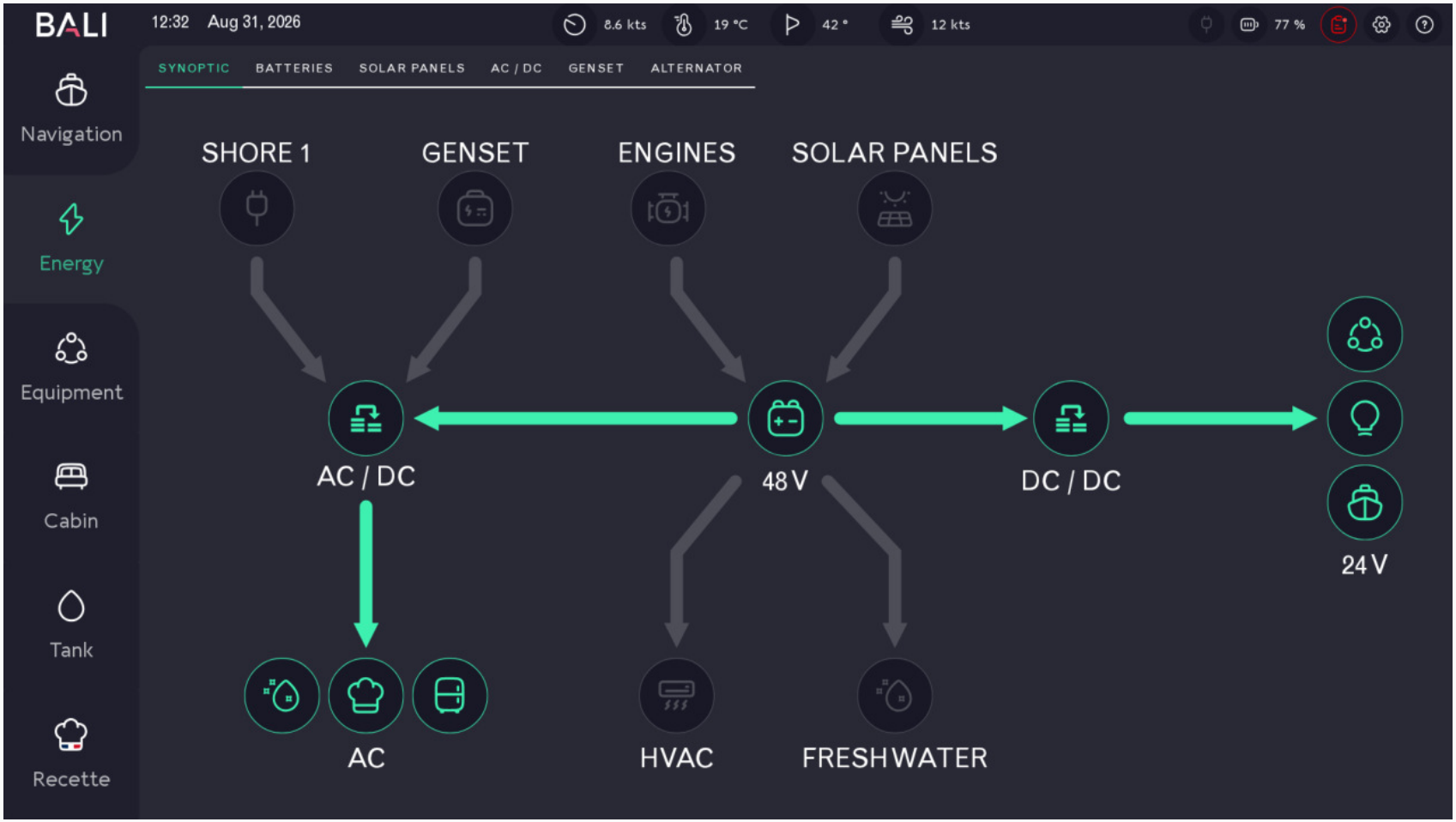
A single interface for every system on the boat:

- **Navigation** — position, wind, speed and course, autopilot, depth
- **Energy** — batteries, shore power, solar, generator, propulsion
- **Equipment** — lights, pumps, comfort, navigation, cabins
- **Tanks** — fresh water, grey water, black water, diesel
- **Alarms** and diagnostic trouble codes
- **Diagnostics** — network and device health
- Settings, units, language — and the Bali owner's handbook, on board

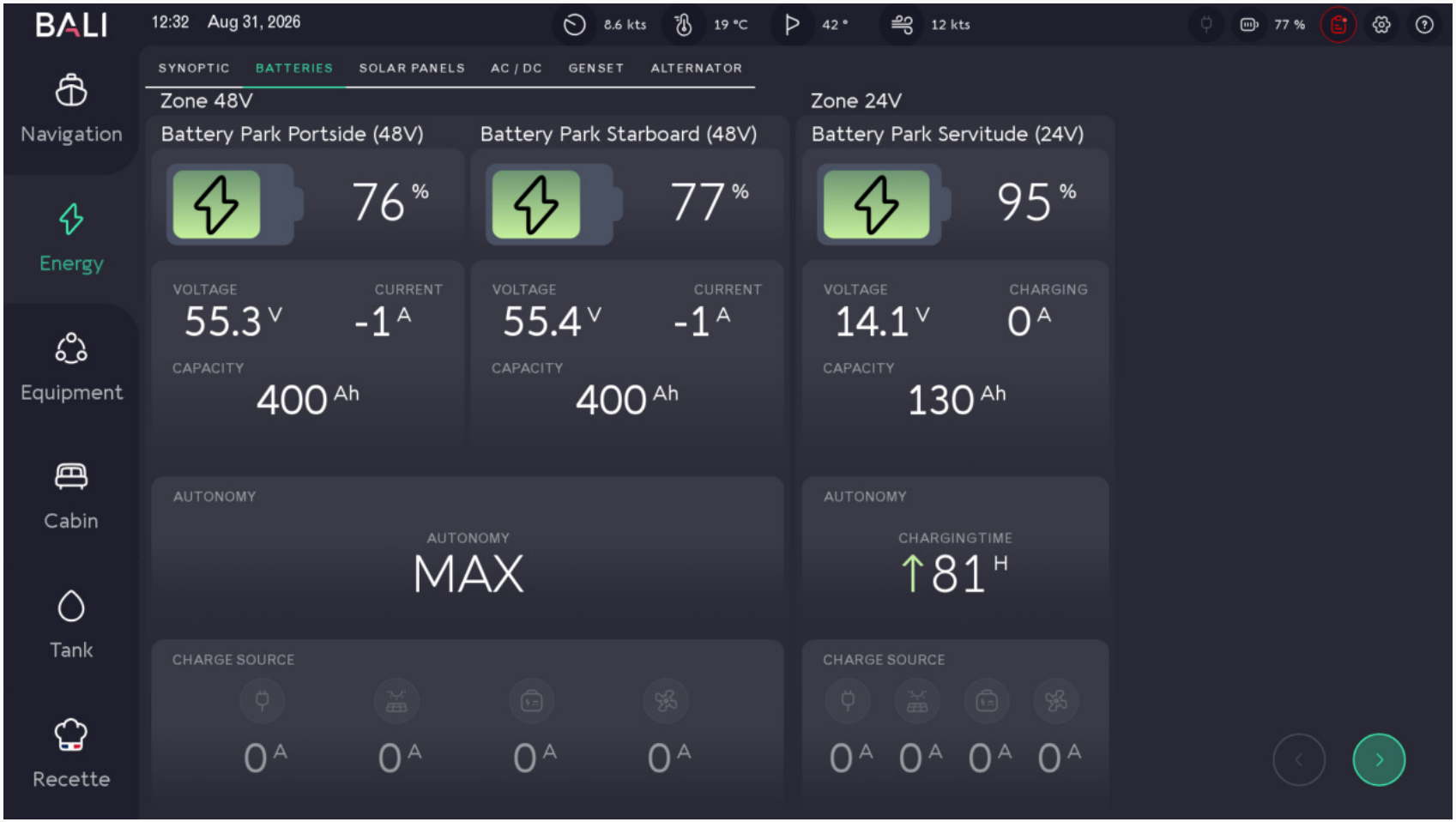
Navigation — the instruments



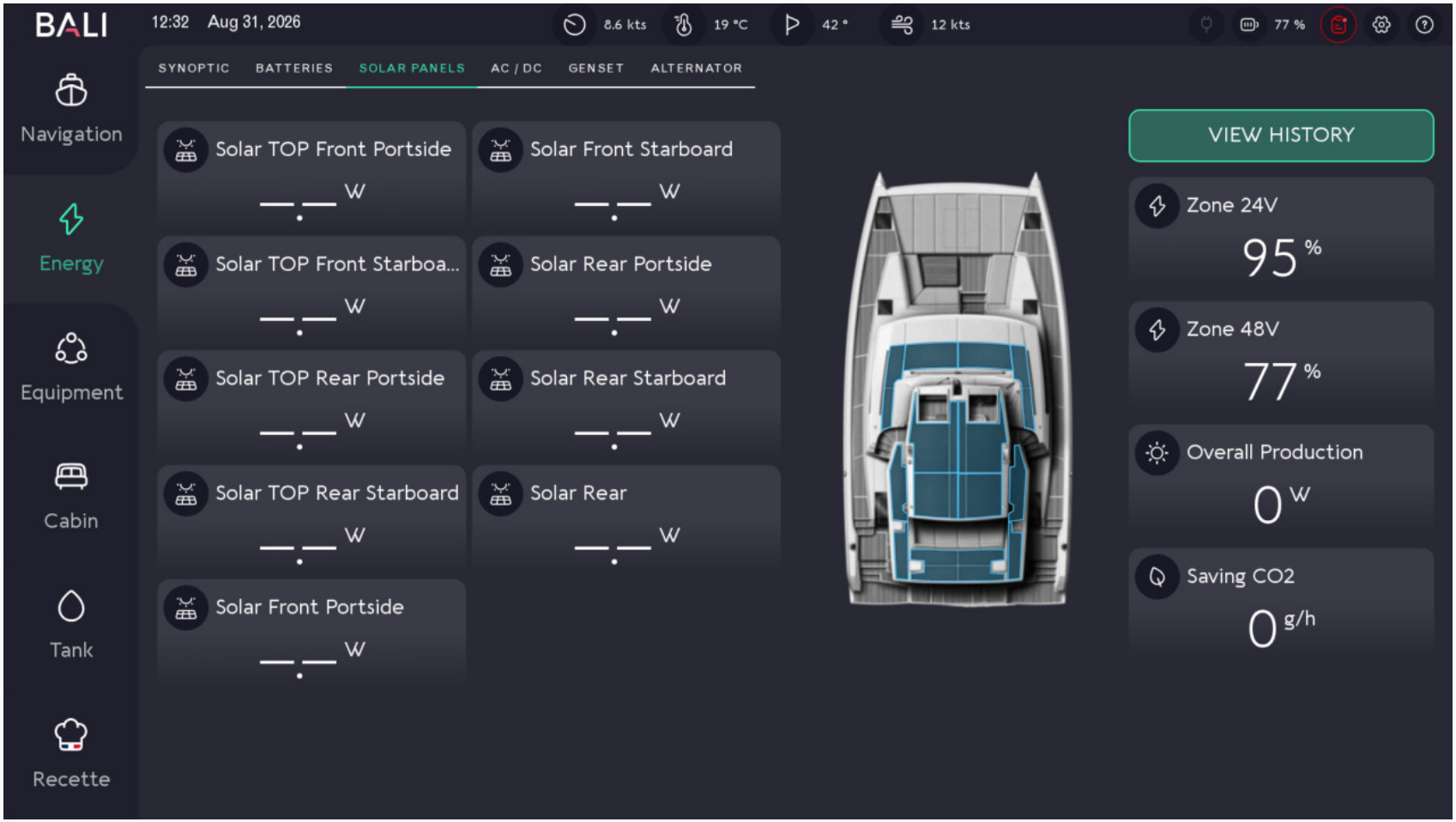
Energy — the synoptic



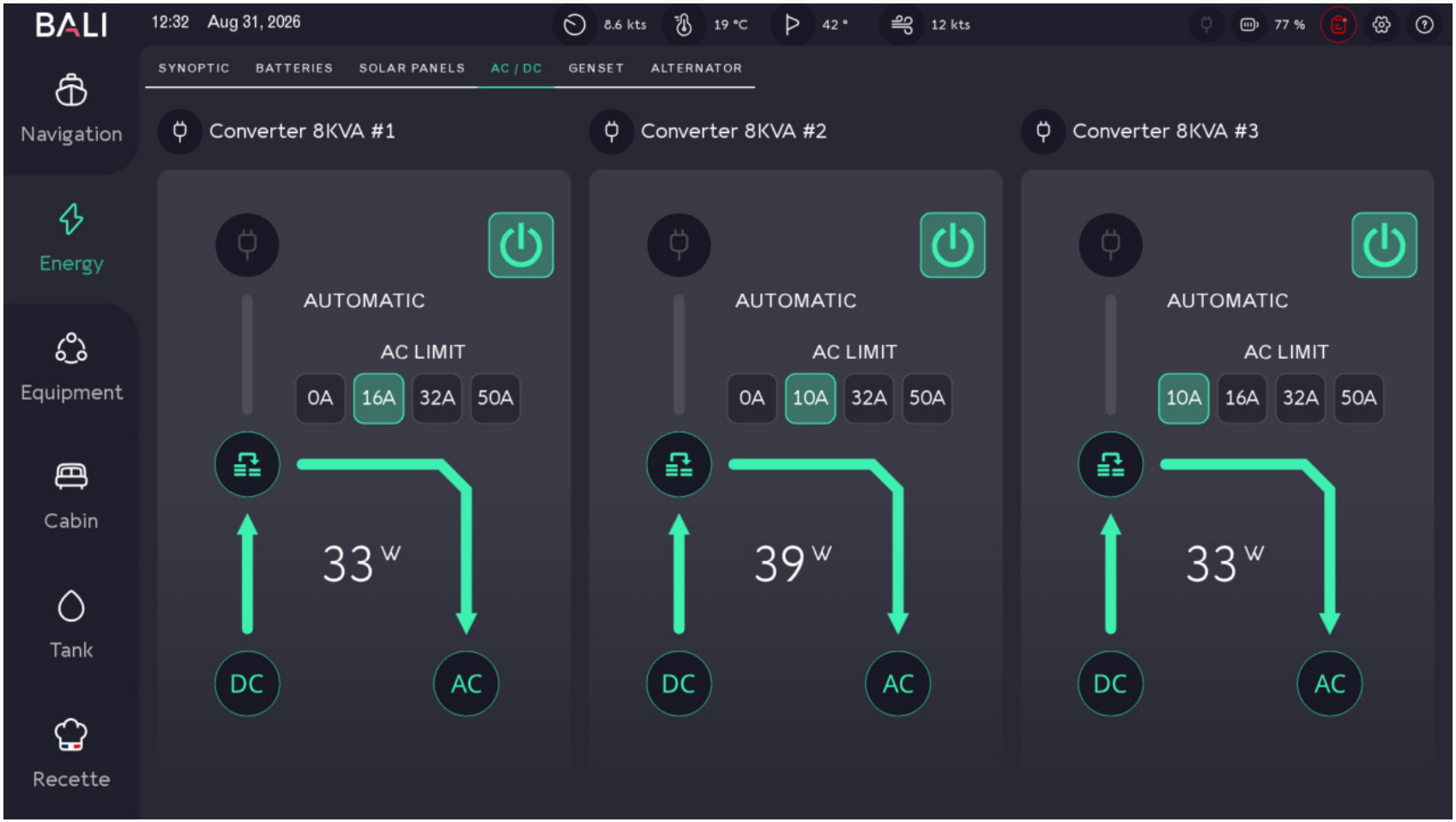
Energy — battery banks



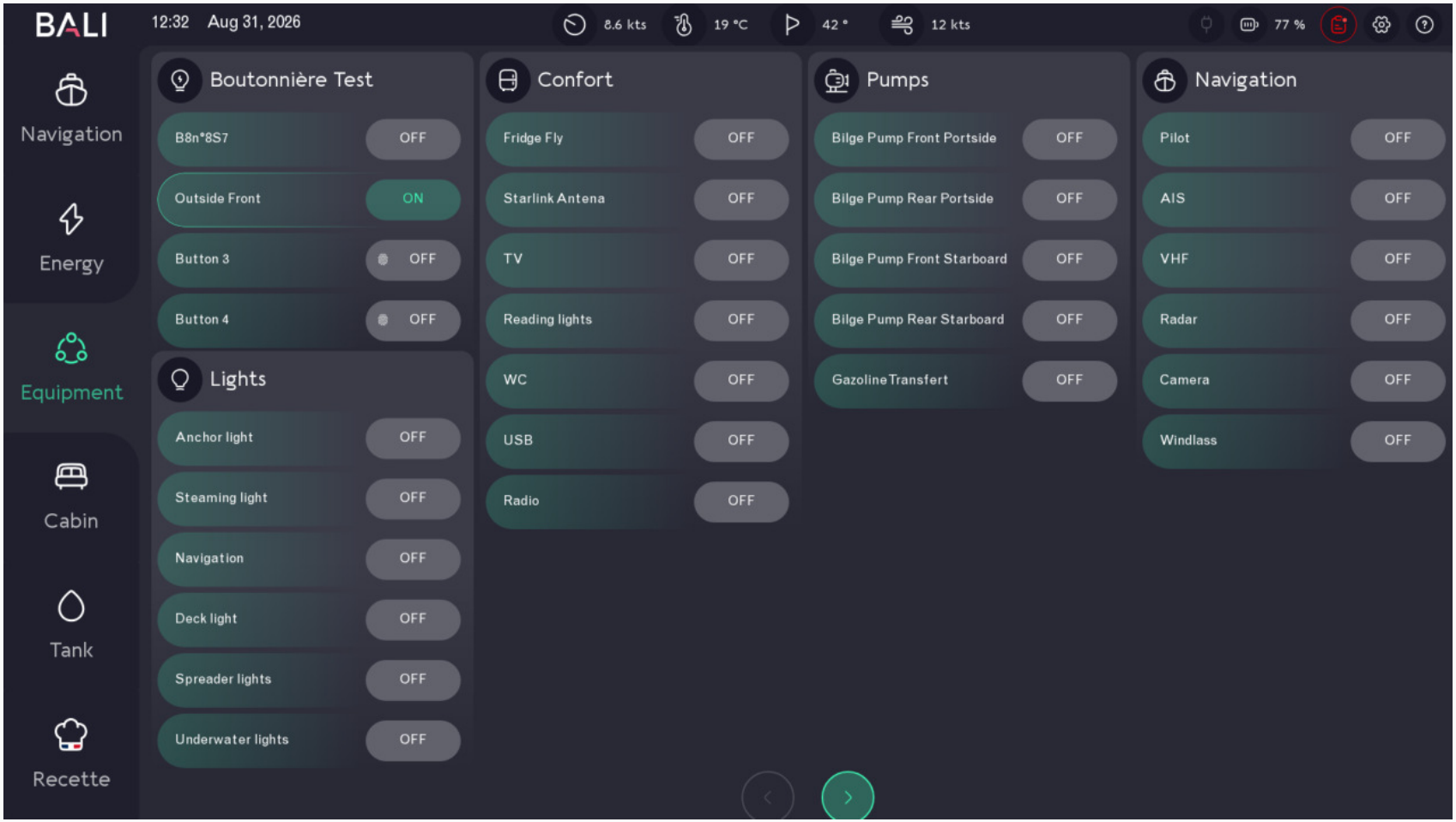
Energy — solar production, panel by panel



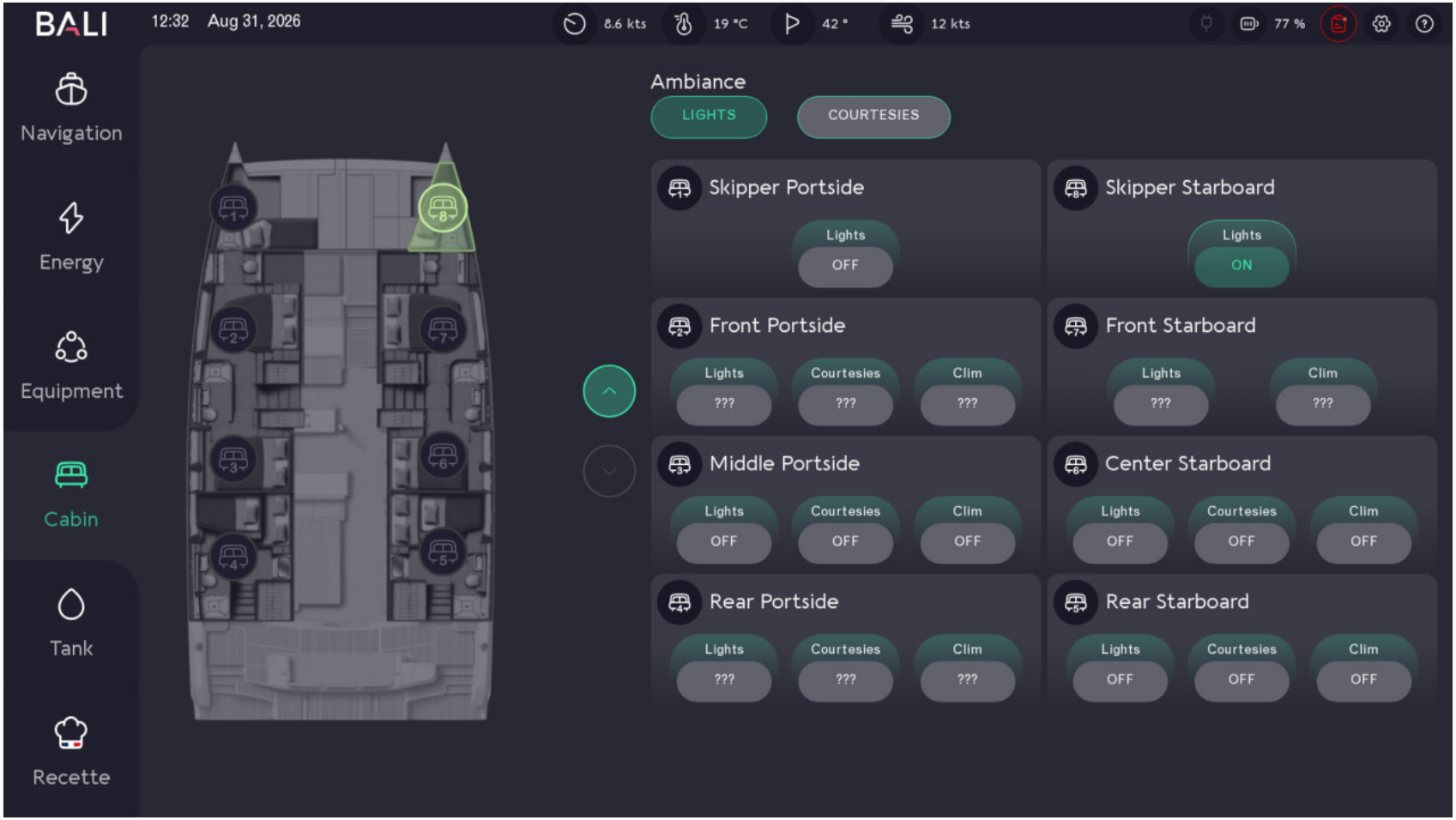
Energy — shore power and chargers



Equipment — every load, on one page



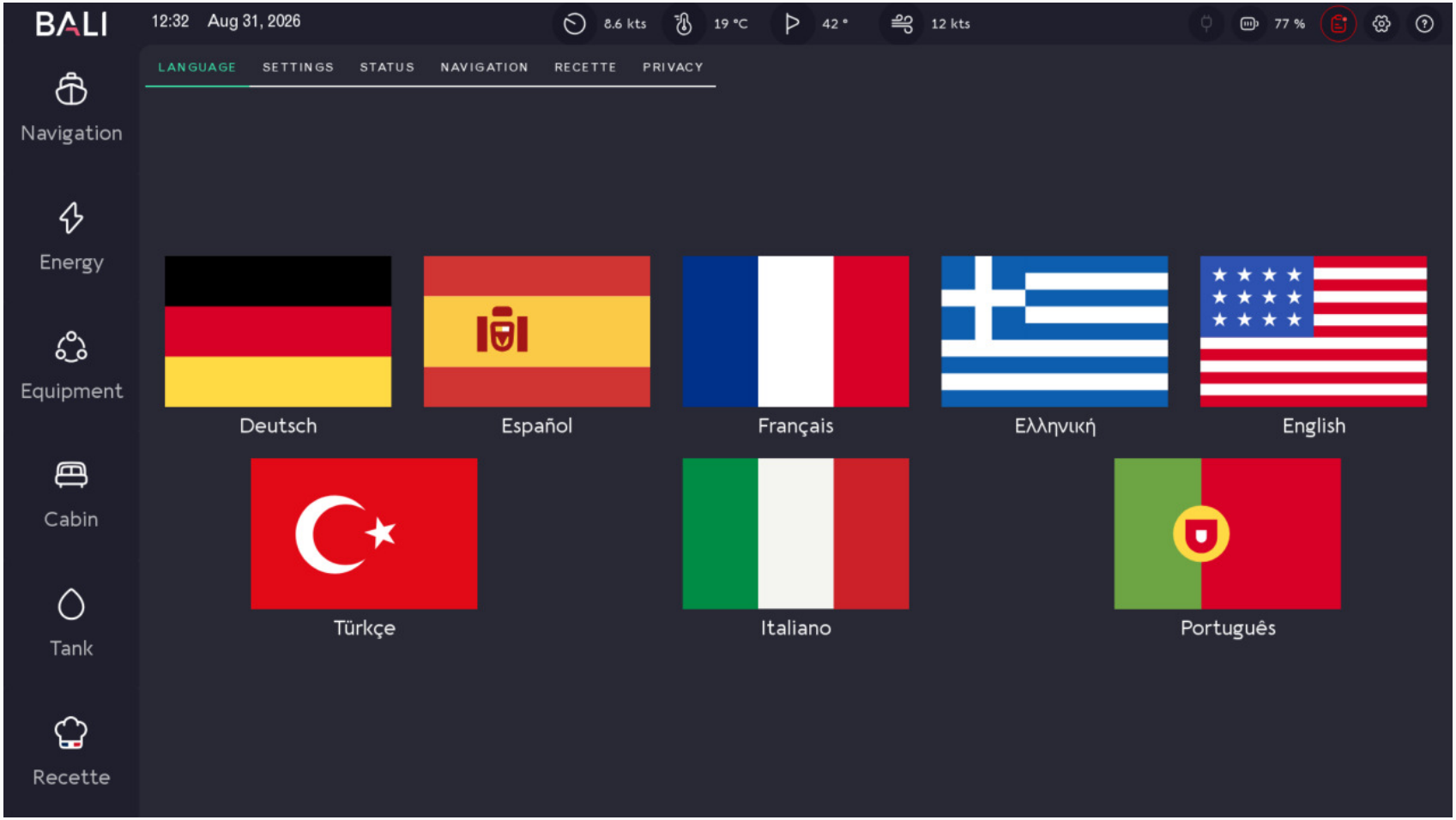
Lighting, by zone



Tanks


BALI
12:32 Aug 31, 2026
8.6 kts
19 °C
42 °
12 kts
77 %
CONSUMPTION
CABINS
PRODUCTION
Navigation
Energy
Equipment
Cabin
Tank
Recette
Fresh Water
PORTSIDE
STARBOARD
600 L
3 / 4
1 / 2
1 / 4
EMPTY
Diesel
PORTSIDE
STARBOARD
600 L
3 / 4
1 / 2
1 / 4
EMPTY

The screen speaks the customer's language



SFSP switches

SFSP — *sans fil, sans pile* — wireless, battery-free switches. Pressing the switch generates the energy that sends the message.

- No wire to the switch — more copper saved, and no hole to drill for it
- No battery to replace
- Each switch has a **unique serial number**
- It is **paired** to a function — the pairing is configuration, not wiring
- The same switch can be reassigned to a different function later

Mount them the right way up: **the CE marking must be readable**.

Three tools, three jobs

Decepticon

Production line

- Firmware loading
- Addressing the Blocs
- Typing the gateways
- Printing traceability labels

Raken

Configuration

- eFuse values and response times
- Over and under voltage protection
- Multiplexing rules
- Tank calibration

VPN / Eagle

Remote support

- Reaching the boat from shore
- Brain and firmware updates
- Reading recorded history

Each tool is taught at its own level. You will not touch any of them today.

Diagnostic

Find the fault, replace the part

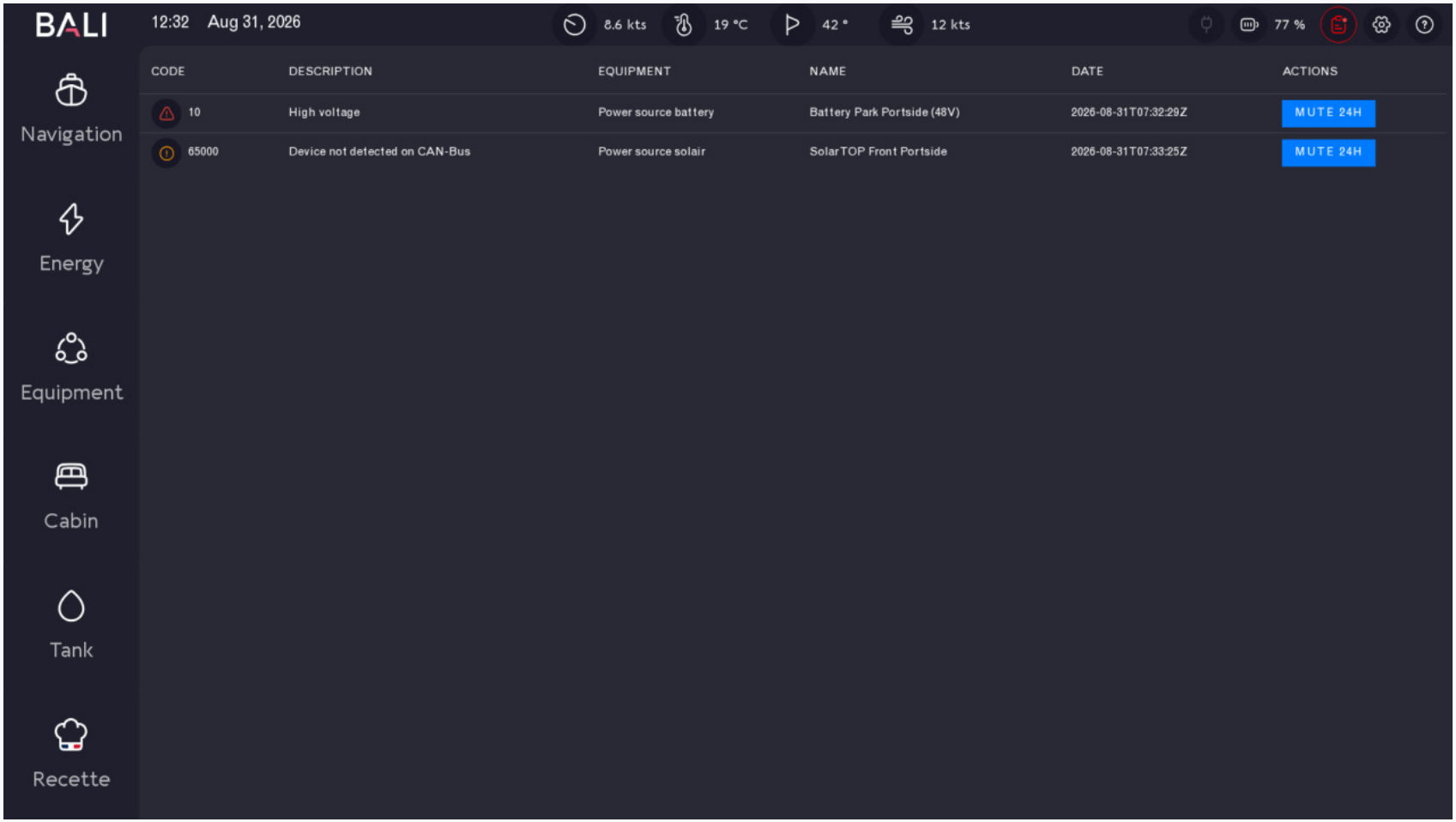
You read the boat before you measure it

On a conventional boat, diagnosis starts with a multimeter. On a multiplexed boat, it starts with what the system already knows.

- The screen shows which circuits are alive and which are not
- The Bloc LEDs show which output has tripped
- Error codes say whether the problem is the equipment or the network

The multimeter is now your second step, not your first. You will find the fault faster — and you will find the right one.

Alarms and trouble codes



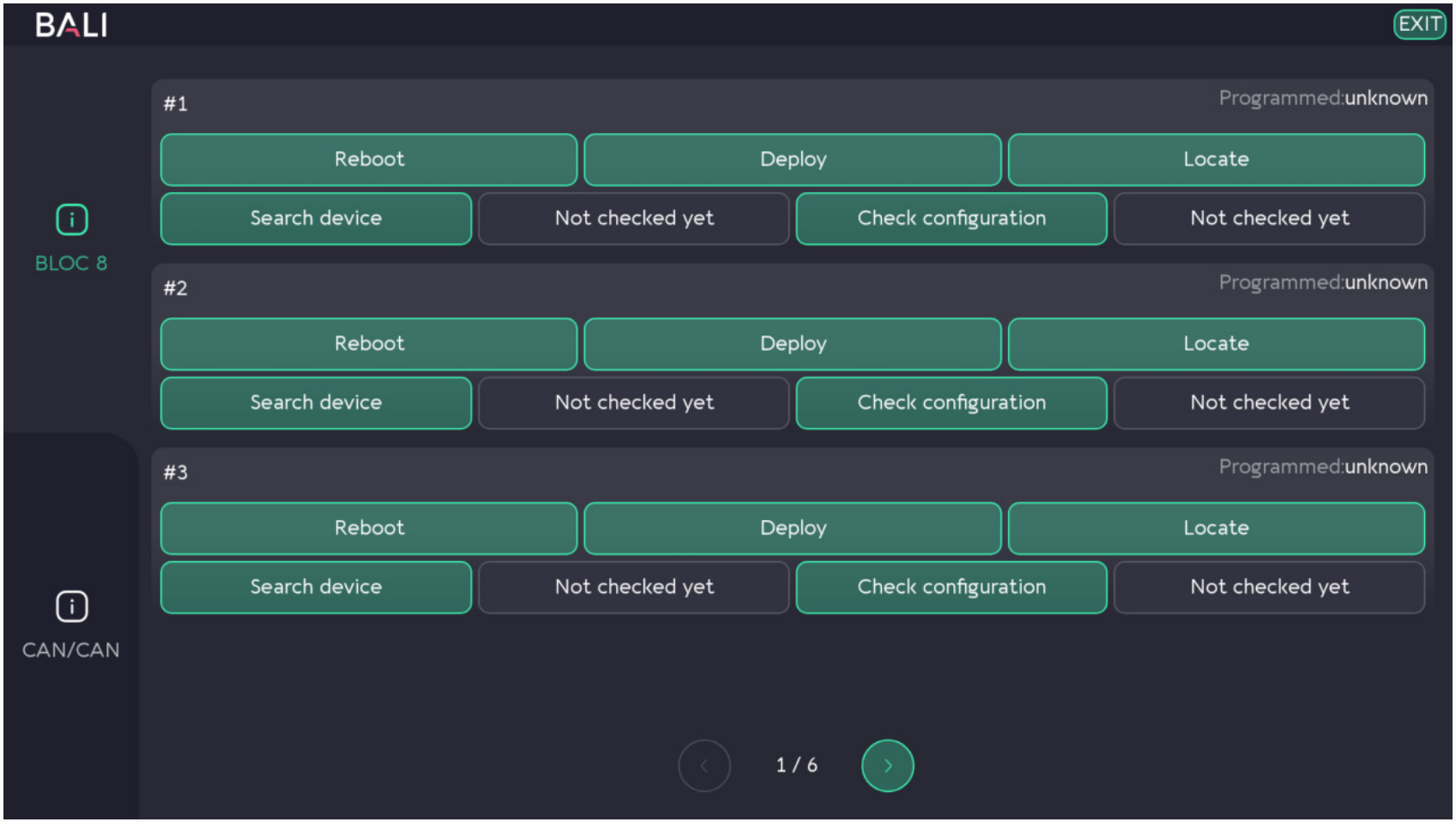
The Bloc 8 — reading the LEDs

Each Bloc also tells you its state on its own front, before you open any tool. This is your first diagnostic.

All LEDs blinking green	Bloc not yet identified — it has no role assigned
Steady green	Output is ON
Blinking green	Output is switching on
Steady red	Output has tripped — short circuit
All LEDs blinking red	Supply fault on the Bloc — over or under voltage

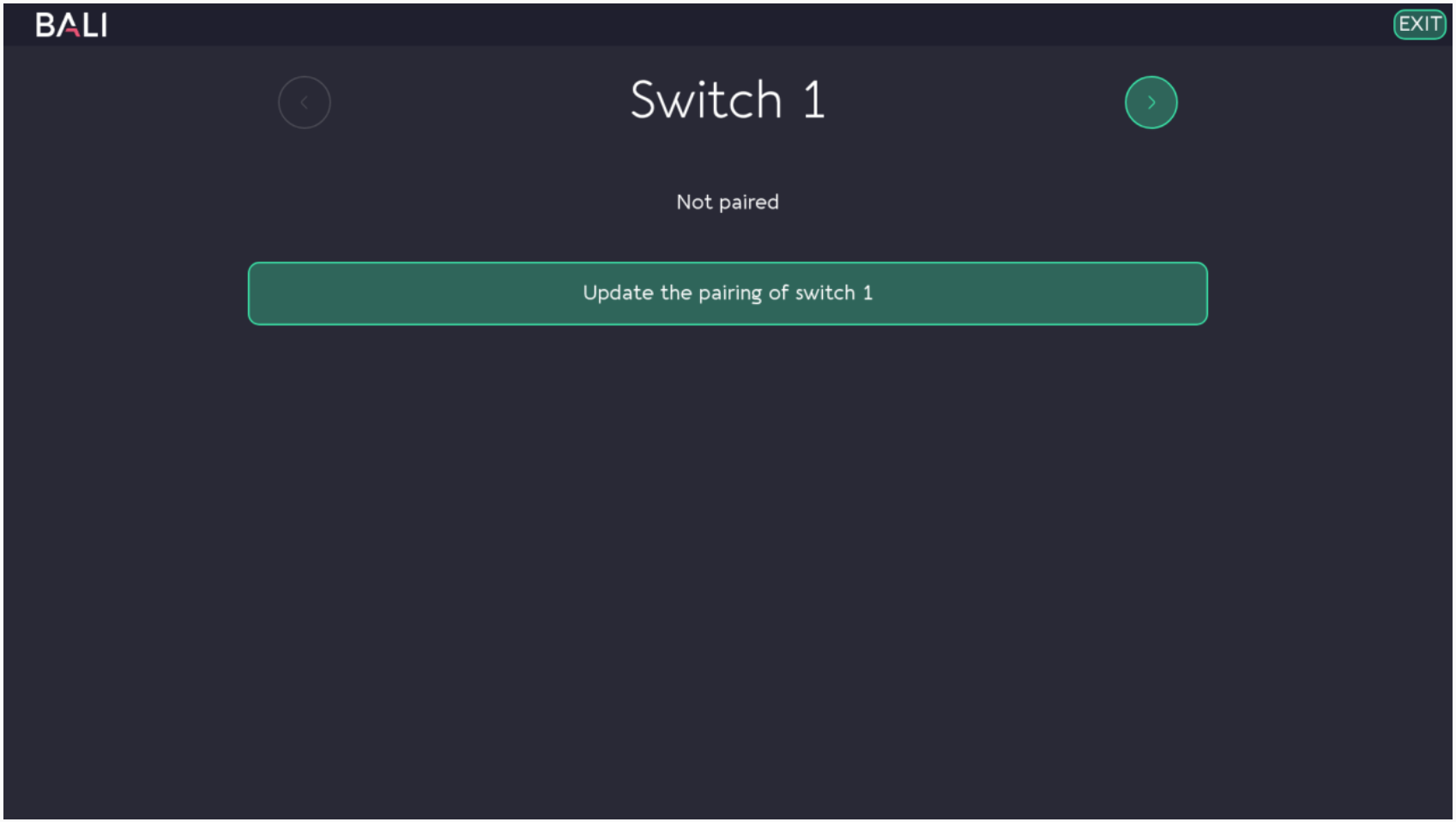
Learn these five patterns. They will save you a trip to the chart table.

Commissioning and replacing a Bloc



This is the page used to commission a new Bloc or replace a faulty one: find the device, deploy the boat's configuration into it, check that it took. Nothing to retype.

Pairing a switch, from the screen



A switch is paired from the screen, with no tool: pick the function, press the switch, done. Replacing a switch or reassigning one is the same operation.

What Changes For You

On the boat, day to day

Configuration replaces wiring

The hardware installed in the boat is largely the same from one boat to the next. What differs is the configuration.

- Options are enabled in the configuration, not wired in
- A spare output is configured, not re-run
- A switch is reassigned, not moved
- The same hardware serves every layout variant

This is why the configuration is controlled: changing it changes the boat. Access to the configuration tool is what separates the training levels.

Six field reflexes

1. **M12 connections** — push home without forcing. If it forces, it is wrong. Catch the thread before screwing, keep the connector in the axis, screw it fully down.
2. **Protect the connectors** from water, dust, glue and sealant. A connector left open, or a cable running upwards into one, will take water sooner or later.
3. **No crushed or pinched cable** — anticipate where the modules and deck sections come down, and keep cables out of traffic areas: nobody should be walking on them.
4. **Apply the electrician's basics** — route them, secure them, no strain on a connector, no cable under tension.
5. **Check the diagnostics on the screen** before reaching for a multimeter. It shows which circuits are alive, which device is not answering, and which output has tripped.
6. **A short-circuit alarm is a real short circuit.** Almost every time, the fault is in the wiring, not in the screen. Find it before you reset it.

None of this is new to your trade. It simply matters more, because one bad connection now affects more than one function.

Three things never to do

- Never connect the NMEA 2000 network to the MUXEN network
- Never remove a terminator to test something — and if you do split the backbone, terminate both halves, then put it back as it was
- Never cut into the backbone to add a device — use a distributor (T)

Each of these produces a fault that works most of the time, which is far worse than a fault that never works.

What Comes Next

Four levels, one tool each

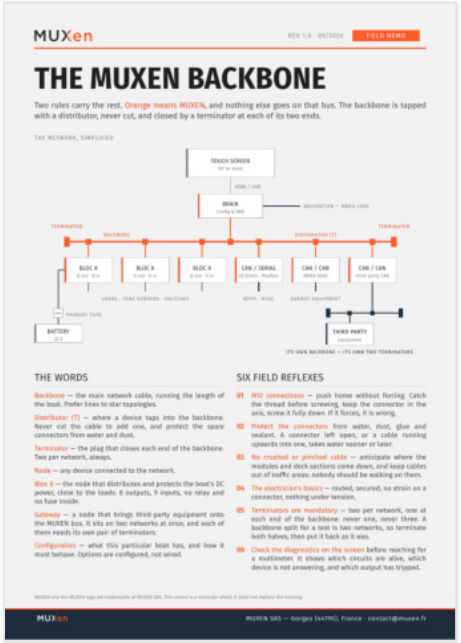
After this session

You should be able to:

- Name the boxes you see on board and say what each one does
- Find your way around the main pages of the screen
- Read a Bloc's LEDs
- Say which tool does what, and which one you will need
- Know the three things never to do

You are not expected to configure anything, diagnose a fault or open a tool. That is the Basic level, and it needs your hands on real hardware.

Your field memos


MUXen

REV 1.0 · 09/2026 FIELD MEMO

THE MUXEN BACKBONE

Two rules carry the rest. Orange means MUXEN, and nothing else goes on that bus. The backbone is tapped with a distributor, never cut, and closed by a terminator at each of its two ends.

THE NETWORK, SIMPLIFIED

TOUCH SCREEN

HDMI / USB

BRAIN

NAVIGATION — NMEA 2000

TERMINATOR

BACKBONE

DISTRIBUTOR (T)

TERMINATOR

BLOC II

BLOC II

BLOC II

CAN / SERIAL

CAN / CAN

CAN / CAN

LOADS · TANK SENSORS · SWITCHES

MPPT · BMSC

ENERGY EQUIPMENT

PRIMARY FUSE

BATTERY

THIRD-PARTY

ITS OWN BACKBONE — ITS OWN TWO TERMINATORS

THE WORDS

Backbone — the main network cable, running the length of the boat. Prefer lines to star topologies.

Distributor (T) — where a device taps into the backbone. Never cut the cable to add one, and protect the spare connectors from water and dust.

Terminator — the plug that closes each end of the backbone. Two per network, always.

Node — any device connected to the network.

Bloc II — the node that distributes and protects the boat's DC power, close to the loads: 8 outputs, 9 inputs, no relay and no fuse inside.

Gateway — a node that brings third-party equipment onto the MUXEN bus. It sits on two networks at once, and each of them needs its own pair of terminators.

Configuration — what this particular boat has, and how it must behave. Options are configured, not wired.

SIX FIELD REFLEXES

01 M12 connections — push home without forcing. Catch the thread before screwing, keep the connector in the axis, screw it fully down. If it forces, it is wrong.

02 Protect the connectors from water, dust, glue and sealant. A connector left open, or a cable running upwards into one, takes water sooner or later.

03 No crushed or pinched cable — anticipate where the modules and deck sections come down, and keep cables out of traffic areas: nobody should be walking on them.

04 The electrician's basics — routed, secured, no strain on a connector, nothing under tension.

05 Terminators are mandatory — two per network, one at each end of the backbone: never one, never three. A backbone split for a test is two networks, so terminate both halves, then put it back as it was.

06 Check the diagnostics on the screen before reaching for a multimeter. It shows which circuits are alive, which device is not answering, and which output has tripped.

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MUXen

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The MUXEN backbone

Orange means MUXEN. Tap it with a distributor, never cut it, and close it with a terminator at each end.

Download it now

Questions?