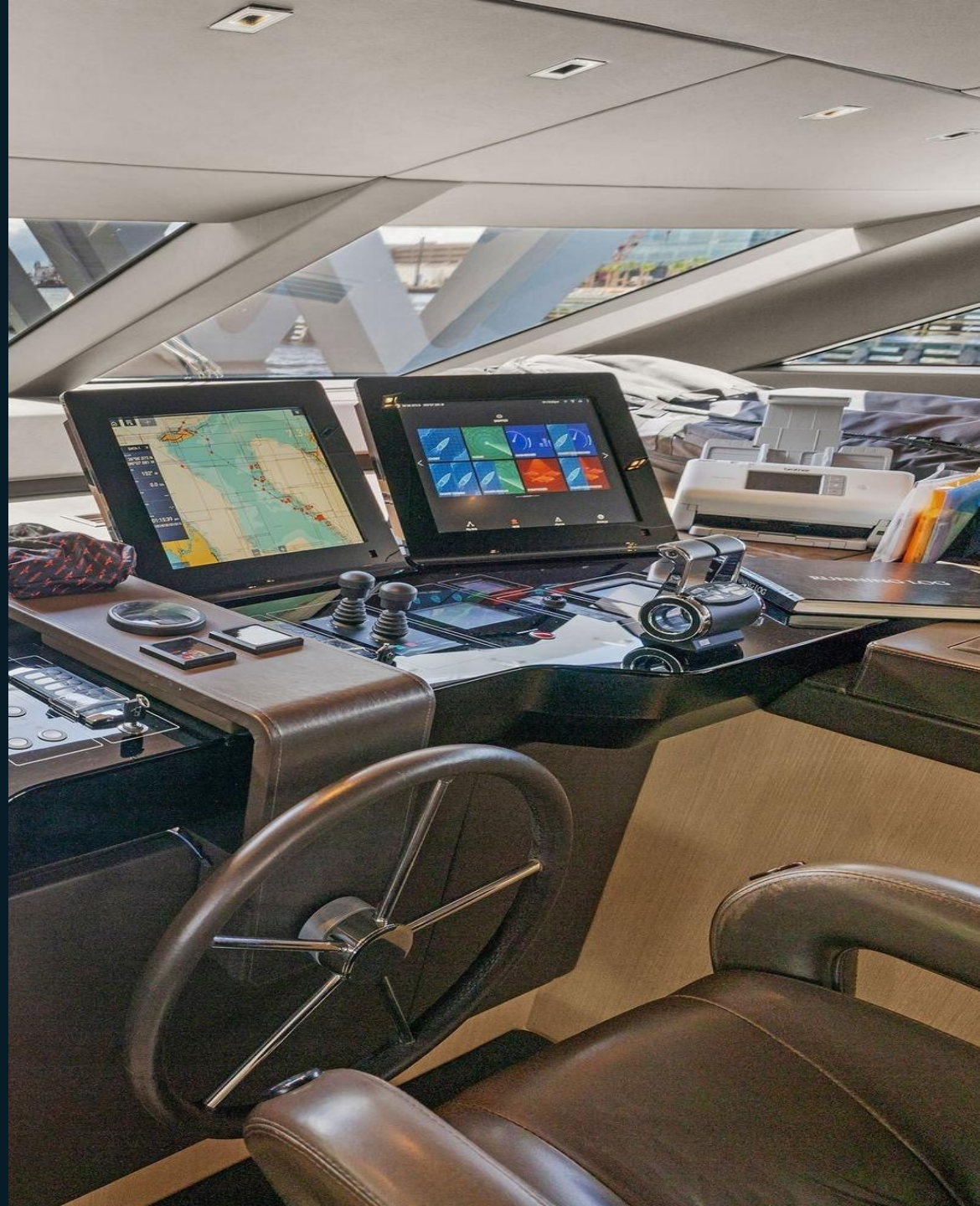
Upgrading Your Marine Electronics

A practical guide for 15- to 40-year-old boats

Todd Sawicki | Sawickipedia Marine | ABYC and NMEA certified



ABOUT THE PRESENTER

Todd’s Marine systems credentials

- ABYC Marine Electrical and Systems Certified
- NMEA Advanced Certified
- Simrad / B&G / Lowrance Certified Dealer / Installer
- CZone Certified Dealer / Installer
- Airmar Certified Technician
- Furuno Dealer / Installer
- Garmin Authorized Reseller / Installer
- Raymarine Authorized Reseller / Installer
- Victron Energy Authorized Dealer / Installer
- Epoch Batteries Authorized Dealer / Installer

Certifications and manufacturer relationships support design, installation, commissioning, and product support.

SETTING THE STAGE

The marine electronics revolution



1995

Standalone instruments
and point solutions



2010

Networked navigation
with growing ecosystems

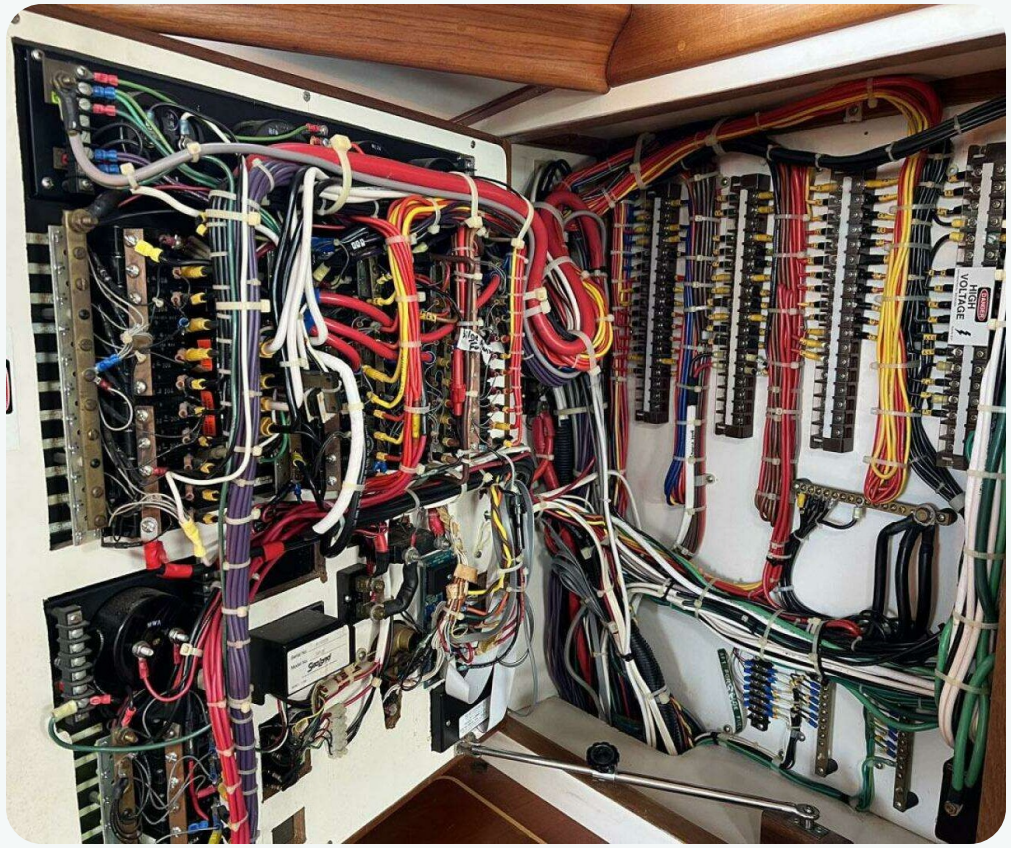


2026

Integrated navigation, power,
monitoring, and control

STANDARDS AND ELECTRICAL SAFETY

Why ABYC standards matter



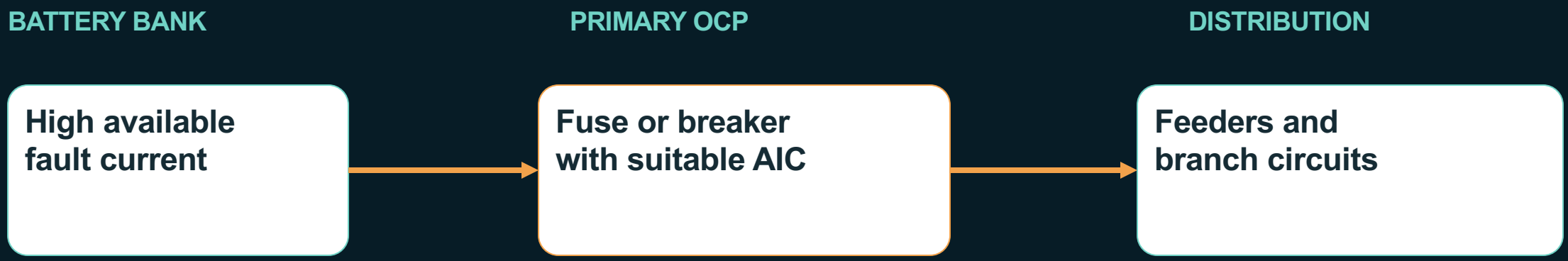
2025 **Supplement 65 revised E-11 and E-13**

2026 **Supplement 66 is the latest annual publication. Its public update list does not include E-11 or E-13.**

- Consensus safety guidance for design, construction, repair, and maintenance
- A common reference point for qualified technicians, surveyors, builders, and insurers
- A better basis for system design than product marketing or online shortcuts

Owner overview only. Use the current licensed ABYC standards for exact requirements, exceptions, and definitions.

E-11: fault current and circuit protection



Key 2025 owner-level changes

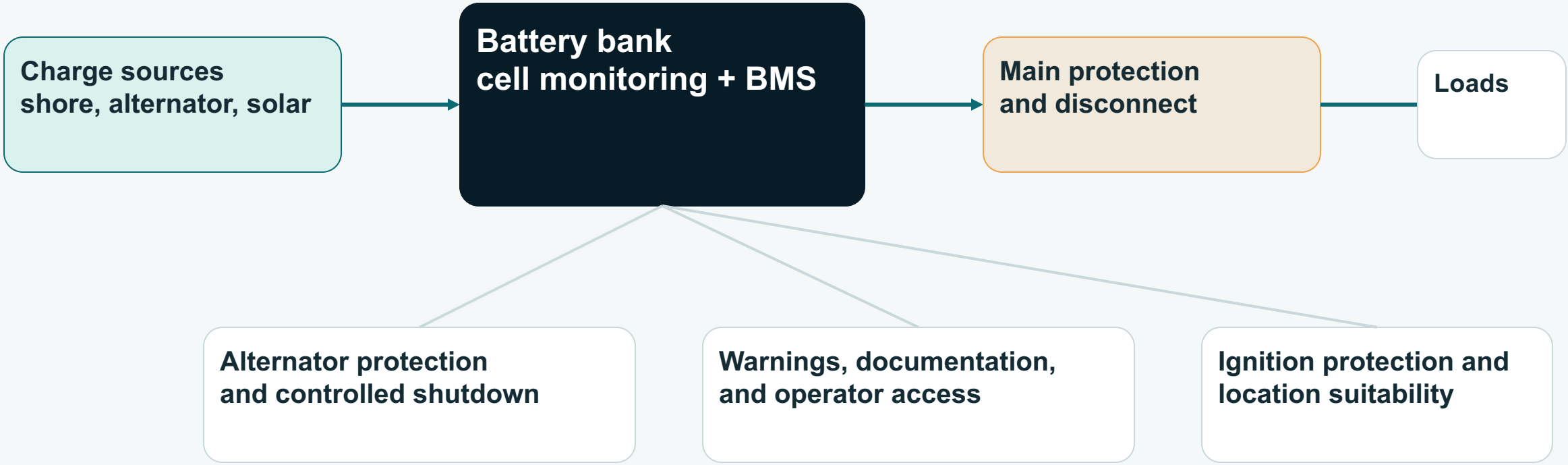
- AIC requirements scale with battery bank characteristics
- Solid-state overcurrent protection can serve qualifying branch circuits
- Programmable settings need identification and protection against accidental change

Conceptual diagram. Primary protection and branch protection serve different jobs.

Five common installation mistakes

01	**Protection**	Fuse location, rating, and interrupting capacity do not match the circuit.
02	**Connections**	Poor crimps, unsupported cable, corrosion, or loose high-current terminals add heat and voltage drop.
03	**Conductors**	Wire size ignores run length, load, bundling, temperature, or required voltage drop.
04	**Product location**	Equipment lacks the ignition, moisture, temperature, or vibration suitability for its space.
05	**Network power**	NMEA 2000 power insertion, termination, topology, or load budget is wrong.

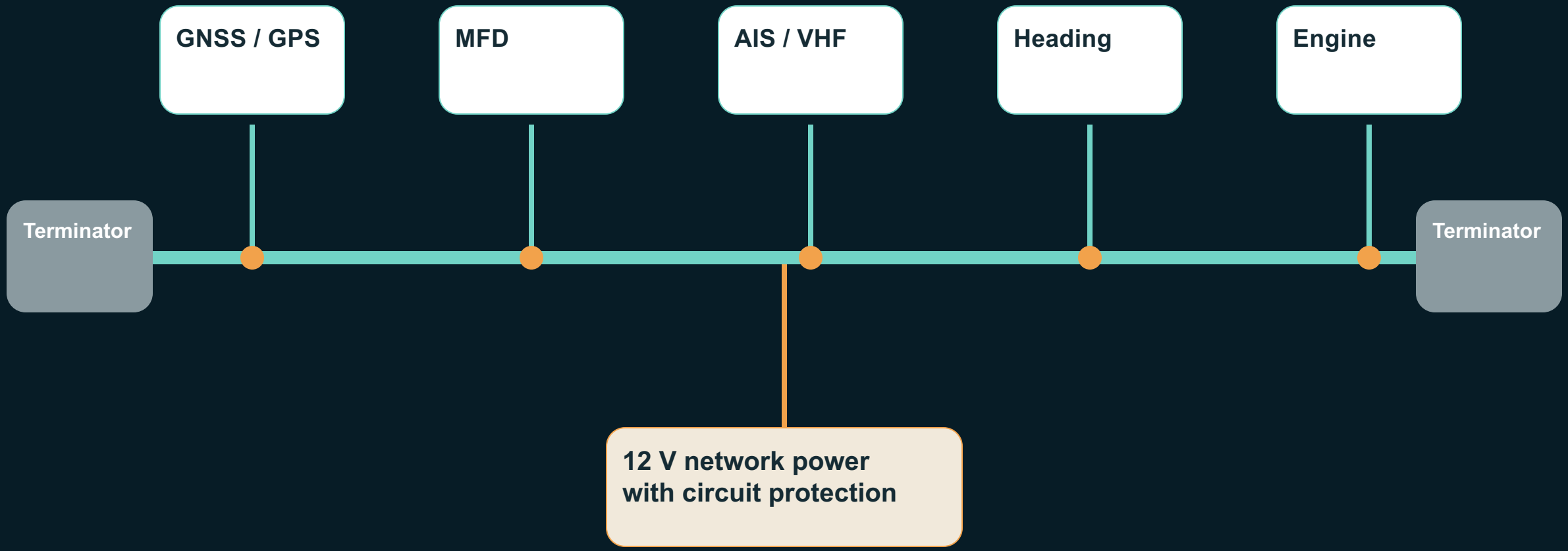
E-13: lithium is a system, not a battery swap



E-13-2025 applies to installed lithium-ion battery systems over 500 Wh.

Concept only. Battery manufacturer instructions and the current licensed ABYC standard govern the actual design.

NMEA 2000: the shared data backbone



Conceptual topology: powered, terminated backbone with short drop cables. Verify power insertion, LEN budget, voltage drop, and cable limits.

Four networks, four different jobs

NMEA 0183

Serial links

Point-to-point
Low bandwidth
Still common on legacy gear

NMEA 2000

CAN-based bus

Shared sensor data
Multi-vendor certification
Power on the backbone

MOST COMMON

Marine Ethernet

High bandwidth

Radar, sonar, video
Often vendor-specific
Connector match is not enough

NMEA OneNet

Standardized IP

IPv6 over Ethernet
100 Mb/s to 10 Gb/s
Certification-based interoperability

NEW!!!

Compatibility requires the right protocol, messages, connectors, software, and vendor support.

Today’s multifunction display

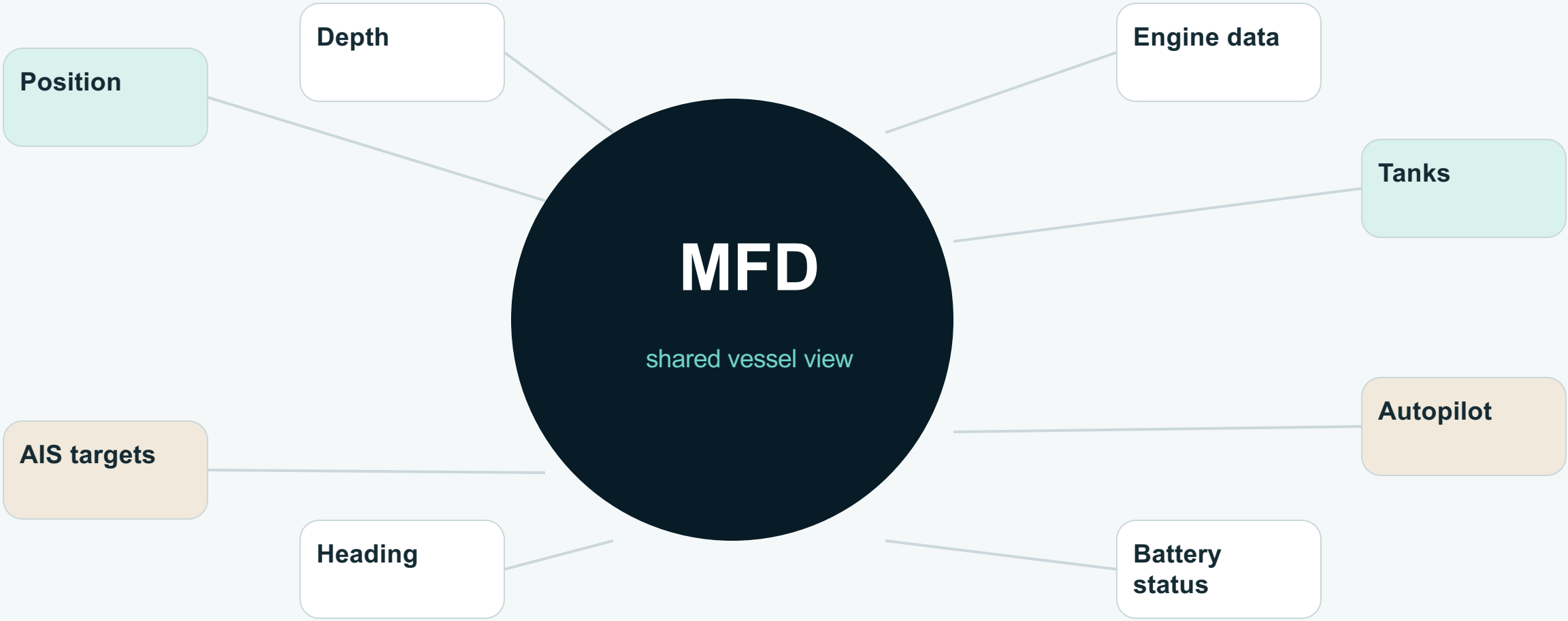


Bigger, Faster and way more Features

- Enhanced Radar and Sonar imaging
- Advanced 3D Charts
- Screens as big as you can imagine with touchscreen
- Multiple displays, remote displays, and cameras
- Loads of 3rd Party Apps and sensor support

HOW ELECTRONICS COMMUNICATE

One display can use data from many devices



The display does not create the data. Sensors and gateways do.

Radar has improved most at short range



Traditional magnetron

- Long-established technology
- Warm-up and pulse characteristics vary by model
- Still capable when correctly installed and operated

Solid-state pulse compression

- Strong close-range performance
- Fast startup and lower power draw on many systems
- Doppler highlighting, dual range, and automated tracking

Heading quality matters for overlay and target tracking.

Features vary by radar and display pairing. Verify compatibility before purchase.

Seeing beyond the chartplotter



Thermal

Detects heat in darkness. Useful for people, vessels, and warm machinery.

Low light

Uses available light for a familiar image. Performance falls as light disappears.

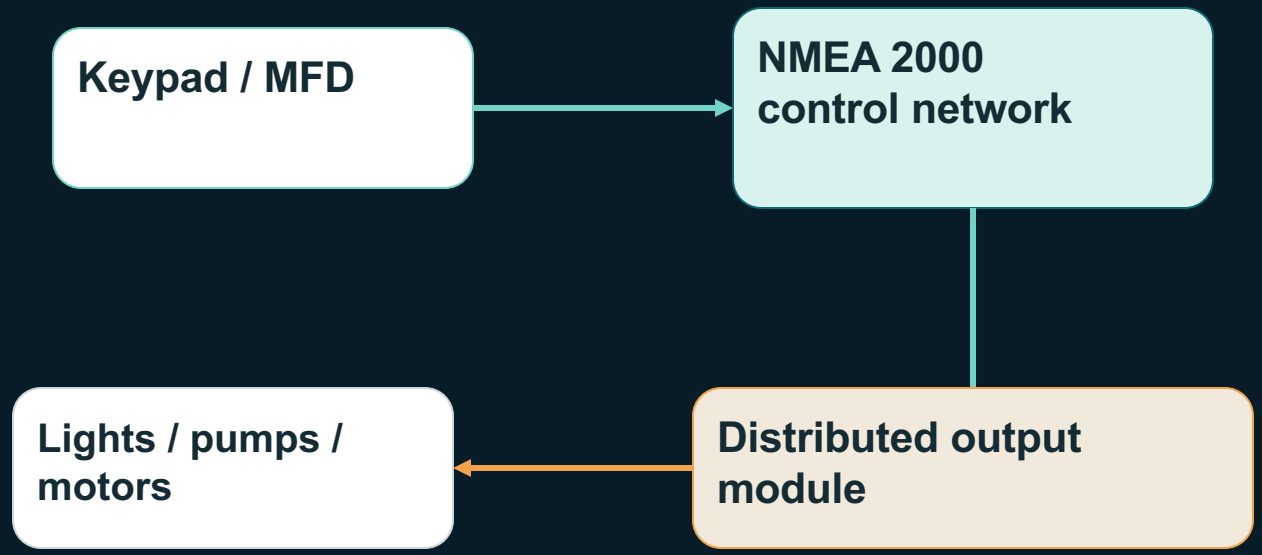
Machine vision

Can flag objects or support docking. Cost, training data, and false alarms still matter.

Useful sensor. Still not a substitute for radar, charts, lights, or a lookout.

Digital switching is a revolution in electrical system designs





Design features

- Decentralized infrastructure and controls
- Manual bypass and local control
- Failure domains and load shedding
- Configuration backup and future service support

Why is everyone talking about Lithium?



Benefits of Lithium

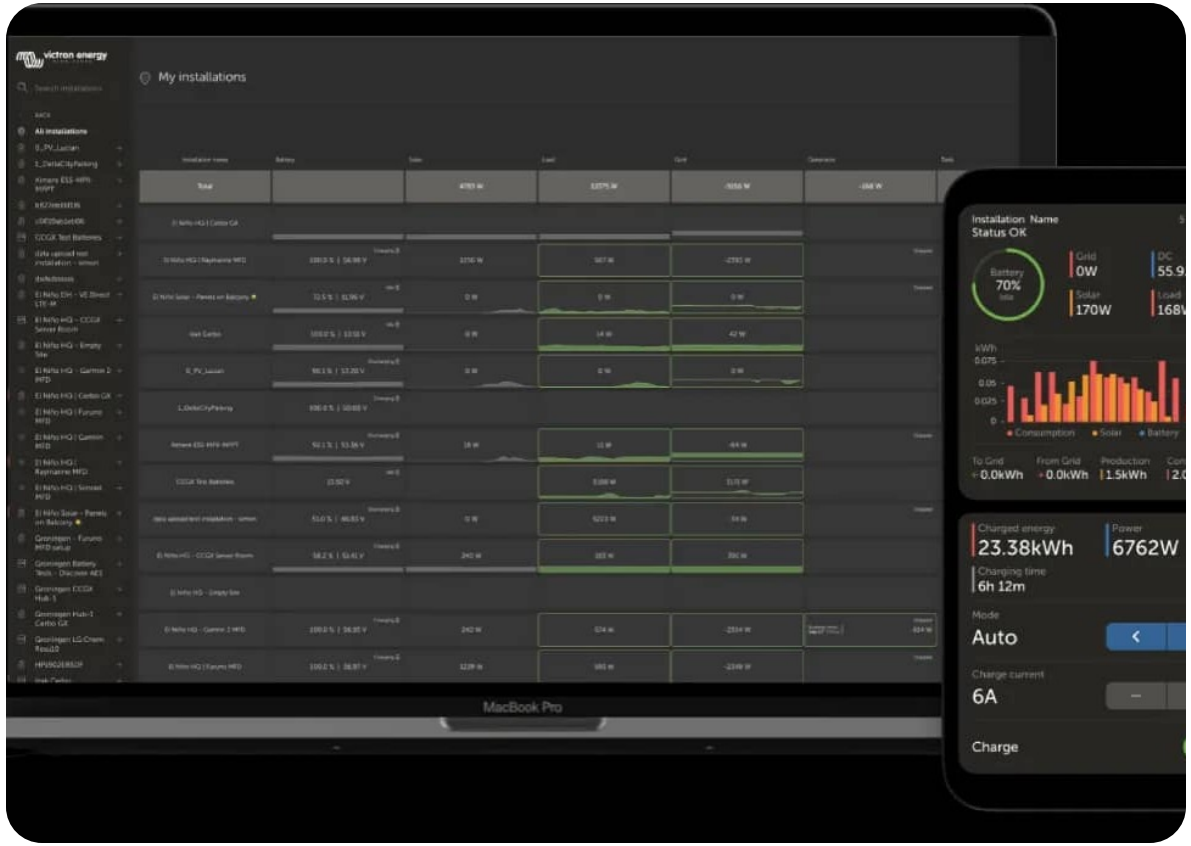
- WAY more usable energy & faster charging
- SO much lighter
- MORE affordable than you realize
- LAST much, much longer (10x or more)
- TONS of integration & communication options

Lithium is a system

- Does require planning and a good system design
- Alternator and charger upgrades are likely

Energy, charging, fault current, shutdown behavior, ignition protection, and serviceability belong in one design.

Remote monitoring and management



Useful alerts anywhere, anytime

- Shore power loss
- Battery voltage or state of charge
- Bilge activity
- Temperature and tank levels

Remote data supports an inspection program. It does not replace one.

Starlink changed connectivity aboard



Starlink Mini receiver

Internet is now part of the cruising experience

- **More comfortable time aboard**

  Streaming, video calls and remote work make longer stays away from the dock more practical.

- **Better planning and support**

  Weather, chart updates, reservations and remote troubleshooting can happen from the boat.

- **A new load in the energy budget**

  Starlink Mini averages 25–40 W and accepts 12–48v input, so connectivity belongs in the power plan.

Connectivity is now an onboard service—not just a marina convenience.

WHAT OWNERS ASK FOR

Two common starting points

“I want lithium.”

More time at anchor
Less generator use
More useful onboard power

“I want a new plotter.”

Easier navigation
Better radar and sonar
A more connected helm

The first purchase starts the conversation. Your cruising goals set the scope.

SETTING THE STAGE

Salish Sea hazards

Reduced visibility

Fog and darkness can turn familiar water into an instrument-navigation problem.

Traffic and narrow passages

Ferries, tugs, fishing vessels, currents, and channel geometry compress decision time.

Cold water and floating hazards

Reliability, detection, communication, and recovery matter more than novelty.

Safety benefit first. Convenience second.



SETTING THE STAGE

Enjoying the Salish Sea

More comfort aboard

Quiet battery power supports refrigeration, heat, lighting, devices, and fewer generator hours.

Less workload underway

Better charts, radar, AIS, and autopilot help manage traffic, weather, and longer passages.

Fewer surprises

Clear battery, charging, tank, temperature, and bilge information catches problems earlier.

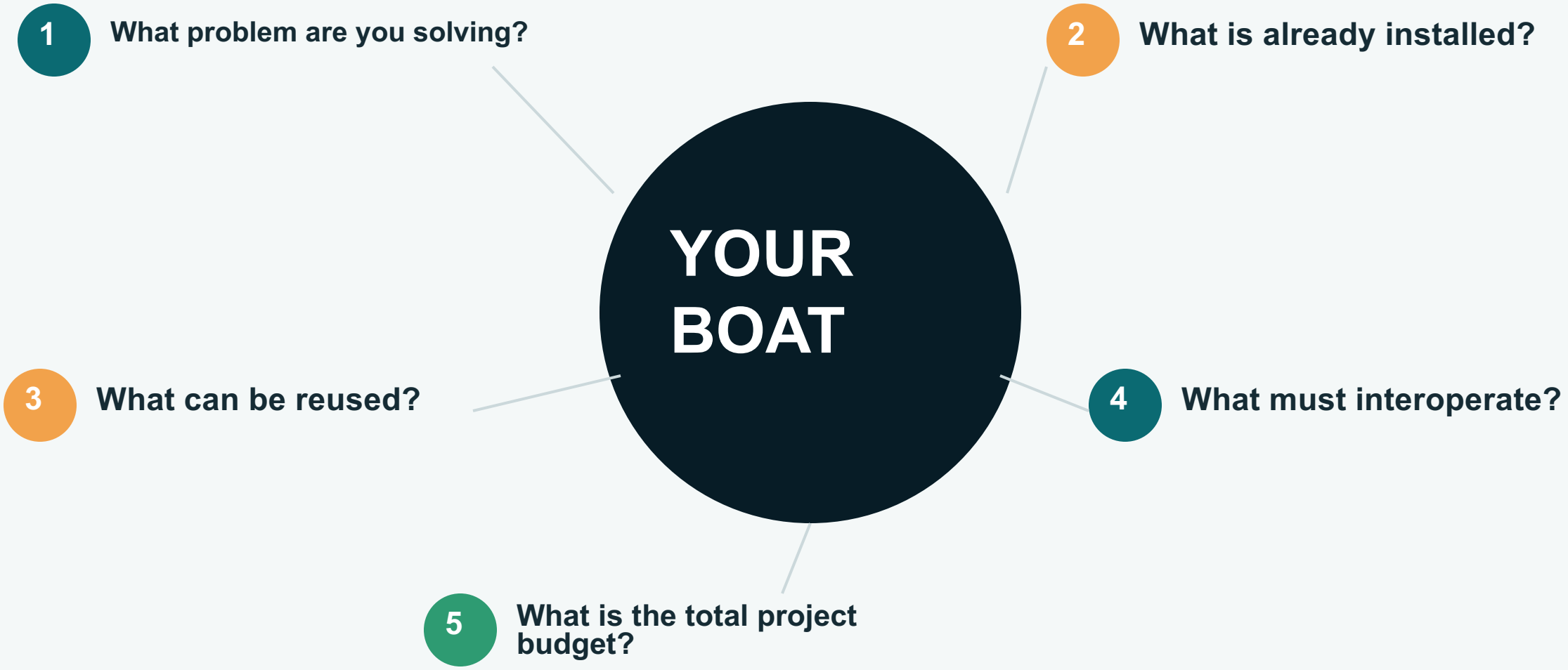
More time enjoying the boat

Trip planning, connectivity, and remote alerts reduce the time spent managing systems.

The goal is more time using the boat and less time managing it.



Five questions before buying anything



Lithium begins with the way you cruise

Quiet nights

Which loads should run without the generator?

Useful capacity

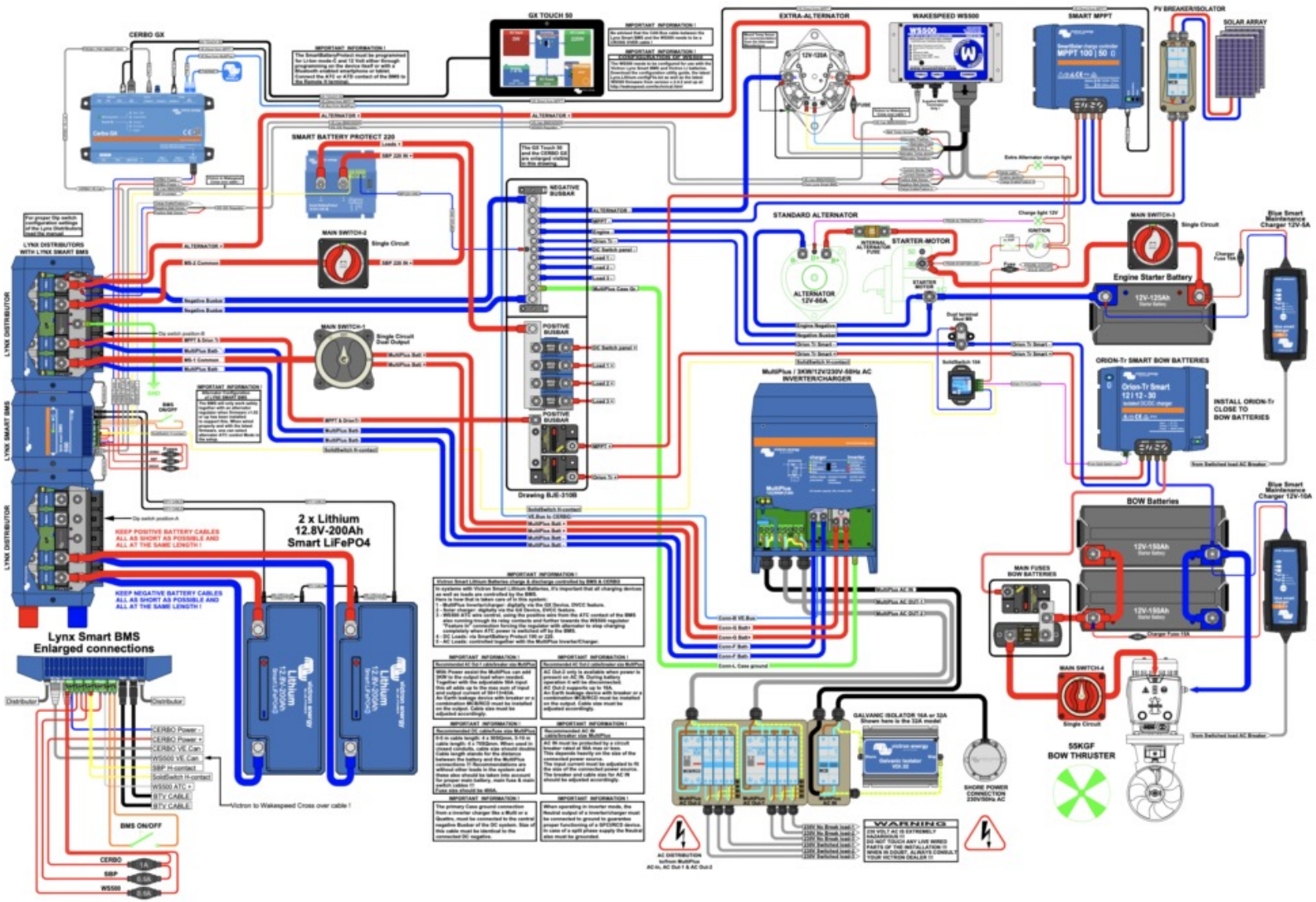
How many hours or days between charging?

A complete charging plan

Shore power, engines and solar must replenish the energy.



The Lithium system behind a comfortable cruiser



Sources

Shore, generator and alternator

Storage and conversion

House bank and inverter/charger

Control and distribution

Monitoring, AC loads and DC loads

HIGH-CAPACITY LITHIUM

Epoch 460 Ah V2-T: a concrete example



5.89 kWh nominal energy

12.8 V × 460 Ah in one house-battery case

230 A continuous discharge

Capacity and maximum output are different limits.

Connected and protected

Victron CAN, heating and serviceable Class T fuse

ARCO Zeus OMEGA: coordinated charging



Distributed control

Controller at the bank, drive module at the alternator

12 V through 48 V

A platform for several charging architectures

System integration

Compatible Victron DVCC and smart-BMS connections

HIGH-CAPACITY LITHIUM

And the next horizon for Lithium is 48v



Compact Size

20x20x6 inches

5.1 kWh

Capacity and maximum output are different limits.

Fits in a closet and powers the boat

MIXED-VOLTAGE REFITS

A 48 V bank can coexist with an older boat

System	Possible role	Planning question
48 V bank + inverter/charger	Higher-power AC appliances	Which loads and how long?
Existing 12 V or 24 V systems	Navigation, lighting and essential services	What stays independent?
DC-DC conversion / charging	Controlled energy transfer between banks	Which direction, rating and failure behavior?
Shore, solar and engine charging	Replenish the 48 V bank	How much energy returns each day?

An architecture option, not a mandate to convert every onboard device to 48 V.

Could batteries replace your generator use?

Illustrative bank	Calculation	Result
Nominal energy	51.2 V × 200 Ah	10.24 kWh
After reserve and inverter loss	10.24 ×80% ×90%	7.37 kWh AC
Average 500 W load	7.37 ÷0.5	About 14.7 hours
Average 2,000 W load	7.37 ÷2.0	About 3.7 hours

A quiet overnight is an energy budget. Unlimited runtime needs replenishment.

Three scopes for a lithium upgrade

Focused	Coordinated	Broader refit
House bank and monitoring	Bank + smart inverter/charger	Separate 48 V energy system
Required charger/protection changes	Engine charging and GX/VRM	AC distribution and charging redesign
Existing loads and voltage retained	A complete power subsystem	Generator role reconsidered
Goal: more useful capacity	Goal: quiet, predictable operation	Goal: a different cruising capability

MAKING THE RIGHT UPGRADE DECISIONS

Three lithium and power upgrade packages

FOCUSED

$3-10K

200-500 AH
Alternator and regulator
Inverter/Charger

COORDINATED

$15-20K

House and starter batteries
Digital Switching starter

BROAD

$25K and up

House, starter and genset replacement
Multiple voltages
Full Digital switching replacement

Illustrative 2026 equipment budgets. Labor, design, cables, antennas, network hardware, panels, and compatibility-driven replacements can materially increase the project cost.

WHAT OWNERS ASK FOR

Two common starting points

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SIMRAD NSO 4 EXAMPLE

The display can become a vessel interface



One place to see the boat

Navigation and compatible vessel-system pages

Integration takes a plan

Hardware, software, configuration and supported data

Axopar’s customized NSO 4 boat-status interface. This is not the default Simrad home screen.

NEXT-GENERATION MFD PLATFORMS

All major MFD brands have launched upgraded devices



SIMRAD

NSO 4-24

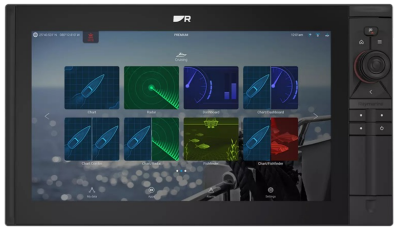
24-inch NEON OS



GARMIN

GPSMAP 9227

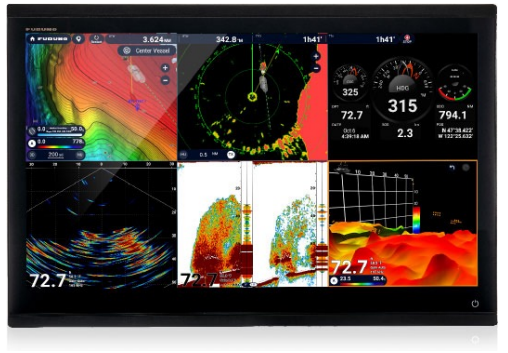
27-inch 4K display



Raymarine

Axiom 2 Pro

16-inch LightHouse 4



FURUNO

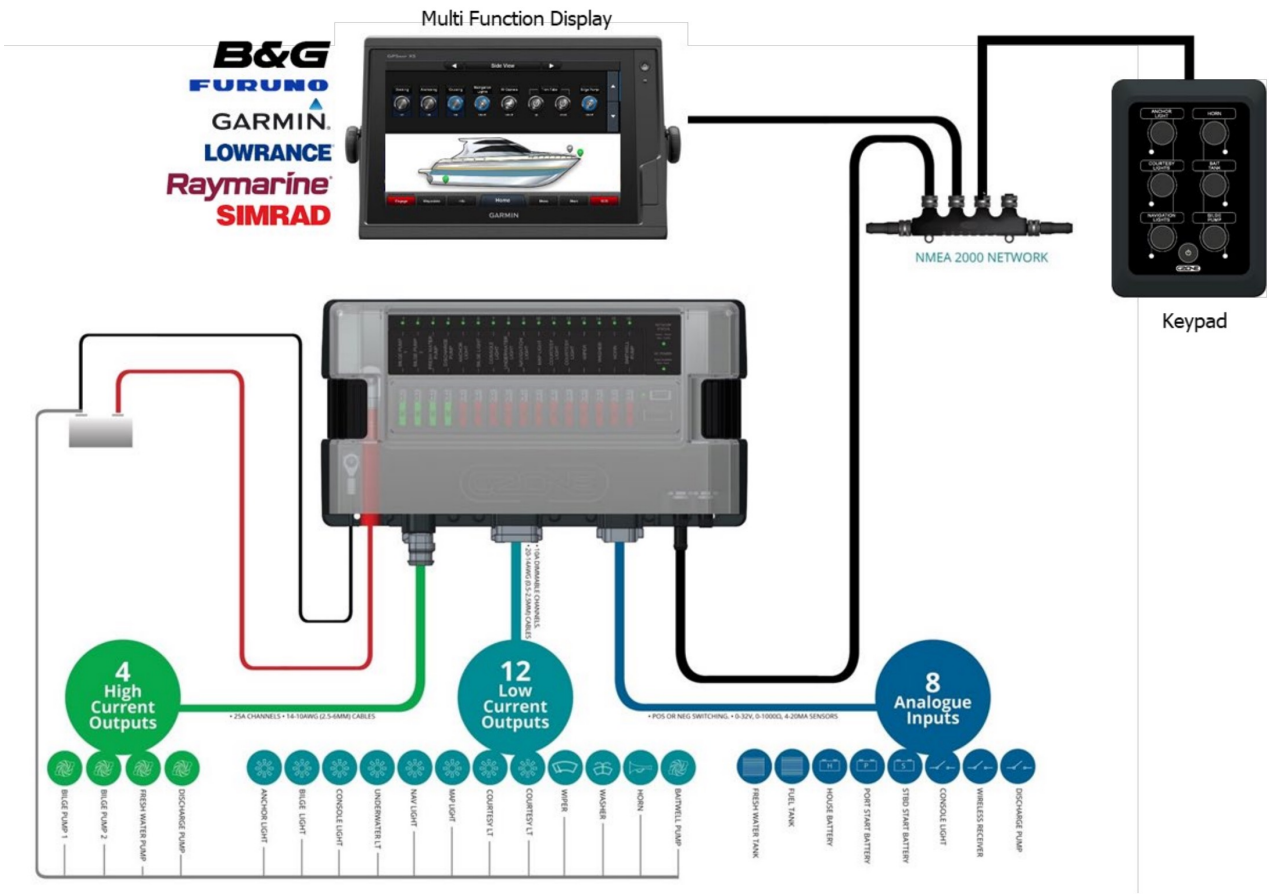
TZtouchXL TZT24X

24-inch TZ Maps

Already own an earlier supported model? New software is available. Review the release notes and update before your next cruise.

MANUFACTURER SYSTEM EXAMPLE

Digital switching brings the electrical system into the MFD



CZone manufacturer example. Circuit selection, configuration, manual bypass and documentation remain part of the refit.

UNDERWATER IMAGING

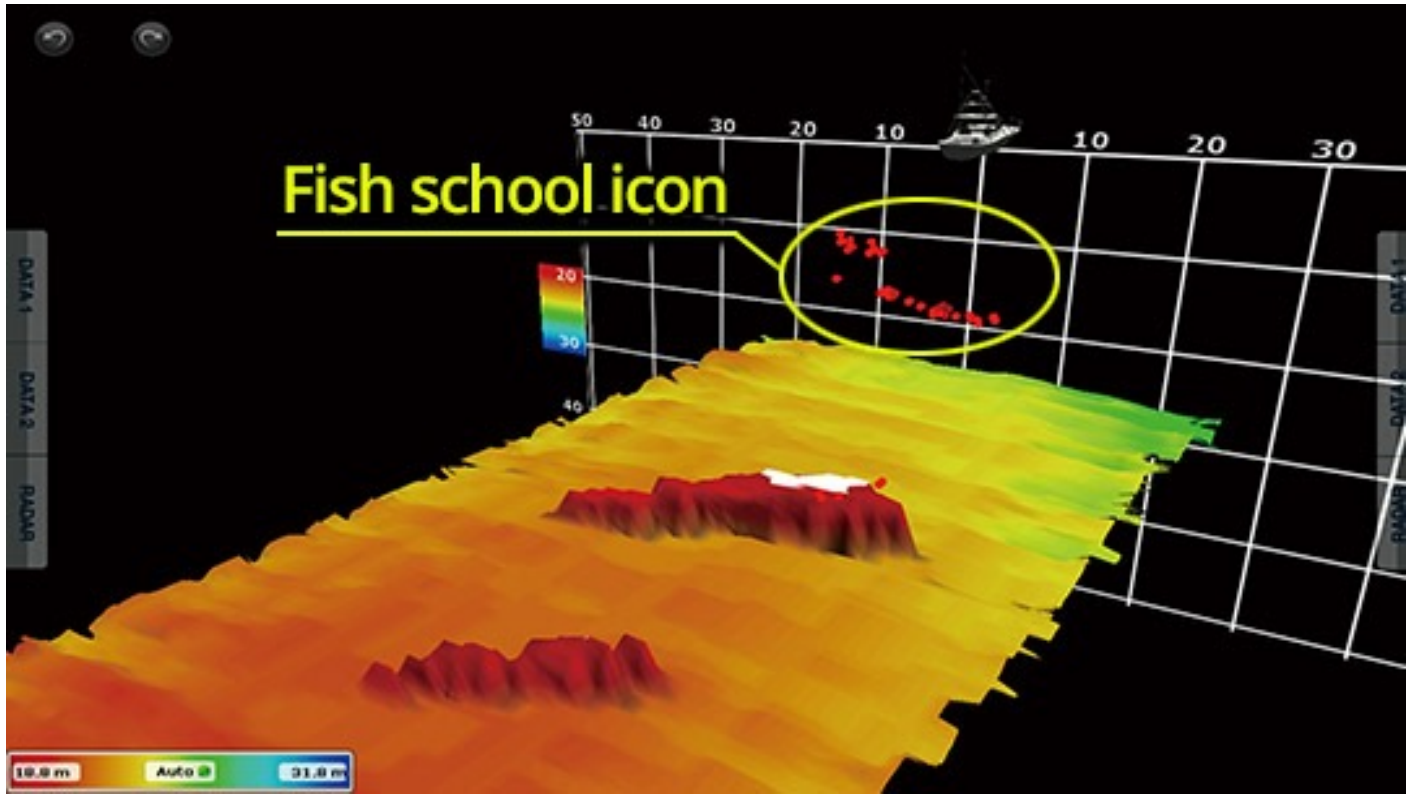
Sonar now shows more than a depth number

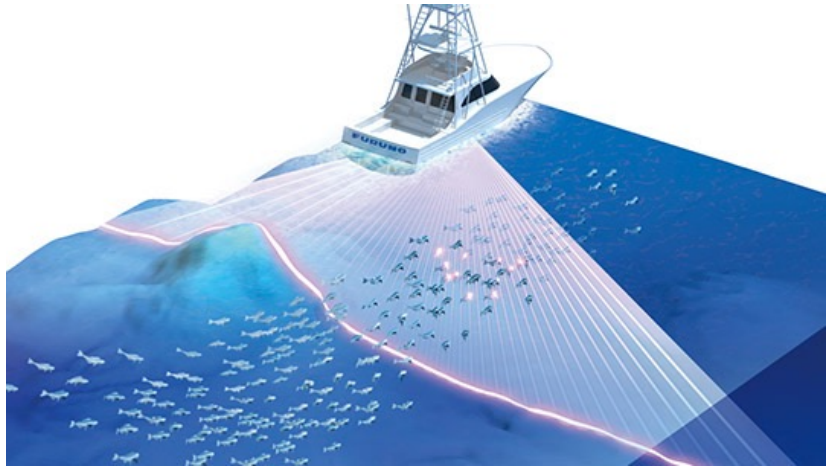
Technology	Example	What the owner sees
CHIRP depth sounding	Compatible broadband transducer + sounder	Targets and bottom beneath the boat
Multibeam 3D	Furuno DFF-3D	120° port-to-starboard swath and 3D history
Live sonar	Lowrance ActiveTarget family	Live views within the selected beam
Omnidirectional scanning	Furuno CSH-10	360° coverage around the vessel

3D, live, forward-looking and 360° describe different capabilities. Installation and coverage differ.

MULTIBEAM SONAR EXAMPLE

Furuno DFF-3D: the view beneath the boat





A 120° swath builds a 3D history as the boat moves.

Manufacturer screen and coverage illustration. DFF-3D is multibeam sonar, not 360° scanning.

Furuno CSH-10: a different scale of installation



Retractable hull unit

Dedicated hull tube, space and structural work

Motion-stabilized beam

A system built to look around the vessel

TZtouchXL integration

Requires compatible software and network setup

A specialist example of what is possible, not the default sonar upgrade for a cruising boat.

Modern radar can track and prioritize targets



Simrad HALO 3000 Bird+ mode

Automated target awareness

- Supported systems can acquire and track contacts
- Shows target vectors, trails, CPA and TCPA
- Colors approaching targets with Doppler processing

Specialized detection modes

- Bird and Bird+ modes optimize flock detection
- Dual-range views show near and far returns
- Harbor, offshore and weather presets reduce setup

Major brands now combine automated tracking with specialized radar modes.

Availability and automation level vary by radar, MFD, software, and heading data.

MAKING THE RIGHT UPGRADE DECISIONS

A phased path from survey to integrated helm



Survey

Inventory
Load analysis
Architecture

Safety

Power cleanup
VHF / DSC
AIS

Navigation

MFD
Radar
Heading

Integration

Autopilot
Monitoring
Selective control

Every phase should leave the boat safe, documented, testable, and ready for the next phase.

The compatibility survey comes before checkout

Existing equipment	Check before purchase	Possible outcome
Radar and sonar modules	Exact model + software support	Keep or replace as a system
Depth / wind / engine instruments	Data protocol and supported messages	Retain, bridge or modernize
Autopilot	Controller, drive and network support	Reuse some components after testing
VHF / AIS	Position, DSC and AIS data paths	Retain working safety functions

MAKING THE RIGHT UPGRADE DECISIONS

Three MFD and electronics upgrade packages

SENSORS + DATA

$1-3K

New sensors
Remote monitoring
Essential network

MODERN HELM

$5-15K

MFD
Solid-state radar
Advanced sonar
Heading and NMEA 2000

MAJOR REFIT

$20-35K+

Multiple displays
Advanced sonar
Digital switching
Monitoring and control

Illustrative 2026 equipment budgets. Labor, design, cables, antennas, network hardware, panels, and compatibility-driven replacements can materially increase the project cost.

MAKING THE RIGHT UPGRADE DECISIONS

1990s cruiser case study



Retain

- Working engine gauges
- Serviceable depth transducer
- Inspected DC distribution

Add

- Small NMEA 2000 backbone
- Heading sensor and AIS
- Shunt-based battery monitor

Replace

- Unsupported chartplotter and radar pair
- VHF without reliable GPS/DSC chain
- Corroded or undocumented wiring

Design the end state first. Install it in phases.

Illustrative case. Replace the photo and decisions with Sawickipedia Marine project evidence when available.

QUESTIONS AND DISCUSSION

Three takeaways

1

Architecture before products

Map power, data, compatibility, and the end state before shopping.

2

Safety systems first, but don’t give up on convenience

Reliable power, VHF/DSC, AIS, radar, and a proper lookout deliver practical value.

3

Upgrade in phases

Reuse working equipment when the interface is safe, supported, and documented.

What would you upgrade first on your boat?