Marine and Maritime Electrification Solutions

Marine energy storage systems based on LiFeYPO4 Water-Based Lithium Yttrium technology

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Global Maritime Electrification Wave

The global maritime industry is undergoing an unprecedented electrification transformation. The International Maritime Organization (IMO) has set stringent carbon reduction targets, requiring a 40% reduction in ship carbon emission intensity by 2030 and a 50% reduction in total emissions by 2050. The EU, the US, and China have all introduced corresponding port zero-emission regulations, promoting the adoption of electric propulsion and hybrid power systems for vessels.

However, extreme marine conditions such as high salt spray, high humidity, severe vibration, and temperature fluctuations pose stringent technical requirements for marine energy storage systems. Traditional lead-acid batteries have low energy density, while **LiFeYPO4 Water-Based Lithium Yttrium** batteries, as a water-based **Lithium Iron Phosphate** (LiFeYPO4) technology, are providing innovative solutions to address the challenges of lithium-ion batteries in terms of safety and durability.

Key Driving Factors

- IMO 2050 Carbon Neutrality Target
- Port Zero-Emission Regulations
- Continuously Rising Fuel Costs
- Improving Battery Technology Maturity

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Core Pain Points in Maritime Applications

Uncontrollable Fire Risk

Traditional lithium batteries are difficult to extinguish after thermal runaway, easily leading to catastrophic consequences in confined ship cabins. NCM/NCA ternary lithium batteries may undergo violent combustion after seawater corrosion or collision.

Accelerated Metal Corrosion

Salt mist and high humidity in the marine environment rapidly corrode metal-cased batteries, leading to seal failure, internal short circuits, significantly shortening system lifespan, and increasing maintenance costs.

Vibration Fatigue Damage

Ships continuously endure wave impacts and engine vibrations during navigation, causing traditional battery connectors to loosen easily and terminals to fracture, leading to reduced system reliability and even safety accidents.

Drastic Temperature Fluctuations

From tropical waters to polar routes, ships face extreme temperature differences ranging from -30°C to +60°C. Ordinary lithium batteries experience severe performance degradation at low temperatures and thermal runaway risks at high temperatures.

Why are ordinary lithium batteries not suitable for marine environments?

Inherent Risks of NCM/NCA Ternary Lithium Batteries

Ternary materials release oxygen when overcharged, overheated, or short-circuited, reacting violently with the electrolyte, reaching temperatures above 800°C. After immersion in seawater, salt accelerates electrochemical reactions, triggering an uncontrollable thermal runaway chain reaction. Multiple ship battery fire incidents demonstrate that traditional lithium batteries pose fundamental safety hazards in marine applications.

Structural Defects of Cylindrical and Square Metal-Cased Batteries

18650/21700 cylindrical batteries have numerous weld points, making them prone to breakage in vibrating environments. Aluminum/steel casings corrode rapidly in salt spray, and aging seals lead to electrolyte leakage. The conductivity of metal casings also increases the risk of short circuits. Case studies show that the average lifespan of traditional lithium batteries in marine applications is only 50-60% of that in land-based applications.

Complexity and Cost of Thermal Management Systems

To ensure the safe operation of ternary lithium batteries, complex liquid cooling systems, multi-level BMS protection, fire extinguishing devices, and other components are required, significantly increasing system weight, volume, and cost. In the limited space of a vessel, these additional devices occupy valuable cargo or activity space.

Natural Advantages of Winston LYP Water-Based Lithium Yttrium

Battery Technology Born for the Maritime Environment

Winston LYP (Water-Based Lithium Yttrium) batteries adopt an intrinsically safe chemical system, preventing thermal runaway even under extreme abuse conditions. The unique plastic casing design fundamentally solves the corrosion problem in marine environments, allowing for long-term stable operation in high-salt spray and high-humidity conditions without additional protection.

Intrinsic Safety Features

LiFeYPO4 material has extremely high thermal stability, with a decomposition temperature exceeding 600°C. Even under short circuit or overcharge, it only undergoes a mild exothermic reaction, preventing fire or explosion, thus completely eliminating the biggest safety hazard for vessels.

Plastic Casing Anti-Corrosion Design

Aerospace-grade reinforced plastic casing is completely immune to salt spray corrosion, and its IP67 protection rating can withstand short-term immersion in water. The battery weight is reduced by 15% compared to metal casings, saving valuable load capacity for vessels.

Stable Operation Across Wide Temperature Range

Operating temperature range from -40°C to +85°C, maintaining over 70% capacity at low temperatures and no thermal runaway risk at high temperatures. No complex thermal management system is required, significantly reducing system complexity and failure rate.

Ultra-Long Cycle Life

With over 6000 cycles at 100% DOD, the practical service life can reach 8-10 years. Compared to ordinary Lithium Iron Phosphate batteries, the total life cycle cost is reduced by more than 40%, significantly increasing return on investment.

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LYP Engineering Performance Verification Data

Winston LYP Water-Based Lithium Yttrium batteries have undergone rigorous maritime environment adaptability testing, with all performance indicators far exceeding industry standards.

3C

Continuous Discharge Rate

Sustained output of 3C current, with peak discharge up to 10C, meeting the high-power demands of ship propulsion systems and providing excellent acceleration performance.

6000+

Cycle Life (cycles)

Over 6000 cycles at 100% DOD (Depth of Discharge), and over 8000 cycles at 80% DOD, significantly exceeding the industry average.

95%

High Temp/Humidity Retention Rate

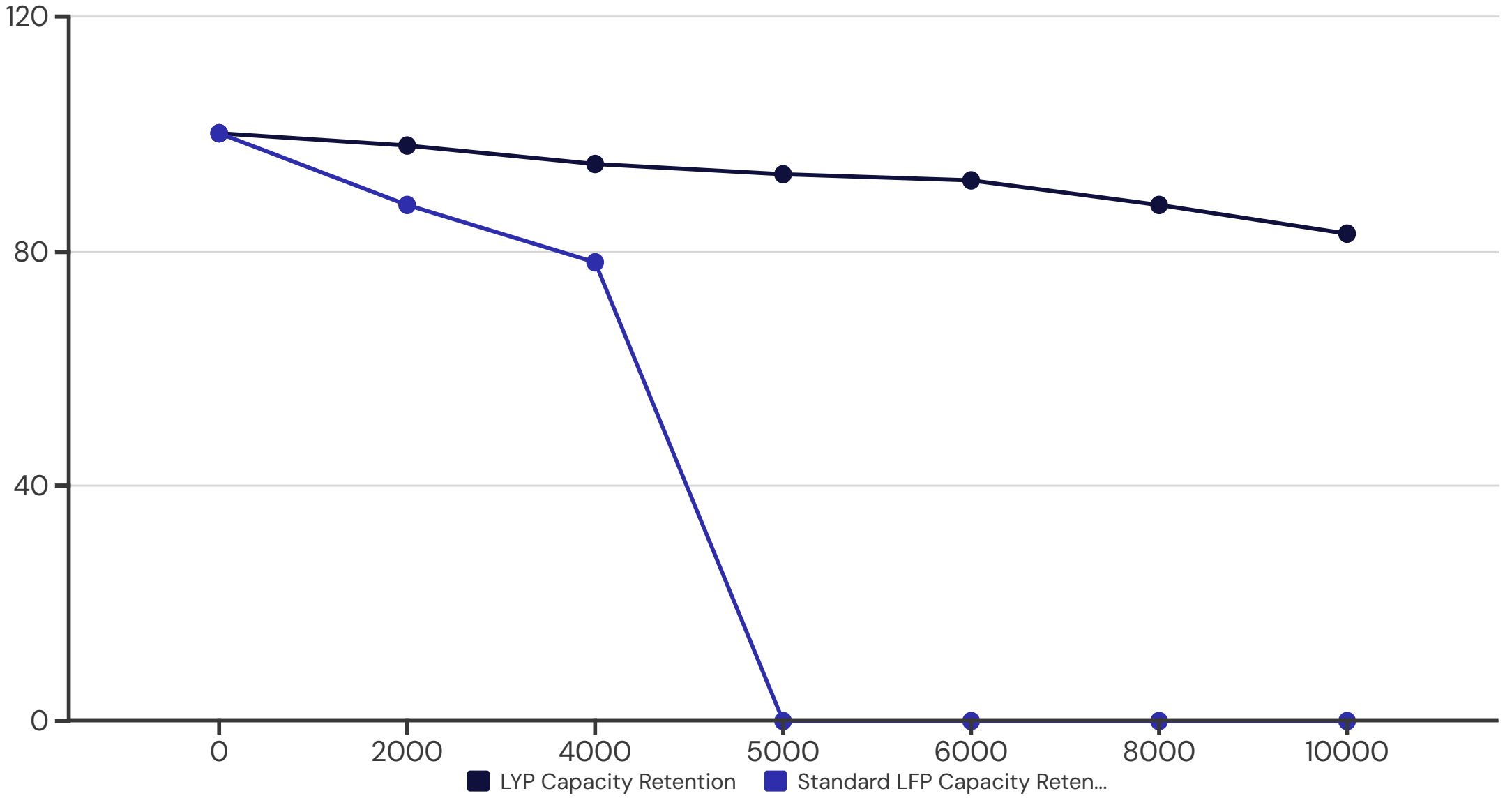
After 1000 hours of continuous operation in an 85°C/85% RH environment, capacity retention remains above 95%.

IP67

Protection Class

Passed IP67 waterproof and dustproof tests, capable of withstanding submersion in 1 meter of water for 30 minutes, fully adaptable to marine cabin environments.

Typical Lithium Iron Phosphate (LFP) batteries in the industry enter the 80% capacity life critical zone after 3000-4000 cycles. However, Winston LYP Water-Based Lithium Yttrium batteries achieve a longer, flatter, and slower decay curve through innovative technologies such as yttrium-doped lattice stabilization, water-based binder systems, and large-capacity square plastic shell design. The actual lifespan of LYP is 2-3 times that of ordinary LFP, and its decay performance remains far superior to the industry average, especially under harsh conditions such as high temperature and high discharge rates.



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Marine Battery System Structural Safety Design

Multi-layer Thermal Insulation Protection

The battery compartment employs a dual protection system of ceramic fiber insulation layer + aerogel insulation board. Even if a single cell malfunctions, heat can be contained locally to prevent spread. The compartment is equipped with a temperature monitoring sensor array for real-time thermal distribution monitoring.

Electromagnetic Compatibility Design

Shielded cables and a grounding system are used to eliminate electromagnetic interference with marine navigation and communication equipment. The BMS system has passed classification society EMC certification, ensuring stable operation in environments dense with radar and radio equipment.

Vibration Damping and Buffering Structure

Battery modules are installed on rubber damping pads with flexible mounting, capable of absorbing impact and vibration under Sea State 6 conditions. All connectors feature anti-fatigue design, eliminating the risks of loosening and fracture present in traditional solutions.

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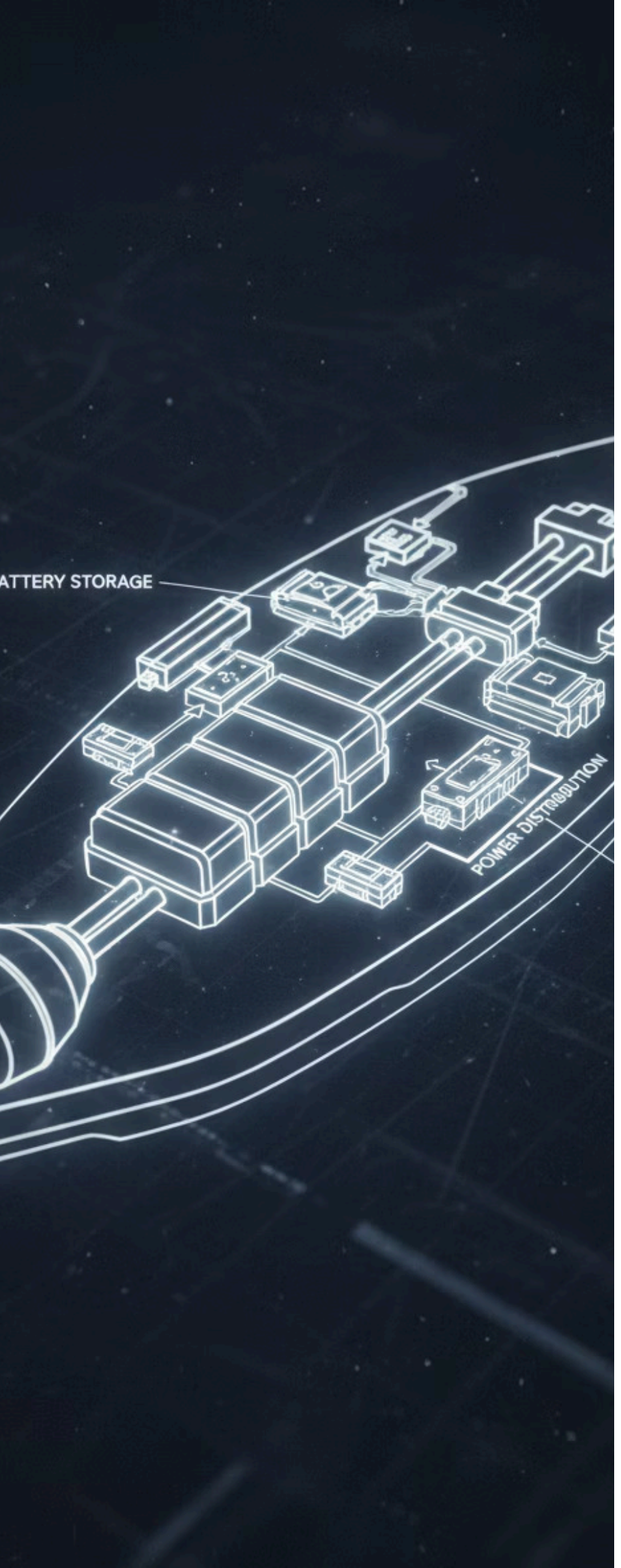

Onboard Energy Storage System Architecture

Winston LiFeYPO4 Water-Based Lithium Yttrium Battery (referred to as LYP battery) can be flexibly configured into marine energy storage systems of various power levels, adapting to different vessel types, and offers superior performance and safety compared to traditional Lithium Iron Phosphate batteries.

01

LiFeYPO4 Water-Based Lithium Yttrium Battery Compartment Energy Storage Unit

Composed of multiple LYP modules connected in series and parallel, equipped with independent BMS for single cell monitoring, balancing management, and fault isolation. Modular design facilitates expansion and maintenance.

02

Power Conversion System

DC/AC inverters convert DC power to three-phase AC power, driving propulsion motors or supplying onboard equipment. Bi-directional converters support shore power charging and generator grid connection.

03

Propulsion and Auxiliary Loads

The electric propulsion system is directly powered by batteries, achieving zero-emission navigation. Auxiliary systems (air conditioning, lighting, navigation) distribute power through distribution cabinets, ensuring uninterrupted operation of critical equipment.

04

Energy Management and Monitoring

Class society certified Energy Management System (EMS) optimizes battery charge and discharge strategies in real-time, extending battery life. The remote monitoring platform supports shore-based teams with real-time diagnostics, and predictive maintenance reduces fault rates.

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Typical Application Cases

Lear Luxury Electric Yacht

Location: Mediterranean Sea | **Power:** 500kWh
Stable operation for over 3 years in high-temperature and high-humidity marine environments, with zero fault records. Pure electric cruising range exceeds 80 nautical miles, and charging time is reduced to 4 hours. Customer feedback indicates significantly reduced noise and vibration, and enhanced ride comfort.

Antarctic Sailboat Hybrid Power

Location: Antarctic | **Power:** 50kWh
System weight is 25% lighter than traditional solutions, allowing more ballast space for the hull. 10C peak discharge capability provides strong power during start-up and sprints. After multiple Antarctic expeditions, battery capacity degradation is only 5%.

Offshore Work Vessel

Location: North Sea Oilfield | **Power:** 1MWh
Continuous operation in harsh sea conditions and severe vibration environments, with system availability exceeding 98%. The plastic casing completely resists salt spray corrosion, allowing 5 years of maintenance-free operation. When configured as a hybrid with a diesel generator, fuel consumption is reduced by 60%, achieving significant emission reduction.

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Comprehensive Value of Winston LYP Marine Solutions

Intrinsic Safety Assurance

Winston LiFeYPO4 Water-Based Lithium Yttrium batteries provide the highest safety level power system, eliminating thermal runaway risks and ensuring the safety of crew and passengers.

Ultra-long Service Life

8-10 years of actual service life, reducing total cost of ownership by 40% and significantly improving ROI.

Maintenance-Free Operation

Corrosion-resistant plastic casing design requires no regular maintenance, reducing operation and maintenance costs and increasing vessel uptime.

Strong Environmental Adaptability

Wide operating temperature range and high protection rating, suitable for all types of global waters and extreme climate conditions.

Winston LYP Water-Based Lithium Yttrium batteries provide a truly reliable, safe, and economical solution for marine electrification. We look forward to cooperating with you to jointly promote the clean energy transition in the shipping industry.