TECHNICAL WHITEPAPER

WINSTON MODULAR SYSTEM

Charging Logic and Infrastructure Requirements

Winston Modular System Charging Architecture, Equipment Matching, and Deployment Guide

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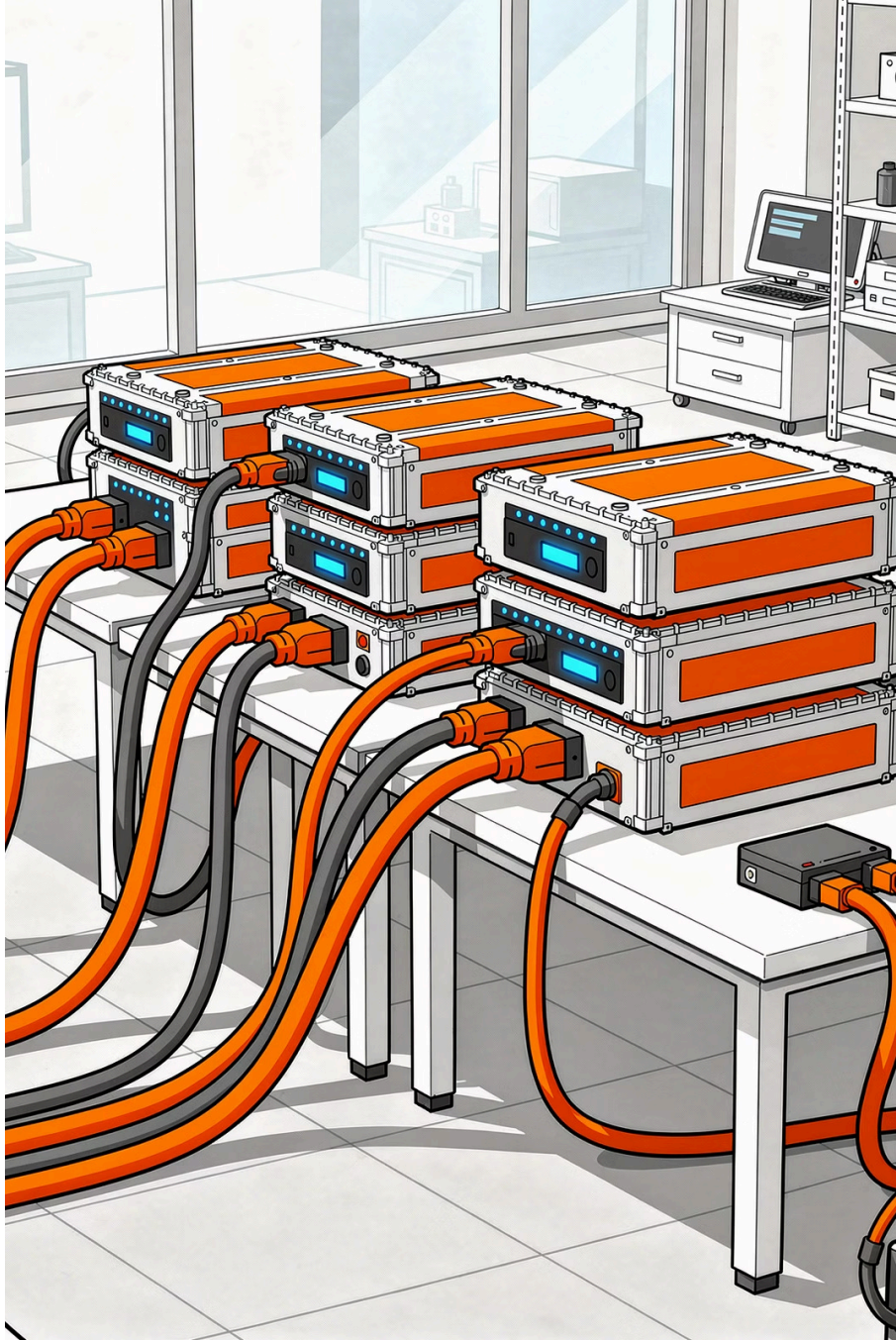

Fundamental Principles: Charging Requirements Determined by System Architecture

In the Winston modular system, its LYP charging logic is the same as LFP, and the **requirements depend on the application architecture, not the battery itself**. A battery is essentially an energy storage component, and the selection of its charging equipment is jointly determined by the following key system parameters:

Energy Source

Solar energy, grid, diesel generator, etc.

System Voltage

Flexible configuration from 12V to 1500V

Power Level

Match power according to load demand

Mobility Requirements

Differences between fixed and mobile applications

Safety Standards

Compliance requirements and protection levels

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CHAPTER 1 CHARGING CATEGORIES OVERVIEW

Three Major Charging Architecture Classifications

All Winston systems can be grouped into one of the following three charging architectures, each corresponding to different equipment requirements and engineering standards. Understanding these classifications is the first step to correct selection.

Class A: Stationary Energy Storage Charging

Integrated inverter/rectifier charging, no public charging stations required

Class B: Mobile System Charging

Requires dedicated chargers or charging stations

Class C: High Voltage Industrial Charging

Industrial-grade high-voltage isolated power electronic equipment

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CATEGORY A

Stationary Energy Storage System Charging

Typical Application Scenarios

- Solar + Battery Energy Storage Systems
- Grid + Battery Peak Shaving and Valley Filling
- Diesel Hybrid + Battery Systems
- Telecom Base Station Backup Power
- Microgrid Distributed Energy Storage

Charging Method

Batteries are charged through the following equipment, with the charging device **integrated within the power conversion system**:

- Inverter/Charger
- Rectifier System
- Solar Charge Controller (MPPT/PWM)

Category A systems **do not require public charging stations**; all charging functions are completed internally within the system.

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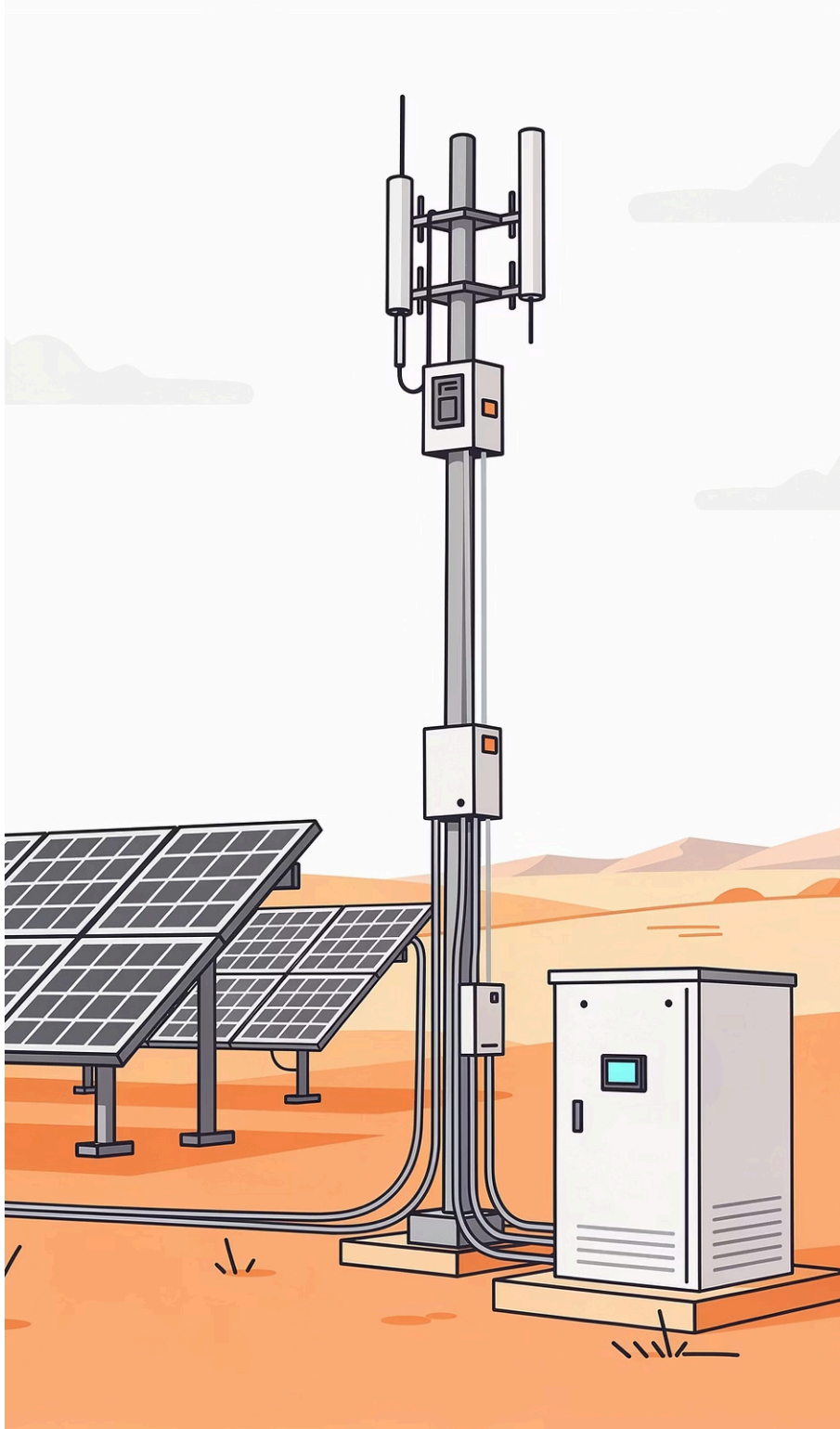

CLASS B

Mobile System Charging

When Winston modules are integrated into mobile platforms (such as electric vehicles, ships, or industrial machinery), dedicated charging equipment or charging station infrastructure is required.

Electric Vehicles

Power battery systems for passenger cars, commercial vehicles, and special vehicles need to be compatible with on-board BMS communication protocols.

Electric Vessels

Propulsion systems for electric vessels in inland rivers and nearshore areas need to consider marine environment corrosion protection and IP rating.

Industrial Machinery

Forklifts, AGVs, mining equipment, etc., require coordination with fleet management systems for efficient charging scheduling.

Key Matching Parameters

1

System Voltage

48V / 96V / 400V, etc.

2

Charging Current Limit

Not exceeding the maximum allowable charging rate of the battery

3

CC-CV Charging Curve

Constant Current - Constant Voltage standard charging protocol

4

BMS Communication Compatible

CAN / RS485 / Modbus and other protocols

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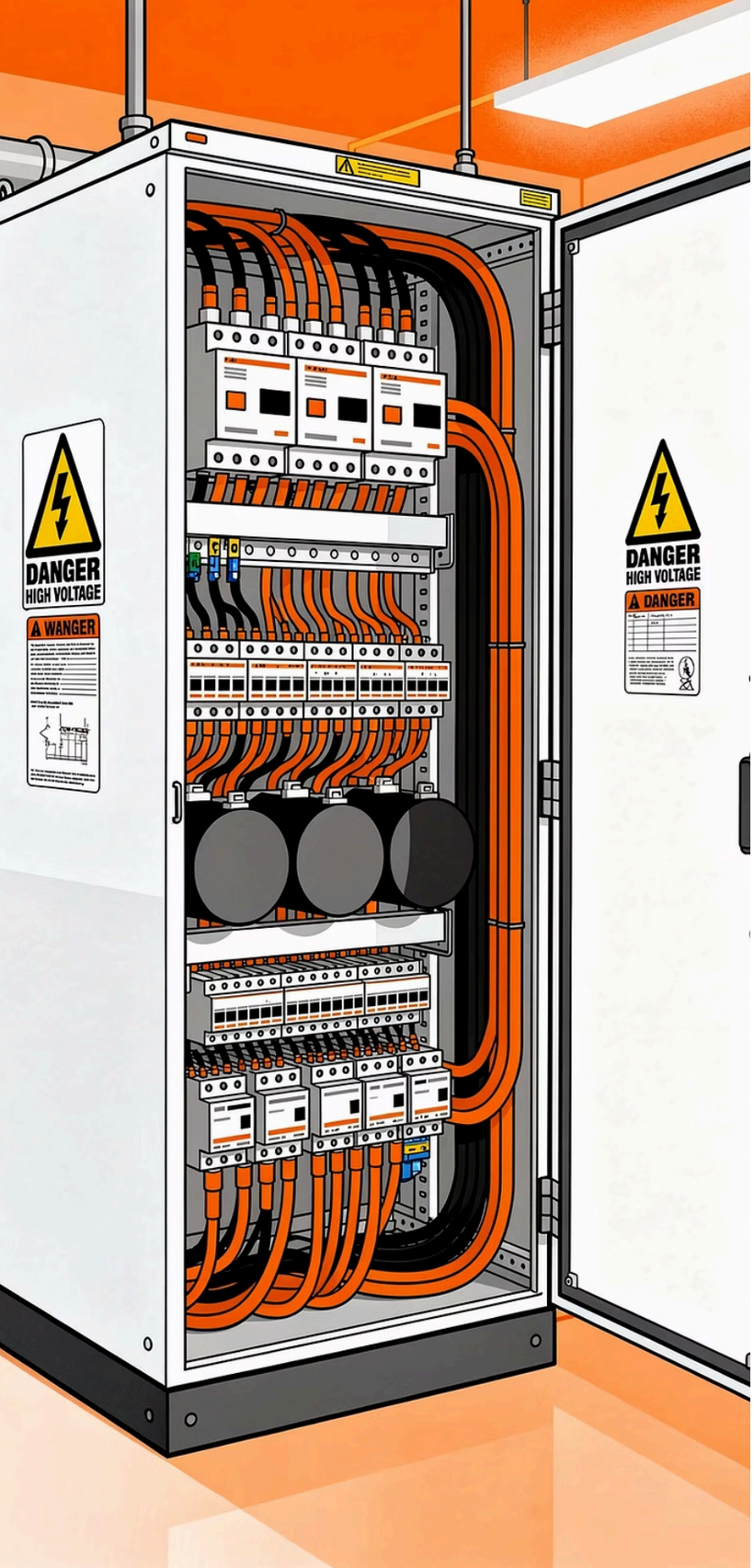

TYPE C

High Voltage Industrial System Charging

Typical Applications

- 400V–1500V Infrastructure
- Utility-scale large energy storage
- Industrial facility power systems

These are engineered power electronics, not consumer-grade chargers.

Mandatory Equipment Requirements

- ### Industrial Grade Design

  Meets heat dissipation and reliability requirements for continuous operation

- ### High Voltage Isolation

  Meets insulation withstand voltage and safety clearance standards

- ### Electrical Safety Compliance

  Complies with applicable standards such as IEC, UL, GB

- ### System-level Protection Coordination

  Interlocks with upstream circuit breakers and grounding systems

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CHAPTER 2 VOLTAGE ARCHITECTURE & CHARGING SPECIFICATIONS

Flexible Voltage Architecture Configuration

Winston 3.2V single cell architecture allows for a wide range of system voltage configurations through series connection. **Charging equipment selection must strictly adhere to the system voltage design**.

12V 4S Configuration	24V 8S Configuration
48V 16S Configuration	96V 30S Configuration
400V 125S Configuration	1500V 469S Configuration

LFP/LYP Charging Curve Technical Specifications

Lithium Iron Phosphate (LFP) batteries are recommended to use the **Constant Current-Constant Voltage (CC-CV) two-stage charging method**. Trickle charging is not recommended. Typical single cell cutoff voltage is **3.45V–3.65V**, and the system-level charging voltage depends on the series connection configuration.

> Key Reminder: LFP batteries **do not require trickle charging**; overcharging will significantly shorten cycle life.

Stage	Description
CC Constant Current	Charges at a set current until cutoff voltage
CV Constant Voltage	Maintains cutoff voltage until current decays
Trickle Charge	❌ Not applicable for LFP

When is a Charging Station Needed?

The configuration requirements for charging stations depend entirely on the system's deployment method and usage scenarios, not the battery type. The following decision matrix can help engineers quickly determine the need.

✅ Charging Station Needed

Mobile Systems

Battery packs installed in vehicles, ships, or mobile platforms

Public Charging Access

Need to provide charging services for external users or multiple parties

Fleet Management

Multiple devices require a scheduled charging management system

❌ Charging Station Not Needed

Stationary Energy Storage Systems

Batteries permanently installed as part of a fixed ESS

Integrated Charging

System internal charging via inverters/rectifiers

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Key Matching Criteria for Charging Equipment

Correct matching of charging equipment with the battery system is fundamental to ensuring safe operation and maximizing cycle life. **Mismatched parameters can lead to system protective shutdowns or accelerated battery aging.**

System Nominal Voltage

Charger output voltage must precisely match the battery pack's nominal voltage and charge termination voltage.

Maximum Charging Current

Must not exceed the maximum allowable charging current set by the BMS, recommended 0.3C–0.5C.

Battery Capacity (Ah)

Charger power needs to match battery capacity to ensure reasonable charging time.

Environmental Conditions

Charging equipment protection rating must meet the temperature, humidity, and dust requirements of the actual deployment environment.

Safety Compliance

Meet UL, IEC, CE, or other applicable electrical safety certification standards for the target market.

Communication Protocols

For BMS integrated scenarios, support for CAN, Modbus, or RS485 communication is required.

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CHAPTER 3 DEPLOYMENT & OPERATIONS

Considerations for Extreme Environment Deployment

Winston batteries can operate reliably in extreme environments, but the **charging equipment must equally meet the stringent conditions of the deployment environment**. Special attention should be paid to the following environmental factors when selecting equipment:

High-Temperature Desert Environments

Ambient temperatures can reach +50°C; charging equipment requires active cooling and high-temperature derating capabilities.

High-Altitude Deployment (4000M)

Low air pressure reduces heat dissipation efficiency and increases insulation distances; equipment must pass high-altitude certification.

Sandstorm Environments

IP65 or higher protection rating to prevent fine particle intrusion and damage to electronic components.

Extreme Cold Climates

Operating capability down to -45°C; requires low-temperature heating startup function.

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Maintenance Logic: Batteries and Charging Equipment

Winston batteries are known for their ultra-low maintenance requirements, but the long-term reliability of the system still requires periodic inspection and maintenance of the charging equipment.

🔋 Battery Maintenance

01

Daily Zero Maintenance

No daily maintenance operations required during normal operation

02

Long-term Storage Charging

When not in use, perform supplementary charging every 6 months to prevent over-discharge

03

Bi-monthly Inspection

During operation, check the tightness of wiring terminals and BMS operating status every two months

🔌 Charging Equipment Maintenance

The maintenance cycle for charging equipment is determined by applicable industry standards and usually includes:

- Cleaning of cooling fans and filters
- Inspection of connectors and cable wear
- Output voltage/current calibration verification
- Communication link function testing
- Ingress protection rating and seal integrity inspection

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Supplier Strategy and Winston Technical Support

Winston Battery adopts an open supplier strategy, **not specifying a particular brand of charging equipment**, but provides comprehensive technical support to ensure system compatibility and safety.

Charging Infrastructure Supplier Selection

Industrial Inverter Manufacturers

Suitable for fixed energy storage system integration

Telecom Rectifier Suppliers

Suitable for communication base station backup power systems

High-Voltage Charger Specialists

Suitable for 400V+ industrial and vehicle charging

System Integrators

Suitable for end-to-end delivery of complete solutions

Winston Provided Support

1. ### Charging Specification Document

   Detailed charging parameters and limitation documents

2. ### Selection Technical Review

   Technical compatibility review of customer's selected charging equipment

3. ### System Compatibility Guidance

   Ensuring safe collaborative operation of battery and charging equipment

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System Safety Responsibility Matrix

Clear division of responsibility is the foundation of engineering design. Battery safety and system safety belong to different levels, requiring coordinated technical safeguards.

Battery Level Safety

Ensured by the following mechanisms:

- BMS (Battery Management System)
- Correct charging curve configuration
- Selection of compatible charging equipment

System Level Safety

Dependent on:

- Qualified electrical system design
- Certified charging equipment
- Compliance with applicable standards

Engineer's Note: Battery-level safety is a necessary but not sufficient condition. Complete system safety requires comprehensive assurance from electrical design, protection coordination, and compliance certification.

SUMMARY

Key Takeaways

Verify Winston Compatibility

Voltage, Current, Protocol, and Environment

Select Charging Equipment

Inverter/Rectifier or Dedicated Charger

Determine System Architecture

Stationary, Mobile, or High-Voltage Industrial

Charging equipment requirements are entirely determined by the system architecture. Winston offers flexible voltage configurations (12V–1500V) and comprehensive charging technical specifications to ensure compatibility with various charging infrastructures and system safety.

Stationary ESS

Inverter/Rectifier Integrated Charging

Mobile Systems

Dedicated Charger or Charging Station

High-Voltage Industrial

Engineered Industrial Power Modules

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