

Digital MES Tracking System Capability Brief - Official Commercial BESS

Technical Overview & Datasheet

EXECUTIVE SUMMARY

The Digital MES (Manufacturing Execution System) Tracking System represents a transformative capability embedded within the Tier-1 commercial energy storage platform, enabling end-to-end traceability, process optimization, and quality assurance across the entire manufacturing lifecycle. Designed for utility-scale and C&I battery energy storage systems (BESS), this digital backbone integrates seamlessly with cell-to-pack production lines, module assembly, and final system integration, ensuring every component—from raw LFP cells to fully assembled cabinets—is uniquely identified, monitored, and validated against stringent quality gates. By leveraging real-time data acquisition, advanced analytics, and cloud-native architecture, the MES Tracking System delivers unparalleled transparency, reduces defect escape rates, and accelerates root-cause analysis, thereby enhancing overall system reliability and reducing total cost of ownership. This brief outlines the technical architecture, key features, compliance standards, and performance specifications of the MES Tracking System as deployed in the Digital MES Tracking System Capability Brief energy storage platform.



SYSTEM ARCHITECTURE & SAFETY

The Digital MES Tracking System is built upon a layered, secure, and scalable architecture that spans from the shop floor to the cloud. At the edge, industrial IoT gateways and barcode/RFID scanners capture granular data at each manufacturing station, including cell grading, welding parameters, torque values, leak test results, and firmware versions. This data is transmitted via OPC-UA and MQTT protocols to a local MES server, which enforces rule-based process controls, automated reject handling, and real-time Andon alerts. The system employs a unique digital twin for each battery module and cabinet, aggregating as-built records and enabling forward/backward traceability. Safety is paramount: the MES enforces mandatory safety interlocks, tracks operator certifications, and logs all safety-critical parameters (e.g., insulation resistance, Hi-pot test outcomes) with immutable audit trails. The platform is

designed for high availability, with redundant servers, encrypted data at rest and in transit (AES-256, TLS 1.3), and role-based access control aligned with IEC 62443 cybersecurity standards.

KEY FEATURES

- End-to-End Traceability: Unique serialization of cells, modules, and cabinets with full genealogy tracking from supplier to installation site.
- Real-Time Process Control: Automated enforcement of process parameters (e.g., weld energy, torque, adhesive dispensing) with instant deviation alerts.
- Digital Twin Generation: Creation of as-built digital records for each unit, enabling predictive maintenance and warranty validation.
- Quality Gate Management: Configurable pass/fail criteria at each station, with automatic routing to rework or scrap.
- Analytics Dashboard: Cloud-based visualization of yield, OEE, defect Pareto, and traceability reports for continuous improvement.
- Integration Ready: Seamless interfaces with ERP, PLM, and SCADA systems via RESTful APIs and standard protocols.

COMPLIANCE & STANDARDS

The Digital MES Tracking System is engineered to meet the rigorous compliance requirements of the global energy storage industry. It supports

traceability and documentation obligations under UL 9540 (Energy Storage Systems and Equipment), IEC 62619 (Safety Requirements for Industrial Batteries), and ISO 9001:2015 quality management principles. The system's data integrity and cybersecurity controls align with IEC 62443 and NIST CSF frameworks, ensuring protection against unauthorized access and data tampering. Additionally, the MES facilitates compliance with EU Battery Regulation 2023/1542 by maintaining detailed records of carbon footprint, recycled content, and supply chain due diligence for each battery passport. All manufacturing and test data is retained for a minimum of 10 years, enabling audit-ready responses to regulatory inquiries and customer quality requests.

TECHNICAL SPECIFICATIONS

The MES Tracking System is delivered as a turnkey software and hardware package, including edge gateways, industrial scanners, local servers, and cloud subscription services. It supports up to 50,000 traceable units per production line per year, with sub-second data latency at the edge and near-real-time synchronization to the cloud. The system is compatible with all major battery chemistries (LFP, NMC) and cell formats (prismatic, cylindrical, pouch). Deployment options include on-premises, hybrid, or fully cloud-hosted models, with scalable licensing based on production volume. Typical integration time is 8 – 12 weeks, including line survey, software configuration, and operator

training.

Parameter	Specification
Deployment Model	On-premises, hybrid, or cloud-hosted
Traceable Units per Line	Up to 50,000 units/year
Data Latency	<1 second at edge; near-real-time cloud sync
Supported Chemistries	LFP, NMC, LTO
Cell Formats	Prismatic, cylindrical, pouch
Cybersecurity	IEC 62443, AES-256, TLS 1.3
Data Retention	10 years minimum
Integration Time	8–12 weeks
Compliance	UL 9540, IEC 62619, ISO 9001, EU Battery Regulation 2023/1542

INDUSTRIAL DEPLOYMENT

The Digital MES Tracking System has been successfully deployed across multiple Tier-1 BESS manufacturing facilities, supporting production volumes exceeding 5 GWh annually. In a representative 2 GWh liquid-cooled LFP cabinet line, the MES reduced defect escape rate by 37%, shortened root-cause analysis

time from days to hours, and improved first-pass yield by 12% within six months of go-live. The system's modular design allows phased rollout, starting with cell-to-module traceability and expanding to full cabinet and system-level genealogy. Operators benefit from intuitive touchscreen interfaces and mobile dashboards, while quality engineers leverage advanced analytics to drive continuous improvement. The MES also enables remote factory acceptance testing (FAT) and digital sign-off, streamlining project delivery for global customers.

