

Cleanroom Class-100,000 Environmental Monitoring Log - Official Commercial

BESS Technical Overview & Datasheet

CLEANROOM CLASS-100,000 ENVIRONMENTAL MONITORING LOG

OFFICIAL COMMERCIAL BESS TECHNICAL OVERVIEW & DATASHEET

EXECUTIVE SUMMARY

This document serves as the definitive technical reference for the Cleanroom Class-100,000 Environmental Monitoring Log, a specialized data acquisition and recording system engineered for integration within our Commercial Battery Energy Storage Systems (BESS). Designed for mission-critical applications in semiconductor fabrication, pharmaceutical manufacturing, and precision electronics assembly, this monitoring solution ensures that the ambient particulate and microbial conditions within the storage enclosure or adjacent technical spaces strictly adhere to the ISO 14644-1 Class 8 (Federal Standard 209E Class-100,000) cleanliness standards. The system provides continuous, auditable logging of airborne particle counts, temperature, relative humidity, and differential pressure, safeguarding sensitive BESS electronics and ensuring operational reliability in high-value industrial environments.



SYSTEM ARCHITECTURE & SAFETY

The Environmental Monitoring Log is architected as a standalone, tamper-proof subsystem within the BESS. It features a distributed network of ISO-compliant particle counters (0.5 μ m and 5.0 μ m channels) interfaced with a central data processing unit (DPU) and a redundant, non-volatile memory storage array. The system architecture is designed with redundant power supplies and network interfaces to ensure uninterrupted logging, even during grid fluctuations or BESS maintenance cycles. Safety is paramount; the monitoring enclosures are constructed from static-dissipative materials, and all sensor cabling is shielded and rated for low-smoke, zero-halogen (LSZH) emissions to prevent

contamination in cleanroom environments. The system continuously validates sensor calibration against NIST-traceable standards and generates immediate local and remote alarms if any monitored parameter drifts outside defined tolerance windows.

KEY FEATURES

- Feature 1: Multi-Parameter Continuous Logging: Simultaneously tracks and records airborne particle counts (0.5µm and 5.0µm), temperature, relative humidity, and differential pressure at user-defined intervals (from 1 to 60 minutes).
- Feature 2: Real-Time Alert & Notification Engine: Provides immediate audible, visual, and cloud-based notifications (SMS/Email) for out-of-spec conditions, including pre-alarm warnings and critical alarm triggers, enabling rapid corrective action.
- Feature 3: Secure, Audit-Ready Data Management: Stores up to 10 years of encrypted log data with a 21 CFR Part 11 compliant audit trail. Data can be exported in standardized formats (CSV, PDF, XML) for regulatory submissions.
- Feature 4: Modular Sensor Architecture: Supports hot-swappable sensor modules for easy maintenance and calibration without disrupting the main BESS operation, minimizing downtime.
- Feature 5: Remote Diagnostics & Cloud Integration: Seamlessly integrates

with the BESS's EMS/SCADA platform, allowing for remote system health checks, sensor calibration status verification, and proactive maintenance scheduling.

COMPLIANCE & STANDARDS

The Cleanroom Class-100,000 Environmental Monitoring Log is engineered to meet and exceed the most stringent global standards for cleanroom monitoring and data integrity.

- Cleanroom Standard: Fully conforms to ISO 14644-1:2015 (Class 8) and Federal Standard 209E (Class-100,000) guidelines for airborne particulate cleanliness.
- Data Integrity & Security: Compliant with FDA 21 CFR Part 11 regulations for electronic records and electronic signatures, ensuring data authenticity, integrity, and confidentiality.
- Quality Management: Developed and manufactured under an ISO 9001:2015 certified Quality Management System.
- Electromagnetic Compatibility: Certified to EMC directives (IEC 61000-6-2, IEC 61000-6-4) for robust performance in industrial and heavy electrical environments.
- Calibration Standards: All particle counters are validated using NIST-traceable

PSL (Polystyrene Latex) spheres, ensuring absolute measurement accuracy and traceability.

- Safety: The system is UL 61010-1 certified for electrical safety and features an ingress protection rating of IP54 for the main enclosure.

TECHNICAL SPECIFICATIONS

The following table details the core technical parameters of the Cleanroom Class-100,000 Environmental Monitoring Log system. All specifications are measured under standard operating conditions (25 ° C, 40% RH) unless otherwise noted.

Parameter	Specification
Sensor Channels	0.5µm & 5.0µm (particle count), Temp, RH, dP
Particle Counting Technology	Isokinetic probe, laser diode sensor (780nm)
Measurement Range (Particles)	0 to 3,000,000 particles/m ³ (0.5µm & 5.0µm)
Temperature Range	-20°C to +70°C (±0.5°C accuracy)
Relative Humidity	0% to 100% RH (±3% RH accuracy)
Differential Pressure	0 to ±250 Pa (±1% accuracy)

Logging Frequency	Configurable: 1 min to 60 min intervals
Data Storage	32GB Internal Memory (>10 years standard logs)
Communication Protocols	Modbus TCP, BACnet/IP, MQTT, RESTful API
Power Supply	24V DC (from BESS auxiliary power, 15W max)
Enclosure Ingress Protection	IP54 (Sensor heads: IP30 for airflow)
Operating Temperature (Ambient)	0°C to +50°C (for DPU)
Regulatory Certifications	ISO 14644-1 Class 8, 21 CFR Part 11, IEC 61000-6-2/4, UL 61010-1, CE Mark



INDUSTRIAL DEPLOYMENT

The Cleanroom Class-100,000 Environmental Monitoring Log is a critical component for industrial and commercial facilities that require guaranteed clean environments. Typical deployment scenarios include:

- Semiconductor Fabs: Monitoring of BESS units integrated with fab sub-fabs or tool bays to ensure backup power stability does not compromise cleanroom integrity.
- Pharmaceutical Manufacturing: Ensures that energy storage systems in fill/finish and API processing areas do not introduce particle contamination.
- Data Centers: Protects high-density computing equipment by ensuring that the air quality in power distribution and UPS rooms is maintained to ISO Class 8 levels.
- Precision Optics & Aerospace: Verifies storage conditions for sensitive components, ensuring long-term reliability and quality.

By providing an immutable and continuous record of environmental conditions, this system mitigates risk, enhances process yield, and provides definitive proof of compliance for internal quality assurance and external regulatory audits.