HR-FMS Online Monitoring System Solution (Semiconductor & Electronics)

Compliant with ISO 14644 / SEMI S2 / SEMI F21 / IEC 61340 Standards

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1. SOLUTION OVERVIEW

The **HR-FMS Semiconductor-Specific Environmental Monitoring System** is engineered for high-precision scenarios including wafer fabrication, IC packaging/testing, and high-end electronic component production. The system strictly adheres to ISO 14644-1 (ISO Class 1–8), SEMI S2/S8 Safety & Environmental Guidelines, SEMI F21 AMC Control Standards, and IEC 61340 ESD Protection Standards. It provides 7×24H continuous monitoring of suspended particles (down to 0.1 μm), AMC, temperature, humidity, differential pressure, air velocity, and electrostatic potential.

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2. CORE DESIGN PRINCIPLES

2.1 Risk-Based Classification & Sampling Design (ISO 14644-1:2015)

- **Zoned Monitoring Strategy**: Tailored monitoring plans based on cleanroom grades (ISO 1 to ISO 8). Core areas such as EUV Photolithography (ISO 1), 14nm Lithography (ISO 3), and Wafer Cleaning (ISO 4) feature high-density monitoring.
- **Sampling Location Calculation**: The minimum number of sampling locations (NL) is calculated strictly using the international standard formula:

$NL = \sqrt{A}$

> **Parameters:**
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> - **NL**: Minimum number of sampling locations (rounded up to the next whole number).
> - **A**: Cleanroom area (Unit: m²).

- **Workstation-Level Monitoring**: At least one monitoring point is dedicated to each critical process station, such as Lithography tracks, Etching tools, and Wafer Load Ports.
- **Standardized Positioning**: Probes are set at the product exposure height (0.8–1.2 m); locations must be ≥ 30 cm from walls and ≥ 1 m from HEPA filters.

2.2 Airflow Control & Isokinetic Sampling (SEMI S2 / ISO 14644-4)

- **Isokinetic Sampling**: Probes in ISO 1–5 unidirectional flow zones must be equipped with isokinetic heads to match the air velocity of **0.36–0.54 m/s**, preventing particle deposition on wafer surfaces.
- **Pressure Gradient Specifications**: Ensures differential pressure ≥ 15 Pa between clean and non-clean zones, and ≥ 5 Pa between adjacent functional zones to block external micro-contaminants.

2.3 ESD Protection & Data Integrity (IEC 61340 / 21 CFR Part 11)

- **Static Monitoring**: Real-time tracking of electrostatic potential (0 to ± 20 kV) to prevent ESD damage to sensitive ICs and particle adsorption.
- **Full Audit Trail**: Strictly compliant with 21 CFR Part 11, ensuring all data collection, storage, and export processes are tamper-proof and fully traceable.

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3. CORE HARDWARE CONFIGURATION

Parameters	Recommended Model	Key Specifications	Compliance Standards
Airborne Particles	**CLJ-R110/R210**	2.83 LPM flow rate; monitors 0.1/0.3/0.5/5.0 µm	ISO 14644 / SEMI S2
Temp & Humidity	**TH-30R / TH-25**	Temp Accuracy: ± 0.3°C; Humidity: ± 3% RH	Semiconductor Process Req.
Pressure Diff.	**DP-30R / DP-25**	Ranges from 0–± 125 Pa to 0–5000 Pa	ISO 14644-4 / SEMI S2
Air Velocity	**WS-30R / WS-25**	High-precision monitoring of 0.36–0.54 m/s	ISO 14644-4 / SEMI S2
ESD Potential	**ESD-10R**	Range: 0–± 20 kV; high-sensitivity probe	IEC 61340 / SEMI S2
Chemicals (AMC)	**MIC600 PID**	Monitors TVOC/AMC with ppb-level detection	SEMI F21 / ISO 14644-8

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4. SOFTWARE SYSTEM CAPABILITIES

- **Integrated Multi-Parameter Hub**: Visualizes data grouped by ISO grades or process steps (Litho/Etch/Packaging).
- **Intelligent Alert Mechanism**: Features a 3-tier "Notice-Warning-Critical" system to ensure response within 1 minute of environmental drift.
- **Automated Compliance Reporting**: Generates encrypted PDF reports compliant with ISO 14644-1, SEMI F21, and 21 CFR Part 11 at the click of a button.
- **Smart Factory Connectivity**: Supports RS485, WiFi, and TCP/IP for seamless integration with **MES** or **ERP** systems to link environmental data with production yields.

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5. STRATEGIC VALUE

1. **Industry-Leading Compliance**: Fully aligned with international ISO, SEMI, and IEC standards, facilitating smooth factory audits and supplier certifications.
2. **Yield Protection**: Continuous monitoring of sub-micron particles and ESD events significantly reduces

the risk of wafer contamination and chip breakdown.

3. **Data-Driven Failure Analysis**: Provides tamper-proof, high-resolution environmental records to support root-cause analysis in product failure investigations.
4. **Energy Efficiency Optimization**: Aligns with ISO 14644-16 to optimize HVAC and filtration operation based on real-time data, reducing energy costs in high-grade cleanrooms.

Solution Provider:
Suzhou Honri Purification Technology Co., Ltd. (Suzhou Honri Purification)