

Turn Key HVAC, EMI & AVI Precision System for Environmental Control of Semiconductor R&D Laboratory and Fab

Description of patented solutions

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Notable Clients



Notable Partners



飛弘科技工程有限公司
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Document Audience

This document is intended for all levels of senior management and senior heads of Research & Development (R&D) laboratories and factory facilities within semiconductor industry who understand the basic requirements and principles of operation of R&D state of the art equipment and/or are involved in strategic planning for 5-10 years in advance for R&D but as well as in day to day seamless operations of R&D labs and sensitive manufacturing equipment.

Turn Key Solution - Executive summary

Our system allows you to maintain a stable humidity and temperature with an accuracy of 0.1 deg. C, with the exchange of air purity class ISO6 or higher at lower than 0.08m/s air velocity.

This installation is based on patented temperature stabilizer and systems of passive and dynamic cooling that ensures trouble-free service with minimal involvement unlike widely used cabinet precision air conditioning.

Our solution takes into account the entire building test facility, such as the elimination of an external electromagnetic field EMI, anti-vibration isolation platform, protection against outflow of harmful gases. The whole is integrated into architecturally refined interior, the walls of which contain the necessary thermal and acoustic insulation. The highest quality and timeless design guarantee a high standard and level of research results for future years.

Introduction

Technological progress causes the production of technologically advanced semiconductor components increasingly requires use of state of the art precision instruments such as transmission electron microscopes (TEMs), high precision manufacturing equipment and other measuring devices with very high accuracy.

Measurements with accuracy in the nano and micro scale require sterile conditions in the areas of measurement, research and production. Maintaining a constant temperature with an accuracy of $\pm 0.1^{\circ}\text{C}$, humidity and air purity is recorded by the measuring equipment and the immutability of the environment is a prerequisite for the accurate research or manufacturing outcome. Also crucial to the entire process are elimination of any electromagnetic active or static noise (EMI) and all types of vibrations (AVI) in the surroundings.

Developed and implemented by Eko-Klimat AC (English: Eco-Climate AC) the Turn Key Solution, installation of which the company made for the world's leading Semiconductor Manufacturing Company science park in Hsinchu, Taiwan - TSMC to meet strict R&D lab requirements of TSMC and our partner's FEI state of the art electron microscopes. Eco-Climate made other implementations such as for the Institute of Engineering Materials and Biomaterials at the Silesian University of Technology in Gliwice, Poland.

The following document will focus on three separate parts of environmental control of enclosed spaces:

1. Provision for precision environmental control of temperature, humidity and air purity (AC),
2. Elimination of Electromagnetic field interference (EMI),
3. Elimination of Vibration through AVI.

1. Innovative system for precision A/C by Eco-Climate AC

Precision air-conditioning capable of maintaining the temperature with an accuracy of $\pm 1^{\circ}\text{C}$ has been known for several decades, and it is carried out using precision close control systems. These devices consist of a freon or water cooler and fans forcing air into the room. However, even the most modern automatic control of cold or heat source is not able to correct, in a small unit of time, solenoids and regulators in order to accurately maintain a stable temperature.

The competitive advantage of an innovative Eco-Climate system

The solution to the above problems is an innovative system to maintain stability of the temperature with an accuracy of 0.1 ° C

Unique features of the precision air-conditioning system by Eco - Climate AC:

- **Highest precision adjustment of the room temperature** (in the range of +/- 0.1 degrees C) - Today, the market offers precision cooling systems maintaining the temperature with an accuracy of +/- 1 °C
- **Significant thermal inertia of the system** - maintaining a constant temperature for a long time (up to 12 h) after turning off the system (e.g. as a result of a failure of power supply systems)
- **Air cleanliness class to ISO 6 or higher** in accordance with ISO 14644-1,
- **Lower noise levels generated by the system (32dB (A))**. Quietest working system based on precision closed control systems meanwhile generates noise at a minimum level of 50 dB (A)
- **Low failure ratio** in consequence increases the durability of system operation in comparison to other solutions currently on the market
- **Reduced negative impact on environment** due to low failure rate and low service needs,
- **Cost of buying a complete installation and its longevity** are considerably lower than the cost of solutions offered by competitors,
- **Low repair costs** due to the simple structure and low failure rate of the system

Reliable operation through innovation and simplicity of construction

This system has been patented in the Patent Office in the Republic of Poland¹ and the European Union². The prototype built for the Silesian Technical University in Gliwice has been operating since 2010. The industrial advantages have been acknowledged by TSMC, an undisputed world leader, who purchased multiple systems in their science park.

2. Elimination of Electromagnetic Field Interference - Invisible Installation

In today's world production in semiconductor facilities Pure Play are exposed to several electromagnetic field interferences that disrupt research results or interfere with high calibration manufacturing equipment. The fluctuations in environmental magnetic field caused by move of magnetic bodies and AC / DC power lines such as the trains, automobiles and the elevators etc., will affect the unfavourable influences to electron beam application equipment like Electron Microscope. The main system AMC-330 detects magnetic fluctuations from any direction through highly sensitive magnetometer and digital controller, and generates reverse magnetic field to cancel the fluctuations by use of the Helmholtz coils.

3. Elimination of Vibration Interference through Isolation (AVI)

Micro vibration control technology is a vibration reduction and shielding technology used to insulate precision instruments, such as semi-conductor production equipment and measuring instruments, and the other vibration-sensitive equipment like electron microscope from the vibration of direct disturbance and ground disturbance.

We can offer all types of passive and active anti vibration solutions for large scale commercial applications and smaller industrial needs

¹ Patent Application (Patent) P.400540

² Patent Application (Patent Pending) No. 1200534-4

* In comparison to conventional precision air-conditioning cooling system

Why choose Eco-Climate AC and It's Partners (Fairtech, TKK and FEI)

Eco-Climate Automatic Control was founded in 2007 as a child company to Eco-Climate Gliwice founded in 1992. Eco-climate's AC main focus is on the implementation of the innovative technology in particular the patented solution as described in this paper. Both companies operate in the ventilation and air-conditioning industry. Overall we have a number of implementations for Global and European clients, for instance R&D facilities from across the manufacturing industries, hospitals (in operating theatres), various institutes (e.g. welding institute), laboratories of computer tomography and many commercial clients (banks, data centres, manufacturers of all types of products).

Company owners have been operating in the industry for over 20 years and have substantial knowledge and experience. From the inception as one of the firsts on the market in Poland and in the European Union carried out implementations of the cutting-edge global technologies, including installations of recuperative heat recovery and ground heat exchangers in the mid- nineties or gas heat absorption pumps in the early noughties.

The patented invention described in this paper, 100 % owned by the family owned company Eco- Climate AC, is the result of nearly 20 years of experience with the most advanced technologies in the field of ventilation and air-conditioning. Eco-climate AC is also in a process of building a production plant in Poland to manufacture all the components of the solution. We provide a complete end-end process from inception, design, implementation and service.

Eco-Climate Partners:

Fairtech Engineering Co. (www.fairtech.com.tw) Established in 1999. World leader in HVAC systems, clean room construction, air pollution control devices and plant engineering facilities.

FEI (www.fei.com) - **World leader in Semiconductor solutions.** Worldwide locations in the USA, Europe, Mexico and the Middle East.

Tokkyokiki Corporation (TKK) (www.tokkyokiki.co.jp), Tokyo, Tapan, Established in 1969. World leader in EMI and Anti Vibration commercial solutions with global range and offices in Japan: Tokyo, Osaka, Chubu and Kyushu and Petach Tikva, Israel.

The experience gained during the work with scientists TSMC in Taiwan, and concepts prepared for such recognized institutions as INFINEON in Munich and the Max Planck Institute in Potsdam place us at the forefront of the world in this segment of research and development.

Yours sincerely

Adrian Paliczka
Company Owner



Figure 1 Eco-Climate head office in Gliwice, Poland



Figure 2 Bespoke Lab Design for FEI Titan Microscope by Eco-Climate



Figure 3 TEM room implementation by Eco-Climate for POLSL



Figure 4 Eco-Climate employees and friends in TSMC Hsinchu