

# SITESA

SEMICONDUCTOR TECHNOLOGY



SITESA AET 100

## The European Epitaxial Reactor

Advanced Epitaxial Technology  
with production facility planning,  
supply of process resources,  
technology transfer, and full support

# The European Epitaxial Reactor - with automated handling, process control, and operations monitoring

The SITESA AET 100 for greater throughput and quality: more than 7000 productive hours a year

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## The SITESA AET 100 Reactor in Brief

### A Brief Review of Features:

- Advanced epitaxial technology
- Unique twin-chamber concept
- Automated robotic wafer handling
- Multiprocessor control
- Functional design and styling
- Comprehensive support and service

### A Brief Review of Applications:

- MOS technology
- Bipolar technology
- Integrated circuits
- Discrete devices
- Selective epitaxial growth (SEG)
- Silicon on sapphire growth (SOS)

### A Brief Review of Capabilities:

- More than 7000 epitaxial production hours a year
- Three consecutive shifts per day, 7 days a week
- Immediate process-to-process switching
- No loss of production time for loading

### A Brief Review of Services:

- Full installation design
- Evaluation of equipment and materials
- Expert problem-solving advice
- Operator training and support
- Installation servicing and maintenance

### Your SITESA AET 100 Reactor:

- Provides perfect epitaxy plus cost-effectiveness
- Operates reliably and dependably
- Produces around the clock, day after day



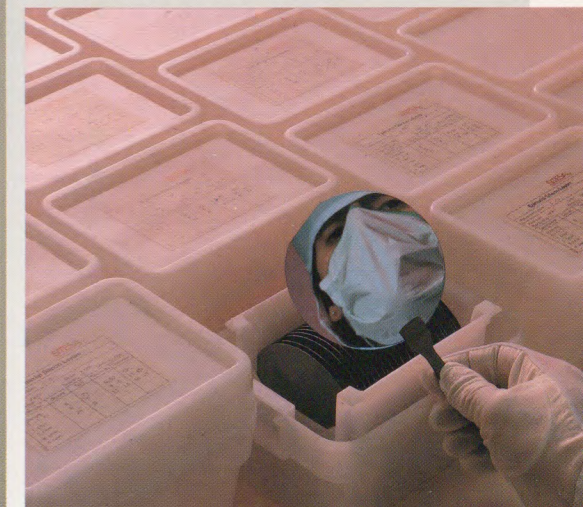
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### Superstandard wafer quality

An epitaxial facility is an integrated system and human resources are a key part of it. Their training and attitude strongly influence the ultimate result.

Our operating philosophy is to help you approach

**ZERO-DEFECT PRODUCTION.**



# The symmetrical twin-chamber reactor switches directly from one thermal cycle to the next without jeopardizing run-to-run quality audits

## SITESA AET 100 Advanced Epitaxial Technology

A chamber configuration for perfect crystal structures

Low gas flow velocity, a modern air-cooled bell jar, and IR-reflecting device.

Precision thermometry with minimized refraction index change

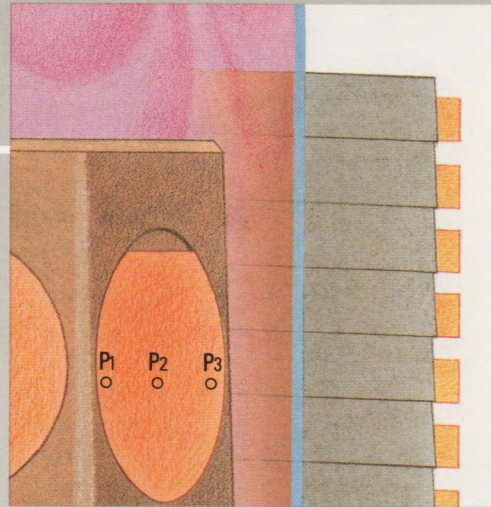
This feature is due to the single-wall bell jar concept.

Temperatures are sampled by external infrared sensors with direct wafer measurement capability.

Susceptor mapping begins with a vertical temperature profile followed by a horizontal, three-point wafer scan. The entire thermal ramping process is also under closed-loop control.

Superstandard epitaxial film quality

The AET 100 is designed for tight thickness control on VLSI, bipolar and MOS devices to guarantee outstanding large batch uniformity and repeatability.



Thickness (center point)

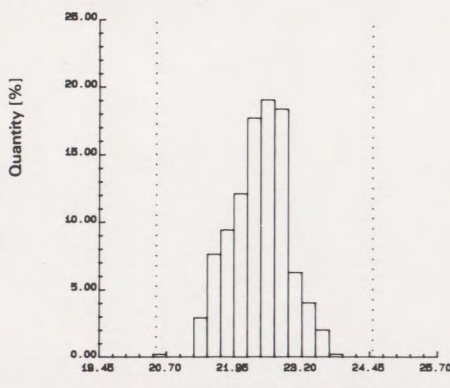
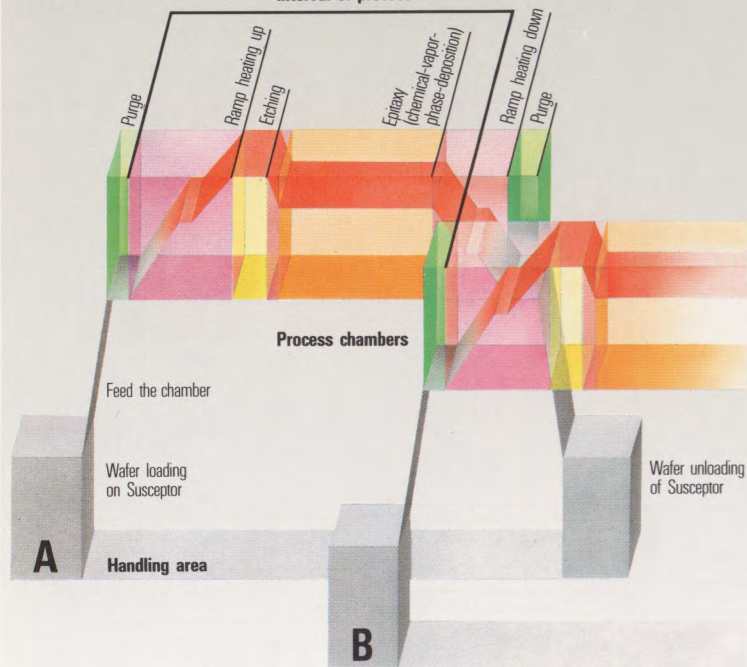


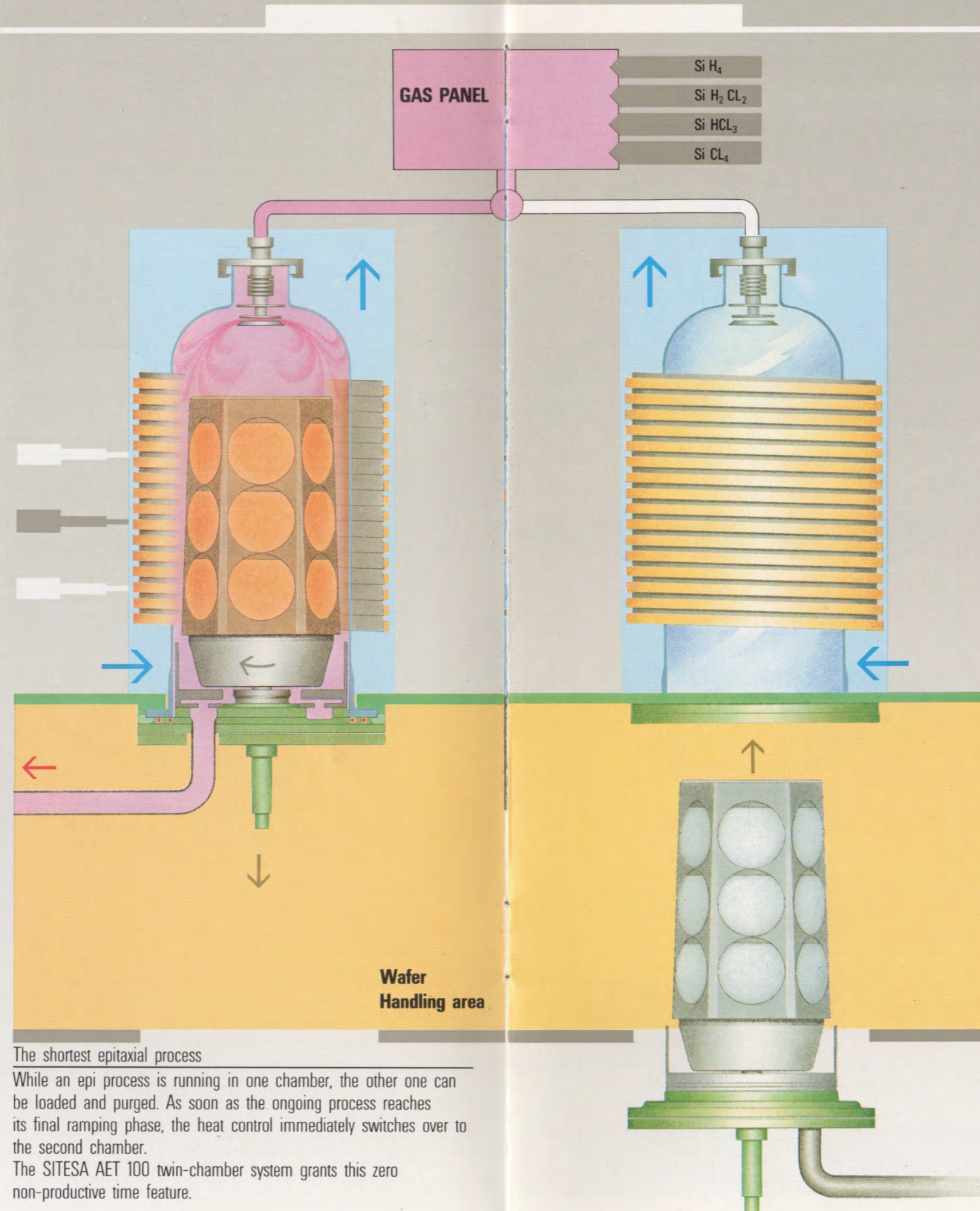
Diagram of epitaxial process steps

Interval of process



directly from one thermal cycle to the next without jeopardizing run-to-run quality audits

The SITESA AET 100 twin-chamber reactor consistently maintains the shortest epitaxial process intervals ever achieved. The chambers were completely redesigned for greater quality and throughput. The AET 100 features optimized gas flow, heating efficiency and thermometry. It also incorporates the first hushed generator ever to be installed in an epi reactor.



### The shortest epitaxial process

While an epi process is running in one chamber, the other one can be loaded and purged. As soon as the ongoing process reaches its final ramping phase, the heat control immediately switches over to the second chamber.

The SITESA AET 100 twin-chamber system grants this zero non-productive time feature.

### High-efficiency heating system

An IR-reflecting device improves the efficiency of the heating system and simplifies back sealing.

### The only reactor with a hushed generator

To enhance the operating environment, we incorporated a medium-frequency (20 kHz) all solid-state generator. This frequency is beyond the range of audibility. The generator is rated at 150 kW. Other generator ratings are available on request.

### The symmetrical gas panel

The gas panel is fully symmetrical relative to the twin-chamber configuration. Operation is possible with four sources:  $\text{SiCl}_4$  and/or  $\text{SiHCl}_3$ ,  $\text{SiH}_2\text{Cl}_2$ , and  $\text{SiH}_4$ . Because they are isolated by valves, the  $0.05 \mu\text{m}$  inlet filters can be removed without any line contamination hazard whatsoever. All gas feed lines are under suction.

### Pressure control versatility

Bipolar devices need low-pressure epitaxial processing at low temperatures to minimize solid-state diffusion and autodoping. The twin-chamber design of the SITESA AET 100 reactor provides atmospheric and subatmospheric (100 to 200 mbar) pressure deposition capability.

### Sophisticated chamber architecture

The chamber is carefully engineered for truly advanced epitaxial quality. The one-pass gas flow concept of the AET 100 delivers a vertically descending flow. Short gas dwell times assure fast purging of outgassed dopant and potential contaminants.

### New bell jar design

The uncoated bell jar is air-cooled for optimum wall temperature hysteresis; this minimizes wall deposition and streamlines both clean-up and servicing. All internal surfaces of the reaction chamber are either inert quartz or SiC-coated graphite.

# State-of-the-art susceptors and automated wafer handling under class 10 conditions: the recipe for better overall quality

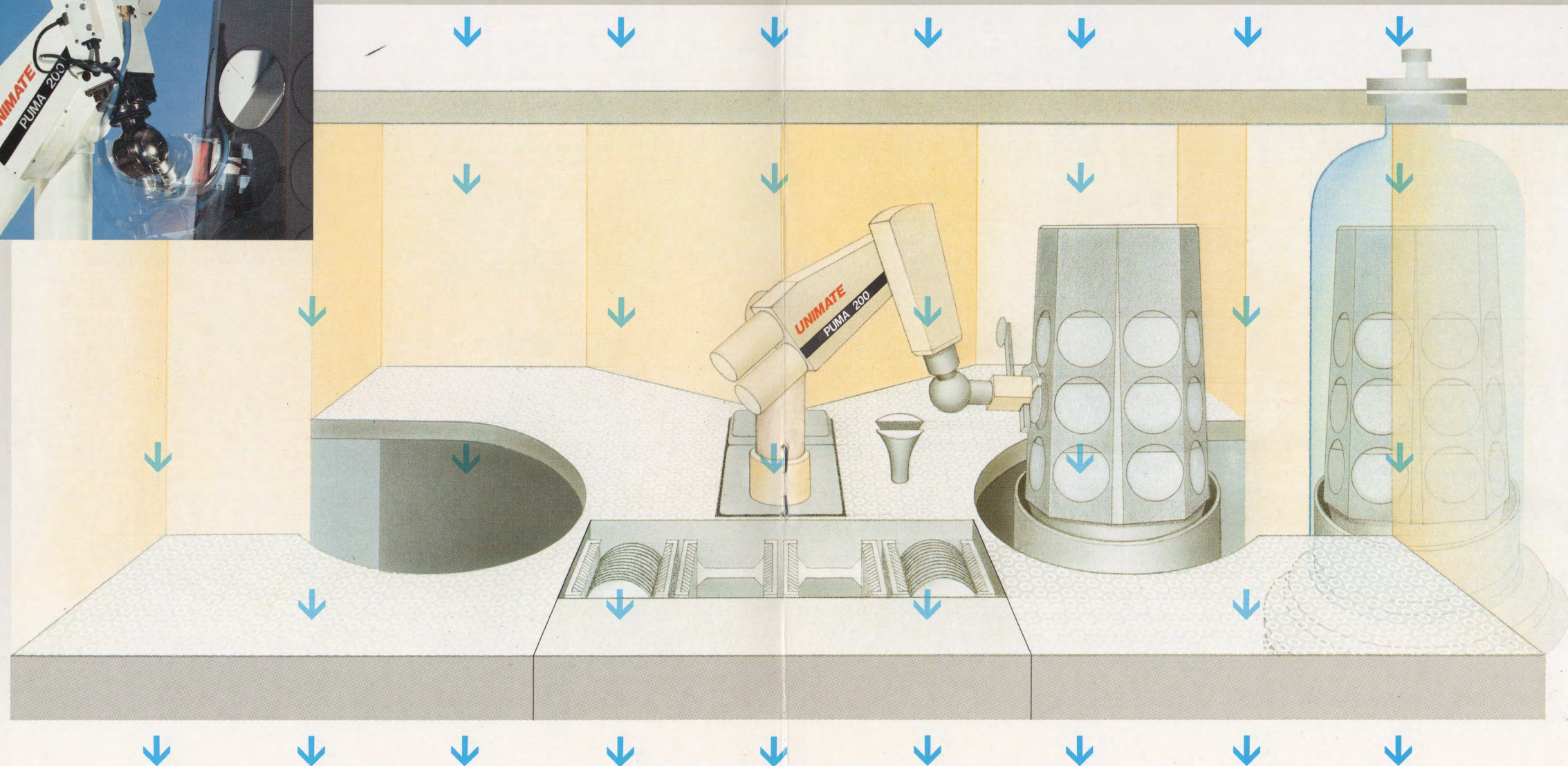
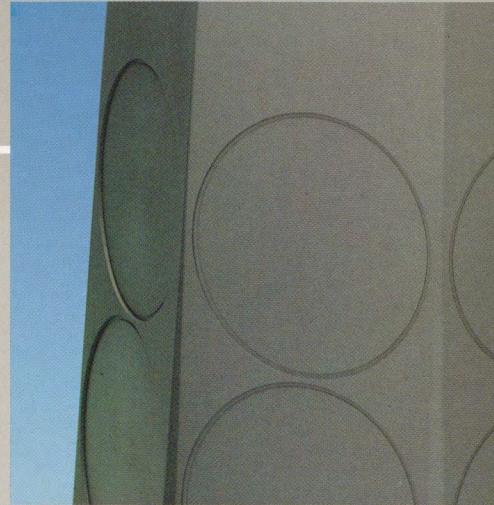
With the zero-defect objective in mind, contamination control in the SITESA AET 100 reactor is assured with several different approaches. Apart from 0.05  $\mu\text{m}$  filtration and an engineered clean room interface, the SITESA particulate control concept also includes susceptor design and handling procedures.

## SITESA AET 100 Advanced Epitaxial Technology

SITESA builds innovative susceptors. Susceptors can have a strong impact on epitaxial results. SITESA susceptors feature an optimized design with:

- predefined angles for uniformity
- parallel walls
- rounded edges
- robot-compatible pockets
- specially designed recesses

Our hyperpure graphite barrel susceptors are manufactured in a tightly controlled production environment. They are optionally available with a smooth crackfree CVD-applied SiC layer which improves their ability to withstand repeated thermal cycling shock and chemical aggression.



### Perfectly laminar airflow

The loading station for both chambers is within a class 10 environment maintained by top-to-bottom laminar airflow. The system's architecture minimizes clean room intrusion and airflow disruption - perfect conditions for perfect results.

### Handling area design

All susceptor movements are vertical; there is no horizontal displacement. By the time when liftdown of the processed batch occurs, the loaded clean susceptor is already in the chamber. This means that contaminants from the processed susceptor cannot be entrained to the unprocessed wafers.

### Robot loading and unloading

The loading process involves insertion of the standard 25-wafer cassette into the drawer by the operator. Cassette-to-cassette handling is performed by a 6-axis industrial robot with an integrated control system and extensive diagnostics. The robot is equipped with an exclusive wafer holder composed of suction and gripper elements for two-point soft-edge contact.

### Manual loading

In the unlikely event of a robot malfunction, the system offers a convenient manual loading and unloading mode.

### Flat finder

The optical wafer orientation identification device is integrated in the robot arm. The robot incorporates sealed articulations and specially treated exterior surfaces to ensure Class 10 environment compatibility.

### Two clean room interfacing concepts

Our customers typically prefer the to-the-wall installation mode. This flush-mount configuration eliminates clean room disturbance and maintains contamination control effectiveness. Optionally, the SITESA AET 100 is available with a clean room tunnel design.

### No clean room downtime for maintenance and servicing

When cleaning or servicing is needed, the susceptor or the entire bell jar can be transferred to a location outside the clean room.

# Intelligent process and system control for total security - your guarantee for consistently superior wafer characteristics

SITESA AET 100  
Advanced Epitaxial Technology

Keep your system up to date with our unique control system architecture

The process control concept of the SITESA AET 100 has been completely redesigned from the bottom up. The new, modular multi-processor control system is configured on VME (Versa Module on Eurocard) circuit boards.

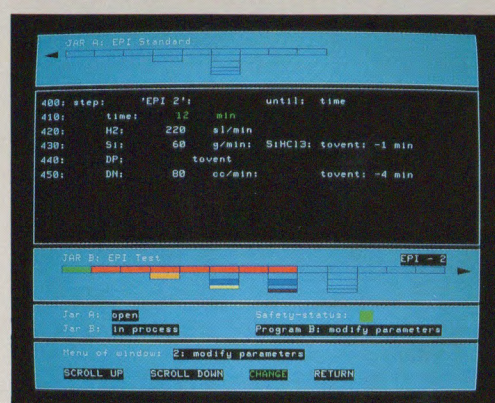
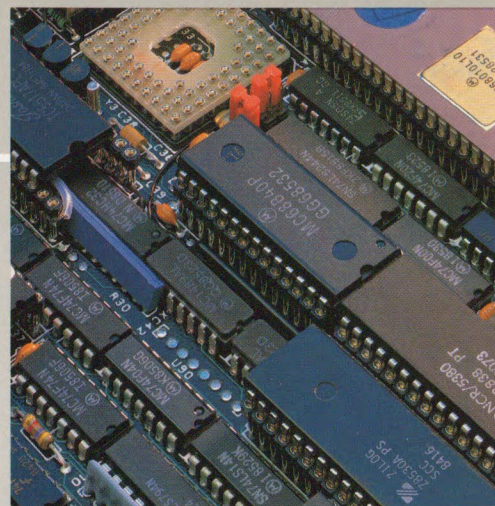
Ample memory capacity is provided to accommodate the latest operating software releases with new functions or technologies. Updating is simple: all you have to do is insert the microdisk with the new software version and run the transfer program.

Innovative programming and operating philosophy

The user-friendly process programm editor is designed to ensure that only valid processes can be created. The screen displays the process steps and the programming instructions. Syntax and parameter errors are detected and must be eliminated before continuing. No instruction manual is ever needed in the clean room. The clean room-compatible keyboard, incidentally, has no moving contacts. It features a soft-touch piezoelectric pad for added comfort and security.

Convenient host link

The built-in SECS I/II data interface makes it possible to integrate the SITESA AET 100 in a computer-based manufacturing system. Modern personal computers can manage complete epitaxial reaction systems and instrumentation.



A total safety concept

A complex process such as chemical vapor deposition requires extensive control and supervision to safeguard the health of the operator, the integrity of the reactor and the quality of the wafers.

The SITESA AET 100 computer identifies five different safety-related deviations from the normal operating modes. Plain language information is displayed on the system terminal in each case.

Warning mode:

A warning is generated in this mode although no risk to process integrity is involved.

Check mode:

The computer has identified a malfunction which can be remedied at no risk to epitaxial results.

Abort mode:

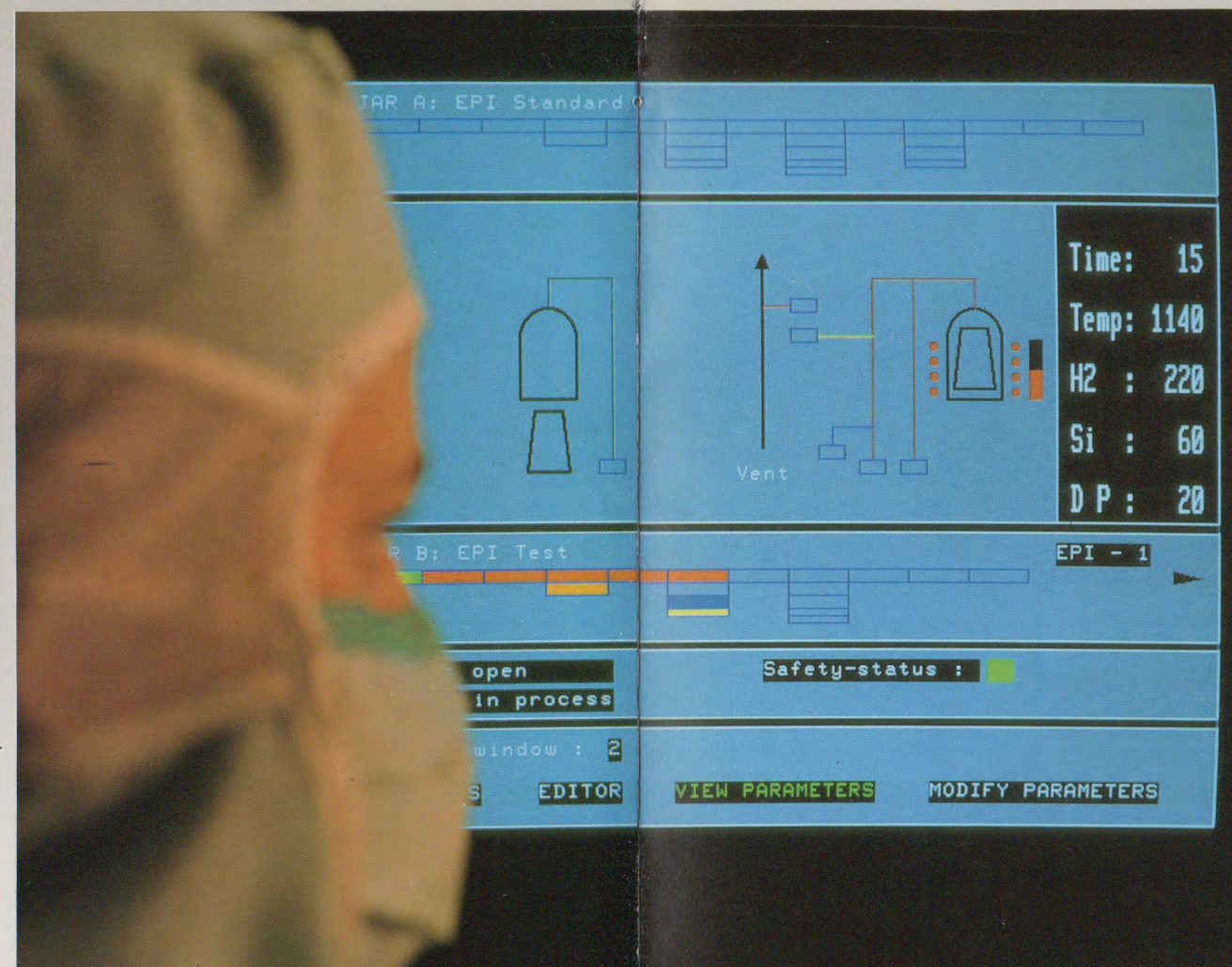
Malfunctions covered by this mode can alter the epitaxial results.

Security mode:

This mode involves a malfunction which can damage the reactor.

Emergency mode:

When this state occurs, the system automatically performs a hard shutdown.



Protected access levels

Unauthorized persons have no access to the control system. It only accepts commands preceded with the valid password. Thus, the service engineer has access to the maintenance level, and the operator may change parameters on his assigned level but only the system supervisor can alter process steps.

List printer, maintenance terminal

An optional printer is available for users who prefer to generate hardcopies of their process programs. Further, an additional maintenance terminal can be installed outside the clean-room area. It is used to control the reactor during maintenance procedures.

The high-tech multiprocessor control system gives you more flexibility in harnessing advanced epitaxial technologies. It lets you create, edit and run process programs with fully protected access. It features a unique five-level security concept with warning, check, abort modes to protect the operator and the system. The reactor can also be interfaced with a host computer.

The industry's first fully interactive color terminal. Important process-related information is continuously displayed on the five-section color graphics screen; this enhances the operator's ability to survey the reaction.

The fields are assigned as follows

Jar A status information:

The mimic diagram represents each program step with a rectangle. Separate colors are used to identify completed and active steps.

Working space:

This space contains a large, easy-to-read real-time display of the main process parameters related to the momentary reaction phase as well as gas line status data and the currently active program steps. Also, parameters and process steps can be modified in this field.

Jar B status information:

Same as jar A.

Annex systems field:

Displays status information related to reactor subsystems and not specific to either jar.

Function keys for immediate access to complementary information

A window opens in the master display to provide additional information for operator guidance and improved process surveyability.

Available keys:

Help:

The window shows information related to the currently selected command.

Info:

The window displays lists, process programs, or system log files to support the operator in any given situation.

View:

The window provides low-level help information such as command-line syntax.

Gas:

The window displays cumulative gas consumption.

Password:

Accepts the password needed to gain access to another level.

Program administration

All program handling operations such as downloading, uploading, duplicating and making backups are now easier than ever before with the dual floppy drive station for 3 1/2" double-sided microdisks. The on-board memory capacity is sufficient to hold an entire week's programs.

Remote telephone diagnosis by modem

This service is based on the use of a modem for computer-aided diagnosis by telephone. In problem situations, our remote troubleshooting and repair capabilities will effectively cut downtime and help you achieve the 7000+ production hour objective.

# Single-source epitaxial expertise, ongoing project-to-product support, and international responsiveness.



## SITESA AET 100 Advanced Epitaxial Technology

### Planning and design competence

SITESA experts will provide assistance in the following areas:

- Preparation of manufacturing specifications
- Definition of performance criteria
- Evaluation of support equipment
- Building planning
- Configuration planning
- Clean-room concept

It is SITESA's commitment to remain at the leading edge of epitaxial technology. We will be pleased to place our know-how at your disposal.

### Customized software for epitaxial economy

One of the key assets of advanced software in the epitaxial reactor industry is process economy. As competition grows, knowledge of the real current cost of the individual epitaxial processes is indispensable. Our software enables you - during a telephone call - to run a conservative estimate of or post-calculate a specific process under consideration of all parameters.

### R&D resources on demand

It is in our interest to get your SITESA AET 100 reactor on line as quickly as possible. For this reason, you can use our epitaxial research and development center while your project is being implemented. You can work on the same reactor type you have ordered. And our center remains open to you later as well.

### The epitaxial package

In our capacity as a single-source epitaxy supplier, we will assume global responsibility for:

- On-schedule delivery
- Clear instruction manuals
- Professional installation
- Problem-free commissioning

### The training curriculum

Training is provided at our epitaxial research and production center. We hold in-depth courses on:

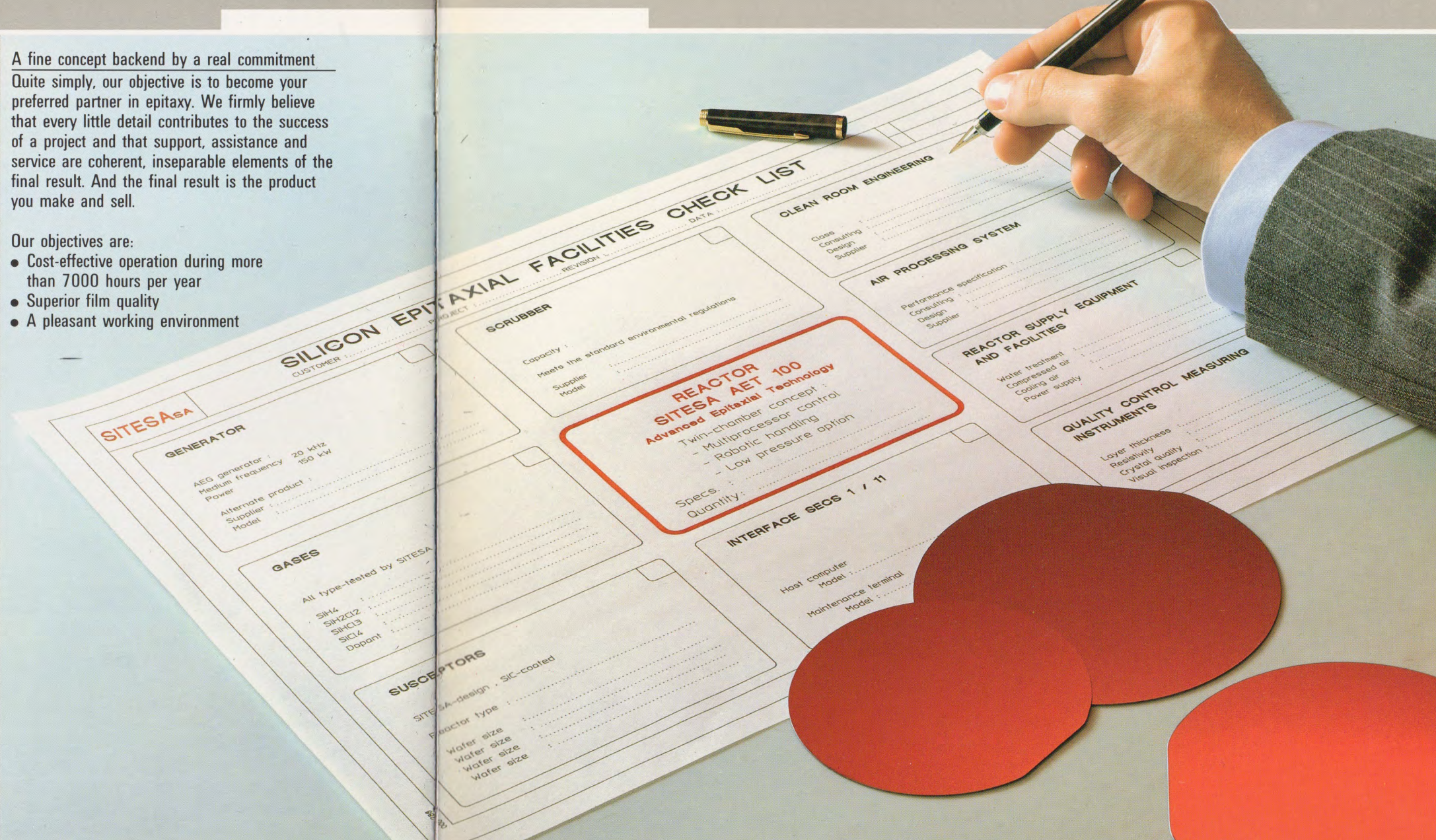
- Installation
- Production
- Service and maintenance
- Quality control
- Troubleshooting

Your staff will quickly adopt the skills needed to use the equipment expertly, economically and effectively.

A fine concept backed by a real commitment  
Quite simply, our objective is to become your preferred partner in epitaxy. We firmly believe that every little detail contributes to the success of a project and that support, assistance and service are coherent, inseparable elements of the final result. And the final result is the product you make and sell.

### Our objectives are:

- Cost-effective operation during more than 7000 hours per year
- Superior film quality
- A pleasant working environment



### The service philosophy

To maximize uptime, an epitaxial production facility must be able to rely on easily accessible field support. Our epitaxy experts or the troubleshooting team are as close as your telephone or a few hours away if on-site interventions are needed.

### The underlying objective

**ZERO-DEFECT PRODUCTION**

With its revolutionary Speed Canard, GYROFLUG GmbH attracted the attention of the international aviation community. The "duck" - an aircraft with full composite structure - designed for civilian applications, was certified in 1983 as the first aircraft of its kind.



DIGITRON AG designs and manufactures integrated material handling systems based on robot vehicles as well as advanced high-bay warehousing facilities for production environments.



SITESA SA Semiconductor Technology is a member of the Justus Dornier Holding AG, a group of high-technology companies which includes Gyroflug GmbH, Digitron AG, ZWAG Zschokke Wartmann AG and the aircraft division of FFA Flug- und Fahrzeugwerke AG. Each of these group companies is a dynamic leader in its respective field.

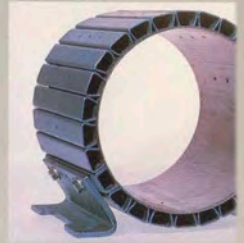
SITESA operates ultra-modern production facilities specially created to handle high-technology processes, with particular emphasis on epitaxial deposition requirements.

SITESA headquarters are located in Biasca. This city in the southern part of Switzerland lies on the main international expressway network which links northern and southern Europe. The site is close to the international airports of Zurich, Milan and Geneva, as well as to the local airport of Lugano. The intercity rail service provides convenient links to major business centers.

SITESA SA Semiconductor Technology is a leader in epitaxial reactor engineering; it has an innovative management, qualified and experienced human resources, modern production facilities and a strong financial background. SITESA is geared to technological leadership, competence and sound growth.



ZWAG Zschokke Wartmann AG has developed unique automatic production systems for motor housings; they are characterized by excellent heat dissipation properties, light weight and simple design. The company is also active in the field of specialized food-processing plants, e.g., vacuum-driers.



FFA Flug- und Fahrzeugwerke AG (aircraft division) is the designer and manufacturer of the swiss BRAVO training aircraft for civil and military pilots.

FFA (aircraft division) operates, on its own airport, a general and military aviation maintenance and repair center. A separate division of the company is specialized in surface treatments for alloyed metals.



## SITESA<sup>SA</sup>

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