Malta Model

Automatic Quartz Tubes Cleaner

www.spm-semiconductor.it

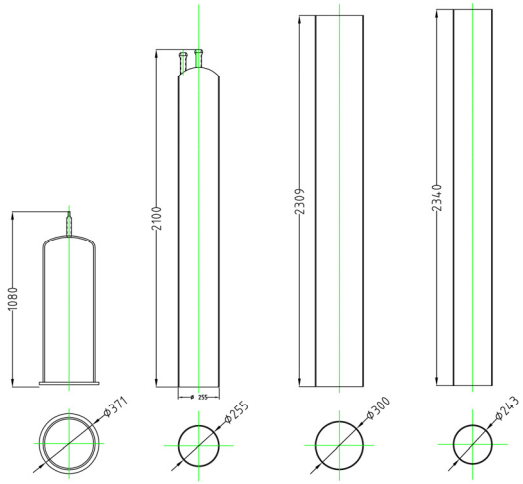
Process tubes used in semiconductor industry (thermal processes **APCVD**, **LPCVD**) require preventive maintenance when the process purity degree cannot be assured anymore caused by tube walls incrustations.

After a certain number of processed wafers (oxidation/ deposition) the process tubes must be extracted from the furnace and must be cleaned.

SPM realized since 26 years quartz tubes cleaning equipments. There are 2 different approaches:

- Horizontal cleaner
- Vertical cleaning

Each approach has positive and negative remarks. The main difference between the two choices is the cleaning method: immersion with horizontal cleaners and spray with vertical tools.



Malta Model is an equipment designed to perform the vertical **quartz or silicon carbide** tubes cleaning. Based on the tool configurations it's possible to load tubes with a total length from 400mm **up to 2400mm**. The system is so capable to clean different tubes length-diameter *without any conversion operations needed.*

DELIVERY TIME: 2 working months.

Special Plastic Module for semiconductor industry

Front-end Quartz Treatments

02 December 2013

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PROCESS

The progressive transition from 6” to 8” wafers and even larger, created the problem of furnace quartz parts cleaning, that come in contact with wafer gases. Keeping all chambers and connections clean is very important.

In the past, this clean up problem was a bit disregarded, or at least it was not considered as a process integrating phase, as semiconductor processes were less sophisticated.

The Malta Model is a revolutionary clean up system for quartz tunes and quartzware, that warrants the **repeatability of its cleaning phases**. It is proposed in vertical and spray cleaning version, with rotational plateau, in which the operator will position quartz tube to be cleaned. Clean up step (with **chemicals solution mixed directly by the system**) and H_2ODI rinse up will be accomplished into the same chamber, in different steps. Access to the cleaning chamber will be allowed at cleaning cycle end, that is after **HOT H_2ODI and HOT N_2 drying**.

Our system operates in spray version (spray becomes necessary to wash all furnaces connections); **the most interesting thing is that this clean up system adapts to different types of quartz tubes dimensions**.

The system we projected has been designed with the intention to reduce footprint dimension, **saving clean room space**.

The system is divided in three modules:

1. Tubes cleaning
2. Quartzware cleaning
3. Chemical solutions Mixing/ storage

We thought at a vertical clean up for space saving and for maintaining quartz tubes in its original process position, considering these parts are very fragile. The main problem was the accurate clean up of the quartz tube and its drying, either externally or internally.

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TUBES CLEANING

Quartz tubes cleaning module includes a process chamber with transparent door. The entire chamber is sealed to contains dangerous chemicals and fumes. **All process fumes are intercepted by exhaust** connection inside the chamber.

In the bottom part of the chamber is located a rotating plateau. There are **no metals parts, to warrant non-contamination**.

In the top part of the chamber is located a mobile flange. The UP/DW movement permits to **adapt to different tubes lengths automatically**.

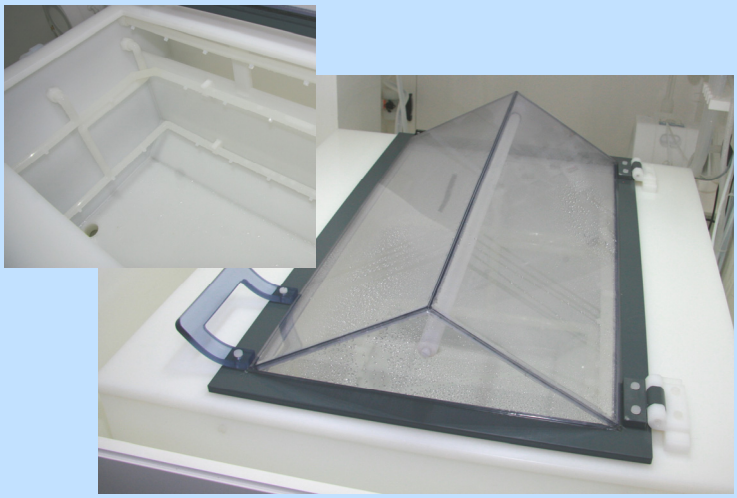
In bottom plateau and top flange are placed in strategic positions special nozzles that are used for the internal tubes cleaning: acid process, rinsing with H_2ODI and drying.

Additional peripheral nozzles are located for external tubes rinsing and drying. Special pinwheel are also placed to spray H2ODI on chamber wall keeping the cleaning box always perfectly cleaned, ensuring both: process non-contamination and operators safety.

QUARTZWARE

All quartz parts related to tubes can be cleaned in a dedicated tank with a manual cover.

This special tank is provided with three nozzle collectors and from recipe it's possible to select which activate based on part height **saving chemicals consumption** and providing a better cleaning since spray action is more focused.



CHEMICALS MIXING

Malta Model is equipped with a full automatic chemicals mixing station. The module is composed by 3 buffer tank with a total volume capacity of 170 liters. In each tank it's possible to **compose different chemical solutions**.

The PLC monitors constantly the solution level with analog sensors and perform **automatic tank refilling** to warrant no waiting time for starting process.

Chemical mixing is made measuring inlet quantity with **ultra-sonic flowmeter**. Specific touch screen parameters permits to set deseeded chemicals ratio.

Metal free Ultra-sonic dosing flowmeters

Pneumatic PTFE pumps transfer the solution from buffer tank to process chamber for tubes cleaning or to quartzware tank during acid process. The solution is so spread trough nozzles and cleaning process starts.

Chemical Mixing Buffer Tanks

While transferred the sufficient quantity, the inlet of fresh solution stops and another pump (one for tubes cleaning and one for quartzware) will starts recirculating the solution.

All valves, pumps, sensors and piping connections are metal free to warrant non contamination.

There is also a **recovery tank used to store the used chemical solution**. This solution can be used (selectable from touch screen recipe) for a next process, saving chemicals consumption and environment.

Used Chemical Solution Recovery

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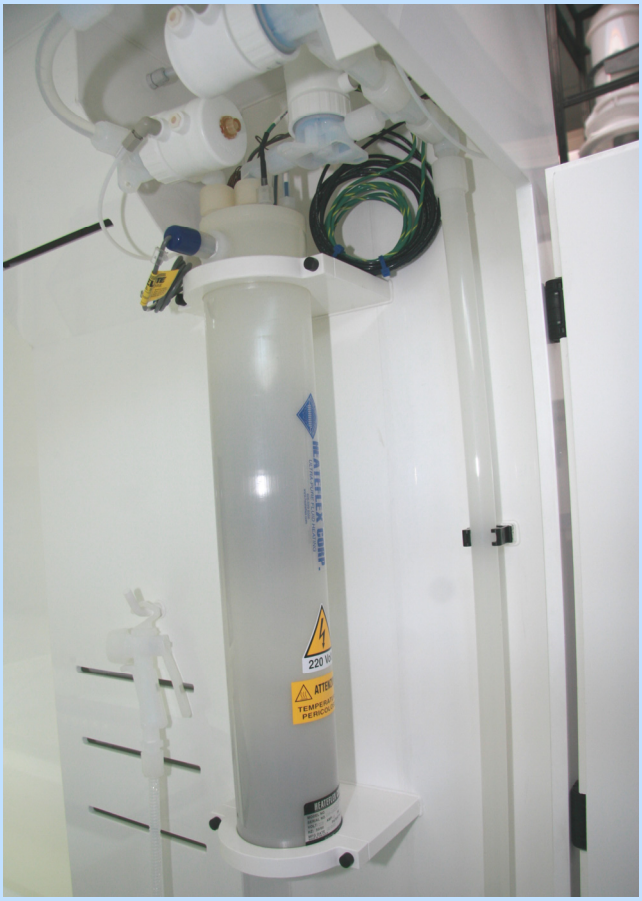
HEATERS

Malta Model is equipped with 2 heaters: one is dedicated for producing HOT H2ODI for a pre-drying operation. The other heat exchanger is for N2.

The **HOT H2ODI** helps to remove all acid traces from the quartz tubes and also reduce the drying time.

Drying is obtained injecting **HOT N2** into the quartz tube and the process chamber.

In-line N2 heater



10 Kw Ultra Pure in-line H2ODI heater

Thermo-regulation is managed by the PLC and **redundant PT100** are installed to check constantly the temperature limit settings for safety.

PUMPS & VALVES

Adopted valves are specifically *designed for high purity media*. **All medium wetted parts are made of PFA-HP of PTFE (diaphragm).** The exterior actuator parts of the piston actuator are made of PDVF.

Pumps represents the latest generation of plastic air-operated double diaphragm pumps made in solid design.

All wetted parts are made in PFTE that is electrochemically, biochemically, enzymatically, and **chemically virtually inert.**

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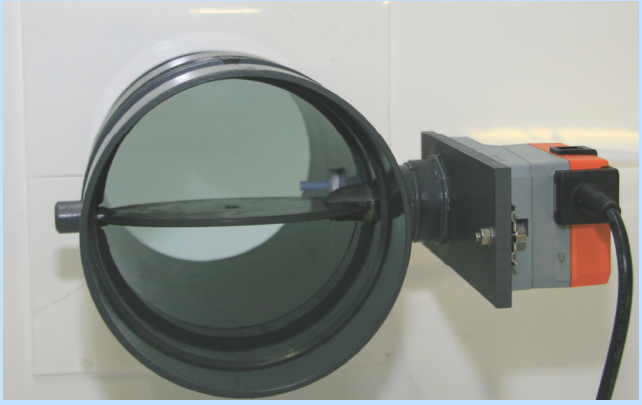
EXHAUST CONROL

Exhaust de-pressure is constantly monitored by the system thank to Low differential Pressure sensors. Those sensors have a 4~20mA out connected to an analog inlet of PLC that consent to monitor **constantly the rate level inside the exhaust plenum**.

An electric shutter is positioned just before the exhaust connection, and so regulating the opening we can ensure keep constant the de-pressure value.



PVC Automatic exhaust shutter

From touch screen are previewed a series of parameters that permit to set the desired exhaust level, of course it's possible to view in real time the rate level for each installed sensor.

SAFETY

All doors of the equipment are protected with **safety interlocks**.

Access doors for quartzware end tubes cleaning are also equipped PNE cylinders that lock doors while a process is running to warrant operator safety.

Each modules are designed with a general safety containment tank. **PTFE Leak sensors** are installed in each modules and in case of triggering, the PLC stops immediately every active functions.

Safety drain with PTFE leak sensor

The equipment has a 4 colour **semaphore** that indicate the machine status. In case of alarms a buzzer emits also a sound indication.

Emergency buttons are placed on front and back side of the equipment and are managed by an OMRON safety relay (**emergency stop unit**).

In case of low exhaust alarm the running cycles are stopped and a special rinsing cycle will start ensuring that quartz parts has no acid traces.

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GENERAL CONTROL

Malta Model is ruled by an **OMRON PLC** that manage the whole system.

The HMI interface is a **10” OMRON touch screen** with specific software developed by SPM.

Valves and pumps are pneumatically actuated with **SMC solenoid valves**.

An **inverter** controls the motor for the bottom plateau of the quartz tubes cleaning module rotation.

Heaters are controlled by Solid **State Relays** and in case of emergency a **contactors** will cut immediately the HIGH voltage power.

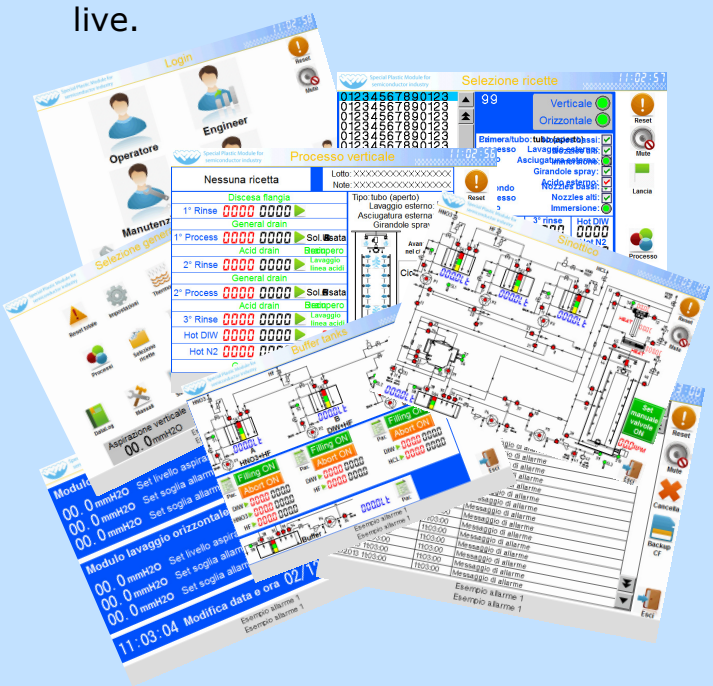
General Control

SOFTWARE

Software is entirely designed by SPM engineers. That warrant an high flexibility for custom modifications. Standard SPM software includes:

- User access management
- Process monitoring
- Datalog for alarms and events
- Recipes management
- Cycle settings
- Live synoptic (with manual set valve for maintenance)
- Chemicals mixing management and monitoring...

It’s possible to add to the equipment the **remote control** capability providing to SPM to perform system checks and software modifications live.



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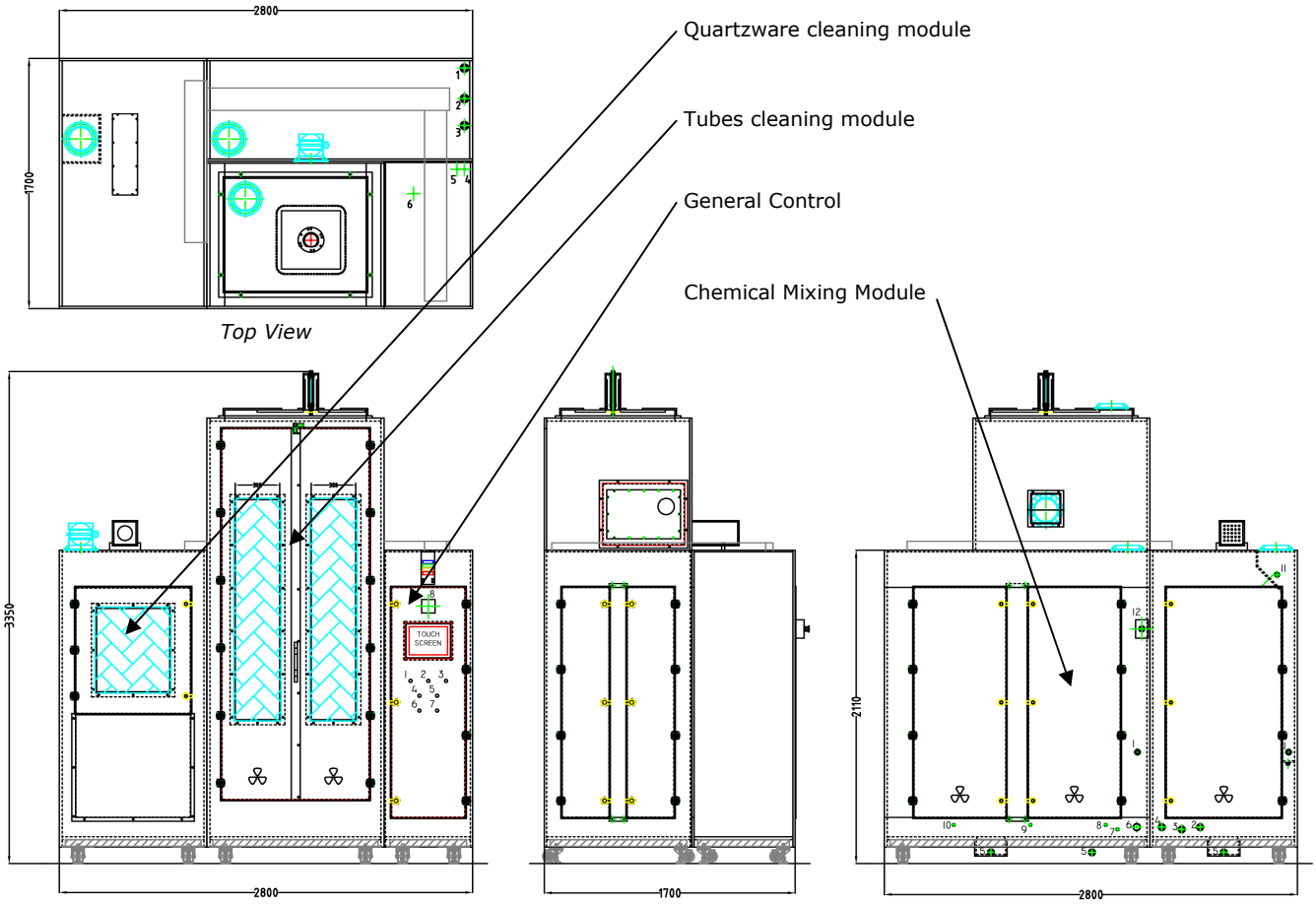

Top View

Front View

Side View

Back View

For futher information don't hesiatate to contact us!

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