INTRODUCTION

Model 8667 and Model 8671 are batch type systems specifically designed for use in research and development and in low volume production applications.

Model 8667 will sputter one to three targets simultaneously and sequentially; Model 8671 will sputter one to three targets, only in the sequential mode.

DEFINITIONS: A basic 8667/8671 is defined as a MODULE. An 8667 module/8671 module is not equipped with the components needed to produce and maintain vacuum. A VACUUM STATION is a self-contained unit capable of producing and maintaining vacuum. The coupling of a MODULE and a VACUUM STATION create a SYSTEM.

CATHODES

RF MAGNETRON AND DC MAGNETRON DEPOSITION

Quantity:	Up to three cathodes
Size:	6.5" standard for RFM/DCM at any position; 8" magnetron cathodes are optionally available.
BP Material:	Copper
Cooling:	Water-cooled, internal to backing plate.
Location:	90° apart in chamber top plate.
Replacement:	Top plate moves vertically to allow access.
Seals:	Viton O-Rings for low outgassing.
Dark Space Shield:	Stainless steel.
Insulator:	Pyrex.

RF DIODE DEPOSITION

Quantity:	Up to three cathodes
Size:	8" standard for RF Diode at any position.
Type:	"B" (no water-to-vacuum seals).
BP Material	Stainless Steel.
Cooling:	Water-cooled, internal to backing plate.
Location:	90° Apart in chamber top plate.
Replacement:	Top plate moves vertically to allow access.
Seals:	Viton O-Rings for low outgassing.
Dark Space Shield:	Stainless steel.
Insulator:	Pyrex.

ROTATING ANODE

Description:	Rotating anode table, center-mounted through the top plate. RF etch/RF bias capability standard. No electrical or water connections made to vacuum. The center anode post rotates through a double-pumped feedthrough in the chamber top plate.
Size:	24" OD x 6" ID.
Cooling:	Water-cooled.
Seals:	Viton O-Ring, double-pumped.
Dark Space Shield:	Aluminum.
Insulator:	Pyrex.
Positioning:	Fixed positioning at 90° intervals, or variable rotation 1 to 5 rpm.
Capabilities:	RF etch/RF bias.

CHAMBER

Type:	Cylindrical, heliarc-welded.
Material:	1/8" stainless steel.
Size:	26" OD X 10" high.
Viewport:	4" window, front center of chamber.
Feedthroughs:	Four V4 Flanges. 1) V4-199 (micrometer and shut-off for process gas) 2) V4-160 (leak valve for chamber vent) 3) Two blank flanges
Seals:	Viton O-Ring for low outgassing.

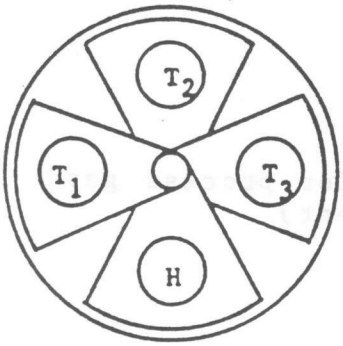
SHUTTERS -- 8667

Description: Up to four shutters, individually positioned. One shutter is assigned to each cathode (up to three cathodes, 90° apart in the top plate) and one for heat (optional), located in the fourth quadrant.

Note: When Heat is not ordered, its position in the top plate is blanked off. This also applies for the 8671.

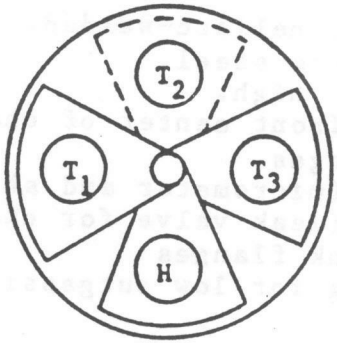
Shutter positioning is assured via locking and positive locating mechanisms. Shutters can move either clockwise or counterclockwise.

Examples of Shutter Positioning:



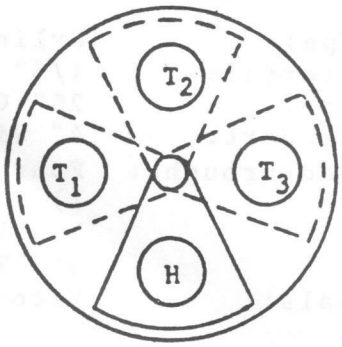
RF ETCH

All four shutters are positioned 90° apart to protect the cathodes and heater (optional) from etched material.



T_2 SPUT

T_2 cathode is exposed with its respective shutter relocated to an idle position.



3 TARGET SIMULTANEOUS SPUT

All three cathode shutters are positioned under the heater (optional), allowing the exposure of all three targets.

Material: Stainless steel.

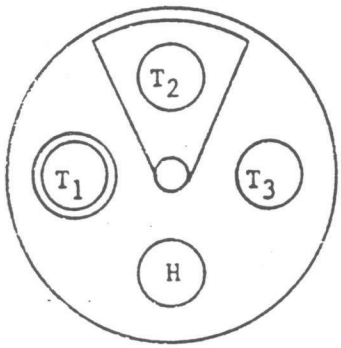
Feedthroughs: Drive shafts for the shutters utilize double-pumped feedthroughs (Viton O-ring sealed) in the chamber top plate.

Operation: Each shutter is driven manually. Shutter drive knobs are located on either side of the network chassis, above the chamber top plate.

SHUTTERS -- 8671

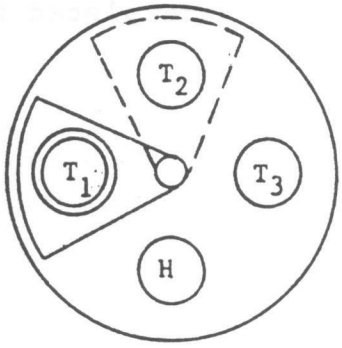
Description: A single large diameter shutter with one opening is standard. A single lobe shutter is supplied to cover the opening in the large diameter shutter in order to facilitate RF etch. Shutter positioning is assured via locking and positive locating mechanisms.

Examples of Shutter Positioning:



T_1, T_2, or T_3 Sput

The opening in the large diameter shutter is positioned at the desired cathode, in this example, at T_1, with the single lobe shutter placed at an idle position.



RF Etch

The opening is stationed at the T_1 cathode with a single lobe shutter covering the opening to prevent etched material from depositing on the T_1 cathode.

Material: Stainless steel.

Feedthroughs: Drive shafts for the shutters utilize double-pumped feedthroughs (Viton O-ring sealed) in the chamber top plate.

Operation: Each shutter is driven manually. Shutter drive knobs are located on either side of the network chassis, above the chamber top plate.

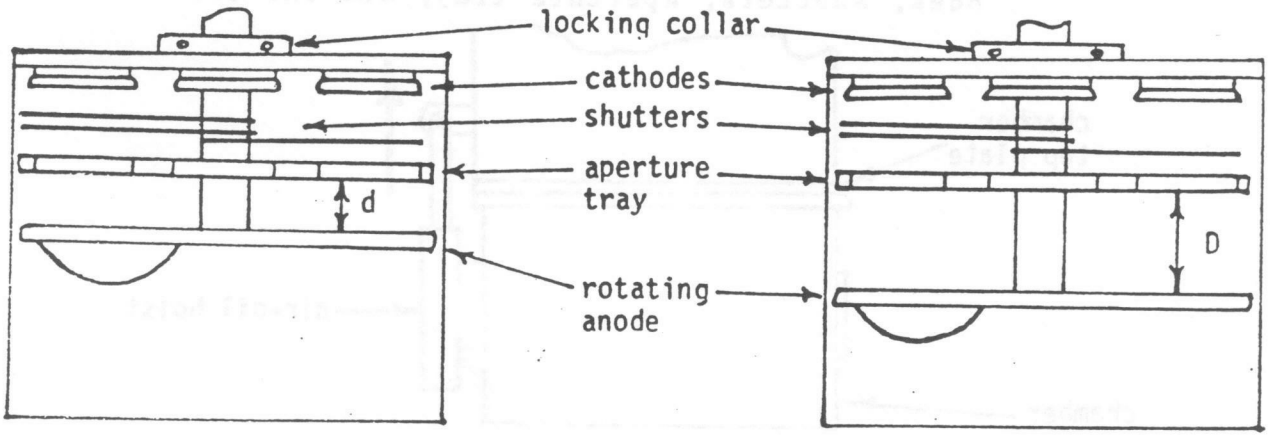
UNIFORMITY CORRECTION APERTURES -- STANDARD IN 8667/8671

Description: In rotational deposition, the uniformity correction apertures provide uniform deposition for round diode and magnetron cathodes, by enhancing their deposition characteristics.

Operation: A stationary aperture tray is positioned and fixed between the rotating anode and the shutters. This tray contains three holes 90° apart, each hole corresponding to a cathode. The uniformity apertures are placed in these holes.

CATHODE-TO-ANODE SPACING

The rotating anode can be relocated vertically in order to accommodate substrates of varying heights. In the standard 8667/8671 the following range of cathode-to-anode spacing is available:



Minimum clearance: d = flush to aperture tray.
Maximum clearance: D = 3/4".

The aperture tray is located in a fixed position just beneath the shutters. Actual clearance is measured from the stationary aperture tray to the anode.

Adjustments can be made by loosening the locking collar on the chamber top plate and moving the anode up or down to the desired location.

RF GENERATOR

A 1.5 kW RF Generator, rated at an ISM assigned value of 13.56 MHz, is supplied as standard for RF diode, RF magnetron, RF etch, and RF bias operations. This unit meets or exceeds FCC and OSHA specifications. A 3 kW generator is optionally available.

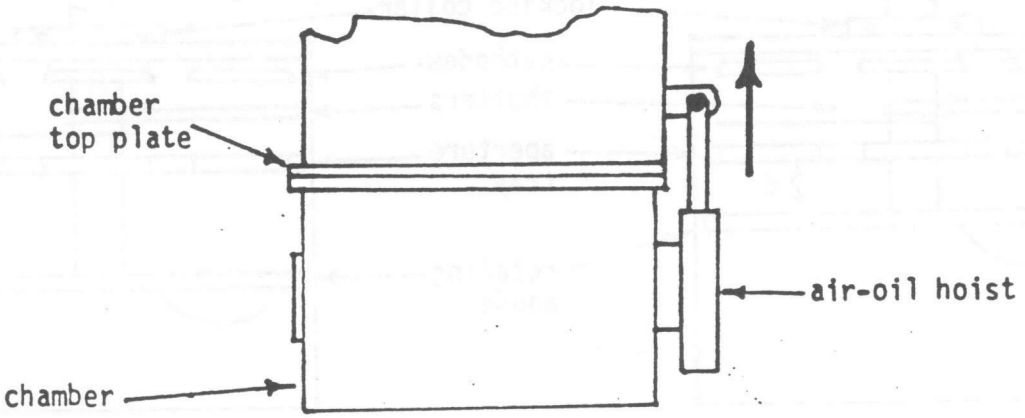
DC MAGNETRON POWER SUPPLY

A 5 kW DC power supply is supplied as standard for DC magnetron deposition. The supply is SCR controlled and incorporates short circuit protection, arc suppression and current limiting.

NOTE: In systems utilizing RF and DC, the DC power supply will be housed in a separate short tower.

TOP PLATE HOIST

Description: To raise the top plate off the chamber, an air/hydraulic cylinder is supplied. The top plate may be raised in order to obtain access to the cathodes, shutters, aperture tray, and the chamber.



RF MATCHING NETWORK

Located above the top plate and enclosed in a sheet metal housing. An individual load tuning circuit and RF switch is provided for each RF operation. The network input circuit provides efficient matching to sput/etch/bias loads utilizing vacuum capacitors.

RF ETCH/RF BIAS

RF Etch and RF Bias capabilities are integrally designed into the rotating anode.

RF ETCH: Up to 1.5 kW RF power can be applied to the anode to provide sputter cleaning of the substrates. RF etch can take place either in a stationary or a rotational mode.

RF BIAS: 2% to 10% of the applied RF target voltage can be applied to the substrates during sputter deposition to enhance film density, purity, step coverage, and adhesion. Bias can be performed while simultaneously or sequentially sputtering in RF.

VACUUM STATIONS

Both 8667/8671 modules can become systems by utilizing the many available vacuum stations. The module itself mates to a stainless steel base plate in the vacuum station table top. All vacuum stations are classified as either automatic or manual, as follows:

AUTOMATIC: In the automatic vacuum station an automatic vacuum valve sequencer controller is provided. This automatic valve sequencer controller permits one button operation to pumpdown the chamber from atmosphere to high vacuum.

MANUAL: In the manual vacuum station all valve sequencing is performed manually. The operator must perform all necessary valve sequencing.

When a vacuum station is ordered, the following is included:

1) One 17.7 cfm mechanical pump for chamber roughing and high vacuum pump backing. The mechanical pump is situated in the rear of the vacuum station.

2) A Pirani gauge for monitoring high vacuum pressure.

NOTE: A coaxial or bakeable trap is not supplied with the vacuum station, and therefore must be ordered separately.

AUTOMATIC VACUUM STATIONS

Description: Steel cabinet, 50" wide x 32" deep x 42" high. Electropneumatic valves: high vacuum, roughing, foreline. Electric solenoid valve: venting. Automatic Valve Sequencer Controller. Fitting in foreline for leak detector. Ionization and thermocouple gauges provided to sense hi-vacuum and roughing pressures. 26" stainless steel base plate. Long-life liquid nitrogen cold trap. Gas throttle valve located below the liquid nitrogen trap.

MODELS	HI-VAC PUMP
2A	M6 diffusion pump (1500 l/s for air).
2BA	VHS-6 diffusion pump (2400 l/s for air).
3A	L-H 450 turbomolecular pump (450 l/s for air).
4A	CTI-8 cryopump (1500 l/s for air). This option includes a bakeable trap; the liquid nitrogen cold trap is deleted.

Vacuum Gauging:

G-P 260 rack mount for monitoring hi-vacuum and rough pressure, utilizing ionization and thermocouple gauges.

Pressure Sensing Gauges:

Chamber hi-vacuum pressure> Bayard-Alpert ion gauge.
Chamber rough pressure> thermocouple gauge.
Sputter gas pressure> Schulz-Phelps gauge.

MANUAL VACUUM STATIONS

Description: Steel cabinet 50" wide x 32" deep x 42" high. Manually operated valves: high vacuum, roughing, foreline, vent. Fitting in foreline for leak detector. Ionization and thermocouple gauges for sensing hi-vacuum and roughing presures. 26" stainless steel base plate. Long-life liquid nitrogen cold trap. No throttle valve. Gas conductance controlled by manual manipulation of the high vacuum gate valve.

MODELS	HI-VAC PUMPS
2M	M6 diffusion pump (1500 l/s for air)
2BM	VHS-6 diffusion pump (2400 l/s for air)

Vacuum Gauges:

G-P 260 rack mount for monitoring hi-vacuum and rough pressures, utilizing ionization and thermocouple gauges.

Pressure Sensing Gauges:

Chamber hi-vacuum pressure> Bayard-Alpert ion gauge.
Chamber rough pressure> thermocouple gauge.
Sputter gas pressure> Schulz-Phelps gauge.

UTILITY REQUIREMENTS

	MODULE	SYSTEM
POWER	208V, 3 Phase, 60 Hz, 25 amp 5 wire, wye	208V,3-Phase, 60Hz, 40 amp 5 wire, wye
WATER	2.5 GPM 35-55 psi, 55 - 80^{0}F	3 GPM 35-55 psi, 55 - 80^{0}F
AIR	80 - 100 psi (filtered)	80-100 psi (filtered)
ARGON	5 psi 50 - 150 sccm	5 psi 50 - 150 sccm

MODULE DIMENSIONS

35" High Closed (47" open) x 26" Diam. Chamber

SYSTEM DIMENSIONS

78" High Closed (90" open)x 36" deep x 53" wide

WEIGHT

Module: 750 lb. (340 kg)

System: 1,900 lb. (865 kg)

OPTIONS

FOR POWER:

3 KW RF GENERATOR
For process requirements up to 3 kW in the RF mode. RF etch is limited to 1.5 kW.

RF VOLTAGE STABILIZATION
Closed-loop feedback control of specified RF sput/etch/bias voltage is provided in order to assure consistent process operation. RF Automaintain/RF Autotune must be ordered with this option.

RF AUTOMAINTAIN (8667 only)
In the 8667 three target simultaneous sputtering can be performed. Each cathode must be manually tuned; at this point RF Automaintain can be initiated. RF Automaintain automatically maintains tuning as long as the process conditions are not altered by the operator. In the sequential mode, each target can be controlled individually.

RF AUTOTUNE (8671 only)
In the 8671 sequential sputtering only is available. Therefore, in RF Autotune the operator selects the desired RF power, initiates RF Autotune, and allows all RF power levels to be maintained automatically without operator assistance.

FOR PROCESS:

SUBSTRATE HEAT
The radiant calrod-type heater is located in the center rear quadrant of the chamber top plate. Static substrates can be heated up to 400°C. A pyrometer and thermocuople are used to monitor the substrate temperatures.

ADJUSTABLE TIMER
The adjustable timer allows timed control of sputter and etch processes.

STAND-BY WIRING
In addition to the specified process function at a given cathode position (RFM/RFD/DCM), an alternate stand-by process mode may be selected as a working process at any or all cathode positions. This option provides the appropriate interconnections and switching; the appropriate power supply and other related components must already exist within the system. Does not include magnets or cathodes.

RFM Stand-by
RFD Stand-by
DCM Stand-by

NOTE: In the 8667 a 5 kW DC power supply is also required at each DCM stand-by to facilitate DCM simultaneous sputtering.

EXTRA LONG CENTER ANODE SHAFT FOR INCREASED CATHODE-TO-ANODE SPACING FOR TALLER SUBSTRATES
Increased spacing is obtained by lengthening the center anode shaft. New spacing dimensions:

Minimum Clearance: d = 2 3/4"
Maximum Clearance: D = 4 3/4"

FERROFLUIDIC FEEDTHROUGH FOR CENTER ANODE SHAFT
A ferrofluidic feedthrough is available in lieu of the standard double-pumped feedthrough.

MULTIGAS
A three gas assembly is available, with individual micrometers and shut-off valves, to accommodate up to three different process gases.

AUTO GAS TURN-ON
A solenoid placed between the gas manifold and the chamber allows one button ON/OFF control of the process gases (supplied only on systems).

FOR VACUUM:

COAXIAL TRAP
An in-line trap, placed in the mechanical pump vacuum line, prohibits mechanical pump oil backstreaming. This trap has no regeneration capability.

BAKEABLE TRAP
A bakeable trap performs the same function as a coaxial trap. The absorbent medium can be regenerated or cleaned by heat bake-out. This bakeable trap can be used repeatedly.

AUTO LIQUID NITROGEN CONTROLLER
A rack mountable controller provides automatic closed-loop control of the liquid nitrogen level in the liquid nitrogen cold trap located in the vacuum stack. This option cannot be used with the 4A vacuum station.

WATER BAFFLE ABOVE THE DIFFUSION PUMP
A baffled water-cooled chamber, placed between the liquid nitrogen cold trap and the throttle valve, prevents backstreaming of oil from the hi-vacuum diffusion pump (for use only with 2M, 2BA, or 2BM vacuum stations).

AUTO PRESSURE CONTROL
Auto Pressure Control provides automatic closed-loop control of the sputter gas pressure. A Veeco pressure controller is used in conjunction with a variable orifice PV-10 valve and a Schulz-Phelps ion tube pressure sensor.

35 CFM MECHANICAL PUMP
A mechanical pump with 35 cfm capacity is available in lieu of the 17.7 cfm mechanical pump. A 17.7 cfm mechanical pump is standard with a system.

ION TUBE AT THE THROTTLE VALVE
An ion gauge placed at the throttle valve collar monitors hi-vacuum pressure in the vacuum stack.

SPUTTERING OPERATION -- 8667

The 8667 is designed to allow RFM/RFD/DCM simultaneous or sequential sputtering capability.

SIMULTANEOUS RFM/RFD SPUTTERING

Power from the RF generator can be split two or three ways to facilitate two or three target simultaneous sputtering operations. Split power to these cathodes is independently variable up to the split power level; i.e., with the 1.5 kW RF generator, 0.5 kW can be applied and varied to each of the three cathodes. This type of power control allows versatile process capabilities. A 3 kW generator is optional.

SEQUENTIAL RFM/RFD SPUTTERING

Full rated power, up to 1.5 kW RF from the RF generator, can be applied to each RF cathode. A 3 kW RF generator is optional.

SIMULTANEOUS DCM SPUTTERING

Power from the 5 kW DC power supply cannot be split; therefore, a 5 kW DC power supply is required for each DC magnetron cathode. For three DC magnetron cathodes, three separate and independent 5 kW DC power supplies are required. Power can be varied up to the rated 5 kW for each cathode. As in RF, simultaneous DC magnetron sputtering offers versatile process capability.

SEQUENTIAL DCM SPUTTERING

Full rated power from each 5 kW DC power supply can be applied to each DC magnetron cathode.

SPUTTERING OPERATION -- 8671

The 8671 is designed to allow RFM/RFD/DCM sequential sputtering capability.

SEQUENTIAL RFM/RFD/DCM SPUTTERING

Full rated power, up to 1.5 kW from the RF generator and 5 kW from the DC power supply, can be applied to each RF/DC cathode. A 3 kW RF generator is optional.