Agilent

Trusted Answers

Agilent Ion Pumps

Solutions for Ultra and Extreme-High Vacuum


Agilent
Diode
Vacuum Products

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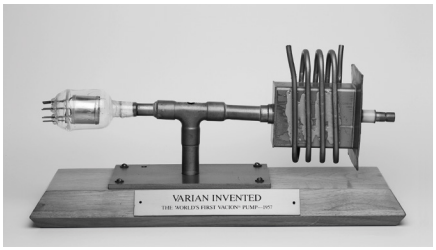
UHV pumping technology evolution

Leading the Way in Ultra High Vacuum

The Agilent ion pump was invented in 1957 at Varian Associates by Jepsen, Helmer, and Hall. This was the milestone that made ultra high vacuum (UHV) possible. The development of this critical enabling technology has provided clean high and ultrahigh vacuum for many applications in science and technology, from particle accelerators and analytical instruments to semiconductors and coatings.



The first ion pump, invented at Varian, now Agilent, in 1957.

VacIon Plus

VacIon Plus is a complete family of ion pumps, controllers, and accessories, designed to provide solutions to every application.

Parameters such as operating pressure, gas mixture to be pumped and starting pressure, can vary so dramatically that Varian, today Agilent, decided to develop dedicated ion pump solutions for different applications.

The VacIon Plus family includes Diode, Noble Diode, and StarCell pump versions that allow Agilent to provide the best technology for each field of application. The family is complemented by the 4UHV and IPCMini ion pump controllers, that provide different power levels and interface capabilities.

VacIon Plus 200
The first ion pump with maximum pumping speed at low pressure. *See Page 38.*

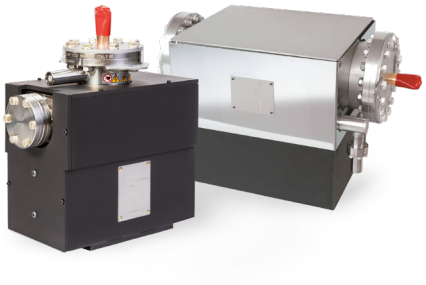
VacIon Plus 1000
Designed for gravitational wave detectors and other critical research applications. *See Page 48.*

Ion CombiTSP pumps

The CombiTSP pumps integrate ion pump, TSP cartridge, and TSP cryopanel to increase pumping speed in the same footprint.

The titanium sublimation creates high getterable gas pumping speeds, while the ion pumping mechanisms handle the nongetterable gases, such as argon and methane. The combination pump includes the cylindrical cryopanel (or the new ambient shield) and TSP source mounted to the extra port. Customized pump configurations are also available. *See Page 50.*

Ion CombiNEG pumps



The Agilent Ion CombiNEG pump integrates the high-capacity nonevaporable cartridge inside a Vaclon pump.

A smart solution combining an ion pump with a sintered NEG cartridge for best UHV performance. The NEG cartridge provides extra pumping speed for active gases and the StarCell or diode ion pump provides high pumping speeds for argon and other residual noble gases, making the CombiNEG pump a good choice for ultrahigh (UHV) and extreme high vacuum (XHV. *See Page 58).*

Ion Pumps Features and Benefits

Widest pumping speed range

- Miniature/appendage pumps from 0.2 to 2 L/s
- Small/medium pumps from 10 to 75 L/s
- Large size pumps from 150 to 1000 L/s
- Ion CombiTSP pumps
- Ion CombiNEG pumps
- Custom solutions with special pumping speed, size, and magnetic field

Agilent feedthroughs

- Eliminate corrosion
- Implement the high voltage cable interlock
- Provide an easy connection
- Prevent unintentional extraction
- Minimize overall dimensions

Any of the common industry feedthroughs are also available.

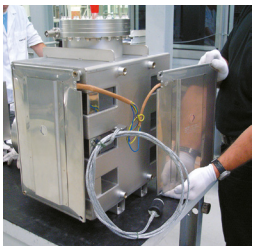
Vacuum processing

To ensure cleanliness, all pumps are:

- Factory processed at high temperature (450 °C) in ultrahigh vacuum for a thorough outgassing of the body and all internal components
- Shipped under vacuum, and an RGA spectrum can be provided with each pump
- Helium leak check

Heaters

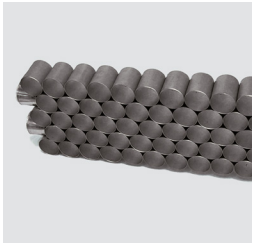
- The pump can be supplied with heaters for pump baking, which assists in obtaining lower pressure
- Minimize operational costs



Element cells and insulators

Cell sizes and geometries are optimized to:

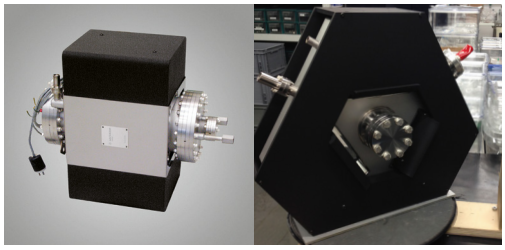
- Maximize the discharge intensity
- Maximize the pumping speed
- The special design of the ceramic insulators prevents a buildup of sputtered conductive coating, and maximizes pump life.



Custom

The pump body can be configured to meet optional requirements including:

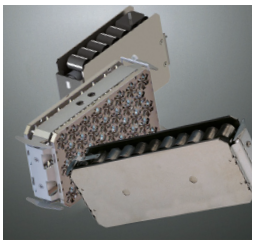
- Cryopanel (or ambient shield) and TSP, side- or bottom-mounted
- Integral heaters
- Additional roughing ports
- Other custom solutions



Pumping elements

Three different types of pumping elements are available to cover all possible gas mixtures and optimize the application-specific performances:

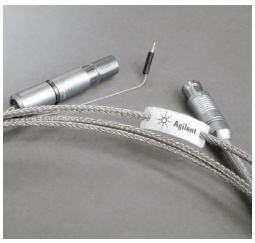
- Diode
- Noble Diode
- Our unique StarCell



Agilent cables

- Agilent cables have an HV safety interlock that prevents any chance of electrical shock
- If the cable is disconnected from the pump, the voltage is automatically cut off
- Available in different lengths and with different connectors (on both pump-side and controller-side)
- Robust, flexible and metal-shielded
- 10^7 Gy (Gray) radiation tolerance

Agilent can supply additional cable options on request.



Courtesy of CERN

More choice and flexibility to drive Agilent ion pumps.

The VacIon Plus pump family is complemented by ion pump controllers, that provide different power levels and interface capabilities.

The range of Agilent ion pump controllers includes the IPCMini, the 4UHV, the TSP controller, and OEM dedicated series of IPCU controllers.

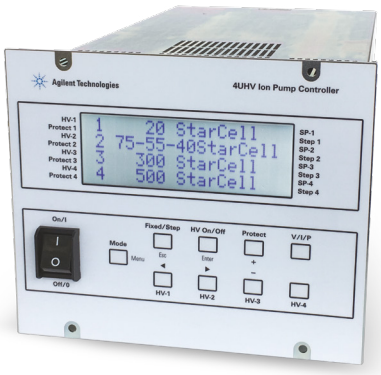
4UHV and IPCMini ion pumps controllers

Learn more about ion pumps controllers and ion pumps application:

www.agilent.com/en/product/vacuum-technologies/ion-pumps-controllers/ion-pump-controllers

4UHV – For ultra and extreme high vacuum

The 4UHV 1/2-rack ion pump controller operates up to four pumps simultaneously and independently. The 4UHV starts and controls ion pumps of any type (Diode, Noble Diode, StarCell) and size (from 2 to 1000 L/s).



4UHV ion pump controller

A large LCD display allows simultaneous reading of individual pump voltage, current, and pressure.
The variable step voltage feature ensures optimum pumping speed and pressure reading throughout the operating pressure range.

Built-in setpoints, remote operation, and RS-232/485 computer interface as standard; Ethernet and Profibus versions are available.

A 4UHV fast response version is available for use in applications such as large synchrotron and linear particle accelerators that require quick trigger responses to protect UHV system integrity.

IPCMini – Innovation at your touch

The IPCMini is a 1/4-rack ion pump controller with 3.5 inch resistive touch panel that has an intuitive display which can be easily read from a distance.

IPCMini ion pump controller

The IPCMini can operate pumps from 0.2 to 500 L/s with 40 W of power. With less than 10 ms of I/O response time and 1nA of current resolution, it is suitable when a quick trigger and an accurate pressure reading are required, even at low pressure.

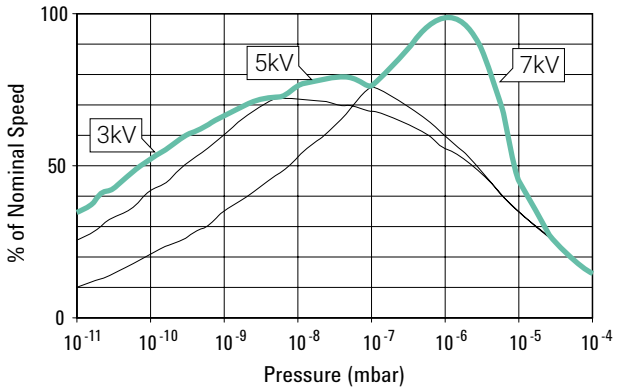
The Intelligent Step (iSTEP) voltage function selects the proper operating voltage to start even large pumps at low pressure and maintain accurate pressure readings in the UHV/XHV region.

The IPCMini is safe and reliable with a dedicated high voltage power button and safety interlock.

Optimized pumping speed

The 4UHV and IPCMini will select the correct operating voltage to optimize the pumping speed of your ion pumps. By applying high voltage in accordance with operating pressure, pumping speed performance is improved.

This is a result of the energy with which the ion bombards the cathode is the nominal applied HV, reduced by the space charge effect due to the electron cloud present in the ion pump cell. Since the space charge effect is pressure related, a variable HV is applied to maintain optimum bombardment energy, resulting in the best possible pumping performance at any pressure.



Pumping speed vs pressure at different voltages

Versatility

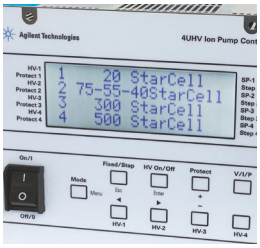
Agilent has single 'IPCMini' and multichannel '4UHV' controllers available in different configurations.

The 4UHV controller can independently power, control, and monitor any combination of multiple pumps of different sizes and polarities, from one to four pumps.

Several options are available:
Fast response, Ethernet and Profibus.

The IPCMini is a single-channel touch screen ion pumps controller that can power ion pumps ranging from 0.2 to 500 L/s. It features high current resolution (1nA) for accurate reading in the low-pressure range.

Ethernet option available.



Intelligence

To access the unit, you can use analog or RS-232/485 ports.
The controller uses the same protocol as our other intelligent vacuum devices (TwisTorr turbo pump controller and inverter driven scroll and rotary vane pumps), giving you fast, convenient access to all elements of the vacuum system.

Profibus and Ethernet communications are available as options.

Safety

To protect you against high voltage, the cables are equipped with an interlock system, which immediately shuts down the high voltage when the plug is removed from the pump.
The protect mode limits the current to protect the pump and the controller.

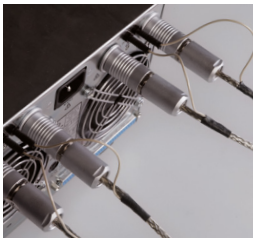
Low noise

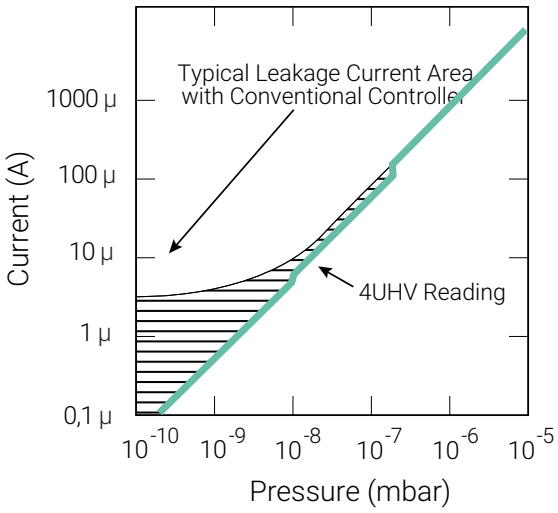
For SEM applications, the remaining AC component of the high voltage output is reduced to a minimum. It is much lower than in any other existing unit, and in many cases eliminates the need for extra filters.

Pressure reading

The 4UHV and IPCMini are preprogrammed to automatically convert current reading of any Vaclon Plus pump into pressure. The controllers are able to detect ion current as low as 1nA (IPCMini) or 10nA (4UHV).

IPCMini allows pressure measurement in the 10^{-11} mbar range, while 4UHV allows pressure measurement in the 10^{-10} mbar range. To ensure reliable pressure reading down to the UHV region, the 4UHV and IPCMini optimize the applied high voltage as a function of pressure. As a result, the leakage current of the ion pump is eliminated, providing more accurate pressure readings.





Typical current vs pressure curve

Dedicated solutions for SEM applications

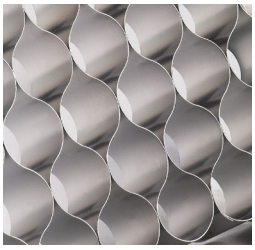
Agilent is the only manufacturer to offer specially designed SEM ion pumps. These pumps are ideal for the electron guns operating in the high vacuum region where a stable vacuum and low leakage current are required to control and preserve the charged particle filament.

The key to this superior performance is the Agilent patented anode design, which uses contoured cells and simplified electrical elements. This ensures stable current readings and lower particle generation.

When combining the SEM ion pump on the gun with a StarCell ion pump on the lower column, Agilent ion pumps can offer a powerful combination optimized for modern E-beam columns. SEM ion pumps are available on request; ask Agilent for technical details.

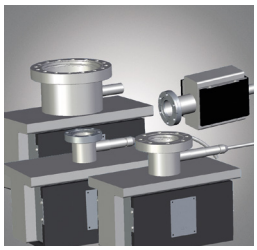
Innovative SEM anode geometry

- Better current stability
- Lowest leakage current in the industry (< 10 nA)
- Double shielded ceramics
- Longer pump life
- Longer pressure stability
- Maximum uptime



Wide, dedicated range

- A complete range of SEM ion pumps from 10 to 75 L/s, tailored to your specific vacuum needs
- Small footprint for easier system integration

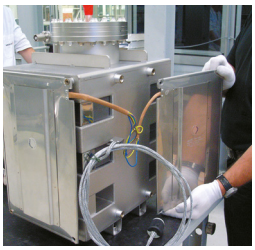


Compact design

- Lighter pump weight
- Fast magnets replacement
- Maintenance-free

Dedicated heaters

- Dedicated heaters
- Dedicated heater for every pump size
- The new heaters are designed to perform a more effective pump baking, which results in lower obtained pressure
- Lower power and operational costs

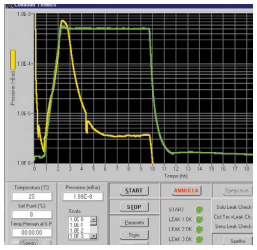


Dedicated power supplies

- 4UHV controller:
  special low noise electronics for better SEM imaging
- IPCMini controller: very low ripple noise for sensitive applications
- IPCU Controller: two supply channels with special low noise electronics for better SEM imaging, and optional display and front panel.

RGA-guaranteed ultimate vacuum

- The pump is vacuum processed at 450 °C to outgas the pump inner surfaces
- The pump is shipped under vacuum
- An RGA (residual gas analysis) spectrum is performed to guarantee pump specifications and cleanliness after the manufacturing process is complete.



Agilent feedthroughs and cables

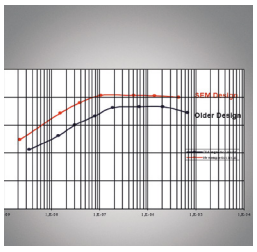
- The HV safety interlock prevents any chance of electrical shock
- The voltage is automatically cut off as soon as the cable is disconnected from the pump
- Safer pump operation

Particle Shield

- Minimized particle emission
- Minimum conductance reduction
- Total column protection
- Maximum E-gun life
- Secondary emission shield

VacIon 200 L/s: Higher pumping speed in UHV

- Optimized magnetic field for maximum performance in a compact package
- Faster pump down
- The new VacIon 200 has the maximum pumping speed peak in the low pressure region



UHV/XHV for research and development

Particle accelerators and synchrotron light sources

In these machines, electrically charged particles (electrons for the production of synchrotron light or ions for particle accelerators) are forced to follow a curved trajectory in a ring called a storage ring.
Charged particles circulate for hours in the storage ring, at constant energy.

Before their injection into the storage ring, the particles first have to be accelerated inside an injection system composed of one or two accelerators (the linac and the booster).

All along their path within the machine, the particles (electrons or ions) have to circulate inside a vacuum chamber. Otherwise, they would collide with the air molecules and would be absorbed very rapidly.

Linac

The linac is a linear accelerator. The charged particles enter into a first RF cavity, which accelerates them and at the same time groups them into bunches. They are then accelerated by a succession of RF cavities throughout the length of the linac. Vacuum within the linac can be created by Agilent VacIon Plus pumps from 20 L/s to 75 L/s.

Courtesy PSI SLS.

Booster

Charged particles that have already been accelerated in the linac, are accelerated with more energy by the booster. The acceleration is produced by RF cavities through which the charged particles pass many times, gaining in energy at each pass. Once the maximum level of energy has been reached, the beam of particles is transferred from the booster to the storage ring.
The vacuum in the booster is generally produced by ion pumps. Agilent VacIon Plus pumps fit this application perfectly.

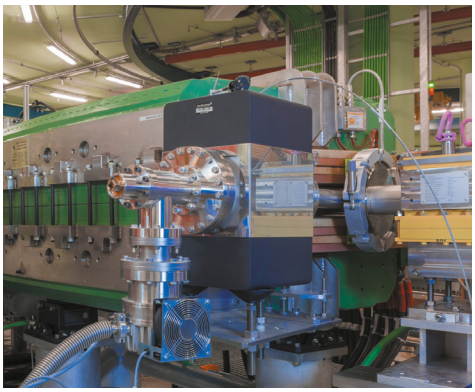
Storage ring

Charged particles circulate inside the storage ring at constant energy levels. All along the ring there are curved and straight sections. The storage ring is placed inside a tunnel with very thick concrete walls to contain emitted radiation in case of beam loss. Ultrahigh vacuum is an absolute necessity in this part of the machine since the particles travel through the storage ring for hours.
The less residual gas there is, the more focused the beam remains.
Large Agilent VacIon Plus pumps, in the 300 to 500 L/s range are used for this demanding application.

Courtesy LBNL Advanced Light Source.

Front ends

The front end is the pipe work which transports the particles under a vacuum from the extraction zone up to the beamline outside of the tunnel of the ring. The front end houses the beam shutter and other devices that allow isolation of the ring vacuum from the beamline vacuum, which often has lower pressure.

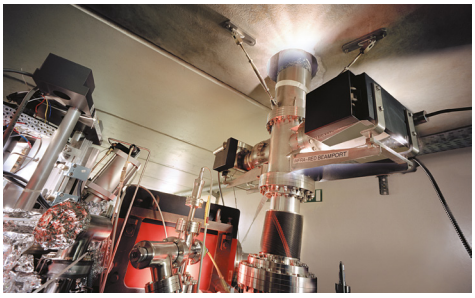


Courtesy MedAustron.

Beam lines

The experimental hall, around the storage ring, houses the beamlines built tangentially to the ring. The beamlines are usually specialized in a field of research (such as biology, polymers, and magnetism) or an experimental method (such as diffraction, extended X-Ray absorption fine structure (EXAFS), and imaging).

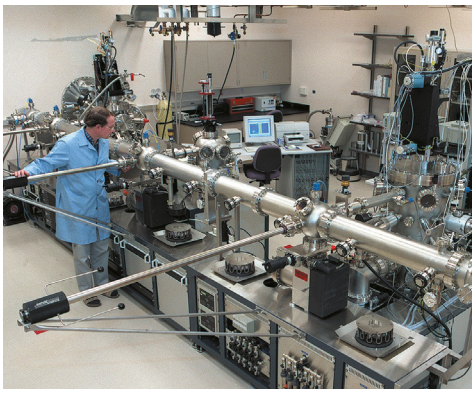
Some of the longest beamlines are built outside the experimental hall. Generally, large pumps are used in this part of the instrument, from 300 L/s to 500 L/s. They can be combined with a TSP and a cryopanel to increase pumping speed.



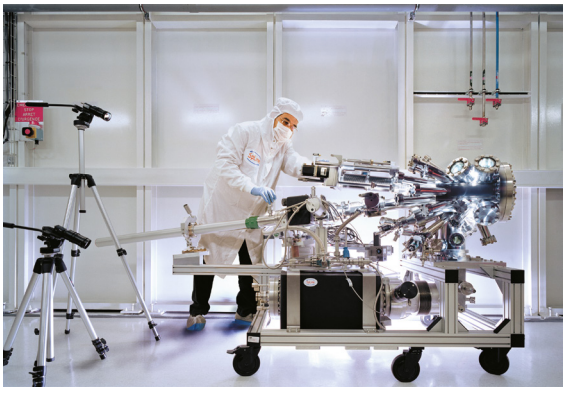
Courtesy Pacific Northwest National Laboratory.

Miscellaneous projects

Most fundamental research projects that use very sensitive equipment (necessitating ultrahigh vacuum with no mechanical vibration) will find the solution in Agilent VacIon Plus pumps. The new gravitational waves detectors (GWD), such as VIRGO in Italy and LIGO in the U.S., use Agilent pumps to produce and maintain the required vacuum.



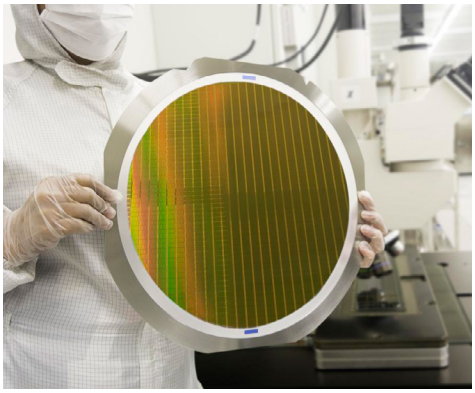
Courtesy P. Ginter - ESRF Grenoble.



Courtesy P. Ginter - ESRF Grenoble.

Mass spectrometry

- Analytical systems that use focused charged particle beams (CPB) and certain types of mass spectrometers, such as magnetic sector or Fourier Transfer often require ultrahigh vacuum.
- These applications have stringent performance requirements for sensitivity, resolution, sample throughput, and measurement repeatability.
  The requirements are driven by the need to analyze ever-smaller samples, especially in semiconductor, manufacturing, and other high-tech applications.
- In general, these applications require very clean vacuum pumping, and only VacIon pumps can certify the required level of cleanliness because Agilent is the only ion pump manufacturer that bakes each pump in a vacuum furnace, and supplies each pump with an RGA scan.
- Agilent offers a full range of pumps, from 0.2 L/s to 1000 L/s, as well as combination and custom pumps, so analytical system designers can meet all their vacuum requirements from one supplier.
- Over 65 years of ion pump experience makes Agilent uniquely qualified to supply customized solutions for special applications.



Semiconductor manufacturing

Nanotechnologies

- The Agilent line of high performance VacIon ion pumps are suited to the vacuum requirements of Transmission Electron Microscopes (TEM), Scanning Electron Microscopes (SEM), Focused Ion Beam (FIB) and surface analysis equipment.
- Agilent is the only manufacturer to offer SEM application and specific ion pumps, with a unique anode design.
- The Diode SEM pump, with its extremely low leakage current, is ideal for the gun section of the column.
- The StarCell pump element has a unique design that is the ideal solution for high pressure operation of the columns.
  StarCell is also the best pump for noble gases and hydrogen.
- Agilent completes its microscope manufacture offerings with a full line of controller/ power supplies, including low-cost power supplies and fully featured, multiple output controllers.
- With the addition of the Agilent's complete line of oil-free, low vibration turbo pumps, ideal for sample chamber vacuum requirements, roughing pumps, and vacuum gauges, Agilent can supply all the vacuum components required for electron microscopes.

Industrial vacuum processes

Several industrial processes, including the production and operation of medical, broadcasting, and defense equipment rely on VacIon pumps to produce ultra-high vacuum (UHV) pressure in challenging environments. The attributes that make VacIon pumps ideal for these applications include:

- Performance at ultra-high vacuum (UHV) pressure
- Low vibration
- High bake-out temperature
- High reliability
- High tolerance to radiation

Medical equipment that is used to treat cancer and other diseases requires ultra-high vacuum pressure in the accelerator: pressure only achievable with VacIon pumps.

The absence of moving parts means that VacIon pumps can be installed in the most sensitive mechanical equipment to produce ultra low pressure without creating mechanical vibration that could compromise the devices' performance.

Manufacturing of X-ray tubes for medical imaging requires the achievement of ultra-clean interior surfaces to ensure tube longevity. High bake-out temperatures (above 250 °C) are essential to accelerate the desorption of water and other contaminants from each tube's interior.

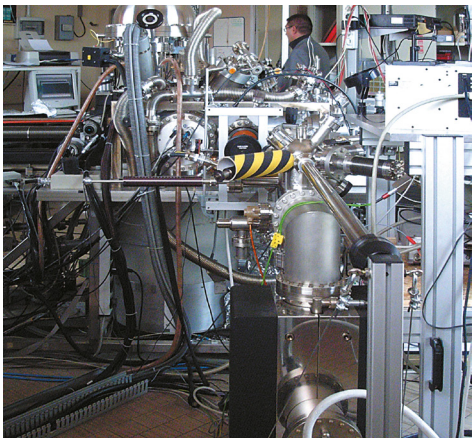
The VacIon pumps 450 °C bakeout temperature limit (magnets removed, 350 °C with magnets in place), makes them ideally suited for this application. Other vacuum pumps limited to lower bake-out temperature would slow down production and potentially compromise the x-ray tube's lifetime.

While semiconductors have replaced electron tubes in many applications due to size and efficiency, many high-power applications still make use of modified versions of the original Varian (now Agilent) Klystron tube.

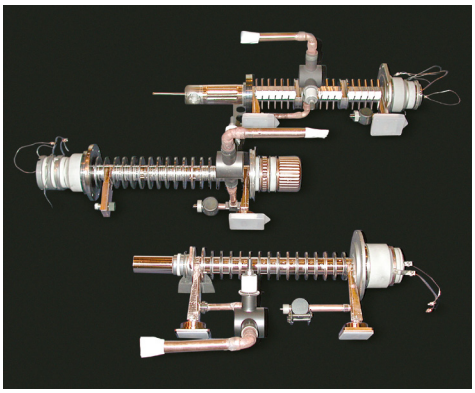
Microwave transmission and some radar applications still rely on high power electron tubes, and VacIon pumps are essential in their production. Free electron laser (FEL) devices, optical versions of the Klystron, also employ VacIon pumps in their manufacturing.

Small ion pumps from 2 to 10 L/s are particularly suited to the production cycle of these common types of electron devices but are also ideal for maintaining ultra-high vacuum in instruments during shipment.

They can be operated with battery power, and their low power consumption allows them to operate as "appendage" pumps: ensuring complex equipment arrives at a customer site still under vacuum, maintaining product integrity and speeding up installation.



Courtesy University of Modena.



Courtesy CPI.

Operating vacuum equipment in an environment subjected to radioactivity is challenging to say the least!

VacIon pumps' ability to operate effectively in this environment make them uniquely suited to this application

Radiation tolerant materials are also used in the manufacturing of Agilent connectors and cables to ensure reliability and longevity.

VacIon Pumps Models

	Miniature Pump	2 L/s Pump	10 L/s Pump	Vaclon Plus 20		
Inlet flange				DN 40 CF-F (2.75 in CFF)		
Element type	Diode	Diode and Noble Diode	Diode	StarCell	Noble Diode	Diode
Pumping speed (L/s) (saturated pump at 1 x 10^{-6} mbar) nitrogen	0.4	2	10	20	22	27
Operating life (h) (1 x 10^{-6} mbar)	N/A	8,000	40,000	80,000	50,000	50,000
Maximum starting pressure (mbar)	1 x 10^{-4}	1 x 10^{-4}	≤ 1 x 10^{-4}	≤ 5x10^{-2}	≤ 1x10^{-3}	≤ 1x10^{-3}
Maximum baking temperature without HV cable (°C)	400 (no magnet) 150 (with magnet)	400 (no magnet) 150 (with magnet)	350	350	350	350
Maximum baking temperature with HV cable (°C)	220	220	220	220	220	220
Weight kg (lb)	Net 0.3 (0.66) Shipping 0.6 (1.33)	Net 0.3 (0.66) Shipping 0.6 (1.33)	Without magnet 4 (9)	Net 7 (15) Shipping 11 (24)		
SEM version available: **Y** for all pumps that offer SEM versions; **N** for all pumps that do not offer SEM versions.	N	N	Y	Y		




	Vaclon Plus 40*			Vaclon Plus 55*			Vaclon Plus 75*		
Inlet flange	DN 40 CF-F (2.75 in CFF)			DN 63 CF-F (4.5 in CFF)			DN 100 CF-F (6 in CFF)		
Element type	StarCell	Noble Diode	Diode	StarCell	Noble Diode	Diode	StarCell	Noble Diode	Diode
Pumping speed (L/s) (saturated pump at 1 x 10^{-6} mbar) nitrogen	34	36	40	50	53	60	65	68	75
Operating life (h) (1 x 10^{-6} mbar)	80,000	50,000	50,000	80,000	50,000	50,000	80,000	50,000	50,000
Maximum starting pressure (mbar)	≤ 5x10^{-2}	≤ 1x10^{-3}	≤ 1x10^{-3}	≤ 5x10^{-2}	≤ 1x10^{-3}	≤ 1x10^{-3}	≤ 5x10^{-2}	≤ 1x10^{-3}	≤ 1x10^{-3}
Maximum baking temperature (°C)	350	350	350	350	350	350	350	350	350
Maximum baking temperature with HV cable (°C)	220	220	220	220	220	220	220	220	220
Weight kg (lb)	Net 17 (37) Shipping 21 (46)			Net 18 (39) Shipping 22 (48)			Net 19 (42) Shipping 23 (51)		
SEM version available: **Y** for all pumps that offer SEM versions; **N** for all pumps that do not offer SEM versions.	Y			Y			Y		
	*Version with particle shield available			*Version with particle shield available			*Version with particle shield available		



	Vaclon Plus 150*			Vaclon Plus 200			Vaclon Plus 300		
Inlet flange	DN 100 CF-F (6 in CFF)			DN 160 CF-F (8 in CFF)			DN 160 CF-F (8 in CFF)		
Element type	StarCell	Noble Diode	Diode	StarCell	Noble Diode	Diode	StarCell	Noble Diode	Diode
Pumping speed (L/s) (saturated pump at 1 x 10^{-6} mbar) nitrogen	125	135	150	180	185	200	240	260	300
Operating life (h) (1 x 10^{-6} mbar)	80,000	50,000	50,000	80,000	50,000	50,000	80,000	50,000	50,000
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	≤ $1x10^{-3}$	≤ $1x10^{-3}$	≤ $5x10^{-2}$	≤ $1x10^{-3}$	≤ $1x10^{-3}$	≤ $5x10^{-2}$	≤ $1x10^{-3}$	≤ $1x10^{-3}$
Maximum baking temperature without HV cable (°C)	350	350	350	350	350	350	350	350	350
Maximum baking temperature with HV cable (°C)	220	220	220	220	220	220	220	220	220
Weight kg (lb)	Net 43 (94) Shipping 53 (110)			Net 45 (99) Shipping 51 (112)			Net 69 (149) Shipping 94 (207)		
	*150 "slim body" available								

Vaclon Plus 150

Vaclon Plus 150 slim body

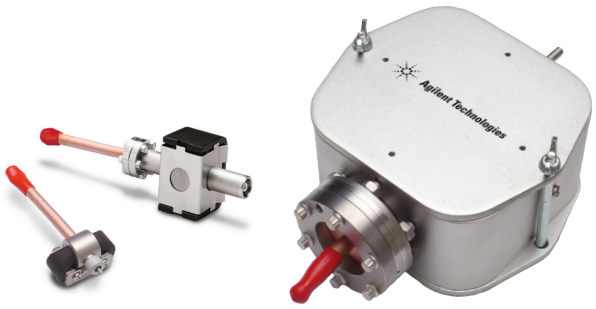
	Vaclon Plus 500			Vaclon Plus 800		Vaclon Plus 1000	
Inlet flange	DN 160 CF-F (8 in CFF)			DN 160 CF-F (8 in CFF)	DN 200 CF-F (10 in CFF)	DN 250 CF-F (12 in CFF)	
Element type	StarCell	Noble Diode	Diode	StarCell		StarCell	Diode
Pumping speed (L/s) (saturated pump at 1 x 10^{-6} mbar) nitrogen	410	440	500	685	910	800	1000
Operating life (h) (1 x 10^{-6} mbar)	80,000	50,000	50,000	80,000		80,000	50,000
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	≤ $1x10^{-3}$	≤ $1x10^{-3}$	≤ $5x10^{-2}$		≤ $5x10^{-2}$	≤ $1x10^{-3}$
Maximum baking temperature without HV cable (°C)	350	350	350	350	350	450 350	450 350
Maximum baking temperature with HV cable (°C)	220	220	220	220	220	220	220
Weight kg (lb)	Net 120 (264) Shipping 138 (204)			Net 198 (437) Shipping 213 (470)		Net 265 (585) Shipping 308 (679)	

Miniature and small VacIon pumps

Agilent offers a wide variety of small size ion pumps, designed for electron device and detector applications.

The Miniature VacIon pump is a diode configuration and provides approximately 0.2 L/s of nitrogen pumping speed. The 2 L/s model is a modified diode configuration to enhance starting at low pressure.
The 10 L/s pump is a noble gas optimized diode configuration with high efficiency for residual gases, such as hydrogen. The pumping speed for noble gases is about 20% of the nominal speed.

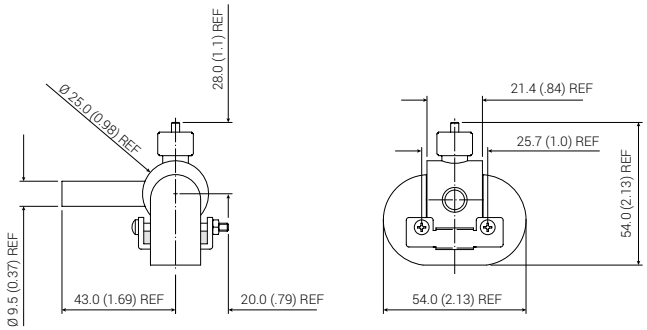
Pumps that are processed are baked to 400 °C and pinched off under vacuum, which allows the vacuum integrity to be verified by the user just before use. Non-processed pumps are tested to ensure they have no vacuum leaks and minimum leakage current.



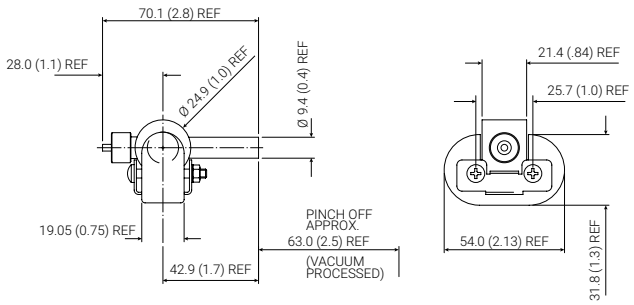
Modified and customized versions

Modified versions of standard pumps can be provided when different inlet tube lengths, angles, and diameters are required. These pumps can also be customized with different high voltage feedthroughs, body geometries, and pumping cell arrangements. Special testing procedures can be quoted for customers who have specific requirements in this area.

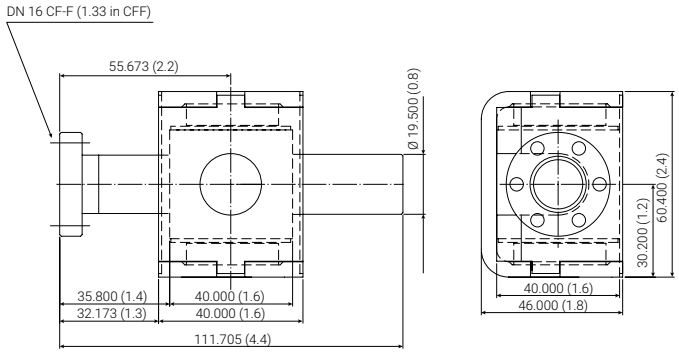
Miniature pump (90 deg. config.)



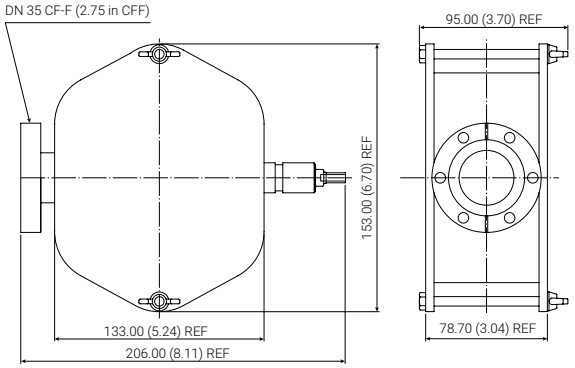
Miniature pump (180 deg. config.)



2 L/s pump



10 L/s pump



Dimensions: millimeters (inches)

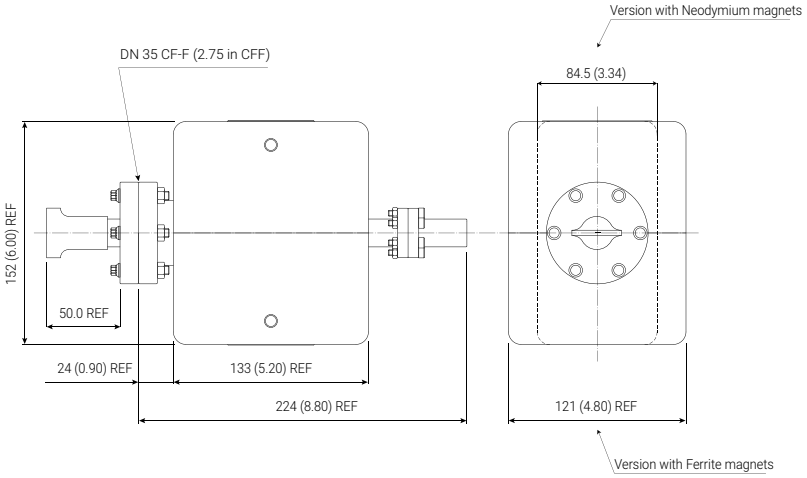
The miniature and 2 L/s pumps are available with copper or stainless steel inlet tubes in 90 or 180 degree configurations, relative to the high-voltage feedthrough.

Ordering Information

Description	Weight kg (lb)	Part number
Miniature pump		
With ⅜ inch od 180° stainless steel tube	0.5 (1.0)	9130038
With ⅜ inch od 90° stainless steel tube	0.5 (1.0)	9130041
With ⅜ inch od 180° copper tube, vacuum processed	0.5 (1.0)	9130049
With ⅜ inch od 90° copper tube, vacuum processed	0.5 (1.0)	9130050
Magnet for miniature pump	0.5 (1.0)	9130042
HV cable, 2.4 m (8 ft), Kings 10 kV (SHV) connector on controller side, for mini VacIon pumps	0.9 (2.0)	9240122
2 L/s pump		
With ¾ inch od 180° stainless steel tube	0.9 (2.0)	9190521
With ¾ inch od 180° copper tube, vacuum processed	0.9 (2.0)	9190522
With ¾ inch od 180° stainless steel tube, vacuum processed	0.9 (2.0)	9190523
With ¾ inch od 90° stainless steel tube, tee style	0.9 (2.0)	9190524
With DN 16 CF-F (1.33 in CFF) 180° vacuum processed	0.9 (2.0)	9190520
Magnet for 2 L/s pump	0.9 (2.0)	9190038
HV bakeable cable, radiation resistant, Kings (SHV), 4 m (13 ft) with interlock for 2 L/s pump	0.9 (2.0)	9290706
HV bakeable cable, radiation resistant, Fischer, 4 m (13 ft) with interlock for 2 L/s pump	0.9 (2.0)	9290705
10 L/s pump		
10 L/s VacIon pump, vacuum processed, with DN 40 CF-F (2.75 in CFF)	3.6 (8.0)	9195005
Magnet assembly for 10 L/s VacIon pump	5.0 (11.0)	9110030
HV cable, 3 m (10 ft), Kings 10 kV (SHV) connector on controller side, Varian diode feedthrough on pump side, bakeable, radiation resistant	0.9 (2.0)	9240741
HV bakeble Cable, 4 m (13 ft), Fischer connector on controller side, old Varian diode feedthrough on pump side, radiation resistant		9290712

Magnets must be ordered separately.
See Pages 68-69 for IPCMini controller, cables, and accessories.

VacIon Plus 20 pump



Dimensions: millimeters (inches)

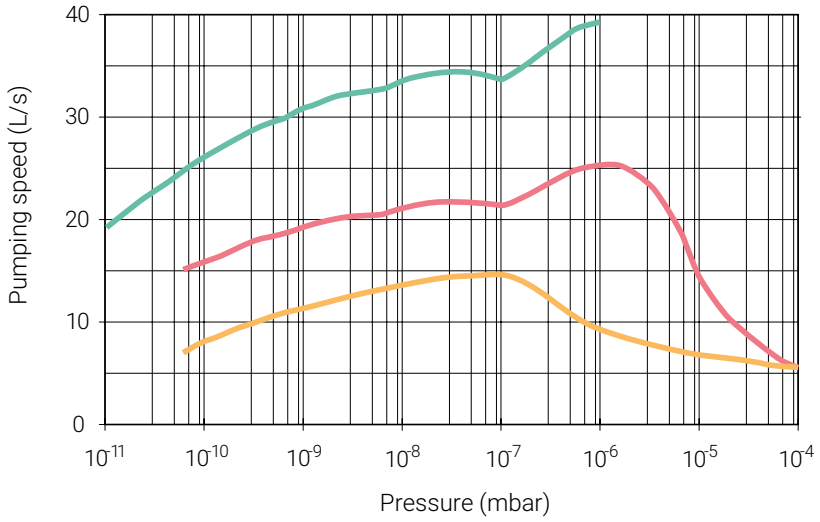
Technical Specifications

	StarCell	Noble Diode	Diode
Nominal pumping speed for nitrogen (*) (L/s)	20	22	27
Operating life at $1x10^{-6}$ mbar (hours)	80,000	50,000	50,000
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	≤ $1x10^{-3}$	≤ $1x10^{-3}$
Ultimate pressure (mbar)	Below 10^{-11}		
Rotatable Inlet flange	DN 40 CF-F (2.75 in CFF) AISI 304 ESR SST		
Maximum baking temperature (°C)	Pump without magnets 450 Pump with magnets 350 HV cable 220		
Weight, kg (lb) (with ferrite magnets)	Net: 5,4 (11,9), shipping 11 (24)		
Weight, kg (lb) (with Neodymium magnets)	Net: 4,7 (10,4), shipping 9 (19,9)		

(*) Tested according to ISO/DIS 3556-1-1992

SEM pump version and customized designs available.
Contact your local Agilent office for more details.

VacIon Plus 20 - Pumping speed vs pressure



Ordering Information

Description	Part number
Pumps	
Diode with Ferrite magnets	9191115
Diode without magnets	9191114
StarCell with Ferrite magnets	9191145
StarCell without magnets	9191144
StarCell with Neodymium magnets (slim body)	9191146M018
Noble Diode with Ferrite magnets	9191125
Noble Diode without magnets	9191124
Agilent offers these pumps with the SHV 10 kV (SAFECONN) feedthrough option. For further information, please contact Agilent or your local rep.	
4UHV controller*	
200 W neg	9299010
200 W pos	9299011
IPCMini controller*	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001

**Ion pump controllers (4UHV and IPCMini) are available in multiple configurations.*

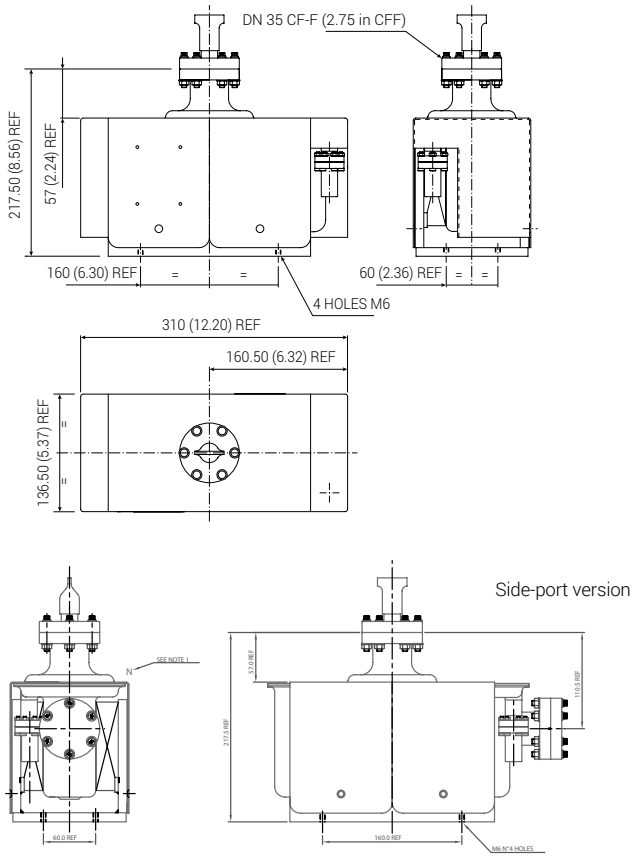
For a complete list of part numbers, see 4UHV and IPCMini controller sections on Pages 68-71.

Diode, Noble Diode	Positive
StarCell	Negative

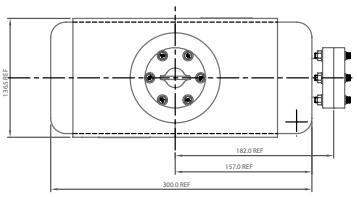
Negative or positive? See more on page 70.

Description	Part number
HV cables	
HV cable, 4 m (13 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290705
HV bakeable cable, 7 m (23 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290707
HV cable, 10 m (33 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290708
HV cable, 20 m (66 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290709
**For other cable lengths, contact Agilent or your local sales representative.*	
Replacement parts	
HV pump feedthrough, Fischer, with interlock	9595125
Magnet assembly, Ferrite, for VacIon Plus 20 Diode pump	9191001
Magnet assembly, Ferrite, for VacIon Plus 20 Noble Diode pump	9191002
Magnet assembly, Ferrite, for VacIon Plus 20 StarCell pump	9191004
VacIon Plus 20 Neodymium magnet assembly	9191006
Heaters*, 120 V, input power 140 W	9191110
Heaters*, 220 V, input power 140 W	9191111
** To order replacement heaters or upgrade existing pumps, contact your local Agilent Vacuum Products representative.*	

VacIon Plus 40 pump



SEM pump version, particle shield version,
and customized designs are available.
Contact your local Agilent office for more details.

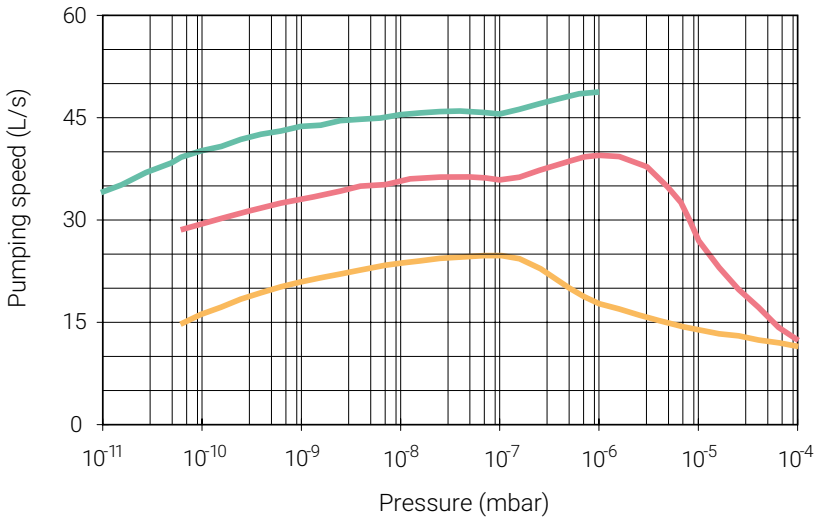


Dimensions: millimeters (inches)

Technical Specifications

	StarCell	Noble Diode	Diode
Nominal pumping speed for nitrogen (*) (L/s)	34	36	40
Operating life at $1x10^{-6}$ mbar (hours)	80,000	50,000	50,000
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	≤ $1x10^{-3}$	≤ $1x10^{-3}$
Ultimate pressure (mbar)	Below 10^{-11}		
Inlet flange	DN 40 CF-F (2.75 in CFF) AISI 304 ESR SST		
Maximum baking temperature (°C)	Pump without magnets 450 Pump with magnets 350 HV cable 220		
Weight, kg (lb)	Net 17 (37), Shipping 21 (46)		
(*) Tested according to ISO/DIS 3556-1-1992			

VacIon Plus 40 - Pumping speed vs pressure



Ordering Information

Description	Part number
Pumps	
Diode with Ferrite magnets	9191210
Diode with Ferrite magnets and DN 40 CF-F (2.75 in CFF) side-port*	9191213
Diode without magnets	9191214
StarCell with Ferrite magnets	9191240
StarCell with Ferrite magnets and DN 40 CF-F (2.75 in CFF) side-port*	9191243
StarCell without magnets	9191244
Noble Diode with Ferrite magnets	9191220
Noble Diode without magnets	9191224
Agilent offers these pumps with the SHV 10 kV (SAFECONN) feedthrough option. For further information, please contact Agilent or your local rep.	
4UHV controller**	
200 W neg	9299010
200 W pos	9299011
IPCMini controller**	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001

** Side port non rotatable.*

***Ion pump controllers (4UHV and ICPMini) are available in multiple configurations.*

For a complete list of part numbers, see 4UHV and IPCMini controllers' sections on Pages 68-71.

Description	Part number
HV cables	
HV cable, 4 m (13 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290705
HV cable, 7 m (23 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290707
HV cable, 10 m (33 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290708
HV cable, 20 m (66 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290709

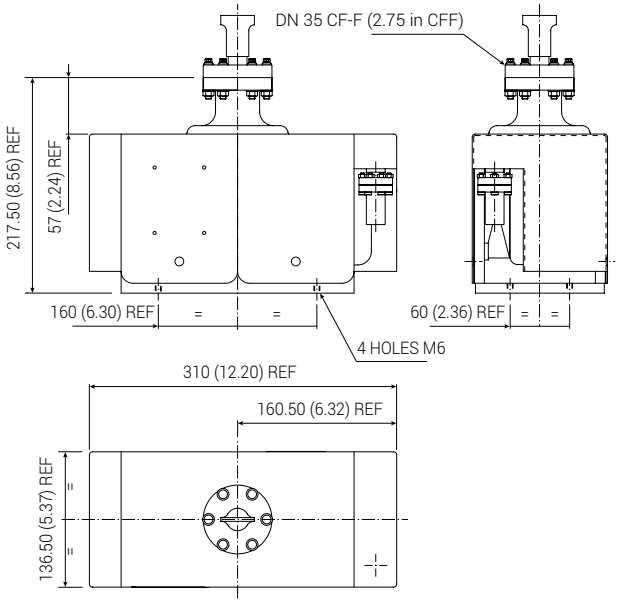
Replacement parts	
HV pump feedthrough, Fischer, with interlock	9595125
Heaters*, 120 V, input power 250 W	9190071
Heaters*, 220 V, input power 250 W	9190070

** To order replacement heaters or upgrade existing pumps, contact your local Agilent Vacuum Products representative.*

Diode, Noble Diode	Positive
StarCell,	Negative

Negative or positive? See more on page 70.

VacIon Plus 40 pump with particle shield



Dimensions: millimeters (inches)

The pump is provided with a shield that prevents particles emitted by the ion pump from escaping into the vacuum chamber, as well as blocking the emission of secondary particles.

The shield reduces the gas conductance and can therefore reduce the effective pumping speed. Agilent design is the best in terms of shield efficiency and pumping speed.

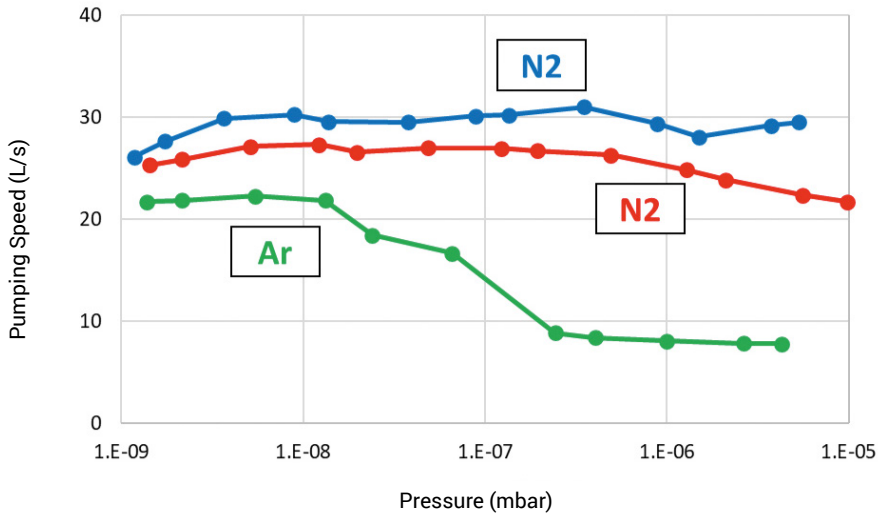
Two typical applications, among many others, are high-energy physics (HEP) particle accelerators and scanning electron microscopes (SEM) where UHV is required as well as absence of emission of charged particles from the pump into the chamber.

Technical Specifications

	StarCell	Diode
Nominal pumping speed for nitrogen (*) (L/s)	27	31
Operating life at $1x10^{-6}$ mbar (hours)	80,000	50,000
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	≤ $1x10^{-3}$
Ultimate pressure (mbar)	Below 10^{-11}	
Inlet flange	DN 40 CF-F (2.75 in CFF) AISI 304 ESR SST	
Maximum baking temperature (°C)	Pump without magnets 450 Pump with magnets 350 HV cable 220	
Weight, kg (lb)	17 (37)	
(*) Tested according to ISO/DIS 3556-1-1992		

VacIon Plus 40 with particle shield- Pumping speed vs pressure

VIP40 Diode with particle shield
VIP40 StarCell with particle shield
VIP40 StarCell with particle shield



Ordering Information

Description	Part number
Diode	9191210M012
StarCell	X3609-64200
Agilent offers these pumps with the SHV 10 kV (SAFECONN) feedthrough option. Please contact Agilent or your local rep.	
4UHV controller	
200 W neg	9299010
200 W pos	9299011
IPCMini controller	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001

For more information, please contact your Agilent representative or visit:
Ion Pumps & Controllers, Ultra & Extreme High Vacuum - UHV & XHV | Agilent

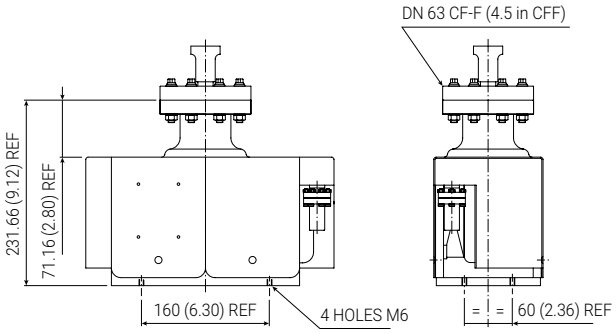
Description	Part number
HV cables	
HV cable, 4 m (13 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290705
HV cable, 7 m (23 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290707
HV cable, 10 m (33 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290708
HV cable, 20 m (66 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290709
Replacement parts	
HV pump feedthrough, Fischer, with interlock	9595125
Heaters*, 120 V, input power 250 W	9190071
Heaters*, 220 V, input power 250 W	9190070

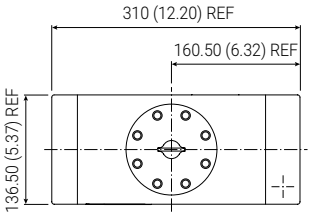
** To order replacement heaters or upgrade existing pumps, contact your local Agilent Vacuum Products representative.*

Diode, Noble Diode	Positive
StarCell	Negative

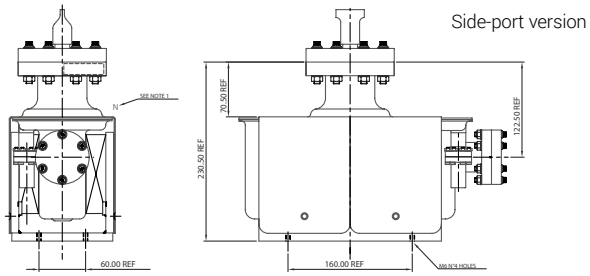
Negative or positive? See more on page 70.

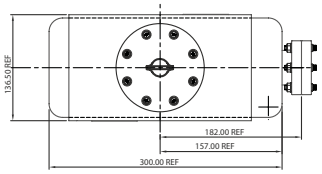
VacIon Plus 55 pump





Side-port version





Dimensions: millimeters (inches)

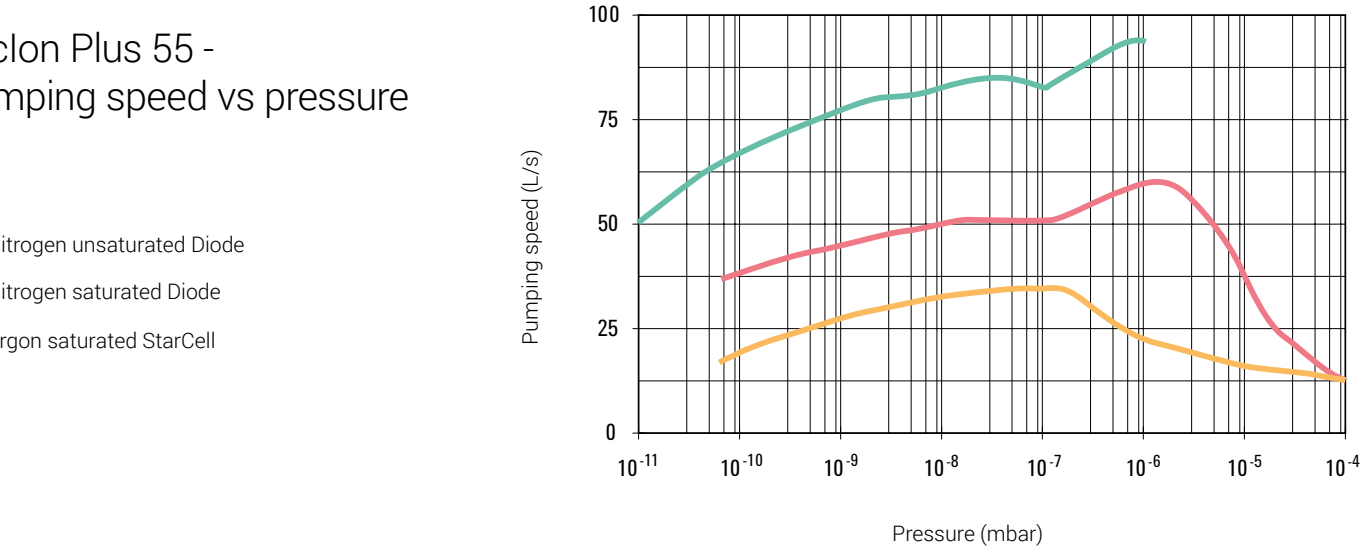
SEM pump version, particle shield version,
and customized designs are available.
Contact your local Agilent office for more details.

Technical Specifications

	StarCell	Noble Diode	Diode
Nominal pumping speed for nitrogen (*) (L/s)	50	53	60
Operating life at 1x10^{-6} mbar (hours)	80,000	50,000	50,000
Maximum starting pressure (mbar)	≤ 5x10^{-2}	≤ 1x10^{-3}	≤ 1x10^{-3}
Ultimate pressure (mbar)	Below 10^{-11}		
Inlet flange	DN 63 CF-F (4.5 in CFF) AISI 304 ESR SST		
Maximum baking temperature (°C)	Pump without magnets 450 Pump with magnets 350 HV cable 220		
Weight, kg (lb)	Net 18 (39), Shipping 22 (49)		

(*) Tested according to ISO/DIS 3556-1-1992

VacIon Plus 55 - Pumping speed vs pressure



Ordering Information

Description	Part number
Pumps	
Diode with Ferrite magnets	9191310
Diode with additional DN 40 CF-F (2.75 in CFF) port*	9191313
Diode without magnets	9191314
StarCell with ferrite magnets	9191340
StarCell with additional DN 40 CF-F (2.75 in CFF) port*	9191343
StarCell without magnets	9191344
Noble Diode with Ferrite magnets	9191320
Noble Diode without magnets	9191324
Agilent offers these pumps with the SHV 10 kV (SAFECONN) feedthrough option. Please contact Agilent or your local rep.	
4UHV controller**	
200 W neg	9299010
200 W pos	9299011
IPCMini controller**	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001

** Side port non rotatable.*

***Ion pump controllers (4UHV and ICPMini) are available in multiple configurations.*

For a complete list of part numbers, see 4UHV and IPCMini controllers' sections on Pages 68-71.

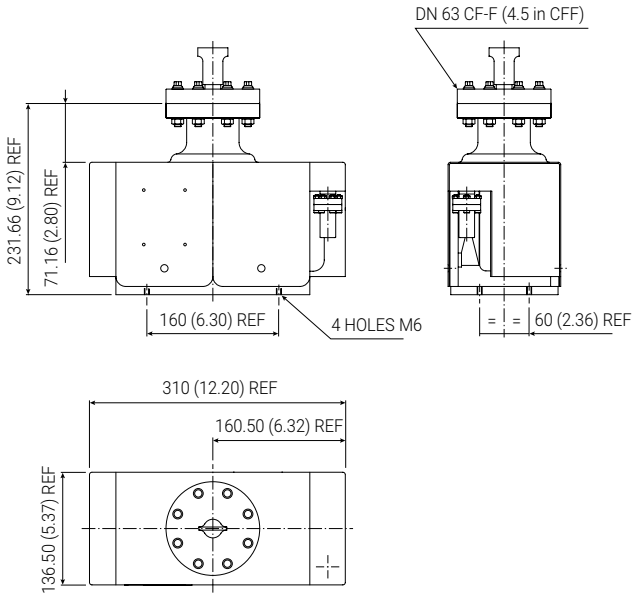
Description	Part number
HV cables	
HV cable, 4 m (13 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290705
HV cable, 7 m (23 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290707
HV cable, 10 m (33 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290708
HV cable, 20 m (66 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290709
Replacement parts	
HV pump feedthrough, Fischer, with interlock	9595125
Heaters*, 120 V, input power 250 W	9190071
Heaters*, 220 V, input power 250 W	9190070

** To order replacement heaters or upgrade existing pumps, contact your local Agilent Vacuum Products representative.*

Diode, Noble Diode	Positive
StarCell	Negative

Negative or positive? See more on page 70.

VacIon Plus 55 pump with particle shield



Dimensions: millimeters (inches)

The pump is provided with a shield that prevents particles emitted by the ion pump from escaping into the vacuum chamber, as well as blocking the emission of secondary particles.

The shield reduces the gas conductance and can therefore reduce the effective pumping speed. Agilent design is the best in terms of shield efficiency and pumping speed.

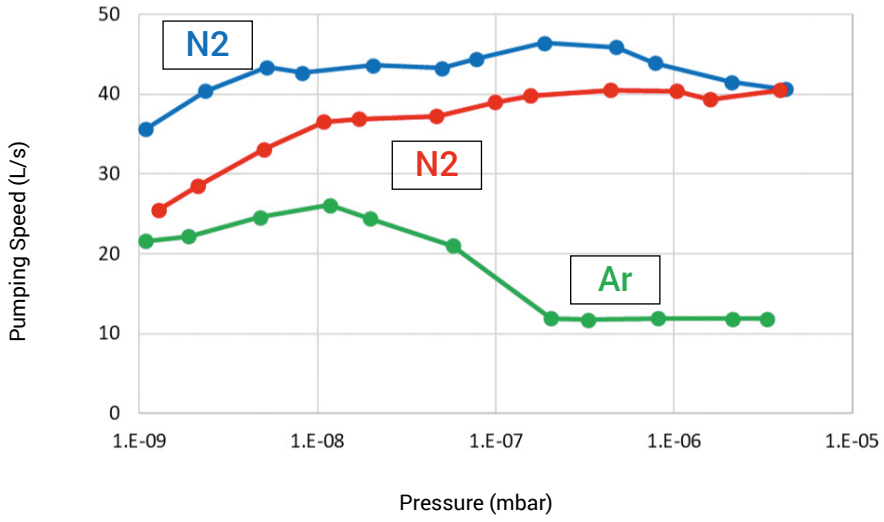
Two typical applications, among many others, are high-energy physics (HEP) particle accelerators and scanning electron microscopes (SEM) where UHV is required as well as absence of emission of charged particles from the pump into the chamber.

Technical Specifications

	StarCell	Diode
Nominal pumping speed for nitrogen (*) (L/s)	41	46
Operating life at $1x10^{-6}$ mbar (hours)	80,000	50,000
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	≤ $1x10^{-3}$
Ultimate pressure (mbar)	Below 10^{-11}	
Inlet flange	DN 63 CF-F (4.5 in CFF) AISI 304 ESR SST	
Maximum baking temperature (°C)	Pump without magnets 450 Pump with magnets 350 HV cable 220	
Weight, kg (lb)	18 (39)	
(*) Tested according to ISO/DIS 3556-1-1992		

VacIon Plus 55 with particle shield- Pumping speed vs pressure

VIP55 Diode with particle shield
VIP55 StarCell with particle shield
VIP55 StarCell with particle shield



Ordering Information

Description	Part number
Diode	9191310M012
StarCell	X3609-64200
Agilent offers these pumps with the SHV 10 kV (SAFECONN) feedthrough option. Please contact Agilent or your local rep.	
4UHV controller	
200 W neg	9299010
200 W pos	9299011
IPCMini controller	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001

For more information, please contact your Agilent representative or visit:
Ion Pumps & Controllers, Ultra & Extreme High Vacuum - UHV & XHV | Agilent

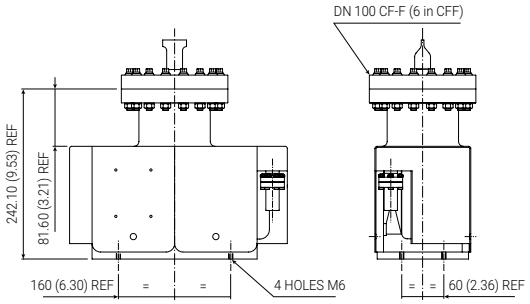
Description	Part number
HV cables	
HV cable, 4 m (13 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290705
HV cable, 7 m (23 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290707
HV cable, 10 m (33 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290708
HV cable, 20 m (66 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290709
Replacement parts	
HV pump feedthrough, Fischer, with interlock	9595125
Heaters*, 120 V, input power 250 W	9190071
Heaters*, 220 V, input power 250 W	9190070

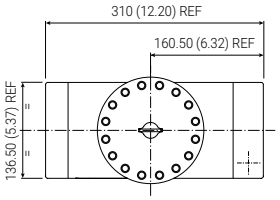
** To order replacement heaters or upgrade existing pumps, contact your local Agilent Vacuum Products representative.*

Diode, Noble Diode	Positive
StarCell	Negative

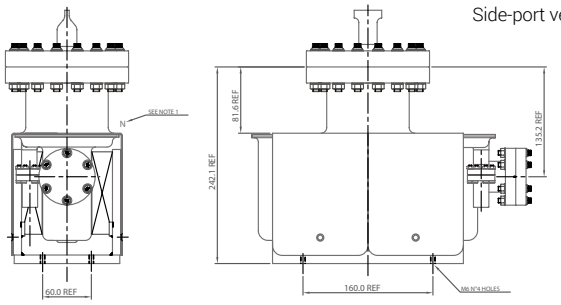
Negative or positive? See more on page 70.

VacIon Plus 75 pump

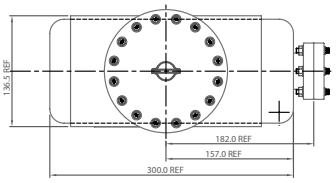




Side-port version



SEM pump version, particle shield version,
and customized designs are available.
Contact your local Agilent office for more details.

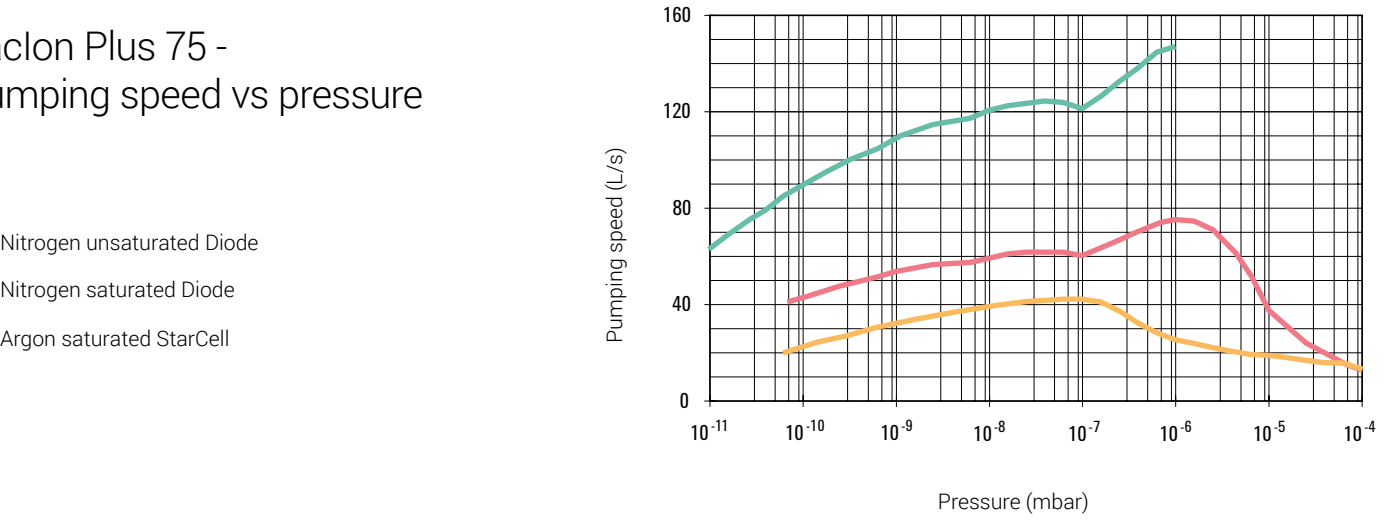


Dimensions: millimeters (inches)

Technical Specifications

	StarCell	Noble Diode	Diode
Nominal pumping speed for nitrogen (*) (L/s)	65	68	75
Operating life at $1x10^{-6}$ mbar (hours)	80,000	50,000	50,000
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	≤ $1x10^{-3}$	≤ $1x10^{-3}$
Ultimate pressure (mbar)	Below 10^{-11}		
Inlet flange	DN 100 CF-F (6 in CFF) AISI 304 ESR SST		
Maximum baking temperature (°C)	Pump without magnets 450 Pump with magnets 350 HV cable 220		
Weight, kg (lb)	Net 19 (42), Shipping 22.5 (49.6)		
(*) Tested according to ISO/DIS 3556-1-1992			

VacIon Plus 75 - Pumping speed vs pressure



Ordering Information

Description	Part number
Pumps	
Diode with Ferrite magnets	9191410
Diode with Ferrite magnets and DN 40 CF-F (2.75 in CFF) port*	9191413
Diode without magnets	9191414
StarCell with Ferrite magnets	9191440
StarCell with Ferrite magnets and DN 40 CF-F (2.75 in CFF) port*	9191443
StarCell without magnets	9191444
Noble Diode with Ferrite magnets	9191420
Noble Diode without magnets	9191424
Agilent offers these pumps with the SHV 10 kV (SAFECONN) feedthrough option. Please contact Agilent or your local rep.	
4UHV controller**	
200 W neg	9299010
200 W pos	9299011
IPCMini controller**	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001
IPCMini, 100/240 V Fischer HV, pos	X3602-64001

** Side port non rotatable.*

***Ion pump controllers (4UHV and ICPMini) are available in multiple configurations.*

For a complete list of part numbers, see 4UHV and IPCMini controllers' sections on Pages 68-71.

Description	Part number
HV cables	
HV cable, 4 m (13 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290705
HV cable, 7 m (23 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290707
HV cable, 10 m (33 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290708
HV cable, 20 m (66 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290709

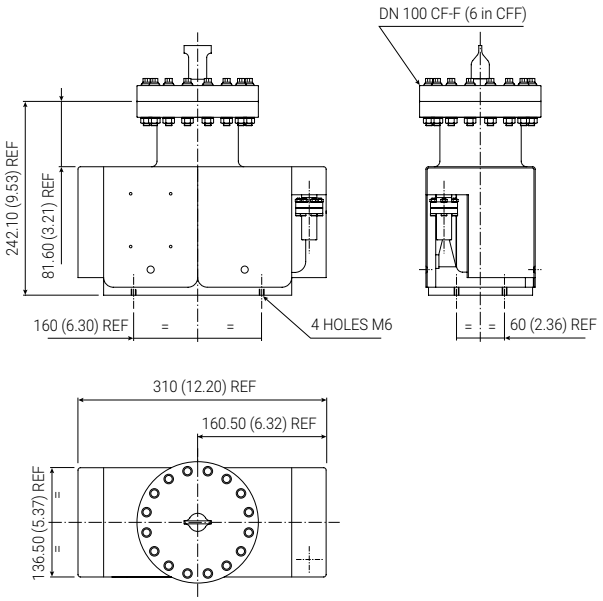
Replacement parts	
HV feedthrough with interlock	9595125
Heaters*, 120 V, input power 250 W	9190071
Heaters*, 220 V, input Power 250 W	9190070

** To order replacement heaters or upgrade existing pumps, contact your local Agilent Vacuum Products representative.*

Diode, Noble Diode	Positive
StarCell	Negative

Negative or positive? See more on page 70.

VacIon Plus 75 pump with particle shield



Dimensions: millimeters (inches)

The pump is provided with a shield that prevents particles emitted by the ion pump from escaping into the vacuum chamber, as well as blocking the emission of secondary particles.

The shield reduces the gas conductance and can therefore reduce the effective pumping speed. Agilent design is the best in terms of shield efficiency and pumping speed.

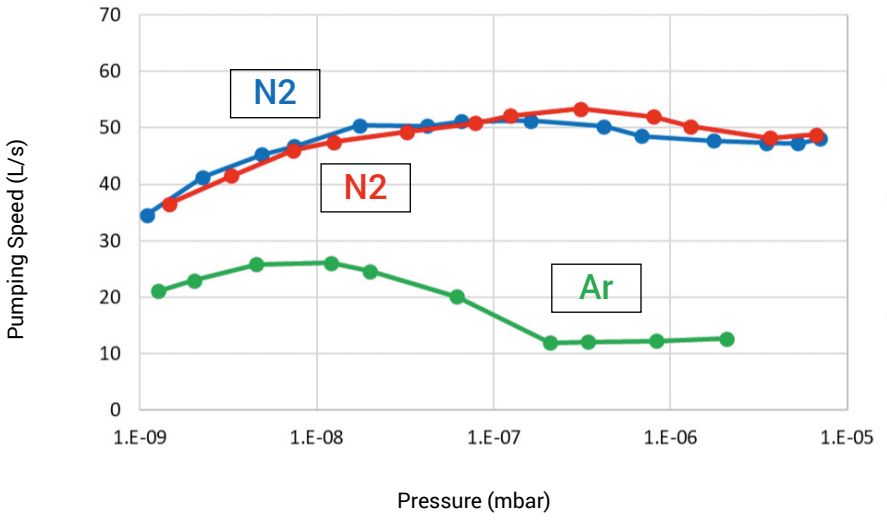
Two typical applications, among many others, are high-energy physics (HEP) particle accelerators and scanning electron microscopes (SEM) where UHV is required as well as absence of emission of charged particles from the pump into the chamber.

Technical Specifications

	StarCell	Diode
Nominal pumping speed for nitrogen (*) (L/s)	53	51
Operating life at $1x10^{-6}$ mbar (hours)	80,000	50,000
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	≤ $1x10^{-3}$
Ultimate pressure (mbar)	Below 10^{-11}	
Inlet flange	DN 100 CF-F (6 in CFF) AISI 304 ESR SST	
Maximum baking temperature (°C)	Pump without magnets 450 Pump with magnets 350 HV cable 220	
Weight, kg (lb)	19 (42)	
(*) Tested according to ISO/DIS 3556-1-1992		

VacIon Plus 75 with particle shield - Pumping speed vs pressure

VIP75 Diode with particle shield
VIP75 StarCell with particle shield
VIP75 StarCell with particle shield



Ordering Information

Description	Part number
Diode	9191410M012
StarCell	X3609-64200
Agilent offers these pumps with the SHV 10 kV (SAFECONN) feedthrough option. Please contact Agilent or your local rep.	
4UHV controller	
200 W neg	9299010
200 W pos	9299011
IPCMini controller	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001

For more information, please contact your Agilent representative or visit:
Ion Pumps & Controllers, Ultra & Extreme High Vacuum - UHV & XHV | Agilent

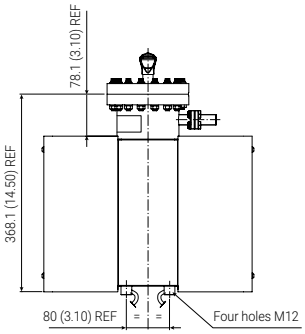
Description	Part number
HV cables	
HV cable, 4 m (13 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290705
HV cable, 7 m (23 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290707
HV cable, 10 m (33 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290708
HV cable, 20 m (66 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290709
Replacement parts	
HV pump feedthrough, Fischer, with interlock	9595125
Heaters*, 120 V, input power 250 W	9190071
Heaters*, 220 V, input power 250 W	9190070

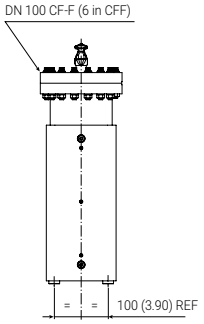
** To order replacement heaters or upgrade existing pumps, contact your local Agilent Vacuum Products representative.*

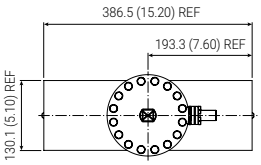
Diode, Noble Diode	Positive
StarCell	Negative

Negative or positive? See more on page 70.

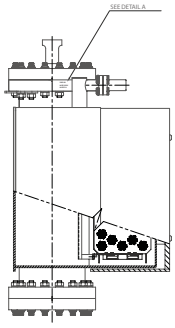
VacIon Plus 150 pump

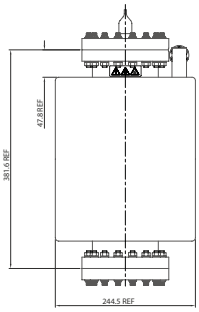


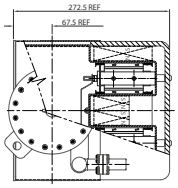




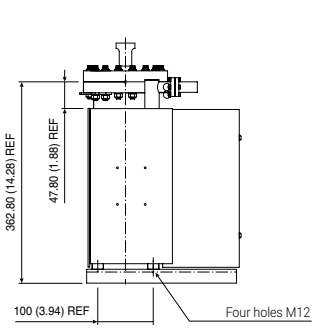
VacIon Plus 150 Slim Body

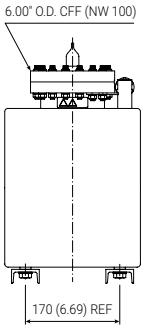


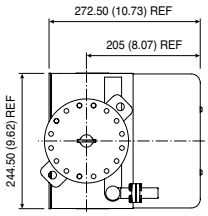




VacIon Plus 150 Double Ended







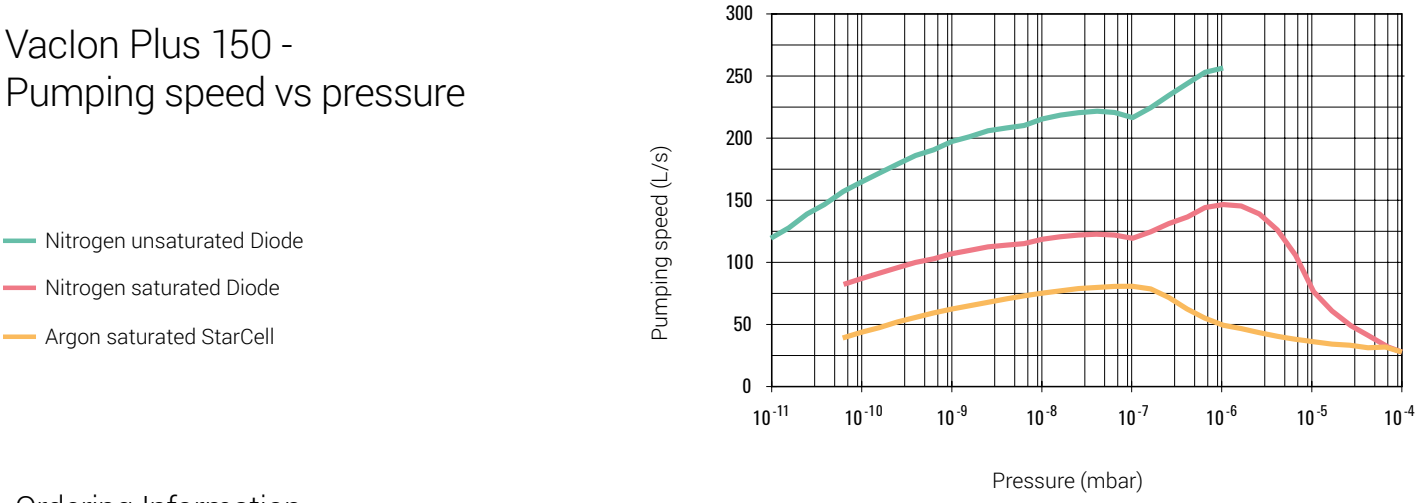
VacIon Plus 150

Dimensions: millimeters (inches)

Technical Specifications

	StarCell	Noble Diode	Diode
Nominal pumping speed for nitrogen (*) (v)	125	135	150
Operating life at $1x10^{-6}$ mbar (h)	80,000	50,000	50,000
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	≤ $1x10^{-3}$	≤ $1x10^{-3}$
Ultimate pressure (mbar)	Below 10^{-11}		
Inlet flange	DN 100 CF-F (6 in CFF) AISI 304 ESR		
Maximum baking temperature (°C)	Pump without magnets 450 Pump with magnets 350 HV cable 220		
Weight, kg (lb)	43 (94)		
Internal volume (L)	12.1		
(*) Tested according to ISO/DIS 3556-1-1992			
Customized designs available on request			

VacIon Plus 150 - Pumping speed vs pressure



Ordering Information

Description	Part number
Pumps	
Diode	9191510
Diode, with 120 V heaters installed	9191511
Diode, with 220 V heaters installed	9191512
Diode, double-ended	9191550
Diode, double-ended with 120 V heaters installed	9191551
Diode, double-ended with 220 V heaters installed	9191552
StarCell	9191540
StarCell, with 120 V heaters installed	9191541
StarCell, with 220 V heaters installed	9191542
StarCell, double-ended	9191580
StarCell, double-ended with 120 V heaters installed	9191581
StarCell, double-ended with 220 V heaters installed	9191582
Diode, "slim body"	9191510M004
Diode, "slim body" with 120 V heaters installed	9191511M003
Diode, "slim body" with 220 V heaters installed	9191512M008
StarCell, "slim body"	9191540M012
StarCell, "slim body" with 120 V heaters installed	9191541M003
StarCell, "slim body" with 220 V heaters installed	9191542M010
Noble Diode	9191520
Noble Diode, double-ended	9191560
Noble Diode, double-ended with 120 V heaters installed	9191561
Noble Diode, double-ended with 220 V heaters installed	9191562
Agilent offers these pumps with the SHV 10 kV (SAFECONN) feedthrough option. Please contact Agilent or your local rep.	
4UHV controller* **	
200 W neg	9299010
200 W pos	9299011
IPCMini controller* **	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001

Description	Part number
HV cables	
HV cable, 4 m (13 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290705
HV cable, 7 m (23 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290707
HV cable, 10 m (33 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290708
HV cable, 20 m (66 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290709
Replacement parts	
HV feedthrough with interlock	9595125
Pumping element* for Diode	9199040
Pumping element* for Noble Diode	9199045
Pumping element* for StarCell	9199030
Heaters**, 120 V, input power 480 W	9190073
Heaters**, 220 V, input power 480 W	9190072
Heaters for Slim versions cannot be sold separately	

** Quantity required: 2.*
*** To order replacement heaters or upgrade existing pumps, please contact your local Agilent Vacuum Products representative.*

****Ion pump controllers (4UHV and ICPMini) are available in multiple configurations.*

For a complete list of part numbers, see 4UHV and IPCMini controllers sections on Pages 68-71.

Diode, Noble Diode	Positive
StarCell	Negative

Negative or positive? See more on page 70.

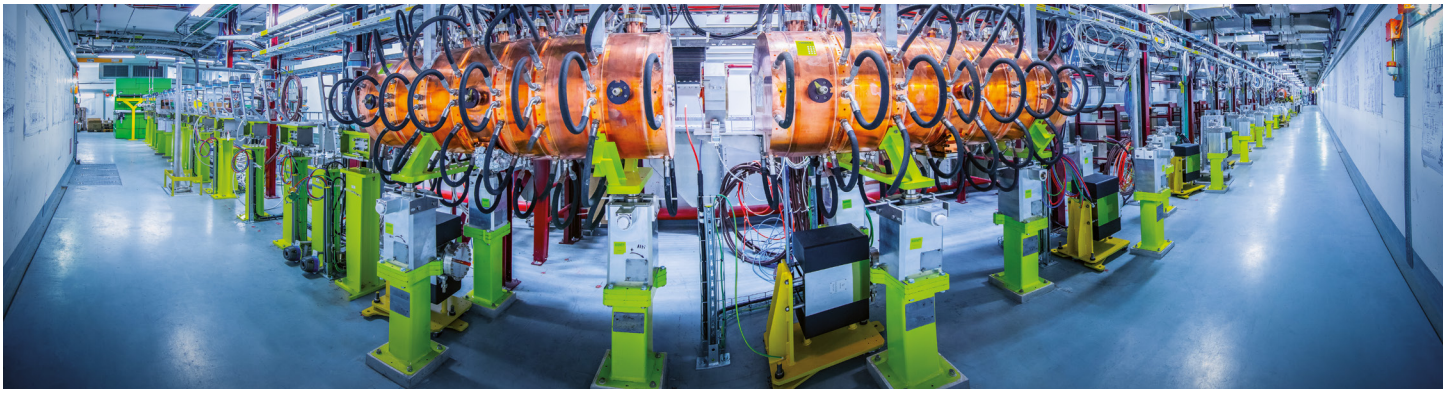


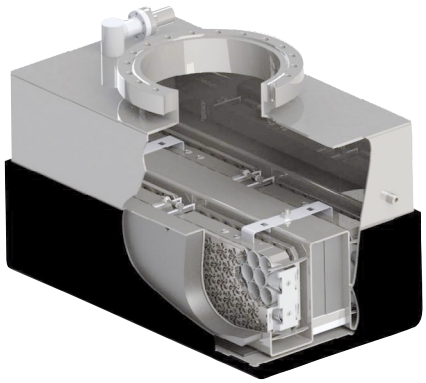
Image courtesy of CERN

VacIon Plus 200 pump

The first ion pump with maximum pumping speed at low pressure

Extreme high vacuum performance

- Maximum pumping speed at low pressure (10^{-8} mbar range)
- Best in class pumping speed for nitrogen and argon
- Factory processed at high temperature in ultraclean vacuum to reduce outgassing
- New Diode and Noble Diode element design (more cells versus volume)
- StarCell element: superior performance and stability for Noble gases.
- Optimized magnetic field distribution gives higher pumping speed



VacIon Plus 200 is the ideal pump for XHV (extreme high vacuum) and UHV (ultra high vacuum) applications

- Research centers
- Universities and laboratories
- Particle accelerators
- Beamlines

Versatile and compact design

- The smallest size in its category
- Wide range of configurations available, including sideport and different HV feedthroughs
- New heater design allows for high thermal efficiency and easy installation
- Pumping elements are fully replaceable

Agilent quality

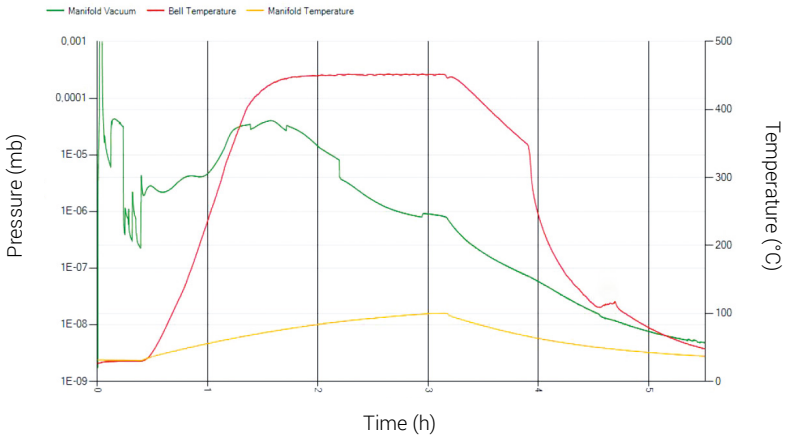
- Recognized technology and market leadership from the ion pump inventor: *"All innovations introduced by Agilent in ion pump technology have become the standard in the industry".*
- Ion pump manufacturing line has been completely renovated, doubling the production capacity.
- Durable reliability and performance guaranteed by severe test methodology (Agilent Product Life Cycle)

Innovative vacuum treatment

Standard outgassing process at high temperature (450 °C) in UHV oven

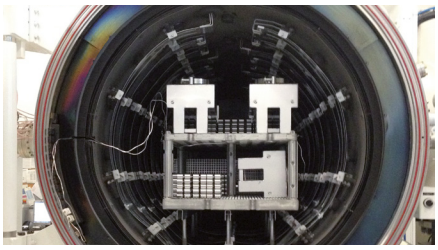
As a result of Agilent's standard outgassing process, less time is required to reach base pressure compared to standard Ion pumps (up to 40% faster).

Outgassing process cycle - VacIon Plus 200 pump



Vacuum firing process

The vacuum firing process shown in the chart above, is applied to all surfaces exposed to the vacuum. It effectively reduces the hydrogen outgassing rate and allows faster pumpdown to ultimate pressure.



Vacuum firing results

In the design of a large vacuum system, stainless steel is the most common material selected for vacuum chambers, because it can routinely achieve an outgassing rate of 10^{-12} mbar L/s (cm^2) for hydrogen after a 24 hour bakeout at 300 °C. Much lower outgassing rates have been measured for vacuum fired stainless steel, in the range of 10^{-15} mbar L/s (cm^2).

Vaclon Plus 200: optimized magnetic field

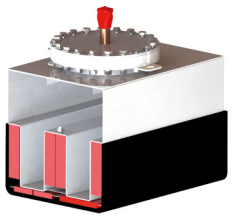
Thanks to the optimized magnetic field distribution and element design, the VIP 200 is the most compact pump in its category.

The VIP 200 achieves peak pumping speed in the 10^{-8} mbar range, the normal operating range for ion pumps, while conventional ion pumps peak at higher pressure (10^{-6} mbar).

Best pumping speed at 10^{-8} mbar range

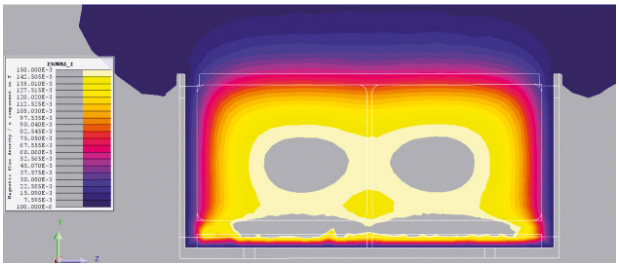
The increased magnetic field (16 magnets for Diode/Noble Diode, 20 magnets for StarCell) offers:

- Uniformity of the field inside the pump pocket is greatly enhanced
- Improved magnetic field inside the pump without impact to stray magnetic field
- Increased pumping speed

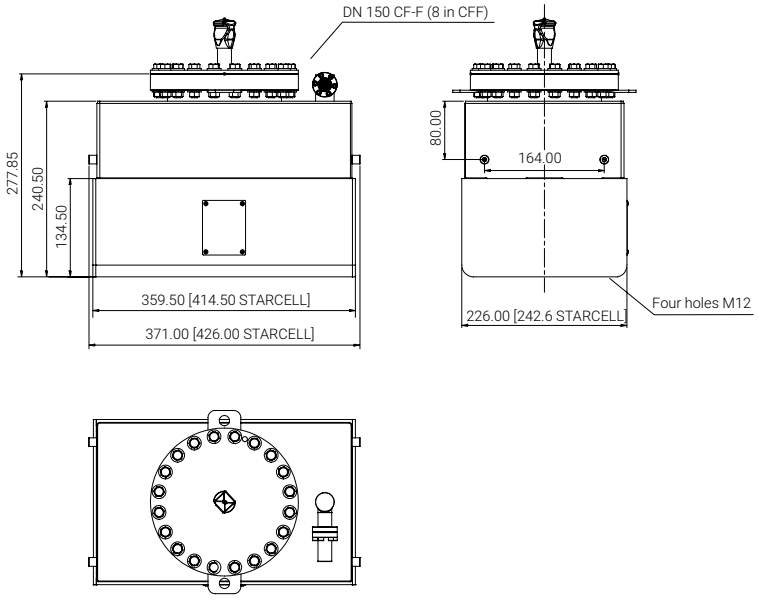


Isovalue curves show the values of the magnetic field in the direction of the cell axis inside the element housing.

- Dark blue: Low magnetic field values
- Yellow: High magnetic field values
- Gray in the center and bottom of the pocket: Above 1500 G.
- Gray area outside:
  Below the minimum measurement of the scale



VacIon Plus 200 pump



Dimensions: millimeters (inches)

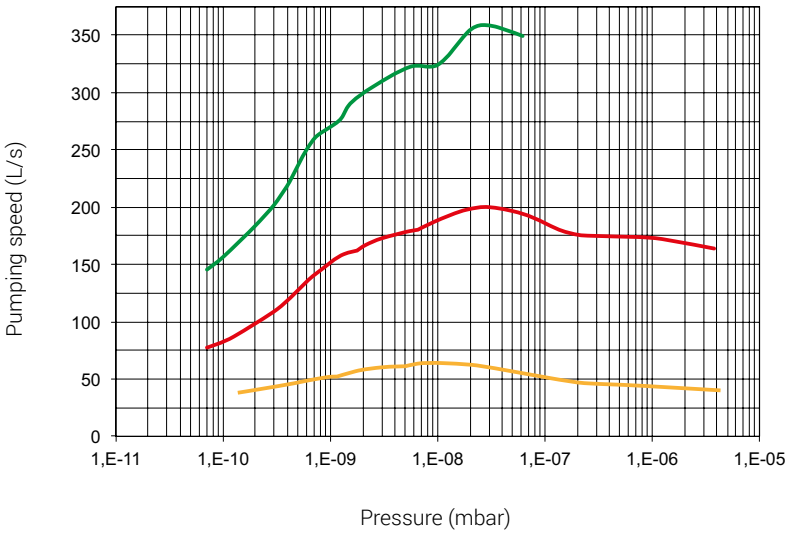
Technical Specifications

	StarCell	Noble Diode	Diode
Nominal pumping speed for nitrogen (*) (L/s)	180	185	200
Nominal pumping speed for argon (*) (L/s)	63	60	
Operating life at $1x10^{-6}$ mbar of nitrogen (h)	80,000	50,000	50,000
Protect current	50 mA	50 mA	50 mA
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	≤ $1x10^{-3}$	≤ $1x10^{-3}$
Ultimate pressure (mbar)	10^{-11}	10^{-11}	10^{-11}
Inlet flange	DN 160 CF-F (8 in CFF) AISI 304 ESR		
Internal volume (L)	14	12.2	12.2
Maximum Baking temperature (°C)	Pump without magnets 450 Pump with magnets 350 HV cable 220		
Weight without heaters, kg (lb)	Net 51 (112), Shipping 59 (130)	Net 45 (99); shipping 53 (117)	Net 45 (99); shipping 53 (117)

(*) Tested according to ISO/DIS 3556-1-1992

VacIon Plus 200 - Pumping speed vs pressure

- Nitrogen unsaturated Diode
- Nitrogen saturated Diode
- Argon saturated StarCell



Ordering Information

Description	Part number
Pumps	
Diode	X3601-64000
Diode, with 120 V heaters installed	X3601-64002
Diode, with 220 V heaters installed	X3601-64004
Diode, with side port DN 40 CF-F (2.75 in CFF)	X3601-64001
Diode, with side port DN 40 CF-F (2.75 in CFF), 120 V heaters installed	X3601-64003
Diode, with side port DN 40 CF-F (2.75 in CFF), 220 V heaters installed	X3601-64005
StarCell	X3601-64040
StarCell, with 120 V heaters installed	X3601-64042
StarCell, with 220 V heaters installed	X3601-64044
StarCell with side port DN 40 CF-F (2.75 in CFF)	X3601-64041
StarCell, with side port DN 40 CF-F (2.75 in CFF), 120 V heaters installed	X3601-64043
StarCell, with side port DN 40 CF-F (2.75 in CFF) and 220 V heaters	X3601-64045
Agilent offers these pumps with the SHV 10kV (SAFECONN) feedthrough option. Please contact Agilent or your local rep.	
4UHV Controller*	
200 W neg	9299010
200 W pos	9299011
IPCMini Controller*	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001

Ion pump controllers (4UHV and ICPMini) are available in multiple configurations.

For a complete list of part numbers, please see 4UHV and IPCMini controllers sections: on Pages 68-71.

Diode, Noble Diode	Positive
StarCell	Negative

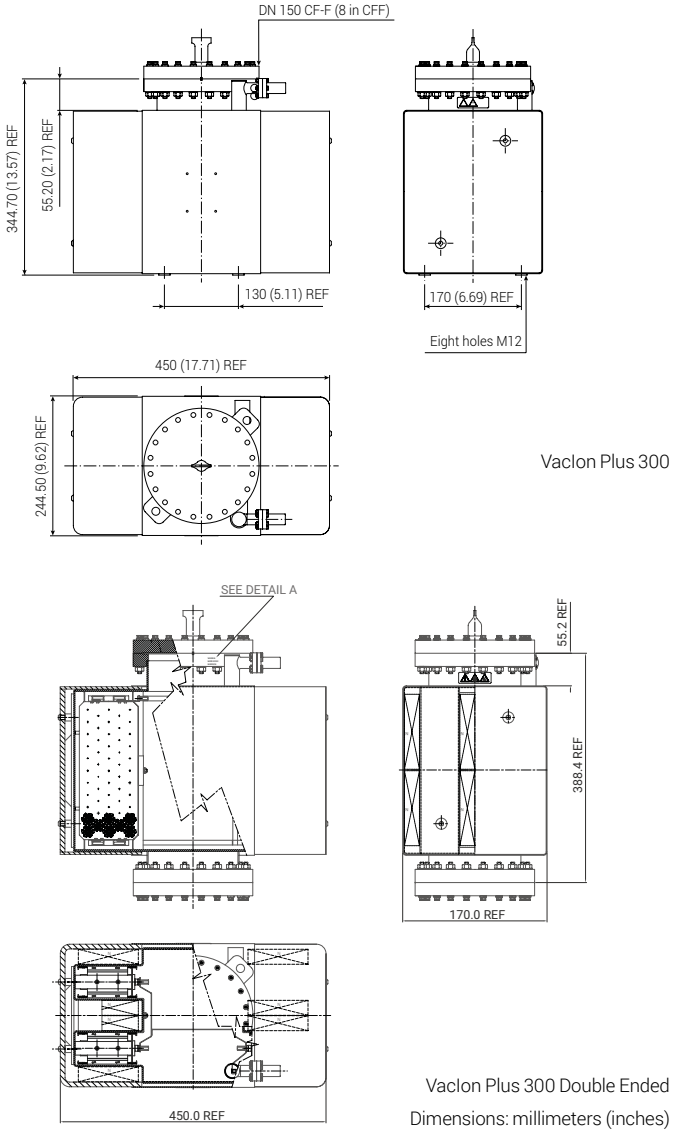
Negative or positive? See more on page 70.

Description	Part number
HV cables	
HV cable, 4 m (13 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290705
HV cable, 7 m (23 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290707
HV cable, 10 m (33 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290708
HV cable, 20 m (66 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290709
Replacement parts	
HV pump feedthrough, Fischer, with interlock	9595125
Heaters, 120 V (2/pk), Diode	X3601-68003
Heaters, 220 V (2/pk), Diode	X3601-68004
Heaters, 120 V, for side port version (2/pk), Diode	X3601-68007
Heaters, 220 V, for side port version (2/pk), Diode	X3601-68008
Heaters, 120 V (2/pk), StarCell	X3601-68005
Heaters, 220 V (2/pk), StarCell	X3601-68006
Heaters, 120 V, for side port version (2/pk), StarCell	X3601-68009
Heaters, 220 V, for side port version (2/pk), StarCell	X3601-68010

** To order replacement heaters or upgrade existing pumps, please contact your local Agilent Vacuum Products representative.*

VacIon Plus 300 pump

Customized designs available on request:
contact your local Agilent office for more details.



VacIon Plus 300

VacIon Plus 300 Double Ended

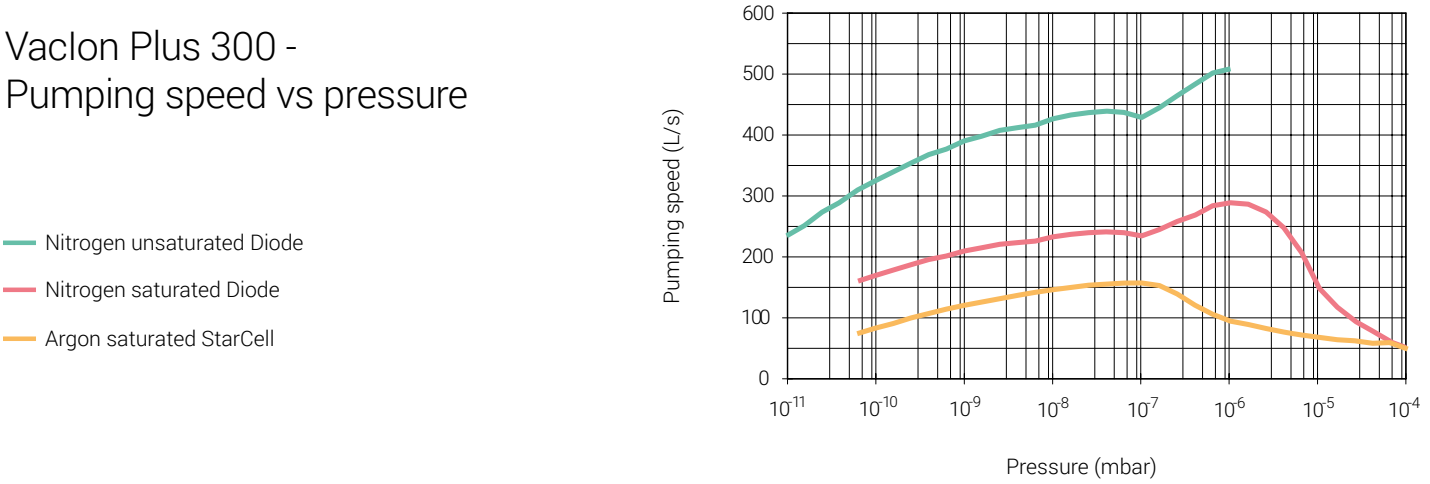
Dimensions: millimeters (inches)

Technical Specifications

	StarCell	Noble Diode	Diode
Nominal pumping speed for nitrogen * (L/s)	240	260	300
Operating life at $1x10^{-6}$ mbar (h)	80,000	50,000	50,000
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	≤ $1x10^{-3}$	≤ $1x10^{-3}$
Ultimate pressure (mbar)	Below 10^{-11}		
Inlet flange	DN 160 CF-F (8 in CFF) AISI 304 ESR		
Maximum baking temperature (°C)	Pump without magnets 450 Pump with magnets 350 HV cable 220		
Weight, kg (lb)	Net 69 (149); Shipping 94 (207)		
Internal volume (L)	18.6		

(*) Tested according to ISO/DIS 3556-1-1992

VacIon Plus 300 - Pumping speed vs pressure



Ordering Information

Description	Part number
Pumps	
Diode	9191610
Diode, with 120 V heaters installed	9191611
Diode, with 220 V heaters installed	9191612
Diode, double-ended	9191650
Diode, double-ended with 120 V heaters installed	9191651
Diode, double-ended with 220 V heaters installed	9191652
StarCell	9191640
StarCell, with 120 V heaters installed	9191641
StarCell, with 220 V heaters installed	9191642
StarCell, double-ended	9191680
StarCell, double-ended with 120 V heaters installed	9191681
StarCell, double-ended with 220 V heaters installed	9191682
Noble Diode	9191620
Noble Diode, with 120 V heaters installed	9191621
Noble Diode, with 220 V heaters installed	9191622
Noble Diode, double-ended	9191660

Agilent offers these pumps with the SHV 10 kV (SAFECONN) feedthrough option. Please contact Agilent or your local rep.

4UHV controller*	
200 W neg	9299010
200 W pos	9299011
IPCMini controller*	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001

**Ion pump controllers (4UHV and ICPMini) are available in multiple configurations.*

For a complete list of part numbers, please see 4UHV and IPCMini controllers sections: on Pages 68-71.

Description	Part number
HV cables	
HV cable, 4 m (13 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290705
HV cable, 7 m (23 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290707
HV cable, 10 m (33 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290708
HV cable, 20 m (66 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290709
Replacement parts	
HV pump feedthrough, Fischer, with interlock	9595125
Pumping element* Diode	9199040
Pumping element* Noble Diode	9199045
Pumping element* StarCell	9199030
Heaters**, 120 V, input power 580 W	9190075
Heaters**, 220 V, input power 580 W	9190074

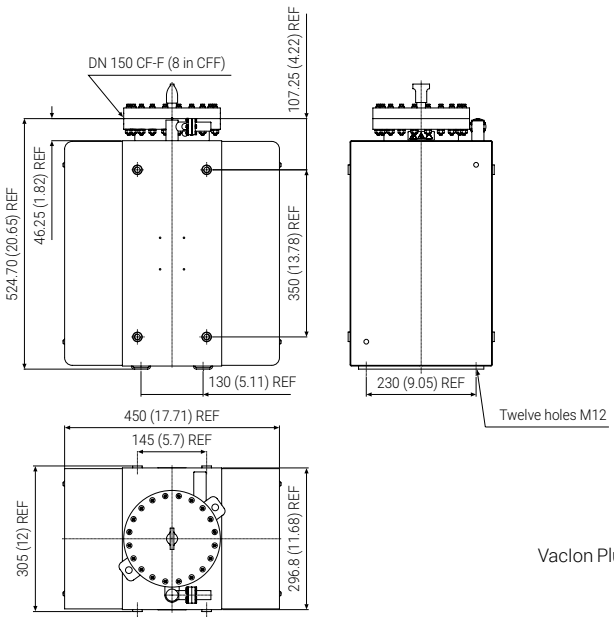
**Quantity required: 4.*
***To order replacement heaters or upgrade existing pumps, contact your local Agilent Vacuum Products representative.*

Diode, Noble Diode	Positive
StarCell	Negative

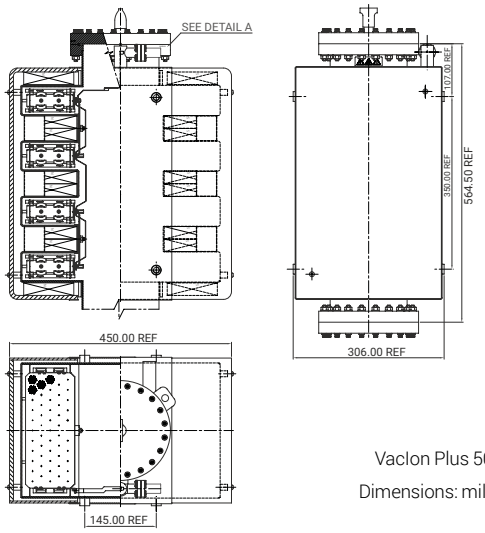
Negative or positive? See more on page 70.

VacIon Plus 500 pump

Customized designs available on request:
contact your local Agilent office for more details.



VacIon Plus 500



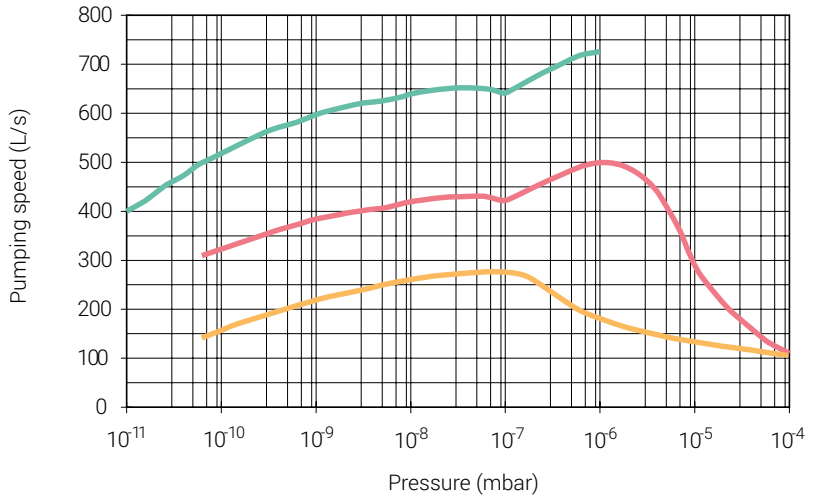
VacIon Plus 500 Double Ended
Dimensions: millimeters (inches)

Technical Specifications

	StarCell	Noble Diode	Diode
Nominal pumping speed for nitrogen * (L/s)	410	440	500
Operating life at $1x10^{-6}$ mbar (h)	80,000	50,000	50,000
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	≤ $1x10^{-3}$	≤ $1x10^{-3}$
Ultimate pressure (mbar)	Below 10^{-11}		
Inlet flange	DN 160 CF-F (8 in CFF) AISI 304 ESR		
Maximum baking temperature (°C)	Pump without magnets 450 Pump with magnets 350 HV cable 220		
Weight without heaters, kg (lb)	Net 120 (264); Shipping 138 (304)		
Internal volume (L)	36.2		

(*) Tested according to ISO/DIS 3556-1-1992

VacIon Plus 500 - Pumping speed vs pressure



Ordering Information

Description	Part number
Pumps	
Diode	9191710
Diode, with 120 V heaters installed	9191711
Diode, with 220 V heaters installed	9191712
Diode, double-ended	9191750
Diode, double-ended with 120 V heaters installed	9191751
Diode, double-ended with 220 V heaters installed	9191752
StarCell	9191740
StarCell, with 120 V heaters installed	9191741
StarCell, with 220 V heaters installed	9191742
StarCell, double-ended	9191780
StarCell, double-ended with 120 V heaters installed	9191781
StarCell, double-ended with 220 V heaters installed	9191782
Noble Diode	9191720
Noble Diode, with 120 V heaters installed	9191721
Noble Diode, with 220 V heaters installed	9191722
Noble Diode, double-ended	9191760

Agilent offers these pumps with the SHV 10 kV (SAFECONN) feedthrough option. Please contact Agilent or your local rep.

4UHV controller*	
200 W neg	9299010
200 W pos	9299011
IPCMini controller*	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001

**Ion pump controllers (4UHV and ICPMini) are available in multiple configurations.*

For a complete list of part numbers, please see 4UHV and IPCMini controllers sections: on Pages 68-71.

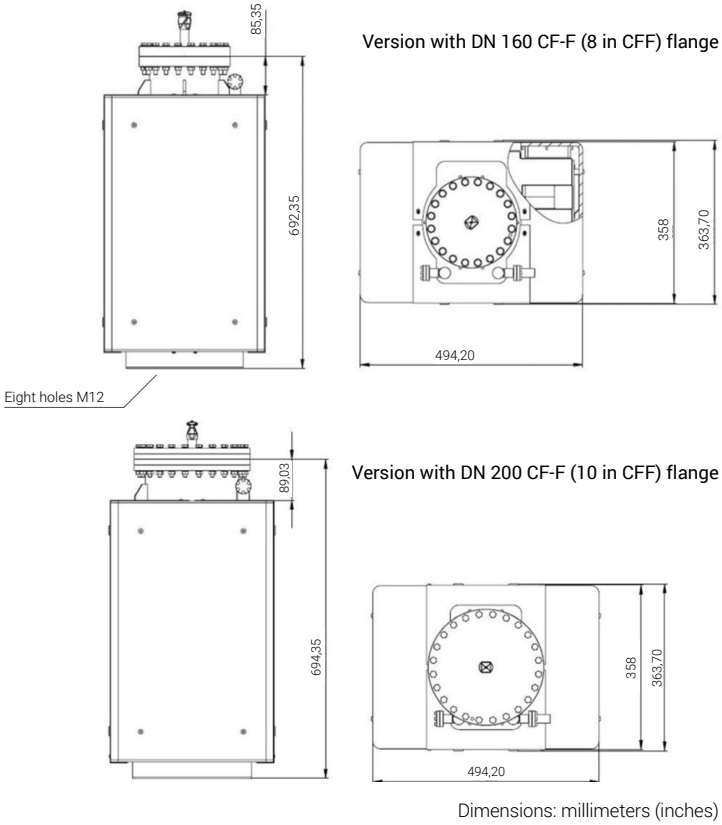
Description	Part number
HV cables	
HV cable, 4 m (13 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290705
HV cable, 7 m (23 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290707
HV cable, 10 m (33 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290708
HV cable, 20 m (66 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290709
Replacement parts	
HV pump feedthrough, Fischer, with interlock	9595125
Pumping element** Diode	9199040
Pumping element** Noble Diode	9199045
Pumping element* StarCell	9199030
Heaters***, 120 V, input power 780 W	9190077
Heaters***, 220 V, input power 780 W	9190076

***Quantity required: 4.*
****To order replacement heaters or upgrade existing pumps, contact your local Agilent Vacuum Products representative.*

Diode, Noble Diode	Positive
StarCell	Negative

Negative or positive? See more on page 70.

VacIon Plus 800 pump



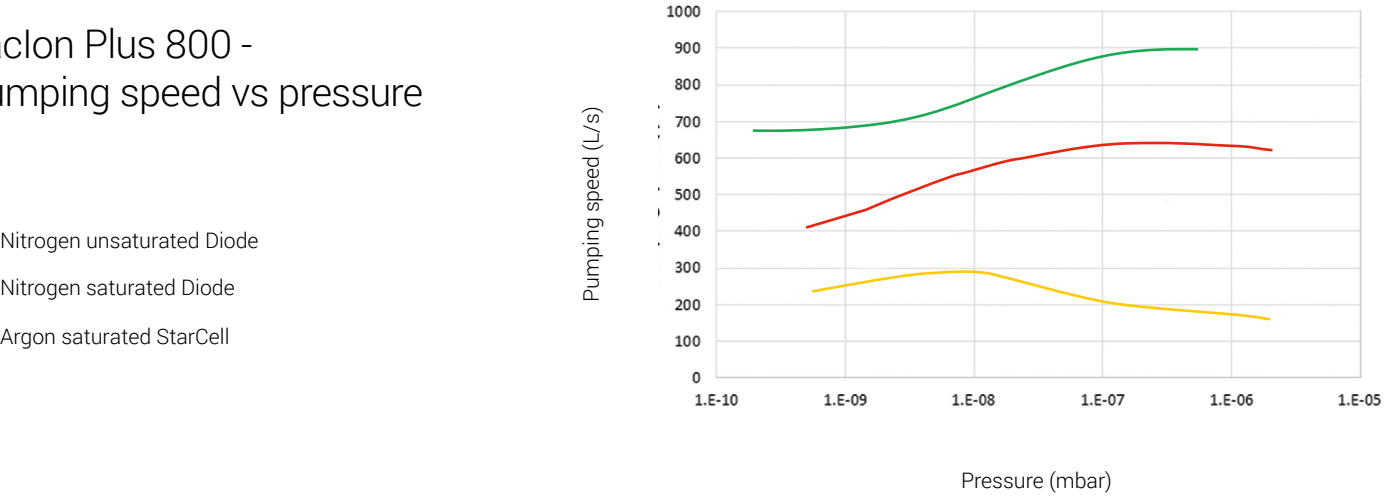
Dimensions: millimeters (inches)

Technical Specifications

	Flange 10 in	Flange 8 in
Nominal pumping speed* for nitrogen (L/s)	650	530
Nominal pumping speed* for argon (L/s)	295	260
Operating life at e^{-6} mbar (h)	80000	
Maximum baking temperature (°C)	Pump without magnets 450 Pump with magnets 350 HV cable 220	
Protect current (mA)	150	
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	
Ultimate pressure (mbar)	<$1x10^{-11}$	
Inlet flange	DN 160 CF-F (8 in CFF) AISI 304 ESR DN 200 CF-F (10 in CFF) AISI 304 ESR	
Weight without heaters kg (lb)	Net 198 (437), Shipping 213 (470)	
Internal volume (L)	115	
(*) Tested according to ISO/DIS 3556-1-1992		

Customized designs available on request:
contact your local Agilent office for more details.

VacIon Plus 800 - Pumping speed vs pressure



Ordering Information

Description	Part number
Pumps	
StarCell, DN 200 CF-F (10 in CFF) inlet flange	X3607-64200
StarCell, DN 200 CF-F (10 in CFF) inlet flange, with 230 V heater installed	X3607-64201
StarCell, DN 200 CF-F (10 in CFF) inlet flange, with 115 V heater installed	X3607-64202
StarCell, DN 160 CF-F (8 in CFF) inlet flange	X3607-64203
StarCell, DN 160 CF-F (8 in CFF) inlet flange, with 230 V heater installed	X3607-64204
StarCell, DN 160 CF-F (8 in CFF) inlet flange, with 115 V heater installed	X3607-64205
Controller unit: 4UHV*	
200 W NEG	9299010
2 x 80 W NEG	9299200
2 x 200 W NEG	9299020
4 x 80 W NEG	9299400
2 x 80 W NEG and 1 x 200 W NEG	9299210

*The ion pump controller 4UHV is available in multiple configurations. Please see 4UHV controller section on Pages 70-71.

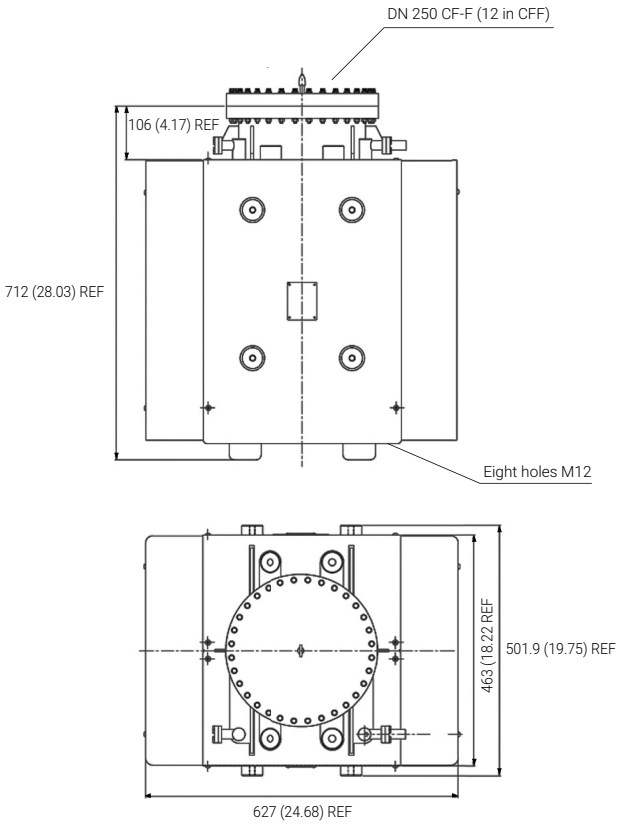
Description	Part number
Cables selection	
HV cable, 4 m (13 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290705
HV cable, 7 m (23 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290707
HV cable, 10 m (33 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290708
HV cable, 20 m (66 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290709
Replacement parts	
HV pump feedthrough, Fischer, with interlock	9595125
Pumping element** StarCell	9199030
Heaters***, 115 V, input power 800 W	X3607-68001
Heaters***, 230 V, input power 800 W	X3607-68000

Pumps are equipped with standard Fischer high voltage feedthroughs.

***Quantity required: 12.*

****To order replacement heater or upgrade existing pumps, please contact your local Agilent Vacuum Products representative.*

VacIon Plus 1000 pump



Dimensions: millimeters (inches)

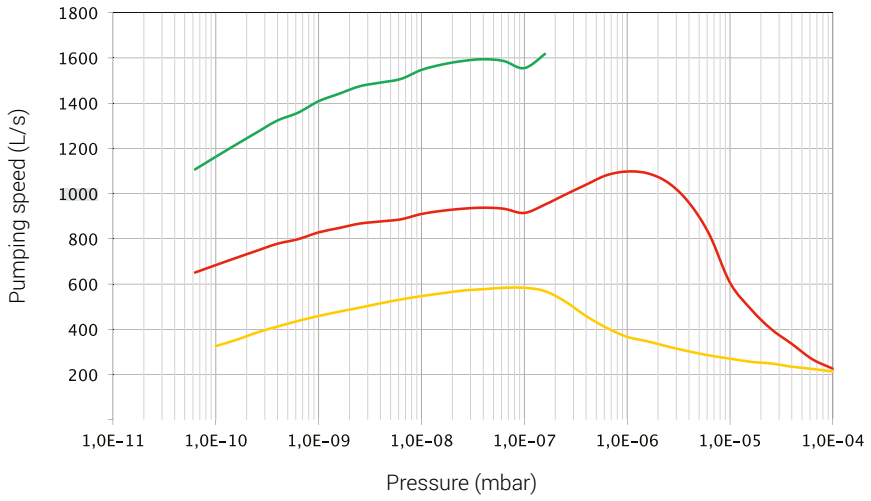
Technical Specifications

	Diode	StarCell
Nominal pumping speed* for nitrogen (L/s)	1100	900
Nominal pumping speed* for argon (L/s)	295	585
Operating life at e^{-6} mbar (h)	50000	**80000**
Maximum baking temperature (°C)	Pump without magnets 450 Pump with magnets 350 HV cable 220	
Protect current (mA)	200	
Maximum starting pressure (mbar)	≤ $5x10^{-2}$	
Ultimate pressure (mbar)	10^{-11}	
Inlet flange	DN 250 CF-F (12 in CFF) AISI 304 ESR	
Weight without heaters kg (lb)	Net 265 (585); Shipping 308 (679)	
Internal volume (L)	136	
(*) Tested according to ISO/DIS 3556-1-1992		

Customized designs available on request:
contact your local Agilent office for more details.

VacIon Plus 1000 - Pumping speed vs pressure

- Nitrogen unsaturated Diode
- Nitrogen saturated Diode
- Argon saturated StarCell



Ordering Information

Description	Part number
Configurations	
Diode, without heater	X3604-64000
Diode, with 115 V heater	X3604-64101
Diode, with 230 V heater	X3604-64102
StarCell, without heater	X3604-64120
StarCell, with 115 V heater	X3604-64121
StarCell, with 230 V heater	X3604-64122
Controller unit: 4UHV	
200 W neg	9299010
200 W pos	9299011

The ion pump controller 4UHV is available in multiple configurations. Please see 4UHV controller section on page 70-71.

The selection of the controller is strictly dependent on the starting pressure. If starting pressure is in the 10^{-6} mbar range, a single channel with 200 Watts is sufficient to start and maintain the operational function of the pump.

Diode, Noble Diode	Positive
StarCell	Negative

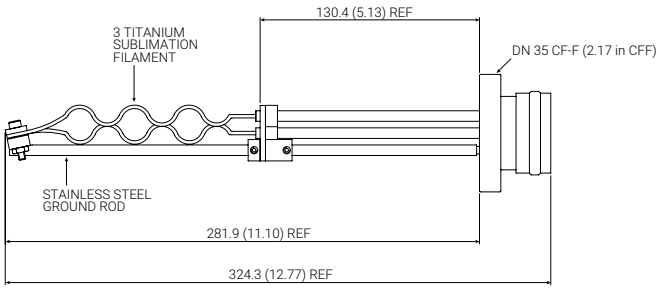
Negative or positive? See more on page 70.

Description	Part number
Replacement parts	
HV pump feedthrough*, Fischer, with interlock	9595125
Pumping element** Diode	9199040
Pumping element** StarCell	9199030
Cables selection	
HV cable, 4 m (13 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290705
HV cable, 7 m (23 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290707
HV cable, 10 m (33 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290708
HV cable, 20 m (66 ft), Fischer controller to Fischer pump side, bakeable, radiation resistant, with interlock	9290709

*Pumps are equipped with standard Fischer high voltage feedthroughs (Pumps with 2 feedthroughs are available on request).

**Quantity required: 16.

TSP cartridge



Dimensions: millimeters (inches)

Titanium sublimation pumps (TSPs) are typically used as an effective way to pump getterable gases, such as hydrogen and nitrogen, in UHV systems. TSPs are often combined with ion pumping, since the ion pump is effective with nongetterable UHV gases, such as argon and methane. The TSP can be added to the inside of the ion pump, or as a separate pumping unit.

Agilent offer a (TSP) titanium sublimation pump using a filament source. Filament-type TSP sources are most popular with UHV systems since they can be turned off between sublimations and do not add thermally induced outgassing.

How it works

Titanium sublimation pumping is accomplished by coating the inner surfaces of a vacuum system with sublimated titanium films. Since it involves a chemical reaction, this kind of pumping is useful where mainly active gases are present.
The pumping speed per unit area depends on the reactive gas species, as shown in the table on page 57.

Sublimated titanium forms a thin layer that has a high pumping speed for reactive gases, which are either forming a chemical compound with the layer or being absorbed. By cooling the surfaces with water or liquid nitrogen, the pumping speed can be increased considerably if the TSP is used in with a liquid.

The TSP ambient shield works at ambient temperature. When combined with a TSP cartridge, its optimized geometry provides increased pumping speed performance for active gases over a standard TSP and uncooled cryopanel, or a cylindrical chamber of similar diameter and length, to reach UHV/XHV pressures faster.

TSP cartridge filament source

The popular TSP cartridge is provided on a DN 40 CF-F (2.75 in CFF) flange and contains three titanium molybdenum filaments, each with 1.1 g of usable titanium. The cartridge assembly is bakeable to 400 °C. Maximum sublimation is achieved at 300 W of source power.

Technical Specifications

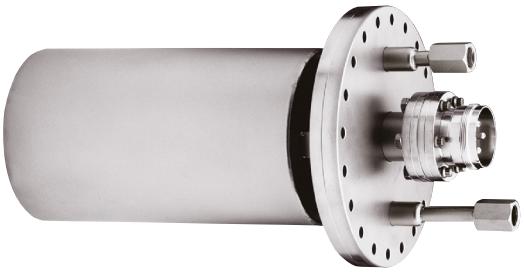
Usable titanium (per filament)	1.1 g
Total usable	3.3 g
Operating range	10^{-4} to 10^{-12} mbar

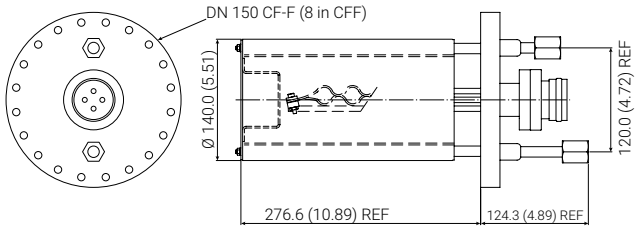
Ordering Information

Titanium sublimation pumps	Part number
TSP Filament cartridge on a DN 40 CF-F (2.75 in CFF)	9160050
TSP replacement filaments, 1 package of 12. Each TSP cartridge requires 3 filaments.	9160051

For informations about the TSP Controller see page 72-73.

TSP cryopanel





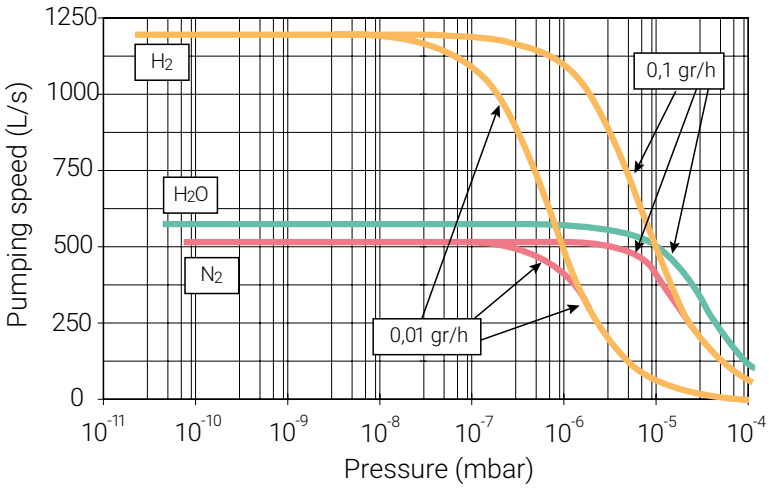
Dimensions: millimeters (inches)

Designed for use with the TSP cartridge source*, this sublimation cryopanel is mounted to a DN 160 CF-F (8 in CFF) flange.
It can operate with water cooling, liquid nitrogen, or uncooled if used at UHV

This cryopanel can be mounted to double-end or sideport ion pumps and can also be used independently in any DN 160 CF-F (8 in CFF) flange port with 11 in depth/clearance.

**The cryopanel does not include the cartridge.*

Pumping Speed vs pressure at different evaporation rates



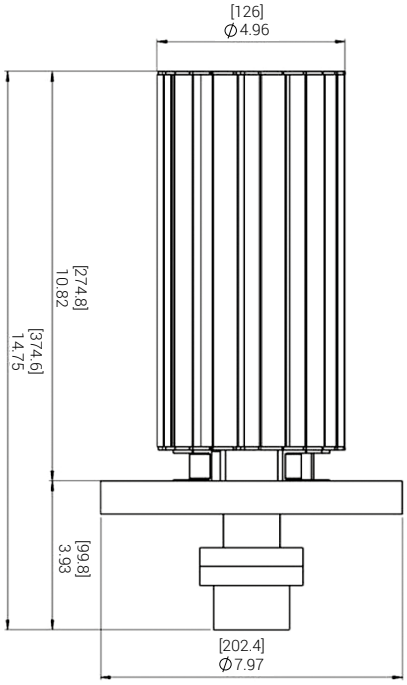
Technical Specifications

	N_2	H_2	H_20
Pumping speed at 20 °C water-cooled (L/s)	515	1200	575
Inner pumping surface (cm^2)	826		
Main flange	8.00 in od CFF (NW 150)		
Reservoir volume (L)	1.8		
Cooling connection	3/8 in Gas		
Titanium source flange	2.75 in CFF		

Ordering Information

Titanium sublimation cryopanel	Part number
Sublimation cryopanel on a DN 160 CF-F (8 in CFF)	9190180

TSP Ambient Shield



Dimensions: millimeters (inches)

The TSP ambient shield* is an evolution of the TSP cryopanel. It has been designed to increase surface area for sublimated titanium in applications where cooling is not possible, not practical, or simply not desired.

The internal dimensions of the TSP ambient shield generate a total surface area of 1300 cm² (201.5 in.²).

The shape of the twelve wings, as well as the shield at the opposite side of the inlet flange, are designed to prevent line of sight migration of titanium that could coat the insulators (if present in the system).
This would create an electrical path that could lead to electrical leakage or short circuit in the worst case.

Thanks to its DN 160 CF-F (8 in CFF) flange with integrated DN 40 CF-F (2.75 in CFF) to accommodate the TSP cartridge into combination pumps, the ambient shield can be completely integrated into a large size ion pump body.

Agilent combination pump configurations are available for the VacIon Plus 150, 300, or 500 models and include the ambient shield, and an extra side- or bottom-mounted DN 160 CF-F (8 in CFF) flange port.

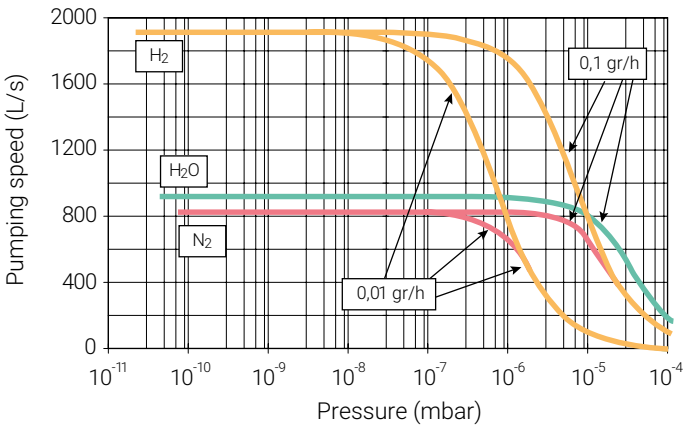
**The TSP ambient shield does not include the cartridge.*

Technical Specifications

	N_2	H_2	H_20
Pumping speed at 20 °C (L/s)	890	2195	1025
Inner pumping surface (cm^2)	1300		
Main flange	8.00 in od CFF (NW 150)		
Titanium source flange	2.75 in CFF		

Ordering Information

	Part number
TSP Ambient Shield	9190180M001



Pumping Speed vs pressure at different evaporation rates.

VacIon Plus CombiTSP pumps

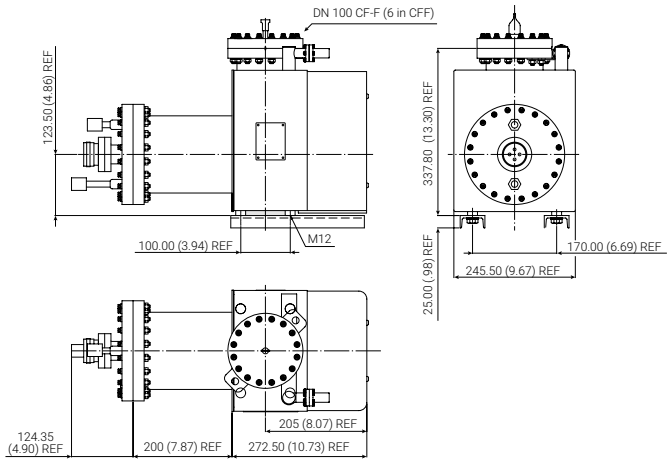
The CombiTSP integrates the VacIon pump, TSP cartridge, and TSP cryopanel, or Ambient Shield, to increase pumping speed in the same footprint.

The gettering properties of the TSP cartridge deliver faster pump down to ultrahigh and extreme high vacuum (UHV/XHV) enabling lower ultimate base pressure.
The cryopanel, or Ambient Shield, further improve pumping efficiency for getterable gases.

The StarCell element provides the highest speed and capacity for methane, argon, and helium.

Ideal for particle physics and other low-pressure based research, such as surface science, nanotechnology, and materials science, these pumps are customizable with different high-voltage feedthroughs, body geometries, and pumping elements to meet your needs.

VacIon Plus 150 CombiTSP pump (side-mounted TSP)



Dimensions: millimeters (inches)

Customized designs available on request: contact your local Agilent office for more detail.

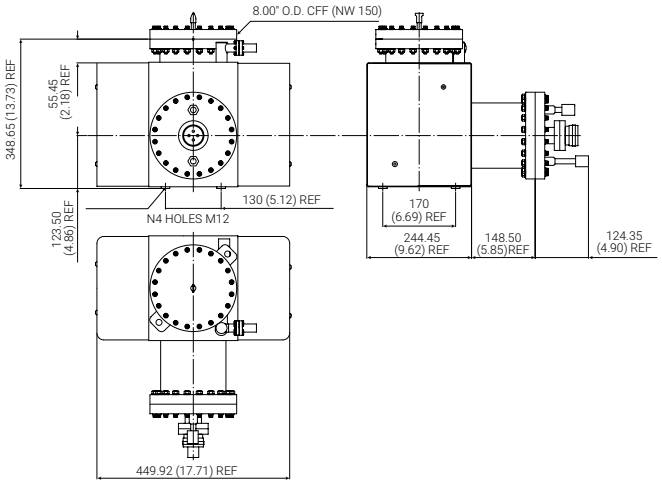
Technical Specifications

Pump	
VacIon Plus 150 CombiTSP	N_2 – 610 H_2 – 1,380
VacIon Plus 300 CombiTSP	N_2 – 720 H_2 – 1,580
VacIon Plus 500 CombiTSP	N2 – 880 H_2 – 1,930

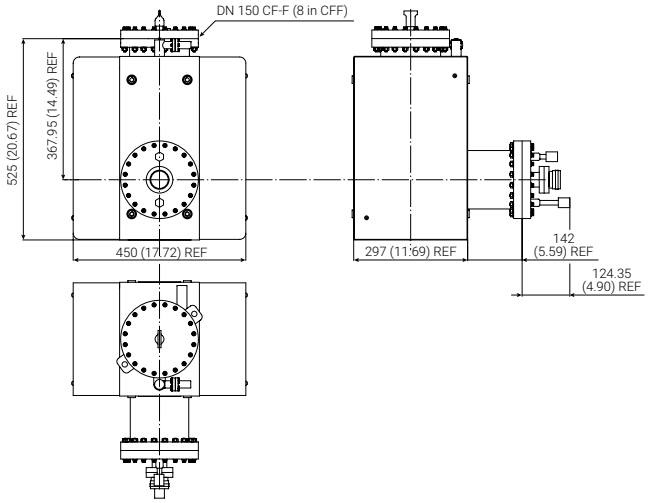
Nominal net pumping speed at 20 °C (L/s) with StarCell elements (water-cooled cryopanel)

Titanium sublimation combination pumps models

Vaclon Plus 300 CombiTSP pump (side-mounted TSP)



Vaclon Plus 500 CombiTSP (side-mounted TSP)



Dimensions: millimeters (inches)

Titanium sublimation combination pumps

- Titanium sublimation combination ion pumps offer maximum pumping performance for creating ultra and extreme high vacuum environments. The titanium sublimation creates extra high getterable gas pumping speeds, while the ion pumping mechanisms handle the nongetterable gases such as argon and methane.
- This CombiTSP pump is a Vaclon Plus 150, 300, or 500 pump with an extra side–or bottom–mounted 8 in ConFlat port. The combination pump includes the cylindrical cryopanel and TSP source mounted to the extra port. Getterable gases enter the end of the cylindrical cryopanel and are pumped by being combined with the freshly deposited titanium there. Liquid nitrogen cooling the cryopanel or ambient shield increases the efficiency of the gettering process and adds to the water pumping speed.
- CombiTSP combination pumps are now also available with an ambient shield that replaces the cryopanel. See Page 52.
- The Agilent Vaclon Plus series of combination pumps allow the addition of a cryopanel or ambient shield, at the bottom of the pump* or from the side. This can be a significant advantage in situations where height restrictions are present.

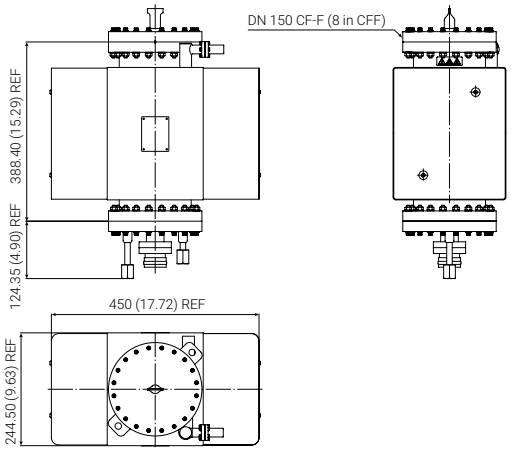
Customized pump configurations are also available.

**Not available on Vaclon Plus 150 Combi Pumps.*

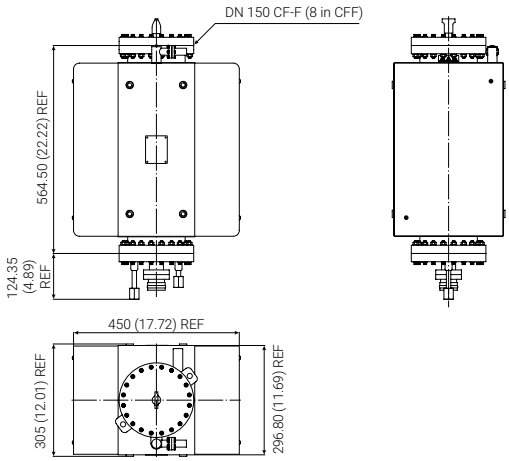
For ion pump control unit selection, see IPCMini and 4UHV controllers on pages 58 and 60 respectively

VacIon Plus CombiTSP pumps

VacIon Plus 300 CombiTSP pump (bottom-mounted TSP)



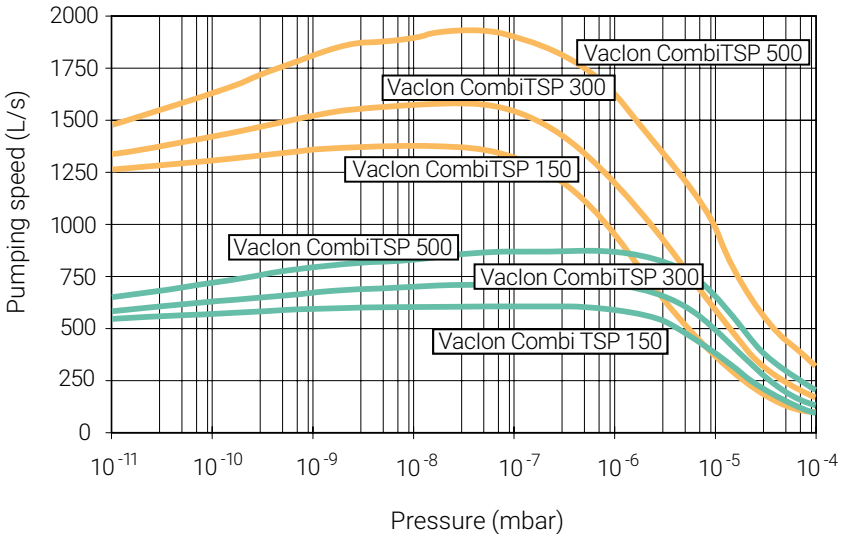
VacIon Plus 500 CombiTSP pump (bottom-mounted TSP)



Dimensions: millimeters (inches)

Ion CombiTSP pumps with Cryopanel at 20°C - pumping speed

- Nitrogen StarCell
- Hydrogen StarCell



Ordering information

The VacIon Plus CombiTSP 150, 300, and 500 pumps can be supplied with the factory-installed sublimation cryopanel, or ambient shield (for PN list see page 57), and TSP cartridge included, not installed.
Cables and controllers should be ordered separately. For VacIon Plus part numbers, see Pages 26-35.

VacIon Plus 150, 300, and 500 CombiTSP pumps	Voltage	Part number
VacIon Plus 150 Diode, with side-mounted cryopanel, TSP cartridge, and installed heater	120 V	9192510
VacIon Plus 150 Diode, with side-mounted cryopanel, TSP cartridge, and installed heater	220 V	9192511
VacIon Plus 150 StarCell, with side-mounted cryopanel, TSP cartridge, and installed heater	120 V	9192540
VacIon Plus 150 StarCell, with side-mounted cryopanel, TSP cartridge, and installed heater	220 V	9192541
VacIon Plus 150 Noble Diode, with side-mounted cryopanel, TSP cartridge, and installed heater	120 V	9192520
VacIon Plus 150 Noble Diode, with side-mounted cryopanel, TSP cartridge, and installed heater	220 V	9192521
VacIon Plus 300 Diode, with side-mounted cryopanel, TSP cartridge, and installed heater	120 V	9192610
VacIon Plus 300 Diode, with side-mounted cryopanel, TSP cartridge, and installed heater	220 V	9192611
VacIon Plus 300 StarCell, with side-mounted cryopanel, TSP cartridge, and installed heater	120 V	9192640
VacIon Plus 300 StarCell, with side-mounted cryopanel, TSP cartridge, and installed heater	220 V	9192641
VacIon Plus 300 Diode, with cryopanel, TSP cartridge, and installed heater bottom-mounted	120 V	9192612
VacIon Plus 300 Diode, with cryopanel, TSP cartridge, and installed heater bottom-mounted	220 V	9192613
VacIon Plus 300 StarCell, with cryopanel, TSP cartridge, and installed heater bottom-mounted	120 V	9192642
VacIon Plus 300 StarCell, with side-mounted cryopanel, TSP cartridge, and installed heater bottom-mounted	220 V	9192643
VacIon Plus 300 Noble Diode, with side-mounted cryopanel, TSP cartridge, and installed heater	120 V	9192620
VacIon Plus 300 Noble Diode, with side-mounted cryopanel, TSP cartridge, and installed heater	220 V	9192621
VacIon Plus 300 Noble Diode, with bottom-mounted cryopanel, TSP cartridge, and installed heater	120 V	9192622
VacIon Plus 300 Noble Diode, with bottom-mounted cryopanel, TSP cartridge, and installed heater	220 V	9192623
VacIon Plus 500 Diode, with side-mounted cryopanel, TSP cartridge, and installed heater	120 V	9192710
VacIon Plus 500 Diode, with side-mounted cryopanel, TSP cartridge, and installed heater	220 V	9192711
VacIon Plus 500 StarCell, with side-mounted cryopanel, TSP cartridge, and installed heater	120 V	9192740
VacIon Plus 500 StarCell, with side-mounted cryopanel, TSP cartridge, and installed heater	220 V	9192741
VacIon Plus 500 Diode, with bottom-mounted cryopanel, TSP cartridge, and installed heater	120 V	9192712
VacIon Plus 500 Diode, with bottom-mounted cryopanel, TSP cartridge, and installed heater	220 V	9192713
VacIon Plus 500 StarCell, with bottom-mounted cryopanel, TSP cartridge, and installed heater	120 V	9192742
VacIon Plus 500 StarCell, with bottom-mounted cryopanel, TSP cartridge, and installed heater	220 V	9192743
VacIon Plus 500 Noble Diode, with side-mounted cryopanel, TSP cartridge, and installed heater	120 V	9192720
VacIon Plus 500 Noble Diode, with side-mounted cryopanel, TSP cartridge, and installed heater	220 V	9192721
VacIon Plus 500 Noble Diode, with bottom-mounted cryopanel, TSP cartridge, and installed heater	120 V	9192722
VacIon Plus 500 Noble Diode, with bottom-mounted cryopanel, TSP cartridge, and installed heater	220 V	9192723

Pumps are equipped with standard Fischer high voltage feedthroughs.
Agilent also offers pumps with the SHV 10 kV (SAFECONN) feedthrough option.
For further information, please contact Agilent or your local rep.

4UHV and IPCMini control units available.

See Pages 68-71.

Replacement parts and accessories	Voltage	Weight kg (lb)	Part number
TSP filament cartridge on DN 40 CF-F (2.75 in CFF)		2.7 (6.0)	9160050
TSP replacement filaments, 1 package of 12. Each TSP cartridge requires 3 filaments.		0.4 (2.0)	9160051
Titanium sublimation pump control unit (order cables separately)	120 V	17.7 (39.0)	9290032
Titanium sublimation pump control unit (order cables separately)	220 V	17.7 (39.0)	9290033
TSP cartridge cable, 3.5 m (12 ft)		9.1 (20.0)	9240730
Sublimation cryopanel on DN 160 CF-F (8 in CFF)		10.5 (23.0)	9190180

Typical pumping speed per square centimeter (per square inch) of titanium sublimation surface for various gases

When used together, the ambient shield and titanium sublimation pumps are particularly suitable for gases such as H_2, N_2, H_2O, CO, CO_2, and O_2.

The following table shows the pumping speed expected for each gas according to the inner ambient shield available surface.

Gas	H_2	N_2	O_2	CO	CO_2	H_20	CH_4	Ar	He
Typical pumping speed per unit area, in L/s*cm² (L/s*in²)	3.1 (20)	4.7 (30)	9.3 (60)	9.3 (60)	7.8 (50)	3.1 (20)	0	0	0

Note: Ambient shield inner pumping surface: 1300 cm² - 201.5 in²
Ambient temperature: 20°C

Ordering Information

CombiTSP pump with ambient shield	Part number
TSP Ambient Shield	**9190180M001**
VacIon Plus 150 Diode, with side-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192510M100
VacIon Plus 150 Diode, with side-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192511M100
VacIon Plus 150 Noble Diode, with side-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192520M100
VacIon Plus 150 Noble Diode, with side-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192521M100
VacIon Plus 150 StarCell, with side-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192540M100
VacIon Plus 150 StarCell, with side-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192541M100
VacIon Plus 300 Diode, with side-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192610M100
VacIon Plus 300 Diode, with side-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192611M100
VacIon Plus 300 Noble Diode, with side-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192621M100
VacIon Plus 300 StarCell, with side-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192640M100
VacIon Plus 300 StarCell, with side-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192641M100
VacIon Plus 300 Diode, with bottom-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192612M100
VacIon Plus 300 Diode, with bottom-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192613M100
VacIon Plus 300 Noble Diode, with bottom-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192622M100
VacIon Plus 300 Noble Diode, with bottom-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192623M100
VacIon Plus 300 StarCell, with bottom-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192642M100
VacIon Plus 300 StarCell, with bottom-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192643M100
VacIon Plus 500 Diode, with side-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192710M100
VacIon Plus 500 Diode, with side-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192711M100
VacIon Plus 500 Noble Diode, with side-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192720M100
VacIon Plus 500 StarCell, with side-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192740M100
VacIon Plus 500 StarCell, with side-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192741M100
VacIon Plus 500 Diode, with bottom-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192712M100
VacIon Plus 500 Diode, with bottom-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192713M100
VacIon Plus 500 Noble Diode, with bottom-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192722M100
VacIon Plus 500 Noble Diode, with bottom-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192723M100
VacIon Plus 500 StarCell, with bottom-mounted ambient shield, with TSP cartridge and with installed heater 120 V	9192742M100
VacIon Plus 500 StarCell, with bottom-mounted ambient shield, with TSP cartridge and with installed heater 220 V	9192743M100

Ion CombiNEG Pumps

The perfect partnership between UHV leaders

Agilent Ion CombiNEG pumps are the result of more than 100 years combined vacuum experience between Agilent Technologies and SAES Getters. Agilent (formerly Varian Vacuum) is the inventor of the ion pump, and SAES the originator of the NEG pump concept.

The Ion CombiNEG pump combines our patented StarCell ion pump with the SAES NEG cartridge that is easily inserted into the ion pump and uses the same pump volume. Our StarCell ion pump provides high pumping speed for argon and other residual noble gases. The NEG cartridge provides extra pumping speed for active gases enabling pressure values as low as 10^{-12} mbar.

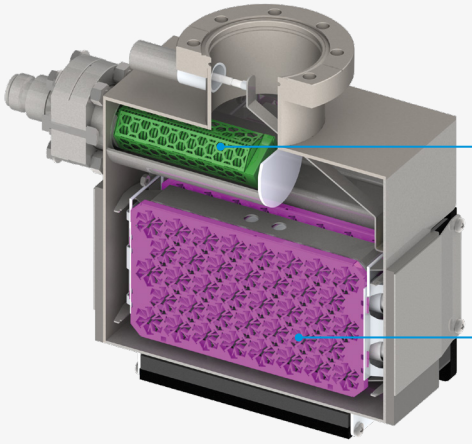
Performance is further boosted by the optimized magnetic field and vacuum firing manufacturing process, assuring minimum outgassing at low pressure. The inner shield preserves the NEG operating life.

This is the only pump that handles high amounts of noble gases, with the highest pumping speed and capacity for methane, argon, and helium. It is meant for demanding applications where extra pumping speed is required at ultrahigh and extreme high vacuum.

Ion CombiNEG typical applications:

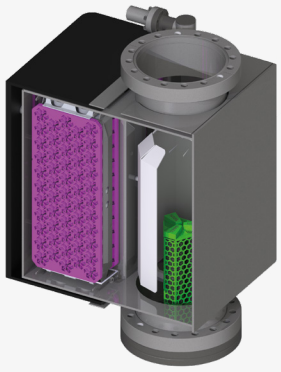
- Particle accelerators
- Synchrotron radiation sources and related equipment
- General purpose UHV systems
- Surface science
- Scanning electron microscopes

Ion CombiNEG 40-400

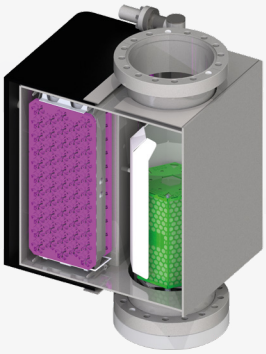


ION CombiNEG 40-400
with DN 63 CF-F (4.5 in CFF) inlet flange

Ion CombiNEG 150-1000 and 150-2000

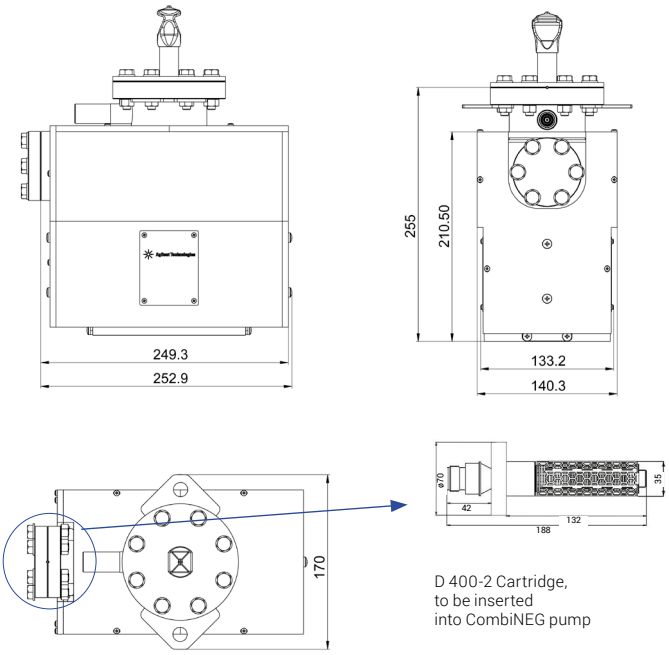


ION CombiNEG 150-1000
with DN 100 CF-F (6 in CFF) inlet flange



ION CombiNEG 150-2000
with DN 100 CF-F (6 in CFF) inlet flange

Ion CombiNEG 40-400 pump



D 400-2 Cartridge,
to be inserted
into CombiNEG pump

Dimensions: millimeters (inches)

Technical Specifications

	Diode (*)	StarCell
Nominal saturated pumping speed for nitrogen (L/s) with shield (without shield)*	35 (39)	38 (43)
Nominal saturated pumping speed for argon (L/s) with shield (without shield)*	--	20 (22)
Operating life at 1E-6 mbar of nitrogen (hours)	50000	80000
Suggested maximum baking pressure with ion pump on (mbar)	5E-6	
Protect current	30 mA	
Operating voltage (max)	+7000 Vdc +/- 10 %	-7000 Vdc +/- 10 %
Suggested starting pressure (mbar)	≤ 1E-5	≤ 1E-4
Ultimate pressure (mbar)	below 1E-11	

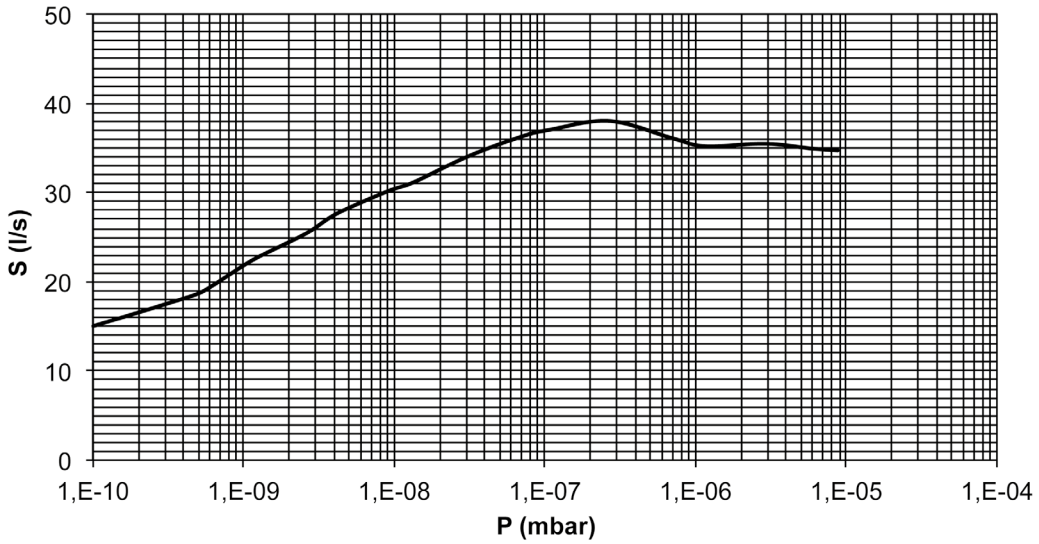
Technical Specifications

Inlet flange		DN 63 CF-F (4.5 in CFF) AISI 304L ESR
Side port		DN 40 CF-F (2.75 in CFF)
Internal volume (L)		3.0
Temperature limits (°C):		
Pump without magnets		**450**
Pump with magnets		**350**
HV cable		**220**
Getter pump		**(**)**
Material:	Body	AISI 304L
	Cathodes	Titanium Titanium
	Anodes	AISI 304L
	Magnets	Ferrite (Ceramic 8)
	Pole piece	Iron
Weight, kg (lb)		22.5 (49.6)

(*) Tested according to ISO/DIS 3556-1-1992
(**) See to the Operating Instructions Manual provided with the getter pump.

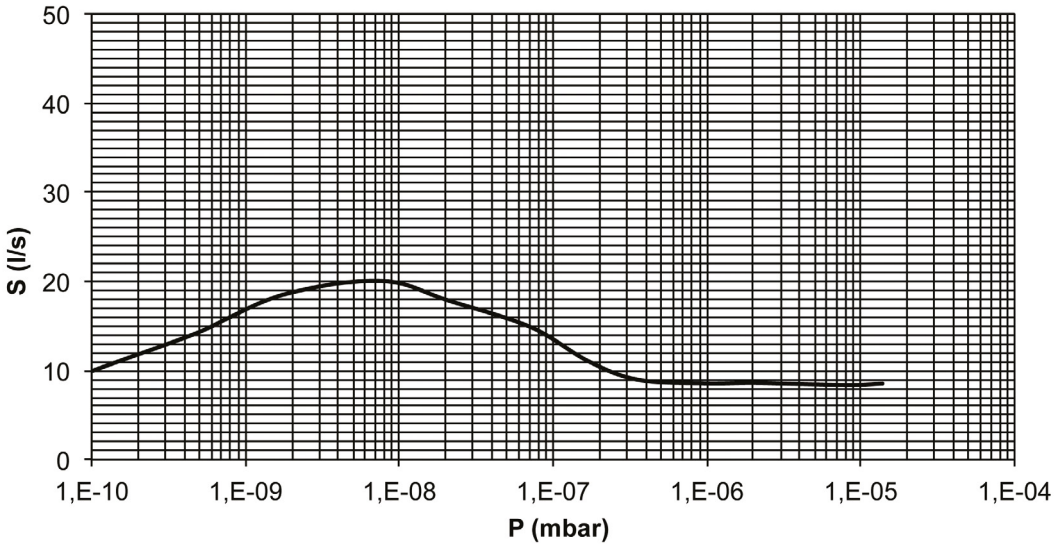
Pumping speed - Ion CombiNEG 40-400 - StarCell, nitrogen

Typical pumping speed vs pressure diagram for nitrogen
(Ion pump only, StarCell, saturated, equipped with shield).



Pumping speed - Ion CombiNEG 40-400 - StarCell, argon

Typical pumping speed vs pressure diagram for argon
(Ion pump only, StarCell, saturated, equipped with shield).

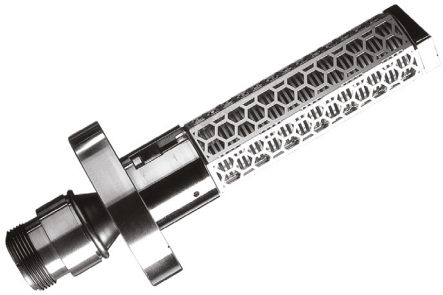


NEG cartridge D400-2

The Ion CombiNEG 40-400 has a DN 40 CF-F (2.75 in CFF) side port that can accommodate a SAES CapaciTorr D400-2 getter pump.

The CapaciTorr D 400-2 pump uses the high performing SINTERED St 172 (Zr-V-Fe) material in the form of disks to achieve high pumping performances in a very compact configuration.

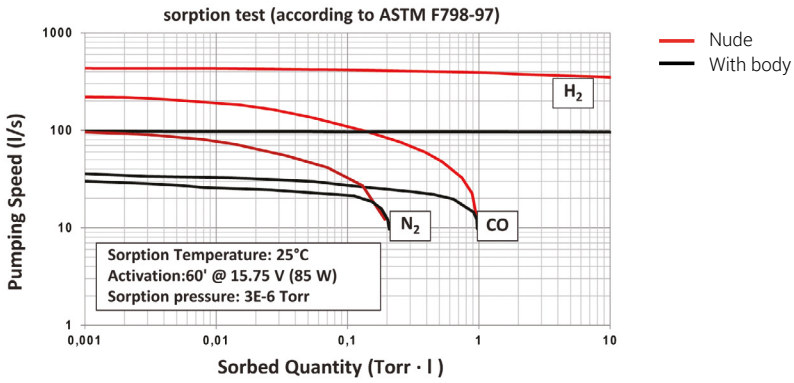
A dedicated power supply is needed for the D400-2 pump.

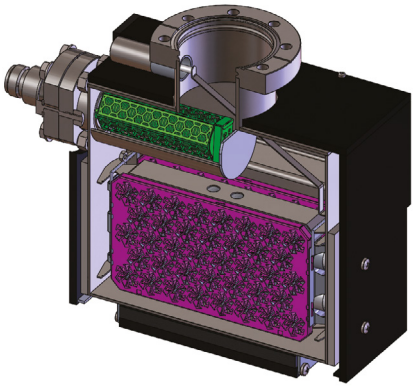


D 400-2 Cartridge

D400-2 pumping speed

CapaciTorr D 400-2





Cut-away showing the main pump assembly of the Ion CombiNEG 40-400 pump (StarCell version), with the D 400-2 getter pump mounted.

Technical Specifications

Typical pump characteristics		CapaciTorr D 400-2
Alloy type		St 172
Alloy composition		ZrVFe
Getter mass (g)		45
Getter surface (cm2)		380
Pumping speed (l/s)	H_2	400
	CO	180
Sorption capacity (Torr • l)	H_2	450
	CO at 25 °C	0.9
	CO total	400

Technical Specifications

Cartridge controller characteristics	
Input	110-240 VAC
Frequency	50-60 Hz
Mains cord connector	IEC Type 6A 250 V
Over-voltage class	Cat II
Output voltage	8.6-16.5 VDC
Output current	6.0 A
Output power	100 W

Ordering Information

Pumps	Part number
Ion CombiNeg 40-400 pump, Diode, with heater, 115 V	X3606-64000
Ion CombiNeg 40-400 pump, Diode, with heater, 230 V	X3606-64001
Ion CombiNeg 40-400 pump, StarCell, with heater, 115 V	X3606-64040
Ion CombiNeg 40-400 pump, StarCell, with heater, 230 V	X3606-64041
Cables and heaters	
HV radiation resistant cable, 4 m (13 ft), with interlock (for Fischer feedthrough)	9290705
HV radiation resistant cable, 7 m (23 ft), with interlock (for Fischer feedthrough)	9290707
HV radiation resistant cable, 10 m (33 ft), with interlock (for Fischer feedthrough)	9290708
HV radiation resistant cable, 20 m (66 ft), with interlock (for Fischer feedthrough)	9290709
Heater, Ion CombiNEG 40-400 pump, 230 V, 160 W	9192837M005
Heater, Ion CombiNEG 40-400 pump, 120 V, 160 W	9192837M006

For cable part numbers with other feedthroughs, see your local Agilent representative.

Controllers for Ion CombiNEG pump	
4UHV controller*	
200 W neg	9299010
200 W pos	9299011
IPCMini controller*	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001

Ordering Information

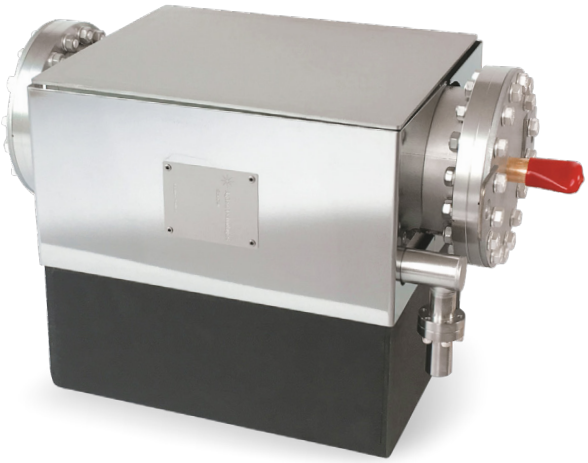
Getter pump	
D400-2 NEG Cartridge, with heater	X3605-68010
CF35 base flange with connector	X3605-68020
Controller* for NEG Cartridge D400-2	X3605-68030
Cable (controller to cartridge) for NEG Cartridge D400-2, 3 m	X3605-68050
Cable (controller to cartridge) for NEG Cartridge D400-2, 20 m	X3605-68054

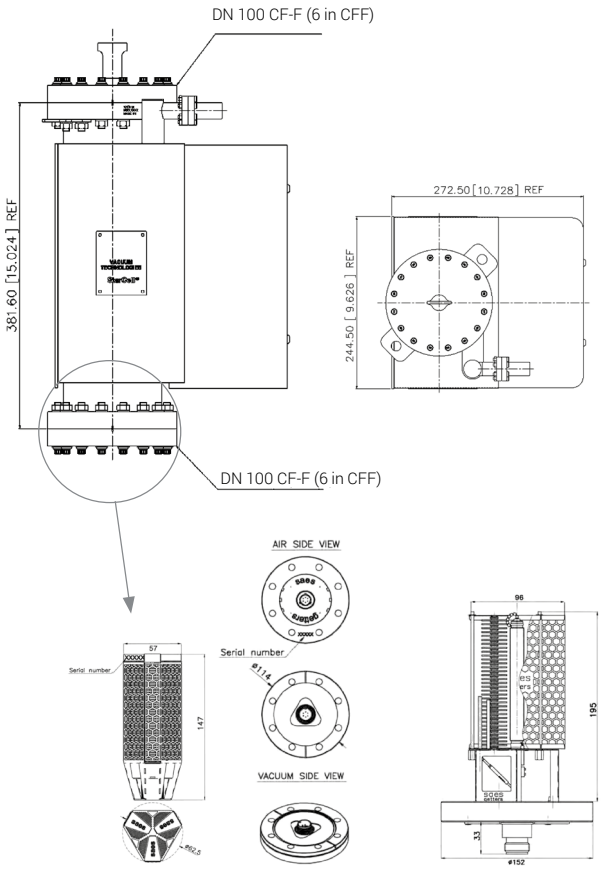
(*) Power cord not included

*Ion pump controllers (4UHV and ICPMini) are available in multiple configurations. See Pages 68-71.

For a complete list of part numbers, check www.agilent.com or ask your Agilent representative.

Ion CombiNEG 150-1000 and 150-2000 pumps





D–1000 Cartridge, and D–2000 Cartridge to be inserted into CombiNEG pump

Dimensions: millimeters (inches)

Technical Specifications

Nominal saturated pumping speed for nitrogen (L/s) with shield	125*
Nominal saturated pumping speed for argon (L/s) with shield	80*
Operating life at 1E-6 mbar (hours)	80,000
Max starting current	300 mA
Max baking current	25 mA
Protect current	50 mA
Operating voltage (max)	-7000 Vdc +/- 10 %
Maximum starting pressure (mbar)	≤1 x 10^{-3}
Ultimate pressure (mbar)	Below 10^{-11}
Inlet flange	6.00" O.D. CFF (NW 100)

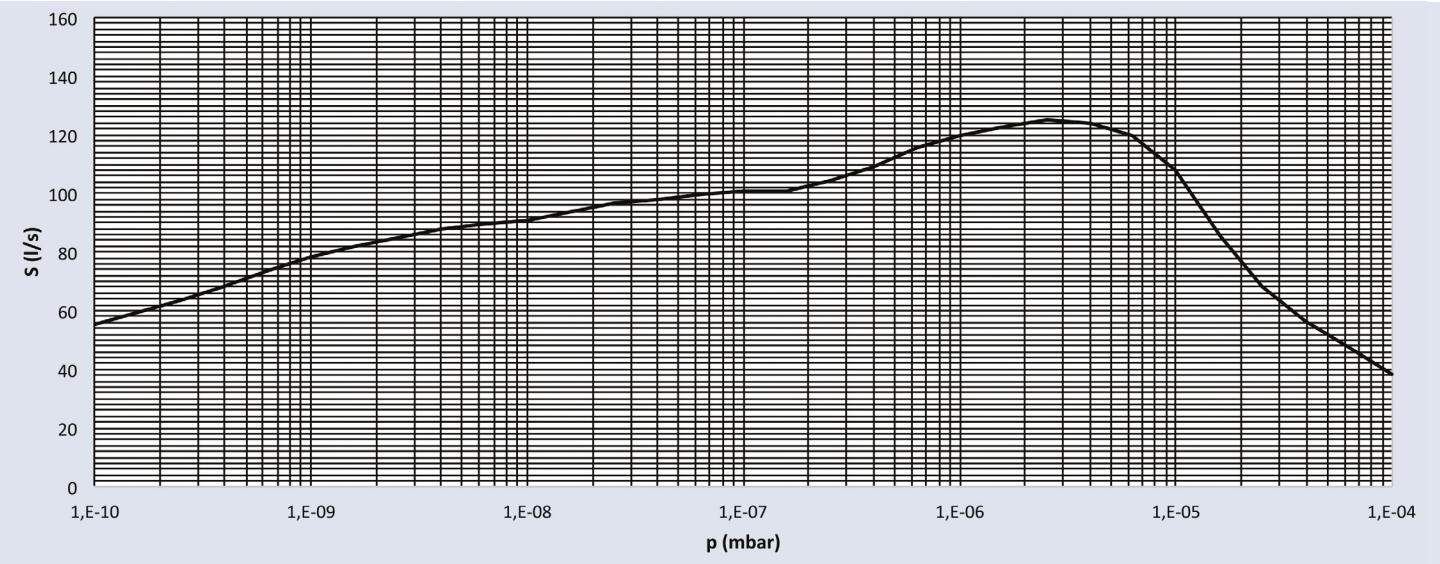
(*) Tested according to ISO/DIS 3556-1-1992

Technical Specifications

NEG flange connection		DN 100 CF-F (6 in CFF)
Internal volume (L)		12.1
Maximum baking temperature (°C)		350
Temperature limits (°C):		
Pump without magnets		400
Pump with magnets		350
Flange		500
Getter pump		(*)
Material:	Body	AISI 304 SST
	Cathodes	Titanium
	Anodes	AISI 304 SST
	Magnets	Ferrite
Weight, kg (lb)		43 (94)

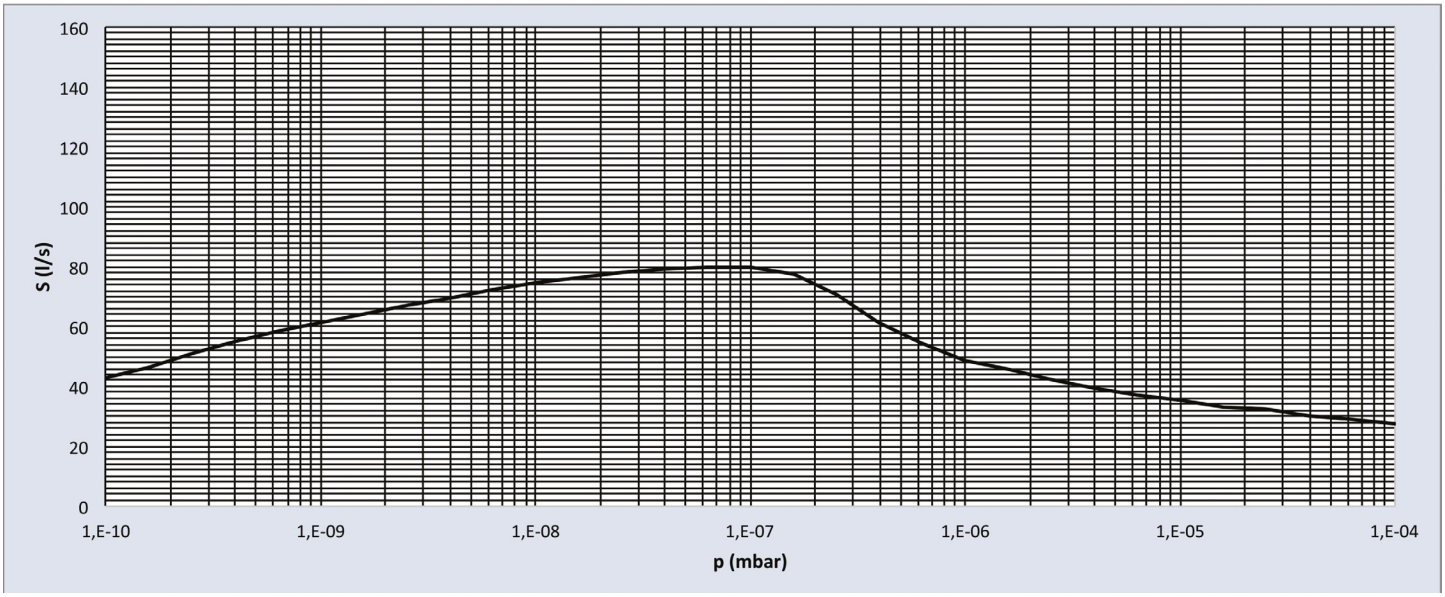
Pumping speed - Ion CombiNEG 150-1000 and 150-2000 - StarCell, nitrogen

Typical pumping speed vs pressure diagram for nitrogen
(Ion pump only, StarCell, saturated, equipped with shield.)



Pumping speed - Ion CombiNEG 150-1000 and 150-2000 - StarCell, argon

Typical pumping speed vs pressure diagram for argon
(Ion pump only, StarCell, saturated, equipped with shield.)



NEG cartridges D–1000 and D–2000

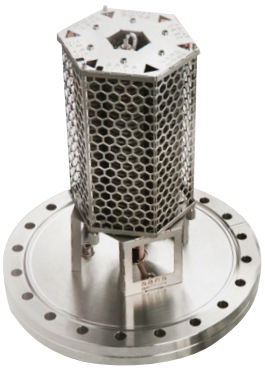
The SAES GETTERS D–1000, and D–2000 nonevaporable getter cartridges are made of sintered St 172 (Zr-V-Fe) material that outperforms lower-quality, pressed-powder NEG cartridges.

They can achieve high pumping speeds in a compact configuration. Each getter cartridge has a built-in heater that directly connects to the flange power feedthrough.

A bakeable connector provides an easy and fast connection to the power supply for activation and monitoring purposes.

SAES GETTERS NEG cartridges deliver the best pumping speeds for all gases when mounted directly inside StarCell VacIon pumps.

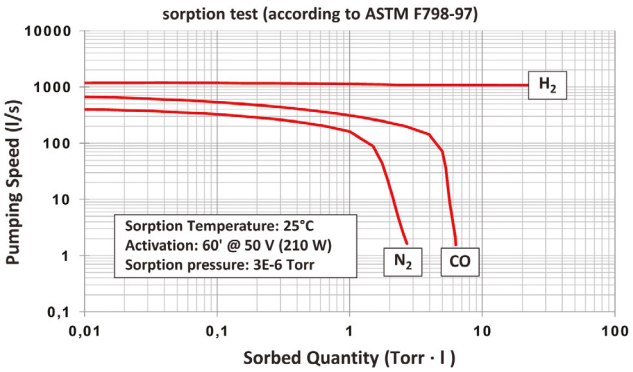
D–1000 cartridge



D–2000 cartridge

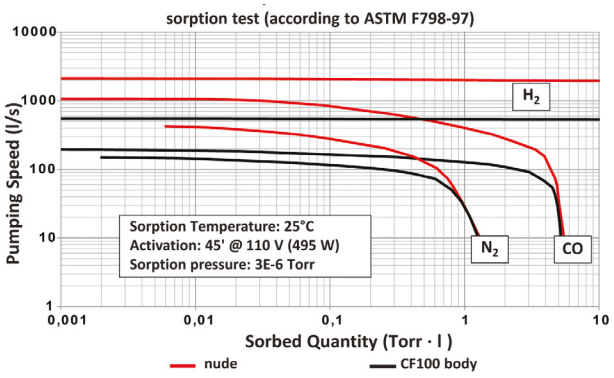
D–1000 pumping speed

CapaciTorr D–1000

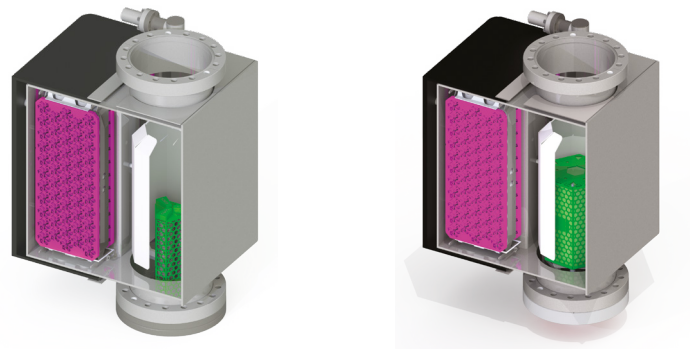


D–2000 pumping speed

CapaciTorr D–2000



Cut-away showing the main pump assembly of the Ion CombiNEG 150-1000 and 150-2000 pumps (StarCell version), with the D–1000 and D–2000 getter pumps mounted.



Technical Specifications

Typical pump characteristics		D–1000	D–2000
Alloy type		St 172	St 172
Alloy composition		ZrVFe	ZrVFe
Getter mass (g)		136	225
Getter surface (cm^2)		1140	1900
Pumping speed (L/s)	H_2	1000	2000
	CO	600	1000
Sorption capacity (Torr • l)	H_2	1360	2250
	CO at 25 °C	4	5
	CO total	1224	2000

Ordering Information

Description	Part number
Ion CombiNEG 150-1000 and 150-2000 pumps	
Ion CombiNeg 150-1000/2000 pump, StarCell, with heater, 120 V	X3606-64060
Ion CombiNeg 150-1000/2000 pump, StarCell, with heater, 230 V	X3606-64061
Note: Diode versions are available on request	
Cables and heaters	
HV radiation resistant cable, 4 m (13 ft), with interlock (for Fischer feedthrough)	9290705
HV radiation resistant cable, 7 m (23 ft), with interlock (for Fischer feedthrough)	9290707
HV radiation resistant cable, 10 m (33 ft), with interlock (for Fischer feedthrough)	9290708
HV radiation resistant cable, 20 m (66 ft), with interlock (for Fischer feedthrough)	9290709
Heater, Ion CombiNEG 150-1000 or 2000 pump, 120 V, 480 W	9190072
Heater, Ion CombiNEG 150-1000 or 2000 pump, 120 V, 480 W	9190073
For part numbers of cables with other feedthrough types, see your local Agilent representative.	

Controllers for Ion CombiNEG pump	Part number
4UHV controller*	
200 W neg	9299010
200 W pos	9299011
IPCMini controller*	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001

Technical Specifications

Cartridge controller characteristics	
Input	
Maximum power	3.5 kW
Supply voltage	110-220 V_{AC}
Frequency	50-60 Hz
Input current	20 A / 110 Vac - 14 A / 230 Vac
Noise at 1 mt	<40 dBA
Mains cord connector	IEC Type 16A 250 V
Output 1-4 at 110 V	
Output power	700 W+overload
Output voltage	0-110 V_{DC}
Overload	110% for one minute
Supply current	10 A

Ordering Information

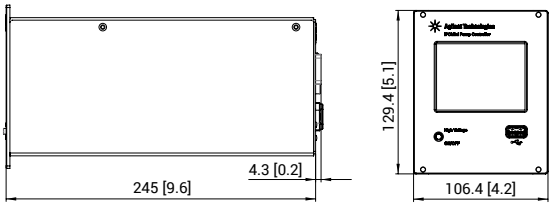
Description	Part number
D–1000 and D–2000 cartridges	
D–1000 NEG Cartridge, with heater	X3605-68012
CF100 base flange with connector (for D–1000)	X3605-68022
Cable (controller to cartridge) for NEG cartridge D–1000, 3 m	X3605-68051
D–2000 NEG cartridge	X3605-68013
CF100 base flange with connector and heater (for D –2000)	X3605-68023
Cable (controller to cartridge) for NEG cartridge D–2000, 3 m	X3605-68052
Cable (controller to cartridge) for NEG Cartridge D–2000, 20 m	X3605-68058
Controller* for NEG cartridge D-1000 and D-2000	X3605-68031
(*) Power cord with Type F (Schuko) plug included	

* Agilent 4UHV and IPCMini ion pump controllers are available in multiple configurations.

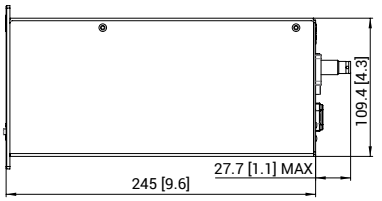
See Pages 68-71 for details.

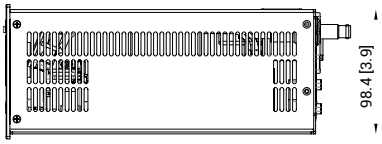
IPCMini ion pump controller

Version with Fischer connector



Version with King (SHV) connector





Dimensions: millimeters (inches)

Innovation at your touch

The IPCMini ion pump controller with intuitive 3.5 in touch panel enables powering, control, and monitoring of ion pumps ranging from 0.2 to 500 L/s, and ensures a completely new user experience.

- Touch screen
- High current resolution (1nA) for accurate reading in the low pressure range
- I/O response time of <30 msec (typical)
- New iSTEP voltage function improves start up in the low pressure range
- Standard quarter rack
- Front panel USB port for data acquisition
- RS-232/485 computer interface, or Ethernet

Technical Specifications

Input	
Voltage:	100 - 240 Vac (±10 %)
Frequency:	50/60 Hz
Power:	160 VA
Output	
High voltage:	± 7000 Vdc (± 5 %)
HV short circuit current:	20 mA
HV power max:	40 W
Operating temperature	0 to 45 °C
Storage temperature	-40 to +70 °C
Voltage measurement	Resolution 100 V (± 5 %)
Current resolution	1 nA
Ripple noise	20 V

Weight	Net 1.9kg (4.2 lb); Shipping 3kg (6.6 lb)
Installation category	II
Max. altitude	2000 m
Pollution degree	2
Communications	RS-232/485 standard - Ethernet optional
Compliance with	
EN 61010-1 2010:	Safety requirements for electrical equipment for measurement, control, and laboratory use
EN 61326-1 2013:	Electrical equipment for measurement, control, and laboratory use - EMC requirements (Cl.A)

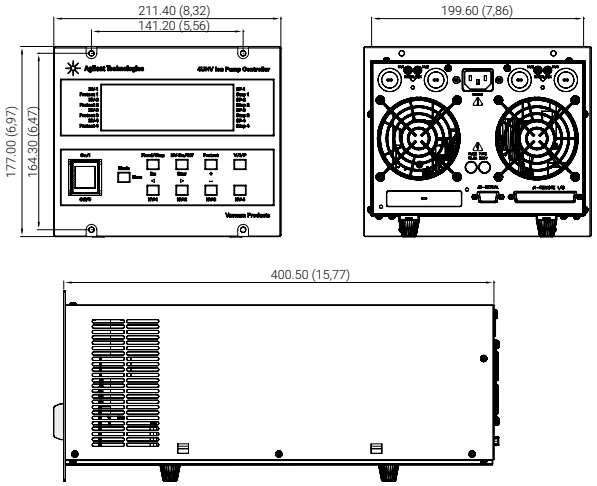
Ordering Information

Description	Part number
Controller selections	
IPCMini basic unit	
IPCMini, 100/240 V Fischer HV, neg	X3602-64000
IPCMini, 100/240 V Fischer HV, pos	X3602-64001
IPCMini, 24 VDC, Fischer HV, neg	X3602-64002
IPCMini, 24 VDC, Fischer HV, pos	X3602-64003
IPCMini, 100/240 V Kings (SHV) HV, neg	X3602-64020
IPCMini, 100/240 V Kings (SHV) HV, pos	X3602-64021
IPCMini, 24 VDC, Kings (SHV) HV, neg	X3602-64022
IPCMini, 24 VDC, Kings (SHV) HV, pos	X3602-64023
IPCMini with Ethernet	
IPCMini, 100/240 V Fischer HV, neg, ETH	X3602-64010
IPCMini, 100/240 V Fischer HV, pos, ETH	X3602-64011
IPCMini, 24 VDC, Fischer HV, neg, ETH	X3602-64012
IPCMini, 24 VDC, Fischer HV, pos, ETH	X3602-64013
IPCMini, 100/240 V Kings (SHV) HV, neg, ETH	X3602-64030
IPCMini, 100/240 V Kings (SHV)HV, pos, ETH	X3602-64031
IPCMini, 24 VDC, Kings (SHV) HV, neg, ETH	X3602-64032
IPCMini, 24 VDC, Kings (SHV) HV, pos, ETH	X3602-64033
Diode, Noble Diode StarCell *Negative or positive? See more on page 70.*	Positive Negative
Accessories	
I/O adapter MiniVac to IPCMini	X3602-68001
Interlock adapter, IPCMini to Safeconn	X3602-68002
RS232 cable, 3 meters, adapts IPCMini DB15 to Minivac DB9 pinouts	X3602-68003
Power cord selection	
Mains cable NEMA plug 3 m (10 ft)	9699958
Mains cable European plug 3 m (10 ft)	9699957
Power cord, China plug 10 A	8121-0723

Ordering Information

Description	Part number
High voltage cables (pump - controller)	
HV cable for miniature pumps, 2.5 m (8 ft) miniature - Kings (SHV)	9240122
HV radiation resistant cable, 4 m (13 ft) Fischer - Kings (SHV)	9290706
HV radiation resistant cable, 4 m (13 ft) Fischer - Fischer	9290705
HV radiation resistant cable, 7 m (23 ft) Fischer - Fischer	9290707
HV radiation resistant cable, 10 m (33 ft) Fischer - Fischer	9290708
HV radiation resistant cable, 20 m (66 ft) Fischer - Fischer	9290709
HV cable bakeable, 4 m (13 ft). Varian StarCell - Fischer	9290710
HV cable bakeable, 4 m (13 ft), Varian Diode - Fischer	9290712
HV cable w/o interlock, 4 m (13 ft) Kings (SHV) - Fischer	9290710M023
HV cable w/o interlock, 7 m (23 ft) Kings (SHV) - Fischer	9290710M024
HV cable w/o interlock, 10 m (33 ft) Kings (SHV) - Fischer	9290710M025
HV cable w/o interlock, 20 m (66 ft) Kings (SHV) - Fischer	9290710M026
Note: Contact Agilent for other cable lengths	

4UHV ion pump controller

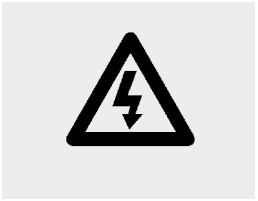


Dimensions: millimeters (inches)

How much power do I need for my ion pumps?

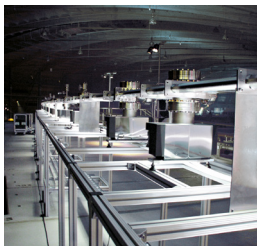
Power requirements depend on the pump size and starting pressure; the larger the pump and higher the starting pressure, the higher the power consumption.

A 1000 L/s ion pump can be easily started with 200 W up to 7 x 10^{-5} mbar, a 500 L/s ion pump can be started with 200 W up to 10^{-5} mbar, while a medium size ion pump (75 L/s) needs less than 80 W to be started at the same pressure. 40 W is sufficient to easily operate a 75 L/s ion pump at 10^{-6} mbar or a 500 L/s ion pump in the typical operating range (below 1x10^{-6} mbar).



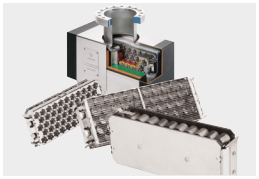
Why was a higher power rating necessary in the past?

In the past, ion pumps were started with the aid of sorption pumps, able to reach only 10^{-4} mbar. As a consequence, much larger and more powerful ion pump controllers were needed. Starting at such high pressures shortened the life of the ion pumps (1 minute of operation at 10^{-4} mbar is equivalent to two months at 10^{-9} mbar).
Today's oil-free turbo pumps, backed by oil-free primary pumps, achieve lower pressures, reducing the starting pressure of the ion pump. This reduces the maximum power requirement of the pump controller and extends the lifetime of the pump.



Negative or positive?

The requirement of negative or positive potential depends on the pumping element installed in the ion pump. Diode style elements (Diode and Noble Diode) need positive voltages, while Triode style elements (old style Triode and StarCell) need negative voltages for operation.



Is a fast response version available?

In addition to the standard 4UHV, the 4UHV Fast Response version can be used whenever the output signal is crucial for triggering a fast response in the acquisition process or to triggering an action (such as closing a valve when a sudden pressure increase is detected).

Technical Specifications

Input voltage	100 - 240 Vac (+/-10 %)
Input frequency	50/60 Hz
Dimensions	400.5 x 211.4 x 177.0 mm (l x w x h)
Display	4 rows with 20 characters
Available configurations	1 x 200 W, 2 x 80 W, 2 x 200 W, 4 x 80 W, 2 x 80 W +1 x 200 W
Minimum configuration	One HV card with 200 W or 2x80 W
Output voltage (open circuit)	3 kV, 5 kV and 7 kV
Output current (short circuit)	40 mA for 80 W channel, 100 mA for 200 W channel
Modes of operation	Local/serial/remote
Front panel readings	Voltage, pressure, current, status
Safety marks	CE, C_CSA_US

Technical Specifications

Current measurement range	10 nA to 100 mA
Input signals	On/off; protect; step mode;
Output signals	Analog out; NC setpoint; NO setpoint
HV connector	Fischer type 105
Output power maximum	400 W
Communications	RS-232/485 standard Profibus or Ethernet optional
Relay and analog output response time	4UHV standard unit: 1 s typical (*) 4UHV fast response unit: 20 ms typical (*) (**)

(*) test performed with a step load from 100nA to 1mA and setpoint set to 1µ.

(**) Warning: Electrical discharges may occur inside the ion pump. To achieve 20 ms response time filtering on the relay and on the analog, the output has been reduced. If, by chance, those discharges last more than 20 ms, the controller could activate the relay and generate a false positive (due to discharges and not to a real pressure increase).

Ordering Information

Description	**Part number**		
4UHV controller*	**Standard**	**Ethernet config.**	**Profibus**
200 W neg	9299010	7299010	8299010
200 W pos	9299011	7299011	8299011
2 x 80 W neg	9299200	7299200	8299200
2 x 80 W pos	9299201	7299201	8299201
2 x 200 W neg	9299020	7299020	8299020
2 x 200 W pos	9299021	7299021	8299021
1 x 200 W pos and 1 x 200 W neg	9299022	7299022	8299022
4 x 80 W neg	9299400	7299400	8299400
4 x 80 W pos	9299401	7299401	8299401
2 x 80 W pos and 2 x 80 W neg	9299402	7299402	8299402
2 x 80 W neg and 1 x 200 W neg	9299210	7299210	8299210
2 x 80 W pos and 1 x 200 W pos	9299211	7299211	8299211
2 x 80 W pos and 1 x 200 W neg	9299212	7299212	8299212
2 x 80 W neg and 1 x 200 W pos	9299213	7299213	8299213

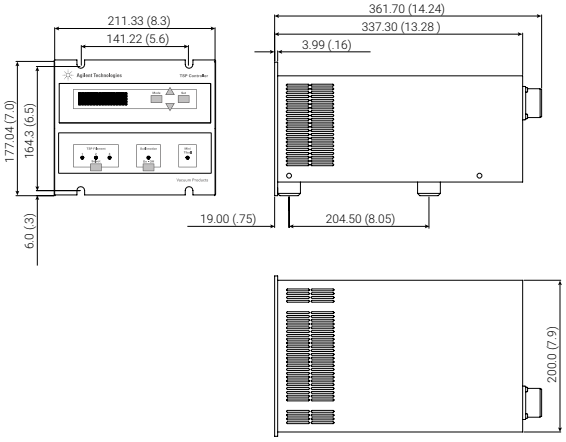
HV Cables	
HV radiation resistant cable, 4 m (13 ft) Fischer - Fischer	9290705
HV radiation resistant cable, 7 m (23 ft) Fischer - Fischer	9290707
HV radiation resistant cable,10 m (33 ft) Fischer - Fischer	9290708
HV radiation resistant cable, 20 m (66 ft) Fischer - Fischer	9290709
HV cable bakeable, 4 m (13 ft). Varian StarCell - Fischer	9290710
HV cable bakeable, 4 m (13 ft), Varian Diode - Fischer	9290712
HV cable w/o interlock, 4 m (13 ft) Kings (SHV) - Fischer	9290710M023
HV cable w/o interlock, 7 m (23 ft) Kings (SHV) - Fischer	9290710M024
HV cable w/o interlock, 10 m (33 ft) Kings (SHV) - Fischer	9290710M025
HV cable w/o interlock, 20 m (66 ft) Kings (SHV) - Fischer	9290710M026

Accessories	
Rack adapter, 19 in	9290064
Mains cable NEMA plug, 3 m (10 ft)	9699958
Mains cable European plug, 3 m (10 ft)	9699957
Power cord, China plug 10 A	8121-0723

** Add M1000 to p/n for fast response units:*
for example, 9299010M1000 is a 4UHV 200 W neg fast response unit

*** The unit does not include the power cable, please order the cable separately.*

TSP controller



Dimensions: millimeters (inches)

The TSP controller, available in compact standard half rack, operates the Agilent TSP filament cartridge. This controller provides 300 W of source power to the cartridge.

Combine the TSP controller, cartridge, and cryopanel for maximum UHV/XHV performance.

- Pump cable lengths of up to 50 m
- Compact design that is half the standard rack width
- Automatic or manual operation
- Remote control via RS-232/485 (standard)
- To operate TSP filament cartridge
- Safety marks: CE, cCSAus

Technical Specifications

Input	100, 120, 220, 240 Vac ±10% 1-phase
Voltage (selectable at the rear of the case)	• 90 to 110 Vac - 1 Ø (use setting 100 Vac) • 110 to 130 Vac - 1 Ø (use setting 120 Vac) • 190 to 230 Vac - 1 Ø (use setting 220 Vac) • 230 to 265 Vac - 1 Ø (use setting 240 Vac)
Frequency:	50/60 Hz
Power consumption	1400 VA (maximum, see note)

Output current	30 to 50 A
Temperature	0 to + 45 °C
Humidity	90% maximum non condensing humidity
Storage temperature	–20 to +70 °C
In compliance with norms	EN 61010-1 EN 61326-1 - Class A (industrial application)

Protection category	IP 20
Internal use only	
Installation category	II
Pollution degree	2
Power cable	3 m – 3 wires Ø AWG14, NEMA plug (only for model 929-0032) – 3 wires Ø 0.75 mm, 2 European plug (only for model 929-0033)
Weight	Net 12 kg (26.5 lb); Shipping 16.5 kg (36.3 lb)

Note: *When the controller is powered by means of a transformer, the transformer power must be at least 3000 VA to avoid a distorting of the power waveform.*

Ordering Information

Controllers*	Part number
Sublimation controller set for 220 Vac	9290033
Sublimation controller set for 110 Vac	9290032
*Power cord included	

Accessories	Part number
Cable for TSP pump (3.5 m)	9240730
Cable for TSP pump (7 m)	9240730M002
Cable for TSP pump (10 m)	9240730M001
Cable for TSP pump (30 m)	9240730M017
Cable for TSP pump (40 m)	9240730M015
Rack adapter	9290064
Mains cable NEMA plug, 3 m (10 ft)	9699958
Mains cable European plug, 3 m (10 ft)	9699957
Power cord, China plug 10 A	8121-0723

Technical Notes

Ion pumping is used to remove gases from systems to create ultrahigh vacuum environments. The earliest evidence of ion pumping was reported by J. Plucker (1858, Germany) who found that it took ever-increasing voltages to maintain a current in a gas discharge tube.

This, he rightly concluded, is due to a reduction of pressure in the tube by some mechanism involving the cathode.

Later, as an offshoot of his work on electrical discharge in gases, F. Penning (1937, Holland) developed a cold cathode ionization gauge for measuring pressures in the range of 10-3 to 10-5 Torr. Due to the sputtering effect of the high voltage, ions were both buried in and “gettered” by the cathode material. (Gettering is the chemical combination of active gases with a suitably reactive substance).

The result of this pumping action was a noticeable pressure reduction. The Penning cell has been used as a commercially available vacuum gauge ever since, but it was not until the late 1950s that its pumping characteristics were exploited, resulting in the invention of the ion pump. This was done to improve the life and performance of microwave tubes by continuous pumping with “appendage” ion pumps.

The invention of the sputter ion pump ushered in the era of ultrahigh vacuum, just in time to make a large contribution to the space age. The availability of vacuum systems that could routinely achieve pressures in the low 10-11 Torr range enhanced R&D efforts. Space hardware and space-compatible materials were tested by simulating many of the conditions they would encounter. Today, ion pumps are used in both research and industrial applications wherever a pristine, oil-free, vibration-free, cost-effective environment is required.

Operation

Vacuum pumps in general operate on the basis
of maintaining a lower gas density within themselves than exists in the environment they are pumping.
This results in a net gas migration into the pump due to the random motion of the molecules under molecular flow conditions. Once in the pumps, few escape and are either displaced or captured, depending on the type of pump.

Rather than being a displacement pump that actually moves molecules of gas through to the atmosphere, the ion pump instead captures and stores them. As a result, at some point, the pump must be reconditioned or replaced.
This is generally required only after many years of use.

The generic name sputter ion pump (or ion getter pump) comes from the fact that some of the gas molecules undergo ionization and cause sputtering of the gettering agent. This material chemically reacts with the active gases to form stable compounds that are deposited on the internal walls of the pump.
The getter, usually titanium, is provided by a plate or electrode of that material, which is in turn sputtered and eroded by gas ions formed under the influence of the high voltage. These electrical potentials are usually in the range of 3,000 to 7,000 Vdc.

Most ionization devices operate in the same way. Gas molecules are bombarded by high-energy electrons. When a collision occurs, a molecule may lose one or more of its own electrons and is thereby left as a positively charged ion.
Under the influence of a strong electric field, the ion is accelerated into the titanium cathode.
The force of this collision is sufficient to cause atoms to be ejected from the cathode and “sputtered” onto the adjacent walls of the pump. Freshly sputtered titanium is extremely reactive and will chemically react with active gases.
The resulting compounds accumulate on the surfaces of the pump elements and walls.

Active gases are those such as oxygen, nitrogen, CO, CO2, and water, as opposed to noble gases like helium, neon, argon, krypton, and xenon, which are nonreactive. The latter are pumped by "ion burial" (ion burial is the "plastering over" of inert gas atoms by the sputtered getter atoms).

The simplest form of ion pump is the Penning cell, which was originally conceived as a cold cathode vacuum gauge. It consists of a central anode wire which is at positive high voltage. In an ion pump the anode can either be a short section of metal tubing or a square, box-like structure, open at each end like a unit of an egg crate. Opposite each open end is a plate of titanium that is connected to the ground to form the cathode structure.

An external permanent magnetic circuit generates a magnetic field, usually ranging from 800 to 2,000 G, parallel to the anode cell axis. A cell configured in this way is said to be a diode pump (Figure 1). It is then packaged in a suitable enclosure and the assembly becomes a pump.

To make a higher speed pump, it is now simply a matter of making a package containing more cells with a larger cathode (Figure 2). The function of the anode cell structure is to contain a "cloud" of high energy electrons, which are constrained by the magnetic field.

This field causes the electrons to move in oscillating spiral paths (Figure 3) that increase their chances of striking gas molecules and thereby create positive ions. These ions are accelerated away from the positive anode voltage and collide with the titanium cathode plates (Figure 3). This results in the removal of titanium atoms by "sputtering".
The sputtered titanium is deposited on the internal surfaces of the pump where it reacts with absorbed active gases to form stable compounds.

The pumping efficiency depends on the electron "cloud" density (which determines the number of ions produced) and on the sputtering yield (which determines the quantity of active getter material produced).

Figure 1

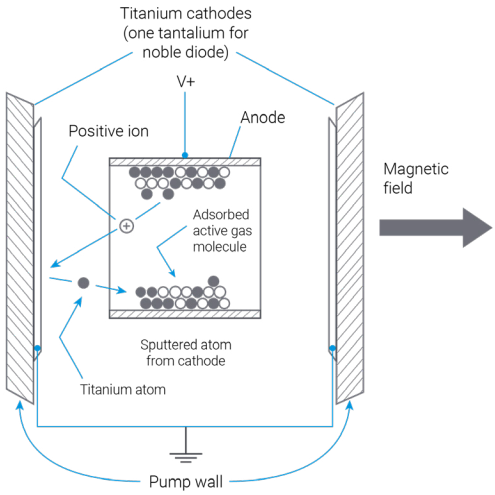


Figure 2

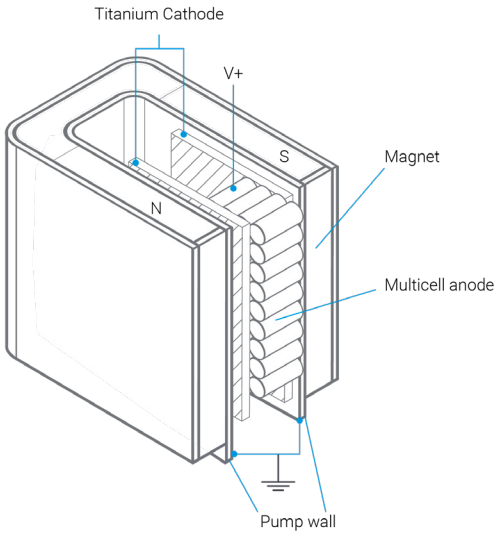
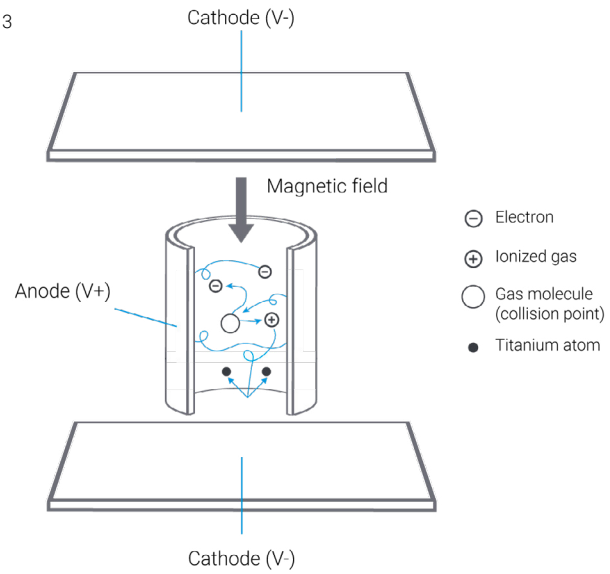


Figure 3



The electron cloud density mainly depends on the Penning cell geometry and the electric and magnetic field strengths. By adjusting these parameters, the pump performance can be modified according to the application. In particular, using an "intelligent" high-voltage power supply, the right voltage can be automatically selected as the pressure changes.

The sputtering efficiency depends on the cathode geometry and material, and on the gas species. Thus the cathode configuration can also be optimized for the gas used in the application. Agilent offers three different cathode configurations that will satisfy many applications involving different gases and operating pressures. It should be noted that a few types of gases do not need to be ionized to be pumped. Hydrogen, for instance, forms a solid solution directly with the titanium cathode plates as well as the sputtered film.
It is the function of the ions to maintain a fresh supply of "gettering" material. In this regard, the ion pump is self-regulating; it only sputters as much getter material as is needed at that particular pressure.

At low pressures, cathode plates are not wasted and electric power is conserved.
Some of the noble gas atoms are pumped as a result of being ionized.

In this case, they are implanted (at least temporarily) in the cathodes by the force of the accelerating voltage. Others are pumped by burial in the sputtered titanium film (Figure 4). Generally, pumping noble gases does not pose a problem because they are present in such small quantities. When it is necessary to deal with considerable amounts of noble gases, a pump of the triode configuration should be used (*Figure 2*).

In the triode pump, the cathode is at negative potential and built with slits that permit grazing incidence sputtering.
As a result, they tend not to be implanted to any appreciable extent and the unsputtering of previously buried noble gases is largely eliminated. Instead, the gases either react with or are buried by the sputtered film on the walls of the pump body and on the anode.

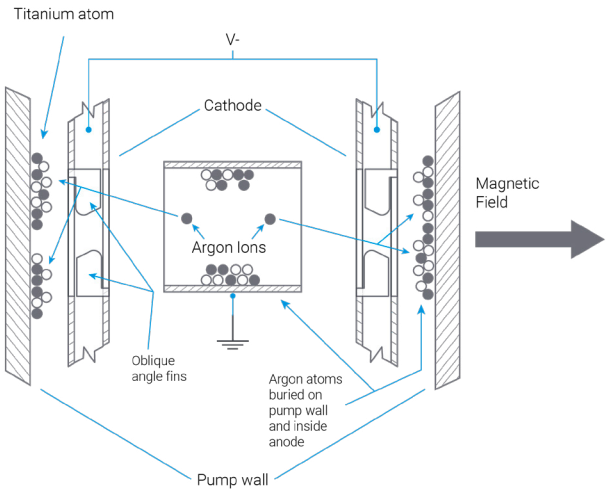
Selecting Vaclon Plus pumps

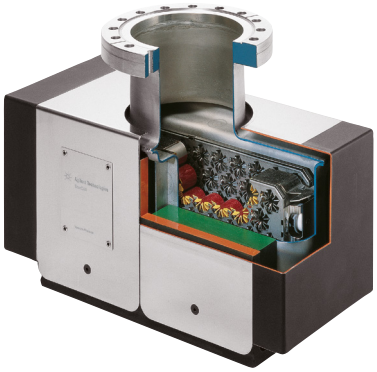
Ion pumps are commonly used to create ultra high vacuum (UHV) and extreme high vacuum (XHV), due to their cleanliness, ability to pump different gases, and maintenance- and vibration-free operation.

Long operating life and ability to read pressure are also important features of ion pumps.

The Vaclon Plus family has been designed to enhance all of these characteristics, and offers the most advanced and valuable solution to any ion pumping requirement.

Figure 4





Ion pump cutaway

Cleanliness

To reach very low pressures (for example 10-11 mbar) in any system, both the chamber and pump outgassing must be minimized. If not cleaned properly, the ion pump itself can be a source of gas at UHV.
To ensure cleanliness, VacIon Plus pumps are factory processed at high temperature in ultraclean vacuum for a thorough outgassing of the body and all internal components.
The cleanliness of the ion pump element at high temperature (450 °C) in ultraclean is even more critical, due to the continuous cathode bombardment. Any gas trapped on the surface or in the bulk of the cathode will eventually be released.

Ion pump outgassing system

The ion pump outgassing system is a fully automated computer controlled thermal process that ensures the ion pumps are UHV clean and verifies they meet the advertised specifications. The bake-out of the pump is done in a nitrogen-controlled atmosphere to protect the external pump body from oxidation.
See Figure 5 for system outline.

The system is based on the principle of thermal outgassing the ion pump internal surfaces through the control of the their intrinsic outgassing. Therefore pressure, not time, is the driving factor of the overall process.
The bake-out time depends on the internal cleaning of the pump components and all the pumps will have, the same final outgassing rate and base pressure.

Figure 6 shows the working principle. The red curve represents the temperature and the yellow curve shows the pressure read by the gauge located on the vacuum control system, placed on the bottom of the outgassing station (see Figure 5).
The temperature is maintained at the setpoint level until the pressure does not change any more, which means the outgassing of the pump for the defined bake-out temperature is completed.

The gas analyser, placed on the vacuum system, provides the spectrum of the different gases degassed by the pump. If H_2 and the other peaks normally present in a well-baked vacuum system exceed the acceptance levels, the pump is baked again. Otherwise, it is pinched off and its base pressure monitored. The base pressure is evaluated through the ion current reading. The current decrease is monitored by the computer, and the pump is ready to be shipped once the base current is reached.

Figure 7 shows the result of the residual gas analysis performed at the end of the bake-out.

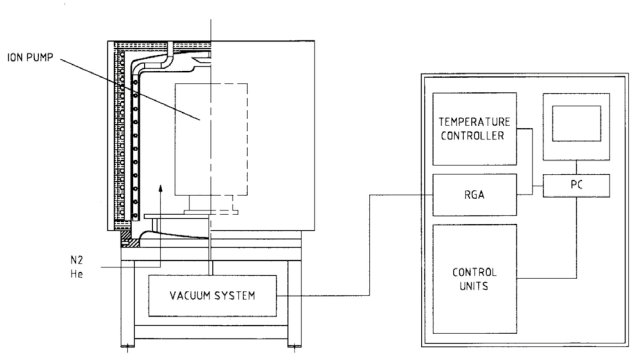


Figure 5: System outline. At the end of the thermal process, once room temperature is achieved, an RGA is performed.

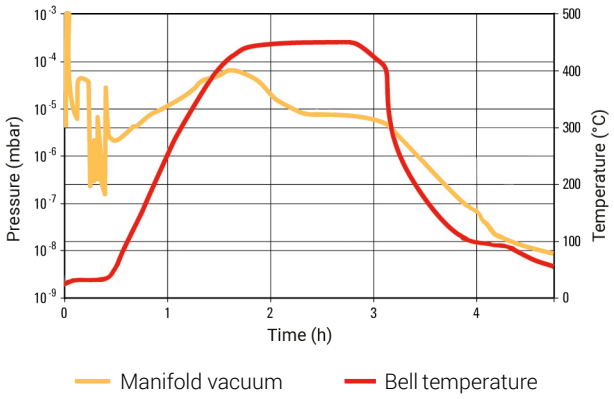


Figure 6: Thermal process working principle

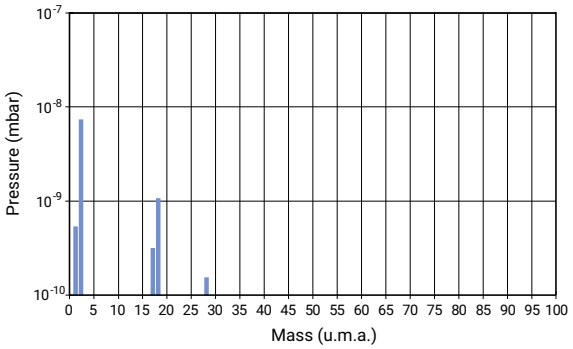


Figure 7: Residual gas analysis

Pumping of different gases

In general, all ion pumps can pump all gases to some degree. To obtain the best performance and base pressure, different types of ion pumps have been developed with optimized performance in different pressure ranges and with different gases.

The Agilent VacIon Plus is a complete product family that offers the choice among three different elements: Diode, Noble Diode, and StarCell. Whatever the application, there is a VacIon Plus pump designed for it.

Long operating life

All VacIon Plus pumps have rated lives in excess of many thousands of hours at a pressure of $1x10^{-6}$ mbar (50,000 hours for the Diode pump, and 80,000 hours for the StarCell).

With many ion pumps, maintenance may be required well before the rated life, due to metallization of insulators or pumping element distortion.

All VacIon Plus elements are designed to minimize cathode distortion (even after repetitive bake-outs and starting at high pressure), and the insulators are protected from sputtered titanium by using a double re-entrant design and a cap shield.

Pressure reading

The ability to read pressures using an ion pump comes from the direct proportionality between pump current and operating pressure. The reliability of readings at very low pressure is limited by leakage current, and the leakage current from field emission is heavily dependent on the voltage applied to the pump.

The 4UHV and IPCMini controllers, designed for use with any VacIon Plus pump, provide the unique ability to adjust the voltage in accordance with the operating pressure. By doing this, the leakage current is minimized at low pressure, providing a reliable pressure reading down to the 10^{-10} mbar range.

Custom design and flexibility

All ion pumps can be mounted in any position and do not need an isolation valve in case of venting or power failure.

VacIon Plus pumps are the most compact ion pumps in each speed range. The pumps can be configured with additional flanges and can accommodate other pumping systems (like titanium sublimation pumps), allowing the best use of available space.

Agilent feedthrough options

An Agilent standard feedthrough is available on all ion pumps, though other common industry feedthroughs are also available.
The innovative Agilent feedthrough provides these significant advantages:

Corrosion free

The design of the feedthrough will drastically reduce corrosion that may occur when the pump is used in humid environments. Our tests and experience have demonstrated that the corrosion starts and increases with the presence of humidity between feedthrough and connector. The high voltage during pump operation ionizes the entrapped water vapor; the ions react with the brazing alloy and corrode it.

Safety against unintentional extraction

When the HV cable connector is inserted into the new patented feedthrough, it is firmly and mechanically secured to it. A latch on the cable prevents disconnection

The design of the standard feedthrough aims to solve these issues:

- The design structure of the feedthrough presents a negligible quantity of air.
- The brazing is done on the vacuum side so that the brazing alloy surface exposed to air is minimal.

High voltage cable interlock

The standard feedthrough has been designed for the “HV cable safety interlock” implementation. This feature avoids any electrical shocks since the voltage is automatically cut off as soon as the cable is disconnected from the pump.

Our ion pump control units (4UHV and IPCMini) and the HV cable are already able to support this safety feature when connected to an ion pump with the feedthrough.

Easy connection

Fitting the cable connector to the feedthrough requires simply inserting and pushing the connector. Retention screws is not required.

Compactness

The standard feedthrough design allows a significant gain of space for the customer.

The VacIon Plus family

Diode Vaclon Plus

The diode version of the Vaclon Plus pump has the highest pumping speed among all ion pumps for oxygen (O_2), nitrogen (N_2), carbon dioxide (CO_2), carbon monoxide (CO), and any other getterable gas. It provides the highest pumping speed and capacity for hydrogen (H_2) as well. Its simple mechanical structure enables a reliable current/pressure reading down to very low pressures, as well as vibration-free operation. The pump's geometric and electrical configuration allows it to be used in the vicinity of electron detectors or similar devices.
Diode Vaclon Plus pumps are therefore widely and successfully used in general purpose UHV systems, for evacuating electron devices and in the most sensitive electron microscopes. However, diode pumps are not suggested for applications where noble gases such as argon (Ar), helium (He), and methane (CH_4) are to be pumped.

Noble Diode Vaclon Plus

The Noble Diode Vaclon Plus element is a version of the diode element, in which one of the titanium cathodes is replaced by a cathode in tantalum. This substitution allows for higher pumping speeds and stability for pumping noble gases (mainly argon and helium). The element is otherwise equivalent to the Diode Vaclon Plus.

Noble Diode Vaclon Plus pumps are used in any application where pumping of noble gases is an important characteristic. As with the diode configuration, the Noble Diode retains a consistent pumping speeds for all gases at very low pressures. However, pumping speed for H_2 and getterable gases are lower than for the corresponding Diode.

The Noble Diode Vaclon Plus is typically used in UHV applications where a mixture of gas is to be pumped and where the pressure is quite constant (for example, no sudden gas bursts or systematic high pressure cycling).

Its characteristics of consistent speed for almost any gas, even at very low pressures, make it ideal for whenever the ion pump alone is used to obtain UHV pressures. This is often the situation in particle accelerators or synchrotron rings, as well as in surface analysis applications.

Other Vaclon Plus versions are suggested whenever the application requires cycling to higher pressures, pumping large amounts of H_2, or when the ion pump is combined with other UHV pumps, such as titanium sublimation pumps or nonevaporable getters.

StarCell Vaclon Plus

The StarCell Vaclon Plus element is the latest variation of the Triode configuration. Its design makes this ion pump the only one that can handle a high amount of noble gases (better than the Noble Diode) and hydrogen (comparable to the Diode). The pump also provides the highest speed and capacity for methane, argon, and helium.
Its high total capacity for all the different gases, together with its good speed performance at relatively higher pressures, makes the StarCell Vaclon Plus ideal for applications requiring constant operation at 10^{-8} mbar or above. This typically includes electron microscopes and mass spectrometers.

Its high pumping speed for argon, helium, and methane (the highest of any ion pump at any pressure) has made StarCell the standard for any application where the ion pump is used in combination with TSP or NEG pumps, where its pumping performance is enhanced.

The lowest attainable pressure has been obtained with combinations of StarCell Vaclon Plus and TSP/NEG pumps, thanks to the optimized characteristics of these combinations.

Most existing particle accelerators and synchrotron sources, beam lines, transfer lines, and similar devices have used and are successfully using these combinations to obtain the maximum speed for all gas species.

For more specific information regarding the pumping speeds for different element configurations relevant to different gases, see the curves published in the Vaclon Plus pumping speed section. The aim of this section is to help you choose the best Vaclon Plus configuration. Whatever the application, there is a Vaclon Plus version suited for it.

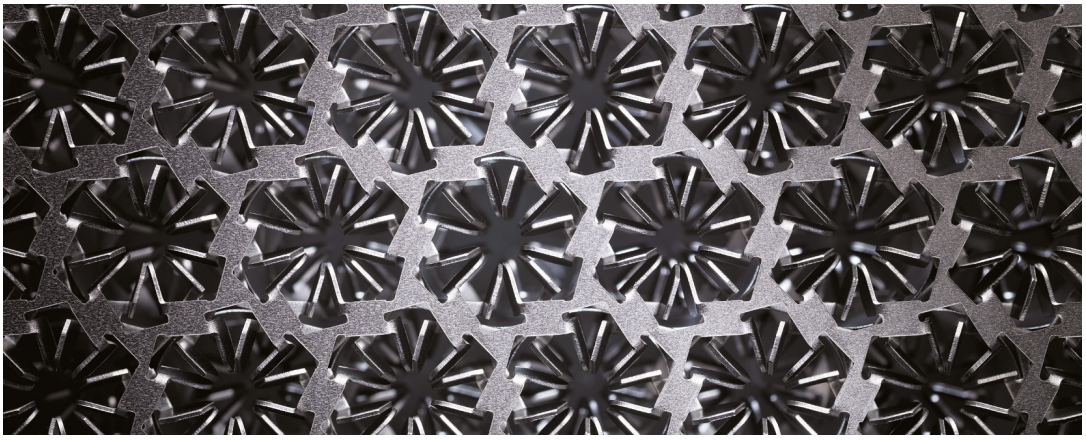


Figure 9 - StarCell pumping element

Do not hesitate to contact your local Agilent representative if you need more assistance in making the right choice.

For Vaclon Plus and NEG integrated pumps,
please ask Agilent for a special quotation.

VacIon Plus pumping speed

The most common parameter used to express the capability of a pump to remove molecules from a given volume is pumping speed. It is usually measured in liters per second and expresses the volume of gas (at a given pressure) removed per time unit.

In an ion pump, the net pumping effect results from the sum of different phenomena:

- The pumping action of the getter film produced by the sputtering of cathode material from ion bombardment.
- • The pumping action due to the ion implantation and diffusion into the cathode.
- • Gas burial on the anodes and pump walls.
- • The gas re-emission from the cathode due to cathode heating and erosion.

When an ion pump is new or has been regenerated, for example by baking, the surface layer of the cathode is clean and the gas re-emission from it is negligible. In this condition, the ion pump is called “unsaturated” and the pumping effect is due to the gettering effect, and ion implantation and diffusion. As the number of gas molecules implanted into the cathode increases, the re-emission due to ion bombardment increases.

As a consequence, the net pumping speed decreases until an equilibrium condition between ion implantation and gas re-emission is reached. In this condition, the ion pump is “saturated” and the net pumping speed, due only to the gettering action of the material sputtered from the cathode, is about half the pumping speed of the unsaturated pump.

Since the saturation effect depends on the quantity of gas molecules implanted into the cathode, the time required to saturate an ion pump is inversely proportional to the pressure at which the pump is operated. Thus, the lower the pressure, the longer the time before the pump saturation occurs (Figure 10).

In an ion pumped UHV system with a proper bakeout procedure (and consequent pump regeneration), a pressure in the 10^{-11} mbar range is possible. At this pressure, the ion pump will work at higher (unsaturated) pumping speed values for a few years before it is saturated.
When pump saturation is reached, the pumping speed is constant and no longer depends on the quantity of pumped gas. The values of the pumping speed curve after saturation are the lowest obtainable at any given pressure.

Generally, the ion pump works in an intermediate condition between the unsaturated and saturated extremes. The “nominal” pumping speed is defined as the maximum point on the pumping speed curve for a saturated pump; the reference gas is usually nitrogen.

The nominal pumping speed therefore defines only a part of the characteristics of an ion pump. A more comprehensive description of an ion pump performance is given by the complete pumping speed vs pressure curve. By using these plots and keeping in mind the application, the best pump can be chosen.

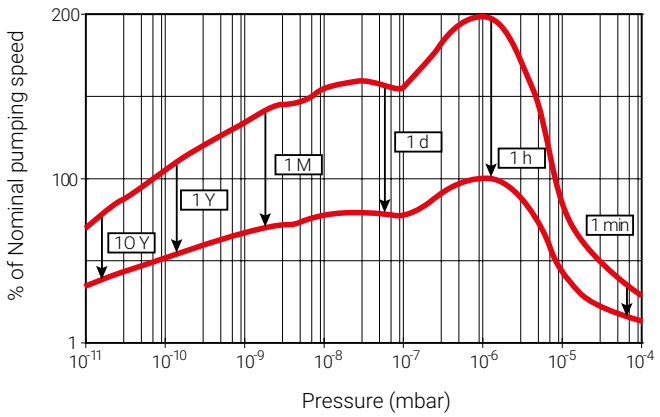


Figure 10: Saturation effect

Active gases (N_2, O_2, CO, CO_2, and others)

A characteristic of these gases is their ability to easily react with most metals forming stable compounds. In an ion pump, these active gas molecules react with the fresh titanium film produced by the sputtering of the cathode material. These active gas molecules do not diffuse deeply in the cathode.

The saturation effect, due to the re-emission of these molecules trapped on the cathode surface, is very strong.

Diode and Noble Diode elements show a higher pumping speed at low pressure, while StarCell elements perform better at higher pressure, because the Penning discharge is better confined inside the element (Figures 11, 12).

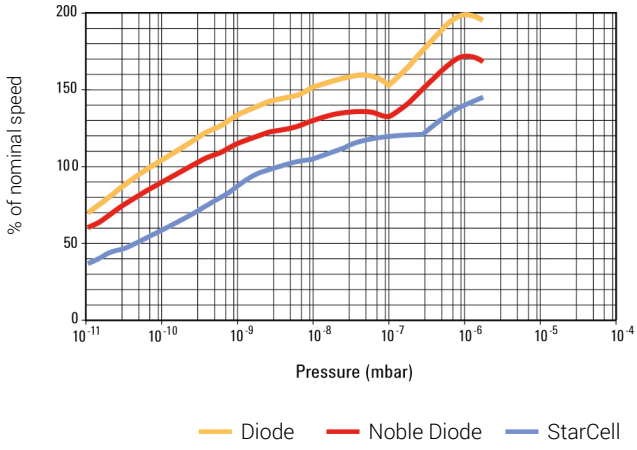


Figure 11 - Nitrogen pumping speed before saturation

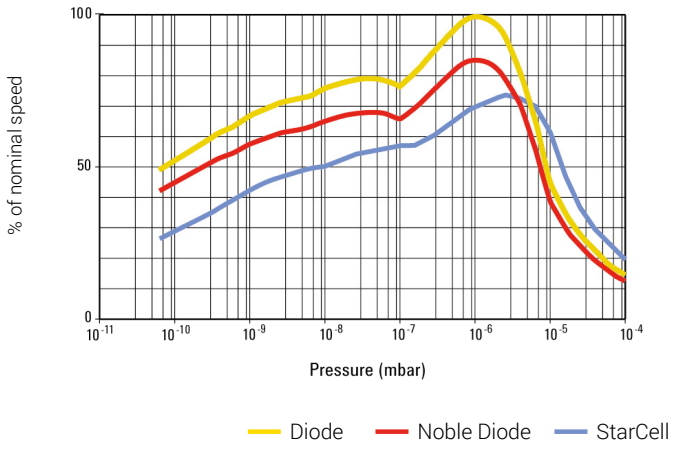


Figure 12 - Nitrogen pumping speed after saturation

Hydrogen

Hydrogen is an active gas but, due to its small mass, the sputtering rate is very low. Despite this, the pumping speed for H_2 is very high because it quickly diffuses into the cathode with negligible re-emission.
When pumping H_2, the ion pump always works in the unsaturated condition. As a result, the nominal speed for H_2 is about twice the corresponding value for nitrogen.

Furthermore, if some traces of heavier gases are present, the increased sputtering rate produces an even higher hydrogen pumping speed.

The Diode element shows a higher pumping speed than the Noble Diode since the H_2 solubility in the tantalum cathode is lower than in a titanium cathode. StarCell elements combine good performance at higher pressures with enhanced capacity for H_2.

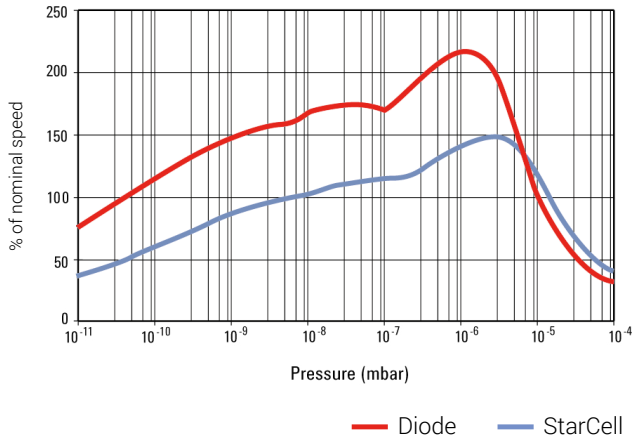


Figure 13 - Hydrogen pumping speed

Noble gases (He, Ne, Ar, and others)

The main characteristic of noble gases is that they do not react with any other element.
Therefore, the film produced by the sputtering of cathode material does not provide getter pumping for helium and argon. Moreover, since these gases do not tend to diffuse into the cathode, the pumping effect due to the ion implantation is not permanent. Nevertheless, all ion pump elements have some capacity to remove these gases.

Noble gases are pumped by being buried by titanium. Noble gas ions can be neutralized and scattered from the cathode without losing their energy. These neutral atoms maintain enough energy to implant or stick on the anode and on the pump walls where they will be buried by sputtered titanium and thus permanently pumped.

In the Diode configuration, the neutralization and back scattering probability is very small, thus the pumping speed for noble gases is only a small percentage of the N_2 pumping speed. Moreover, when operating at a relatively high argon partial pressure (for example, higher than 10^{-8} mbar), sudden bursts of pressure due to the re-emission of temporarily implanted argon in the cathode are observed. After this occurs, a Diode pump is not able to pump more argon until its source is stopped. This phenomenon is known as “argon instability”.

Figure 15 shows that the StarCell pump is superior in comparison to diode pumps with differential cathodes.
The test was performed on a 75 L/s ion pump, at 10^{-5} mbar. The differential cathode diode showed instability after pumping argon for less than 10 hours, while the StarCell remained stable after pumping argon for more than 100 hours.
The gas pumped prior to instability occurrence corresponds to 3 mbar/L for a Diode element and to 70 mbar/L for a StarCell element, proving that the StarCell element is ideal for pumping non-getterable gases.

In the Noble Diode element, one titanium cathode is replaced with one tantalum cathode. The high nuclear mass of tantalum increases the back-scattering probability and consequently the pumping speed for noble gases also increases.

The best results for noble gas pumping speeds are obtained using the open cathode structure typical of StarCell elements. In these configurations, the flat cathode structure has been replaced with a structure that allows glancing collisions with ions.

These are neutralized and then forward scattered toward the pump wall or the anode with a much higher probability than in the flat cathode case. The result is a pumping speed for noble gases of up to 60% of N_2.

Due to the unique design that allows optimal use of all available titanium, the operating life of a StarCell pump is about 50% longer than all other pumps.

Figure 14 - Argon and helium pumping speed

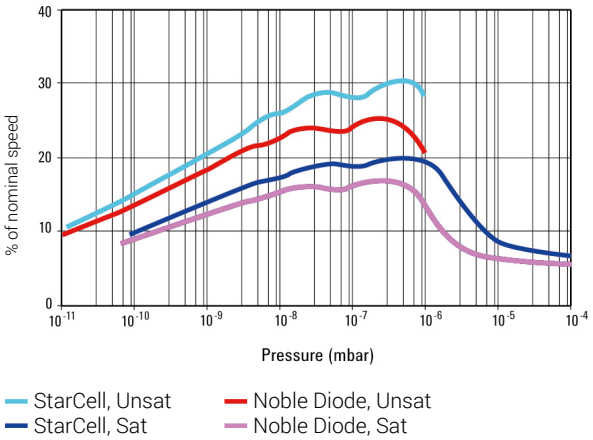
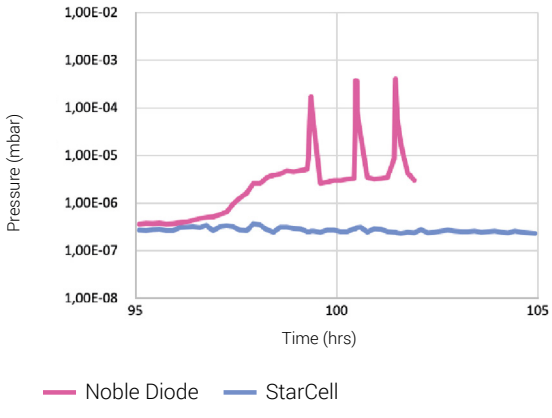


Fig. 15 - Pressure vs time with argon gas flow of 1E-5 mbar l/s



Methane

Although methane is not a noble gas, it does not react with any getter material. It is always present to some degree in UHV systems as a reaction product of hydrogen and carbon present in the vacuum system walls. Methane is a particular problem in electron accelerators where it is the main cause of beam decay.

Due to the Penning discharge in ion pumps, the methane molecule (as well as other hydrocarbon molecules) is cracked and transformed into smaller getterable compounds (C, CH_3, H).

The result is that the pumping speed for methane and light hydrocarbons is always higher than the speed for N_2.

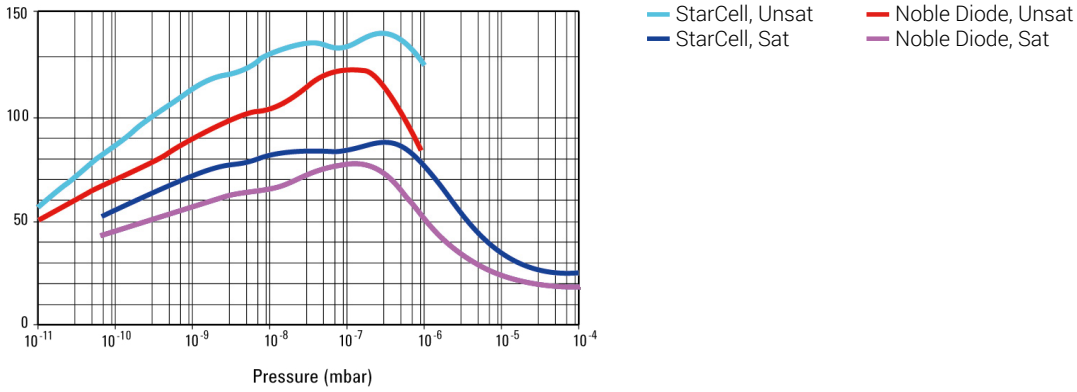


Figure 16 - Methane pumping speed

Basic performance factors

Pumping speed, as in the case of any high vacuum pump, is one of the factors determining the ultimate (base) pressure of a system. However, ion pumps pump various gases at different rates – from very fast for hydrogen to quite slow for argon. It is therefore necessary to check the specifications to ensure the pump matches the application. The pump history (in terms of gas load after a bakeout) also influences pumping speed. Agilent pumps are rated by their equilibrium or "saturated" speed levels.
Unsaturated pumps temporarily deliver higher speeds, especially at UHV.
A typical pumping speed vs pressure curve is shown on Page 69.

Maximum throughput of an ion pump is located in the 10-4 to 10-5 mbar pressure range. Since ion pumps are generally operated at much lower pressures, throughput is generally not a major consideration.

Starting pressure is the pressure to which the ion pump must first be rough-pumped before the glow discharge will be confined to the anode cell structure and the pumping effect begins. To prevent the pump from overheating and any possible damage when the pump is saturated at higher pressure, the controllers automatically reduce the output voltage to maintain power below a safety level.

Pump life is determined by various factors, including cathode life; this is limited by cathode erosion, which is proportional to the average operating pressure. At 10^{-6} mbar, cathode life ranges from 35,000 to 80,000 hours.

Bakeability. In general, baking a UHV system and its ion pump at 200 to 250 °C generates adequate outgassing to attain low pressures after atmospheric exposure.
Some processes require higher bakeout temperatures.
In general, ion pump bodies can be baked at 450 °C when the magnets are removed, or 350 °C when the magnets are on the pump. When bakeable cables are connected to the ion pumps, the temperature should not exceed 220 °C.

Titanium sublimation pumps

Thin films of reactive materials have been used for "gas cleanup" or "gettering" for over a century.
The early electron tube makers were only able to mechanically pump to about $1x10^{-4}$ mbar, but through the use of "getters" flashed on the internal surfaces, pressures in the low 10^{-7} mbar scale were attained. These getters were typically metals like barium, titanium, zirconium, or thorium. Gettering materials are still used in tubes today even though pressures of $1x10^{-8}$ mbar are readily attained by the pumps in the manufacturing process.

Gettering was not employed extensively in vacuum systems until the 1960s, when it was found to be highly compatible with ion pumping. Titanium was the metal commonly used because of its availability and its ability to sublime readily over a moderate temperature range.

Titanium sublimation pumps -Basic performance factors

Pumping Speed. The pumping speed of a Ti film is proportional to the film area and to the sticking coefficient.
This is the probability that an impinging gas molecule reacts with Ti forming a stable compound.

The pumping speed of Titanium films are reported in Table 1. Using these coefficients, the intrinsic pumping speed (Si) of a Ti film can be evaluated using the following equation:

Si[L/s] = coefficient x surface.

As the gas molecules react with the surface Ti atoms, the number of active sites decreases and, as a consequence, the pumping speed decreases. A plot of the specific pumping speed vs time at different pressures is reported in Figure 17. Using this plot, it is possible to estimate how frequently the Ti film has to be renewed.

Note: that the actual pumping speed (S) of a TSP depends on the conductance (C) between the active surface and the vacuum vessel according to the following equation:

1/S = 1/C + 1/Si

Throughput. When the impingement rate of the gas molecules on the active film becomes higher than the Ti sublimation rate (excess of gas molecules respect the available Ti atoms), the pumping speed does not depend on the sticking coefficient any more.

It is simply controlled by the quantity of available Ti atoms according to the stoichiometric reaction.

If n Ti atoms need to pump a gas molecule (example: $2Ti + N_2 = 2TiN$, n=2), the gas throughput Q is given by:

$$Q\ [\text{mbar L/s}] = \frac{0.13}{n} R \left[\frac{gr}{h}\right]$$

Applications

Due to cleanliness, bakeability, low power consumption, vibration-free operation, long pumping life, and high pumping speed, titanium sublimation pumping (TSP) is the ideal cost-effective companion to ion pumping in ultrahigh vacuum.

Applications for this pumping mode are found in many areas, such as:

- Auger electron spectrometry
- Electron spectroscopy for chemical analysis
- Electron tube manufacturing
- Mass spectrometers
- Materials science conductor R&D
- Nuclear physics
- Outer space simulation
- Particle accelerators
- Secondary ion mass spectroscopy
- Solid state semiconductors

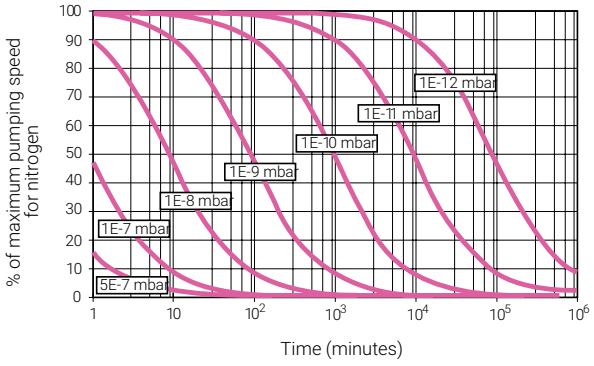


Figure 17 - Pumping speed vs time at different pressures

Table 1 Typical pumping speeds per square inch (per square centimeter) of titanium sublimation surface for various gases (L/s)

Gas		H_2	N_2	O_2	CO	CO_2	H_2O	CH_4	Ar	He
Surface temperature	20 °C	20 (3.1)	30 (4.7)	60 (9.3)	60 (9.3)	50 (7.8)	20 (3.1)	0	0	0
Surface temperature	–195 °C	65 (10.1)	65 (10.1)	70 (10.9)	70 (10.9)	60 (9.3)	90 (13.9)	0	0	0

Titanium sublimation pumps - Basic performance factors

Where R is the Ti sublimation rate, in this condition, the pumping speed is not constant but it depends on the pressure and is directly proportional to the sublimation rate (Figure 18).

The overall performance of a titanium sublimation pump is a function of several variables, including gas species, pressure, gas temperature, getter film temperature, getter film area, the geometry of the area, sublimation rate, sticking coefficient, and the conductance from the film to the area being evacuated. For further information, see "Predicting and Evaluating Titanium Sublimation Pump Performance" by D.J. Harra, 1974 (Vacuum Report VR-88).

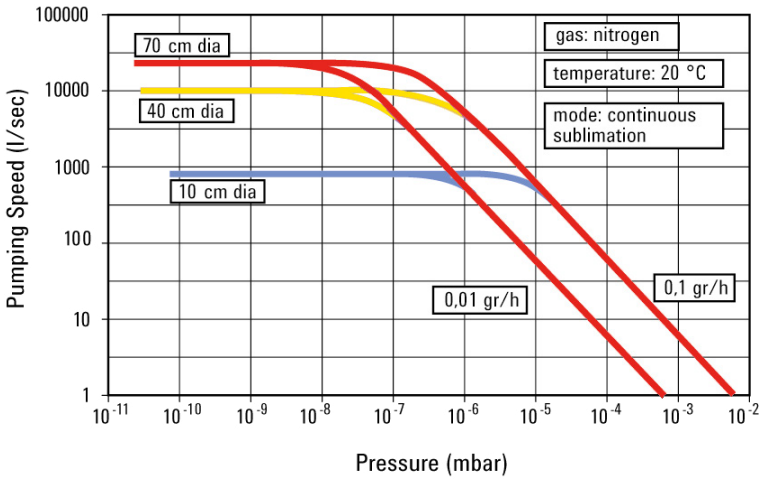


Figure 18 - Pumping speed vs pressure

Operation

- All sources are mounted on Agilent 2.75 in ConFlat Flanges and fit through 1.50 in ports.
- The three-filament source contains 3.3 g of useful titanium.

Operation

Titanium sublimation pumping is accomplished by coating the inner surfaces of a vacuum system with sublimed titanium films. Since it involves a chemical reaction, this kind of pumping is useful where mainly active gases are present.

The pumping speed of a unit area varies with different reactive gas species, as shown in the following table. It can also be seen that cooling the substrate to liquid nitrogen temperature markedly increases the speed for hydrogen and water.

The gases that are "gettered" form stable compounds with titanium and are stored in the system until they are removed by cleaning. Since there is generally unreacted pyrophoric titanium buried in the deposits, caution should be used when cleaning. If the desired gas throughput is known (Q = pumping speed x pressure) the maximum theoretical operating time is given by:

$$\text{Operating time [h]} = \frac{0.13}{n} \frac{T\,[gr]}{Q\,[mbar\ L/s]}$$

Where T is the usable titanium.

For example, using our cryopanel at 1 x 10^{-8} mbar with a three-filaments cartridge Ti source, the theoretical operating time is given by:

$$\frac{0.13}{2} \quad \frac{3.6\,[gr]}{500\,[L/s] \times 10^{-8}\,[mbar]} = 46{,}800\ h = \text{about 5 years}$$

After this time, the filament cartridge should be replaced.

Agilent Ion Pump Service and Support Plan

Agilent Vacuum Technologies offers one of the most comprehensive service and support plans in the industry.

As a worldwide company we strive to offer added value to our customers wherever they may be located. Excellence in service and support is a key factor in added value.

Support can be accomplished with qualified engineers and an appropriate logistic infrastructure. Technical skills and infrastructure are two areas where we are continuously making long-term investments.

Our daily customer support philosophy is focused on two important factors: quick response and no hassle. Agilent Vacuum Products is committed to providing our customers with the most comprehensive service plans possible.
This pages shows the standard sections of our ion pump service and support plan.

For more information, or if you need customized solutions, please contact your Agilent representative. Excellent products are often not enough: Agilent's constant customer service presence as a responsive partner is what really make a difference.

Exchange and repair programs

The Agilent ion pumps and controllers enable unmatched reliability, performance and cleanliness.

To maximize uptime, and for those occasions where time is essential, Agilent offers ion pump controller exchange units for advance shipment.

Exchange units are fully remanufactured to the same strict standards as new products.

Overnight shipping is available in select locations.

The repair program is available for those situations where control of assets is important and when the requested turnaround time is less critical.

The exchange and repair programs allow global OEMs and end-users consistent delivery time, pricing, part numbers, and order processing procedures.

To order Exchange products, contact your local Agilent Vacuum Products representative.

End user extended warranty

The end-user extended warranty is a service agreement that provides coverage extension beyond the standard 12 month warranty of a product. It covers you for an additional 12 months for failures due to material and crafting defects.

By extending the warranty of purchased products, post-sales satisfaction is guaranteed. This is the result of the relevant cost decrease while cost predictability is increased.

The end-user extended warranty has been designed to cover the needs of the high energy physics ultrahigh vacuum applications.

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Technical assistance

As an Agilent customer, you can rely on an attentive and professional support staff, dedicated to providing you with the easiest and most personalized service possible.

Customer support

Our toll-free lines, with native language technical support engineers at worldwide locations, allow us to provide you with quick, corrective responses for your needs.

Whenever a new problem is identified and solved by our support personnel, it is entered into our technical support system and becomes available to all Agilent technical support centers.

This system allows all Agilent locations to provide excellent first-and second-level technical support to customers worldwide. In addition, the technical support centers are in daily contact with our R&D departments for a third level of support.

Application support - application training

Agilent has a leadership position in vacuum technology and we continuously search for innovative solutions through research and development.

To meet the most demanding needs, our application engineer team can bring our knowledge into your factory.

Application support is a project-based activity where our experts assist you towards the solution of your application issues that might arise both at pre- and postsale levels.

By designing solutions that meet customers needs, Agilent aims to create a positive and synergetic relationship with customers.

Our experts can keep you well-informed and up-to-date on industrial and scientific applications with the goal of optimizing the use of our products on your system, as well as the development of new vacuum techniques.

Call us today for more information

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