Ultra High Vacuum Pumps

TiTan™ Ion Pumps

BOOSTIVAC™
Titanium Sublimation Pumping (TSP)
Non-evaporable Getter (NEG)

DIGITEL™
Ion Pump Controllers
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### Ultra High Vacuum Pumps

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TiTan™ Ion Pumps

Ion pumps are used in a wide variety of high and ultra-high vacuum (UHV) environments. They can reach the lowest possible vacuum for an economical cost. In addition, ion pumps have some technical advantages over other technologies:

**Advantage for the User**
- Vibration free operation
- Low operational cost
- Bakeable
- Low maintenance
- Pressure indication
- Permanent gas capture
- Radiation tolerance
- Long operational life
- Non-contaminating technology

**Characteristics**

**Lifetime**
All Gamma Vacuum ion pumps are designed to operate for 45,000 – 50,000 hours at 1 x 10^{-6} mbar. Lifetime increases linearly with decreased pressure. At 1 x 10^{-8}, for example, an ion pump can last for many years.

**Ultimate Pressure**
Ion pumps are capable of reaching pressures below 1 x 10^{-10} mbar. Ultimate pressure of an ion pump is dictated by overall system conditions and materials.

**Vacuum Processing**
Ion pumps are shipped under vacuum at pressures less than 1 x 10^{-10} mbar. Certificates of conformance are provided and record all leak check points and pump characteristic values. RGA scans can be provided upon request.

**Port Configurations**
Each ion pump can be configured with a variety of pumping port options. Additional ports are available in most designs on the top, bottom, or side and can accommodate TSP or non-evaporable getter (NEG) modules.

**Feedthroughs**
Gamma Vacuum has standardized on the commercially available 10kV SHV feedthrough since 1996. For legacy purposes, alternate feedthroughs are available.

**Heaters**
Integrated heaters can be added to ion pumps for economical and efficient baking.

**Cables**
In addition to incorporating the SAFECONN interlock system, high voltage cables are made of flexible silicone materials that are bakeable and have high radiation tolerance.
## Ion Pump Applications

<table>
<thead>
<tr>
<th>Ion Pump Size</th>
<th>2 – 3</th>
<th>3 – 20</th>
<th>20 – 75</th>
<th>100+</th>
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<tr>
<td><strong>Application</strong></td>
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<td><strong>Industry and Medical Processes</strong></td>
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<tr>
<td>Radar</td>
<td>■</td>
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<td>Traveling Wave Tubes (TWT)</td>
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<td>Klystrons</td>
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<td>X-Ray Tube Evacuation</td>
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<td>X-Ray Sources</td>
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<tr>
<td>Treatment &amp; Diagnostics</td>
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<td><strong>Semiconductor</strong></td>
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<tr>
<td>Critical Dimension SEM (CD SEM)</td>
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<td><strong>Instrumentation</strong></td>
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<tr>
<td>Electron Microscopes (SEM/TEM)</td>
<td>■</td>
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<tr>
<td>Focused Ion Beam (FIB)</td>
<td>■</td>
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<tr>
<td>Scanning Probe Microscope (SPM)</td>
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<tr>
<td>Surface Analysis (AES, XPS, SIMS, EDX)</td>
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<td>Mass Spectrometry (MS)</td>
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<td>Molecular Beam Epitaxy (MBE)</td>
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<td><strong>High Energy Physics</strong></td>
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<td>Accelerators</td>
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<td>Boosters</td>
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<td></td>
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<tr>
<td>Storage Rings</td>
<td>■</td>
<td>■</td>
<td></td>
<td></td>
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<tr>
<td>Front Ends</td>
<td>■</td>
<td>■</td>
<td></td>
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<tr>
<td>Beam Lines</td>
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<td>End Stations</td>
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<tr>
<td>Free Electron Lasers (FEL)</td>
<td>■</td>
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<tr>
<td>Laser Interferometers</td>
<td>■</td>
<td>■</td>
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</tr>
</tbody>
</table>
Small Ion Pumps (MINI – 75S)

Small ion pumps come in a wide variety of sizes and configurations. Gamma Vacuum maintains stock of the most common configurations for same-day shipping. These pumps have the added advantage that they can be mounted in any orientation without additional support.

Low Profile Ion Pumps (100L – 1200LX)

Low Profile ion pumps are under 12 in. (300 mm) high for standard configurations. The closed magnetic loop of these pumps reduces the stray magnetic field created by the pump making these pumps ideal for any type of charged particle application.

Tall Profile Ion Pumps (150TV – 600TV)

Tall Profile ion pumps are designed for mounting in narrow locations and matching competitive dimensions. These pumps are built to order and designed to fit into locations where a Low Profile ion pump might not fit.

TiTan Ion Pump Elements

TiTan™ ion pump elements are “tuned” for specific pumping applications. Surfaces are chemically processed to remove potential surface contaminants and provide maximum adhesion for extended lifetime. Ceramics are optimally shielded to reduce exposure to sputtered material.

- TiTan™ CV (Conventional)
  – two titanium cathodes for high pumping speed of reactive gases.

- TiTan™ DI (Differential)
  – a titanium and tantalum cathode for maintained pumping speeds of reactive gases and long term stability of noble gases.

- TiTan™ TR
  – classic triode element for higher pressure operation
## Technical Data and Ordering Information

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Pumping Speed l/s</th>
<th>Inlet Flange</th>
<th>Dimensions L x W x H (mm (inch))</th>
<th>Weight kg (lbs)</th>
<th>On Request</th>
</tr>
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<tbody>
<tr>
<td><strong>Small Ion Pumps</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>MINI</td>
<td>0.2</td>
<td>DN 16 CF</td>
<td>38 x 51 x 38 (1.5 x 2.0 x 1.5)</td>
<td>0.35 (0.8)</td>
<td>on request</td>
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<tr>
<td>3S</td>
<td>2 – 3</td>
<td>DN 16 CF</td>
<td>45 x 108 x 41 (1.8 x 4.3 x 1.6)</td>
<td>0.45 (1.0)</td>
<td>on request</td>
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<tr>
<td>10S</td>
<td>8 – 10</td>
<td>DN 40 CF</td>
<td>113 x 214 x 152 (4.4 x 8.4 x 6.0)</td>
<td>6 (13)</td>
<td>on request</td>
</tr>
<tr>
<td>25S</td>
<td>15 – 20</td>
<td>DN 40 CF</td>
<td>25 x 130 x 202 (4.9 x 5.1 x 8.0)</td>
<td>9 (20)</td>
<td>on request</td>
</tr>
<tr>
<td>45S</td>
<td>30 – 40</td>
<td>DN 40 CF</td>
<td>251 x 130 x 202 (9.9 x 5.1 x 8.0)</td>
<td>16 (34)</td>
<td>on request</td>
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<tr>
<td>75S</td>
<td>40 – 75</td>
<td>DN 40 CF</td>
<td>242 x 130 x 277 (9.5 x 5.1 x 10.9)</td>
<td>22 (48)</td>
<td>on request</td>
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<tr>
<td><strong>Low Profile Ion Pumps</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100L</td>
<td>80 – 100</td>
<td>DN 100 CF DN 160 CF</td>
<td>328 x 294 x 294 (12.9 x 11.6 x 11.6)</td>
<td>29 (62)</td>
<td>on request</td>
</tr>
<tr>
<td>200L</td>
<td>160 – 200</td>
<td>DN 100 CF DN 160 CF</td>
<td>413 x 233 x 325 (16.3 x 9.2 x 12.8)</td>
<td>50 (112)</td>
<td>on request</td>
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<tr>
<td>300L</td>
<td>240 – 300</td>
<td>DN 160 CF</td>
<td>413 x 337 x 325 (16.3 x 13.3 x 12.8)</td>
<td>66 (145)</td>
<td>on request</td>
</tr>
<tr>
<td>400L</td>
<td>320 – 400</td>
<td>DN 160 CF</td>
<td>413 x 413 x 325 (16.3 x 16.3 x 12.8)</td>
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<td>on request</td>
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<tr>
<td>400LX</td>
<td>320 – 400</td>
<td>DN 160 CF</td>
<td>490 x 408 x 508 (19.3 x 16.1 x 20.0)</td>
<td>95 (210)</td>
<td>on request</td>
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<tr>
<td>600L</td>
<td>480 – 600</td>
<td>DN 160 CF DN 200 CF</td>
<td>513 x 513 x 325 (20.2 x 20.2 x 12.8)</td>
<td>103 (226)</td>
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<tr>
<td>600LX</td>
<td>480 – 600</td>
<td>DN 160 CF DN 200 CF</td>
<td>413 x 336 x 537 (16.3 x 13.2 x 21.1)</td>
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<tr>
<td>800LX</td>
<td>640 – 800</td>
<td>DN 160 CF DN 200 CF</td>
<td>413 x 413 x 537 (16.3 x 16.3 x 21.1)</td>
<td>127 (280)</td>
<td>on request</td>
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<tr>
<td>1200LX</td>
<td>960 – 1200</td>
<td>DN 160 CF DN 200 CF</td>
<td>513 x 513 x 650 (20.2 x 20.2 x 25.6)</td>
<td>206 (452)</td>
<td>on request</td>
</tr>
<tr>
<td><strong>Tall Profile Ion Pumps</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150TV</td>
<td>120 – 150</td>
<td>DN 100 CF</td>
<td>247 x 231 x 338 (9.7 x 9.1 x 13.3)</td>
<td>32 (70)</td>
<td>on request</td>
</tr>
<tr>
<td>300TV</td>
<td>240 – 300</td>
<td>DN 160 CF</td>
<td>450 x 231 x 345 (17.7 x 9.1 x 13.6)</td>
<td>65 (143)</td>
<td>on request</td>
</tr>
<tr>
<td>600TV</td>
<td>480 – 600</td>
<td>DN 160 CF</td>
<td>450 x 305 x 525 (17.7 x 12.0 x 20.7)</td>
<td>109 (243)</td>
<td>on request</td>
</tr>
</tbody>
</table>
Titanium Sublimation Pumps (TSPs) are often used in combination with ion pumps or independently to remove reactive gases from the vacuum environment. Combined with an ion pump, the TSP allows for low ultimate pressures in a shorter amount of time. All TSP components are bakeable to 400°C.

**Advantage for the User**

**Ease of Use**

The TSP and MPC controllers are each fully controlled with an intuitive touch panel LCD.

**Filaments**

Each titanium-molybdenum filament contains 1.5 grams of usable titanium and averages 20 hours of operation.

**Connectivity**

TSP/NEG cables have MS style connectors that are bakeable and radiation resistant.

**Safety**

High currents travel over distances up to 15 meters through bakeable and radiation-resistant insulated and strain relief cabling.

**DIGITEL™ Flexibility**

The DIGITEL™ line is flexible enough to control a wide variety of ion pump and TSP configurations. The QPCe and MPC can operate up to four ion pumps simultaneously or independent operation of one or two ion pumps respectively. The MPCe and QPCe are capable of controlling one or two TSP or NEG cartridges independently from the remote TSP or NEG controller or the MPCe’s optional internal TSP (iTSP) or NEG (iNEG).
The filament cartridge is mounted on a 2-3/4" CFF (NW 35). The feedthrough supports three titanium-molybdenum filaments and a return path for ground isolation. Each filament contains 1.5 grams of usable titanium and averages 20 hours of operation.

The liquid cryoshroud consists of a double walled, type 304L stainless steel cylinder with two liquid nitrogen feedthroughs with flare type fittings. It provides 1578 cm² (245 in.²) of liquid nitrogen cooled surface area that provides pumping speeds up to 12,000 l/s for hydrogen (see table). The shroud is mounted on an 8 in. CFF (DN 160) or 10 in. CFF (DN 200).

The ambient sputter shield economically maximizes surface area when cooling is not practical or possible. It provides 827 cm² (128 in.²) of ambient temperature surface area that provides pumping speeds up to 2,200 l/s for hydrogen (see table). The shield is mounted on an 8 in. CFF (DN 160) or a 6 in. CFF (DN 100).

A TSP or NEG can be fully operated from the LCD touchscreen of the QPC or MPC. They can be fired manually or automatically based on the pressure of either ion pump the controller is monitoring. Timed modes also let the user have full control over exact parameters of operation. A single remote controller can operate up to eight TSP filaments or two NEG pumps.
# Technical Data

<table>
<thead>
<tr>
<th>Controller</th>
<th>DIGITEL TSP/NEG</th>
<th>Remote TSP/NEG</th>
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<td>Input power</td>
<td>90 – 130 or 200 – 240</td>
<td>48 – 62</td>
</tr>
<tr>
<td>Voltage</td>
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<tr>
<td>Frequency</td>
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<tr>
<td>Output power</td>
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<td></td>
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<tr>
<td>Open circuit voltage</td>
<td>19 / 32</td>
<td>19 / 32</td>
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<tr>
<td>Current (maximum)</td>
<td>55 / –</td>
<td>55 / –</td>
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<tr>
<td>Watts (maximum)</td>
<td>850 / 220</td>
<td>850 / 220</td>
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<td>Resolution</td>
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<td>High current connections</td>
<td>MS style / XLR style</td>
<td>MS style / XLR style</td>
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<tr>
<td>Display</td>
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</tr>
<tr>
<td>Type</td>
<td>1/4 VGA touchscreen LCD</td>
<td>touchscreen LCD via MPC/QPC</td>
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<tr>
<td>Readouts</td>
<td>Current, on-time, and programmable options</td>
<td>Current, on-time, and programmable options via MPC/QPC</td>
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<tr>
<td>Analog outputs</td>
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</tr>
<tr>
<td>Voltage</td>
<td></td>
<td>linear configurable</td>
</tr>
<tr>
<td>Current / pressure</td>
<td></td>
<td>linear or logarithmic, configurable</td>
</tr>
<tr>
<td>Communications</td>
<td>Local/Remote/Full Ethernet</td>
<td>Local/Remote/Full via MPC/QPC</td>
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<tr>
<td></td>
<td>Serial: 232, 422, 485</td>
<td>Ethernet via MPC/QPC</td>
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<tr>
<td>Conformity to norms</td>
<td>EN 55011 Class A, IEC 801-2</td>
<td>EN 801-3, IEC 801-4, EN 61010-1</td>
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<tr>
<td>Weight</td>
<td>kg</td>
<td>16.8</td>
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<tr>
<td></td>
<td>lbs</td>
<td>37</td>
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<tr>
<td>Size</td>
<td>3U high, 1/2 rack wide</td>
<td>233 x 219 x 130 mm (min.)</td>
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<tr>
<td></td>
<td>438 mm (17.2 in.) deep</td>
<td>(12 x 9 x 5 in)</td>
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<tr>
<td>Additional features</td>
<td>TSP Enable</td>
<td>TSP Enable via MPC/QPC</td>
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1) N410 has MS style

## Typical TSP Pumping Speeds

<table>
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<th>Area</th>
<th>Liquid Cryoshroud</th>
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<tr>
<td>m²</td>
<td>(in.²)</td>
<td>(8 in.)</td>
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<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>cm²</td>
<td>709 / 1578</td>
</tr>
<tr>
<td></td>
<td>(in.²)</td>
<td>110 / 245*</td>
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<tr>
<td>Temperature</td>
<td>°C</td>
<td>20 / -195</td>
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<tr>
<td>H₂</td>
<td>Rate</td>
<td>2.6 / 17</td>
</tr>
<tr>
<td></td>
<td>Speed</td>
<td>1,843 / 12,053</td>
</tr>
<tr>
<td>CO</td>
<td>Rate</td>
<td>8.2 / 11</td>
</tr>
<tr>
<td></td>
<td>Speed</td>
<td>5,814 / 7,799</td>
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<tr>
<td>H₂O</td>
<td>Rate</td>
<td>7.3 / 14.6</td>
</tr>
<tr>
<td></td>
<td>Speed</td>
<td>5,176 / 23,039</td>
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</table>

*Applies to H₂O speed only

## Ordering Information

### Part No.

Regarding ordering information please contact your nearest Leybold representative.
DIGITEL™ Ion Pump Controllers

The DIGITEL family of Ion Pump Controllers offers the right balance of performance, power and protection.

**Advantage for the User**

**Ease of Use**
Each DIGITEL™ has a highly visible display. The SPCe has an easy-to-read LCD that displays pressure, current and voltage. The QPC and MPCe are each fully controlled with an intuitive touch panel LCD. Digital resolution down to 1nA is possible depending on pump size and current requirements.

**Communications**
Serial communications (RS232, RS422, and RS485) are standard on all DIGITEL™ products. Ethernet protocol for advanced facility and instrumentation communications is available on all units.

**Connectivity**
Each DIGITEL™ has programmable analog and interlock capabilities. This allows for optimal flexibility when integrating with standard or legacy setpoint and analog monitoring systems.

**Operator Safety**
The integrated SAFECO NN high voltage interlock system eliminates electrical shocks and false positive pressure readings. The controller automatically shuts off high voltage when the cable is disconnected from the ion pump or controller end. The system is isolated and guarantees ground, high voltage, and safety connectivity that prevents accidental arcing.

**DIGITEL™ Flexibility**
The DIGITEL™ line is flexible enough to control a wide variety of ion pump and TSP/NEG configurations. The QPC and MPCe can operate up to four ion pumps simultaneously or independent operation of one or two ion pumps, respectively. The MPCe is capable of controlling one or two TSP/NEG cartridges independently.
**DIGITAL™ SPCe – Small Pump Controller**

The SPCe is a versatile way to fully operate ion pumps 0.2 – 75 l/s with up to 40 mA (50 watts) of power. An LCD pressure/current/voltage display along with standard serial communications makes the SPCe able to accommodate the needs of basic and advanced users. Nano amp resolution provides gauging capabilities using the appropriate ion pump set-up.

**DIGITAL™ QPCe – Quad Pump Controller**

Ion pumps 100 l/s and larger required higher currents for starting and higher pressure operation. The QPCe supplies up to four ion pumps with 125 mA (125 watts) each. The easy-to-read color touchscreen display simultaneously displays pressure, current, and voltage. Standard serial and standard Ethernet communications along with legacy set-point and analog outputs allow for easy system integration. The QPCe fits into any rack at just 3U high and 1/2 rack wide.

**DIGITAL™ MPCe – Multiple Pump Controller**

Ion Pump Control

The MPCe allows for high current control of one or optionally two ion pumps independently or up to four in parallel with 500 mA (1000 watts). At 3U high and a full rack in width, the MPCe is ideal for operating a wide variety of ion pump configurations on any system.

**TSP/NEG Control**

A TSP or NEG can be fully operated from the LCD touchscreen of the QPCe or MPCe. They can be fired manually or automatically based on the pressure of either ion pump the controller is monitoring. Timed modes also let the user have full control over exact parameters of operation. A single remote controller can operate up to eight TSP filaments or two NEG pumps.
## Ion Pump Compatibility

<table>
<thead>
<tr>
<th>Ion Pump Size</th>
<th>SP Ce</th>
<th>QPC</th>
<th>Mf Pc</th>
<th>TSP</th>
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<tbody>
<tr>
<td><strong>Small Ion Pumps</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MINI</td>
<td>✓</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3S</td>
<td>✓</td>
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<td>5S</td>
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<td>45S</td>
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<td>75S</td>
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### Technical Data

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<th>SPCe</th>
<th>QPCe</th>
<th>MPc</th>
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<tbody>
<tr>
<td><strong>Input power</strong></td>
<td></td>
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</tr>
<tr>
<td>Voltage</td>
<td>V              90 – 240 or 24 VDC</td>
<td>100 – 240</td>
<td>90 – 230 or 200 – 240</td>
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<tr>
<td>Frequency</td>
<td>Hz              48 – 62</td>
<td>50 – 60</td>
<td>48 – 62</td>
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<td><strong>Output power</strong></td>
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<tr>
<td>Independent outputs</td>
<td>V              1 – 4</td>
<td>1 or 2</td>
<td>±5600 or 7000</td>
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<tr>
<td>Open circuit voltage</td>
<td>VDC            ±3000 – 7000</td>
<td>programmable</td>
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<tr>
<td>Current (maximum)</td>
<td>mA             40</td>
<td>125</td>
<td>500</td>
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<tr>
<td>Watts (maximum)</td>
<td>W              50</td>
<td>125</td>
<td>1000</td>
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<td>Resolution</td>
<td>nA             1</td>
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<td><strong>High voltage connections</strong></td>
<td>One 10kV SHV or Fischer</td>
<td>1-4, 10kV SHV or Fischer</td>
<td>1-4, 10kV SHV or Fischer</td>
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<tr>
<td><strong>Display</strong></td>
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<tr>
<td>Type</td>
<td>LCD</td>
<td>Wide VGA Touchscreen</td>
<td>1/4 VGA Touchscreen LCD</td>
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<tr>
<td>Readouts</td>
<td>Pressure, current, voltage, and programmable options</td>
<td>Pressure, current, voltage, and programmable options</td>
<td>Pressure, current, voltage, and programmable options</td>
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<td><strong>Setpoints</strong></td>
<td>One relay, one TTL</td>
<td>Four relay, four TTL</td>
<td>Four relay, four TTL</td>
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<td><strong>Analog outputs</strong></td>
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<td>Voltage</td>
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<tr>
<td>Current / pressure</td>
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<td>linear or logarithmic, configurable</td>
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<tr>
<td><strong>Communications</strong></td>
<td>Local/Remote/Full Ethernet (optional)</td>
<td>Local/Remote/Full Ethernet (standard)</td>
<td>Local/Remote/Full Ethernet (optional)</td>
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<td><strong>Conformity to norms</strong></td>
<td>EN 55011 Class A, IEC 801-2</td>
<td>EN 801-3, IEC 801-4, EN 61010-1</td>
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<tr>
<td><strong>Weight</strong></td>
<td>kg             1.5</td>
<td>9.5</td>
<td>16.8 / 25.4 (min./max.)</td>
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<tr>
<td></td>
<td>lbs            3.3</td>
<td>21</td>
<td>37 / 56 (min./max.)</td>
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<tr>
<td><strong>Size</strong></td>
<td>2U high, 1/4 rack wide 313 mm (12.3 in.) deep</td>
<td>3U high, 1/2 rack wide 438 mm (17.2 in.) deep</td>
<td>3U high, full rack wide 438 mm (17.2 in.) deep</td>
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<tr>
<td><strong>Additional features</strong></td>
<td>SAFECONN AUTOSTART/AUTORUN High Voltage Enable Fowler-Nordheim Calibration High-Pot Capability</td>
<td>SAFECONN AUTOSTART/AUTORUN High Voltage Enable Remote TSP/NEG Control</td>
<td>SAFECONN AUTOSTART/AUTORUN High Voltage Enable Remote TSP/NEG Control</td>
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### Ordering Information

**Part No.**

Regarding ordering information please contact your nearest Leybold representative.