QUAD PUMP CONTROLLER (QPCe) USERS MANUAL

PN 900031, Rev C

GAMMA VACUUM

7.0 kV   PUMP1- Pump 1 Running
69 uA   2.4e-08M

7.0 kV   PUMP2- Pump 2 Running
69 uA   2.4e-08M

7.0 kV   PUMP3- Pump 3 Running
69 uA   2.4e-08M

7.0 kV   PUMP4- Pump 4 Running
69 uA   2.4e-08M

Bat

Power

Supply 1 2 3 4

Gamma Vacuum

DIGITEL™ Vacuum Pump Power Supply

CE   TÜV SUD   RoHS COMPLIANT

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EDWARDS

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GENERAL INFORMATION

The DIGITEL™ QPCe is an ion pump power supply controller.

It is designed to operate up to four ion pumps independently or up to four simultaneously along with and a titanium sublimation pump (TSP).

It can accommodate pump sizes from 10 l/s and up to 1200 l/s.

It is microprocessor-based controller containing a metering circuit, 8 process set points, and support standard serial communications. The front panel display provides direct readout of the ion pump voltage, current, or pressure.

Individual model specification information is located on our website at: www.gammavacuum.com.

WARNING: Do not use unauthorized parts. Such parts may compromise safety. Contact Gamma Vacuum with any questions.

Read this entire manual and follow installation instructions. Failure to do so may cause injury and/or may void warranty.

APPROVALS

The DIGITEL QPCe is shown to meet the intent of Directive 89/336/EEC for Electromagnetic Compatibility and Low Voltage Directive 73/23/EEC for product Safety. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

- EN 55011 Class A radiated and Conducted Emissions
- IEC 801-2 Electrostatic Discharge Immunity
- IEC 801-3 RF Electromagnetic Field Immunity
- IEC 801-4 Electrical Fast Transient/Burst Immunity
- EN 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use

WARNINGS

WARNING: SHOCK HAZARD. CAN CAUSE INJURY OR DEATH. REMOVE POWER BEFORE SERVICING.

ALERTE: RISQUE DE CHOC. PEUT CAUSER DES BLESSURES OU LA MORT. RETIRER LA SOURCE D'ALIMENTATION AVANT LE SERVICE.

警告：点検・修理の際は 必ず全ての電源を お切りください。 使用者が感電した り、死亡、または 重傷を負う危険が あります。

安全警告: 触电危险。触电可 能导致受伤或死亡。 请于维修前去掉电 源。

ADVERTENCIA: PELIGRO POR DESCARGA. PUEDE CAUSAR LESIÓN O INCLUSO LA MUERTE. RETIRE Y DESCONECTE LA FUENTE DE ALIMENTACION ELECTRICA, ANTES DE PROCEDER AL SERVICIO DE REPARACIÓN, MANTENIMIENTO O REVISION INTERNA.

ACHTUNG: GEFAHR ELEKTRISCHER SCHLÄGE. VERLETZUNGS- ODER LEBENSGEFAHR. TRENNEN SIE ALLE ELEKTRISCHEN ANSCHLÜSSE VON DER SPANNUNGSVERSORGUNG BEVOR SIE ARBEITEN AN DEM GERÄT AUSFÜHREN.

WARNING: HEAVY OBJECT. TO AVOID MUSCLE STRAIN OR BACK INJURY, USE LIFTING AIDS AND PROPER LIFTING TECHNIQUES WHEN REMOVING OR REPLACING.

ALERTE: OBJET LOURD. POUR EVITER UNE TENSION MUSCULAIRE OU UN MAL DE DOS, UTILISER DES AIDES ET DES TECHNIQUES DE LEVAGE APPROPRIEES POUR L'ENLEVEMENT OU LE DEPLACEMENT.

警告: 大変重い装置です。 筋挫傷、背部損傷等を防ぐ為、移動や移設の際は適切な技術や補助機器等を使用してください。

安全警告: 重物。为避免肌肉拉伤或背部受伤，当移动或归位时请使用起重设备以及适当的起重技术。

ADVERTENCIA: OBJETO PESADO. PARA EVITAR UN SOBRE-ESFUERZO MUSCULAR O DAÑO FÍSICO, UTILIZE LA AYUDA DE ELEVADORES Y TÉCNICAS APROPIADAS PARA EL MANEJO DE OBJETOS PESADOS, CUANDO LO TRANSPORTE, DESPLAZE O CONSIDERE REEMPLAZARLO.

ACHTUNG: SCHWERES OBJEKT. ZUR VERMEIDUNG VON MUSKELZERRUNGEN ODER RÜCKENSCHÄDEN BEIM TRANSPORT GEEIGNETE HUBVOR-RICHTUNGEN UND HEBETECHNIKEN VERWENDEN.

WARNING: READ AND UNDERSTAND OPERATOR'S MANUAL BEFORE USING THIS MACHINE. FAILURE TO FOLLOW OPERATING INSTRUCTIONS COULD RESULT IN INJURY OR DAMAGE TO EQUIPMENT.

ALERTE: LIRE ET COMPRENDRE LE MANUEL D'OPERATION AVANT D'UTILISER CETTE MACHINE . NE PAS SUIVRE LES INSTRUCTIONS D'OPERATION PEUT CAUSER DES BLESSURES OU DES DEGATS A L'EQUIPEMENT.

警告: この装置を使用される前に必ず取扱説明書を熟読し理解した上でご使用ください。取扱説明書の通り操作をしなかった場合、装置が損傷、破損することがあります。

安全警告: 在使用这台机器前, 请务必阅读并理解 "操作员手册（指南）"。如果未能遵循操作・骤说明, 将可能导致设备的损坏。

ADVERTENCIA: LEA, ESTUDIE, Y ENTIENDA BIEN EL MANUAL DE OPERACION, ANTES DE USAR ESTA MAQUINARIA. UNA FALLA POR NO SEGUIR LAS INSTRUCCIONES OPERATIVAS, PUDIERA RESULTAR EN DAÑO O PERJUICO DEL EQUIPO.
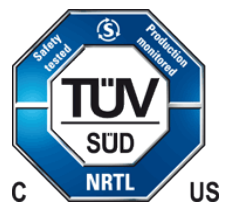
ACHTUNG: LESEN UND VERSTEHEN SIE DIE BEDIENUNGSANLEITUNG BEVOR SIE DAS GERÄT IN BETRIEB NEHMEN. FEHLBEDIENUNGEN KÖNNEN ZU VERLETZUNGEN FÜHREN ODER DIE AUSRÜSTUNG BESCHÄDIGEN.

UNPACKING THE CONTROLLER

Inspect for any obvious damage

If the controller is damaged in any way, a claim should be filed with the carrier immediately and notification given to Gamma Vacuum.

If equipment must be retuned for inspection or repair, obtain authorization from Gamma Vacuum prior to shipping. Contact Gamma Vacuum for authorization and return instructions.

Check the equipment received

Ensure that all items shipped have been received. If any items are missing, notify the carrier and Gamma Vacuum. Save all packaging material for inspection.

SAFETY NOTICES

1. Gamma vacuum controllers designed for ion pump operation are capable of delivering 7000 vdc under open-circuit or low-pressure operating conditions. Gamma vacuum products are designed and manufactured to provide protection against electrical and mechanical hazards for the operator and the area surrounding the product.
2. Installation procedures are for use by qualified, authorized personnel who have experience working with 50 volts or greater. To avoid personal injury, do not perform any installation or service unless qualified to do so.
3. There are no serviceable parts inside the controller power-supply, and voltages over 5000V are present. Do not open the supply case under any circumstances. In the event of the power-supply requiring attention, return it to Gamma Vacuum.
4. Do not disconnect the high-voltage cable with the power on. After turning the power off, allow at least one minute before disconnecting electrical equipment.
5. Do not operate the controller without a proper electrical ground or near water. The controller may be damaged and its safety reduced if it is operated outside of its specifications.

INSTALLATION

NOTES:

- The DIGITEL QPCe is a 1/2 rack controller. It can joined with a second QPCe, or it can be installed with a 19 in. rack mount kit(part # 320261).
- When installing, make sure the rear power cord is accessible.
- Maintain a 2.52 in. (64 mm) clearance behind controllers for cable bend radius and proper airflow.
- Maintain a .125 in. (3 mm) gap between vertically mounted controllers. This gap is designed in the rack mount kit, and they can be mounted directly above or below each other.
- Position the control so that the power plug can be reached to disconnect power.

CAUTION: This equipment uses a high voltage, detachable power supply cord. Do not replace with inadequately rated supply cords.

CAUTION: Remove all metal jewelry prior to working with any potential electrical hazards.

Required Items

You will need the following items to install the controller:

1. A 3-wire, detachable, universal input power cable (included).
2. A high voltage (HV) cable for each pump (ordered separately).
3. A safety ground cable for each pump.

Installation Procedure

1. Place the controller in its location and secure as necessary.
2. Connect the safety ground cable to the pump and the safety ground stud at the DIGITEL rear panel.
3. Connect the high voltage cable to the ion pump and the high voltage connector on the DIGITEL rear panel (J501–J506).
4. If you have the optional SAFECONN feature, an additional connector is part of the HV cable. Connect it to the SAFECONN connector (J401–J406).
5. Verify correct input voltage requirements. Connect the AC input power cable to input power receptacle on the DIGITEL rear panel.

FRONT PANEL OPERATION
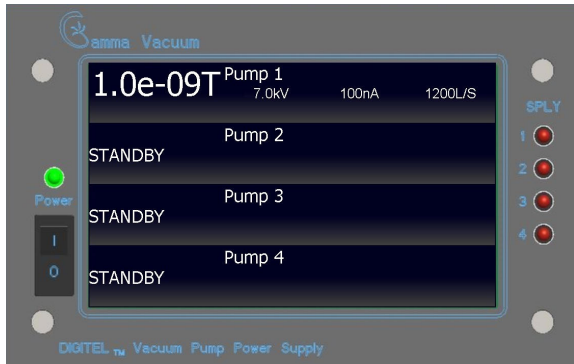
QPCe Home Screen

Description

Power On/Off Switch
The Power switch controls the input power to the controller. Turning the controller Off will immediately disable all power from the outputs on the back panel.

High Voltage Indicator Lights
Four high voltage (HV) indicator LEDs indicate if HV is on. All four are installed regardless of how many high voltage sections are present.

LCD Touch Screen
A WVGA LCD touchscreen is used for all front panel operations, excluding the main power On/Off switch.

Initial Power Up
Do not turn on the controller until after following the installation instructions. Ion pump size must be programmed into the controller before high voltage operation can be started.

High Voltage Operation (Quick Start)
Prior to starting the ion pump, confirm the following:

• The controller and connected ion pumps are grounded with a redundant grounding wire.

• The high voltage cable is attached between the controller and the ion pump.

• The controller's high voltage output has the correct output polarity for the ion pump (positive for diode and negative for triode).

NOTE: More power and current are required to start larger ion pumps or pumps started at higher pressures. Use the full extent of available rough pumping before starting an ion pump to extend the pump's lifetime, improve system ultimate pressure, and give the most accurate current readings.

Evacuate the Vacuum System
1. Rough pump down to 1x10-4 Torr or less (the lower the better). See Rough Pump manual for details.

2. Ensure contaminants do not exist in the system.

3. If an ion pump is not new or has been exposed to atmospheric pressure, it may be necessary to bake the pump into the roughing pump to achieve the best pressure. See Ion Pump manual for details.

Starting the Ion Pump
1. If the ion pump size has not been programmed into the controller, enter the ion pump size. The High Voltage output will not start until the ion pump size has been entered.
2. Press and hold the HVX OFF button on the Setup Screen display for approximately 2 seconds to start the HVX output.
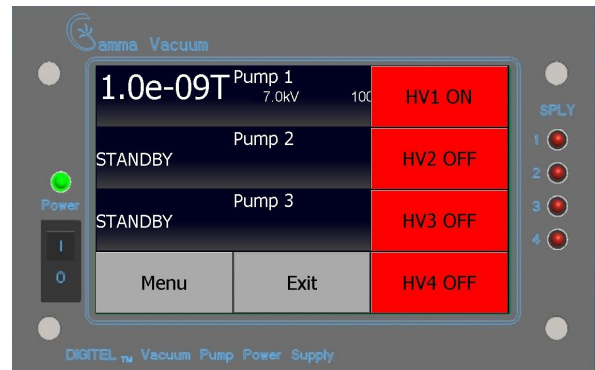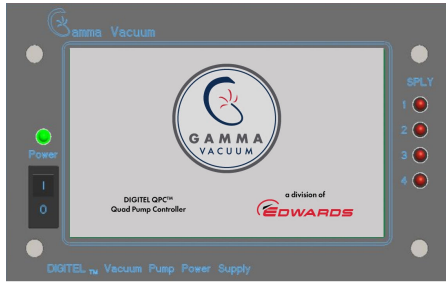

Menu/HV On-Off Screen

Stopping the Ion Pump
Press the HVX ON button on the Setup Screen to disable high voltage.

Startup Screen

Upon powering the controller, the Startup Screen is shown on the LCD.

Startup Screen

Notification Screen (HV Supply Configuration)

After the Startup Screen the Notification Screen lists the HV supplies that are present in the QPCe. Press OK to proceed.
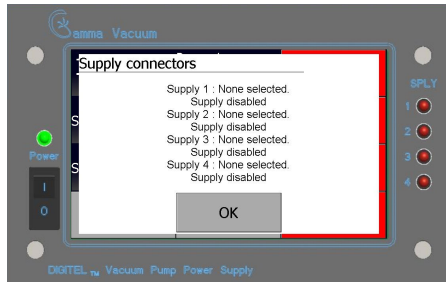
Notification Screen

Home Screen

This display is comprised of four areas:
1. Supply 1 status and operational parameters.
2. Supply 2 status and operational parameters.
3. Supply 3 status and operational parameters.
4. Supply 4 status and operational parameters.
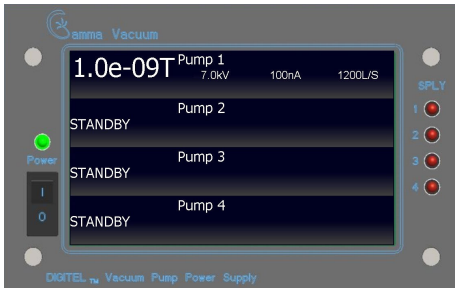
Home Screen

Setup Screens

The Setup Screens are accessed by pressing anywhere on the screen while at the Home Screen. Press "Setup" button to proceed to theSetup Screen. The following screen image shall be displayed.
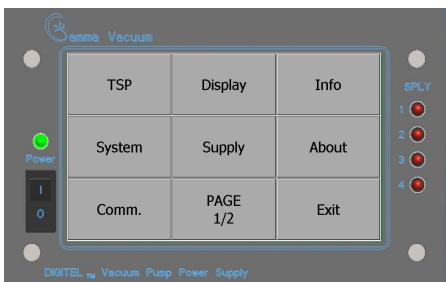
Setup Screen (Page 1)

Setup Screen (Page 2)

Page 2 of Setup Screen is accessed by pressing the "PAGE ½" button.
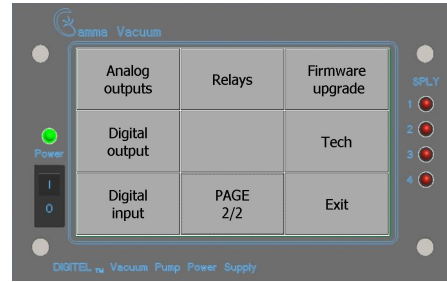
Setup Screen (Page 2)

Supply Settings Screen

From the Setup Screen (Page 1), press "Supply" button.Select the supply to modify (1, 2, 3 or 4) at the "Supply # Select Screen"

Supply # Select Screen

Supply Settings Screen

Pump Size Screen

From the "Supply Settings Screen", press "Pump Size" button.

Pump Size Settings Screen

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At the "Pump Size Screen", enter the pump size that is connected to the supply selected. When pump size value is entered, press "Accept" button. Control shall move back to Supply Settings Screen. If "Cancel" button is pressed, the prior pump size remains unchanged and control moves back to Supply Settings Screen.

Voltage Level Setting Screen

From the "Supply Settings Screen", press "Output Voltage" button.

Voltage Level Setting Screen

At the "Voltage Level Screen", enter the voltage that the supply shall have as a maximum after pump has started and stabilized. When supply voltage value is entered, press "Accept" button. Control shall move back to Supply Settings Screen. If "Cancel" button is pressed, the prior voltage remains unchanged and control moves back to Supply Settings Screen.

NOTE: Voltage level setting is restricted to a range of 3kV to 7kV. A setting less than 3kV or greater than 7kV will be rejected.
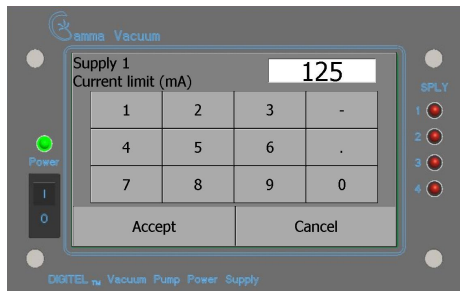
Current Limit Setting Screen

Current Limit Setting Screen

From the "Supply Settings Screen", press "Current Level" button.

At the "Current Limit Screen", enter the current that the supply shall have as a maximum. When supply current limit value is en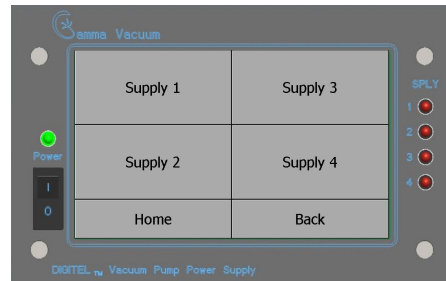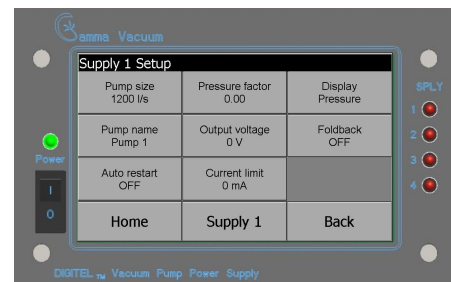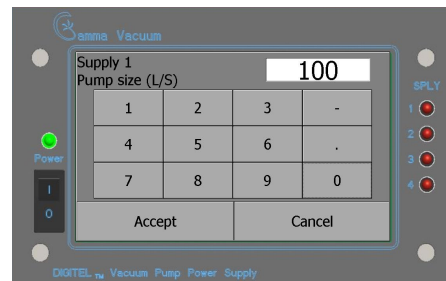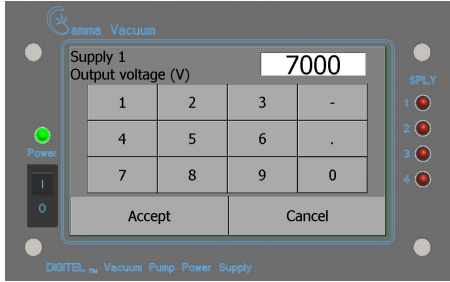tered, press "Accept" button. Control shall move back to Supply Settings Screen. If "Cancel" button is pressed, the prior current setting remains unchanged and control moves back to Supply Settings Screen.

NOTE: The Current Limit setting is restricted to a range of 2 mA to 125 mA. A setting greater than 125 mA or less than 2 mA will be rejected.

Serial Settings Screen

The Serial Settings Screen is accessed by pressing the "Comm." button at the Setup Screen (Page 1), then pressing the "Serial Settings button on the following screen (not shown).
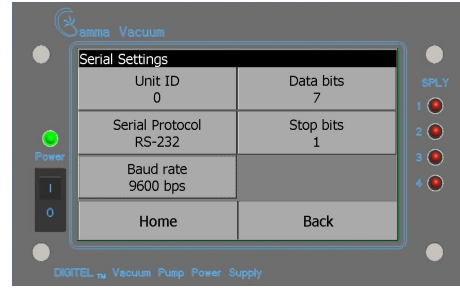
Serial Setting Screen

Baud Rate
Supported baud rates are 9600, 19200, 38400, 57600,and 115200. The default value is 9600.

Serial Protocol
The controller supports RS232, RS485 2-Wire and RS485 4-Wire protocols.

Unit ID
Gamma command packet structure requires a Unit ID (address). Address range is from 0 to 255. Default Unit ID is 5.

Data bits
The number of data bits is 8.

Stop bits
The number of stop bits is 1.

Ethernet Settings Screen

The Ethernet Settings Screen is accessed by pressing the "Comm." button at the Setup Screen (Page 1), then pressing the "Ethernet Settings" button on the following screen (not shown).
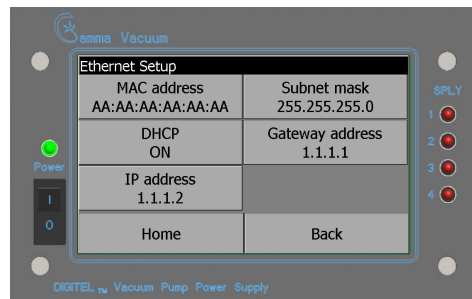
Ethernet Setting Screen

DHCP
The QPCe is capable of acting as a DHCP (Dynamic Host Configuration Protocol) client. When enabled (ON), as a DHCP client, the QPCe will obtain needed network information from a DHCP server.

When DHCP is disabled (OFF), the user may change the QPCe Ethernet address. Currently IPv4 is the only supported format.

BACK PANEL OPERATION

Description

Power input is a standard IEC interface.
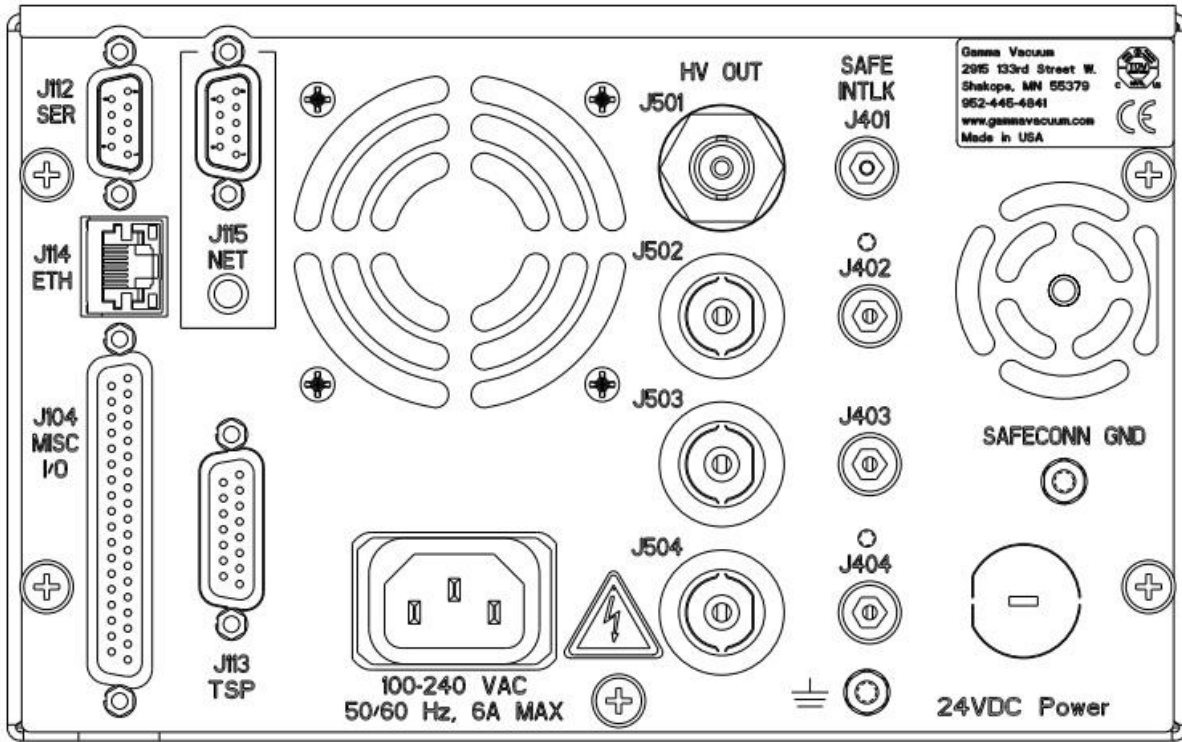
DIGITEL QPCe Rear Panel

10kV SHV/SAFECONN, J401-J504 Pairings

A 10kV SHV and corresponding SMB connector is required for each high voltage connection on the rear panel of the controller. 10kV connections are used to relay high voltage to the ion pump. The SMB connections are used to relay the SAFECONN signal from the QPCe to the ion pump high voltage feedthrough.

Insert the mating connector into the desired J50X connection and rotate clockwise until the connection is locked in.

SMB connectors are push-on connectors. Press firmly until the connector snaps into place.

Serial Interface, J112
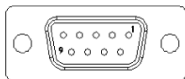
J112 is a 9-pin, female DE-9 connector that routes serial interface signals. Supported serial protocols are RS232, RS485 full duplex (four wire setup), and RS485 half duplex (two wire setup). The default serial protocol is RS 232. The desired serial protocol is configured at the factory per costumer order.

RS-232	
RXD	2
TXD	3
GND	5

RS-485 Full Duplex Operation	
+TX	2
-TX	8
GND	5
+RX	3
-RX	7

RS-485 Half Duplex Operation	
+TX/+RX	2
-TX/-RX	8
GND	5

NOTE: RS 422 is not bidirectional.

Cabling for RS-232 serial protocol

The QPCe functions as data terminal equipment (DTE) devices. When the controller is connected to another DTE device (such as a personal computer), a null modem serial cable or a simple 3 wire serial crossover cable is required to connect the devices. The null modem cable swaps the signal and control lines so the receive and transmit signals are properly connected.

NOTE: For RS 232, the serial cable between the PC and the QPCe only needs to cross Rx and Tx pins. No other signals are needed, except ground pin 5. For other standards, see Serial Interface, J112 section on 8.

NOTE: Hardware handshaking is not supported.

Serial Operation

Command Packet Structure

The command packet is made up of at least five fields and contains information needed for a remote controller to perform a command. The minimum command packet (single command with no data) is 11 bytes long and consists of the following fields:

- No new commands should be sent to the controller before the response from the previously sent command has been received.
- No software handshaking is supported.

<START CHAR>	<space>	<ADDRESS>	<space>	<COMMAND>	<space>	<CHECKSUM>	<CARRIAGE RETURN>
1 byte	1 byte	2 bytes	1 byte	2 bytes	1 byte	2 bytes	1 byte

Field	Size	Comment
1. START Character	1 character (byte)	ASCII character is '~' (TILDA)
Start is the first byte in the command packet and tells remote controllers to start decoding a message. It should be implemented as a #define, so that it can be changed if necessary. As a #define, the character is rarely changed because it is hard coded into the QPCe.		
<SPACE>		
2. ADDRESS	2 hex characters	Range 00 through FF
This field should be filled in with the hexadecimal representation of the integer address of the controller. The range provides 255 unique addresses. Only 32 devices may reside on the same serial port due to hardware loading limitations. **NOTE:** Must be supplied, even when running RS 232.		
<SPACE>		
3. COMMAND CODE	2 hex characters, single byte	Range 00 through FF
This field is one of 255 possible hexadecimal numbers, which is typically an index into a table of functions on the remote controller. Commands should be implemented as #defines with integers between 0 and 255. The integer value must be converted into ASCII hex before placement into the command packet character array. The command code must be two hex digits, even if the first is a zero.		
<SPACE>		
4. DATA field(s)	As needed	ACSII printable characters only
Data field(s) are for any commands that have a data value. For instance, a command to set a beam voltage in some unit would probably consist of a command to set the beam voltage, along with a value of beam voltage. If the command had more than one data value associated with it, such as setting an X and a Y value in a unit, the command field could be followed by two data fields (X and Y) separated by a space between them. All data must be sent in ASCII printable format (no binary or "control" characters). There is no limit on the number or size of data fields. It is up to the remote unit designer to keep practicality in mind when determining these fields. A data field is not required for all commands. **NOTE:** Optional, needed only if the command code requires it.		
<SPACE>		
5. CHECKSUM	2 hex characters	Computed checksum of packet
The calculated checksum must have its value in ASCII hexadecimal notation. It is calculated by adding the decimal value of all characters in the packet (excluding start, checksum, and terminator), and then dividing the result by 256. The integer remainder converted to two ASCII hex digits is the checksum. When a remote device receives a packet, the passed checksum is compared with a computed checksum and if they do not match, the device discards the packet. **NOTE:** Checksum field can be bypassed by specifying "00".		
6. CARRIAGE RETURN	2 hex characters	ASCII carriage return
This field is an ASCII carriage return placed at the end of a command packet. This character is not the new line character "\n", but can be used in string assign statements as "\r". There is not a space between the checksum and terminator field.		

Command Packet Example

Command to be sent is "0x01" - GET CONTROLLER MODEL

Serial address of the controller is 5.

Command packet

"~ 05 01 00<CR>" where "<CR>" is return carriage character.

Command packet in ASCII hexadecimal

"7e 20 30 35 20 30 31 20 30 30 0D"

NOTES:

Response to "0x01" - GET CONTROLLER MODEL

"05 OK 00 DIGITEL QPCe 46<CR>" Where "<CR>" is the return carriage character.

NOTE: Command checksum is set to "00" to bypass the checksum field verification by the controller.

Communication Standard

Devices cannot send data until they have been addressed by the controlling computer. A typical command exchange for a device would be:

1. The computer sends a command.
2. Devices read the address.
3. When a device recognizes its address, it decodes the message and returns an acknowledgement to the computer, along with any data that was requested.

Every communications exchange between the controlling computer and a Gamma Vacuum controller using the standard interface consists of a command packet (sent by the controlling computer) and a response packet (returned by the remote controller). All characters in these packets are ASCII. All fields are separated by a space (not required between the checksum and terminator character (carriage return). Hexadecimal numbers can be represented in either upper or lower case.

Decoding the Command Packet

The QPCe operates in one of three modes: monitor, receive, and respond. Receipt of data is interrupt driven or otherwise multiplexed, so other tasks are performed by the unit's microprocessor. When the controller receives a command packet, it continues monitoring for new commands while the current one is carried out.

1. MONITOR: The controller monitors serial data traffic. When a "start" character is detected, the controller changes to the RECEIVE MODE.
2. RECEIVE: After receiving a start character, the controller tests subsequent characters for a valid command packet. This mode must have a count down timer associated with it, which is a predetermined time for a valid command packet to be received. Furthermore if another start character is received while in this mode, (i.e. the first start character was actually part of a command packet for a different device) the controller responds by going back to the beginning of the RECEIVE mode, with a fresh timer setting. If a command packet is not received within the allowed time frame or if the checksum does not match, the timer is disabled, the packet is discarded, and the mode is reset back to MONITOR. Once a command packet is received, the mode changes to RESPOND. The only way the controller can get to a RESPOND is by receiving:
   • a valid start character followed by a space,
   • a 2-byte hex value matching the controller's address followed by a space,
   • at least one 2-character hex value command followed by a space,
   • a 2-byte hex checksum matching the command packet's actual checksum,
   • and a carriage return terminator.

• RESPOND: The controlling computer is in count-down timer mode, waiting for a response from the QPCe. All controllers must respond within 500 milliseconds once a valid command has been received. A valid response could be an error code indicating that the controller is BUSY with a previous command or an acknowledging response packet. After returning a response packet, the unit returns to MONITOR and executes the command. If the controlling computer needs to verify that the last command was successful, it sends a command to the unit requesting status feedback.

Response Packet

The response packet is made up of at least five fields and contains information to let the controlling computer know the command requested was either recognized and accepted (STATUS = "OK"), or an error condition occurred (STATUS = "ER"). The minimum packet also contains a RESPONSE CODE that is used either to pass an error code (if STATUS = "ER"), or is available for each unit to use as needed for a STATUS return of "OK". The minimum response packet (simple acknowledgment with no data) would consist of the following fields, and would be 12 bytes long.

NOTE: No new commands should be sent to the controller before the response from the previously sent command has been received.

\<ADDRESS\>	\<space\>	\<STATUS\>	\<space\>	\<RESPONSE CODE\>	\<space\>	\<CHECKSUM\>	\<TERMINATOR\>
2 bytes	1 byte	2 bytes	1 byte	2 bytes	1 byte	2 bytes	1 byte

NOTE: When a device responds to the controlling computer, that response has been requested and is expected by the computer. For this reason, a specific "start" character is not required in the response packet. The address of the responding unit is included in the packet, so the controlling computer can verify it to make the data exchange easier to view on an ASCII terminal.

Field	Size	Comment
1. ADDRESS of unit	2 hex characters	Range 00 through FF
This field is filled in with the hexadecimal representation of the integer address of the unit. The range provides 255 unique addresses. The controlling computer will use this field to determine that the correct remote unit is responding.		

\<SPACE\>

Field	Size	Comment
2. STATUS	2 ASCII characters	Either OK or ER
This field is made up of two ASCII characters and is either OK or ER. OK indicates success in recognizing the command. ER indicates an error condition, which can mean that the command is invalid, or the remote unit received the command but is still busy with a previous command. Specific information about ER is reported in the RESPONSE CODE field.		

\<SPACE\>

Field	Size	Comment
3. RESPONSE CODE	2 hex characters	Range 00 through FF
For an error condition with an incoming command, this field returns an error number to the controlling computer. For non-error conditions, this field returns a status byte/word to the controlling computer, which is defined in the QPCe and can vary with the needs of individual commands within a unit, as well as varying from unit to unit. Data must be in ASCII printable format. **NOTE:** Add a code if applicable, otherwise use "00".		

\<SPACE\>

Field	Size	Comment
4. RESPONSE DATA	As needed	ACSII printable characters only
Data field(s) are used to respond to commands requesting data. For example, a command requesting the current voltage setting in a unit would have the reading placed in a data field. Data must be in ASCII printable format. There is no limit on the number or size of data fields. Data is not required for all responses. **NOTE:** Optional, only required if the command code requires it.		

\<SPACE\>

Field	Size	Comment
5. CHECKSUM	2 hex characters	Computed checksum of packet
Checksum contains a simple computed checksum of the command packet. The value must be in ASCII hexadecimal notation. The checksum is calculated by adding the decimal value of all characters in this packet (including the space before the checksum field) and then dividing the result by 256 (base 10). The integer remainder converted to two ASCII hex digits is the packet checksum. When the controlling computer receives a response packet, the passed checksum is converted from the hex value to a binary integer and compared with a computed checksum. If they are not the same, considers it an error, and repeats the last command. When qualified technicians are testing the remote unit using a dumb terminal this returned checksum value can be ignored.		
6. Terminator character	2 hex characters	ASCII carriage return
This field is an ASCII carriage return placed at the end of a packet. This character is not the new line character "\n" which is actually an ASCII linefeed, but can be assigned using the "\r" designation in a string. There is not a space between the checksum and terminator field.		

RS 232/485 General Commands

Hex Command	Description	Data Field	Response	Data/Response Description
01	MODEL NUMBER A description of the controller.		DIGITEL QPCe	
02	VERSION Firmware revision level.		FIRMWARE: X.X.nn	X.X is the numerical revision level for major changes and n is an alpha character for minor changes
07	MASTER RESET Executes a complete software reset.			No response due to initialization of controller
0E	SET PRESS UNITS Specifies the default pressure units	U or UUU		U, UUU is pressure units U = T (Torr), M (Mbar), P (Pascal) UUU = Torr, MBR, PA
0F	GET DATE/TIME Reads the date and time		w mm/dd/yy hh:mm	w is day of the week (0=Sun) dd is date mm is month yy is year hh is hour mm is min
10	SET DATE/TIME Sets the date and time	w mm/dd/yy hh:mm		w is day of the week (0=Sun) dd is date mm is month yy is year hh is hour mm is min
24	GET LINE FREQUENCY Reads the line frequency		50HZ or 60HZ	
32	CONTROL FAN Turns the cooling fan on or off	"ON or OFF"		
3C	GET SETPOINT Reads configuration of specified set point	n	n, s, X.XE-XX, Y.YE-YY, ST	n = set point number (1-8)s= configured supply (1, 2, 3 or 4) X.XE-XX = On Point Y.YE-YY = Off Point ST = 1 (active), 0 (inactive)
3D	SET SETPOINT Configures a specified set point	n, s, X.XE-XX, Y.YE-YY		n = set point number (1-8)s= configured supply (1, 2, 3 or 4) X.XE-XX = On Point Y.YE-YY = Off Point
44	LOCK KEYPAD Established Remote Mode			
45	UNLOCK KEYPAD Established Local Mode			
50	GET ANALOG MODE Reads the current/pressure analog output mode for each supply	s	0–7	s= configured supply (1, 2, 3 or 4) 0 = Logarithmic pressure 1 = Logarithmic current 2 = Volts per 1.0uA 3 = Volts per 10.0uA 4 = Volts per 100.0uA 5 = Volts per 1.0mA 6 = Volts per 10.0mA 7 = Volts per 50.0mA

Hex Command	Description	Data Field	Response	Data/Response Description
51	SET ANALOG MODE Sets the current/pressure analog output mode for each supply	s, n		s= configured supply (1, 2, 3 or 4) n = 0-7 0 = Logarithmic pressure 1 = Logarithmic current 2 = Volts per 1.0uA 3 = Volts per 10.0uA 4 = Volts per 100.0uA 5 = Volts per 1.0mA 6 = Volts per 10.0mA 7 = Volts per 50.0mA
60	IS FAN ON Indicates if the internal fan is currently operational		YES or NO	
61	IS HIGH VOLTAGE ON Indicates if the high voltage for Supply 1, 2, 3 or 4 is enabled	"1", "2", "3" or "4"	YES or NO	1, 2, 3 or 4 indicates the supply
62	SET SERIAL ADDRESS Sets the controller's serial address		nnn	nnn = new serial address (000-255)
63	IHIGH OFFSET Sets the offset value for high current metering	s, nnn		s= configured supply (1, 2, 3 or 4) nnn = -999 to 999 mA
68	HVE RESTART Specifies the mode of the interlock input pins to either restart or remain off after an open circuit is detected.	c		c = "y" for yes or "n" for no Yes indicates that shorted pins will restart the supply after an open circuit is detected. No indicates that the shorted pins will not restart the supply after an open circuit is detected.
69	GET HVE RESTART Displays the mode of the interlock input pins to either restart or remain off after an open circuit is detected.		YES or NO	Yes indicates that shorted pins will restart the supply after an open circuit is detected. No indicates that the shorted pins will not restart the supply after an open circuit is detected.
CB	READ EVENT LOG Reads event data from the event log		String	0 = latest event 1-50 = specific event String = pump#, message type, time/date, voltage, current, pump size, supply size, # of arcs, # cool down cycles, 0 0 0 0 (reserved)
CC	READ LAST EVENT Reads event data from the last entry in the event log		String	String = pump#, error code, time/date, voltage, current, pump size, supply size, # of arcs, # of cool down cycles, 0 0 0 0
CD	CLEAR EVENT LOG Removes all entries from the event log			
D3	SET COMM MODE Sets the communication mode to local, full, or remote	N		N is the mode 0 = Local 1 = Remote 2 = Full
D4	GET COMM MODE Returns the current communication mode.		"N"	N is the mode 0 = Local 1 = Remote 2 = Full

RS232/485 DIGITEL QPCe Supply Specific Commands

Hex Command	Description	Data Field	Response	Data/Response Description
0A	READ CURRENT Reads pump current from Supply 1, 2, 3 or 4	"1","2", "3" or "4"	X.XE-X AMPS	1, 2, 3 or 4 indicates the supply.0.1E-9 = HV OFF STATUS
0B	READ PRESSURE Reads pump pressure from Supply 1, 2 , 3 or 4	"1","2", "3" or "4"	X.XE-XX UUU	1, 2, 3 or 4 indicates the supply UUU is pressure units (Torr, MBR, or PA) 0.1E-10 = HV OFF STATUS
0C	READ VOLTAGE Reads pump voltage from Supply 1, 2, 3 or 4	"1","2", "3" or "4"	XXXX	1, 2, 3 or 4 indicates the supply in volts
0D	GET SUPPLY STATUS	"1", "2", "3" or "4"	WAITING TO START STANDBY SAFE-CONN RUNNING COOL DOWN XX PUMP ERROR XX SAFE-CONN XX RUNNING XX INTERLOCK XX SHUT DOWN XX CALIBRATION XX	1, 2, 3 or 4 indicates the supplyXX is the pump error code
11	GET PUMP SIZE Reads pump size in liters per second	"1", "2", "3" or "4"	ssss L/S	ssss is pump size
12	SET PUMP SIZE Sets pump size in liters per second	"1, ssss","2, ssss" "3, ssss","4, ssss"		1, 2, 3 or 4 indicates the supply, ssss is pump size
1C	GET SUPPLY SIZE Reads high voltage transducer size	"1", "2", "3" or "4"	"LARGE" or "MEDIUM"	Large = 500 mA max current Medium = 100 mA max current
1D	GET CAL FACTOR Reads the calibration factor that modifies pressure	"1", "2", "3" or "4"	n.nn	n.nn range is 0.00 – 9.99
1E	SET CAL FACTOR Sets the calibration factor that modifies pressure	"1, n.nn", "2, n.nn", "3, n.nn" or "4, n.nn"		n.nn range is 0.00 – 9.99
20	GET HV STRAPPING Reads the supplies strapped high voltage output	"1", "2", "3" or "4"	5600 or 7000	1, 2, 3 or 4 indicates the supply
25	SET DISPLAY Changes the displays main parameter	"1, P", "2, P" "3, P" or "4, P"		1, 2, 3 or 4 indicates the supply P = V (volts), C (current), or P, (pressure)
33	SET AUTO-RESTART Sets supplies to automatically restart on power up. This applies to both HV sections.	"YES" or "NO"		
34	GET AUTO RESTART Reads auto restart status of supplies. This applies to both HV sections.		YES or NO	
37	START PUMP Enables high voltage of specified supply	"1", "2", "3" or "4"		1, 2, 3 or 4 indicates the supply
38	STOP PUMP Disables high voltage of specified supply	"1", "2", "3" or "4"		1, 2, 3 or 4 indicates the supply

Remote TSP/NEG Related Commands

Remote TSP/NEG Related serial commands can be located in the Titanium Sublimation and Controller Users Manual (part number 900027).

CRC Checksum Example

The following is an example of the CRC checksum calculation:

1. The response from the controller to command 01 is:
   00 OK 00 DIGITEL QPC E0
2. The table below gives the values of the response.
3. Add all values below to get 4E0h[1].
4. Divide by 100h (256d). 4E0h ÷ 100h = 4h with a remainder of E0h.
5. The remainder, E0h, is the CRC.

[1]   h indicates a hexadecimal (base 16) value while d indicates a decimal (base 10) value.

Characters	Value (Hex)
0	30
0	30
space	20
O	4F
K	4B
space	20
0	30
0	30
space	20
D	44
I	49
G	47
I	49
T	54
E	45
L	4C
space	20
Q	51
P	50
C	43
space	20

Set Point Relays/TTL Inputs/Outputs/ Analog Outputs, J104
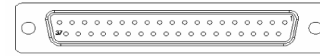
J104 is a 37-pin, female Sub-D connector that provides connectivity for the QPCe's eight set point signals and four voltage/current analog output signals.

Pin	Set Point Signals
1	Setpoint Relay 1 Common
2	Setpoint 1 NC
3	Setpoint 1 NO
4	Setpoint Relay 2 Common
5	Setpoint 2 NC
6	Setpoint 2 NO
7	Setpoint Relay 3 Common
8	Setpoint 3 NC
9	Setpoint 3 NO
10	Setpoint Relay 4 Common
11	Setpoint 4 NC
12	Setpoint 4 NO
13	Ground
14	Ground
15	TTL_Out 1
16	Ground
17	TTL_Out 2
18	Ground
19	TTL_Out 3
20	5Vdc Out (80 mA max)
21	12Vdc Out (80 mA max)*
22	TTL_In 1
23	TTL_In 2
24	TTL_In 3
25	TTL_In 4
26	12Vdc Out (80 mA max)*
27	Ground
28	Ground
29	Ground
30	Analog Out 1
31	Ground
32	Analog Out 2
33	Ground
34	Analog Out 3
35	Ground
36	Analog Out 4
37	TTL_Out 4

*   12 Vdc at pins 21 and 26 are from a common source. The sum of current from pins 21 and 26 shall not exceed 80 mA.

User Configurable TTL Logic Outputs (pins 15, 17, 19, 37 of J104)

The function of the TTL logic output pins can be selected by the user to be:

- HV On/Off (any channel)
- A Set Point (any channel)
- An error condition (to be defined)
- Future function options

Analog Voltage/Current/Pressure (pins 30, 32, 34, 36 of J104)

The analog output pins can be configured to output supply voltage, current, pressure or fast responding voltage.

Remote TSP/NEG Control, J113 (Optional)
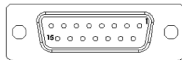
The Remote TSP/NEG Controller requires a 15-pin Sub-D connector to facilitate communications between the QPCe and Remote TSP/NEG Controller. This connection is made using a 15-pin Sub-D cable available from Gamma Vacuum.

Details of the TSP/NEG option are available in the Titanium Sublimation and Controller Users Manual (part number 900027).

SPECIFICATIONS

Rack Mount.....................................(24.1cm) 9.5 in. x (13.3cm) 5.25 in. x (44.5cm) 17.5 in.

Shipping Weight ....(9.5kg) 21 lbs.

Operating Temperature ....0 to 40C Free airflow around the unit is required.

Altitude ....Sea level to (2000m) 6560 ft.

Humidity ....0 to 80% RH (non-condensing)

Storage Temperature......................20 to 70C

Input voltage ....100-240Vac +/- 10% No adjustment necessary.

Input current..................................6A

Line Frequency 50/60Hz

Battery Backup (optional)...............A connector for battery backup can be specified.

High Voltage Output

   Voltage......................................0 – 7000V

   ....Maximum HV is user selectable (3000 to 7000V)

   Current......................................0 – 125 mA (one HV supply)

   ....0 – 250 mA (2 HV supplies coupled together)

   Power 125W, 250W

SafeConn...A SafeConn connector can be specified for each HV output.

Display/Controls.............................3.5 in. x 6 in. TFT WVGA (800x480) Color, Touchscreen

Status Display

   Standard display mode ....Volts/Current/Pressure, setpoints,

   ....Starting/Running status and HV Off/On

   ....Pressure units is user selectable (Pa, mbar or Torr)

Communications ....RS232, RS422, RS485 (selectable baud rate), Ethernet, Profibus

Low Voltage Outputs

   Setpoint Relays............................4 NO/NC relay pairs

   Logic Inputs................................4 TTL inputs

   Logic Outputs.............................4 TTL Outputs

   Analog Outputs ....4 user-defined analog outputs (voltage, current or pressure)

   Remote TSP/NEG (Optional) ....A connector for remote TSP or NEG operation can be specified

WARRANTY & SERVICE

Service

Cleaning Procedure
Prior to any cleaning of the pump, the mains power should be disconnected. Once powered off, use a 50% distilled water and 50% isopropyl alcohol solution to clean the entire unit. A soft, non abrasive cloth will ensure no damage to the LCD screen and finish of the unit.

Service Requests
Upon notification, Gamma Vacuum will identify the level of service required. To assist in this process, please provide the following information in as much detail as possible:
- Part Number
- Serial Number
- Detailed Description of the Vacuum System Hardware
- Detailed Description of the Vacuum System Process (gas species introduced, ultimate pressure, operational pressure)
- Reason for Service Request
- Required Documentation

To expedite this process, please forward this information to service@gammavacuum.com.

Direct Support
Prior to recommending replacement parts or service at our facility, Gamma Vacuum can assist with general vacuum issues via e-mail or by telephone at no charge. It is our goal to have vacuum systems functional with minimal time and financial investment.

To do this, our service technicians require as much information as possible about the vacuum system in need of support. To assist in this process, please provide the following information in as much detail as possible:
- Part Number
- Serial Number
- Detailed Description of the Vacuum System Hardware
- Detailed Description of the Vacuum System Process (gas species introduced, ultimate pressure, operational pressure)
- Reason for Support Inquiry

To expedite this process, please forward this information to service@gammavacuum.com or contact our facility directly at the numbers below.

Warranty

General Terms
Gamma Vacuum warrants to the Buyer that the equipment sold is new equipment, unless previously stated, and is, at the time of shipment to Buyer from Gamma Vacuum, free from defects in material and workmanship. As Buyer's sole exclusive remedy under this warranty, Gamma Vacuum agrees to either repair or replace, at Gamma Vacuum's option and free of parts charge to Buyer, and part or parts which, under proper and normal conditions of use, prove to be defective within twelve (12) months from the date of receipt by buyer.

As expendable items may have a life time of less than one year, their warranty is subject to reasonable service and will be replaced as determined by Gamma Vacuum. All warranty claims must be brought to the attention of Gamma Vacuum within thirty (30) days of failure to perform.

This warranty does not cover loss, damage, or defects resulting from transportation to the buyer's facility, improper or inadequate maintenance by buyer, buyer supplied software or interfacing, unauthorized modifications of misuse, operation outside of environmental specifications for the equipment or improper site preparation and maintenance.

In-warranty repaired or replacement parts are warranteed only for the remaining unexpired portion of the original warranty period applicable to the parts which have been repaired or replaced. After expiration of the applicable warranty period, the Buyer shall be charged at Gamma Vacuum's then current prices for parts, labor, and transportation.

Reasonable care must be used to avoid hazards. Gamma Vacuum expressly disclaims responsibility for any loss or damage caused by the use of its products other than in accordance with proper operating and safety procedures.

EXCEPT AS STATED HEREIN, GAMMA VACUUM MAKES NO WARRANTY, EXPRESSED OR IMPLIED (EITHER IN FACT OR BY OPERATION OF LAW), STATUTORY OR OTHERWISE: AND, EXCEPT AS STATED HEREIN, GAMMA VACUUM SHALL HAVE NO LIABILITY FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND OR FROM ANY CAUSE ARISING OUT OF THE SALE, INSTALLATION, OR USE OF ANY OF ITS PRODUCTS.

Statements made by any person, including representatives of Gamma Vacuum, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon Gamma Vacuum unless reduced to writing and approved by an officer of Gamma Vacuum.

Gamma Vacuum may at any time discharge its warranty as to any of its products by refunding the purchase price and taking back the products.

Warranty Claims

Upon notification, Gamma Vacuum will investigate Warranty Claims. To initiate a Warranty Claim, please contact Gamma Vacuum or a representative of Gamma Vacuum directly. To assist in this evaluation, please provide the following information in as much detail as possible:

- Part Number

- Serial Number

- Detailed Description of the Vacuum System Hardware

- Detailed Description of the Vacuum System Process (gas species introduced, ultimate pressure, operational pressure)

- Detailed Reason for the Warranty Claim

To expedite this process, please forward this information to service@gammavacuum.com.

Returning Material

Return Procedure

In the event a product requires service, exchange, or return, a Return Material Authorization (RMA) number must be obtained from Gamma Vacuum prior to shipment.

RMA numbers can be obtained by calling Gamma Vacuum toll-free. The RMA process will be expedited if any of the following information can be provided:

- Original Purchase Order Number

- Gamma Vacuum Sales Order Number

- Product Order Number and/or Product Description

- Product Serial Number

All products received for repair or replacement shall be prepaid. Items not labeled with an RMA number will be accepted; however substantial delay in processing may result. A standard restocking fee may apply.

NOTE: Prior to issuance of an RMA, the required documents must be submitted to Gamma Vacuum.

Required Documentation

During a lifetime of system operation, it is possible that certain contaminants, some of which could be hazardous, may be introduced into the vacuum system, thus contaminating the components. Please complete the form on the next page to identify any known hazardous substances that have been introduced into the vacuum system.

This will enable us to evaluate your equipment and determine if we have the facilities to make the repair without risk to employee health and safety. Return, repairs, or credit will not be authorized until this form has been signed and returned.

NOTE: Prior to returning any materials, Gamma Vacuum must issue an RMA. The RMA number should be clearly labeled on all shipping information and packages.

RETURN MATERIAL AUTHORIZATION FORM

Thank you for taking the time to complete this form. Please complete this form and return to Gamma Vacuum in electronic format (Adobe PDF format [.pdf] preferred), or via fax. Digital signatures are acceptable.

Assigned RMA: _____

Your Reference: _____

CONTACT INFORMATION

Name: _____

E-mail Address: _____

Phone: _____

Fax: _____

Website: _____

COMPANY INFORMATION

Company Name: _____

Date: _____

Address: _____

_____

RETURN INFORMATION

Type of Product:
Ion Pump
Ion Pump Controller
Other

Contaminant Status*:
Has Not Been Exposed
Has Been Exposed

Claim Status:
Warranty Claim
Service Request
Shipping Error
Evaluation
Other

Reason for Return:

Additional Information: _____

_____

Part Number: _____

Description: _____

Serial Number: _____

Original Purchase Order: _____

Your Reference: _____

Signature of Certifying Official: _____

Name and Title of Certifying Official: _____

* Contaminants to vacuum systems are defined as: any substance that, because of its properties, is not compatible with ultra-high vacuum (UHV) operation. Some of these are: silicon (in the form of silicones), sulfur, cadmium, fluorine and chlorine. Contaminants have been determined by vapor pressure curves and/or properties that are detrimental to the operation of UHV products.

** *Hazardous substance* means a chemical or substance, or mixture of chemicals or substances, which:

- is regulated by the Federal Occupational Safety and Health Administration under Code of Federal Regulations, title 29, part 1910, subpart Z;

- is either toxic or highly toxic, an irritant, corrosive, a strong oxidizer, a strong sensitizer, combustible, either flammable or extremely flammable, dangerously reactive, pyrophoric, a carcinogen, a teratogen, a mutagen, a reproductive toxic agent, or that otherwise, according to generally accepted documented medical or scientific evidence, may cause substantial acute or chronic personal injury or illness during or as a direct result of any customary or reasonably foreseeable accidental or intentional exposure to the chemical or substance. (Common examples: arsenic, cadmium, gallium, cesium, mercury, radiation, etc.)

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