Gamma Vacuum

Creating the purest vacuum environments on Earth.

Small Pump Controller (SPC) Users Manual

PN 900014, Rev B

Specification information is located on our website at:

www.gammavacuum.com

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General Information

The DIGITEL SPC is an ion pump power supply. It requires a 24V DC power supply, and an external mains adapter is available to permit operation from 85 to 260V AC, 50 or 60Hz. The SPC is an 'intelligent' programmable power supply.

It can be controlled from the front panel or remotely through a serial communication interface. The serial interface is compatible with RS-232/422/485 hardware and uses an industry standard communication protocol.

Features

Soft Configuration

Most aspects of the operation and calibration of the SPC power supply are controlled using software, these can be changed by the user from the front-panel or using a PC-based application programme - there are no hardware links or internal adjustments.

Serial Port

The serial port allows the SPC to be configured and controlled remotely from a computer. A PC application is available which allows the user to fully calibrate and configure the operation of the SPC power supply through the serial port. The serial interface hardware is itself fully software configurable, so that the SPC may be programmed to communicate using any one of RS-232, RS-422 or RS-485 serial standards. The serial protocol used is described starting on page 18 below.

Ion Pump Output

The EHT output is a 15W, 15mA supply. It is generated using proven switchmode design technology for high reliability. The desired output voltage may be programmed to be in the range 3500 to 7000 volts to match the ion pump. The output connector is a standard Kings SHV-10kV and includes a SAFE-CONN interlock.

SAFE-CONN

A SAFE-CONN interlock connector is provided, the SPC will automatically turn off the EHT output is this interlock is removed.

Set Point

A programmable process control relay is available, this is controlled by the pressure read-back from the ion pump. Both normally-open and normally-closed contacts are available from the relay. This relay is energised when the pressure is below a value set by the user.

Pump Protection

The SPC supply continuously monitors the ion pump current, voltage, power and pressure during both start-up and continuous operation. If a problem occurs the SPC power-supply will act to prevent damage, for example in

the event of a vacuum failure the SPC power-supply will immediately shut down the EHT to protect the pump. In the event of power failures the SPC supply can be configured to automatically restart the ion pump, if required.

Analog Outputs

Two buffered analogue outputs (0 .. 10V) are provided, one reports ion-pump current and the other reports ion-pump voltage. These can be scaled in software.

Remote Control

A digital input is provided which can be used to remotely turn the SPC power-supply on or off. This input can be fully configured from software, it can be ignored or inverted, and it can separately be allowed to enable or disable the SPC power-supply.

A digital output is provided which reports the state of the SPC supply, this is driven when the EHT output is active.

Specifications

Parameter	Specification
Input voltage	24V DC
EHT output voltage	3500 to 7000Vdc
EHT output current	15mA
EHT output power	20W
EHT polarity	SPC positive, SPC-N negative.
Set Point Controller Output	Floating Relay contacts, NO and NC.
Set Point Range	1e-4 down to 1e-9 or OFF.
Analogue Output – Voltage monitor	Default 1V per 1kV, can be configured by user.
Analogue Output – Current monitor	Default 1V per 1mA, can be configured by user.
Storage Temperature	-20 to 65°C
Operating Temperature	0 to 40°C
Humidity	0 to 80% RH, noncondensing.
Dimensions mm (in.) W x H x D	140mm x 89mm x 250mm 5.6” x 3.5” x 9.9”
Pump Size	Complete control of pumps up to 50l/s. Can be used with pumps up to 640l/s at low pressure.

Approvals

SPC was tested as supplied and was 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 50081-1 Emissions

- EN 55011 Class A radiated and Conducted Emissions

EN 50082-1 Immunity

- IEC 801-2 Electrostatic Discharge Immunity
- IEC 801-3 RF Electromagnetic Field Immunity
- IEC 801-4 Electrical Fast Transient/Burst Immunity

Low Voltage Directive 73/23/EEC

- EN 61010-1 Safety requirements for electrical equipment for measurement, control and laboratory use

Installation

Receiving and Unpacking

Inspect for any obvious damage. If the equipment is damaged in any way, a claim should be filed with the carrier (one copy to Gamma Vacuum). If equipment must be retuned for inspection or repair, authorization must be obtained from Gamma Vacuum Prior to reshipping. Instructions for return will be provided at that time.

Check the equipment received against the packing list enclosed to insure that all items shipped have been received. If there are any shortages, notify the carrier and Gamma Vacuum. Save all packaging material for inspection.

Safety Notices

WARNING: Gamma Vacuum, LLCs' products are designed and manufactured to provide protection against electrical and mechanical hazards for the operator and the area surrounding the product. The procedures provided in Sections 2 and 5 of this manual and in other Gamma Vacuum, LLC product manuals must be followed to ensure that these protections are not impaired in any way.

WARNING: Installation procedures are for use by qualified and authorized personnel who have experience working with voltages greater than 50 volts. To avoid personal injury, do not perform any installation or service procedures unless qualified to do so.

Voltages up to 7000V are present. An interlock is provided to shut off power when the top cover is removed. Do not defeat this interlock.

Do not disconnect the high-voltage cable with power on. After turning power off, allow at least one minute before disconnecting electrical equipment

Do not operate the control without a proper electrical ground or near water. The control may be damaged and its safety reduced, if it is operated outside of its specifications.

Installation Procedure

WARNING: The SPC power-supply is designed and manufactured to provide protection against electrical and mechanical hazards for the operator. The following procedures must be followed to ensure the effectiveness of this protection.

WARNING: The SPC power-supply must be installed by personnel who are qualified and who have experience working with high voltages.

WARNING: The SPC may become active as soon as power is supplied to the unit. Since it is possible to configure the SPC to automatically start driving the ion pump as soon as power is applied care must be taken when connecting the SPC to any external power supply.

Do not disconnect the high-voltage cable with power on. After disconnecting the SPC supply from input power, allow at least one minute before disconnecting the ion pump.

Do not operate the SPC power-supply without an electrical ground connection.

Do not operate the SPC power-supply near any conducting fluid.

There are no serviceable parts inside the SPC power-supply, and voltages up to 7500V are present. Do not open the supply case under any circumstances. In the event of the power-supply requiring attention return it to Gamma.

Connecting the SPC

The SPC supply can be used as a free standing unit or mounted in a standard 19” rack. A rack-mounting kit is available which can be used to mount up to three SPC units side by side.

The following items are required to install the SPC supply:

- 24V supply cable or AC to 24V universal mains adapter. One of these will be supplied with the SPC.
- High voltage cable to connect to the ion pump.
- Safety ground cable.

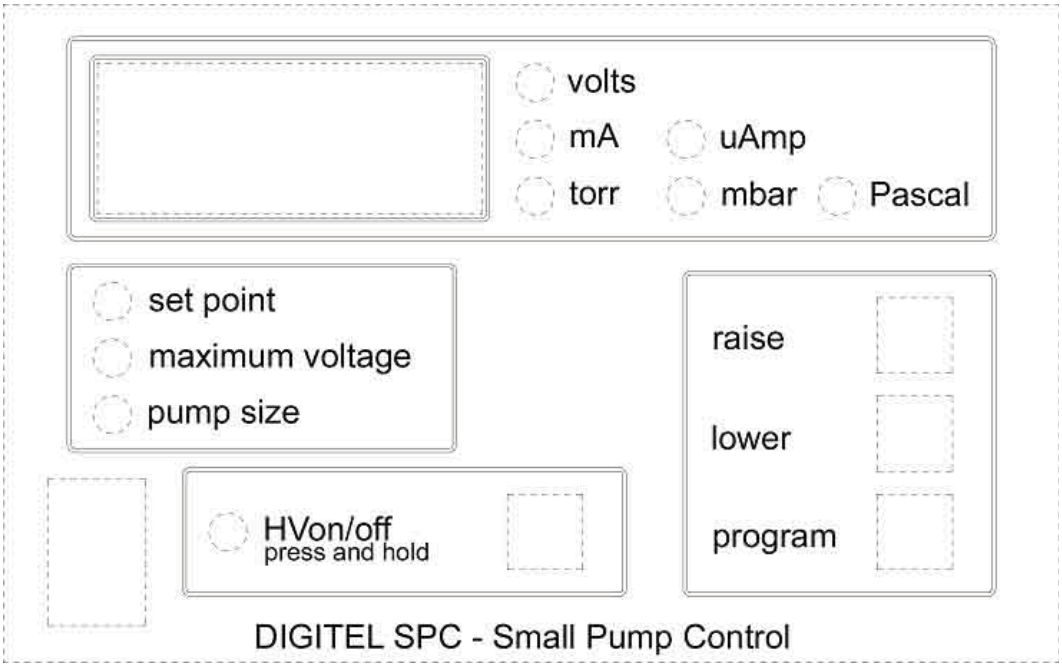
Use the following procedure to install the SPC:

1. Locate the SPC and secure as required.
2. Connect the safety ground cable between the stud on the SPC power-supply rear panel and the ion pump.
3. Connect the miscellaneous I/O cable and/or serial I/O cables if required.
4. Connect the high voltage cable to the ion pump and to the EHT connector on the SPC power-supply rear panel.
5. If fitted to the cable, also connect the SafeConn connector on the cable to the SafeConn connector on the SPC rear panel. If the cable does not have a SafeConn connector, then a dummy SafeConn cable must be used to connect the SafeConn connector on the SPC rear panel to the safety ground stud on the SPC rear panel. Contact your distributor for details.
6. Connect the SPC supply to a 24V DC supply.
7. At this point the SPC supply should be active and the correct pump size must be set before using the power-supply.

Front Panel Operation

Description

The figure below shows the SPC front panel controls and displays.



Indicators

The "HV" indicator is lit whenever the high-voltage output to the pump is driven. During normal operation the "Volts", "mA", "uAmp", "torr", "mbar" and "Pascal" indicators are used to show what parameter the display is currently showing. During setup the "set point", "maximum Voltage" and "pump size" indicators are used to show which parameter is currently being changed. The SPC unit calculates pressure readings from the output voltage and output current. Since this is not accurate for low voltages it will not display pressure readings until the voltage output to the ion pump exceeds a minimum value, by default this is 2kV.

Buttons

The power button in the bottom-left corner of the front panel allows the user to completely disable the SPC by physically disconnecting the 24V input to the unit.

Note: The other buttons may be disabled by a serial command if the serial port is connected to a computer or terminal.

The "HV on/off" button allows the operator to control the high voltage output to the pump. To turn the HV on this button must be pressed and held for approximately two seconds. If the HV is on, touching this button will turn it off immediately.

The "program" button is used to change between normal operation and setup mode.

In normal operation the “raise” and “lower” buttons select the display mode, they button between voltage, current or pressure display. Which parameter is being displayed is shown by the indicator lights. In setup mode the “raise” and “lower” buttone are used to change the value of the parameter being modified.

High Voltage Operation

By default, the HV output to the pump will be disabled when the SPC is powered up and will remain disabled until the operator requests it, either using the front panel switch or through the serial port. However, by using the serial configuration software it is possible to configure the SPC to start up with the HV enabled, or to allow external HV control through the misc. I/O port.

To turn the HV on from the front panel the "HV on/off" switch should be pressed and held for approximately two seconds. The SPC supply will then illuminate the "HV" indicator and attempt to start the ion pump.

To turn the HV off from the front panel the "HV on/off" switch should be pressed and not held for more than two seconds. As soon as the switch is pressed the HV will be disabled. The operator should be aware that it is possible for the HV to be re-enabled by an external controller using the serial link or the misc. I/O port.

In every case the "HV" indicator light will be illuminated whenever the HV output is active.

Using the Controls

Setup Mode

Setup mode is used to set some essential operating parameters for the SPC power supply and the ion pump. These are the maximum voltage, the pump size, the set point pressure and the units used for the pressure display.

The setup procedure is as follows:

1. Press the "program" button once. The display will flash showing the name of the currently selected pressure unit.
2. Use the "raise" and/or "lower" keys until the display shows the name of the desired pressure units.
3. Press the "program" button once. This moves on to editing the next parameter, in this case the set point pressure.
4. Use the "raise" and/or "lower" keys until the display shows the required set point pressure. If set point operation is not required use the "lower" key until the display shows "off". This disables the set point relay.
5. Press the "program" button once. This moves on to editing the next parameter, in this case the maximum voltage.
6. Use the "raise" and/or "lower" keys until the display shows the required maximum voltage.
7. Press the "program" button once. This moves on to editing the final parameter, the ion pump size.
8. Use the "raise" and/or "lower" keys until the display shows the required ion pump size.
9. Press the "program" button once. This finishes editing the parameters and returns the unit to normal operation.

These parameter values are stored permanently and remain set until they are edited again by the operator.

Normal Mode

During normal operation the only interaction between an operator and the SPC supply will be to enable/disable the high voltage and to change the display mode to show the required parameter – pump voltage, pump current or calculated pressure.

Display Mode Selection

The front panel display can be used to show the output voltage, the output current or the calculated pressure.

By pressing the "raise" or "lower" keys it is possible to change which of these parameters is being displayed. The indicator lights to the right of the numeric display show which parameter is currently being displayed.

Set Point Mode Selection

The “set point" indicator will be illuminated whenever the set-point relay is driven, this indicates that the calculated ion-pump pressure is lower than the set point pressure.

Display Messages

During operation the SPC power supply may detect and report a number of possible operating conditions. For example, the SafeConn connector may become disconnected, the vacuum may fail or the ion-pump may have a problem. These conditions are reported by the following messages on the numeric display:

Display	Interpretation
SAFE	This indicates that the SafeConn connector is not connected. While this is displayed the SPC will not generate any high-voltages.
Err1	This indicates that the SPC power supply has tried and failed to start the ion pump three times. This error message will be continue to be displayed and the SPC power supply will not try again until the operator intervenes, usually by pressing the “HV on/off” switch.
Err2	This indicates that the ion pump pressure has slowly risen to above 1e-4 Torr and remained higher than this for more than 10 minutes.
Err3	This indicates that the SPC output current has exceeded the specification.
Err4	This indicates that the pressure has risen above 1e-4 Torr during the startup process. The SPC supply will attempt to restart the pump after a delay.
Err5	The power that the SPC has supplied to the ion pump has exceeded the power dissipation limit for the ion pump. The SPC supply will attempt to restart the pump after a delay to allow the pump to cool down.
Err6	The SPC output current has exceeded the specification. The SPC supply will attempt to restart the pump after a delay.
Err7	The output voltage has been pulled below 400V, this usually represents a short-circuit in the ion pump. The SPC supply will attempt to restart the pump after a delay.
ErrC	This indicates that the software controlling the SPC has detected a checksum error in the stored program, please consult your distributor.

Back Panel Operation

Description

Remote Hardware Option

The SPC supply can be controlled to a limited extent from hardware using the miscellaneous I/O port.

Miscellaneous port pin number	Function
1	Set point relay common
2	Set point relay NC
3	GND
4	GND
5	-14V
6	+14V
7	+5V
8	Remote HV Enable
9	Set point relay NO
10	+14V
11	Set point logic output
12	Output Current Monitor
13	HV Enable Monitor
14	Output Voltage Monitor
15	+14V

High Voltage Monitoring

Pin 13 on the misc. I/O connector can be used to determine if the HV is enabled. It is designed to drive a relay, or logic signals as required. When the HV is enabled, pin 13 is pulled down to 0V and can sink 100mA. When the HV is disabled, pin 13 is pulled up to +14V through a 4K7 resistor.

Output Voltage Monitoring

Pin 14 on the misc. I/O connector is a buffered voltage output which is proportional to the HV output voltage and which can be used to monitor the HV voltage. The scaling factor defaults to 1V per 1KV out.

Output Current Monitoring

Pin 12 on the misc. I/O connector is a buffered voltage output which is proportional to the HV output current and which can be used to monitor the HV current. The scaling factor defaults to 1V per 1mA out.

Setpoint Relay

The setpoint relay is driven while the following conditions are all true:

1. The SPC unit is powered up.
2. The HV is enabled.
3. The output voltage is high enough for a valid pressure to be read. By default this is greater than 2kV.
4. The calculated pressure is lower than the user-selected setpoint pressure.

Note: There is a delay after turning the HV until the SPC considers the calculated pressure reading to be valid, this can take up to one minute. The setpoint relay will not be driven during this period.

Pin 1 is the relay common, pin 2 is the normally closed and pin 9 is the normally open contact.

Pin 11 is a TTL logic level output (with a 1K resistor in series for protection) which mimics the set point relay state. It is high whenever the set point relay is driven.

Power Supplies

The following power supply pins are available on the misc. I/O connector. These power supplies are not protected and should be used with care. Do not attempt to power the SPC by connecting external power supplies to these pins.

Pin 5 is connected to (approximately) –14V.

Pin 10, pin 6 and pin 15 are connected to (approximately) +14V.

Pin 7 is connected to (approximately) +5V.

Pin 3 and pin 4 are connected to 0V.

The +14V and –14V supplies are regulated but not calibrated - in practice they may vary over the range 12V to 15V or so. Do not draw more than 50mA from any of these supplies, and do not inject significant levels of noise onto them.

The +5V supply may range from +4.9V to +5.1V. Do not draw more than 100mA from this supply.

Serial Operation

Serial Connector

This is a 9-pin Sub-D. The function and pin-out of this connector is determined by software running in the SPC power supply. This can be configured using the PC configuration tool, and this tool will also display the currently defined pin-out for the serial port.

The default pin-outs for some of the possible serial interfaces are shown below.

By default the SPC power supply will use 3-wire RS-232 with the pin-outs shown in the RS-232 column below, though these can be overridden using the PC configuration tool. By default the SPC does not support any of the RS-232 control lines, if these are required they can be enabled using the PC configuration tool.

Do not connect to any pin other then the ones appropriate for the serial mode you have selected. Some of the pins not used by the current mode may still be driven even though they are not used.

Serial Port Pin	RS-232	RS-422	RS-485	PHI/DD-485
1				
2	RxD	TXA(+)	A(+)	TXA(+)
3	TxD	RXA(+)		RXA(+)
4				
5	GND	GND	GND	GND
6				
7		RXB(-)		RXB(-)
8		TXB(-)	B(-)	TXB(-)
9				

Serial Operation

RS-232, RS-422 and RS-485 are all electrical standards which specify the hardware requirements for a serial link, but not the software protocol used to convey meaningful information across this serial link.

The SPC power-supply can be configured in software to use any of the above hardware standards, and the SPC supports many variations of these ‘standards’ to increase the range of devices with which it is compatible.

Equally important for serial communication is the use of a common software protocol. To this end the SPC power supply supports a number of serial protocols including, for compatibility, a super-set of a ‘standard’ protocol used by some other ion pump power supplies.

The SPC power supply recognises the following serial commands and returns the following fixed-length responses (with ‘x’ replaced by an appropriate digit):

Hex command	Description	SPC Parameter or Response
01	MODEL Number.	No parameter, replies “SPC2 ”
02	VERSION	No parameter, replies “FIRMWARE x.xx ”
0A	Read Current	No parameter, replies “x.xE-x AMPS ”
0B	Read Pressure	No parameter, replies “x.xE-x Torr ”
0C	Read Voltage	No parameter, replies “xxxx ”
0D	Read Status	No parameter, replies “SAFE-CONN ” or “STANDBY ” or “STARTING ” or “RUNNING ” or “COOL DOWN 0x ” or “PUMP ERROR 0x ”
0E	Set Pressure Units	One text parameter - the first letter is checked for “T”, “M” or “P” and anything extra is ignored. Null reply.
11	Get Pump Size	No parameter, replies “xxx.x ”, i.e. “040.0 ” = 40l/s
12	Set Pump Size	One floating point parameter, i.e. “40 ” or “0.2 ”. Null reply.
33	Set Auto-Restart	One text parameter – the first letter is checked for “y” or “n” and anything extra is ignored. Null reply.
34	Get Auto-Restart	“yes ” or “no ”
37	START Pump	No parameter, null reply.
38	STOP Pump	No parameter, null reply.
3C	Get Setpoint	No parameter, replies “x.xE-x, y.yE-y ”
3D	Set Setpoint	1 floating point parameter, i.e. “1.0e-7 ”. Null reply.
44	Lock Keypad	No parameter, null reply.
45	Unlock Keypad	No parameter, null reply.
51	Set Maximum Voltage	1 Floating point parameter, e.g. “5000 ”. Null reply.
FF	RESET SPC	No parameter and no reply. This completely resets the SPC.

These commands should be fully compatible with the Phi protocol, except for the Get/Set Pump Size commands, which use floating point numbers to allow pump sizes to be specified down to 0.1 l/s, and the Get/Set Setpoint commands.

The Get Setpoint command returns the set and release pressures only, there are no other values. The Set Setpoint command accepts only one number, this is the set pressure. The SPC calculates the release pressure by multiplying the set pressure by 1.2, based on a hysteresis value of 20%. This value can be changed using the PC configuration utility.

Note: The SPC is fairly flexible wherever a floating point parameter is required, the following are examples of numbers the SPC would find acceptable:

1, 1.2, 1.2e-3, 10, 0.0001, 1e-2, 1e+2, etc. . .

Note: The SPC can return floating point values in various forms, including numbers with leading zeros – i.e. “040.0” and this (rarely) includes exponential notation with a first digit of 0, for example “0.9e-9”, “0.5e-6”, etc.

Contact Gamma Vacuum to configure the SPC to drive RS-232, RS-422 or RS-485 lines, or an alternate baud rate.

Protocol Details

he serial protocol consists of command packets sent from a host computer to the SPC power supply, and response packets sent back from the SPC power supply back to the host computer.

To permit a host computer to control more than one device on the same serial line each packet contains a device address number and each device has a unique address. Only the device corresponding to the address in the command packet responds to the command.

To help ensure reliable communications both the command and the response packets contain checksum information.

The serial port settings would normally be set to 9600 baud, 8 data bits, no parity, and 1 stop bit. Normally the handshaking should be set to ‘none’, though the SPC can be configured to support XON/XOFF software handshaking and/or CTS/RTS hardware handshaking.

The SPC baud rate can be configured using the PC configuration utility from 2400 to 57600 baud, but by default it is set to 9600 baud.

The SPC unit ID is set to one by default, this can also be configured using the PC configuration utility. The SPC baud rate and unit ID can also be set manually, see the Advanced Settings chapter below.

The command packet may or may not contain additional information as a data field, hence there are two possible formats for the command packet.

The format of the command packet (without optional data) is as follows:

Start Character	1 byte	“~”(7Eh)
<space>	1 byte	“ ” (20h)
Device address	2 bytes	“xx” two hex digits
<space>	1 byte	“ ” (20h)
Command	2 bytes	“xx” two hex digits
<space>	1 byte	“ ” (20h)
Checksum	2 bytes	“xx” two hex digits
Terminator	1 byte	0Dh

The format of the command packet (with optional data) is as follows:

Start Character	1 byte	“~”(7Eh)
<space>	1 byte	“ ” (20h)
Device address	2 bytes	“xx” two hex digits
<space>	1 byte	“ ” (20h)
Command	2 bytes	“xx” two hex digits
<space>	1 byte	“ ” (20h)
Data field	unknown	ASCII characters
<space>	1 byte	“ ” (20h)
Checksum	2 bytes	“xx” two hex digits
Terminator	1 byte	0Dh

The checksum is calculated by summing all the characters sent after the Start character and before the Checksum field.

After a valid command packet has been received it is the responsibility of the device to react and respond to the command within 500mS. The SPC power supply has one exception to this rule, which is the RESET command. This immediately resets the SPC unit so it is unable to send a response packet. This command is intended to be used by the PC configuration utility and should only be used with care by other software.

The response packet is similar, but does not include the start character field. It also may or may not contain additional information as a data field, hence there are two possible formats for the response packet.

The format of the response packet (without optional data) is as follows:

Device address	2 bytes	“xx” two hex digits
<space>	1 byte	“ ” (20h)
Status	2 bytes	“OK” or “ER”
<space>	1 byte	“ ” (20h)
Response Code	2 bytes	“xx” two hex digits
<space>	1 byte	“ ” (20h)
Checksum	2 bytes	“xx” two hex digits
Terminator	1 byte	0Dh

The format of the response packet (with optional data) is as follows:

Device address	2 bytes	“xx” two hex digits
<space>	1 byte	“ ” (20h)
Status	2 bytes	“OK” or “ER”
<space>	1 byte	“ ” (20h)
Response Code	2 bytes	“xx” two hex digits
<space>	1 byte	“ ” (20h)
Data field	unknown	ASCII characters
<space>	1 byte	“ ” (20h)
Checksum	2 bytes	“xx” two hex digits
Terminator	1 byte	0Dh

The checksum is calculated by summing all the characters sent including the Device address up to but not including the Checksum field.

The SPC power supply will only recognise and respond to serial commands after the following events have occurred:

- The SPC has received a "~" start character.
- The Device address field matched the SPC's internally set address.
- There was a valid 2 hex digit command field.
- The calculated checksum matched the received checksum field.
- There was a carriage return terminator.

Once a valid serial command has been recognised it will be acted upon and a response packet returned within 500mS.

Provided messages don't exceed 64 bytes in length the SPC will handle them correctly, even when sent without pause at 57600 baud. Messages longer than 64 bytes are not supported and will be ignored. The SPC doesn't send any reply messages longer than 30 bytes.

Normally no handshaking is required between the SPC and the external controller, but where the controller is unable to keep up with the SPC, the SPC can be configured to support XON/XOFF or any combination of the RTS, CTS, DSR, and DCD hardware handshaking lines.

When using XON/XOFF, the remote controller can send an XOFF character ($13) to stop the SPC, then send an XON character ($11) to restart the SPC transmission. The SPC is fast enough to keep up with incoming data at any speed up to and including 57600 baud, so it will never send either XON or XOFF.

Serial Command Examples

For example, the following strings represent valid commands and checksums, and could be sent by simply typing them into a terminal. Do not type the "" quotes, and the spaces are significant. These assume the unit ID of the SPC is set to 1:

- Command 01, GET MODEL NUMBER
- Send "~ 01 01 22" + a carriage return

If the SPC is connected correctly it should respond with a message containing it's model name. Currently this is as follows:

- SPC replies "01 OK 00 SPC2 F3" + a carriage return.
- Command 02, GET VERSION
- Send "~ 01 02 23" + a carriage return

If the SPC is connected correctly it should respond with a message containing it's software version number. Currently this is as follows:

- SPC replies "01 OK 00 FIRMWARE 1.00 17" + a carriage return.

If you are talking to the SPC from a PC make sure that your handshake options are correct, usually this means setting them to NONE. Also, note that the default PC communications software requires you to 'disconnect' and 'call' again before any of the changes you make to the settings take effect.

Warranty & Service

Service

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 Buyers sole exclusive remedy under this warranty, Gamma Vacuum agrees to either repair or replace, at Gamma Vacuums 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 30 days of failure to perform.

This warranty does no 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 warranted only for the remaining unexpired portion the 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 it's 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 IT'S 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 it's warranty as to any of it's 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 directly or a representative of Gamma Vacuum. 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 the Gamma Vacuum toll-free number. 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 process 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.

Product Contamination Declaration Form

Thank you for taking the time to complete this form. Please complete this form in word and return to Gamma Vacuum in word, Adobe Acrobat format (.pdf), or via fax. An on-line version of this form is available at www.gammavacuum.com. The "tab" key moves between fields. Digital signatures are acceptable.

Assigned RMA: **Your Reference:**

Company Information

Company Name: Date:
Address:

Contact Information

Name: Phone:
Primary E-mail: Fax:
Web Site Address:

Return Information

Type of Product: ☐ ION PUMP
☐ ION PUMP CONTROLLER
☐ OTHER
Part Number:
Description:
Serial Number:
Contaminant Status*: ☐ HAS NOT BEEN EXPOSED
☐ HAS BEEN EXPOSED
Original Purchase Order:
Claim Status: ☐ WARRANTY CLAIM
☐ SERVICE REQUEST
☐ SHIPPING ERROR
☐ EVALUATION
☐ OTHER
Your Reference:

Reason for Return:

Additional Information:

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:

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