DIGITEL MPCq Controller
Instruction manual

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The content of this manual may change from time to time without notice. We accept no liability for any errors that may appear in this manual nor do we make any expressed or implied warranties regarding the content. As far as practical we have ensured that the products have been designed and constructed to be safe and without risks when properly installed and used in accordance with their operating instructions.

We accept no liability for loss of profit, loss of market or any other indirect or consequential loss whatsoever.

Product warranty and limit of liability are dealt with in our standard terms and conditions of sale or negotiated contract under which this document is supplied.

You must use this product as described in this manual. Read the manual before you install, operate, or maintain the product.

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1. Safety and compliance

1.1. Definition of Warnings and Cautions

NOTICE:

For safe operation from the start, read these instructions carefully before you install or commission the equipment and keep them safe for future use.

Read all the safety instructions in this section and the rest of this manual carefully and make sure that you obey these instructions. The equipment must only be operated and maintained by trained personnel in the proper condition and as described in this instruction manual.

Obey local and state requirements and regulations. If you have any questions about safety, operation or maintenance of the device, please contact our nearest subsidiary.

Important safety information is highlighted as warning and caution instructions. Obey these instructions.

WARNING:

If you do not obey a warning, there is a risk of injury or death. Different symbols are used according to the type of hazard.

CAUTION:

If you do not obey a caution, there is a risk of minor injury, damage to equipment, related equipment or process.

NOTICE:

Information about properties or instructions for an action which, if ignored, will cause damage to the pump or the system.

We reserve the right to change the design and the stated data. The illustrations are not binding.

Keep the instructions for future use.

1.2. Safety symbols

The safety symbols on the products show the areas where care and attention is necessary.

The safety symbols that follow are used on the product or in the product documentation.

	Warning/Caution An appropriate safety instruction must be followed or caution to a potential hazard exists.
	Warning - Dangerous voltage Identifies possible hazards from dangerous voltages.
	Warning - Heavy object Identifies a possible hazard from a heavy object.
	Warning - Read the manual

1.3. Warnings

	WARNING: Shock hazard. Can cause injury or death. Remove power before servicing.	AVERTISSEMENT : Risque de choc électrique. Peut entraîner des blessures, voire la mort. Coupez l'alimentation électrique avant l'entretien.	警告: 感電事故。怪我や死亡事故の原因になります。保守を行う前に、電源を切ってください。
	ADVERTENCIA: Peligro de descarga. Pueden producirse lesiones o incluso la muerte. Desconecte la alimentación antes de realizar cualquier tarea de mantenimiento.	WARNUNG: Stromschlaggefahr. Es besteht Verletzungs- und Todesgefahr. Vor Wartungsarbeiten vom Strom trennen.	警告： 触**电**危**险**。可能**导**致人**员**伤亡。**维护**之前先断**电**。

	WARNING: Heavy object. To avoid muscle strain or back injury, use lifting aids and proper lifting techniques when removing or replacing.	AVERTISSEMENT : Objet lourd. Pour éviter les blessures musculaires ou dorsales, utilisez des engins de levage et des techniques de levage appropriées lors du retrait ou du remplacement d'un objet lourd.	警告: 重量のある装置、部品。筋挫傷、背中や腰の怪我を避けるために、取り外しや交換はリフトを使用した適切な吊り上げ方法で行ってください。
	ADVERTENCIA: Objeto pesado. Para evitar distensiones musculares o lesiones en la espalda, utilice ayudas para la elevación y técnicas de elevación adecuadas durante la retirada o sustitución del equipo.	WARNUNG: Schwerer Gegenstand. Um Muskelverspannungen oder Rückenverletzungen zu vermeiden, verwenden Sie beim Entfernen oder Ersetzen Hebehilfen und geeignete Hebetechniken.	警告： 重物。为了避免肌肉劳损或背部损伤，执行卸除或更换操作时，应使用起重工具，并采用适当的起重技巧。

	WARNING: Read and understand operator's manual before using this machine. Failure to follow operating instructions could result in injury or damage to equipment.	AVERTISSEMENT : Lisez et comprenez le mode d'emploi avant d'utiliser cette machine. Le non-respect des instructions d'utilisation peut entraîner des blessures ou endommager l'équipement.	警告: 本機械を使用する前に、取扱説明書をよく読み、十分に理解してください。操作手順に従わない場合、怪我や機器が損傷する原因となることがあります。
	ADVERTENCIA: Lea y comprenda el manual del operador antes de utilizar este equipo. Si no se siguen las instrucciones de funcionamiento, podrían producirse lesiones o daños en el equipo.	WARNUNG: Sie müssen diese Bedienungsanleitung lesen und verstehen, bevor Sie diese Maschine benutzen. Die Nichtbeachtung der Gebrauchsanleitung kann zu Verletzungen oder Schäden an der Anlage führen.	警告： 使用本设备之前，请阅读并理解操作员手册。不遵守操作手册说明可能导致人员受伤和设备损坏。

1.4. Safety notices

1. Gamma vacuum controllers designed for ion pump operation are capable of delivering 7 kV 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 V 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 as high as 7 kV may be 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.

2. General information

The DIGITEL MPCq is an ion pump power supply controller.

It is designed to operate up to two independent ion pumps along with a Titanium Sublimation Pump (TSP).

It can accommodate any ion pump size up to 1200 L/s.

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.

WARNING:

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

2.1. Approvals

- The DIGITEL MPCq 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:
- IEC 61010-1
- EN 61010-1
- UL 61010-1
- CAN/CSA-C22.2 No. 61010-1

3. Unpacking the controller

3.1. 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 customer centre where the order originated and/or Gamma Vacuum.

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

3.2. Check the equipment received

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

4. Installation

The DIGITEL MPCq is a full 19-inch rack controller. No additional hardware needed to install in a standard 19-inch wide device rack.

Maintain a 2.52 in. (64 mm) clearance behind controllers for cable bend radius and proper airflow.

CAUTION:

This equipment uses a detachable power supply cord. Do not replace with inadequately rated supply cords.

4.1. 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 (ordered separately).

4.2. 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 - J504).
4. If high voltage cable has an optional safeconn feature (HV interlock), an additional connector is part of the high voltage cable. Connect it to the safeconn connector (J401 - J404), otherwise, use safeconn shorting jumper cable to connect to safeconn connector (J401 - J404). Safeconn interlock must be satisfied, otherwise HV cannot be turned on.
5. Verify correct input voltage requirements. Connect mains AC power cable to input power receptacle on the controller rear panel.

5. Controller configuration

Following configuration options are specified at order time:

5.1. Input mains AC voltage (110 V a.c. vs. 220 V a.c.)

Controller does not have universal power input, thus input mains AC voltage is part of the controller configuration.

Care must be taken when connecting controller to mains AC voltage to avoid connecting controller to wrong input voltage.

5.2. Supply configuration

Following controller configurations are valid:

1. One HV supply or channel
2. Two HV supplies or channels
3. One HV supply or channel and one internal TSP supply

5.3. Output voltage polarity for each HV channel (positive vs negative)

In case of positive polarity, output voltage is set to 7 kV by default.

In case of negative polarity, output voltage is set to -5.6 kV by default.

Output voltage is fixed (linear power supply, transformer tap).

5.4. Type of the HV output connectors

Following are standard HV connector types for J501 - J504:

1. SHV-10 kV (matching safeconn connector type is SMB style).
2. Fischer (matching safeconn connector type is mini banana style) other HV connector types are available per request.

5.5. Number of HV output connectors per HV supply

There can be more than one HV output connector tied to the same HV supply. In such case, connectors are tied in parallel.

Controller can have maximum of 4 HV output connectors in any configuration. For example, 2 HV output connectors per 1 HV supply.

5.6. Communication interface

Controller comes standard with Serial and Ethernet interface.

Profibus interface is optional.

5.7. Remote TSP control

Controller comes standard with connector J505 CTRL installed.

Connector can be used to connect and control remote TSP Controller.

See rear panel section for connector location.

If internal TSP supply is installed, connector J505 is not available.

6. HV control or ion pump operation

6.1. Prior to using an ion pump

Confirm following:

- Rough pump down to 1 x 10^{-4} torr or less (the lower the better). 1 x 10^{-6} torr is recommended. See Rough Pump user manual for details.

  NOTE:

  Use the full extent of available rough pumping before starting an ion pump to extend pump's lifetime, improve system ultimate pressure, and get accurate current readings.

- Evacuate the Vacuum System.
- Ensure contaminants do not exist in the system.
- If necessary (i.e. ion pump exposed to atmospheric pressure) bake the ion pump and system into roughing pump to achieve lowest pressure. See ion Pump user manual for details.

6.2. Prior to turning on HV and starting an ion pump

Confirm following:

- Verify high voltage cable is installed and connecting controller High Voltage (HV) output connector (rear panel, J501 - J504) to the ion pump.
- Verify controller and connected ion pumps are grounded using redundant ground wire.
- Verify controller's high voltage output has correct polarity for the connected ion pump (positive for diode pump, negative for triode pump).
- Verify safeconn interlock is satisfied. If high voltage cable has optional safeconn interlock feature, an additional connector is part of the high voltage cable. Connect it to controller's safeconn connector (J401 - J404). If high voltage cable does not have safeconn interlock feature, use safeconn shorting jumper cable to connect to controller's safeconn connector (J401 - J404).
- Safeconn interlock must be satisfied, otherwise HV cannot be turned on.
- If safeconn interlock is not satisfied, controller will display error 20 (safeconn interlock not satisfied) for that HV channel.
- Verify proper pump size is configured. HV cannot be turned on if pump size is set to 0. By default pump size is set to 0. If pump size is set to zero, controller will display error 22 (pump size not configured) for that HV channel.

6.3. Turn HV on and off

Turning HV on and off can be achieved:

- Using front panel touchscreen.
- Using remote communication (serial, ethernet or profibus).
- Using rear panel connector J104, Misc. I/O. (Digital Inputs).

7. Pressure measurement

Pressure value is determined using following equation

$$P = \frac{(0.066 * I * (\frac{5600}{V}) * U * F)}{S}$$

Where:

I - Current in amps.

V - Voltage in volts.

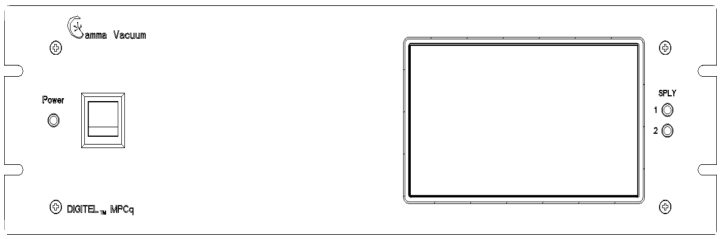
U - Pressure units conversion factor (1 for Torr, 1.33 for mbar and 133 for Pascal).

F - Configured pump pressure factor. Typically set to 1. See Supply setup on page 20.

S - Configured pump size in L/s. See Supply setup on page 20.

8. Front panel

Figure 1. *MPCq front panel*



8.1. Description

Front panel contains:

- Main power on and off rocker type switch (hard switch, when in off position main power is completely cut off from the unit).
- Main power indicator lamp (colour green).
- 7” TFT WVGA (800 x 480) colour LCD, 16:9 aspect ratio, touchscreen capable (primary user interface).
- Two supply HV on and off indicator lamps (colour red). Note, both lamps are installed even in single supply configuration.

9. Touchscreen user interface

9.1. Home screen

Touch anywhere on the screen to invoke button controls.

Figure 2. *Home screen (two HV supplies installed)*

Figure 3. *Home screen (with internal TSP supply installed)*

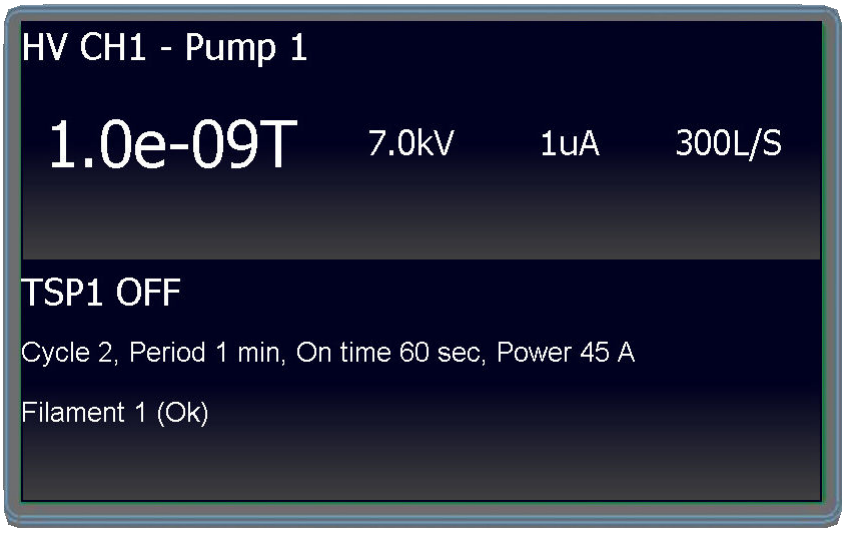
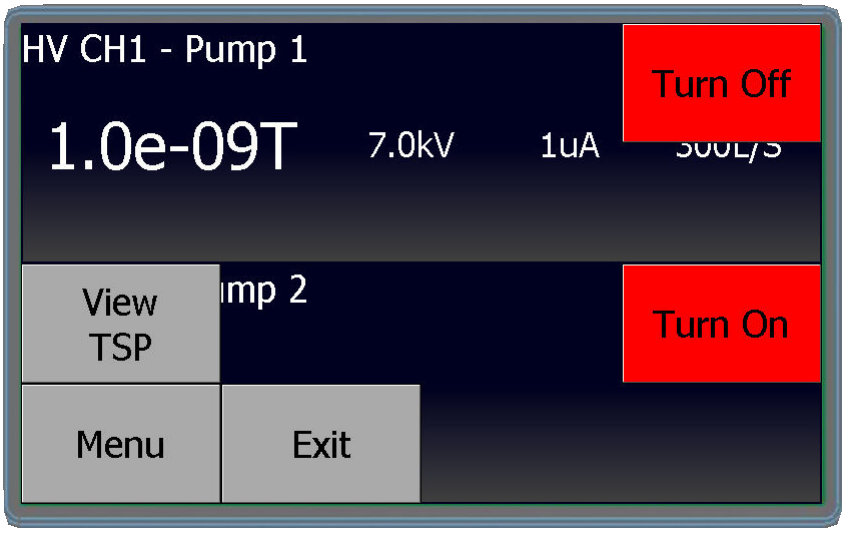


Figure 4. *Home screen with control buttons invoked*



Available options:

View TSP - Switches home screen to TSP view. Button is available only if Remote TSP Controller is connected to the MPCq Controller.

Menu - Invokes main menu.

Exit - Clears screen and hides control buttons.

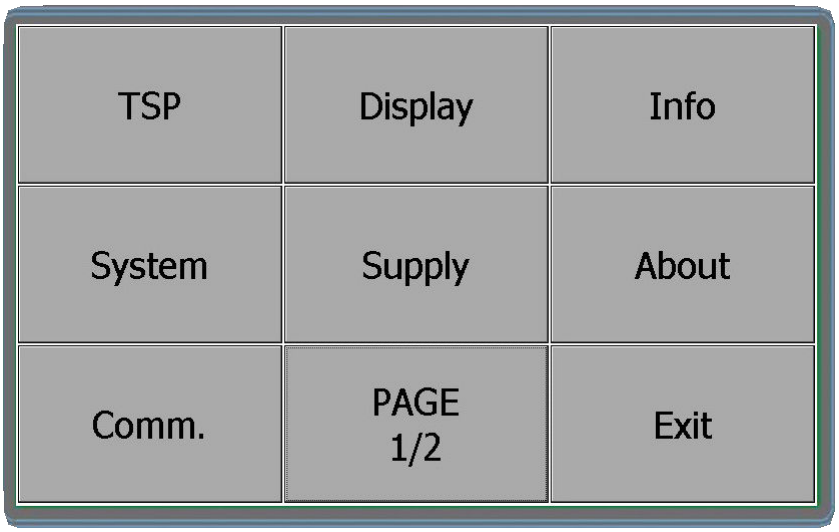
Turn On and Off - Turns HV on and off for respective HV channel.

9.2. Main menu (Page 1)

Page 1 of main menu is accessed by pressing the “PAGE 1/2” button.

Exit button will exit main menu and show home screen.

Figure 5. *Main menu (Page 1)*

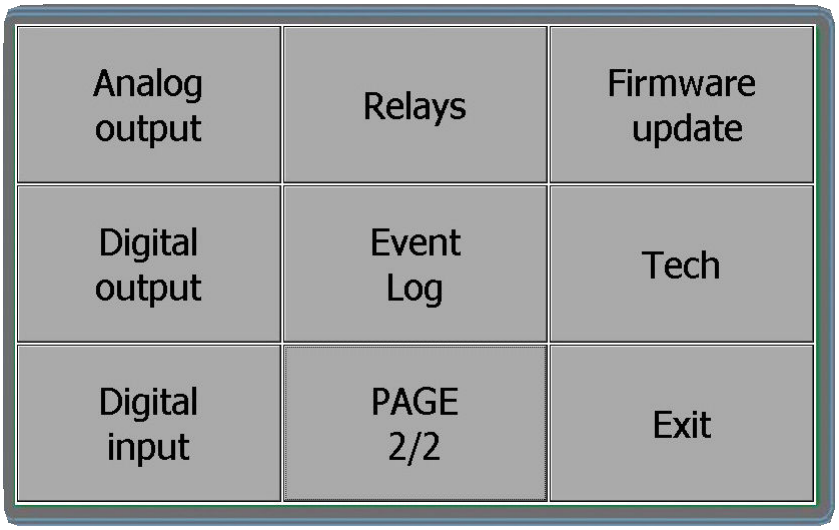


9.3. Main menu (Page 2)

Page 2 of setup screen is accessed by pressing the “PAGE 2/2” button.

Exit button will exit main menu and show home screen.

Figure 6. *Main menu (Page 2)*



9.4. Supply setup

Available setup:

Pump name - Configures pump name. Maximum of 15 characters.

Pump size - Configures pump size (0 - 1200).

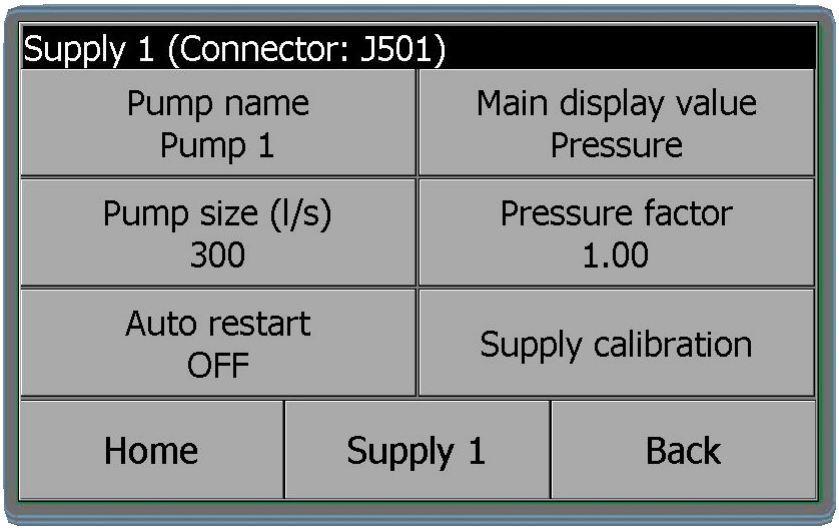
Auto restart - Configures supply auto restart option (on and off).

Main display value - Configures main display value (voltage, current, pressure).

Pressure factor - Configures pump pressure factor. See Pressure measurement on page 16 for details.

Supply calibration - Invokes supply calibration (zeroing) process.

Figure 7. *Supply setup screen*



9.5. Display setup

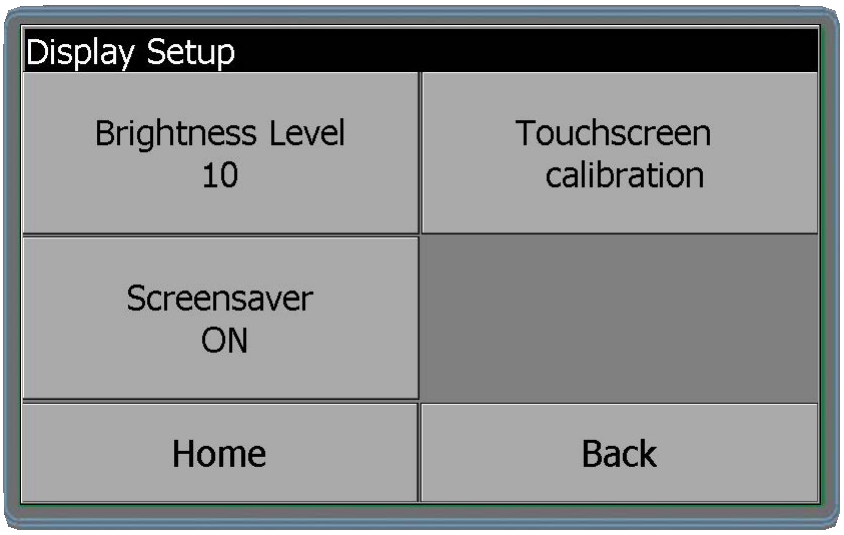
Available setup:

Brightness level - Configures screen brightness level (1 - 10).

Screen saver - Configures screen-saver on and off state. Turning screen saver off is not recommended as this will shorten screen back light lifetime.

Touchscreen calibration - Invokes touchscreen calibration process.

Figure 8. *Display setup screen*



9.6. System setup

Available setup:

Language - Configures user interface language.

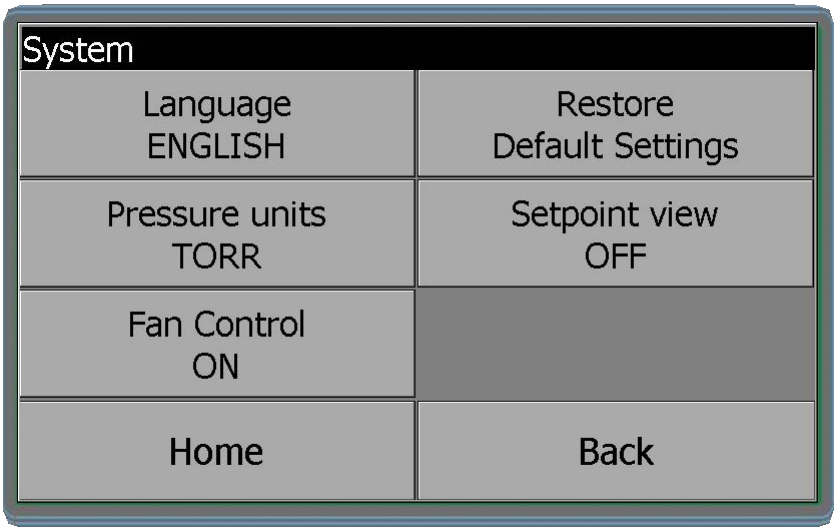
Pressure units - Configures system pressure units (Torr, mbar, Pascal).

Fan control - Configures fan control (on, auto).

Restore default settings - Resets all settings to system defaults.

Setpoint view - Turns on and off setpoint view button on the home screen.

Figure 9. *System setup screen*



9.7. Analog output

Total of four analog outputs on connector J104:

Analog output 1 (J104, pin 30)

Analog output 2 (J104, pin 32)

Analog output 3 (J104, pin 34)

Analog output 4 (J104, pin 36)

By default, all analog outputs are turned off (function set to off).

Analog output signal range 0 - 10 V.

Available functions:

- OFF
- Pressure, logarithmic
- Current, logarithmic
- Current, 1 V / 1 nA
- Current, 1 V / 10 nA
- Current, 1 V / 100 nA
- Current, 1 V / 1 uA
- Current, 1 V / 10 uA
- Current, 1 V / 100 uA
- Current, 1 V / 1 mA
- Current, 1 V / 10 mA
- Current, 1 V / 50 mA
- Voltage, 1 V / 1 kV

Supply Source - Selects supply driving analog output.

Options applicable to 'Pressure, logarithmic' and 'Current, logarithmic' functions:

Offset: Valid range from - 15 to + 15

Output State: Normal vs. Inverted.

Logarithmic current example:

Current = 2 x 10^{-8} (20 nA), Offset = 8, Output state = Normal

Step 1: Calculate the log of the current (Log (2 x 10^{-8}) = - 7.7)

Step 2: If 'Output state = Inverted' multiply current log value in step 1 by (-1)

Step 3: Add the offset value (-7.7 + 8 = 0.3 V)

The analog output pin will read 0.3 V.

Logarithmic pressure example:

Pressure = 1 x 10^{-9} torr, Offset = 11, Output state = Normal

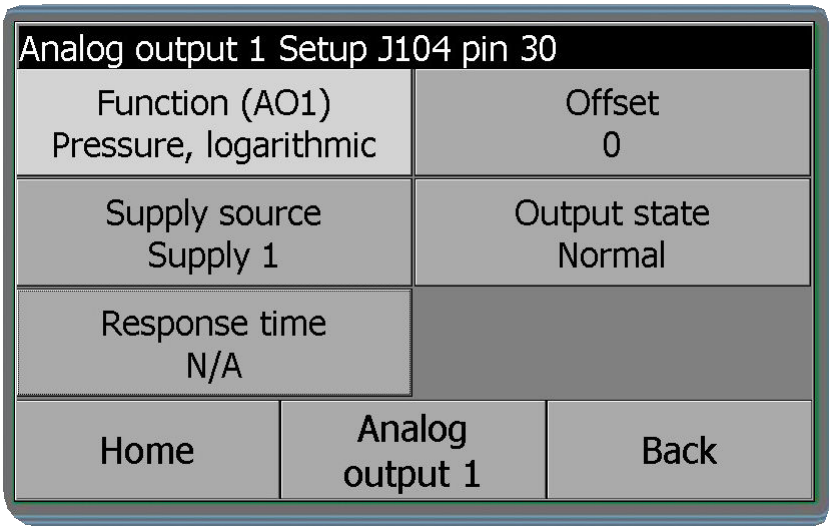
Step 1: Calculate log of pressure (Log (1 x 10^{-9}) = - 9)

Step 2: If 'Output state = Inverted' multiply current log value in step 1 by (-1)

Step 3: Add offset value (-9 + 11 = 2 V)

The analog output pin will read 2 V.

Figure 10. *Analog output screen*



9.8. Digital input setup

Total of four digital inputs on connector J104.

Digital input 1 (J104, pin 22)

Digital input 2 (J104, pin 23)

Digital input 3 (J104, pin 24)

Digital input 4 (J104, pin 25)

By default all digital inputs are turned off (function set to off).

Available functions:

- OFF
- HV interlock
- HV switch
- TSP 1 interlock
- TSP 2 interlock

HV interlock function

Ground pin to satisfy interlock. If interlock is not satisfied, HV cannot run.

HV switch function

Ground pin to turn on HV, otherwise HV is off.

TSP 1 interlock function

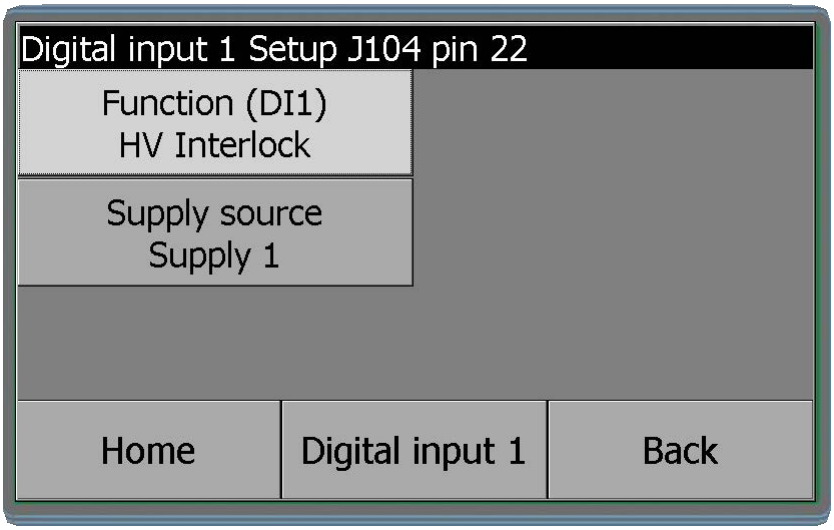
Ground pin to satisfy TSP 1 interlock. If interlock is satisfied, TSP 1 cannot run.

TSP 2 interlock function

Ground pin to satisfy TSP 2 interlock. if interlock is not satisfied, TSP 2 cannot run.

Supply source - Selects supply that will be controlled by this setup.

Figure 11. *Digital input setup screen*



9.9. Digital output setup

Total of four digital outputs on connector J104:

Digital output 1 (J104, pin 15)

Digital output 2 (J104, pin 17)

Digital output 3 (J104, pin 19)

Digital output 4 (J104, pin 37)

By default, all digital outputs are turned off (function set to off).

Digital output signal 0 - 5 V.

Available functions:

- OFF
- Pressure setpoint
- HV error
- HV output state

Pressure setpoint function:

ON pressure - When pressure value gets below this point, digital output is asserted.

OFF pressure - When pressure value gets above this point, digital output is de-asserted.

HV error function:

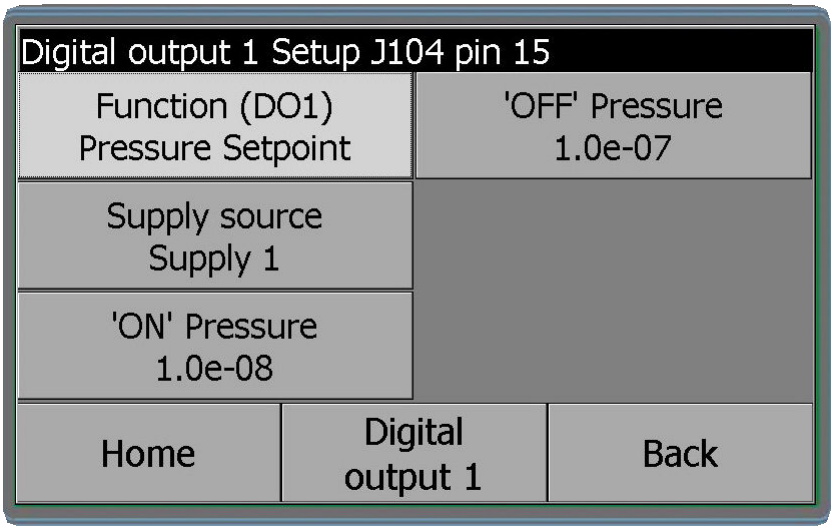
Digital output is asserted when supply error is detected.

HV output state function:

Digital output is asserted when supply is on (HV on), or de-asserted when supply is off (HV off).

Supply source - Selects supply driving digital output.

Figure 12. *Digital output screen*



9.10. Relay setup

Total of four relays on connector J104:

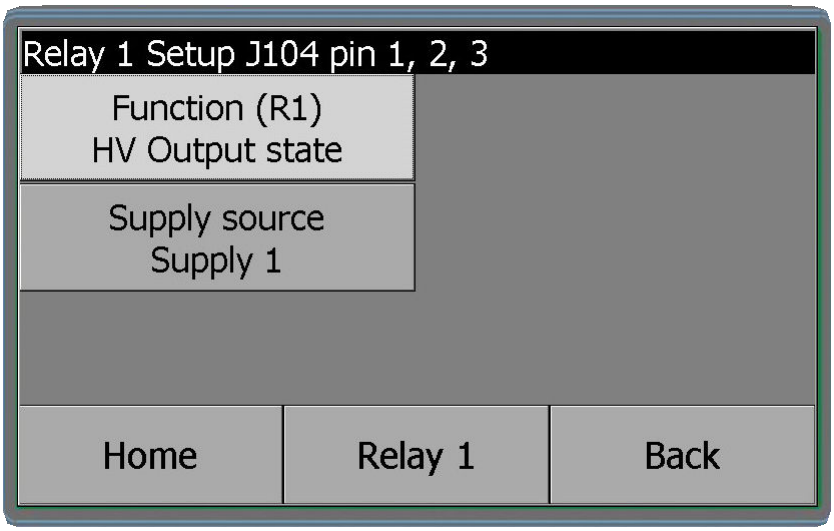
- Relay 1 (J104, pins 1, 2, 3)
- Relay 2 (J104, pins 4, 5, 6)
- Relay 3 (J104, pins 7, 8, 9)
- Relay 4 (J104, pins 10, 11, 12)

By default, all relays are turned off (function set to off).

Setup is identical to digital output setup. See Digital output setup on page 24.

For relay pinout details see Table: J104 connector pinout.

Figure 13. *Relay setup screen*



9.11. Serial port setup

Available setup:

Node address - Configures unit node address (1 - 255). Gamma protocol command packet structure requires node address.

Serial standard - Selects serial standard: RS-232, RS-485HD (two wire mode), and RS-485FD (four wire mode).

Baud rate - Selects baud rate (9600, 19200, 38400, 57600, 115200).

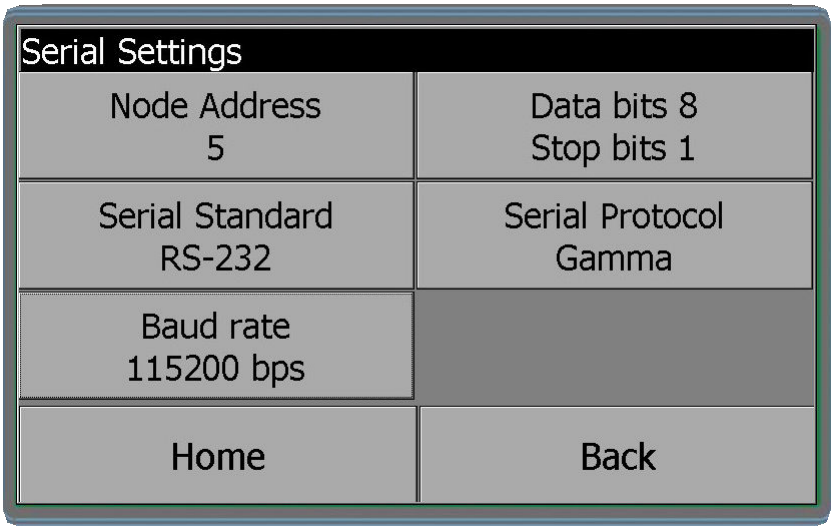
Data bits and stop bits - Information only.

Serial protocol - Selects serial protocol running on the serial port. Supported protocols are Gamma, Modbus ASCII, and Modbus RTU.

NOTE:

Modbus register map is available on Gamma Vacuum website under download section.

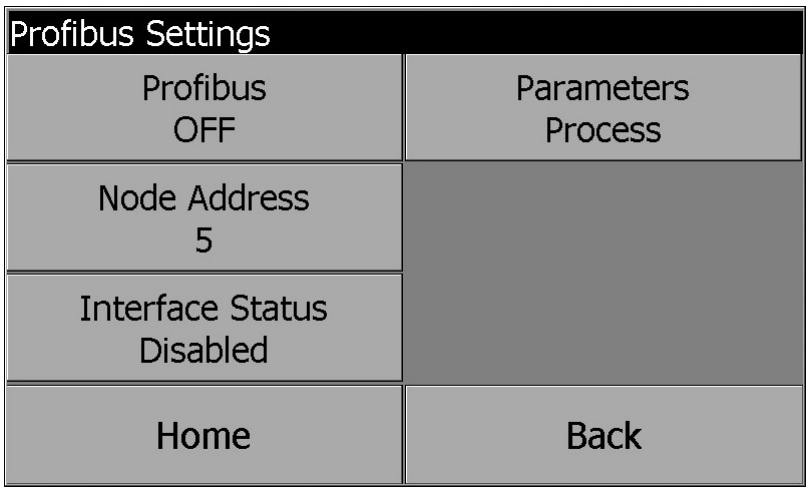
Figure 14. *Serial port setup screen*



9.12. Profibus setup

For Profibus information reference Profibus user manual, document 900033 available on Gamma Vacuum website under download section.

Figure 15. *Profibus setup screen*



9.13. Ethernet interface setup

Available setup:

MAC address - Information only. Ethernet MAC address. Cannot be changed.

DHCP - Selects DHCP client on and off.

IP address - Configures Ethernet IP address.

Subnet mask - Configures Ethernet subnet mask address.

Gateway address - Configures Ethernet gateway address.

Link state - Information only.

Supported protocols:

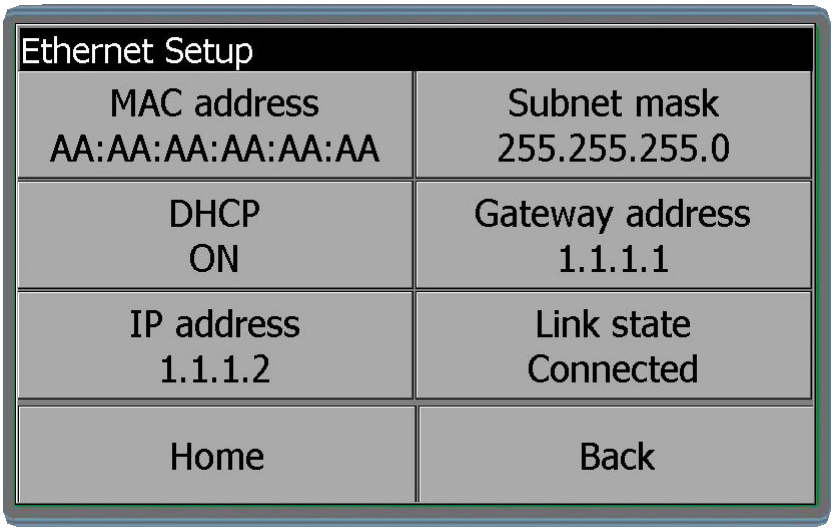
Gamma protocol (running on TCP port 23)

Modbus TCP protocol (running on TCP port 502)

NOTE:

Modbus register map is available on Gamma Vacuum website under download section.

Figure 16. *Ethernet setup screen*



9.14. TSP sublimation view

First text line indicates current TSP status. Here 'TSP 1 OFF'.

Second text line indicates current TSP configuration as defined in the TSP Setup window.

Third text line indicates currently active TSP filament. This is the filament that will be sublimated.

Available TSP status:

'TSP Initializing' - TSP is initializing.

'TSP OFF' - TSP is off.

'TSP ON' - TSP is currently sublimating.

'TSP Armed' - TSP is running programmed mode, but not currently sublimating TSP filament.

'TSP Armed, Supply is off' - TSP cannot continue because pressure window is set, but supply is off.

'TSP Armed, Outside the pressure window' - TSP cannot continue because pressure window is set, but pump pressure is outside the pressure window.

'TSP Armed, Interlock - Active' - TSP cannot continue because TSP interlock is set, but not satisfied.

'TSP Armed, Waiting – In use' - TSP cannot continue because other TSP is currently running the sublimation cycle.

Figure 17. *TSP sublimation view screen (no control buttons)*

9.15. TSP sublimation view with controls

View pump - Switches home screen to pump view.

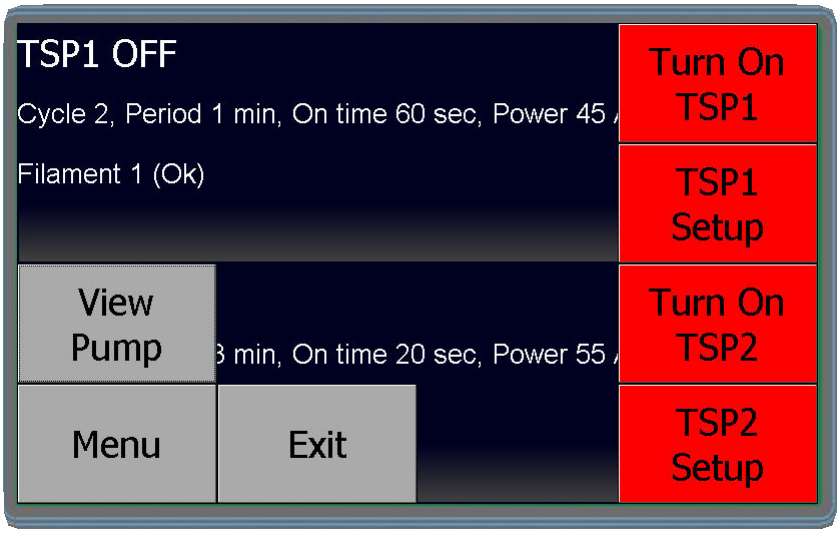
Menu - Invokes main menu.

Exit - Clears screen and hides control buttons.

Turn On TSP (Turn Off TSP) - Starts TSP programmed mode according to the parameters defined in TSP setup window. If TSP programmed mode is running this button will turn off TSP operation.

TSP setup - Invokes TSP setup screen.

Figure 18. *TSP sublimation view screen with controls*



9.16. TSP setup

Available setup:

Filament - Selects active filament (1 - 4). Filament status reads (OK) if at the end of the firing cycle, filament current reached 80% of current target value. A question mark (?) is

displayed if filament current did not reach 80% of the current target value.

Current target (A) - Configure sublimation current target level.

On time (s) - Configures sublimation time in seconds.

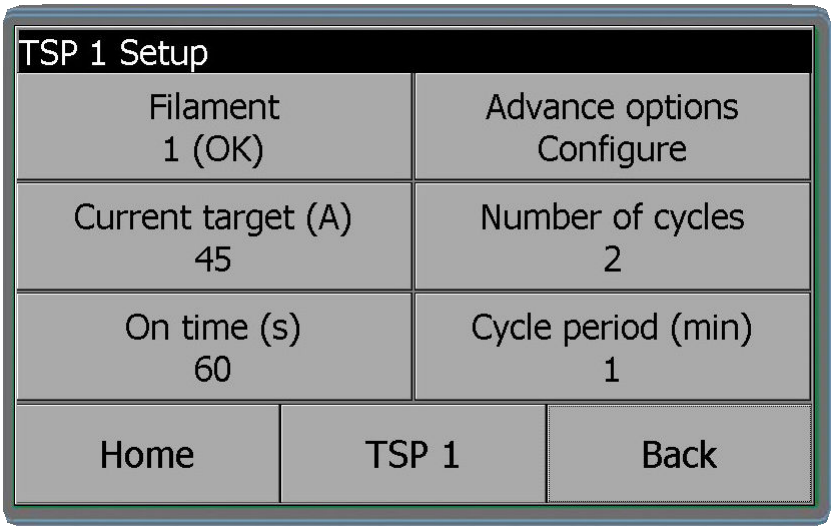
Number of cycles - Configures number of sublimation cycles to run.

Cycle period - Configures time in minutes between each sublimation cycle.

Advance options configure - Invokes TSP advance options window.

TSP 1 and TSP 2 - Selects TSP for which above parameters are configured.

Figure 19. *TSP setup screen*



9.17. TSP pressure window setup

Available setup:

Pressure window - Turns on and off pressure window option.

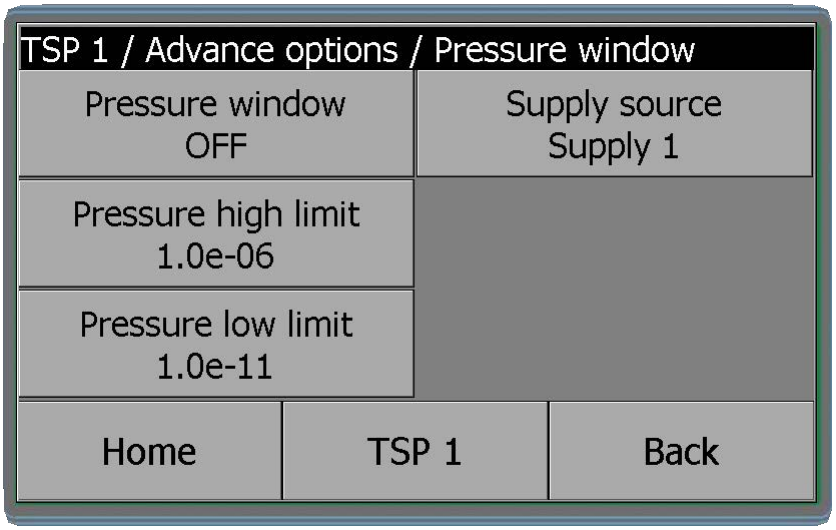
When pressure window is enabled sublimation process will run only if pump pressure is within the defined pressure window. If pump pressure is outside the defined pressure window, the TSP status will read 'TSP Armed, Outside the pressure window' and sublimation process is not allowed.

Pressure high limit - Specifies upper pressure limit.

Pressure low limit - Specifies lower pressure limit.

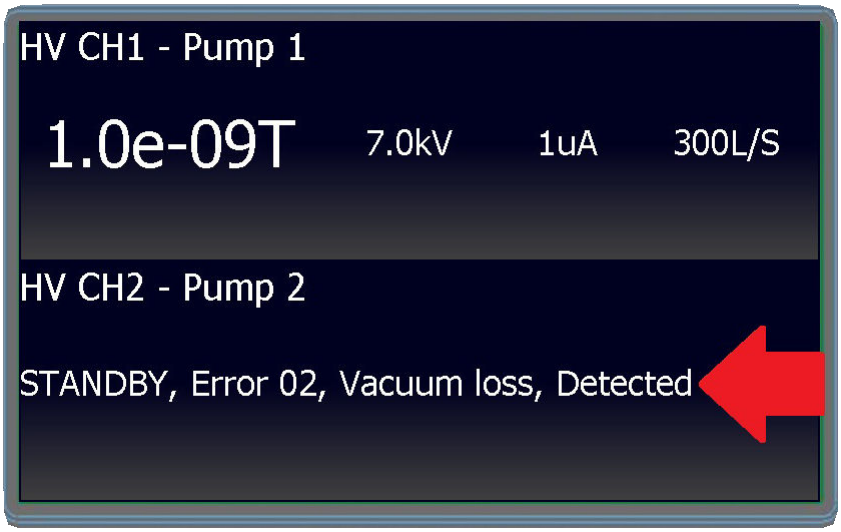
Supply source - Specifies which supply and pump pressure reading will be taken into consideration for pressure window.

Figure 20. *TSP pressure window screen*



10. Error/status codes

Figure 21. *Display error/status codes screen*



10.1. Error example 'STANDBY, Error 02, vacuum loss, detected'

'STANDBY' - Indicates supply HV can be turned on. In comparison, 'DISABLED' indicates supply HV cannot be turned on.

Turning on supply HV will clear all outstanding errors not requiring user intervention.

For example, error 02 indicates vacuum loss detected while pump was running. User can turn on HV and start pump again, no other action is required.

In comparison, error 20 indicates safeconn (HV interlock) is not satisfied. The state will read 'DISABLED'. User cannot turn on HV until safeconn is satisfied.

'Error 02' - See Table: Error/status codes for description of the errors.

'Vacuum Loss' - Short description of the error.

'Detected' - Indicates error status. Detected means error was detected at some time in the past, but not active anymore.

In comparison, 'Active' indicates error was detected and still active at this time. Addition user intervention is required to clear the error.

Table 1. *Error/status codes*

Error/status code	Description
1	Too many cool down cycles occurred during pump starting.
2	Vacuum loss detected. Output voltage dropped to less than 1.2 kV while pump was running.
3	Short circuit detected during pump starting.

Error/status code	Description
5	Excess power detected. Excess amount of power delivered to the pump for the configured pump size.
7	Excess pump start time. The output voltage did not reach 2 kV within maximum pump starting time of 5 minutes.
12	Pump thermal runaway detected. Significant drop in voltage detected during pump starting.
20	Safeconn (HV Interlock) not satisfied. HV cannot run.
21	HV interlock not satisfied or HV switch is off. HV cannot run. See Digital input setup on page 23 for details.
22	Pump size set to 0 L/s. HV cannot run.
23	Supply not calibrated. Current metering might not be accurate.
26	Supply over-temperature detected. HV cannot run.

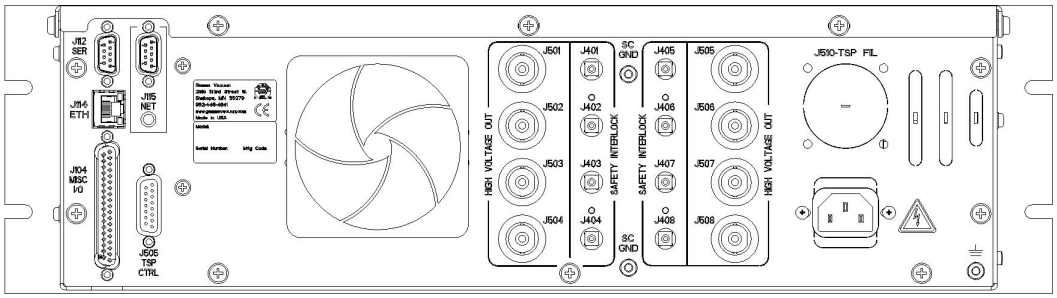
Note:

If error code is not listed in the table please contact Gamma Vacuum for more information.

11. Rear panel

Power input is a standard IEC interface.

Figure 22. *MPCq rear panel*



11.1. Connector pair, HV output connectors and safeconn connectors

Connector pair J501 - 504/J401 - 404, HV output connectors and safeconn (HV interlock) connectors

The SHV 10 kV (Fischer) type connector and corresponding SMB (mini banana) connector is supplied for each high voltage output connection.

The SHV 10 kV (Fischer) type connectors are used to relay high voltage to the ion pump.

The SMB (mini banana) connections are used to relay safeconn (HV interlock) logic signal from controller to the ion pump high voltage feedthrough.

When connection HV cable to the controller, insert mating connector into desired J50X connection and lock the connector.

SMB (mini banana) connectors are push-on connectors. Press firmly until the connector snaps into place.

Note:

Other connector types available per request.

11.2. Connector J115, NET (Profibus, optional)

Standard Sub-D 9-pin female connector. Connection to Profibus interface.

For Profibus information reference Profibus user manual, document 900033, available on Gamma Vacuum website under download section.

11.3. Connector J505, CTRL

Standard Sub-D 15-pin female connector.

Used in combination with Remote TSP controller to facilitate communications between controllers. Connection is made using straight-through Sub-D 15-pin cable available from Gamma Vacuum (PN 380049 - length 3 m, PN 380050 - length 6 m, PN 380085 - length 15 m, PN 380895 - length 30 m).

Note:

Connector is not installed if controller is configured with internal TSP supply.

11.4. Connector J114, ETH

Standard RJ-45 connector. Connection to Ethernet interface.

Connector has two LED indicators

- Green LED - Indication of link state.
- Orange LED - Indication of data activity.

11.5. Connector J510, TSP FIL (TSP, optional)

Installed in case when MPCq is configured with internal TSP supply.

Three filament, keyed TSP Pump connector.

Use high current cable to connect to Titanium Sublimation Pump (TSP).

11.6. Connector J104, Misc I/O

Standard Sub-D 37-pin female connector.

Table 2. *J104 connector pinout*

Pin	Description
1	Relay 1 Common*
2	Relay 1 NC
3	Relay 1 NO
4	Relay 2 Common*
5	Relay 2 NC
6	Relay 2 NO
7	Relay 3 Common*
8	Relay 3 NC
9	Relay 3 NO
10	Relay 4 Common*
11	Relay 4 NC
12	Relay 4 NO
13	Reserved - do not use, ground
14	Reserved - do not use, ground
15	DIGITAL OUT 1 - output, digital, 0/+ 5 V d.c., 7 mA maximum
16	Reserved - do not use, ground
17	DIGITAL OUT 2 - output, digital, 0/+ 5 V d.c., 7 mA maximum
18	Reserved - do not use, ground
19	DIGITAL OUT 3 - output, digital, 0/+ 5 V d.c., 7 mA maximum
20	Reserved – do not use, output, digital, 0/+ 5 V d.c., 7 mA maximum

Pin	Description
21	Reserved – do not use, output, digital, 0/+ 5 V d.c., 7 mA maximum
22	DIGITAL IN 1 - input, pulled-up internally to + 3.3 V, ground to activate assigned function
23	DIGITAL IN 2 - input, pulled-up internally to + 3.3 V, ground to activate assigned function
24	DIGITAL IN 3 - input, pulled-up internally to + 3.3V, ground to activate assigned function
25	DIGITAL IN 4 - input, pulled-up internally to + 3.3 V, ground to activate assigned function
26	+ 12 V d.c. - supply, regulated, 80 mA maximum
27	Not connected
28	Not connected
29	Reserved - do not use, ground
30	ANALOG OUT 1 - output, analog, range 0 to + 10 V d.c.
31	Ground
32	ANALOG OUT 2 - output, analog, range 0 to + 10 V d.c.
33	Ground
34	ANALOG OUT 3 - output, analog, range 0 to + 10 V d.c.
35	Ground
36	ANALOG OUT 4 - output, analog, range 0 to + 10 V d.c.
37	DIGITAL OUT 4 - output, digital, 0/+ 5 V d.c., 7 mA maximum

* Maximum relay current 500 mA, maximum voltage 28 V. Common and NC pins are connected in default or de-energized state.

11.7. Connector J112, SER

Standard Sub-D 9-pin female connector. Connection to serial interface. Supported serial standards are RS-232, RS-485 full duplex (four wire setup), and RS-485 half duplex (two wire setup).

Cabling for RS-232 serial protocol

The MPCq 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 lines so the receive and transmit signals are properly connected.

Note:

For RS-232, the serial cable between the PC and the controller only needs to cross Rx and Tx pins. No other signals are needed, except ground pin 5.

Table 3. *J112 connector pinout*

RS-232	
RXD	2
TXD	3
GND	5

RS-485 full duplex (4 wire)	
+TX	2
-TX	8
GND	5
+RX	3
-RX	7

RS-485 half duplex (2 wire)	
+TX/+RX	2
-TX/-RX	8
GND	5

12. Serial communication

Following serial protocols are supported:

- Gamma protocol
- Modbus ASCII protocol
- Modbus RTU protocol

Note:

Modbus register map is available on Gamma Vacuum website under download section.

12.1. Gamma protocol over serial connection

Gamma protocol command packet structure over serial connection

The command packet is made up of at least five fields. The minimum command packet (single command with no data) is 11 bytes long. No new commands should be sent to the controller before the response from the previously sent command has been received.

Table 4. *Command packet structure over serial connection*

Start	Space	Address	Space	Command	Space	Data	Space	Checksum	Terminator
1 byte	1 byte	2 bytes	1 byte	2 bytes	1 byte	variable	1 byte	2 bytes	1 byte

	Field	Size	Comment
1	START	1 ASCII character	ASCII character is '~' (TILDA)
Start is the first byte in the command packet and tells remote controllers to start decoding a message.			
2	ADDRESS	2 ASCII 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.*			
3	COMMAND CODE	2 ASCII hex characters	Range 00 through FF
See Gamma protocol commands on page 42 for list of available command codes. The command code must be two hex digits, even if the first is a zero.			
4	DATA field(s)	As needed	ASCII printable characters only
Data field(s) are for any commands that have a data value. Not all commands require data field. If command has more than one data value associated with it, such as setting X and a Y value, the command field could be followed by two data fields (X and Y) separated by a comma and space between them. All data must be sent in ASCII printable format (no binary or "control" characters).			

	Field	Size	Comment
5	CHECKSUM	2 ASCII 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	TERMINATOR	1 ASCII hex character	ASCII carriage return
ASCII value of carriage return character placed at the end of a command packet. There is not a space between the checksum and terminator field.			

12.2. Gamma protocol response packet structure over serial connection

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 acknowledgement with no data) would consist of the following fields and would be 12 bytes long.

Table 5. *Response packet structure over serial connection*

Address	space	Status	space	Response code	space	Response data	space	Checksum	Terminator
2 bytes	1 byte	2 bytes	1 byte	2 bytes	1 byte	variable	1 byte	2 bytes	1 byte

	Field	Size	Comment
1	ADDRESS	2 ASCII 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.			
2	STATUS	2 ASCII hex 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 followed by an error code. See Table: Response code error codes.			
3	RESPONSE CODE	2 ASCII hex characters	Range 00 through FF

Field		Size	Comment
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. See Table: Response code error codes. **Note:** *If there is not an applicable error code, a "00" will be transmitted.*			
4	RESPONSE DATA	As needed	ASCII 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.*			
5	CHECKSUM	2 ASCII 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.			
6	TERMINATOR	1 ASCII hex character	ASCII carriage return
ASCII value of carriage return character placed at the end of a packet. There is not a space between the checksum and terminator field.			

Table 6. *Response code error codes*

Code	Description
0	Command executed successfully.
1	Bad command format. Returned is command syntax is not valid.
2	Bad command code. Returned in command code is not valid.
3	Bad checksum. Returned if checksum is not valid.
4	Timeout. Returned if complete command packet was not received within 2 seconds from receiving the tilde start character.
6	Unknown error. Used for internal purpose.
7	Communication error. Returned if null character 0x00 is received or if buffer overflow occurred.
8	Bad parameter. Returned if command parameters are not valid.

12.3. CRC checksum example

Note:

A checksum of "00" will bypass checksum field verification by the controller.

The command to be sent to the unit is

0x01 – SYS GET MODEL.

Full command is:

'~ 01 01 XX' + carriage return,

where XX is an unknown checksum at this time.

NOTE:

This command assumes the unit address is set to 1.

1. To calculate command checksum, add decimal values of all characters in the packet, excluding start, checksum, and terminator. Divide result by 256 and the integer remainder converted to two ASCII hex digits is the checksum for the command. See Table: Command CRC checksum.
2. Example in decimal, take 290 mod 256 and result is 34, which converted to hex is 0x22. This is the command checksum. Example in hex, take 0x122 mod 0x100 and result is 0x22. This is the command checksum.
3. The command to be sent to the unit is, '~ 01 01 22' + carriage return.
4. The unit will respond with, '01 OK 00 DIGITEL MPCQ 0E'.
5. To verify checksum for the response, perform similar calculations. See Table: Response CRC checksum.
6. Example in decimal, take 1326 mod 256 and result is 46, which converted to hex is 0x2E. This is the response checksum. Example in hex, take 0x52E mod 0x100 and result is 0x2E. This is the response checksum.

Table 7. *Command CRC checksum*

Characters	Value (Decimal)	Value (Hex)
space	32	0x20
0	48	0x30
1	49	0x31
space	32	0x20
0	48	0x30
1	49	0x31
space	32	0x20
	Total = 290	Total = 0x122

Table 8. *Response CRC checksum*

Characters	Value (Decimal)	Value (Hex)
0	48	0x30
1	49	0x31

Characters	Value (Decimal)	Value (Hex)
Space	32	0x20
O	79	0x4F
K	75	0x4B
space	32	0x20
0	48	0x30
0	48	0x30
space	32	0x20
D	68	0x44
I	73	0x49
G	71	0x47
I	73	0x49
T	84	0x54
E	69	0x45
L	76	0x4C
space	32	0x20
M	77	0x4D
P	80	0x50
C	67	0x43
Q	81	0x51
space	32	0x20
	Total = 1326	Total = 0x52E

12.4. Examples - Gamma protocol over serial connection

For example, 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 examples assume unit address is set to 1 and supply 1.

Note:

Command checksum can be set to “00” to bypass checksum field verification by the controller.

Example 1

Command - SYS GET MODEL, 0x01

Tx – “~ 01 01 22” + carriage return

Rx – “01 OK 00 DIGITEL MPCQ 2E” + carriage return

Example 2

Command - HV GET CURRENT, 0x0A

Tx – “~ 01 0A 01 B3” + carriage return

Rx – “01 OK 00 1.33E-11 AMPS C5” + carriage return

Example 3

Command - HV GET PRESSURE, 0x0B

Tx – “~ 01 0B 01 B4” + carriage return

Rx – “01 OK 00 1.0E-11 TORR A5” + carriage return

12.5. Gamma protocol commands

Table 9. *Gamma protocol commands*

Hex command	Description	Data field	Response	Data and response interpretation
01	SYS GET MODEL Get controller model string.		DIGITEL MPCQ	
02	SYS GET FIRMWARE VERSION Get firmware version.		SW Version X.XX	Where: X.X is firmware version number
0E	SYS SET PRESSURE UNITS Set pressure units.	U		Where: U is pressure units (T - Torr, M - mbar, P - Pascal)
4F	SYS TFTP SERVER ADDRESS Configures the IP address of the TFTP server used in the firmware upgrade process. If no parameter is specified, the current address is returned.	X.X.X.X	X.X.X.X	Where: X.X.X.X is the IP address of the TFTP server
8F	SYS SET FIRMWARE UPDATE Tells system firmware update is wanted. Send the command and cycle power. Upon power up, bootloader shall be running.			No parameters.
ED	SYS GET/SET PUMP NAME Sets/gets pump name. If only S parameter is specified, the current name is returned.	S, TEXT	TEXT	Where: S is supply (1-2) TEXT is string up to 15 characters

Hex command	Description	Data field	Response	Data and response interpretation
FF	SYS RESET Restarts the system.	N		Where: N is the reboot mode 0 = Reboot 1 = Reboot and start boot loader 3 = Reset non-vol parameters to defaults
0A	HV GET CURRENT Reads supply current	S	X.XE-X AMPS	Where: S is supply (1-2)
0B	HV GET PRESSURE Reads supply pressure	S	X.XE-XX UUU	Where: S is supply (1-2) UUU is pressure units (TORR, m Bar, or PASCAL)
0C	HV GET VOLTAGE Reads supply voltage	S	XXXX	Where: S is supply (1-2)
0D	HV GET STATUS Reads pump status.	S, XX	YY	Where: S is supply (1-2) XX is option. Currently only option 00 is available. YY can be “00” for pump standby “01” for pump starting “02” for pump running “03” for pump cooldown “04” for pump error
11	HV GET PUMP SIZE Reads pump size.	S	N L/s	Where: S is supply (1-2) N is pump size
12	HV SET PUMP SIZE Sets pump size.	S, N		Where: S is supply (1-2) N is pump size
1D	HV GET PUMP PRESSURE FACTOR Reads the pump pressure factor.	S	N.NN	Where: S is supply (1-2) N.NN is pump pressure factor (0.01 - 9.99)
1E	HV SET PUMP PRESSURE FACTOR Sets the pump pressure factor.	S, N.NN		Where: S is supply (1-2) N.NN is pump pressure factor (0.01 - 9.99)
33	HV SET SUPPLY AUTO RESTART Sets supply auto restart option.	S, X		Where: S is supply (1-2) X is Y for on and N for off

Hex command	Description	Data field	Response	Data and response interpretation
34	HV GET SUPPLY AUTO RESTART Reads supply auto restart option.	S	YES or NO	Where: S is supply (1-2)
37	HV TURN ON Turns on supply HV.	S		Where: S is supply (1-2)
38	HV TURN OFF Turns off supply HV.	S		Where: S is supply (1-2)
3B	HV GET/SET SET-POINT Configures setpoints. Set-points (N parameter) 1-4 are relays. Set-points (N parameter) 5-8 are digital outputs. If only N parameter is specified, the current set-point configuration and state is returned.	N, F, S, X.XE-XX, Y.YE-YY	N, F, S, X.XE-XX, Y.YE-YY, A	Where: N is the set-point number (1-8) F is the function 0=Off, 1=Pressure Setpoint, 2=HV Error, 3=HV On/Off Indicator S is the configured supply (1, ,2 ,3 or 4) X.XE-XX is the On Pressure Y.YE-YY is the Off Pressure* A indicates: 1 = Relay/TTL output energized, 0 = Relay/TTL output de-energized) *Off Pressure must be at least 20% greater than On Pressure. If not, controller will automatically set Off Pressure to 20% greater than On Pressure.
58	HV GET/SET DIGITAL INPUT Configures digital inputs. If only N parameter is specified, the current digital input configuration is returned.	N, S, F	S, F	Where: N is the digital input (1-4) S is the pump (1-2) F is function: “00” - Off “01” - HV Interlock “02” – HV Switch On/Off “03” – TSP 1 Interlock “04” - TSP 2 Interlock

Hex command	Description	Data field	Response	Data and response interpretation
5A	HV GET/SET ANALOG OUTPUT Configures analog outputs. If only N parameter is specified, the current analog output configuration is returned.	N, S, F, O, I, R	S, F, O, I, R	Where: N is analog channel (1-4) S is pump (1-4) F is function (see below) O is log offset (-15 to +15) I is inverted mode (0-normal, 1-inverted) R is response mode (0-normal, 1-fast) Function: “00” - Off “01” - Logarithmic pressure “02” - Logarithmic current “03” - Volts per 1 uA “04” - Volts per 10 uA “05” - Volts per 100 uA “06” - Volts per 1 mA “07” - Volts per 10 mA “08” - Volts per 50 mA “09” - Volts per 1 nA “10” - Volts per 10 nA “11” - Volts per 100 nA “12” - Volts per 1 kV
28	TSP TURN OFF Turns off TSP sublimation.	R		Where: R is TSP (1-2)
29	TSP SET ACTIVE FILAMENT Sets TSP active filament.	R, N		Where: R is the TSP (1-2) N is the filament number (1-4)
2D	TSP TURN ON Turns on TSP programmed mode.	R		Where: R is TSP (1-2)
DF	TSP GET ACTIVE FILAMENT Reads active TSP filament.	R	N	Where: R is TSP (1-2) N is the active filament.

Hex command	Description	Data field	Response	Data and response interpretation
30	TSP GET SUBLIMATION TARGET LEVEL Reads sublimation target power level.	R	X, P	Where: R is TSP (1-2) X is number of amps/watts P is 'A' for Amps or 'W' for Watts
31	TSP GET LOWER PRESSURE Reads lower TSP pressure. See pressure window option.	R	Z.Ze-ZZ	Where: R is TSP (1-2) Z.Ze-ZZ is lower pressure
EB	TSP SET LOWER PRESSURE Sets upper TSP pressure. See pressure window option.	R, Z.ZE-ZZ		Where: R is TSP (1-2) Z.Ze-ZZ is lower pressure
EA	TSP SET UPPER PRESSURE Sets upper TSP pressure. See pressure window option.	R, Z.ZE-ZZ		Where: R is TSP (1-2) Z.Ze-ZZ is the upper pressure
82	TSP GET UPPER PRESSURE Reads upper TSP pressure. See pressure window option.	R	Z.Ze-ZZ	Where: R is TSP (1-2) Z.Ze-ZZ is the upper pressure
72	TSP GET ONTIME Reads TSP sublimation on time.	R	D	Where: R is TSP (1-2) D is the on-time (duration) value in seconds.
73	TSP GET PERIOD Reads TSP cycle period.	R	DD	Where: R is TSP (1-2) D is the cycle period value in minutes.
74	TSP GET RUNTIME POWER LEVEL Reads current power level.		X, P	Where: X is number of watts/amps. P is 'W' for Watts or 'A' for Amps

Hex command	Description	Data field	Response	Data and response interpretation
78	TSP SET SUBLIMATION TARGET LEVEL Sets sublimation target power level.	R, X, M		Where: R is TSP (1-2) X is number of amps/watts M is 'A' for Amps or 'W' for Watts
79	TSP SET PARAMETERS Configures TSP parameters.	R, M, N, X.XE-XX, Y.YE-YY, D, P		Where: R is TSP (1 or 2) M is cycle period in minutes (time between fires) N is number of cycles X.XE-XX is high pressure limit Y.YE-YY is low pressure limit D is sublimation duration in seconds P is pressure window (0 = on, 1 = off/ignore)
8B	TSP SET SUPPLY Configures TSP supply.	R, S		Where: R is TSP (1-2) S is supply (0-2), 0 indicates no supply, pressure window is off
8C	TSP GET SUPPLY Reads TSP supply.	R	S	Where: R is TSP (1-2) S is supply (1-2)
DE	TSP GET TSP STATUS Reads TSP status.	R, X	YY	Where: R is TSP (1-2) X is option. Currently option 0 is only supported. YY is a two digit status code "00" - for TSP Initializing "01" - for TSP Off "02" - for TSP Armed (Running) "03" - for TSP Armed (Waiting, pressure window, supply is off) "04" - for TSP Armed (Waiting, pressure window, pump pressure outside the defined pressure window) "05" - for TSP Armed (Waiting, Interlock not satisfied) "06" - for TSP Armed (Waiting, Other TSP is firing) "07" - for TSP Firing

13. Ethernet communication

Following protocol are support over Ethernet connection:

Gamma Protocol (Running on TCP port 23)

Modbus TCP Protocol (Running on TCP port 502)

Note:

Modbus register map is available on Gamma Vacuum website under download section.

13.1. Gamma protocol over ethernet connection

Gamma protocol command packet structure over ethernet connection.

A raw TCP session may be established to port TCP 23, allowing remote control. Once the TCP session is established, commands may be issued.

Note:

In comparison to communication over serial connection, no address field and no checksum fields are required.

Gamma protocol response packet structure over ethernet connection

In comparison to response structure over serial communication, no address and no checksum fields are supplied in response. See Table: Response packet structure over serial connection for more information.

Table 10. *Command packet structure over ethernet connection*

Start	space	Command code	space	Data (optional)	Terminator
3 bytes	1 byte	2 bytes	1 byte	Variable	1 byte

	Field	Size	Comment
1	START	3 ASCII hex characters	ASCII characters are ‘cmd’
Start is the first 3 digits in the command packet and tells controller to start decoding a message.			
3	COMMAND CODE	2 ASCII hex characters	Range 00 through FF
See Gamma protocol commands on page 42 for list of available command codes. The command code must be two hex digits, even if the first digit is a zero.			
4	DATA	As needed	ASCII printable characters only

	Field	Size	Comment
Data field(s) are for any commands that have a data value. Not all commands require data field. If command has more than one data value associated with it, such as setting X and a Y value, the command field could be followed by two data fields (X and Y) separated by a comma and space between them. All data must be sent in ASCII printable format (no binary or “control” characters).			
5	TERMINATOR	1 ASCII hex characters	ASCII carriage return
ASCII value of carriage return character placed at the end of a command packet. There is no space before the terminator field.			

13.2. Examples - Gamma protocol over ethernet connection

Example 1

Command - SYS GET MODEL, 0x01

Tx – “cmd 01” + carriage return.

Rx – “OK 00 DIGITEL MPCQ” + carriage return

Example 2

Command - HV GET CURRENT, 0x0A

Tx – “cmd 0A 01” + carriage return

Rx – “OK 00 1.33E-11 AMPS” + carriage return

Example 3

Command - HV GET PRESSURE, 0x0B

Tx – “cmd 0B 01” + carriage return

Rx – “OK 00 1.0E-11 TORR” + carriage return

14. Profibus communication

For Profibus information reference Profibus user manual, document 900033, available on Gamma Vacuum website under download section.

15. Technical specifications

Dimensions (maximum)	472 X 432 X 131 mm, length x width x height (fits standard 19-inch wide device rack)
Shipping weight (maximum)	32 (66) kg (lbs) (fully configured with two supplies)
Operating temperature	0 to 40 °C Free airflow around the unit is required.
Altitude	Sea level to (2000 m) 6560 ft.
Humidity	0 to 80% RH (non-condensing)
Storage temperature	10 to 70 °C
Input voltage	110 V a.c. or 220 V a.c., +/- 10%. (input mains voltage configuration specified at order time)
Input current	10 A fused
Line frequency	50/60 Hz
High Voltage Supply	
▪ Power supply type	Linear (HV transformer)
▪ Number of channels (maximum)	2
▪ Voltage (fixed output)	Default configuration + 7 kV (CV/DI) or - 5.6 kV (TR)
▪ Voltage resolution	100 V
▪ Current per channel (maximum)	500 mA (short circuit)
▪ Current resolution (maximum)	0.1 uA
▪ Power per channel (maximum)	500 W
▪ Output connector type	SHV-10 or Fischer Type (other connector types are available per request)
▪ SAFECONN Connector	(HV Interlock) SMB (with SHV-10 output connector) or Mini Banana (with Fisher output connector)
Display or controls	7” TFT WVGA (800 x 480) Colour LCD, 16:9 aspect ratio, Touchscreen
Communications	Ethernet, Serial (RS-232, RS-485HD 2 wire mode, RS-485FD 4 wire mode), Profibus (optional)
Available analog and digital I/O connections	
Setpoint relays	4 relays, 500 mA maximum, 28 V maximum, user configurable
Setpoint logic outputs	4 TTL Outputs, 6 mA maximum, 5 V, user configurable
Logic inputs	4 TTL inputs, internally pulled up to 3.3 V, user configurable
Analog outputs	4 analog outputs 0 - 10 V, user configurable (voltage, current or pressure)

Remote TSP control	A connector for remote TSP operation supplied
TSP supply (In combination with remote TSP control or if internal TSP supply is installed)	
Power supply type	Linear (transformer)
Number of filaments	4 for internal TSP supply, 8 in combination with Remote TSP Controller
Power output (maximum)	800 W
Current output (maximum)	55 A (maximum programmable TSP filament sublimation current value)
Current resolution	0.1 A
Control	Fully user programmable via front panel touchscreen or using remote communication

16. Warranty and service

16.1. Service

16.1.1. 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.

16.1.2. 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.

16.1.3. 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 numbers.

16.2. Warranty

16.2.1. General terms

Gamma Vacuum warrants to the Buyer that the equipment sold is new, 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 lifetime 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 warranted only for the remaining unexpired portion 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, labour, 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.

16.2.2. 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.

16.3. Returning material

16.3.1. 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 tollfree. 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 product description
- Product serial number

All products received for repair or replacement shall be prepaid. Items not labelled 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.

16.3.2. 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 labelled on all shipping information and packages.

17. Disposal

Dispose of the pump and any components and accessories safely and in accordance with all local and national safety and environmental requirements.

Particular care must be taken with any components that have been contaminated with dangerous process substances.

Take appropriate action to avoid inhalation of any particles that may be present in the pump.

P20010443A

EU Declaration of Conformity

Gamma Vacuum
Part of the Atlas Copco Group
2700 4th Ave E, Suite 100
Shakopee, MN 55379
USA

Documentation Officer
Jana Sigmunda 300
Lutín , 78349
Czech Republic
T: +42(0) 580 582 728
documentation@vt.atlascopco.com

The product specified and listed below

MPCQ, TSPQ, NEGQ Controller:
TUV: SUD Certificate U8 17 11 60983 025
Model= T-U-V-W-X-Y-Z
Where:
T= Number of High Voltage Sections
U=High Voltage Polarity
V=Connector Type
W=Number of Connectors per High Voltage Section
X=Input Voltage
Y= Communication Port Options
Z=TSP or NEG Options

Is in conformity with the relevant requirements of European CE legislation:

2014/35/EU	Low voltage directive (LVD)
2014/30/EU	Electromagnetic compatibility (EMC) directive Class A Emissions, Industrial Immunity
2011/65/EU	Restriction of certain hazardous substances (RoHS) directive as amended by Delegated Directive (EU) 2015/863

Based on the relevant requirements of harmonised standards:

EN 61010-1:2010/A1:2019	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements

This declaration, based on the requirements of the listed Directives and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: *2021-04-21*

You must retain the signed legal declaration for future reference
This declaration becomes invalid if modifications are made to the product without prior agreement.

Ian Keech, VP Engineering
Scientific Vacuum Division
Burgess Hill, UK

Marcus Thierley
General Manager
Shakopee, USA

P20010443A

Declaration of Conformity

Gamma Vacuum
Part of the Atlas Copco Group
2700 4th Ave E, Suite 100
Shakopee, MN 55379
USA

Documentation Officer
Innovation Drive
Burgess Hill
West Sussex
RH15 9TW
documentation@vt.atlascopco.com

This declaration of conformity is issued under the sole responsibility of the manufacturer.

MPCQ, TSPQ, NEGQ Controller:
TUV: SUD Certificate U8 17 11 60983 025
Model= T-U-V-W-X-Y-Z
Where:
T= Number of High Voltage Sections
U=High Voltage Polarity
V=Connector Type
W=Number of Connectors per High Voltage Section
X=Input Voltage
Y= Communication Port Options
Z=TSP or NEG Options

The object of the declaration described above is in conformity with relevant statutory requirements:

Electrical Equipment (Safety) Regulations 2016

Electromagnetic Compatibility Regulations 2016

Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Relevant designated standards or technical specifications are as follows:

EN 61010-1:2010/A1:2019	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements Class A Emissions, Industrial Immunity

This declaration, based on the requirements of the listed Statutory Instruments and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: *2021-04-21*

You must retain the signed legal declaration for future reference
This declaration becomes invalid if modifications are made to the product without prior agreement.

Signed for and on behalf of Gamma Vacuum

Ian Keech, VP Engineering
Scientific Vacuum Division
Burgess Hill, UK

Marcus Thierley
General Manager
Shakopee, USA

ADDITIONAL LEGISLATION AND COMPLIANCE INFORMATION

EMC (EU, UK): Class A/B Industrial equipment

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

RoHS (EU, UK): Material Exemption Information

This product is compliant with no Exemptions

REACH (EU, UK)

This product is a complex article which is not designed for intentional substance release. To the best of our knowledge the materials used comply with the requirements of REACH. The product manual provides information and instruction to ensure the safe storage, use, maintenance and disposal of the product including any substance-based requirements.

Article 33.1 Declaration (EU, UK)

This product does not knowingly or intentionally contain Candidate List Substances of Very High Concern above 0.1%ww by article as clarified under the 2015 European Court of Justice ruling in case C-106/14.

Additional Applicable Requirements

The product is in scope for and complies with the requirements of the following:

2012/19/EU	Directive on waste electrical and electronic equipment (WEEE)
Product is certified to CAN/CSA-C22.2 No.61010-1-12:2012/A1:2018-11	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
Product is certified to UL61010-1 3rd Edition	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements

材料成分声明

China Material Content Declaration

表示该有害物质在该部件的所有均质材料中的含量低于 GB/T 26572 标准规定的限量要求。

Indicates that the hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in GB/T 26572.

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