DUETTING TECHNOLOGIES

Original operating instructions

PRV valve

UHV gas inlet valve with piezo drive

Electrical equipment

Current version	1.0
Date	November 28, 2024
Scope	30 pages

IMPORTANT:

READ CAREFULLY BEFORE USE

KEEP FOR FUTURE REFERENCE

Manufacturer

Duetting Technologies UG
(limited liability)

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1 Introduction

1.1 Identification

Product name	PRV valve
Product	Electrical equipment (low voltage)
Year	2024

1.2 Manufacturer

Manufacturer	Duetting Technologies UG (limited liability)
Street	Korbmacherweg 26
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Country	Germany
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1.3 Information about the operating instructions

Current version	1.0
Date	November 28, 2024

1.4 Change tracking

Date	Version	Affected chapters	Reason for change
11/28/2024	1.0	All	Final version of the document created.

1.5 EU Declaration of Conformity

EU-Konformitätserklärung

im Sinne der EU-Niederspannungsrichtlinie 2014/35/EU, Anhang IV

Der Hersteller

Duetting Technologies UG (haftungsbeschränkt)
Korbmacherweg 26
48268 Greven

erklärt hiermit, dass das folgende Produkt, in der vom Hersteller in Verkehr gebrachten Ausführung

Name:	PRV - UHV Gaseinlassventil mit Piezoantrieb	**Baujahr:**	2024

Funktionsbeschreibung:
Das PRV-Ventil dient der Feindosierung von Gasen in UHV-Anlagen. Die Feinsteuerung der Ventilplatten erfolgt über einen Piezoaktor. Die offene Ventilstellung ist proportional zur anliegenden Spannung.

die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt und diese allen einschlägigen Bestimmungen der Richtlinie 2014/35/EU „Niederspannungsrichtlinie" – einschließlich derer zum Zeitpunkt dieser Erklärung gültigen Änderungen – entspricht.

Das Produkt entspricht ebenfalls den einschlägigen Bestimmungen der folgenden weiteren Richtlinien - einschließlich derer zum Zeitpunkt dieser Erklärung gültigen Änderungen:

Verweis	Name
2011/65/EU	RoHS Richtlinie 2011/65/EU
2014/30/EU	Richtlinie 2014/30/EU des Europäischen Parlaments und des Rates vom 26. Februar 2014 zur Harmonisierung der Rechtsvorschriften der Mitgliedstaaten über die elektromagnetische Verträglichkeit (Neufassung)

Die folgenden harmonisierten Normen nach Artikel 12 der Niederspannungsrichtlinie 2014/35/EU wurden angewandt:

Verweis	Name
EN 60204-1:2018	Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen - Teil 1: Allgemeine Anforderungen
EN 61010-1:2010/A1:2019	Sicherheitsbestimmungen für elektrische Mess-, Steuer-, Regel- und Laborgeräte - Teil 1: Allgemeine Anforderungen

Unterzeichnet für und im Namen von

Name, Funktion

Ort, Datum

Unterschrift

Figure 1. EC Declaration of Conformity

1.6 CE mark

The CE mark shown opposite is affixed to the product.

The mark indicates that the product complies with all EC directives applicable to the product at the time it was placed on the market.

1.7 Type plate

Figure 2 Type plate

The type plate shown above is attached to the product.

This contains identification data that can be found in sections 1.1 and 1.2 of this manual.

1.8 Applicable documents

In addition to this operating manual, the following applicable documents must be observed:

- Circuit diagram
- Operating instructions PRV.bmp

2 About this operating manual

2.1 Target group

This operating manual is intended for qualified personnel. Qualified personnel:

- is authorized by the operators to operate the product;
- is qualified through training and experience to perform work on the product;
- has basic experience with the system (e.g., electrical control) on which work is to be performed;
- has advanced experience with the system (e.g., functional safety) on which work is to be performed;
- has additional qualifications and experience relating to the relevant life phases.

2.2 Presentation of notes

Safety notes are indicated in the manual by a pictogram and a keyword.

The content of the notes is structured as follows:

Type/source of danger!

Possible consequences!

➢ Preventive measures

⚠ DANGER!

"DANGER" is used when death or serious injury **will** occur if the warning is not heeded.

⚠ WARNING!

"WARNING" is used when death or serious health damage **may** occur if the warning is not heeded.

⚠ CAUTION

"CAUTION" is used when moderate or minor health damage may occur if the warning is not heeded.

ATTENTION
"NOTICE" is used when damage to the product or environment may occur if the warning is not heeded.

NOTE
Helpful application notes and information for using the product.

	Cross-reference to a specific document.

2.3 Presentation of lists

Enumerations are displayed as lists with bullet points. Example:

- Point 1
- Point 2

2.4 Presentation of calls to action

2.4.1 Calls to action with a specific order

Calls to action to be performed, with a specified sequence, are numbered and displayed in a list. The system response of the product to the respective action is displayed in italics and marked with a check mark. Example:

Action request

1. Action, e.g., press the "Horn on" button.

☑ *Response 1, e.g., "the signal tone sounds."*

2. Action, e.g., press the "horn off" button.

☑ *Response 1, e.g., "the signal tone stops sounding."*

2.4.2 Calls to action without a specific order

Actions to be performed, in no particular order, are indicated by an arrow. The system response of the product to the respective action is shown in italics and marked with a check mark. Example:

Action

➢ Action, e.g., press the "Horn off" button.

☑ *Response 1, e.g., "the signal tone stops."*

3 Safety

3.1 General safety instructions

- Damage caused by incorrect use of the product. The product has been manufactured in accordance with the current state of the art and in compliance with relevant legal regulations. Nevertheless, hazards to persons and/or the environment may arise. Only use trained personnel.
- Failure to observe these operating instructions can have serious consequences for people or the environment. Always observe the operating instructions.
- Improper use of the product can result in serious damage to people and the product. Use the product only for its intended purpose.

3.2 Intended use

- The valve is intended exclusively for use in vacuum systems.
- The product is intended exclusively for industrial and laboratory use.
- The personnel employed must be sufficiently experienced in terms of qualifications, training, and professional experience to be able to carry out the intended work.
- The exact limits of the product can be found in the technical data in Chapter 4 of this manual.

3.3 Reasonably foreseeable misuse

All applications that do not comply with the specifications for intended use are considered misuse.

In addition:

- Any working method that aims to circumvent or render ineffective protective devices must be avoided.

In particular, damage caused by:

- improper transport, installation, assembly, trial operation, or operation that has damaged the product,
- functional or structural modifications,
- changes to the specified performance data of individual components or the entire product,
- changes or deviations from the specified connection values,
- operation of the machine in a faulty condition,
- improper repairs or operation by untrained persons,
- operation without protective devices or protective devices that are not in perfect condition or have been modified without the manufacturer's approval,
- Failure to observe the information in the original operating instructions,
- unauthorized access via the control system or the network.

3.4 Residual risks

Hazards that apply to almost the entire life cycle:

Danger from overcurrent or electric shock

Using a power source without interruption in the event of a fault will result in severe burns or even death.

➢ Use a proper power source with interruption in the event of a fault.

Deviating environmental conditions

Deviating environmental conditions can cause damage to the product and result in faulty operation of the product.

➢ Only use the valve under the specified environmental conditions (not outdoors).

➢ Observe cleaning instructions (avoid condensation , do not wipe with a damp cloth).

3.5 Obligation for operators

Operators are obliged to comply with national and, where applicable, regional occupational safety regulations.

Operators are obliged to ensure that persons working with the product

- read this manual
- instruct them on the contents of these instructions,
- instruct them on basic occupational safety and accident prevention regulations,
- and to provide personal protective equipment for the safe use of the product.

3.6 Obligation for personnel

All persons working with the product are obliged to

- read and understand these instructions before using the product for the first time,
- refrain from working practices that negatively affect product safety,
- Report any defects in the product immediately and have them repaired professionally.
- only operate the product with protective devices in place,
- prevent and report obviously incorrect actions by third parties.

3.7 Qualification of personnel

The personnel employed must be sufficiently experienced in terms of qualifications, training, and professional experience to be able to carry out the intended work. Experience is largely defined by the personnel's ability to prevent damage to people and products.

4 Technical data

4.1 Dimensions

Length	85 mm
Diameter	72 mm
Weight	approx. 300 g

4.2 Voltage

Operating voltage (BNC socket)	0 to 10 V DC

4.3 Connections

Gas line	3 mm Swagelok
Connection flange (vacuum side)	DN40 CF, fixed
Gas inlet pressure	0.25 to 0.5 bar

4.4 Ambient conditions

4.4.1 Operating/storage conditions

Range	Interior
Component temperature	20 °C to 100 °C

4.4.2 Time limits

The service life depends on the operating times and maintenance intervals carried out by qualified personnel. This operating time is particularly influenced by preventive maintenance, which includes the timely replacement of wear parts.

4.4.3 Spatial limits

The product is placed within the closed laboratory in such a way that sufficient space for movement is guaranteed for specialist personnel in every phase of its service life.

5 Design and function

5.1 Product overview

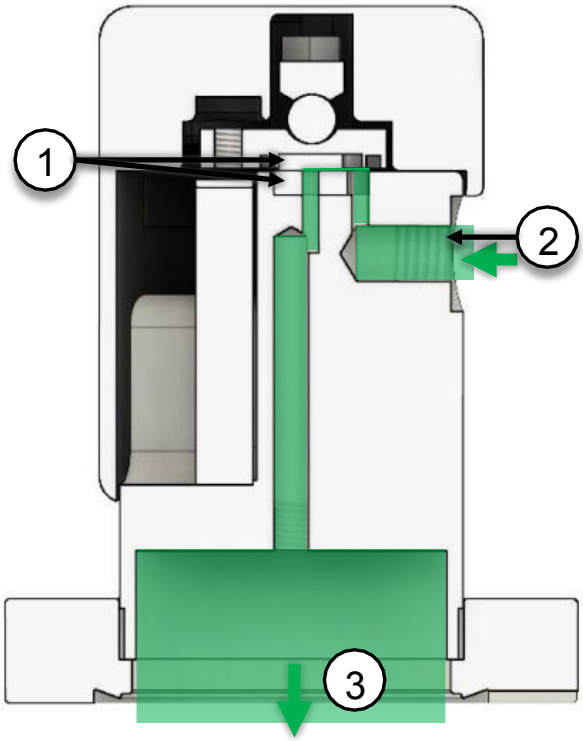


Figure 3 Product overview

Item	Designation
→	Path of the gas
1	sapphire plates
2	Gas line with Swagelok connection
3	Connection flange (vacuum side)
Not shown	Power connection (BNC connector), piezo actuator

5.2 Function

The PRV valve is mounted on a gas source using the connection flange (item 3) and connected to a UHV or HV system (e.g., mass spectrometer, gas ion sources, sputtering systems, vapor deposition systems, etc.) using the Swagelok connection of the gas line (item 2). Voltage is applied via the power connection (BNC connector). Now, by manually applying a DC voltage between 0 and 10 V, it is possible to introduce very small amounts of gas with a high degree of precision.

The product consists of two compressed sapphire plates (item 1). One of the sapphire plates has a central hole with a channel to the vacuum side. To let gas in, the upper sapphire plate is slightly raised on one side using a piezo actuator

so that gas can flow between the two sapphire plates while the force on the plates is maintained. The higher the DC voltage and the greater the inclination, the more gas flows in.

The gas around the sapphire plates is sealed by a Viton gasket; the materials that come into contact with the UHV are sapphire and stainless steel; the sapphire plate is bonded with a UHV-compatible ceramic adhesive.

When the BNC connector is disconnected, the piezo actuator is discharged via a resistor and the valve is closed (BNC socket with switch). The BNC is basically potential-free and only connected to the piezo actuator.

6 Transport, assembly, installation, commissioning

Target group: Qualified personnel

6.1 Special safety instructions

ATTENTION

Incorrect or improper installation

Incorrect or improper installation can lead to damage to components or malfunction.

➢ Only allow trained and instructed personnel to carry out work.

6.2 Transport

Call to action

1. Carry the packaged product to the desired location.
2. Open the packaging and remove the product.
3. Inspect the product visually.
4. Separate the packaging and recycle it.

6.3 Assembly and installation

NOTE

Electrical supply cables must be fed through the openings provided in the electrical control cabinet and connected. The electrical supply cables must be secured with a cable strain relief.

Observe regional and national laws and regulations.

6.4 Commissioning the product

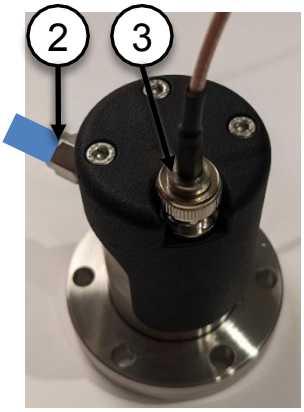
Action required

1. Ensure that the flange is clean and undamaged.
2. Place the connection flange (item 1) of the product on the desired gas source.
3. Ensure that the sealing ring of the product is undamaged and lies flat between the flange and the connection point.
4. Ensure that the gas line is facing the correct direction and that the power connection is easily accessible.

Note: *There is an M5 thread on the underside of the product for attaching a capillary tube to guide the gas flow within the vacuum chamber.*

5. If necessary, connect the capillary using a suitable tool.

6. Mount the product on the vacuum chamber or the respective assembly in a star pattern using 6 M6 screws corresponding to the flange and a suitable tool.



7. Connect the Swagelok connection of the gas line (item 2) to a UHV or HV system. Tighten the union nut until the tube can no longer be turned by hand or moved axially in the fitting. Mark the union nut at the 6 o'clock position. For 3 mm tube fittings, tighten the union nut by ¾ turn at the 3 o'clock position.
8. Connect the BNC plug to the power connection (item 3). To do this, attach the BNC plug by hand and turn it ¼ turn (bayonet lock).

☑ *The product is now ready for operation.*

NOTE

Connect the power cable to the power supply (laboratory power supply or similar).
The power cables must be secured with a cable strain relief.

Observe regional and national laws and regulations.

6.5 Check the product

Call to action

- ➢ Check fastenings.
- ➢ Check the power supply connections.
- ➢ Check all connections for leaks.

7 Operation

Target group: Qualified personnel

7.1 Special safety instructions

⚠ DANGER!

Danger due to overcurrent or electric shock

Using a power source without interruption in the event of a fault will result in severe burns or even death.

➢ Use a professional power source with interruption in the event of a fault.

CAUTION

Deviating environmental conditions

Deviating environmental conditions can cause damage to the product and result in faulty operation.

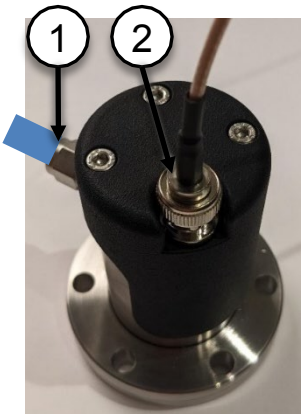
➢ Only use the valve under the specified environmental conditions (not outdoors).

➢ Observe cleaning instructions (avoid condensation, do not wipe with a damp cloth).

7.2 Operating the product

Call to action

1. Perform a visual inspection.



2. Apply a voltage between 0 and 10 V via the BNC connector (item 2) or adjust the pressure control. *Gas*

☑ *is supplied via the gas inlet (item 1) and flows between the two sapphire plates inside the product. A very precise admission of small amounts of gas into the connected UHV or HV system can be carried out. Manual adjustment is not necessary.*

NOTE

Experience has shown that the achievable vacuum pressure with an inlet pressure of 0.25 to 0.5 bar of laboratory gas (e.g., Ar or O_2) in pumping stages with HiPace 80 is between approx. 5E-4 mbar and <1E-8 mbar. Further measurements by the manufacturer will follow.

A better vacuum of <1E10 mbar can still be achieved if the gas line is evacuated.

8 Cleaning and maintenance

Target group: Specialized personnel

8.1 Special safety instructions

⚠ CAUTION!

Different intervals

Frequency of use and environmental conditions may lead to deviations in the intervals of the described activities and thus to injuries or property damage.

➢ Instruct the persons responsible for cleaning the product accordingly.

ATTENTION

Work not described

Work that is not described may only be carried out by authorized customer service personnel, otherwise damage to the product may result.

➢ Contact customer service to change parameters and programs.

8.2 Customer service

Manufacturer:	Duetting Technologies UG (limited liability)
Street:	Korbmacherweg 26
Postal code, city:	48268 Greven
Country:	Germany
Phone	+49 160 8368414
Email	info@duetting-technologies.com
Web	www.duetting-technologies.com

8.3 Maintenance/inspection schedule

Activity	Maintenance interval
Visual inspection of product.	Daily
Clean (wipe the product dry), checking that the connections are secure.	Weekly
Check the product for condensation and dry if necessary.	Weekly or more often as needed

NOTE

Some of the tasks mentioned depend on usage and environmental conditions. The cycles mentioned are minimum specifications. Different maintenance cycles may be necessary in individual cases. In this case:

- ➢ correct the information in this operating manual,
- ➢ instruct the personnel accordingly.

8.4 Troubleshooting

CAUTION

Unknown error messages

Unknown faults and attempts to rectify them can lead to damage to the product.

- ➢ If a fault is present and is not shown in the fault message list, inform customer service.

The following overview provides information about faults, their causes, and remedies:

Malfunction	Possible cause	Troubleshooting
Product does not respond.	➢ No power supply.	➢ Check the connection of the BNC plug. ➢ Check external power source.
	➢ Gas is not connected.	➢ Check the gas source.
	➢ Pressure measurement does not respond.	➢ Check the pressure measurement of the vacuum system.

9 Disassembly, decommissioning, and disposal

Target group: Qualified personnel

9.1 Special safety instructions

⚠ DANGER!

Risk of electric shock

Touching live parts will result in severe burns or even death.

- ➢ Before starting work, disconnect the system from the power supply and secure it against being switched back on.
- ➢ Work may only be carried out by trained specialist personnel.

⚠ CAUTION!

Various electrical hazards during disassembly

Incorrect disassembly can result in electric shock.

- ➢ Disconnect the external power source before removing the BNC connector.
- ➢ Only allow trained specialists to carry out this work.

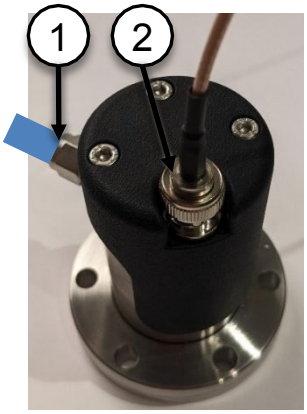
⚠ CAUTION!

Danger due to hot valve housing

During disassembly, the heated valve housing may cause burns to the hands.

- ➢ Allow the product to cool to room temperature before starting work.

9.2 Temporary shutdown (without disassembly)



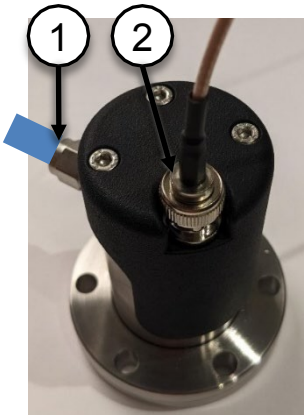
Action required

1. Ensure that the external power source has been disconnected.
2. Ensure that the product has cooled down completely.
3. Disconnect the BNC plug from the power connection (item 2).

☑ *When the BNC plug is disconnected, the piezo actuator is discharged via a resistor and the valve is closed (BNC socket with switch).*

4. If necessary, disconnect the Swagelok connection of the gas line (item 1) from the UHV or HV system.

9.3 Disassembly



Call to action

1. Ventilate the vacuum system.
2. Ensure that the external power source has been disconnected.
3. Ensure that the product has cooled down completely.
4. Disconnect the BNC plug from the power connection (item 2).
5. When the BNC connector is disconnected, the piezo actuator is discharged via a resistor and the valve is closed (BNC socket with switch).
6. Disconnect the Swagelok connection of the gas line (item 1) from the UHV or HV system.

7. Loosen the 6 M6 screws in a star pattern using a suitable tool.
8. Lift the product and, if necessary, loosen the capillary attachment on the underside.
9. Clean the product if necessary.

9.4 Storage after disassembly

Observe the information on temporary shutdown in Section 9.2.

Proper storage guarantees a long service life.

Call to action

- Pack the product in a suitable cardboard box and store it exclusively in closed and well-ventilated rooms.
- Take appropriate measures to protect against corrosion during long-term storage.
- Ensure that the operating instructions can be retrieved.

9.5 Disposal

Call to action

- Recycle the product in accordance with local regulations.

NOTE

Electrical equipment must be taken to collection points (usually recycling centers) in Germany.

If in doubt about the disposal method, contact the manufacturer or your local waste disposal company.

10 Appendix

10.1 Instruction protocol

COPY TEMPLATE!

➢ Copy first, then fill in.

Date	Name	Type of instruction	Instruction provided by	Signature

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