Installation and Operating Instructions

Turbomolecular pumps
Turbo TM 1100 A

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0870564260 / 131105 / Original instructions / Modifications reserved
Introduction

Congratulations on your purchase of the Busch turbomolecular pump. With watchful observation of the field’s requirements, innovation and steady development Busch delivers modern vacuum and pressure solutions worldwide.

This operating instructions contain information for

- product description,
- security,
- transport,
- storage,
- installation and commissioning
- maintenance,
- accessories,
- overhaul

of the turbomolecular pump.

For the purpose of these instructions, «handling» the turbomolecular pump means the transport, storage, installation, commissioning, influence on operating conditions, maintenance and overhaul of the turbomolecular pump.

The user should read this instruction manual and any other additional information supplied by Busch before operating the equipment. Busch will not be held responsible for any events occurring due to non-compliance, even partial, with these instructions, improper use by untrained persons, non-authorized interference with the equipment or any action contrary to that provided for by specific national standards.

Keep this operating instructions and, if applicable, other pertinent operating instructions available on site.
**Product description**

**Use**

The turbomolecular pump is intended for
- the suction of
- air and other dry, non-aggressive, non-toxic and non-explosive gases.

The Turbo TM 1100 A is a turbomolecular pump for high and ultra-high vacuum applications. It can pump any type of gas or gas compound. It is not suitable for pumping liquids or solid particles.

During normal operation, the motor is fed with a voltage of 56 Vrms three-phase at 761 Hz. To reduce losses during start-up to a minimum, the frequency increases according to a ramp with a higher initial voltage/frequency ratio.

This equipment is destined for use by professionals.

**Pump used with corrosive gases**

To prevent damage to the bearings, an inert gas must flow into the pump body around the upper bearing towards the forevacuum line. To supply the inert purge gas (e.g., nitrogen) to the pump through the purge port, connect a gas purge valve between the pressure regulator and the pump.

Adjust the pressure regulator in order to read a gas flow rate of 0.1 to 0.8 mbar l/s.

**CAUTION**

To prevent bearing damage, Busch suggests a minimum purge gas flow rate of 20 scm (0.33 mbar l/s). This value can be exceeded, according to the process requirements. Please contact Busch for specific applications.

The purge gas throughput with the recommended forepump allows to achieve a high vacuum pressure in the 10^-8 mbar range.
The recommended gas flow maintains a pressure into the pump body higher than the forevacuum pressure.

The recommended procedure to vent the system and the pump avoiding the contact between the pump bearings and the corrosive gas is described in the following points:

- Close the corrosive gas flow into the system.
- Leaving the Turbo TM 1100 A and the backing pump running and the purge gas flowing, wait for enough time to evacuate the corrosive gas from the system.
- Turn off the Turbo TM 1100 A.
- Open the Turbo vent port slowly until to reach atmospheric pressure in the system.
- When the Turbo pump and the backing pump are stopped and the system is at atmospheric pressure, for a better bearing protection it is advisable to leave the purge gas flowing into the Turbo pump, with the chamber or the Turbo vent valve opened, to avoid system overpressures. If the vent valve can't be kept opened, the backing pump should be left operating.

Purge layout

1 Purge gas line
2 Pressure regulator
3 Gas purge valve
4 Gas purge port
5 Forevacuum pump
6 Turbopump
7 Vent valve

Pump used in presence of magnetic fields

Magnetic fields induce eddy currents in the rotor of a turbomolecular pump that tend to oppose to its rotation. The result is increased electrical power consumption by the motor, most of which is dissipated in the rotor.

Since the rotor is not in contact with the stator the above power can leave the rotor mainly by radiation and hence the rotor may be overheated while static parts of the pump remain cool. This effect is strongly dependant from the intensity, time function and distribution of the magnetic field.

In general, therefore, an increase in jump current can be expected. If this increase is lower than 50% of the current value drawn by the motor in high vacuum operation, no particular problem should be expected. However if the effect is greater, than the case should be carefully reviewed by Busch specialist.

As a matter of fact, in case of high magnetic fields, also important forces might be generated and applied to the rotor.

Principle of operation

The pumping action is obtained through a high speed turbine (max. 45660 rpm) driven by a high performance 3-phase electric motor. The Turbo TM 1100 A is free of contaminating agents and, therefore, is suitable for applications requiring a « clean » vacuum.

The pump consists of a high frequency motor driving a turbine. The turbine rotates in an anticlockwise direction when viewed from the high vacuum flange end. The turbine is made of high-strength aluminium alloy, machined from a single block.

The turbine rotor is supported by permanently lubricated high precision ceramic ball bearings installed on the forevacuum side of the pump.

The static blades of the stators are supported and accurately positioned by spacer rings. The Macrotorr stators are in the form of self-positioning machined discs with pumping channels and an opening restricted by the corresponding rotor discs. These are made of aluminium alloy.

In order to avoid the suction of solids, the vacuum pump is equipped with a mesh screen in the suction connection.

When used with Navigator controller 969-8978M005, the pump is equipped with auxiliary connectors to supply an additional fan, to control the vent valve, to be controlled from a remote site by means of an host computer connected through a serial line (RS232 or RS485).

The following paragraphs contain all the information necessary to guarantee the safety of the operator when using the equipment.

Detailed information is supplied in the appendix « Technical information ».

Cooling

The turbomolecular pump must be always water cooled using the dedicated channels on the pump body.

Minimum required water flow is 3.5 l/min and the water temperature must be between +10°C et +20°C.

NOTE: Select WATER COOLING setting (Navigator Controller: WIN 106 = 1) When pumping NITROGEN or lighter gases (in this case the max power is 400 W).

Select AIR COOLING setting (Navigator Controller: WIN 106 = 0) when pumping ARGON gas (in this case the max. power is 260 W).

On/ Off switch

The turbomolecular pump comes without on/ off switch. The control of the turbomolecular pump is to be provided in the course of installation.

Safety

Intended use

DEFINITION: For the purpose of these instructions, “handling” the vacuum pump means the transport, storage, installation, commissioning, influence on operating conditions, maintenance, troubleshooting and overhaul of the turbomolecular pump.

The turbomolecular pump is intended for industrial use. It must only be handled by qualified personnel.

The allowed media and operational limits according to the “Product Description” and the “Installation Prerequisites” of the vacuum pump shall be observed both by the manufacturer of the machinery into which the turbomolecular pump is to be incorporated and by the operator.

The maintenance instructions shall be observed.

Prior to handling the turbomolecular pump these operating instructions shall be read and understood. If anything remains to be clarified please contact your Busch representative!

Safety Guideline for Turbomolecular Pumps

Turbomolecular pumps as described in the following operating manual contain a large amount of kinetic energy due to the high rotational speed in combination with the specific mass of their rotors.

In case of a malfunction of the system for example rotor/ stator contact or even a rotor crash the rotational energy may be released.

Safety

Page 4
AVERTISSEMENT
In case of non-compliance with the installation prerequisites:
Risk of damage or destruction of the vacuum pump and adjoining plant components!
Risk of injury!
The installation prerequisites must be complied with.

A thermistor sensor is mounted near the upper bearing to prevent the pump from overheating.

Safety notes
The turbomolecular pump has been designed and manufactured according to the state-of-the-art. Nevertheless, residual risks may remain. These operating instructions inform about potential hazards where appropriate. Safety notes are tagged with one of the keywords DANGER, WARNING and CAUTION as follows:

DANGER
Disregard of this safety note will always lead to accidents with fatal or serious injuries.

WARNING
Disregard of this safety note may lead to accidents with fatal or serious injuries.

CAUTION
Disregard of this safety note may lead to accidents with minor injuries or property damage.

NOTE: The notes contain important information taken from the text.

Transport
The Turbo TM 1100 A is supplied in a special protective packing. If this shows signs of damage which may have occurred during transport, contact your local sales office.

When unpacking the system, be sure not to drop it and avoid any kind of sudden impact or shock vibration to it.

Do not dispose of the packing materials in an unauthorized manner. The material is 100% recyclable and complies with EEC Directive 85/399.

NOTE: Normal exposure to the environment cannot damage the Turbo TM 1100 A. Nevertheless, it is advisable to keep it closed until it is installed in the system, thus preventing any form of pollution by dust.

Packed in a packaging, the vacuum pump may be out of the box without any means of lifting.

CAUTION
In order to prevent outgassing problems, do not use bare hands to handle components which will be exposed to vacuum.
Always use gloves or other appropriate protection.

CAUTION
Please check out the weight of the turbomolecular pump before lifting it up (see “Technical Data”).
Use adequate lifting gear for this.

Storage
Short-term Storage
In order to guarantee the maximum level of performance and reliability of turbomolecular pumps, the following guidelines must be followed:

- Make sure that the suction connection/gas inlet and the gas discharge/pressure connection are cooled (leave the provided plugs in)
- The storage of turbomolecular pumps must take place under the following environmental conditions:
  - Temperature range: -20°C to +70°C
  - Relative humidity range: 0 to 95% (non condensing)
- The turbomolecular pumps must be always soft-started when received and operated for the first time by the customer.
- The shelf life of a turbomolecular pump is 10 months from the shipping date.

CAUTION
If for any reason the shelf life time is exceeded, the pump has to be returned to the factory.

Please contact the local Busch Vacuum Sales and Service representative for informations.

NOTE: If the Turbo TM 1100 pump has been stored at a temperature below 5°C, please wait for the system to reach an ambient operating temperature of +5°C to 35°C.

Installation and Commissioning
Installation prerequisites

CAUTION
In case of non-compliance with the installation prerequisites:
Risk of damage or destruction of the turbomolecular pump and adjoining plant components!
Risk of injury!
The installation prerequisites must be complied with.

- Make sure that the integration of the turbomolecular pump is carried out such that the essential safety requirements of the Machine Directive 2006/42/EC are complied with (in the responsibility of the designer of the machinery into which the vacuum pump is to be incorporated; see also the note in the EC-Declaration of Conformity).

Mounting Position and space
- Do not install or use the pump in an environment exposed to atmospheric agents (rain, snow, ice), dust, aggressive gases, or in explosive environments or those with a high fire risk.
- Make sure that the environmental conditions comply with the protection class of the drive motor (according to the nameplate)
- During operation, the following environmental conditions must be respected:
  - Maximum pressure: 2 bar above atmospheric pressure
  - Temperature: from 5°C to +35°C
  - Relative humidity: 0-95% (non condensing)
**CAUTION**
Do not remove the adhesive and protective cap before connecting the turbopump to the system.

In the presence of magnetic fields the pump must be protected using a ferromagnetic shield. See the chapter « Technical data ».

The turbopump must be connected to a primary pump (See « Technical Data »).

Fix the Turbo TM 1100 A in a stable position mounting the inlet flange of the turbopump to the system counter-flange, with a connection capable of withstanding a torque of 8900 Nm around its axis.

The Turbo TM 1100 A can be installed in any position.

**NOTE:** The Turbo TM 1100 A cannot be fixed by means of its base.

The pump can operate in any position and can be supported on the high vacuum flange (suction).

Make sure that the turbomolecular pump cannot be hit by falling objects.

Make sure that the turbomolecular pump will not be touched inadvertently during operation, provide a guard if appropriate.

The pump is balanced after assembly with a residual vibration amplitude less than 0.01 μm.

### Suction Connection

**CAUTION**
Do not put hands into the inlet aperture.

Risk of body damage!

**CAUTION**
Intruding foreign objects or liquids can destroy the vacuum pump.

**WARNING**
If a rotor failure occurs, the connection of the pump to the system could be subjected to a significant torque. If the connection is not sufficient to withstand that torque, the pump could detach from the system or the motor housing could detach from the pump envelope. In this case metal fragments could be projected from the pump or system, which could cause serious injury or death and/or damage to surrounding equipment.

Dimension of the suction flange:
- ISO 200 F

The following table shows, for the ISO-F suction flange, the necessary number of screws and the relevant fixing torque.

<table>
<thead>
<tr>
<th>Suction flange</th>
<th>Number of screws</th>
<th>Fixing torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 200 F</td>
<td>12</td>
<td>5 Nm</td>
</tr>
</tbody>
</table>

The class of the steel screws for « F » flange must be > 8.8

Dimension of the exhaust flange:
- KF 40 NW

A flange ISO 200 F is available to connect the turbomolecular pump to the fore-vacuum pump. A hose or vacuum approved pipe can be used. If a rigid pipe is used, any vibration generated by the mechanical pump must be eliminated through the use of bellows.

**NOTE:** The Turbo TM 1100 A pump is characterized by its high compression ratio also for oil vapors. When using a mechanical oil-sealed pump, it is advisable to install a suitable trap between the turbopump and the fore-vacuum pump in order to prevent oil backstreaming.

### Electrical connection/ Controls

- Make sure that the stipulations acc. to the EMC-Directive 2004/108/EC, the EN-standards, electrical and occupational safety directives and the local or national regulations, respectively, are complied with (this is in the responsibility of the designer of the machinery into which the vacuum pump is to be incorporated; see also the note in the EC-Declaration of Conformity).

- Make sure that the power supply is compatible with the data on the nameplate of the drive motor

- Make sure that an overload protection according to EN 60204-1 is provided for the drive motor

- Make sure that the drive of the vacuum pump will not be affected by electric or electromagnetic disturbance from the mains; if necessary seek advice from the Busch service

### Installation

**Mounting**
- Make sure that the “Installation Prerequisites” are complied with

- Set down or mount the vacuum pump at its location

### Connecting electrically

**WARNING**
Risk of electrical shock, risk of damage to equipment.

Electrical installation work must only be executed by qualified personnel who knows and observes the following regulations:
- IEC 364 or CENELEC HD 384 or DIN VDE 0100, respectively,
- IEC-Report 664 or DIN VDE 0110,
- BGV A2 (VBG 4) or corresponding national accident prevention regulation.

- The Turbo TM 1100 A pump with Navigator controller 969-8978M005 belongs to the second installation (or overvoltage) category as per directive EN 61010-1. Connect the device to a mains line that satisfies the above category.

- The Turbo TM 1100 A pump has Input/Output and serial communication connectors that must be connected to external circuits in such a way that no electrical part is accessible. Be sure that the insulation of the device connected to the Turbo TM 1100 A pump is adequate even in the case of single fault as per directive EN 61010-1.

- The Turbo TM 1100 A pump is connected to the controller through an 8-pin connector. Pins B, C and D are the 3-phase supply to the motor, pins A and F are connected to the temperature...
sensor (NTC type, 30 kΩ resistance at 25°C) and pin E is connected to the pump ground; pins G and H are not connected.

- If the temperature sensor is disconnected, the pump will not start. To prevent damage to the pump when the temperature exceeds 60°C, the sensor automatically cuts out the power supply.

**Controller description (969-8978M005)**

The dedicated controller is a solid-state frequency converter which is driven by a single chip microcomputer and is composed of two PCBs which include power supply and 3-phase output, analog and input/output section, microprocessor and digital section.

The power supply, together with the 3-phase output, converts the single phase AC mains supply into a 3-phase, low voltage, medium frequency output which is required to power the pump.

The controller can be operated by a remote host computer via the serial connection. A Window-based software is available (optional).

**Interconnections – controller model 969-8978M005**

The following figure shows the Turbo TM 1100 A interconnections with Navigator controller (969-8978M005). For Rack Controller models see the specific controller manuals.

**P3 – Vent**

This is a dedicated 24 Vdc connector to control the optional vent valve.

**P4 – External fan**

This is a dedicated 24 Vdc connector to supply an optional external fan.

**J1 – In – Out**

This connector carries all the input and output signals to remote control the Turbo TM 1100 A.

It is a 15-pins D type connector; the available signals are detailed in the table, the following paragraphs describe the signal characteristics and use.

<table>
<thead>
<tr>
<th>Pin N.</th>
<th>Signal Name</th>
<th>Input/Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>START/STOP (+)</td>
<td>IN</td>
</tr>
<tr>
<td>2</td>
<td>START/STOP (-)</td>
<td>IN</td>
</tr>
<tr>
<td>3</td>
<td>INTERLOCK (+)</td>
<td>IN</td>
</tr>
<tr>
<td>4</td>
<td>INTERLOCK (-)</td>
<td>IN</td>
</tr>
<tr>
<td>5</td>
<td>SPEED SETTING (+)</td>
<td>IN</td>
</tr>
<tr>
<td>6</td>
<td>SPEED SETTING (-)</td>
<td>IN</td>
</tr>
<tr>
<td>7</td>
<td>SOFT START (+)</td>
<td>IN</td>
</tr>
<tr>
<td>8</td>
<td>SOFT START (-)</td>
<td>IN</td>
</tr>
<tr>
<td>9</td>
<td>+24 Vdc</td>
<td>OUT</td>
</tr>
<tr>
<td>10</td>
<td>SPARE</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>PROGRAMMABLE SET POINT</td>
<td>OUT</td>
</tr>
</tbody>
</table>
Signal description

- **START/STOP**: input signal to start or stop the pump. With the supplied cover connector the START/STOP (+) signal is connected to the +24 Vdc pin and the START/STOP (-) signal to the GROUND pin: in this condition the pump automatically starts as soon as the controller recognises the input supply (“Plug & Pump”).

- **INTERLOCK**: input signal to control the pump rotation. With the supplied cover connector the INTERLOCK (+) signal is connected to the +24 Vdc pin and the INTERLOCK (-) signal to the GROUND pin.

- **SPEED SETTING**: PWM input signal to set the pump speed. The PWM signal characteristics must be the following:
  - Frequency: 100 Hz +/-20%
  - Amplitude: 24 V max
  - Duty cycle range: from 25% to 75%

Corresponding to a pump speed from 500 Hz to 761 Hz (see the following diagram).

![Diagram showing speed setting characteristics](image)

**NOTE:** The duty cycle percentage is referred to the low level portion of the PWM signal.

**PROGRAMMABLE ANALOG SIGNAL:**

This output signal is a voltage (from 0 to 10Vdc) proportional to a reference quantity (frequency or power) set by the user. The default setting is the frequency (see the following example diagram).

![Diagram showing programmable analog signal](image)

**FAULT:**

This open collector output signal is ON when a system fault condition is detected.

**PROGRAMMABLE SET POINT:**

This open collector output signal is enabled when the reference quantity chosen (frequency, current or time) is higher than the set threshold. The signal can be

- **“high level active”** (that is the output is normally at 0 Vdc and becomes 24 Vdc when activated), or
- **“low level active”** (that is the output is normally at 24 Vdc and becomes 0 Vdc when activated).

Moreover, if the reference quantity is the frequency or the current drawn, it is possible to set the hysteresis (in % of the threshold value) to avoid bouncing.

- For example:
  - Reference quantity: frequency
  - Threshold: 500 Hz
  - Hysteresis: 1%
  - Activation type: “high level”

The set point output stays at 0 Vdc until the frequency becomes higher than 505 Hz (that 500 Hz + 1% of 500 Hz), then the output goes at 24 Vdc and stays at 24 Vdc until the frequency becomes lower than 495 Hz (that is 500 Hz – 1% of 500 Hz).

It is possible to delay the set point checking for a programmable delay time.

The **PROGGRAMMABLE SET POINT** signal has the following default settings:

- Reference quantity: frequency
- Threshold: 643 Hz
- Hysteresis: 2%
- Activation type: “high level”
- Delay time: 0 second

**NOTE:** The Navigator Software (optional) allows the operator to set all the programmable feature.

When no external input-output device is available this connector must be closed with the supplied mating connector that short-circuits the START and INTERLOCK inputs with the GROUND input (see the following figure).
How to connect the open-collector inputs of the controller

Here below there are the typical connections of the open collector input of Turbo TM 1100 A to an external system. Two cases are considered:

- The customer supplies the 24 Vdc
- The customer does not supply the 24 Vdc

Please note that on the connector a 24 Vdc, 60mA voltage, a GROUND signal and the open collector pin are available.

Case 1
Case 2 with relay utilization
Case 2 with transistor utilisation
How to connect the outputs of the controller

The following figure shows a typical logic output connection (relay coil) but any other device may be connected e.g. a LED, a computer, etc., and the related simplified circuit of the controller. The figure example refers to the programmable set point signal on pins 11 and 9.

![Typical output connection](image)

**J2 – Serial**

This is a 9 pin D-type serial input/output connector to control via an RS 232 or RS 485 connection the Turbo TM 1100 A.

**NOTE:** the vent valve can also be controlled by means of the serial connection.

A serial communication kit with a serial cable and the Navigation software is available (optional).

![9 pin D-type serial input/ output connector](image)

### RS 232/ RS 485 Communication

**Description**

Both the RS 232 and the RS 485 interfaces are available on the connector J2.

The communication protocol is the same (see the structure below), but only the RS 485 manages the address field. Therefore to enable the RS 485 is necessary to select the type of communication as well as the device address by means of the Navigator software.

**Communication Format**

- 8 data bit
- no parity
- 1 stop bit
- Baud rate: 600/1200/2400/4800/9600 programmable

**Communication Protocol**

The communication protocol is a MASTER/SLAVE type where:

- Host = MASTER
- Controller = SLAVE

The communication is performed in the following way:

- the host (MASTER) send a message + CRC to the controller (SLAVE);
- the controller answer with an answer + CRC to the host.
- The MESSAGE is a string with the following format:

```plaintext
<STX><ADDR><WIN><COM><DATA><ETX><CRC>
```

**NOTE:** When a data is indicated between two quotes (‘...’) it means that the indicated data is the corresponding ASCII character.

where:

- `<STX>` (Start of transmission) = 0x02
- `<ADD>` (Address) = 0x80 (for RS 232), 0x80 + device number (0 to 31) (for RS 485)
- `<WIN>` (Window) = a string of 3 numeric character indicating the window number (from ‘000’ to ‘999’); for the meaning of each window see the relevant paragraph.
- `<COM>` (Command) = 0x30 to read the window, 0x31 to write into the window.
- `<DATA>` = an alphanumeric ASCII string with the data to be written into the window. In case of a reading command this field dis not present. The field length is variable according to the data type as per the following table:

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Field Length</th>
<th>Valid Characters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic (L)</td>
<td>1</td>
<td>'0' = OFF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>'1' = ON</td>
</tr>
<tr>
<td>Numeric (N)</td>
<td>6</td>
<td>'0'... '9' right</td>
</tr>
<tr>
<td></td>
<td></td>
<td>justified with '0'</td>
</tr>
<tr>
<td>Alphanumeric (A)</td>
<td>10</td>
<td>From blank to ' ' (ASCII)</td>
</tr>
</tbody>
</table>

- `<ETX>` (End of transmission) = 0x03

**<CRC>** = XOR of all characters subsequent to <STX> and including the <ETX> terminator. The value is hexadecimal coded and indicated by two ASCII character.

The addressed SLAVE will respond with an ANSWER whose structure depends from the MESSAGE type.

When the MESSAGE is a reading command, the SLAVE will respond transmitting a string with the same structure of the MESSAGE.

**NOTE:** Using the RS 485 interface, the message structure remains identical to the one used for the RS 232 interface, the only difference being that the value assigned to the ADDRESS `<ADD>`.

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The controller can answer with the following response types:
The controller can reply with the following types of response:

<table>
<thead>
<tr>
<th>Type</th>
<th>Length</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic</td>
<td>-</td>
<td>-</td>
<td>After a read instruction of a logic window.</td>
</tr>
<tr>
<td>Numeric</td>
<td>6 bytes</td>
<td>-</td>
<td>After a read instruction of a numeric window.</td>
</tr>
<tr>
<td>Alphanumeric</td>
<td>10 bytes</td>
<td>-</td>
<td>After a read instruction of a alphanumeric window.</td>
</tr>
<tr>
<td>ACK</td>
<td>1 byte</td>
<td>(0x6)</td>
<td>Execution of the command has been successful.</td>
</tr>
<tr>
<td>NACK</td>
<td>1 byte</td>
<td>(0x15)</td>
<td>Execution of the command has failed.</td>
</tr>
<tr>
<td>Unknown Window</td>
<td>1 byte</td>
<td>(0x32)</td>
<td>The window specified in the command is not a valid window.</td>
</tr>
<tr>
<td>Data Type Error</td>
<td>1 byte</td>
<td>(0x33)</td>
<td>The data type specified in the command (Logic, Numeric or Alphanumeric) is not in agreement with the Window specified.</td>
</tr>
<tr>
<td>Out of Range</td>
<td>1 byte</td>
<td>-</td>
<td>The value expressed during a write command is not within the range value for the specified window.</td>
</tr>
<tr>
<td>Win Disabled</td>
<td>1 byte</td>
<td>(0x35)</td>
<td>The window specified is Read Only or is temporarily disabled (for example you can’t write the Soft Start when the Pump is running).</td>
</tr>
</tbody>
</table>

Examples:

**COMMAND: START**
Source: PC

Destination: Controller

<table>
<thead>
<tr>
<th>STX</th>
<th>ADDR</th>
<th>WINDOW</th>
<th>WR</th>
<th>ON</th>
<th>ETX</th>
<th>CRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>80</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>31</td>
<td>31</td>
</tr>
</tbody>
</table>

Source: Controller

<table>
<thead>
<tr>
<th>STX</th>
<th>ADDR</th>
<th>ACK</th>
<th>ETX</th>
<th>CRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>80</td>
<td>06</td>
<td>38</td>
<td>35</td>
</tr>
</tbody>
</table>

Command: STOP
Source: PC

Destination: Controller

<table>
<thead>
<tr>
<th>STX</th>
<th>ADDR</th>
<th>WINDOW</th>
<th>WR</th>
<th>OFF</th>
<th>ETX</th>
<th>CRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>80</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>31</td>
<td>31</td>
</tr>
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Source: Controller

<table>
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<td>80</td>
<td>06</td>
<td>38</td>
<td>35</td>
</tr>
</tbody>
</table>

Commande: SOFT-START (ON)
Source: PC

Destination: Controller

<table>
<thead>
<tr>
<th>STX</th>
<th>ADDR</th>
<th>WINDOW</th>
<th>WR</th>
<th>ON</th>
<th>ETX</th>
<th>CRC</th>
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</thead>
<tbody>
<tr>
<td>02</td>
<td>80</td>
<td>31</td>
<td>30</td>
<td>30</td>
<td>31</td>
<td>31</td>
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Source: Controller

<table>
<thead>
<tr>
<th>STX</th>
<th>ADDR</th>
<th>ACK</th>
<th>ETX</th>
<th>CRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>80</td>
<td>06</td>
<td>38</td>
<td>35</td>
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</table>

Command: SOFT-START (OFF)
Source: PC

Destination: Contrôleur

<table>
<thead>
<tr>
<th>STX</th>
<th>ADDR</th>
<th>WINDOW</th>
<th>WR</th>
<th>OFF</th>
<th>ETX</th>
<th>CRC</th>
</tr>
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<tr>
<td>02</td>
<td>80</td>
<td>31</td>
<td>30</td>
<td>30</td>
<td>31</td>
<td>31</td>
</tr>
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</table>

Source: Controller

<table>
<thead>
<tr>
<th>STX</th>
<th>ADDR</th>
<th>ACK</th>
<th>ETX</th>
<th>CRC</th>
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</thead>
<tbody>
<tr>
<td>02</td>
<td>80</td>
<td>06</td>
<td>38</td>
<td>35</td>
</tr>
</tbody>
</table>
### Window Meanings

<table>
<thead>
<tr>
<th>N.</th>
<th>Read / Write</th>
<th>Data Type</th>
<th>Description</th>
<th>Admitted Values</th>
</tr>
</thead>
</table>
| 000 | R/W | L | Start/Stop (in remote mode the window is a read only) | Start = 1  
Stop = 0 |
| 008 | R/W | L | Remote (default) or Serial configuration | Remote = 1  
Serial = 0  
(default = 1) |
| 100 | R/W | L | Soft Start (write only in Stop condition) | YES = 1  
NO = 0 |
| 101 | R/W | N | Set Point type | 0 = Frequency  
1 = Current  
2 = Time  
(default = 0) |
| 102 | R/W | N | Set Point threshold (expressed in Hz, mA or s) (default = 582) |
| 103 | R/W | N | Set Point delay: time between the pump start and the set point check (seconds) | 0 à 99999 (default = 0) |
| 104 | R/W | L | Set Point signal activation type: the signal can be “high level active” or “low level active” | 0 = high level active  
1 = low level active  
(default = 0) |
| 105 | R/W | N | Set point hysteresis (in % of threshold) | 0 to 100  
(default = 2) |
| 106 | R/W | L | Intercooling | 0 = NO  
1 = YES |
| 107 | R/W | L | Active Stop (write only in stop) | 0 = NO  
1 = YES |
| 108 | R/W | N | Baud rate | 600 = 0  
1200 = 1  
2400 = 2  
4800 = 3  
9600 = 4  
(default = 4) |
| 109 | W | L | Pump life / cycle time / cycle number reset | To reset write ‘1’ |
| 110 | R/W | L | Interlock type (default = 1) | Impulse = 0  
Continuous = 1 |
| 111 | R/W | L | Analog output type: output voltage signal proportional to frequency or power | 0 = frequency  
1 = power  
(default = 0) |
| 120 | R/W | N | Rotational frequency setting (Hz) | 500 to 761  
(default = 761) |
| 121 | R/W | N | Maximum rotational frequency in Hz (active only in Stop condition) | 500 to 761  
(default = 761) |
| 122 | R/W | L | Set vent valve on/off (on=closed) | On = 1  
Off = 0  
(default = 1) |
| 123 | Reserved to Busch service |
| 124 | | | |
| 125 | R/W | L | Set the vent valve operation | Automatic = 0 (see note 1.)  
On command = 1 (see note 2.) |
| 126 | R/W | N | Vent valve opening delay (expressed in 0.2 sec) | 0 to 65535  
(corresponding to 0 to 13107 sec) |
| 130 | Reserved to Busch service |
| 200 | R | N | Pump current in mA dc |
| 201 | R | N | Pump voltage in Vdc |
| 202 | R | N | Pump power in W (pump current x pump voltage duty cycle) |
| 203 | R | N | Driving frequency in Hz |
| 204 | R | N | Pump temperature in °C | 0 to 70 |
| 205 | R | N | Pump status | Stop = 0  
Waiting intlk = 1  
Starting = 2  
Auto-tuning = 3  
Braking = 4  
Normal = 5  
fail = 6 |
| 206 | R | N | Error code | Bit description : see the following figure |
| 300 | R | N | Cycle time in minutes (zeroed by the reset command) | 0 to 999999 |

---

**Installation and Commissioning**

Page 12
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>301</td>
<td>R</td>
<td>N</td>
<td>Cycle number (zeroed by the reset command) 0 to 9999</td>
</tr>
<tr>
<td>302</td>
<td>R</td>
<td>N</td>
<td>Pump life in hours (zeroed by the reset command) 0 to 999999</td>
</tr>
<tr>
<td>320 to 399</td>
<td></td>
<td></td>
<td>Reserved to Busch service</td>
</tr>
<tr>
<td>400</td>
<td>R</td>
<td>A</td>
<td>CRC EPROM (QE) QE5XXXX (or “XXXX” are variable)</td>
</tr>
<tr>
<td>402</td>
<td>R</td>
<td>A</td>
<td>CRC Param. (PA) PA5XXXX (or “XXXX” are variable)</td>
</tr>
<tr>
<td>500</td>
<td></td>
<td></td>
<td>Reserved to Busch service</td>
</tr>
<tr>
<td>503</td>
<td>R/W</td>
<td>N</td>
<td>RS 485 address 0 to 31 (default = 0)</td>
</tr>
<tr>
<td>504</td>
<td>R/W</td>
<td>L</td>
<td>Serial type select 0 = RS 232 1 = RS 485 (default = 0)</td>
</tr>
</tbody>
</table>

**NOTE:** Automatic means that when the controller stops, the vent valve is opened with a delay defined by window n.126; when the controller starts, the vent valve is immediately closed.

On command means that the vent valve is opened or closed by means of window n.122.

```
Window N. 206, Bit Description
```

![Diagram of window N. 206, bit description]
Operation Notes

Application

CAUTION
The turbomolecular pump is designed for operation under the conditions described below.

In case of disregard risk of damage or destruction of the vacuum pump!

Risk of Injury!

The turbomolecular pump must be operated under the conditions described below.

CAUTION
Make all electrical an pneumatic connections before the use of the system.

While heating the vacuum chamber, the temperature of the inlet flange must not exceed 80°C.

CAUTION
Never use the turbopump when the inlet flange is not connected to the vacuum chamber or is not blanked.

Do not touch the turbopump or any of its accessories during the heating process. The high temperatures may cause burns.

CAUTION
Avoid impacts, oscillations or harsh movements of the pump when in operation. The bearings may become damaged.

Use air or inert gas free from dust or particles for venting the pump. The pressure at the vent port must be less than 2 bar (above atmospheric pressure).

For pumping aggressive gases, these pumps are fitted with a special port to allow a steady flow of inert gas (like N2, Ar) for pump bearing protection (see the appendix «Technical Information»).

CAUTION
When employing the pump for pumping toxic, flammable, or radioactive gases, please follow the required procedures for each gas disposal.

Do not use the pump in presence of explosive gases.

Switching on

The following instructions apply to the Turbo TM 1100 A used together with Navigator controller (model 969-8978M005).

To switch on the Turbo TM 1100 A pump it is necessary to supply the mains. The integrated controller automatically recognizes the interlock and start signals presence and start up the pump.

The first pump start up is in «Soft Start» mode. When the start up cycle is finished, the «Soft Start» mode automatically is disabled, and the following start ups are without the „Soft Start” mode.

To re-enable the «Soft Start», mode it must be activated by the suitable software command (see the paragraph « RS232/RS485 COMMUNICATION DESCRIPTION »).

System operating conditions

- **with no flashing:** the pump is normally rotating
- **slowly flashing (period of about 400 ms):** the system is in ramp, or in braking, or in Stop, or in «Waiting for interlock» status.

Turbo pump, switching off

To switch off the Turbo TM 1100 A pump, it is necessary to remove the mains. The integrated controller immediately stops the pump.

WARNING
The turbomolecular controller must be powered with 3-wire power cord (see orderable parts table) and plug (internationally approved) for user’s safety. Use this power cord and plug in conjunction with a properly grounded power socket to avoid electrical shock and to satisfy CE requirements.

WARNING
High voltage developed in the controller can cause severe injury or death. Before servicing the unit, disconnect the input power cable.

Emergency Stop

To immediately stop the Turbo TM 1100 A pump in an emergency condition it is necessary to remove the supply cable from the mains plug.
Maintenance

The Turbo TM 1100 A pump does not require any maintenance. Any work performed on the system must be carried out by authorized personnel.

**WARNING**

Before carrying out any work on the system, disconnect it from the mains, vent the pump by opening the appropriate valve, wait until the rotor has stopped turning and wait until the surface temperature of the pump falls below 50°C.

In the case of breakdown, contact your local Busch service center who can supply a reconditioned system to replace that broken down.

**NOTE:** Prior to shipping, the turbomolecular pump must imperatively be decontaminated and the degree of contamination must be documented in a declaration of decontamination (« Declaration of Decontamination »), which can be downloaded from www.busch-vacuum.com.

Inlet Screen Installation

![Inlet Screen](image)

The inlet screens mod. 969-9304 and 969-9316 prevent the blades of the pump from being damaged by debris greater than 0,7 mm diameter.

**NOTE:** The inlet screen, does reduce the pumping speed by about 10%.

The inlet screen is fitted in the upper part of the pump, as shown in the figure.

Water Cooling Kit Installation

Two types of water cooling kits are available to be mounted. The Turbo TM 1100 A pump must be always water cooled.

The two models part numbers are:
- 969-9825
- 969-9826

![Water Cooling Kits](image)
CAUTION

The items of the kit 969-9826 must be assembled as shown in the following figure.

The assembled kit must be screwed into the suitable holes of the pump body with a recommended closing torque of 5 Nm.

During operation, the following environmental conditions must be respected:
- The water temperature must be between +10°C and +35°C
- Inlet pressure between 3 and 5 bar
- This allows a flow of about 3.5 l/min.

NOTE: The water electrical conductance must be ≤500 µS/cm. When the conductance is higher, in closed water circuit, the use of up to 20% of Ethyl-Glycole is suggested.

Vent Accessories

The vent valve and vent device allow to avoid undesired venting of the pump during temporary power failure and enables an automatic vent operation.

Navigator Controller Compatible Vent Valve model 969-9834

This vent valve waits before opening a minimum time of about 5 sec. This time can be increased up to about 220 min. by means of a setting of the Navigator software (optional). To install the vent valve, unscrew the threaded plug (see figure below).

CAUTION

Do not overtighten the valve as this may damage the thread on the pump.

- Then screw the vent valve into the pump and tighten it using a 16 mm hexagonal spanner with a torque of 2.5 Nm.
Then connect the cable from the valve to the suitable connector on the controller (see the paragraph “INTERCONNECTIONS”).

Purge Valve Installation
A gas purge valve is available to protect the pump bearings against particulate and corrosive gases that could move into the pump. To install the gas purge valve it is necessary to unscrew the purge port cover as shown in the following figure:

Screw the gas purge valve (with a torque of 2,5 Nm) as shown in the following figure.

Serial Cable Installation (for 969-8978M005 Navigator controller only)
The supplied serial cable must be installed when the Turbo TM 1100 A or the optional vent valve have to be controlled by means of a remote computer.

The cable is installed fixing the 9 pin D-type connector into the P2 serial connector as shown in the following figure.

Turbo TM 1100 A Navigator Controller Installation
The controller can be mounted on the pump bottom. To install the controller execute the following procedures:

Bottom mounting
See the following figure:
- Turn the pump upside-down.
- Place the three washers on the pump bottom in correspondence of three hole at 120°.
- Place the controller on the washers, with the pump cable toward the pump body.
- Fix the controller to the pump bottom by means of the three socket head screws M5.
- Turn the pump again.
- Plug the line card and connect the pump cable to the pump.
- Connect the mating connector with the jumper on the interlock signal to start the pump.
CAUTION
In order to achieve best efficiency and a long life the turbomolecular pump was assembled and adjusted with precisely defined tolerances.

This adjustment will be lost during dismantling of the vacuum pump.

It is therefore strictly recommended that any dismantling of the vacuum pump that is beyond of what is described in this manual shall be done by the Busch service.

CAUTION
Improper work on the turbomolecular pump put the operating safety at risk.

Risk of explosion!
Approval for operation will be void!

Any dismantling of the turbomolecular pump that is beyond of what is described in this manual must be done by specially trained Busch service personnel only.

Removal from Service
Dismantling and Disposal
Recommissioning

CAUTION
Only authorised personnel may carry out dismantling work on the vacuum pump. Before work begins, the operator of the turbomolecular pump must fill in a form or a « Declaration of Decontamination » that provides information on possible dangers and appropriate measures.

If this form has not been filled in completely and signed, the vacuum pump may not be dismantled.

CAUTION
During dismantling of the turbomolecular pump protective equipment and clothing must be worn.

- dispose of the turbomolecular pump as scrap metal
- dispose of the different components of the turbomolecular pump in compliance with applicable regulations

Meaning of the "WEEE" logo found in labels
The following symbol is applied in accordance with the EC WEEE (Waste Electrical and Electronic Equipment) Directive. This symbol (valid only in countries of the European Community) indicates that the product it applies to must NOT be disposed of together with ordinary domestic or industrial waste but must be sent to a differentiated waste collection system. The end user is therefore invited to contact the supplier of the device, whether the Parent Company or a retailer, to initiate the collection and disposal process after checking the contractual terms and conditions of sale.

According to the best knowledge at the time of printing of this manual the materials used for the manufacture of the turbomolecular pump.

<table>
<thead>
<tr>
<th>Product</th>
<th>No.</th>
<th>Certificate of Compliance CSA</th>
</tr>
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<tbody>
<tr>
<td>TM 1100 A</td>
<td>1381564280</td>
<td>969-8978***</td>
</tr>
<tr>
<td>Made in EU</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Dimensions

Turbo TM 1100 A

The following figure shows the Turbo TM 1100 A outlines (dimensions are in mm)

868-8962R001 (Inlet flange ISO 200 F – KF40 foreline flange)
Pumping speed diagram for 869-8962R001 (ISO 200F flange) turbopump model, with a 36 m³/h foreline pump.

Graph of compression ratio vs foreline pressure.
Spare parts

**NOTE:** when ordering spare parts or accessories acc. to the table below please always quote the type and the serial no. of the vacuum pump. This will allow Busch service to check if the vacuum pump is compatible with a modified or improved part.

The exclusive use of genuine spare parts and consumables is a prerequisite for the proper function of the vacuum pump and for the granting of warranty, guarantee or goodwill.

This parts list applies to a typical configuration of the standard vacuum pump. Depending on the specific order deviating parts data may apply.
## Technical data

<table>
<thead>
<tr>
<th>Technical data</th>
<th>Turbo TM 1100 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumping speed</td>
<td>m³/h</td>
</tr>
<tr>
<td>N₂: 3888</td>
<td>He: 4140</td>
</tr>
<tr>
<td>H₂: 2628</td>
<td>Ar: 3744</td>
</tr>
<tr>
<td>Compression ratio</td>
<td></td>
</tr>
<tr>
<td>N₂: 5 \times 10^7</td>
<td>He: 4 \times 10^4</td>
</tr>
<tr>
<td>H₂: 1.5 \times 10^4</td>
<td>Ar: 5 \times 10^4</td>
</tr>
<tr>
<td>Base pressure with recommended forepump</td>
<td>hPa (mbar)</td>
</tr>
<tr>
<td>1 \times 10^{-10} *</td>
<td></td>
</tr>
<tr>
<td>Inlet flange, nominal diameter</td>
<td>ISO 200-F</td>
</tr>
<tr>
<td>Foreline flange, nominal diameter</td>
<td>KF 40 NW</td>
</tr>
<tr>
<td>Rotational speed</td>
<td>min⁻¹</td>
</tr>
<tr>
<td>45660</td>
<td></td>
</tr>
<tr>
<td>Start-up time minutes</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Recommended forepump m³/h</td>
<td>36</td>
</tr>
<tr>
<td>Operating position</td>
<td>Any</td>
</tr>
<tr>
<td>Operating ambient temperature °C</td>
<td>+5°C...+35°C</td>
</tr>
<tr>
<td>Bakeout temperature °C</td>
<td>80°C at inlet flange max. (ISO flange)</td>
</tr>
<tr>
<td>Vibration level µm</td>
<td>&lt; 0.01 at inlet flange</td>
</tr>
<tr>
<td>Lubricant</td>
<td>Permanent lubrication</td>
</tr>
<tr>
<td>Cooling requirements</td>
<td>Water</td>
</tr>
<tr>
<td>Coolant water</td>
<td>Minimum flow l/min</td>
</tr>
<tr>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>Temperature °C</td>
<td>+10...+20</td>
</tr>
<tr>
<td>Pressure bar</td>
<td>3...5</td>
</tr>
<tr>
<td>Noise level (EN ISO 2151) dB(A)</td>
<td>&lt;45 (at 1 meter)</td>
</tr>
<tr>
<td>Power supply:</td>
<td></td>
</tr>
<tr>
<td>Input voltage : Vac</td>
<td>100-240</td>
</tr>
<tr>
<td>Input frequency : Hz</td>
<td>50-60</td>
</tr>
<tr>
<td>Max input power : VA</td>
<td>600</td>
</tr>
<tr>
<td>Stand-by power W</td>
<td>30 to 35</td>
</tr>
<tr>
<td>Max operating power</td>
<td>400 W using Nitrogen or lighter gases (WATER cooling setting)</td>
</tr>
<tr>
<td>260 W using ARGON (AIR cooling setting)</td>
<td></td>
</tr>
<tr>
<td>Protection fuse (Navigator Controller) A</td>
<td>1 \times 6.3</td>
</tr>
<tr>
<td>Power cable</td>
<td>With European or NEMA plug 3 meters long (optional)</td>
</tr>
<tr>
<td>Serial communication (Navigator kit)</td>
<td>RS232 cable with a 9-pin D type male connector and a 9-pin D female connector, and Navigator software (optional)</td>
</tr>
<tr>
<td>Installation category</td>
<td>II</td>
</tr>
<tr>
<td>Pollution degree</td>
<td>2</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-20°C to +70°C</td>
</tr>
<tr>
<td>Weight (flange ISO 200) kg</td>
<td>26.7</td>
</tr>
<tr>
<td>Navigator Controller kg</td>
<td>5.4</td>
</tr>
</tbody>
</table>

*According to standard DIN 28428, the base pressure is that measured in a leak-free test dome, 48 hours after the completion of test dome bake-out, with a Turbopump fitted with a Conflat flange and using the recommended pre-vacuum pump.*
EC Declaration of Conformity

NOTE: This Declaration of Conformity and the -mark affixed to the nameplate are valid for the vacuum pump within the Busch-scope of delivery. When this vacuum pump is integrated into a larger machinery the manufacturer of the larger machinery (this can be operator, too) must conduct the conformity assessment process acc. to the Directive Machinery 2006/42/EC for the larger machine, issue the Declaration of Conformity for it and affix the -mark.

We
Ateliers Busch S.A.
Zone Industrielle
2906 Chevenez
Switzerland

represented in the European Union by
Dr.-Ing. K. Busch GmbH
Schauinslandstr. 1
79689 Maulburg
Germany

declare that the vacuum pumps Turbo TM 1100 A

in accordance with the European Directives
"Machinery" 2006/42/EC,
"Electromagnetic Compatibility" 2004/108/EC

have been designed and manufactured to the following specifications:

<table>
<thead>
<tr>
<th>Standards</th>
<th>Title of the standard</th>
</tr>
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<tbody>
<tr>
<td>Harmonised standards</td>
<td></td>
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<tr>
<td>UNI EN 292-1</td>
<td>Fundamental concepts, general design principles - terminology, basic methodology; Part 1</td>
</tr>
<tr>
<td>UNI EN 292-2</td>
<td>Fundamental concepts, general design principles - Specifications and technical principles; Part 2</td>
</tr>
<tr>
<td>EN 55011CI.A</td>
<td>Industrial, scientific and medical (ISM) radio-frequency equipment - Radio disturbance characteristics - Limits and methods of measurement</td>
</tr>
<tr>
<td>EN ISO 13857</td>
<td>Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs</td>
</tr>
<tr>
<td>EN 1012-2</td>
<td>Compressors and vacuum pumps - Safety requirements - Part 2</td>
</tr>
<tr>
<td>EN 61010-1</td>
<td>Electrical equipment of machines - Part 1</td>
</tr>
<tr>
<td>EN 61000-4-2</td>
<td>Electromagnetic compatibility (EMC) – Electrostatic discharge immunity test; Part 2</td>
</tr>
<tr>
<td>EN 61000-4-3</td>
<td>Electromagnetic compatibility (EMC) – Radiated, radio-frequency, electromagnetic field immunity test; Part 3</td>
</tr>
<tr>
<td>EN 61000-4-4</td>
<td>Electromagnetic compatibility (EMC) – Testing and measurement techniques - Electrical fas transient/burst immunity test; Part 4</td>
</tr>
<tr>
<td>EN 61000-4-5</td>
<td>Electromagnetic compatibility (EMC) – Testing and measurement techniques - Surge immunity test; Part 5</td>
</tr>
<tr>
<td>EN ISO 2151</td>
<td>Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)</td>
</tr>
</tbody>
</table>

Manufacturer: Christian Hoffmann
General director

Mandatory within the EC: Dr.-Ing. Karl Busch
General director

Person authorised to compile the technical file: Gerd Rohweder
Product manager
Appendix:
TV 141 Navigator vent valve

Overview
The "TV 141 Navigator Vent Valve" kit, consisting of a control unit and valve, is a complete unit for automatic pump venting when the pump is switched off or during a power failure. The valve is normally open during power off conditions, is electromechanically activated and secured (Viton-sealed) by means of an M8 thread with related O-ring on the high vacuum port. The air input into the valve is filtered by means of a specific filter located on the valve's own air inlet.

The control unit is powered by the Turbo-V controller which is not suitable for rack mounting.

The control unit is activated with a preset delay of approximately 0.8 seconds to avoid undesired venting during a temporary power failure and to allow the closure of the system valves before venting.

Vent valve

<table>
<thead>
<tr>
<th>Valve status</th>
<th>Normally open (closed when power is supplied)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum connection</td>
<td>M8 thread</td>
</tr>
<tr>
<td>Air intake filter</td>
<td>Sintered bronze</td>
</tr>
<tr>
<td>Hole dimension</td>
<td>1.2 mm (0.05 inch)</td>
</tr>
<tr>
<td>Pressure ranges</td>
<td>$10^{-6}$ mbar to 1 bar ($10^{-7}$ Torr to 760 Torr)</td>
</tr>
<tr>
<td>Air intake adapter</td>
<td>Ø 6.35 mm (1/4 inch)</td>
</tr>
<tr>
<td>Leak rate</td>
<td>$\leq 1 \times 10^{-7}$ mbar l/s</td>
</tr>
<tr>
<td>Life span</td>
<td>1 million cycles</td>
</tr>
<tr>
<td>Input voltage</td>
<td>24 Vdc $\pm$ 10 %</td>
</tr>
</tbody>
</table>

The following figure shows the valve's overall dimensions.

Installation
The following figures show the various components of the TV 141 Navigator Vent Valve kit. These components come disassembled and it is therefore up to the customer to assemble the kit.
When assembling the kit, be careful not to unscrew the coil securing ring and nut inside the valve.

- Once the kit is assembled, install it on the pump.
- Remove the screw cap from the pump, then secure the valve to the pump using a 16 mm wrench making sure to tighten the nut with a torque equivalent to 2.5 Nm.

The following figure shows an example of installation.

### Technical data

<table>
<thead>
<tr>
<th></th>
<th>Control unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>24 Vdc ± 10 %</td>
</tr>
<tr>
<td>- power (max)</td>
<td>2.5 W</td>
</tr>
<tr>
<td>Output voltage (max)</td>
<td>24 Vcc ± 10 %</td>
</tr>
<tr>
<td>- power (max)</td>
<td>1.2 W</td>
</tr>
<tr>
<td>Delay</td>
<td>Approx. 0.8 seconds</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>0 to 40°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-20 to 50°C</td>
</tr>
</tbody>
</table>

### Connection cables

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>120 mm (4.72 inches)</td>
</tr>
<tr>
<td>Output from valve</td>
<td>200 mm (7.87 inches)</td>
</tr>
</tbody>
</table>

### Disposal

**Meaning of the “WEEE” logo found in labels**

The following symbol is applied in accordance with the EC WEEE (Waste Electrical and Electronic Equipment) Directive.

This symbol (valid only in countries of the European Community) indicates that the product it applies to must NOT be disposed of together with ordinary domestic or industrial waste but must be sent to a differentiated waste collection system.

The end user is therefore invited to contact the supplier of the device, whether the Parent Company or a retailer, to initiate the collection and disposal process after checking the contractual terms and conditions of sale.

---

Upon completion of the mechanical installation, attach the connection cable between the valve to the control unit, and the connection cable between the electrovalve control unit to the pump’s controller. Use the velcro provided to secure the controller box.
Gas purge valve 87-900-890-01(A)

General

The gas purge valve is a protection device to protect the pump bearings against particulate and corrosive gases that could move into the pump.

This device is available with:
- Large leak (see Fig. 1).

The following table shows the model part number:

<table>
<thead>
<tr>
<th>Fittings/ Version</th>
<th>Large Leak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swagelock 7/16&quot;</td>
<td>969-9242</td>
</tr>
<tr>
<td>M12</td>
<td></td>
</tr>
</tbody>
</table>

The valve is made with a thin calibrate sapphire orifice mounted into a cartridge, with two special PTFE membranes on each tube side. This is to avoid any particulate, powder and any liquid to come into and occlude the thin hole.

The pieces are mounted altogether into a SST leak tight body.

Gas purge valve characteristics

The Large leak version of the valve is suited for a particular application:
- Large leak (~ 20 sccm at 1000 mbar) for heavy corrosive operations (etching, CVD), when the partial pressure of the corrosive gas is >10^-5 mbar.

If you wish to use a different flow rate, you might change the supply pressure. For a given supply pressure value, the gas purge valve can give you a fixed flow rate value.

Please note that the flow amount does not depend on the vacuum side pressure of the valve, if the pressure is lower than ~ 0.5 of the supply pressure.

Refers to the following diagrams to find the precise correlation. These diagrams refer to dry nitrogen and argon, for other gases you may correct the flow rate according to the calibration factor:

\[
f_x = \sqrt{\frac{M_x}{M_{N2}}}\]

where:
- \(M_{N2}\) is the molecular weight of Nitrogen
- \(M_x\) is the molecular weight of the other gas.

For example the gas purge flow rate for 1000 mbar of Ar for the single tube valve is:

\[
Q = Q_{N2} \cdot f_{Ar} = Q_{N2} \cdot \sqrt{\frac{40}{28}}
\]

where \(Q_{N2}\) is the corresponding nitrogen flow rate at 1000 mbar.

Operation notes

Always use no less than Agilent minimum suggested purge flow rates to properly purge the pump (see the relevant pump manual). Please note that you can use all the purging flows between the minimum specified into the instruction manual and 3500 sccm, if your system is able to pump and withstand higher flow rates.

Always operate the pump with gas purge on: during pump running, during stops, even if corrosive gases were not flowing. This provides protection against particulate that could move into the pump.

Non-observation of this basic, simple rules could affect pump warranty.

NOTE: The Soft start is recommended for the installation of the pump and may be disabled when the pump is continuously operated and the interval between different run is not more than 1 week.
Vent procedure

Venting may be done in three different ways:

1. **Through the vent port** (using vent valve or vent device).
   In this case the only precaution required is to keep the gas purge port on even during vent procedure.

2. **Through the gas purge port**
   The maximum air flow allowed for venting through the gas purge port is 3500 sccm (58.3 mbarl/sec). If the required flow for venting the turbopump is higher than the flow allowed by the gas purge valve, a “T” connector can be put on the purge port. On one side is connected the vent valve, and on the other side is connected the gas purge valve.
   
   **CAUTION**
   When venting is performed through the gas purge port, be sure that the foreline pump is on, in order to avoid overpressure.

3. **Through the chamber**
   The vent flow rate into the chamber must be less than three times the chamber volume (in litres) multiplied by the flow rate through the gas purge port. This is done to maintain the pressure into the pump body higher than into the chamber in order to avoid any corrosive or powder flow-back.

   E.g. **chamber volume** : 250 litres;  
   **gas purge flow** : 20 sccm  
   (0.33 mbarl/sec)

   
   chamber venting flow rate =  
   3x250x20 = 15000 sccm
   
   and the venting time will be:

   chamber venting =  
   = (chamber volumex1000)/chamber flow rate=  
   = (250 x 1000)/15000 = 17 min.
**NITROGEN FLOW-RATES**

![Nitrogen Flow-Rates Graph]

**Large leak**

Fig. 3 Gas purge valve flow rate vs supplying pressure for Nitrogen

**ARGON FLOW-RATES**

![Argon Flow-Rates Graph]

**Large leak**

Fig. 4 Gas purge valve flow rate vs supplying pressure for Argon