TPS-mini

Models
9699180, 9699181, 9699182

Manuale di istruzioni	**Instruksjon manual**
Bedienungshandbuch	**Ohjekäsikirja**
Notice de mode d'emploi	**Felhasználói kézikönyv**
Manual de istrucciones	**Podrecznik instrukcji**
Manual de istruções	**Návod k použití**
Bedrijfshandleiding	**Návod na obsluhu**
Istrukstionsbog	**Priročnik za navodila**
Bruksanvisning	**User Manual**

Agilent Technologies

Notices

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Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

TPS-mini

16
Instructions for Use

Original Instructions

Agilent Technologies
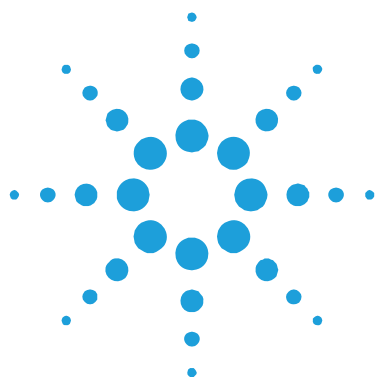
Safety Guideline for Turbomolecular Pumps

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.

WARNING!

To avoid damage to equipment and to prevent injuries to operating personnel the installation instructions as given in this manual should be strictly followed!

General Information

This equipment is destined for use by professionals. The user should read this instruction manual and any other additional information supplied by Agilent before operating the equipment. Agilent 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.

The TPS-mini is an integrated system with a turbo-molecular pump for high and ultra-high vacuum applications associated with its relevant controller and its primary pump. The system can pump any type of gas or gas compound. It is not suitable for pumping liquids or solid particles. The pumping action is obtained through a high speed turbine driven by a high-performance 3-phase electric motor. The TPS-mini is free of contaminating agents and, therefore, is suitable for applications requiring a "clean" vacuum.

The TPS-mini is equipped with auxiliary connectors to control the vent valve, to be controlled from a remote site by means of an host computer connected through a serial line.

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".

This manual uses the following conventions

| WARNING! | Warning messages are for attracting the attention of the operator to a particular procedure or practice which, if not followed correctly, could lead to serious injury. |

| CAUTION! | The caution messages are displayed before procedures which, if not followed, could cause damage to the equipment |

| NOTE | Notes contain important information taken from the text. |

Symbols used

The following symbols are used consistently throughout in all illustration:

⚠️	Warning "see installation/operating"	🔵	Protective conductor terminal
♨️	Hot surface "Danger of burns if hot parts are touched"	▌	On (Power)
⚡	Caution, risk of electric shock	◯	Off (Power)

WARNING!

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. The pump is designed to pump high throughput of N2, Ar and lighter gas. Should you need to pump gases heavier than Ar, please contact Agilent technical support for informations.

Storage

In order to guarantee the maximum level of performance and
reliability of Agilent Turbomolecular pumps, the following guidelines
must be followed:

- when shipping, moving and storing pumps, the following
  environmental specifications should not be exceeded:

  - temperature range: refer to the manuals of the single TPS
    components

  - relative humidity range: refer to the manuals of the single TPS
    components

- 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 12 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 Agilent Vacuum Sales and Service representative for informations.

Preparation for installation

The TPS-mini 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.

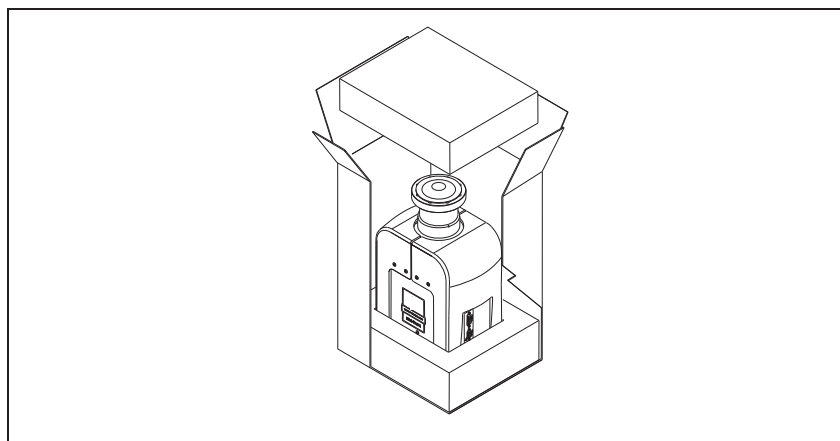| CAUTION!	In order to prevent outgassing problems, do not use bare hands to handle components which will be exposed to vacuum. Always use gloves or other appropriate protection.

Figure 1

NOTE	Normal exposure to the environment cannot damage the TPS-mini . Nevertheless, it is advisable to keep it closed until it is installed in the system, thus preventing any form of pollution by dust.

Installation

CAUTION!	Do not remove the adhesive and protective cap before connecting the turbopump to the system.
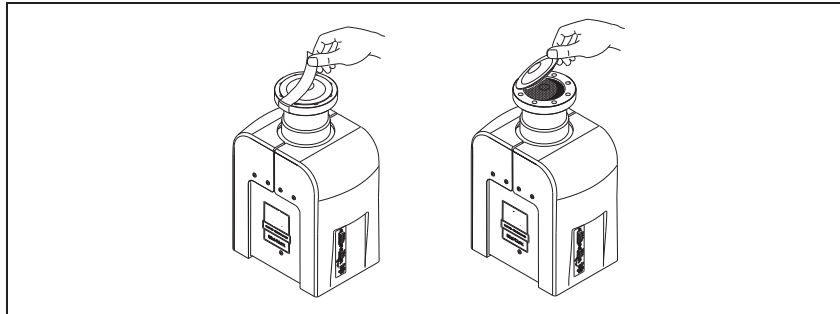
Figure 2

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. During operation, the following environmental conditions must be respected:

- maximum pressure: 2 bar above atmospheric pressure

- temperature: refer to the manuals of the single TPS components

- relative humidity: refer to the manuals of the single TPS components.

In the presence of magnetic fields the pump must be protected using a ferromagnetic shield. See the appendix "Technical Information" for detailed information.

The TPS-mini can be installed in any position. Fix the TPS-mini in a stable position connecting the inlet flange of the turbopump to a fixed counter-flange capable of withstanding a torque of 50 Nm around its axis.

The turbopump with ISO inlet flange must be fixed to the vacuum chamber by means of clamps or claws. The following table shows, for each fixing device, the necessary number of clamps or claws and the relevant fixing torque.

Tab. 1

FLANGE	FIXING DEVICE	N.	FIXING TORQUE
ISO 63	M10 clamps	4	22 Nm
	M8 claws	4	11 Nm

The turbopump with ConFlat inlet flange must be fixed to the vacuum chamber by means of the appropriate Agilent hardware. See the appendix "Technical Information" for a detailed description.

NOTE	The TPS-mini cannot be fixed by means of its base.

For installation of optional accessories, see "Technical Information".

WARNING!	**The System must be installed in a way that allows an easy interruption of the line voltage.**

WARNING!	**Power supply cord: The correct cable for electrical wiring is a three wires (Ph+N+Earth) cable. The wire section has to be at least 0.75 mm^2 (AWG18).**

CAUTION!	Assure a free space all around the system at minimum of 20 cm to allow proper air circulation.

Use

This paragraph details the fundamental operating procedures.

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 120 °C with ConFlat flanging and 80 °C with ISO flanging.

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

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

WARNING! **Avoid impacts or harsh movements of the pump when in operation. The bearings may become damaged and damages to the persons or the things could be taken place.**

| CAUTION! | Use inert gas free from dust, particles or humidity (like Nitrogen) for venting the pump. The pressure at the vent port must be less than 2 bar (above atmospheric pressure). |

| WARNING! | **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 and Use of TPS-mini

To switch on the TPS-mini it is sufficient to supply the mains and then move the external switch to ON position (red light on). The integrated controller automatically recognizes the mains presence and start up the pump.

At the first start up it is recommended to use the "Soft Start" mode by enabling it on the controller. For the following start ups it is recommended to disable the "Soft Start" mode. For the "Soft Start" mode activation procedure, see the paragraph "Signal Description" in the chapter "Technical Information".

The blue LED "STATUS" located on the TPS-mini base front panel indicates with its flashing frequency the 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;

- fast flashing (period of about 200 ms): error condition.

See the appendix "Technical Information" for a detailed description of the TPS-mini control panel.

TPS-mini Switching off

To switch off the TPS-mini it is sufficient to move the external switch to OFF position (red light off). The integrated controller immediately stops the pump.

Emergency Stop

To immediately stop the TPS-mini in an emergency condition it is necessary to remove the supply cable from the mains plug or moving the external switch to OFF position.

Maintenance

The TPS-mini 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 Agilent service center.

NOTE   Before returning the system to the constructor for repairs, the "Request for Return" sheet attached to this instruction manual must be filled-in and sent to the local sales office. A copy of the sheet must be inserted in the system package before shipping.

If a system is to be scrapped, it must be disposed of in accordance with the specific national standards.

Cleaning

The exterior surfaces of the TPS-Mini may be cleaned with mild detergents only.

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.

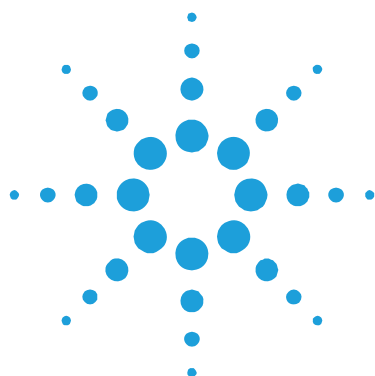The end user is therefore invited to contact the supplier of the device, whether the Parent Company or a retailer, to initiate the collection and disposal process after checking the contractual terms and conditions of sale.

For more information refer to;

http://www.agilent.com/environment/product/index.shtml

16   Instructions for Use
Disposal

17
Technical Information

Original Instructions

Agilent Technologies

Description of the TPS-mini

The TPS-mini pumping system consists of a pump with an integrated controller and a forepump and is available in three models which differ only in the high vacuum flange.

The four models are:

- Model 9699180 with KF 40 high vacuum flange;

- Model 9699181 with ISO 63 high vacuum flange;

- Model 9699182 with ConFlat 4.5" external diameter high vacuum flange.

The following figures show the three models.

Turbopump Description

The turbopump consists of a high frequency motor driving a turbine fitted with many bladed stages and Twistorr drag stages. The turbine rotates in an anticlockwise direction when viewed from the high vacuum flange end.

The turbine is made of high-strength, light aluminium alloy, and is machined from a single block of aluminium. The Twistorr stages are in the form of discs.

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 stator are fabricated in stainless steel. These are supported and accurately positioned by spacer rings.

The TwisTorr stators are in the form of selfpositioning machined disks. On each disk there are parallel spiral pumping channels designed to pump in centrifugal direction on one side and in centripetal direction on the other side. These are made of aluminium alloy.

During normal operation, the motor functions with a power feed at 54 Vac three-phase at 1167 Hz. To reduce losses during start-up to a minimum, the frequency increases according to a ramp with a higher initial voltage/frequency ratio.

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

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

TURBOPUMP

FOREPUMP

CONTROL PANEL AND
INTEGRATED CONTROLLER
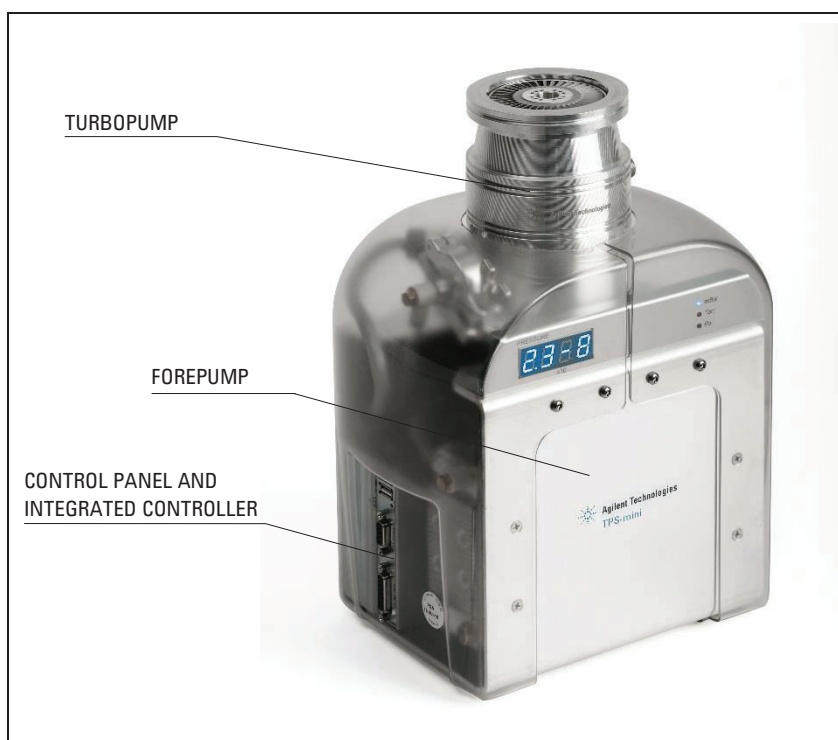
Figure 3

Controller Description

The integrated controller is a solid-state frequency converter which is driven by a single chip microcomputer and is composed of a PCB which includes a power supply with a 3-phase AC output, analog and input/output section, microprocessor and digital section. The controller recognizes the mains presence and converts the single phase AC mains supply into a 3-phase, medium frequency output which is required to power the pump.

The controller can be operated by a remote host computer via the serial connection.

Diaphragm Forepump Description

The pump consists of an electric DC motor driving an eccentric which moves an elastic diaphragm. The pump has four heads.The compression chamber is hermetically separated from the drive mechanism by means of the diaphragm.

The pump transfers, evacuates and compresses completely oil-free. The motor is supplied with a voltage of 24 Vdc.

NOTE A diaphragm pump cleaning from the humidity is recommended to improve the system performance using dry air or nitrogen. It is recommended to open manually the vent valve after every start command for about 30 seconds.

Control Panel Description

The following picture shows the TPS-mini control panel; the associated table lists the available commands. For a detailed description see the following paragraphs.
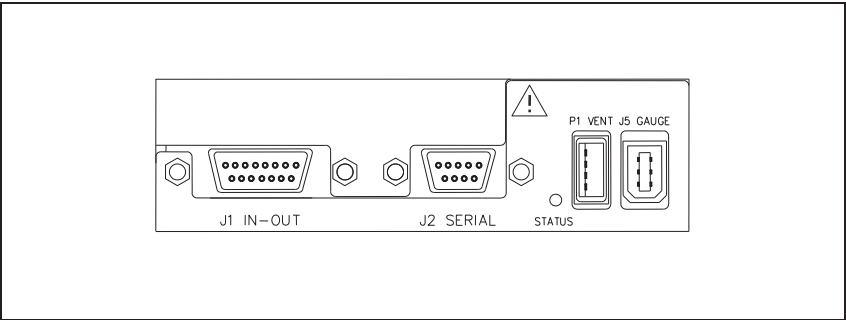
Figure 4

Tab. 2

CONTROL NAME	DESCRIPTION
J1 IN-OUT	Input-output connector to remote control the TPS-mini
J2 SERIAL	Serial input-output connector to control the TPS-mini via an RS 232 or RS 485 connection
STATUS	Blue LED to show the system operating condition
P1 VENT	Connector to control the optional vent valve
J5 GAUGE	Connector to control external EyeSys Gauge
ON-OFF red switch with integrated light (not shown in the picture)	It is located on the other side of the system (with respect to the illustrated control panel). It is the power supply switch. The integrated red light shows the power supply status: it lights when the power supply is applied to the TPS-mini

Technical Specification

Tab. 3

Pumping speed (l/s) (With inlet screen)	With CF 4.5″ or ISO 63: N_2: 48 l/s He: 44 l/s H_2: 32 l/s	With KF 40 NW: N_2: 37 l/s He: 29 l/s H_2: 23 l/s
Base pressure*	5×10^{-8} mbar (3.75×10^{-8} Torr)	
Inlet flange	CF 4.5" O.D.; ISO63; KF 40 NW	
Rotational speed	70000 RPM	
Start-up time	< 2 minutes	
Operating position	any	
Operating ambient temperature	+ 5 °C to + 35 °C	
Bakeout temperature	120 °C at inlet flange max. (CF flange) 80 °C at inlet flange max. (ISO flange)	
Noise level	56.4 dB (A) at 1 meter	
Lubricant	permanent lubrication	

Power supply (Line type):
    Input voltage:
    Input frequency:
    Max input power:
    Stand-by power:
	
	100 – 240 Vac
	50 – 60 Hz
	220 VA
	10 W	

Protection fuse	2.5 A	
Compliance with:	EN 55011 (Class A Group 1) EN 61326-1 EN 61010-1 EN 1012-2 EN 12100	
Indoor Use Only Max Altitude 2000m		
Installation category	II	
Pollution degree	2	
Power cable	With European, USA or UK plug 2 meters long	

Serial communication (kit)	RS232 cable with a 9-pin D type male connector and a 9-pin D type female connector, and software (optional)
Storage temperature	- 20 °C to + 70 °C
Weight kg (lbs)	KF: 7.9 kg (17.4 lbs) ISO: 7.5 kg (16.5 lbs) CFF: 8.8 kg (19.4 lbs)

*According to standard DIN 28 428, 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.

> **NOTE** When the TPS-mini has been stored at a temperature less than 5 °C, wait until the TPS-mini has reached the above mentioned temperature.

TPS-mini Outline

The following figure shows the TPS-mini outline.
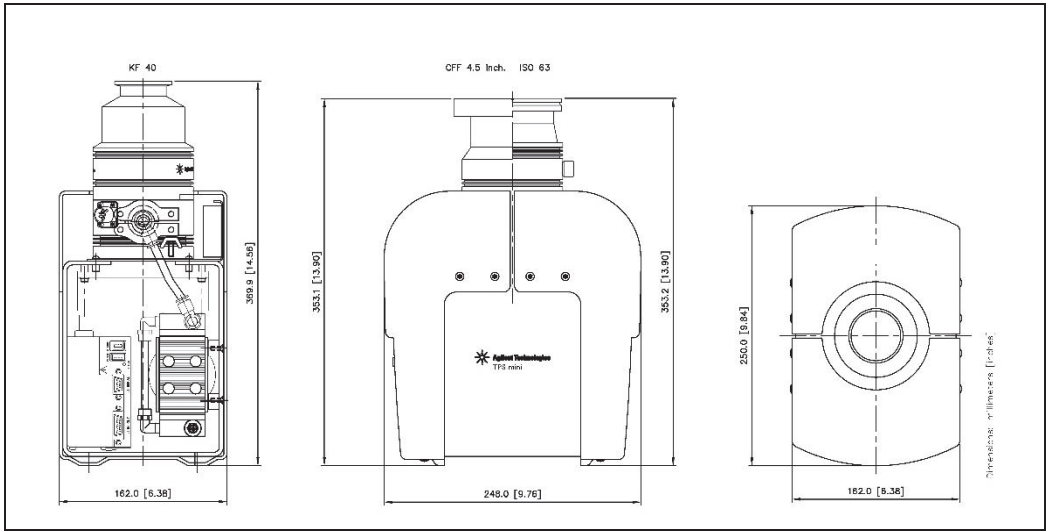
Figure 5
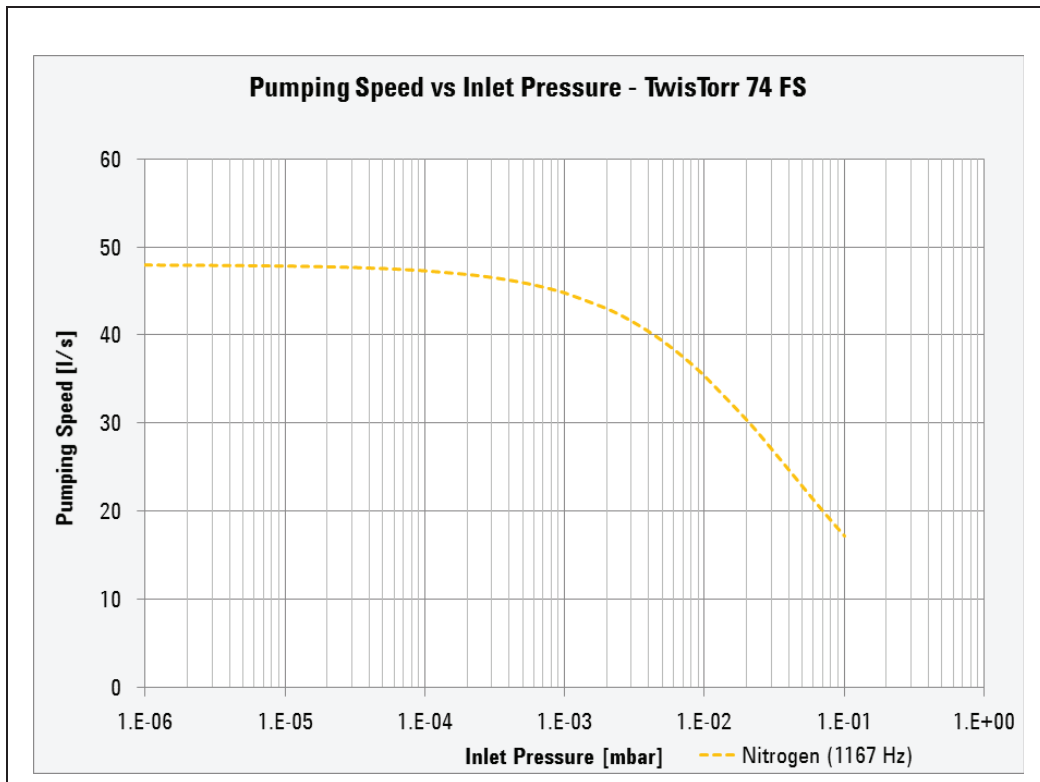
Figure 6   Graph of pumping speed vs inlet pressure (N2)
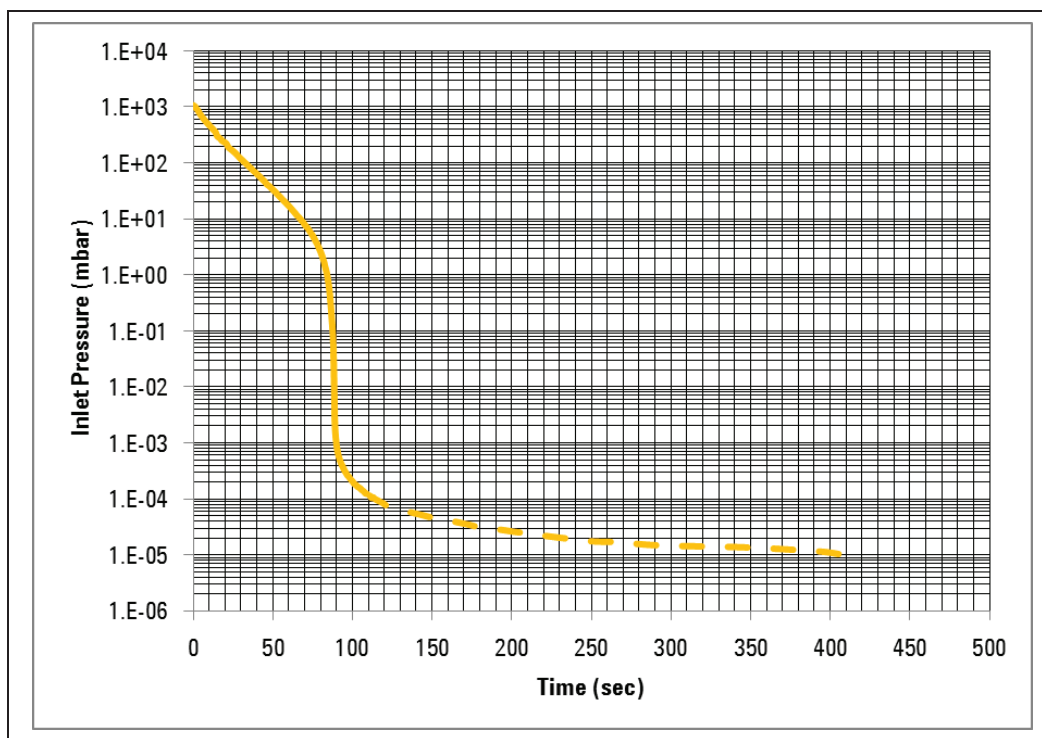
Figure 7   Graph of pressure vs time (with a pump down volume of 1 litre)

Inlet Screen Installation
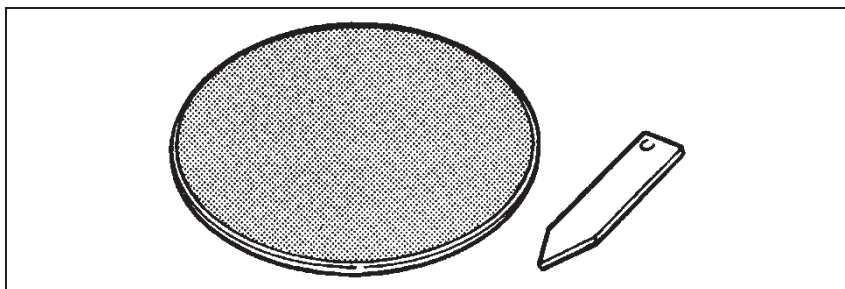
Figure 8

The inlet screens mod. 9699300 and 9699309 prevent the blades of the pump from being damaged by dust greater than 0.7 mm diameter.

The inlet screen, however, 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.
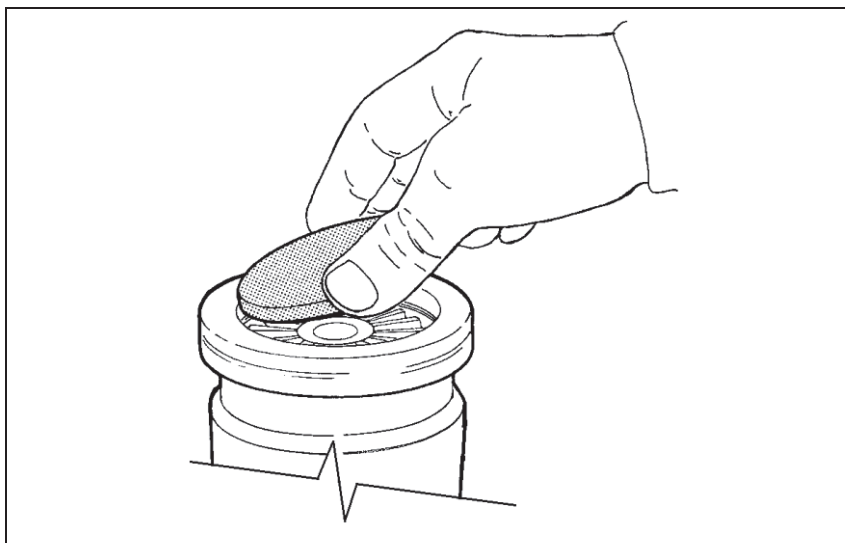
Figure 9

The screen can be mounted on either pump series and is supplied with a small tab for easy removal (see figure).
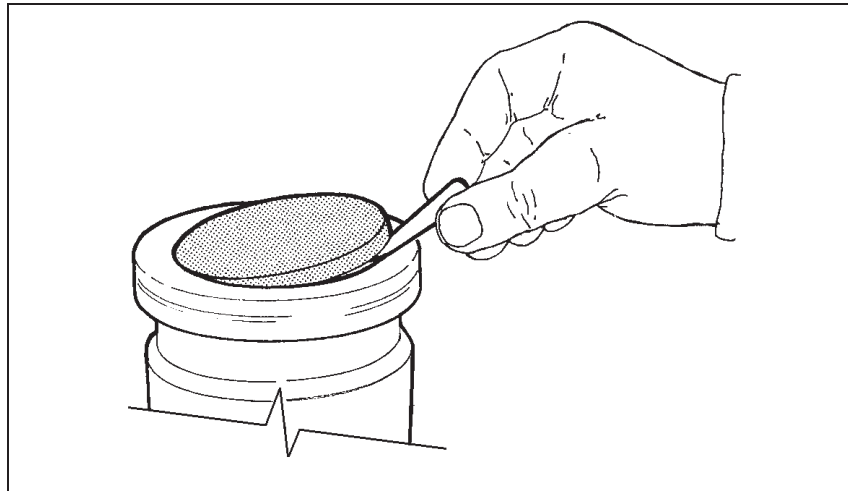
Figure 10

The following figure shows the overall flange dimensions with the protection screen fitted on pump with ISO flange (on the left side) and pump with 4.5" CFF flange (on the right side).
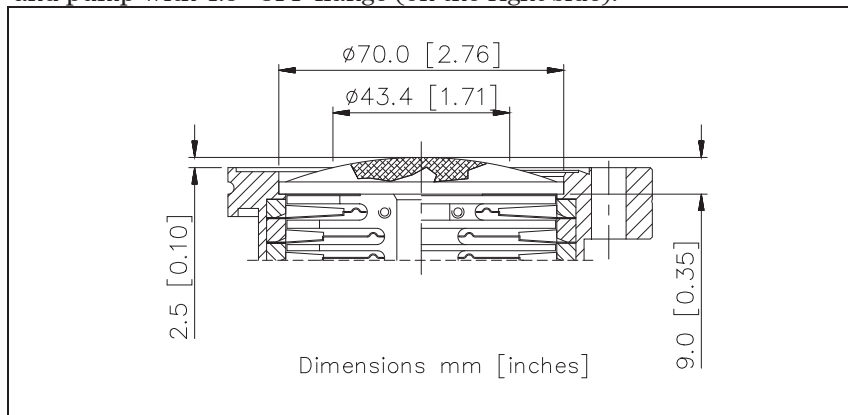
Figure 11

High Vacuum Flange Connection

To connect the Turbo pump to the ISO inlet flange, remove the outer ring and position the centering ring as shown in the figure.
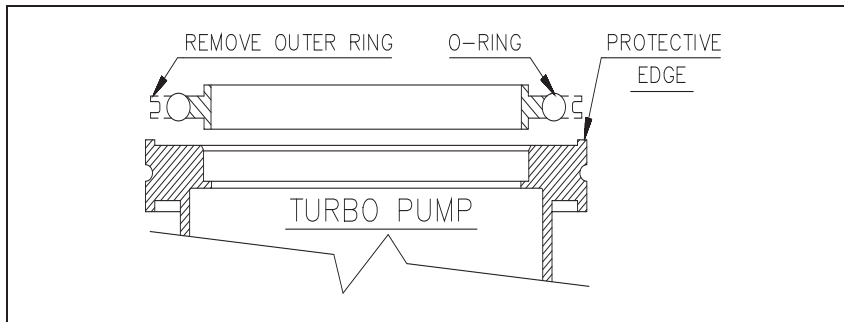
Figure 12

Then fix the two flanges with the clamps or claws as shown in the figure.
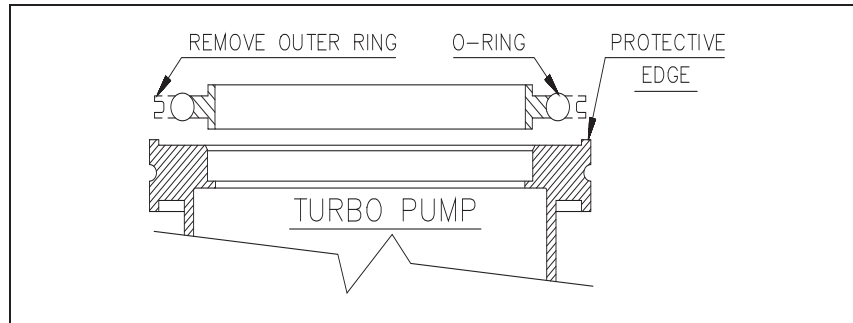
Figure 13

For ConFlat flange connections we recommend using Agilent hardware.

To facilitate assembly and dismantling, apply Fel-pro C-100 high temperature lubricant to the screw threads protruding from the flange and between the nuts and flange. Note that the 2.75" CF flange has six blind holes.

Attach the units and tighten each one in turn. Repeat the sequential tightening until the flange faces meet.

CAUTION!   Exercise care when tightening nuts and bolts to avoid creating dents in the envelope as this may cause the pump rotor to lock.

High Vacuum Flange Connection Configurations
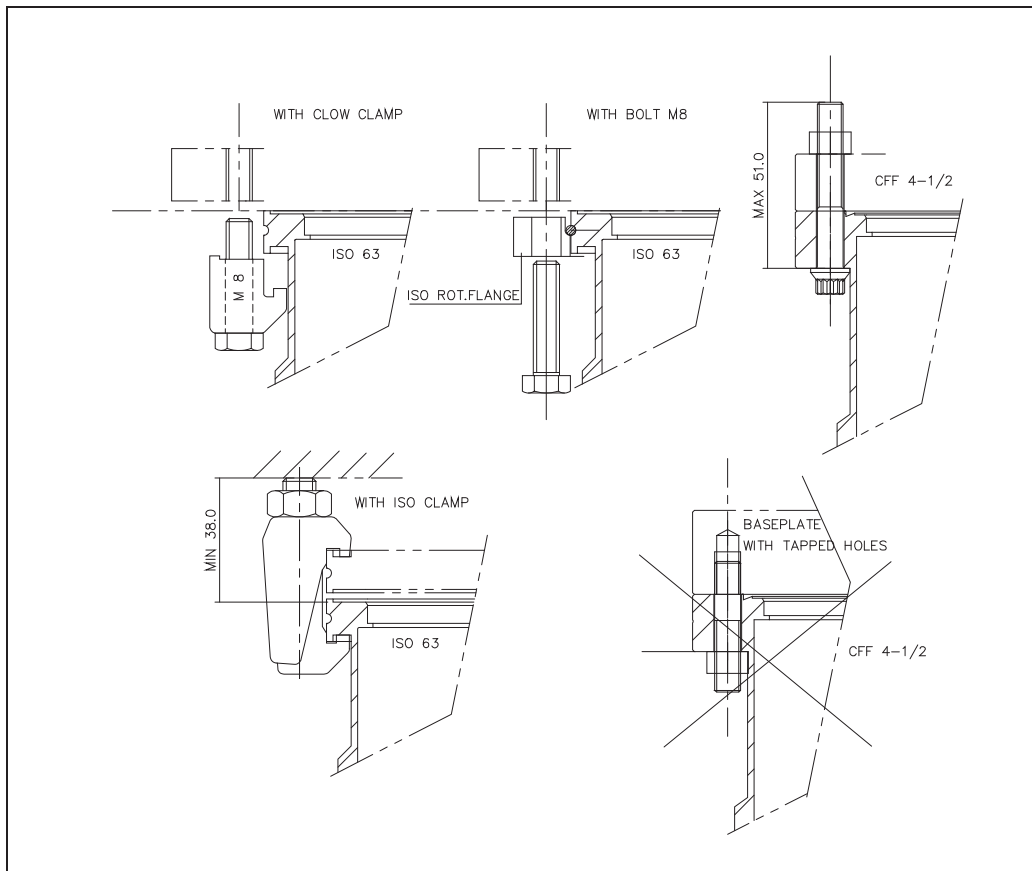
Figure 14

Interconnections

Input Power Connector

The following figure shows the input power connector.

LINE

LINE

HEART

Figure 15

P1 – Vent

COMMON
ENABLE N.C. VALVE
ENABLE N.O. VALVE
+24VDC I MAX 100mA
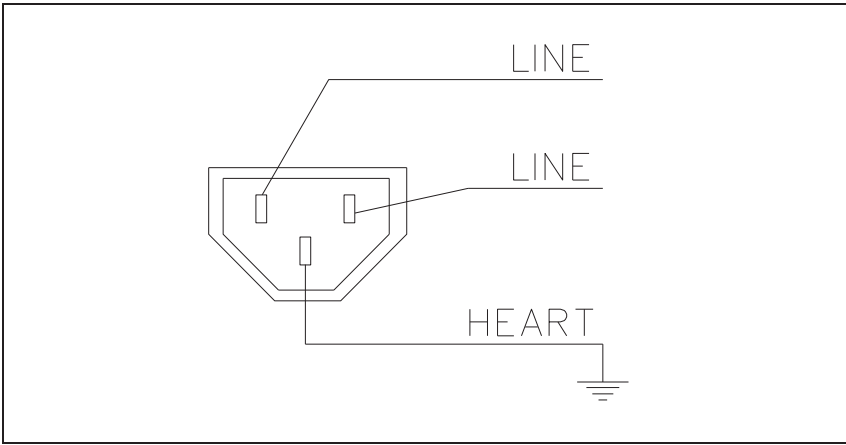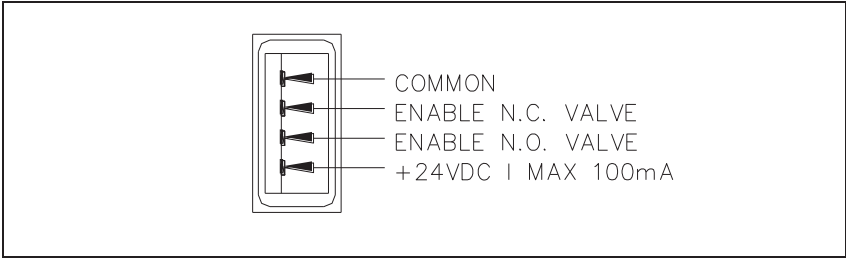
Figure 16   Vent Connector

This is a dedicated 24 Vdc connector to control the optional vent valve (available on request).

The vent valve can be driven by controller automatically or by serial line.
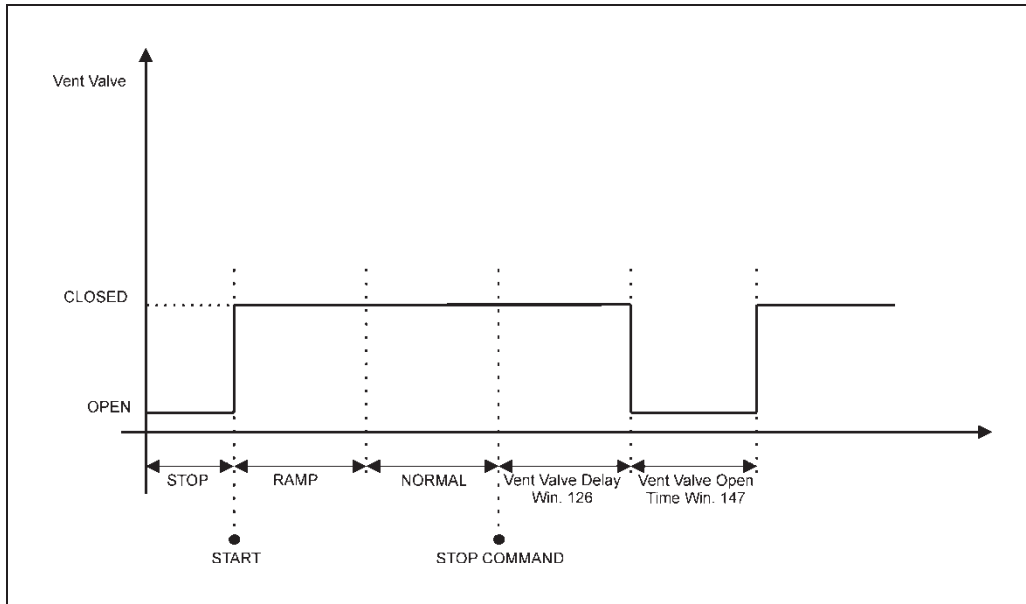
Figure 17   Vent Valve Diagram in "Auto" mode

J5 – Gauge Connector

TPS-mini is equipped with new generation gauge reading card able to drive/read a Agilent-Full Range Gauge FRG-700.
The FRG-700 Full Range Gauge is a combined technologies gauge (Inverted Magnetron plus Pirani Gauge).
FRG-700 measure from $5x10_{-9}$ mbar to atmosphere ($3.8x10_{-9}$ Torr to atmosphere) and its temperature range goes from 5 °C to 55 °C [41 °-131 °F].

Pressure data is available on three independent reading channels:

1   On-board display (data expressed in mbar, Torr or Pa) – (see Pressure Display Module picture)

2   Serial communication line (Win 224)

3   Analogical output.

Pressure gauge can be connected/disconnected from the TPS-mini during normal operation.
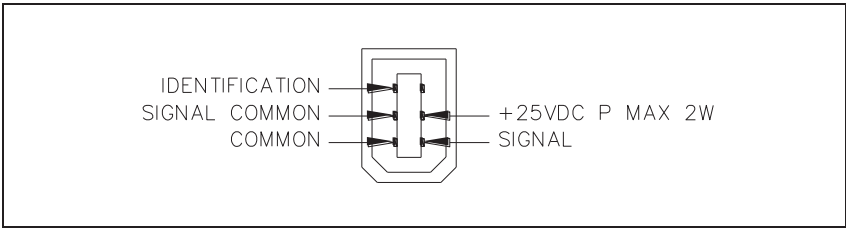
Figure 18   Gauge Connector

| **NOTE** | The FRG700 gauge is intended for high vacuum use, so with pressure above 50 mTorr the signal is misinterpreted and a "false" pressure is displayed. Use a transition gauge to understand if the reading is really under 50 mTorr or not. |

Pressure Display Module
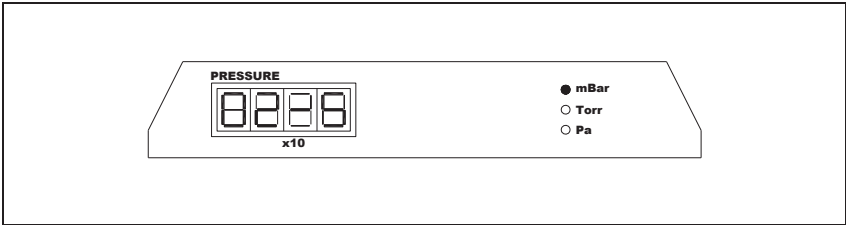
Figure 19   Pressure display module
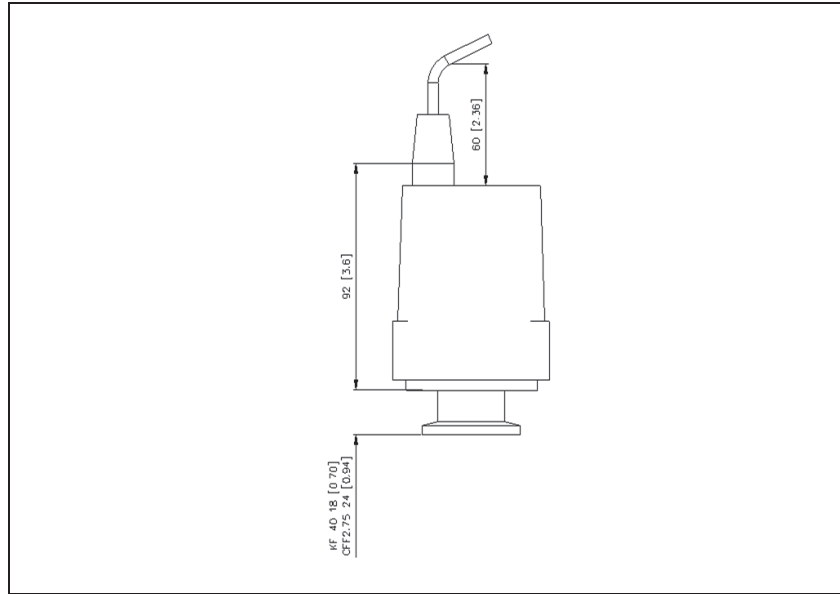
Figure 20   FRG-700 gauge dimensions

Procedure to Connect the Serial and I/O ports to an External Cable

In the following picture, it has showed the right procedure to connect a cable to the I/O or to the serial port.

A shieleed cable of 30 m (to be checked with Riccardo the max length) maximum length has to be utilized for both serial and I/O port connection.

NOTE   Take care to have a good contact between the metallic case and the external shield of the wire. Moreover, this operation has to be done at least on the controller side.

In this way, you will be sure to reduce the influence of the external noise and to accomplish the EMC requests. In picture d is showed the cable assembled.

SHILDED CABLE

Picture a

SHIELD

SHIELD SOLDERED TO CONNECTOR METALLIC CASE

Picture b

SHELL

Picture d

ASSEMBLED SHELL
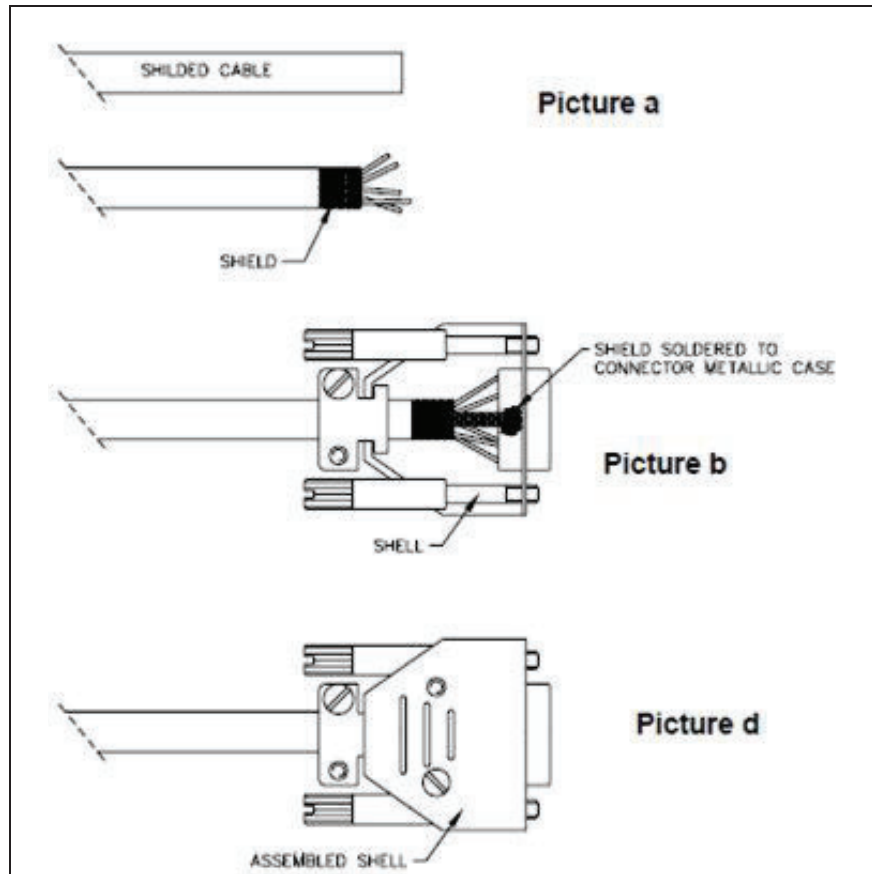
J1 – IN-OUT
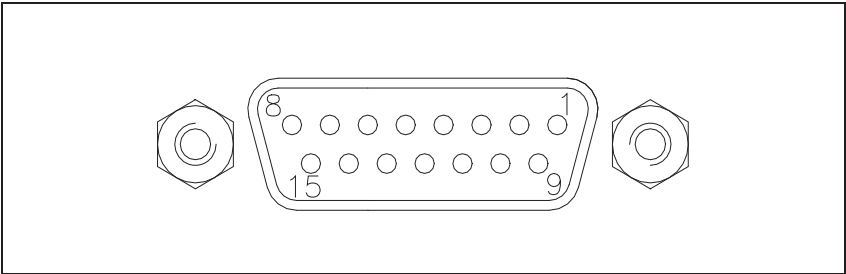
Figure 21

This connector carries all the input and output signals to remote control the TPS-mini .

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.

Tab. 4

PIN N.	SIGNAL NAME	INPUT/OUTPUT
1	START/STOP (+)	IN
2	START/STOP (-)	IN
3	INTERLOCK (+)	IN
4	INTERLOCK (-)	IN
5	SPEED SETTING (+)	IN
6	SPEED SETTING (-)	IN
7	SOFT START (+)	IN
8	SOFT START (-)	IN
9	+24 Vdc I_{max} = 30 mA	OUT
10	NORMAL OUTPUT (relay) V_{max} = 125V I_{max} = 200 mA	OUT
11	PROGRAMMABLE SET POINT	OUT
12	NORMAL OUTPUT	OUT
13	FAULT OUTPUT	OUT

PIN N.	SIGNAL NAME	INPUT/OUTPUT
14	PROGRAMMABLE ANALOG SIGNAL (+)	OUT
15	• GROUND • PROGRAMMABLE ANALOG SIGNAL (-)	OUT

Signal Description

START/STOP: input signal to start or stop the pump. Without the supplied cover connector the turbomolecular pump automatically starts, if you want to stop the turbo-pump from outside, you have to connect the START/STOP (+) signal to the +24 Vdc pin and the START/STOP (-) signal to the GROUND pin (this is the default configuration of the cover connector).

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; in this condition the pump is stopped.

SOFT START: this input is used to provide a "soft start" to the pump; in this condition the ramp-up time could be up to 20 min.

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 1100 Hz to 1167 Hz (see the following diagram).
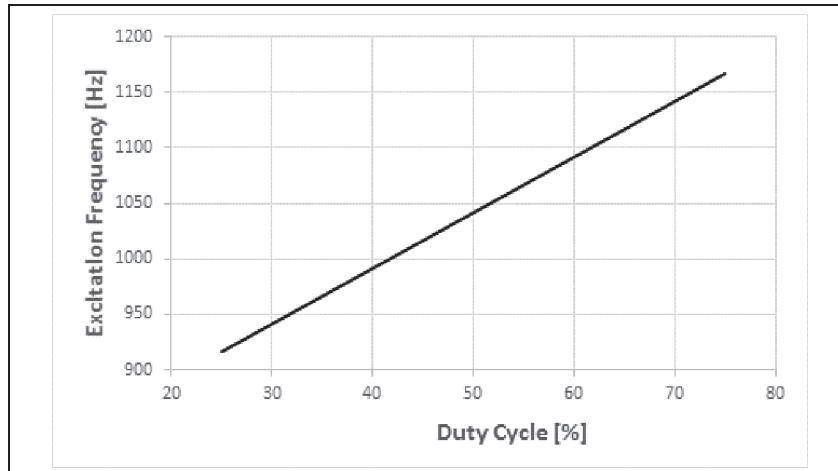
Figure 22

PROGRAMMABLE ANALOG SIGNAL: this output signal is a voltage (from 0 to 10 Vdc) proportional to a reference quantity (frequency or power or Temperature or Pressure) set by the user. The default setting is the frequency (see the following example diagram).
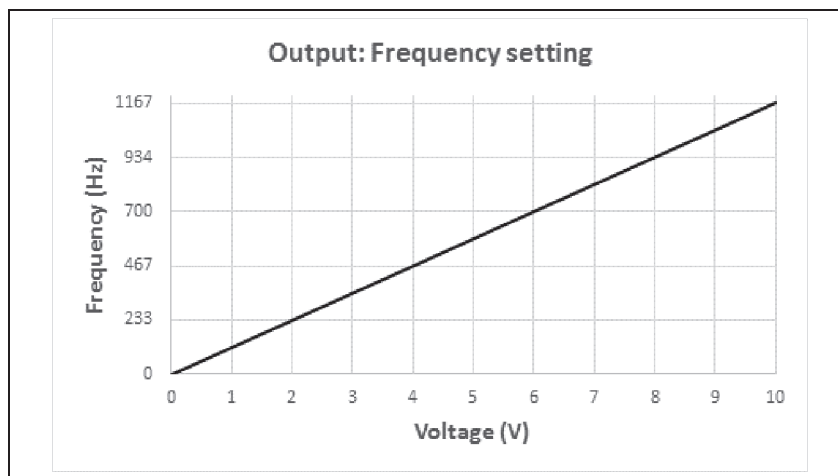
Figure 23
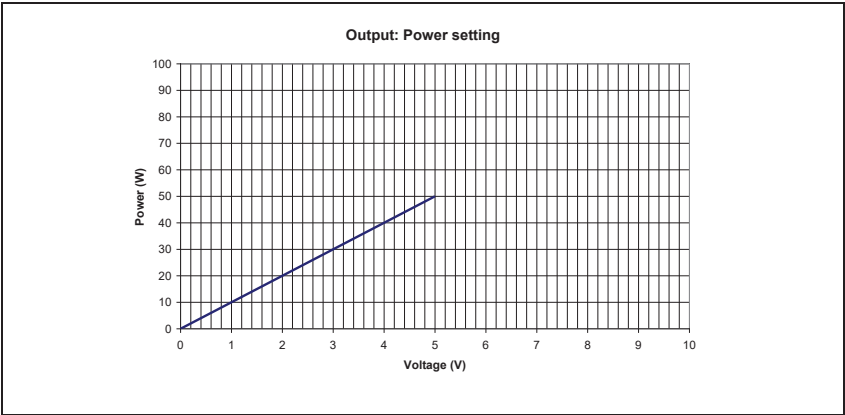
Figure 24
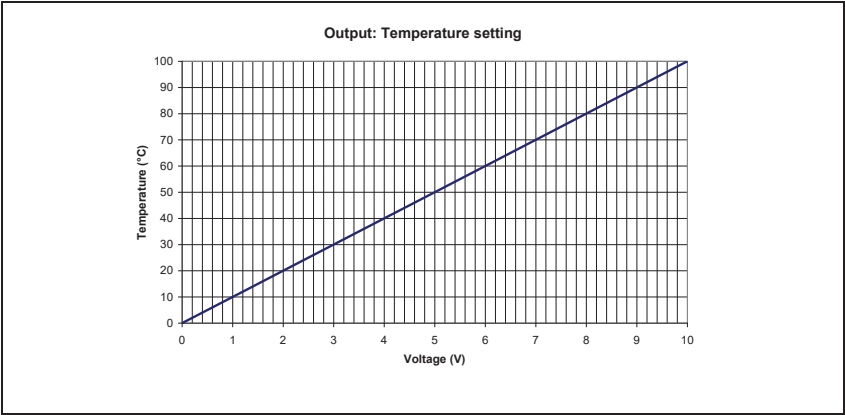
Figure 25
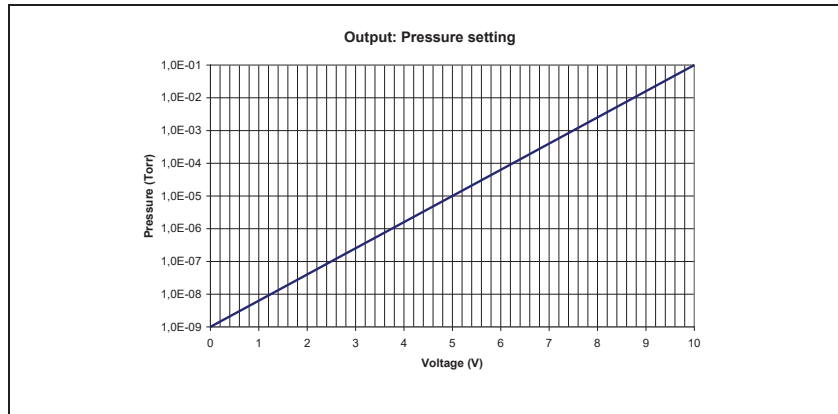
Figure 26

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, power or time or pressure or normal) is higher than the set threshold. The signal can be "high level active" (that is the output is normally OFF and becomes ON when activated), or "low level active" (that is the output is normally ON and becomes OFF when activated). Moreover, if the reference quantity is the frequency or the power or pressure drawn, it is possible to set the hysteresis (in % of the threshold value) to avoid bouncing.

For example:

- reference quantity: frequency

- threshold: 867 Hz

- hysteresis: 2 %

- activation type: "high level"
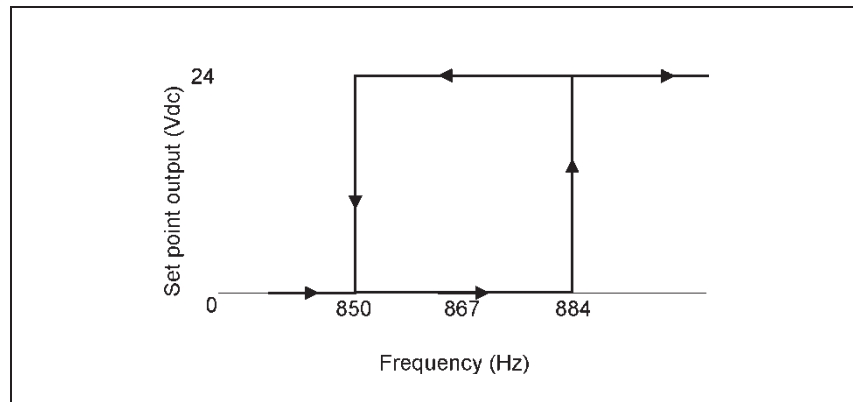
Figure 27

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

The PROGRAMMABLE SET POINT signal has the following default settings:

- reference quantity: frequency

- thereshold: 867 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. |

How to Connect the Open Collector Input of the Controller

Here below there are the typical connections of the open collector input of TPS-mini to an external system. Two cases are considered:

1   the customer supplies the 24 Vdc

2   the customer does not supply the 24 Vdc.

Please note that on the connector a 24 Vdc, 30 mA voltage, a GROUND signal and the open collector pin are available.
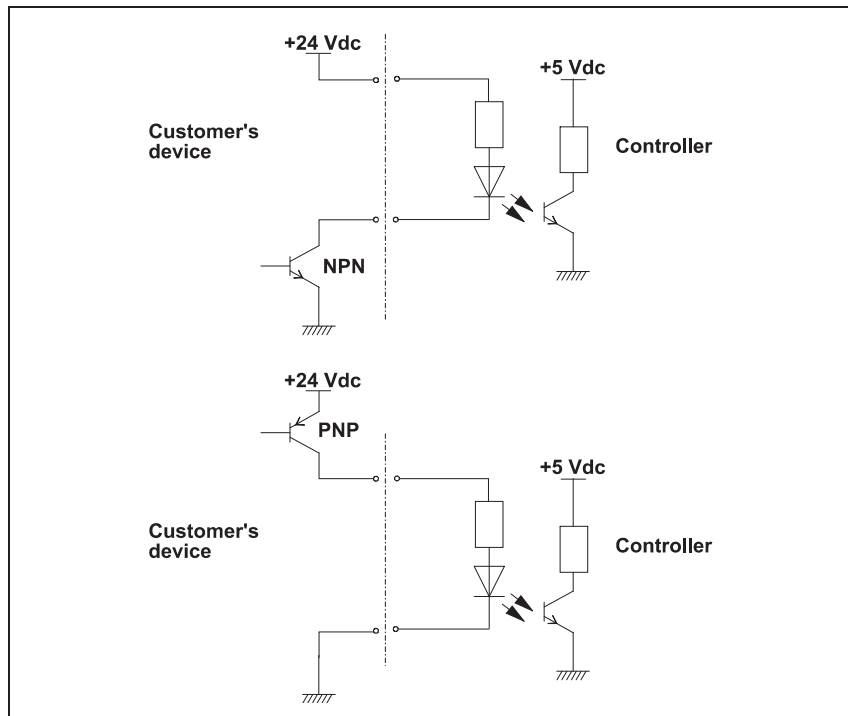
Figure 28   Case 1
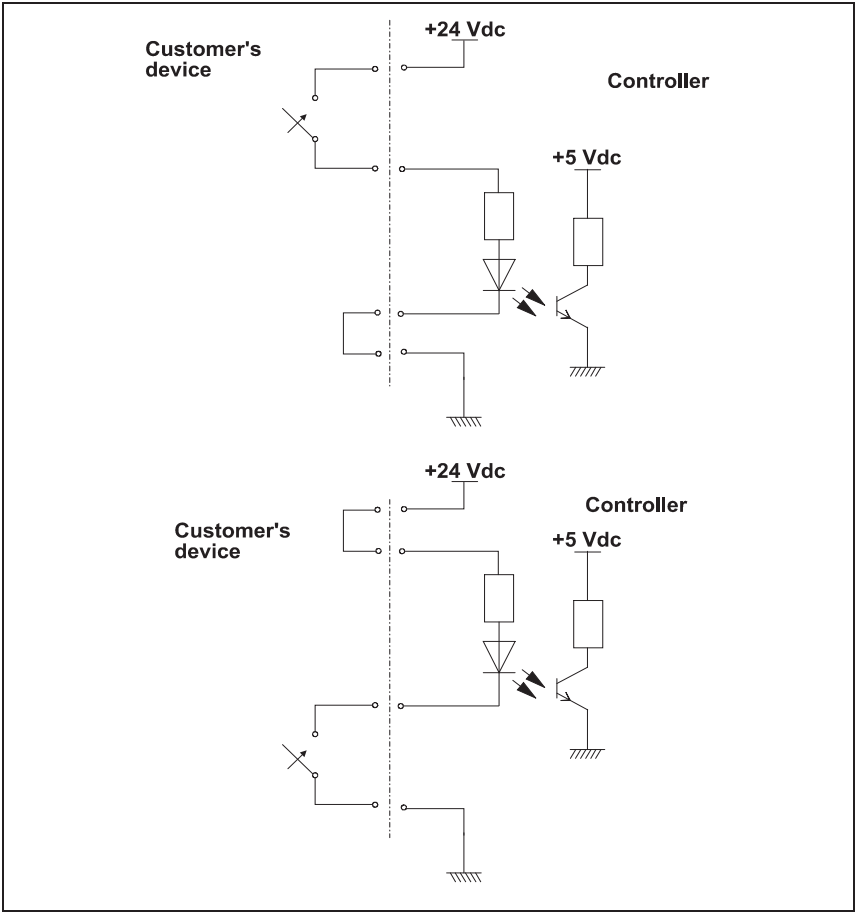
Figure 29   Case 2 with relay utilisation
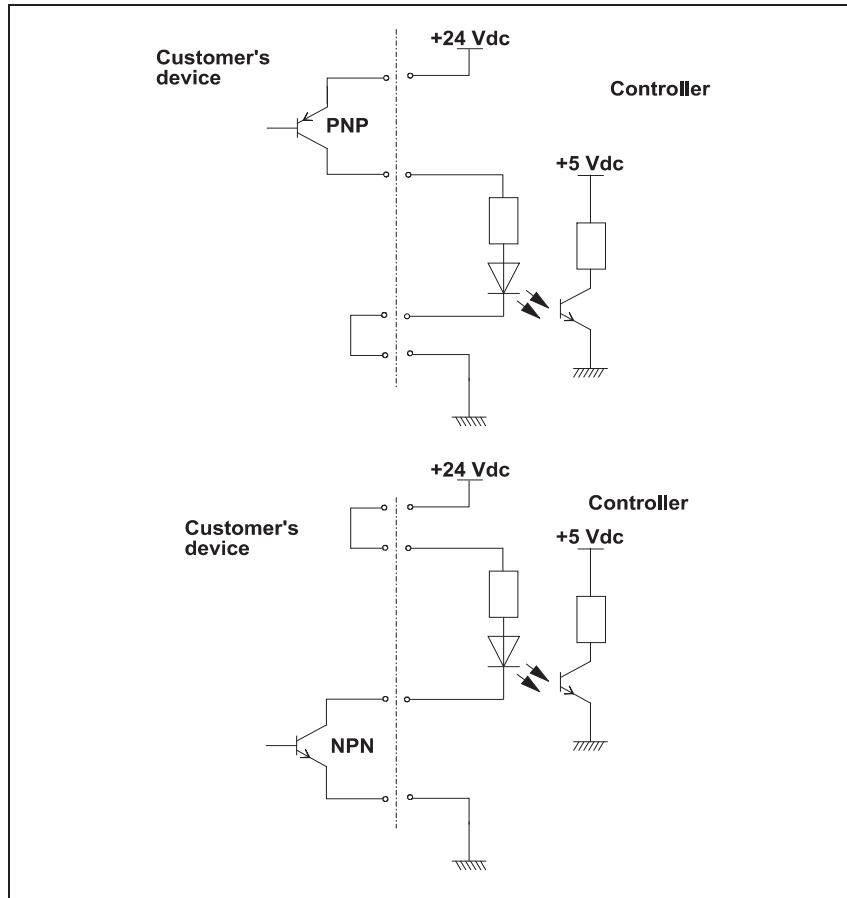
Figure 30   Case 2 with transistor utilisation

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.
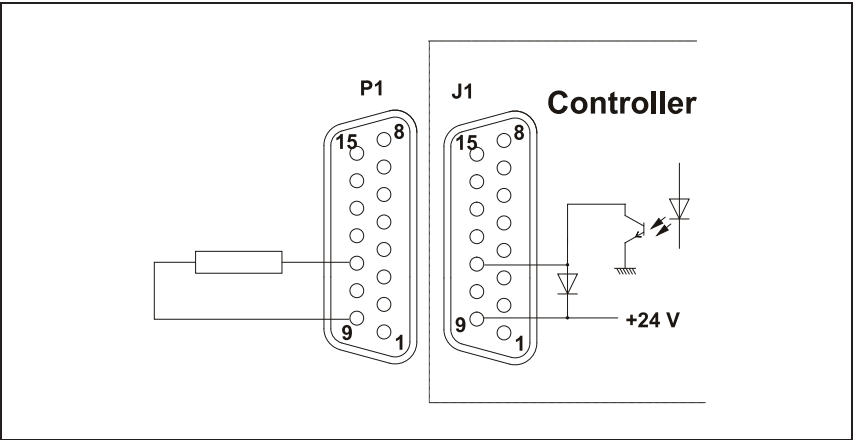
Figure 31   Typical output connection 1

J2 - Serial
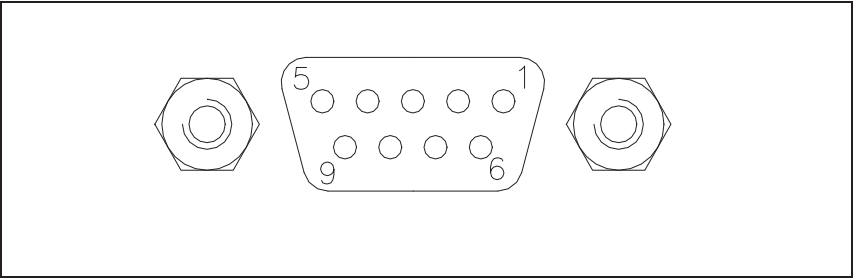
Figure 32

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

Tab. 5

PIN N.	SIGNAL NAME
1	+5 V (OUT)
2	TX (RS232)
3	RX (RS232)
4	Not used
5	GND
6	A + (RS485)
7	Not used
8	B - (RS485)
9	Not used

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

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 software.

Communication Format

- 8 data bit

- no parity

- 1 stop bit

- baud rate: 600/1200/2400/4800/9600 programmable
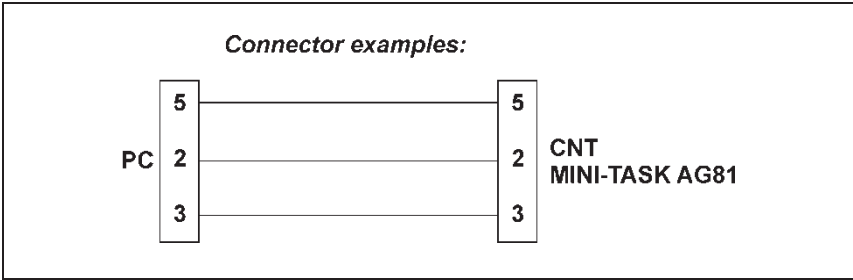
Figure 33   RS 232 Connection
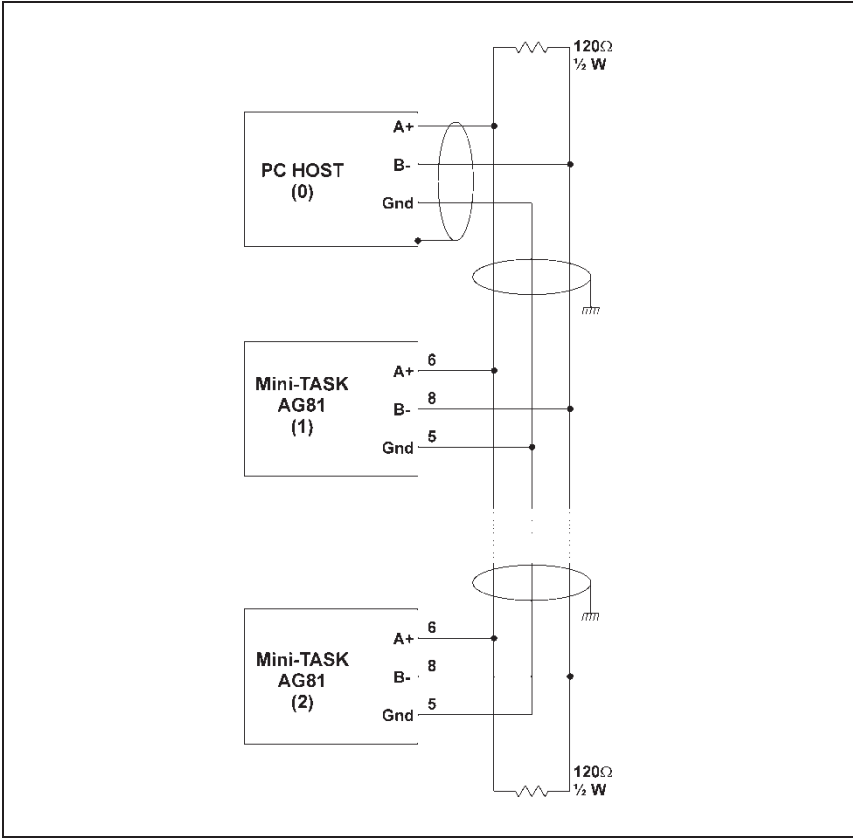
Figure 34   RS 485 Connection

The communication port mating connector is supplied with the RS232 PCB (AMP/Cannon or equivalent 15-pin "D" type male connector).

For example, the Transmit data signal from controller (pin 2) must be connected to the host computer's receive data line (pin 2) and vice versa. Consult the host computer's instruction manual for its serial port connections.

> **NOTE**   Agilent cannot guarantee compliance with FCC regulations for radiated emissions unless all external wiring is shielded, with the shield being terminated to the metal shround on the 0-subconnector. The cable should be secured to the connector with screws.

Serial Communication Descriptions

This unit can communicate by two different protocol:

- protocol (old system) "letter"
- "Window" protocol (new system).

These two protocols can be used as well with 232 or 485 media.

> **NOTE**   Please use "Window" protocol for new development.

Window Protocol

Description

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:

1. the host (MASTER) send a `MESSAGE + CRC` to the controller (SLAVE);

2. the controller answer with an `ANSWER + CRC` to the host.

The `MESSAGE` is a string with the following format:

<STX>+<ADDR>+<WIN>+<COM>+<DATA>+<ETX>+<CRC>

where:

NOTE	When a data is indicated between two quotes ('...') it means that the indicated data is the corresponding ASCII character.

- `<STX>` (Start of transmission) = 0x02

- `<ADDR>` (Unit address) = 0x80 (for RS 232)
  `<ADDR>` (Unit address) = 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 is not present. The field length is variable according to the data type as per the following table

Tab. 6

Data Type	Field Length	Valid Characters
Logic (L)	1	'0' = OFF '1' = ON
Numeric (N)	6	'-', '.', '0' . . . '9' right justified with '0'
Alphanumeric (A)	10	from blank to '_' (ASCII)

- <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 <ADDR>.

The controller can answers with the following response types:

Tab. 7

Type	Response Length	Response Value	Description
Logic	1 byte	-	After a read instruction of a logic window
Numeric	6 bytes	-	After a read instruction of a numeric window
Alphanumeric	10 bytes	-	After a read instruction of an alphanumeric window
ACK	1 byte	(0x6)	The command execution has been successfully completed
NACK	1 byte	(0x15)	The command execution has been failed
Unknown Window	1 byte	(0x32)	The specified window in the command is not a valid window
Data Type Error	1 byte	(0x33)	The data type specified in the command (Logic, Numeric or Alphanumeric) is not accorded with the specified Window
Out of Range	1 byte	(0x34)	The value expressed during a write command is out of range value of the specified window
Win Disabled	1 byte	(0x35)	The specified window is Read Only or temporarily disabled (for example) you can't write the Soft Start when the Pump is running)

Examples

Command: START
Source: PC
Destination: Controller

02	80	30	30	30	31	31	03	42	33
STX	ADDR	WINDOW				WR	ON	ETX	CRC

Source: Controller
Destination: PC

02	80	06	03	38	35
STX	ADDR	ACK	ETX	CRC	

Command: STOP
Source: PC
Destination: Controller

02	80	30	30	30	31	30	03	42	32
STX	ADDR	WINDOW				WR	OFF	ETX	CRC

Source: Controller
Destination: PC

02	80	06	03	38	35
STX	ADDR	ACK	ETX	CRC	

Command: SOFT-START (ON)
Source: PC
Destination: Controller

02	80	31	30	30	31	31	03	42	32
STX	ADDR	WINDOW			WR	ON	ETX	CRC	

Source: Controller
Destination: PC

02	80	06	03	38	35
STX	ADDR	ACK	ETX	CRC	

Command: SOFT-START (OFF)
Source: PC
Destination: Controller

02	80	31	30	30	31	30	03	42	33
STX	ADDR	WINDOW			WR	OFF	ETX	CRC	

Source: Controller
Destination: PC

02	80	06	03	38	35
STX	ADDR	ACK	ETX	CRC	

Command: READ PUMP STATUS
Source: PC
Destination: Controller

02	83	32	30	35	30	03	38	37
STX	ADDR	WINDOW			RD	ETX	CRC	

Source: Controller (with address = 3 in stop status)
Destination: PC

02	83	32	30	35	30	30	30	30	30	30	03	38	37
STX	ADDR	WINDOW			DATA (STATUS)						ETX	CRC	

Command: READ SERIAL TYPE
Source: PC
Destination: Controller (with address = 3 in 485 mode)

02	83	35	30	34	30	03	38	31
STX	ADDR	WINDOW			RD	ETX	CRC	

Source: PC
Destination: Controller (with address = 3 in 485 mode)

02	83	35	30	34	30	31	03	42	30
STX	ADDR	WINDOW			RD	DATA	ETX	CRC	

Window-Meanings

Tab. 8

N.	Read/Write	Data Type	Description	Admitted Values
000	R/W	L	Start/Stop (in remote/ mode the window is a read only)	Start = 1 Stop = 0
001	R/W	L	Low Speed Activation (in remote/ mode the window is a read only)	No = 0 Yes = 1 (default = 0)
008	R/W	L	Remote 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	R1 Set Point type	0 = Frequency 1 = Power 2 = Time 3 = Normal 4 =Pressure (default = 0)
102	R/W	N	R1 Set Point valve (expressed in Hz, W or s)	(default = 867)
103	R/W	N	Set Point delay: time between the pump start and the set point check (seconds)	0 to 999999 (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 value)	0 to 100 (default = 2)

N.	Read/ Write	Data Type	Description	Admitted Values
107	R/W	L	Active Stop (write only in stop)	0 = NO 1 = YES (default = 0)
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 = 1) 2 = Pump temperature 3 = Pressure
117	R/W	N	Low Speed frequency (Hz)	1100 to "Maximum rotational frequency" (win 120) (default = 1100)
120	R/W	N	Rotational frequency setting (Hz)	1100 to 1167 (default = 1167)
122	R/W	L	Set vent valve on/off	0 = Closed 1 = Open (default = 1)
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) (default = 15)

N.	Read/ Write	Data Type	Description	Admitted Values
147	R/W	N	Vent open time See "vent connector" paragraph	0 = infinite 1 bit = 0.2 sec 1 to 65535
155	R	N	Power limit applied Read the maximum allowable power	watt
157	R/W	N	Gas load type Select the gas load to the pump	$\emptyset$ = N_2 1 = Ar
161	R/W	N	Pressure Reading Connection Factor Table A1 Appendix A FRG700 Manual	0 to 10 0 = 0 10 = 1 = N_2
162	R/W	A	R1 Set Point Pressure Valve Valid if Win. 101 = 4 Format X.X E. XX Where X = 0 to 9 s = + or -	
163	R/W	N	Pressure unit of measure	0 = mBar 1 = Pa 2 = Torr
167	R/W	A	Stop speed reading Activates / deactivates the pump speed reading after Stop command	0 = disable 1 = enable (default = 0)
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	
203	R	N	Driving frequency in Hz	
204	R	N	Pump temperature in °C	0 to 110 (60 °C = Threshold Pump Overtemperature)

N.	Read/ Write	Data Type	Description	Admitted Values
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
211	R	N	Controller Heatsink Temperature (°C)	0 to 110
216	R	N	Controller Air Temperature (°C).	0 to 70
224	R	A	Pressure reading Format = X.X E XX	
226	R	N	Rotation Frequency (rpm)	
300	R	N	Cycle time in minutes (zeroed by the reset command)	0 to 999999
301	R	N	Cycle number (zeroed by the reset command)	0 to 9999
302	R	N	Pump life in hours (zeroed by the reset command)	0 to 999999
310 to 347	Reserved to Agilent service			
400	R	A	CRC EPROM (QE)	QE8XXXX (where "XXXX" are variable)
401	R	A	Boot CRC (BL)	BL2XXXX (where "XXXX" are variable)
402	R	A	CRC Param. (PA)	PA8XXXX (where "XXXX" are variable)
404	R	A	CRC Parameter structure	"XXXX"
406	R	A	Program Listing Code	"XXXXXXXXXX"
407	R	A	Parameter Listing Code	"XXXXXXXXXX"

N.	Read/ Write	Data Type	Description	Admitted Values
500	Reserved to Agilent service			
503	R/W	N	RS 485 address	0 to 31 (default = 0)
504	R/W	L	Serial type select	0 = RS 232 1 = RS 485 (default = 0)

NOTE	1. 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.

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

3. These commands remove the pump motor supply for a short time. If they are used continuously, they can cause the pump stopping.
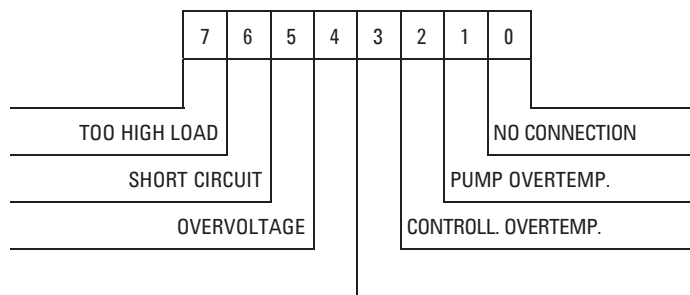
Figure 35   Window N. 206 Bit Description

Replacement Parts and Accessories

Tab. 9

Description	Part number
Mains cable NEMA plug [3m]	9699958
Mains cable EU plug [3m]	9699957
Serial cable and T-Plus Software	9699883
DIY Full Range Gauge Kit / 74 FS KF 40	9699190
DIY Full Range Gauge Kit / 74 FS ISO 63	9699192
DIY Full Range Gauge Kit / 74 FS CFF 4.5″	9699193
FRG-700 3 m cable	9699960
FRG-700 5 m cable	9699961
Inlet screen DN40	9699309
Inlet screen DN63	9699300

For a complete overview of Agilent's extensive product lines, please refer to the Agilent catalog.

Agilent Technologies

Vacuum Products Division

Dear Customer,

Thank you for purchasing an Agilent vacuum product. At Agilent Vacuum Products Division we make every effort to ensure that you will be satisfied with the product and/or service you have purchased.

As part of our Continuous Improvement effort, we ask that you report to us any problem you may have had with the purchase or operation of our products. On the back side you find a Corrective Action request form that you may fill out in the first part and return to us.

This form is intended to supplement normal lines of communications and to resolve problems that existing systems are not addressing in an adequate or timely manner.

Upon receipt of your Corrective Action Request we will determine the Root Cause of the problem and take the necessary actions to eliminate it. You will be contacted by one of our employees who will review the problem with you and update you, with the second part of the same form, on our actions.

Your business is very important to us. Please, take the time and let us know how we can improve.

Sincerely.

Giampaolo LEVI
Vice President and General Manager
Agilent Vacuum Products Division

Note: Fax or mail the Customer Request for Action (see backside page) to Agilent Vacuum Products Division (Torino) – Quality Assurance or to your nearest Agilent representative for onward transmission to the same address.

Agilent Technologies

CUSTOMER REQUEST FOR CORRECTIVE / PREVENTIVE / IMPROVEMENT ACTION

TO: AGILENT VACUUM PRODUCTS DIVISION TORINO – QUALITY ASSURANCE FAX

N°:   XXXX-011-9979350

ADDRESS: AGILENT TECHNOLOGIES ITALIA S.p.A. – Vacuum Products Division –

            Via F.lli Varian, 54 – 10040 Leinì (TO) – Italy

E-MAIL: vpd-qualityassurance_pdl-ext@agilent.com

NAME	COMPANY	FUNCTION

ADDRESS:

TEL. N° :   FAX N° :

E-MAIL:

PROBLEM / SUGGESTION :

REFERENCE INFORMATION (model n°, serial n°, ordering information, time to failure after installation, etc.):

DATE

CORRECTIVE ACTION PLAN / ACTUATION   LOG N°
(by AGILENT VPD)

XXX = Code for dialing Italy from your country (es. 01139 from USA; 00139 from Japan, etc.)

Agilent Technologies

Vacuum Products Division
Instructions for returning products

Dear Customer,

Please follow these instructions whenever one of our products needs to be returned.

Complete the attached **Request for Return form** and send it to Agilent Technologies (see below), taking particular care to include the completed **Health and Safety** declaration Section. No work can be started on your unit until we receive a completed copy of this form.

After evaluating the information, Agilent Technologies will provide you with a **Return Authorization (RA) number** via email or fax, as requested. Note: Depending on the type of return, a Purchase Order may be required at the time **the Request for Return is submitted**. We will quote any necessary services (evaluation, repair, special cleaning, eg).

Product preparation

o   Remove all accessories from the core product (e.g. inlet screens, vent valves).
o   Prior to shipment and if applicable for your product, drain any oils or other liquids, purge or flush all gasses, and wipe off any excess residue.
o   If ordering an Advance Exchange product, please use the packaging from the Advance Exchange to return the defective product.
o   Seal the product in a plastic bag, and package product carefully to avoid damage in transit. You are responsible for loss or damage in transit.
o   Include a copy of the Health and Safety Declaration in the shipping documentation on the outside of the shipping box of your returning product.
o   Clearly label package with RA number. Using the shipping label provided will ensure the proper address and RA number are on the package. Packages shipped to Agilent without a RA clearly written on the outside cannot be accepted and will be returned.
o   Return only products for which the RA was issued.

Shipping

o   Ship to the location specified on the printable label, which will be sent, along with the RA number, as soon as we have received all of the required information. Customer is responsible for freight charges on returning product.
o   Return shipments must comply with all applicable Shipping Regulations (IATA, DOT, ADR, etc.) and carrier requirements.

RETURN THE COMPLETED **REQUEST FOR RETURN** FORM TO YOUR NEAREST LOCATION:

EUROPE:	**NORTH AMERICA:**	**PACIFIC RIM:**
Fax: 00 39 011 9979 330		
Fax Free: 00 800 345 345 00	Fax: 1 781 860 9252	Please visit our website for
Toll Free: 00 800 234 234 00	Toll Free: 800 882 7426, Option 3	individual office information
vpt-customercare@agilent.com	vpl-ra@agilent.com	http://www.agilent.com

TERMS AND CONDITIONS

Please read the terms and conditions below as they apply to all returns and are in addition to the Agilent Technologies Vacuum Product Division – Products and Services Terms of Sale.

o   Unless otherwise pre-negotiated, customer is responsible for the freight charges for the returning product. Return shipments must comply with all applicable **Shipping Regulations** (IATA, DOT, etc.) and carrier requirements.

o   Agilent Technologies is not responsible for returning customer provided packaging or containers.

o   Customers receiving an Advance Exchange product agree to return the defective, rebuildable part to Agilent Technologies **within 15 business days**. Failure to do so, or returning a non-rebuildable part (crashed), will result in an invoice for the non-returned/non-rebuildable part.

o   Returns for credit toward the purchase of new or refurbished Products are subject to prior Agilent approval and may incur a restocking fee. Please reference the original purchase order number.

o   Units returned for evaluation will be evaluated, and a quote for repair will be issued. If you choose to have the unit repaired, the cost of the evaluation will be deducted from the final repair pricing. A Purchase Order for the final repair price should be issued within 3 weeks of quotation date. Units without a Purchase Order for repair will be returned to the customer, and the evaluation fee will be invoiced.

o   Products returned that have not been drained from oil will be disposed.

o   A Special Cleaning fee will apply to all exposed products.

o   If requesting a calibration service, units must be functionally capable of being calibrated.

Agilent Technologies

Vacuum Products Division
Request for Return Form

Customer information

Company :	Contact Name:	
Address:	Tel:	Fax:
	Email:	

Equipment

Product description	Agilent PartNo	Agilent Serial No	Original Purchasing Reference
Failure description		Type of process (for which the equipment was used)	

Type of return

☐ Non Billable ☐ Billable ➤ New PO # (hard copy must be submitted with this form): _____

☐ Exchange ☐ Repair ☐ Upgrade ☐ Demo ☐ Calibration ☐ Evaluation ☐ Return for Credit

Health and safety

The product has been exposed to the following substances:

(by selecting 'YES' you MUST complete the table to the right)

Toxic	☐ YES ☐ NO		
Harmful	☐ YES ☐ NO		
Corrosive	☐ YES ☐ NO		
Reactive	☐ YES ☐ NO		
Flammable	☐ YES ☐ NO		
Explosive (*)	☐ YES ☐ NO		
Radioactive (*)	☐ YES ☐ NO		
Biological (*)	☐ YES ☐ NO		
Oxidizing	☐ YES ☐ NO		
Sensitizer	☐ YES ☐ NO		
Other dangerous substances	☐ YES ☐ NO		

Substances (please refer to MSDS forms)

* Agilent will not accept delivery of any product that is exposed to radioactive, biological, explosive substances or dioxins, PCB's without written evidence of decontamination.

Trade name	Chemical name	Chemical Symbol	CAS Number

Goods preparation

If you have replied YES to one of the above questions. Has the product been purged? ☐ YES ☐ NO
If yes, which cleaning agent/method:

Has the product been drained from oil? ☐ YES ☐ NOT APPLICABLE
I confirm to place this declaration on the outside of the shipping box. ☐

I declare that the above information is true and complete to the best of my knowledge and belief.
I understand and agree to the terms and conditions on page 2 of this document.

Name:	Authorized Signature:
Position:	
Date:	

NOTE: If a product is received at Agilent which is contaminated with a toxic or hazardous material that was not disclosed, **the customer will be held responsible** for all costs incurred to ensure the safe handling of the product, and is liable for any harm or injury to Agilent employees as well as to any third party occurring as a result of exposure to toxic or hazardous materials present in the product.