USER MANUAL

PCU16

POWER CONTROL UNIT

PREVAC

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Rev. 2

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Precision and Vacuum Technology

PREVAC

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1 INTRODUCTION

Please read this manual carefully to ensure optimum operating conditions right from the start. This user manual handbook contains important information about functionality, installation, start-up and operation of the PCU16 device.

1.1 RELEASE NOTE

Information about PCU16 device version can be found at *www.prevac.pl*, in the tab: *DOWNLOAD*.

On this page you can find information about possible changes between successive versions of the device, or changes between successive versions of the software.

1.2 INTENDED TO USE

The PCU16 Power Control Unit is a compact, standalone microprocessor controlled device for controlling a complete UHV system. It allows connection of various pumps, gauges and valves, and also provides operational interlocks to protect the vacuum system in the event of power loss or device failure.

The PCU16 supports one ultra-high vacuum pump (e.g. turbo molecular pump, ion pump, cryo pump, etc.), electromagnetic vent valve, electromagnetic safety valve, fore vacuum pump and two vacuum gauges based on the 0 - 10 V output standard.

The PCU16 displays the state of all of the connected peripheral devices on a large touch panel TFT LCD display as an easy to interpret MIMIC diagram, providing clear readouts of important system parameters. The front display MIMIC diagram represents the locations of chamber, valves, gauges and pumps, thereby providing an accurate, easy to follow representation of the system status.

1.2.1 CONFIGURATION TYPES

PCU16 can operate in one of five available configurations. Configurations A and C are the base configurations which match the most common types of vacuum systems. A further three configurations, designated R, U and T are also supplied to meet the needs of other, less common vacuum system types. Below is a short brief description of all five configurations.

1.2.1.1 CONFIGURATION TYPE A

In device configuration A, the safety valve is located between the fore pump and turbo molecular pump. This configuration also includes vent valve (for venting inert gas) and gate isolation valve. Configuration type A is shown in Figure1.1. A detailed description of this configuration type operation is described in section 4.1.

1.2.1.2 CONFIGURATION TYPE C

Configuration C differs from Configuration A with the addition of a safety valve located between the turbo pump and vacuum chamber. This valve has the designated name SV2. Configuration type C is shown in Figure 1.2. A detailed description of this configuration type operation is described in section 4.2.

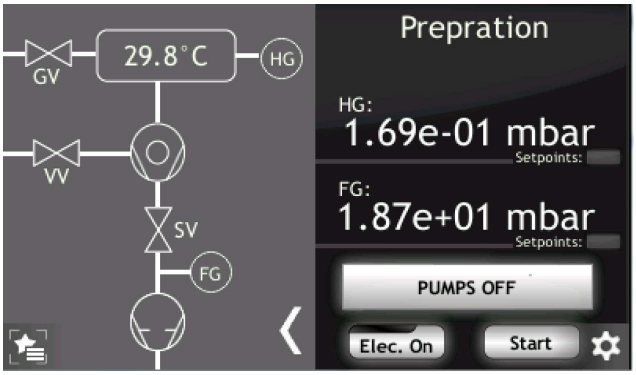

Figure 1.1: Panel for configuration A

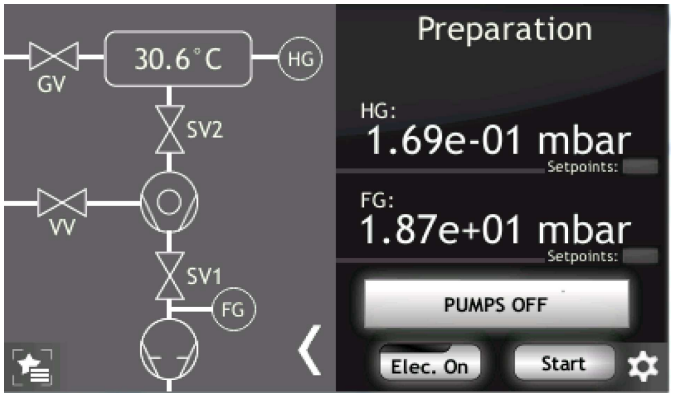

Figure 1.2: Panel for configuration C

1.2.1.3 CONFIGURATION TYPE D

Configuration D differs from Configuration C with the addition of a bypass valve located between the fore pump and the vacuum chamber. This valve has the designated name V4. Configuration type D is shown in Figure 1.3. A detailed description of this configuration type operation is described in section 4.3.

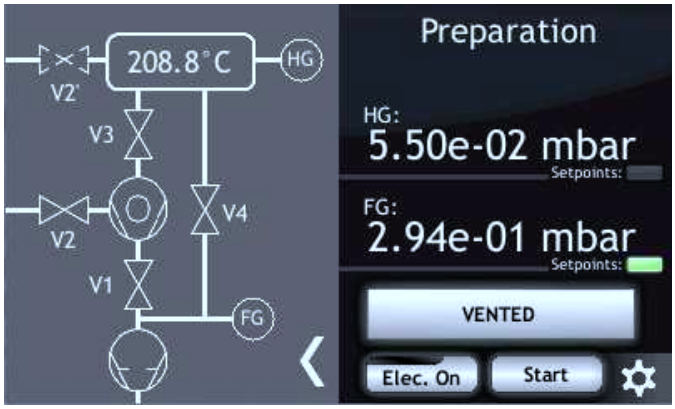

Figure 1.3: Panel for configuration D

1.2.1.4 CONFIGURATION TYPE T

Configuration T is specifically for vacuum systems that utilise a vacuum buffer tank and is significantly different from either of the previous configurations. Configuration type T is shown in Fig-

ure1.4. The following additional items are included to serve the vacuum buffer tank:

- fore pump trough the safety valve (SV1)
- turbomolecular pump which can be linked directly or through second safety valve (SV2)

The vacuum buffer is used in order to save the turbomolecular pump and reduce noise.

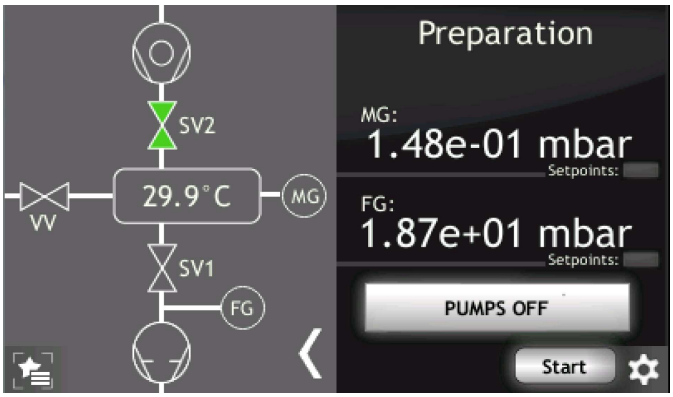

Figure 1.4: Panel for configuration T

The following example shows a sample T configuration in the context of the entire vacuum system which is shown in Figure1.5

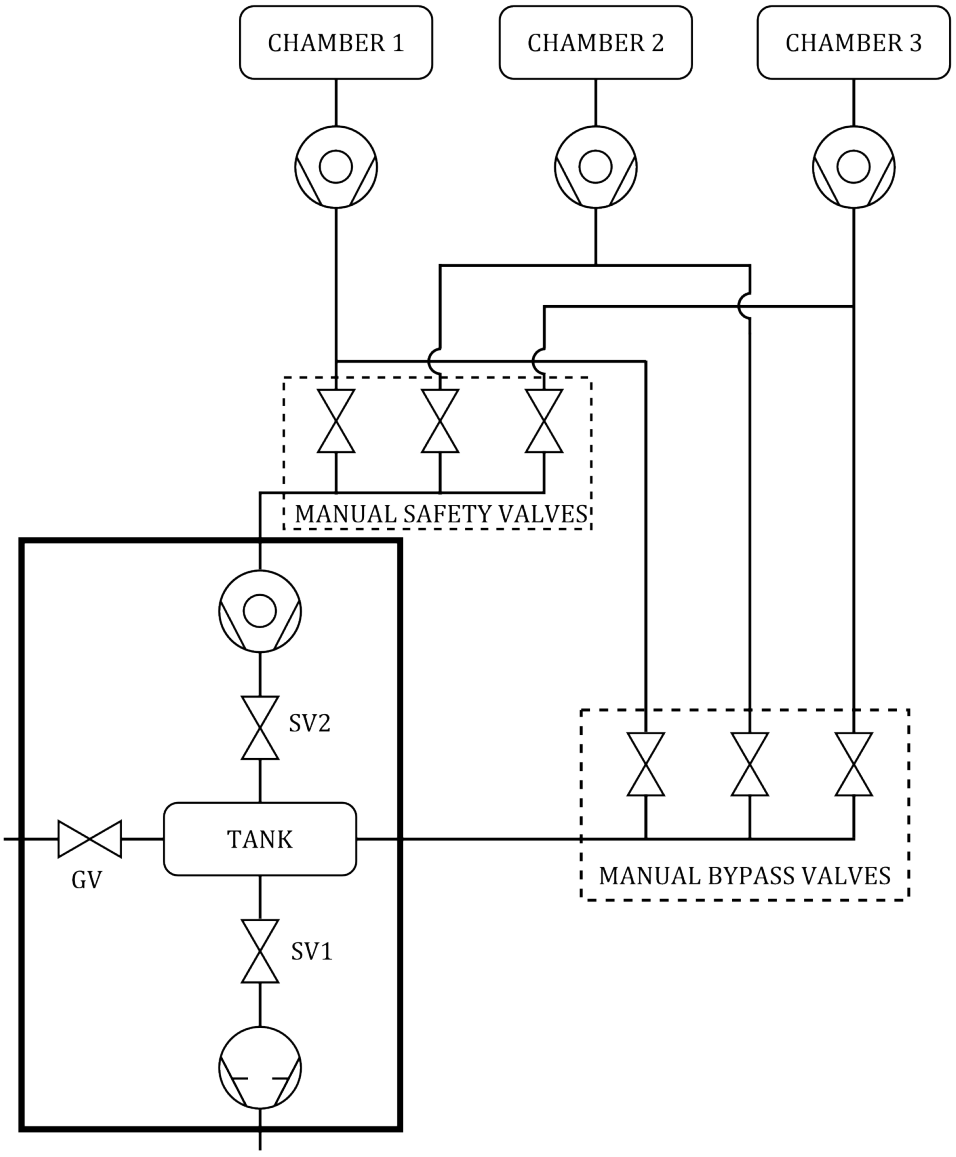

Figure 1.5: Configuration T example

The Bypass vacuum valve group serves to generate the fore vacuum in the overriding chambers (CHAMBER 1, CHAMBER 2 CHAMBER 3). During this process (obtaining fore vacuum):

- A group of BVM valves (manual bypass valves) is open
- A group of SVM valves (manual safety valves) is closed

During normal operation in this configuration:

- A group of BVM valves (manual bypass valves) is closed
- A group of SVM valves (manual safety valves) is open

A detailed description of this configuration type operation is described in section 4.4.

1.2.1.5 CONFIGURATION TYPE R

Configuration R has an additional feature for gas pre-heating (to determine the appropriate reaction temperature). In this mode all of the standard security mechanisms are active, such as dependency of the turbo pump operating from pre-vacuum. Heating parameters such as heating duration and power are accessed in the setup menu. Configuration type R is shown in Figure 1.6. A detailed description of this configuration type operation is described in section 4.5.

Figure 1.6: Panel for configuration R

1.2.1.6 CONFIGURATION TYPE U

Configuration U is a dedicated configuration specific to PREVAC's UVS Ultra-Violet Light Source. Configuration type U is shown in Figure 1.7. A detailed description of this configuration type operation is described in section 4.6.

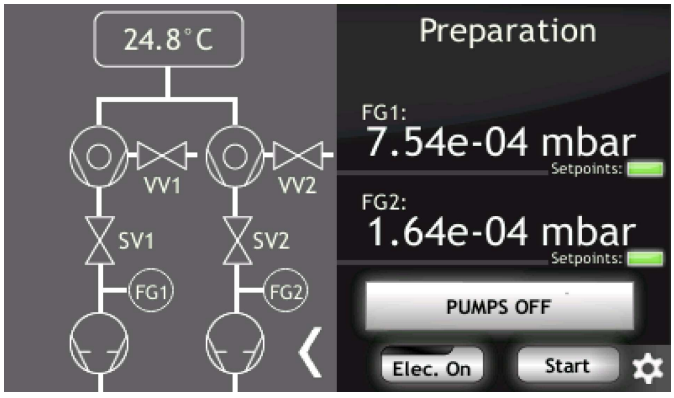

Figure 1.7: Panel for configuration U

Note:
Changing configuration described above requires a low level password in the service application. Please contact PREVAC for this password if required.

1.3 SAFETY

The owner of the equipment must ensure that all users are aware of the Health and Safety information contained in this manual. If the equipment is sold or passed to another owner, this manual must be included with the equipment.

1.3.1 PERSONNEL QUALIFICATIONS

All the work described in this document should only be carried out by persons who have suitable technical training and the necessary experience or who have been instructed by the end user of the product.

1.3.2 ILLUSTRATION OF RESIDUAL DANGERS

This Operating Manual illustrates safety notes concerning residual dangers as follows:

1. Information on preventing any kind of physical injury

2. Information on preventing extensive equipment and environmental damage

3. Information on correct handling or use. Disregarding safety notes can lead to malfunctions.

4. **Note: Indicates particularly important, but not safety-relevant information.**

1.3.3 GENERAL SAFETY INSTRUCTIONS

The PCU16 protects the operator and surrounding area from electric shock or burn, mechanical hazards, excessive temperature, and spread of fire from the instrument. Environmental conditions outside of the conditions below may pose a hazard to the operator and surrounding area.

- Indoor use.
- Altitude to 2000 meters.
- Temperature for safe operation: 5 °C to 40 °C.
- Maximum relative humidity: 80% for temperature up to 31 °C decreasing linearly to 50% at 40 °C.
- Power supply voltage fluctuations not to exceed ±10% of the nominal voltage.
- Safety Class 1.

Figure 1.8: Do not insert objects through louvers and keep device dry

For all work you are going to do, adhere to the applicable safety regulations. Also observe all safety notes given in this document and forward the information to all other users of the product. In particular, pay attention to the following safety notes:

DANGER

Mains voltage.
Contact with live parts is extremely hazardous when any objects are introduced or any liquids penetrate into the device. Make sure that no objects enter through the louvers of the device. Keep the device dry.

WARNING

Improper use.
Improper use can damage the PCU16 . Use the PCU16 only as intended by the manufacturer.

WARNING

Improper installation and operation data.
Improper installation and operation data may damage the PCU16 . Strictly adhere to the stipulated installation and operation data.

WARNING

Individual configuration of the device.
Individual configuration of the device by the client via the service application will void the liability of PREVAC.

1.3.4 GROUNDING

This product is a Safety Class 1 instrument. To minimize shock hazard, the instrument chassis must be connected to an electrical ground. Plug the power cable into an approved three-contact electrical outlet or use a three-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. For instruments designed to be hard-wired to the supply mains, the protective earth terminal must be connected to the safety electrical ground before another connection is made. Any interruption of the protective ground conductor, or disconnection of the protective earth terminal will cause a potential shock hazard that might cause personal injury.

1.3.5 LIVE CIRCUIT

Operating personnel must not remove the instrument cover. No internal adjustment or component replacement is allowed by non-PREVAC qualified personnel. Never replace components with power cable connected. To avoid injuries, always disconnect power , discharge circuits and remove external voltage source before touching components.

1.3.6 PARTS SUBSTITUTION AND MODIFICATIONS

Parts substitutions and modifications are allowed by authorized PREVAC service personnel only. For repairs or modifications, the instrument must be returned to PREVAC service facility.

1.3.7 VENTILATION

The instrument has ventilation holes in its side covers. Do not block these holes when the instrument is operating.

1.3.8 EXPLOSIVE ATMOSPHERE

DANGER

Explosive atmosphere
Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

1.3.9 CLEANING

Do not submerge instrument. Clean only with a damp cloth and mild detergent. Exterior only.

1.4 TECHNICAL DATA

1.4.1 MECHANICAL DATA

This section describes mechanical parameters, Figure 1.9 shows the PCU16 rack mounted and stand alone dimensions.

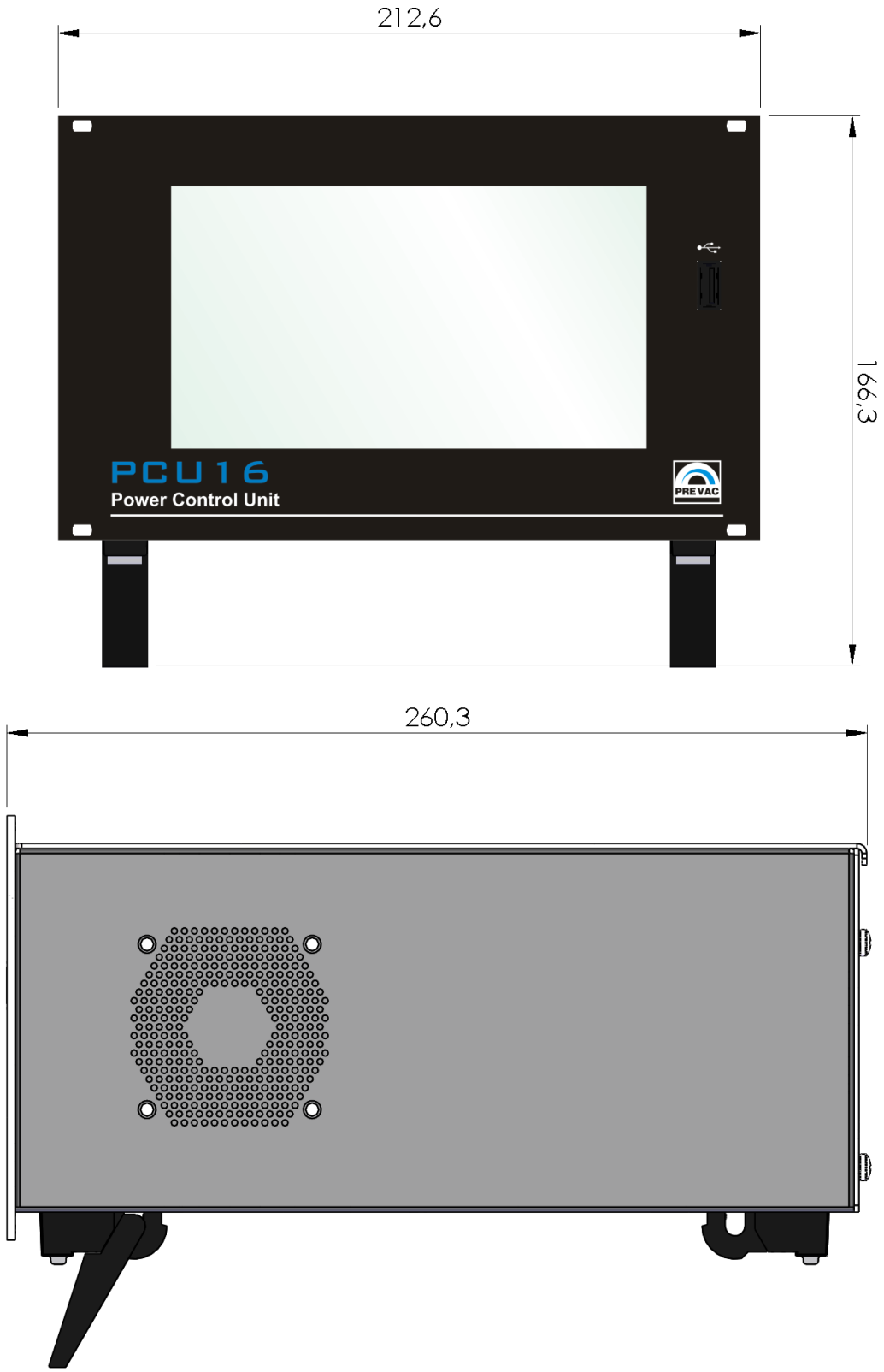

Figure 1.9: Dimensions

1.4.2 SPECIFICATION

PARAMETER	DESCRIPTION
VALVE CONTROL OUTPUTS	
Quantity	4
Type	Relay output 0/24V
Connector	1 in M12 standard - Figure 2.8 3 in M8 standard - Figure 2.9
TMP POWER SUPPLY OUTPUT	
Quantity	1
Type	24V/125W - Figure 2.11
Connector	CPC-0-0182921-1
TMP CONTROL	
Quantity	1
Type	relay/serial interface for Turbo Molecular Pumps control - Figure 2.22
Connector	female 9 pin D-sub standard
THERMOCOUPLE INPUT	
Quantity	1
Type	thermocouple K - Figure 2.6
Connector	MPJ-K-F
BAKEOUT POWER OUTPUT	
Quantity	1
Type	regulated power supply (from 0 VAC to 100-120 VAC/200-240 VAC) - Figure 2.7
Connector	STAKEI 2
UNIVERSAL FORE VACUUM PUMP CONTROL	
Quantity	1
Type	input/output signals and power supply (24VDC) for external high power fore vacuum pumps control - Figure 2.10
Connector	M12 standard
EXTERNAL CONNECTOR	

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PARAMETER	DESCRIPTION
Quantity	1
Type	multi purpose analog and digital input-s/outputs - Figure 2.23
Connector	female 15 pin D-sub standard
UPS IN CONNECTOR	
Quantity	1
Type	auxiliary main power supply input for safety purpose - section 2.3.10
Connector	male IEC 60320 C14 (10A)
LINE POWER OUTPUTS	
Quantity	3
Type	controlled line power outputs (100-120 VAC/200-240 VAC) - Figure 2.12
Connector	female IEC 60320 C13 (10A)
COMUNICATION	
Comunication Interfaces	RS232, RS485, Ethernet - Figure 2.1
VACUUM GAUGE INPUT	
Quantity	2
Supported gauges	see table: 1.4.4
Connector	chanel 1 - RJ45 - Figure 2.6 chanel 2 - RJ45 / female 15 pin D-sub - Figure 2.7
ELECTRICAL PARAMETERS	
Voltage	100-120 VAC/200-240 VAC
Frequency	50 – 60 Hz
Overvoltage category	II
Protection class	1
Connection	European appliance connector IEC C20 16A
Power consumption	Max. 250W
Current consumption	1,2 A (for 230V) 2,4 A (for 110V)

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PARAMETER	**DESCRIPTION**
Supply power cord	1.8 m (supplied with the device)
ENVIRONMENT	
Operation temperature	5 °C to 40 °C
Storage temperature	0 - 70°C
Relative humidity	Max. 80% (up to 31°C), decreasing to max. 50% (above 30°C)
Allocation	Use indoors only
MECHANICAL	
Dimensions	Width: 212.6 mm (42HP) Height: 128.4 mm (3HU) Depth: 260.3 mm
Net weight	3,58kg
Installation	Rack mounted or Desktop device
(*) - available as options.	

Table 1.1: Device specification

1.4.3 OPERATION

The device can be controlled in two ways:

- Manually via control panel with integrated touch screen.
- Remote control via RS232, RS485 or Ethernet see chapter 6.

1.4.4 VACUUM GAUGE CHANNEL

Independent vacuum gauge may be connected to the PCU16 .

PARAMETER	VALUE
PRESSURE CHANNEL:	
Sensor connector	RJ45
Compatible sensors	CTR90/91, TTR90, TTR211/216, PTR225/237, PTR90, ITR90, ITR100, BARATRON, ANALOG-IN, MKS870b, MKS937, MKS937A, PKR251, PCR280, PG105, ATMION
Voltage	Relative to voltage reading: ±0,3%
Absolute	±2 mV
Measuring rate	10 s^{-1}
Display rate	4 s^{-1}
Temperature drift	Temperature drift < 0.1 % per °C
Unit of measurement	mbar, Pa, Torr
Resolution of the A/D converter	24 bit

Table 1.2: Pressure channels specyfications

GAUGE TYPE EXAMPLES	PRESSURE LOW	PRESSURE HIGH	UNIT
Total measuring range	$2 \cdot 10^{-12}$	$2.1 \cdot 10^{5}$	mbar
CERAVAC transmitters	(CTR 90 and CTR 91):		
0.1 Torr (CTR 91 only)	$1 \cdot 10^{-5}$	$1 \cdot 10^{-1}$	Torr
1 Torr	$1 \cdot 10^{-4}$	$1 \cdot 10^{0}$	Torr
10 Torr	$1 \cdot 10^{-3}$	$1 \cdot 10^{1}$	Torr
100 Torr	$1 \cdot 10^{-2}$	$1 \cdot 10^{2}$	Torr
1000 Torr	$1 \cdot 10^{-1}$	$1 \cdot 10^{3}$	Torr
THERMOVAC transmitters	$5 \cdot 10^{-4}$	$1 \cdot 10^{3}$	mbar
IONIVAC transmitters ITR90	$5 \cdot 10^{-10}$	$5 \cdot 10^{-4}$	mbar
IONIVAC transmitters ITR100	$2 \cdot 10^{-10}$	$1 \cdot 10^{-1}$	mbar
Baratron transmiters (model dependent)	$1.3 \cdot 10^{-1}$	$2.1 \cdot 10^{5}$	mbar
10 Torr	$1 \cdot 10^{-3}$	$1 \cdot 10^{1}$	Torr
50 Torr	$5 \cdot 10^{-3}$	$5 \cdot 10^{1}$	Torr
100 Torr	$1 \cdot 10^{-2}$	$1 \cdot 10^{2}$	Torr
500 Torr	$5 \cdot 10^{-2}$	$5 \cdot 10^{2}$	Torr
1000 Torr	$1 \cdot 10^{-1}$	$1 \cdot 10^{3}$	Torr
20 psia	$2 \cdot 10^{-2}$	$2 \cdot 10^{1}$	psia
30 psia	$3 \cdot 10^{-2}$	$3 \cdot 10^{1}$	psia
50 psia	$5 \cdot 10^{-2}$	$5 \cdot 10^{1}$	psia
60 psia	$6 \cdot 10^{-2}$	$6 \cdot 10^{1}$	psia
100 psia	$1 \cdot 10^{-1}$	$1 \cdot 10^{2}$	psia
250 psia	$2.5 \cdot 10^{-1}$	$2.5 \cdot 10^{2}$	psia
500 psia	$5 \cdot 10^{-1}$	$5 \cdot 10^{2}$	psia
750 psia	$7.5 \cdot 10^{-1}$	$7.5 \cdot 10^{2}$	psia
1000 psia	$1 \cdot 10^{0}$	$1 \cdot 10^{3}$	psia
2000 psia	$2 \cdot 10^{0}$	$2 \cdot 10^{3}$	psia
3000 psia	$3 \cdot 10^{0}$	$3 \cdot 10^{3}$	psia
PTR transmitters (model dependent)	$5 \cdot 10^{-9}$	$1 \cdot 10^{3}$	mbar
PG105	$1.3 \cdot 10^{-3}$	$1 \cdot 10^{3}$	mbar

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GAUGE TYPE EXAMPLES	PRESSURE LOW	PRESSURE HIGH	UNIT
PKR 251	$5 \cdot 10^{-9}$	$1 \cdot 10^{3}$	mbar
PCR 280	$5 \cdot 10^{-5}$	$1.5 \cdot 10^{3}$	mbar
ATMION	$1 \cdot 10^{-10}$	$1 \cdot 10^{3}$	mbar
Analog In	0.000	10.000	V

Table 1.3: Vacuum Channels - Measuring Ranges

1.4.5 STANDARDS

SAFETY:

- LVD 2006/95/EC Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006 on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.
- PN-EN 61010-1 - Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements

EMC:

- EMC 2004/108/EC Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC
- EN 61326-1:2006 Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements

2 INSTALLATION

This chapter describes the procedures for unpacking, mechanical installation and electrical installation. Take care when lifting the unit that the weight and position do not exceed comfortable limits.

2.1 UNPACKING

1. Visually inspect the transport packaging for signs of external damage.
2. Unpack the PCU16 and retain the packaging materials.

   Note: Retain the packaging materials for later use. The PCU16 must be stored and transported in the original packaging material only.
3. Examine the PCU16 for completeness.
4. Visually inspect the PCU16 for signs of damage.

DANGER

Damaged product.
Putting a damaged product into operation can be extremely dangerous. Never attempt to put a damaged product into operation. Secure the damaged product from unintended operation. Send a damage report to the haulage company or the insurer.

2.2 MECHANICAL INSTALLATION

The PCU16can be used as follows:

- As a desk-top device, after installation of the supplied mounting feet,
- Mounted in a 19" rack DIN 41 494 (19", 3 HU), occupying half the width of the cassette.

In each of these cases you must pay attention to the following safety note:

WARNING

Ambient temperature.
Exceeding the maximum permitted ambient temperature may damage the device. Make sure that the maximum permitted ambient temperature is not exceeded and that the air can flow freely through the louvers. Do not expose the device to direct sunlight.

DANGER

Protection class of the rack.
If the product is installed in a rack, it is likely to lower the protection class of the rack (protection from foreign bodies and water) e.g. according to the EN 60204-1 regulations for switching cabinets. Take appropriate measures to restore the required protection class of the rack.

When using the PCU16as a desk-top device, first install the feet as shown in the following steps:

1. Locate marked points (Fig. 2.1).

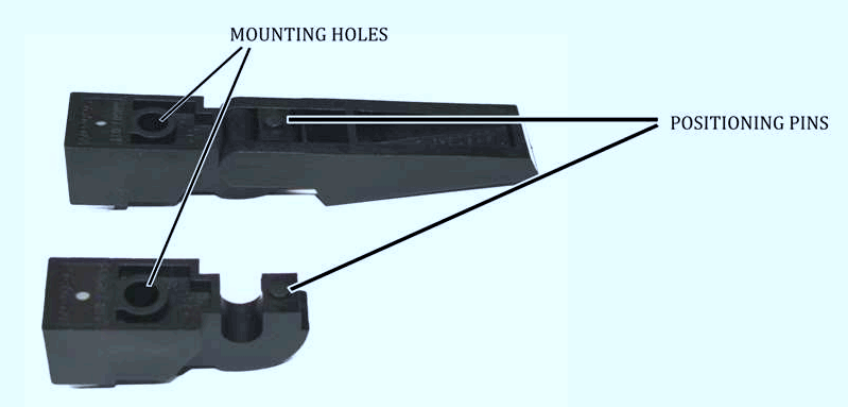


Figure 2.1: Foots

2. Turn the PCU16upside down.
3. Locate on the bottom of chassis the marked points (Fig. 2.2).
4. Match feet to designated locations on the bottom(Fig. 2.3).
5. Attach the legs using the supplied screws - type B3x10/BN3334. Alternatively, the screws type B3x10/BN384 or M3x10/D7985 can be used.

WARNING

Maximum screws length.
The legs should be mounted using the supplied screws. If you use other screws do not use screws longer than 10mm – they may damage the internal parts of device.

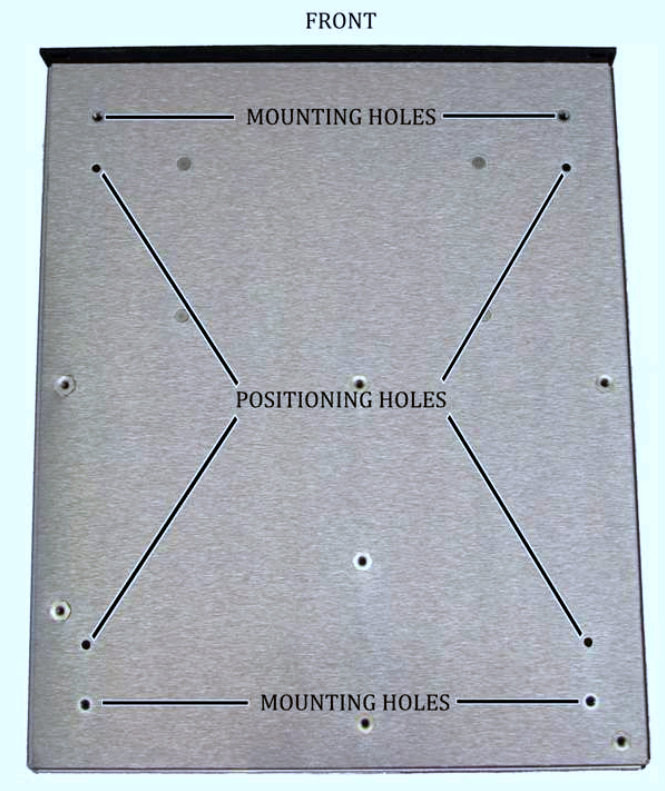


Figure 2.2: Bottom view

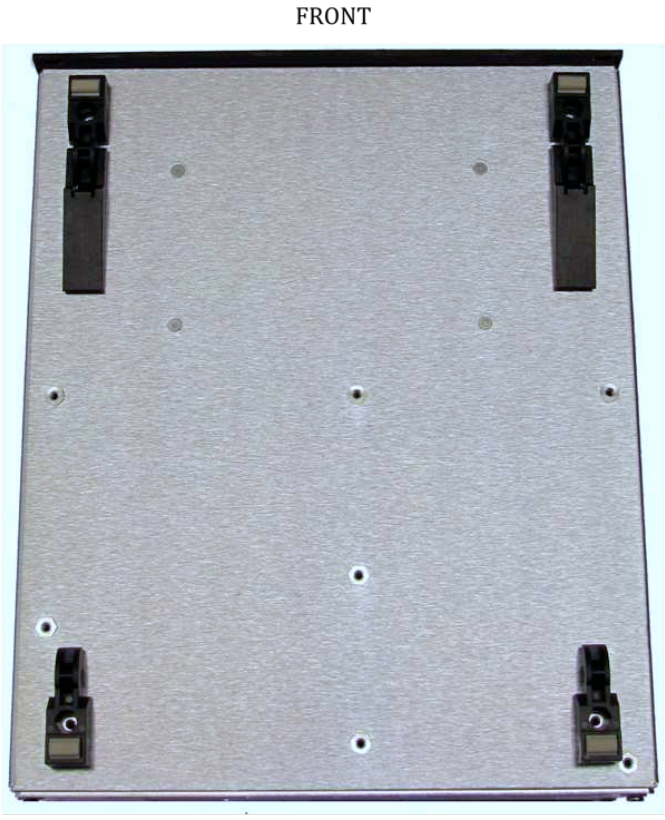


Figure 2.3: Bottom side with feet installed

2.3 ELECTRICAL INSTALLATION

2.3.1 DEVICE REAR PANEL

The rear side of the PCU16 with a description of the all sockets on the rear panel is shown in Figure 2.4.

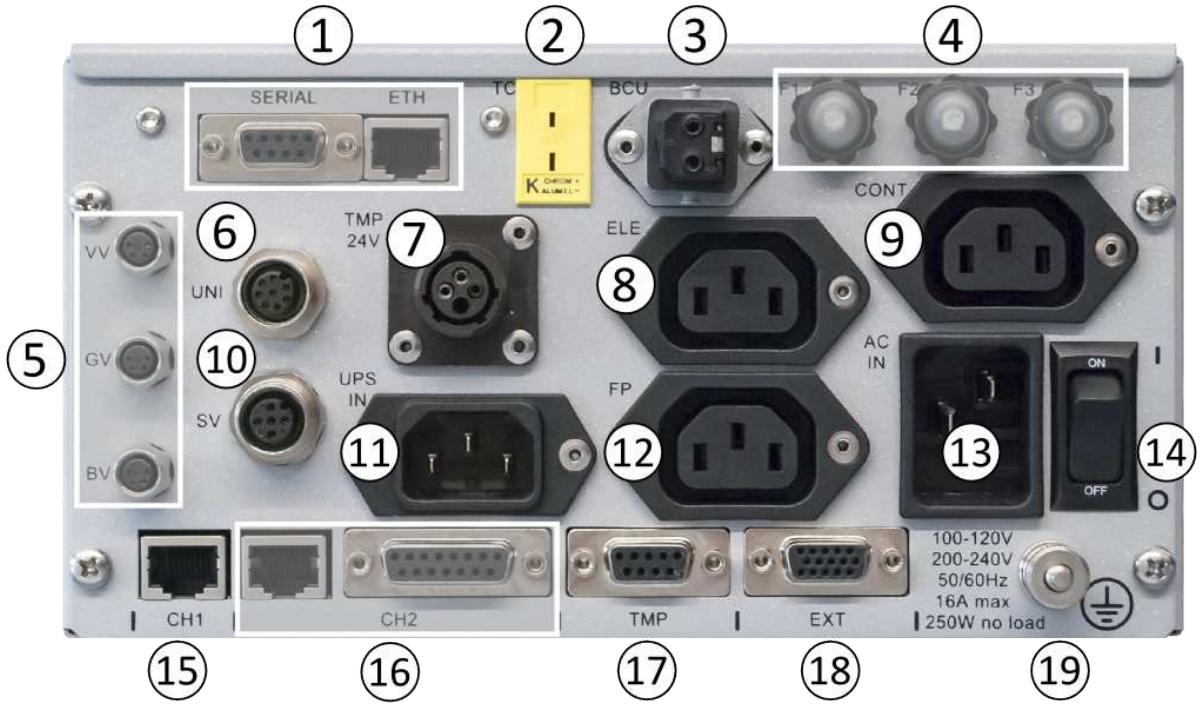


Figure 2.4: Rear panel sockets description

1 - Remote Control - RS232/485 + Ethernet
2 - Thermocouple connector
3 - BCU output
4 - Fuses
5 - Valve connectors(vent, gate, bypass)
6 - UNI connector
7 - TMP 24V DC
8 - Electronics power output
9 - Continuous power output
10 - Safety Valve connector
11 - UPS power input
12 - Fore Pump power output
13 - Mains connection
14 - Power switch
15 - Channel 1 vacuum sensor connector
16 - Channel 2 vacuum sensor connector (CH2_R or CH2_D)
17 - Turbo Molecular Pump input/output
18 - External Control
19 - Ground bold(screw)

2.3.2 REMOTE CONTROL (ITEM 1)

The device comes supplied with the following communication interfaces:

- Serial interface RS232/RS485 (selected from menu),
- Ethernet interface (IEEE 802 standard),

The remote interface allows read-back of the device parameters. In order to control and set the device parameters, the device must be switched to the remote control mode.
For a detailed description of the remote interface configuration, please see section 6

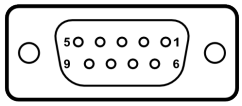


Figure 2.5: Serial interface connector(female 9 pin D-sub)

Pin assignment of the D-sub connector is shown in Table 2.1:

PIN NUMBER	FUNCTION	DESCRIPTION
2	RX	RS232 - Data signal RX
3	TX	RS232 - Data Signal TX
5	GND	Ground
8	D+	RS485 - Data signal positive
9	D-	RS485 - Data signal negative
1,4,6,7	none	not used

Table 2.1: Serial interface connector - pin description

2.3.3 THERMOCOUPLE CONNECTOR (ITEM 2)

The K type thermocouple socket (Figure 2.6) that can be used for temperature measurement for example during the system bakeout or the Load Lock heating.

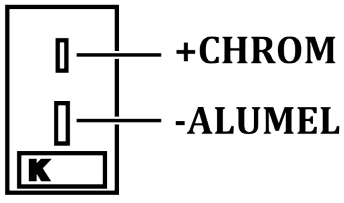


Figure 2.6: Thermocouple connector

2.3.4 BAKEOUT CONNECTOR (ITEM 3)

For connection of an external heater e.g. halogen lamp. The signal on this connector is controlled by the phase regulator in the PCU16 unit and varies automatically to reach the set temperature. The bakeout connector socket is shown in Figure 2.7. The BCU output is protected by 6A fuse.

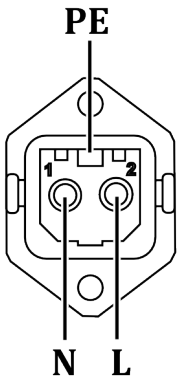


Figure 2.7: Bakeout connector

2.3.5 FUSES (ITEM 4)

Three output circuits of the device are protected by fuses:

- Electronics output(Item 8) – Electronics power strip, protected by fuse F1,
- Bakeout output(Item 3) – control external heating element, protected by fuse F2,
- Fore pump output(Item 12) – Fore pump power, protected by fuse F3.

2.3.6 VALVE CONNECTORS (ITEM 5, 10)

Three of the valves: the vent valve, the gate valve and the bypass valve, have the same type of a 4-pole connector which is shown in Figure 2.8. Each of these valves can be operated with or without the positional control.

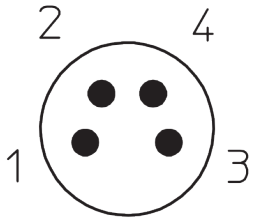


Figure 2.8: 4-pole valve connector

Pin assignment of this connector is shown in Table 2.2:

PIN NUMBER	FUNCTION	DESCRIPTION
1	24 V DC	Safety valve ON (brown color wire)
2	0V DC	Ground (white color wire)
3	Input signal	Safety Valve open position read (blue color wire)
4	Input signal	Safety Valve close position read (black color wire)

Table 2.2: Pin assignment of the 4-pole valve connector

The safety valve has a 5-pole connector (Figure 2.9) which can be operated with or without the positional control:

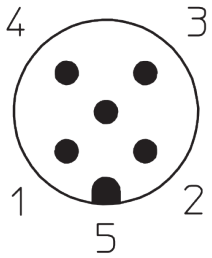


Figure 2.9: 5-pole connector

Pin assignment of this connector is shown in Table 2.3:

PIN NUMBER	FUNCTION	DESCRIPTION
1	Output signal	Safety valve ON 24VDC drive signal (brown color wire)
2	GND	Signal GND(white color wire)
3	Input signal	Safety Valve open position read (blue color wire)
4	Input signal	Safety Valve close position read(black color wire)
5	GND	Signal GND(gray color wire)

Table 2.3: Pin assignment of the 5-pole valve connector

2.3.7 UNI CONNECTOR (ITEM I)

The UNI connector (Figure 2.10) is an external interface for high power fore vacuum pumps. Such cannot be directly connected to the FP connector(Item 12).

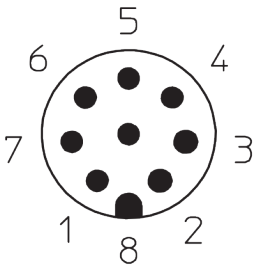


Figure 2.10: UNI connector

Pin assignment of this 8-pin connector is shown in Table 2.4:

PIN NUMBER	FUNCTION	DESCRIPTION
1	GND	Ground (white color wire)
2	24 V DC	Power supply(brown color wire)
3	Output signal	Relay output control signal(FP_ON_24VDC) to power FP PUMP through an external 24 V DC contact (this signal is relay based Normally Open contact inside PCU) (green color wire).
4	Input signal	Fore Pump power failure external signal(active low)(yellow color wire)
5	Input signal	Fore pump power failure external signal ON (active low)(gray color wire)
6	GND	Ground(pink color wire)
7	GND	Ground(blue color wire)
7	GND	Ground(red color wire)

Table 2.4: Pin assignment of the UNI connector

2.3.8 TMP 24 V (ITEM 7)

Power supply output for Turbo Molecular Pump driver is shown in Figure 2.11. Pin assignment is shown in Table 2.5:

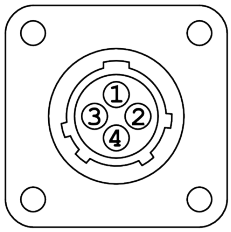


Figure 2.11: TMP 24 V DC connector

PIN NUMBER	FUNCTION	DESCRIPTION
1	24 V DC	Power supply (max current 10A)
2	GND	Signal GND
3	PE	Earth
4	No connect	Not connected

Table 2.5: Pin assignment of the TMP 24 V socket

2.3.9 POWER CONNECTORS (ITEMS 8, 9, 12)

The PCU16 has three power supply outputs (230 V AC):

- **FP socket** - power to the Fore Pump, this output is powered while the PCU16 operates and the firmware switches the Fore Pump on. The socket is protected by the 10 A fuse.
- **CONT socket** – power to other devices (e.g. an external UPS), this output is powered always while the PCU16 is on.
- **ELE socket** - power to the devices which can work only if the vacuum level exceeds the predetermined trigger level (HG trigger). This output is powered after pressing the ELEC ON button in the System Menu. The socket is protected by the 6 A fuse.

The power supply connector is shown in Figure 2.12:

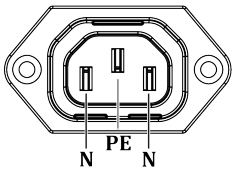


Figure 2.12: Power supply connector

WARNING

Fore pump nominal current.
FP socket, do not connect the pump with ***nominal current*** greater than 7A. Since the start of the pump is taken several times larger current.

2.3.10 UPS IN CONNECTOR (ITEM 11)

PCU16 driver has two separate power circuits:

1. A circuit powered from the main connection (230V, 16A). It powers the outputs: CONT, FP ELE and BCU module.

2. A circuit powered from the UPSIN. It powers the PCU16 logic and the valves outputs: SV, BV, VV and GV.

There are two possible configurations of the power to the PCU16 driver:

1. If no external UPS is connected, the jumper must be connected between the CONT output and the UPSIN input. In this way the UPS circuit is powered via the main incoming supply and the device will power off in the event of loss of main power.

2. If a UPS is connected, the output of the UPS is connected to the UPSIN input. In the event of loss of main power the device will continue to work and the logic will continue to supervise the vacuum system. It will also be possible to manually control the valves.

WARNING

Recommended configuration of work.
The recommended configuration of the PCU16 is to work with an external UPS. If there is loss of main power, it is still possible to control the vacuum system from the PCU16 driver level in this configuration.

2.3.11 MAINS CONNECTION (ITEM 13)

The mains connection is designed for a mains cable which contains a European appliance connector IEC 320 C14 on the device side (Fig. 2.13). A mains cable is supplied with the device. The ground screw can be used to connect the PCU16 with the protective ground of the system by protective conductor.

DANGER

Mains power.
Improperly grounded devices can be extremely dangerous in the event of a fault. Use three-wire mains or extension cables with protective ground only. Plug the mains cable into wall sockets with protective ground only.

In order to power the PCU16 device complete the following steps:

1. Connect the European appliance connector of the mains cord with the mains connection of the device.

2. Connect the plug of the mains cable with the wall socket.

Note: If the device is installed in a switching cabinet, the mains power can be supplied via a switchable central power distributor.

Figure 2.13: AC input Connector

2.3.12 AC POWER SWITCH (ITEM 14)

The power switch is located on the rear of the PCU16 . The switch is a toggle type, marked with **I** and **O**. The **I** (on) position applies the power to the instrument. The **O** (off) position cuts off the power to the instrument. However, turning the power switch off does not fully remove the AC power from inside the instrument.
Always disconnect the power cord from the power entry module to fully remove AC power from inside the instrument.

DANGER

Risk Of Electric Shock
Do NOT use the power switch as a disconnecting device; disconnect the power cord from the power entry module to fully remove hazardous voltage from inside the PCU16 .

2.3.13 CHANNEL 1 SENSORS CONNECTOR (ITEM 15)

The channel 1 vacuum sensors connector is shown in Figure 2.14).

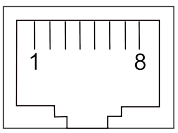


Figure 2.14: Channel 1 sensors connector

Pin assignment of this connector is shown in Table 2.6:

PIN NUMBER	FUNCTION	DESCRIPTION
1	24 V	Power supply
2	GND	Ground
3	Input 0 - 10 V	Analog measurement signal
4	Input signal	Gauge type identification signal
5	GND	Signal GND
6	Input signal	Emission ON status signal
7	No connect	Not connected
8	Output signal	HV ON(emission) 24 V steering signal

Table 2.6: Pin assignment of the channel 1 sensors connector

WARNING

Improper transmitter.
Transmitters which are not designed for use with the PCU16 may damage the device. Operate the PCU16 with proper transmitters only. See compatible sensors list in Measuring Channel section in Operation chapter.

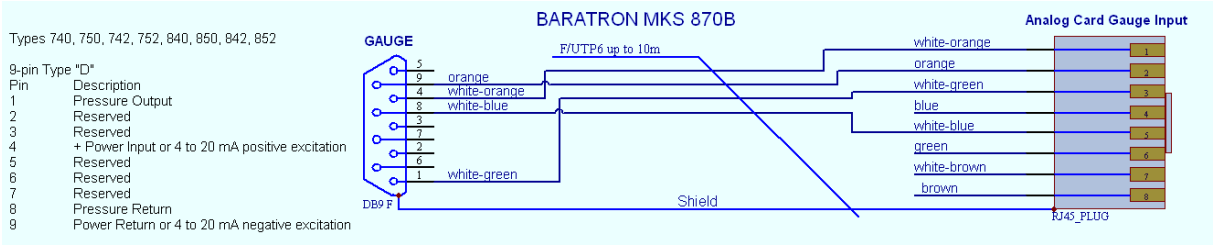


Figure 2.15: Baratron MKS gauge connection

Figure 2.16: Pirani gauge connection

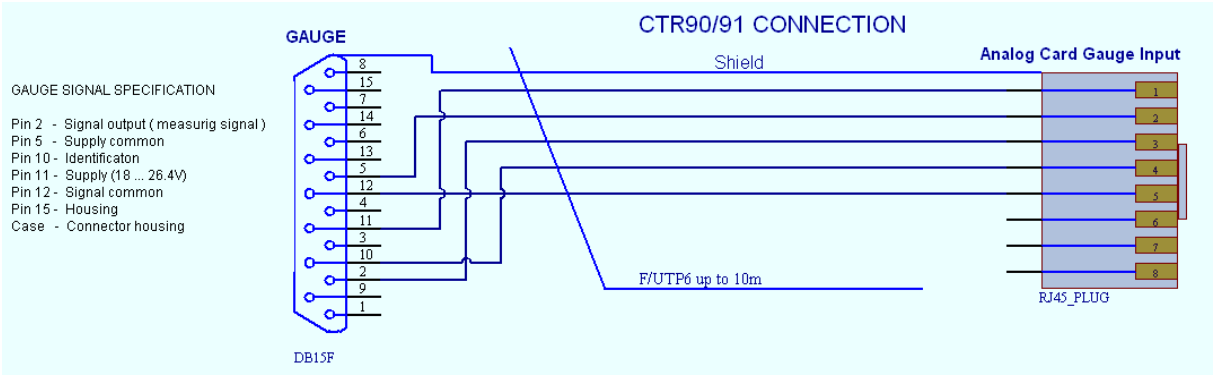


Figure 2.17: CTR90/91 gauge connection

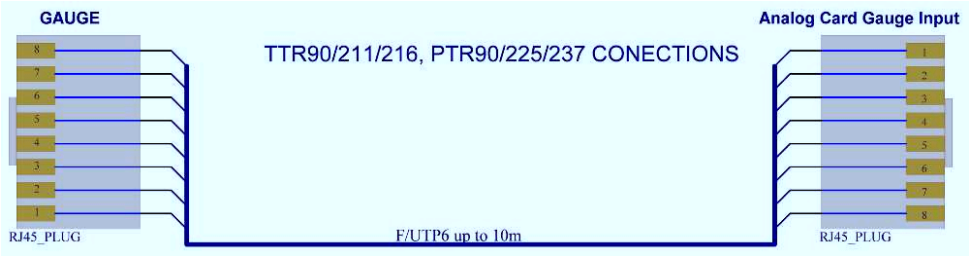


Figure 2.18: TTR/PTR gauge connection

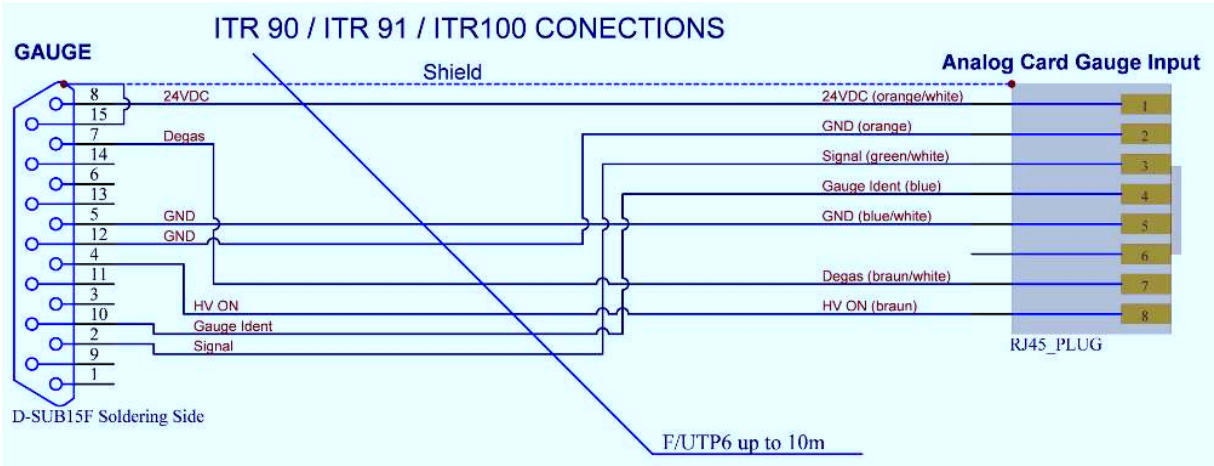


Figure 2.19: ITR gauge connection

2.3.14 CHANNEL 2 SENSORS CONNECTOR (ITEM 16)

The vacuum channel 2 sensors connectors(RJ45 and female 15 pin D-sub) are shown in Figures 2.20 and 2.21.

Pin assignment of the channel 2 sensors connector (CH2_R) is shown in Table 2.7:

To make proper connection between gauge and PCU16 see in the previous section 2.15

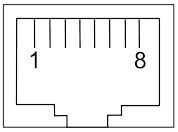


Figure 2.20: Channel 2 sensors connector (CH2_R)

PIN NUMBER	FUNCTION	DESCRIPTION
1	24 V	Power supply
2	GND	Ground
3	Input 0 - 10 V	Analog measurement signal
4	Input signal	Gauge type identification signal
5	GND	Signal GND
6	Input signal	Emission ON status signal
7	No connect	Not connected
8	Output signal	HV ON(emission) 24 V steering signal

Table 2.7: Pin assignment of the channel 2 sensors connector (CH2_R)

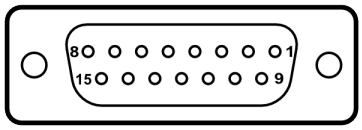


Figure 2.21: Channel 2 sensors connector (female 15 pin D-sub)

Pin assignment of the channel 2 sensors connector is shown in Table 2.8:

PIN NUMBER	FUNCTION	DESCRIPTION
1	Input signal	Emission ON status signal
2	Input 0 - 10 V DC	Analog measurement signal
3	No connect	Not connected
4	Output signal	HV ON(emission) 24 V steering signal
5	GND	Signal GND
6	No connect	Not connected
7	Output signal	DEGAS ON steering signal
8	24 V	Power supply
9	No connect	Not connected

continued on next page

continued from previous page

PIN NUMBER	FUNCTION	DESCRIPTION
10	Input signal	Gauge type identification signal
11	No connect	Not connected
12	GND	Signal GND
13	No connect	Not connected
14	No connect	Not connected
15	GND	Signal GND

Table 2.8: Pin assignment of the channel 2 sensors connector (CH2_D)

WARNING

Improper transmitter.
Transmitters which are not designed for use with the PCU16 may damage the device. Operate the PCU16 with proper transmitters only. See compatible sensors list in ***Measuring Channels*** section in ***Introduction*** chapter.

WARNING

Multiple connection.
Only one transmitter may be connected to each of the channels, otherwise the connected transmitters will be damaged. Never connect more than one transmitter per channel.

2.3.15 TMP - TURBO MOLECULAR PUMP (ITEM 17)

The turbo molecular pump connector(female D-sub 9pin) is shown in Figure 2.22. This socket is used for controlling(in relay mode) and communicate with the Turbo Molecular Pump driver(using RS232 or RS485 interface).

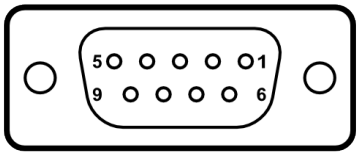


Figure 2.22: TMP connector (female 9 pin D-sub)

Pin assignment of the TMP connector is shown in Table 2.9:

PIN NUMBER	FUNCTION	DESCRIPTION
1	TMP start	Common relay contact
2	TMP start	Normal open relay contact
3	Tx/A+	Communication line
4	TMP normal operation	Input pin, to read from TMP driver normal operation status
5	TMP failure	Input pin, to read from TMP driver failure status
6	24 V DC	Power supply
7	Rx/B-	Communication line
8	0 V DC	Ground
9	No used	Not connected

Table 2.9: Pin assignment of the TMP connector

2.3.16 EXTERNAL CONNECTOR (ITEM 18)

An EXTERNAL connector(female 15 pin D-sub) is shown in Figure 2.23. This connector is used to connect the external devices (e.g. high power bakeout).

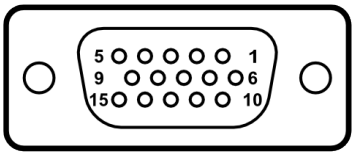


Figure 2.23: EXTERNAL connector (female 15 pin D-sub)

Pin assignment of the EXTERNAL connector is shown in Table 2.10:

Relay contact was drive by BCU or high vacuum level(interlock). For example: after reaching interlock HG relay 2 is ON. All digital inputs are active low level, its mean to active input connect short to GND

PIN NUMBER	FUNCTION	DESCRIPTION
1	Input signal	Input High Vacuum (Active Low)
2	Relay 2	Relay 2 Common contact(drive by interlock High Vacuum signal)
3	Relay 1	Relay 1 Common contact(drive by BCU ON signal)
4	GND	Signal GND
5	Analog output 1	0-10V output control signal for eg. external BCU module
6	External input	External BCU power failure
7	Relay 2	Relay 2 Normal Open contact(drive by interlock High Vacuum signal)
8	Relay 1	Relay 1 Normal Open contact(drive by BCU ON signal)
9	Analog output 2	0-10V signal for retransmission
10	External IN1	External input, active low level(assigned to remote control enable function)
11	External OUT2	External output, open collector type(Reserved for future use)
12	External OUT1	External output, open collector type(Reserved for future use)
13	External IN4	External input, active low level (Reserved for future use)
14	External IN3	External input, active low level(Reserved for future use)
15	External IN2	External input, active low level (Reserved for future use)

Table 2.10: Pin assignment of the EXTERNAL connector

2.3.17 GROUND BOLD (ITEM 19)

A grounding lug is located on the rear panel, near the power entry module. Use heavy ground wire, wire braid, or copper strap of 4mm2 or larger to connect this grounding lug directly to a facility protective earth ground to provide additional protection against electrical shock. The ground screw can be used to connect the PCU16 with the protective ground of e.g. a pumping station.

DANGER

Screw for internal protective conductor.
The internal protective conductor is connected to the casing with a screw. Do not turn or loosen this screw.

2.3.18 POWER CORD

The PCU16 comes with a detachable, three-wire power cord for connection to a power source with protective ground. The PCU16 chassis is connected to the power ground to protect against electrical shock. Always connect to an AC outlet which has a properly connected protective ground. If necessary, or when in doubt, consult a certified electrician.

3 OPERATING

Interaction with the PCU16 takes place mainly via the touch panel and encoder.

3.1 TURN ON DEVICE

In order to turn on the device make sure that all of the connections on the rear panel are made correctly and that the AC connection meets the AC source requirements. If these conditions are met, set ***Power Switch*** into ***ON*** position on the rear panel. The instrument is on when the logo appears. The Introduction screen displays and the main application will start. The instrument is ready to use. After connecting and switching on the PCU16 the outputs are not active.

3.2 FRONT PANEL

There are several principal parts of the PCU16 user interface:

- Touch panel display,
- USB port,
- Backlight logo.

Front panel of the PCU16 device is shown in Figure 3.1.

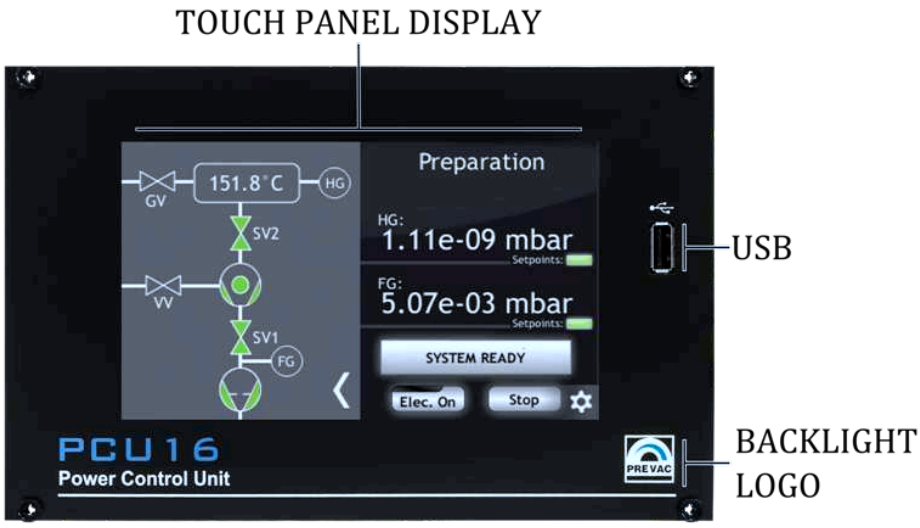


Figure 3.1: Front panel

3.2.1 TOUCH PANEL DISPLAY

The device has a TFT color display with a resolution of 800x480 pixels and a diagonal of 7" with 16:10 aspect ratio. The display has an integrated touch panel, which provides the user interface.

CAUTION

The touch panel is capable of processing only one input signal at a time. It is not permissible to simultaneously touch the touch panel at several points.

CAUTION

To operate the touch panel, do not use any pointed or sharp items. Such items can damage the foil resulting in input errors.

3.2.2 USB CONNECTOR

Allows removable media to be used for e.g. firmware or software upgrade . It is also possible to play videos on the screen.

3.3 USER INTERFACE

The PCU16 is equipped with a colour display touch screen. All data and functions are accessible via the menus from this touch screen interface. Every operation must be performed by a tap on screen.

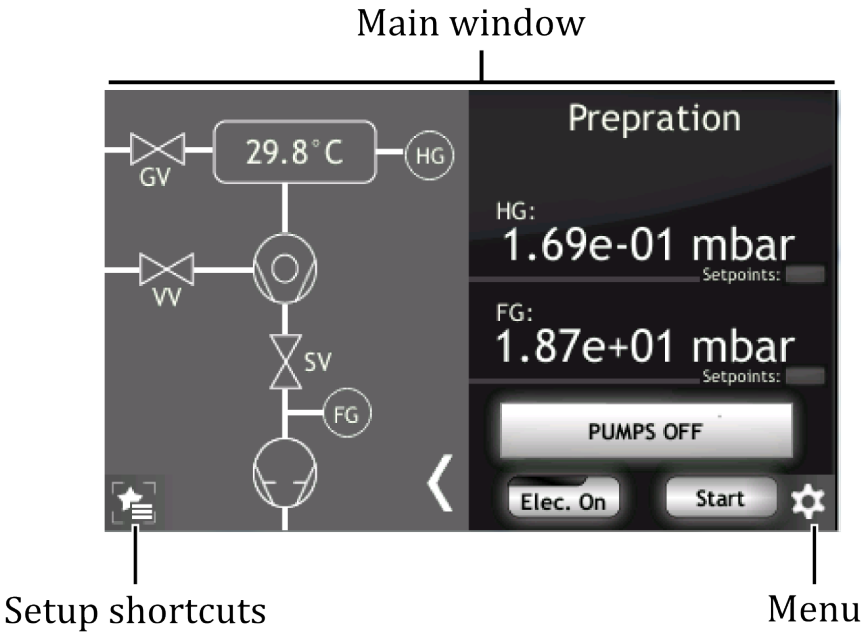


Figure 3.2: Screen main view

Main view contains 3 elements:

1. Main window - split into two parts: the vacuum diagram and the vacuum gauge measurement,

2. Menu - contains the device menu from where the user may enter the setup menu, upgrade firmware, show contents of the usb stick, play videos,

3. Setup shortcut - contains list of favourites setup positions (see section ***Setup shortcuts***).

3.3.1 PANELS OVERVIEW

The device contains two panels. First main panel divided into two parts: the vacuum diagram and the vacuum gauge measurement. This second part can be displayed separately on the main screen after tapping the arrow as shown in Figure 3.3. Second timer panel display current date and time and provide set timer counter 3.5.

Figure 3.3: Available screens

In order to return to the previous view, tap the arrow on the top of the screen as shown in Figure 3.4.

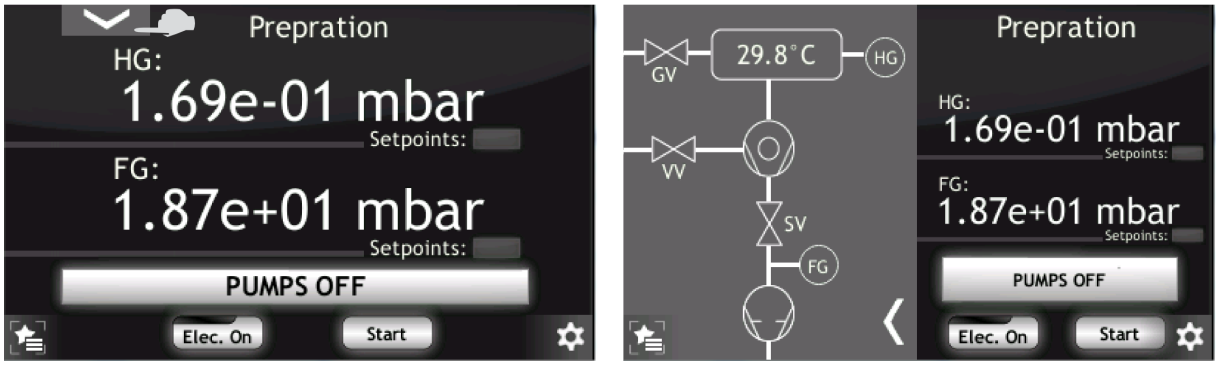


Figure 3.4: Available screens - returning to the previous view

The figures 3.6 to 3.21 describe each panel configuration and each interactive area which can be changed by tapping.

Figure 3.5: Available screens - switching to timer panel

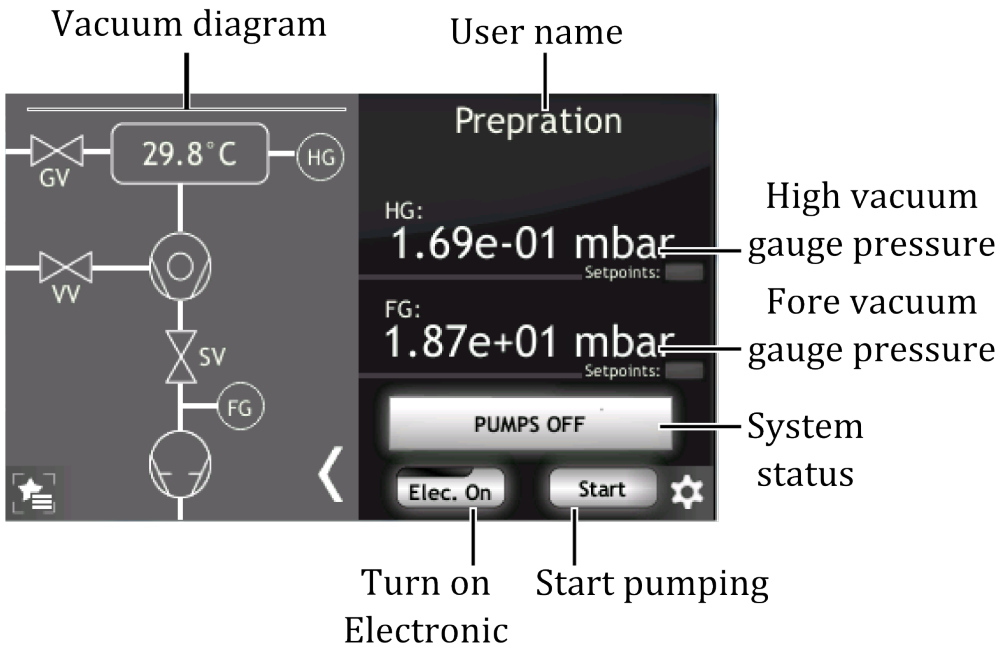
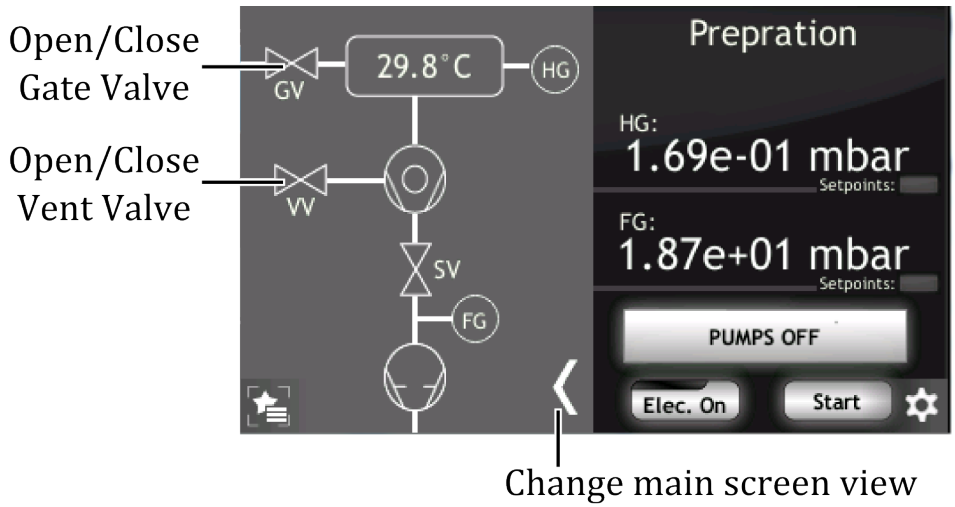


Figure 3.6: Main panel description



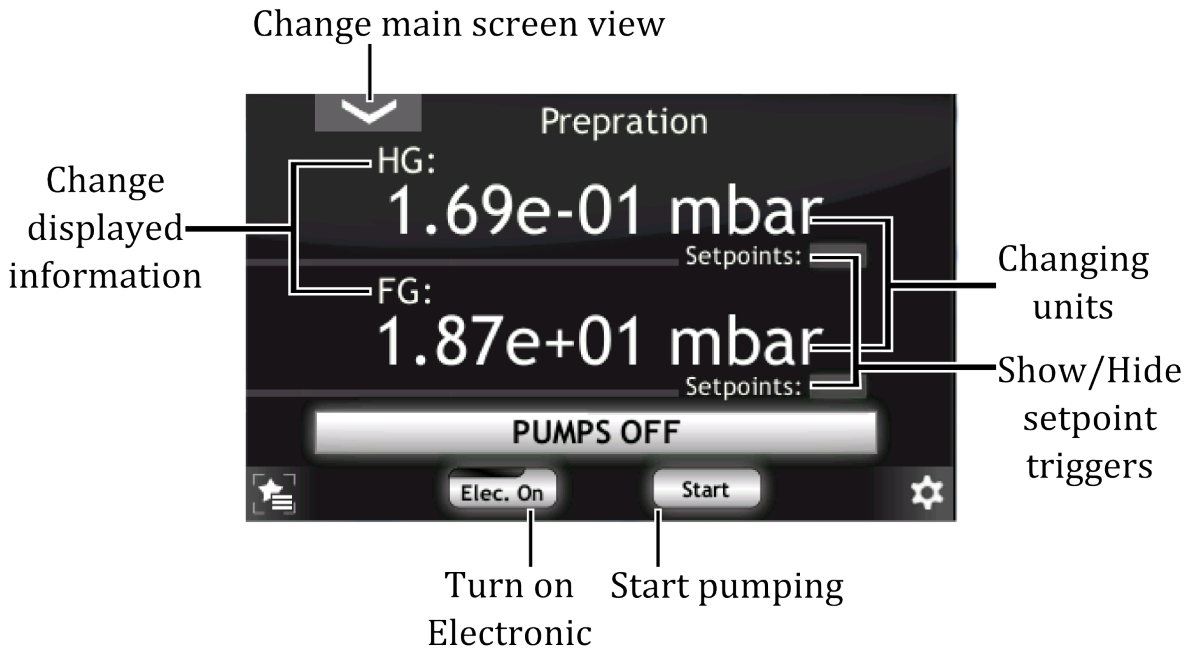


Figure 3.7: Main panel active areas

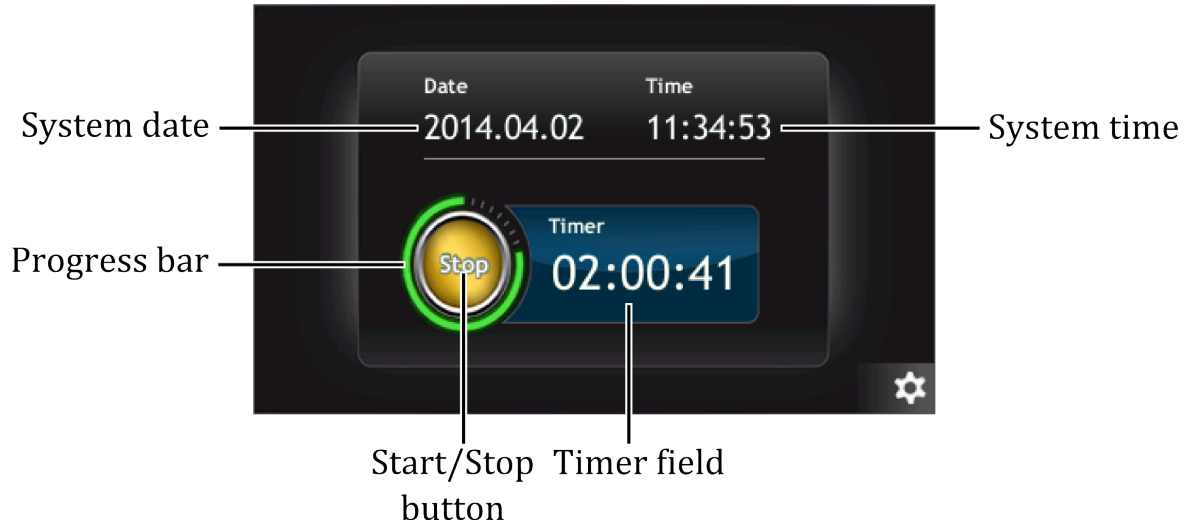


Figure 3.8: Timer panel description

3.3.2 VACUUM DIAGRAM SYMBOLS

A vacuum diagram displayed on the main screen is composed of few elements. This elements inform about the current state of the controller.

SYMBOL	DESCRIPTION
	Valve close
	Valve half open (option available for 3 position valve)
	Valve open
	Fore pump OFF
	Fore pump ON
	Turbo molecular pump OFF
	Turbo molecular pump is accelerating. During accelerating the internal circle will blinking
	Turbo molecular pump working in normal operation
	Turbo molecular pump cascade mode(serial connection of two or three trubo molecular pumps)
	Bakeout/LoadLock module is ON
	Bakeout/LoadLock work is discontinued due to eg interlock failure(when interlock autostart option is active)
	Setpoint diode, indicates that the value of the vacuum is above the ***Setpoint HIGH***. Diode is light until vacuum value not less than ***Setpoint LOW***
	Setpoint diode, indicates that the value of the vacuum is below the ***Setpoint LOW*** value

Table 3.1: Vacuum diagram symbol description

3.3.3 NUMERIC KEYBOARD

Numeric values can be entered via the numeric keyboard. It consists of the numbers 0 to 9 and additional function keys to facilitate data entry and editing of the current data. The numeric keyboard is shown in Figure 3.9.

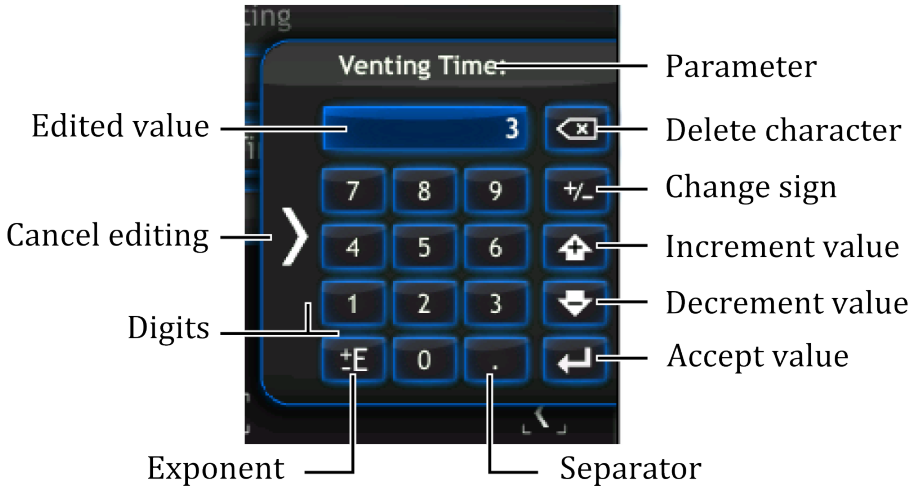


Figure 3.9: Numeric keyboard

It is possible to enter data:

- directly from the numeric keypad by typing a value and confirming the entered value,
- by entering data in the form of the mantissa and exponent,
- by increasing or decreasing the current value step by step.

Increment or decrement current value:

1. Select value to edit (e.g. Tooling Sens 2).
2. Tap on ***2*** and ***0*** to increment value by 20.
3. Tap on the ***Increment value*** button (every tap on the button increments the value by 20).
4. To decrement value just tap on the ***Decrement value*** button (every tap on the button decrements the value by 20).
5. Value is decrement.
6. Confirm value by tapping the ***Accept value*** button.

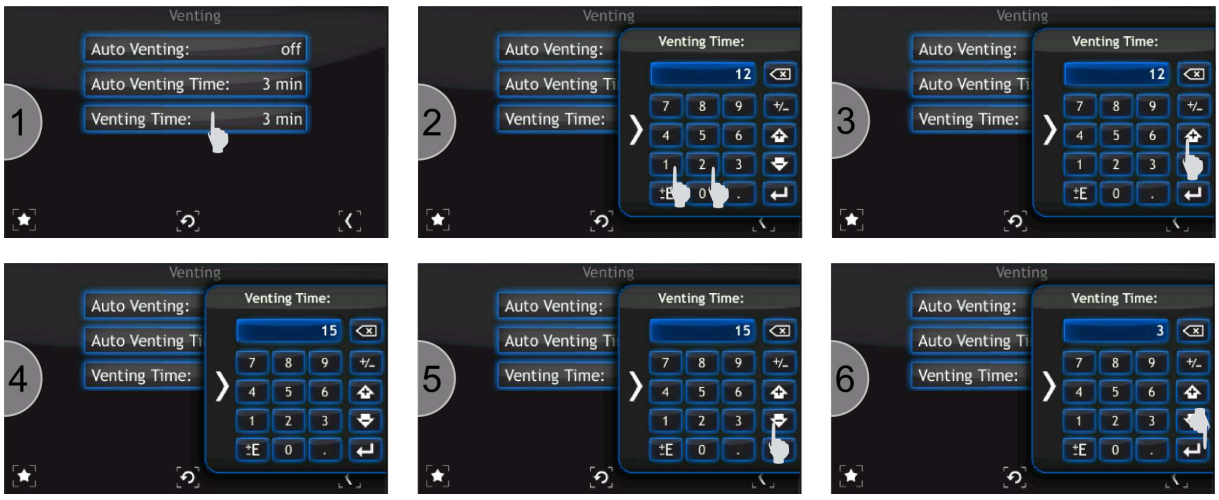


Figure 3.10: Increment/decrement value by numeric keyboard

To enter a number in exponential form:

1. Enter the numeric value of the mantissa number along with a sign (e.g. -12.5).
2. Press the ***Exponent*** button. To enter a negative exponent symbol, press the ***Exponent*** button twice.
3. Enter exponent value.
4. After entering the value, it is possible to modify the sign of mantissa and the sign of exponent by using the***Exponent*** button or the ***Change sign*** button (see Figure 3.9).
5. Confirm value by tapping the ***Accept value*** button.

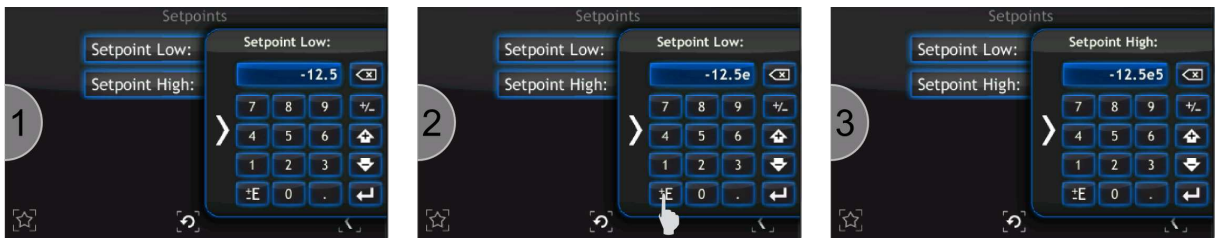


Figure 3.11: Number in exponential form

3.3.4 ALPHANUMERIC KEYBOARD

The on-screen keyboard is used for entering alphanumeric data and also facilitates text entry. Figure 3.12 shows the alphanumeric keyboard with description of main keys.

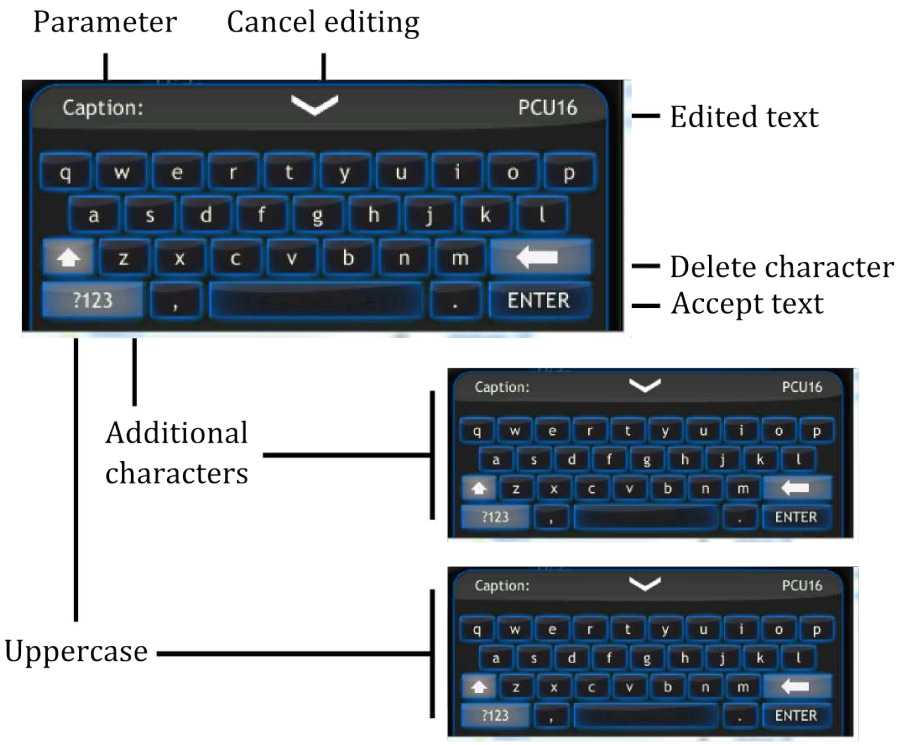


Figure 3.12: Alphanumeric keyboard

3.3.5 DEVICE INTERACTION

To change the displayed measurement units:

1. Tap on units to change (e.g. pressure).
2. Select target units.
3. Value in new units is displayed.

Figure 3.13: Changing displayed measurement units

In order to change the vacuum gauges setpoints:

1. Tap on ***Setpoints***.

2. Setpoints value are displayed. Tap on the arrow on displayed area.
3. Setpoint values can be modified.

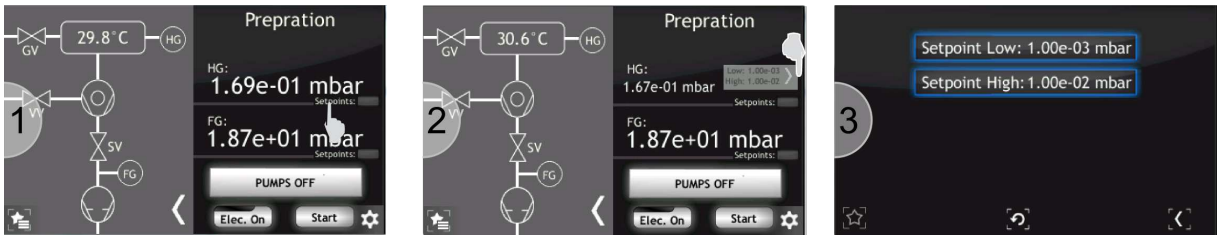


Figure 3.14: Changing setpoints

To select the parameter displayed on the main screen (pressure or temperature):

1. Tap on ***HG***/Temp or ***FG***/Temp.
2. Select target parameter.
3. Chosen parameter is displayed.

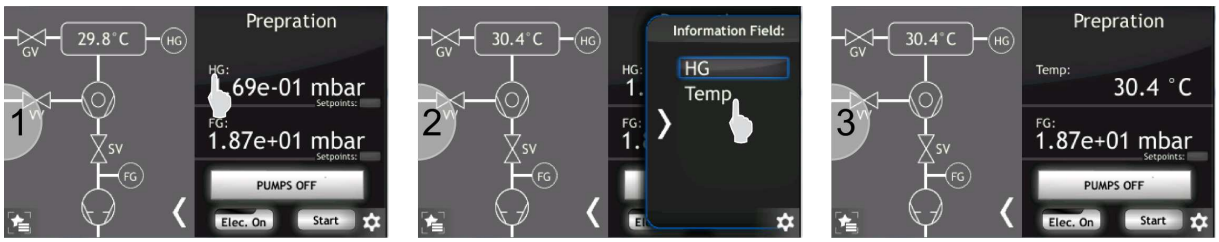


Figure 3.15: Changing displayed parameter

3.3.6 SETUP

Advanced configuration of the device parameters is possible via the setup menu. Tap the menu icon to expand the menu and then tap device setup icon (see Figures 3.16 - 3.17).

3.3.7 SETUP SHORTCUTS

Frequently used commands/settings can be conveniently accessed by creating shortcuts.
To create a shortcut:

1. Navigate to the setup position where a shortcut should be created.
2. Tap on ***Setup shortcut*** to add the position to shortcuts (To remove position from shortcut list tap again on the ***Setup shortcut*** button).

To use shortcut:

1. On main panel tap on ***Setup shortcut*** button.
2. Select setup shortcut to enter (e.g. Mode).
3. Current setup position should be displayed.

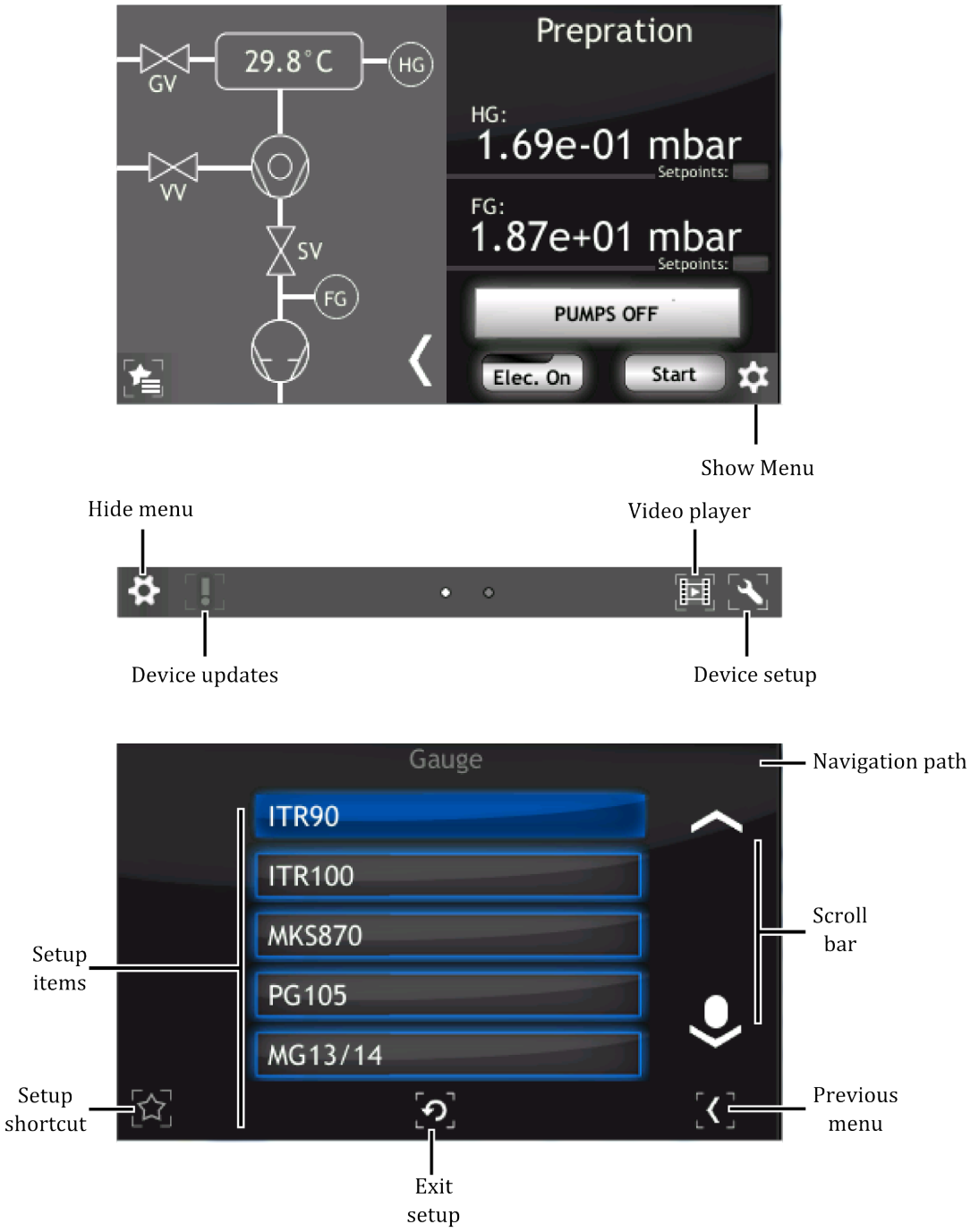


Figure 3.16: Device setup

Figure 3.17: Navigating the setup (example)

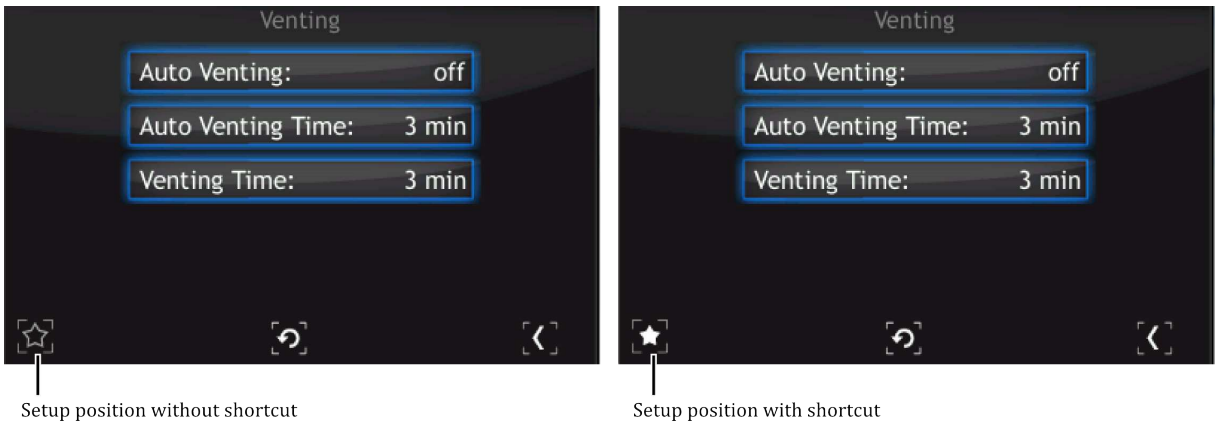


Figure 3.18: Setup shortcut on setup menu

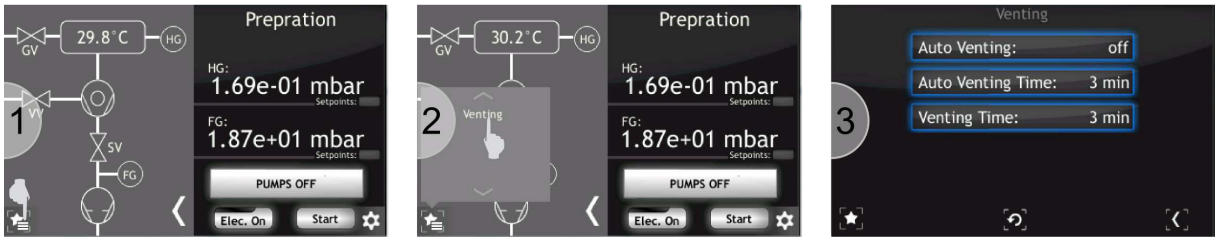


Figure 3.19: Using setup shortcut

3.3.8 TIMER PANEL

Additional screen contains countdown timer and information about the current time and date. Elapsed time is paired with a progress bar indicator located around the Start/Stop button. Timer value can be set from 23h:59m:59s to 00h:00m:01s. After pressing the ***Start*** button the time is counted from set value to zero. An audible beep sounds when the timer has completed and the set value is displayed once again.

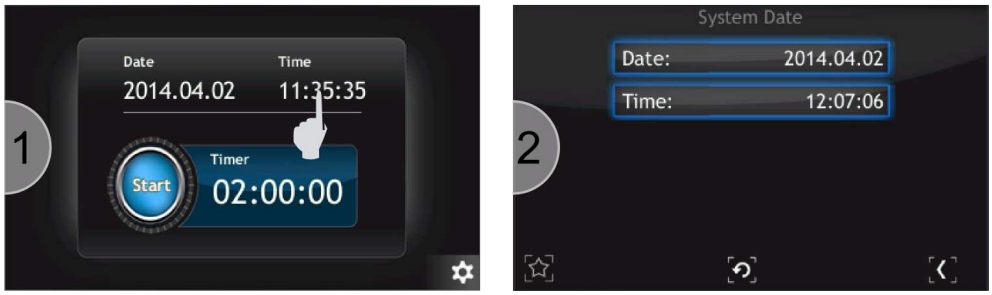


Figure 3.20: Go to system date

3.3.8.1 SETTING TIMER VALUE

In order to set the timer start value:

1. Tap ***timer field***.
2. Type a timer initial value using numeric button ***from 0 to 9*** and ***":" symbol as separator***. Confirm value by tapping ***Enter*** button.

3. New value is set and display in ***timer field***. Tap ***Start*** in order to run the timer
4. Timer is counting down,

The time may also be entered in seconds. The entered value is automatically converted to ***hh:mm:ss*** format

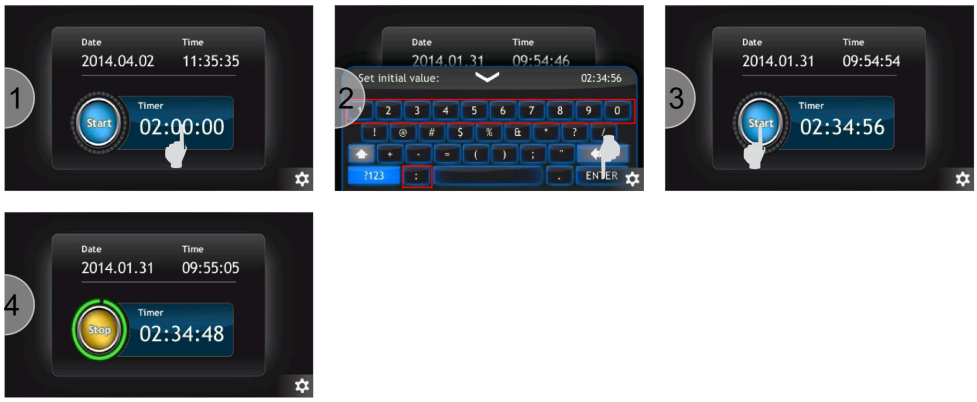


Figure 3.21: Set timer value

3.3.9 MESSAGES

The PCU16 will automatically display both warning and error messages as appropriate.

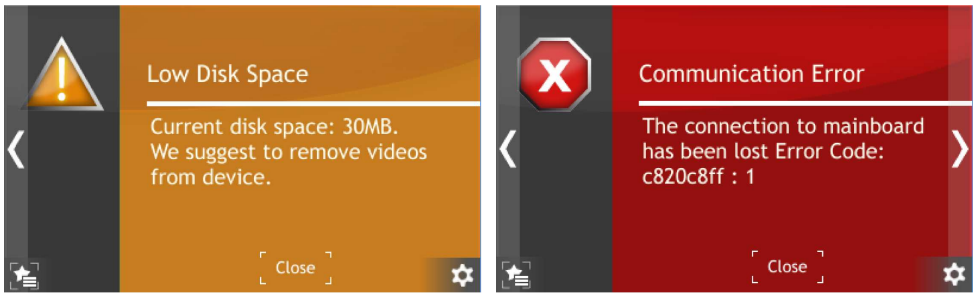


Figure 3.22: Messages

3.3.9.1 WARNING MESSAGE

Warning messages are displayed on the right of the screen. When present, they can be clicked to display the full warning information (see Figure 3.23). Warning messages consist of information together with a description field. When the problem causing the error no longer exists, the message is automatically removed whether or not it has been acknowledged.

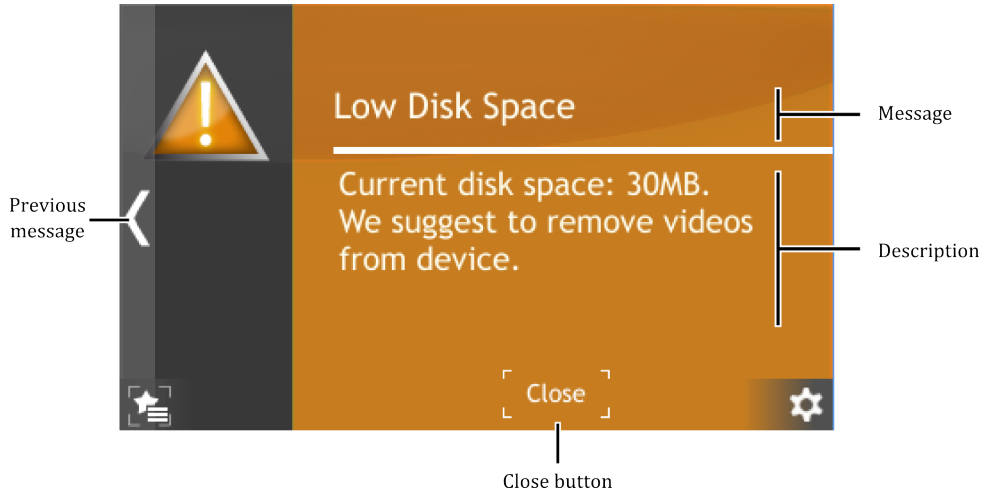


Figure 3.23: Warning message

3.3.9.2 ERROR MESSAGE

Error messages inform about critical issues. The message is displayed in full screen (see Figure 3.24). Error messages consist of an information field together with a description of the error. If the cause of error no longer exists, the error message will disappear after the user clicks OK. When the user clicks OK but the error still exists, then information about the event will continue to be displayed on the right hand side of the screen. If the cause of error still exists, please contact the manufacturer.

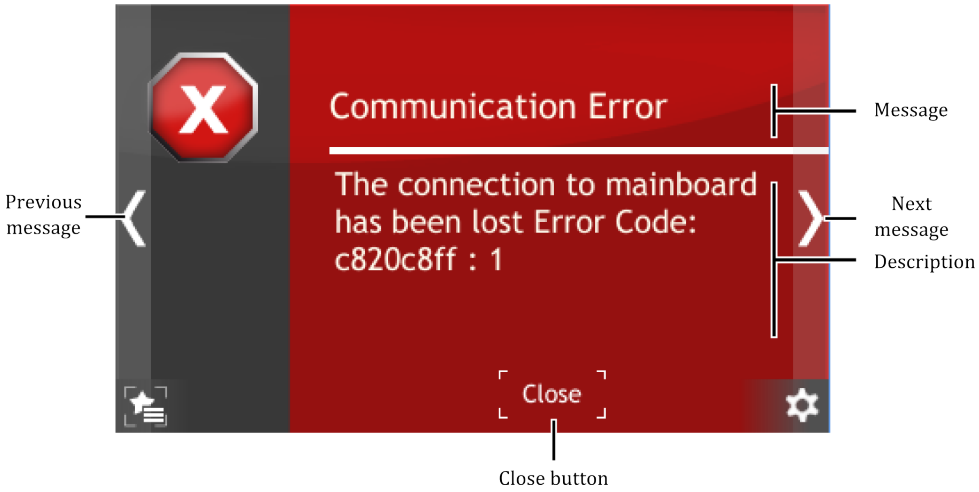


Figure 3.24: Error message

3.3.9.3 MULTIPLE MESSAGES

If several errors or warnings occur simultaneously they are indicated with a counter on the bottom right hand corner of a screen. The first digit (red) indicates the number of errors, the second digit (yellow) indicates the number of warnings. Clicking on this counter will bring up the message list. The list is displayed in date/time order from most recent to oldest. Error messages appear in the list before Warning messages.

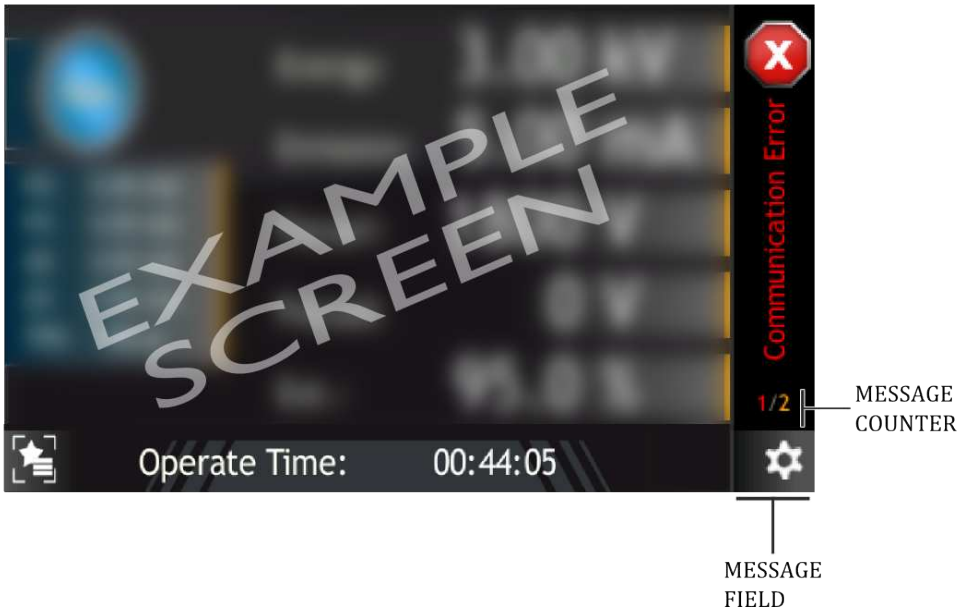


Figure 3.25: Multiple messages

3.3.10 VIDEO PLAYER

The PCU16 device can play video files. Files can be played only from the device. Full instructions on how to copy a video file onto the device is in the subsection ***Copy video file to the device***. A short guide on how to play the video is included in subsection ***Playing Video***.

3.3.10.1 PLAYING VIDEO

In order to play a video go to the main screen and tap the ***Menu icon*** on the bottom right corner of the screen to display the menu bar. Then tap the ***Video player*** icon on the bottom right (see Figure 3.26).

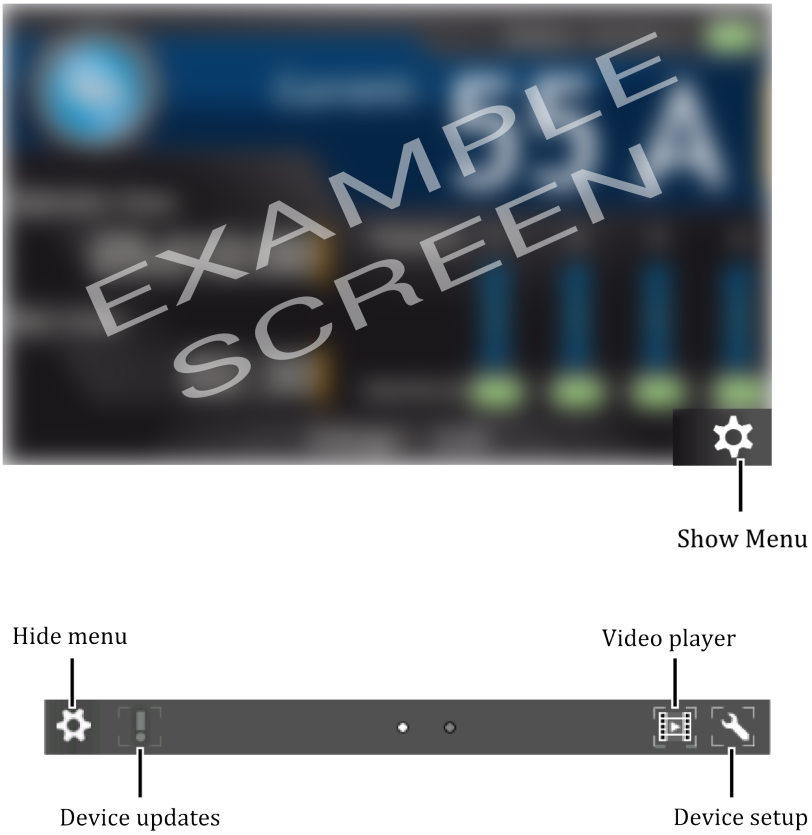


Figure 3.26: Menu bar - video player

1. Tap on the desired file to open video menu.

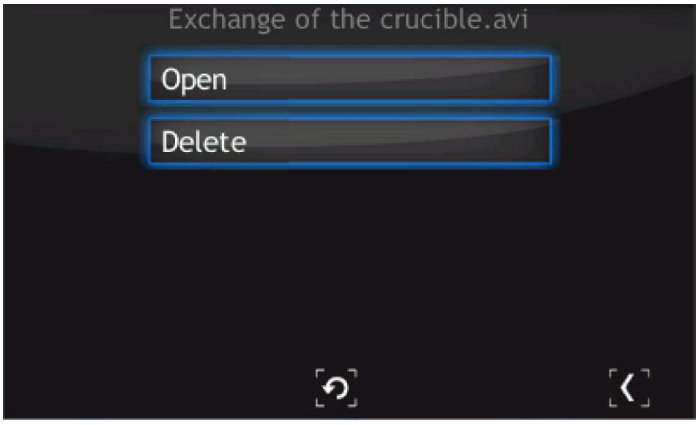


Figure 3.27: Video player - menu

2. From this menu, a video file can be played or deleted. In order to delete the file tap ***Delete*** and confirm the action by tapping ***Yes***.

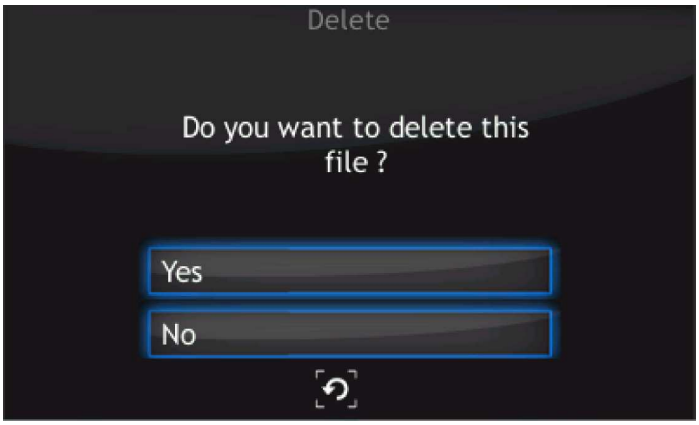


Figure 3.28: Video delete question

3. To open a video, tap ***Open***. The video player is displayed.
4. Tap on the screen to see the video player menu.

From this menu, the following controls are visible:

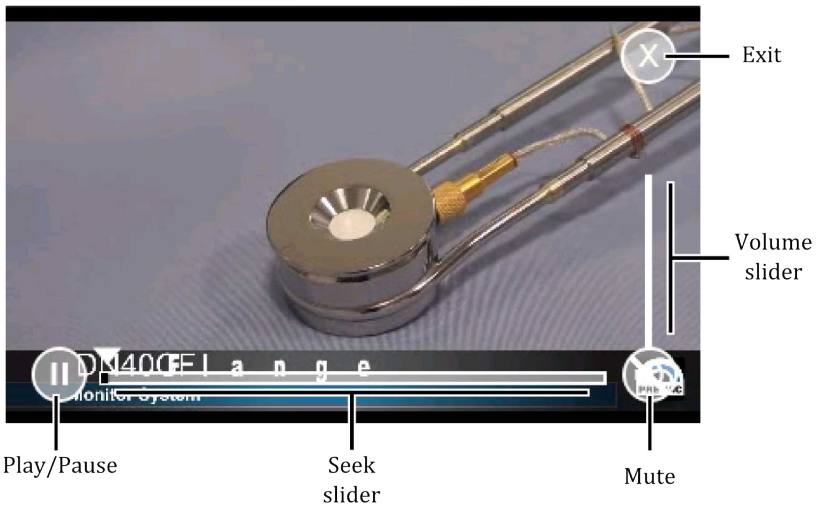


Figure 3.29: Video player

3.3.10.2 COPY VIDEO FILE TO THE DEVICE

In order to copy a video file to the device, connect a USB flash drive which contains the video files. The following hint appears ***New USB device detected***. Tap on the USB menu to show the menu.
Tap on the ***List of videos on USB*** button to see all the videos stored on the USB drive with *.avi extension (see Figure 3.31).

1. Choose a desired file from the list.
2. To copy file, tap ***Copy file to the device***.
3. Depending on the file size, the copy operation can take from a few seconds to several minutes. At the end of the copy operation, tap the ***Return*** button.

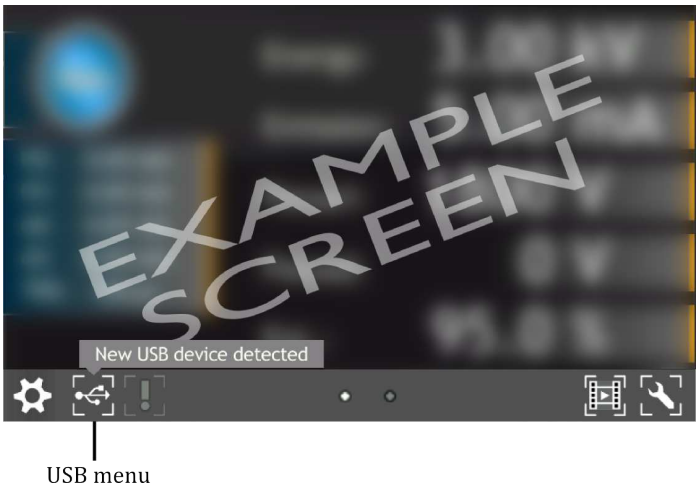


Figure 3.30: USB detected hint

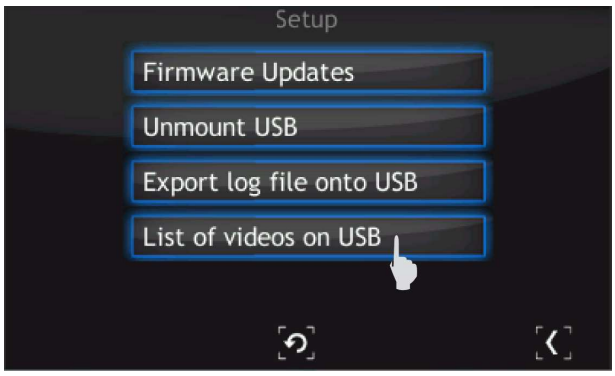


Figure 3.31: USB menu - list of videos on USB

Figure 3.32: Copy *.avi to device

3.4 SETUP MENU

Advanced configuration of the device parameters is possible via the setup menu. This section describes all the items included in the setup menu. To store the changes, save them in accordance with instructions from the section 3.4.14.

3.4.1 Menu structure

Below is the complete menu structure, depending on the configuration the device, some items may not be available

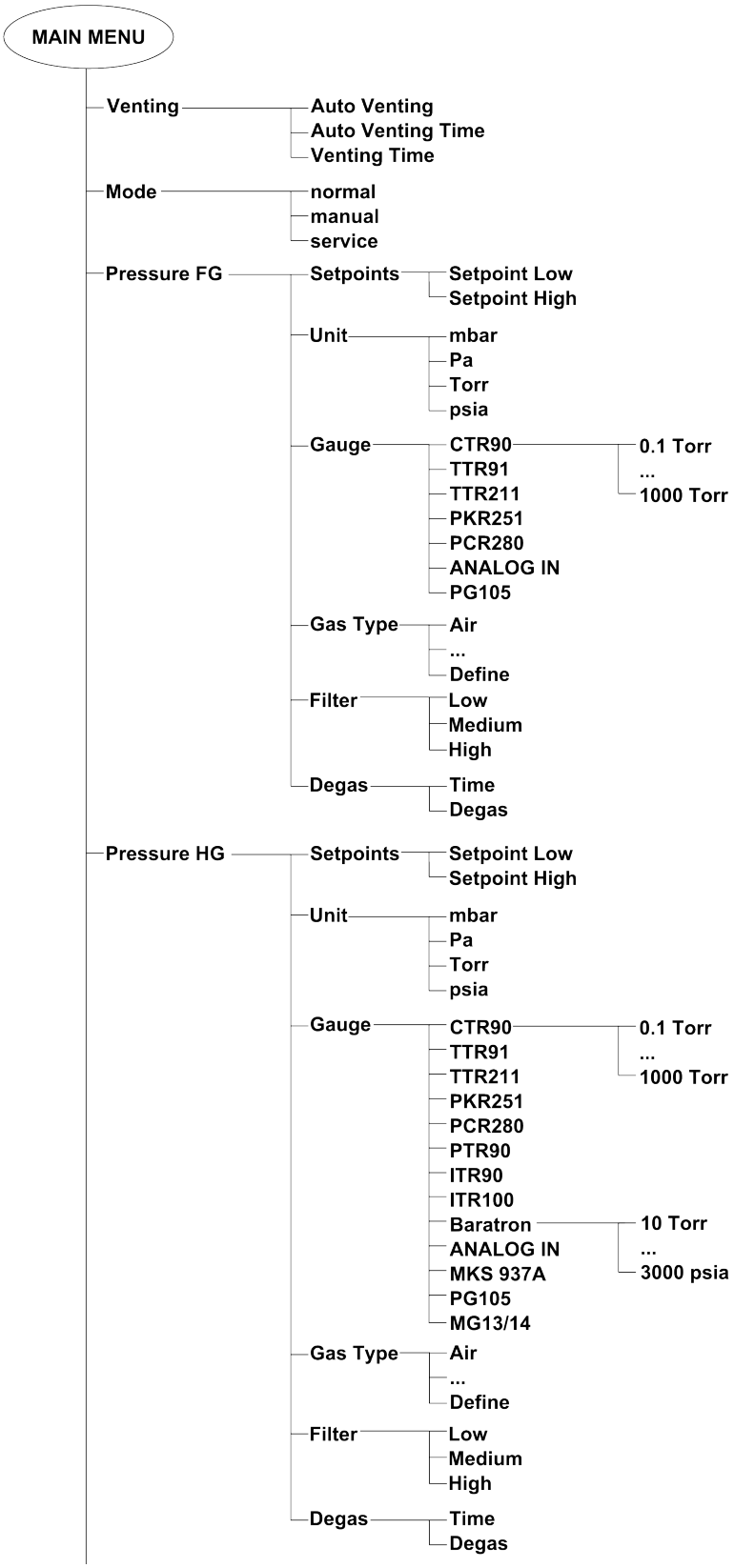


Figure 3.33: Menu tree (part 1)

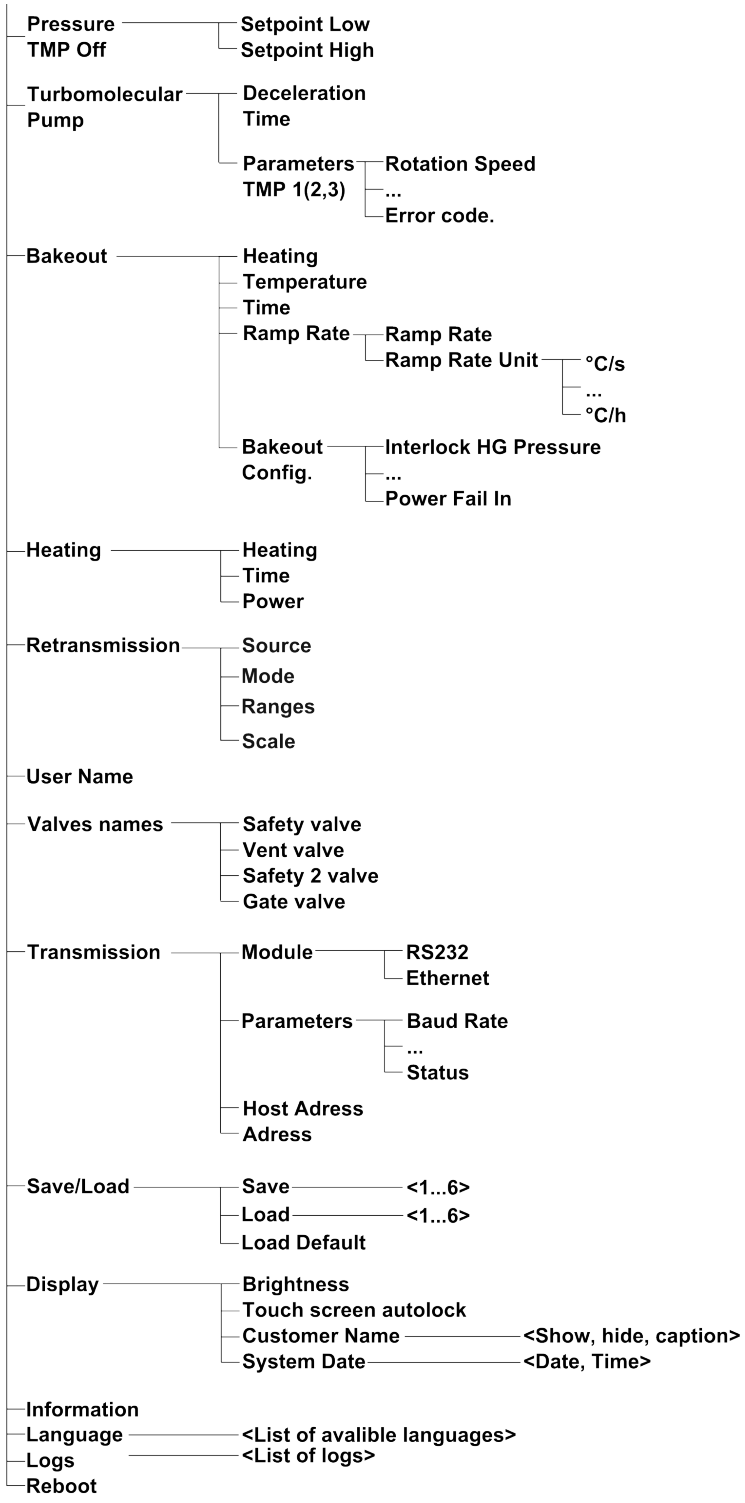


Figure 3.34: Menu tree (part 2)

3.4.2 VENTING SETTINGS

This submenu allows the user to configure the venting process correctly. During the venting procedure the vent valve is opened and the venting gas is introduced into the chamber to obtain atmospheric pressure.

The venting procedure may start automatically some time after the pumping system stops . In order to select the ***Auto Venting*** option, the following steps should be taken:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Venting***.
4. Tap ***Auto Venting***.
5. The ***Auto Venting*** option is on.

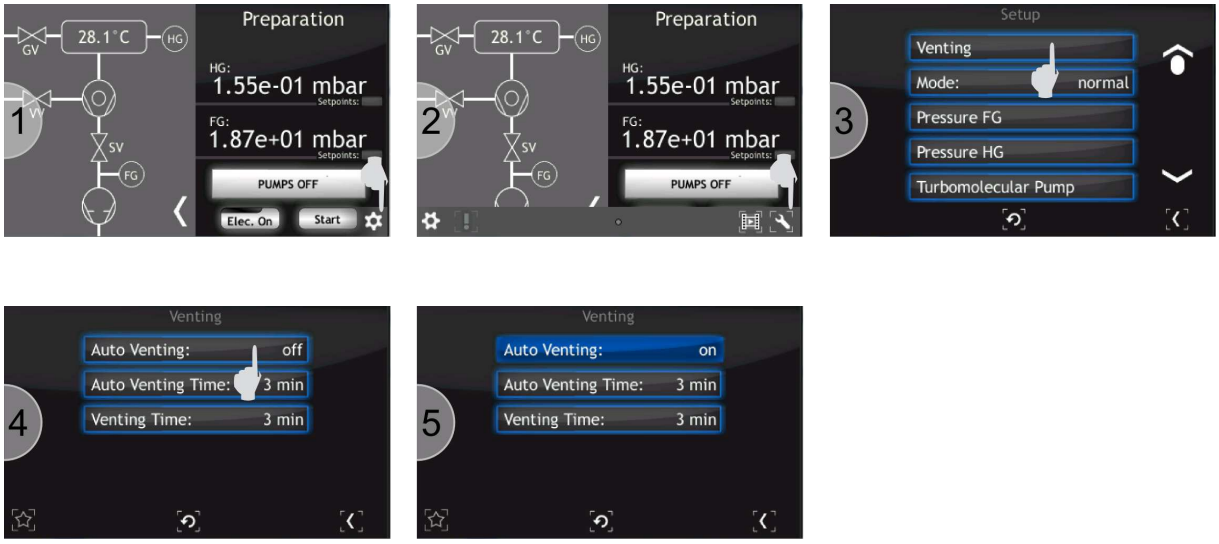
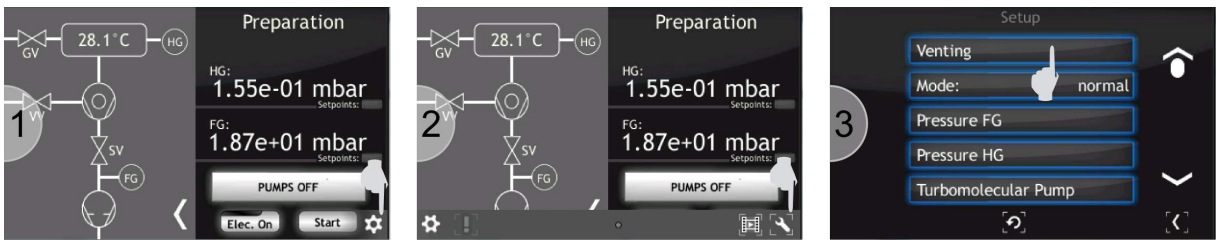


Figure 3.35: Selecting auto venting

If the ***Auto Venting*** option is on, the venting process will be based on two parameters: ***Auto Venting Time*** and ***Venting Time***.

The ***Auto Venting Time*** is the time after which the venting procedure starts (the time between stopping the pumps and opening the vent valve). To set this parameter:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Venting***.
4. Tap ***Auto Venting Time***.
5. Enter the value 0 to 240 minutes on the numeric keyboard.
6. Tap the ***Enter*** button in order to confirm a new Auto Venting Time value.
7. New value is set.



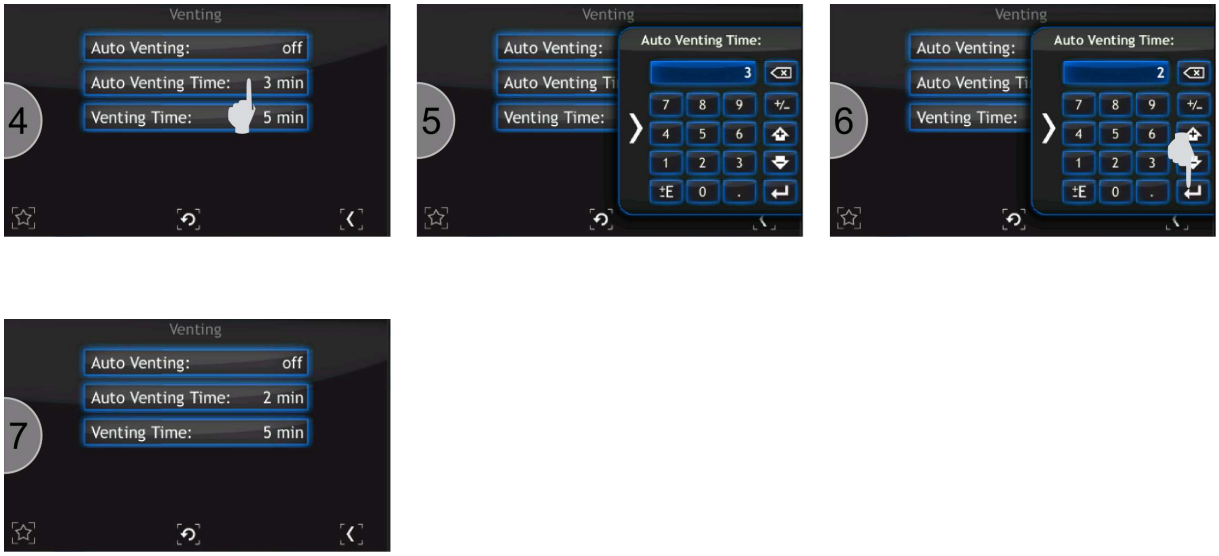


Figure 3.36: Setting auto venting time

The ***Venting Time*** is a duration of the venting process (the time when the vent valve is opened). In order to set this parameter:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Venting***.
4. Tap ***Venting Time***.
5. Enter the value 0 to 240 minutes on the numeric keyboard.
6. Tap the ***Enter*** button in order to confirm a new Venting Time value.
7. New value is set.

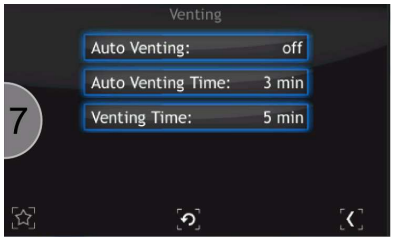


Figure 3.37: Setting venting time

3.4.3 MODE SELECTION

Three different modes of operation are available in the PCU16:

- Normal mode,
- Manual mode,
- Service mode.

3.4.3.1 NORMAL MODE

In the normal mode of operation the opening (turning on) or closing (turning off) of the element is done automatically. The PCU16 software prevents performing actions that could result in damage to the turbomolecular pump.

To select the normal mode of operation the following steps should be taken:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Mode***.
4. Tap ***normal***.
5. Normal mode of operation is selected.

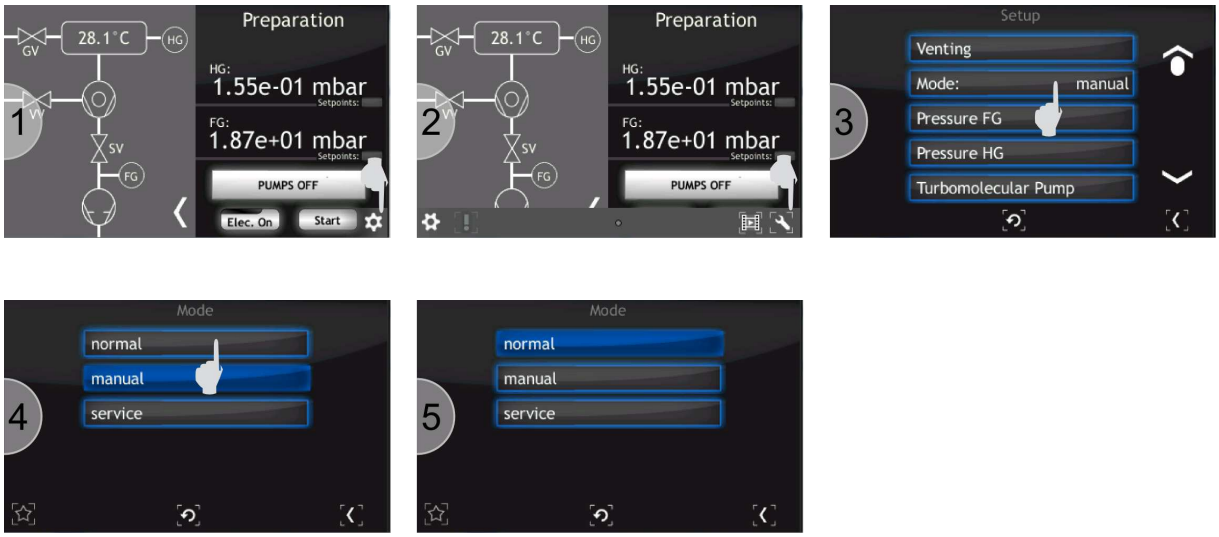


Figure 3.38: Selecting normal mode of operation

3.4.4 MODE SELECTION (Configuration R)

In the R-type configuration of the PCU16 two modes of operation are available :

- Normal mode,
- Service mode.

3.4.4.1 NORMAL MODE

In the normal mode the opening (turning on) or closing (turning off) of the element is done by manual change its state. The system only monitors if the operation is allowed or not at the time. There are also some elements of the automatic operation.

To select the normal mode of operation the following steps should be taken:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Mode***.
4. Tap ***normal***.
5. Normal mode of operation is selected.

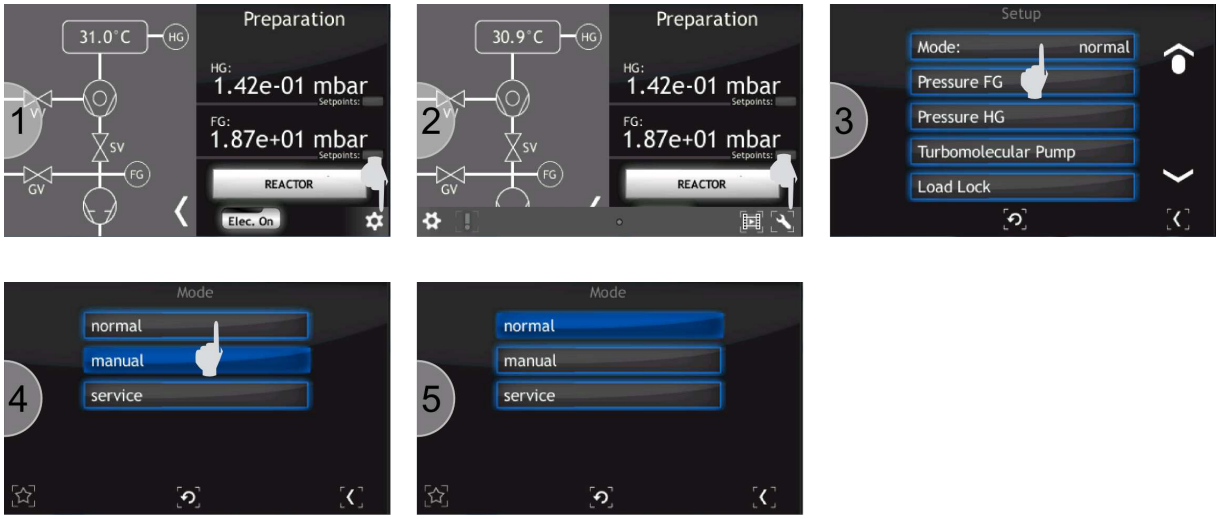


Figure 3.39: Selecting normal mode of operation

3.4.4.2 SERVICE MODE

In the service mode the opening (turning on) or closing (turning off) of the element is performed manually. **The system does not monitor if the operation is allowed or not at the time.**

Note: To access this mode of operation the password is required.

WARNING

Possible damage of the device.
In the service mode of operation the user can manually operate each supported device in the PCU16. As a result it is possible to damage some devices during this operation. Using this mode is allowed only for authorized persons.

3.4.4.3 MANUAL MODE

In the manual mode the opening (turning on) or closing (turning off) of the element is performed manually. The system only monitors if the operation is allowed or not at the time. There are also some elements of automatic operation.

Note: To access this mode of operation the password is required!

In order to select the manual mode of operation the following steps should be taken:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Mode***.
4. Tap ***manual***.
5. Enter the password on the alphanumeric keyboard: tap the ***Additional characters*** button and enter ***6161***.
6. Tap the ***Enter*** button in order to confirm a password.
7. Manual mode of operation is selected.

Figure 3.40: Selecting manual mode of operation

3.4.4.4 SERVICE MODE

In the service mode the opening (turning on) or closing (turning off) of the element is performed manually. **The system does not monitor if the operation is allowed or not at the time.**

Note: To access this mode of operation the password is required.

WARNING

Possible damage of the device.
In the service mode of operation the user can manually operate each supported device in the PCU16. As a result it is possible to damage some devices during this operation. Using this mode is allowed only for authorized persons.

3.4.5 FORE VACUUM GAUGE CONFIGURATION (Configuration U)

The PCU16 can control two fore vacuum gauges. The sockets for connecting the gauge heads are located on the rear panel of the device. The device must be properly configured to ensure the correct operation of the connected gauge types. The menu ***Pressure FG1*** allows the user to configure the input Channel 1 according to the connected first fore vacuum gauge. Similarly, the ***Pressure FG2*** menu is used to configure Channel 2 in accordance with the attached second fore vacuum gauge.

3.4.6 FORE AND HIGH VACUUM GAUGE CONFIGURATION

The PCU16 can control two pressure gauge heads: the fore vacuum gauge and the high vacuum gauge. The sockets for connecting the gauge heads are located on the rear panel of the device. The device must be properly configured to ensure the correct operation of the connected gauge types. The menu ***Pressure FG*** allows the user to configure the input Channel 1 according to the connected fore vacuum gauge. Similarly, the ***Pressure HG*** menu is used to configure Channel 2 in accordance with the attached high vacuum gauge.

To change pressure channel settings go to:
Setup Menu -> Pressure FG/HG
The PCU16 accommodates two pressure gauge heads connections. The sockets for connecting the gauge heads are located on the rear panel of the device. The device must be properly configured to ensure the correct operation of the connected gauge types. To do this, go to the configuration menu and then select *Pressure FG/HG*. Configuration options are described below:
Setup Menu -> Pressure FG/HG -> Setpoints:
Setpoint Low – when reached, the Setpoint Low value is indicated by the Setpoint LED switched off.
Setpoint High – when reached, the Setpoint High value is indicated by the Setpoint LED associated with that measuring channel.
The *Setpoint* value is limited by the device to the range 1.00E-15 – 1.00E-2 mbar. The software does not allow setpoint values outside of this range. It is also not possible to set the *Setpoint Low* with a value greater than the *Setpoint High* and vice versa.
Setup Menu -> Pressure FG/HG -> Unit:
Unit - selection of the pressure display unit.

- **mbar** – the pressure is displayed in millibars.
- **Torr** – the pressure is displayed in Torr.
- **Pa** – the pressure is displayed in Pascals.
- **psia** – the pressure is displayed in pound per square inch (psi).

Changing the displayed measurement units is also possible from the main panel, by tapping Unit field.
Setup Menu -> Pressure FG/HG -> Gauge:

Gauge - type of head selection. Please choose the specific type of head connected to the device. The following types of heads are currently supported: **CTR90/91, TTR90/91, TTR211, PTR225, PKR251, PCR280, PTR90, ITR90, ITR100, Baratron, MKS 937A, PG105, MG13/14** and **ANALOG IN**.
CTR90/91 and *Baratron* models require the additional parameter FS (Full Scale) according to the type of the head attached. This parameter defines the measuring range associated with the specific gauge type. For *CTR90/91* heads, the FS value is expressed in units of *Torr*. For *MKS970B* heads, the FS value is expressed in units of *Torr* and *psi*.
The *PG105* head requires an initial calibration procedure, which is necessary for the correct vacuum display. This is a two-point calibration: at atmospheric pressure and under vacuum. Connection of the *PG105* head requires an additional amplifier (PGA13), shown on the 3.41. The *PG105* is not part of a set PCU16 and has to be ordered separately.

Figure 3.41: Pirani PG105 amplifier

Setup Menu -> Pressure FG/HG -> Gas Type:
Gas Type – defines the process gas correction factor. Sensors are normally calibrated for measurement in nitrogen or in air. If pressure measurements are being performed with other gases, it will be necessary to correct the reading accordingly. The Gas Type parameter is used to adjust the correction factor for the respective gas type. The actual pressure is obtained by multiplying the measured pressure with the correction factor:

$$P = P_{AIR} \cdot R_g \tag{3.1}$$

Where:

P : pressure

P_{AIR} : pressure in air

R_g : gas correction factor

If the gas is not available on the included list it can be defined by the user by selecting *Define* and then manually entering the gas correction value.
Setup Menu -> Pressure FG/HG -> Filter:
Filter – filtering pressure value. Filtering is done by averaging the measured voltage. Depending on the selected parameter(**Low, Medium, High**) changes as the number of samples taken to averaging.
Setup Menu -> Pressure FG/HG -> Degas:
A degas procedure is available for ionization gauge heads *(ITR90, ITR100 ...)* . The PCU16 main panel displays information about the degas state. From the setup menu it is possible to configure the duration of degas and turn degas on/off:
Time - duration of degas (1 - 30min)
Degas - turn degas *on* and *off*

3.4.7 TURBOMOLECULAR PUMP SETTINGS

In order to set the deceleration time of the turbomolecular pump, the following steps should be taken:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Turbomolecular Pump***.
4. Tap ***Deceleration Time***.
5. Enter desired value (1 s to 60000 s) on the numeric keyboard.
6. Confirm by tapping ***Enter*** button.
7. New value is set.

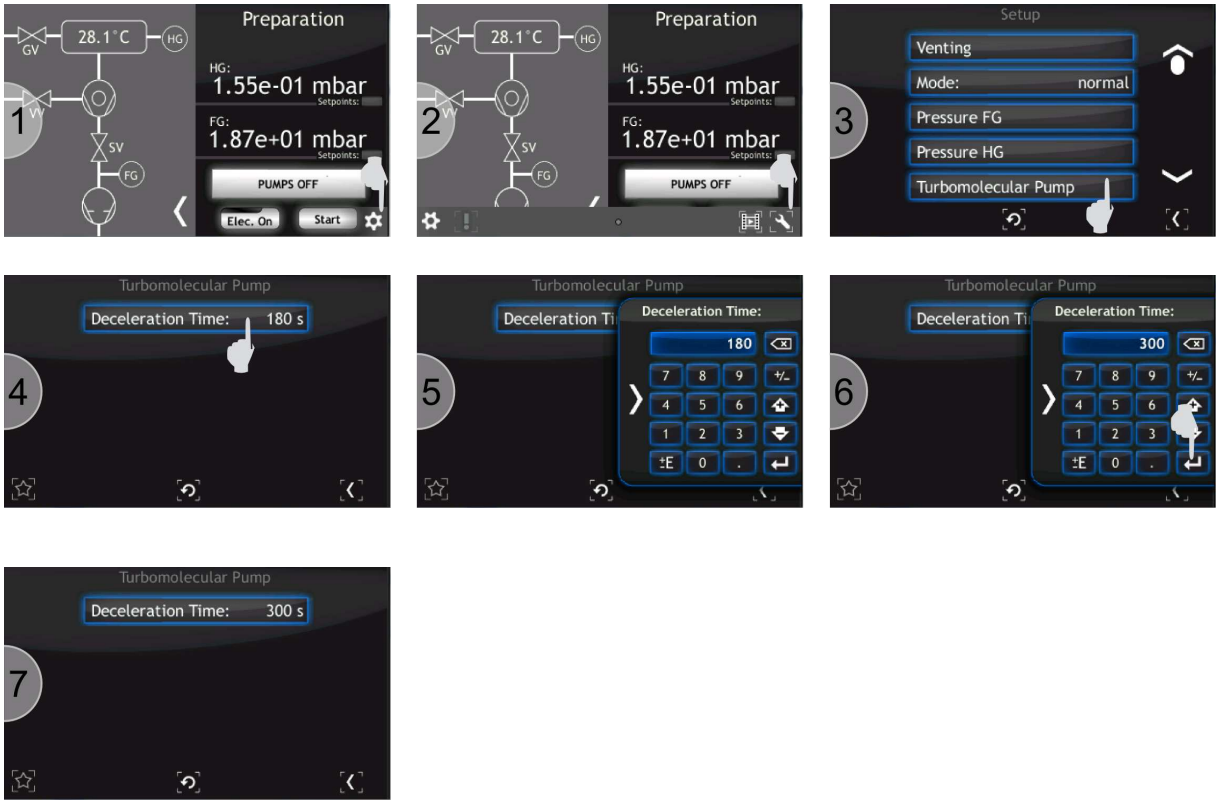


Figure 3.42: Setting turbo molecular pump deceleration time

When the turbomolecular pump is controlled via RS232/485 interface, the pump parameters can be read. These include the rotation speed, actual rotation, supply voltage, motor current, motor temperature, converter temperature, bearing temperature and error code. In order to see values of these parameters:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Turbomolecular Pump***.
4. Tap ***Parameters TMP***.

5. The parameters are shown.

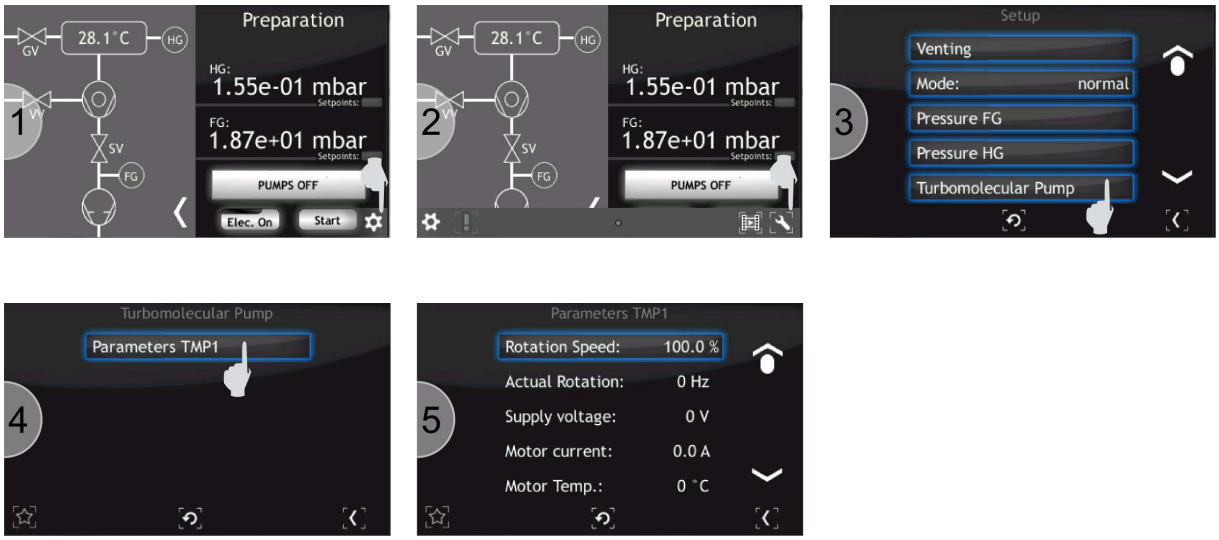


Figure 3.43: Reading the turbo molecular pump parameters

The rotation speed parameter can also be set by the user. In order to do it, the following steps should be taken:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Turbomolecular Pump***.
4. Tap ***Parameters TMP***.
5. Tap ***Rotation Speed***.
6. Enter desired value (0 % to 100 %) on the numeric keyboard.
7. Confirm by tapping ***Enter*** button.
8. New value is set.

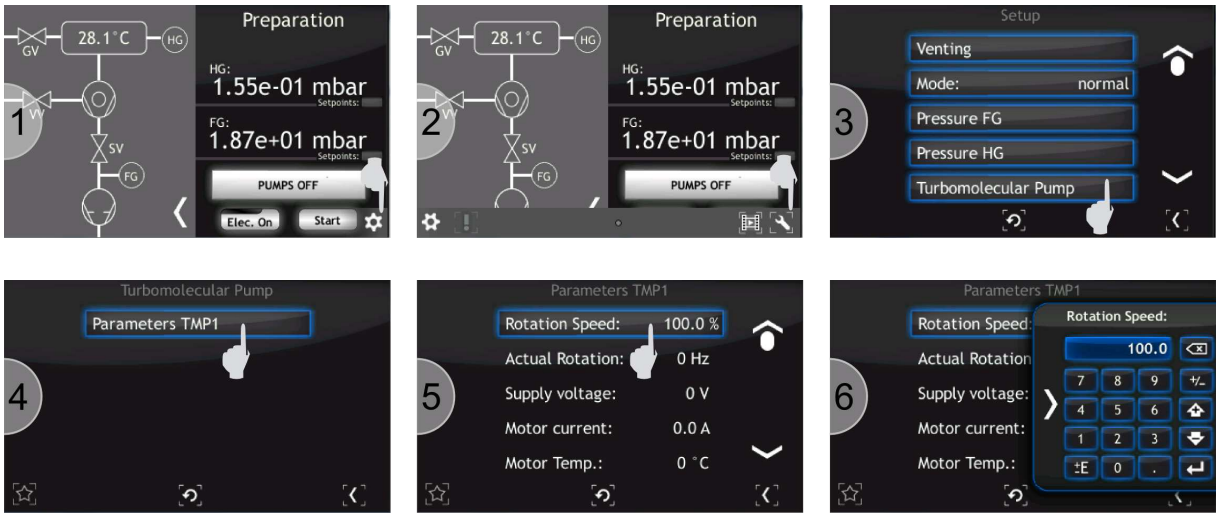
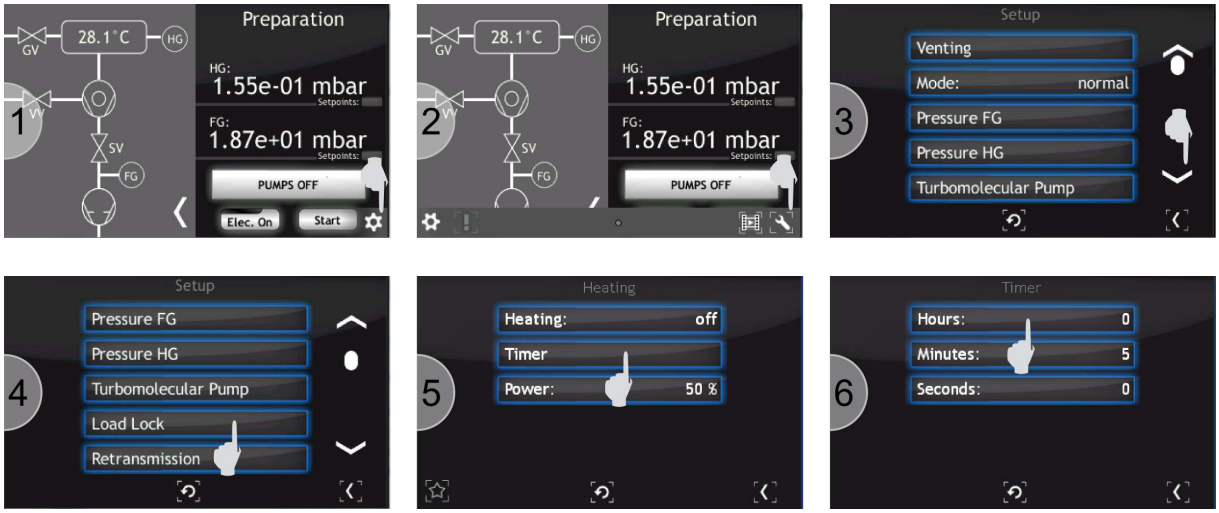


Figure 3.44: Setting turbo molecular pump rotation speed

3.4.8 LOAD LOCK HEATING SETTINGS

The PCU16 also provides the possibility to control a load lock heater. The setup menu allows free selection of both heating duration and heating power as well as on/off controls.
In order to set the heating time:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Arrow***.
4. Tap ***Load Lock***.
5. Tap ***Timer***.
6. Select value (Hours[0-99], Minutes[0-59] or Second[0-59]) e.g. Hours
7. Enter desired value on the numeric keyboard. Confirm by tapping ***Enter*** button.
8. New value is set.



To turn on the heating the following steps should be taken:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Arrow***.
4. Tap ***Load Lock***.

Figure 3.45: Setting the Load Lock heating time

5. Tap ***Heating***.
6. The ***Heating*** is on.
7. Tap on ***Setup Exit*** button.
8. The state of the heating process is now displayed on the main screen.

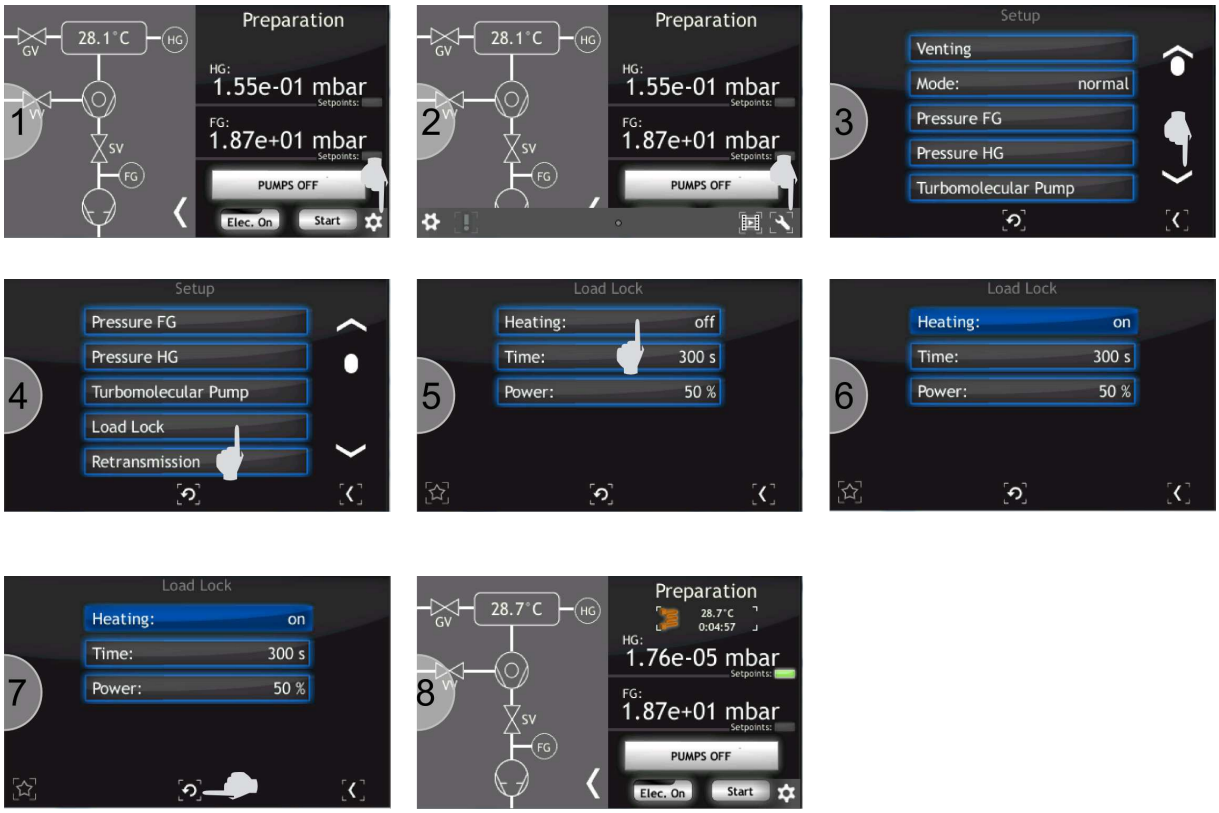


Figure 3.46: Turning on the Load Lock heating

To set the heating power:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Arrow***.
4. Tap ***Load Lock***.
5. Tap ***Power***.

6. Enter desired value (1 % to 100 %) on the numeric keyboard.
7. Confirm by tapping ***Enter*** button.
8. New value is set.

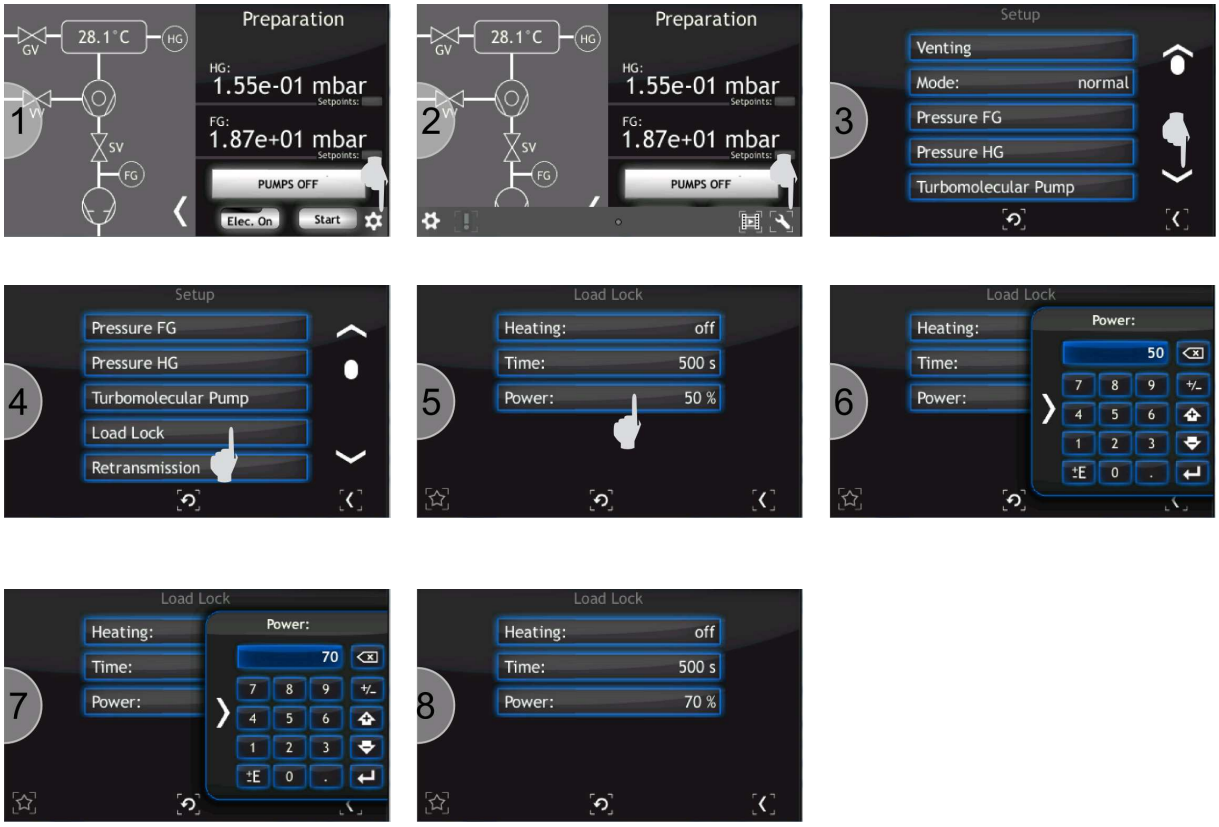


Figure 3.47: Setting the Load Lock heating power

3.4.9 BAKEOUT SETTINGS

The PCU16 also provides the option to control a bakeout heater. The setup menu allows free selection of both heating duration and heating power as well as on/off controls.

To turn on heating the following steps should be taken:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Arrow***.
4. Tap ***Bakeout***.
5. Tap ***Heating***.
6. The ***Heating*** is on. Tap on ***Setup Exit*** button.
7. The state of the heating process (temperature and the heating icon) is now displayed on the main screen.

Figure 3.48: Turning on the bakeout heating

In order to set the bakeout heating temperature:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Arrow***.
4. Tap ***Bakeout***.
5. Tap ***Temperature***.
6. Enter desired value (1 °C to 400 °C) on the numeric keyboard.
7. Confirm by tapping ***Enter*** button.
8. New value is set.

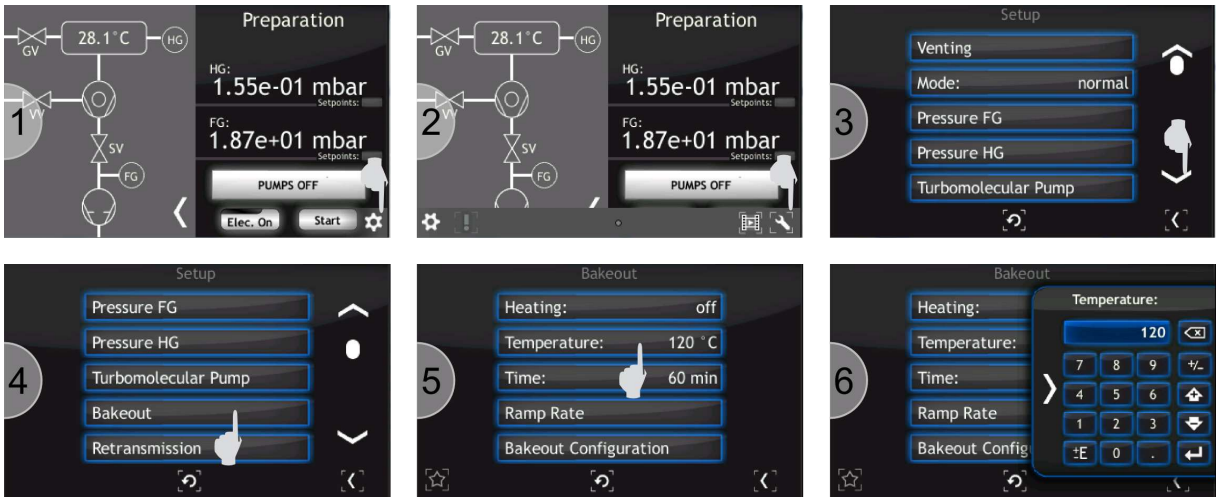


Figure 3.49: Setting the bakeout heating temperature

The next step is setting the bakeout heating time:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Arrow***.
4. Tap ***Bakeout***.
5. Tap ***Timer***.
6. Select value (Hours[0-99], Minutes[0-59] or Second[0-59]) e.g. Minutes
7. Enter desired value on the numeric keyboard. Confirm by tapping ***Enter*** button.
8. New value is set.

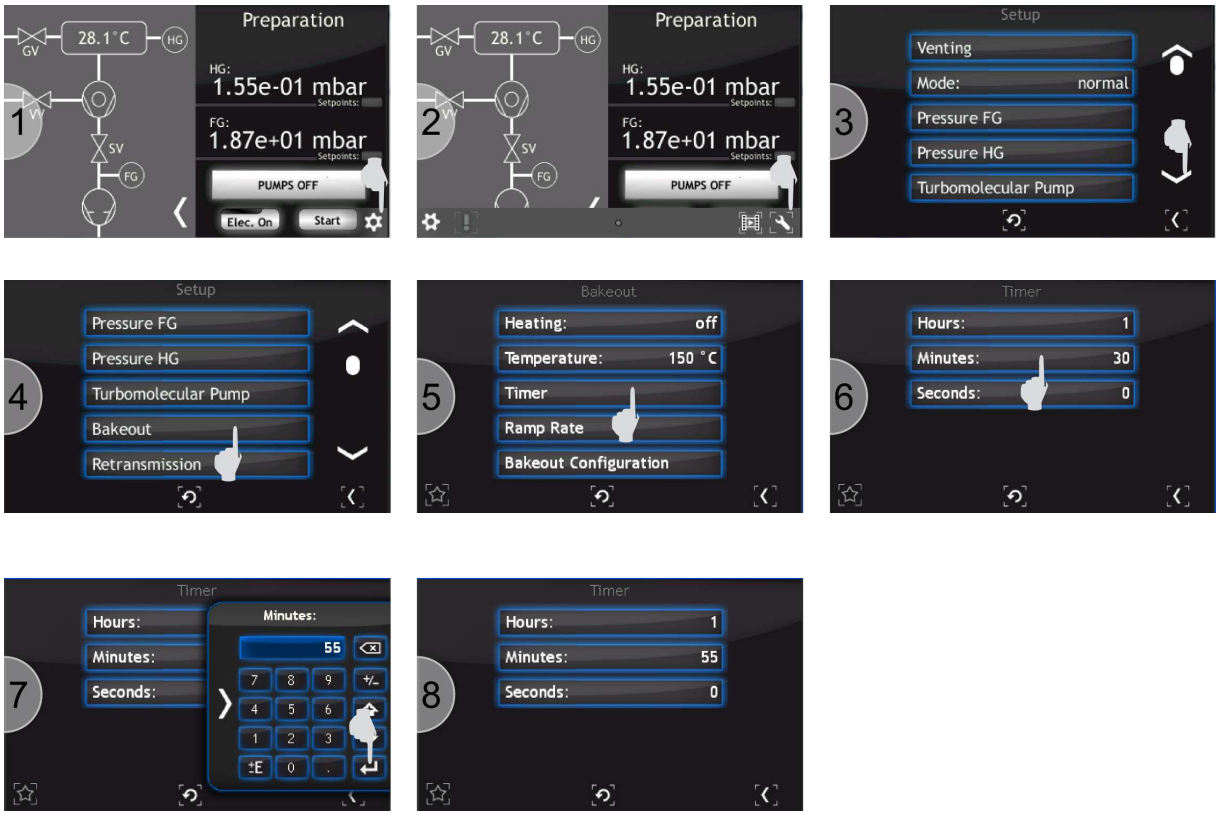


Figure 3.50: Setting the bakeout heating time

Also the bakeout ramp rate can be set in the setup menu:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Arrow***.
4. Tap ***Bakeout***.
5. Tap ***Ramp Rate***.
6. Tap ***Ramp Rate***.
7. Enter desired value on the numeric keyboard.
8. Confirm by tapping ***Enter*** button.
9. New value is set. Tap ***Ramp Rate Unit*** to choose the unit.
10. Tap on selected unit.
11. The unit is set.

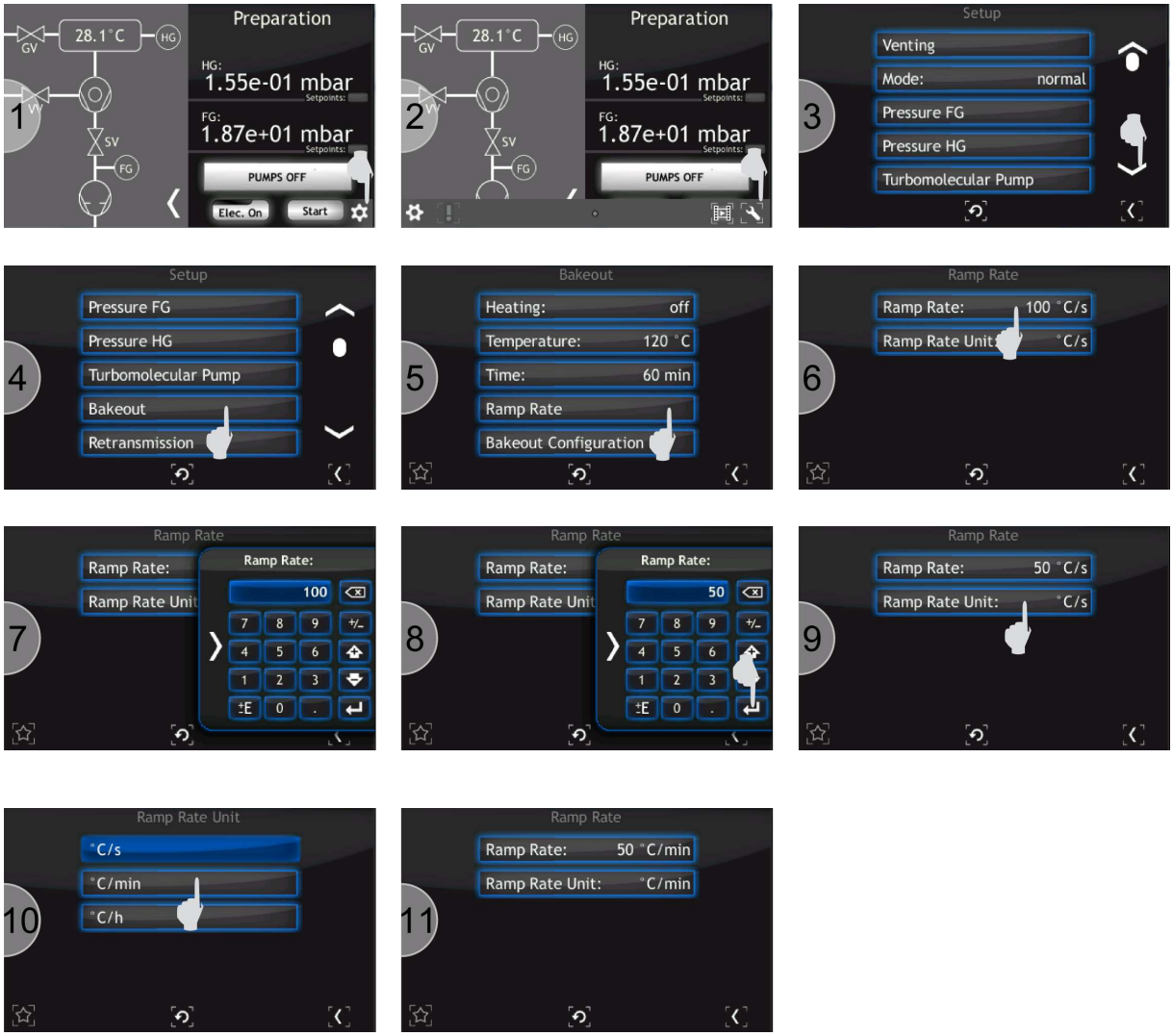


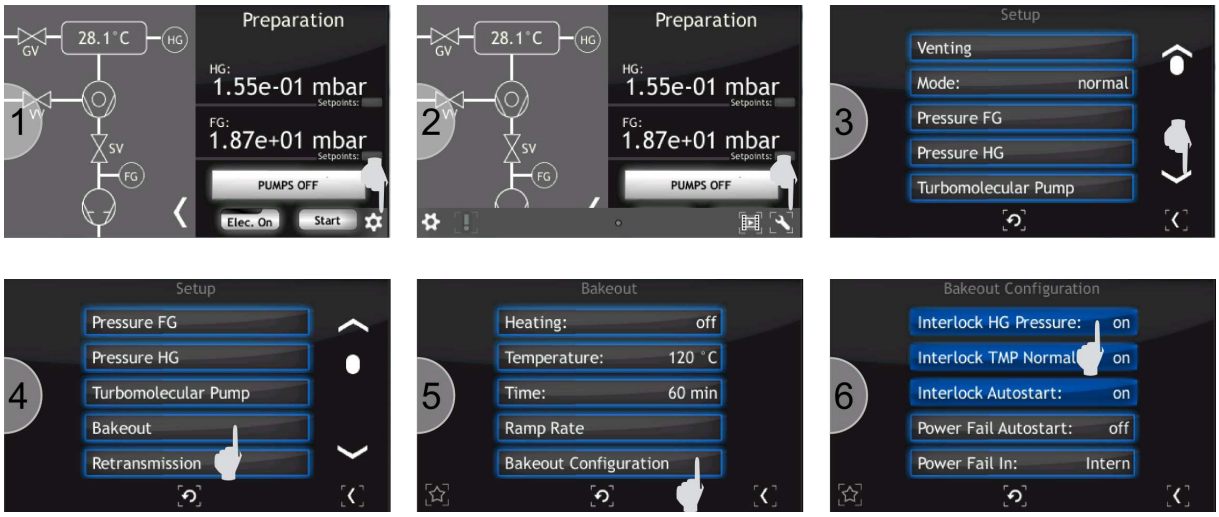
Figure 3.51: Setting the bakeout heating ramp rate

The following bakeout configuration options can be set:

- Interlock HG Pressure - turning on this option prevents heating in the absence of the high vacuum gauge setpoint,
- Interlock TMP Normal - turning on this option prevents heating in the absence of Normal Operation signal from the turbomolecular pump,
- Interlock Autostart - when this option is on, the heating process will be restored after interruption caused by Interlock HG Pressure or Interlock TMP Normal,
- Power Fail Autostart - when this option is on, the heating process will be restored after interruption caused by power failure,
- Power Fail In - when ***Inter*** is selected, an internal power failure signal is taken into account, when ***Extern*** is chosen, the Power Fail signal is derived from to the external socket.

To configure the bakeout heating the following steps should be taken:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Arrow***.
4. Tap ***Bakeout***.
5. Tap ***Bakeout Configuration***.
6. Tap one of the Interlocks to on/off it.
7. Tap ***Power Fail In*** to select internal or external.
8. New value is set.



3.4.10 RETRANSMISSION CONFIGURATION

The PCU16 device has the ability to retransmit the pressure measurement from the Channel 1 and Channel 2. These signals can be registered by an external device. The retransmission process can be configured from the setup menu.

The input signal can be retransmitted from:

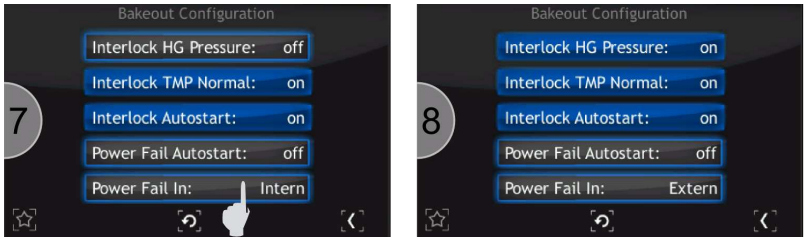
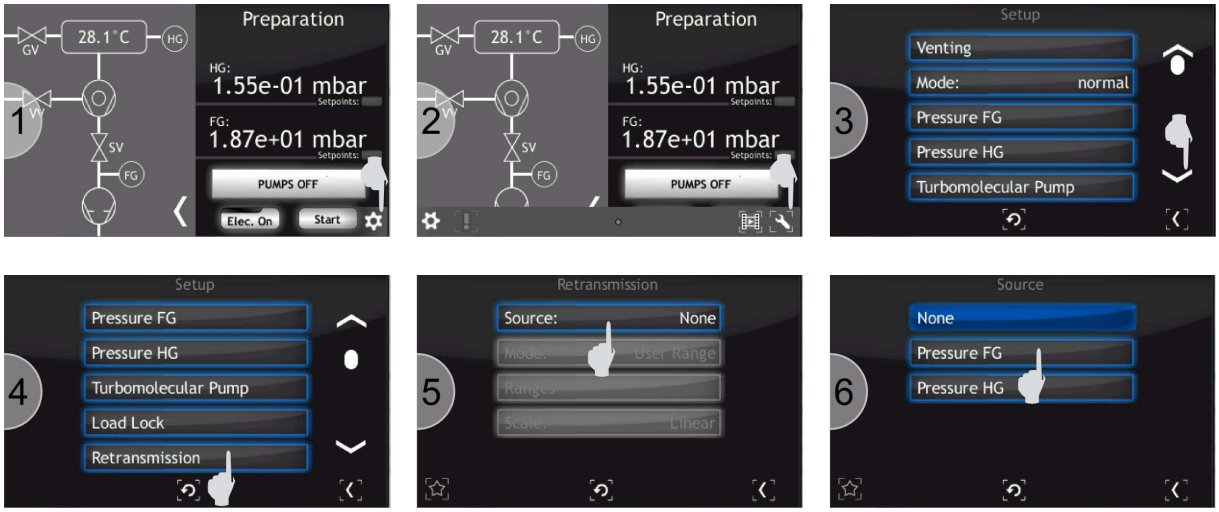


Figure 3.52: Setting the bakeout configuration

- Pressure FG - the device converts and transmits a signal from the fore vacuum gauge,
- Pressure HG - the device converts and transmits a signal from the high vacuum gauge,
- NONE - no signal is retransmitted (retransmission off).

In order to choose the input signal source:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Arrow***.
4. Tap ***Retransmission***.
5. Tap ***Source***.
6. Tap ***Pressure FG*** or ***Pressure HG***.
7. The source is selected.



There are three different modes of signal retransmission:

- 1 to 1 - the signal is retransmitted directly from the input to the output,
- EXPO - the output voltage is calculated on the basis of the exponent, without taking into account the mantissa. Starting from pressure of E-14, output voltage increases by 0.5 V for every decade above this level (e.g. 1E-14 is equivalent to 0 V, 1E+6 is equivalent to 10 V):

$$U_{out} = \frac{Exponent+14}{2}[V]$$

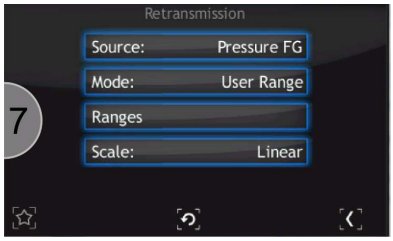
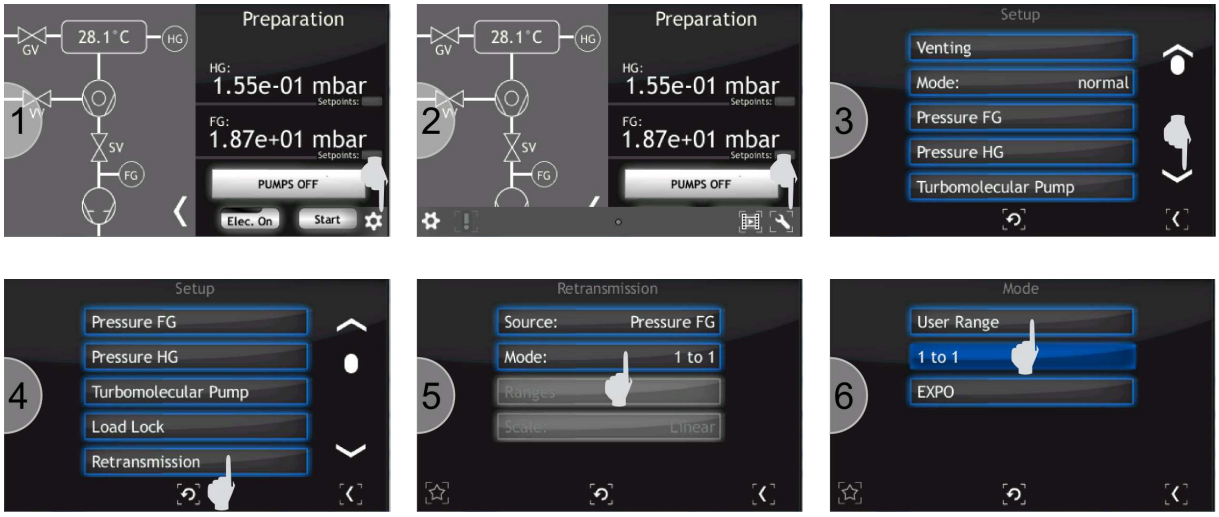


Figure 3.53: Selecting the retransmission source

- User Range - the user defines the pressure range which will be converted to the output voltage:
  - Min Pressure - the pressure value that corresponds to 0 V in the output,
  - Max Pressure - the pressure value that corresponds to 10 V in the output.

To choose the ***User Range*** mode of the measurement signal retransmission:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Arrow***.
4. Tap ***Retransmission***.
5. Tap ***Mode***.
6. Tap ***User Range***.
7. The mode is selected.



In order to select the other modes, proceed in a similar way.
If the ***User Range*** mode is selected, the ***Ranges*** and ***Scale*** parameters must be specified. To set the pressure ranges follow the instructions below:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.

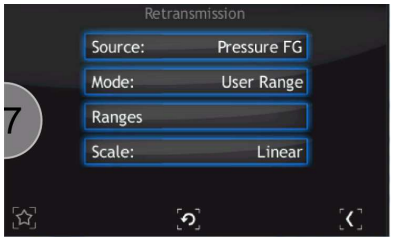
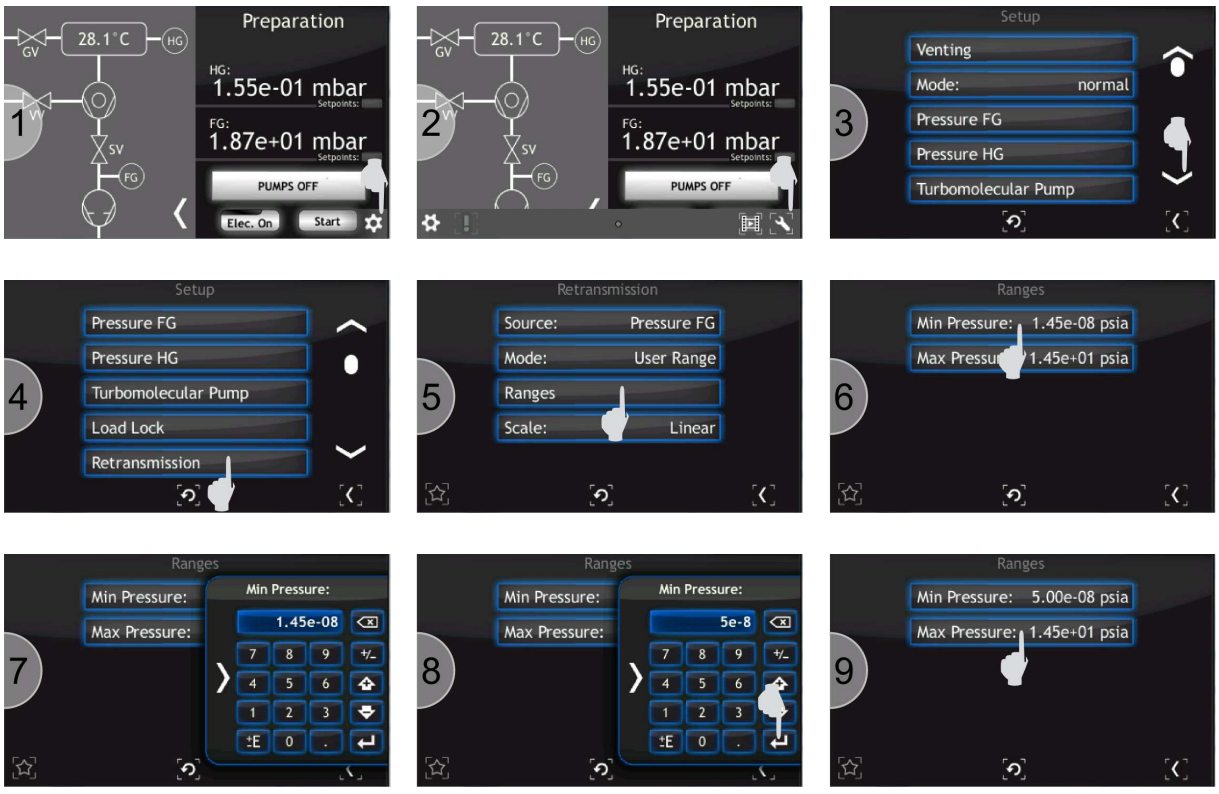


Figure 3.54: Selecting the retransmission mode

3. Tap ***Arrow***.
4. Tap ***Retransmission***.
5. Tap ***Ranges***.
6. Tap ***Min Pressure***.
7. Enter desired value on the numeric keyboard.
8. Confirm by tapping ***Enter*** button.
9. Tap ***Max Pressure***.
10. Enter desired value on the numeric keyboard.
11. Confirm by tapping ***Enter*** button.
12. The value is set.



The ***Scale*** parameter determines how the measured signal is converted. Two characteristics are possible:

Figure 3.55: Setting range in the User Range mode

- Linear -linear output. It is sometimes useful to retransmit the pressure over a narrow range, covering several decades. In this case, the output voltage is directly proportional to the pressure. 10 V corresponds to the upper limit, 0 V corresponds to the lower limit of User Range:

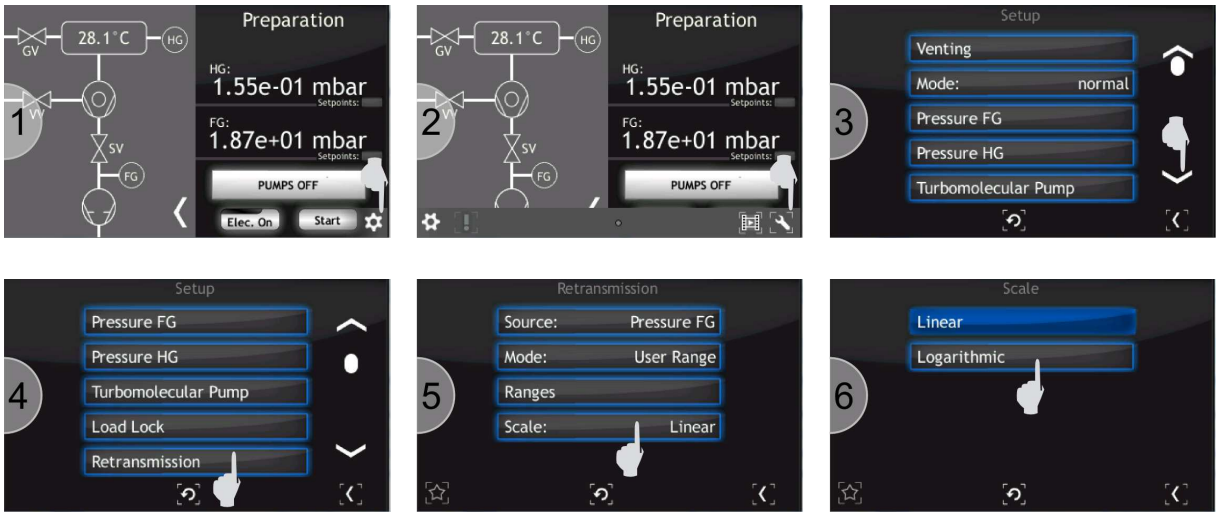
$$U_{out} = 10 \cdot \frac{reading - P_{Low}}{P_{High} - P_{Low}} [V]$$

- Logarithmic - logarithmic output. It is often useful to retransmit the pressure over a wide range, covering over a dozen decades. In this case it is most convenient to operate with a logarithm scale. The logarithmic range is defined according to the relation:

$$U_{out} = Log\left(\frac{reading}{P_{Low}}\right) \cdot \frac{10}{Log\left(\frac{P_{High}}{P_{Low}}\right)} [V]$$

The scale can be selected as follows:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Arrow***.
4. Tap ***Retransmission***.
5. Tap ***Scale***.
6. Tap ***Linear*** or ***Logarithmic***.
7. The scale is selected.



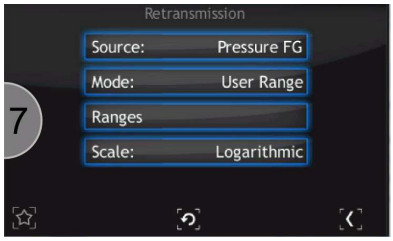
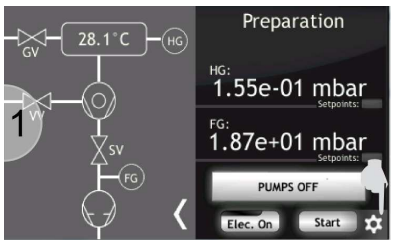


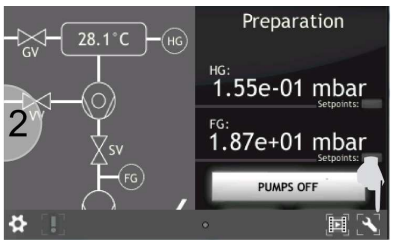
Figure 3.56: Selecting the retransmission scale

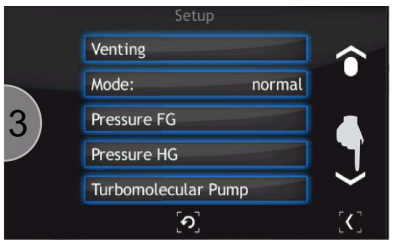
3.4.11 USER NAME

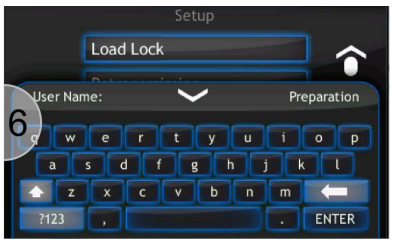
In order to set the system name which will be displayed on the main screen proceed according to the following instructions:

1. Tap ***Menu Bar***.
2. Tap ***Setup Menu***.
3. Tap ***Arrow***.
4. Tap ***Arrow***.
5. Tap ***User Name***.
6. Enter desired name on the alphanumeric keyboard.
7. Confirm by tapping ***Enter*** button.
8. New user name is set.
9. The user name is displayed on the main screen.









3.4.12 VALVES NAMES

Valves name displayed on the main screen can be changed to any three-letter value. In order to set change displayed valve name on the main screen proceed according to the following instructions:

1. Tap ***Menu Bar***.

Figure 3.57: Setting user name

2. Tap ***Setup Menu***.
3. Tap ***Arrow***.
4. Tap ***Valves names***.
5. Select desired valve to change.
6. Enter desired name on the keyboard.
7. Confirm by tapping ***Enter*** button.
8. New valve name is set.
9. The valve name is displayed on the main screen.

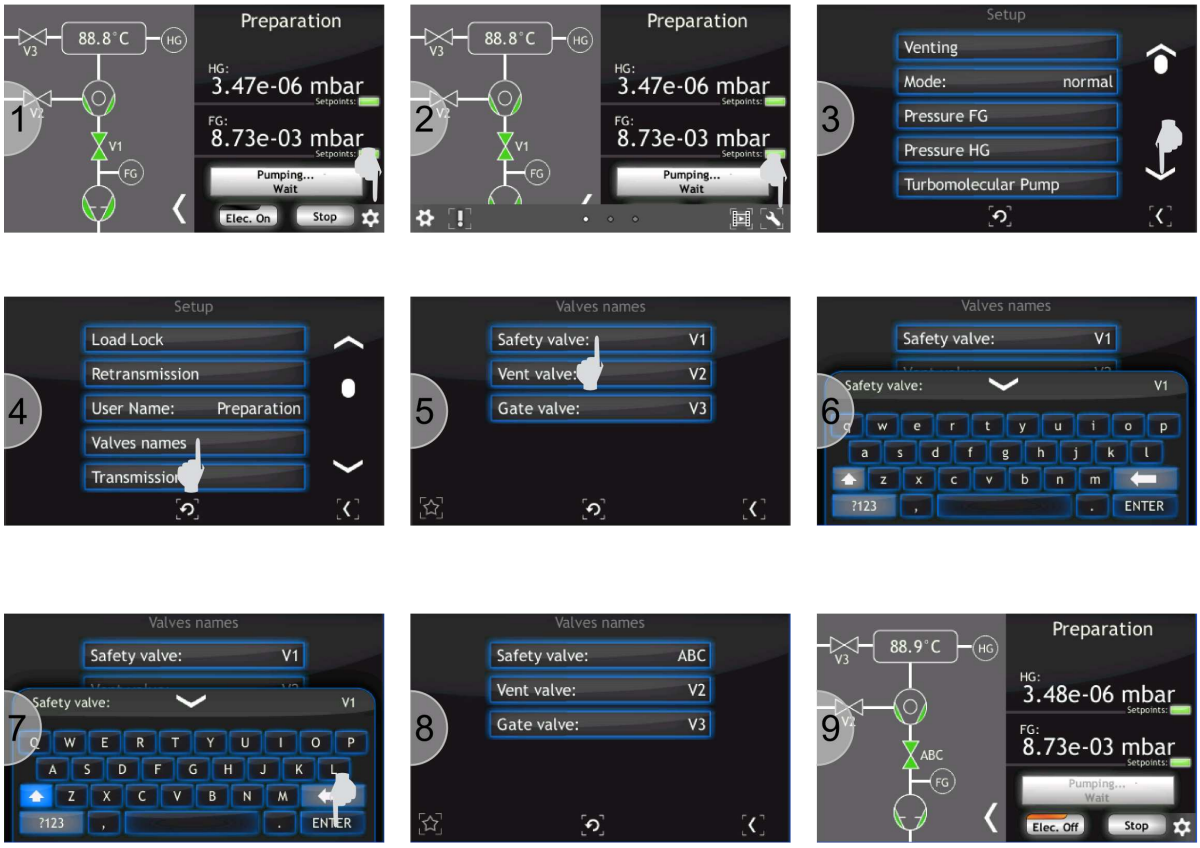


Figure 3.58: Setting valves names

3.4.13 COMMUNICATION SETTINGS

To change communication settings go to: ***Setup Menu -> Communication***
The communication setup allow to configure remote control interface. Allow options:

- **Interface** - determines which interface will be used for communication,
- **Parameters** - advanced parameters for selected module,
- **Host Address** - the device ID that have permission to control (save and set parameters),
- **Address** - the current address,

There are three types of communication interfaces available in the PCU16 :

- **Ethernet**
- **RS232**
- **RS485**

For details about pin assignment of RS232/485 see subsection 6
To change communication interface go to: ***Setup Menu -> Communication -> Interface***
Each communication interface is configured in ***Parameters*** submenu (***Setup Menu -> Communication -> Parameters***):

- ***Baud Rate*** (for interface RS232/RS485 only):
  - available speeds 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps,
  - 8 bits of data, 1 bit stop and no parity parameters are fixed and cannot be changed,
- ***IP*** - adjusted manually if DHCP is disabled. Automatically set in the opposite case, when the device is powered on,
- ***Mask*** - subnetwork mask (logically subdivision of an IP network),
- ***Gateway*** - default gateway on a TCP/IP network,
- ***DHCP*** - Dynamic Host Configuration:
  - ***enable*** - automatic configuration on connection (IP address, gateway, subnet mask),
  - ***disable*** - IP protocol parameters must be set manually,
- ***TCP server port*** - specifies the port number used in network socket created by TCP server,

3.4.14 SAVING AND LOADING SETTINGS

To save or load parameters go to: ***Setup Menu -> Save/Load***
When the PCU16 is powered off, the current device settings are lost. However, there are up to six different parameters slots which can be used to store current device parameters. Each can have an individual name and parameter set. The current status of the device (parameter values) can also be stored in memory.
In order to save the device configuration:

1. Go to menu ***Setup Menu -> Save/Load -> Save***.

2. Choose one of the sockets where settings will be stored (previous parameters will be erased) and tap it.
3. Enter desired name using keyboard.
4. Tap ***Enter*** button in order to accept given name.
5. Current parameters will be saved in the selected slot with a given name.

Restoring the saved settings is also achieved via the configuration menu. In order to load previously saved settings:

1. Go to menu ***Setup Menu -> Save/Load -> Load***.
2. Choose one of the slots from which device settings will be loaded and tap it.
3. Selected device settings will be loaded.

Default factory settings may also be loaded as follows:

1. Go to menu ***Setup Menu -> Save/Load***.
2. Tap ***Load Default*** in order to load factory settings.

3.4.15 DISPLAY SETTINGS

To change display settings go to: ***Setup Menu -> Display***
In *Display* submenu it is possible to change the following settings:
Brightness - display brightness value. Value can be in range 10-100

Touch Screen Autolock - When the value is set to ON the autolock function is active. If the touch panel is not used for longer than 3 min then the screen is locked. Unlock the device by pressing the "Yes" in the displayed message.

Customer Name - The device can be assigned individual name that appears on the top of main screen. This allows to distinguish between several devices of the same type.

System Date - The device has a built-in ***real time clock*** (RTC). The menu allows you to set the current date and time.
Setting a date should be the individual parts separated using the sign "-". For example: ***21-03-2014***
Setting a time should be the individual parts separated using the sign ":". For example: ***13:20:22***.
Alternate form of save time that are accepted: ***3:4:5 -> 03:04:05***, ***12:8:1 -> 12:08:01***

3.4.16 INFORMATION MENU

To display menu information go to:
Setup Menu -> Information.
This menu contains information about the device name and version, the current software version, serial and product number as well as the network parameters such as IP address, netmask and gateway.

3.4.17 LANGUAGE MENU

This submenu allows to change the device language.
In order to select the language go to ***Setup menu -> Language***.
To finish change the language the device must be reset.

3.4.18 LOGS MENU

To display logs menu go to ***Setup Menu -> Logs***.
This submenu displays the error history log. Displayed list of errors includes a description and the date of its occurrence

3.4.19 REBOOT

Restart the application running on the device. To restart device go to ***Setup Menu -> Reboot***.

4 STEP BY STEP

This chapter describes how to use the PCU16 in the normal and manual modes. It contains a description of the steps you must follow in order to start or stop the pumping system and the venting process.

4.1 CONFIGURATION A

4.1.1 NORMAL MODE OF OPERATION

In the normal mode of operation the opening (turning on) or closing (turning off) of the element is performed automatically. The PCU16 software prevents performing actions that could result in damage to the turbomolecular pump.

4.1.1.1 START PUMPING

1. Install the device to the system (Chapter 2. Installation).
2. Turn on the device (Chapter 3. Operating, ***Turn on device*** section).
3. Select the normal mode of operation (Chapter 3. Operating, ***Setup Menu*** section, ***Mode selection*** subsection).
4. Configure the fore and high vacuum gauges (Chapter 3. Operating, ***Setup Menu*** section, ***Fore and high vacuum gauges configuration*** subsection).
5. Set the turbomolecular pump deceleration time (Chapter 3. Operating, ***Setup Menu*** section, ***Turbomolecular pump settings*** subsection).
6. To start pumping the system, press the ***Start*** button on the main panel. If this action is prohibited there is an error (see Chapter 5. Troubleshooting).
7. After pressing ***Start***, the fore pump is on and the safety valve is closed. The information ***Pumping... Wait*** is displayed on the main screen.
8. Pumping continues with the safety valve closed until the vacuum reaches the ***Setpoint High*** value for the fore vacuum gauge.
9. When the Setpoint High is reached the safety valve opens and the system waits 3 seconds on a pressure equalization (the fore vacuum setpoint is not controlled at this time).
10. After re-pumping to the ***Setpoint High*** fore vacuum level, the turbomolecular pump starts.
11. The turbomolecular pump accelerates if the fore vacuum setpoint is reached. When the setpoint value is outside the range, the turbomolecular pump stops accelerating and waits until the setpoint is reached.
12. When the turbomolecular pump is in a normal operation state and the Setpoint High value for the high vacuum gauge is reached then the vacuum system/chamber is pumped and the information ***System Ready*** is displayed on the main screen of the PCU16.
13. It is possible to switch on the electronic output (see Chapter 2. Installation, ***Electrical Installation*** section, ***Power connectors*** subsection) by pressing the ***Elec. On*** button.

14. Disappearance of the setpoint for the high vacuum gauge in the ***System Ready*** state will cause the pumping system to shut down and generate the corresponding error message.

4.1.1.2 STOP PUMPING AND VENTING

To start the venting process:

1. Set the venting parameters (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).
2. Press the ***Stop*** button to turn off the pumping system.
3. The safety valve is opened and the pumps are switched off.
4. The vent valve opens and the venting process begins if there is no warning or error messages (see Chapter 5. Troubleshooting when any problems occurs).
5. The vent valve closes after the ***Venting Time*** (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).
6. The venting process can start automatically if the auto venting option is on (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).
7. The auto venting starts after ***Auto Venting Time*** and ends after ***Venting Time***.
8. The auto venting procedure will not start if normal ventilation conditions are not met.

4.1.1.3 GATE VALVE OPERATION

Depending on the system configuration options the gate valve may be 2- or 3-position and may be controlled automatically or manually. In the case of automatic control, there is an additional item in the ***Setup Menu*** to set the gate valve position. For a 3-position valve one of the positions: ***CLOSE***, ***PART. OPEN*** or ***OPEN*** can be set.

4.1.2 MANUAL MODE OF OPERATION

In manual mode the opening (turning on) or closing (turning off) of the element is performed manually. The system only monitors if the operation is allowed or not at the time. There are also some elements of automatic operation.
Description of possible changes in the state of the elements:

- Turning on the fore pump:
  - not allowed when power failure occurs (see Chapter 5. Troubleshooting),
  - automatically closes the vent valve.
- Turning off the fore pump:
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting),
  - automatically closes the safety valve and turns off the turbomolecular pump.
- Opening the safety valve:
  - not possible when the safety valve error occurs,

  - not allowed when there is no setpoint of the fore gauge and the turbomolecular pump is working.

- Closing the safety valve:
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting),
  - automatically turns off the turbomolecular pump.
- Opening the gate valve:
  - not possible in the GV ON CHECK configuration option when the vent valve is closed.
- Closing the gate valve:
  - always possible.
- Opening the vent valve:
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting),
  - not possible when the fore pump or the turbomolecular pump is on,
  - not permitted when a gate valve is opened and there is no the VENT ON GV configuration option,
  - not possible when the turbomolecular pump is off but is still decelerating,
  - not allowed when the high vacuum gauge setpoint is reached and the emission from the high vacuum gauge is on.
- Closing the vent valve:
  - always possible.
- Turning on the turbomolecular pump:
  - not allowed when the communication with a working turbomolecular pump is interrupted or the turbomolecular pump failure occurs (see Chapter 5. Troubleshooting),
  - not possible when the fore vacuum gauge failure occurs or the fore gauge setpoint is not reached (see Chapter 5. Troubleshooting),
  - not permitted when a power failure occurs (see Chapter 5. Troubleshooting),
  - not possible when the safety valve is closed.
- Turning off the turbomolecular pump:
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting).

Automatic functions of the system:

- The turbomolecular pump accelerates if the fore vacuum setpoint is reached. When the setpoint value is outside the range, the turbomolecular pump stops accelerating and waits until the setpoint is reached again.
- Closing the safety valve during the turbomolecular pump is accelerating or working normally, automatically stops the turbomolecular pump. However, if the safety valve is opened again and the other conditions allow the turbomolecular pump to work, the pump will be turned on automatically.

- When the turbomolecular pump is in normal operating state then the fore gauge setpoint disappearance causes an emergency shutdown of the turbomolecular pump, closing the safety valve and turning off the fore pump.

4.2 CONFIGURATION C

4.2.1 NORMAL MODE OF OPERATION

In the normal mode of operation the opening (turning on) or closing (turning off) of the element is performed automatically. The PCU16 software prevents performing actions that could result in damage to the turbomolecular pump.

4.2.1.1 START PUMPING

1. Install the device to the system (Chapter 2. Installation).
2. Turn on the device (Chapter 3. Operating, ***Turn on device*** section).
3. Select the normal mode of operation (Chapter 3. Operating, ***Setup Menu*** section, ***Mode selection*** subsection).
4. Configure the fore and high vacuum gauges (Chapter 3. Operating, ***Setup Menu*** section, ***Fore and high vacuum gauges configuration*** subsection).
5. To start pumping the system, press the ***Start*** button on the main panel. If this action is prohibited there is an error (see Chapter 5. Troubleshooting).
6. After pressing ***Start***, the fore pump is on and the safety valve is closed. The information ***Pumping... Wait*** is displayed on the main screen.
7. Pumping continues with the safety valve closed until the vacuum reaches the ***Setpoint High*** value for the fore vacuum gauge.
8. When the Setpoint High is reached the safety valve opens and the system waits 3 seconds on a pressure equalization (the fore vacuum setpoint is not controlled at this time).
9. After re-pumping to the ***Setpoint High*** fore vacuum level, the turbomolecular pump starts.
10. The turbomolecular pump accelerates if the fore vacuum setpoint is reached. When the setpoint value is outside the range, the turbomolecular pump stops accelerating and waits until the setpoint is reached.
11. When the turbomolecular pump is in a normal operation state and the Setpoint High value for the high vacuum gauge is reached then the vacuum system/chamber is pumped and the information ***System Ready*** is displayed on the main screen of the PCU16.
12. It is possible to switch on the electronic output (see Chapter 2. Installation, ***Electrical Installation*** section, ***Power connectors*** subsection) by pressing the ***Elec. On*** button.
13. Disappearance of the setpoint for the high vacuum gauge in the ***System Ready*** state will cause the pumping system to shut down and generate the corresponding error message.

4.2.1.2 STOP PUMPING AND VENTING

To start the venting process:

1. Set the venting parameters (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).
2. Press the ***Stop*** button to turn off the pumping system.
3. The safety valve is opened and the pumps are switched off.
4. The vent valve opens and the venting process begins if there is no warning or error messages (see Chapter 5. Troubleshooting when any problems occurs).
5. The vent valve closes after the ***Venting Time*** (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).
6. The venting process can start automatically if the auto venting option is on (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).
7. The auto venting starts after ***Auto Venting Time*** and ends after ***Venting Time***.
8. The auto venting procedure will not start if normal ventilation conditions are not met.

4.2.1.3 SECOND SAFETY VALVE OPERATION

Depending on the system configuration options the second safety valve may be 2- or 3-position and may be controlled automatically or manually. In the case of automatic control, there is an additional item in the ***Setup Menu*** to set the second safety valve position. For a 3-position valve one of the positions: ***CLOSE***, ***PART. OPEN*** or ***OPEN*** can be set.

4.2.2 MANUAL MODE OF OPERATION

In manual mode the opening (turning on) or closing (turning off) of the element is performed manually. The system only monitors if the operation is allowed or not at the time. There are also some elements of automatic operation.
Description of possible changes in the state of the elements:

- Turning on the fore pump:
  - not allowed when power failure occurs (see Chapter 5. Troubleshooting),
  - automatically closes the vent valve.
- Turning off the fore pump:
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting),
  - automatically closes the safety valve and turns off the turbomolecular pump.
- Opening the safety valve:
  - not possible when the safety valve error occurs,
  - not allowed when there is no setpoint of the fore gauge and the turbomolecular pump is working.
- Closing the safety valve:

  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting),
  - automatically turns off the turbomolecular pump.

- Opening the second safety valve:
  - not possible in the GV ON CHECK configuration option when the vent valve is closed,
  - not possible in the TMP ON SV2 configuration option when the high vacuum gauge setpoint is reached but the turbomolecular pump is not in the normal operation state.
- Closing the second safety valve:
  - always possible.
- Opening the vent valve:
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting),
  - not possible when the fore pump or the turbomolecular pump is on,
  - not permitted when the second safety valve is opened and there is no the VENT ON GV configuration option,
  - not possible when the turbomolecular pump is off but is still decelerating,
  - not allowed when the high vacuum gauge setpoint is reached and the emission from the high vacuum gauge is on.
- Closing the vent valve:
  - always possible.
- Turning on the turbomolecular pump:
  - not allowed when the communication with a working turbomolecular pump is interrupted or the turbomolecular pump failure occurs (see Chapter 5. Troubleshooting),
  - not possible when the fore vacuum gauge failure occurs or the fore gauge setpoint is not reached (see Chapter 5. Troubleshooting),
  - not permitted when a power failure occurs (see Chapter 5. Troubleshooting),
  - not possible when the safety valve is closed.
- Turning off the turbomolecular pump:
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting).

Automatic functions of the system:

- The turbomolecular pump accelerates if the fore vacuum setpoint is reached. When the setpoint value is outside the range, the turbomolecular pump stops accelerating and waits until the setpoint is reached again.
- Closing the safety valve during the turbomolecular pump is accelerating or working normally, automatically stops the turbomolecular pump. However, if the safety valve is opened again and the other conditions allow the turbomolecular pump to work, the pump will be turned on automatically.
- When the turbomolecular pump is in normal operating state then the fore gauge setpoint disappearance causes an emergency shutdown of the turbomolecular pump, closing the safety valve and turning off the fore pump.

4.3 CONFIGURATION D

4.3.1 NORMAL MODE OF OPERATION

In the normal mode of operation the opening (turning on) or closing (turning off) of the element is performed automatically. The PCU16 software prevents performing actions that could result in damage to the turbomolecular pump.

4.3.1.1 START PUMPING

1. Install the device to the system (Chapter 2. Installation).
2. Turn on the device (Chapter 3. Operating, ***Turn on device*** section).
3. Select the normal mode of operation (Chapter 3. Operating, ***Setup Menu*** section, ***Mode selection*** subsection).
4. Configure the fore and high vacuum gauges (Chapter 3. Operating, ***Setup Menu*** section, ***Fore and high vacuum gauges configuration*** subsection).
5. To start pumping the system, press the ***Start*** button on the main panel. If this action is prohibited there is an error (see Chapter 5. Troubleshooting).
6. After pressing ***Start***, the fore pump is on and all the valves are closed. The information ***Pumping... Wait*** is displayed on the main screen.
7. Pumping continues with the valves closed until the vacuum reaches the ***Setpoint*** value for the fore vacuum gauge.
8. When the Setpoint is reached, the condition of the bypass valve (V4) opening is checked. There are two possibilities of further pumping. If the vacuum in the chamber is better than the fore vacuum, the bypass valve will not open. And if it is worse, the valve will open:
    - The vacuum in the chamber is better than fore vacuum and the bypass valve does not open:
        - When the fore vacuum gauge ***Setpoint*** is reached, the first safety valve (V1) opens and the turbomolecular pump starts.
        - When the turbomolecular pump is in normal operation (NO) state, the second safety valve (V3) opens.
    - The vacuum in the chamber is worse than fore vacuum and the bypass valve opens:
        - When the fore vacuum gauge ***Setpoint*** is reached, the bypass valve (V4) opens and and the system waits on a pressure equalization.
        - After re-pumping to the ***Setpoint*** fore vacuum level, the first safety valve (V1) opens and the system waits on a pressure equalization.
        - After re-pumping to the ***Setpoint*** fore vacuum level, the bypass valve (V4) closes, the second safety valve (V3) opens and the turbomolecular pump starts.
9. The turbomolecular pump accelerates if the fore vacuum setpoint is reached. When the setpoint value is outside the range, the turbomolecular pump stops accelerating and waits until the setpoint is reached.
10. When the turbomolecular pump is in a normal operation state and the Setpoint value for the high vacuum gauge is reached, then the vacuum system/chamber is pumped and the information ***System Ready*** is displayed on the main screen of the PCU16.

11. Disappearance of the setpoint for the fore vacuum gauge in the ***System Ready*** state will cause the pumping system to shut down and generate the corresponding error message.

4.3.1.2 STOP PUMPING AND VENTING

To start the venting process:

1. Set the venting parameters (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).
2. Press the ***Stop*** button to turn off the pumping system.
3. The bypass valve and the second safety valves are closed, the first safety valve is opened and the pumps are switched off.
4. The vent valve opens and the venting process begins if there is no warning or error messages (see Chapter 5. Troubleshooting when any problems occurs).
5. The vent valve closes after the ***Venting Time*** (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).
6. The venting process can start automatically if the auto venting option is on (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).
7. The auto venting starts after ***Auto Venting Time*** and ends after ***Venting Time***.
8. The auto venting procedure will not start if normal ventilation conditions are not met.

NOTE:
During the venting process the bypass valve (V4) and the second safety valve (V3) are closed. Only the pump group is ventilated. Venting of the chamber is possible via the optional additional valve, connected in parallel with the venting valve (V2). On the vacuum diagram this optional valve is indicated by the dashed line.

4.3.2 MANUAL MODE OF OPERATION

In manual mode the opening (turning on) or closing (turning off) of the element is performed manually. The system only monitors if the operation is allowed or not at the time. There are also some elements of automatic operation.
Description of possible changes in the state of the elements:

- Turning on the fore pump:
  - not allowed when power failure occurs (see Chapter 5. Troubleshooting),
  - automatically closes the vent valve.
- Turning off the fore pump:
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting),
  - automatically closes the safety valve and turns off the turbomolecular pump.
- Opening the safety valve (V1):
  - not possible when the safety valve error occurs,

  - not allowed when there is no setpoint of the fore gauge and the turbomolecular pump is working.

- Closing the safety valve (V1):
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting),
  - automatically turns off the turbomolecular pump.
- Opening the second safety valve (V3):
  - not possible when the pressure difference on both sides of the valve is higher than 100 mbar, or when it is unknown.
- Closing the second safety valve (V3):
  - always possible.
- Opening the vent valve (V2):
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting),
  - not possible when the fore pump or the turbomolecular pump is on,
  - not permitted when the bypass valve or the second safety valve is opened,
  - not possible when the turbomolecular pump is off but is still decelerating,
  - not allowed when the high vacuum gauge setpoint is reached and the emission from the high vacuum gauge is on.
- Closing the vent valve (V2):
  - always possible.
- Opening the bypass valve (V4):
  - not possible when the turbomolecular pump is on, the safety valve is opened and the pressure in the chamber is unknown or lower than the fore vacuum.
- Closing the bypass valve (V4):
  - always possible.
- Turning on the turbomolecular pump:
  - not allowed when the communication with a working turbomolecular pump is interrupted or the turbomolecular pump failure occurs (see Chapter 5. Troubleshooting),
  - not possible when the fore vacuum gauge failure occurs or the fore gauge setpoint is not reached (see Chapter 5. Troubleshooting),
  - not permitted when a power failure occurs (see Chapter 5. Troubleshooting),
  - not possible when the safety valve is closed.
- Turning off the turbomolecular pump:
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting).

Automatic functions of the system:

- The turbomolecular pump accelerates if the fore vacuum setpoint is reached. When the setpoint value is outside the range, the turbomolecular pump stops accelerating and waits until the setpoint is reached again.
- Closing the safety valve during the turbomolecular pump is accelerating or working normally, automatically stops the turbomolecular pump. However, if the safety valve is opened again and the other conditions allow the turbomolecular pump to work, the pump will be turned on automatically.
- When the turbomolecular pump is in normal operating state then the fore gauge setpoint disappearance causes an emergency shutdown of the turbomolecular pump, closing the safety valve and turning off the fore pump.

4.4 CONFIGURATION T

4.4.1 NORMAL MODE OF OPERATION

In the normal mode of operation the opening (turning on) or closing (turning off) of the element is performed automatically. The PCU16 software prevents performing actions that could result in damage to the turbomolecular pump.

4.4.1.1 START PUMPING

1. Install the device to the system (Chapter 2. Installation).
2. Turn on the device (Chapter 3. Operating, ***Turn on device*** section).
3. Select the normal mode of operation (Chapter 3. Operating, ***Setup Menu*** section, ***Mode selection*** subsection).
4. Configure the fore and tank gauges (Chapter 3. Operating, ***Setup Menu*** section, ***Fore and high vacuum gauges configuration*** subsection).
5. Set the Pressure TMP Off setpoints (Chapter 3. Operating, ***Setup Menu*** section, ***Pressure TMP Off*** subsection).
6. To start pumping the system, press the ***Start*** button on the main panel. If this action is prohibited there is an error (see Chapter 5. Troubleshooting).
7. After pressing ***Start***, the fore pump is on and the safety valve is closed. The information ***Pumping... Wait*** is displayed on the main screen.
8. Pumping continues with the safety valve closed until the vacuum reaches the ***Setpoint High*** value for the fore vacuum gauge.
9. When the Setpoint High is reached the safety valve opens and the system waits 3 seconds on a pressure equalization (the fore vacuum setpoint is not controlled at this time).
10. After re-pumping to the ***Pressure TMP Off Setpoint Low***, the second safety valve opens and the turbomolecular pump starts.
11. The turbomolecular pump accelerates if the MG setpoint is reached. When the setpoint value is outside the range, the second safety valve closes and the turbomolecular pump stops accelerating and waits until the setpoint is reached.

12. When the turbomolecular pump is in a normal operation state and the Setpoint Low value for the tank gauge is reached, then the first safety valve closes and the fore pump stops.

13. The fore pump is turned on and the first safety valve is opened cyclically to maintain the MG setpoint in the tank. Operation of the system elements in the normal operation state is shown in Figure 4.1.

4.4.1.2 STOP PUMPING AND VENTING

The venting process is possible if the vent valve is present in the system (configuration option). To start the venting process:

1. Set the venting parameters (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).

2. Press the ***Stop*** button to turn off the pumping system. The first safety valve closes, the second safety valve opens and the turbo pump stops.

3. In the SV ON VENT configuration option the first safety valve must be opened and the fore pump must be turned off in order to start the venting process.

4. The vent valve opens and the venting process begins if there is no warning or error messages (see Chapter 5. Troubleshooting when any problems occurs).

5. The vent valve closes after the ***Venting Time*** (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).

6. The venting process can start automatically if the auto venting option is on (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).

7. The auto venting starts after ***Auto Venting Time*** and ends after ***Venting Time***.

8. The auto venting procedure will not start if normal ventilation conditions are not met.

4.4.2 MANUAL MODE OF OPERATION

In manual mode the opening (turning on) or closing (turning off) of the element is performed manually. The system only monitors if the operation is allowed or not at the time. There are also some elements of automatic operation.
Description of possible changes in the state of the elements:

- Turning on the fore pump:
  - not allowed when power failure occurs (see Chapter 5. Troubleshooting),
  - automatically closes the vent valve (if the system contains the vent valve).
- Turning off the fore pump:
  - always possible.
- Opening the safety valve:
  - not possible when the safety valve error occurs (see Chapter 5. Troubleshooting),
  - not allowed when there is no fore gauge setpoint.

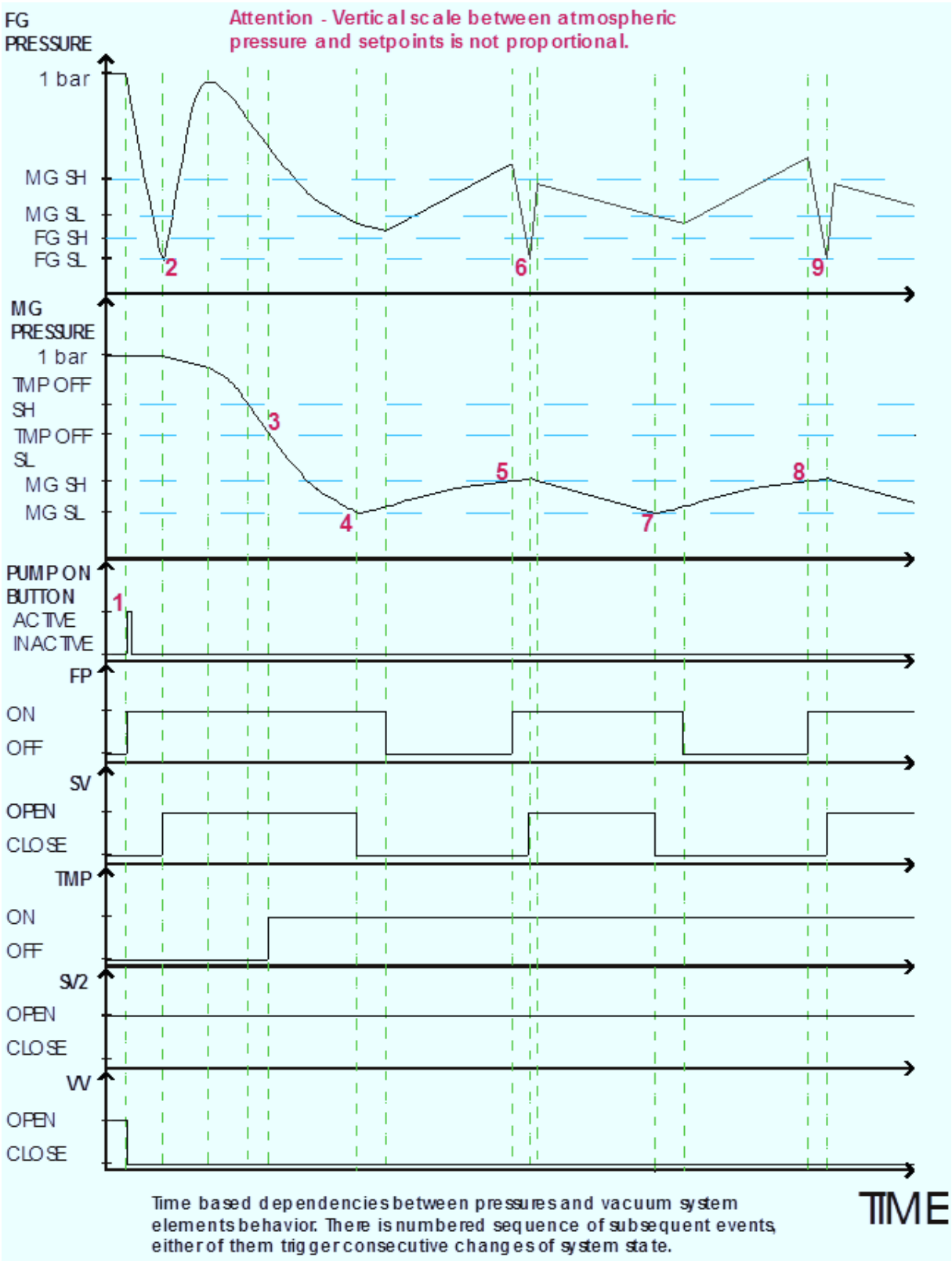


Figure 4.1: Operation process of the PCU16 in the T type configuration

- Closing the safety valve:
  - always possible.
- Opening the second safety valve:

  - not possible when the SV2 error occurs (see Chapter 5. Troubleshooting).

- Closing the second safety valve:
  - not allowed when the communication with a working turbomolecular pump is broken(see Chapter 5. Troubleshooting),
  - automatically turns off the turbomolecular pump.

- Opening the vent valve:
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting),
  - not possible when the fore pump or the turbomolecular pump is on,
  - not possible when the turbomolecular pump is off but is still decelerating.

- Closing the vent valve:
  - always possible.

- Turning on the turbomolecular pump:
  - not allowed when the communication with a working turbomolecular pump is interrupted or the turbomolecular pump failure occurs (see Chapter 5. Troubleshooting),
  - not possible when the tank gauge failure occurs (see Chapter 5. Troubleshooting),
  - not permitted when a power failure occurs (see Chapter 5. Troubleshooting),
  - not possible when the second safety valve is closed,
  - the TMP setpoint is not reached on the MG gauge.

- Turning off the turbomolecular pump:
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting).

Automatic functions of the system:

- The turbomolecular pump accelerates if the tank gauge setpoint is reached. When the setpoint value is outside the range, the turbomolecular pump stops accelerating and waits until the setpoint is reached again.

- Closing the second safety valve during the turbomolecular pump is accelerating or working normally, automatically stops the turbomolecular pump. However, if the safety valve is opened again and the other conditions allow the turbomolecular pump to work, the pump will be turned on automatically.

- When the turbomolecular pump is in normal operating state then the tank gauge setpoint disappearance causes an emergency shutdown of the turbomolecular pump and closing the second safety valve.

4.5 CONFIGURATION R

The pumping system in the R type configuration works in manual mode of operation. The opening (turning on) or closing (turning off) of the element is performed manually. The system only monitors if the operation is allowed or not at the time. There are also some elements of automatic operation.
Description of possible changes in the state of the elements:

- Turning on the fore pump:
  - not allowed when power failure occurs (see Chapter 5. Troubleshooting),
  - automatically closes the vent valve (if the system contains the vent valve).
- Turning off the fore pump:
  - not allowed when the communication with a working turbomolecular pump is broken(see Chapter 5. Troubleshooting),
  - automatically closes the safety valve, stops the turbomolecular pump and closes the gate valve.
- Opening the safety valve:
  - not possible when the safety valve error occurs (see Chapter 5. Troubleshooting),
  - not allowed when there is no fore gauge setpoint and the turbomolecular pump is not stopped.
- Closing the safety valve:
  - not allowed when the communication with a working turbomolecular pump is broken(see Chapter 5. Troubleshooting),
  - automatically turns off the turbomolecular pump.
- Opening the gate valve:
  - not possible in the GV ON CHECK configuration option when the vent valve is closed.
- Closing the gate valve:
  - always possible.
- Opening the vent valve:
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting),
  - not possible when the fore pump or the turbomolecular pump is on,
  - not permitted when the gate valve is opened and there is no the VENT ON GV configuration option,
  - not possible when the turbomolecular pump is off but is still decelerating,
  - not allowed when the high vacuum gauge setpoint is reached and the emission from the high vacuum gauge is on.
- Closing the vent valve:
  - always possible.

- Turning on the turbomolecular pump:
  - not allowed when the communication with a working turbomolecular pump is interrupted or the turbomolecular pump failure occurs (see Chapter 5. Troubleshooting),
  - not possible when the fore vacuum gauge failure occurs or the fore gauge setpoint is not reached (see Chapter 5. Troubleshooting),
  - not permitted when a power failure occurs (see Chapter 5. Troubleshooting),
  - not possible when the safety valve is closed.
- Turning off the turbomolecular pump:
  - not allowed when the communication with a working turbomolecular pump is interrupted (see Chapter 5. Troubleshooting).

Automatic functions of the system:

- The turbomolecular pump accelerates if the fore vacuum setpoint is reached. When the setpoint value is outside the range, the turbomolecular pump stops accelerating and waits until the setpoint is reached again.
- Closing the safety valve during the turbomolecular pump is accelerating or working normally, automatically stops the turbomolecular pump. However, if the safety valve is opened again and the other conditions allow the turbomolecular pump to work, the pump will be turned on automatically.
- When the turbomolecular pump is in normal operating state then the fore gauge setpoint disappearance causes an emergency shutdown of the turbomolecular pump, closing the safety valve and turning off the fore pump when the gate valve is closed.

4.6 CONFIGURATION U

4.6.1 NORMAL MODE OF OPERATION

In the normal mode of operation the opening (turning on) or closing (turning off) of the element is performed automatically. The PCU16 software prevents performing actions that could result in damage to the turbomolecular pump.

4.6.1.1 START PUMPING

1. Install the device to the system (Chapter 2. Installation).
2. Turn on the device (Chapter 3. Operating, ***Turn on device*** section).
3. Select the normal mode of operation (Chapter 3. Operating, ***Setup Menu*** section, ***Mode selection*** subsection).
4. Configure the fore and high vacuum gauges (Chapter 3. Operating, ***Setup Menu*** section, ***Fore and high vacuum gauges configuration*** subsection).
5. Set the turbomolecular pump deceleration time (Chapter 3. Operating, ***Setup Menu*** section, ***Turbomolecular pump settings*** subsection).
6. To start pumping the system, press the ***Start*** button on the main panel. If this action is prohibited there is an error (see Chapter 5. Troubleshooting).

7. After pressing ***Start***, two fore pumps start pumping the system with closed vent valves. The information ***Pumping... Wait*** is displayed on the main screen.
8. Pumping continues with the safety valve closed until the vacuum reaches the ***Setpoint High*** value for the both fore vacuum gauges FG1 and FG2.
9. When the setpoints are reached, the safety valves SV1 and SV2 open and the system waits 3 seconds on a pressure equalization (the fore vacuum setpoints are not controlled at this time). The safety valves are controlled by a single signal so they always work parallel.
10. After re-pumping to the ***Setpoint High*** value for both fore vacuum gauges, the turbomolecular pumps start. These pumps are controlled by a single signal so they always work parallel.
11. The turbomolecular pumps accelerate if the fore vacuum setpoints are reached. When the setpoint values are outside the range, the turbomolecular pumps stop accelerating and wait until the setpoints are reached.
12. When the turbomolecular pumps are in a normal operation state the vacuum system is pumped and the information ***System Ready*** is displayed on the main screen of the PCU16.
13. It is possible to switch on the electronic output (see Chapter 2. Installation, ***Electrical Installation*** section, ***Power connectors*** subsection) by pressing the ***Elec. On*** button.
14. Disappearance of the FG1 or FG2 setpoint in the ***System Ready*** state will cause the pumping system to shut down and generate the corresponding error message.

4.6.1.2 STOP PUMPING AND VENTING

To start the venting process:

1. Set the venting parameters (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).
2. Press the ***Stop*** button to turn off the pumping system.
3. The safety valves are opened and the pumps are switched off.
4. The vent valves open and the venting process begins if there is no warning or error messages (see Chapter 5. Troubleshooting when any problems occurs).
5. The vent valves close after the ***Venting Time*** (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).
6. The venting process can start automatically if the auto venting option is on (Chapter 3. Operating, ***Setup Menu*** section, ***Venting settings*** subsection).
7. The auto venting starts after ***Auto Venting Time*** and ends after ***Venting Time***.
8. The auto venting procedure will not start if normal ventilation conditions are not met.

4.6.2 MANUAL MODE OF OPERATION

In manual mode the opening (turning on) or closing (turning off) of the element is performed manually. The system only monitors if the operation is allowed or not at the time. There are also some elements of automatic operation.
In the U-type configuration of the PCU16 all pumps and valves are doubled and they work parallel, so the change of the state of one element automatically changes the state of the parallel element.
Description of possible changes in the state of the elements:

- Turning on the fore pump:
  - not allowed when power failure occurs (see Chapter 5. Troubleshooting),
  - automatically closes the vent valve.
- Turning off the fore pump:
  - automatically closes the safety valves and turns off the turbomolecular pump.
- Opening the safety valve:
  - not possible when the safety valve error occurs,
  - not allowed when there is no setpoints of the fore gauges and the turbomolecular pumps are working.
- Closing the safety valve:
  - automatically turns off the turbomolecular pumps.
- Opening the vent valve:
  - not possible when the fore pump or the turbomolecular pump is on,
  - not possible when the turbomolecular pump is off but is still decelerating.
- Closing the vent valve:
  - always possible.
- Turning on the turbomolecular pump:
  - not possible when any TMP error occurs,
  - not possible when the fore vacuum gauge failure occurs or the fore gauges setpoints are not reached (see Chapter 5. Troubleshooting),
  - not permitted when a power failure occurs (see Chapter 5. Troubleshooting),
  - not possible when the safety valves are closed.
- Turning off the turbomolecular pump:
  - always possible.

Automatic functions of the system:

- The turbomolecular pumps accelerate if the fore vacuum setpoints are reached. When even one of the setpoints values is outside the range, the turbomolecular pumps stop accelerating and wait until both setpoints are reached again.
- Closing the safety valves during the turbomolecular pumps are accelerating or working normally, automatically stops the turbomolecular pumps. However, if the safety valves are opened again and the other conditions allow the turbomolecular pumps to work, the pumps will be turned on automatically.
- When the turbomolecular pumps are in normal operating state then the fore gauge setpoint disappearance causes an emergency shutdown of the turbomolecular pumps, closing the safety valves and turning off the fore pumps.

4.7 COMMON FUNCTIONALITY

4.7.1 PUMPING POWDERS (valid for configurations A, C, D, T)

Note:
Pumping powders is optional functionality depending on the settings in the service application. Changing settings requires a low level password. Please contact PREVAC for this password if required.

1. When processing with powders or other outgassing materials, press the ***FV pump ON*** button on the main panel. The fore pump starts pumping and the safety valve is closed.
2. After that the ***Start*** button appears on the main screen. Press it to start the normal pumping procedure described in the ***Start pumping*** section.

4.7.2 SYNCHRONOUS WORKING MODE (valid for configurations A, C, D, E, U)

Note:
Synchronous working modes is optional functionality depending on the settings in the service application. Changing settings requires a low level password. Please contact PREVAC for this password if required.

Synchronous mode is used to control more than one PCU16 from one control point. Any number of PCU16 can at the same time start and stop pumping. Only one device operating in synchronous mode can be ***Master*** and be allowed to control the pumping process. Other devices have to work as a ***Slaves*** and have no start/stop pumping buttons.
Figure 4.3 shows PCU16 working in synchronous ***Master*** and ***Slave*** modes.

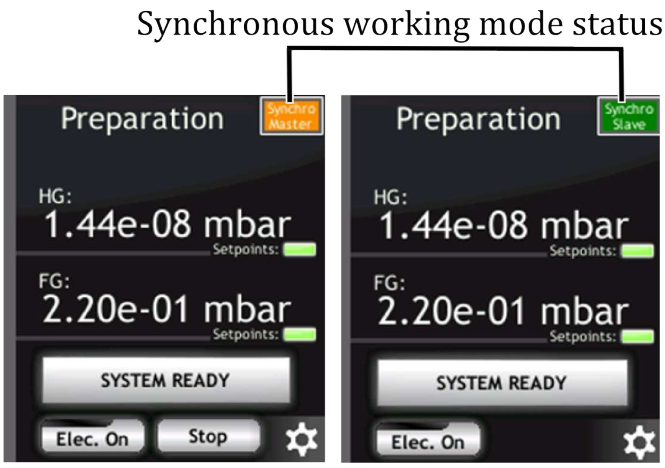


Figure 4.2: PCU16 operating in synchronous mode, as Master and Slave

WARNING

Synchronous mode and remote control.
When the PCU16 operates in synchronous mode there is no possibility of remote control via external communication.

To perform properly the external wiring, should be used additional external relay with NC contact for each linked PCU16.

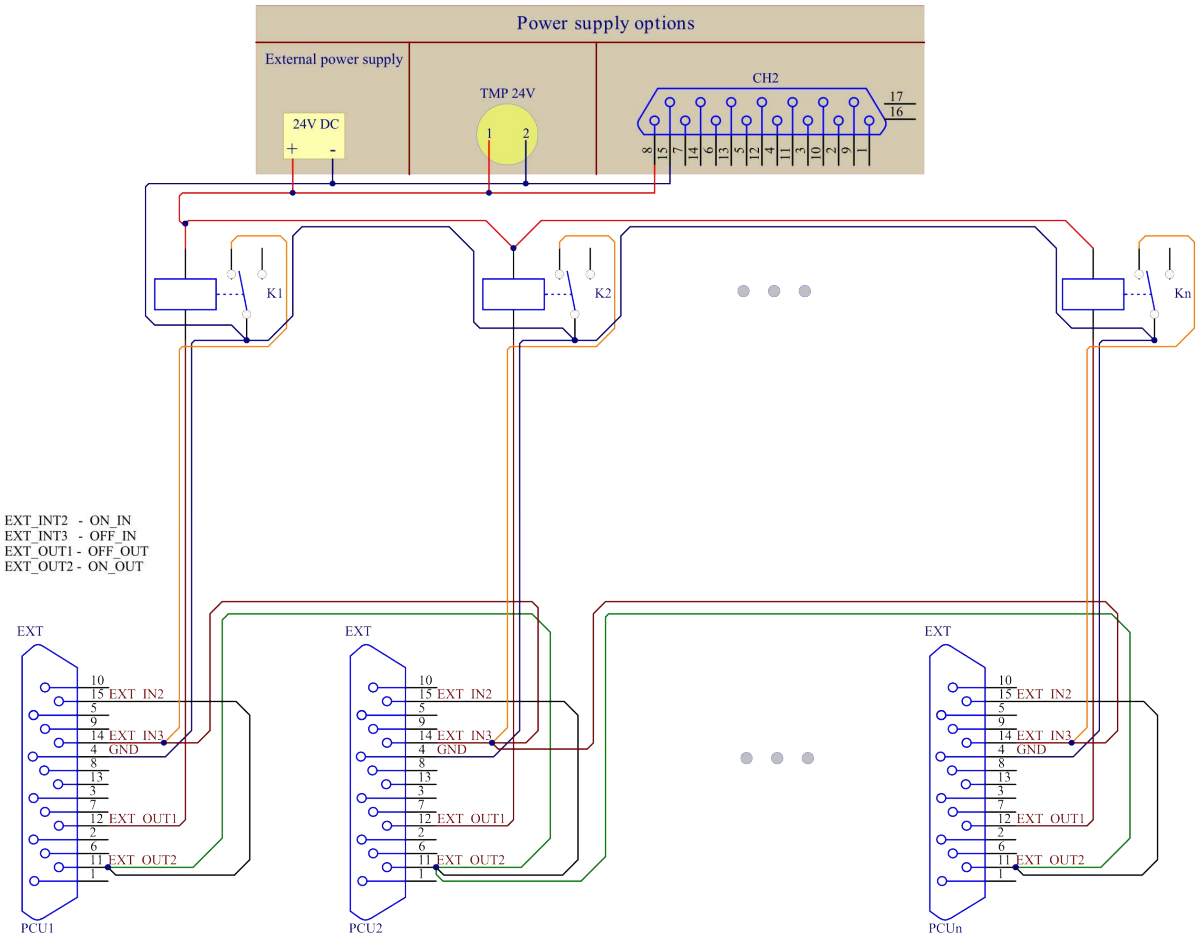


Figure 4.3: Wiring diagram for synchronous operation

5 TROUBLESHOOTING

This section describes the errors, warnings and notifications appearing in PCU16. All information displayed on the screens is divided into two groups:

- Errors and warnings which relate primarily to the device hardware are displayed in the message bar on the right side of the screen. They are identified by the colors red and yellow (for more information about them can be found in the chapter on user interface). Error disappears from the bar when it will be physically eliminated. This informations are stored in 5.1 section.
- All information that is not directly related to operation of the device is displayed as a message box. This informations presents notifications after user interaction. More informations can be found in 5.2 section.

5.1 MESSAGE BAR NOTIFICATIONS

5.1.1 ERRORS

- **E01: Anybus Error: Error Code: <number>**
  Anybus interface communication error.
- **E02: Bluetooth Error: Module not found**
  Bluetooth module is not connected.
- **E03: Fore vacuum gauge FG1 failure.**
  Channel 1 input signal is outside the measurement range or there is no signal at all. Possible solutions to this problem are shown below:
  - check Channel 1 configuration (PRESSURE FG), especially the type of vacuum gauge
  - check that vacuum gauge works correctly
- **E04: Fore vacuum gauge FG2 failure.**
  Channel 2 input signal is outside the measurement range or there is no signal at all. Possible solutions to this problem are shown below:
  - check Channel 2 configuration (PRESSURE FG), especially the type of vacuum gauge
  - check that vacuum gauge works correctly
- **E05: Fore vacuum gauge failure.**
  Channel 1 input signal is outside the measurement range. Possible solutions to this problem are shown below:
  - check Channel 1 configuration (PRESSURE FG), especially the type of vacuum gauge
  - check that vacuum gauge works correctly
- **E06: Fore vacuum pump power failure.**
  Power failure of fore vacuum pump. Possible solutions to this problem are shown below:
  - check the status of the pump power

  - check fuses on rear panel
  - check connections

- **E07: High vacuum gauge failure.**
  Channel 2 input signal is outside the measurement range. Possible solutions to this problem are shown below:
  - check Channel 2 configuration (Pressure HG), especially the type of vacuum gauge
  - check that vacuum gauge works correctly

- **E08: No transmission with Turbo Molecular Pump Driver.**
  Unable to establish communication with TMP controller. Possible solutions to this problem are shown below:
  - check connection cable
  - check that the cable plug is inserted into the correct socket on the rear panel
  - check that the TMP driver is switched on

- **E09: No transmission with working Turbo Molecular Pump Driver.**
  Unable to establish communication with TMP controller. Possible solutions to this problem are shown below:
  - check connection cable
  - check that the cable plug is inserted into the correct socket on the rear panel
  - check that the TMP driver is switched on

- **E10:Tank vacuum gauge failure.**
  Channel 2 input signal is outside the measurement range. Possible solutions to this problem are shown below:
  - check Channel 2 configuration (Pressure HG), especially the type of vacuum gauge
  - check that vacuum gauge works correctly

- **E11: The connection to mainboard has been lost. Error Code: <number>**
  Connection to the mainboard has been lost. Error code is displayed in order to find the source of the problem.

- **E12: Turbo Molecular Pump <number> reports an error code: <number>**
  Check the Turbo molecular Pump manual in order to find more information about a given issue error code.

- **E13: Turbo Molecular pump failure.**
  TMP driver reports an error. Possible solutions to this problem are shown below:
  - check cooling TMP
  - check system for leaks
  - check fore vacuum

- **E14: Valve GV is working incorrectly.**
  This error may occur when:
  - position control error
  - valve position control option is on

  - given state of valve is inconsistent with the readings
  - there is no compressed air available
  - valve is damaged

- **E15: Valve SV is working incorrectly.**
  This error may occur when:
  - operating with valves having position control feature
  - there is no compressed air available
  - valve is damaged

- **E16: Valve SV2 is working incorrectly.**
  This error may occur when:
  - position control error
  - valve position control option is on
  - given state of valve is inconsistent with the readings
  - there is no compressed air available
  - valve is damaged

- **E17: Valve VV error.**
  This error may occur when:
  - valve position control option is on
  - given state of valve is inconsistent with the readings
  - there is no compressed air available
  - valve is damaged

  occurs when the control is on the valve position if the set valve position is not the same as the measured valve position.

- **E18: We hightly recomend to remove videos from device.**
  Error resulting from insufficient space on the SDHC card. Delete videos in order to free up space.

5.1.2 WARNINGS

- **W01: Fore vacuum is too low. Pump group turn off.**
  A leak the vacuum system. Fore pump is not working. Possible solutions to this problem are shown below:
  - check connections
  - check pump
  - check system for leaks

- **W02: Fore vacuum pump can't get pressure FG setpoint. Probably leaking.**
  Pumping process took too long without the reaching FG setpoint. Possible solutions to this problem are shown below:
  - check pump
  - check system for leaks

- **W03: Low Disk Space: We suggest to remove videos from device.**
  Warning resulting from insufficient space on the SDHC card. Delete videos in order to free up space.
- **W04: Stopped heating. Bakeout power failure.**
  Power failure occurred during the heating process. Check fuses and supply voltage.
- **W05: Stopped heating. HG vacuum is too low.**
  During bakeout process, high vacuum decreased below HG Setpoint. Possible solutions to this problem are shown below:
  - set the correct threshold for high vacuum
  - check the system for leaks
- **W06: Stopped heating. TMP not in normal operation.**
  During bakeout process TMP is not in normal operation. Possible solutions to this problem are shown below:
  - wait until the TMP goes normal operation
  - check connections
- **W07: Stopped heating. Thermocouple failure.**
  Lack of temperature measurement. Check the condition of the thermocouple wire. Make sure that the thermocouple is inserted to an appropriate connector on the rear penel.
- **W08: Turbo Molecular Pump can't get normal operation state. Probably leaking.**
  TMP acceleration process took too long. Possible solutions to this problem are shown below:
  - when TMP is controlled by contacts check cable
  - check TMP
  - check system for leaks
- **W09: Turn off ELECTRONICS. HG Vacuum is too low.**
  Vacuum level decreased below the set treshold (HG Setpoint is not reached). Possible solutions to this problem are shown below:
  - set the correct threshold for high vacuum,
  - wait until the vacuum level increases and then turn on ELECTRONICS
  - check system for leaks
- **W10: Turn off ELECTRONICS. TMP is not in normal operation state.**
  ELECTRONICS has been turned off because TMP slowed. Possible leak in the system.

5.2 MESSAGE BOX NOTIFICATIONS

- **M01: Are you sure to start venting.**
  When you click on the VV valve in normal mode, you will be required to confirm the start of venting.
- **M02: Auto venting is unable. Opened valve GV.**
  Ventilation is configured only with closed valve GV. Close the GV valve in order to use auto venting option.

- **M03: Auto venting is unable. Opened valve SV2.**
  Ventilation is configured only with closed valve SV2. Close the SV2 valve in order to use auto venting option.
- **M04: Closing valve SV is forbidden. No transmission with working TMP.**
  Unable to establish communication with TMP controller. Possible solutions to this problem are shown below:
  - check connections between PCU and TMP drivers
  - make sure that cable plug is inserted into the correct socket on the rear panel
  - make sure that the TMP driver is switched on
- **M05: Copy summary: Error when copying a log file.**
  Copying Log file failed.
- **M06: Copy summary: Error when copying a translation file.**
  Copying the translation file failed.
- **M07: Copy summary: Error: Copying log file timeout.**
  Copying the log file took too long, the copying process was interrupted.
- **M08: Copy summary: Error: Copying translation file timeout.**
  Copying the translation file took too long, the copying process was interrupted.
- **M09: Copy summary: Error: No space left on USB.**
  Copying Log file failed due to lack of sufficient space on the USB. Free some space and then copy Log file again.
- **M10: Copy Summary: Error: No space left on device.**
  Disk space on the SDHC reached a critical level. Delete videos in order to free up space.
- **M11: Copy summary: File successfuly copied.**
  Copying process was performed successfully.
- **M12: Copy summary: Log file has been copied.**
  Copying Log file completed successfully.
- **M13: Copy summary: No usb found.**
  Message informing about absence of USB, which could occur for example if the USB device was removed during the copy operation.
- **M14: Translation file has been copied.**
  Translation file copy process ran correctly.
- **M15: DHCP client couldn't obtain ip address.**
  Attempt to obtain an IP address from the DHCP server failed. Check the device connection to the network and the status of DHCP server.
- **M16: Do you want to exit service mode? Check all the safety conditions.**
  Ensure that it is safe to exit the service mode, checking for example for persons or items that may obstruct e.g. valve closures.
- **M17: Fore vacuum gauge failure.**
  Channel 1 input signal is outside the measurement range or there is no signal at all. Possible solutions to this problem are shown below:
  - check Channel 1 configuration (PRESSURE FG), especially the type of vacuum gauge

  - check that vacuum gauge works correctly

- **M18: Fore vacuum is to low. Wait until TMP pump decelerated.**
  TMP not decelerated and FG setpoint is not reached. Wait until TMP pump decelerated.

- **M19: Fore vacuum pump power failure.**
  Power failure of fore vacuum pump. Possible solutions to this problem are shown below:

  - check the status of the pump power
  - check fuses on rear panel
  - check connections

- **M20: New language has been selected. You must reboot device to make changes. Proceed?**
  After selecting one of the available languages, you must reboot the device to apply the changes.

- **M21: No transmission with working TMP.**
  Unable to establish communication with TMP controller. Possible solutions to this problem are shown below:

  - check connections
  - make sure that cable plug is inserted into the correct socket on the rear panel
  - make sure that the TMP driver is switched on

- **M22: Notification: Device running on SERVICE mode(SV).**
  Information displayed only in the service mode. After 15 minutes without any user interaction with the front panel, user is informed with this message on the screen and simultaneously with a voice message.

- **M23: Opening valve GV is forbidden. System must be vented.**
  Checking venting state of the system has been configured for opening GV valve. Perform the system venting.

- **M24: Opening valve GV is forbidden. TMP not in normal operation.**
  Attempt to open GV while TMP is not dispersed. Wait for the TMP to disperse.

- **M25: Opening valve SV2 is forbidden. System must be vented.**
  Checking venting state of the system has been configured for opening SV2 valve. Perform the system venting.

- **M26: Opening valve SV2 is forbidden. TMP not in normal operation.**
  Attempt to open SV2 while TMP is not dispersed. Wait for the TMP to disperse.

- **M27: Opening valve VV is forbidden. No transmission with working TMP.**
  Unable to establish communication with TMP controller. Possible solutions to this problem are shown below:

  - check connections between PCU and TMP drivers
  - make sure that cable plug is inserted into the correct socket on the rear panel
  - make sure that the TMP driver is switched on

- **M28: Parameters has been loaded.**
  Process of reading the stored device settings ran correctly.

- **M29: Probably PG 105 is not connected.**
  This message may be displayed during PG105 calibration, when the calibration fails. It can result from:
  - damaged vacuum gauge
  - disconnected vacuum gauge
  - broken cable
  - the calibration conditions are not fulfilled
  - PCU16 measurement channel error
- **M30: Pumps must be turned off.**
  This message occurs when user attempts to vent the system when the pumps are still running. Possible solutions to this problem are shown below:
  - turn off pumps
  - wait until the venting conditions are fulfilled
- **M31: TMP is decelerating. Wait ...**
  Wait until time specified by "Deceleration time" parameter ("Turbomolecular pump" node located in "Setup menu") will elapse or pump rotations falls below 100Hz frequency.
- **M32: Turbo molecular Pump <name> reports warning code <number>.**
  Check the Turbo molecular Pump manual in order to find more information about a given issue warnings code.
- **M33: Turbo molecular pump failure.**
  TMP driver reports an error. Possible solutions to this problem are shown below:
  - check cooling TMP
  - check system for leaks
  - check fore vacuum
- **M34: Turn off HG gauge emission.**
  While HG setpoint is reached, user cannot turn on emission because it may damage the gauge.
- **M35: Turn off TMP is forbidden. Fore vacuum is to low.**
  TMP pump can not be turned on until the fore vacuum level is sufficient.
- **M36: Turn off TMP is forbidden. Valve SV closed.**
  TMP pump can not be turned on until the SV valve is closed.
- **M37: Turn off fore vacuum pump is forbidden. No transmission with working TMP.**
  Turning off the fore vacuum pump is forbidden because device is unable to establish communication with TMP controller. Possible solutions to this problem are shown below:
  - check connections between PCU and TMP drivers
  - make sure that cable plug is inserted into the correct socket on the rear panel
  - make sure that the TMP driver is switched on
- **M38: Unable degasing. Vacuum gauge does not support degasing.**
  Selected gauge does not support degas functionality.
- **M39: Unable degasing. Vacuum gauge failure.**
  Input signal is out of measurement range. Possible solutions to this problem are shown below:

  - check gauge configuration and in particular the gauge type
  - make sure that vacuum gauge is working

- **M40: Unable degasing. Vacuum is too low.**
  High vacuum is too low. Possible solutions to this problem are shown below:
  - set the correct threshold for high vacuum
  - wait until the vacuum level increases
  - check system for leaks
- **M41: Unable heating. Bakeout power failure.**
  Power failure occurred during the heating process. Check fuses and supply voltage.
- **M42: Unable heating. HG vacuum is too low.**
  Vacuum level is below the set threshold (Setpoint HG is off). Possible solutions to this problem are shown below:
  - set the threshold for high vacuum
  - wait until the vacuum level rises
  - check the system for leaks
- **M43: Unable heating. TMP not in normal operation.**
  Attempt heating while TMP is accelerating. Wait for the TMP to disperse. Check connections.
- **M44: Unable heating. Thermocouple failure.**
  Lack of temperature measurement. Check the condition of the thermocouple wire. Make sure that the thermocouple is inserted to an appropriate connector on the rear penel.
- **M45: Unable turn on ELECTRONICS. HG Vacuum is too low.**
  Vacuum level is below the set threshold (SETPOINT 2 diode is not lit). Possible solutions to this problem are shown below:
  - set the correct threshold for high vacuum
  - wait until the vacuum level rises
  - check the system for leaks
- **M46: Unable turn on ELECTRONICS. TMP not in normal operation.**
  Attempt to turn ELECTRONICS on while TMP is not dispersed. Wait for the TMP to disperse. Check connections.
- **M47: Copy summary: <Summary> Click OK to reset the device.**
  After reading summary informations tap "OK" button in order to reboot device.
- **M48: Copy summary: Mainboard: Everything is up to date. Click OK.**
  Message informing that following elements (mainboard. bus etc) are up to date.
- **M49: Valve GV must be closed.**
  Ventilation is configured only with closed valve GV. Close the GV valve in order to use auto venting option.
- **M50: Valve SV is working incorrectly.**
  This error may occur when:
  - operating with valves having position control feature
  - there is no compressed air available

- valve is damaged

Possible solutions to this problem are shown below:

- check compresed air status
- check connections

- **M51: Valve SV2 must be closed.**
  Error occurs when user tap on VV in manual mode
- **M52: Venting is not possible. Errors in the system.**
  Venting can not be performed until the elimination of errors. Please see the messages displayed in the message bar (the bar on the right side of the screen) in order to diagnosis them.
- **M53: Venting is not possible. Pumps must be turned off.**
  This message occurs when user try to vent the system when the pumps are still running. Possible solutions to this problem are shown below:
  - turn off pumps
  - wait until the venting conditions are fulfilled
- **M54: Venting is not possible. Valve GV must be close.**
  Venting is not available until the closing valve GV.
- **M55: Venting is not possible. Valve SV2 must be close.**
  Venting is not available until the closing valve SV2.

6 REMOTE CONTROL

This chapter describes how to communicate with the device PCU16 with the selected interface. Control PCU16 is possible via one of three interfaces installed on your device RS232, RS485, Ethernet. Only one of these interfaces can be used at the same time. Selection and configuration of the communication interface is done as described in subsection 3.4.13.

6.1 CONNECTION PARAMETERS

PARAMETER	VALUE
Data bits	8
Parity	None
Stop bits	1
Flow control	None
Baud rate	57600 (default value)

Table 6.1: Connection parameters

6.2 DATA FRAME

DATA FRAME	
Byte	**Description**
1 - HEADER	First byte is responsible for identifying the serial protocol. Header in hexadecimal is 0xBB
2 - DATA LENGTH	Length of the data field. Maximum data file length is 0xFF (256 bytes). Prevac Serial Protocol
3 - DEVICE ADDRESS	Identification of hardware device address. Default value is 0xC8
4 - HOST ADDRESS	Host identification address. Assigned to host during the registration process (using a unique ID).
5 - FUNCTION CODE - MSB	First procedure function code byte 8th (MSB) bit is the read(0)/write(1) select bit
6 - FUNCTION CODE - LSB	Second procedure function code byte

continued on next page

continued from previous page	
Byte	**Description**
7 .. [7 + DATA LENGTH] - DATA FIELD	Data capture needed to realize defined functions.
[7 + DATA LENGTH] + 1(last frame position) - CRC	CRC is simple module 256 calculated without protocol header byte(see section 6.2.4)

Table 6.2: Data frame

6.2.1 ORDER TYPES

There are two types of commands:

- write orders,
- read orders.

Type the command defines the most significant bit of command code (see 6.2). If the bit is a logical "1", then the function code is interpreted as a command Save/Set. Otherwise, the order read. For example: order 0x7F06(set customer Name) allow read customer Name, and order 0xFF06(MSB set to "1") allow set customer Name.

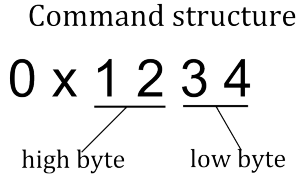


Figure 6.1: Command structure

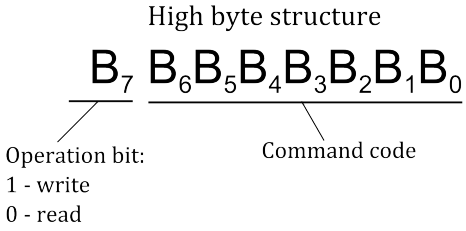


Figure 6.2: High byte command structure

For a read command, the device returns the value in a specific data type assigned to the command (see tables of orders).
For orders write the answers may be as follows:

- write command is correct (proper type, has the appropriate length and value), the device responds 0x00 value in the last byte in the data field.
- write order is incorrect, the device return error code in the last data field byte as shown in Table ref Global communication status codes.

WARNING

Read/Write Parameters.
Reading the parameters of the device is always allowed (even if the device is not in REMOTE CONTROL mode).
Writing parameters to the device requires:

- switching device in REMOTE CONTROL mode,
- registration using a unique ID
- receive permission to control as *Master*.

The registration procedure host is described in subsection 6.3

6.2.2 APPLIED DATA TYPES

DATA TYPE	DESCRIPTION	EXAMPLE
ASCII	The text value of the length specified in the *DATA LENGTH*	"CUSTOMER"
Long	4 bytes integer value in *Big endian* format(The most significant byte is placed first in data field)	0x000082AC
Byte	1 byte integer value, used for enumerate type and control command(ON/OFF)	0x05
Bool	true/false value (0 = false, 1 = true)	0x01, 0x00
Double	8 bytes value in IEEE 754 double-precision binary floating-point in *Big endian* format(The most significant byte is placed first in data field)	0x4028 A4DD 2F1A 9FBE

Table 6.3: Data types

6.2.3 INDEXING

There are 3 types of orders because of the type of indexing:

- indexed - require an index on firs byte of data fields in order to appeal to a particular object (module) on the device. On the following bytes to put the data in a format compatible with the type of order.
- indexed (no matter) - the index does not matter, but it is necessary to provide an index (eg. 1) on first byte data field. On the following bytes to put the data in a format compatible with the type of order
- without an index - only orders from the global group (see global commands table). The value we put from the first byte of the data field.

For example, reading the vacuum level from device that has 2 vacuum channels, needs to be sent command 0x0101 with the index 0x01 to read the value of the first channel:
TX: BB 01 C8 01 01 01 01 CD
Index and 0x02 to read the value of the second channel:
TX: BB 01 C8 01 01 01 02 CE.

WARNING

Index out of range.
If the index value is outside the range defined for a given command, the device returns the error code 0x93 in the last position of the data field.

If the order requires indexing, the table specified item *index* with with the scope of change. If the order does not apply to index this field *Index* is not specified in the table.

6.2.4 CRC

CRC is simple modulo 256 calculate without protocol header byte. Below is a sample code for the enumerator checksum value.

```
1 quint8 mod256_CRC = 0;
2 for(i= 1; i <= InputFrame->size; i++) mod256_CRC += InputFrame(i);
```

6.3 EXAMPLES

6.3.1 READ PARAMETERS FROM DEVICES

Read FG pressure value (Function code 0x0101, data field: 0x01 (index): **Request:**
TX: BB 01 C8 01 01 01 01 CD
Answer (CH1=6.25 E-2):
RX: BB 09 C8 01 01 01 01 3F B0 00 00 00 00 00 00 C4

6.3.2 SETUP PARAMETERS

Shutter control(Function code 0x8207, data field: 0x01 (index), 0x01 (1-ON / 0-OFF)
Request:

TX: BB 02 C8 01 82 07 01 01 56
Answer:
RX: BB 02 C8 01 82 07 01 00 55
Command executed correctly: last byte in data field equal 0.

Setting the target temperature out of range(Function code 0x8706, data field: 0x01[index], 1500.0 [target temperature])
Request:
TX: BB 09 C8 01 87 06 01 40 97 70 00 00 00 00 00 A7
Answer:
RX: BB 02 C8 01 87 06 01 91 EA
The order not executed: returned error code 0x91 in last byte data field (value too high - see **??**).

6.3.3 TAKING OVER CONTROL AS MASTER

Request:
TX: BB 01 C8 01 FF F1 01 BB
Answer:
RX: BB 01 C8 01 FF F1 00 BA
The data field equal to 0 - to take control goes correctly.

6.4 UNIQUE ID

For proper operation of mechanism for the allocation numbers of hosts is necessary to ensure that each computer using the unique ID during the registration process host(command 0x7FF0). A unique string of characters can be extracted from the operating system using the codes explained the program.

6.4.1 WINDOWS OPERATING SYSTEM

```
1  #define _WIN32_DCOM
2  #include <comdef.h>
3  #include <comutil.h>
4  #include <Wbemidl.h>
5  #pragma comment(lib, "wbemuuid.lib")
6
7  long get_uuid(char** uuid, int* size)
8  {
9          HRESULT hr = CoInitializeEx(0, COINIT_MULTITHREADED);
10         if (FAILED(hr))
11                 return 1;
12
13         hr = CoInitializeSecurity(
14                 NULL,
15                 -1,                          // COM authentication
16                 NULL,                        // Authentication services
17                 NULL,                        // Reserved
18                 RPC_C_AUTHN_LEVEL_DEFAULT,   // Default authentication
19                 RPC_C_IMP_LEVEL_IMPERSONATE, // Default Impersonation
20                 NULL,                        // Authentication info
21                 EOAC_NONE,                   // Additional capabilities
22                 NULL                         // Reserved
23                 );
24
```

```
25          if (FAILED(hr)) {
26                  CoUninitialize();
27                  return 1;
28          }
29
30          IWbemLocator *pLoc = NULL;
31
32          hr = CoCreateInstance(
33                  CLSID_WbemLocator,
34                  0,
35                  CLSCTX_INPROC_SERVER,
36                  IID_IWbemLocator, (LPVOID *)&pLoc);
37
38          if (FAILED(hr)) {
39                  CoUninitialize();
40                  return 1;
41          }
42
43          IWbemServices *pSvc = NULL;
44
45          hr = pLoc->ConnectServer(
46                  _bstr_t(L"ROOT\\CIMV2"), // Object path of WMI namespace
47                  NULL,                    // User name. NULL = current user
48                  NULL,                    // User password. NULL = current
49                  0,                       // Locale. NULL indicates current
50                  NULL,                    // Security flags.
51                  0,                       // Authority (for example, Kerberos)
52                  0,                       // Context object
53                  &pSvc                    // pointer to IWbemServices proxy
54                  );
55
56          if (FAILED(hr)) {
57                  pLoc->Release();
58                  CoUninitialize();
59                  return 1;
60          }
61
62          hr = CoSetProxyBlanket(
63                  pSvc,                         // Indicates the proxy to set
64                  RPC_C_AUTHN_WINNT,            // RPC_C_AUTHN_xxx
65                  RPC_C_AUTHZ_NONE,             // RPC_C_AUTHZ_xxx
66                  NULL,                         // Server principal name
67                  RPC_C_AUTHN_LEVEL_CALL,       // RPC_C_AUTHN_LEVEL_xxx
68                  RPC_C_IMP_LEVEL_IMPERSONATE, // RPC_C_IMP_LEVEL_xxx
69                  NULL,                         // client identity
70                  EOAC_NONE                     // proxy capabilities
71                  );
72
73          if (FAILED(hr)) {
74                  pSvc->Release();
75                  pLoc->Release();
76                  CoUninitialize();
77                  return 1;
78          }
79
80          IEnumWbemClassObject* pEnumerator = NULL;
81          hr = pSvc->ExecQuery(
82                  bstr_t("WQL"),
83                  bstr_t("SELECT * FROM Win32_ComputerSystemProduct"),
84                  WBEM_FLAG_FORWARD_ONLY | WBEM_FLAG_RETURN_IMMEDIATELY,
85                  NULL,
86                  &pEnumerator);
87
```

```
88          if (FAILED(hr)) {
89                  pSvc->Release();
90                  pLoc->Release();
91                  CoUninitialize();
92                  return 1;
93          }
94
95          IWbemClassObject *pclsObj = NULL;
96          ULONG uReturn = 0;
97
98          while (pEnumerator)
99          {
100                 HRESULT hr =pEnumerator->Next(WBEM_INFINITE, 1, &pclsObj, &
                        uReturn);
101
102                 if (uReturn == 0)
103                         break;
104
105                 VARIANT vtProp;
106
107                 hr = pclsObj->Get(L"UUID", 0, &vtProp, 0, 0);
108                 *size = SysStringLen(vtProp.bstrVal);
109                 *uuid = _com_util::ConvertBSTRToString(vtProp.bstrVal);
110                 // ConvertBSTRToString allocates a string you must delete!
111                 VariantClear(&vtProp);
112
113                 pclsObj->Release();
114         }
115
116         pSvc->Release();
117         pLoc->Release();
118         pEnumerator->Release();
119         CoUninitialize();
120
121         return 0;
122 }
123
124 // Usage example:
125 //      char* uuid;
126 //      int size;
127 //      get_uuid(&uuid, &size);
128 //      // do sth with uuid
129 //      delete[] uuid;
```

6.4.2 LINUX - OPEARATING SYSTEM

```c
#include <stdio.h>
#include <stdlib.h>

// First make a copy of /sys/class/dmi/id/product_uuid to your source directory.
// Type: sudo cp /sys/class/dmi/id/product_uuid ./product_uuid
// Then change file attributes of the file you've copied.
// Type: sudo chmod 777 ./product_uuid

long get_uuid(char** uuid, int* size)
{
 long error = -1;
 FILE *file = popen("cat ./product_uuid | egrep
 '[A-Fa-f0-9]{8}\-[A-Fa-f0-9]{4}\-[A-Fa-f0-9]{4}\
 -[A-Fa-f0-9]{4}\-[A-Fa-f0-9]{12}'", "r");
 if (file != NULL) {
     *size = 36;
     *uuid = (char*)malloc(*size+1);
        // Allocated buffer you must free!
     if (*uuid != NULL) {
         fread(*uuid, 1, *size, file);
         (*uuid)[*size] = 0;
         error = 0;
     }
     pclose(file);
 }
 return error;
}

// Usage example:
//      char* uuid;
//      int size;
//      get_uuid(&uuid, &size);
//      // do sth with uuid
//      free(uuid);
```

6.4.3 ORDERS TYPES

There are two types of commands:

- Read/Write orders,
- Read only orders,

For read commands, the device returns the requested value in the specified data format.
For write commands, the depends on the send value:

- When send value is correct(correct type, has the correct length and value), then device sends 0x00 value into data field. The answer is located in last byte of the data field,
- When send value is incorrect, an appropriate error code is sent in the last byte of the data field.

6.4.4 REGISTER NEW HOST

If the remote controller connects to the device first time, follow the procedure for obtaining a host address according to the diagram below.

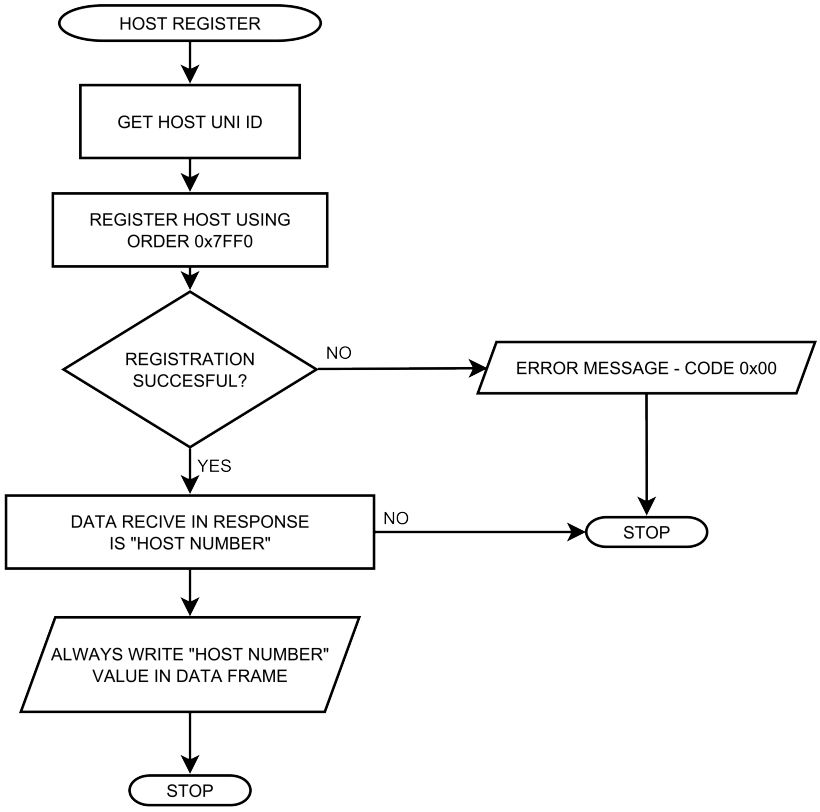


Figure 6.3: Host assign - diagram

Description of the allocation host number order is contained in the table 6.28.

Below is an example procedure for the preparation of a new host address. And then send a command set to Setpoint Low value.

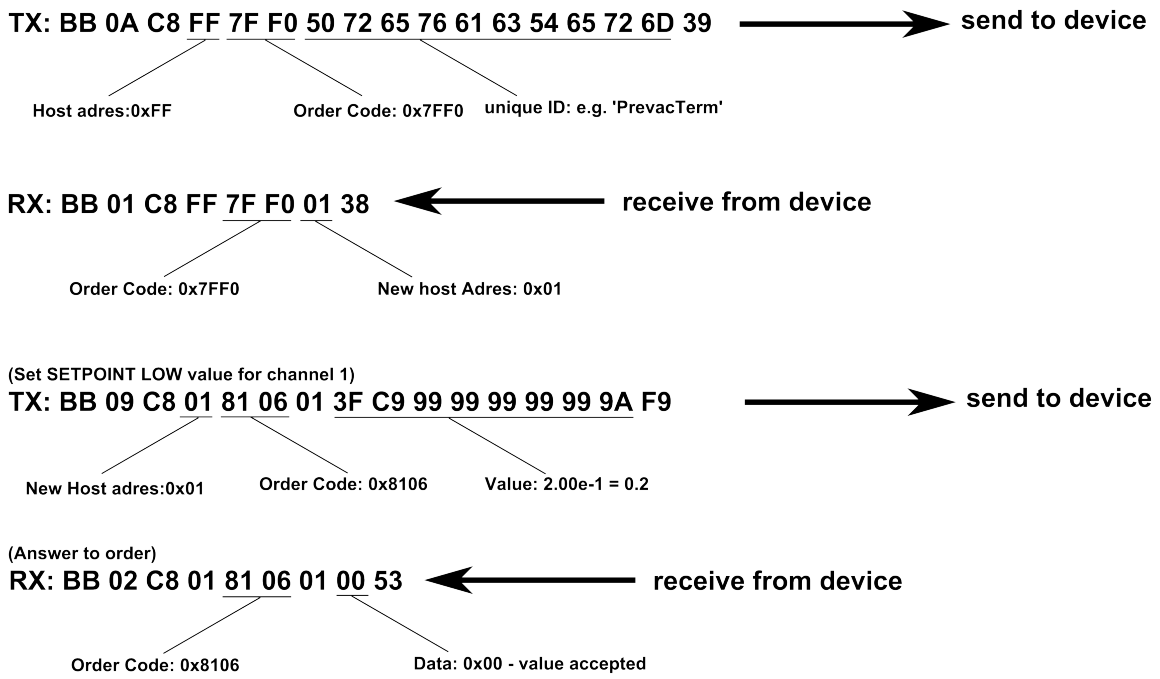


Figure 6.4: Host assign example

6.5 REMOTE CONTROL MODE

REMOTE CONTROL mode operations change the parameters from the touch panel are locked. You can monitor only the parameters on the screen and the settings in the configuration menu of the device. Device in *REMOTE CONTROL* mode display at the top of the main screen information banner with the inscription *"PCU16 - REMOTE CONTROL"*

The device can be entered in remote control mode in two ways: hardware and software.

6.5.1 HARDWARE

Switching to *Remote Control* mode is done by activating the remote interlock input. Located on the rear panel (see section ref logicInputs). The input can be activated permanently by making a short connection between the activating input and pin 24V or activated from the outside (eg .: switch, PLC). Example plug configuration is shown in Figure 6.5. Exit *Remote Control* mode is possible only by deactivating the input *REMOTE INTERLOCK*.

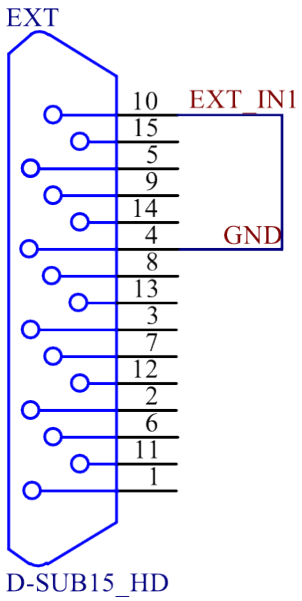


Figure 6.5: Activation *Remote Control Interlock*

6.5.2 SOFTWARE

Software switch to Remote Control mode is provided selecting ***C*OMMUNICATION -> REMOTE CONTROL -> ON**. Then device switches to Remote Control mode and remains in it until switched again to local mode by selecting ***C*OMMUNICATION -> REMOTE CONTROL -> OFF**.

Communication in software Remote Control mode is done according following principles:

- At a time control device it is only possible from one place (panel of the unit or remote computer with *MASTER* permissions). item Permissions to control in RC mode has a host that is in the *MASTER*. On the *Communications* submenu can check which host (of which number) currently has *Master* permissions.

- After the takeover of control by the remote *MASTER* device is locked to return to local control mode from the device menu (item ***C*OMMUNICATION -> REMOTE CONTROL** is grayed out).

- Host have *MASTER* permissions until kept communication with the device (the interval between frames will not be longer than 10 seconds) or relase rights master (using order 0xFFF1; data field = 0).
- In case of loss of communication between the host and the device for longer than 10 seconds the item ***C*OMMUNICATION -> REMOTE CONTROL** is active and is possible return to local control by setting item ***C*OMMUNICATION -> REMOTE CONTROL -> OFF**
- In case of loss of communication between the host and the device for longer than 60 seconds, it becomes possible take over control by another remote host.

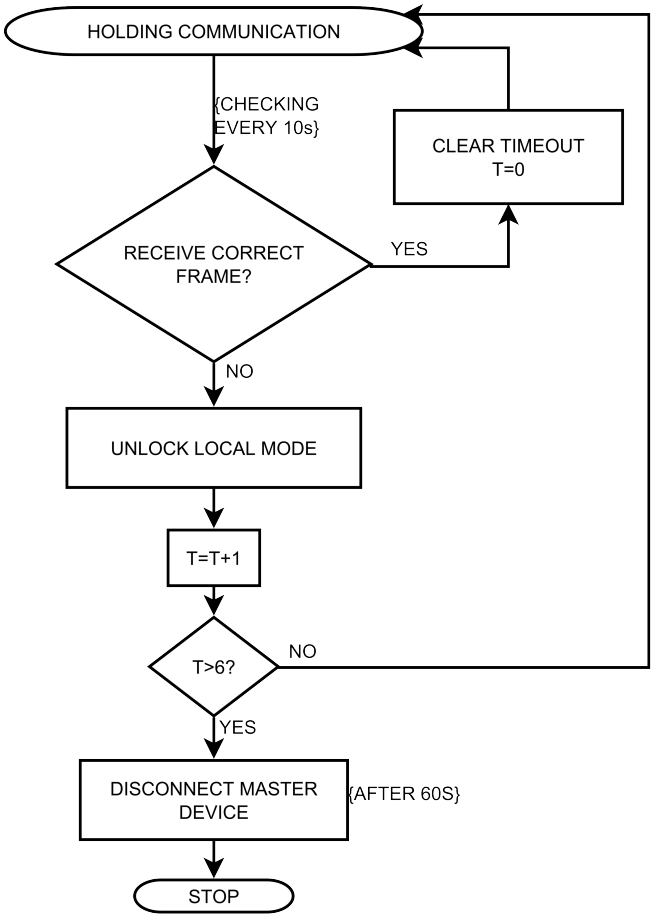


Figure 6.6: Keeping communication- diagram

Properly registered device will appear in the menu ***Communication -> Host address*** and will be able to control the device. If the list contains more than one device, you must choose which is to have permissions to write (control). Other devices in the list will be able to read only parameters.

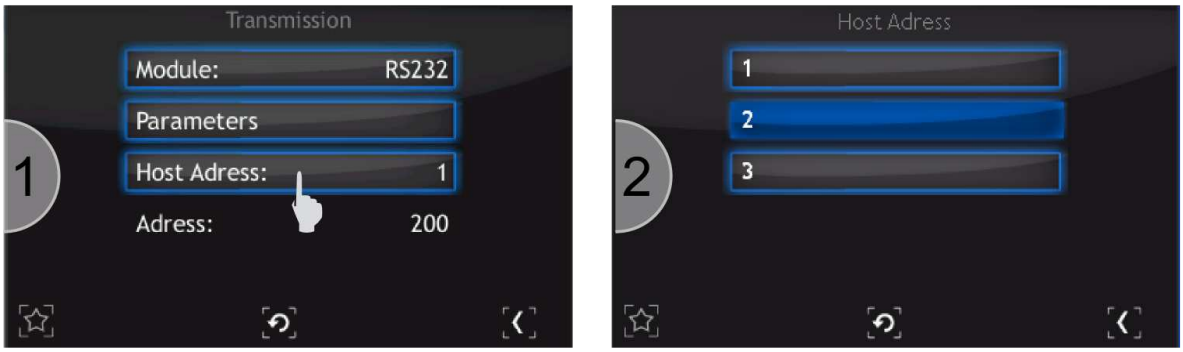


Figure 6.7: Preview of registered host addresses

6.6 GLOBAL DEVICE STATUS

There are two types of device status: errors and warnings. Status appear in the bar at the right of the main screen of the device. To read the error status, use the command 0x7F51, for warning status use command 0x7F52. In response we receive a code whose meaning is contained in the tables below.

Error code	Description
7F01	Internal communication error
7F02	Communication with Anybus module error
7F03	Communication with Bluetooth Anybus module error
7F04	Critically low disk space

Table 6.4: Global error status

Warning code	Description
7F80	Low disk space.
7F06	Invalid read the internal temperature of the device.
7F07	The internal temperature of the device is above safe level.
7F08	The internal temperature of the unit is too high. Switching to standby mode.

Table 6.5: Global warning status

6.7 GLOBAL ERROR CODES

In response to the write command, it is possible to obtain the specifying error status code, which makes impossible execution of the order. The table below lists the global error codes (apply to all orders). Additionally, the device can return specific error codes, depending on the module in which it is equipped.

Status code	Description
0x00	No errors, order executed correctly
0x91	Value is too large
0x92	Value is too small
0x93	Wrong parameter (probably wrong data format or index out of range)
0x95	Read only parameter, write prohibited
0x96	Host not know and not registered
0x97	Host know but not selected to remote control
0x98	Device configured to work in local mode
0x99	Operation or parameter is not available

Table 6.6: Global status codes

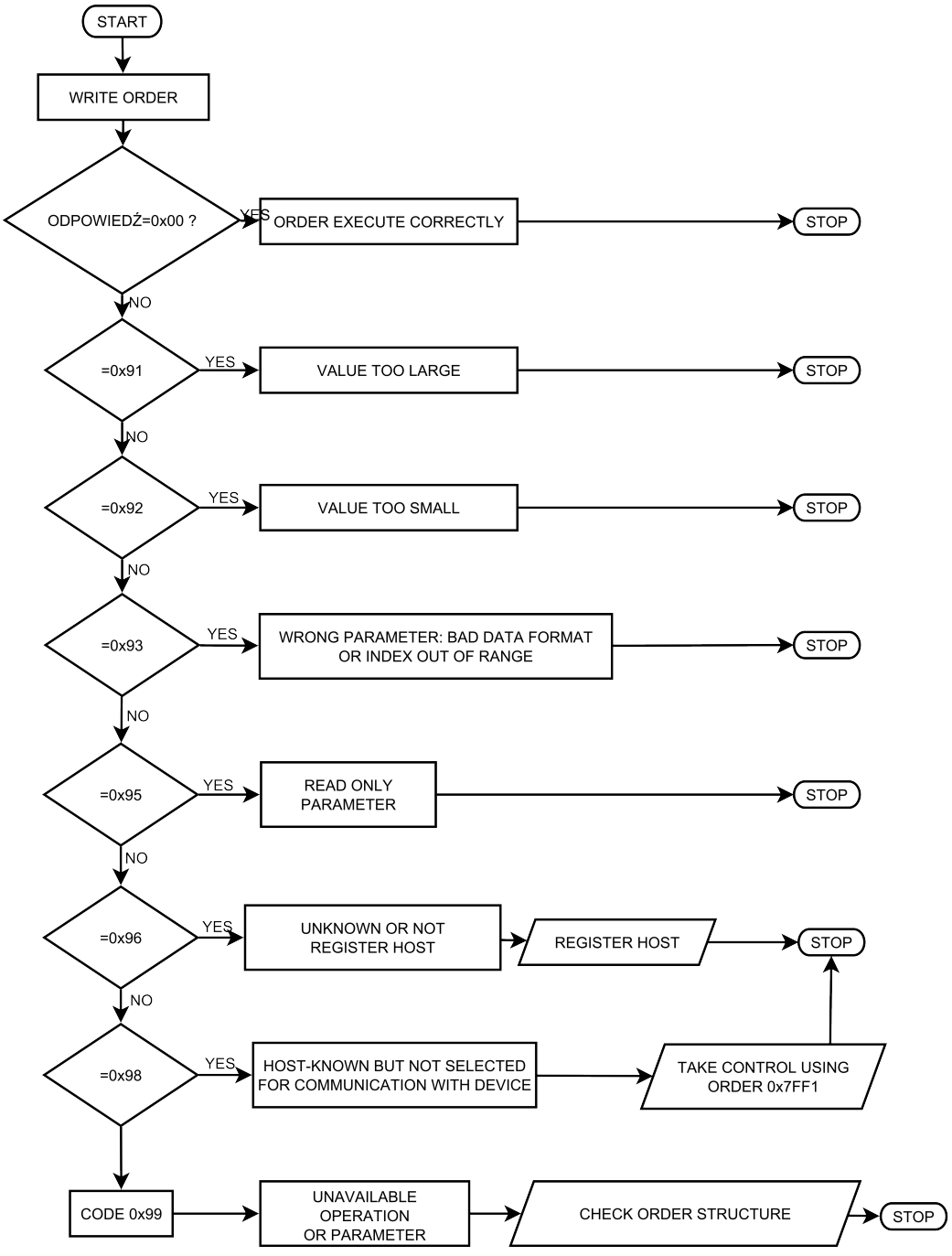


Figure 6.8: Write order example- diagram

6.8 PCU16 STATUS CODE

Table below contain specyfic codes for PCU16 , read codes using function code 0x7F51(errors) and 0x7F52(warnings).

Error code	Description
4001	Fore vacuum pump error
4002	Transmission error with TMP pump
4003	Transmission error with TMP pump (the pump is not moving at the time of transmission loss)
4004	TMP pump error
4005	Transmission error with TMP2 pump
4006	Transmission error with TMP2 pump (the pump is not moving at the time of transmission loss)
4007	TMP2 pump error
4008	V1 valve error (SV)
4009	V2 valve error (VV)
400A	V3 valve error (GV)
400B	V3 valve error (SV2)
400C	V4 valve error
400D	FG pre-vacuum gauge error
400E	FG1 pre-vacuum gauge error
400F	FG2 pre-vacuum gauge error
4010	HG pre-vacuum gauge error

Table 6.7: PCU16 error status

6.9 PCU16 ERROR ORDER CODES

Status code	Description
0x40	electronics can not be turned on, no hg vacuum
0x41	operation not possible
0x42	SV2/GV valve open, venting not possible
0x43	the pumps are turned on, venting not possible

Table 6.8: PCU16 order error codes

6.10 ORDERS LIST

6.10.1 GLOBAL ORDERS - FUNCTION CODE 0x7F..

ORDER NUMBER 0x7F01 READ PRODUCT NUMBER					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1-15	Product number	ASCII			

Table 6.9: Read product number

ORDER NUMBER 0x7F02 READ SERIAL NUMBER					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1-13	Serial number	ASCII			

Table 6.10: Read serial number

ORDER NUMBER 0x7F03 READ DEVICE VERSION					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1 - [DATA LENGTH]	Device version	ASCII			

Table 6.11: Read device version

ORDER NUMBER 0x7F04 READ HASH CODE VERSION					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1 - [DATA LENGTH]	Hash code	ASCII			

Table 6.12: Read hash code version

ORDER NUMBER 0x7F05 READ DEVICE NAME					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1 - [DATA LENGTH]	Device name	ASCII			

Table 6.13: Read device name

ORDER NUMBER 0x7F06 CUSTOMER NAME					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1 - [DATA LENGTH]	Customer name (max 17 characters)	ASCII			

Table 6.14: Customer name

ORDER NUMBER 0x7F50 DEVICE STATUS					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Number of device errors 0 - no errors			0	255
2	Number of device warnings 0 - no warnings			0	255

Table 6.15: Read device status

ORDER NUMBER 0x7F51 ERROR CODES					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index of device error	INT		0	255
2 - 5	Device error code				

Table 6.16: Read error status code

ORDER NUMBER 0x7F52 WARNING CODES					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index of device warning			0	255
2 - 5	Device warning code				

Table 6.17: Read warning status code

ORDER NUMBER 0x7F60 VOLTAGE VALUE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: 1 - U_c 2 - U_e 3 - U_{f1} 4 - U_{f2} 6 - U_{ext} 7 - U_{erg} 8 - U_{wehn} 9 - U_x 10 - U_y	INT			
2-9	Value	Double	V		

Table 6.18: Voltage value

ORDER NUMBER 0x7F61 ACTUAL VOLTAGE VALUE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: 1 - U_c 2 - U_e 3 - U_{f1} 4 - U_{f2} 6 - U_{ext} 7 - U_{erg} 8 - U_{wehn} 9 - U_x 10 - U_y	INT			
2-9	Value	Double	V		

Table 6.19: Actual voltage value

ORDER NUMBER 0x7F62 CURRENT VALUE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: 1 - I_c 2 - I_e 3 - I_{flux} 4 - I_{fil1} 5 - I_{fil2} 6 - I_{fil3} 7 - I_{fil4}	INT			
2-9	Value	Double	V		

Table 6.20: Current value

ORDER NUMBER 0x7F63 ACTUAL CURRENT VALUE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: 1 - I_c 2 - I_e 3 - I_{flux} 4 - I_{fil1} 5 - I_{fil2} 6 - I_{fil3} 7 - I_{fil4}	INT			
2-9	Value	Double	V		

Table 6.21: Actual current value

ORDER NUMBER 0x7F70 RTC DATA SETTINGS					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1-10	Data value in format *yyyy.mm.dd*	ASCII			

Table 6.22: RTC data settings

ORDER NUMBER 0x7F71 RTC TIME SETTINGS					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1-8	Time value in format *hh:mm:ss*	ASCII			

Table 6.23: RTC time settings

ORDER NUMBER 0x7F72 PANEL TIMER TIME SETTINGS					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1-8	Set panel timer value in format *hh:mm:ss*	ASCII			

Table 6.24: Panel Timer time settings

ORDER NUMBER 0x7F73 PANEL TIMER ACTUAL TIME					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1-8	Actual panel timer value in format *hh:mm:ss*	ASCII			

Table 6.25: Actual panel timer value

ORDER NUMBER 0x7F74 PANEL TIMER START/STOP					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Panel Timer Start/Stop (Start=1, Stop=0)	INT			

Table 6.26: Panel timer start/stop

ORDER NUMBER 0x7F0C TOUCH SCREEN AUTOLOCK					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	0 - Touch screen autolock OFF 1 - Touch screen autolock ON				

Table 6.27: Touch screen autolock

ORDER NUMBER 0x7FF0 HOST NUMBER ASSIGN					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
QUERY:					
1 - [DATA LENGTH]	Unique ID	ASCII			
RESPONSE:					
1	Assigned host address	INT		1	255

Table 6.28: Host address assign

ORDER NUMBER 0x7FF1 MASTER MODE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
FOR WRITE ORDER:					
1	Assignment/release *MASTER* mode control 1 - Assignment control, 0 - Relase control,	Byte		0	1
FOR READ ORDER:					
1	*MASTER* control status (bit field) - status zwracany na poszczególnych bitach od B0(LSB) do B7(MSB). **B0:** Working as *MASTER* (0 - no, 1 - yes) **B1:** Take control as *MASTER*(0 - forbidden, 1 - permitted). Bit B1=1 if and only if B2=1, B3=1 i B4=0. **B2:** Device *REMOTE CONTROL* mode(0 - inactive, 1 - activate) **B3:** Host registration status(0 - not registered, 1 - registred) **B4:** Other *MASTER* host device in system (0 - no, 1- yes)	Byte			

Table 6.29: Assignment/release of Master mode

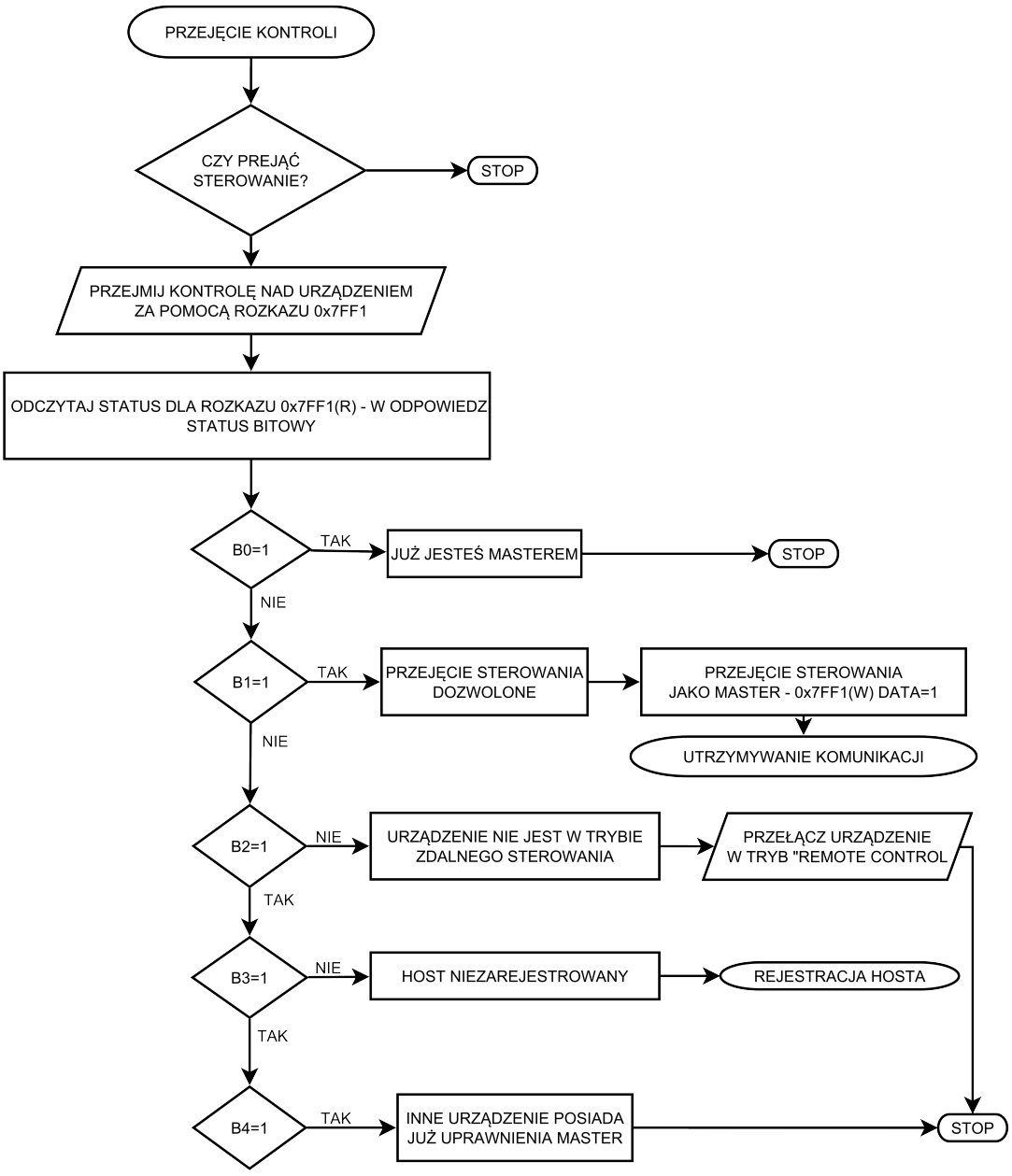


Figure 6.9: Assignment/release of Master mode - sequence diagram

ORDER NUMBER 0x7FAA SEND COMMAND TO DEVICE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1-5	Command (5 characters)	ASCII			
6 - [DATA LENGTH]	Command data (max 32 characters)	ASCII			

Table 6.30: Send command

6.10.2 PCU ORDERS - FUNCTION CODE 0x40..

ORDER NUMBER 0x4001 PUMPING CONTROL					R/W
READ:					
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2	System status: 1 - Pumps OFF 2 - Only Fore Vacuum pumping 3 - Pumping - SV is closed 4 - System in Normal State 5 - Pumping - SV is opened 6 - System is vented 7 - Wait for autoventing 8 - Venting	INT			
WRITE:					
1	Index	nv			
2	0 - Stop pumping 1 - Start pumping	INT		0	1

Table 6.31: Read system status/pumping control

ORDER NUMBER 0x4002 FORE VACUUM PUMPS CONTROL					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: 1 - Fore Vacuum pump 1 2 - Fore Vacuum pump 2 (if available)			1	2
2	0 - Pump OFF 1 - Pump ON	INT		0	1

Table 6.32: Read/control Fore Vacuum pumps

ORDER NUMBER 0x4003 POSSIBILITY OF CHANGE FORE VACUUM PUMPS STATE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: 1 - Fore Vacuum pump 1 2 - Fore Vacuum pump 2 (if available)			1	2
2	0 - Change allowed -1 - Change not allowed in actual working mode 1 - Turning on is not allowed due to power failure 2 - Turning off is not allowed due to TMP transmission failure	INT			

Table 6.33: Read possibility of changing Fore Vacuum pump state

ORDER NUMBER 0x4004 TURBOMOLECULAR PUMPS CONTROL					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
READ:					
1	Index: 1 - Turbomolecular pump 1 2 - Turbomolecular pump 2 (if available)			1	2
2	0 - Pump OFF 1 - Normal Operation 2 - Acceleration 3 - Deceleration	INT			
WRITE:					
1	Index: 1 - Turbomolecular pump 1 2 - Turbomolecular pump 2 (if available)			1	2
2	0 - Pump OFF 1 - Pump ON	INT		0	1

Table 6.34: Read/control Turbomolecular pumps

ORDER NUMBER 0x4005 POSSIBILITY OF CHANGE TURBOMOLECULAR PUMPS STATE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: 1 - Turbomolecular pump 1 2 - Turbomolecular pump 2 (if available)			1	2
2	0 - Change allowed -1 - Change not allowed in actual working mode 1 - Turning on is not allowed due to TMP transmission 2 - Turning on is not allowed due to failure 3 - Turning on is not allowed due to FG failure 4 - Turning on is not allowed due to power failure 5 - Turning on is not allowed. Valve SV is closed 6 - Turning on is not allowed. Fore vacuum is too low 7 - Turning off is not allowed due to TMP transmission failure	INT			

Table 6.35: Read possibility of changing Turbomolecular pump state

ORDER NUMBER 0x4006 VALVES CONTROL					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: 1 - Valve 1 (SV) 2 - Valve 2 (VV) 3 - Valve 3 (GV or SV2 - version depends) 4 - Valve 4 (GV - if available) 5 - Valve 5 (if available)			1	5
2	0 - Valve closed 1 - Valve open 2 - Valve semi-open	INT		0	2

Table 6.36: Read/control Valves

ORDER NUMBER 0x4007 READ TYPE OF VALVES					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: 1 - Valve 1 (SV) 2 - Valve 2 (VV) 3 - Valve 3 (GV or SV2 - version depends) 4 - Valve 4 (GV - if available) 5 - Valve 5 (if available)			1	5
2	0 - 2 position valve 1 - 3 position valve	INT			

Table 6.37: Read type of valves

ORDER NUMBER 0x4008 POSSIBILITY OF CHANGE VALVES STATE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: 1 - Valve 1 (SV) 2 - Valve 2 (VV) 3 - Valve 3 (GV or SV2 - version depends) 4 - Valve 4 (BV or GV - version depends) 5 - Valve 5 (if available)			1	5
2	0 - Change allowed -1 - Change not allowed in actual working mode -2 - Change not allowed. Valve is working incorrectly *For Safety Valve (SV):* 2 - Opening forbidden. TMP pump is decelerating 3 - Closing forbidden. No transmission with working TMP *For Vent Valve (VV):* 1 - Opening forbidden. No transmission with working TMP 2 - Changing forbidden. Pumps are not turned off 3 - Changing forbidden. Valve GV must be closed. 4 - Opening forbidden. TMP pump is decelerating 5 - Opening forbidden. Emission for HG gauge is turned on 6 - Changing forbidden. Valve SV2 must be closed. *For Gate Valve (GV):* 1 - Opening forbidden. System must be vented 2 - Opening forbidden. TMP is not in normal operation 3 - Closing forbidden. Venting process is starting *For Safety Valve 2 (SV2):*	INT			

continued on next page

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ORDER NUMBER 0x4008 POSSIBILITY OF CHANGE VALVES STATE					R
	1 - Opening forbidden. System must be vented 2 - Opening forbidden. TMP is not in normal operation 3 - Closing forbidden. Venting process is starting 4 - Opening forbidden. Pressure level in the chamber is to high 5 - Opening forbidden. TMP must be turned on 6 - Opening forbidden. TMP is not in normal operation 7 - Opening forbidden. TMP pump is decelerating 8 - Opening forbidden. Unknown inlet pressure level of SV2 valve 9 - Opening forbidden. Pressure level in the chamber is to high 10 - Opening forbidden. Pressure level in the chamber is to low *For Bypass Valve (BV):* 1 - Opening forbidden. Pressure level in the chamber is unknown 2 - Opening forbidden. Pressure level in the chamber is to high				

Table 6.38: Device specification

ORDER NUMBER 0x4009 ELECTRONICS CONTROL					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
READ:					
1	Index:	nv			
2	0 - Electronics OFF -1 - Electronics not available in this system 1 - Electronics ON 2 - Electronics OFF. Turning on is not allowed due to high HG pressure 3 - Electronics OFF. Turning on is not allowed due to TMP is not in normal operation	INT			
WRITE:					
1	Index:	nv			
2	0 - Electronics OFF 1 - Electronics ON	INT		0	1

Table 6.39: Read/control Electronics

ORDER NUMBER 0x400A VENTING CONTROL					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index:	nv			
2	0 - Venting OFF 1 - Venting ON	INT		0	1

Table 6.40: Read/control venting

ORDER NUMBER 0x400B POSSIBILITY OF VENTING CONTROL					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index:	nv			
2	0 - Venting is not possible. Errors in the system 1 - Stop venting is possible 2 - Venting is not possible. Valve GV must be close 3 - Venting is not possible. Pumps must be turned off 4 - Start venting is possible 5 - Venting is not possible. Valve SV2 must be close	INT			

Table 6.41: Read possibility of venting control

ORDER NUMBER 0x400C VENTING TIME					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2-5	Venting time	LONG	s	60	1440

Table 6.42: Read/set venting time

ORDER NUMBER 0x400D REMAINING VENTING TIME					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2-5	Venting time	LONG	s		

Table 6.43: Read remaining venting time

ORDER NUMBER 0x400E AUTO VENTING CONTROL					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index:	nv			
2	0 - Auto venting OFF 1 - Auto venting ON	INT		0	1

Table 6.44: Read/control auto venting

ORDER NUMBER 0x400F AUTO VENTING TIME					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2-5	Auto venting time	LONG	s	0	1440

Table 6.45: Read/set auto venting time

ORDER NUMBER 0x4010 REMAINING AUTO VENTING TIME					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2-5	Auto venting time	LONG	s		

Table 6.46: Read remaining auto venting time

ORDER NUMBER 0x4011 OPERATION MODE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2	0 - normal 1 - service 2 - manual	INT			

Table 6.47: Read operation mode

ORDER NUMBER 0x4012 CODE OF STATUS LINES					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: 1 - Code of first status line 1 - Code of second status line				
2	1 - "" 2 - "REACTOR" 3 - "PUMPS OFF" 4 - "Pumping..." 5 - "Wait" 6 - "Venting..." 7 - "SYSTEM READY" 8 - "Vacuum uptake" 9 - "Vacuum Charging" 10 - "VENTED" 11 - "Auto Venting" 12 - "Wait venting" 13 - "Turn off HG" 14 - "FV pumping..." 15 - "Manual Mode" 16 - "Service Mode" 17 - "Wait for" 18 - "Initialization"	INT			

Table 6.48: Read code of status lines

ORDER NUMBER 0x4013 POSSIBLE SYSTEM OPERATION					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2	0 - Nothing 1 - Stop 2 - Start 3 - Fore vacuum pump start	INT			

Table 6.49: Read possible system operation

ORDER NUMBER 0x4014 OPERATION DESTINATION STATE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2	1 - Pumps Off 4 - System normal operation 6 - System vented	INT			

Table 6.50: Read operation destination state

ORDER NUMBER 0x4015 PCU TYPE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2	0 - A 2 - C 3 - D 4 - T (Tank) 5 - R (Reactor) 6 - U (VUV)	INT			

Table 6.51: Read PCU type

ORDER NUMBER 0x4016 ERROR SYSTEM STATUS					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2	0 - No errors 1 - No transmission with working Turbo Molecular Pump Driver 2 - No transmission with Turbo Molecular Pump Driver 3 - Turbo Molecular Pump failure 4 - Fore vacuum gauge failure 5 - High vacuum gauge failure 6 - Fore vacuum pump power failure 7 - Valve 1 (SV) failure 8 - Valve 3 (GV or SV2) failure 9 - Valve 2 (VV) failure 10 - Valve 4 (BV) failure	INT			

Table 6.52: Read error system status

ORDER NUMBER 0x4020 TURBOMOLECULAC PUMP AVAILABILITY					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2	-1 - not available 0 - inactive 1 - available	INT			

Table 6.53: Read Turbomolecular pump availability

ORDER NUMBER 0x4021 TURBOMOLECULAC PUMPS QUANTITY					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2	Turbomolecular pumps quantity	INT			

Table 6.54: Read Turbomolecular pumps quantity

ORDER NUMBER 0x4022 TURBOMOLECULAR PUMPS ROTATION SPEED					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: TMP pump number			1	3
2-9	Rotation speed	Double	%	0.0	100.0

Table 6.55: Read/set Turbomolecular pumps rotation speed

ORDER NUMBER 0x4023 ACTUAL ROTATION SPEED OF TURBOMOLECULAR PUMPS					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: TMP pump number			1	3
2-5	Actual rotation speed	LONG	Hz		

Table 6.56: Read actual rotation speed of Turbomolecular pumps

ORDER NUMBER 0x4024 TURBOMOLECULAR PUMPS SUPPLY VOLTAGE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: TMP pump number			1	3
2	Voltage	INT	V		

Table 6.57: Read supply voltage of Turbomolecular pumps

ORDER NUMBER 0x4025 TURBOMOLECULAR PUMPS SUPPLY CURRENT					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: TMP pump number			1	3
2-9	Current	Double	A		

Table 6.58: Read supply current of Turbomolecular pumps

ORDER NUMBER 0x4026 TURBOMOLECULAR PUMPS TEMPERATURE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: TMP pump number			1	3
2	Temperature	INT	°C		

Table 6.59: Read temperature of Turbomolecular pumps

ORDER NUMBER 0x4027 TURBOMOLECULAR PUMPS CONVERTER TEMPERATURE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: TMP pump number			1	3
2	Temperature	INT	°C		

Table 6.60: Read temperature of Turbomolecular pumps converter

ORDER NUMBER 0x4028 TURBOMOLECULAR PUMPS BEARING TEMPERATURE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: TMP pump number			1	3
2	Temperature	INT	°C		

Table 6.61: Read temperature of Turbomolecular pumps bearing

ORDER NUMBER 0x4029 TURBOMOLECULAR PUMPS ERROR CODE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: TMP pump number			1	3
2-5	Error code	LONG			

Table 6.62: Read error code of Turbomolecular pumps

ORDER NUMBER 0x402A TURBOMOLECULAC PUMP DECELERATION TIME AVAILABILITY					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2	-1 - not available 0 - inactive 1 - available	INT			

Table 6.63: Read Turbomolecular pump deceleration time availability

ORDER NUMBER 0x402B TURBOMOLECULAC PUMP VENTING FREQUENCY AVAILABILITY					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2	-1 - not available 0 - inactive 1 - available	INT			

Table 6.64: Read Turbomolecular pump venting frequency availability

ORDER NUMBER 0x402C TURBOMOLECULAC PUMP DECELERATION TIME					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2-5	Deceleration time	LONG	s	150	60000

Table 6.65: Read/set deceleration time of Turbomolecular pump

ORDER NUMBER 0x402D TURBOMOLECULAC PUMP VENTING FREQUENCY					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	nv			
2-5	Venting frequency	LONG	Hz		

Table 6.66: Read venting frequency of Turbomolecular pump

ORDER NUMBER 0x402E TURBOMOLECULAR PUMPS ERROR STATUS					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: 1 - Turbomolecular pump 1 2 - Turbomolecular pump 2 (if available)			1	2
2	1 - No transmission with working TMP Driver 2 - No transmission with TMP Driver 3 - TMP failure	INT			

Table 6.67: Read Turbomolecular pump error state

6.10.3 VACUUM GAUGE ORDERS - FUNCTION CODE 0x01..

ORDER NUMBER 0x0101 ACTUAL VACUUM GAUGE VALUE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2-9	Value	Double	mbar		

Table 6.68: Read actual vacuum gauge value

ORDER NUMBER 0x0102 ACTUAL VACUUM GAUGE ANALOG VALUE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2-9	Value	Double	V		

Table 6.69: Read actual vacuum gauge analog value

ORDER NUMBER 0x0103 VACUUM GAUGE UNIT					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2	Unit: 0 - mbar 1 - Torr 2 - Pa 3 - psia				

Table 6.70: Vacuum gauge unit

ORDER NUMBER 0x0104 NO SENSOR IN THE VACUUM GAUGE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2	State: 0 - False, 1 - True	Bool		0	1

Table 6.71: Read no sensor state

ORDER NUMBER 0x0105 VACUUM GAUGE STATUS					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2	Status: -1 - "Sensor Break!" 0 - Vacuum 1 - "Wait for emission" 2 - "No Emission" 3 - "Wait for ignition" 4 - "Not Calibrated" 5 - Voltage 6 - "Degasing " + time 7 - "Exter. Setpoint" 8 - "Low Pressure" 9 - "High Pressure" 10 - "0.00e+00"	INT			

Table 6.72: Read vacuum gauge status

ORDER NUMBER 0x0106 LOW SETPOINT IN MBAR					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2-9	Setpoint value	Double	mbar		

Table 6.73: Set/Read LOW Setpoint in mbar

ORDER NUMBER 0x0107 HIGH SETPOINT IN MBAR					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2-9	Setpoint value	Double	mbar		

Table 6.74: Set/Read HIGH Setpoint in mbar

ORDER NUMBER 0x0108 LOW SETPOINT IN VOLTS					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2-9	Setpoint value	Double	V		

Table 6.75: Set/Read LOW Setpoint in volts

ORDER NUMBER 0x0109 HIGH SETPOINT IN VOLTS					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2-9	Setpoint value	Double	V		

Table 6.76: Set/Read HIGH Setpoint in volts

ORDER NUMBER 0x010A TRIGGER STATE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2	State: 0 - Off, 1 -	Bool		0	1

Table 6.77: Read trigger state

ORDER NUMBER 0x010B GAUGE TYPE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2	Type: 0 - CTR90 1 - TTR90 2 - TTR211 3 - PTR225 4 - PTR90 5 - ITR90 6 - ITR100 7 - Baratron 8 - ANALOG IN 9 - MKS 937A 10 - PG105 11 - MG13/14 12 - PKR 251 13 - PCR 280 14 - ATMION	INT			

Table 6.78: Set/Read gauge type

ORDER NUMBER 0x010C CTR90/91 FULL SCALE PARAMETER					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2	FS: 0 - 0.1 Torr 1 - 1 Torr 2 - 10 Torr 3 - 100 Torr 4 - 1000 Torr	INT			

Table 6.79: Set/Read full scale parameter for CTR90/91 gauge unit

ORDER NUMBER 0x010D Baratron FULL SCALE PARAMETER					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2	FS: 0 - 10 Torr 1 - 50 Torr 2 - 100 Torr 3 - 500 Torr 4 - 1000 Torr 5 - 20 psia 6 - 30 psia 7 - 50 psia 8 - 60 psia 9 - 100 psia 10 - 250 psia 11 - 500 psia 12 - 725 psia 13 - 1000 psia 14 - 2000 psia 15 - 3000 psia	INT			

Table 6.80: Set/Read full scale parameter for Baratron gauge unit

ORDER NUMBER 0x010E TYPE OF GAS					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2	Typ of gas: 0 - Air 1 - He 2 - Ne 3 - Ar 4 - Kr 5 - Xe 6 - H2 7 - CO 8 - define	INT			

Table 6.81: Set/Read type of gas

ORDER NUMBER 0x010F DEFINED GAS FACTOR					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2-9	Gas factor value	Double			

Table 6.82: Set/Read defined gas factor

ORDER NUMBER 0x0110 DEGASS POSSIBILITY					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2	Possibility: 0 - degas possible 1 - vacuum gauge damaged 2 - meter does not support degas 3 - too low vacuum in chamber, to start the degassing	INT		0	3

Table 6.83: Read degas possibility

ORDER NUMBER 0x0111 DEGAS STATE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2	0 - OFF, 1 - ON	INT		0	3

Table 6.84: Set/Read degas state

ORDER NUMBER 0x0112 DEGAS TIME					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2-5	Time	LONG	Seconds		

Table 6.85: Set/Read degas time

ORDER NUMBER 0x0113 READ REMAINING DEGAS TIME					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2-5	Time	LONG	Seconds		

Table 6.86: Read remaining degas time

ORDER NUMBER 0x0114 EMISSION STATE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2	Emission: 0 - OFF, 1 - ON	INT			

Table 6.87: Set/Read emission state

ORDER NUMBER 0x0115 READ EMISSION STATE FROM VACUUM GAUGE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2	Emission: 0 - OFF, 1 - ON	INT			

Table 6.88: Read emission state from vacuum gauge

ORDER NUMBER 0x0116 FILTRATION LEVEL OF VACUUM MEASUREMENT					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index	INT		1	2
2	Filtration level: 0 - low 1 - medium 2 - high	INT			

Table 6.89: Set/Read filtration level of vacuum measurement

6.10.4 ANALOG OUTPUTS ORDERS - FUNCTION CODE 0x05..

ORDER NUMBER 0x0501 SIGNAL SOURCE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: Out number. From 1 to number of all analog outs	INT		1	
2	Assigned signal source: Corresponds to the position of signal source in the menu "Source" of Analog out channel. For example, if the menu looks as below: *Source* *Pressure 1* *Pressure 2* *Usource* *Iemis* *None* Code of signal source *Iemi* is 4	INT		1	

Table 6.90: Set/Read signal source

ORDER NUMBER 0x0502 RETRANSMISSION MODE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: Out number. From 1 to number of all analog outs	INT		1	
2	Retransmission mode: 1 - range 2 - 1 to 1 3 - exponent	INT		1	3

Table 6.91: Set/Read work mode

ORDER NUMBER 0x0503 RETRANSMISSION SCALE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: Out number. From 1 to number of all analog outs	INT		1	
2	Retransmission scale: 1 - linear 2 - logarithmic	INT		1	2

Table 6.92: Set/Read retransmission scale

ORDER NUMBER 0x0504 MINIMUM VALUE OF RETRANSMITTED PARAMETER					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: Out number. From 1 to number of all analog outs	INT		1	
2-9	Minimum value Unit and min/max is signal source dependent	Double			

Table 6.93: Set/Read minimum value of the retransmitted parameter.

ORDER NUMBER 0x0505 MAXIMUM VALUE OF RETRANSMITTED PARAMETER					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: Out number. From 1 to number of all analog outs	INT		1	
2-9	Maximum value Unit and min/max is signal source dependent	Double			

Table 6.94: Set/Read maximum value of the retransmitted parameter.

ORDER NUMBER 0x0506 MINIMUM VALUE OF THE OUTPUT VOLTAGE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: Out number. From 1 to number of all analog outs	INT		1	
2-9	Output voltage	Double	V	0	10

Table 6.95: Set/Read minimum value of the output voltage.

ORDER NUMBER 0x0507 MAXIMUM VALUE OF THE OUTPUT VOLTAGE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index: Out number. From 1 to number of all analog outs	INT		1	
2-9	Output voltage	Double	V	0	10

Table 6.96: Set/Read maximum value of the output voltage.

6.10.5 BAKEOUT ORDERS - FUNCTION CODE 0x07..

ORDER NUMBER 0x0701 BCU HEATING					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	BCU heating: 0 - OFF 1 - ON	INT			

Table 6.97: BCU heating ON/OFF

ORDER NUMBER 0x0702 BCU HEATING TIME					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2-5	Heating time	LONG	Seconds		

Table 6.98: BCU heating time

ORDER NUMBER 0x0703 READ REMAINING BCU HEATING TIME					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2-5	Heating time	LONG	Seconds		

Table 6.99: Read remaining BCU heating time

ORDER NUMBER 0x0704 READ ACTUAL TEMPERATURE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2-9	Temperature	Double	°K		

Table 6.100: Read actual bakeout temperature

ORDER NUMBER 0x0706 BAKEOUT TEMPERATURE SETPOINT					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2-9	Temperature	Double	°K		

Table 6.101: Bakeout temperature

ORDER NUMBER 0x0707 RAMP VALUE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2-9	Ramp value	Double	°K		

Table 6.102: Ramp value

ORDER NUMBER 0x0708 RAMP UNIT					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	Temperature unit: 0 - ramp value / s 1 - ramp value / min 2 - ramp value / h	INT			

Table 6.103: Ramp unit

ORDER NUMBER 0x0709 READ SENSOR BREAK STATUS					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	Sensor break status: 0 - NO, 1 - YES	INT			

Table 6.104: Read sensor break status

ORDER NUMBER 0x070A HG INTERLOCK ENABLE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	HG interlock: 0 - DISABLE 1 - ENABLE	INT			

Table 6.105: HG interlock enable

ORDER NUMBER 0x070B READ TMP INTERLOCK ENABLE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	TMP interlock: 0 - DISABLE 1 - ENABLE	INT			

Table 6.106: TMP interlock enable

ORDER NUMBER 0x070C INTERLOCK AUTOSTART ENABLE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	Autostart interlock: 0 - DISABLE 1 - ENABLE	INT			

Table 6.107: Autostart interlock enable

ORDER NUMBER 0x070D POWER FAILURE SIGNAL SOURCE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	Power failure signal source: 0 - INTERNAL 1 - EXTERNAL	INT			

Table 6.108: Power failure signal source

ORDER NUMBER 0x0740 READ BCU MODULE AVAILABILITY					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	BCU module: -1 - not available 0 - not active 1 - available	INT			

Table 6.109: BCU module availability

ORDER NUMBER 0x0741 BCU TURN ON ABILITY					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	BCU turn on ability: 0 - OK 1 - Unable heating. Bakeout power failure 2 - Unable heating. Thermocouple failure 3 - Unable heating. HG vacuum is too low 4 - Unable heating. TMP is not in normal operation	INT			

Table 6.110: BCU turn on ability

ORDER NUMBER 0x0742 HG INTERLOCK FAILURE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	HG interlock failure: 0 - NO 1 - YES	INT			

Table 6.111: HG interlock failure

ORDER NUMBER 0x0743 TMP INTERLOCK FAILURE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	TMP interlock failure: 0 - NO 1 - YES	INT			

Table 6.112: TMP interlock failure

ORDER NUMBER 0x0744 POWER FAILURE					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	Power failure: 0 - NO 1 - YES	INT			

Table 6.113: Power failure

ORDER NUMBER 0x0745 HEATER SYMBOL					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	Heater symbol: 0 - No heater 1 - Hot heater 2 - Cold heater	INT			

Table 6.114: Heater symbol

6.10.6 LOADLOCK SPECIFIED ORDERS - FUNCTION CODE 0x08..

ORDER NUMBER 0x0801 LOADLOCK CONTROL					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	Loadlock: 0 - Turn OFF 1 - Turn ON	INT			

Table 6.115: Loadlock control

ORDER NUMBER 0x0802 LOADLOCK POWER					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2-5	Loadlock power	LONG	%		

Table 6.116: Set/Read loadlock power

ORDER NUMBER 0x0803 LOADLOCK HEATING TIME					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2-5	Loadlock heating time	LONG	s		

Table 6.117: Set/Read loadlock heating time

ORDER NUMBER 0x0804 LOADLOCK REMAINING HEATING TIME					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2-5	Loadlock remaining heating time	LONG	s		

Table 6.118: Read remaining heating time

ORDER NUMBER 0x0805 MAX LOADLOCK TEMPERATURE					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2-5	Maximum Loadlock temperature	LONG	°K		

Table 6.119: Maximum Loadlock temperature

ORDER NUMBER 0x0806 MAX LOADLOCK POWER					R/W
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2-5	Maximum Loadlock power	LONG	%		

Table 6.120: Maximum Loadlock power

ORDER NUMBER 0x0840 READ LOADLOCK MODULE AVAILABILITY					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	Loadlock module: -1 - not available 0 - not active 1 - available	INT			

Table 6.121: Loadlock module availability

ORDER NUMBER 0x0841 LOADLOCK TURN ON ABILITY					R
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
1	Index				
2	Loadlock turn on ability: 0 - OK 1 - Unable to turn on	INT			

Table 6.122: Loadlock turn on ability

7 MAINTANCE AND SERVICE

7.1 MAINTANCE

The PCU16 does not require any special maintenance work.

7.2 CLEANING

For cleaning of the outside of the device, a slightly moistened cloth will usually do. Do not use any aggressive or abrasive cleaning agents.

DANGER

Mains voltage.
Components inside of the PCU16 are components at mains voltage. Do not insert any objects through the louvers of the device. Protect the device from liquids. Do not open the device.

7.3 FIRMWARE UPGRADE

On the pictures below we will use the names of {device_name} and {version}:

- {device_name} in this case means PCU16 .
- {version} is in numerical form and contains 3 digits separated by a dots. E.g: 1.0.0 or 3.1.5

WARNING

Firmware upgrade

During the upgrade, do not turn off the PCU16 or disconnect it from the wall outlet. Failure to do so may cause damage to the PCU16 , with the result that the unit is not unfit for use and will require repair.

In order to update the software/firmware via USB the USB memory stick must be formatted as FAT / FAT32. Then simply copy the update file received from us to the memory stick and insert into the USB slot on the front of the PCU16 . The “New USB Device Detected” hint will appear on the bottom of the screen.

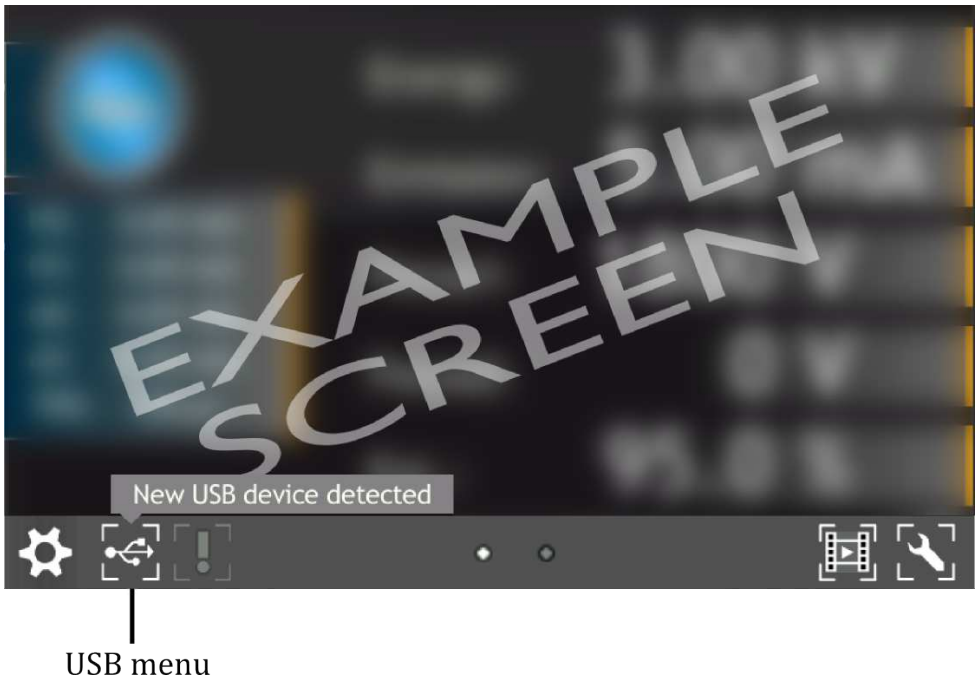

Figure 7.1: USB detected hint

The USB menu is accessed by clicking the USB icon on the bottom of the screen. This displays several options:

- see list of found firmware,
- copy user manual to USB,
- un-mount USB drive,
- export log file onto USB,
- see list of videos on USB,
- copy new language to device,

Figure 7.2: USB menu

To update the current version to a newer version, select the Firmware Updates option. To accelerate the search for updates on the USB drive, delete all files except the updates.

Figure 7.3: Firmware list

In order to choose one of the updates simply click on the name. The “Do you want to update firmware to selected version? After whole procedure device will be rebooted” phrase will appear. Selecting No returns the user to the main menu of Firmware Updates. It is highly recommended to finish all the work on the device and save your data before pressing the “Yes” button.

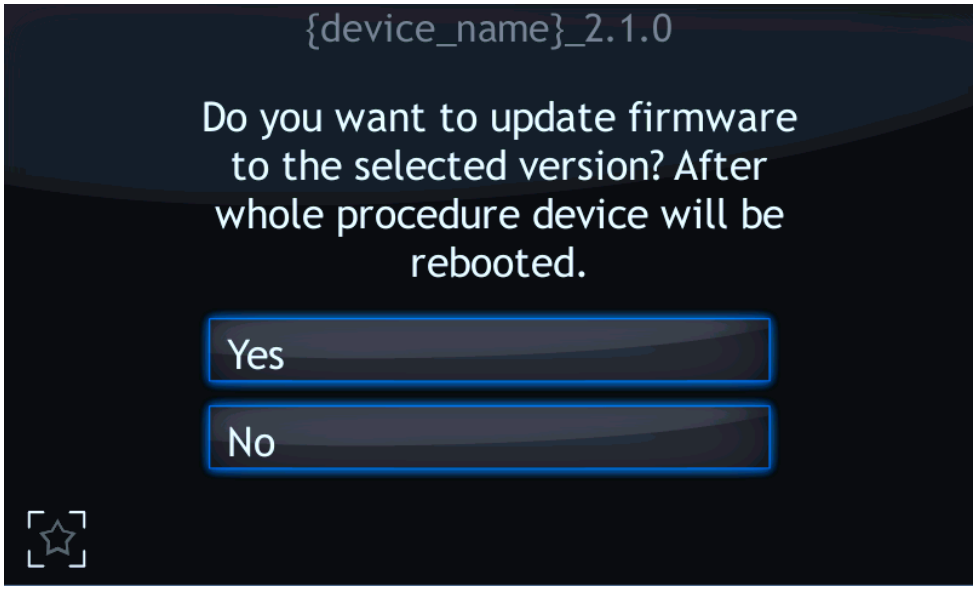

Figure 7.4: Restart message

After selecting to proceed with the update, the device will stop and the updating procedure will be initiated. The update process takes a few minutes during which time the screen below is displayed.

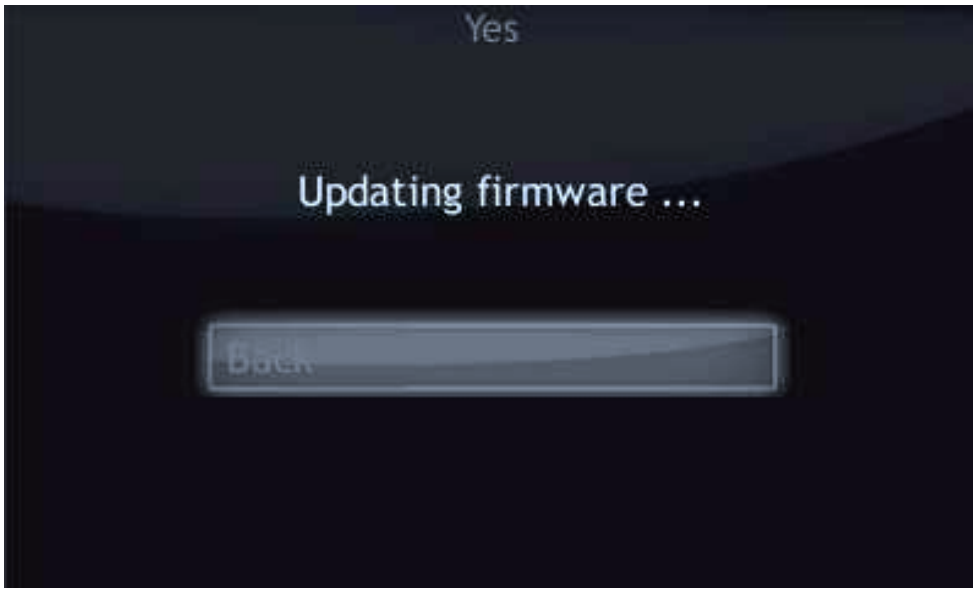

Figure 7.5: Updating firmware

Upon successful installation, the message with "updated" statuses should be displayed.

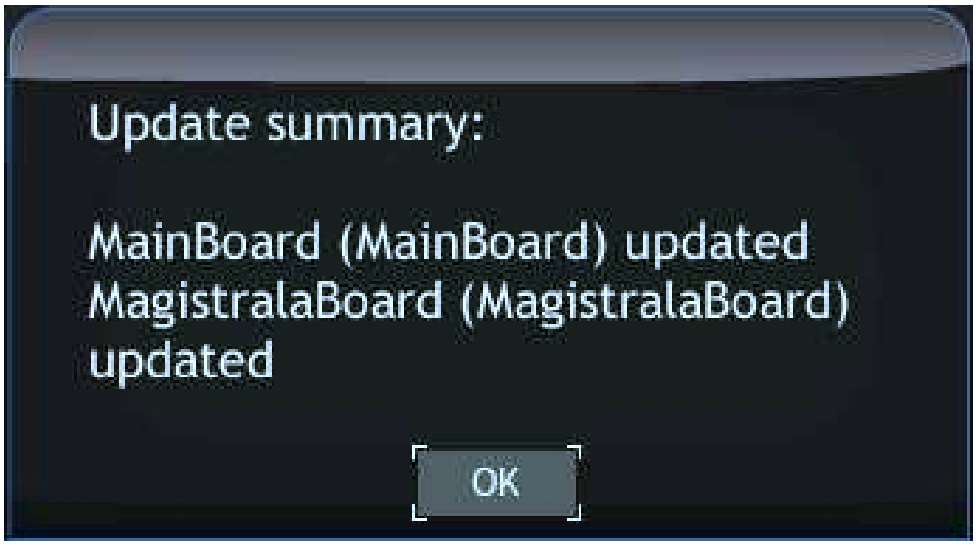

Figure 7.6: Update summary example

Select “OK” to reboot the device and finish the upgrade.

7.3.1 AUTO UPDATE

The auto-update feature compares the current version of main-board and bus firmware with software. In case of any mismatch (for example if the micro SDHC card was swapped) the user will be informed with a blinking exclamation icon.

- To synchronize the firmware, select the exclamation icon.
- The screen below is displayed. If the “Recommended Updates” message is visible, tap the “Auto Update” button in order to synchronize firmware and software. Then follow the procedure from the previous section Upgrading firmware via USB.

Figure 7.7: Auto update 1

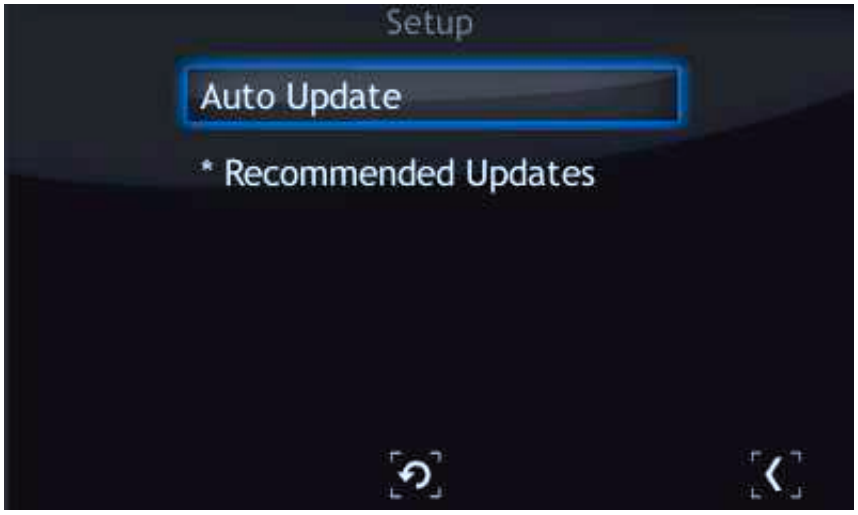

Figure 7.8: Auto update 2

7.4 PREBOOT ENVIRONMENT

To run the Preboot application press on the logo at PCU16 startup (7.9).

Figure 7.9: Enter into preboot environment

The Preboot Environment is an application to boot the PCU16 . Its main task is to launch the device in the version selected by the user. It can also be used to run other tools, such as the gauge calibration application.
The main menu consist three options:

- Reboot – rebooting PCU16 .
- Continue booting – close Preboot Environment and continue starting PCU16 .
- Continue booting (photo mode) – allow to run device with screenshot function.

7.4.1 BOOT MENU

Boot menu allows the user set which version of the PCU16 and Preboot Environment will be run after the start of device. In order to switch software version, click on “Software boot version” combo box.

Figure 7.10: Boot menu

Then select one of the available versions, for example default.

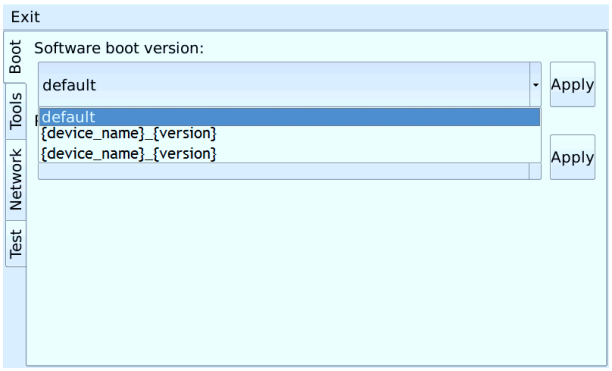

Figure 7.11: Switch software version

To apply changes press Apply button. From now the default version will be automatically run after restarting PCU16 .

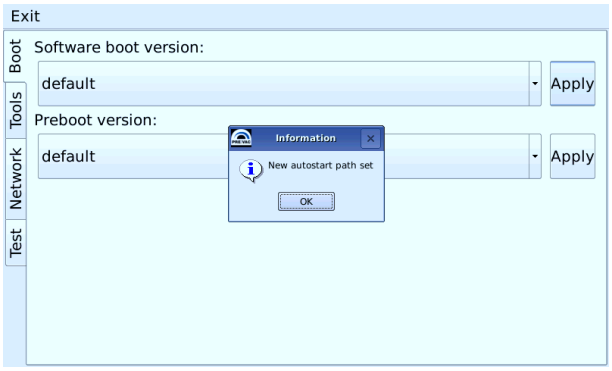

Figure 7.12: Message box confirming the changed settings

7.4.2 TOOLS MENU

The Tools menu allows the user to run applications such as touch screen or power supply calibration.

Figure 7.13: Tools menu

In order to select one of the applications, tap the desired application from the tools combo box and tap the Run button.

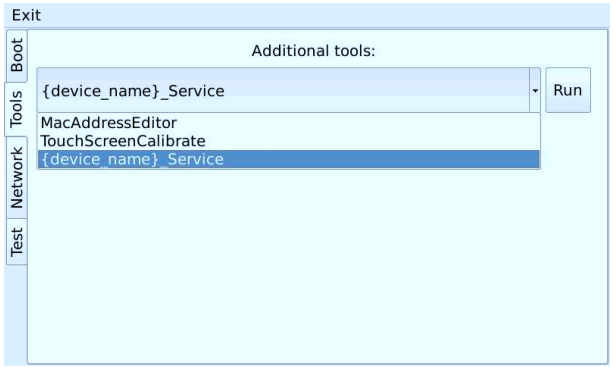

Figure 7.14: Selecting additional tool

7.4.3 NETWORK TAB

From this tab the user can configure the IP address, netmask and enable / disable DHCP.

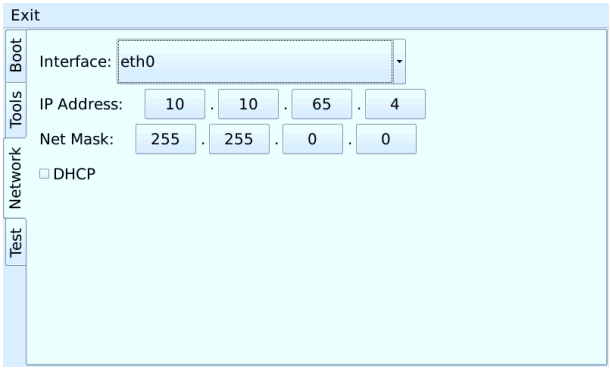

Figure 7.15: Network tab

After tapping on one of the editable fields, the numeric panel for editing values will appear . Input values can be completed by tapping X button in the upper-left corner of the screen.

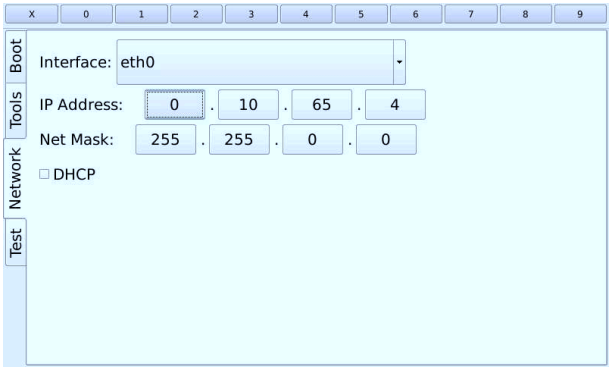

Figure 7.16: Numeric panel

7.4.4 TEST TAB

From this tab the user can test the speaker.

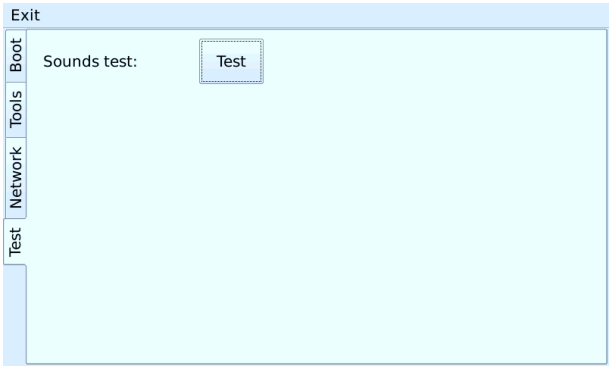

Figure 7.17: Test tab

8 STORAGE AND DISPOSAL

8.1 PACKING

Please retain the original packaging. The packaging is required for storing the PCU16 and for shipping it to an authorized PREVAC service center.

8.2 STORAGE

The PCU16 should only be stored in a dry room. The following requirements must be met:

PARAMETER	VALUE
Ambient temperature	-20...50°C
Humidity	as low as possible; preferably in an air-tight plastic bag with a desiccant

Table 8.1: Storage parameters

8.3 DISPOSAL

The product must be disposed of in accordance with the relevant local regulations for the environmentally safe disposal of systems and electronic components.