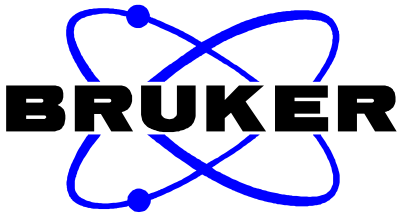


Installation Manual for Bruker NMR Systems

Electronic Atmospheric Pressure Device

Z51996

Version 003

Contents

This manual was written by

Daniel B. Baumann

daniel.baumann@bruker-biospin.ch

CH-8117 Faellanden, Switzerland

P/N: Z31221
DWG-Nr: 891003

Manual Version: ZTKS0060-00

Contents

Contents

BRUKER BIOSPIN AG

Magnet Division

NMR Magnet Systems

phone: **++41 1 825 91 11**

fax: **++41 1 825 96 96**

e-mail: **magnetics@bruker-biospin.ch**

service_magnetics@bruker-biospin.ch

sales_magnetics@bruker-biospin.ch

Installation Manual

Electronic Atmospheric Pressure Device

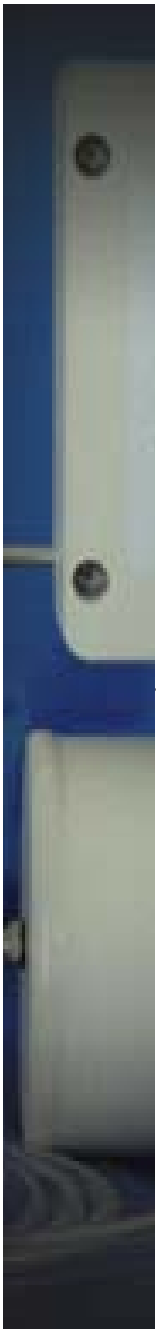
for Bruker Cryostats

Table of Contents

Contents

1 Introduction

Electronic Atmospheric Pressure Device APD Z51996



Due to the excellent sensitivity of NMR systems, the magnetic field is quite sensitive to changes in ambient temperature and atmospheric pressure.

Rapid changes in the atmospheric pressure caused by weather changes may result in a high helium boil off (falling atmospheric pressure) or a zero helium boil off (increasing atmospheric pressure). These pressure changes will affect the helium temperature inside the cryostat and result in different drift rates. Large changes in drift rate is also influence the homogeneity of the magnet.

We recommend the use of Electronic Atmospheric Pressure Devices (APD) for all high field NMR systems (600 MHz and above), when running long term experiments in locations with large changes in atmosperic pressure.

The APD is able to stabilize the helium atmosphere within the helium vessel of the cryostat at a constant pressure of 1030 hPa (1030 mbar). Due to the very sensitive pressure sensor and the high tech proportional valve, this regulation does not produce any additional vibrations in the cryostat. The optimum pressure for stable operation is about 1030 hPa, but this setting may be adjusted by replacing a resistor.

The APD is equipped with a regulator valve, which is fully open if the power fails. If an electrical failure occurs, the valve will open and slowly release the excessive helium pressure into the atmosphere.

Before refilling the helium, the excess pressure in the cryostat needs to be released with a needle valve or simply by switching off the APD.

Building up the pressure after the refilling procedure will take about 6-24 hours.

The proportional regulator valve manufacturer can garantee a long term stability of < 0.5% FS / year (FS = Full Scale = 1060 hPa). This provides for a maximum variation in offset point of approximately 5 mbar per year.

2 Safety precautions

Always keep the APD outside of the 0.5 mT (5 G) stray field line. There is a transformer and a magnetically controlled proportional valve inside which could be affected by the magnetic field.

Never disconnect APD inlet or the gas tubing at the side of the magnet before the cryostat is depressurized. The pressure in the helium vessel is stabilized about 30-70 hPa (mbar) over the ambient pressure. A spontanious pressure decrease cause the magnet system to expierience a high helium boil off, as well as a quench.

The APD must be checked yearly for its offset point. A high discrepancy in the offset point could end up in high drift rates at the magnet system.

Always connect the APD after the one way valve.

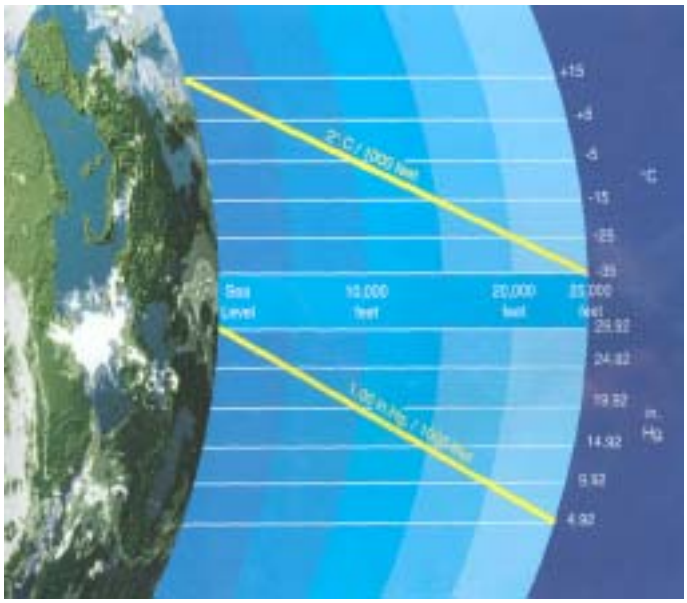
Never connect the APD during magnet charging or cryoshimming. A high helium flow can destroy the membrane of the proportional valve.

We recommend always installing the APD at the end of the line (after the helium flow meter or gas counter).

3 Operating Principles

The APD is able to stabilize the pressure of the helium atmosphere in the cryostat of the magnet system to a constant pressure of 1030 hPa.

Due to the very sensitive proportional regulator valve, the APD will not create any additional vibrations in the helium towers of the cryostat.



Atmospheric pressure conditions:

The weight of the atmosphere generates a pressure in the air, which decreases as the distance from the earth's surface increases.

Near the earth's surface (<10 000m) we can calculate with a linear decline of **100 Pa (1 mbar) for every 8 m** increase in elevation, when we assume a constant temperature.

(This calculation is comparable with **1.0 inch Hg / 1000 feet.)**

Strictly speaking the atmospheric pressure is reacting by the confirmity to Boyle-Mariotte. It is droping down by an exponential function starting at 1013,25 hPa (0 °C).

$$p_h = p_o \cdot e^{-\frac{\rho_o g h}{p_o}} \quad ; \text{at } 0° \text{ C}$$

p_h = Atmospheric pressure at h meters above sea level

p_o = Atmospheric pressure at sea level = 1013.25 hPa = 1013mbar = 29.92 inch Hg

e = 2.71828 (Euler constant)

ρ_o = Air density at earth surface = 1.293 kg/m^3 at 0° C and 1013 hPa

g = Acceleration of gravity = 9.81 m/s^2

h = Altitude in m above sea level

4 Installation

For the following installation you will need:

-A drill, when you prefer to fix it to wall

- Dowel and screws

4.1 Unpacking

The Electronic Atmospheric Pressure Device Z51996 includes:

- APD

- 2 m power cable (Schucko plug)

- 5 m plastic tubing

- Manual APD

- Manual Bronkhorst

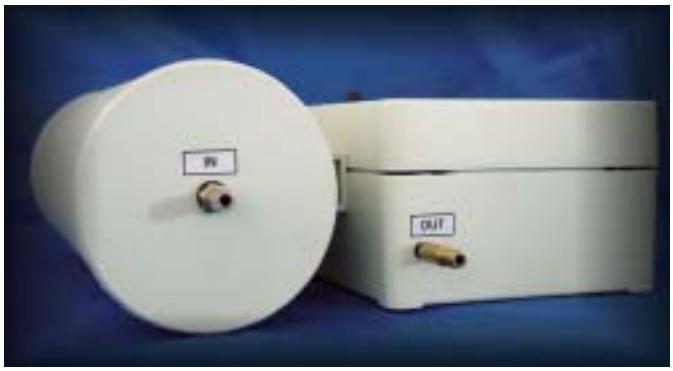
4.2 Power Supply

90 - 264 Volts / 50 - 60 Hz

The APD contains a power supply with a wide operational range from 90 V up to 264 V at 50 - 60 Hz. Connect the APD to the 240 V plug at the console of the spectrometer when there is no other receptacle available. The power consumption for the APD is approximately 12W.

There is 2 A T / ClassB, Group1 fuse at the line input for protection.

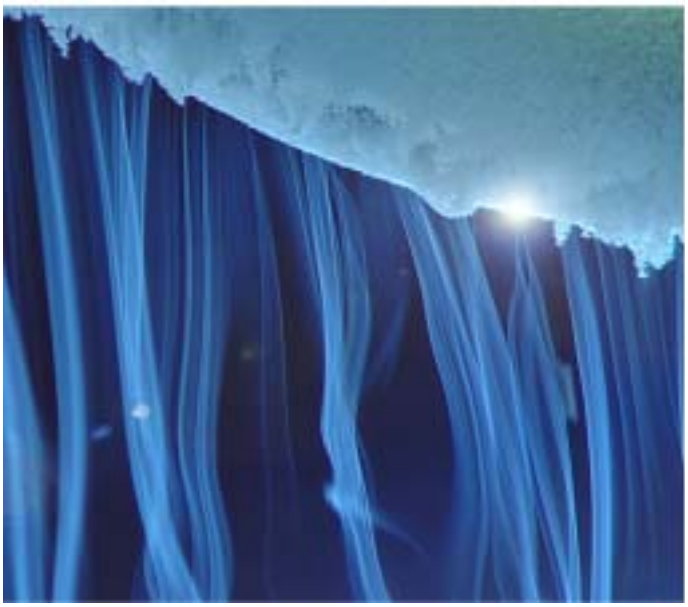
4.3 Connecting to the Cryostat



To connect the APD to the Cryostat, use the 5m plastic tube. For security reasons don’t remove the one way valve.

Connect the outlet of the APD to an additonal tube and bring the helium gas outside of the spectrometer room or close to the air conditioning. The long term effect of helium buildup is that the vacuum of the magnet system will go soft (due to the helium molecules being very small) and the liquid helium boil off will start to increase.

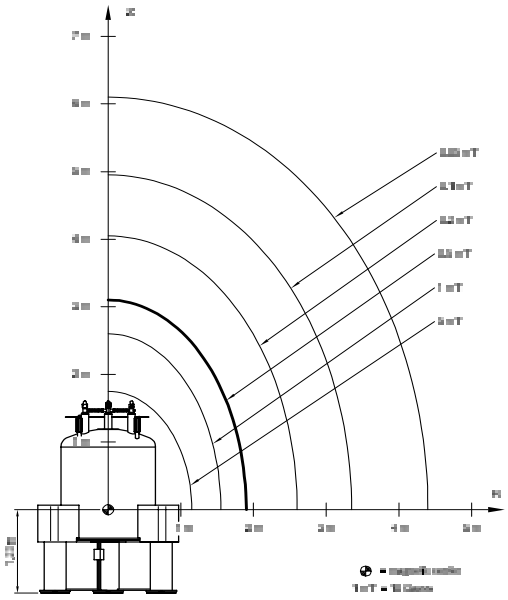
4.4 Connection to Helium Recovery System



Before you connect the outlet of an APD to a recovery system, you must garantee that an overpressure will not affect the regulator.

Keep in mind that the APD regulator operates only when the pressure at the outlet is at least 15 hPa (15 mbar) lower.

4.5 Distance to the magnet



- Always keep the APD away from the magnetic field. Use the 5 mT (5G) stray field as a guideline for protecting the magnet system against hazardous flying objects.

- There is a transformer and a magnetically controlled proportional valve inside the housing.

- The valve can of course also be influenced by the magnetic field of the magnet system and therefore a save operation cannot be guaranteed.

5 Function Switch and LCD Display

The function switch has 4 different positions.

5 Volt Reference:

The LCD monitors the reference voltage. (~5.0 V)

Valve Supply:

0 V : valve fully open

~13 V : valve fully closed

Set point:

1030 hPa (standard setting)

Pressure Sensor:

This is the operation pressure measured at the input side.

6 System Check

Always check the APD under normal working conditions. The 5V reference voltage is generated by the Bronkhorst regulator and its temperature depends on the gas flow through the regulator. Connect the APD to your magnet system and wait a few hours or use N_2-gas for a system check. To adjust your N_2-gas flow use a helium flow meter or something similar.

300-400MHz cryostats: ~ 11 ml/h

500MHz: ~ 17 ml/h

600MHz: ~ 35 ml/h

700MHz: ~ 70 ml/h

1. Switch with the function switch to **Reference Voltage** and check the 5 V reference.

2. Change to **Valve supply** and double check the valve position by reading the display (0 V = valve open; 14 V = valve closed).

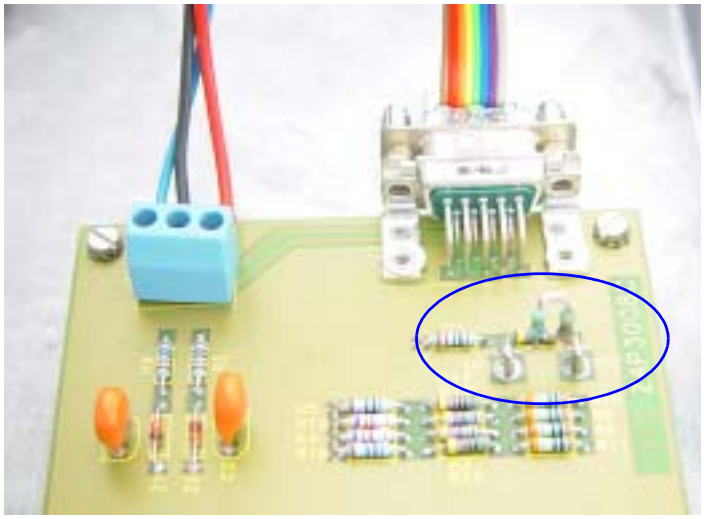
3. Check the **set point**. The standard setting is 1030 hPa.

4. Switch to **Pressure Sensor hPa**. Block the inlet gas tube and remove it from the APD. Release the pressure from the APD regulator valve by switching the unit off and on again. Compare the reading on the display with your local weather forecast or ask for an absolute pressure measurement. Note that the atmospheric pressure in weather forcasts are referenced to sea level. This means that you have to subtract 1 hPa (mbar) for every 8 m that your location is above sea level.

Do not release the pressure from the magnet system, as it needs a long time to build it up again.

Do not try to measure the ambient pressure with the APD for extended period of time (hours). Without flow thru in the regulator valve the reference voltage changes rapidly.

7 Altering the Operating Pressure (set point)



The factory setting for the operating pressure is 1030 hPa. When your customer is located where the average pressure is much lower or higher, than it may make sense to change the adjusting resistor on the printed circuit board. As a customer option Bruker Biospin AG can deliver systems with different set points.

Theoretically, the maximum pressure with R_{adj} = 0 Ω is 1060 hPa. In practice it is not recommended, when using a voltage divider, to have one resistor close to zero. The output is directly dependent on the 5 V reference. So 1045 hPa as the maximum pressure which is practically approved.

The easiest way is to calculate the new set point voltage and adjust than the divider accordingly. $R_{adj} \cong$ 1.5 - 3k (use only 0.1% resistors).

$$U_{\text{new set point}}\,[V] = \frac{U_{rev}\,[V] \bullet \text{New pressure value [hPa]}}{1060\ \text{hPa}}$$

Example:

$$U_{\text{new set point}}\,[V] = \frac{5.0V \cdot 1045\ \text{hPa}}{1060\ \text{hPa}} = 4.929\ V$$

For an optimum regulation the cryostat pressure should be ~15 hPa (~15 mbar) above the highest atmospheric pressure you obtain.

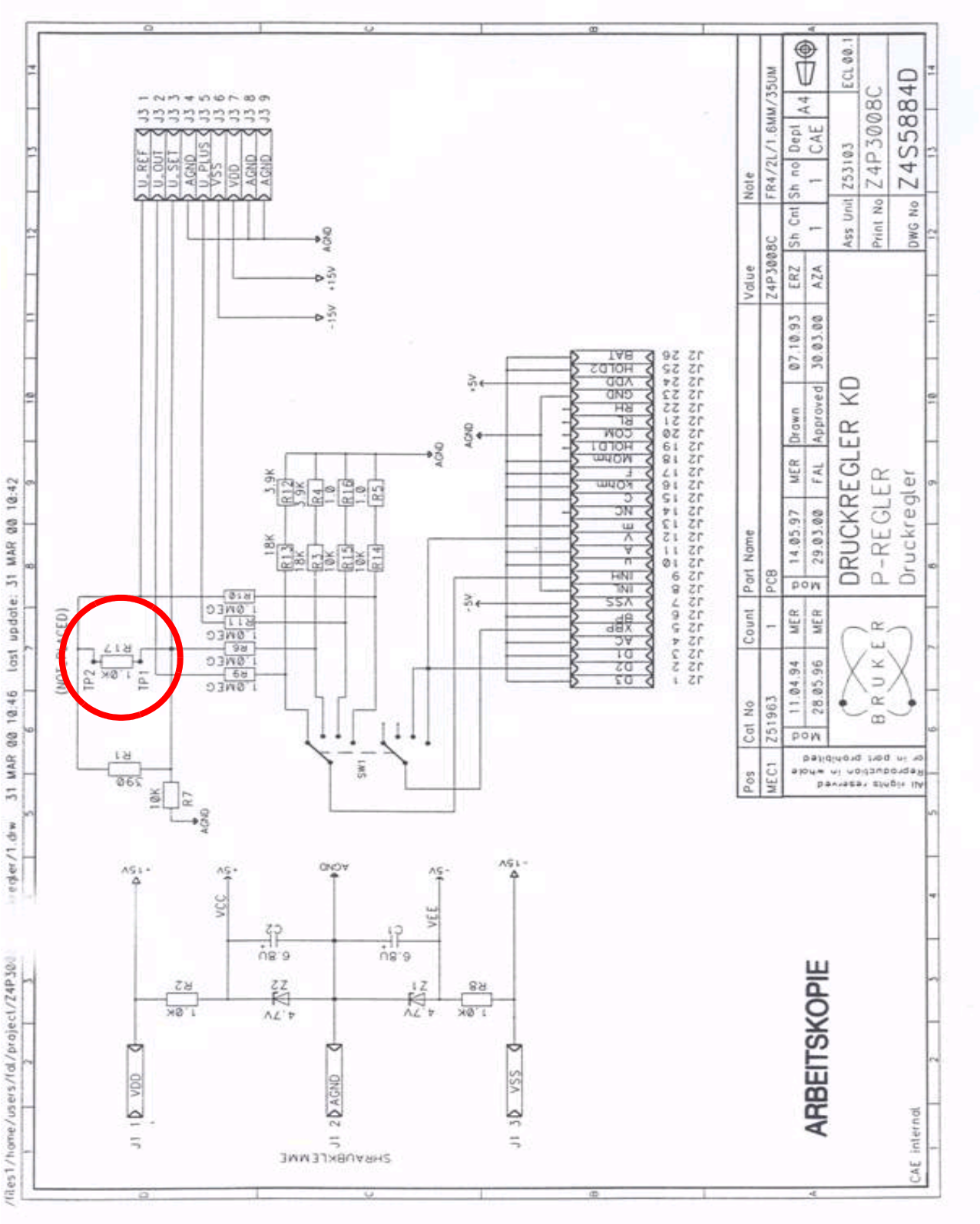
8 Maintenance

The long term stability of the Bronkhorst regulator is 0.5% (~5 hPa) per year. These regulators normally drift to one side, within a few years it can end up with a high offset point, but still running within specification. For this reason the APD must be checked once a year.

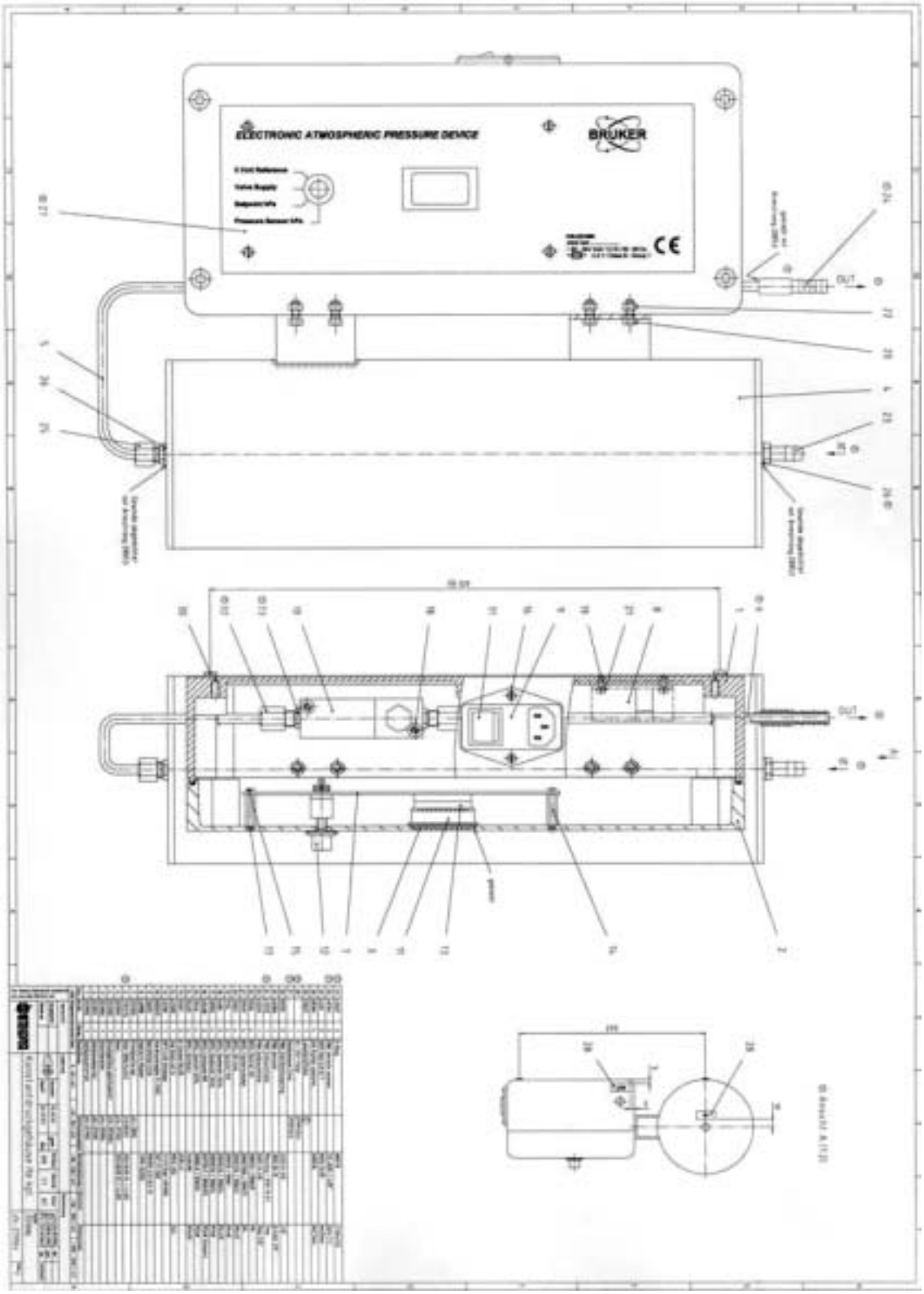
The inlet tube can be blocked, whereas the display must show the ambient pressure. For details refer to chapter 6, “System Check,” on page 8.

With a pressure difference (ΔP) of more ~20-30 hPa the equipment can be shipped back to Bruker for readjustment.

9 Wiring Diagram



10 Mechanical drawings

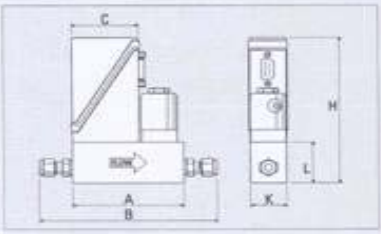


11 Bronkhorst Regulator

EL-PRESS Electronic Pressure Controllers

General

The EL-PRESS Electronic Pressure Controllers are compact devices, comprising an integrated pressure transducer and control valve for K_v-values up to 6,6 x 10^{-2}. For higher flows we recommend to use a separate P-500 pressure transducer, preferably to be mounted outside the flow stream to eliminate frictional losses, and a special, patented Bronkhorst Hi-Tec control valve for K_v-values up to 6,0. To cope with high differential pressure a VARY-P control valve can be offered; the maximum possible differential pressure across this device is 400 bar.



Forward Pressure Controller

	Dimensions (mm)						Weight
Model	A	B	C	H	K	L	(kg)
P-602C/P-612C	77	127	47	123	25	37	0,7

Back Pressure Controller

	Dimensions (mm)						Weight
Model	A	B	C	H	K	L	(kg)
P-702C/P-712C	77	127	47	123	25	37	0,7

EL-PRESS P-702C EPC

For pressure control applications with small pressure differences, series F-004 bellows operated valves can be offered. See pages 8 and 9 for a description of the various control valves.

Fields of application

Chromatography

Programmable pressure profile in

- gas chromatography
- liquid chromatography

Biotechnology

- Fermenter pressure control

Semiconductor Industry

- Vapour pressure control MOCVD
- Chamber pressure control in CVD and sputtering equipment

Surface treatment technology

- Source pressure control ($TiCl_4$)
- Protective gas pressure control in aluminium extrusion moulding processes

Research laboratories

- Pressure control in combustion studies
- Liquid level control in reactor vessels

Pressure ranges (intermediate ranges are available)

Forward Pressure Controllers (absolute or relative)

Model P-602C min. 5 .....100 mbar max. 3,2 .....64 bar
Model P-612C min. 3,2 .....64 bar max. 5 .....100 bar*

Back Pressure Controllers (absolute or relative)

Model P-702C min. 20 .....100 mbar max. 12,8 .....64 bar
Model P-712C min. 12,8 .....64 bar max. 20 .....100 bar*

* For pressures up to 400 bar select P-532C Pressure Meter with F-033C Control Valve

5

12 Troubleshooting

-No display: Check the fuse, the power line and the power supply.

-No regulation: The membrane inside the Bronkhorst regulator for picking up the input pressure is very sensitive to overpressure. In case of a quench it can brakedown and the unit will no work under the standard conditions.

-High boil off: Check the APD's offset point. The display will stay on 1030 hPa, but the input pressure could riseto a much higher point, due to a drifting offset. Go for chapter 8, "Maintenance," on page 11.

A high helium boil off can only occur when the APD is connected. Check the regulator voltage for oszillation (knob position 2). Use helium flow meter to check for a gas oszillation inside the gas tube. Start removing the one way valve. Exchange the gas tube with a longer/shorter one.

-Valve Supply 0V: The regulation valve should be fully open. Check for the ambient pressure. The difference must be at least 15 hPa (15 mbar).

~ 13V: The regulation valve should be fully closed. Check for a He leak at the magnet system.

Index

Index