Beta-Dust Monitor F-701-20
Technical Manual
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1. Applications

The F701-20 Dust Monitor continuously monitors and records dust content in ambient air. It is used in Environmental Monitoring Systems for the monitoring of air pollution. The device contains a fully automatic sample gas extraction system. The sampled dust particles are collected on a filter paper and measured. The marking of the current sampling with date, time and measurement value allows an additional laboratory analysis of the particle composition. With these markings, particular influences under certain circumstances, such as accidents or breakdowns at neighboring factories, can be traced. The system utilizes 4-20 mA outputs, which allows the measuring results to be routed through a Data Acquisition System (DAS). The system also uses a serial interface that can be used to control the system or for data transfer, such as connecting a log printer through the serial port.

2. Description of Functions

2.1. Determining Dust Mass

The Beta Dust Meter measures the dust concentration in mg dust/cubic meters of gas (damp) mg/m³. The sample gas is drawn through a glass fiber filter tape and the volumetric flow of the gas is recorded by the system. The dust particles are then trapped on the filter tape and radiometrically measured. The radiometric measurement is achieved using a Beta-emitter (C-14) and a Geiger-Müller counter. The measuring principle of the determination of dust mass is based on the fact that the beta radiation is weakened by the transmission through matter. The intensity of the radiation is then measured after the transmission through the clean filter tape. After the dust sampling, the intensity of the radiation is measured again. The relationship between the two intensities is a measure of the thickness of the dust layer on the filter tape, assuming that the dust is homogeneously distributed on the filter surface. This provides a measure for the absolute dust mass at a constant cross-section of the covered filter. The absolute dust mass divided by the quantity of gas captured gives the absolute dust concentration. This radiometric measuring procedure can be universally applied to determine the dust mass. It can deal with a great range of dust and gas without being distorted by any chemical or physical properties.

When the dust distribution is homogenous, the dust mass \( m \) on the filter surface \( A_F \) is within \( m \) mg/cm² of the linear equation:

\[
\ln \left( \frac{n_0}{n} \right) = \left( \frac{\mu}{\rho} \right) \cdot d
\]

(Equation 1) calculation of dust mass

where:

- \( d = m/A_F \) in mg/cm² is the surface density of the dust with a dust accumulation in mg onto a constant surface in cm²
- \( \mu/\rho \) in cm²/g is the mass reduction coefficient, which is practically independent from the chemical composition of the dust
- \( \mu \) in cm⁻¹ is the linear coefficient for the weakening of the Beta radiation
- \( \rho \) in g/cm³ is the density of the absorption material
n₀ and n the Beta particles electronically recorded by the counter per minute as current pulses without or with the surface dust density d. The pulse rate is a measure of the radiation intensity.

The mass reduction coefficient \( \mu/\rho \) for the Beta radiation depends on the electron density of the absorber and is proportional to the ratio \( Z/A \).

\[
\text{where: } Z \quad \text{Periodic number} \\
A \quad \text{Mass number}
\]

In most dust, the ratio \( (Z/A) = 0.45 \) to 0.5 is essentially constant. This means the Beta radiation reduction is practically independent of the chemical composition and the distribution of nucleus sizes in the dust. The following table shows several sample elements and their \( (Z/A) \) ratios:

<table>
<thead>
<tr>
<th>Element</th>
<th>AL</th>
<th>C</th>
<th>Ca</th>
<th>Fe</th>
<th>K</th>
<th>Mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z/A</td>
<td>0.482</td>
<td>0.50</td>
<td>0.49</td>
<td>0.466</td>
<td>0.486</td>
<td>0.494</td>
</tr>
</tbody>
</table>

(\text{Table 1}) (Z/A)-ratio of several sample elements

Hydrogen is an exception to these values, where \( (Z/A) = 1 \). However, the quantity of hydrogen in dust is comparatively very low, so that its variation does not noticeably affect the measurements.

Where the filter surface coefficient \( (\mu/\rho) \) is constant, the dust mass striking the filter A can be determined from the radiation reduction using the following formula:

\[
m = A_F \cdot \left( \frac{\rho}{\mu} \right) \cdot \ln \left( \frac{n_0}{n} \right) \quad \text{mass} = f\left( A, \frac{\rho}{\mu}, \ln \left( \frac{n_0}{n} \right) \right)
\]

where: 
\( m \quad \text{Absolute dust mass in mg} \) \\
\( A_F \quad \text{Filter surface area in cm}^2 \)

Since the mass absorption coefficient \( (\mu/\rho) \) decreases with the reduction of the maximal Beta energy, the mass determination becomes more sensitive as the energy from the Beta radiation decreases. This makes the carbon isotope C14 particularly suitable, since it has a half-life of \( T_{1/2} = 5.370 \) years and a maximal energy \( W_{\text{max}} = 0.156 \) MeV. The pipe inlet is designed
specifically to provide an even distribution of dust on the filter surfaces. The results of the measurement are unaffected by a lack of homogeneity of the dust particles themselves, radiation scattering effects, and uneven sensitivity of the Geiger-Müller counter’s window.

The dust concentration is the result of the absolute mass divided by the recorded volume:

\[
c = \frac{m}{Q}
\]

\((\text{Equation 3})\) concentration = \(f(m, Q)\)

where:

- \(c\) Dust concentration mg/m³
- \(Q\) Collected gas volume in m³/h

3. Design of the F701-20

3.1. Functional Overview of the F701-20

The F701 operation diagram shown in figure 1 illustrates the major components of the F701-20 system. The measuring unit is compactly designed. Except the sampling probe itself and the optional tube heating element, all components are contained in a single enclosure.

![Operation Diagram F701-20](image)

**Fig. 1: Operation Diagram F701-20**

The machine is controlled by a microcontroller board.

At the start of the standard measuring procedure, an clean section of filter is moved between the C14 radiation source and the Geiger-Müller counter. The radiation intensity (0-rate) is measured for 300 seconds. During this time, pulses from the Geiger-Müller counter are registered in the microcontroller. The filter adapter is subsequently opened and the filter tape is
advanced until this section is in the sampling position. The filter adapter is then closed again and the sampling procedure starts. The length of this procedure is determined by the programmed cycle time.

After taking the sample, the filter unit is opened again and the filter paper is moved back to its original position under the counter tube. The filter unit closes and the radiation intensity (m-rate) is again measured for 300 seconds. After the measurement is completed, these counts are then put into the evaluation formula -(Equation 2) – (or the calibrated evaluation polynomial). The dust concentration is then calculated with -(Equation 3)-.

After the measurement and evaluation is completed, the results have been calculated, the filter paper printer (optional) will mark the measurements, date, and time next to the relevant portion of the filter. The results of the measurement will also be shown on the display and can be printed to an external printer as well, if desired.

There are mA output signals for the absolute mass and the dust concentration measurements. If desired, the device can also cover the measured dust samples with film to prevent smearing and loss so the samples can later be examined in a laboratory.
3.2. Device Dimensions

Fig. 2: Device Dimensions F701-20
3.3. Measuring head types

Depending on the exact application, different sampling and measuring heads can be inserted (Fig. 3). The TSP measuring head is used to collect and measure all types of dust. The PM10 measuring head is used when the particle sizes are less than $\leq 10 \ \mu m$. Finally, the PM2.5 is used to evaluate dust particles $\leq 2.5 \ \mu m$.

![Fig. 3: Measurement Head Types](image)

3.4. Tube Heating Unit (optional)

The sample tube heating unit may be recommended depending on the location of the device. This option should be applied when the surrounding conditions may cause condensation at the gas probe. The moisture that could arise binds dust particles to the tube walls before they land on the filter paper. This will result in a lower, inaccurate measure of dust mass. If the condensation is particularly strong, water droplets from the inside of the tube may land directly on the filter paper. This disrupts the drying effect of the filter heating and the additional moisture on the filter surface gives a false reading.

The sampling tube heater can be installed as a preventative measure. A heating coil with adjustable temperature is wrapped around the sampling tube to prevent condensation from the air within. The length of the heating coil and its temperature depend on the location of the unit and the design of the installation.

The following picture gives some details for installation the heating coil Pt100 and isolation shell.
Wind cable 5 times around pipe

PT with 4 m cable

Stick excess cable in here

Mounting the PT (sidedview)

Wind heater 5 times around pipe and fasten 4-5 times using straps

9-pi Sub-D plug for PTs

Strap all cables to pipe

PT with 1 m cable. Push underneath heater and fasten with strap

Power plug for heater

Fig. 4: Assembly instructions for heated sampling system
4. Selection of the Measurement Area

The technical specification and requirements of the F-701-20 must be fulfilled when the system is installed. The standard model should not be installed outdoors, rather in work stations, measurement stations or other suitable control rooms. Depending on the desired measurements, the sampling system can be placed indoors or outdoors to monitor breathing air.

Additional mounting pieces and ceiling mounts are available. The F-701-20 should be protected from moisture. The ambient temperature range lies between 0-30 °C. If the operating conditions are more demanding (outdoors, wider temperature range, unsupervised operation), special optional accommodations are needed.

The F-701-20 can be used as a free-standing unit or mounted in a 19 inch box. In both cases, the perpendicularly mounted sample tube must not encounter any obstructions or turns between the top of the unit and the sampling point. Particularly when mounted in a 19-inch box with multiple measurement devices, the F-701-20 should be mounted in the uppermost slot. Make sure that the heat transfer from within the unit is not disrupted during modifications or from sediment deposits. The ventilation slits in the floor and lid of the device should always be kept open.

The measuring unit should be operated on a level base. The sampling head or measuring head should be positioned away from other objects or structural features. Strong air currents at the measuring location should also be avoided, so that the dust collection readings are not inaccurate.
5. Electrical Connections

On the rear side of the instrument are the connectors for power supply, for analog measuring signals, for digital status signals, for temperature measurement inputs on the head and on the sampling tube heater, for external recording devices and control systems.

In the figure - Fig. 5: Device Interface / mA Outputs/ Status Signal F701-20 ("Data") - the standard design is shown.

Fig. 5: Device Interface / mA Outputs/ Status Signal F701-20 ("Data")
The 50-pin Sub-D plug is located on the back of the F-701-20 enclosure. A plug with the same connection plan is also built into the control board and can be used the same way for repairs. The individual signals have the following meanings:

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
<th>Pin-No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit ON</td>
<td>after „&gt;Power-On-Check“, switch contact is closed</td>
<td>01, 04</td>
</tr>
<tr>
<td>Measuring Value present</td>
<td>Switch contact is closed</td>
<td>07, 10</td>
</tr>
<tr>
<td>Zero Check, Reference Check or Referencefoil Value present</td>
<td>Switch contact is closed</td>
<td>19, 22</td>
</tr>
<tr>
<td>Measurement Range Error</td>
<td>Occurs if the measured values are below or above the concentration measuring ranges that have been set</td>
<td>03, 49</td>
</tr>
<tr>
<td>Volume flow error</td>
<td>Occurs if the measured air volume falls outside the range from 950 to 1050 liters/hour for more than 30 sequential seconds. This is monitored during the suction procedure.</td>
<td>06, 09</td>
</tr>
<tr>
<td>General Error “Fault”</td>
<td>“OR”-Connection in case an error is detected including: measurement range error, torn filter, volume flow error, or vacuum error. The red LED on the front panel will also light up when this occurs.</td>
<td>12, 15</td>
</tr>
<tr>
<td>Filter Crack</td>
<td>Occurs when no filter paper is between the Beta-emitter and the Geiger-Müller tube and causes the impulse rate to increase above the error limit of &gt;138000 impulses per minute. The check occurs after the 0-and M-rate measurement and after the suction procedure. The unit switches into stand-by mode. The filter paper must be replaced. Filter crack will be deactivated automatically if impulse rate will be &lt; 100000 pulses per minute.</td>
<td>18, 22</td>
</tr>
<tr>
<td>Vacuum Error</td>
<td>Occurs if the vacuum switch measures to strong a vacuum (&gt; -0.4 bar, relative). The check takes place during the suction procedure.</td>
<td>24, 27</td>
</tr>
<tr>
<td>Out 2</td>
<td>Voltage output 0…1V (Option)</td>
<td>35, 38</td>
</tr>
<tr>
<td>Measuring Value 2</td>
<td>Current output 4…20 mA for the dust concentration in mg/m³ (standard). The measuring range parameters can be adjusted from the service menu. It’s possible to parameterize the output with other values (optional).</td>
<td>41, 44</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
</tbody>
</table>

| Measuring Value 1 | Current output 4…20 mA for the dust concentration in mg/m³ (standard). The measuring range parameters can be adjusted from the service menu. It’s possible to parameterize the output with other values (optional). | 47, 50 |

<table>
<thead>
<tr>
<th>IN0</th>
<th>Unused</th>
<th>02, 14</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>IN1</th>
<th>Unused</th>
<th>05, 14</th>
</tr>
</thead>
</table>

| IN2               | Input for „Start the measurement cycle over the contact“. If this contact is to be used, this function has to be parameterized on the instrument | 08, 14 |

In the figure – Fig. 6: RS232 Interface / serial connections between PC and F-701-20 ("PC", "Print") – the I/O- connectors of serial interfaces for a PC and a Printer is shown (both connectors are equal).

![RS232 Interface diagram](image)

**Fig. 6: RS232 Interface / serial connections between PC and F-701-20 ("PC", "Print")**

It’s possible to connect a computer on the F-701-20 with an interface cable. The computer has to contain the necessary communication software and the user is able now to read out and evaluate the measured values, programmed parameters and error signals."
In the following figure - Fig. 7: Interface for temperature inputs on F-701-20 ("Temp") (options) - the input connector is shown.

As option for the F-701-20 it's possible to connect a Pt100 on pins 01, 06 for the measurement of the ambient temperature on the sampling head. The flow rate of the internal vacuum pump will controlled dependent on the ambient temperature. The flow rate on the sampling head is then 1 m³/h independent of the ambient temperature.

Another option is the sample inlet heater. The installation is necessary if the moisture concentration in the ambient air is very high. The temperature of a heat tape will controlled and measured by a Pt100 on pins 02, 07. For installation see 13.7 Specification for heating tape for sample probe (option)

For both measurement of the ambient temperature and the measurement of heat tape temperature please see picture Fig. 4: Assembly instructions for heated sampling system.
6. Operating the F701-20

6.1. Using the display

The F701-20 is housed in a 19" 6U frame with a display unit in the front panel. The 5"-display provides a 107x57 mm negative blue viewing area. The surface of the panel is anti-glare and scratch-resistant. The panel functions similar to a foil keyboard and can be finger or pen operated with a pressure of 150-200 g. The 701-20 is operated by means of the display unit which is designed as touch panel keyboard.

Dependent on the displayed menu step, different keys are available on the display. Touching the key pad will carry out the corresponding action. The different keys are described in the following part of the manual by their symbol. The following general keys are available in the lower part of most menus:

- Toggling between Measuring, data display and service mode.
- Go to a sub menu
- Maintenance menu call-up
- Parameter or data print

6.2. Power-On

After switching on mains a start screen is shown and the measuring mode is automatically activated when the jumper J5 is in the (normal) open position. The measuring cycle is started in case the start parameter has been set to automatic. Otherwise, the start function is performed as programmed. The 701-20 displays the Measuring menu.

6.3. Basic Functions

By means of the key one can toggle during normal operation between the following menus:

- **Measuring Mode:** Dust measuring and displaying the results, showing activities, performing service actions
- **Data Display Mode:** Displaying measured values in graphical or tabular form
- **Service Mode:** Display and modification of unit parameters

6.3.1. Measuring Mode

While in measuring display mode a sketch of the unit is shown on the display together with the measured value and currently performed actions.

Possible actions are:

- **Standby** Waiting for next cycle (see parameter ‘Start’)
- **nth- Measuring** Number of cycle when multiple sampling has been selected
- **Measuring** Measuring cycle
- **Ref. Foil** Reference foil measuring
- **Reference** Reference measuring
- **Zerocheck** Zero measuring
- **Paper forw.** Filter tape transport forward
- **Paper backw.** Filter tape transport backward
• Adapter open  Adapter opening
• Adapter close  Adapter closing

Additional information of the current action is shown one line below, like start, open, close, forward, backw., 0-rate, m-rate and volume.

Hitting the key \( \rightarrow \) will show besides date and time, the results of the GM counter, flow, ambient air temperature and pressure. The trailing asterisk is shown whenever a substitute value has been used. All measured values are stored additionally in a data base. In case the measuring start parameter has been set to manual, the key \( \rightarrow \) is additionally available.

6.3.2. Data Display Mode

Display Measurements

Currently measured values are shown on the display during Measuring Mode and are stored in a data storage area which can hold up to 1000 values. In the Data Display Mode this data can be displayed either graphically or in tabular form. Toggling is performed by the key \( \leftarrow \).

Press the keys \( \uparrow \) or \( \downarrow \) to browse gradually or use the keys \( \leftarrow \) or \( \rightarrow \) to go page by page.

Newer values are to the right (top), older values to the left (bottom).

Pressing the key \( \rightarrow \) will cause a print-out of all stored data via the printer interface.

In front of date and time the following information is displayed:

- Z  Zero point measuring
- M  Measuring
- R  Reference point measuring
- F  Reference foil measuring

Following the time, the measured dust concentration, volume, error count and sample count is shown.
Display Messages

Pressing the key \( \leftarrow \) once again will display the stored messages instead of the values. The following messages are available:

- -----Power On-----
- Filter crack / Filter crack gone
- Fault GM Tube / GM Tube well
- Volume error / Volume error gone
- Adapter Temp flt / Adapter Temp well
- Air Temp fault / Air Temp well
- Heater Temp fault / Heater Temp well
- Adapter blocked / Adapter unblocked
- Range error
- Vacuum break off
- GM fault
- User Stop
- Change Battery
- Clear Measurement
- Clear Messages
- Program Error
- Watchdog

6.3.3. Service Mode

All Parameters can be displayed and can be modified after password entry in the Service Mode. Interim results can be displayed and service actions can be performed. The call-up of the Service Mode does not interfere with the current measuring. When entering the Service Mode, the last displayed parameter will be shown.

Browsing through the parameters is done by the keys \( \downarrow \) and \( \uparrow \). The selected menu item or parameter is marked by a leading arrow \( \rightarrow \). The key \( \leftarrow \) is used to branch to a sub menu or to parameter entry. Sub menus are identified by a missing value on the right.

Parameters can only be changed after entering the correct password. Three different passwords are available:

- Password1 for parameter modification
- Password2 for performing service actions
- Password3 for modification of output signals

Password1 is set to 1111.

30 minutes after the last password entry the admittance (the entered password) is automatically cleared.
Parameter Modification

Using the keys ▼ / ▲ a parameter can be selected and can be called-up by the key ►. Either a pick-list or a decimal keyboard is activated for selecting/entering the parameter value. Some of the parameters are fixed and cannot be altered.

Pick-List

When a pick-list is activated, the leading arrow has been changed to a trailing arrow and the keys ▼ / ▲ can be used for selecting the parameter value. If the desired value is shown it will be taken over and stored by pressing the key ►. In case the data entry is terminated using the key ◄ the selected parameter remains unchanged.

Decimal keyboard

When entering data by using the decimal keyboard the selected parameter is shown inversely and overwritten by pressing a key. When the value is fully entered the entry is completed by pressing the key CR and the new value will be stored. Numbers can be individually cleared by pressing the key BS. If all numbers are cleared and the key BS is pressed again, the data entry is terminated and the parameter remains unchanged.

Values entered using the decimal keyboard are validity checked. Invalid values are rejected and an error message is shown together with the permitted data range. The originally stored value remains unchanged. Any further key stroke returns to parameter display.

6.3.4. Parameter Menu

The parameter menu consists of the following sub menus:

- Password  Entering the Password
- Measurement Display of measured/stored values
- Parameter Display and entry of main parameters
- SubParameter Display and entry of sub parameters
- Adjust  Adjusting of input and output signals
- Interface Setting the interface parameters
- Date/Time Setting the clock
- Actions Performing actions like erasure of stored data
- Service  Basic workshop functions, error locating

Frequently modified parameters are shown in the Parameter Menu, rarely used parameters in the SubParameter Menu.
Measurement

The following measured results can be shown:

- Adapter [°C] Adapter temperature
- Air [°C] Ambient air temperature
- Heater [°C] Probe tube heating temperature
- Output 1 [mA] The currently driven mA signal for output 1 is shown
- Output 2 [mA] The currently driven mA signal for output 2 is shown
- 0-Rate Last 0-rate measuring
- M-Rate Last M-rate measuring
- Mass [µg] Mass of last measuring cycle
- Volume [mV] Raw analog input signal, as can be measured at the terminals
- Pressure [mA] Raw analog input signal, as can be measured at the terminals

The shown measured values cannot be altered.

Parameter

Frequently used parameters are combined in this menu item.

- Cycle Time Definition of the sampling time, ½ up to 24 hours. A modified cycle time will be considered when a new measuring cycle is started.
- SampleCount Definition of multiple filter sampling, number of forward/backward cycles. Possible values are from 1 up to 10. When during the third sampling of a multiple sample the sample count will be reduced from 5 to 2, the next measuring will take place on a new filter spot. In case the sample count will be increased from 3 to 5, the forth and fifth sampling will be performed on the same filter spot.
- Pressure [hPa] Substitute value for absolute pressure, used for calculating the standardized volume, if no external sensor is present. A modified value for pressure will be used during the next calculation. Range is 900 to 1100.
- Repl.Air [°C] Substitute value for ambient air temperature, if no external sensor is present. A modified value for Repl.Air will be used during the next calculation. Range is –20°C to +50°C.
- Start Setting the cycle-start conditions:
  - Manual Run one measuring cycle using the manual start key
  - Auto Automatic restarted (continuous cycles)
  - 60 Min. Hourly started
  - 30 Min. Half-hourly started
  - Relay Started by digital remote signal using input 3
  - Gesitec Started by remote Gesitec command
  - A modification of the start parameter will only be considered when being in the stand-by mode.
- FS Co µg/m³ Full scale of 20mA output concentration in µg/m³. A range modification will immediately be taken into account. In case a range error occurs, an increased full scale value will clear this error. Possible values are from 50µg/m³ up to 9999µg/m³.
- **20mA Output1** Output 1 normally concentration using the full scale defined above, can be set for testing purpose to other values to mass or 20mA as shown for output2. Will be reset after power-on to concentration or will be changed after next parameter modification.

- **20mA Output2** Output 2 for different values. Selected value remains unchanged after power-on until modified by parameter.

  - conc  Concentration, full scale as defined under FS Co µg/m³
  - mass  Mass, full scale 1000 µg
  - temper.  Air temperature (4/20mA = -20°C/+60°C)
  - pressu.  Absolute pressure (4/20mA = 900hPa/1300hPa)
  - volumen  Volume flow (4/20mA = 0l/h / 1600l/h)
  - 20 mA  Constant 20 mA signal

**SubParameter**

- **Language** Choose a language: German, English
- **Adapter [C]** Adapter temperature in °C, sets the desired temperature for the filter holder. With a bimetal switch, this can monitor a temperatures from 20°C up to 70°C. The factory default setting is 50°C.
- **FS Ref.[µg]** Full scale of 20mA output concentration in µg/m³ when running reference value, used in next reference cycle or immediately used when running a reference cycle. Range is 50 µg/m³ to 9999 µg/m³. The factory default setting is 1000 µg/m³.
- **Integration** Number of values used for the floating interval. The factory default setting is 1.
- **Steps forw.** Allows for an exact adjustment of the forward filter transport and can compensate for mechanical tolerances. The factory default setting is 36 mm = 1250 steps. A modified value will be taken into account when the tape is moved next time. Range is 1000 to 1500.
- **Steps backw.** Allows for an exact adjustment of the backward filter transport. The factory default setting is 36 mm = 1250 steps. A modified value will be taken into account when the tape is moved next time. Range is 1000 to 1500.
- **Heater [C]** Set-point for (optional) sampling tube heater temperature in °C, immediately considered. Range is 20°C to 50°C. Factory default setting is 50°C.

**Adjust**

- **Offset [ug]** Uses the equation y= x* Span+Offset, where x = measurement made by the F701. The factory default setting is 0. Modified value used when mass is calculated next time. Range is +/-500 ug.
- **Span** Uses the equation y= x* Span+Offset, where x = measurement made by the F701. The factory default setting is 1. Modified value used when mass is calculated next time. Range is 0.1 to 10.
- **Span Volume** The volume signal is multiplied by the Span Volume correction factor, immediately considered. Range is 0.9 .. 1.1. Factory default setting is 1
- **Air Off [°C]** Offset value for air temperature correction. Factory default setting is 0. Range is –10°C to 10°C.
- **Pressure Off** Additional offset value for pressure correction, defined in hPa. Factory default setting is 0. Range is –200 hPa to 200 hPa.
  \[ Pressure\text{[hPa]} = 'Pressure b' * mA + 'Pressure c' + 'Pressure Off'\]
- **Pressure b** Pressure calculation using the above equation, factory default setting is 25. Range is 1 to 500.
- **Pressure c** See above, factory default setting is 800. Range is 100 to 1300.
Interface
- Gesytec: Gesytec (enable) or Debug (disable). Default setting is Gesytec.
- Gesytec No.: Range is 0 to 999. Factory default setting is 123.
- PC: Setting of the serial interface #1. 1200bd to 19200bd. Factory default setting is 1200bd.
- Parity: Setting of the serial interface #1, 'even 7', 'odd 7' or 'no 8'. Factory default setting is 'even 7'.
- Print: Setting of the serial printer interface. 1200bd to 19200bd. Factory default setting is 9600bd.
- Parity: Setting of the serial printer interface, 'even 7', 'odd 7' or 'no 8'. Factory default setting is 'no 8'.

Date/Time
- Hour: hour definition
- Minute: minute definition
- Day: day definition
- Month: month definition
- Year: year definition
- Set Time: set time: Set RTC using hour ... year data
  no act.: no action, especially no clock setting

RTC will only be set when the set time function has been performed.

Actions
- Clear Memory: Reset!!: Clear all stored measured values
  Save: no action
- Clear Messages: Reset!!: Clear all stored messages
  Save: no action
- NumberPrints: Sets the number of messages that are printed
- Print DB: Starts printout of the database.
- PrintMessages: Starts printout of the messages.
Service

- **Password**
  Special password, required for setting of calibration factors

- **ADC raw values**
  Display of raw values of the analog/digital converters, 0…4095 range, not calibrated, 4095/4092 indicate overflow of analog/digital converters.
  Adapter:
  Adapter temperature.
  Heater:
  Tube heating temperature,
  Air:
  Ambient air temperature,
  Volume:
  Volume flow, 0..4092
  Pressure: Pressure, 0..4092

- **Inputs**
  Display of digital inputs. 0 = open
  Adapt. Open:
  End position switch: Adapter opened
  Adapt. Close:
  End position switch: Adapter closed
  GM static:
  normally open, sporadically (2-3 s) closed
  Underpress:
  Low pressure switch, will terminate measuring cycle, normally open
  Input 1 unused
  Input 2 unused
  Input 3 Run measuring cycle remotely
  Battery 1 = OK

- **Teach-In**
  As no pot’meters are available, fixed measuring results are provided (for instance connecting 100 Ohms instead of a PT100 temperature sensor), read and note down the shown raw ADC value and afterwards run Teach-In and enter the noted value as parameter. Values entered as counts.
  Adapter 100: Adapter temperature value of the A/D converter which was previously read-in using a 100 Ohm resistor (corresponding to 0°C)
  Adapter 120: Adapter temperature value of the A/D converter which was previously read-in using a 120 Ohm resistor (corresponding to 52°C)
Heater 100: Tube temperature value of the A/D converter which was previously read-in using a 100 Ohm resistor (corresponding to 0°C)
Heater 120: Tube temperature value of the A/D converter which was previously read-in using a 120 Ohm resistor (corresponding to 52°C)
Air 100: Ambient air temperature value of the A/D converter which was previously read-in using a 100 Ohm resistor (corresponding to 0°C)
Air 120: Ambient air temperature value of the A/D converter which was previously read-in using a 120 Ohm resistor (corresponding to 52°C)
Vol-In 1 V: Volume flow value of the A/D converter which was previously read-in using a 1 V signal
Vol-In 5 V: Volume flow value of the A/D converter which was previously read-in using a 5 V signal
P-In 4 mA: Absolute pressure value of the A/D converter which was previously read-in using a 4 mA signal
P-In 20 mA: Absolute pressure value of the A/D converter which was previously read-in using a 20 mA signal
4/20 mA Out1: Setting the analog output 1: The F701 drives roughly 20 mA (see parameter output definition 20 mA) and subsequently, a factor has to be calculated in order to achieve an exact 20 mA signal. Raw signal * factor = exactly 20 mA.
4/20 mA Out2: Setting the analog output 2: The F701 drives roughly 20 mA (see parameter output definition 20 mA) and subsequently, a factor has to be calculated in order to achieve an exact 20 mA signal. Raw signal * factor = exactly 20 mA.
i: Number of values used for the floating interval.
Offset Serv.: Additional offset, default 0
Span Serv.: Additional span, default 1
M debounce: Set to 10 to suppress messages shorter than one minute (default). Set to 1 to get all messages (for testing only).

- Serial No. Serial number of F701-20
- Q-Check Manufacturer identifier, to identify the worker who has checked the unit.
- Ser.No.CPU Serial board number
- SW Software Version

6.4. Maintenance menu / mode

Pressing the maintenance key activates the maintenance menu which allows to move the filter tape or the adapter and to perform calibration actions.

- Open the adapter
- Close the adapter
- Move filter tape forward
- Move filter tape backward
- Run reference cycle
- Run zero cycle
- Run reference foil cycle

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Pressing the desired key will not in every case start the corresponding action immediately. It may be necessary to complete the current action before running the new command. While waiting for the completion of the current action the pressed key stays inverse. Please note that a reference foil measuring requires user activities.

Once a maintenance cycle has been started, it can be cancelled by pressing the key.

Using the key will shorten the current performed cycle down to at least 10 seconds and is also used to confirm insertion and removal of the foil for the reference foil cycle.

These pictures show the steps for the reference foil cycle.

6.5. Built-in Test Program

Caution: Please do not use this main board test other than board testing. Improper use can damage the device. No external components like stepper motor, GM counter adapter etc. should be connected.

When powering-on the unit with the jumper J5 in the closed position, the built-in test program is activated instead of the normal measuring mode. While staying in this test mode, no dust monitoring is being performed. The test mode can only be switched off by setting the jumper J5 to the open position and restart the unit (powering off/on).

With this test program all functions of the F701 can be activated or checked separately.

6.5.1. Dig.Out: Checking digital output

All available digital output signals can be activated individually or together. Pushing the corresponding key will actuate (close) the output and the key will stay inverse. Hitting the same key again will release the output again and show the key in the normal mode.
The following signals are available:

- **SM P 1** Tape stepper motor phase 1
- **SM P 2** Tape stepper motor phase 2
- **SM P 3** Tape stepper motor phase 3
- **SM P 4** Tape stepper motor phase 4
- **SpanMot** Tape tightening motor
- **HubMot1** Adapter motor 1
- **HubMot2** Adapter motor 2
- **Bypass1** Bypass motor 1
- **Bypass2** Bypass motor 2
- **Begleit** Probe heating
- **VolPump** Volume pump
- **Ad.Heiz** Adapter heating

### 6.5.2. Dig.In: Checking digital input

The current status of all digital inputs will be shown in this menu. A leading “0” will show an open contact, a “1” will be shown while the contact is in the closed position. The following signals are available:

- Adapter closed (Adapter zu)
- Adapter opened (Adapter auf)
- Low pressure switch (Unterdruckschalter)
- Input 1 (Datenstecker Relay1)
- Input 2 (Datenstecker Relay2)
- Input 3 (Datenstecker Relay3)

### 6.5.3. 15mA: Checking analog output

Both analog outputs will be set to 15 mA while in this test menu. Please note that when leaving this menu, the analog outputs will remain showing 15 mA.

The maximally allowable resistive load of each output can be 500 Ohms.

### 6.5.4. An.In: Checking analog input

All analog input values are read-in using an Analog/Digital Converter ADC. The counts of these ADC are shown in different ranges. The counts are shown as four-digit counts.
Range 0…4095
- Adapter temperature (Adapter-Temp.)
- Heating tube temperature (Begleitheiz.-Temp.)
- Ambient air temperature (Luft-Temp.)

Range 0…1023
- Pressure sensor (Drucksensor)
- Adapter temperature (Adapter Temp). This signal is available twice (see above).
- Volume flow (Volumen Sonde)

6.5.5. Dauer: Continuous run test

While in this continuous run test, the analog inputs will be shown one after the other as analog output.

In case the two serial interfaces are not connected by a Null-modem cabling, errors will be shown.

6.5.6. GM Rohr: Continuous run test of GM counter

The GM Counter will be checked using this menu. Pushing the key ‘GM Rohr’ more often will increase the measuring time up to 600 seconds. Ten measuring cycles are measured and averaged. All subsequent measurements are compared to the average value and classified. In case all results are between 99.5 and 100.5 % of the average, ‘=100%’ is shown. If values beyond or above occur they are shown for instance as ‘<100% - 0/0/0/0/0’. The shown zeros denote <99.5/<98.5/<97.5/<96.5/<95.5 % of the average value.

6.5.7. Relais: Checking the relay output

All available relay output signals can be activated individually or together. Pushing the corresponding key will actuate the relay and the key will stay inverse. Hitting the same key again will release the relay again and show the key in the normal mode.

The following signals are available:
- Relay 1 to 12 (Rel 1 to Rel 12)
- The green LED on the main PCB (LED gn)
- The red LED on the main PCB (LED rt)
6.5.8. **LoeschDB: Erase Database**  
Erases all data, so all stored values will be lost.

6.5.9. **Setze DB: Create Database**  
Create random values for testing.

6.5.10. **C, D, L**  
The remaining keys C, D, and L are currently not in use. Pressing the keys won’t cause any action.
6.6. Data logger (option)

This software version includes an additional data logger function. The instrument stores the dust concentration value including date, time and status information. Maximum 1023 data blocks (hour mean values of 40 days) will be stored. If the storage is full, the older values will overwrite. The data memory is battery-buffered. Data will be kept if power supply failed. For reading and downloading of data blocks please follow the next instructions:

The download function is implemented for the use with a terminal program like "Hyper Terminal", but you can use it also with a separate program (written by yourself). You can get data from the F701-20 by the commands:

- P<CR> - Parameters
- M<nnn><CR> - Measure DB n-numbers
- E<nnn><CR> - Error and message n-numbers
- <CR> - Last measurement
- <CR> (carriage return character)

There are no differences between 'P' and 'p', M/m and E/e. If the F701-20 get an unknown command it will send a short help text. The command string must be closed by a <CR>. If you request more data sets (measure or messages) as stored in the memory you will get in maximum the number of stored data sets.

The following file "Terminalprogram.txt" is an example for use of the download function. It's a log file of the received data from the F701.

Before you get the requested data you will get an echo of the request (with additional character '>').

>Help Print Function:

P - Parameters
M<nnn> - Measure DB n-numbers
E<nnn> - Error and Message n-numbers
<CR> - Last Measurement

>m100<CR>

Measurement DB

Me : 09.04.2003 16:00 Co : 56ug/m3 Vo : 800 Litre Er : 0 Sc : 1
Me : 09.04.2003 17:00 Co : 74ug/m3 Vo : 883 Litre Er : 0 Sc : 2
Me : 09.04.2003 18:00 Co : 68ug/m3 Vo : 883 Litre Er : 0 Sc : 3
Re : 09.04.2003 19:08 Co : 648ug/m3 Vo : 0 Litre Er : 0 Sc : 0
Re : 09.04.2003 19:18 Co : 620ug/m3 Vo : 0 Litre Er : 0 Sc : 0
ZC : 09.04.2003 19:33 Co : 1ug/m3 Vo : 0 Litre Er : 0 Sc : 0
ZC : 09.04.2003 19:50 Co : 5ug/m3 Vo : 0 Litre Er : 0 Sc : 0
Fo : 09.04.2003 20:01 Co : 731ug/m3 Vo : 0 Litre Er : 0 Sc : 0
Fo : 09.04.2003 20:13 Co : 704ug/m3 Vo : 0 Litre Er : 0 Sc : 0
Me : 09.04.2003 21:00 Co : 191ug/m3 Vo : 799 Litre Er : 0 Sc : 1
Me : 09.04.2003 22:00 Co : 149ug/m3 Vo : 883 Litre Er : 0 Sc : 2
Me : 09.04.2003 23:00 Co : 122ug/m3 Vo : 883 Litre Er : 0 Sc : 3
Me : 10.04.2003 00:00 Co: 107ug/m3 V0: 799 Litre Er: 0 Sc: 1
Me : 10.04.2003 01:00 Co: 89ug/m3 883 Litre Er: 0 Sc: 2
Me : 10.04.2003 02:00 Co: 78ug/m3 V0: 883 Litre Er: 0 Sc: 3
Me : 10.04.2003 03:00 Co: 71ug/m3 V0: 800 Litre Er: 0 Sc: 1
Me : 10.04.2003 04:00 Co: 63ug/m3 V0: 883 Litre Er: 0 Sc: 2
Me : 10.04.2003 05:00 Co: 42ug/m3 V0: 883 Litre Er: 0 Sc: 3
Me : 10.04.2003 06:00 Co: 34ug/m3 V0: 800 Litre Er: 0 Sc: 1
Me : 10.04.2003 07:00 Co: 29ug/m3 V0: 883 Litre Er: 0 Sc: 2
Me : 10.04.2003 08:00 Co: 32ug/m3 V0: 883 Litre Er: 0 Sc: 3
Me : 10.04.2003 09:00 Co: 39ug/m3 V0: 800 Litre Er: 0 Sc: 1

>m8<CR>
Measurement DB
Me : 10.04.2003 02:00 Co: 78ug/m3 V0: 883 Litre Er: 0 Sc: 3
Me : 10.04.2003 03:00 Co: 71ug/m3 V0: 800 Litre Er: 0 Sc: 1
Me : 10.04.2003 04:00 Co: 63ug/m3 V0: 883 Litre Er: 0 Sc: 2
Me : 10.04.2003 05:00 Co: 42ug/m3 V0: 883 Litre Er: 0 Sc: 3
Me : 10.04.2003 06:00 Co: 34ug/m3 V0: 800 Litre Er: 0 Sc: 1
Me : 10.04.2003 07:00 Co: 29ug/m3 V0: 883 Litre Er: 0 Sc: 2
Me : 10.04.2003 08:00 Co: 32ug/m3 V0: 883 Litre Er: 0 Sc: 3
Me : 10.04.2003 09:00 Co: 39ug/m3 V0: 800 Litre Er: 0 Sc: 1

>e100<CR>
Messages:
09.04.2003 15:55 -----Power On----
09.04.2003 15:58 -----Power On----
09.04.2003 15:58 -----Power On----
09.04.2003 15:58 -----Power On----
09.04.2003 19:08 User Stop
09.04.2003 20:30 -----Power On----

>e3<CR>
Messages:
09.04.2003 15:58 -----Power On----
09.04.2003 19:08 User Stop
09.04.2003 20:30 -----Power On----

>><CR>
Messages:
10.04.2003 09:00 Ma: 60ug Co: 39ug/m3 V0: 800 Litre Er: 0 Sc: 1
6.7. Heavy metal sampling (option)

This option consists of a cover foil holder and a filter tape printer. This option is important and necessary for a later analysis of the dust compound.

The cover foil will be rolled parallel on the filter tape during the transport and covers the sampled dust spots.

The filter tape printer is necessary for inscription of a dust spot on the filter tape after the sampling time and the measuring cycle. The filter spot will be definitely marked by the date and time at the beginning of the sampling cycle, date and time at the end of the sampling cycle and the mass absolutely sampled during this sampling time (dust spot parameters).

A cable connection has to be between the main PC-board BF701LP10 and the control board BA-170 for the micro dot printer. The connecting pins on both ends of the cable are as follows:

<table>
<thead>
<tr>
<th>Name</th>
<th>Connecting pins on the F701 No10</th>
<th>Connecting pins on the control board BA-170III (modified screw clamp connection)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 V power supply</td>
<td>X24:1</td>
<td>AB 10 (2)</td>
</tr>
<tr>
<td>Serial signal (TxD), 5V voltage level</td>
<td>X24:2</td>
<td>B 8 (3)</td>
</tr>
<tr>
<td>0V power supply</td>
<td>X24:3</td>
<td>AB 11, 12 (1)</td>
</tr>
</tbody>
</table>

After the installation of the control board BA-170 and the micro dot printer including the connecting cables between main PC-board BF701LP10/control board BA-170 and control board BA-170/micro dot printer, the instrument is ready for function. Any activation / deactivation or parameterizing is not necessary.

The tape printer prints date and time at the beginning of the sampling cycle, date and time at the end of the sampling cycle and the mass absolutely (sampled during this sampling time) on the filter tape near by the dust spot.

Because the tape printer is not directly located at the sampling positions on the filter tape, the dust spot parameters will be stored for these spots are between printer and filter adapter. During a filter transport (forward) the dust spots will be marked time delayed by the tape printer. Because the spot parameters will be stored, additional filter transport procedures are not necessary.

The print is located directly below the dust spot.

Examples:

The dust spot is a result of a sampling cycle on 1.09.03 (date) between 13:00 (begin of sampling time) and 17:53 (end of sampling time). The calculated mass abs. is 54 µg.
<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.09.03 13:12</td>
<td>Test print during forward feed of the filter tape by pressing the key with the symbol for “forward”</td>
</tr>
<tr>
<td>11.09.03 17:53</td>
<td>Asterisk before and behind the print of the dust mass occurs if maybe the print is not correct regarding an error is on or the user has done some operation during the measuring cycle.</td>
</tr>
<tr>
<td>11.09.04 13:00</td>
<td>Asterisk before and behind the print of the dust mass occurs if maybe the print is not correct regarding an error is on or the user has done some operation during the measuring cycle.</td>
</tr>
<tr>
<td>11.09.04 13:00</td>
<td>**** 54 µg ****</td>
</tr>
</tbody>
</table>

**Effects:**
- Print position can be not correct.
- The printed mass or time at the end of the sampling cycle can be faulty.

**Causes:**
- Error Filtercrack
- User activities: Filter adapter open/close, filter tape backward, check cycle with reference foil, user stop
- No power supply

With the information in the intermediate data base for measuring values and messages, errors can be partially manual corrected or the weight of the dust spots calculated.
6.8. F-701-20-software update

How to do a software update at the F701-20 CPU:

- **Read or download the Memory of the F701-20, because the update will destroy the whole memory data!!**
- On the PC there should be installed the Software “FlashTools98” (see "Phytec Spectrum-CD")
- Connect the PC-Com Port with the Plug X25 of the electronic of the F701. X25:3 -> TxD, X25:5 -> RxD, X25:9 -> GND. If you use a cable like the cable of the printer port (inside of the F701) you can connect it directly to a PC. You have to use only a female plug instead of male plug (9-pol-SUB-D) (Cable see on the rear).
- Switch the F701 off, set the jumper J2 (see point "15.1Main PC-board BF701LP10").
- Switch F701 ON. Now the bootstrap program of the electronic is running.
- Run Program “FlashTools98” on PC.
- Click on icon connect bottom (have a look at the port: COM1: or COM2:)
- Select the sheet “bank utilities”
- Select in window “erase bank” the bank#1 and hit bottom “erase bank”. Now the bank 1 will be erased and is ready for download the new software.
- Select the sheet “File Download”
- Click on icon “File Open” and select the file with the new software e.g. “F701.hex”.
- Click on icon “Download”. The download takes about 20 sec. Download status see on the display.
- Now the download is finished, remove Jumper J2, switch power OFF/ON. You can check the software version in the service menu on the F701 display “SW 1.01”

Cable between CPU (F701 No10 X25:) and your notebook:

<table>
<thead>
<tr>
<th>X25:</th>
<th>your notebook 9-pol D-Sub</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
7. Measurement Value Outputs / Time Lapse / Diagrams

7.1. Time Lapse of a Single Filter Sampling

Fig. 8: Time Lapse for a Single Filter Sampling

Zeitabläufe
Time Diagram
bei Einfachbelegung des Filterflecks (VR= 1)
single spot measurement (VR= 1)

Display

Nullpunktkontrolle
Zero Control

Meßwertausgabe
Measured Value Output
(Display, mA, Drucker)

Statussignale
Status Signals:

System ON

nach Einschaltprüfung
after Power-ON-Check

Operation

nach Betätigung der START-Taste
after START-key pressed

Nullkontrolle
Zero Control

Meßzeit
Measuring Time

Zyklusende
End of Cycle

O: Messung O-Rate / Measuring O-Rate
M: Messung M-Rate / Measuring M-Rate
S: Probenentnahme / Sampling

Filterbandtransport vor
Filter Tape Transport forward

Filterbandtransport zurück
Filter Tape Transport backwards

Fig. 8: Time Lapse for a Single Filter Sampling

Zeit / Time

Filterfleck 1 / Filter Tape Spot 1
Filterfleck 2 / Filter Tape Spot 2
Filterfleck 3 / Filter Tape Spot 3
7.2. Time Lapse of a Multiple Filter Sampling

**Zeitabläufe**
bei Mehrfachbelegung des Filterflecks (z.B. VR= 3)
several cycles on one filter tape spot (e.g. VR= 3)

---

**Einschalten**
Power ON

---

**Display**
Nullpunktkontrolle
Zero Control

Meßwert ausgabe
Display, mA, Drucker
(measured value output)

---

**Statussignale**

Gerät ein
System ON

Betrieb
Operation

Nullkontrolle
Zero Control

Meßzeit
Measuring Time

Zyklusende
End of Cycle

---

O: Messung O-Rate / Measuring O-Rate
M: Messung M-Rate / Measuring M-Rate
S: Probenernahme / Sampling

---

Fig. 9: Time Lapse for a Multiple Filter Sampling
7.3. **Time Lapse using „Remote Start“**

![Time Diagram](image-url)

**Fig. 10:** Time Lapse Using „Remote Start“
8. The GESYTEC protocol for real time transfer of numerical data

8.1. Setting the Parameters F701

The relevant parameter for the Gesytec protocol are:

<table>
<thead>
<tr>
<th>Menu Item</th>
<th>Function</th>
<th>Parameter/Start Settin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter/Start</td>
<td>Setting the start conditions</td>
<td>Start of a measurement cycle will be done by a Gesytec Start command</td>
</tr>
<tr>
<td>Interface/ Gesytec</td>
<td>Enable Gesytec</td>
<td>Set parameter to enable the Gesytec communication</td>
</tr>
<tr>
<td>Interface/ Gesytec No.</td>
<td>Address of the measuring instrument</td>
<td></td>
</tr>
<tr>
<td>Interface/ RS232</td>
<td>Specify the communication setting: baud rate</td>
<td>1200 baud, 2400 baud … 9600 baud, 19200 baud</td>
</tr>
<tr>
<td>Interface/ Parity</td>
<td>Specify the communication setting: data bits and parity</td>
<td>Possible settings are: 8 bit no parity, 7 bit even parity, 7 bit odd parity</td>
</tr>
</tbody>
</table>

8.2. Basic requirement

The F701 is equipped with a RS232 serial port D-SUB 9 (male). For the communication only the pins 3 (TxD), 2 (RxD) and 5 (GND) are used. The potential ground is separated from the system ground but tide together with the ground of the RS232 serial printer port. No hardware (CTS/RTS) or software (XON/OFF) handshake is used.

The settings of the RS232 are selectable: 1200 up to 19200 baud / 8N1, 7E1 or 7O1

8.3. Message types and format details

Request for data from a PC (master) to F701 (slave)

Response depends not to the address of the measuring instrument (parameter: “gesystec no”)

<table>
<thead>
<tr>
<th>Index-No.</th>
<th>Start Byte</th>
<th>End Byte</th>
<th>Data Format</th>
<th>Index Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>&lt;STX&gt;</td>
<td>Start of text</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td>DA</td>
<td>Protocol identification</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>&lt;ETX&gt;</td>
<td>End of text</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4</td>
<td>&lt;BBC1&gt;</td>
<td>upper nibble of BCC</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
<td>&lt;BBC2&gt;</td>
<td>lower nibble of BCC</td>
</tr>
</tbody>
</table>
**Request for data from a PC (master) to F701 (slave)**

Response depends on the address of the measuring instrument (parameter: “gesystec no”)

<table>
<thead>
<tr>
<th>Index-no.</th>
<th>Start byte</th>
<th>End byte</th>
<th>Data format</th>
<th>Index description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>&lt;STX&gt;</td>
<td>Start of text</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td>DA</td>
<td>Protocol identification</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>5</td>
<td>nnn</td>
<td>Address of the measuring instrument</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>6</td>
<td>&lt;ETX&gt;</td>
<td>End of text</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>7</td>
<td>&lt;BBC1&gt;</td>
<td>upper nibble of BCC</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>8</td>
<td>&lt;BBC2&gt;</td>
<td>lower nibble of BCC</td>
</tr>
</tbody>
</table>

**Transmission of data from the F701 (slave) to a PC (master)**

<table>
<thead>
<tr>
<th>Index-no.</th>
<th>Start byte</th>
<th>End byte</th>
<th>Data format</th>
<th>Index description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>&lt;STX&gt;</td>
<td>Start of text</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td>MD</td>
<td>Protocol identification</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>5</td>
<td>nnn#</td>
<td>Number of instruments of the measuring system</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>9</td>
<td>nnn#</td>
<td>Address of the measuring instrument (instrument address, 1-255), programmable on the instrument</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>18</td>
<td>±nnnn±ee#</td>
<td>Concentration (nnnn in micrograms) e.g. “+0047+03 “ for “47µg/m³”</td>
</tr>
<tr>
<td>6</td>
<td>19</td>
<td>21</td>
<td>hh#</td>
<td>Function status</td>
</tr>
<tr>
<td>7</td>
<td>22</td>
<td>24</td>
<td>hh#</td>
<td>Error status</td>
</tr>
<tr>
<td>8</td>
<td>25</td>
<td>35</td>
<td>hhh#hhhhh#</td>
<td>Instrument type-Nr., rest not used</td>
</tr>
<tr>
<td>9</td>
<td>36</td>
<td>36</td>
<td>&lt;ETX&gt;</td>
<td>End of text</td>
</tr>
<tr>
<td>10</td>
<td>37</td>
<td>37</td>
<td>&lt;BBC1&gt;</td>
<td>upper nibble of BCC</td>
</tr>
<tr>
<td>11</td>
<td>38</td>
<td>38</td>
<td>&lt;BBC2&gt;</td>
<td>lower nibble of BCC</td>
</tr>
</tbody>
</table>
## Allocation for function- and error status messages

<table>
<thead>
<tr>
<th>Function status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 0</td>
<td>1 - standby, 0 - measuring, zero- reference or foil check</td>
</tr>
<tr>
<td>Bit 1</td>
<td>Foil check</td>
</tr>
<tr>
<td>Bit 2</td>
<td>Zero check</td>
</tr>
<tr>
<td>Bit 3</td>
<td>Reference check</td>
</tr>
<tr>
<td>Bit 4</td>
<td></td>
</tr>
<tr>
<td>Bit 5</td>
<td></td>
</tr>
<tr>
<td>Bit 6</td>
<td></td>
</tr>
<tr>
<td>Bit 7</td>
<td>Dust concentration measurement</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Error status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 0</td>
<td>Volume flow error</td>
</tr>
<tr>
<td>Bit 1</td>
<td>Vacuum error</td>
</tr>
<tr>
<td>Bit 2</td>
<td></td>
</tr>
<tr>
<td>Bit 3</td>
<td></td>
</tr>
<tr>
<td>Bit 4</td>
<td></td>
</tr>
<tr>
<td>Bit 5</td>
<td>Change the battery</td>
</tr>
<tr>
<td>Bit 6</td>
<td>Filter crack error</td>
</tr>
<tr>
<td>Bit 7</td>
<td></td>
</tr>
</tbody>
</table>

**Time relationship between the measuring value and the status/error messages:**

The status bits 1, 2, 3 and 7 defined the kind of the measuring value. The error status bits 0 and 1 defined the errors during the measuring. Status bit 0 defined whether the systems is actual busy or standby. If Error Status bit 5 or 6 are TRUE the error is actual active.
Transmission of Parameter from a PC (master) to the F701 (slave)

<table>
<thead>
<tr>
<th>Index-no.</th>
<th>Start byte</th>
<th>End byte</th>
<th>Data format</th>
<th>Index description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>&lt;STX&gt;</td>
<td>Start of text</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td>ST</td>
<td>Protocol identification</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>6</td>
<td>nnn#</td>
<td>Identification of the measuring instrument (instrument address, last three numbers of S/N for example), programmable on the instrument</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>7</td>
<td>A</td>
<td>Starts the measuring cycle defined by the transmission control character, one character (mnemonic)</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>8</td>
<td>&lt;ETX&gt;</td>
<td>End of text</td>
</tr>
<tr>
<td>6</td>
<td>9</td>
<td>9</td>
<td>&lt;BBC1&gt;</td>
<td>upper nibble of BCC</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>10</td>
<td>&lt;BBC2&gt;</td>
<td>lower nibble of BCC</td>
</tr>
</tbody>
</table>

Transmission control (A =)

<table>
<thead>
<tr>
<th>M</th>
<th>Dust measurement cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>Reference check (TB-CAL.)</td>
</tr>
<tr>
<td>N</td>
<td>Zero check</td>
</tr>
<tr>
<td>S</td>
<td>Stop measurement cycle</td>
</tr>
</tbody>
</table>

The ST-command is only carried out in standby status. To detect the standby status see functions status of the data (requested by DA-command). To stop a actual measurement cycle use the transmission control command “S”.

8.4. Getting starting

A function test of the Gesytec protocol can be easy done by a terminal program like “HyperTerminal”. In this case you can substitute the 3 ending characters (<ETX>, <BBC1> and <BBC2>) by a <CR>.

Try at first the easiest request: <STX>DA<CR>. Remember <STX> can be made by simultaneous hit of <ctrl> and b.
### 8.5. Examples

#### Data request

**Master → Slave (request “DA”)**

<table>
<thead>
<tr>
<th>Index</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format</td>
<td>&lt;STX&gt; DA &lt;ETX&gt; &lt;BBC1&gt; &lt;BBC2&gt;</td>
<td>Request from master</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Slave → Master (transmission “MD”)**

<table>
<thead>
<tr>
<th>Index</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format</td>
<td>&lt;STX&gt; MD nn# nnn# ±nnn±ee# hh# hh# &lt;ETX&gt; &lt;BBC1&gt; &lt;BBC2&gt;</td>
<td>Answer from slave</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instr.no.</td>
<td>01</td>
<td>one instrument</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address F701</td>
<td>070</td>
<td>1-255</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentr.</td>
<td>+0057+03</td>
<td>57µg/m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>00</td>
<td>Measuring (dust, zero, reference or foil check)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>01</td>
<td>standby</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>02 or 03</td>
<td>Foil check.result 03 during standby</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>04 /05</td>
<td>Zero check.result</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>08 /09</td>
<td>TB-CAL_.result</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>80 /81</td>
<td>dust concentr.result</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>01</td>
<td>Flow error</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>02</td>
<td>Vac. error</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>20</td>
<td>Battery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>40</td>
<td>F.crack error</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instr.Type</td>
<td>701</td>
<td>F-701</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Data transmission

**Master → Slave (transmission “ST”)**

<table>
<thead>
<tr>
<th>Index</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format</td>
<td>&lt;STX&gt; ST nnn# A &lt;ETX&gt; &lt;BBC1&gt; &lt;BBC2&gt;</td>
<td>Transmission from master</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address F701</td>
<td>255</td>
<td>1-255</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transm.Control</td>
<td>M</td>
<td>Dust measurement cycle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transm.Control</td>
<td>K</td>
<td>Reference check</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transm.Control</td>
<td>N</td>
<td>Zero check</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transm.Control</td>
<td>S</td>
<td>Breaking off the measuring, forces F701-20 to stand by</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. Analysis of Measurement Errors/ Setting the Cycle Times

The F701-20 Dust Monitor has an accuracy of ±10µg for the absolute dust mass on a filter segment. The accuracy of the dust concentration measurement is dependent on the gas volume used. To achieve a high level resolution for a small dust concentration, a large gas volume should be used. This can be attained by extending the vacuum period and the cycle time. The procedures for setting the cycle time are as follows:

1. The expected average dust concentration should be estimated. For example, assume a dust concentration of 100 µg/m³.

2. The F 701-20 Dust Monitor operates optimally with min. 0,3 mg (absolute mass) of dust. Dividing 0,3 mg absolute mass by a dust concentration of 100 µg/m³ gives a volume of 3 m³. The F701 has a suction capacity of 1 m³/h, so the vacuum procedure should be 3 hours long. The cycle time should then be the 3 hours of vacuum as well as 300 seconds for the zero point measurement and 300 seconds for measurement. Since both these measurement times are extremely small compared to the overall length of this cycle, setting the overall cycle time for 3 hours is probably sufficient.

3. If a flexible evaluation system is available, the dust collection period can also allow dust to be collected on several different filter segments. The computer can be triggered by the “Zero point calibration” status signal. For example, a 3-hour dust collection period could be conducted by covering the same filter segment during three 1-hour cycles. The advantage of such a procedure is that multiple intermediate values can be measured, which will give the same accuracy over the entire time period. This is especially beneficial in increasing the dynamic range of the system.

4. The accuracy of the dust concentration measurement can be calculated from the following formula:

\[
\Delta c = \pm 10\mu g / Q
\]

where \(\Delta c\) Margin of error for the dust concentration measurement

\(Q\) Total collected gas volume
10. Maintenance

The unit should be checked and maintained at regular intervals. This especially includes these parts: filter adapter, transport roll, pump, hoses and sample inlet.

The filter band should also be changed as needed.

10.1. Maintenance of the device

The following points in the display should be checked:

<table>
<thead>
<tr>
<th>Check:</th>
<th>Desired value:</th>
<th>See Menu:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter temperature</td>
<td>Same as entered</td>
<td>6.3.4. Parameter Menu</td>
</tr>
<tr>
<td>Volume flow</td>
<td>1000 Liter/h ±50 Liter</td>
<td>6.3.1. Measuring Mode</td>
</tr>
<tr>
<td>Counter rate</td>
<td>Between about 30000 - 65000 counts/min.</td>
<td>6.3.1. Measuring Mode, (Additional information)</td>
</tr>
</tbody>
</table>

The filter adapter should be cleaned at least every 6 months. The upper portion of the filter adapter should be carefully removed. With a dry cloth, **carefully** clean the interior.

**Warning:** make sure not to damage the film on the Geiger counter.

![Fig. 11: Upper portion of the filter adapter (from below)](image-url)
The Beta emitter should be carefully cleaned with a dry cloth. Check the thin metallic foil on it not to be damaged.

![Fig. 12: Lower portion of the filter adapter](image)

Check the transport roll for soiling, especially at the edges, and clean if needed.

![Fig. 13: Transport roll](image)

The pump should be checked annually. The seals, filters (both internal and external), blades etc. should be changed as stated in the maintenance guidelines for the pump itself. See "15.6. Specification for sample gas pump" for details.

Check the hoses inside for soiling and clean or replace if needed.
If the optional printer is installed, check the ribbon cartridge and replace if needed.

If the optional heavy metal sampling is installed, replace the tape if needed.

10.2. Maintenance of the sample inlet

The sample inlet should be maintained, cleaned and greased regularly according to EN12341 (appendix B) and US-EPA maintenance instructions.

10.3. Instruction for Changing a Filter Roll

Opening the supply filter reel:
Remove the front part of the supply filter reel by turning it while holding the back part.
Open the adapter by key in maintenance menu.

Lift the pad roll and lock it in the intended hole in the panel.
Opening the uptake filter reel: Remove the front part of the uptake filter reel by turning the center part while holding the back part. Then the rest of the tape can be removed. Keep the empty cardboard roll and move it to the uptake reel.

Place on the new filter roll in the shown direction.
Push the tape through the filter adapter.

Lead the tape by the transport roll.
Fix the Tape on the cardboard roll with an adhesive tape

Turn the uptake reel 2 to 3 times to the left to fix the tape some more
Release the pad roll onto the transport roll, so the tape is pressed on the roll.

Fix the front part of the uptake reel by turning it while holding the back part.
Fix the front part of the supply reel by turning the front part while holding the back part.

Close the adapter by key in maintenance menu.
### 11. Error Messages/Troubleshooting

The unit can detect the following errors:

<table>
<thead>
<tr>
<th>Error type</th>
<th>Cause/Symptom</th>
<th>Corrective Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume error</td>
<td>The volume flow is outside the 950-1050 liter/hour range. This error must be</td>
<td>1. Test the pump function</td>
</tr>
<tr>
<td></td>
<td>detected for at least 30 seconds to generate this error message.</td>
<td>2. Check that all tubes are tightly sealed and without leaks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Check if any of the tubes are blocked.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Check the function of the flow monitor and regulator (block the gas suction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tube and see if the display values change).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Check the regulator valves (block the gas suction tube and see if the motor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>valve alters its activity – if necessary, remove the lid of the motor valve).</td>
</tr>
<tr>
<td>Torn filter</td>
<td>The counter rate has exceeded 2300 pulses/second (the filter paper is no</td>
<td>Insert new filter paper in the unit. Begin measurements.</td>
</tr>
<tr>
<td></td>
<td>longer absorbing radiation intensity)</td>
<td></td>
</tr>
<tr>
<td>Measurement</td>
<td>The measurements lie outside the programmed measurement range</td>
<td>Change the measurement range limits</td>
</tr>
<tr>
<td>range error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vacuum error</td>
<td>The vacuum switch is detecting a vacuum of more than -0.4 bar, relative after</td>
<td>This usually occurs only on filters with high levels of dust accumulation. It may be</td>
</tr>
<tr>
<td></td>
<td>the filter adapter</td>
<td>necessary to decrease the cycle time. (Check to see if the measured absolute mass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lies near the optimal quantity of 0.3 mg)</td>
</tr>
<tr>
<td>General error</td>
<td>One or more of the above errors has occurred</td>
<td></td>
</tr>
</tbody>
</table>
## 12. Instruments and Spare Parts

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Artikel-Nr. / Part No.</th>
<th>Beschreibung/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F-701/TSP</td>
<td>Ambient Air Dust Analyzer for TSP incl. Monitor (7), TSP-inlet (10), 2m Sample line (8,9)</td>
</tr>
<tr>
<td>2</td>
<td>F-701/PM-10UST</td>
<td>Ambient Air Dust Analyzer for PM10 incl. Monitor (7), PM-10-inlet (US-EPA)(11), 2 m Sample Line (8,9)</td>
</tr>
<tr>
<td>3</td>
<td>F-701/PM-10EU</td>
<td>Ambient Air Dust Analyzer for PM10 incl. Monitor (7), PM-10-Inlet (European-Standard)(12), 2 m Sample Line (8,9)</td>
</tr>
<tr>
<td>4</td>
<td>F-701/PM-2.5UST</td>
<td>Ambient Air Dust Analyzer for PM2.5 incl. Monitor (7), PM-2.5-Inlet (US-EPA)(13), 2 m Sample Line (8,9)</td>
</tr>
<tr>
<td>5</td>
<td>F-701/PM-2.5EU</td>
<td>Ambient Air Dust Analyzer for PM2.5 incl. Monitor (7), PM-2.5-Inlet (European-Standard)(14), 2 m Sample Line (8,9)</td>
</tr>
<tr>
<td>6</td>
<td>F-701/EG</td>
<td>Exhaust Gas Dust Analyzer for non-condensing exhaust gases incl. Monitor (7), Exhaust Gas Probe (17), 5m Sample Line</td>
</tr>
<tr>
<td>7</td>
<td>F-701</td>
<td>Basic Monitor for Ambient Air or exhaust Gas (non-condensing) incl. instrument and standard accessories (26)</td>
</tr>
<tr>
<td>8</td>
<td>F-701/ST1</td>
<td>Sample Inlet Tube, first meter</td>
</tr>
<tr>
<td>9</td>
<td>F-701/STF</td>
<td>Sample Inlet Tube, following meter (max. 4m total)</td>
</tr>
<tr>
<td>10</td>
<td>F-701/InT</td>
<td>TSP-Inlet acc. VDI 2463</td>
</tr>
<tr>
<td>11</td>
<td>F-701/In10UST</td>
<td>PM-10 Inlet acc. US-EPA</td>
</tr>
<tr>
<td>12</td>
<td>F-701/In10EU</td>
<td>PM-10 Inlet acc. European-Standard EN12341</td>
</tr>
<tr>
<td>13</td>
<td>F-701/In2.5UST</td>
<td>PM-2.5 Inlet acc. US-EPA</td>
</tr>
<tr>
<td>14</td>
<td>F-701/In2.5EU</td>
<td>PM-2.5 Inlet acc. European-Standard EN12341</td>
</tr>
<tr>
<td>15</td>
<td>F-701/STHT</td>
<td>Heater for Sample Inlet Tube, 1m</td>
</tr>
<tr>
<td>16</td>
<td>F-701/STRI</td>
<td>Roof Insert for Sample Inlet Tube</td>
</tr>
<tr>
<td>17</td>
<td>F-701/SPEG</td>
<td>Sample Probe for non-condensing exhaust gas</td>
</tr>
<tr>
<td>18</td>
<td>F-701/RF</td>
<td>Reference Foil for control of reproducibility</td>
</tr>
<tr>
<td>19</td>
<td>F-701/HMS</td>
<td>Accessories for Heavy Metal Sampling, incl. cover foil holder, cover foil, filter tape printer</td>
</tr>
<tr>
<td>21</td>
<td>F-701/110</td>
<td>110V, 60Hz. power supply</td>
</tr>
<tr>
<td>22</td>
<td>F-701/OC</td>
<td>Outdoor Cabinet, incl. air conditioner</td>
</tr>
<tr>
<td>23</td>
<td>F-701/CK</td>
<td>Consumables Kit for one year of operation</td>
</tr>
<tr>
<td>24</td>
<td>F-701230/SK</td>
<td>Spare Parts Kit of suggested parts (230V, 50Hz)</td>
</tr>
<tr>
<td>25</td>
<td>F-701115/SK</td>
<td>Spare Part Kit of suggested parts (115V, 60Hz)</td>
</tr>
<tr>
<td>26</td>
<td>F-701/Acc.</td>
<td>Standard Accessories: 1 roll Filter tape (45m), 1 power cable, 1 each connector incl. housing for 9 and 50 pins</td>
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</table>
# F-701, Consumables and Spare Parts

<table>
<thead>
<tr>
<th>Part</th>
<th>Part-Nr.</th>
<th>Used in</th>
<th>Estimated annual use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass-Fiber Tape, 30 m, low heavy metal content</td>
<td>703-227030</td>
<td>12...25</td>
<td></td>
</tr>
<tr>
<td>Glass-Fiber Tape, 45 m, low heavy metal content</td>
<td>703-227045</td>
<td>20</td>
<td>8...20</td>
</tr>
<tr>
<td>Cover Foil, 30 m (option)</td>
<td>703-111030</td>
<td>12...25</td>
<td></td>
</tr>
<tr>
<td>Cover Foil, 45 m (option)</td>
<td>703-111045</td>
<td>8...20</td>
<td></td>
</tr>
<tr>
<td>Glass-Fiber Tape, 30 m, low heavy metal content</td>
<td>703-227030</td>
<td>12...25</td>
<td></td>
</tr>
<tr>
<td>Glass-Fiber Tape, 45 m, low heavy metal content</td>
<td>703-227045</td>
<td>20</td>
<td>8...20</td>
</tr>
<tr>
<td>Cover Foil, 30 m (option)</td>
<td>703-111030</td>
<td>12...25</td>
<td></td>
</tr>
<tr>
<td>Cover Foil, 45 m (option)</td>
<td>703-111045</td>
<td>8...20</td>
<td></td>
</tr>
<tr>
<td>Ribbon (internal/external printer), 3 per box (option)</td>
<td>904-0180</td>
<td>3</td>
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<tr>
<td>Maintenance kit for Sample Gas Pump, consists of:</td>
<td>701-PP-KT-20</td>
<td>1</td>
<td>1</td>
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<tr>
<td>• 4x Carbon Blade (3)</td>
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<td></td>
<td></td>
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<tr>
<td>• 1x Filter cartridge (5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 1x Sealing ring (6)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>• 1x Sealing disc (7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal tubing set</td>
<td>701-0358-20</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Reference Foil (external) 4.0</td>
<td>701-RF040</td>
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<tr>
<td>Geiger-Müller-Countertube w/ housing</td>
<td>703-000GMK</td>
<td>1</td>
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<tr>
<td>GMZ Preamp/Power supply board</td>
<td>703-SM5700</td>
<td>1</td>
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</tr>
<tr>
<td>GMZ Preamp/Power supply board/Housing</td>
<td>703-010615-20</td>
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<tr>
<td>C-14 Source</td>
<td>701-000C14</td>
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<tr>
<td>Filter Holder complete, w/o detector &amp; source</td>
<td>701-581937-20</td>
<td>1</td>
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<tr>
<td>Filter Holder, sample gas inlet complete</td>
<td>701-581100-20</td>
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<tr>
<td>Filter Holder, solenoid mechanism</td>
<td>703-701242-20</td>
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<td></td>
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<tr>
<td>Filter Holder, DC drive motor, 22V</td>
<td>701-ESCAP-20</td>
<td>1</td>
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<tr>
<td>Filter Holder, heater cartridge</td>
<td>904-0158</td>
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<tr>
<td>Filter Holder, Pt100</td>
<td>701-00005-20</td>
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<tr>
<td>Front Panel, Display with Touchpanel</td>
<td>701-2407CTP-20</td>
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<tr>
<td>Pushbutton switch, main power</td>
<td>701-115108152-20</td>
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<tr>
<td>Sample Tube Heater, Pt100 (option)</td>
<td>701-00621-20</td>
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<tr>
<td>Sample Tube Heater, heat tape 230V (option)</td>
<td>703-HBST230-20</td>
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<tr>
<td>Sample Tube Heater, heat tape 110V (option)</td>
<td>703-HBST110-20</td>
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<tr>
<td>Sample Inlet, Pt100 (option)</td>
<td>701-00616-20</td>
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</tr>
<tr>
<td>Description</td>
<td>Code</td>
<td></td>
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<tr>
<td>----------------------------------------------------------------------------</td>
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<td></td>
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</tr>
<tr>
<td>Tape Printer complete (option)</td>
<td>703-150160</td>
<td></td>
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<tr>
<td>Tape Printer, printer mechanism (option)</td>
<td>703-160160</td>
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<tr>
<td>Tape Printer, PC-board (option)</td>
<td>703-000160</td>
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<tr>
<td>Tape Transport Mechanism, Roll complete</td>
<td>703-137081</td>
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<tr>
<td>Tape Transport Mechanism, Stepping motor, type SAIA</td>
<td>904-0027UFB2</td>
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<tr>
<td>Tape Transport Pad Roll Support complete</td>
<td>703-033702</td>
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<tr>
<td>Tape Transport Pad Roll Support, Spring</td>
<td>703-543470</td>
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<tr>
<td>Tape Reel, Motor variodrive, 24V</td>
<td>701-93754-20</td>
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<tr>
<td>Tape Reel, variotronik</td>
<td>701-93724-20</td>
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<tr>
<td>Main PC-Board, BF701LP10</td>
<td>701-LP10-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution Board, BF701LP20</td>
<td>701-LP20-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airflow-Sensor 1m³/h, complete</td>
<td>701-9026-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Gas Pump complete, 230V 50/60Hz</td>
<td>701-1025130110-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Gas Pump complete, 115V 50/60Hz</td>
<td>701-1025130111-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outlet Filter complete with insert incl. O-ring</td>
<td>701-CSS04-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outlet Filter insert incl. O-ring</td>
<td>701-W04-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Supply Modul</td>
<td>701-108909-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power distribution board BF701LPA4</td>
<td>701-A4</td>
<td></td>
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</tr>
<tr>
<td><strong>Consumable Kit</strong></td>
<td>F-701/CK</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Spare Parts Kit (230V, 50Hz)</strong></td>
<td>F-701230/SK</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Spare Parts Kit (115V, 60Hz)</strong></td>
<td>F-701115/SK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(for completion of “CK” and “SK” regarding type and options of devices see last column!)</td>
<td></td>
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</tr>
</tbody>
</table>
13. **Warranty**

Prior to shipment any VEREWA instrument is thoroughly inspected, tested, and calibrated to ensure a safe and accurate automatic or manual operation.

The F-701-20 is warranted for 12 months (1 year) after shipment. In the event of a failure, VEREWA assures its customers that prompt service and support will be available.

All VEREWA warranty is based on the newest edition of the „General Conditions of Supply and Delivery for Products and Services of the Electrical Industry (ZVEI)“. If required, we can provide the complete text.

**Excluded from the warranty are all Consumables (see**
12. Instruments and Spare Parts (for a complete list). Warranty is waived, if the required maintenance is not carried out and documented (see Fehler! Verweisquelle konnte nicht gefunden werden. for the schedule). Warranty is limited to VEREWA’s F-701 and does not cover any other losses such as data loss or its effects, or any other subsequent losses.

VEREWA's warranty covers all material and labor, if the instrument is returned either to VEREWA or to the nearest designated Service Center, freight pre-paid. Please ensure using the original packaging. When the instrument will be returned, freight has to be paid by the customer.

On-site repair during warranty is available according to the local distributor's scheme. If VEREWA personnel is required on-site for warranty repair, the actual cost for travel and accommodation will be charged.

Optional equipment or instruments provided with the F-701-20, but not manufactured by VEREWA, are warranted or repaired to the extent and according to the current terms and conditions of the respective original manufacturer's warranty.

If modules in the F-701-20, marked as „Only to be opened and/or modified by the manufacturer“ will be opened or modified, the warranty automatically expires. The warranty also expires, if the F-701-20 has been subject to abnormal use. „Abnormal Use“ for the purpose of this warranty is defined as any use to which the instrument is exposed other than the specified or intended as evidenced by purchase or written sales representation. Other than the above, no other warranty, expressed or implied, shall apply to any and all such equipment furnished and sold by VEREWA.
## 14. Technical Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranges</td>
<td>selectable between 0-0.1 and 0-10 mg/m³</td>
</tr>
<tr>
<td>Lower Detectable Limit</td>
<td>&lt;0.001 mg/m³</td>
</tr>
<tr>
<td>Total Accuracy</td>
<td>&lt;±2% F.S.</td>
</tr>
<tr>
<td>Zero Drift (Temperature)</td>
<td>&lt;1% / 10°C (18°F)</td>
</tr>
<tr>
<td>Span Drift (Temperature)</td>
<td>&lt;1% / 10°C (18°F)</td>
</tr>
<tr>
<td>Zero Drift</td>
<td>automatic zero correction</td>
</tr>
<tr>
<td>Voltage Coefficient</td>
<td>&lt;2% / 10% change in voltage</td>
</tr>
<tr>
<td>MTBF</td>
<td>&gt;95 % availability</td>
</tr>
<tr>
<td>Startup Time</td>
<td>10 min</td>
</tr>
<tr>
<td>Maintenance-free Operation</td>
<td>&gt;1 year (w/o filter tape)</td>
</tr>
<tr>
<td>Power Supply</td>
<td>230 V / 50 Hz, 110 V / 60 Hz, +10% / -15%</td>
</tr>
<tr>
<td>Required Power</td>
<td>app. 0.4 kVA</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>0°C to +50°C (14 to 122°F)</td>
</tr>
<tr>
<td>Signal Output</td>
<td>4 - 20 mA, 2x RS-232, Device Interface, Gesytec protocol (Bayern/Hessen)</td>
</tr>
<tr>
<td>Measure database</td>
<td>1023 Sets</td>
</tr>
<tr>
<td>Message/error database</td>
<td>1023 Sets</td>
</tr>
<tr>
<td>Source</td>
<td>C-14-Flat Top Source, totally enclosed</td>
</tr>
<tr>
<td>Half Lifetime</td>
<td>5.730 years</td>
</tr>
<tr>
<td>Total Activity</td>
<td>&lt;450 kBq (&lt;12.5 mCi)</td>
</tr>
<tr>
<td>Detector</td>
<td>Geiger-Müller-Counter-Tube</td>
</tr>
<tr>
<td>Filter Material</td>
<td>Glass-Fiber-Filter 99.95%&gt;0.3mm</td>
</tr>
<tr>
<td>Filter Adapter</td>
<td>20°C to 70°C (68°F to 158°F), temperature controlled (preconditioning of tape) user adjustable</td>
</tr>
<tr>
<td>Filter Spot Area</td>
<td>0.79cm² (0.12 in²)</td>
</tr>
<tr>
<td>Filter Advance per Spot</td>
<td>36 mm (1.4”)</td>
</tr>
<tr>
<td>Filter Tape Length</td>
<td>30 m, 45 m (98 ft, 148 ft)</td>
</tr>
<tr>
<td>Sample Flow Rate</td>
<td>1000 l/h , Flow controlled</td>
</tr>
<tr>
<td>Accuracy Sample Flow Rate</td>
<td>&lt; ±5%</td>
</tr>
<tr>
<td>Sample Flow Correction Temperature</td>
<td>Yes, Optional: Automatic correction by measuring the temperature</td>
</tr>
<tr>
<td>Sample Flow Correction absolute pressure</td>
<td>Yes, Optional: Automatic correction by measuring the pressure</td>
</tr>
<tr>
<td>Cycle Time</td>
<td>user-selectable, between 30 minutes and 24 h</td>
</tr>
<tr>
<td>F/B Operation (Forward/Backward)</td>
<td>max. 8 cycles (24 h average @ 3 h cycle time)</td>
</tr>
<tr>
<td>Dimensions (H x W x D)</td>
<td>320 x 450 x 500 mm (12.6 x 19 x19.7”)</td>
</tr>
<tr>
<td>Weight</td>
<td>26 kg (57 lbs)</td>
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<tr>
<td>Component</td>
<td>Specification / Description</td>
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<tr>
<td>--------------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>Color</td>
<td>RAL 7032 (grey)</td>
</tr>
<tr>
<td>Sampling System</td>
<td>acc. VDI 2463, pg. 8; (TSP); PM-10 or PM-2.5 inlet (US-EPA, EN 12341)</td>
</tr>
<tr>
<td>Sample Tube Heater</td>
<td>Heater Coil with Controller</td>
</tr>
<tr>
<td>Pump</td>
<td>Built-in Disc Vacuum Pump, 1m³/h</td>
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</tbody>
</table>
15. Service documents

15.1. Main PC-board BF701LP10
15.2. Distribution Board BF701LP20
15.3. Distribution and switch board for peripheral components A4
15.4. GMT preamplifier PCB
15.5. Air Flow Sensor

Installation Instructions for the MICRO SWITCH AWM5000 Series Microbridge Mass Airflow Sensor

GENERAL INFORMATION

AWM5000 Series Microbridge Mass Airflow Sensors operate on the theory that airflow directed across the surface of a sensing element causes heat transfer. Output voltage varies in proportion to the mass of air or other gas flowing through a given sensor’s inlet and outlet ports.

Current sink/source. Maximum current ratings are 10 mA sinking and 20 mA sourcing, governed by an LM224 operational amplifier in the final stage of the instrumentation amplifier.

MEDIA CONTAMINATION

Media flowing through the sensor should be free of condensing moisture and particulate contaminants. An inexpensive 5 micron filter upstream of the sensing element substantially reduces the risk of damage due to contaminants.

MOUNTING INSTRUCTIONS

Mount AWM5000 Series sensors with 6-32 screws. Use of washers below screw head is recommended. Mounting torque is 1.1 Nm (9.75 in/lb) max. for steel screws, or 0.75 Nm (6.75 in/lb) max. for brass screws.

NOTICE

When making flow connections to mounted sensor, the AWM5000 must be supported at the flow adapter.

If end adapters are twisted with respect to the flow tube during installation, the seal between O-ring and flow tube will be broken, causing a small temporary leak. The leak can be as high as 1 psi, or may remain within specification. It will self-heal as the O-ring conforms. About 85% of the leak will be gone in 24 hours, with complete recovery within 48 hours.

Do not expose ports to forces greater than 1 kg (2 pounds) in a direction perpendicular to the port centerline.

Torque on ports should not exceed 4.52 Nm (40 in/lb).

ELECTRICAL CONNECTION

The AWM5000 Series accepts a latch detente connector, such as:
1. Amp part number 103956-3,
2. MICRO SWITCH part number SS-12143.
Information and literature on latch detente connectors is available from Amp Product Information Center, 1-800-522-6752 or the Customer Hotline, 1-800-722-1111.

RECOMMENDED AMP LITERATURE

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>82160</td>
<td>MTE Interconnection System (AMP/ODU) Catalog</td>
</tr>
<tr>
<td>108-25034</td>
<td>Product Specification (technical performance information)</td>
</tr>
<tr>
<td>114-25026</td>
<td>Application Specification (describes product, proper assembly, full tooling information)</td>
</tr>
<tr>
<td>IS 6919</td>
<td>Instruction Sheet for assembly procedure</td>
</tr>
</tbody>
</table>

TO MAKE ELECTRICAL CONNECTIONS

1. Remove (unlatch) the connector from the AWM5000.
2. Hand-crimp the interface wire to the appropriate pin on connector. Suggested tool: AMP Hand-Crimp Tool, part number IS9407.
3. Insert the terminal contacts into the connector housing after carrier strip (lead-frame) is removed.
4. Reconnect (latch) connector to AWM5000 device.

CLEANING

NOTICE

Do not use ultrasonics when cleaning. This may damage the microstructure.

Cover the ends of the tube during cleaning, since certain solvents may attack the epoxy which seals the chip tube to the ceramic substrate. Do not use: III tri-chloroethane, methylene chloride, methyl pyrrolidine, or any oxidizing type acid such as formic acid.
### AWM5000 Series

#### SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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<tbody>
<tr>
<td>Recommended power supply (1)</td>
<td>10 ± 0.01 VDC</td>
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<tr>
<td>Minimum power supply</td>
<td>8.0 VDC</td>
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<tr>
<td>Maximum power supply</td>
<td>15.0 VDC</td>
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<tr>
<td>Power consumption</td>
<td>100 mW max.</td>
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<tr>
<td>Output type</td>
<td>Linear, 1 to 5 VDC</td>
</tr>
<tr>
<td>Calibration gas Suffix</td>
<td>VA = Argon, VC = CO₂ Carbon Dioxide, N₂O Nitrous Oxide, VN = N₂ Nitrogen, O₂ Oxygen, Air</td>
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<tr>
<td>Gas flow range</td>
<td>AWM5101 0 to 5 SLM (5)</td>
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<td></td>
<td>AWM5102 0 to 10 SLM</td>
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<tr>
<td></td>
<td>AWM5103 0 to 15 SLM</td>
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<tr>
<td></td>
<td>AWM5104 0 to 20 SLM</td>
</tr>
<tr>
<td>Output at laser trim point</td>
<td>5.0 VDC at Full Scale Flow</td>
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<tr>
<td>Differential pressure at full scale</td>
<td>See Pressure vs Flow Chart</td>
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<tr>
<td>Null output</td>
<td>1.00 ± 0.05 VDC</td>
</tr>
<tr>
<td>Null output shift, -20 to 70°C</td>
<td>± 0.050 VDC typ., ± 0.200 VDC max.</td>
</tr>
<tr>
<td>Full scale output shift, -20 to +25°C and +25 to +70°C</td>
<td>Suffix VA or VN: ± 7.0 % F.S.O.</td>
</tr>
<tr>
<td></td>
<td>Suffix VC: ± 10.0 % F.S.O.</td>
</tr>
<tr>
<td>Linearity error (2)</td>
<td>± 3.0% reading</td>
</tr>
<tr>
<td>Repeatability &amp; hysteresis</td>
<td>± 0.5% Reading</td>
</tr>
<tr>
<td>Response time</td>
<td>60.0 msec max.</td>
</tr>
<tr>
<td>Temperature range, operating and storage</td>
<td>-20 to +70°C (-4 to +158°F)</td>
</tr>
<tr>
<td>Termination (0.100” centers)</td>
<td>0.025” square</td>
</tr>
<tr>
<td>Connector (4 pin receptacle), included (3)</td>
<td>AMP (103956-3)</td>
</tr>
<tr>
<td>Weight</td>
<td>60 grams (2.06 oz.)</td>
</tr>
<tr>
<td>Shock rating</td>
<td>100 g peak, 6 msec half-sine (3 drops, each direction of 3 axes)</td>
</tr>
<tr>
<td>Vibration rating</td>
<td>15 g, 10-2000-10 Hz</td>
</tr>
<tr>
<td>Overpressure</td>
<td>50 psi max.</td>
</tr>
<tr>
<td>Leak rate, max.</td>
<td>0.1 psi/min, at static condition</td>
</tr>
</tbody>
</table>

1. Cannot guarantee calibration at supply voltages other than 10.0 ± 0.01 VDC.
2. Linearity specification applies from 2 to 100% full scale of gas flow range and does not apply to null output at 0 SLM.
3. Supplied in strip form. Other strip form receptacles are available as are various tools to assemble receptacles in strip form. Individual receptacle assemblies are also available from Amp.
4. SLM sensors have larger Full scale shifts over temperature. 0-20 SLM sensors have lowest shifts with respect to temperature.
5. SLM denotes standard liters per minute which is a flow measurement referenced to standard conditions of 0°C, 760 torr (sea level), 50% RH.
AWM5000 Series

**CHARACTERISTICS**

**AWM5101V Series**
1-5 VDC Linear Output

**AWM5102V Series**
1-5 VDC Linear Output

**AWM5103V Series**
1-5 VDC Linear Output

**AWM5104V Series**
1-5 VDC Linear Output

**PRESSURE vs. AIRFLOW**

<table>
<thead>
<tr>
<th>Catalog Listing</th>
<th>Flow Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWM5101VA</td>
<td>5 SLPM, Argon calibration</td>
</tr>
<tr>
<td>AWM5101VC</td>
<td>5 SLPM, CO₂ calibration</td>
</tr>
<tr>
<td>AWM5101VN</td>
<td>5 SLPM, N₂ calibration</td>
</tr>
<tr>
<td>AWM5102VA</td>
<td>10 SLPM, Argon calibration</td>
</tr>
<tr>
<td>AWM5102VC</td>
<td>10 SLPM, CO₂ calibration</td>
</tr>
<tr>
<td>AWM5102VN</td>
<td>10 SLPM, N₂ calibration</td>
</tr>
<tr>
<td>AWM5103VA</td>
<td>15 SLPM, Argon calibration</td>
</tr>
<tr>
<td>AWM5103VC</td>
<td>15 SLPM, CO₂ calibration</td>
</tr>
<tr>
<td>AWM5103VN</td>
<td>15 SLPM, N₂ calibration</td>
</tr>
<tr>
<td>AWM5104VA</td>
<td>20 SLPM, Argon calibration</td>
</tr>
<tr>
<td>AWM5104VC</td>
<td>20 SLPM, CO₂ calibration</td>
</tr>
<tr>
<td>AWM5104VN</td>
<td>20 SLPM, N₂ calibration</td>
</tr>
</tbody>
</table>

All listings have 1-5 VDC linear output with 10 VDC supply over given flow range for a given gas.
AWM5000 Series

MOUNTING DIMENSIONS (for reference only)

OUTPUT CONNECTIONS

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+ Supply voltage</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>No connection</td>
</tr>
<tr>
<td>4</td>
<td>Output voltage</td>
</tr>
</tbody>
</table>

Note: Flow direction is marked on housing.

WARRANTY/REMEDY

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Commencing with date of shipment, Honeywell's warranty runs for 18 months. If warranted goods are returned to Honeywell during that period of coverage, Honeywell will repair or replace without charge those items it finds defective. The foregoing is Buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose.

For application assistance, current specifications, pricing or name of the nearest Authorized Distributor, contact a nearby sales office. Or call:

FAX 1-815-235-6545 USA
INTERNET http://www.sensing.honeywell.com info@micro.honeywell.com

Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

While we provide application assistance, personally and through our literature, it is up to the customer to determine the suitability of the product in the application.
15.6. Specification for sample gas pump

**Pump ranges**
These operating instructions concern the following dry-running rotary vane vacuum pumps: Models VTE 3 → VTE 10.
The pumping curves showing capacity against pressure can be found in data sheet D 187.

**Description**
All models are complete with a pipe connection on the inlet and an exhaust silencer on the outlet. All the air handled is filtered by a built-in micro-fine filter. The motor fan cools the motor and pump housing. Both the motor and pump have a common shaft.

**Optional extras.** As required, vacuum regulating valve (ZRV), non return valve (ZRK) and motor starter (ZMS).

**Suitability**
- The units VTE are suitable for the use in the industrial field and protection equipment corresponds to EN DIN 294 table 4, for people aged 14 and above.
- The VTE can be used for the evaporation of a cold system or for a permanent vacuum from 100 to 1000 mbar (abs.).
- The ambient and suction temperatures must be between 5 and 40°C. For temperatures outside this range please contact your supplier.

These dry-running vacuum pumps are suitable for use with air of relative humidity of 30 to 90%.
- Dangerous mixtures (i.e. flammable or explosive gases or vapours), extremely humid air, water vapour, aggressive gases or traces of oil and grease must not be handled.
- The standard versions may not be used in hazardous areas.
- All applications where an unplanned shut down of the vacuum pump could possibly cause harm to persons or installations, then the corresponding safety backup system must be installed.

**Handling and Setting up (pictures 1 and 2)**
- Pumps that have reached their operating temperature, may have on the VTE 6 and VTE 8 a surface temperature at position (Q) of more than 70°C. WARNING! Do Not Touch.
- There must be a minimum space of 20 cm in front of the housing cover (d) for servicing. The cooling air exits (E) and the cooling air exits (F) must have a minimum distance of 8 cm from any obstruction. The discharged cooling air must not be recirculated.

The VTE pumps can only be operated reliably if they are installed horizontally. Other built-in positions on request.

For installations that are higher than 1000 m above sea level there will be a loss in capacity. For further advice please contact your supplier.

Installed on a solid base these pumps may be installed without fixing down. If the pumps are installed on a base plate we recommend fitting anti-vibration mounts. This range of vacuum pumps are almost vibration free in operation.

**Installation (pictures 1 and 2)**
- For operating and installation follow any relevant national standards that are in operation.
  1. Vacuum connection at (A).
     - The air handled can be exhausted into the atmosphere through the exhaust port (E) or by utilising a pipe connection and pipeline.
  2. Long and/or small bore pipework should be avoided as this tends to reduce the capacity of the pump.
  3. The electrical data can be found on the motor data plate (P). The motors correspond to DIN VDE 0530 and have IP 54 protection and insulation class B or F. The connection diagram can be found in the terminal box on the motor (unless a special plug connection is fitted). Check the electrical data of the motor for compatibility with your available supply (voltage, frequency, permissible current etc.).
  4. Connect the motor via a motor starter. It is advisable to use thermal overload motor starters to protect the motor and wiring. All cabling used on starters should be secured with good quality cable clamps.

We recommend that motor starters should be used that are fitted with a time delayed trip resulting from running beyond the amperage setting. When the unit is started cold overvoltage may occur for a short time.

The electrical installation may only be made by a qualified electrician under the observance of EN 60204. The main switch must be provided by the operator.
Initial Operation

1. Initially switch the pump on and off for a few seconds to check the direction of rotation against the direction arrow (see motor data plate (P)).

Note: The suction pipework should not be connected. If the pump runs backwards this could result in damaged rotor blades.

2. Connect the suction pipe at (A).

3. Vacuum regulating valve (optional extra). The vacuum can be adjusted by turning the regulating valve (C) according to the symbols on the top of the regulating valve.

Potential risks for operating personnel

Noise Emission: The worst noise levels concerning direction and intensity according to DIN 45635 part 3 (as per 3. GSGV) are shown in the table at the back. When working permanently in the vicinity of an operating pump we recommend wearing ear protection to avoid any damage to hearing.

Maintenance and Servicing

When maintaining these units and having such situations where personnel could be hurt by moving parts or by live electrical parts of the pump must be isolated by totally disconnecting the electrical supply. It is imperative that the unit cannot be re-started during the maintenance operation. Do not maintain a pump that is at its normal operating temperature as there is a danger from hot parts.

1. Lubrication

The VTE pumps have bearings that are greaseless for life. They need not be serviced.

2. Air filtration (picture 3)

The capacity of the pump could be reduced if the air inlet filters are not maintained correctly.

The filter cartridge (f) has to be cleaned monthly depending on the amount of contamination. This is achieved by blowing compressed air from the inside of the cartridge outward. Even if the cartridges are cleaned their separating efficiency deteriorates. We would therefore recommend exchanging the cartridges once a year depending on operating conditions.

Changing the filter: Screw off housing cover (d). Remove filter cartridge (f) with gaskets from filter room (g). Clean or exchange filter and check gaskets. Reassemble in reverse order.

3. Blades (picture 3)

Checking blades: The models VTE have 4 blades which have a low but permanent wear factor.

First check after 6,000 operating hours, thereafter every 1,000 operating hours. Screw off housing cover (d) from housing. Remove blades (e) for inspection. All blades must have a minimum height (X) of larger than 10 mm (VTE 3 and VTE 6) and 12 mm (VTE 8 and VTE 10).

Blades must be changed completely.

Changing blades: If the minimum height is reached, then the whole set of rotor blades should be changed.

Before fitting new blades clean the housing and rotor slots with compressed air. Place the blades with the radius outward (Y) such that the bevel is in the direction of rotation (Z) and corresponds with the radius of the housing (Z). Replace housing cover (d) and slightly tighten the screws (s). Start pump and check for free and smooth running blades. Then firmly tighten and cover screws (s).

Troubleshooting:

1. Motor starter cuts out vacuum pump:

   1.1 Check that the incoming voltage and frequency corresponds with the motor data plate.
   1.2 Check the connections on the motor terminal block.
   1.3 Incorrect setting on the motor starter.
   1.4 Motor starter trips too fast. Solution: Use a motor starter with a time delay trip (version as per IEC 947-4).
   1.5 Back pressure on the exhaust pipework is excessive.

2. Insufficient suction capacity:

   2.1 Inlet filters are obscured.
   2.2 Suction pipe work is too long or too small.
   2.3 Leak on the pump or on the system.
   2.4 Blades are damaged.

3. Vacuum pump does not reach ultimate vacuum:

   3.1 Check for leaks on the suction side of the pump or on the system.
   3.2 Blades are worn or damaged.

4. Vacuum pump operates at an abnormally high temperature:

   4.1 Ambient or suction temperature too high.
   4.2 Cooling air flow is restricted.
   4.3 Problem as per 1.5.

5. Unit emits abnormal noise:

   5.1 The pump cylinder is worn. Solution: send your complete unit off for repair to the supplier or approved service agent.
   5.2 The regulating valve (if fitted) is noisy. Solution: replace valve.
   5.3 Blades are damaged.

Appendix:

Repair on Site: For all repairs on site an electrician must disconnect the motor so that an accidental start of the unit cannot happen. All repairs are recommended to be carried out by the manufacturer or a competent person. The address of the nearest repair shop can be obtained from the manufacturer or application.

After a repair or before re-installation follow the instructions as shown under the headings “Installation and Initial Operation”. Storage: VTE units must be stored in dry, ambient conditions with normal humidity. We recommend a relative humidity of over 80% that the pumps should be stored in a sealed container with the appropriate “drying” chemicals.

Disposal: The wearing parts (as listed in the spare parts list) should be disposed of with due regard to health and safety regulations.

Spare parts list:

<table>
<thead>
<tr>
<th>E 187</th>
<th>VTE 3</th>
<th>VTE 6</th>
<th>VTE 8</th>
<th>VTE 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>VTE</td>
<td>3</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Noise level (max.) dB(A)</td>
<td>50 Hz</td>
<td>60 Hz</td>
<td>60 Hz</td>
<td>60 Hz</td>
</tr>
<tr>
<td>Weight</td>
<td>kg</td>
<td>6.5</td>
<td>7.5</td>
<td>8.0</td>
</tr>
<tr>
<td>Length</td>
<td>mm</td>
<td>209</td>
<td>234</td>
<td>249</td>
</tr>
<tr>
<td>Width</td>
<td>mm</td>
<td>153</td>
<td>157</td>
<td>157</td>
</tr>
<tr>
<td>Height</td>
<td>mm</td>
<td>151</td>
<td>157</td>
<td>157</td>
</tr>
<tr>
<td>Grundsteile</td>
<td>Basic parts</td>
<td>Elemente de base</td>
<td>Parti fondamentali</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
<td>------------------</td>
<td>-------------------</td>
<td></td>
</tr>
<tr>
<td>Gehäuse</td>
<td>Housing</td>
<td>Corps</td>
<td>Corpo pompa</td>
<td></td>
</tr>
<tr>
<td>Läufer</td>
<td>Rotor</td>
<td>Rotor</td>
<td>Rotore</td>
<td></td>
</tr>
<tr>
<td>Gehäusesockel</td>
<td>Housing cover</td>
<td>Coque</td>
<td>Cocon de corps</td>
<td></td>
</tr>
<tr>
<td>Filterpatrone</td>
<td>Filter cartridge</td>
<td>Cartouche</td>
<td>Cartouche filtre</td>
<td></td>
</tr>
<tr>
<td>Dichtring</td>
<td>Sealing ring</td>
<td>Anneau</td>
<td>Anneau d'étanchéité</td>
<td></td>
</tr>
<tr>
<td>Dichtring</td>
<td>Sealing disc</td>
<td>Disque</td>
<td>Disque d'étanchéité</td>
<td></td>
</tr>
<tr>
<td>Schalube</td>
<td>Disc</td>
<td>Rondelle</td>
<td>Rondelle ressort</td>
<td></td>
</tr>
<tr>
<td>Feder scheibe</td>
<td>Spring shim</td>
<td>Vis</td>
<td>Vis à contre-sobresoubres</td>
<td></td>
</tr>
<tr>
<td>Sauchenzahntrieb</td>
<td>Hexagon head screw</td>
<td>Vis</td>
<td>Vis à contre-sobresoubres</td>
<td></td>
</tr>
<tr>
<td>Distanzscheibe</td>
<td>Spacer shim</td>
<td>Rondelle entre-toile</td>
<td>Rondelle entre-toile</td>
<td></td>
</tr>
<tr>
<td>Motor mit Anschlußdeckel</td>
<td>Motor with connection cover</td>
<td>Vis</td>
<td>Vis</td>
<td></td>
</tr>
<tr>
<td>Schraube</td>
<td>Screw</td>
<td>Vis</td>
<td>Vis</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anbauteile</th>
<th>Assembly parts</th>
<th>Elemente de montage</th>
<th>Elementi di montaggio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schlauchanschluß</td>
<td>Hose connection</td>
<td>Raccord tuyau</td>
<td>Attacco portapennetta</td>
</tr>
<tr>
<td>Verschlußschaube</td>
<td>Lock plug</td>
<td>Bouche obturateur</td>
<td>Vite di chiusura</td>
</tr>
<tr>
<td>Dichtring</td>
<td>Sealing ring</td>
<td>Ansaugdichtung</td>
<td>Anno di tenuta</td>
</tr>
<tr>
<td>Auslassschalldämpfer</td>
<td>Extract silencer</td>
<td>Silenciador silenciador</td>
<td>Silenziatore allo scarico</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zubehör</th>
<th>Optional extras</th>
<th>Accessoires</th>
<th>Accessori</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vakuums-Regulierventil</td>
<td>Vacuum regulating valve</td>
<td>Valve réglage valve</td>
<td>Valvola regolatore vaso</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Schalter</th>
<th>Labels</th>
<th>Plaques signalétiques</th>
<th>Tarbette</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daten schalter</td>
<td>Data plate</td>
<td>Etiquette caractéristique</td>
<td>Tarbetta dati</td>
</tr>
<tr>
<td>Motorschalter</td>
<td>Motor name plate</td>
<td>Etiquette caractéristique</td>
<td>Tarbetta dati motore</td>
</tr>
<tr>
<td>Firmen schalter mit Fabrikations-Nr.</td>
<td>Company label with serial-no</td>
<td>Etiquette compagnia con numero di serie</td>
<td>Tarbetta compagnia con numero di serie</td>
</tr>
</tbody>
</table>
15.7. Specification for control valve of sample gas pump

Type: 2-way- motorized valve
Connection: G 1/2
Operating pressure: -0.9 up to 10 bar
Standard voltage: 24 V DC
Actuation: DC motor

Operating time through 90°: 10 – 14 s
Cutoff at limit provided by micro switches

Motorised valve

For neutral gases and liquids
G 1/4 to G 1 female thread
Cartridge system
Operating pressure -0.9 to 10 bar (see table)

Description (standard valve)
Motorised valve for hot water, oil, air for example
Flow direction: determined
Fluid temperature: max. +90°C
Ambient temperature: max. +40°C
Mounting position: optional, preferably with drive upright
Material Body: brass
Seal: NBR
Control discs: oxide-ceramic

Features
- Low power consumption
- Choice of compact drives
- Valve remains on last setting if power lost
- Will handle dirty fluids
- Throttle setting produced by wear-resistant control discs

Functional symbol:
Throttle setting with overlap

Characteristic data

<table>
<thead>
<tr>
<th>NO</th>
<th>Connection</th>
<th>Operating pressure with gases and liquids up to 49 m³/h (6bar)</th>
<th>kV-value</th>
<th>Weight</th>
<th>Sectional diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>[min]</td>
<td>[max]</td>
<td>[bar]</td>
<td>[m³/h]</td>
</tr>
<tr>
<td>15</td>
<td>cartridge</td>
<td>-0.9</td>
<td>10</td>
<td>1.1</td>
<td>0.7</td>
</tr>
<tr>
<td>15</td>
<td>G 1/2</td>
<td>-0.9</td>
<td>10</td>
<td>1.1</td>
<td>0.9</td>
</tr>
<tr>
<td>20</td>
<td>G 1</td>
<td>-0.9</td>
<td>6</td>
<td>4.4</td>
<td>1.6</td>
</tr>
<tr>
<td>20</td>
<td>G 1</td>
<td>-0.9</td>
<td>6</td>
<td>4.4</td>
<td>1.6</td>
</tr>
</tbody>
</table>

1 Not gas tight
2 See motor drives for motor Cat no and power supply
3 Operating pressure increases to 10 bar for 9623, 9624 and 9651 motor drives
## Motor drives

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DC motor</td>
<td>24 [V]</td>
<td>1.5</td>
<td>IP 54</td>
<td>120</td>
<td>0.91</td>
<td>10 - 14 s</td>
<td>no</td>
<td>9614.02400</td>
</tr>
<tr>
<td>DC motor</td>
<td>24 [V]</td>
<td>1.5</td>
<td>IP 54</td>
<td>120</td>
<td>0.91</td>
<td>10 - 14 s</td>
<td>no</td>
<td>9615.02400</td>
</tr>
<tr>
<td>DC motor</td>
<td>24 [V]</td>
<td>1.5</td>
<td>IP 54</td>
<td>120</td>
<td>0.91</td>
<td>10 - 16 s</td>
<td>no</td>
<td>9650.02400</td>
</tr>
<tr>
<td>Synchronous motor</td>
<td>24 50 [Hz]</td>
<td>3.0</td>
<td>IP 54</td>
<td>120</td>
<td>0.31</td>
<td>10 s</td>
<td>no</td>
<td>9636.02450</td>
</tr>
<tr>
<td>Stepping motor</td>
<td>24 3</td>
<td>5.0</td>
<td>IP 54</td>
<td>120</td>
<td>0.31</td>
<td>10 s</td>
<td>no</td>
<td>9638.02400</td>
</tr>
<tr>
<td>DC motor</td>
<td>24 [V]</td>
<td>2.0</td>
<td>IP 54</td>
<td>200</td>
<td>0.31</td>
<td>10 s</td>
<td>no</td>
<td>9623.02400</td>
</tr>
<tr>
<td>DC motor</td>
<td>24 [V]</td>
<td>2.0</td>
<td>IP 54</td>
<td>200</td>
<td>0.31</td>
<td>10 s</td>
<td>no</td>
<td>9624.02400</td>
</tr>
<tr>
<td>DC motor</td>
<td>24 [V]</td>
<td>2.5</td>
<td>IP 54</td>
<td>200</td>
<td>0.31</td>
<td>10 s</td>
<td>no</td>
<td>9651.02400</td>
</tr>
</tbody>
</table>

1 Operating time depends on operating pressure
2 Nominal stepping frequency 200 Hz
3 Only in conjunction with G 1/4 or G 1

**Note! All motor drives fulfill the requirements of the generic standards for the electromagnetic compatibility EN 50081-1 and EN 50082-2 to Directive 89/336/EEC.**

### Further technical data for DC motor Cat. nos. 9615, 9624

Motor with feedback potentiometer for servo-amplifier

- **Feedback potentiometer**
  - Resistor: 1 kΩ
  - Resistor tolerance: ± 20%
  - Control: eg. by means of servo-amplifier
    - Cat. no. 82 781 02.0000
    - (Publication 7501548)

Only part of the potentiometer’s range is used.

### Further technical data for motor drives Cat. nos. 9650, 9651

Drives with integrated position controller

- The set point input can be set to the required signal range with the 2 jumpers.
- **Power supply residual ripple:** max. 1.2 V<sub>pp</sub>
- **Set point input:**
  - 0 - 10 V J1, J2 not inserted
  - 0 - 20 mA J1 inserted, J2 not inserted
  - 4 - 20 mA J1, J2 inserted
- **Input signal ripple:**
  - max. 40 mV<sub>pp</sub> with voltage signal
  - max. 0.08 mA<sub>pp</sub> with current signal
- **Input resistance:**
  - 200 kΩ with voltage signal
  - 500 Ω with current signal

- **Auxiliary voltage for external potentiometer:** 12 V ±3 %
  - max. 10 mA

### Further technical data for stepper motor Cat. no. 9638

Control:
- Bipolar, by means of SAA 1042 A (Motorola) stepper motor driver or equivalent
- With drop resistance of 44 Ω per phase at a driver (full-step) operating voltage of 24 V ±5 %

- **Resistance per phase:** 9 Ω
- **Inductance per phase:** 25 mH
- **Steps for opening angle of 90°:** 2028
Wiring diagrams

01

DC motor
Wiring:
+ to 1  Direction of operation: CLOSE
− to 2
+ to 2  Direction of operation: OPEN
− to 1
Cutoff at limits provided by microswitches

02

DC motor
Wiring:
+ to 1  Direction of operation: CLOSE
− to 2
+ to 2  Direction of operation: OPEN
− to 1
Cutoff at limits provided by microswitches
Resistance between 3 and 4:
minimum value – valve closed
maximum value – valve opened

03

DC motor
Wiring:
1 and 2  Power supply
3 and 4  Input control voltage
5  Output/auxiliary

04

Synchronous motor
Wiring:
AC to 1 and 3  Direction of operation: CLOSE
2 unused
AC to 2 and 3  Direction of operation: OPEN
1 unused
Cutoff at limits provided by microswitches

05

Stepper motor
Wiring:
1  Motor frame (possibly for screening)
2  Reference potential for contacts
3  Limit feedback signal (OPEN) contact opened at limit
4  Limit feedback signal (CLOSED) contact opened at limit
5 and 6  Connections for phase 1
7 and 8  Connections for phase 2
Notes

- To provide a temperature regulation system, the motorised valve can be combined with the 9368 drive, the 82 690 microprocessor-controlled PID three-point stepper regulator (Publication 7501533) and the 12 443 62 digital temperature sensor.

Further models

available at extra cost

- XX XXX 60.96XX FKM seat seal
- XX XXX 61.96XX EPDM seat seal
- XX XXX 62.96XX Control discs for $k_{va} = 3.4$, $p_{max} = 6$ bar, only for G $1/2$ and cartridge models
- XX XXX 64.96XX EPDM seat seal, control discs for $k_{va} = 3.4$, $p_{max} = 6$ bar, only for G $1/2$ and cartridge models

Further drive models and electronic controllers available on request.
- Flow regulation kit available on request

On request
- Explosion-proof drives
- Firedamp-proof models
- Degreased model
- Distance drive, max. fluid temperature +130°C
- Other models/combinations

Sectional dimension diagrams

01

1000 9900 100

- These parts form a complete wearing unit.

When ordering spare parts please state full cat. and Series nos.

*100 Valve cartridge
1000 Motor drive
9900 Cheese-head screw
Dimension diagrams

01

02

<table>
<thead>
<tr>
<th>Dimension table</th>
<th>Dimension diagram</th>
<th>G</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>01</td>
<td>( \frac{1}{2} )</td>
<td>14.0</td>
</tr>
<tr>
<td>02</td>
<td>02</td>
<td>( \frac{3}{4} )</td>
<td>12.5</td>
</tr>
<tr>
<td>03</td>
<td>02</td>
<td>G 1</td>
<td>14.0</td>
</tr>
</tbody>
</table>
Sectional diagrams
01

101 Valve body
*102 O-ring
103 Ceramic disc
104 Round plate
105 Valve spindle
106 Holder
*107 O-ring
108 Pin
*109 Compression spring
*110 Seal-wiper ring
111 Body cover
112 Fillister-head screw
*113 Shouldered bush
1000 Motor drive
9900 Fillister-head screw

02

101 Valve body
*102 O-ring
103 Ceramic disc
104 Round plate
105 Valve spindle
106 Holder
*107 O-ring
108 Pin
*109 Compression spring
*110 Seal-wiper ring
111 Body cover
112 Cheese-head screw
*113 Shouldered bush
1000 Motor drive
9900 Fillister-head screw
### 15.8. Specification for pressure switch

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>VH 0880100</td>
</tr>
<tr>
<td>Measuring range</td>
<td>-1 ... 0 bar</td>
</tr>
<tr>
<td>Maximum voltage</td>
<td>250 VAC</td>
</tr>
<tr>
<td>Maximum power consumption</td>
<td>400 VA</td>
</tr>
<tr>
<td>Maximum pressure</td>
<td>80 bar</td>
</tr>
<tr>
<td>Maximum current</td>
<td>3 A</td>
</tr>
<tr>
<td>Maximum temperature</td>
<td>80 °C</td>
</tr>
</tbody>
</table>

#### Switch selection

The switching points should normally be in about the middle of the adjustable range.

Do not exceed electrical ratings.

Torque for connector screw: 0.7 ± 0.1 Nm

Electrical connection in accordance with local regulations. For outdoor installation sufficient protection has to be provided for.

Critical conditions are: Aggressive atmosphere, drastic changes in temperature, solar radiation, salt bearing atmosphere.

In case of sudden pressure changes and/or pressure peaks with liquid fluids, install surge damper, Cat. No. 9574793.

With flanged design (peak-to-valley height of flanged surface Rd ≤ 12 µm), O-ring 5 x 1.5, Cat. No. 0664986, is enclosed in the delivery. Load-bearing length of thread is min. 7.5 mm. Max. diameter of pressure port is 3 mm.

#### Setting of switching points

Adjust either upper or the lower switching point. The opposite one is then determined by the fixed switching pressure difference. Use pressure gauge for adjustment.

The switching points may be set even during operation. Proceed as follows:

1. Loosen stop screw.
2. Adjust switching points by means of a 6 mm hexagon spanner. Depending on the sense of rotation the switching points move upwards (clockwise rotation) or downwards (counter-clockwise rotation).
3. Tighten stop screw.

---

**Diagram**

- **Type 18 D**
- **Switching function:** Microswitch SPDT
  - Terminals 1–3: Contacts close on rising pressure
  - Terminals 1–2: Contacts open on rising pressure

**Schaltfunktion**
- Einempoliger Mikroschalter (Umschalter)
  - Klemmen 1–3: bei steigendem Regelwert Kontakt schließend
  - Klemmen 1–2: bei steigendem Regelwert Kontakt öffnend

**Schema de branchement du micro-contact**
- Bornes 1–3: le contact ferme lorsque la pression monte
- Bornes 1–2: le contact ouvre lorsque la pression monte

**Funciones de comutación**
- Un microruptor unipolar (2 contactos comutadores)
  - Función 1–3: si sube el valor, regulador cierre
  - Función 1–2: si sube el valor, regulador abre
Auswahl und Einbauhinweise

Bereichsauswahl: optimal, wenn die Schaltpunkte in der Mitte des Schaltbereiches liegen.
Elektrische Anschluß: Verdrahtung gemäß VDE-Vorschriften.
Anzeigedrehmoment für Steckdose 0,7 ± 0,1 Nm.
Montage im Freien nur bei ausreichendem Schutz gegen kritische Umgebungsbedingungen (z.B. aggressive Atmosphäre, salzhaltige Atmosphäre, stark Temperaturschwankungen).
Beim Auftreten schädigender Druckänderungen und Druckspitzen bei flüssigen Fluiden ist die Dämpfungsvorrichtung, Bestell-Nr. 0674775, vorzusehen.
Beide der Auffanschlaufeührung (Reahte des Flanschflaße R ≤ 12 mm) gehört der C-Fling 5 x 1,5, Bestell-Nr. 0664098 zum Lieferumfang. Tragende Gewindelänge min. 5 mm. Max. Durchmesser der Druckanschlußbohrung 3 mm.

Einstellung der Schaltpunkte

Eingestellt wird entweder der obere Schaltpunkt p1 oder der untere Schaltpunkt p2. Der andere ergibt sich jeweils aus der festgelegten Schaltdruckdifferenz. Zum Einstellen der Schaltpunkte ist ein Manometer zu Hilfe zu nehmen.
Die Schaltpunkte können auch während des Betriebes wie folgt eingestellt oder verändert werden:
1. Arretierungsschraube lösen.
2. Schaltpunkteinstellung mit einem 5 mm - Schraubenschlüssel durchführen.
4. Arretierungsschraube festdrehen.
Weitere Details entnehmen Sie bitte der Schrift NID5.11.021.

Choix et instructions de montage

Les points de fonctionnement doivent normalement se situer aux environs du milieu de la plage de réglage.
Le raccordement électrique doit être conforme aux normes en vigueur.
Couple de serrage du connecteur 0,7 ± 0,1 Nm
En cas de montage à l’extérieur, il faut prévoir une protection suffisante contre d’éventuelles mauvaises conditions ambiantes (pour exemple : atmosphères agressives, salines, avec de fortes variations de températures etc.).
Dans le cas de liquides avec des pointtes de pression ou en cas de variations très rapides de la pression, il faut monter une vis d’ame-Novation 0574773.
Dans le cas d’exécution fausse (aspérite du plan de pince brûlée R ≤ 12 mm), le joint O-Ring 5 x 1,5 est inclus dans la livraison.

Réglage des points de fonctionnement

Il convient de régler le point de fonctionnement supérieur p1 ou inférieur p2. Le second point est alors déterminé par la fourchette de retour fixe. L’utilisation d’un manomètre est recommandée pour un réglage précis.
Il est possible de régler ou de modifier le réglage pendant le fonctionnement de l’appareil.
1. Dévisser le bouton moleté.
2. Régler le point de fonctionnement avec une clé 6-pats de 5 mm.
Le déplacement de l’oeil ou le bas du point de fonctionnement est obtenu en tournant le bouton de réglage vers la droite ou vers la gauche.
3. Revisser le bouton moleté.
Pour obtenir plus d’information s.v.p. consulter documentation NID5.11.021.

Selección de los valores de funcionamiento

Se recomienda ajustar los valores de funcionamiento alrededor de la mitad del campo de ajuste. Las conexiones eléctricas se deben efectuar según normas VDE.
Par de arranque del conector eléctrico 0,7 ± 0,1 Nm.
Si se montan al aire libre, los aparatosis deben protegerse suficientemente contra las condiciones ambientales (atmosfera agresiva, temperaturas extremas o variaciones fuertes de estas, etc.).
En caso de líquidos con puntos de presión hay que anteponer al presostato la cámara de amortiguación no. 0574773.
En la versión con bridas (profundidad de rugosidad de la brida R ≤ 12 mm) el O-ring 5 x 1,5, no. 0664098, es parte del envío. Longitud de la rosca soporte min. 5mm. Diámetro de perforación de la conexión de presión 3mm.

Ajuste de los valores de funcionamiento

Se ha de ajustar el punto de conmutación superior p1 o el punto de conmutación inferior. El otro será dado por el propio diferencial de presión. Para un ajuste preciso se recomienda el uso de un manómetro. Los puntos de conmutación también se pueden ajustar durante el funcionamiento:
1) Soltar el tornillo de retención.
2) Ajustar los puntos de conmutación con un macho hexagonal de 5mm.
3) Fijar el ajuste con el tornillo de retención.
Para más información por favor consulte la hoja técnica NID5.11.021.
15.9. Specification for heating tape for sample probe (option)

Heating tape : Type HBST
Length 1.0 m
Standard voltage 230 V AC or 110 V AC
Standard power consumption 50 W or 45 W

Electromechanical power control : Type HLM for 230 V AC or 110 V AC

**Betriebsanleitung für Heizbänder**

**HORST** Heizbänder und Heizkabel sind flexible Heizung ste für den industriellen Einsatz. Sie werden zum Aufheizen und Ausgleichen von Wärmeverlusten an Rohrleitungen, Behälter, Kappen oder als Dachrinnenbeheizung, um nur einige Einsatzmöglichkeiten zu nennen, eingesetzt.

Die vielseitigen Einsatzmöglichkeiten erfordern auch unterschiedliche Heizbandausführungen.

Prüfen Sie deshalb vor dem Einsatz, ob Ihre Heizbänder den betrieblichen Anforderungen entsprechen.
- Ist Feuchtigkeitsschutz erforderlich?
- Ist die max. Heizleitertemperatur ausreichend?
- Ist das Heizband mit oder ohne Schutzleiter ausgeführt?
- Ist für eine Temperatureinstellung vorgesehen?

**Weitere Hinweise:**
- Vor Inbetriebnahme die Übereinstimmung der Netzspannung mit der auf dem Typenschild angegebenen Nennspannung prüfen.
- Beim Wickeln (z. B. um ein Rohr) mit der Anschlussleiste beginnen.
- Darauf achten, daß scharfe Kanten, Gratw um, die Beheizung nicht schädigen.
- Für gute Wärmeverteilung sorgen.
- Nicht überinduzieren, da entstehende Übertemperatur die Beheizung zerstören wird.
- Heizbänder und Heizschienen nur mit Regler oder mit Leistungsteiler betreiben.
- Gegen Einbrüche und Beschädigungen von außen durch einen Metalldraht oder Metallschutz schützen.
- Die einschlägigen Sicherheitsbestimmungen beachten.
- Heizbänder mit Schutzleiter sind in die Schutzmaßnahmen der Schutzklasse I einzubeziehen.
- Heizbänder ohne Schutzleiter sollten nur über einen Fehlerstromschalter betrieben werden.

**Mode d’emploi — rubans et cables de chauffage**

**HORST** Rubans et cables de chauffage sont des chauffages flexibles pour l‘emploi industriel. Ils sont utilisés par exemple pour chauffer ou compenser des dégagements de chaleur de récipients, tuyauteries et ou pour chauffer des gouttières.

La variété des possibilités d‘emploi demande différentes versions de rubans de chauffage.

Pour cette raison, vérifiez avant la mise en marche, si vos rubans de chauffage correspondent aux exigences de l‘utilisation.
- est-ce qu‘il faut une protection contre l‘humidité?
- est-ce que la température maximale est suffisante?
- est-ce que le ruban de chauffage est avec ou sans conducteur de protection?
- est-ce qu‘il y a un contrôle de température?

**Autres recommandations:**
- Avant de mettre en marche, vérifier que la tension du circuit d‘alimentation soit la même que celle indiquée sur la plaque de l‘appareil.
- Commencer l‘enroulement (autour d‘un tube p.e.) au côté où se trouve le dispositif de branchement.
- Faire attention qu‘il n‘y ait pas des endommagements par des arêtes ou des points.
- Veiller à un bon transfo de chaleur.
- Ne pas enrouler en plusieurs couches, parce que cela provoque l‘une température trop haute, qui détruit le chauffage.
- Ne pas mettre en marche des rubans et cables de chauffage sans utiliser un régulateur.
- Protéger contre des manipulations et endommagements par un entrelacs ou une gaine en métal.
- Faire attention aux mesures de sécurité courantes.
- Appliquer les mesures de sécurité de la classification I pour des rubans de chauffage avec conducteur de protection.
- Rubans de chauffage sans conducteur de protection ne doivent être mis en marche que avec un
Verlegebeispiele von Heizbändern mit Temperaturregler

Glasseiden-Klebeband
zum Fixieren von Heizbändern. Klebefest bis 180°C.
Trägermaterial: Glasseide, 450°C.
Liefereinheit: 50-m-Rollen
Größe | Bestell-Nr.
--- | ---
15 × 0,2 mm | GKB 15

Glasseideband
zum Abbinden und Befestigen von Heizbändern. Max. 450°C
Liefereinheit: 50-m-Rollen
Größe | Bestell-Nr.
--- | ---
25 × 0,16 mm | GB25
16 × 0,16 mm | GB16

Textilglasband
zum Bandagen von beheizten Ströcken. Auch geeignet zum Isolieren von kurzen Heizstrecken wie z. B. Abzweigungen. Max. 450°C
Liefereinheit: 30-m-Rollen
Größe | Bestell-Nr.
--- | ---
25 × 3 mm | GBW 25

Glasseidenkordel
zur Befestigung von Heizbändern bzw. zur Verbindung von Heizmatten. Max. 450°C
Größe | Bestell-Nr.
--- | ---
Ø 2 mm | GK/02 pro Meter
Ø 3 mm | GK/03 pro Meter

Sicherheitsregler im IP 65-Gehäuse
Serie HTD
Fühler 1 = Regelung des Mediums
Fühler 2 = Temperaturbegrenzung des Heizbandes

Temperaturregler mit eingebauter Steckdose
Serie HT 30