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1 Safety

Prior to handling the machine, this instruction manual should be read and understood. If anything needs to be clarified, please contact your Busch representative.
Read this manual carefully before use and keep for future reference.
This instruction manual remains valid as long as the customer does not change anything on the product.
The machine is intended for industrial use. It must be handled only by technically trained personnel.
Always wear appropriate personal protective equipment in accordance with the local regulations.
The machine has been designed and manufactured according to state-of-the-art methods. Nevertheless, residual risks may remain. This instruction manual highlights potential hazards where appropriate. Safety notes and warning messages are tagged with one of the keywords DANGER, WARNING, CAUTION, NOTICE and NOTE as follows:

⚠️ DANGER
... indicates an imminent dangerous situation that will result in death or serious injuries if not prevented.

⚠️ WARNING
... indicates a potentially dangerous situation that could result in death or serious injuries.

⚠️ CAUTION
... indicates a potentially dangerous situation that could result in minor injuries.

⚠️ NOTICE
... indicates a potentially dangerous situation that could result in damage to property.

ℹ️ NOTE
... indicates helpful tips and recommendations, as well as information for efficient and trouble-free operation.
2  Product Description

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IN</td>
<td>Suction connection</td>
</tr>
<tr>
<td>OUT</td>
<td>Discharge connection</td>
</tr>
<tr>
<td>NP</td>
<td>Nameplate</td>
</tr>
<tr>
<td>ECO</td>
<td>Electrical connection (+V&lt;sub&gt;Batt&lt;/sub&gt;)</td>
</tr>
<tr>
<td>COM</td>
<td>6-pole HDSCS connector (CAN)</td>
</tr>
<tr>
<td>PRE</td>
<td>Pressure relief valve</td>
</tr>
</tbody>
</table>

**NOTE**

Technical term.

In this instruction manual, we consider that the term ‘machine’ refers to the ‘vacuum pump’.

2.1 Operating Principle

The machine works on the claw principle.
2.2 Application

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

Conveying of other media leads to an increased thermal and/or mechanical load on the machine and is permissible only after a consultation with Busch.

The machine is intended for the placement in a non-potentially explosive environment.

Permitted environmental conditions, see Technical Data [► 16].

3 Transport

**NOTICE**

If the machine has a relief valve

*Risk of damage to the machine!*

- Do not handle the machine by the relief valve.

• Check the machine for transport damage.

If the machine is secured to a base plate:

- Remove the machine from the base plate.

4 Storage

• Seal all apertures with adhesive tape or reuse provided caps.

If the machine is to be stored for more than 3 months:

• Wrap the machine in a corrosion inhibiting film.

• Store the machine indoors, dry, dust free and if possible in original packaging preferably at temperatures between 0 ... 40 °C.
5 Installation

5.1 Installation Conditions

**NOTICE**

Use of the machine outside of the permitted installation conditions.

**Risk of premature failure!**

**Loss of efficiency!**

- Take care that the installation conditions are fully complied with.

- Make sure that the environment of the machine is not potentially explosive.
- Make sure that the ambient conditions comply with the Technical Data [16].
- Make sure that the installation space or location is vented such that sufficient cooling of the machine is provided.
- Make sure that all provided covers, guards, hoods, etc. are mounted.

If the machine is installed at an altitude greater than 1000 meters above sea level:
- Contact your Busch representative, the motor should be derated or the ambient temperature limited.
5.2 Connecting Lines / Pipes

• Remove all protective caps before installation.
• Make sure that the connection lines cause no stress on the machine's connection; if necessary use flexible joints.
• Make sure that the line size of the connection lines over the entire length is at least as large as the connections of the machine.

In case of very long connection lines it is advisable to use larger line sizes in order to avoid a loss of efficiency. Seek advice from your Busch representative.

5.2.1 Suction Connection

⚠️ WARNING
Unprotected connection.
Risk of severe injury!
• Do not put hand or fingers in the connection.

⚠️ NOTICE
Ingress of foreign objects or liquids.
Risk of damage to the machine!
If the inlet gas contains dust or other foreign solid particles:
• Install a suitable filter (≤5 micron meter - ≤5 µm – 5 x 10^-6 µm ) upstream from the machine.

Connection size:
– G1/2
Depending on the specific order, other connection dimensions may apply.

5.2.2 Discharge Connection

⚠️ WARNING
Unprotected connection.
Risk of severe injury!
• Do not put hand or fingers in the connection.

Connection size:
– G1/2
Depending on the specific order, other connection dimensions may apply.
5.3 Electrical Connection

**DANGER**

Live wires.

Risk of electrical shock.

- Electrical installation work must only be executed by qualified personnel.
- Make sure that the motor of the machine will not be affected by electric or electromagnetic disturbance from the mains; if necessary seek advice from Busch.
- Electrically connect the machine

![Diagram of electrical connection](image)

5.3.1 Version with Analogue Speed Control

![Diagram of version with analogue speed control](image)

| 1 = 0 ... 5 V (= 0 ... 6600 rpm) | 2 = - | 3 = CAN L (actual values) | 4 = - | 5 = - | 6 = - |
5.3.2 Version with CAN-Communication

1 = KL15
2 = CAN H
3 = CAN L
4 = +5V supply for Mass Flow Sensor (optional)
5 = SENT for Mass Flow Sensor (optional)
6 = GND for Mass Flow Sensor (optional)

6 Commissioning

**NOTICE**

Lubricating a dry running machine (compression chamber).

**Risk of damage to the machine!**

- Do not lubricate the compression chamber of the machine with oil or grease.

**CAUTION**

During operation the surface of the machine may reach temperatures of more than 70°C.

**Risk of burns!**

- Avoid contact with the machine during and directly after operation.

**CAUTION**

Noise of running machine.

**Risk of damage to hearing!**

If persons are present in the vicinity of a non noise insulated machine over extended periods:

- Make sure that ear protection is being used.

- Make sure that the installation conditions (see Installation Conditions [► 6]) are met.
- Switch on the machine.
- Make sure that the maximum permissible number of starts does not exceed 12 starts per hour. Those starts should be spread within the hour.
- Make sure that the operating conditions comply with the Technical Data [► 16].

As soon as the machine is operated under normal operating conditions:

- Measure the motor current and record it as reference for future maintenance and troubleshooting work.
6.1 Relief Valve Adjustment

The factory setting of the relief valve is set at 600 hPa (mbar) absolute for a permanent usage. In case of cycling one, it can be adjusted down to 450 hPa (mbar) absolute.

To proceed, install the vacuum pump on a pneumatic bench with an absolute pressure sensor, an inlet valve and, if available, a volume flow sensor set at the outlet.

- Remove the black cap.
- Unlock the relief valve position by unscrewing the small hexagon socket bolt (with hex key 2).

![Diagram of relief valve](image1)

- Fully open the valve (decrease the spring resistance) by a clockwise rotation. Fully close the bench inlet valve so that fresh air comes in by the relief valve only (volume flow sensor mentions 0 lpm).

![Diagram of valve position](image2)

- Adjust the relief valve position by closing the valve (increase the spring resistance) by a counter-clockwise rotation to achieve 450 hPa (mbar) absolute +/- 5 hPa.

![Diagram of valve adjustment](image3)

- Lock the relief valve position by screwing the small hexagon socket bolt.
- Reposition the black cap.
6.2 Standard Version

The machine starts automatically with maximum speed as soon as electrical power is supplied.

6.3 Version with Analogue Speed Control

The electronic is automatically activated as soon as electrical power is supplied. The speed can be controlled by a potentiometer connected to terminal 1 (KL15) on the HDSC connector (CON).

Observe the following diagram to adjust the speed.

![Graph showing speed in rpm against voltage in V]

6.4 Version with CAN-Communication

The machine is controlled via CAN communication (see CAN Protocol [► 15]). The CAN control message send all necessary signals and reference values to the machine. There are two different operating modes.

The speed control mode controls the speed of the machine.

The mass flow control mode controls the speed of the machine depending on the mass flow. For mass flow control mode the machine must be equipped with a mass flow sensor. In case of a failure of the mass flow sensor the machine switches automatically to speed control mode.

**Terminal 1 (KL15)**

High voltage level on terminal 1 (KL15) switches on the internal power supply of the machine. After switching on, the machine waits 10 seconds for a valid CAN control message before a CAN failure will be detected.

In case of a voltage level below 1.2V on terminal 1 (KL15) the machine decelerates to a speed of 1800 min⁻¹. After 10 seconds the machine stops. After further 2.5 seconds the internal power supply of the machine switches off.

**CAN Status Message (Actual Values)**

One second after startup, the machine sends every 50 ms a CAN status message with actual values. If the machine receives a CAN control message before the first second after startup the machine sends the CAN status message immediately.
Power-On Bit
After startup a power-on bit is set in the CAN status frame for one second. The power-on bit can be used to identify unexpected resets/restarts.

Loss of CAN Communication
If a loss of CAN communication occurs the reference value for mass flow will be set to 100 g/min. A loss of CAN communication will be detected if no valid CAN control message have been received for 500 ms. As soon as the CAN communication is available again the machine switches to normal operation immediately.

Speed reduction by temperature
The maximum speed of the machine depends on the electronic temperature to ensure safe operation of the machine at any temperatures.

The machine will reduce the speed if the electronic temperature is too high even if the reference speed value is higher than the actual speed. The speed reduction resulted from the electronic temperature is indicated by the sixth bit in the CAN status frame. There will be no indication on the sixth bit if the actual speed limited by the electronic temperature complies with the maximum speed.

Loss of mass flow sensor
At loss of the mass flow sensor the software switches automatically into the speed control mode with the predefined speed precontrol value.

The loss of mass flow sensor is visible in the CAN Status bit (see CAN Protocol). This failure is automatically reset as soon as new values are received from the mass flow sensor.

Over current protection
The electronics is protected against a blocked rotor or overload by an overcurrent protection. If an overcurrent is detected the motor stops immediately. The bit 7 “overcurrent” in the CAN Status frame is set for about 2 seconds.

One second after the stop of the motor the electronic tries to restart the motor automatically. If the overcurrent error occurs one more time, the motor stops again and the error bit in the can status frame stays on.

Plausibility check
A blocked rotor cannot be detected under all conditions by an overcurrent detection. Therefore, an additionally plausibility check is implemented.

The plausibility check checks different ratios inside the motor controller. If a plausibility check error occurs the motor stops immediately and the bit 5 “plausibility error” in the CAN Status frame is set.

The timing for the error bit and the restart is identical to the overcurrent protection.

Electronics limits

<table>
<thead>
<tr>
<th>Status and diagnostic</th>
<th>Bit number</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong voltage</td>
<td>4</td>
<td>24 V motor ➔ 35 V</td>
</tr>
<tr>
<td>Temperature limit</td>
<td>6</td>
<td>130 ... 145 °C ➔ rotation speed decrease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;145 °C ➔ motor off</td>
</tr>
<tr>
<td>Overcurrent</td>
<td>7</td>
<td>55 A at 24 V</td>
</tr>
</tbody>
</table>
7 Maintenance

**WARNING**
Machines contaminated with hazardous material.
Risk of poisoning!
Risk of infection!
If the machine is contaminated with hazardous material:
• Wear appropriate personal protective equipment.

**CAUTION**
Hot surface.
Risk of burns!
• Prior to any action requiring touching the machine, let the machine cool down first.
• Shut down the machine and lock against inadvertent start up.
• Vent the connected lines to atmospheric pressure.
If necessary:
• Disconnect all connections.

7.1 Maintenance Schedule
The maintenance intervals depend very much on the individual operating conditions. The intervals given below are desired to be considered as starting values which should be shortened or extended as appropriate. Particularly harsh applications or heavy duty operation, such as high dust loads in the environment or in the process gas, other contamination or ingress of process material, can make it necessary to shorten the maintenance intervals significantly.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Maintenance work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every 12000 hours, at the latest after 6 years</td>
<td>• Replace the machine.</td>
</tr>
</tbody>
</table>

8 Decommissioning
• Shut down the machine and lock against inadvertent start up.
• Vent the connected lines to atmospheric pressure.
• Disconnect all connections.
If the machine is going to be stored:
• See Storage [5].

8.1 Dismantling and Disposal
• Drain the oil.
• Separate special waste from the machine.
• Dispose of special waste in compliance with applicable regulations.
• Dispose of the machine as scrap metal.
9  Spare Parts

![NOTICE]

Use of non-Busch genuine spare parts.

**Risk of premature failure!**

**Loss of efficiency!**

- The exclusive use of Busch genuine spare parts and consumables is recommended for the correct functioning of the machine and to validate the warranty.

There is no standard spare parts kits available for this product, if you require Busch genuine parts:

- Contact your Busch representative for the detailed spare parts list.
### CAN Protocol

<table>
<thead>
<tr>
<th>Transmit Control Unit</th>
<th>No. Control Unit</th>
<th>Message Name</th>
<th>Signal Name</th>
<th>Identifier</th>
<th>DLC</th>
<th>Repetition Rate</th>
<th>Start Bit</th>
<th>Bit Length</th>
<th>Signal Resolution</th>
<th>Signed/Unsigned Value</th>
<th>Offset</th>
<th>Signal Unit</th>
<th>Comments</th>
<th>Default Value</th>
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</thead>
<tbody>
<tr>
<td>SMCU</td>
<td></td>
<td>Mass Flow Gsel</td>
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<td>Enable Pump</td>
<td>sg</td>
<td>4</td>
<td>8</td>
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<td>0</td>
<td>2</td>
<td>Unsigned</td>
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<td>0</td>
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<td></td>
<td>0</td>
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<td>SMCU</td>
<td></td>
<td>Enable Mass Flow Governor</td>
<td>sg</td>
<td>4</td>
<td>8</td>
<td>1</td>
<td>2</td>
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<td>Unsigned</td>
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<td>0</td>
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### PCU Actual Values

<table>
<thead>
<tr>
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<th>Identifier</th>
<th>DLC</th>
<th>Repetition Rate</th>
<th>Start Bit</th>
<th>Bit Length</th>
<th>Signal Resolution</th>
<th>Signed/Unsigned Value</th>
<th>Offset</th>
<th>Signal Unit</th>
<th>Comments</th>
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<td></td>
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<td>3</td>
<td>8</td>
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<td>0.00</td>
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<td>Actual Voltage</td>
<td>sg</td>
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<td>8</td>
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<td>8</td>
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<td>0.00</td>
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<td>Actual Intake air Volume</td>
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<td>8</td>
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<td>0</td>
<td></td>
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<td>0.00</td>
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<td>8</td>
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### PCU Parameter Value

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<th>Bit Length</th>
<th>Signal Resolution</th>
<th>Signed/Unsigned Value</th>
<th>Offset</th>
<th>Signal Unit</th>
<th>Comments</th>
<th>Default Value</th>
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</thead>
<tbody>
<tr>
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### PCU Acknowledgment

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<th>Repetition Rate</th>
<th>Start Bit</th>
<th>Bit Length</th>
<th>Signal Resolution</th>
<th>Signed/Unsigned Value</th>
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<th>Signal Unit</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
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<th>Identifier</th>
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<th>Repetition Rate</th>
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<th>Bit Length</th>
<th>Signal Resolution</th>
<th>Signed/Unsigned Value</th>
<th>Offset</th>
<th>Signal Unit</th>
<th>Comments</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Status and Diagnose Word (area idle)</td>
<td>sg</td>
<td>8</td>
<td>1</td>
<td>0</td>
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<tr>
<td>1</td>
<td>Status and Diagnose Word (area idle)</td>
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<td>1</td>
<td>0</td>
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<tr>
<td>2</td>
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</tr>
<tr>
<td>3</td>
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### Technical Data

<table>
<thead>
<tr>
<th>Specification</th>
<th>MB 0018 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal max. pumping speed</td>
<td>m³/h 18</td>
</tr>
<tr>
<td>Ultimate pressure</td>
<td>hPa (mbar) abs. 600* / 450**</td>
</tr>
<tr>
<td>Nominal motor rating</td>
<td>kW 0.5</td>
</tr>
<tr>
<td>Nominal motor voltage</td>
<td>V DC 24 (20-32)</td>
</tr>
<tr>
<td>Permitted motor speed range</td>
<td>min⁻¹ 480 ... 6000 (peak 6600)</td>
</tr>
<tr>
<td>Noise level (EN ISO 2151) at 3000 / 6000 min⁻¹</td>
<td>dB(A) 68 / 73 (inlet and outlet connected to a system)</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>°C -40 ... +40</td>
</tr>
<tr>
<td>Ambient pressure</td>
<td>Atmospheric pressure</td>
</tr>
<tr>
<td>Oil capacity</td>
<td>l 0.10</td>
</tr>
<tr>
<td>Dimensions</td>
<td>mm 329.5 x 120 x 199</td>
</tr>
<tr>
<td>Weight approx.</td>
<td>kg 6.5</td>
</tr>
</tbody>
</table>

*permanent usage / **cycle of 6 minutes operation, 4 minutes stop
12 EU Declaration of Conformity

This Declaration of Conformity and the CE-mark affixed to the nameplate are valid for the machine within the Busch scope of delivery. This Declaration of Conformity is issued under the sole responsibility of the manufacturer. When this machine is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process for the superordinate machine or plant, issue the Declaration of Conformity for it and affix the CE-mark.

The manufacturer

Busch Clean Air S.A.
Chemin des Grandes-Vies 54
CH-2900 Porrentruy

declares that the machine(s): **Mink MB 0018 A**
has (have) been manufactured in accordance with the European Directives:
- ‘Machinery’ 2006/42/EC
- ‘Electromagnetic Compatibility’ 2014/30/EU

and following the standards.

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title of the Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN ISO 12100:2010</td>
<td>Safety of machinery - Basic concepts, general principles of design</td>
</tr>
<tr>
<td>EN ISO 13857:2008</td>
<td>Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs</td>
</tr>
<tr>
<td>EN 1012-1:2010</td>
<td>Compressors and vacuum pumps - Safety requirements - Part 1 and Part 2</td>
</tr>
<tr>
<td>EN ISO 2151:2008</td>
<td>Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)</td>
</tr>
<tr>
<td>EN 61000-6-2:2005</td>
<td>Electromagnetic compatibility (EMC) - Generic standards. Immunity for industrial environments</td>
</tr>
<tr>
<td>EN ISO 13849-1:2015</td>
<td>Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design</td>
</tr>
</tbody>
</table>

Person authorised to compile the technical file: Gerd Rohweder
Busch Dienste GmbH
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Porrentruy, 10.10.2018

Dominique Biesen, General director

(1) In case control systems are integrated.
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