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Bonding Station

Operating Manual - General Description

E. Thallner Ges.m.b.H.
St. Florian-Gewerbegebiet
A-4780 Schärding
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1. Note to the user

Installation, specified adjustments and software changes are only allowed to be done by an qualified EVG service engineer.

Please read the operation instructions before you are operating with the EV 501.

The equipment must be operated by trained personnel.

No liability will be accepted for personal injury nor material damages in the event that damage or breakdowns occur as a result of failure to comply with these operating instructions; neither will any guarantees relating to repairs or replacements of our products apply.

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2. Safety

2.1 Safety Instructions

• The equipment represents the state-of-the-art technology and the optimum operation is reliable. The user may however be exposed to hazards if it’s used careless or for other purposes than it’s made.

• If the equipment is used for any other than it´s intended purposes, all warranty and claims will be void.

• All unauthorized modifications and alterations affecting the safety are prohibited!

• The use of self made parts is not allowed in any case

• Any operation by untrained or unauthorized personnel may increase the potential danger.

• Never use inflammable or explosive gases. Ignoring this notice may lead to an explosion of the bonder!

• If the Installation and operation requirements are not fulfilled, the full function of our equipment is not guaranteed.
The following precautions should be strictly followed to protect all personnel and to prevent damage to the equipment.

**DANGER**

When performing maintenance on the EV501. A/C power must be disconnected from source or main power switch must be locked out to avoid accidently energizing power and causing harm to maintenance personnel.

![DANGER](image)

**208 VOLTS**

**WARNING**

All personnel involved in the use of the equipment should wear heat resistant gloves and protective eyewear during placement and removal of bond tools in the bond chamber. The operator must be aware that with the cover open there is a possibility that the surfaces inside the Bond Chamber may be hot enough to cause burns to the skin. Also if wafers are loaded and unloaded manually, with tweezers or vacuum wands extreme caution must be taken to avoid burns from any hot surfaces.

**CAUTION**

When opening the top cover of the EV501 it is important that the cover be opened to it’s full extension to avoid the possibility of the cover falling closed. Lifting of the cover should be done carefully and with 2 hands to avoid the potential of back strain. When closing the cover the operator must ensure that it is fully closed before release of the handle to avoid injury.

![WARNING](image)
CAUTION

The act of loosening and tightening the 4 clamp nuts on the top cover could cause or be a contributing cause of Carpal Tunnel Syndrome or other similar problems if performed more than 6 times per hour over an extended period of time.

CAUTION

Clothing should not be loose fitting and should have nothing dangling that might fall into the bond chamber.

CAUTION

Maintenance shall be performed only by qualified personnel.

CAUTION

In order to prevent possible damage to components, the power switch must be off when removing or inserting any electrical components in the EV501.
CAUTION

If it is necessary to perform any maintenance on the underside of the bonder making it necessary to invert the machine it is recommended by Electronic Visions that this be performed by at least 2 people. The Bonder weighs over 100 lbs, so back injury could occur if lifted without help.

CAUTION

The EV501 should only be operated by trained personnel and all safety warnings and placards should be followed.
2.2 Safety devices

2.2.1 Overtemperature switch in the bondoven.

When the temperature of the heating cartridge ground plate gets over 80°C the overtemperature switch releases the heaters switch and the heaters are shut off immediately. If you want to start heating again you have to switch on the heaters switch and restart your process.

2.2.2 Electronic control of the lamp socket temperature

If the temperature of the lamp sockets gets over 350°C (max. temperature of the lamp sockets) an electronic control switches off the heaters. When the temperature falls some degrees below 350°C the heaters are switched on again.

2.2.3 Heaters switch

Compare with 2.2.1 is released when the halogen lamp base plate gets too hot and when the Main switch is shut off. You have to switch it manually on at each start up of the bonder.
2.2.4 Emergency stop button

Push it in case of an emergency. When it’s pushed the heaters, the high voltage are switched off and the piston moves up. The electronic control rack and the computer are still working.

To release it turn it into the direction of the arrow on the knob.

2.2.5 Cover closing mechanism

If you open one of the four star knobs while the piston is down and the high voltage is on, the microswitch in the clamping unit opens the security circuit, the piston moves up and the high voltage will be switched off.
## 3. Installation and operation requirements

<table>
<thead>
<tr>
<th></th>
<th>Supply voltage: 208 Volts +/- 5%, 47-63Hz, 3 phase, N, G</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power requirements:</strong></td>
<td>6” 6” with top side heater</td>
</tr>
<tr>
<td><strong>total power</strong></td>
<td>6,8 kW 7,8 kW</td>
</tr>
</tbody>
</table>

**Nitrogen:** (alternative compressed air)  
Minimum 6 bar / 116psi (dried and filtered) connected with a flexible hose inner diameter 6mm.  
Flow rate 130l/min (4,26 ft³/min)

**Cooling water:**  
3-5 bar (44-73 psi); connected with a flexible hose inner diameter 9 mm (3/8”)  
Flow rate 3 - 5 l/min (1-1,6 gal/min)  
**pH value:** 7-9  
**use Glycol:** 40-50%. (recommended)

**Water quality:** (recommended)  
Closed loop system.  
Water must be filtered (50 micron filter), mechanically clean, optically clear, without deposits, to keep the cooling circuit free from dirt and organic suspended matter. To avoid corrosion damages the following requirements for the cooling water must be met:  
**max. oxygen content:** < 4 mg/kg  
**Max. chloride content:** <100 mg/kg  
No aggressive carbon dioxide and ammonia should be detectable
4. Characteristics of the EV 501

4.1 Dimensions:

| W x D x H     | 460 mm x 400 mm x 350 mm |

4.2 Weight:

| all inclusive | 46 kg / 102 lbs |

4.3 max voltage:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>intern</td>
<td>1200 V</td>
</tr>
<tr>
<td>intern</td>
<td>2000 V</td>
</tr>
<tr>
<td>extern 1</td>
<td>2000 V</td>
</tr>
<tr>
<td>extern 2</td>
<td>250 V</td>
</tr>
</tbody>
</table>

4.4 max current:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Intern</td>
<td>50 mA</td>
</tr>
<tr>
<td>extern 1</td>
<td>50 mA</td>
</tr>
<tr>
<td>extern 2</td>
<td>3 A</td>
</tr>
</tbody>
</table>

4.5 max. heating temperature:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom side heater</td>
<td>550°C</td>
</tr>
<tr>
<td>(optional)</td>
<td>(650°C)</td>
</tr>
<tr>
<td>Top side heater</td>
<td>550°C</td>
</tr>
<tr>
<td>(optional)</td>
<td>(650°C)</td>
</tr>
</tbody>
</table>

**Attention:** When heating upto 650°C, you must first heat the chuck to around 250°C, at this point it is then possible to heat to the maximum temperature. By doing this, you ensure that the observation temperature of the base unit does not exceed 350°C.

4.6 max. contact force:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>standard pressure cover</td>
<td>3500 N</td>
</tr>
<tr>
<td>(optional)</td>
<td>7000 N</td>
</tr>
<tr>
<td>(optional)</td>
<td>10500 N</td>
</tr>
<tr>
<td>special pressure cover</td>
<td>40000 N</td>
</tr>
</tbody>
</table>
Declaration of the Manufacturer

In accordance with EU machine guideline 89/392/EEC, Appendix II B and the directive on electromagnetic comparability 89/336/EEC, Appendix 1 (2).

The EV500 bonder series are in conformity with the following standards, according to the provisions of the EEC directive mentioned above. Any modification of the equipment without prior consultation of EVG will cancel the validity of that declaration.

Applied harmonized standards


Schärding, 19.12.1995

Erich Thallner, President
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1 Bonder Startup

Turn the red and yellow **Main Switch** on the bonder to the **ON** position. The computer will automatically start to work.

1.1 Heaters Switch

To connect the heater card with the top and the bottom side heater turn on the **Heaters Switch**.
2 System Startup

On your Windows surface you'll see this icon which is called EV501.

Doubleclick on this icon and the system program will start automatically. A start screen like below is shown.

After the startup of the program the main menu will appear.
3 Main Menu

This section of the operation manual describes all windows, buttons and commands which can be opened or activated.

3.1 Startup Menu

In the thermocouple selection window you can select your thermocouple. Which thermocouple measures which temperature will be explained afterwards. Select for the first time the HEATING CHUCK TC.
3.2 Sub menu Manual Setup

In this sub menu you are able to perform your bond processes manually. The advantage in this setup is that you can change the different parameters and values direct and immediately. The manual mode is normally used to research and develop your process or to finish an interrupted automatic process. On the following pages the different sections of the manual setup window will be explained more detailed.

3.2.1 Heating Section:

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>h:mm:ss</td>
<td>[7:59:59]</td>
<td>With [0:00:00] you heat up as fast as possible.</td>
</tr>
<tr>
<td>Temp Top</td>
<td>[0-650°C]</td>
<td>Setpoint temperature for the top side heater</td>
</tr>
<tr>
<td>Temp Bot.</td>
<td>[0-650°C]</td>
<td>Setpoint temperature for the bottom side heater</td>
</tr>
</tbody>
</table>

Attention: When heating upto 650°C, you must first heat the chuck to around 250°C, at this point it is then possible to heat to the maximum temperature. By doing this, you ensure that the observation temperature of the base unit does not exceed 350°C.
3.2.2 Electrode/Piston Down Section

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cont. Force/N</td>
<td>[1-3500]</td>
<td>Enter the pressure you want to apply on the waferstack</td>
</tr>
</tbody>
</table>

3.2.3 Voltage Section

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Internal</td>
<td>[0-2000]</td>
</tr>
<tr>
<td>Source</td>
<td>Extern 1</td>
<td>[0-250]</td>
</tr>
<tr>
<td>Source</td>
<td>Extern 2</td>
<td>[0-2000]</td>
</tr>
<tr>
<td>Voltage</td>
<td>[0-2000]</td>
<td>Enter the value of the high voltage</td>
</tr>
<tr>
<td>Mode</td>
<td></td>
<td>Here you can change the polarity of the high voltage</td>
</tr>
</tbody>
</table>

To change from Extern 1 to Extern 2 you have to activate the field with the mouse and you can switch between the 2 inputs with the keys 1 and 2.

3.2.4 Current Section

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>0-50mA</td>
<td>Enter limit for the current</td>
</tr>
</tbody>
</table>
### 3.2.5 Bonding Section

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>h:mm:ss</td>
<td>[7:59:59]</td>
<td>How long the voltage is switched on. (Anodic head)</td>
</tr>
<tr>
<td>Pulse</td>
<td></td>
<td>The voltage is always on until the time you've entered ran out. The voltage is 50sec on and 10 sec off.</td>
</tr>
<tr>
<td>Start</td>
<td></td>
<td>&gt;Heating: The voltage will be switched on after reaching the setpoint temp. &lt;Heating: The voltage will be switched on during heating up.</td>
</tr>
</tbody>
</table>

### 3.2.6 Cooling Section

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>h:mm:ss</td>
<td>[7:59:59]</td>
<td>Cooling ramp (compare with heating ramp page 5)</td>
</tr>
<tr>
<td>Temp. Top</td>
<td>[0-650°C]</td>
<td>Setpoint temperature for the top side heater</td>
</tr>
<tr>
<td>Temp. Bot</td>
<td>[0-650°C]</td>
<td>Setpoint temperature for the top side heater</td>
</tr>
</tbody>
</table>
3.2.7 Activating Bar

With this bar you are able to activate all functions. The values you have entered in the different sections will be set.

By pushing the Heating button the system will heat up to the entered setpoint temperature. You are able to activate all other functions during heating up.

When you click on the Piston button, the electrode will press on the waferstack with the entered force.

By pushing the Flags out button, the three flags will pull out immediately

By pushing the voltage bottom, the value of the high voltage you have entered in the voltage selection will be applied on the waferstack.

By pushing this button you can increase or decrease the voltage in 20 Volt steps.

The Cooling button is only active when the Heating field isn’t active and reverse.

When you click on the Waferbow button, the waferbow pin will move down and you can pull out the flags without movement of the waferstack.
Click on the PUMP button to evacuate the chamber to high vacuum. You are not able to control the vacuum with this function.

Click this button to vent the chamber.

If you want to purge the chamber with a purging gas, press this button.

Push this button to load the actual state of the bonder into the PC.

If you want to record the different curves in the recorder press the REC button. For a detailed information about this function refer to chapter 3.4 Sub Menu Recorder.

The process timer counts the time from the point when the REC button is pressed until it’s released again.

With the RUN button you can start an automatic process. The recorder will also updated automatically if you press RUN.

With the STOP button you stop an automatic bond process.
### 3.2.8 State Line

The line on the bottom of the screen gives information about the Bonder state. The line will be updated by pressing the Update button or automatically (every 5 seconds) during the process, during heating or cooling and with AutoUpdate on.

<table>
<thead>
<tr>
<th>TChuck</th>
<th>Actual top chuck temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tool</td>
<td>Actual bond tool temperature</td>
</tr>
<tr>
<td>BCHuck</td>
<td>Actual bottom chuck temperature</td>
</tr>
<tr>
<td>HiVolt</td>
<td>OFF or setpoint of the high voltage</td>
</tr>
<tr>
<td>Flags</td>
<td>State of separation flags (IN/OUT)</td>
</tr>
<tr>
<td>Piston</td>
<td>State of Piston (UP/DOWN)</td>
</tr>
<tr>
<td>STATE</td>
<td>Actual Bonder Status</td>
</tr>
<tr>
<td></td>
<td>HEATING</td>
</tr>
<tr>
<td></td>
<td>BONDING</td>
</tr>
<tr>
<td></td>
<td>COOLING</td>
</tr>
<tr>
<td></td>
<td>STANDBY (waiting for new command)</td>
</tr>
<tr>
<td></td>
<td>NO. CONN: (no connection to EV501)</td>
</tr>
<tr>
<td></td>
<td>EM-STOP (Emergency Stop)</td>
</tr>
<tr>
<td></td>
<td>ERROR</td>
</tr>
<tr>
<td>Cover</td>
<td>OPEN/CLOSE</td>
</tr>
<tr>
<td>Press.</td>
<td>Air pressure (GOOD/FAIL)</td>
</tr>
<tr>
<td>Waterflow</td>
<td>Flowrate for top side cooling (GOOD/FAIL)</td>
</tr>
<tr>
<td>Tool</td>
<td>Shows which type of bondtool is loaded in the chamber (steel/Teflon)</td>
</tr>
<tr>
<td>Input 1-4</td>
<td>= activated</td>
</tr>
<tr>
<td>Output 1-4</td>
<td>= ON</td>
</tr>
</tbody>
</table>
3.2.9 Menu Line

Following items describe the Menu Function

FILE

RUN

WINDOWS

OPTIONS

HELP

3.2.1.1 File Menu

<table>
<thead>
<tr>
<th>To choose</th>
<th>Press</th>
<th>Function description</th>
</tr>
</thead>
</table>
| Open      | Ctrl+F2 | Opens the File Open Menu  
Select the file and press OK to load the data.  
Only files with the filename extension  
*.abm (Manual Setup File)  
*.aba (Automatic Setup File)  
*.abr (Recorder File) can be opened! |
| Write to … | F2 | Opens the File Write Menu  
Enter a filename and press OK to save the data of the current program.  
The user has to take care that the file extension corresponds to the activated module. Otherwise an Error Message will appear |
| Print     |       | Print the Recorder graphic which is shown on the screen or an Automatic setup file on the system printer |
| Exit      | Ctrl+X | Exits the EV501 program |
### 3.2.1.2 Run Menu

<table>
<thead>
<tr>
<th>To choose</th>
<th>Press</th>
<th>Function description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUN</td>
<td>F5</td>
<td>Starts an Automatic process</td>
</tr>
<tr>
<td>STOP</td>
<td>F6</td>
<td>Stops an Automatic process</td>
</tr>
<tr>
<td>Heating</td>
<td>Ctrl+H</td>
<td>The system heat up to the entered setpoint</td>
</tr>
<tr>
<td>Electrode</td>
<td>Ctrl+E</td>
<td>The electrode will press on the waferstack with the entered force</td>
</tr>
<tr>
<td>Flags Out</td>
<td>Ctrl+F</td>
<td>Pull out the flags</td>
</tr>
<tr>
<td>Voltage On</td>
<td>Ctrl+V</td>
<td>The value of voltage you have entered in the voltage section will be applied on the waferstack</td>
</tr>
<tr>
<td>Cooling</td>
<td>Ctrl+C</td>
<td>The system cools down to the entered Setpoint</td>
</tr>
<tr>
<td>Waferbow</td>
<td>Ctrl+W</td>
<td>The waferbow pin will move down</td>
</tr>
<tr>
<td>AutoUpdate</td>
<td>Ctrl+A</td>
<td>Load the actual status of the bonder into the PC</td>
</tr>
</tbody>
</table>
3.2.1.3 Windows Menu

<table>
<thead>
<tr>
<th>To choose</th>
<th>Press</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Setup</td>
<td>F7</td>
<td>Activates the Manual Setup Window</td>
</tr>
<tr>
<td>Automatic Setup</td>
<td>F8</td>
<td>Activates the Automatic Setup Window</td>
</tr>
<tr>
<td>Process Monitor</td>
<td>F4</td>
<td>Activates the Process Monitor</td>
</tr>
<tr>
<td>Recorder</td>
<td>F9</td>
<td>Activates the Recorder</td>
</tr>
<tr>
<td>Extended Bond Monitor</td>
<td>F11</td>
<td>Activates the Extended Bond Monitor</td>
</tr>
</tbody>
</table>

3.2.1.4 Options Menu

<table>
<thead>
<tr>
<th>To choose</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermocouple</td>
<td>You are able to select, which thermocouple should be used for your bond sequence. If you select TOOL TEMP TC, the temperature of the bond tool will be measured. The bonder will heat up until the given temperature is reached on the bond tool. If you select HEATING CHUCK TC, the temperature will be measured with the thermocouple in the heating chuck. The bonder will heat up until the chosen temperature is reached. The thermocouple in the heating chuck measures generally a higher temperature than the tool thermocouple.</td>
</tr>
</tbody>
</table>

If you will bond under high vacuum (<1mbar) please select HEATING CHUCK TC

<table>
<thead>
<tr>
<th>Unit</th>
<th>You are able to select which unit should be used for your bond sequence. You can select between N (mbar) and lbs (torr)</th>
</tr>
</thead>
</table>

3.2.1.5 Help Menu

<table>
<thead>
<tr>
<th>To choose</th>
<th>Press</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help</td>
<td>F1</td>
<td>Activates the EV501 help</td>
</tr>
<tr>
<td>About</td>
<td></td>
<td>Displays information about the EV501 software</td>
</tr>
</tbody>
</table>
3.3 Sub menu Automatic Setup

After pushing the Password button, the following window will appear:

Enter your password and click at the the OK button

Without knowing the correct password you can only read and use recipes. If you want to edit the recipes you have to know the right password.

If you want to change the password, enter the old password and click at the Change button.

Then the software will ask you for the new password. Enter the new password and click the OK button.

Then the software will ask you to confirm the new password. Enter the new password again an click the OK button.
If you enter the correct password, you have access to the automatic setup and you can edit the Automatic Setup recipes.

![Automatic Setup window](image)

After pushing the EDIT button, the following windows will be shown on the screen:

![Automatic SETUP window](image)

The different commandlines are explained on the following pages.
**Commandset and explanation**

**Heating:**
Use this command to heat the bonder up to your process temperature.

Double click on heating or push enter when heating is already chosen (blue background). **It’s the same with all other commands.**
Enter the setpoint temperature of the bottom heater.
Enter the setpoint temperature of the top heater.
Your commandline should now look like this:

<table>
<thead>
<tr>
<th>Command</th>
<th>Param 1</th>
<th>Param 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Heating</td>
<td>400</td>
<td>0.00:00</td>
</tr>
<tr>
<td>2 Set Temp. Top</td>
<td>400</td>
<td></td>
</tr>
</tbody>
</table>

**Attention:** When heating upto 650°C, you must first heat the chuck to around 250°C, at this point it is then possible to heat to the maximum temperature. By doing this, you ensure that the observation temperature of the base unit does not exceed 350°C.

**Cooling:**
Use this command to cool your system down after bonding.
Enter the setpoint temperature of the bottom heater.
Enter the setpoint temperature of the top heater.

<table>
<thead>
<tr>
<th>Command</th>
<th>Param 1</th>
<th>Param 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Cooling</td>
<td>20</td>
<td>0.00:00</td>
</tr>
<tr>
<td>2 Set Temp. Top</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

**Piston Up:**
Use it to bring the electrode back in it’s basic position.
**Attention:** Do not use this command when the voltage is still on !!

**Piston Down:**
Use it to bring the electrode in contact with your waferstack. You can also apply pressure.

**Preheating:**
With the preheating command you can hold the temperature at a defined value after the process is finished (just enter this command as last step in your Automatic Setup).
Voltage On:
Use this command to switch on the voltage when the electrode is in contact with the top wafer.
You have 3 sources you can chose:

Intern neg: max. 2000V / 50mA negativ with internal high voltage power supply
Extern High: max. 2000V / 50mA you have to connect your own power supply on the rear wall (Refer to external connections)
Extern Low: max. 250V / 3A you have to connect your own power supply on the rear wall (Refer to external connections)

After you have chosen your source type, you have to insert the voltage you need.
The sample below shows 1500 Volts with the internal high voltage power supply.
Attention: Don’t switch on the voltage when the flags are in !!

<table>
<thead>
<tr>
<th>Command</th>
<th>Param 1</th>
<th>Param 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Voltage ON</td>
<td>intern neg.</td>
</tr>
<tr>
<td>2</td>
<td>** END **</td>
<td></td>
</tr>
</tbody>
</table>

Voltage Off:
Use this command to switch off the voltage.

Flags Out:
Use this command to pull the flags out. You choose between five different ways to pull out the flags.

Pump On
Use this command to start the evacuation of the chamber.

Pump Off
This command closes the chamber valve. The vacuum in the chamber will decrease slowly depending on the leak rate of the chamber.

Vent On
Opens the vent-valve. The chamber will be vented.

Vent Off
Closes the vent-valve.
WAIT

This command is used to get several delays in the process. As you can see below, you can wait for inputs, time and pressure.

WAIT Input ON
The program will stay in this step until one of the four inputs is ON.

WAIT Input OFF
The program will stay in this step until one of the four inputs is OFF.

WAIT Time
The program will stay in this step until the time is over.

Wait Temperature
The program will stay in this step until bottom side reaches this temperatures

WAIT Pressure
The program will stay in this step until the pressure is reached.
WAIT Current
The program will stay in this step until the current value is reached.

WAIT Current Gradient
With this command the program will wait until the current gradient become smaller than the entered value.

WAIT Charge
The program will stay in this step until the charge is reached.
Bondmode
With this command you can pulse the high-voltage.

*For example:*

<table>
<thead>
<tr>
<th>Time Code</th>
<th>Command</th>
<th>Param 1</th>
<th>Param 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00:00</td>
<td>Voltage ON</td>
<td>Intern</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>Bondmode</td>
<td>0:00:20</td>
<td>0:00:20</td>
</tr>
</tbody>
</table>

The high-voltage (500V) is switched on and off every 20 seconds. Parameter 1 means HV 20s **ON**, Parameter 2 means HV 20s **OFF**.

Purge On
This command opens the purge valve which is connected to the inert gas line. You can apply an relative overpressure up to 2 bar with this command.

Purge Off
Closes the purge valve.

Waferbow
With this command you activate the wafer bow (Before you activate the wafer bow, check the thickness of the wafer stack)

Set Current
With this command you can set the limit for the bondcurrent to a defined value.

Set temp. Top
With this command you can enter the temperature for the topside heater

Check ch. pres.
With this step you can check the chamber pressure. Parameter 1 is for the low limit. Paramter 2 is for the high limit.

Check temp. top
With this step you can check the temperature of the top heater. Parameter 1 is for the low limit. Paramter 2 is for the high limit.

Check temp. bot
With this step you can check the temperature of the bottom heater. Parameter 1 is for the low limit. Paramter 2 is for the high limit.

Max proc. Time
With this command you can set the maximum process time.
### 3.4 Sub menu Recorder

In this menu you can record all process parameters and save it to a disk. The maximum recording time is 24 hour. After that the recorder will stop automatically.

**Recorder Setup**

In the recorder setup you are able to select which graph you want to see and in which color it should be displayed. In the state lines you can display if the chosen parameter is on or off. When it’s on the line will be displayed bold, is it off the line will get thin again. To quit your selection click on the OK field.
Note: After an automatic process is finished you have the possibility to display graphs which you have not selected. Just go to the recorder setup and click on the parameters you want to see (you can also change all the colors). Click on the OK field and press the refresh button and the process data with the actual selected parameters and colors will be displayed on the recorder.

With the C-button you can change the view of the recorder. The entire recorder file is then shown on the screen and it is not necessary to scroll the window.

3.5 Sub menu Process monitor

The process monitor shows, which command in the Automatic-setup program is processing at the moment.

The present step is in the red line, the successfully completed command before is in the green one.

With the „Next“ button you can skip to the next command.
3.6 Sub menu Pressure conversion

It's used to calculate the right pressure for the exact force on the waferstack. You can chose if you type in your values in torr or in mbar.

Enter the atmospheric pressure you have in your clean room into the first window. The second window is to know which pressure you have in your chamber when the piston moves down. If you evacuate the chamber during the automatic process, you have to enter the pressure you want to achieve in this process before starting the automatic bond process. Otherwise the force on the waferstack is not correct. If the vacuum is < 1 mbar just enter 0.

In the third window you have to enter the force you want to apply to the waferstack. After you have entered all the values, the last window will show you the pressure you have to enter in the automatic setup (Piston down, Electrode down).
3.7 Sub Menu Extended Bond Monitor

All important values of the bond-process are displayed in the Extended Bond Monitor.

4 Error Messages

*Following error messages may appear:*

*EMERGENCY STOP!*
*COVER OPEN!*
*TEMPERATURE CONTROLLER ERROR!*
*HEATING ERROR!*
*HOST HAS NO CONNECTION TO EV501!*
*FLAG SWITCH doesn't respond!***
4.1 Emergency Stop

Emergency Stop button is pressed. The bonder doesn't execute any commands. The EV501 Electronic control and the PC are still working. High voltage, pressure for the pressure head and the heaters are turned off.

4.2 Cover Open

Cover is open. If this message is wrong, click on the State update button to load the newest status of the bonder to the PC. If this doesn’t help it might be that an endswitch of the pressure head cylinders or an endswitch of the cover locks isn't adjusted. The bonder can't execute the commands "Electrode Down", "Voltage On" and “Process START”.

4.3 Temperature Controller Error

The Temperature Controller is not in "Remote Mode" or the entered setpoint is higher than 650°C.

4.4 Heating Error

Bonder cannot reach the setpoint - temperature  -  Heating chuck is defective or there is no Bondtool on the chuck. At a pressure fail or chuck temperatures over 100 degrees Celsius the bonder can't execute any heating commands.

4.5 Host has no connection to EV501

PC has no connection to the electronics of the bonder. Push the button State Update and make sure that the main switch is switched on. Check the serial line to the electronic rack.

4.6 Flag Switch Error

One (or more) separation flags can't be pulled out and the process is stopped.
5 External HV-connections

You can apply voltage up to 2000V/50mA
You can apply voltage up to 250V/3A

How to apply these voltages to the electrode please refer to
Automatic Setup / 3.3.1. Commandset an explanation / Voltage On
Manual Setup / 3.2.3 Voltage Section
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EV501
Bonding Station

Operating Manual – Operation of the Bonder

E. Thallner Ges.m.b.H.
St. Florian-Gewerbegebiet
A-4780 Schärding

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4.1 **OPEN AND CLOSE THE COVER** 6  
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5 **PROCESS START** 8  
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5.2 **AUTOMATIC SETUP** 9
1 Bonder Startup

Turn the red and yellow Main Switch on the bonder to the ON position. The computer and the roughing pump will automatically start to work.

1.1 Heaters Switch

To connect the heater card with the top and the bottom side heater turn on the Heaters Switch. This switch is a safety feature. It’s, switched off automatically when the temperature of the base plate of the bond chamber gets to hot.
2 System Startup

On your Windows surface you’ll see this icon which is called EV501. Doubleclick on this icon and the system program will start automatically. The start screen like below is shown.

![EVG501](image)

After the startup of the program the main menu will appear.
3 Main Menu

This section of the operation manual describes all windows, buttons and commands which can be opened or activated.

3.1 Startup Menu

In the thermocouple selection window you can select your thermocouple. Which thermocouple measures which temperature will be explained afterwards. Select for the first time the HEATING CHUCK TC.
4 How to open the cover and to bring in the bondchuck top

4.1 Open and close the cover

Attention: After closing the cover make sure that the 4 star knobs are tightened well by hand. Do not retighten after evacuation the chamber!

Close the cover and fix the cover by tightening the 4 star knobs crosswise.

4.2 How to bring the bondchuck top into the chamber

Open the cover first. Take the bondchuck top, where the already aligned waferstack is clamped, with the handling tool and bring it in. The 2 positioning pins must fit into the holes of the bondchuck top. Only when you put the bondchuck top into the right position the TOOL thermocouple fits exactly into the hole on the steel insert. See the figures below.
Use this 2 position pins to load the bondtool correctly into the chamber.

Position pins

Tool Temp thermocouple

Position of the tool temp thermocouple

Please note: TC should not touch heater surface!
5 Process Start

You can start a process with 2 different setups, the manual setup and the automatic setup.

5.1 Manual Setup

To activate this window doubleclick on the Icon for Manual Setup and the following window will appear:

Now you can online control and change all different parameters and values. The manual setup is mainly used to research and develop a process. For a detailed description of the use and the commands refer to the menu description chapter 3.2 Manual Setup.
5.2 Automatic Setup

To activate the automatic Setup doubleclick on the icon for Automatic setup and the following window will appear:

In this menu you are able to write a program which performs automatically the process. For a detailed command description refer to the menu description chapter 3.3 Sub Menu Automatic setup.
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EVG501 Bonding Station

Operating Manual - Maintenance

E. Thallner Ges.m.b.H.
St. Florian-Gewerbegebiet
A-4780 Schärding
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Attention: Before you do any maintenance work make sure that the main switch is in the OFF position !!!

1 Daily Maintenance

1.1 Check the heating circuits.
This can be done by watching the LED display on the right side wall of the bondoven. There are 5 LED’s which display the status of the different heating circuits.

![HEATER CIRCUIT MONITOR](image)

The 4 LED’s which labeled with bottom shows the 4 circuits of the bottom heating chuck. If 1 isn’t on there’s a failure in this circuit. That means that your heating up time lasts longer and that the temperature uniformity is quite bad.

When the LED for the top heater isn’t on you aren’t able to work with the top side heater because there’s just one circuit.

If one of the LED’s is off refer to chapter 5 in this manual.

1.2 Main pressure
Inspect the main pressure regulator on the rear wall. The normal pressure would be around 6 bar, when you activate cooling the pressure shouldn’t drop below 5.5bar.
1.3 Bondtools
Make a visual control of the bondtool surface. There should be no deposits or scratches visible.

1.4 Flags
Make a visual inspection of the flags on the bondtools. Check if they are bent or if the screw which fixes the flags is loose.

1.5 Clamping glasses
Make a visual inspection of the clamping glasses. Check if the glass is scratched or if it has a crack.
2 Weekly maintenance

2.1 Flatness of the bondtools
Check the bondtool inserts with a straight edge. Make sure that the surface is absolutely even and no spots are visible.

2.2 Flag pulling mechanism
Control the motion of the flag pulling mechanism manually. It has move real smooth and there shouldn’t be any cracked waferpieces in the bellow of the pulling mechanism.

2.3 Top side pressure glass
Make a visual check of the top side pressure glass. There should be no crack or spot detectable.

2.4 Tool Temp TC
Check the position of the bondchuck top TC. Refer to the figure below for the exact position.
3 Monthly maintenance

In addition to the weekly maintenance check the following points

3.1 Cover connection lines
Check all the lines (pneumatic, electric, water cooling) about cracks. Make sure that the pneumatic lines are not crimped.

3.2 Piston Motion
The motion of the piston has to be real smooth and it must fully retract.

3.3 Main Pressure Regulator Unit
Check the main pressure regulator and the filter about oil or water.

3.4 Emergency Stop
Check if the emergency stop is full functional.

3.5 Vacuum System
Check the full functionality of the vacuum system.

3.6 Roughing pump
Oil sealed pump:
Check the color of the oil in the Roughing pump. Refer to the color table in the technical manual of the pump. Check also the next point.
Dry pump:
Check the endvacuum of the pump by connecting a vacuum gauge at the end of the tube.

3.7 Cover Open/Close
Take care that all covers open and close real smooth.
4 Yearly maintenance

Check the following points in addition to the monthly maintenance

4.1 Cleaning Procedure
Clean all chambers with IP alcohol. Therefore you have to take out the inner reflector shield. After you have cleaned the whole chamber (including the heating chuck) wipe also all surfaces of the bonder with IP alcohol. After you have cleaned everything heat the chamber up to 300°C and evacuate it overnight.

4.2 Zero Contact of the Piston
Check if the piston contacts the bondtool when you enter 1N contact force. The adjustment has to be done by an authorized EV service engineer.

4.3 Heater Air Cooling
Check the flow rate for the bottom side heater. Compare the rate with the recommended one.

A yearly maintenance done by an EVG service engineer is strongly recommended.
5 How to exchange the bottom side heating cartridge

5.1 Changing the heating unit

1. Shut off the bonder and disconnect from main voltage.

2. Open the 4 star knobs and remove the cover as explained in Pos.5.2.

3. Take the vacuum equipment off. Open the DN 40 fitting on the right side of the bondchamber and remove the PN and the voltage connector on the rear wall.

4. Remove the 4 covering on the edge of the bonder and screw in the 4 service tools for heater exchange. Then it is necessary to invert the machine. It is recommended by Electronic Visions that this be performed by at least 2 people. The bonder weights over 100lbs, so back injury could occur if lifted without help.

5. Remove the 4 leveling mounts and open the 2 hexagon screws which fix the ground plate on the front and and on the back side and put the ground cable which is fixed on it off.

6. Loosen the 2 hexagon screws on the backside of the fan shield to remove it.
7. Remove all electric and pneumatic wiring which are connected with the heating cartridge.

8. Open the 4 hexagon screws which fix the heating cartridge. Now you can take out the whole heating cartridge very carefully.

9. Check all halogen lamps to find out which is defect. Replace the lamp by removing the crimp contacts and pull it out. Put the new lamp in and reconnect it.

**Alternative:** Change the whole heating unit.

**Note:** The heating cartridge has a normal lifetime from about 1500 hours. If your cartridge is near this, we recommend to exchange the whole unit.
5.2 Changing the cover

Switch off the bonder and unplug all connectors from the cover to the bonder. Remove the right screw, slightly lift up the cover and pull out the fixing bolt.

Take the cover with two hands and lift it up straightly.

Change the cover, insert the fixing bolt and fix it with the screw. Then plug in all connectors and restart the Bonder.
6 Troubleshooting

6.1 Bonder doesn’t heat

6.1.1 Bonder doesn’t heat

- Check heater switch
- Check display
- Transfer of desired temp. value
- OK     NOK
- Load process parameter again
- OK     NOK
- Call EV Service to change the heating circuit

- Which LED is not ON?
  - Few LED
  - All LED

- Which LED?
  - TOP A, TOP B, TOP C, BOT A, BOT B, BOT C

- Heating circuit XXX is defect
- Call EV Service to change heating circuit

- Check fuses on card
- OK     NOK
- Change defect fuse and try again

- Observation temp. is too high
- Wait until temp. decreases

- Check heat enable plug-in
- OK     NOK

- Check LED’s on heater plug-in
- OK     NOK

- Check OUT LED OMRON
- OK     NOK

- Check Remote LED OMRON
- OK     NOK

- Load process parameter again
- Transfer of desired temp. value
- Ref. to OMRON operation manual
- Call EV Service
6.2 Bonder doesn’t reach end temperature

Bonder doesn’t reach end temperature

Check observation temperature in the window "extended bond monitor"

- Temperature above 350 °C
- Temperature below 350 °C

Insufficient cooling

Check cooling pressure 6 bar

- OK
- NO

Check fan’s on underside

- OK
- NO

Adjust correct value

Try again

Correct placement of bond tool?

Atmosphere or vacuum

OK

ATM

VAC

Ventilate

Under vacuum it takes a long time to reach the end temperature!

Correct position of thermocouple

- OK
- NO

Load bond tool new

Move in correct position

OK

NOK

Call EV Service

OK

NOK

Call EV Service

Call EV Service

Check lamp cooling

- OK
- NO

Repair and try again

Atmosphere or vacuum

Call EV Service
6.3 Endvacuum not reached

- **Turbo Pump on full speed?**
  - Ok
  - Nok
  - **Endvacuum not reached**

- **Cover properly sealed**
  - Ok
  - Nok
  - **Which error is displayed**
    - Refer to Turbo pump manual
    - Run up time expired
    - Others

- **All fittings tight?**
  - Ok
  - Nok
  - **Grease the sealrings with high vacuum grease**
    - Ok
    - Nok
    - **Make helium leak test**
      - Tighten and grease them with high vacuum grease
      - Call EV Service

- **Check roughing pump**
  - Ok
  - Nok
  - **Tighten and grease them with high vacuum grease**
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Controlrack EVG501

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Output board 20201
D/A board 20803
Input board 20102
Relay board 20305
High-voltage power supply E5HV1-V15
Temperature controller board 30802-V
Temperature controller E5CK
Heater switch 20HS1

2nd rack

**Power bus 20605**

Heater driver 10008
Main switch 20A03
Voltage monitor board E5VM2

3rd rack

**Pneumatic interface bus 20F03**

Pneumatic interface card IC-8M3/2-0,9-24TH

**Pneumatic power bus 206A4**

Pneumatic cassette circuit diagram E5052-PN

Pneumatic cassette overview E5052

Valve controller 20V04

Inside and backwards

**RS485 connection board ETH-S**

**PN-Rack backplane 20PR1**

**Power supply 100-240V Mitra PE3238/02**

**Power supply SXI50-24S**

**User I/O 20403**

**Controlrack overview**
This drawing must not be loaned or copied without permission from ELECTRONIC VISIONS CO.
This drawing must not be loaded or copied without permission from EV GROUP.
This drawing must not be loaded or copied without permission from EV GROUP.
OPERATING INSTRUCTIONS
Operating Instructions and Description
(30.06.93)

Warning Notes

for Heinzinger units with output voltages exceeding 350 V

CAUTION High-tension!
Lethal Danger!

1. The units deliver potentially lethal high voltage. Note that, particularly in the case of components carrying voltages > 1 kV lethal danger may exist even without direct physical contact; this is because the associated high field strengths make arcing a possibility. To avoid this risk, appropriate safety spacing is to be observed or earthed screening is to be employed (Faraday’s cage effect). The equipment must not be put into operation or operated by anyone other than specialist personnel. It is imperative to read the Operating Instructions before putting into operation. Prior to starting up satisfy yourself that all safety measures have been taken on the unit, on the connecting cable and on the load.

In respect of units with floating-potential outputs note that the 0V point of the electronic circuit is connected to an output pole (generally +) unless it is specifically stated otherwise in the Operating Instructions. On units with analogue interfaces the 0V point is accessible on the plug serving the interface.

2. Any contact with the output voltage on units with high output current (as low as 20 mA upwards) or high output power (above all capacitor charging equipment) will certainly be lethal.

3. It is imperative to connect the output cable before switching on the high-tension voltage. Different output sockets only provide the necessary dielectric strength when the associated plug has been inserted. Unless specifically stated otherwise in the following Operating Instructions, the so-called earthy pole ("0V") on the unit is not permanently connected to earth and is protected against high voltages by an over-voltage surge arrester, which responds at a potential difference of approximately 350V. This surge arrester must not be subjected to loads for extensive periods. In view of this, the earthy pole either has to be permanently connected to earth (bridge between "0V" socket and earthing socket) or have a fixed potential connected to it.

We specifically point out that, on all units potentially lethal voltages occur between both output poles as well as between the output and components connected to the 0V point of the electronic circuit (e.g., via the analogue interface).

4. The indicating instruments do not measure the output voltage or the current directly, but are supplied through measurement amplifiers. When the instrument is switched off or the power has failed any output magnitudes which may still be present will not be displayed. According to type, after the units have been switched off potentially lethal voltages may continue on the output for different lengths of time. To exclude risk, the two output poles must be short-circuited with suitable devices (e.g., earthing bars for high voltages and powers) before doing any work on the switched-off unit.
5. In addition to the voltage on the output of the unit, potentially lethal voltages can also occur inside the equipment. In view of this, only specialist tradesmen are permitted to open such units under any circumstances. Moreover, note that unauthorized interference with the unit renders the manufacturer’s liability under the terms of the warranty null and void. In case of any doubt, please contact the manufacturer.

6. Amongst other things, the units liberate considerable energy at the output (according to output capacity). In the event of incorrect circuiting or when establishing and disconnecting electrical connections, this energy can result in dangerous risks at the unit output, the nature and degree of which depend upon the selected output voltage and output current. For this reason, connections should only be made or broken when no current is flowing. Particular caution is advisable with inductive loads. In case of any doubt, please contact the manufacturer.
Contents:

I  Operating instructions
   Specifications

II  Application specific design

III Interfaces (IEEE 488, RS 232)

IV  Circuit diagrams
I  Operating instructions
    Specifications

1. General  2
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3. Technical data  4
4. Operating principle  5
1. General

Series NCE instruments (power supply unit with chopper, integral-type configuration) are stabilised DC power supply modules with a low ripple factor.

CAUTION:
These instruments deliver a hazardous high voltage.

Before an instrument is put into service, appropriate measures must be taken to protect personnel against electric shocks.

All models in the series are proof against continuous short circuiting. Maximum current can be drawn at any voltage, even in short circuit condition.

If a short circuit or flashover occurs, the filter capacitors in the output circuit are rapidly discharged. Maximum current is limited by the built-in protective resistors and can rise briefly to 500 times the rated current.

Any type of loading can be applied. Under high-capacity loadings, however, slow oscillations may occur under certain circumstances.

All models can be set to provide outputs from approx. 2% to the rated output by way of external potentiometers or control voltages (0-10V).

2. Installation and entry into service

Mains connection:
The requisite mains voltage and capacity of the built-in fuse can be determined from the rating plate. Connection to the mains is usually made to a 220 V supply, between the phase and directly-earthed conductors. The use of a protective conductor is required for reasons of safety.

Fuse protection:
For back-up protection, slow-blowing fuses of the nearest size should be used. If automatic circuit-breakers are used, we recommend G- or K-types.

Output:
Connection to the load should, as far as possible, be made by way of a shielded high voltage cable, permitting the shield to be used as a return lead for the earthed apparatus. To prevent faults arising from possible flashovers, the earthy return of the output current should take place either through the high voltage cable shield or a separate lead connected to the "0V" - pin.

CAUTION:
Return must not take place via the mains earth only (output current flowing back through mains earth).

Connection:
The connections for the mains input voltage and the requisite control and monitoring voltages must be carried out in accordance with the accompanying connection diagram.
The HV output is connected at pin 22 of the socket connector for output voltages up to 1200 V. Above 1200 V, it is led out through a shielded HV cable (0.5 m).

To control the output voltage or current, two 10-kOhm potentiometers are generally used. The +10.0V reference voltage is connected at pin d16. The 0V frame potential (and 0V high voltage) are connected at pins Z8 and Z2.

The set current strength is connected at pin d8 and the set voltage at pin d2 by way of the 10-kOhm potentiometer slider. A control voltage of 0-10 V establishes an output strength of 0-100% in each case. The circuitry permits control of the output voltage from 0 to 100% and the output current from 2% to 100%.

The monitor output for the actual voltage is connected at pin d4. The monitor output for the actual current is connected at pin d6. Both monitor outputs are standardised at 0-10V (corresponding to 0-100% of the actual value). These outputs have an internal 8-kOhm-type resistor.

The respective control statuses are indicated at pin d14 and pin d12.

In constant voltage operation (voltage control activated), a voltage of approx. +15 V (\(R_i = 1\) kOhm) is connected at pin d12, opposite Z12 (0V).

In constant current operation (current control activated), a voltage of approx. 15V (\(R_i = 1\) kOhm) is connected at pin d14, opposite Z14 (0V).

If both voltages are connected simultaneously, this indicates an irregular operating condition.

**Mains inputs**

Pin 32: protective earth conductor  
Pin 30: phase, line  
Pin 28: neutral conductor

**CAUTION:**  
The high voltage 0V is always connected to the 0V of the control system or to the monitor outputs.

After the apparatus has been switched off, it is possible for high voltage to be present at the output for some time, while the apparatus is still in the no-load condition.
3. Technical data

Input voltage: 220 V +/- 10%, 50/60 Hz
Input power: Dependent on model, internal mains fuse

VOLTAGE CONTROL

Mains adjustment: ± 1 x 10^-4
Load adjustment, from 10% to 90%: 1 x 10^-3
Linearity, from 10% to 100%: 5 x 10^-3
Residual ripple: 1 x 10^-3
Stability, 8h: 1 x 10^-3
Tc: 2 x 10^-4/K

CURRENT CONTROL

Mains adjustment: ± 1 x 10^-4
Load adjustment at 10% voltage change 1 x 10^-3
Linearity, from 10% to 100%: 1 x 10^-2
Residual ripple: 1 x 10^-3
Stability, 8h: 1 x 10^-3
Tc: 2 x 10^-4/K

Mechanical configuration: Euro-cassette to DIN 41494, 3 HE, HV output up to 1200 V at plug connector, above 1200 V via shielded cable (length, 0.5 m).
4. Operating principle

CONFIGURATION:
The instrument essentially consists of four subassemblies, i.e.

1. Power supply, half-bridge, HF transformer (primary)

2. HF transformer (secondary), high voltage rectifier, filtering

3. Measurement and control amplifier, PWM-IC

4. Auxiliary supply generation, reference

OPERATION:
1. Mains power supply - auxiliary supply
The power supply for the half-bridge is obtained direct from the mains rectifier. In addition, the
+15V supply voltage for the electronics is drawn from the mains voltage by way of an auxiliary
transformer, rectifier and filter. A monolithic integrated module (ref. 01) generates the highly
stable reference voltage (+10V).

2. High voltage section
The HF transformer is located in the diagonal of the half-bridge. Operating on the push-pull
principle, the half-bridge generates a square-wave voltage via the primary winding of the HF
transformer. The rectangular signals are stepped up by the HV transformer, then rectified, filtered
and led to the output via the protective resistor.

The output voltage is led to the control electronics via a voltage divider. To improve dynamic
characteristics, the voltage from the HV rectifier is measured by way of a capacitor voltage
divider and added to the DC value. Current from the earthy pole flows through a shunt. Drop-out
voltage at the shunt is led to the current regulator.

3. Measuring and regulating amplifiers
The voltage delivered by the measurement voltage divider is amplified in the measuring amplifier
to the standardized voltage (+10V) in accordance with its polarity. This standardized voltage
forms the actual value for the voltage regulating amplifier. It is also available as V-monitor. The
voltage regulating amplifier compares this voltage with the set value (by way of the reference
voltage divided by the voltage-setting potentiometer) and controls the PWM-IC with the
differential signal via an OR-logic.

The voltage delivered by the shunt is amplified in the measuring amplifier to the standardized
voltage (+10V) in accordance with its polarity. This standardized voltage forms the actual value
for the current regulating amplifier. It is also available as I-monitor. The current regulating
amplifier compares this voltage with the set value (by way of the reference voltage divided by the
current-setting potentiometer) and controls the PWM-IC with the differential signal via an OR-
logic.

The OR-logic consists of two diodes and serves to separate the two control circuits. The two
differential signals from the regulating amplifiers (comparators) simultaneously serve to indicate
the control status.

The control signals collected from the OR-logic now control the PWM-IC direct. By means of the
PWM regulating function, the power transmission through the HV transformer, and thus the
output strengths, are controlled.
CE Konformitätserklärung
für
Einbaugeräte

Das vorliegende Gerät wurde entsprechend den zutreffenden Vorschriften geprüft und entspricht damit folgenden Normen:

- aus EN 50081 Teil 1/03-93
  EN 55022 Klasse B
- aus EN 50082 Teil 2/03-93
  EN 61000 Teil 4, EN 60801-2

Die Einhaltung dieser Normen setzt folgende Betriebsbedingungen voraus:
- die Versorgung des Geräts muß über geeignete Filter erfolgen
- der Einbau des Geräts darf nur von Fachpersonal erfolgen
- Anschluß an die Programmierbuchse (falls vorhanden) nur mittels ordnungsgemäß abgeschirmter Steuerleitungen
- die Last und deren Anschlußleitungen dürfen keine Störstrahlung abgeben bzw. aufnehmen können (evtl. muß die gesamte Last incl. Anschlußleitungen geschirmt werden)

I. A. W. Gschwendner
Technischer Leiter
HEINZINGER electronic GmbH ROSENHEIM

Title: NCE 1200-50 neg NCE 60WHV<3KV

Date: November 3, 1995 | Sheet 1 of 1
Nicht benannte Dioden = 1N4148
CURRENT REGULATION

INSTRUMENT CURRENT

INSTRUMENT VOLTAGE

VOLTAGE REGULATION

CURRENT MODE

VOLTAGE MODE

IF THE HV-OUTPUT NOMINAL IS > 1kV, P.22 WILL BE NOT CONNECTED. THE HV-OUTPUT WILL BE BY SEPERATE CABLE.
Preface

Thank you for your purchase of your E5CK compact, intelligent digital controller. The E5CK allows the user to carry out the following:

• Select from many types of temperature and analog input (multiple input)
• Select output functions such as control output or alarm (output assignment)
• Use two setpoints (multi-SP function)
• Monitor the control loop by LBA (Loop Break Alarm)
• Use the communications function
• Calibrate input or transfer output
• It also features a watertight construction (NEMA4: equivalent to IP66)

This User’s Manual describes how to use the E5CK compact, high-function digital controller.

Before using your E5CK, thoroughly read and understand this manual in order to ensure correct use.

About this manual

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(2) No patent liability is assumed with respect to the use of the information contained herein.

(3) Moreover, because OMRON is constantly striving to improve its high-quality products, the information in this manual is subject to change without notice. Every precaution has been taken in the preparation of this manual. Nevertheless, OMRON assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained in this publication.
How to Read Display Symbols

The following tables show the correspondence between the symbols displayed on the displays and alphabet characters.

<table>
<thead>
<tr>
<th>ABCDEFGHIJKLMNOPQRSTUVWXYZ</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>ABCDEFGHIJKLMNOPQRSTUVWXYZ</th>
</tr>
</thead>
</table>

“Reference” mark

This mark indicates that extra, useful information follows, such as supplementary explanations and how to apply functions.

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to the product.

DANGER Indicates information that, if not heeded, is likely to result in loss of life or serious injury.

WARNING Indicates information that, if not heeded, could possibly result in loss of life or serious injury.

Caution Indicates information that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.

OMRON Product References

All OMRON products are capitalized in this manual. The word “Unit” is also capitalized when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

The abbreviation “Ch,” which appears in some displays and on some OMRON products, often means “word” and is abbreviated “Wd” in documentation in this sense.
The abbreviation “PC” means Programmable Controller and is not used as an abbreviation for anything else.
# How this Manual is Organized

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Learning about the general features of the E5CK</td>
<td>Chapter 1 Introduction</td>
<td>This chapter describes the features of the E5CK, names of parts, and typical functions.</td>
</tr>
<tr>
<td>• Setting up the E5CK</td>
<td>Chapter 2 Preparations</td>
<td>This chapter describes the operations that you must carry out (e.g. installation, wiring and switch settings) before you can use the E5CK.</td>
</tr>
<tr>
<td>• Basic E5CK operations</td>
<td>Chapter 3 Basic Operation</td>
<td>These chapters describe how to use the front panel keys and how to view the display when setting parameters of the major functions for the E5CK.</td>
</tr>
<tr>
<td></td>
<td>Chapter 5 Parameters</td>
<td></td>
</tr>
<tr>
<td>• Applied E5CK operations</td>
<td>Chapter 4 Applied Operation</td>
<td>These chapters describe the important functions of the E5CK and how to use the parameters for making full use of the E5CK.</td>
</tr>
<tr>
<td></td>
<td>Chapter 5 Parameters</td>
<td></td>
</tr>
<tr>
<td>• Communications with a host computer</td>
<td>Chapter 6 Using the Communications Function</td>
<td>This chapter mainly describes the communications commands, and gives program examples.</td>
</tr>
<tr>
<td>• Calibration</td>
<td>Chapter 4 Applied Operation / 4.5 Calibration</td>
<td>This chapter describes how the user should calibrate the E5CK.</td>
</tr>
<tr>
<td>• Troubleshooting</td>
<td>Chapter 7 Troubleshooting</td>
<td>This chapter describes what to do if any problems occur.</td>
</tr>
</tbody>
</table>
If you remove the controller from its case, never touch nor apply shock to the electronic parts inside.

Do not cover the top and bottom of the controller. (Ensure sufficient space around the controller to allow heat to escape.)

Use a voltage (AC100-240V or AC/DC24V at 50 to 60 Hz). At power ON, the prescribed voltage level must be attained within two seconds.

When wiring input or output lines to your controller, keep the following points in mind to reduce the influence from inductive noise:

- Allow adequate space between the high voltage/current power lines and the input/output lines.
- Avoid parallel or common wiring with high voltage sources and power lines carrying large currents.
- Using separating pipes, duct, and shielded line is also useful in protecting the controller, and its lines form inductive noise.

- Allow as much space as possible between the controller and devices that generate a powerful, high frequency (high-frequency welders, high-frequency sewing machines, and so forth) or surge. These devices may cause malfunctions.
- If there is a large power-generating peripheral device and any of its lines, attach a surge suppressor or noise filter to the device to stop the noise affecting the controller system. In particular, motors, transformers, solenoids and magnetic coils have an inductance component, and therefore can generate very strong noises.
- When mounting a noise filter, be sure to first check the filter’s voltage and current capacity, then mount the filter as close as possible to the controller.
- Do not use the controller in places where icing, condensation, dust, corrosive gas (especially sulfured gas or ammonia gas), shock, vibration, splashing liquid, or oil atmosphere occur. Also, avoid places where the controller can be subjected to intense heat radiation (like from a furnace) or sudden temperature changes.
- Ambient temperature must be kept between -10°C to 55°C. Ambient humidity must be kept between 35%RH to 85%RH (with no icing or condensation). If the controller is installed inside a control board, the ambient temperature must be kept under 55°C, including the temperature around the controller. If the controller is subjected to heat radiation, use a fan to cool the surface of the controller to under 55°C.
- Store the controller at an ambient temperature between -25°C to 65°C. The ambient humidity must be between 35%RH to 85%RH (with no icing or condensation).
- Never place heavy objects on, or apply pressure to the controller that may cause it to deform and deterioration during use or storage.
- Avoid using the controller in places near a radio, television set, or wireless installation. These devices can cause radio disturbances which adversely affect the performance of the controller.
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REVISION HISTORY
CHAPTER 1 INTRODUCTION

This chapter introduces the ESCK. First-time users should read this chapter without fail.
For details on how to use the controller and parameter settings, see Chapters 2 onwards.

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**Front panel**
- **Operation indicators**
  - OUT1
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- **Display key**
- **Down key**
- **Up key**
- **No.1 display**
- **No.2 display**
- **PV**

---

1-2
About the displays

- **No.1 display**
  Displays the process value or parameter symbols.

- **No.2 display**
  Displays the set point, manipulated variable or parameter settings.

- **Operation indicators**
  - OUT1: Lits when the pulsed output function assigned to "control output 1" is ON.
  - OUT2: Lits when the output function assigned to "control output 2" is ON.
  - SUB1: Lits when the output function assigned to "auxiliary output 1" is ON.
  - MANU: Lits in the manual operation mode.
  - STOP: Lits when operation has stopped.
  - RMT: Lits during remote operation.
  - AT: Flashes during auto-tuning.

How to use keys

- **A/M key**
  Each press of this key switches between the auto and manual operations.

- **ESC key**
  The functions of this key change according to how long it is pressed. If the key is pressed for less than one second, the parameters are switched. If the key is pressed for one second or more, the menu display appears. In key operations from here on, “press the key” refers to pressing the key for less than one second.
  For details on parameter switching and menu display items, see page 1–7.

- **key**
  Each press of the key increments or advances the values or settings on the No.2 display, while each press of the key decrements or returns the values or settings on the No.2 display.

  Functions vary, for example, when the key is held down simultaneously with the display key, or a key is held down continuously. For details, see page 1-7. Also, chapters 3 and 4 describe examples using various key combinations.
1.2 Input and Output

The E5CK supports four inputs.

**Input**

- **Temperature input/Voltage input/Current input**
  - Only one of temperature input, voltage input and current input can be selected and connected to the controller. The above figure shows temperature input connected to the controller.
  - The following input sensors can be connected for temperature input:
    - Platinum resistance thermometer: JPt100, Pt100
  - The following currents can be connected for current input:
    - 4 to 20 mA, 0 to 20 mA
  - The following voltages can be connected for voltage input:
    - 1 to 5 VDC, 0 to 5 VDC, 0 to 10 VDC

- **Event input**
  When using event input, add on the input unit (E53-CKB). You can select from the following five event inputs:
  - Multi-SP
  - Run/Stop
  - Auto/Manual
The E5CK supports the following four outputs.
- Control output 1
- Control output 2
- Auxiliary output 1
- Transfer output

When using control outputs 1 and 2, set the output unit (sold separately).
Eight output units are available to suit the output circuit configuration.
When using transfer output, add on the communication unit (E53-CKF).

Note: The output functions of the E5CK do not operate for five seconds after the E5CK is turned ON.

The E5CK supports the following eight output functions.
- Control output (heat)
- Control output (cool)
- Alarms 1 to 3
- LBA
- Error 1 (input error)
- Error 2 (A/D converter error)

Assign these output functions to control outputs 1 and 2 and auxiliary output 1.
Only control output (heat), control output (cool), alarms 1 to 3, and LBA can be assigned to control outputs 1 and 2. Also, only alarms 1 to 3, LBA, and errors 1 and 2 can be assigned to auxiliary output 1.
In the example on the previous page, “control output (heat)” is assigned to “control output 1”, “alarm 1” is assigned to “control output 2”, and “alarm 2” is assigned to “auxiliary output 1”. Accordingly, the configuration is such that heating control output is connected to control output 1, and alarm output is connected to control output 2 and auxiliary output 1.

In a heating and cooling control, assign “control output (cool)” to either of “control output 1” or “control output 2”.

The E5CK supports the following five transfer outputs.
- Set point
- Set point during SP ramp
- Process value
- Heating side manipulated variable
- Cooling side manipulated variable

These transfer outputs can be output after being scaled. Setting of an upper limit value smaller than the lower limit value is allowed, so reverse scaling can also be carried out.
1.3 Parameters and Menus

- **Protect mode**
  This mode is used to limit use of the menu and \( \text{AM} \) keys. The protect function is for preventing unwanted modification of parameters and switching between the auto and manual operation.

- **Manual mode**
  In this mode, the controller can be switched manual operation. The manipulated variable can be manipulated manually only in this mode.

- **Level 0 mode**
  Set the controller to this mode during normal operation. In this mode, you may change the set point during operation, and stop and start operation. You can also monitor (not change) the process value, ramp SP and manipulated variable.

- **Level 1 mode**
  This is the main mode for adjusting control. In this mode, you can execute AT (auto-tuning), and set alarm values, the control period and PID parameters.

- **Level 2 mode**
  This is the auxiliary mode for adjusting control. In this mode, you can set the parameters for limiting the manipulated variable and set point, switch between the remote and local modes, and set the loop break alarm (LBA), alarm hysteresis and the digital filter value of inputs.

- **Setup mode**
  This is the mode for setting the basic specifications. In this mode, you can set parameters that must be checked or set before operation such as the input type, scaling, output assignments and direct/reverse operation.

- **Expansion mode**
  This is the mode for setting expanded functions. In this mode, you can set ST (self-tuning), SP setting limiter, selection of advanced PID or ON/OFF control, specification of the standby sequence resetting method, initialization of parameters, time for automatic return to the monitoring display.

ESCK parameters are distributed between the following nine modes.

- Protect mode
- Manual mode
- Level 0 mode
- Level 1 mode
- Level 2 mode
- Setup mode
- Expansion mode
- Option mode
- Calibration mode

The settings of parameters in each of seven modes (excluding the protect mode and manual mode) can be checked and modified by selection on the menu display.
1.3 Parameters and Menus

- **Option mode**
  This is the mode for setting option functions. You can select this mode only when the option unit is set in the controller. In this mode, you can set the communications conditions, transfer output and event input parameters to match the type of option unit set in the controller.

- **Calibration mode**
  This mode is provided so that the user can calibrate inputs and transfer output. When calibrating input, the selected input type is calibrated. Whereas, transfer output can be calibrated only when the communications unit (E53-CKF) is set in the controller.

### Selecting modes

The following diagram shows the order in which modes are selected.

- **Menu display**
  - To select the menu display in any of the above modes (excluding the protect mode and manual mode), press the key for 1 second minimum. If you select the desired mode using the or keys and press the key, the top parameter in the specified mode is displayed.
  - When you have selected the menu display, the previous mode is selected. For example, if you selected the menu display while in the level 0 mode, the No.2 display changes to as shown on the left.
  - Protected modes cannot be selected. Also, the menu display does not appear when modes are protected up to the level 1 mode.

- **Level 0 to 2 modes**
  - If you select or in the menu display, the level 0, level 1 and level 2 modes, respectively, are selected.
  - These modes are selected with control still continuing.
CHAPTER 1  INTRODUCTION

Setup mode

• If you select [Setup] or [Expansion] in the menu display, the setup, expansion, option and calibration modes, respectively, are selected.

• When these modes are selected, the control is reset. So, control outputs and auxiliary output are turned OFF. When another mode is selected while in these modes, reset is canceled.

Protect mode

• To set the controller to the protect mode or to return to the level 0 mode from the protect mode, press the [A/M] key and [Set] key for 1 second minimum simultaneously.

Manual mode

• To set the controller to the manual mode, press the [A/M] key for 1 second minimum in the level 0 to 2 mode. To return to the level 0 mode from the manual mode, press the [A/M] key for 1 second minimum.

Selecting parameters

• When not in the manual mode, each press of the [Set] key switches the parameter.

• If you press the [Set] key when at the final parameter, the display returns to the first parameter.

Fixing settings

• When you have changed a parameter setting, specify the parameter using the [↑] or [↓] keys, and either leave the setting for at least two seconds or press the [Set] key. This fixes the setting.

• When another mode is selected, the content of the parameters before the mode was selected is fixed.

• When turning the power OFF, you must first fix the settings and parameter contents (by pressing the [Set] key or selecting another mode). The settings and parameter contents are sometimes not changed by merely pressing the [↑] or [↓] keys.
1.4 About the Communications Function

The E5CK can be provided with a communications function that allows you to check and set controller parameters from a host computer. If the communications function is required, add on the communications unit. For details on the communications function, refer to Chapter 6.

- **RS-232C**
  When using the communications function on the RS-232C interface, add on the communications unit (E53-CK01).

- **RS-485**
  When using the communications function on the RS-485 interface, add on the communications unit (E53-CK03).
About Calibration

The E5CK controller is calibrated before shipment from the factory. So, the user need not calibrate the E5CK controller during regular use.

However, if the E5CK controller must be calibrated by the user, use the parameters provided for user to calibrate temperature input, analog input (voltage, current) and transfer output.

Also, note that calibration data is updated to the latest value each time the E5CK controller is calibrated. Calibration data set before shipment from the factory cannot be returned to after calibration by the user.

The input type selected in the parameter is the item to be calibrated. The E5CK is provided with the following four calibration parameters.

- Thermocouple
- Platinum resistance thermometer
- Current input
- Voltage input

Two parameters are provided for thermocouple and voltage input.

Transfer output can be calibrated when the communications unit (E53-CKF) is added on.

When calibrating each item, the calibration data is temporarily registered. This data can be registered as final calibration data only when all items have been newly calibrated. So, all items must be temporarily registered when calibrating the E5CK controller.

When registering data, information regarding whether or not calibration has been carried out is also registered.

To calibrate these items, the user must prepare separate measuring devices and equipment. For details on handling these measuring devices and equipment, refer to the respective manuals.

For details, see 4.5 Calibration (page 4-11).
CHAPTER 2 PREPARATIONS

This chapter describes the operations you should carry out before turning the E5CK ON.

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   Draw-out .................................... 2–2
   Setting the input type ..................... 2–2
   Setting up the output unit ............... 2–3
   Setting up the option unit ................ 2–3

2.2 Installation ................................. 2–4
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   Terminal arrangement ..................... 2–6
   Precautions when wiring .................. 2–6
   Wiring ...................................... 2–6
2.1 Setting up

This section describes how to set the input type jumper, and set up the output unit or option unit.

**Draw-out**

First, draw out the internal mechanism from the housing

1. Pull out the internal mechanism while pressing the hooks on the left and right sides of the front panel.
2. Draw out the internal mechanism towards you holding both sides of the front panel.

**Setting the input type**

- For details on the jumper connector position, see page 1-2.
- Set the input type jumper connector to one of temperature input, voltage input or current input matched to the sensor connected to the input terminal.

<table>
<thead>
<tr>
<th>I : Current input</th>
<th>V : Voltage input</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC, PT : Temperature input</td>
<td></td>
</tr>
</tbody>
</table>

- The factory setting is “TC/PT (temperature input).”
- When removing or inserting the jumper connector, do not touch the pins directly with your fingers.
- When you have set the jumper connector, insert the internal mechanism into the rear case.
- When inserting the internal mechanism, push in until you hear the hooks on the front panel click into place.
Setting up the output unit

Output unit list

The following table shows the output units that can be set in the E5CK controller.

<table>
<thead>
<tr>
<th>Model</th>
<th>Specifications (control output 1/control output 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E53-R4R4</td>
<td>Relay/Relay</td>
</tr>
<tr>
<td>E53-Q4R4</td>
<td>Voltage (NPN)/Relay</td>
</tr>
<tr>
<td>E53-Q4HR4</td>
<td>Voltage (PNP)/Relay</td>
</tr>
<tr>
<td>E53-C4R4</td>
<td>4 to 20 mA/Relay</td>
</tr>
<tr>
<td>E53-C4DR4</td>
<td>0 to 20 mA/Relay</td>
</tr>
<tr>
<td>E53-V44R4</td>
<td>0 to 10 V/Relay</td>
</tr>
<tr>
<td>E53-Q4Q4</td>
<td>Voltage (NPN)/Voltage (NPN)</td>
</tr>
<tr>
<td>E53-Q4HQ4H</td>
<td>Voltage (PNP)/Voltage (PNP)</td>
</tr>
</tbody>
</table>

Setup

(1) Two rectangular holes for slotting are provided on the power board (on right side of controller). Fit the two protrusions on the output unit into these two holes.

(2) With the output unit fitted into the power board, fit the output unit into the connector on the control board (on left side of controller).

Setting up the option unit

Option unit list

The following table shows the option units that can be connected to the E5CK controller.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Model</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications unit</td>
<td>E53-CK01</td>
<td>Communications (RS-232C)</td>
</tr>
<tr>
<td>Communications unit</td>
<td>E53-CK03</td>
<td>Communications (RS-485)</td>
</tr>
<tr>
<td>Input unit</td>
<td>E53-CKB</td>
<td>Event input: 1 input</td>
</tr>
<tr>
<td>Communications unit</td>
<td>E53-CKF</td>
<td>Transfer output: 4 to 20 mA</td>
</tr>
</tbody>
</table>

Setup

(1) Place the controller with its bottom facing up, and fit the board horizontally into the connector on the power board (on right side of controller).

(2) With the power board connected, fit the board vertically into the connector on the control board (on left side of controller).
2.2 Installation

- **Dimensions**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Unit (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>58</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
<tr>
<td>44.8</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td></td>
</tr>
</tbody>
</table>

- **Panel cutout**

- Recommended panel thickness is 1 to 5 mm.
- Maintain the specified vertical and horizontal mounting space between each controller.
- Controllers must not be closely mounted vertically or horizontally.
2.2 Installation

Mounting

(1) Insert the E5CK controller into the mounting hole in the panel at the position shown in the figure above.
(2) Push the adapter along the controller body from the terminals up to the panel, and fasten temporarily.
(3) Tighten the two fixing screws on the adapter. When tightening screws, tighten the two screws alternately keeping the torque to approximately 0.29 to 0.39 N\textcdot m, or 3 to 4 kgf\textcdot cm.

About the Terminal Cover

E5CK-AA1-500 controller is provided with a terminal cover (E53-COV07). Fast the terminal cover as follows by using the snap pin.
2.3 Wiring Terminals

■ Terminal arrangement

Use ducts to separate input leads and power lines in order to protect the controller and its lines from external noise.

We recommend using solderless terminals when wiring the controller.

Tighten the terminal screws using a torque no greater than 0.78 Nm, or 8 kgf cm max. Take care not to tighten the terminal screws too tightly.

Use the following type of solderless terminals for M3.5 screws.

Precautions when wiring

In the following wiring diagrams, the left side of the terminal Nos. indicates the inside of the controller.

Wiring

Power supply

Input power to terminal Nos. 4 and 5. Power specifications are as follows:

AC100-240V~ 50/60Hz, 15VA

(AC/DC24V, 50/60Hz, 6VA, 3.5W)

About the power blocks

The E5CK has independent power supplies for each of the terminal blocks shown on the right. However, note that the power supplies for blocks C (exclude relay output) and D are shared for the following option unit.

Option unit: E53-CKB or E53-CKF
• Connect the input to terminal Nos. 6 to 8 as follows according to the input type.

<table>
<thead>
<tr>
<th>Terminals</th>
<th>Thermocouple</th>
<th>Platinum resistance</th>
<th>Thermometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>+</td>
<td></td>
<td>TC</td>
</tr>
<tr>
<td>7</td>
<td>-</td>
<td></td>
<td>PT V</td>
</tr>
<tr>
<td>6</td>
<td>+</td>
<td></td>
<td>I mA</td>
</tr>
</tbody>
</table>

• Match the inputs with the internal jumper settings for each input type. For thermocouple or platinum resistance thermometer inputs, set the inputs to a common position (TC/PT) as the temperature input. For details on jumper connector positions, see page 2-2.

• Terminal Nos. 11 and 12 are for control output 1 (OUT1). The five output types and internal equalizing circuits are available according to output unit:

<table>
<thead>
<tr>
<th>Control output</th>
<th>Relay</th>
<th>NPN</th>
<th>PNP</th>
<th>0 to 10 V</th>
<th>4 to 20 mA/0 to 20 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>E53-R4R4</td>
<td>E53-Q4R4</td>
<td>E53-Q4Q4</td>
<td>E53-V44R4</td>
<td>E53-C4R4</td>
</tr>
<tr>
<td>12</td>
<td>E53-Q4R4</td>
<td>E53-Q4Q4</td>
<td>E53-C4R4</td>
<td>E53-C4DR4</td>
<td>E53-C4DR4</td>
</tr>
</tbody>
</table>

• Terminal Nos. 9 and 10 are for control output 2 (OUT2). The three output types and internal equalizing circuits are available according to output unit:

<table>
<thead>
<tr>
<th>Control output</th>
<th>Relay</th>
<th>NPN</th>
<th>PNP</th>
<th>0 to 10 V</th>
<th>4 to 20 mA/0 to 20 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>E53-R4R4</td>
<td>E53-V44R4</td>
<td>E53-Q4R4</td>
<td>E53-C4R4</td>
<td>E53-C4DR4</td>
</tr>
<tr>
<td>10</td>
<td>E53-Q4Q4</td>
<td>E53-Q4HR4</td>
<td>E53-Q4HQ4H</td>
<td>E53-Q4HR4</td>
<td>E53-C4DR4</td>
</tr>
</tbody>
</table>

• The following table shows the specifications for each output type.

<table>
<thead>
<tr>
<th>Output Type</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relay</td>
<td>250VAC, 3 A</td>
</tr>
<tr>
<td>Voltage (NPN)</td>
<td>12VDC, 20 mA (with short-circuit protection)</td>
</tr>
<tr>
<td></td>
<td>12VDC, 20 mA (with short-circuit protection)</td>
</tr>
<tr>
<td>0 to 10V</td>
<td>0 to 10VDC, Permissible load impedance: 1 kΩ min., Resolution: Approx. 2600</td>
</tr>
<tr>
<td>4 to 20mA</td>
<td>4 to 20 mA, Permissible load impedance: 500 Ω max., Resolution: Approx. 2600</td>
</tr>
<tr>
<td>0 to 20mA</td>
<td>0 to 20 mA, Permissible load impedance: 500 Ω max., Resolution: Approx. 2600</td>
</tr>
</tbody>
</table>
CHAPTER 2 PREPARATIONS

- Terminal Nos. 2 and 3 are for auxiliary output 1 (SUB1).
- The internal equalizing circuit for auxiliary output 1 is as follows:

- Relay specifications are as follows:
  SPST-NO, 250VAC, 1A

- Terminal Nos. 1, 13 and 14 are valid only when the option unit is set in the controller.
- The following four connections are possible depending on the type of option unit.

- For details on RS-232C and RS-485 communications functions, see Chapter 6 Using the Communications Function.
- Use event inputs under the following conditions

  Contact input
  ON: 1 kΩ max., OFF: 100 kΩ min.

  No-contact input
  ON: residual voltage 1.5V max., OFF: leakage current 0.1mA max.

  Polarities during no-contact input are as follows:

- Transfer output specifications are as follows:
  4 to 20 mA, Load 500 Ω max., Resolution approx. 2600
CHAPTER 3 BASIC OPERATION

This chapter describes an actual example for understanding the basic operation of the E5CK.

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   Scaling ............................................... 3–3
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   Control period ..................................... 3–6
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3.1 Control Example

This chapter describes the following control example to facilitate understanding of the basic operation of the E5CK controller. This description assumes that the controller is operated under the following conditions:

- A humidity sensor of output 4 to 20 mA is connected to the controller. The measuring range of the humidity sensor is set to 10 to 95%.
- A humidifier is controlled by pulse output to maintain humidity at a constant 60%.
- An alarm is output when the humidity exceeds the upper limit value (70%) or lower limit value (50%).

**Setup**

- Output unit: relay/relay type (E53-R4R4)
- Input type jumper connector: “I (current input)"

![Diagram of control example](image-url)
3.2 Setting Input Specifications

- **Input type**
  - Set the type No. (0 to 21) in the "input type" parameter. The factory setting is "2: K1 (thermocouple)."
  - For details on input types and setting ranges, see page 5-22.

- **Scaling**
  - When the voltage input and current input are selected, scaling matched to the control is required.
  - The "scaling upper limit," "scaling lower limit" and "decimal point" parameters (setup mode) are used for scaling.
  - The "scaling upper limit" parameter sets the physical quantity to be expressed by the upper limit value of input, and the "scaling lower limit" parameter sets the physical quantity to be expressed by the lower limit value of input. The "decimal point" parameter sets the number of digits past the decimal point.
  - The following figure shows scaling example of 4 to 20 mA input. After scaling, the humidity can be directly read. In this case, the "decimal point" parameter is set to "1".

- **Input shift**
  - When temperature input is selected, scaling is not required. This is because input is treated as the "temperature" as it is matched to the input type. However, note that the upper and lower limit values of the sensor can be shifted. For example, if both the upper and lower limit values are shifted by 1.2°C, the process value (before shift) is regarded as 201.2°C after shift when input is 200°C before shift.
  - To set input shift, set shift values in the "input shift upper limit" and "input shift lower limit" parameters (level 2 mode).

About the temperature unit

To switch the temperature unit from "°C" to "°F" for temperature unit, switch the setting of the "C°/F selection" parameter to [°C] from [°F].
In this example, let’s set the parameters as follows:

- “input type” = “17 (4 to 20 mA)”
- “scaling upper limit value” = “950”
- “scaling lower limit value” = “100”
- “decimal point” = “1”

1. Select the menu display, and select [ ] (setup mode) using the 
   or 
   keys. For details on selecting the menu display, see page 1-7.

2. Press the 
   key to enter the setup mode. The top parameter in the
   setup mode [ ] “input type” is displayed. The parameter default
   is “2”.

3. Press the 
   key until the display indicates “17”.

4. Press the 
   key to fix the set value. The display changes to [ ]
   (“scaling upper limit value” parameter). The parameter default is
   “100”.

5. Press the 
   key until the display indicates “950”.

6. Press the 
   key to fix the set value. The display changes to [ ]
   (“scaling lower limit value” parameter). The parameter default is “0”.

7. Press the 
   key until the display indicates “100”.

8. Press the 
   key to fix the set value. The display changes to [ ]
   (“decimal point” parameter). The parameter default is “0”.

9. Press the 
   key until the display indicates “1”.

Setting Example
3.3 Setting Output Specifications

- Eight output are supported:
  - control output (heat)
  - control output (cool)
  - alarm outputs 1 to 3
  - LBA, and
  - error 1 (input error)
  - error 2 (A/D converter error).
  These functions are assigned to control outputs 1 and 2, and auxiliary output 1.
- Restrictions on assignment destination are placed on some of the outputs. The following table shows where outputs may be assigned to.

<table>
<thead>
<tr>
<th>Assignment Destination</th>
<th>Control Output</th>
<th>Auxiliary Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control output (heat)</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Control output (cool)</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Alarm 1</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Alarm 2</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Alarm 3</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>LBA</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Error 1: Input error</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Error 2: A/D converter error</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

With control output (cool) the conditions for switching from standard control to heating and cooling control are reached when the output function is assigned at the cooling side during heating and cooling control.

In other words, heating and cooling control is carried out when control output (cool) is assigned, and standard control is carried out when output is not assigned. For details on heating and cooling control, see 4.1 Selecting the Control Method (page 4-2).
- The same output function can not be assigned to a single destination more than once.
- Factory settings are as follows:
  - Control output (heat) = control output 1
  - Alarm 1 = control output 2
  - Alarm 2 = auxiliary output 1.
- Output assignments are set in the “control output 1 assignment”, “control output 2 assignment” and “aux output 1 assignment” parameters (setup mode).

- “Direct operation” (or normal operation) refers to control where the manipulated variable is increased according to the increase in the process value. Alternatively, “reverse operation” refers to control where the manipulated variable is decreased according to the decrease in the process value.
  For example, when the process value (PV), is lower than the set point (SP), in a heating control system, the manipulated variable increases by the difference between the PV and SP values.
  Accordingly, this becomes “reverse operation” in a heating control system. Alternatively, this becomes “direct operation” in a cooling control system.
- Direct/reverse operation is set in the “direct/reverse operation” parameter (setup mode).
When the output unit is pulse output such as relay output, set the pulse output cycle (control period). Though a shorter pulse period provides better control performance, the control period should be set taking the life expectancy of the output unit into consideration when the output unit is relay.

- The control period is set in the “control period (heat)” parameter (level 1 mode). Factory setting is “20: 20 seconds.”

**Setting Example**

In this example, let’s set the parameters as follows:

- “control output 1 assignment” = “control output (heat)”
- “control output 2 assignment” = “alarm output 1”
- “direct/reverse operation” = “reverse operation”
- “control period” = “20 seconds”

All of the above settings in this example are factory settings. So, in this example, we are only going to check the parameter settings.

1. Select the menu display, and select [Setup] (setup mode) using the or keys. For details on selecting the menu display, see page 1-7.
2. Press the key to enter the setup mode. The top parameter in the setup mode [00] “input type” is displayed. In this example, the parameter setting is “17: 4 to 20 mA.”
3. Press the key until [ ] (“control output 1 assignment” parameter) is displayed. The parameter default is [Heat].
4. As the setting in this example is to be left as it is, press the key. The display changes to [ ] (“control output 2 assignment” parameter). The parameter default is [Alarm].
5. As the setting in this example is to be left as it is, press the key until [ ] (“direct/reverse operation” parameter) is displayed. The parameter default is [Reverse].
6. As the setting in this example is to be left as it is, press the or keys to select [ ] (level 1 mode). For details on selecting the menu display, see page 1-7.
7. Press the key to enter the level 1 mode. The top parameter in the level 1 mode [AT] “AT execute/cancel” is displayed.
8. Press the key until [ ] (“control period” parameter) is displayed. The parameter default is “20”. As the setting in this example is to be left as it is, quit key operation.
3.4 Setting Alarm Type

- Three alarm outputs are supported: alarms 1 to 3. Of these, only the alarm assigned as the output can be used.
- Alarm output conditions are determined according to the combination of the “alarm type”, “alarm value” and “alarm hysteresis” parameter settings.
- The contact conditions when alarm output is ON can be set to “open” or “closed” in the “close in alarm/open in alarm” parameter.

The following table shows the alarm types supported by the E5CK controller and their respective operations.

<table>
<thead>
<tr>
<th>Alarm Type</th>
<th>Alarm Output Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Upper-and lower-limit alarm (deviation) ON OFF Always ON</td>
</tr>
<tr>
<td>2</td>
<td>Upper-limit alarm (deviation) ON OFF ON OFF</td>
</tr>
<tr>
<td>3</td>
<td>Lower-limit alarm (deviation) ON OFF ON OFF</td>
</tr>
<tr>
<td>4</td>
<td>Upper-and lower-limit range alarm (deviation) ON OFF Always OFF</td>
</tr>
<tr>
<td>5</td>
<td>Upper-limit alarm with standby sequence (deviation) ON OFF ON OFF</td>
</tr>
<tr>
<td>6</td>
<td>Lower-limit alarm with standby sequence (deviation) ON OFF ON OFF</td>
</tr>
<tr>
<td>7</td>
<td>Absolute-value upper-limit alarm ON OFF ON OFF</td>
</tr>
<tr>
<td>8</td>
<td>Absolute-value lower-limit alarm ON OFF ON OFF</td>
</tr>
<tr>
<td>9</td>
<td>Absolute-value upper-limit alarm with standby sequence ON OFF ON OFF</td>
</tr>
<tr>
<td>10</td>
<td>Absolute-value lower-limit alarm with standby sequence ON OFF ON OFF</td>
</tr>
</tbody>
</table>

- Alarm types are set independently for each alarm in the “alarm 1 to 3” parameters (setup mode). Factory setting is “2: Upper-limit alarm (deviation)”.

Alarm values are indicated by “X” in the table above. Alarm output operation differs according to whether the value of the alarm is positive or negative.

- Alarm values are set independently for each alarm in the “alarm value 1 to 3” parameters (level 1 mode). Factory setting is “0”.

3-7
### Alarm Hysteresis

- The hysteresis of alarm outputs when alarms are switched ON/OFF can be set as follows.

<table>
<thead>
<tr>
<th>Upper Limit Alarm</th>
<th>Lower Limit Alarm</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>

- Alarm hysteresis is set independently for each alarm in the “alarm 1 to 3 hysteresis” parameters (level 2 mode). Factory setting is “0.02%FS”.

### Standby Sequence

- “Standby sequence” is a function for unconditionally turning alarm output OFF when the process value has left the alarm range once and it next enters the alarm range.
- For example, when the alarm type is set to “deviation lower limit,” generally the process value is within the alarm range, and alarm output becomes ON as it is as the process value when the power is turned ON is smaller than the set point. However, if the alarm type is set to “deviation lower limit with standby sequence”, alarm output first becomes ON when the process value exceeds the alarm setting value to leave the alarm range and once again falls below the alarm value.

### Close in Alarm/Open in Alarm

- When the controller is set to “close in alarm,” the status of the alarm output function is output as it is. When set to “open in alarm,” the status of the alarm output function is output inverted.

<table>
<thead>
<tr>
<th>Alarm Type</th>
<th>Output Status</th>
<th>Output LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close in alarm</td>
<td>ON</td>
<td>Lit</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>Not lit</td>
</tr>
<tr>
<td>Open in alarm</td>
<td>ON</td>
<td>Lit</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>Not lit</td>
</tr>
</tbody>
</table>

- Alarm type and close in alarm (normally open)/open in alarm (normally close) can be set independently for each alarm.
- Close in alarm/open in alarm is set in the “alarm 1 to 3 open in alarm” parameters (setup mode). Factory setting is “close in alarm”.

### Summary of Alarm Operations

The figure below visually summarizes the above description of alarm operations (when alarm type is set to “lower limit alarm (deviation) with standby sequence”):
When a set point for a humidity exceeds ±10.0%, alarm1 will be output.

In this example, let’s set the parameters as follows:

- "alarm type 1" = "1: deviation upper-and lower-limit"
- "alarm value 1" = "10.0"
- "alarm hysteresis" = "0.20"
- "close in alarm/open in alarm" = "1: close in alarm"

Meanings of parameters, "alarm hysteresis" and "open in alarm/close in alarm" are the same settings at the shipment, so settings for operations are omitted.

1. Select the menu display, and select [①] (setup mode) using the or keys. For details on selecting the menu display, see page 1-7.
2. Press the key to enter the setup mode. The top parameter in the setup mode [①] “input type” is displayed. In this example, the parameter setting is “17: 4 to 20 mA”.
3. Press the key until [①] (“alarm type 1” parameter) is displayed. The parameter default is “2: deviation upper limit”.
4. Press the key to return to “1: deviation upper and lower limit”.
5. Select the menu key, and select [①] (level 1 mode) using the or keys. For details on selecting the menu display, see page 1-7.
6. Press the key to enter the level 1 mode. The top parameter in the level 1 mode [①] “AT execute/cancel” is displayed.
7. Press the key until [①] (“alarm value 1” parameter) is displayed.
8. In this example, the parameter setting is “0.0” so press the key until “10.0” is displayed.

About the Decimal Point of the Alarm Value

The decimal point of the alarm value conforms to the setting of the “decimal point” parameter (setup mode). In this example, the “decimal point” parameter is set “1”. (During temperature input, the decimal point of the alarm value conforms the set sensor.)
3.5 Protect Mode

- **Security**
  - This parameter allows you to protect until start of operation parameters that do not change during operation to prevent unwanted modification.
  - The set value of the “security” (protect) parameter specifies the range of protected parameters.
  - When this parameter is set to “0”, parameters are not protected.
  - When this parameter is set to “1” to “3”, the number of modes that can be displayed on the menu display is limited.
  - When set to “1”, level 0 to 2, setup, expansion and option modes only can be selected. When set to “2”, only level 0 to 2 modes can be selected. When set to “3”, only level 0 and 1 modes can be selected.
  - When this parameter is set to “4” to “6”, operations in only the level 0 mode can be selected, and the mode is not displayed on the menu display.
  - When this parameter is set to “5”, only the “PV/SP” parameter can be used.
  - When this parameter is set to “6”, only the “PV/SP” parameter can be used. (The set point can not change.)
  - Default is “1”.

- **A/M key protect**
  - This parameter disables use of the [A/M] key during operation. For example, if you protect use of the [A/M] key by the “A/M key protect” parameter (protect mode) during auto operation, the controller cannot be set to the manual mode, preventing manual operation of the controller during operation.

**Setting Example**
- Let’s protect the setup, expansion, option and calibration modes. Set the parameters as follows:
  - “security” = “2: Usable only in level 0 to 2 modes”

1. Press for 1 second minimum the [A/M] and [SEC] keys simultaneously, the controller enters the protect mode.
2. In the protect mode, the top parameter in the protect mode “security” is displayed. The parameter default is “1”. Press the [SEC] key to change the parameter setting to “2”.
3. Press for 1 second minimum the [A/M] and [SEC] keys simultaneously, the display changes to the “PV/SP monitor” parameter (level 0 mode).
3.6 Starting and Stopping Operation

- You can start and stop operation by changing the setting of the “run/stop” parameter (level 0 mode).
- You can switch the RUN/STOP function up to 100,000 times.
- To stop operation, set the “run/stop” parameter to [STOP] (stop). In a stop state, the “STOP” LED lights.

- To set output during a stop, specify the manipulated variable (Standard: -5.0 to 105.0%, Heating and cooling: -105.0 to 105.0%) in the “MV at stop” parameter (level 2 mode). Factory setting is “0.0: 0.0%”.

The following example describes the procedure to follow to stop control during operation of the controller.

(1) Select the menu display, and select [LEVEL0] (level 0 mode) using the 
or keys. For details on selecting the menu display, see page 1-7.
(2) Press the key to enter the level 0 mode. The PV and SP are displayed.
(3) Press the key until [r-5] (“run/stop” parameter) is displayed.
(4) Press the key to select [STOP] (stop). The “STOP” LED lights, and operation stops.

To resume operation, follow the above procedure to select [r U “run”).
The “STOP” LED goes out and operation starts.
3.7 Adjusting Control Operation

Changing the set point

- You can change the set point in the “set point” parameter (level 0 mode).
- However, note that you cannot change the set point when the “security” parameter (protect mode) is set to “6”.
- To change the set point, press the [△] or [▼] keys to select the desired value. If you leave the setting for two seconds, the set point is updated to the new setting.

Setting Example

In the following example, let’s change the humidity set point from “60%” to “50%”.

1. Select the PV/SP monitor display.
2. Press the [△] key to change the setting to “50.0: 50.0%”.

Manual operation

- To set manual operation and manually set the manipulated variable, press for 1 second minimum the [A/M] key. The controller enters the manual mode.
- The manipulated variable is displayed on the No.2 display. To change the manipulated variable, press the [△] or [▼] keys. After two seconds, the manipulated variable is updated to the new setting.
- Other modes cannot be selected while in the manual mode. To select other modes, press for 1 second minimum the [A/M] key. The manual mode is quit.
- The automatic return of display function does not work while in the manual mode.
- When switching between manual and auto operation, the manipulated variable is subject to balance-less, bump-less operation.
- If the power is interrupted during manual operation, manual operation is resumed at the manipulated variable at power interruption when the power is reset.
- You can switch the AUTO/MANUAL function up to 100,000 times.

Balance-less, Bump-less Operation

To prevent sudden changes in the manipulated variable when switching between manual and auto operation, operation is resumed using the value that was active immediately before operation was switched, and the value is brought gradually closer to the value immediately after operation was switched.
3.7 Adjusting Control Operation

The following diagram summarizes manual operation.

- AT (auto-tuning) cannot be executed while operation is canceled or during ON/OFF control.
- When you execute auto-tuning, the optimum PID parameters are automatically set by forcibly changing the manipulated variable to calculate the characteristics (called the “limit cycle method”) of the control target. During auto-tuning, the AT LED flashes.
- 40%AT or 100%AT can be selected by the limit cycle of MV change width. Specify \( \text{40%AT} \) or \( \text{100%AT} \), respectively, in the “AT execute/cancel” parameter (level 1 mode).
- During heating and cooling control, only 100%AT can be executed. (So, \( \text{40%AT} \) will not be displayed.)
- To cancel AT execution, specify \( \text{AT cancel} \).

**40%AT**

In order to set the limit cycle of MV change width to 40%, select 40%AT to execute auto-tuning with fluctuations in the process value kept to a minimum. However, note that auto-tuning takes longer to execute compared with 100%AT.

The timing by which limit cycles are generated varies according to whether or not the deviation (DV) at the start of AT execution is 10% full-scale or less.

---

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When control characteristics are already known, the PID parameters can be directly adjusted. PID parameters are set in the "proportional band" (P), "integrated time" (I), and "derivative time" (D) parameters (level 1 mode). For details on the setting ranges of these parameters, see Chapter 5 Level 1 Mode (page 5-11).

### 100% AT

In order to set the limit cycle of MV change width to 100%, select 100% AT to shorten the AT execution time without worrying about fluctuations in the process value.

![Diagram showing limit cycle of MV change width 100%]

**Setting Example**

In this example, let's execute 40% AT.

1. Select [Level 1 mode] using the [Enter] or [Set] keys. For details on selecting the menu display, see page 1-7.
2. Press the [Set] key to enter the level 1 mode. The top parameter in the setup mode [AT execute/cancel] is displayed. In this example, the parameter setting is [AT cancel].
3. Press the [Enter] key to specify [AT cancel].
4. The AT LED flashes, and AT execution starts. When the AT LED goes out (end of AT execution), the parameter automatically returns to [AT cancel].

- In addition to AT, the E5CK is also provided with fuzzy self-tuning (ST) that allows automatic calculation of the PID parameters suited to the control target. However, note that the ST function operates only during standard control by temperature input. For further information regarding ST, please see page 5-29 and A-10.

### About PID Parameters

When control characteristics are already known, the PID parameters can be directly adjusted. PID parameters are set in the "proportional band" (P), "integrated time" (I), and "derivative time" (D) parameters (level 1 mode). For details on the setting ranges of these parameters, see Chapter 5 Level 1 Mode (page 5-11).
This chapter describes each of the parameters required for making full use of the features of the E5CK. Read this chapter while referring to the parameter descriptions in chapter 5.

4.1 Selecting the Control Method .............. 4–2
   Heating and cooling control ............ 4–2
   ON/OFF control .......................... 4–3
4.2 Operating Condition Restrictions .......... 4–4
   Manipulated variable restrictions ...... 4–4
   Set point limiter ......................... 4–5
   SP ramp .................................. 4–5
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   Event input .............................. 4–7
   Transfer output ......................... 4–8
4.4 LBA .................................. 4–9
4.5 Calibration .............................. 4–11
   Calibrating thermocouple .............. 4–12
   Calibrating platinum
   resistance thermometer ................. 4–15
   Calibrating current input ............... 4–17
   Calibrating voltage input ............... 4–18
   Checking indication accuracy .......... 4–20
4.1 Selecting the Control Method

When selecting the control method, set the parameters according to the following table. (Parameters are factory-set to heating control.)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control Method</th>
<th>Control output 1 assignment</th>
<th>Control output 2 assignment</th>
<th>Direct/Reverse operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating control (Standard)</td>
<td>Control output (heat)</td>
<td>–</td>
<td>Reverse operation</td>
<td></td>
</tr>
<tr>
<td>Cooling control (Standard)</td>
<td>Control output (heat)</td>
<td>–</td>
<td>Direct operation</td>
<td></td>
</tr>
<tr>
<td>Heating and cooling control</td>
<td>Control output (heat)</td>
<td>Control output (cool)</td>
<td>Reverse operation</td>
<td></td>
</tr>
</tbody>
</table>

For details on how to assign outputs, see 3.3 Setting Output Specifications (page 3-5).

- When heating and cooling control is selected, the “deadband” and “cooling coefficient” parameters can be used.

The deadband is set with the set point as its center. The deadband width is the set value of the “deadband” parameter (level 1 mode). Setting a positive value produces a deadband, while setting a negative value produces an overlap band.

**Heating and cooling control**

- **Dead band**

  - **Output**
  - **Dead band: dead band width = positive**
  - **Overlap band: dead band width = negative**

**Cooling coefficient**

If the heating and cooling characteristics of the control target greatly differ, preventing satisfactory control characteristics from being obtained by the same PID parameters, adjust the proportional band (P at cooling side) using the cooling coefficient to balance control between the heating and cooling sides. In heating and cooling control, P at the heating or cooling side is calculated by the following formula:

\[
\text{Heating side } P = P; \quad \text{Cooling side } P = \text{cooling coefficient} \times P
\]

**Manipulated variable at stop**

- **In heating and cooling control, the manipulated variable output that is output when controller operation is stopped is dependent on the set value of the “MV at stop” parameter (level 2 mode) in the same way as for standard control.**

  - **However, note that in heating and cooling control, the manipulated variable at the cooling side is treated as a negative value for the sake of convenience. When the manipulated variable at STOP is a negative value, the manipulated variable is output to only the cooling side, and when a positive value, the manipulated variable is output to only the heating side.**

  The factory setting is “0”. If the controller is operated using the factory setting, the manipulated variable is not output to both the heating and cooling sides.

**Switching with Manual operation**

When the overlap band is set, the bumpless function that operates when switching between manual and automatic operation may not work.
## ON/OFF control

- Switching between advanced PID control and ON/OFF control is carried out by the “PID / ON/OFF” parameter (expansion mode). When this parameter is set to [PC OFF], advanced PID control is selected, and when set to [PC ON], ON/OFF control is selected. Default is [PC OFF].
- In ON/OFF control, hysteresis is provided in the program when switching between ON and OFF to stabilize operation. The hysteresis width provided during ON/OFF control is simply referred to as “hysteresis.” Control output (heat) and control output (cool) functions are set in the “hysteresis (heat)” and “hysteresis (cool)” parameters, respectively.
- In standard control (heating or cooling control), hysteresis can be set only for the heating side.

### Hysteresis

- In heating and cooling control, a dead band can be set. So, 3-position control is made possible.

### Parameters

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Name: Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>set 1</td>
<td>Control output 1 assignment: Setup</td>
<td>For specifying control method</td>
</tr>
<tr>
<td>set 2</td>
<td>Control output 2 assignment: Setup</td>
<td>For specifying control method</td>
</tr>
<tr>
<td>set 3</td>
<td>Direct/Reverse operation: Setup</td>
<td>For specifying control method</td>
</tr>
<tr>
<td>set 4</td>
<td>Dead band: Level 1</td>
<td>Heating and cooling control</td>
</tr>
<tr>
<td>set 5</td>
<td>Cooling coefficient: Level 1</td>
<td>Heating and cooling control</td>
</tr>
<tr>
<td>set 6</td>
<td>MV at stop: Level 2</td>
<td>Manipulated variable when control operation is stopped</td>
</tr>
<tr>
<td>hys 1</td>
<td>Hysteresis (heat): Level 1</td>
<td>ON/OFF control</td>
</tr>
<tr>
<td>hys 2</td>
<td>Hysteresis (cool): Level 1</td>
<td>ON/OFF control</td>
</tr>
<tr>
<td>ents</td>
<td>PID / ON/OFF: Expansion</td>
<td>ON/OFF control</td>
</tr>
</tbody>
</table>
4.2 Operating Condition Restrictions

The upper-and lower-limit values of the manipulated variable can be restricted by the MV limiter, and the change rate of the manipulated variable can be restricted by the MV change rate limiter.

**MV limiter**

The upper-and lower-limit values of the manipulated variable are set in the “MV upper limit” and “MV lower limit” parameters (level 2 mode). When the manipulated variable calculated by the E5CK is outside of the range of the MV limiter, actual outputs are dependent on the set value of these parameters.

In heating and cooling control, the manipulated variable at the cooling side is treated as a negative value for the sake of convenience. The upper limit is set for the heating side (positive value), and the lower limit is set for the cooling side (negative value) as shown in the following figure.

**MV change rate limiter**

The “MV change rate limit” parameter (level 2 mode) sets the maximum permissible change width per second of the manipulated variable. If a change in the manipulated variable exceeds this parameter setting, the value calculated by the E5CK is reached while changing the value by the per-second value set in this parameter.
4.2 Operating Condition Restrictions

The limiters are invalid or cannot be set when any of the following conditions occur:
- During ON/OFF control
- During ST execution
- During AT execution (only by MV change rate limiter)
- During manual operation
- When operation is stopped
- When an error has occurred.

The setting range of the set point is limited by the set point limiter. The upper-and lower-limit values of this set point limiter are set in the “Set point upper limit” and “Set point lower limit” parameters (expansion mode), respectively. However, note that when the set point limiter is reset, the set point is forcibly changed to the upper-or lower-limit value of the set point limiter if the set point is out of the limiter range. Also, when the input type, temperature unit and scaling (sensor) range are changed, set point limiter is forcibly reset to the scaling (sensor) range.

SP ramp

With the SP ramp function, the controller operates according to the value (set point during SP ramp) limited by a change rate, instead of the changed set point when set point is changed. The interval in which the set point during SP ramp is limited is referred to as the “SP ramp”.

Diagram:
- Limiter operation conditions
- Set point limiter
- SP ramp
The change rate during the SP ramp is specified by the “SP ramp set value” and “SP ramp time unit” parameters. At the “SP ramp set value” default “0”, the SP ramp function is disabled. The set point changing in SP ramp can be monitored in the “Set point during SP ramp” parameter (level 0 mode).

**Operation at start**

The limiters are invalid or cannot be set when any of the following conditions occurs:

- If the SP ramp function is enabled when the power is turned ON, and when “run” is switched to from “stop,” process value may reach the set point after SP ramp in the same way as when the set point is changed. In this case, operation is carried out with the process value regarded as the set point before the change was made.

The direction of the SP ramp changes according to the relationship between the process value and the set point.

**Restrictions during SP ramp**

- Execution of auto-tuning starts after the end of SP ramp.
- When the controller is switched to the manual mode, the set point changes continuously until SP ramp ends.
- When an error occurs, the SP ramp function becomes invalid.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Name: Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta L - H$</td>
<td>MV upper limit: Level 2</td>
<td>Manipulated variable restrictions</td>
</tr>
<tr>
<td>$\Delta L - L$</td>
<td>MV lower limit: Level 2</td>
<td>Manipulated variable restrictions</td>
</tr>
<tr>
<td>$\Delta r - L$</td>
<td>MV change rate limit: Level 2</td>
<td>Manipulated variable restrictions</td>
</tr>
<tr>
<td>$\delta L - H$</td>
<td>SP setting upper limit: Expansion</td>
<td>SP setting restrictions</td>
</tr>
<tr>
<td>$\delta L - L$</td>
<td>SP setting lower limit: Expansion</td>
<td>SP setting restrictions</td>
</tr>
<tr>
<td>$\delta P_{\text{set}}$</td>
<td>SP ramp set value: Level 2</td>
<td>SP changing restrictions</td>
</tr>
<tr>
<td>$\delta P_{ramp}$</td>
<td>SP ramp time unit: Level 2</td>
<td>SP changing restrictions</td>
</tr>
</tbody>
</table>
4.3 How to Use Option Functions

- For details on the communications function, refer to Chapter 6 Using the Communications Function.

**Event input**

- When using event input, add on the input unit (E53-CKB).

**Input assignments**

- You can choose from the following three event input functions:
  - Run/Stop
  - Auto/Manual
  - Multi-SP

- When selecting an option function, first determine whether or not the multi-SP function is to be used. You can select two of the remaining option functions only when the multi-SP function is not in use.

- When using the multi-SP function, set the “multi-SP function” parameter (option mode) to “1: ON”. When using other functions, set this parameter to “0: OFF”.

- When specifying event input other than the multi-SP function, specify event input in the “event input assignment 1” parameter (option mode). The following table shows the relationship between parameter settings and event input functions.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON :</td>
<td>Stop</td>
</tr>
<tr>
<td>/OFF :</td>
<td>Run</td>
</tr>
<tr>
<td>ON :</td>
<td>Manual</td>
</tr>
<tr>
<td>/OFF :</td>
<td>Auto</td>
</tr>
</tbody>
</table>

**Run/Stop**

- When event input is set to “ON”, controller operation is stopped and the “STOP” LED lights. The content of event input is reflected in the “run/stop” parameter (level 0 mode).

- Run/Stop can be switched up to 100,000 times.

**Auto/Manual**

- When event input is set to “ON”, the controller is switched for manual operation, and the “MANU” LED lights.

- Turn event input ON/OFF while the controller is ON.

- Auto/Manual can be switched up to 100,000 times.

**About the event input and key operation**

There is no order of priority when inputting events and operating the keys. However, because event input of run/stop or auto/manual must be carried out in either of the physical ON/OFF states, parameters ultimately conform to event input even if an attempt is made to switch the setting by key operation.
Multi-SP

- The set points set to the "set point 0" and "set point 1" parameters (level 1 mode) can be switched for use. However, note that these parameters cannot be set when the multi-SP function is not selected.
- The set point can be switched up to 100,000 times.
- When event input is "OFF", set point 0 is used, and when "ON" set point 1 is used.
- When you have changed the set point, the set point of the currently selected parameter is changed.
- When you have switched between "set point 0" and "set point 1", the SP ramp function works if the SP ramp function is enabled. The following examples show how the set point changes when you switch from set point 0 and set point 1.

Transfer output

- When using transfer output, add on the communications unit (E53-CKF).
- You can select the following data items in the "transfer output type" parameter (option mode) as the transfer outputs:
  - Set point
  - Set point during SP ramp
  - Process value
  - Manipulated variable (heat), and
  - Manipulated variable (cool).
- These transfer outputs can be scaled according to the settings of the "transfer output upper limit" and "transfer output lower limit" parameters before output. Setting of an upper limit value smaller than the lower limit value is allowed, so reverse scaling can also be carried out. Also, the scale can be enlarged by the upper-and lower-limit width specified for each data item. The following example shows scaling of the reading side manipulated variable.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Symbol</th>
<th>Parameter Name/ Mode</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-SP</td>
<td>( \text{E} )</td>
<td>Event input functions</td>
<td></td>
</tr>
<tr>
<td>Event input assignment 1</td>
<td>( \text{S} )</td>
<td>Set point 0</td>
<td></td>
</tr>
<tr>
<td>Multi-SP</td>
<td>( \text{S} )</td>
<td>Set point 1</td>
<td></td>
</tr>
<tr>
<td>Transfer output type</td>
<td>( \text{M} )</td>
<td>Transfer output designation</td>
<td></td>
</tr>
<tr>
<td>Transfer output upper limit</td>
<td>( \text{H} )</td>
<td>Transfer output scaling</td>
<td></td>
</tr>
<tr>
<td>Transfer output upper limit</td>
<td>( \text{L} )</td>
<td>Transfer output scaling</td>
<td></td>
</tr>
</tbody>
</table>
4.4 LBA

- The LBA (Loop Break Alarm) function can be used only when assigned as an output. Also, the LBA function does not work when a memory error or A/D converter error occurs.
- LBA (Loop Break Alarm) is a function for judging that an error has occurred somewhere on the control loop and outputting an alarm when the process value does not change with the manipulated variable at a maximum or minimum state. Accordingly, the LBA function can be used as a means for detecting a malfunctioning control loop.

**LBA detection time**

- Normally, when output is set to maximum or minimum, the process value rises or falls after the dead time has elapsed. LBA is output if the process value does not change in the predicted direction after a fixed amount of time has elapsed. This fixed amount of time is the “LBA detection time.”

**LBA detection width**

- LBA operation sometimes becomes unstable when the process value fluctuates considerably due to the control characteristics. The LBA detection width is provided so that changes with respect to output can be correctly detected. Changes smaller than the detection width due to LBA detection timing are not regarded as changes.

**LBA detection example**

- The following example describes what happens when a heater burnout at maximum output.

![Diagram](image)

- LBA judgment is carried out at each LBA detection time from the point of maximum output. In above figure, the process value (PV) is changing greatly at the 1st judgment timing, so LBA remains OFF.
- At the 2nd judgment timing, the process value increases as indicated by the broken line of the process value is normal. This means that the change width exceeds the LBA detection width, and LBA output remains OFF.
- If the heater burns out at the point shown in the above figure, the process value “decreases.” Accordingly, it is judged that “the process value is not changing in the increasing direction” at the 2nd judgment timing and the LBA output becomes ON.
### Setting the LBA detection time
- The LBA detection time is automatically set by auto-tuning (except in heating and cooling control).
- If the optimum LBA detection time cannot be obtained by auto-tuning, set the time in the "LBA detection time" parameter (level 2 mode).

### Determining the LBA detection time
- Calculate the LBA detection time as follows:
  1. Set output to maximum.
  2. Measure the time it takes for the input change width to reach the LBA detection width (default: 0.2% full-scale).
  3. Take a value twice that of the measurement time as the LBA detection time.

### Equation
\[ \text{LBA detection time} = T_m \times 2 \]

4. In the case of ON/OFF operation, set the LBA detection time to a value longer than the control period.

### Parameters

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Name: Mode</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>for AT Execute/Cancel : Level 1</td>
<td>Automatic setting of LBA detection time</td>
<td></td>
</tr>
<tr>
<td>LB</td>
<td>LBA detection time : Level 2</td>
<td>Setting of LBA detection time</td>
</tr>
<tr>
<td>LB</td>
<td>LBA detection width : Expansion</td>
<td>Changing of LBA detection width</td>
</tr>
</tbody>
</table>
4.5 Calibration

- To calibrate the E5CK controller, select [Rd] in the menu display to select the calibration mode. [Rds] is displayed.
- However, note that [Rds] may not be displayed on the menu display when, for example, the user is calibrating the E5CK controller for the first time. If this happens, [Rds] is displayed by changing the "security" parameter (protect mode) to "0".
- The parameters in the calibration mode are configured as follows.

![Diagram showing calibration parameters]

- To select the desired parameter, press the [Esc] key. Parameters are displayed in the following order:
  - Calibration of inputs → Calibration of transfer output → Saving of calibration data
  - Calibration of inputs → Saving of calibration data
  - Only inputs that have been set in the "input type" parameter (setup mode) can be calibrated. To temporarily save data for each of the calibration parameters, press the [Esc] key for 1 second.
  - Transfer output can be calibrated only when the communications unit (E53-CKF) is set in the controller. To adjust data items, press the [Esc] or [Esc] keys.
  - The data save menu is displayed only when all calibration items have temporarily been saved.
  - After calibrating input, you must always check indication accuracy. For details, see page 4-20.
CHAPTER 4 APPLIED OPERATION

• Parameters are displayed on the No.1 display, and the process value is displayed in Hexadecimal on the No.2 display.

• Normally, the process value changes by several digits. The process value flashes, for example, when a sensor error causes the process value to stray from the calibration target range.

• When the process value display is flashing, the process value is not saved as data even if the [ ] key is pressed.

• Once the E5CK controller has been calibrated by the user, [ ] precedes the “.” mark when the calibration mode is selected.

• Calibrate according to the type of thermocouple, thermocouple 1 group (K1, J1, L1, E, N, W, PLII) and thermocouple 2 group (K2, J2, L2, R, S, B, T, U).

• When calibrating, do not cover the bottom or top of the controller. Also, do not touch the input terminals (Nos. 6 and 7) and compensating conductor on the E5CK controller.

• Set the cold junction compensator to 0°C. However, make sure that internal thermocouples are disabled (tips are open).

• In the above figure, STV refers to a standard DC current/voltage source, and DMM refers to a precision digital multimeter.

• Use a compensating conductor selected thermocouple. However, note that when thermocouple R, S, E, B, W or PLII is used, the compensating conductor can be substituted with the cold junction compensator for thermocouple K and compensating conductor.

Correct process values cannot be obtained if you touch the contact ends of the compensating conductor during calibration of a thermocouple. Accordingly, select (enable) or open (disable) the tip of the compensating conductor inside the cold junction compensator as shown in the figure below to create a contact or non-contact state for the cold junction compensator.
This example describes how to calibrate a thermocouple when the transfer output function is supported. If the transfer output function is not supported, skips steps (7) to (10).

1. When \([ Rd \) \] is displayed, the 30-minute timer is displayed on the No.2 display and counts down. This timer serves as a guide for the aging time when aging is required.

2. First, calibrate the main input. Press the \( \) key to display \([ 50mV \) calibration display]. Set STV output to 50mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the \( \) key to temporarily save the calibration data.

3. Press the \( \) key to display \([ 0mV \) calibration display]. Set STV output to 0mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the \( \) key to temporarily save the calibration data.

4. Next, calibrate the cold junction compensator. Press the \( \) key to display \([ 310mV \) calibration display]. Set STV output to 310mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the \( \) key to temporarily save the calibration data.

5. Press the \( \) key to display \([ 0mV \) calibration display]. Set STV output to 0mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the \( \) key to temporarily save the calibration data.

6. Finally, calibrate the bias compensation value. Disconnect the STV, and enable the thermocouple of the cold junction compensator. When carrying this out, make sure that the wiring on the STV is disconnected. Make sure that the cold junction compensator is set to 0°C and press the \( \) key. The display changes to \([ 26 \) calibration display for the bias compensation value]. When the value on the No.2 display has stabilized (changes of several digits max.), press the \( \) key to temporarily save the calibration data.

7. Next, calibrate the transfer output function. If the transfer output function is not supported, skip to step (11). Press the \( \) key. The display changes to \([ 20mA \) calibration display].

8. Set the output to 20mA by the \( \) or \( \) keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is “20mA”.

9. Press the \( \) key. The display changes to \([ 4mA \) calibration display].

10. Set the output to 4mA by the \( \) or \( \) keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is “4mA”.

11. Press the \( \) key until the display changes to the data save display. Press the \( \) key. The No.2 display changes to \([ 5E5 \), and two seconds later the calibration data is saved to internal memory. If you press the \( \) key when the No.2 display reads \([ 0 \), the calibration data is invalidated.

12. This completes calibration of the thermocouple 1 group. Press the \( \) key to return the display to \([ Rd \) group].
CHAPTER 4 APPLIED OPERATION

Calibration: thermocouple 2

This example describes how to calibrate a thermocouple when the transfer output function is supported. If the transfer output function is not supported, skips steps (7) to (10).

1. When [ Rd] is displayed, the 30-minute timer is displayed on the No.2 display and counts down. This timer serves as a guide for the aging time when aging is required.

2. First, calibrate the main input. Press the [c] key to display [20mV] (20mV calibration display). Set STV output to 20mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the [e] key to temporarily save the calibration data.

3. Press the [c] key to display [0mV] (0mV calibration display). Set STV output to 0mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the [e] key to temporarily save the calibration data.

4. Next, calibrate the cold junction compensator. Press the [c] key to display [310mV] (310mV calibration display). Set STV output to 310mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the [e] key to temporarily save the calibration data.

5. Press the [c] key to display [0mV] (0mV calibration display). Set STV output to 0mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the [e] key to temporarily save the calibration data.

6. Finally, calibrate the bias compensation value. Disconnect the STV, and enable the thermocouple of the cold junction compensator. When carrying this out, make sure that the wiring on the STV is disconnected.

Make sure that the cold junction compensator is set to 0℃ and press the [c] key. The display changes to [4mA] (calibration display for the bias compensation value). When the value on the No.2 display has stabilized (changes of several digits max.), press the [e] key to temporarily save the calibration data.

7. Next, calibrate the transfer output function. If the transfer output function is not supported, skip to step (11). Press the [c] key. The display changes to [20mA] (20mA calibration display).

8. Set the output to 20mA by the [c] or [d] keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is “20mA”.

9. Press the [e] key. The display changes to [4mA] (4mA calibration display).

10. Set the output to 4mA by the [c] or [d] keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is “4mA”.

11. Press the [c] key until the display changes to the data save display. Press the [e] key. The No.2 display changes to [4.05], and two seconds later the calibration data is saved to internal memory. If you press the [c] key when the No.2 display reads [0a], the calibration data is invalidated.

12. This completes calibration of the thermocouple 2 group. Press the [c] key to return the display to [Rd].
Calibrating platinum resistance thermometer

Preparation

- Use leads of the same thickness when connecting to the platinum resistance thermometer.
- In the above figure, 6-dial refers to a precision resistance box, and DMM stands for a digital multimeter. However, note that the DMM is required only when the transfer output function is supported.
- Connect (short) the leads from terminal Nos. 6 and 7.

Calibration

This example describes how to calibrate a platinum resistance thermometer when the transfer output function is supported. If the transfer output function is not supported, skip steps (7) to (10).

1. When \[ R_d \] is displayed, the 30-minute timer is displayed on the No.2 display and counts down. This timer serves as a guide for the aging time when aging is required.

2. First, calibrate the main input. Press the \[ \) \key{DMM} \] key to display \[ 300 \Omega \] (300\,Ω calibration display). Set the 6-dial to 300Ω. When the value on the No.2 display has stabilized (changes of several digits max.), press the \[ \) \key{DMM} \] key to temporarily store the calibration data.

3. Press the \[ \) \key{DMM} \] key to switch \[ 0 \Omega \] (0Ω calibration display). Short terminal No.6 to 8. When the value on the No.2 display has stabilized (changes of several digits max.), press the \[ \) \key{DMM} \] key to temporarily store the calibration data.

4. Next, calibrate the B-B' input. Change the wiring as follows.

Make the connection across terminals 6 and 7 and the 6-dial as short as possible. Short terminals 6 and 8.

5. Press the \[ \) \key{DMM} \] key to display \[ 10 \Omega \] (10Ω calibration display). Set the 6-dial to 10Ω. When the value on the No.2 display has stabilized (changes of several digits max.), press the \[ \) \key{DMM} \] key to temporarily store the calibration data.

6. Press the \[ \) \key{DMM} \] key to display \[ 0 \Omega \] (0Ω calibration display). Set the 6-dial to 10Ω. When the value on the No.2 display has stabilized (changes of several digits max.), press the \[ \) \key{DMM} \] key to temporarily store the calibration data.
(7) Next, calibrate the transfer output function. If the transfer output function is not supported, skip to step (11). Press the \( \text{CAL} \) key. The display changes to \( \text{CAL} \) (20mA calibration display).

(8) Set the output to 20mA by the \( \uparrow \) or \( \downarrow \) keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is "20mA".

(9) Press the \( \text{CAL} \) key. The display changes to \( \text{CAL} \) (4mA calibration display).

(10) Set the output to 4mA by the \( \uparrow \) or \( \downarrow \) keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is "4mA".

(11) Press the \( \text{CAL} \) key until the display changes to the data save display.

Press the \( \text{SET} \) key. The No.2 display changes to \( \text{YES} \), and two seconds later the calibration data is saved to internal memory. If you press the \( \text{CAL} \) key when the No.2 display reads \( \text{NO} \), the calibration data is invalidated.

(12) This completes calibration of the platinum resistance thermometer.

Press the \( \text{CAL} \) key to return the display to \( \text{INSTR} \).
### Calibrating current input

#### Preparation

In the above figure, STV refers to a standard DC current/voltage source, and DMM refers to a precision digital multimeter. However, note that the DMM is required only when the transfer output function is supported.

#### Calibration

This example describes how to calibrate a current input when the transfer output function is supported. If the transfer output function is not supported, skip steps (4) to (7).

1. When \([ \text{rd} ]\) is displayed, the 30-minute timer is displayed on the No.2 display and counts down. This timer serves as a guide for the aging time when aging is required.

2. Press the \([ \text{rd} ]\) key. The display changes to \([ \text{rd} ]\) (20mA calibration display). Set the STV output to 20mA. When the value on the No.2 display has stabilized (changes of several digits max.), press the \([ \text{rd} ]\) key to temporarily store the calibration data.

3. Press the \([ \text{rd} ]\) key. The display changes to \([ \text{rd} ]\) (0mA calibration display). Set the STV output to 0 mA. When the value on the No.2 display has stabilized (changes of several digits max.), press the \([ \text{rd} ]\) key to temporarily store the calibration data.

4. Next, calibrate the transfer output function. If the transfer output function is not supported, skip to step (8). Press the \([ \text{rd} ]\) key. The display changes to \([ \text{rd} ]\) (20mA calibration display).

5. Set the output to 20mA by the \([ \text{rd} ]\) or \([ \text{rd} ]\) keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is "20mA".

6. Press the \([ \text{rd} ]\) key. The display changes to \([ \text{rd} ]\) (4mA calibration display).

7. Set the output to 4mA by the \([ \text{rd} ]\) or \([ \text{rd} ]\) keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is "4mA".

8. Press the \([ \text{rd} ]\) key until the display changes to the data save display. Press the \([ \text{rd} ]\) key. The No.2 display changes to \([ \text{rd} ]\), and two seconds later the calibration data is saved to internal memory. If you press the \([ \text{rd} ]\) key when the No.2 display reads \([ \text{rd} ]\), the calibration data is invalidated.

9. This completes calibration of current input. Press the \([ \text{rd} ]\) key to return the display to \([ \text{rd} ]\).
Chapter 4  Applied Operation

Calibrating voltage input

Preparation

In the above figure, STV refers to a standard DC current/voltage source, and DMM refers to a precision digital multimeter. However, note that the DMM is required only when the transfer output function is supported.

This example describes how to calibrate voltage input when the transfer output function is supported. If the transfer output function is not supported, skip steps (4) to (7).

1. When [Rd] is displayed, the 30-minute timer is displayed on the No.2 display and counts down. This timer serves as a guide for the aging time when aging is required.

2. Press the [Rd] key. The display changes to [Rd] (5 V calibration display). Set the STV output to 5 V. When the value on the No.2 display has stabilized (changes of several digits max.), press the [Rd] key to temporarily store the calibration data.

3. Press the [Rd] key. The display changes to [Rd] (0 V calibration display). Set the STV output to 0 V. When the value on the No.2 display has stabilized (changes of several digits max.), press the [Rd] key to temporarily store the calibration data.

4. Next, calibrate the transfer output function. If the transfer output function is not supported, skip to step (8). Press the [Rd] key. The display changes to [Rd] (20 mA calibration display).

5. Set the output to 20 mA by the [Rd] or [Rd] keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is “20 mA”.

6. Press the [Rd] key. The display changes to [Rd] (4 mA calibration display).

7. Set the output to 4 mA by the [Rd] or [Rd] keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is “4 mA”.

8. Press the [Rd] key until the display changes to the data save display. Press the [Rd] key. The No.2 display changes to [Rd], and two seconds later the calibration data is saved to internal memory. If you press the [Rd] key when the No.2 display reads [Rd], the calibration data is invalidated.

9. This completes calibration of voltage input (0 to 5 V, 1 to 5 V). Press the [Rd] key to return the display to [Rd].
This example describes how to calibrate voltage input when the transfer output function is supported. If the transfer output function is not supported, skips steps (4) to (7).

1. When [ ] is displayed, the 30-minute timer is displayed on the No.2 display and counts down. This timer serves as a guide for the aging time when aging is required.
2. Press the key. The display changes to [ ] (10V calibration display). Set the STV output to 10V. When the value on the No.2 display has stabilized (changes of several digits max.), press the key to temporarily store the calibration data.
3. Press the key. The display changes to [ ] (0V calibration display). Set the STV output to 0V. When the value on the No.2 display has stabilized (changes of several digits max.), press the key to temporarily store the calibration data.
4. Next, calibrate the transfer output function. If the transfer output function is not supported, skip to step (8). Press the key. The display changes to [ ] (20mA calibration display).
5. Set the output to 20mA by the or keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is “20mA”.
6. Press the key. The display changes to [ ] (4mA calibration display).
7. Set the output to 4mA by the or keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is “4mA”.
8. Press the key until the display changes to the data save display. Press the key. The No.2 display changes to [ ], and two seconds later the calibration data is saved to internal memory. If you press the key when the No.2 display reads [ ], the calibration data is invalidated.
9. This completes calibration of voltage input (0 to 10V). Press the key to return the display to [ ].
CHAPTER 4 APPLIED OPERATION

Checking indication accuracy

- After calibrating input, make sure that you check indication accuracy to make sure that the E5CK controller has been correctly calibrated.
- Operate the E5CK controller in the PV/SP monitor (level 0 mode) mode.
- Check the indication accuracy at the upper and lower limits and midpoint.

Thermocouple

- Preparation
  The following figure shows the required device connection. Make sure that the E5CK controller and cold junction compensator are connected by a compensating conductor for the input type that is to be used during actual operation.

- Operation
  Make sure that the cold junction compensator is at 0°C, and set STV output to the voltage equivalent to the starting power of the check value.

Platinum resistance thermometer

- Preparation
  The following figure shows the required device connection.

- Operation
  Set the 6-dial to the resistance equivalent to the check value.

Current or voltage input

- Preparation
  The following figure shows the required device connection.

- Operation
  Set the STV to the current or voltage value equivalent to the check value.
This chapter describes the parameters of the E5CK. Use this chapter as a reference guide.

Conventions Used in this Chapter ............. 5-2
Protect Mode .................................... 5-3
Manual Mode .................................... 5-5
Level 0 Mode .................................... 5-6
Level 1 Mode .................................... 5-9
Level 2 Mode .................................... 5-15
Setup Mode ...................................... 5-21
Expansion Mode ................................ 5-27
Option Mode ..................................... 5-32
Calibration Mode ................................. 5-36
Conventions Used in this Chapter

The meaning of icons used in this chapter

- **Function**: Describes the functions of the parameter.

- **Comment**: Describes the range and defaults of the parameter setting.

- **Monitor**: Used for monitor-dedicated parameters. Describes the range of the monitor values.

- **Example of use**: Describes a procedure using parameters in operating instructions.

- **See**: Describes related parameters and items.

- **Model**: Describes models of the E5CK or option units supporting the parameter being described.

About parameter display

On the E5CK controller, only parameters that can be used are displayed. These parameters are displayed only when the “Conditions of Use” on the right of the parameter heading are satisfied. However, note that the settings of protected parameters are still valid, and are not displayed regardless of the conditions of use.
The protect mode is for disabling (protecting) the functions of the menu key or A/M key. Before changing parameters in this mode, first make sure that protecting the menu key or A/M key will not cause any problems in operation.

To select this mode, press the A/M key and [Esc] key simultaneously for 1 second minimum. To exit this mode, press the A/M key and [Esc] key down again simultaneously for 1 second minimum.

The following table shows the parameters supported in this mode and the page where the parameter is described.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Name</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>$SECr$</td>
<td>Security</td>
<td>5-3</td>
</tr>
<tr>
<td>$PEyP$</td>
<td>[A/M] key protect</td>
<td>5-4</td>
</tr>
</tbody>
</table>

This parameter specifies which parameters are protected. However, note that the protect mode and manual mode cannot be protected.

- When this parameter is set to “0” to “3”, only the modes indicated by the “$f$” mark in the table below can be selected on the menu display. For example, when this parameter is set to “2”, only level 0 to 2 modes can be selected.
- When this parameter is set to “4” to “6”, operations in only the level 0 mode can be selected, and the mode is not displayed on the menu display.
- When this parameter is set to “5”, only the “PV/SP” parameter in the level 0 mode can be used.
- When this parameter is set to “6”, only the “PV/SP” parameter in the level 0 mode can be used. (The set point cannot change.)
- Default is “1”. (Only the calibration mode is protected.)

See Related article 3.5 Protect Mode (page 3-10)
Invalidate the function of the \( \text{[A/M]} \) key. In other words, you cannot switch between the auto and manual operations by key operation.

- \( \text{[A/M]} \) key protect ON
- \( \text{[A/M]} \) key protect canceled
- Default = \( \text{[A/M]} \)

Related article
3.5 Protect Mode (page 3-10)
In this mode, manual operations are possible, and the “MANU” LED lights.

When this mode is selected, the manipulated variable that was active immediately before the mode was switched to is output. When changing the manipulated variable, change it using the [△] or [∇] keys. When this mode is selected during auto-tuning, auto-tuning is canceled.

To select this mode when in the level 0 to 2 modes, press the [A/M] key for 1 second minimum. To exit this mode, press the [A/M] key for 1 second minimum. The mode changes to the level 0 mode.

“Manual MV” is the only parameter available in this mode.

**Manual MV**

Set the manipulated variable for manual operation.

The process value is displayed on the No.1 display, and the manipulated variable is displayed on the No.2 display. Change the manipulated variable using the △ or ▽ keys.

The manual manipulated variable is held when the power is interrupted.

<table>
<thead>
<tr>
<th>Control Method</th>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>-5.0 to 105.0</td>
<td>%</td>
<td>0</td>
</tr>
<tr>
<td>Heating and cooling</td>
<td>-105.0 to 105.0</td>
<td>%</td>
<td>0</td>
</tr>
</tbody>
</table>

Related article

3.7 Adjusting Control Operation (page 3-12)
• The parameters in this mode can be used only when the “security” parameter (pro-
tect mode) is set to “0” to “4”.
• The “PV/SP” parameter can also be used when the “Security” parameter is set to “5”
or “6”. However, note that when set to “6”, the SP cannot be changed.
• This mode is used for monitoring the process value, set point and manipulated vari-
able during operation, and for checking and setting the SP setting value. It is also
used for starting and stopping controller operation.
• To select this mode when in the levels 1 and 2, setup, expansion, option and calibra-
tion modes, press the key for 1 second minimum. The display changes to the
menu display. If you select then press key for 1 second minimum, the
controller enters the level 0 mode.
• To select parameters in this mode, press the key. To change parameter settings,
use the or keys.
• The following table shows the parameters supported in this mode and the page where
the parameter is described.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Name</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV/SP</td>
<td>Set point during SP ramp</td>
<td>5-6</td>
</tr>
<tr>
<td>θ</td>
<td>MV monitor (heat)</td>
<td>5-7</td>
</tr>
<tr>
<td>θ</td>
<td>MV monitor (cool)</td>
<td>5-7</td>
</tr>
<tr>
<td>θ</td>
<td>Run/Stop</td>
<td>5-8</td>
</tr>
</tbody>
</table>

• The process value is displayed on the No.1 display, and the set point is displayed on
the No.2 display. The set point can be set.
• When the multi-SP function is in use, the value of whichever is set, set point 0 or 1,
is linked.
• The decimal point position is dependent on the selected sensor during temperature
input and on the results of scaling during analog input.

• Process value

<table>
<thead>
<tr>
<th>Monitor Range</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scaling lower limit -10%FS to scaling upper limit +10%FS</td>
<td>EU</td>
</tr>
</tbody>
</table>

During temperature input, the range of the currently selected sensor is taken as the
monitor range.

• Set point

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP setting lower limit to SP setting upper limit</td>
<td>EU</td>
<td>0</td>
</tr>
</tbody>
</table>

Related article
3.7 Adjusting Control Operation (page 3-12)
Related parameters
“Input type” “Scaling upper limit” “Scaling lower limit” “Decimal point” (setup mode)
“SP setting upper limit” “SP setting lower limit” (expansion mode)
**Set point during SP ramp**

Conditions of Use
The SP ramp function must be enabled.

- Sets the set point.

<table>
<thead>
<tr>
<th>Monitor Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP setting lower limit to SP setting upper limit</td>
<td>EU</td>
<td>0</td>
</tr>
</tbody>
</table>

- Related article
3.7 Adjusting Control Operation (page 3-12)

- Related parameters
  - “PV/SP” (level 0 mode)
  - “SP ramp time unit” “SP ramp set value” (level 2 mode)
  - “Set point upper limit” “Set point lower limit (expansion mode)"

**MV monitor (heat)**

- This parameter cannot be set.
- Monitors the manipulated variable on the heating or cooling side.
- The manipulated variable in a standard control system is checked in the “MV monitor (heat)" parameter.
- The “MV monitor (cool)” parameter can be used only during heating and cooling control.

<table>
<thead>
<tr>
<th>Control</th>
<th>Monitor Range</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>-5.0 to 105.0</td>
<td>%</td>
</tr>
<tr>
<td>Heating and cooling</td>
<td>0.0 to 105.0</td>
<td>%</td>
</tr>
</tbody>
</table>

**MV monitor (cool)**

<table>
<thead>
<tr>
<th>Control</th>
<th>Monitor Range</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating and cooling</td>
<td>0.0 to 105.0</td>
<td>%</td>
</tr>
</tbody>
</table>
CHAPTER 5 PARAMETERS

This parameter is used for checking the operating status of the controller, and for specifying start and stop of operation.

When the "run/stop" function is assigned to event input, "stop" is set when event input is ON, and "run" is set when event input is OFF. There is no order of priority in key operations.

To start operation, set this parameter to \[ R \rightarrow S \] press the \( \text{Run} \) or \( \text{Stop} \) keys. To stop operation, set this parameter to \( S \rightarrow R \). When operation is stopped, the "STOP" LED lights.

Default is \( R \rightarrow S \).

Related article
3.6 Starting and Stopping Operation (page 3-11)
**Level 1 Mode**

- The parameters in this mode can be used only when the “security” parameter (protect mode) is set to “0” to “3”.
- This mode contains the main parameters for adjusting control. These parameters include parameters for executing AT (auto-tuning), setting the alarm values, setting the control period, and setting PID parameters.
- To select this mode when in the levels 0 and 2, setup, expansion, option and calibration modes, press the key for 1 second minimum. The display changes to the menu display. If you select then press the key for 1 second minimum, the controller enters the level 1 mode.
- To select parameters in this mode, press the key. To change parameter settings, use the or keys.
- The following table shows the parameters supported in this mode and the page where the parameter is described.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Name</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT</td>
<td>AT Execute/Cancel</td>
<td>5-10</td>
</tr>
<tr>
<td>SP-0</td>
<td>Set point 0</td>
<td>5-10</td>
</tr>
<tr>
<td>SP-1</td>
<td>Set point 1</td>
<td>5-10</td>
</tr>
<tr>
<td>RL-1</td>
<td>Alarm value 1</td>
<td>5-11</td>
</tr>
<tr>
<td>RL-2</td>
<td>Alarm value 2</td>
<td>5-11</td>
</tr>
<tr>
<td>RL-3</td>
<td>Alarm value 3</td>
<td>5-11</td>
</tr>
<tr>
<td>P</td>
<td>Proportional band</td>
<td>5-11</td>
</tr>
<tr>
<td>t</td>
<td>Integral time</td>
<td>5-11</td>
</tr>
<tr>
<td>d</td>
<td>Derivative time</td>
<td>5-11</td>
</tr>
<tr>
<td>SC</td>
<td>Cooling coefficient</td>
<td>5-12</td>
</tr>
<tr>
<td>db</td>
<td>Dead band</td>
<td>5-12</td>
</tr>
<tr>
<td>Fr</td>
<td>Manual reset value</td>
<td>5-13</td>
</tr>
<tr>
<td>HYS</td>
<td>Hysteresis (heat)</td>
<td>5-13</td>
</tr>
<tr>
<td>cHYS</td>
<td>Hysteresis (cool)</td>
<td>5-13</td>
</tr>
<tr>
<td>CP</td>
<td>Control period (heat)</td>
<td>5-14</td>
</tr>
<tr>
<td>cCP</td>
<td>Control period (cool)</td>
<td>5-14</td>
</tr>
</tbody>
</table>
### AT Execute/Cancel

**Function**
- Selects the limit cycle of MV change width (40% or 100%) for execution. After AT execution, the "PID" and the "LBA detection time" (LBA: Loop Break Alarm) parameters are set automatically.
- During heating and cooling control, only 100%AT can be executed.
- When this parameter is selected, the setting becomes [OFF].
- To execute 40%AT, select [OFF], and to execute 100%AT, select [ON]. During execution of auto-tuning, the AT LED flashes. However, note that during heating and cooling control, [OFF] is not displayed.
- When AT execution ends, the parameter setting automatically returns to [OFF].

**Conditions of Use**
The controller must be in operation, control must be advanced PID control, and ST must be set to OFF.

- Related article
  3.7 Adjusting Control Operation (page 3-13)
- Related parameters
  “Run/Stop” (level 0 mode)
  “Proportional band” “Integral time” “Derivative time” (level 1 mode)
  “LBA detection time” (level 2 mode)

### Set point 0

**Function**
- When event input is OFF, the "set point 0" parameter is used, and when ON, the "set point 1" parameter is used.
- When the “set point” parameter has been changed, the setting of whichever is selected in event input, “set point 0” or “set point 1”, is linked and changed.
- The decimal point position is dependent on the selected sensor during temperature input and on the results of scaling during analog input.

**Setting Range**
- Scaling lower limit to Scaling upper limit
- Unit: EU
- Default: 0

**Related article**
4.3 How to Use Option Functions (page 4-8)

**Related parameters**
- “Multi-SP function” (option mode)
- “Set point” (level 0 mode)
- “Input type” “Scaling upper limit” “Scaling lower limit” “Decimal point” (setup mode)
### Level 1 Mode

#### Alarm value 1
- **Conditions of Use**
  - Alarms must be assigned as outputs. For example, if alarm outputs 1 and 2 only are assigned as outputs, the "alarm value 3" parameter cannot be used.
  - This parameter is used for monitoring or changing the alarm values of alarm outputs 1 to 3.
  - During temperature input, the decimal point position is dependent on the currently selected sensor, and during analog input on the results of scaling.

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1999 to 9999</td>
<td>EU</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Proportional band
- **Conditions of Use**
  - Control must be advanced PID control, and ST must be set to OFF.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportional band</td>
<td>0.1 to 999.9</td>
<td>%FS</td>
<td>10.0</td>
</tr>
<tr>
<td>Integral time</td>
<td>0 to 3999</td>
<td>Second</td>
<td>233</td>
</tr>
<tr>
<td>Derivative time</td>
<td>0 to 3999</td>
<td>Second</td>
<td>40</td>
</tr>
</tbody>
</table>

- Sets the PID parameters. However, note that the PID parameter settings are changed to optimum values when auto-tuning is executed, and self-tuning is selected.

- Related article
  - 3.7 Adjusting Control Operation (page 3-12)
- Related parameters
  - “Input type” “Scaling upper limit” “Scaling lower limit” “Decimal point” “Control output 1 assignment” “Control output 2 assignment” “Auxiliary output 1 assignment” “Alarm 1 type” “Alarm 2 type” “Alarm 3 type” “Alarm 1 open in alarm” “Alarm 2 open in alarm” “Alarm 3 open in alarm” (setup mode)
  - “Alarm 1 hysteresis” “Alarm 2 hysteresis” “Alarm 3 hysteresis” (level 2 mode)
  - “Standby sequence reset method” (expansion mode)

- Related parameter
  - “AT Execute/Cancel” (level 1 mode)
## Level 1 Mode

### Cooling coefficient

**Conditions of Use**
The control must be heating and cooling control, and advanced PID control.

- In heating and cooling control, P at the cooling side is calculated by the following formula:
  \[ \text{Cooling side } P = \text{cooling coefficient } \times P \]

**Setting Range**

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01 to 99.99</td>
<td>None</td>
<td>1.00</td>
</tr>
</tbody>
</table>

- Related article
  4.1 Selecting the Control Method (page 4-2)
- Related parameter
  “Proportional band” (level 1 mode)

### Dead band

**Conditions of Use**
The control system must be heating and cooling control.

- Sets the output dead band width in a heating and cooling control system. A negative setting sets an overlap band.

**Setting Range**

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>-19.99 to 99.99</td>
<td>%FS</td>
<td>0.00</td>
</tr>
</tbody>
</table>

- Related article
  4.1 Selecting the Control Method (page 4-2)
Manual reset value

**Conditions of Use**
The control must be standard control, advanced PID control, ST must be set to OFF, and the “integral time” parameter must be set to “0”.

- Sets the required manipulated variable to remove offset during stabilization of P or PD control.

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 to 100.0</td>
<td>%</td>
<td>50.0</td>
</tr>
</tbody>
</table>

Hysteresis (heat)

**Conditions of Use**
The control system must be ON/OFF control.

- Sets the hysteresis for ensuring stable operation at ON/OFF switching.
- In standard control, use the “hysteresis (heat)” parameter. The “hysteresis (cool)” parameter cannot be used.
- In heating and cooling control, the hysteresis can be set independently for heating and cooling. Use the “hysteresis (heat)” parameter to set the heating side hysteresis, and use the “hysteresis (cool)” parameter to set the cooling side hysteresis.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hysteresis (heat)</td>
<td>0.01 to 99.99</td>
<td>%FS</td>
<td>0.10</td>
</tr>
<tr>
<td>Hysteresis (cool)</td>
<td>0.01 to 99.99</td>
<td>%FS</td>
<td>0.10</td>
</tr>
</tbody>
</table>

- Related article
  4.1 Selecting the Control Method (page 4-3)
- Related parameters
  “Control output 1 assignment”  “Control output 2 assignment” (setup mode)
  “PID / ON/OFF” (expansion mode)
### Level 1 Mode

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control period (heat)</td>
<td>1 to 99</td>
<td>Second</td>
<td>20</td>
</tr>
<tr>
<td>Control period (cool)</td>
<td>1 to 99</td>
<td>Second</td>
<td>20</td>
</tr>
</tbody>
</table>

#### Conditions of Use
- Relay or voltage output must be set as the outputs, and the control must be set to advanced PID control.

- Sets the pulse output period. Set the control period taking the control characteristics and life expectancy of the controller into consideration.
- In standard control, use the "control period (heat)" parameter. The "control period (cool)" parameter cannot be used.
- In heating and cooling control, the control period can be set independently for heating and cooling. Use the "control period (heat)" parameter to set the heating side control period, and use the "control period (cool)" parameter to set the cooling side control period.

#### Related article
- 3.3 Setting Output Specifications (page 3-5)

#### Related parameters
- "Control output 1 assignment" "Control output 2 assignment" (setup mode)
The parameters in this mode can be used only when the “security” parameter (protect mode) is set to “0” to “2”.

This mode contains the auxiliary parameters for adjusting control. These parameters include parameters for limiting the manipulated variable and set point, parameters for switching between remote and local operation, and parameters for setting the LBA (Loop Break Alarm), alarm hysteresis, and input digital filter values.

To select this mode when in the levels 0 and 1, setup, expansion, option and calibration modes, press the key for 1 second minimum. The display changes to the menu display. If you select using the key then press the key for 1 second minimum, the controller enters the level 2 mode.

To select parameters in this mode, press the key. To change parameter settings, use the or keys.

The following table shows the parameters supported in this mode and the page where the parameter is described.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Name</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>-L</td>
<td>Remote/Local</td>
<td>5-16</td>
</tr>
<tr>
<td>SP_rU</td>
<td>SP ramp time unit</td>
<td>5-16</td>
</tr>
<tr>
<td>SP_rE</td>
<td>SP ramp set value</td>
<td>5-16</td>
</tr>
<tr>
<td>LBA</td>
<td>LBA detection time</td>
<td>5-17</td>
</tr>
<tr>
<td>nu_s</td>
<td>MV at stop</td>
<td>5-17</td>
</tr>
<tr>
<td>nu_e</td>
<td>MV at PV error</td>
<td>5-17</td>
</tr>
<tr>
<td>OL-H</td>
<td>MV upper limit</td>
<td>5-18</td>
</tr>
<tr>
<td>OL-L</td>
<td>MV lower limit</td>
<td>5-18</td>
</tr>
<tr>
<td>orL</td>
<td>MV change rate limit</td>
<td>5-18</td>
</tr>
<tr>
<td>cNF</td>
<td>Input digital filter</td>
<td>5-19</td>
</tr>
<tr>
<td>ALH1</td>
<td>Alarm 1 hysteresis</td>
<td>5-19</td>
</tr>
<tr>
<td>ALH2</td>
<td>Alarm 2 hysteresis</td>
<td>5-19</td>
</tr>
<tr>
<td>ALH3</td>
<td>Alarm 3 hysteresis</td>
<td>5-19</td>
</tr>
<tr>
<td>LNSH</td>
<td>Input shift upper limit (temperature)</td>
<td>5-20</td>
</tr>
<tr>
<td>LOSL</td>
<td>Input shift lower limit (temperature)</td>
<td>5-20</td>
</tr>
</tbody>
</table>
Remote/Local

- Switches between remote and local operation.
- To change the parameter setting during remote operation, use the communications function. To change the parameter setting during local operation, change the setting on the E5CK controller.
- You can check the parameter setting by both communications and on the E5CK controller regardless of whether the controller is switched to remote or local operation.

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]: remote / [ ]: local</td>
<td></td>
</tr>
</tbody>
</table>

SP ramp time unit

- Specifies the change rate during SP ramp operation. Set the maximum permissible change width per unit of time (minute or hour) as the “SP ramp set value”. However, note that when set to “0”, the SP ramp function is disabled.
- The time unit and SP ramp set value are independent of each other. For example, when setting “30 per minute”, set the “SP ramp set value” parameter to “30” and the “SP ramp time unit” parameter to [ ] (“minute”). However, if you change the time unit only to [ ] (“hour”), the set time becomes “30 per hour.”
- During temperature input, the decimal point position of the SP ramp set value is dependent on the currently selected sensor, and during analog input on the results of scaling.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP ramp time unit</td>
<td>[ ]: minute / [ ]: hour</td>
<td>None</td>
<td>$\infty$</td>
</tr>
<tr>
<td>SP ramp set value</td>
<td>0 to 9999</td>
<td>EU</td>
<td>0</td>
</tr>
</tbody>
</table>

During temperature input, the range of the currently selected sensor it taken as the setting range for the “SP ramp set value” parameter.

- Related article
  4.2 Operating Condition Restrictions (page 4-5)
- Related parameters
  “Input type” “Scaling upper limit” “Scaling lower limit” “Decimal point” (setup mode)
The LBA (Loop Break Alarm) function must be assigned as an output.

- This parameter is automatically set by AT execution.
- The LBA is output if the change width of the process value falls below 0.2 % full-scale of the time preset to this parameter when the manipulated variable is set in the "MV upper limit" or "MV lower limit" parameters.
- The LBA function is disabled when this parameter is set to "0".

**Setting Range**

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 9999</td>
<td>Second</td>
<td>0</td>
</tr>
</tbody>
</table>

**Related article**

4.4 LBA (page 4-9)
7.3 How to Use Error Output (page 7-5)

**Related parameters**

"AT Execute/Cancel" (level 1 mode)
"Control output 1 assignment" "Control output 2 assignment" "Auxiliary output 1 assignment" (setup mode)

The "MV at stop" parameter sets the manipulated variable when operation stops.

The "MV at PV error" parameter sets the manipulated variable when an input error occurs.

The setting ranges during standard control and heating and cooling control are different.

The manipulated variable at the cooling side during heating and cooling control is expressed as a negative value.

<table>
<thead>
<tr>
<th>Control Method</th>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>-5.0 to 105.0</td>
<td>%</td>
<td>0</td>
</tr>
<tr>
<td>Heating and cooling</td>
<td>-105.0 to 105.0</td>
<td>%</td>
<td>0</td>
</tr>
</tbody>
</table>

**Related articles**

MV at stop : 3.6 Starting and Stopping Operation (page 3-11)
MV at PV error : 7.2 How to Use the Error Display (page 7-3)
CHAPTER 5 PARAMETERS

MV upper limit
- The "MV upper limit" and "MV lower limit" parameters set the upper and lower limits of the manipulated variable. When the manipulated variable calculated by the E5CK controller is outside of the upper-and lower-limit range, the upper limit or lower limit set to these parameters is output, respectively.

MV lower limit
- The "MV lower limit" parameter sets the upper and lower limits of the manipulated variable. When the manipulated variable calculated by the E5CK controller is outside of the upper-and lower-limit range, the upper limit or lower limit set to these parameters is output, respectively.

MV change rate limit
- The "MV change rate limit" parameter sets the maximum permissible change width per second of the manipulated variable. If a change in the manipulated variable causes this parameter setting to be exceeded, the calculated value is reached while changing the value by the per-second value set in this parameter. The "MV change rate limit" function is disabled when this parameter is set to "0.0".

Control Method

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MV lower limit +0.1 to 105.0</td>
<td>%</td>
<td>105.0</td>
</tr>
<tr>
<td>Heating and cooling</td>
<td>0.0 to 105.0</td>
<td>%</td>
</tr>
</tbody>
</table>

MV lower limit
- The setting ranges during standard control and heating and cooling control are different. Also, the manipulated variable at the cooling side during heating and cooling control is expressed as a negative value.

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-5.0 to MV upper limit +0.1</td>
<td>%</td>
<td>-5.0</td>
</tr>
<tr>
<td>Heating and cooling</td>
<td>-105.0 to 0.0</td>
<td>%</td>
</tr>
</tbody>
</table>

MV change rate limit
- The setting ranges during standard control and heating and cooling control are different. Also, the manipulated variable at the cooling side during heating and cooling control is expressed as a negative value.

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 to 100.0</td>
<td>%</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Related article
4.2 Operating Condition Restrictions (page 4-4)
**Input digital filter**

- Sets the time constant of the input digital filter. The following figures shows the effect on data after passing through the digital filter.

![Diagram of input digital filter](image)

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 9999</td>
<td>Second</td>
<td>0</td>
</tr>
</tbody>
</table>

**Alarm 1 hysteresis**

*This parameter is for checking the hysteresis of alarm outputs 1 to 3.*

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01 to 99.99</td>
<td>%FS</td>
<td>0.02</td>
</tr>
</tbody>
</table>

**Alarm 2 hysteresis**

**Alarm 3 hysteresis**

*Conditions of Use*

Alarms must be assigned as outputs. For example, if alarm outputs 1 and 2 only are assigned as outputs, the “alarm 3 hysteresis” parameter cannot be used.

- Related article
  - 3.4 Setting Alarm Type (page 3-7)
- Related parameters
  - “Alarm 1 type” “Alarm 2 type” “Alarm 3 type” “Alarm 1 open in alarm” “Alarm 2 open in alarm” “Alarm 3 open in alarm” (setup mode)
  - “Alarm value 1” “Alarm value 2” “Alarm value 3” (level 1 mode)
**Level 2 Mode**

- **Input shift upper limit**
  - **Function**: Sets each of the shift amounts for the input shift upper limit values.
  - **Setting Range**: -199.9 to 999.9
  - **Unit**: °C or °F
  - **Default**: 0.0

- **Input shift lower limit**
  - **Conditions of Use**: The input type must be set to temperature input (thermocouple or platinum resistance thermometer).
  - **Function**: Sets each of the shift amounts for the input shift lower limit values.
  - **Setting Range**: -199.9 to 999.9
  - **Unit**: °C or °F
  - **Default**: 0.0

- **Related article**: 3.2 Setting Input Specifications (page 3-3)
- **Related parameter**: “Input type” (setup mode)
• The parameters in this mode can be used only when the “security” parameter (pro-
tect mode) is set to “0” and “1”.
• This mode contains the parameters for setting the basic specifications of the E5CK
controller. These parameters include parameters for specifying the input type, scal-
ing, output assignments, and direct/reverse operation.
• To select this mode when in the levels 0 to 2, expansion, option and calibration modes,
press the [ ] key for 1 second minimum. The display changes to the menu display.
If you select [Setup] using the [ ] key then press the [ ] key for 1 second mini-
mum, the controller enters the setup mode.
• To select parameters in this mode, press the [ ] key. To change parameter settings,
use the [ ] or [ ] keys.
• The following table shows the parameters supported in this mode and the page where
the parameter is described.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Name</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{In} )</td>
<td>Input type</td>
<td>5-22</td>
</tr>
<tr>
<td>( \text{In-H} )</td>
<td>Scaling upper limit</td>
<td>5-23</td>
</tr>
<tr>
<td>( \text{In-L} )</td>
<td>Scaling lower limit</td>
<td>5-23</td>
</tr>
<tr>
<td>( dP )</td>
<td>Decimal point</td>
<td>5-23</td>
</tr>
<tr>
<td>( \text{C}/\text{F} ) selection</td>
<td>Parameter initialize</td>
<td>5-23</td>
</tr>
<tr>
<td>( \text{Out-1} )</td>
<td>Control output 1 assignment</td>
<td>5-24</td>
</tr>
<tr>
<td>( \text{Out-2} )</td>
<td>Control output 2 assignment</td>
<td>5-24</td>
</tr>
<tr>
<td>( \text{Sub-1} )</td>
<td>Auxiliary output 1 assignment</td>
<td>5-25</td>
</tr>
<tr>
<td>( \text{AL-1} )</td>
<td>Alarm 1 type</td>
<td>5-25</td>
</tr>
<tr>
<td>( \text{AL-1A} )</td>
<td>Alarm 1 open in alarm</td>
<td>5-26</td>
</tr>
<tr>
<td>( \text{AL-1B} )</td>
<td>Alarm 2 type</td>
<td>5-25</td>
</tr>
<tr>
<td>( \text{AL-1B} )</td>
<td>Alarm 2 open in alarm</td>
<td>5-26</td>
</tr>
<tr>
<td>( \text{AL-3} )</td>
<td>Alarm 3 type</td>
<td>5-25</td>
</tr>
<tr>
<td>( \text{AL-3A} )</td>
<td>Alarm 3 open in alarm</td>
<td>5-26</td>
</tr>
<tr>
<td>( \text{Dr.E} )</td>
<td>Direct/Reverse operation</td>
<td>5-26</td>
</tr>
</tbody>
</table>
### Setup Mode

#### Input type

- Match the setting (software) of this parameter with the setting (hardware) of the input type jumper connector.
- Set the input types to be connected to terminal Nos. 6 to 8 by the input type codes in the table below.
- Set the code according to the following table. Default is “2: K1 thermocouple”.

<table>
<thead>
<tr>
<th>Set value</th>
<th>Input Type</th>
<th>Jumper Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Pt</td>
<td>-199.9 to 650.0 (°C) / -199.9 to 999.9 (°F)</td>
</tr>
<tr>
<td>1</td>
<td>K1</td>
<td>-200 to 1300 (°C) / -300 to 2300 (°F)</td>
</tr>
<tr>
<td>2</td>
<td>K2</td>
<td>0.0 to 500.0 (°C) / 0.0 to 900.0 (°F)</td>
</tr>
<tr>
<td>3</td>
<td>J1</td>
<td>-100 to 850 (°C) / -100 to 1500 (°F)</td>
</tr>
<tr>
<td>4</td>
<td>J2</td>
<td>0.0 to 400.0 (°C) / 0.0 to 750.0 (°F)</td>
</tr>
<tr>
<td>5</td>
<td>T</td>
<td>-199.9 to 600.0 (°C) / -199.9 to 700.0 (°F)</td>
</tr>
<tr>
<td>6</td>
<td>L1</td>
<td>-199.9 to 850 (°C) / -199.9 to 1500 (°F)</td>
</tr>
<tr>
<td>7</td>
<td>L2</td>
<td>0.0 to 400.0 (°C) / 0.0 to 750.0 (°F)</td>
</tr>
<tr>
<td>8</td>
<td>N</td>
<td>-200 to 1300 (°C) / -300 to 2300 (°F)</td>
</tr>
<tr>
<td>9</td>
<td>R</td>
<td>0 to 1700 (°C) / 0 to 3200 (°F)</td>
</tr>
<tr>
<td>10</td>
<td>S</td>
<td>0 to 1700 (°C) / 0 to 3200 (°F)</td>
</tr>
<tr>
<td>11</td>
<td>B</td>
<td>100 to 1800 (°C) / 200 to 3300 (°F)</td>
</tr>
<tr>
<td>12</td>
<td>W</td>
<td>0 to 2300 (°C) / 0 to 4100 (°F)</td>
</tr>
<tr>
<td>13</td>
<td>PLcu</td>
<td>0 to 1800 (°C) / 0 to 3300 (°F)</td>
</tr>
<tr>
<td>14</td>
<td>4 to 20mA</td>
<td>-199.9 to 850 (°C) / -199.9 to 1500 (°F)</td>
</tr>
<tr>
<td>15</td>
<td>0 to 20mA</td>
<td>-199.9 to 850 (°C) / -199.9 to 1500 (°F)</td>
</tr>
<tr>
<td>16</td>
<td>1 to 5V</td>
<td>-199.9 to 850 (°C) / -199.9 to 1500 (°F)</td>
</tr>
<tr>
<td>17</td>
<td>0 to 5V</td>
<td>-199.9 to 850 (°C) / -199.9 to 1500 (°F)</td>
</tr>
<tr>
<td>18</td>
<td>0 to 10V</td>
<td>-199.9 to 850 (°C) / -199.9 to 1500 (°F)</td>
</tr>
</tbody>
</table>

- **Platinum resistance thermometer**
- **Thermocouple**

**Related article**

3.2 Setting Input Specifications (page 3-3)

**Related parameters**

- When input type is set to temperature input: “C/F selection” (setup mode)
- When input type is set to voltage input or current input: “Scaling upper limit” “Scaling lower limit” “Decimal point” (setup mode)
Scaling upper limit

Scaling lower limit

Decimal point

- This parameter can be used only when voltage input or current input is selected as the input type.
- When voltage input or current input is selected as the input type, scaling is carried out. Set the scaling upper limit in the “scaling upper limit” parameter and the scaling lower limit in the “scaling lower limit” parameter.
- The “decimal point” parameter specifies the decimal point position of parameters (set point, etc.) whose unit is set to EU (Engineering Unit).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scaling upper limit</td>
<td>+1 to 9999</td>
<td>EU</td>
<td>100</td>
</tr>
<tr>
<td>Scaling lower limit</td>
<td>-1999 to scaling upper limit-1</td>
<td>EU</td>
<td>0</td>
</tr>
</tbody>
</table>

- Decimal point : default : 0

<table>
<thead>
<tr>
<th>Set Value</th>
<th>Setting</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 digits past decimal point</td>
<td>1234</td>
</tr>
<tr>
<td>1</td>
<td>1 digit past decimal point</td>
<td>123.4</td>
</tr>
<tr>
<td>2</td>
<td>2 digits past decimal point</td>
<td>12.34</td>
</tr>
<tr>
<td>3</td>
<td>3 digits past decimal point</td>
<td>1.234</td>
</tr>
</tbody>
</table>

- Related article
  3.2 Setting Input Specifications (page 3-3)
- Related parameter
  “Input type” (setup mode)

Parameter initialize

- Returns parameter settings to their defaults. However, note that the following parameters are not affected by execution of this parameter: “input type”, “scaling upper limit”, “scaling lower limit”, “decimal point” and “°C/°F selection”.
- When this parameter is selected, [NO] (“no”) is first displayed. To initialize parameters, press the key to specify [YES] (“yes”).
CHAPTER 5 PARAMETERS

E5CK

5-24

C/F selection

Conditions of Use
The input type must be set to temperature input (thermocouple or platinum resistance thermometer).

- This parameter can be used when thermocouple or platinum resistance thermometer is selected as the input type.
- Set the temperature input unit to either of “°C” or “°F”.

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C / °F</td>
<td>°C</td>
</tr>
</tbody>
</table>

• Related article
3.2 Setting Input Specifications (page 3-3)

• Related parameter
“Input type” (setup mode)

Control output 1 assignment

- Assigns the output functions to either of control output 1 or 2.
- The following six output functions can be assigned as outputs:
  Control output (heat), Control output (cool), Alarms 1 to 3, and LBA.
- Errors 1 and 2 cannot be assigned as outputs.
- When the output function assigned to control output 1 is ON, the OUT1 LED lights. However, note that the OUT1 LED does not light when control output (heat) or control output (cool) are assigned to linear outputs such as current and voltage.
- When the output function assigned to control output 2 is ON, the OUT2 LED lights.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>H</th>
<th>E</th>
<th>R</th>
<th>L</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>LBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Control output (heat)</td>
<td>Control output (cool)</td>
<td>Alarm 1</td>
<td>Alarm 2</td>
<td>Alarm 3</td>
<td>LBA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

 Defaults:
“Control output 1” = [H E R L], “Control output 2” = [R1 R2 R3 LBA]

• Related article
3.3 Setting Output Specifications (page 3-5)

• Related parameters
  • Alarm-related parameters
  • Heating and cooling related parameter
  “LBA detection time” (level 2 mode)
Auxiliary output 1 assignment

- Assigns output functions to auxiliary output 1. The following six output functions can be assigned as outputs:
  - Alarms 1 to 3, LBA, Error 1 (input error), and Error 2 (A/D converter error).
- Control output (heat) and control output (cool) cannot be assigned as outputs.
- When the output function assigned to auxiliary output 1 is ON, the SUB1 LED lights.

### Symbol

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm 1</td>
<td>AL</td>
</tr>
<tr>
<td>Alarm 3</td>
<td>AL</td>
</tr>
<tr>
<td>Error 1</td>
<td>E</td>
</tr>
</tbody>
</table>

Defaults: [AL, AL, LB, E, E]

- Related article
  - 3.3 Setting Output Specifications (page 3-5)
- Related parameter
  - Alarm-related parameter
  - "LBA detection time" (level 2 mode)

### Conditions of Use

Alarms must be assigned as outputs. For example, if alarm outputs 1 and 2 only are assigned as outputs, the "alarm 3 type" parameter cannot be used.

### Alarm 1 type

- "Alarm 1 to 3 type" parameters specify the operation of the alarm by the one of the set values in the following table. For details of operation at an alarm, see page 3-7.

<table>
<thead>
<tr>
<th>Set Value</th>
<th>Settings</th>
<th>Set Value</th>
<th>Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Upper-and lower-limit alarm (deviation)</td>
<td>7</td>
<td>Lower-limit alarm with standby sequence (deviation)</td>
</tr>
<tr>
<td>2</td>
<td>Upper-limit alarm (deviation)</td>
<td>8</td>
<td>Absolute-value upper-limit alarm</td>
</tr>
<tr>
<td>3</td>
<td>Lower-limit alarm (deviation)</td>
<td>9</td>
<td>Absolute-value lower-limit alarm</td>
</tr>
<tr>
<td>4</td>
<td>Upper-and lower-limit range alarm (deviation)</td>
<td>10</td>
<td>Absolute-value upper-limit alarm with standby sequence</td>
</tr>
<tr>
<td>5</td>
<td>Upper-and lower-limit alarm with standby sequence (deviation)</td>
<td>11</td>
<td>Absolute-value lower-limit alarm with standby sequence</td>
</tr>
<tr>
<td>6</td>
<td>Upper-limit alarm with standby sequence (deviation)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Defaults: Deviation upper limit

- Related article
  - 3.4 Setting Alarm Type (page 3-7)
- Related parameters
  - "Alarm value 1" "Alarm value 2" "Alarm value 3" (level 1 mode)
  - "Alarm 1 hysteresis" "Alarm 2 hysteresis" "Alarm 3 hysteresis" (level 2 mode)
  - "Alarm 1 open in alarm" "Alarm 2 open in alarm" "Alarm 3 open in alarm" "Control output 1 assignment" "Control output 2 assignment" (setup mode)
**Setup Mode**

**Alarm 1 open in alarm**

- Selects the output states of alarms 1 to 3.
- When the controller is set to "close in alarm," the status of the alarm output function is output as is. When set to "open in alarm," the status of the alarm output function is output inverted. The following table shows the relationship between alarm output functions, output and output LEDs.

<table>
<thead>
<tr>
<th>Alarm Status</th>
<th>Output Status</th>
<th>Output LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close in alarm</td>
<td>OFF</td>
<td>Not lit</td>
</tr>
<tr>
<td>Open in alarm</td>
<td>ON</td>
<td>Lit</td>
</tr>
</tbody>
</table>

**Conditions of Use**

Alarms must be assigned as outputs. For example, if alarm outputs 1 and 2 only are assigned as outputs, the "alarm 3 open in alarm" parameter cannot be used.

**Direct/Reverse operation**

- "Direct operation" (or normal operation) refers to control where the manipulated variable is increased according to the increase in the process value. Alternatively, "reverse operation" refers to control where the manipulated variable is increased according to the decrease in the process value.

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct operation</td>
<td>Reverse operation</td>
</tr>
</tbody>
</table>

**Related article**

3.3 Setting Output Specifications (page 3-5)
• The parameters in this mode can be used only when the “security” parameter (pro-
tect mode) is set to “0” and “1”.
• This mode contains the parameters for setting expanded functions. These param-
ters include parameters for setting ST (self-tuning), setting the SP setting limiter,
selecting advanced PID and ON/OFF control, specifying the standby sequence reset
method, and automatic return of display mode.
• To select this mode when in the levels 0 to 2, setup, option and calibration modes,
press the [MOD] key for 1 second minimum. The display changes to the menu display.
If you select [MOD] using the [MOD] key then press the [MOD] key for 1 second mini-
mum, the controller enters the expansion mode.
• To select parameters in this mode, press the [MOD] key. To change parameter settings,
use the [ACS] or [MOD] keys.
• The following table shows the parameters supported in this mode and the page where
the parameter is described.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Name</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL-H</td>
<td>Set point upper limit</td>
<td>5-28</td>
</tr>
<tr>
<td>SL-L</td>
<td>Set point lower limit</td>
<td>5-28</td>
</tr>
<tr>
<td>ENT</td>
<td>PID / ON/OFF</td>
<td>5-28</td>
</tr>
<tr>
<td>ST</td>
<td>ST</td>
<td>5-29</td>
</tr>
<tr>
<td>SL-b</td>
<td>ST stable range</td>
<td>5-29</td>
</tr>
<tr>
<td>ALFA</td>
<td>α</td>
<td>5-29</td>
</tr>
<tr>
<td>AB-G</td>
<td>AT calculated gain</td>
<td>5-30</td>
</tr>
<tr>
<td>REST</td>
<td>Standby sequence reset method</td>
<td>5-30</td>
</tr>
<tr>
<td>AR</td>
<td>Automatic return of display mode</td>
<td>5-31</td>
</tr>
<tr>
<td>AB-H</td>
<td>AT hysteresis</td>
<td>5-31</td>
</tr>
<tr>
<td>LBA</td>
<td>LBA detection width</td>
<td>5-31</td>
</tr>
</tbody>
</table>
**Expansion Mode**

- Set point upper limit
- Set point lower limit

- Limits the upper and lower limits of the set point. When the set point exceeds the settings of the "Set point upper limit" and "Set point lower limit" parameters, the E5CK controller regards the settings of the "Set point upper limit" and "Set point lower limit" parameters as the set points.
- When the input type is changed to temperature input, the set point upper and lower limits are changed to the upper and lower limits of the currently selected sensor. And when the input type is changed to analog input, the set point upper and lower limits are changed to the scaling upper and lower limits.
- During temperature input, the decimal point position is dependent on the currently selected sensor, and during analog input on the results of scaling.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP setting upper limit</td>
<td>SP setting lower limit +1 to scaling upper limit</td>
<td>EU</td>
<td>1300</td>
</tr>
<tr>
<td>SP setting lower limit</td>
<td>Scaling lower limit to SP setting upper limit -1</td>
<td>EU</td>
<td>-200</td>
</tr>
</tbody>
</table>

During temperature input, the range becomes the range of use of the selected sensor instead of the scaling upper and lower limit values.

- Related article
  4.2 Operating Condition Restrictions (page 4-5)
- Related parameters
  "Input type" "Scaling upper limit" "Scaling lower limit" "Decimal point" (setup mode)

**PID / ON/OFF**

- Selects advanced PID or ON/OFF control.

- Related article
  4.1 Selecting the Control Method (page 4-3)
- Related parameters
  "Hysteresis (heat)" "Hysteresis (cool)" (level 1 mode)
### Expansion Mode

#### ST

**Parameter:** ST function<br>**Function:** ST<br>**Comment:** ST stable range<br>**Setting Range:** 0.1 to 999.9<br>**Unit:** °C or °F<br>**Default:** 15.0

- **Conditions of Use:**<br>  - The input type must be set to temperature input, and the control must be either standard control or advanced PID control.
  - When the “ST” parameter is set to “ON”, the self-tuning (ST) function is active. During operation of the ST function, the power on the load side connected to the control output must be turned ON at the same time or before start of E5CK operation.
  - The “ST stable range” parameter sets the stable range width during self-tuning. However, note that this parameter cannot be used when the “ST” parameter is set to “OFF”.

- **Related article:** Fuzzy self-tuning (page A-10)
- **Related parameters:**<br>  - “Input type” (setup mode)<br>  - “PID / ON/OFF” (expansion mode)

#### ALF

**Parameter:** ALF<br>**Function:** ALF<br>**Comment:** ALF<br>**Setting Range:** 0.00 to 1.00<br>**Unit:** None<br>**Default:** 0.65

- **Conditions of Use:**<br>  - The control must be advanced PID control, and ST must be set to OFF.

- **Related parameter:**<br>  - “PID / ON/OFF” (expansion mode)
**Expansion Mode**

### AT calculated gain

**Conditions of Use**
The control must be advanced PID control, and ST must be set to OFF.

- Sets the gain when adjusting the PID parameters by auto-tuning.
- To give priority to response, decrease the set value of this parameter. To give priority to stability, increase the set value of this parameter.

**Setting Range**

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 to 10.0</td>
<td>None</td>
<td>1.0</td>
</tr>
</tbody>
</table>

- Related parameters
  - "AT Execute/Cancel" (level 1 mode)
  - "PID / ON/OFF" (expansion mode)

### Standby sequence reset method

- Selects the conditions for enabling reset after the standby sequence of the alarm has been canceled.
  - Condition A:
    Control started (including power ON), and set point, alarm value or input shift value changed, and when set points 1 and 2 are switched.
  - Condition B:
    Power ON

**Setting Range**

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Condition A / 1: Condition B</td>
<td>0</td>
</tr>
</tbody>
</table>

- Related parameters
  - "Alarm 1 type" "Alarm 2 type" "Alarm 3 type" (setup mode)
Automatic return of display mode

- If you do not operate any of the controller keys for the time set in this parameter when in levels 0 to 2 modes, the display automatically returns to the PV/SP display.
- When this parameter is set to “0”, this function is disabled.
- This parameter is invalid while the menu is displayed.

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 99</td>
<td>Second</td>
<td>0</td>
</tr>
</tbody>
</table>

AT hysteresis

- The levels of limit cycle operations during AT execution are given hysteresis at event ON/OFF switching. This parameter sets this hysteresis width.

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 to 9.9</td>
<td>%FS</td>
<td>0.2</td>
</tr>
</tbody>
</table>

LBA detection width

- This parameter can be used when LBA is assigned as an output.
- When the change width of the manipulated variable is below the width set in this parameter, the controller regards this as detection of an LBA.

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 to 999.9</td>
<td>%FS</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Conditions of Use

- The control must be advanced PID control, and ST must be set to OFF.
- The LBA (Loop Break Alarm) function must be assigned as an output.
The parameters in this mode can be used only when the “security” parameter (pro-
tect mode) is set to “0” and “1”.

You can select this mode only when the option unit is set in the controller. In this
mode, you can set the communications conditions, transfer output and event input
parameters to match the type of option unit set in the controller.

To select this mode when in the levels 0 to 2, setup, expansion and calibration modes,
press the key for 1 second minimum. The display changes to the menu display.
If you select using the key then press the key for 1 second mini-
imum, the controller enters the option mode.

To select parameters in this mode, press the key. To change parameter settings,
use the or keys.

The following table shows the parameters supported in this mode and the page where
the parameter is described.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Name</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>E5CK</td>
<td>Multi-SP function</td>
<td>5-33</td>
</tr>
<tr>
<td>E5-1</td>
<td>Event input assignment 1</td>
<td>5-33</td>
</tr>
<tr>
<td>Sbtt</td>
<td>Communication stop bit</td>
<td>5-34</td>
</tr>
<tr>
<td>Len</td>
<td>Communication data length</td>
<td>5-34</td>
</tr>
<tr>
<td>Prty</td>
<td>Communication parity</td>
<td>5-34</td>
</tr>
<tr>
<td>Bps</td>
<td>Communication baud rate</td>
<td>5-34</td>
</tr>
<tr>
<td>U-n</td>
<td>Communication unit No.</td>
<td>5-34</td>
</tr>
<tr>
<td>Tr-t</td>
<td>Transfer output type</td>
<td>5-35</td>
</tr>
<tr>
<td>Tr-H</td>
<td>Transfer output upper limit</td>
<td>5-35</td>
</tr>
<tr>
<td>Tr-L</td>
<td>Transfer output lower limit</td>
<td>5-35</td>
</tr>
</tbody>
</table>
### Multi-SP function

**Conditions of Use**
The event input function must be in use.

- This parameter specifies the number of set points (SP) when using the multi-SP function. When set to "0", the multi-SP function cannot be used.

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1</td>
<td>None</td>
<td>0</td>
</tr>
</tbody>
</table>

- Related article
  4.3 How to Use Option Functions (4-7)

- Related parameter
  "Event input assignment 1" (option mode)

- Option unit
  Event input unit (E53-CKB)

### Event input assignment 1

**Conditions of Use**
Event input must be specified when the event input function is in use.

- This parameter specifies event input other than the multi-SP function. The following two functions can be specified:
  - Run/Stop and Manual/Auto.
- Event input is disabled while the menu is displayed.
  It is also disabled in set up, expansion, option and calibration modes.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Function</th>
<th>Event Input Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>⏺ ⏺</td>
<td>Run/Stop</td>
<td>ON: Stop, OFF : Run</td>
</tr>
<tr>
<td>⏺ ⏺</td>
<td>Manual/Auto</td>
<td>ON: Manual, OFF : Auto</td>
</tr>
</tbody>
</table>

- Related article
  4.3 How to Use Option Functions (page 4-7)

- Related parameter
  "Event input assignment 1" (option mode)

- Option unit
  Event input unit (E53-CKB)
CHAPTER 5 PARAMETERS

Communication stop bit
Communication data length
Communication parity
Communication baud rate
Communication unit No.

Conditions of Use
The communications function must be in use.

These parameters set the communications conditions. Make sure that the stop bit, data length, parity and baud rate of the host computer and the E5CK controller are matching. These parameters are valid when the power is turned ON again or when level 0 to 2 modes are switched.

When connecting two or more E5CK controllers to the host computer, set unit Nos. that will not conflict with the unit Nos. of other controllers.

“Communication stop bit” parameter

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>bits</td>
<td>2</td>
</tr>
</tbody>
</table>

“Communication data length” parameter

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>7, 8</td>
<td>bits</td>
<td>7</td>
</tr>
</tbody>
</table>

“Communication parity” parameter

<table>
<thead>
<tr>
<th>Setting</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Even</td>
</tr>
<tr>
<td>Even</td>
<td>Odd</td>
</tr>
<tr>
<td>Odd</td>
<td></td>
</tr>
</tbody>
</table>

“Communication baud rate” parameter

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2, 2.4, 4.8, 9.6, 19.2</td>
<td>kbps</td>
<td>9.6</td>
</tr>
</tbody>
</table>

“Communication unit No.” parameter

<table>
<thead>
<tr>
<th>Setting Range</th>
<th>Unit</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 99</td>
<td>None</td>
<td>0</td>
</tr>
</tbody>
</table>

Related article
Capter 6 Using the Communications Function (page 6-1)

Related parameter
“Remote/Local” (level 2 mode)

Option unit
RS-232C unit (E53-CK01), RS-485 unit (E53-CK03)
### Conditions of Use

The transfer output function must be in use.

### Transfer output type

These parameters set the transfer output conditions.

- The “transfer output type” parameter selects one of the following as the transfer output type, and assigns this to transfer output:
  - Set point
  - Set point during SP ramp
  - Process value
  - Manipulated variable (heat)
  - Manipulated variable (cool)

  However, note that “manipulated variable (cool)” can be selected only during heating and cooling control.

- The “transfer output upper limit” and “transfer output lower limit” parameters are used for scaling of transfer output. The setting range varies according to the output data. Also, a lower limit value larger than the upper limit value may be set.

- During temperature input, the decimal point position of the set point, set point during SP ramp or process value is dependent on the currently selected sensor, and during analog input on the results of scaling.

<table>
<thead>
<tr>
<th>Transfer Type</th>
<th>Transfer Output Lower Limit to Transfer Output Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$SP$</td>
<td>Set point, set point lower limit to set point upper limit</td>
</tr>
<tr>
<td>$SP \cdot\cdot\cdot$</td>
<td>Set point during SP ramp, set point lower limit to set point upper limit</td>
</tr>
<tr>
<td>$PV$</td>
<td>Process value, scaling lower limit to scaling upper limit</td>
</tr>
<tr>
<td>$\overline{a}$</td>
<td>Manipulated variable (heat), 0.0% to 105.0%</td>
</tr>
<tr>
<td>$\overline{\overline{a}}$</td>
<td>Manipulated variable (cool), 0.0% to 105.0%</td>
</tr>
</tbody>
</table>

- The output ranges of the set point, set point during SP ramp or process value when temperature input is selected are the ranges supported by the selected sensor.

- When you have selected the “manipulated variable (heat)” parameter, the transfer output lower limit during heating and cooling control becomes “0.0”.

### Related article

- 4.3 How to Use Option Functions (page 4-8)

### Option unit

Transfer output unit (E53-CKF)
The parameters in this mode can be used only when the “security” parameter (protect mode) is set to “0”. When selecting this mode for the first time after the E5CK has left the factory, return the “security” parameter to “0”.

This mode contains the parameters for user calibration of inputs and outputs. Only parameters relating to input types specified in the “input type” parameter (setup mode) can be used. Also, related output parameters can be used only when the communications unit (E53-CKF) is added on.

To select this mode when in the levels 0 to 2, setup, expansion and option modes, press the key for 1 second minimum. The display changes to the menu display. If you select \[ \text{using the key then press the key for 1 second minimum, the controller enters the calibration mode.} \]

For details on parameters in the calibration mode, see 4.5 Calibration (page 4-11).
This chapter mainly describes communications with a host computer and communications commands.

6.1 Outline of the Communications Function ........ 6–2
Outline ........................................ 6–2
Transfer procedure ............................ 6–2
Interface ...................................... 6–2

6.2 Preparing for Communications .......... 6–3
Cable connections ............................. 6–3
Setting the communications specifications ........ 6–4

6.3 Command Configuration ................ 6–5

6.4 Commands and Responses ............ 6–6
Reading/writing parameters .............. 6–6
Issuing special commands ............... 6–9

6.5 How to Read Communications 
Error Information ........................... 6–10
Undefined error ............................... 6–11

6.6 Program Example ...................... 6–12
How to use programs ....................... 6–12
Program list (language: IBM PC) ........ 6–13
Examples of use ............................. 6–14
6.1 Outline of the Communications Function

The communications function allows you to monitor and set E5CK parameters by a program prepared and running on a host computer connected to the E5CK controller. This chapter describes operations as viewed from the host computer.

When using the communications function, the option unit for RS-232C or RS-485 communications must be added on. The E5CK communications function allows you to carry out the following:

• Reading/writing of parameters;
• Operation instructions; and
• Selecting the setting level.

The communications function assumes the following conditions:

• Writing of parameters is possible in during remote operation. Also, parameters cannot be written during execution of auto-tuning;
• Writing parameters are provided with a setting level. Writing conditions are as follows depending on the setting level:
  - Setting level 1: No restrictions
  - Setting level 0: Writing of parameters in the setup and expansion modes only is prohibited.
• For details on switching between setting levels, see page 6-9.
• The “run/stop”, “remote/local” and “AT execute/cancel” parameters are set aside from other parameters as special commands for instructing operations.

The host computer sends a “command frame” to the controller, and the controller returns a “response frame” corresponding to the content of the command sent by the host computer. In other words, a response frame is returned for each command frame sent.

The following diagram shows command frame/response frame operations.

The host computer carries out communications conforming to the RS-232C or RS-485 interface specifications.

Option units supporting the RS-232C and RS-485 specifications are as follows:

• Option units
  - E53-CK01 (RS-232C)
  - E53-CK03 (RS-485)
6.2 Preparing for Communications

For details on wiring when using the communications, see Chapter 2 Preparations.

Cable connections

- **RS-232C**
  - Only one controller can be connected to the host computer.
  - The cable length should not exceed 15 meters.
  - Use shielded twisted-pair cables (AWG28 or more) for the cables.

- **RS-485**
  - Up to 32 controllers including a computer can be connected to the host computer.
  - The total cable length should not exceed 500 meters.
  - Use shielded twisted-pair cables (AWG28 or more) for the cables.
  - Attach terminators to the controllers at both ends of a series of controllers connected in an open configuration. For example, in the following configuration, connect the terminator to the host unit and the unit No.30, and do not connect terminators to unit Nos.0 to 29.
  - Use terminators having a resistance of 120Ω (1/2 W). The total resistance of both ends should be at least 54Ω.
CHAPTER 6 USING THE COMMUNICATIONS FUNCTION

Setting the communications specifications

Match the communications specifications of the host computer and E5CK controller. When two or more controllers are connected to the host computer, make sure that the communications specifications of all controllers are the same.

This section describes how to set the communications specifications of the E5CK controller. For details on the host computer, see the relevant manual supplied with the host computer.

Communications parameters

Set the communications specifications of the E5CK in the controller’s communications parameters. The communications parameters are set on the front panel of the E5CK controller.

The following table shows the communications parameters provided on the E5CK controller and their respective settings.

<table>
<thead>
<tr>
<th>Parameter/Symbol</th>
<th>Setting</th>
<th>Set Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit No.</td>
<td>0 to 99</td>
<td>0 to 99</td>
</tr>
<tr>
<td>Baud rate</td>
<td>1.2/2.4/4.8/9.6/19.2 (kbps)</td>
<td>1.2/2.4/4.8/9.6/19.2</td>
</tr>
<tr>
<td>Bit length</td>
<td>7/8 (bit)</td>
<td>7/8</td>
</tr>
<tr>
<td>Parity</td>
<td>None/even/odd</td>
<td>None/even/odd</td>
</tr>
<tr>
<td>Stop bit</td>
<td>1/2</td>
<td>1/2</td>
</tr>
</tbody>
</table>

Inverted items are factory-settings.
6.3 Command Configuration

Command configuration is as follows and are paired with a response.

**Command**

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Command code</th>
<th>Data</th>
<th>FCS</th>
<th>*CR</th>
</tr>
</thead>
</table>

**Response**

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Command code</th>
<th>End code</th>
<th>Data</th>
<th>FCS</th>
<th>*CR</th>
</tr>
</thead>
</table>

- **“@”**
  - The start character. This character must be inserted before the leading byte.
- **Unit No.**
  - Specifies the “unit No.” of the E5CK. If there are two or more transmission destinations, specify the desired destination using “unit No.”
- **Command type**
  - Specifies the command type by codes “1” to “3”: parameter read, parameter write and special commands.
- **Command code**
  - Specifies the command for each command type. With parameter read/write commands, this becomes the parameter No.
- **Data**
  - Specifies the set value or setting content. In the parameter read command, set dummy data “0000”. In the response, this is inserted only when the end code is “00”.
- **End code**
  - Sets the communication results. For details on the types and meanings of end codes, see 6.5 How to Read Communications Error Information (page 6-10).
- **FCS (Frame Check Sequence)**
  - Set the frame check results from the start character to the data section. For details on the frame check, see 6.6 Program Example (page 6-12).
- **“*” “CR (Carriage Return) code”**
  - Indicates the end (terminator) of the command or response block.
CHAPTER 6 USING THE COMMUNICATIONS FUNCTION

6.4 Commands and Responses

This section describes commands and response in detail. The conventions used in this section and data restrictions are as follows:

- Data is expressed in 1-byte units and in ASCII code.
- When the read or write data is a numerical value, the data to be set must conform to the following conditions:
  1. The decimal point "." is not indicated in fractions.
  2. The leftmost bit of minus numerical data must be expressed as follows:

\[ \text{example} \]

-10.0=[0100], -150.0=[A500], -15=[F015]

Reading/writing parameters

### Reading parameters

<table>
<thead>
<tr>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Command Diagram]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Response Diagram]</td>
</tr>
</tbody>
</table>

Writing parameters

<table>
<thead>
<tr>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Command Diagram]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Response Diagram]</td>
</tr>
</tbody>
</table>

- Reading or writing of the parameters of a specified controller is executed.
- Writing is possible only during remote operation.
- Reading is impossible during executing auto-tuning.
- The followings are set aside as special commands. For details, see page 6-9.

- "run/stop", "remote/local", "AT execute/cancel"
- For details on parameters in each setting level, see the tables on pages 6-7 and 6-8.

Writing the Set Value

With X format “MA” and “ME” commands (see page A-I), you can select non-volatile RAM or RAM as the memory for the set value. The limit for the number of times that non-volatile RAM can be written to is 100,000 times. When the number of times that the set point is written exceeds this limit, set RAM write mode as the memory.
### Parameter No. | Parameter | Data Setting and Monitor Range | Mode
--- | --- | --- | ---
00 | PV monitor | Scaling lower limit -10% to scaling upper limit +10% | Level 0
86 | SP monitor during SP ramp | Set point lower limit to set point upper limit | Level 0
04 | MV monitor (heat) | -5.0 to 105.0 | Level 0
42 | MV monitor (cool) | 0.0 to 105.0 | Level 0
01 | Set point | Set point lower limit to set point upper limit | Level 0
02 | Alarm value 1 | -1999 to 9999 | Level 1
03 | Alarm value 2 | -1999 to 9999 | Level 1
41 | Alarm value 3 | -1999 to 9999 | Level 1
19 | Proportional band | 0.1 to 9999.9 | Level 1
20 | Integral time | 0 to 3999 | Level 1
21 | Derivative time | 0 to 3999 | Level 1
22 | Cooling coefficient | 0.01 to 99.99 | Level 1
09 | Dead band | -19.99 to 99.99 | Level 1
23 | Manual reset value | 0.0 to 100.0 | Level 1
06 | Hysteresis (heat) | 0.01 to 99.99 | Level 1
43 | Hysteresis (cool) | 0.01 to 99.99 | Level 1
07 | Control period (heat) | 1 to 99 | Level 1
08 | Control period (cool) | 1 to 99 | Level 1
44 | SP ramp time unit | 0: Minutes, 1: Hours | Level 2
45 | SP ramp set value | 0 to 9999 | Level 2
46 | LBA detection time | 0 to 9999 | Level 2
47 | MV at stop | -5.0 to 105.0 | Level 2
48 | MV at PV error | -5.0 to 105.0 | Level 2
50 | MV upper limit | MV lower limit +0.1 to 105.0 | Level 2
49 | MV lower limit | -5.0 to MV upper limit -0.1 | Level 2
51 | MV change rate limit | 0.0 to 100.0 | Level 2
56 | Input digital filter | 0 to 9999 | Level 2
25 | Alarm 1 hysteresis | 0.01 to 99.99 | Level 2
26 | Alarm 2 hysteresis | 0.01 to 99.99 | Level 2
52 | Alarm 3 hysteresis | 0.01 to 99.99 | Level 2
53 | Input shift upper limit | -199.9 to 999.9 | Level 2
54 | Input shift lower limit | -199.9 to 999.9 | Level 2

*1 Possible only during reading
*2 During temperature input, the range becomes the range of use of the selected sensor.
*3 During heating and cooling control, the range becomes 0.0 to 105.0.
*4 During heating and cooling control, the range becomes -105.0 to 105.0.
*5 During heating and cooling control, the range becomes -105.0 to MV upper limit -0.1.

### About invalid parameters
Currently, if a command is used for invalid parameters (parameters that do not satisfy the conditions of use in Chapter 5), the “undefined” error (end code: IC) is output.


## CHAPTER 6 USING THE COMMUNICATIONS FUNCTION

<table>
<thead>
<tr>
<th>Parameter No.</th>
<th>Parameter</th>
<th>Data Setting Range</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>Input type</td>
<td>0 to 21</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>Scaling upper limit</td>
<td>Scaling lower limit +1 to 9999</td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>Scaling lower limit</td>
<td>-1999 to scaling upper limit -1</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>Decimal point</td>
<td>0 to 3</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>°C/°F selection</td>
<td>0 : °C, 1 : °F</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>Control output 1 assignment</td>
<td>0 to 4, 6</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>Control output 2 assignment</td>
<td>0 to 4, 6</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>Auxiliary output 1 assignment</td>
<td>2 to 4, 6</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>Alarm 1 type</td>
<td>1 to 11</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>Alarm 1 open in alarm</td>
<td>0: closed in alarm, 1: open in alarm</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>Alarm 2 type</td>
<td>1 to 11</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>Alarm 2 open in alarm</td>
<td>0: closed in alarm, 1: open in alarm</td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>Alarm 3 type</td>
<td>1 to 11</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>Alarm 3 open in alarm</td>
<td>0: closed in alarm, 1: open in alarm</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>Direct/Reverse operation</td>
<td>0: Reverse operation, 1: Direct operation</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Set point upper limit</td>
<td>Set point lower limit +1 to scaling upper limit</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Set point lower limit</td>
<td>Scaling lower limit to Set point upper limit -1</td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>PID / ON/OFF</td>
<td>0: Advanced PID, 1: ON/OFF</td>
<td></td>
</tr>
<tr>
<td>73</td>
<td>ST</td>
<td>0 : OFF, 1 : ON</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>ST stable range width</td>
<td>0.1 to 999.9</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>α</td>
<td>0.00 to 1.00</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>AT calculated gain</td>
<td>0.1 to 10.0</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Standby sequence reset method</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Automatic return of display mode</td>
<td>0 to 99</td>
<td></td>
</tr>
<tr>
<td>93</td>
<td>AT hysteresis</td>
<td>0.1 to 9.9</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>LBA detection width</td>
<td>0.0 to 999.9</td>
<td></td>
</tr>
</tbody>
</table>

*1 See page 5-22.
*2 0: Control output (heat), 1: Control output (cool), 2: Alarm 1, 3: Alarm 2, 4: Alarm 3, 6: LBA.
*3 2: Alarm 1, 3: Alarm 2, 4: Alarm 3, 6: LBA, 7: Error 1, 8: Error 2
*4 See page 5-25.
*5 During temperature input, the range becomes the range of use of the selected sensor.
*6 See page 5-30.

**Reading the status**

To read the E5CK controller status, use the X format “RX” command. For detail see the Appendix: X Format Head List (page A-13).
Issuing special commands

The following functions are issued as special commands.

- **Run/Stop**
  Runs or stops programs. This command cannot be issued in setting level 1. Run/Stop can be switched up to 100,000 times.
- **Remote/Local**
  Selects remote operation or local operation.
- **AT Execute/Cancel**
  Executes or cancels auto-tuning. This command cannot be issued in setting level 1.
- **Move to setting level 1**
  Issue this command when writing parameters in setup and expansion modes.
- **Software reset**
  A response is not returned to this command. Also, communications with the E5CK cannot be carried out for five seconds after reset.

The following table shows the special commands that are available on the E5CK controller.

<table>
<thead>
<tr>
<th>Command No.</th>
<th>Command</th>
<th>Instruction Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>Run/Stop</td>
<td>0000: Run, 0001: Stop</td>
</tr>
<tr>
<td>02</td>
<td>Remote/Local</td>
<td>0000: Remote, 0001: Local</td>
</tr>
<tr>
<td>07</td>
<td>AT Execute/Cancel</td>
<td>0000: Cancel, 0001: 40%AT execution, 0002: 100% AT execution</td>
</tr>
<tr>
<td>09</td>
<td>Move to setting level 1</td>
<td>0000</td>
</tr>
<tr>
<td>11</td>
<td>Software reset</td>
<td>0000</td>
</tr>
</tbody>
</table>

To return to setting level 0 from setting level 1, issue the “software reset” command. If the parameter write command is issued for the setup and expansion modes in setting level 0, an error occurs, and the end code (0D = Command cannot be execute is returned.)
CHAPTER 6 USING THE COMMUNICATIONS FUNCTION

6.5 How to Read Communications Error Information

The result of communications on the E5CK can be checked by the end code in the response frame. Use this end code to remedy errors that may occur.

End code

Communications are normal when the end code in the response is “00”. If the end code is not “00”, this indicates that an error other than a undefined error has occurred. The end code format is as follows and does not contain a data area.

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Command code</th>
<th>End code</th>
<th>FCS</th>
<th>CR</th>
</tr>
</thead>
</table>

End code  | Code name            | Description                                                                                                                                 |
---        |----------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
0D         | Command cannot be executed |
  • Writing was carried out during local operation.  
  • Writing was carried out during executing auto-tuning.  
  • An attempt was made to execute 40%AT during heating and cooling control.  
  • An attempt was made to switch run/stop in setting level 1.  
  • An attempt was made to execute AT in setting level 1.  
  • Issue the parameter read or write commands in conditions other than above.  

End code  | Code name            | Description                                                                 |
---        |----------------------|-----------------------------------------------------------------------------|
10         | Parity error         | Parity check error was detected in the received data.                        |
  • Check the communications condition. If the communications condition of the host computer and E5CK controller match, then a probable cause is a problem in the communications circuit of one or both of the host computer and E5CK controller.  |

End code  | Code name            | Description                                                                                                                                 |
---        |----------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
11         | Framing error        | Stop bit cannot be detected.                                                                                                                  |
  • Check the communications condition. If the communications condition of the host computer and E5CK controller match, then a probable cause is a problem in the communications circuit of one or both of the host computer and E5CK controller.  |

About the unit No.  
Responses are not returned unless the target unit for communications and the unit No. in the command match.

6-10
### How to Read Communications Error Information

**E5CK**

#### 6.5

<table>
<thead>
<tr>
<th>End code</th>
<th>Code name</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Overrun error</td>
<td>The receive buffer overflowed.</td>
<td>Check the communications condition. If the communications condition of the host computer and E5CK controller match, then a probable cause is a problem in the communications circuit of one or both of the host computer and E5CK controller.</td>
</tr>
<tr>
<td>13</td>
<td>FCS error</td>
<td>The FCS (Frame Check Sequence) do not match.</td>
<td>Check the FCS program.</td>
</tr>
<tr>
<td>14</td>
<td>Format error</td>
<td>The received command length does not match the length defined in the frame format.</td>
<td>Check the communications condition. If the communications condition of the host computer and E5CK controller match, then a probable cause is a problem in the communications circuit of one or both of the host computer and E5CK controller.</td>
</tr>
<tr>
<td>15</td>
<td>Setting range error</td>
<td>Numerical values or code values in the data are not within the setting range.</td>
<td>Check the parameter and read or write data of special commands.</td>
</tr>
</tbody>
</table>

#### Undefined error

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>2B</td>
<td>An undefined header code has been received.</td>
<td>Check the parameter No.</td>
</tr>
<tr>
<td>2B</td>
<td>A currently invalid parameter (e.g. the scaling command during temperature input) has been received.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>FCS</th>
<th>* CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>
6.6 Program Example

How to use programs

The program described below is for obtaining corresponding response frame data when some of the command frame data is input. The input format is as follows. The FCS and terminator are automatically generated, and need not be input.

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Command code</th>
<th>Data</th>
<th>FCS</th>
<th>* CR</th>
</tr>
</thead>
</table>

The output format is as follows. The content of the response frame is displayed as it is.

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>End code</th>
<th>Data</th>
<th>FCS</th>
<th>* CR</th>
</tr>
</thead>
</table>

Procedure

1. Read the program.
2. Enter “RUN”.
3. When “send data:” is displayed, enter the command data (from @ to the command string).
4. The content of the response frame is displayed following “receive data:”.

Conditions when running a program

- Set the communications condition as follows:
  - Baud rate: 9600 bps
  - Bit length: 7 bits
  - Parity: Even
  - Stop bit: 2
- Make sure that the communications cable is properly connected.
Program list (language: IBM PC COMPATIBLE MACHINE)

1000 ' -----------------------------------------------
1010 ' PROGRAM : E5CK Communication Program
1020 ' -----------------------------------------------
1030 ' Copyright (C) 1995 OMRON Corporation All Rights Reserved.
1040 ' -----------------------------------------------
1050 ' RS-232C SPEED: 9600BPS, PARITY: EVEN, DATA: 7, STOP: 2
1060 ' -----------------------------------------------
1070 OPEN "COM: 9600, E, 7, 2, CD0, DS0, RB256, RS *FOR RANDOM AS #1 LEN=256
1080 REPEAT
1090 ' Make Command
1100 PRINT "send data : ":
1110 INPUT SEND$
1120 ' FCS calculation
1130 FCS=0
1140 FOR IFCS=1 TO LEN (SEND$)
1150 FCS=FCS XOR ASC (MID$ (SEND$, IFCS, 1))
1160 NEXT
1170 FCS$=RIGHT$ ("0"+HEX$ (FCS), 2)
1180 ' Send data to communication port
1190 PRINT #1, SEND$+FCS$+"*"
1200 ' Receive data from communication port
1210 RECCNT=0: TMP$=
1220 DRECLOOP:
1230 IF LOC (1) <> 0 THEN DREC1
1240 RECCNT=RECCNT+1
1250 IF RECCNT=5000 THEN *DRECERR ELSE DRECLOOP
1260 'DREC1
1270 TMP$=TMP$+INPUT$ (LOC (1), #1)
1280 IF RIGHT$ (TMP$, 1)=CHR$ (13) THEN DRECEND
1290 DRECERR:
1300 TMP$="No response !!"
1310 DRECEND:
1320 RECV$=TMP$
1330 PRINT "response: ": RECV$
1340 ' Repeat to make Command
1350 GOTO REPEAT
1360 ' END
1370 CLOSE #1
1380 END


Examples of use

Set the unit No. to “00”

• In the following examples, data is shown in individual blocks to make the examples easier to understand. However, when actually creating programs, do not leave spaces between frame items. Also, response are displayed without spaces between frame items.

Set the set point to “300.0”

• Input data

```
@ 00 2 01 3000
```

300.0
Set point
Write parameter

• Response

```
@ 00 2 01 00 3000 (FCS) *
```

Normal end

Start running

• Input data

```
@ 00 3 00 0000
```

Run
Run/Stop
Special command

• Response

```
@ 00 3 00 00 0000 (FCS) *
```

Normal end

Monitor process value

• Input data

```
@ 00 1 00 0000
```

Dummy data
Monitor process value
Read parameter

• Response

```
@ 00 1 00 00 2000 (FCS) *
```

Process value = 2000
Normal end
This chapter describes how to find out and remedy the cause if the E5CK does not function properly.

7.1 Initial Checks ............................... 7-2
7.2 How to Use the Error Display .......... 7-3
7.3 How to Use Error Output ............... 7-5
7.4 Checking Operation Restrictions ....... 7-6
7.1 Initial Checks

If trouble occurs, first of all check the following.

(1) Power supply
   Make sure that the power supply is ON. Also, make sure that the power supply is within the rated voltage range.

(2) Input type jumper connectors
   Make sure that the jumper connectors are at their correct positions.
   The following table shows the operations when the jumper connector positions do not match the “input type” parameter settings.

<table>
<thead>
<tr>
<th>Jumper Connector</th>
<th>Parameter</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC + PT</td>
<td>Current (0 to 20mA)</td>
<td>Fixed at scaling lower limit value</td>
</tr>
<tr>
<td></td>
<td>Current (4 to 20mA)</td>
<td>Fixed at scaling lower limit value</td>
</tr>
<tr>
<td></td>
<td>Voltage (0 to 10V, 0 to 5V)</td>
<td>Fixed at scaling lower limit value</td>
</tr>
<tr>
<td></td>
<td>Voltage (1 to 5V)</td>
<td>$\text{ERR}$</td>
</tr>
<tr>
<td>I</td>
<td>Temperature input</td>
<td>Fixed at scaling lower limit value</td>
</tr>
<tr>
<td></td>
<td>Voltage (0 to 10V, 0 to 5V)</td>
<td>Fixed at scaling lower limit value</td>
</tr>
<tr>
<td></td>
<td>Voltage (1 to 5V)</td>
<td>$\text{ERR}$</td>
</tr>
<tr>
<td>V</td>
<td>Temperature input</td>
<td>$\text{ERR}$</td>
</tr>
<tr>
<td></td>
<td>Current (0 to 20mA)</td>
<td>Fixed at scaling lower limit value</td>
</tr>
<tr>
<td></td>
<td>Current (4 to 20mA)</td>
<td>$\text{ERR}$</td>
</tr>
</tbody>
</table>

(3) Wiring
   Make sure that all cables are properly connected.

(4) Communications condition
   When communicating using the RS-232C or RS-485 communications interfaces, make sure that the baud rate and other communications condition settings on the host computer and E5CK controller are matching, and are within the permissible ranges.

If there appears to be nothing wrong after checking the E5CK controller, and the same phenomenon continues, check the controller in more detail, for example, on the error display.
7.2 How to Use the Error Display

When an error has occurred, the No.1 display alternately indicates error codes together with the current display item. This section describes how to check error codes on the display, and the actions you must be taken to remedy the problem.

### Input error

- **Meaning**: Input is in error.
- **Action**: Check the wiring of inputs, disconnections, and shorts, and check the input type and the input type jumper connector.
- **Operation at error**: For control output functions, output the manipulated variable matched to the setting of the “MV at PV error” parameter (level 2 mode). Alarm output functions are activated when the upper limit is exceeded.

### Memory error

- **Meaning**: Internal memory operation is in error.
- **Action**: First, turn the power OFF then back ON again. If the display remains the same, the E5CK controller must be repaired. If the display is restored to normal, then a probable cause can be external noise affecting the control system. Check for external noise.
- **Operation at error**: Control output functions turn OFF (2mA max. at 4 to 20mA output, and output equivalent to 0% in case of other outputs). Alarm output functions turn OFF.

### A/D converter error

- **Meaning**: Internal circuits are in error.
- **Action**: First, turn the power OFF then back ON again. If the display remains the same, the E5CK controller must be repaired. If the display is restored to normal, then a probable cause can be external noise affecting the control system. Check for external noise.
- **Operation at error**: Control output functions turn OFF (2mA max. at 4 to 20mA output, and output equivalent to 0% in case of other outputs). Alarm output functions turn OFF.
CHAPTER 7 TROUBLESHOOTING

Calibration data error

This error is output only during temperature input, and is displayed for two seconds when the power is turned ON.

- **Meaning**: Calibration data is in error.
- **Action**: Must repair.
- **Operation at error**: Both control output functions and alarm output functions operate. However, note that readout accuracy is not assured.

Display range over

Though not an error, this is displayed when the process value exceeds the display range when the control range (setting range ±10%) is larger than the display range (-1999 to 9999).

- When less than “-1999” [cccc]
- When greater than “9999” [dddd]

- **Operation**: Control continues, allowing normal operation.
7.3 How to Use Error Output

The E5CK controller allows you to assign error output to terminals as outputs. For details on output assignments, see 3.3 Setting Output Specifications (page 3-5).

- **LBA** (Loop Break Alarm) can be used as a means for detecting loop breaks when the control loop is not functioning normally. For details, see page 4-9.
  - LBA allows you to detect the following errors:
    1. Heater burnout
    2. Output error (contact weld, damaged transistors, etc.)
    3. Sensor error (constant input values, etc.)
  - If you use the LBA function, set the loop break detection time matched to the control characteristics in the “LBA detection time” parameter (level 2 mode).

- **Input errors**
  - If you assign error 1 as the output, an error can be output when input is in error. When this error occurs, remedy by following the description for “Input error” (page 7-3).

- **A/D converter error**
  - If you assign error 2 as the output, an error can be output when the A/D converter is in error. When this error occurs, remedy by following the description for “A/D converter error” (page 7-3).
7.4 Checking Operation Restrictions

With the E5CK controller, auto-tuning or self-tuning sometimes do not operate depending on the way functions are combined. The table below summarizes the main operating restrictions.

If the E5CK controller is not operating properly, first check whether operating conditions violate the restrictions in this table.

<table>
<thead>
<tr>
<th>Restriction</th>
<th>Inoperable or Invalid Functions</th>
<th>ST Execution</th>
<th>AT Execution</th>
<th>Limiter Function</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>At analog input</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At heating and cooling control</td>
<td>×</td>
<td></td>
<td>40%AT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At ON/OFF control</td>
<td>×</td>
<td>×</td>
<td></td>
<td>Manipulated variable MV change rate</td>
<td></td>
</tr>
<tr>
<td>AT = ON</td>
<td>×</td>
<td>×</td>
<td>Manipulated variable MV change rate</td>
<td>SP ramp function</td>
<td></td>
</tr>
<tr>
<td>AT AT execution</td>
<td>×</td>
<td>×</td>
<td>Manipulated variable MV change rate</td>
<td>Parameter setting</td>
<td></td>
</tr>
<tr>
<td>At stop</td>
<td>×</td>
<td>×</td>
<td>Manipulated variable MV change rate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Items marked by a “×” indicates combinations of conditions not acceptable during ST or AT execution.

Items marked by “—” are impossible combinations.
<table>
<thead>
<tr>
<th>INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
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<td>Alarm 1 type . 5-25</td>
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<td>Alarm 2 hysteresis . 5-19</td>
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<tr>
<td>Alarm 2 open in alarm . 5-26</td>
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<td>Alarm 2 type . 5-25</td>
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<tr>
<td>Alarm 3 hysteresis . 5-19</td>
</tr>
<tr>
<td>Alarm 3 open in alarm . 5-26</td>
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<td>Alarm 3 type . 5-25</td>
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<td>Alarm type . 3-7</td>
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<td>How to use keys</td>
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<td>Hysteresis(heat)</td>
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<td>Input and Output</td>
</tr>
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<td>Input digital filter</td>
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<td>MV change rate limit</td>
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<tr>
<td>MV change rate limiter</td>
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<tr>
<td>MV limiter</td>
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<tr>
<td>MV lower limit</td>
</tr>
<tr>
<td>MV monitor(cool)</td>
</tr>
<tr>
<td>MV monitor(heat)</td>
</tr>
<tr>
<td>MV upper limit</td>
</tr>
<tr>
<td>Main parts</td>
</tr>
<tr>
<td>Manipulated variable at stop</td>
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<tr>
<td>Manipulated variable restrictions</td>
</tr>
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<td>Manual MV</td>
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Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.

Cat. No. H078-E1-3A

The following table outlines the changes made to the manual during each revision. Page numbers refer to previous version.
<table>
<thead>
<tr>
<th>Revision code</th>
<th>Date</th>
<th>Page</th>
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<tr>
<td>1</td>
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</table>
| 2             | April 1996  | Page IV: | Changed “100 to 240 VAC” to “AC/100-240V or AC/DC24V”.
|               |            | Page 1-3: | Modified the spellings in Operation indicators.                                |
|               |            | Page 1-7: | Modified the diagram of mode.                                                  |
|               |            | Page 2-6: | Modified the power specifications in “Terminal arrangement”.                   |
|               |            | Page 2-7: | Modified the diagram in “Control output”.                                      |
|               |            | Page 3-2: | Modified the diagram in “Setup”.                                               |
|               |            | Page 3-8: | Added some texts to summary of alarm operations.                               |
|               |            | Page 3-9: | Changed “temperature” to “humidity”.                                            |
|               |            | Page 9:  | Added “upper and” to the text of step (4).                                     |
|               |            | Page 3-12: | Changed “temperature” to “humidity” in “Setting example”.
|               |            |         | Changed “C” to “%” in “Setting example”.                                        |
|               |            | Page 3-13: | Moved a block (that was the 7th bullet) to the end of the step (4) of “Setting example” on page 3-14. |
|               |            | Page 4-5: | Modified the diagram in “Set point limiter”.                                   |
|               |            | Page 4-7: | Added some texts to “Input assignments”, “Run/Stop” and “Auto/Manual”.          |
|               |            | Page 4-11: | Changed a text in the diagram.                                                  |
|               |            | Page 4-12: | Added text to Preparations.                                                     |
|               |            | Page 4-15: | Modified the diagram in “Preparation”.                                          |
|               |            | Page 4-17: | Modified the diagram in “Preparation”.                                          |
|               |            | Page 4-18: | Changed “voltage” to “current” in step (9).                                    |
|               |            | Page 4-20: | Modified the diagrams on this page.                                             |
|               |            | Page 5-2: | Added some texts to the meanings of the model icons.                           |
|               |            | Page 5-3: | Added some texts to the comment descriptions.                                  |
|               |            | Page 5-5: | Added some texts to Manual Mode.                                                |
|               |            | Page 5-6: | Added some texts to Level 0 Mode.                                               |
|               |            | Page 5-7: | Deleted “Related parameters” in “Set point during SP ramp”.                    |
|               |            | Page 5-17: | Deleted some texts in “LBA detection time”.                                     |
|               |            | Page 5-18: | Added a sentence to the Function descriptions.                                 |
|               |            | Page 5-27: | Changed “SP setting” to “Setpoint” on the table.                               |
|               |            | Page 5-30: | Added some texts to Condition A.                                               |
|               |            | Page 5-34: | Changed the descriptions of “Related article”.                                 |
|               |            | Page 6-3: | Changed the diagram of RS-232C.                                                  |
|               |            | Page 6-7: | Changed “-999.9” to “-999.9” in the parameters No.53 and 54.                   |
|               |            | Page 6-9: | Added a sentence to Run/Stop.                                                   |
|               |            | Page 6-10: | Added the “End code”.                                                          |
|               |            | Page 6-13: | Changed the program address No. “1110” to “1120”.                              |
|               |            | Page 7-6: | Changed “Not possible only with 40%AT” to “40%AT” on the table.                |
|               |            | Page 8-2: | Changed the table of “Ratings”.                                                 |
|               |            | Page 8-3: | Changed “0.1%FS” to “0.01%FS” in the description of Hysteresis on table.       |
|               |            | Page 8-5: | Added some texts to the diagram.                                               |
|               |            | Page 8-7: | Modified the setting list table.                                               |
|               |            | Page 8-10: | Changed the descriptions of “SRT Startup Conditions”.                         |
|               |            | Page 8-13: | Modified the list table of “Model list”.                                       |
| 2A            | July 1996   | Page 6-9: | Changed the table of “Instruction Code”.                                        |
| 2B            | September 1996 | Page 1-7: | Modified the diagram in “Selecting modes”.                                    |
|               |            | Page 5-33: | Changed the Event Input Operation “ON-Run” to “OFF-Run”.
<p>|               |            | Page A-2: | Added text to “*1”.                                                            |
|               |            | Page A-8: | Modified the diagram in “PARAMETER OPERATIONS LIST”.                           |
|               |            | Page A-10: | Changed the letter “k” to “K”.                                                  |</p>
<table>
<thead>
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<th>Date</th>
<th>Revised content</th>
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| 3             | April 1997 | Page 1-7: Added text to Menu display.  
Page 2-7: Deleted the Specifications of 0 to 20mA on the table of “Control output”.  
Page 3-4: Added “1 second min.” to the display flowchart.  
Page 3-6: Added text to Control period.  
Changed “control period” to “control period (heat)” in “Setting Example”.  
Added “1 second min.” to the display flowchart.  
Changed “control period” to “control period (heat)” in step (B).  
Page 3-9: Added “1 second min.” to the display flowchart.  
Page 3-11: Changed “(-5.0 to 105.0%)” to “(Standard:-5.0 to 105.0%, Heating and Cooling: -5.0 to 105.0%)” in Manipulated variable at stop.  
Page 3-12: Deleted the display of “Changing the set point”.  
Page 3-13: Added a display to “Manual operation”.  
Page 3-14: Added a display to “100%AT”.  
Page 3-15: Added “1 second min.” to the display flowchart.  
Page 3-17: Modified the lower figure for “MV limiter”.  
Page 4-7: Moved “Run/Stop, Auto/Manual, Reference” to “Transfer output scaling”.  
Page 4-8: Moved “Run/Stop, Auto/Manual, Reference” to “Multi-SP”.  
Page 4-10: Deleted (4) in Determining the LBA detection time.  
Page 4-15: Modified display flowchart.  
Page 4-17: Added “Conditions of Use” to “MV at stop”.  
Page 5-27: Deleted “resetting the parameters” in the sixth lines from the top.  
Page 5-29: Added “Usually use the default value.” to “Set point”.  
Page 5-30: Added “Usually use the default value.” to “AT calculated gain”.  
Added a figure to “Standby sequence reset method”.  
Page 5-31: Added “Usually use the default value.” to “At Hysteresis”.  
Page 5-35: Deleted some texts to the table.  
Deleted “When you have selected the manipulated variable (heat) parameter, the transfer output lower limit during heating and cooling control becomes ‘0.0’”.  
Page 6-11: Deleted “End code12”.  
Page 7-5: Added “(auxiliary output 1)” to “Error inputs and A/D converter error”.  
Page A-4: Modified the table of “Output Unit Ratings and Characteristics”.  
Page A-5: Modified the diagram.  
Page A-6: Added Remarks to the Parameter of “Remote/Local”.  
Page A-7: Changed the description “-5.0 to 105.06%” of “E” to “Standard: -5.0 to 105.0%”.  
Page A-10: Deleted “At the time the E5CK starts operation” in “Startup Conditions of SRT”.  
Page A-11: Deleted “At the time set point is changed”.  
Page A-13: Changed “Type Name” and “Specification” in “Base unit”.  
Page A-14: Added some texts to “Format”.  
Modified the diagram in “Command”.  
Modified “X FORMAT HEAD LIST”.  
Added “Note”.  
Page A-17: Changed “OR-DR/OR-R” to “OR-DR/OR-R” in the Table.  

3A April 1998  
Page 3-5: Added some texts to “Output assignments”.  
Page A-7: Changed “OR-DR/OR-D” to “OR-DR/OR-R” in the Table.
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Operating instructions
Interface card

Type IC-8M 3/2-0.9-24 PH
Order code 13 798
IC-8M 3/2-0.9-24 TH
Order code 14 024
IC-8MO 3/2-0.9-24 PH
Order code 15 147
IC-8MO 3/2-0.9-24 TH
Order code 15 148

254 555
Bedienungsanleitung
Interface-card

Typ IC-8M 3/2-0.9-24 PH
Bestellbezeichnung 13 798
IC-8M 3/2-0.9-24 TH
Bestellbezeichnung 14 024
IC-8MO 3/2-0.9-24 PH
Bestellbezeichnung 15 147
IC-8MO 3/2-0.9-24 TH
Bestellbezeichnung 15 148

Que faut-il savoir pour la mise en œuvre
d'éléments Festo?
Le bon fonctionnement des matériaux étant assuré qu'a
la condition de se conformer aux indications données et de
ne pas dépasser les valeurs maximales indiquées telles
que pression, tension et température, il est par conséquent
indispensable que l'opérateur veille à ce que cette condi-
tion soit remplie.
Il veillera de même à l'utilisation d'air comprimé non pollué
et de fluides non agressifs, en tenant compte des condi-
tions d'exploitation régissant sur les lieux de mise en œuvre.
En cas d'utilisation en zone de sécurité, se conformer aux
règlements des caisses mutuelles d'assurance accident
et des services de surveillance technique ou aux règlements
nationaux en vigueur.

¿Qué es lo que se tiene que observar
para la aplicación de los elementos de Festo?
Es imprescindible atenerse a los valores límites indicados
para presiones, tensiones, temperaturas y observar las
advertencias para conseguir un funcionamiento impecable.
El aplicador tiene que garantizar esta condición con
absoluta seguridad.
Se tiene que cuidar de un servicio con aire comprimido
debidamente preparado, sin medios agresivos. Además
se tienen que tomar en consideración las correspondien-
tes condiciones del ambiente en el lugar de la aplicación.
Al aplicar los elementos de Festo en zonas de seguridad,
se tienen que respetar siempre las correspondientes dis-
posiciones del Sindicato Profesional y del Comité de Con-
trato Técnico o las respectivas disposiciones nacionales.
1. **Constructional principle of the Interface card**

Scope of delivery:
Interface card without pneumatic multi tube connector (pneumatic manifold) and without multi pole strip (electrical terminal strip).

Accessories required:
Pneumatic multi tube connector
Type ICP-27-PK-3, order code 15 166,
or type ICP-11-PK-3-2-PK-6, order code 15 169.

Other accessories:
Electrical terminal strip (flat cable adaptor),
type ICP-24 P-FLK, order code 15 174 for positive switching inputs (card types PH and TH);
order code 15 175 for negative switching card (TH).
Instead of the electrical terminal strip,
one may also use a multi pole socket to DIN 41 612, design D, 32 poles, a und c fitted.

Standard parts required:
Rack: Schroff company, Europac Rational.
2. Installation

1. Gasket E is inside Interface card G.

2. In view of the possibility of dismantling at a later date, apertures in the pneumatic multi tube connector B may be sprayed with silicone.

3. Screw multi pole socket A and pneumatic multi tube connector B into the rack. (Total width 14T)
   Gap between A, B is 5 threaded holes C from the front.

4. Snap supporting strip D into the rack.

5. Snap guide rail F for printed circuit board 5 into rack.

6. Slide Interface card G into F and screw it to face plate C with screws H.

7. Dismantling recess I makes it possible to raise the Interface card with a screwdriver.

3. Operating modes

Manually: Only after activating the release input (MAN ON) for manual operation.
Electrically: Through electric signals (relay, limit or stop switch, PLO).
With card 14024 and 14148, manual operations (MAN ON) may be selected by switching a red-white miniature switch F on the card from "non interrupting" to "interrupting".

2. Montage

1. Dichtungsplatte E befindet sich in Inteface-card G.


4. Auflagenleiste D in den Baugruppenträger einschrauben.

5. Führungsschiene F für die Leiterplatte C im Baugruppenträger einschrauben.

6. Interface-card G in F einschieben und an der Frontplatte H mit den Schrauben H verschrauben.


3. Betriebsarten

Manuell: erst nach Aktivierung des Freigabeknopfes (MAN ON) für Handbetätigung.
Elektrisch: über elektrische Signale (Relais, Endschalter, SPS).
Bei der Karte 14022 und 14148 sind die Handbetätigungen (MAN ON) über einen rot-weissen Miniaturschalter 12 auf der Karte von "nicht rastend" auf "rastend" umstellbar.
4. Integrated block allocation

Unscrew printed circuit board (4 screws) and pull it out.

① to ⑧ solenoid valve numbers
⑨ Fixing screws
⑩ Sealing connections

Should servicing be required, unscrew and replace solenoid valve or flow amplifier.

Solenoid valve type MEL-3-0.9
order code14 543

For type 15 147/15 148, solenoid valve
MOEL-3-0.9,
order code 14 025

4. Integrationsbelegung

Leiterplatte abschrauben (4 Schrauben) und abziehen.

① bis ⑧ Magnetventil-Nummer
⑨ Befestigungsschrauben
⑩ Dichtungsplatte

Im Servicefall Magnetventil oder Mengenverstärker abschrauben und auswechseln.

Magnetventil Typ MEL-3-0.9,
Bestellbezeichnung 14 543

Bei Typ 15 147/15 148 Mengenventil
MOEL-3-0.9,
Bestellbezeichnung 14 025
5. Connector allocation on installation side

Pneumatic/Pneumatik

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</table>

TH-cards (15 148/14 024)

Inputs, positive switching:
Connect PIN row B and MAN ON – to GND1, connect MAN ON + to VSS (5 to 24 V).

Inputs, negative switching:
Connect PIN row A and MAN ON + to VSS (5 to 24 V), connect MAN ON – to GND1.
GND1 and GND2 may be connected to each other.

PH-cards (13 798/15 147)

Inputs, positive switching:
Connect MAN ON to VSS (24 V).

6. Technical data

Plugged in components: 8 off, ½-solenoid valves, type MEL-3-0.9
MOEL-3-0.9 for type 15 147/15 148, max. pressure: 6 bar

For type 13 198 and 15 147 (PH), input voltage (inputs 1 to 8): 24 V DC
Current consumption per input 1...8: 75 mA.

Current consumption MAN ON: 700 mA
(all 8 solenoid valves simultaneously energised manually).

5. Steckerbelegung auf Installationsseite

PH

Electrical/Elektrik

Type/Typ 13 798
15 147

TH

Type/Typ 14 024
15 148

TH-Karte (15 148/14 024):
Eingänge Plus-schaltend:
PIN-Reihe (B) und MAN ON – auf GND1 legen.
MAN ON + auf VSS (5 bis 24 V) legen.

Eingänge Minus-schaltend:
PIN-Reihe (A) und MAN ON + auf VSS (5 bis 24 V) legen. MAN ON – auf GND1 legen.
GND1 und GND2 können verbunden werden.

PH-Karte (13 798/15 147):
Eingänge Plus-schaltend:
MAN ON auf VSS (24 V) legen.

6. Technische Daten

Bestückung: 8 Stück ½-Magnetventile
Typ MEL-3-0,9
MOEL-3-0,9 bei Type 15 147/15 148
max. Druck: 6 bar.

Bei Typ 13 198 und 15 147 (PH):
Eingangsspannung (Input 1...8): 24 VDC
Stromaufnahme pro Input 1...8: 75 mA
Stromaufnahme MAN ON: 700 mA
(bei gleichzeitiger Handbetätigung aller 8 Magnetventile).
For types 14 024 and 15 148 (TH):
Supply voltage (VSS): 24 V DC
Current consumption (all solenoid valves energised by VSS): 700 mA.
Input voltage (inputs 1...8):
PIN row A: 5 to 24 V DC
Activating current (inputs 1 to 8): 10 mA
Input voltage (MAN ON +):
5 to 24 V DC
Input voltage (MAN ON -):
GND (0 V)
Activating current MAN ON: 10 mA.

Bei Typ 14 024 und 15 148 (TH):
Versorgungsspannung (VSS): 24 V DC
Stromaufnahme (alle Magnetventile erregt bei VSS): 700 mA
Eingangsspannung (Input 1...8):
PIN-Reihe A: 5 bis 24 VDC
Ansteuerstrom (Input 1...8): 10 mA
Eingangsspannung (MAN ON +):
5 bis 24 VDC
Eingangsspannung (MAN ON -):
GND (0 V)
Ansteuerstrom MAN ON: 10 mA.

7. Connection of the solenoid valves

<table>
<thead>
<tr>
<th>Solenoid valve 1/Magnetventil 1</th>
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</tr>
<tr>
<td>Solenoid valve 6/Magnetventil 6</td>
<td>15</td>
<td>24</td>
<td>6</td>
<td>Input 5</td>
</tr>
<tr>
<td>Solenoid valve 7/Magnetventil 7</td>
<td>16</td>
<td>25</td>
<td>7</td>
<td>Input 6</td>
</tr>
<tr>
<td>Solenoid valve 8/Magnetventil 8</td>
<td>17</td>
<td>26</td>
<td>8</td>
<td>Input 7</td>
</tr>
</tbody>
</table>

7. Anschluß der Magnetventile

Typ 13 798/14 024 Grundstellung geschlossen

<table>
<thead>
<tr>
<th>Solenoid valve 1/Magnetventil 1</th>
<th>P</th>
<th>A</th>
<th>R</th>
<th>Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solenoid valve 2/Magnetventil 2</td>
<td>11</td>
<td>20</td>
<td>2</td>
<td>Input 1</td>
</tr>
<tr>
<td>Solenoid valve 3/Magnetventil 3</td>
<td>12</td>
<td>21</td>
<td>3</td>
<td>Input 2</td>
</tr>
<tr>
<td>Solenoid valve 4/Magnetventil 4</td>
<td>13</td>
<td>22</td>
<td>4</td>
<td>Input 3</td>
</tr>
<tr>
<td>Solenoid valve 5/Magnetventil 5</td>
<td>14</td>
<td>23</td>
<td>5</td>
<td>Input 4</td>
</tr>
<tr>
<td>Solenoid valve 6/Magnetventil 6</td>
<td>15</td>
<td>24</td>
<td>6</td>
<td>Input 5</td>
</tr>
<tr>
<td>Solenoid valve 7/Magnetventil 7</td>
<td>16</td>
<td>25</td>
<td>7</td>
<td>Input 6</td>
</tr>
<tr>
<td>Solenoid valve 8/Magnetventil 8</td>
<td>17</td>
<td>26</td>
<td>8</td>
<td>Input 7</td>
</tr>
</tbody>
</table>

Typ 15 147/15 148 Grundstellung offen

<table>
<thead>
<tr>
<th>Solenoid valve 1/Magnetventil 1</th>
<th>P</th>
<th>A</th>
<th>R</th>
<th>Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solenoid valve 2/Magnetventil 2</td>
<td>2</td>
<td>20</td>
<td>11</td>
<td>Input 1</td>
</tr>
<tr>
<td>Solenoid valve 3/Magnetventil 3</td>
<td>3</td>
<td>21</td>
<td>12</td>
<td>Input 2</td>
</tr>
<tr>
<td>Solenoid valve 4/Magnetventil 4</td>
<td>4</td>
<td>22</td>
<td>13</td>
<td>Input 3</td>
</tr>
<tr>
<td>Solenoid valve 5/Magnetventil 5</td>
<td>5</td>
<td>23</td>
<td>14</td>
<td>Input 4</td>
</tr>
<tr>
<td>Solenoid valve 6/Magnetventil 6</td>
<td>6</td>
<td>24</td>
<td>15</td>
<td>Input 5</td>
</tr>
<tr>
<td>Solenoid valve 7/Magnetventil 7</td>
<td>7</td>
<td>25</td>
<td>16</td>
<td>Input 6</td>
</tr>
<tr>
<td>Solenoid valve 8/Magnetventil 8</td>
<td>8</td>
<td>26</td>
<td>17</td>
<td>Input 7</td>
</tr>
</tbody>
</table>

Types/Typen 13 798/14 024

Allocation: Electrical connections
Zuordnung: Elektrische Anschlüsse
Pneumatic connections
Pneumatische Anschlüsse

Types/Typen 15 147/15 148

Subject to alterations
Änderungen vorbehalten

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E. Thallner GmbH

board nr.: diagram nr.:
20PR1 20PR1

EV501/520 PN- RACK BACK PLANE

revision    date       scale       page
20PR1       08.06.99   1/1

This drawing must not be loaded or copied without permission from EV GROUP.
1. UNPACKING

On delivery, check the power supply to ascertain that no damage has occurred in transit. Retain all packing materials until all items of the power supply have been accounted for and checked.

Claims: In the event of obvious damage or shortages, or if the safety of the supply is suspect, a claim should be filed with the carrier immediately. An Mitra Power Systems Sales or Customer Support Organisation should also be notified in order to facilitate the repair.

2. GENERAL

This power supply may incorporate minor variations from the information contained in this sheet; only values with tolerances or limits can be considered as guaranteed data.

The ambient temperature is defined as the temperature 20mm below the unit: the air circulation through the unit may not be impeded.

3. WARNING: IMPAIRED SAFETY PROTECTION

Warning: The apparatus must be connected to the power source only by a qualified person

Whenever it is likely that safety-protection has been impaired, the instrument must be made inoperative and be secured against any operation; the matter should then be referred to the appropriate servicing authority.

Before any connection is made to a voltage source, the protective earth terminal must be connected in accordance with the local safety regulations. The minimum distance between any part of the power supply and any conductive part must be in accordance with the relevant safety regulations.

When a power supply is brought from a cold to a warm environment, condensation may cause a hazardous situation: ensure therefore that the earthing requirements are strictly adhered to.

After disconnection, allow 4 minutes before handling the power supply.

Before replacing a fuse, disconnect the power supply from any power source. If nominal values are changed, the rating type-plate must be suitably amended.

MITRA POWER SYSTEMS
We convert needs into deeds
4. ELECTRICAL DATA

4.1 Input

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>Low: 90V - 130V</th>
<th>High: 180V - 265V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting Voltage</td>
<td>85V</td>
<td></td>
</tr>
<tr>
<td>Inrush Current</td>
<td>220A (also warm)</td>
<td></td>
</tr>
<tr>
<td>Source Frequency</td>
<td>47.6k Hz</td>
<td></td>
</tr>
</tbody>
</table>

4.2 Output

<table>
<thead>
<tr>
<th>Reference Conditions</th>
<th>OUT1</th>
<th>OUT2</th>
<th>OUT3</th>
<th>OUT4</th>
<th>Power Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{\text{in}} = 60%$ of $I_c$</td>
<td>$U_{\text{in}}$</td>
<td>$V$</td>
<td>$P_{\text{max}}$</td>
<td>$U_{\text{in}}$</td>
<td>$V$</td>
</tr>
<tr>
<td>Control range</td>
<td>$4.5, 5.5$</td>
<td>$23.5, 25$</td>
<td>$4.8, 15.2$</td>
<td>$2.6, 15.0$</td>
<td>$5$</td>
</tr>
</tbody>
</table>

\[ P_{\text{max}} = U_{\text{in}} + U_{\text{in}} + U_{\text{in}} + U_{\text{in}} \leq 200W \] (Outputs galvanically separated)

If $I_{\text{in}} < I_{\text{min}}$, the supply is operational, but some output data may differ from the specified values (non-destructive effects).

### Fixed Adj. OVP

- Mains: input fuse
- Sense: OUT1
- OVP: OUT1/2/4
- Load: No feedback current limitation

**WARNING:** This power supply is intended only for installation by a professional installer within other equipment: must not be operated as a stand-alone product.

The CE marking applies for the **Low Voltage Directive 73/23/EEC**.

When correctly installed this power supply complies with EN 60950 with the provision that the installer is responsible for protection against contact with live parts.

The CE marking applies for the **EMC Directive 89/336/EEC (Equipment Intended Exclusively for Professional Purposes)** with the provision that the installer takes the necessary mitigation measures described in this User's Guide (TYPICAL TEST SET-UP).
6.1 SAFETY

<table>
<thead>
<tr>
<th>In accordance</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSAC22.2-234</td>
<td>EI 32796</td>
</tr>
<tr>
<td>UL 1950</td>
<td>EI 32796</td>
</tr>
<tr>
<td>EN60950</td>
<td>301.98046</td>
</tr>
<tr>
<td>IEC60950</td>
<td>UL2187-132796/USA</td>
</tr>
<tr>
<td>EN60601-1(NP)</td>
<td>EI 32796</td>
</tr>
</tbody>
</table>


Leakage current
Dielectric strength test
≤0.5mA
- NC(normal conditions: on delivery): from chassis to earth 254V/50Hz
Every unit has been factory tested (reinforced insulation): details are supplied on request

6.2 EMC

When loaded with a resistive load of approximately 80% of nominal output power and installed as described below the power supply meets the following specifications:

**IMMUNITY**

<table>
<thead>
<tr>
<th>port</th>
<th>phenomena</th>
<th>test</th>
<th>criteria</th>
<th>reference standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>enclosure</td>
<td>RF field (80% AM)</td>
<td>3V/m</td>
<td>A</td>
<td>EN 61000-4-3</td>
</tr>
<tr>
<td></td>
<td>RF field (conducted)</td>
<td>(0-100MHz)</td>
<td>A</td>
<td>EN 61000-4-5</td>
</tr>
<tr>
<td></td>
<td>ESD</td>
<td>8kV air 4kV contact</td>
<td>B</td>
<td>EN 61000-4-2</td>
</tr>
<tr>
<td>AC input</td>
<td>Fast transients common mode</td>
<td>(5/50ns)</td>
<td>2kV</td>
<td>EN 61000-4-4</td>
</tr>
<tr>
<td></td>
<td>Voltage dips</td>
<td>-30% 10ms</td>
<td>B</td>
<td>EN 61000-4-1 1</td>
</tr>
<tr>
<td></td>
<td>Voltage interr.</td>
<td>-60% 100ms</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Surges</td>
<td>&gt;95% 5 s</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>common mode</td>
<td>(1,2/50μs)</td>
<td>2kV</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>diff. mode</td>
<td></td>
<td>1kV</td>
<td>B</td>
</tr>
</tbody>
</table>

**EMISSION**

<table>
<thead>
<tr>
<th>port</th>
<th>freq. range</th>
<th>limits</th>
<th>reference standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC input</td>
<td>0 - 2KHz</td>
<td></td>
<td>EN 610003-2</td>
</tr>
<tr>
<td>(conducted)</td>
<td>0.15-30MHz</td>
<td>B</td>
<td>EN 55011 - EN55022</td>
</tr>
<tr>
<td>enclosure</td>
<td>30-230MHz</td>
<td>R</td>
<td>EN 55011 - EN55022</td>
</tr>
<tr>
<td>(radiated)</td>
<td>230-1000MHz</td>
<td>(3m)</td>
<td></td>
</tr>
</tbody>
</table>
"PFC Gold" PE 3238/02
Universal input: 200W Quad.output

resistive load on heatsink

power supply

ferrite ring core
\( \Phi = 24\text{mm}, 5 \text{ turns}\)

12nc: 4330 030 34441
(Place the ferrite closed to the mains connector of the rack)

AC supplied fan

The proposed set-up need not to be considered as the only possible solution to achieve conformity of the final product with the specified EMC requirements. The assembler has to evaluate compliance of the final product.
7. CLIMATIC CONDITIONS

<table>
<thead>
<tr>
<th>Designation</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>0 to +50°C</td>
</tr>
<tr>
<td>- rated range of use</td>
<td></td>
</tr>
<tr>
<td>(with internal fan)</td>
<td></td>
</tr>
<tr>
<td>- storage and transport</td>
<td>-40°C to 85°C</td>
</tr>
<tr>
<td>Humidity (ambient air, non condensing)</td>
<td>10% to 95%</td>
</tr>
</tbody>
</table>

8. MECHANICAL DATA
"PFC Gold" PE 3238/02
Universal input; 200W Quad.output

9 CONNECTIONS

9.1 Output

Connectors:
- Input: 2 pole snap-pin terminal 15 A/300 V (7.62 mm)
- Safety earth: ring tongue terminal
- Output 1: two M4 screws
- Other outputs: MTA 156
- Signals output: 2.54 mm vertical 4 A male headers

Mounting:
Standard mounting accessory: kit ref. 5304 500 10004

Connectors:
- GND
- \( V_{\text{LX}} \) (12 V - 200mA max.)
- MAY NOT BE USED
- OV SIGNAL / REMOTE ON/OFF
- FAN FAIL SIGNAL
- OV SIGNAL
- SRS SIGNAL
- ACF SIGNAL
- REMOTE ON/OFF
- ACF SIGNAL
- SENSE- (#1)
- SENSE+ (#1)
- (#4)
- (#4)
- (#3)
- (#3)
- (#2)
- (#2)
- (#2)
- (#2)
9.2 Sense

- Remote sensing facility on output 1
  Maximum voltage drop = 0.5V
- The power supply is protected against sense lead interruption.
- Without connecting the sense, the power supply works by means of its internal sense

9.3 SIGNALS sequence

- AC FAIL
- SYS RESET
- FAN FAIL
ACfail (ACF), sysreset (SRS).

During the rise time of all DC outputs, both the ACF and SRS signals remain at logical "0" level. When the output voltage is stabilized, ACF reaches the "1" level. In accordance to VME bus specification, SRS signal gives up more than 200ms after DC outputs.

If input voltage becomes to low to maintain continuously the regulation of DC outputs, the ACF signal becomes low followed by the SRS after minimum 2 ms. Between the ACF fall and the moment when outputs goes out of tolerances a minimum of 4ms is guaranteed.

The sequence described occurs also when power supply comes in current limit mode.

Remote ON/OFF

When ON/OFF signal is forced to "0", the converter stand by (output voltage = 0).
When the input ON/OFF is in high impedance or at 5V, the power supply restarts.

Fan Fail

The Fan Fail signal becomes "0" in case of a fan fault.

The "Remote ON/OFF" and "Fan FAIL" signals generates the VME sequence before to stop power supply.

9.4 Output and OVP adjustment.

- Voltage adjustment:

To modify the output voltage setting, introduce a slim screwdriver into the potentiometer identified by the label "adjust/\text{x}" on the screening, where x is the output to change. Turn clockwise to increase the voltage, turn counter clockwise to decrease.

9.5 Input (mains)

- Connecting the mains:
  - First connect the protective earth.
  - Connect the mains wires to the power supply. (L - N)
  - Then connect the plug to the mains.

* Remark. the length of the stripped part of the wire must not exceed 5mm

- Unconnecting the mains:

  - First remove the plug from the mains.
  - Then unconnect the mains wires of the power supply
9.5 Input (l.T. mains)

This power supply may be connected to an IT-power system.

- The line is fused in the power supply.
- With IT power systems, it is obligatory to install externally a fuse of 4 A.T. in neutral.

10. ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADJ</td>
<td>Adjustment (by the user): if not mentioned, the adjustments are fixed in the factory and must not be modified by the user.</td>
</tr>
<tr>
<td>I_{nom}</td>
<td>Maximum output current admitted</td>
</tr>
<tr>
<td>I_{in}</td>
<td>Inrush current (mains): cold or warm start, nominal conditions</td>
</tr>
<tr>
<td>N.E.</td>
<td>Nonpatient Equipment</td>
</tr>
<tr>
<td>OVP</td>
<td>Overvoltage protection</td>
</tr>
<tr>
<td>PE</td>
<td>Protective earth</td>
</tr>
</tbody>
</table>
| P_{nom}      | Total nominal output power (see l.,,)
| SELV         | Safety Extra Low Voltage |
| U_{in}       | Nominal mains input voltage |
| U_{out}      | Nominal output voltage |
| U_{OVP}      | Trip voltage of OVP; the output voltage is reduced. The output voltage is restored by interrupting the mains for at least 2 minutes. |
|             | Factory settings |

11. SYMBOLS

- Protective earth (ground) terminal (black)
- Electrostatic discharge (ESD) (yellow/black)
- "DANGER": RISK OF ELECTRIC SHOCK! Live Parts (yellow/black)
- Any interruption of the protective conductor inside or outside the apparatus, or disconnection of the protective conductor from the apparatus, is likely to make the apparatus dangerous. Intentional interruption is prohibited.
"PFC Gold" PE 3238/02
Universal input; 200W Quad.output

notes:
The above-mentioned component type power supply has been found to comply with applicable essential requirements of:


In conformity with following standard(s) or normative document(s):

- "Safety of ITE": EN60950/A4

- "Generic Emission and Immunity": EN55022(08-94)+A1(05-95) and EN61000-3-2(04-95) EN50082(08-97)

In the typical configuration with all the mitigation measures and restrictions described in the following user's guide:

480487244853

Wavre, 24-juin-99

M. Miller, General Manager Mitra Power Systems
### Switching Power Supplies

**SX/ SXI Series**

**15 - 150 Watt**

- Smallest enclosed power supplies with screw terminals
- Up to 80% efficiency
- EMI complies with EN 55022, class B and FCC-B
- With UL and CSA safety approval, CE-mark
- Short-circuit protected
- Overvoltage protection
- 2 years warranty

The SX/ SXI-series are very compact switching power supplies for cost critical applications. They deliver 15 to 150 W of continuous power. Use of high quality components and good thermal dissipation make them very reliable products with a calculated MTBF up to 200’000 h.

### Models / Modelle

<table>
<thead>
<tr>
<th>Order code</th>
<th>Output power max.</th>
<th>Output 1</th>
<th>Output 2</th>
<th>Output 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bestellnummer</strong></td>
<td><strong>Ausgangsleistung max.</strong></td>
<td><strong>Ausgang 1</strong></td>
<td><strong>Ausgang 2</strong></td>
<td><strong>Ausgang 3</strong></td>
</tr>
<tr>
<td>SXI 15-03 S</td>
<td>15 Watt</td>
<td>3.3 VDC / 3.0 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 15-05 S</td>
<td></td>
<td>5 VDC / 3.0 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 15-12 S</td>
<td></td>
<td>12 VDC / 1.3 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 15-24 S</td>
<td></td>
<td>24 VDC / 0.7 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 15-0522 T</td>
<td></td>
<td>5 VDC / 1.5 A</td>
<td>+12 VDC / 0.6 A</td>
<td>-12 VDC / 0.4 A</td>
</tr>
<tr>
<td>SXI 15-0333 T</td>
<td></td>
<td>5 VDC / 1.5 A</td>
<td>+15 VDC / 0.5 A</td>
<td>-15 VDC / 0.3 A</td>
</tr>
<tr>
<td>SXI 30-03 S</td>
<td>30 Watt</td>
<td>3.3 VDC / 6.0 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 30-05 S</td>
<td></td>
<td>5 VDC / 6.0 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 30-12 S</td>
<td></td>
<td>12 VDC / 2.6 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 30-24 S</td>
<td></td>
<td>24 VDC / 1.4 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 30-0522 T</td>
<td></td>
<td>5 VDC / 4.0 A</td>
<td>+12 VDC / 1.2 A</td>
<td>-12 VDC / 0.6 A</td>
</tr>
<tr>
<td>SXI 30-0533 T</td>
<td></td>
<td>5 VDC / 4.0 A</td>
<td>+15 VDC / 1.0 A</td>
<td>-15 VDC / 0.5 A</td>
</tr>
<tr>
<td>SXI 50-03 S</td>
<td>50 Watt</td>
<td>3.3 VDC / 10.0 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 50-05 S</td>
<td></td>
<td>5 VDC / 9.5 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 50-12 S</td>
<td></td>
<td>12 VDC / 4.2 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 50-24 S</td>
<td></td>
<td>24 VDC / 2.2 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 50-0522 T</td>
<td></td>
<td>5 VDC / 6.0 A</td>
<td>+12 VDC / 1.5 A</td>
<td>-12 VDC / 0.8 A</td>
</tr>
<tr>
<td>SXI 50-0533 T</td>
<td></td>
<td>5 VDC / 6.0 A</td>
<td>+15 VDC / 1.2 A</td>
<td>-15 VDC / 0.7 A</td>
</tr>
<tr>
<td>SXI 100-05 S</td>
<td>100 Watt</td>
<td>5 VDC / 20.0 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 100-12 S</td>
<td></td>
<td>12 VDC / 8.4 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 100-24 S</td>
<td></td>
<td>24 VDC / 4.4 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 150-05 S</td>
<td>150 Watt</td>
<td>5 VDC / 30.0 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 150-12 S</td>
<td></td>
<td>12 VDC / 12.5 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXI 150-24 S</td>
<td></td>
<td>24 VDC / 6.5 A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Bestellcode für 85–132VAC Eingang: SX
Input Specifications  

<table>
<thead>
<tr>
<th>Specification</th>
<th>Eingangsspezifikationen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage range</td>
<td>SX 85 – 132 VAC</td>
</tr>
<tr>
<td></td>
<td>SXI 170 – 264 VAC</td>
</tr>
<tr>
<td>Input frequency</td>
<td>47 - 63 Hz</td>
</tr>
<tr>
<td>Input surge current</td>
<td>SX/SXI 15/30 20 A typ.</td>
</tr>
<tr>
<td></td>
<td>SX/SXI 50 28 A typ.</td>
</tr>
<tr>
<td></td>
<td>SXI 100/150 15 A typ.</td>
</tr>
<tr>
<td></td>
<td>SXI 100/150 30 A typ.</td>
</tr>
<tr>
<td>Start-up time</td>
<td>100 ms max.</td>
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</tbody>
</table>

Output Specifications  

<table>
<thead>
<tr>
<th>Specification</th>
<th>Ausgangsspezifikationen</th>
</tr>
</thead>
<tbody>
<tr>
<td>O utput voltage adjustment range</td>
<td>± 10 %</td>
</tr>
<tr>
<td>- single output models</td>
<td>± 5 %</td>
</tr>
<tr>
<td>- triple output models</td>
<td>± 5 % (factory set)</td>
</tr>
<tr>
<td>Regulation</td>
<td>± 0.2 % max.</td>
</tr>
<tr>
<td>- Input variation</td>
<td>± 0.5 % max.</td>
</tr>
<tr>
<td>- Load variation</td>
<td>± 2.5 % max.</td>
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<tr>
<td>Ripple and noise</td>
<td>50 mVpk-pk max.</td>
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<tr>
<td>- Ripple</td>
<td>80 mVpk-pk max.</td>
</tr>
<tr>
<td>O utput current limitation</td>
<td>120 - 140 % lout</td>
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<tr>
<td>O vervoltage protection (O utput 1)</td>
<td>110 - 130 % Vout</td>
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General Specifications  

<table>
<thead>
<tr>
<th>Specification</th>
<th>Allgemeine Spezifikationen</th>
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<tbody>
<tr>
<td>Temperature range</td>
<td>Temperaturbereich</td>
</tr>
<tr>
<td>- Operating</td>
<td>-10 °C ... +60 °C</td>
</tr>
<tr>
<td>- Storage</td>
<td>-20 °C ... +85 °C</td>
</tr>
<tr>
<td>Derating above +50 °C</td>
<td>4 % / °C</td>
</tr>
<tr>
<td>Temperature coefficient</td>
<td>0.02 % / °C</td>
</tr>
<tr>
<td>Humidity (non condensing)</td>
<td>85 % rel H max.</td>
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<tr>
<td>Switching frequency</td>
<td>40 kHz - 400 kHz</td>
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<tr>
<td>Efficiency</td>
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<td></td>
<td>70 % typ.</td>
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<tr>
<td>M TBF (MIL HDBK 217 E 25 °C)</td>
<td>100'000 – 200'000 h typ.</td>
</tr>
<tr>
<td>Hold-up time</td>
<td>20 ms typ.</td>
</tr>
<tr>
<td>Isolation voltage</td>
<td>Prüfspannung</td>
</tr>
<tr>
<td>- Input / Output</td>
<td>3'000 VAC (1 minute)</td>
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<tr>
<td>- Input / Case</td>
<td>1'500 VAC (1 minute)</td>
</tr>
<tr>
<td>- O utput / Case</td>
<td>500 VAC (1 minute)</td>
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<td>Leakage current</td>
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<td>EMI/RFI</td>
<td>EN 55022/8, FCC-B</td>
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<tr>
<td>Safety standards</td>
<td>SX UL 1950/CSA</td>
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<tr>
<td></td>
<td>SXI EN 60950, IEC 950</td>
</tr>
<tr>
<td>Case material</td>
<td>Stainless steel, rostfreier Stahl</td>
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Specifications can be changed without notice / Technische Änderungen vorbehalten

All specifications valid at nominal input voltage, full load and +25 °C after warm-up time unless otherwise stated.

SX/ SXI 15 W single

Specifications gültig bei Nominal-Eingangsspannung, Vollast und +25 °C nach Aufwärmzeit, ausgenommen anders spezifiziert.

SX/ SXI 100 W single

Specifications and +25°C after warm-up time unless otherwise stated.

All specifications gültig bei Nominal-Eingangsspannung, Vollast und +25°C nach Aufwärmzeit, ausgenommen anders spezifiziert.

Jenatschstrasse 1  
CH-8002 Zürich / Switzerland  
Tel. +41-1-284 29 11  
Fax +41-1-201 11 68
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EVG 501 Uni Maryland
SN:S020013

Bondchamber EVG501

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Operating Instructions
Instructions de service

MZ 2T
MD 4T
MD 4TC

Membranvakuumpumpen
Diaphragm Vacuum Pumps
Pompes à vide à membrane

MZ 2T
MD 4T
MD 4TC
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1.1 Wichtige Hinweise
Prüfen Sie sofort nach dem Auspacken, ob die Sendung mit den Angaben auf dem Lieferschein übereinstimmt.

Lesen Sie die Betriebsanleitung, bevor Sie das Gerät in Betrieb nehmen. Befolgen Sie die Anweisungen in allen Punkten.

Für Schäden und Betriebsstörungen, die aufgrund Nichtbeachtung der Betriebsanleitung entstehen, übernehmen wir weder eine Haftung für Personenschäden noch Gewährleistung für Reparatur oder Ersatz unserer Produkte.


Wenn Sie selbst Reparaturoder Wartungsarbeiten an den Geräten vornehmen, die mit gesundheitsschädlichen Stoffen in Berührung gekommen sind, beachten Sie die entsprechenden Vorschriften.

Beim Geräten, die Sie an uns zu Reparatur- oder Wartungsarbeiten einschicken, beachten Sie folgendes:

- Kontaminierte Geräte (radioaktiv, chemisch etc.) sind vor der Einsendung entsprechend den Vorschriften zu dekontaminieren.
- Verwenden Sie bitte beigefügte Bestätigung.

1 General

1.1 Important Information
Please check immediately after unpacking that the contents of the consignment conforms to the information given on the delivery note.

Please read the operating instructions before you operate the unit and follow them in all respects.

No liability will be accepted for personal injury nor material damages in the event that damage or breakdowns occur as a result of failure to comply with these operating instructions; neither will any guarantees relating to repairs to or replacements of our products apply.

All units comply with the Federal German Law concerning Technical Implementations. The operating instructions comply with the German Industrial Standard DIN 8418.

If you perform repair or maintenance work on units which have come into contact with substances which are detrimental to health, please observe the relevant regulations.

If you return units to us for repair or maintenance work, please follow the instructions below:

- contaminated units (radioactively or chemically etc.) must be decontaminated in accordance with the regulations before they are returned.
- Units returned for repair or maintenance must bear a clearly visible note “Free from harmful substances”. This note must also be provided on the delivery note and accompanying letter.
- Please use the attached attestation declaration.

1 Généralités

1.1 Indications importantes
A la réception de l’envoi, s’assurer au déballage que le contenu du (des) colis correspond bien aux articles énumérés sur le bon de livraison.

Avant que de mettre l’appareil en service, lire attentivement les instructions de service et s’y conformer en tous points.

Pour tout dommage et panne résultant de non respect des instructions de service, nous déclinons toute responsabilité pour les dommages corporels ou matériels et n’accordons pas la garantie en cas de réparation ou de remplacement de nos produits.

Tous les appareils correspondent à la loi sur le matériel technique. Les instructions de service sont rédigées en concordance avec la norme DIN 8418.

L’utilisateur procède-t-il lui-même à des travaux de réparation ou d’entretien sur des appareils qui auraient été en contact avec des matières toxiques, il est alors tenu de respecter les prescriptions afférentes.

Pour les appareils que vous nous renvoyez pour réparation ou maintenance, prière d’observer les points suivants:

- Les appareils contaminés (radioactivement, chimiquement etc.) sont préalablement à décontaminer en vertu de la législation contre les émissions radioactives.
- Les appareils envoyés pour réparation ou maintenance doivent être pourvus d’une étiquette bien visible certifiant qu’ils sont “exempts de matières toxiques”. La même indication est à apposer sur le bon de livraison et sur toute la correspondance afférente.
- Prière de n’utiliser à cet effet que le formulaire ci-joint.
- Sie haben die Möglichkeit, die Geräte durch uns dekontaminieren zu lassen (ausgenommen sind radioaktiv kontaminierte Geräte). Der Reparaturauftrag ist dann entsprechend zu erweitern und die Prozeßgase, mit denen das Gerät in Berührung war, sind anzugeben. Fehlen sie, so werden sie von uns kostenpflichtig ermittelt. Besondere Transportvorschriften sind zu beachten.
- Wir werden eine Dekontamination durchführen und Ihnen berechnen, wenn Sie den Vermerk "Frei von Schadstoffen" am Gerät oder in den Begleitpapieren nicht angebracht haben.

**1.2 Sicherheitsinstruktionen**

Die Membranvakumpumpen sind nach dem neuesten Stand der Technik gebaut und betriebssicher. Von der Pumpe können aber Gefahren ausgehen, wenn sie vom Benutzer unsachgemäß oder zu nicht bestimmungsgemäßem Gebrauch eingesetzt wird.

Bei nicht bestimmungsgemäßem Einsatz erlischt jeglicher Haftungs- und Gewährleistungsanspruch.

**1.2 Instructions de sécurité**

Les pompes à vide à membrane ont été construites conformément à l’état le plus récent de la technique et fonctionnement de manière très fiable. Les pompes peuvent cependant être source de dangers si elles sont utilisées de manière non conforme à leurs destinations ou de manière inadéquate.

Le droit à la garantie expire en cas d’utilisation non conforme à la destination!

- Bediener und Service-Personal müssen die Betriebsanleitung des Produktes gelesen und verstanden haben.
- Warnungen müssen beachtet und Vorsichtsmaßregeln eingehalten werden.
- Das Bediensungs- und Service-Personal muß über alle Gefahren informiert werden, die in Zusammenhang mit der Membranvakumpumpe auftreten können. Das Personal muß in der Lage sein, Gefahren zu erkennen und ihnen entgegenzuwirken.

- Any use by unauthorized personnel ...
- Any use by unauthorized personnel ...
- You can have the units decontaminated by us (excepted are units with radioactive contamination). In this case, the repair order must be extended accordingly, and the process gases with which the unit has come into contact must be stated. If this information is missing, it will be determined by us at extra cost. Any special haulage regulations must be observed.
- We will carry out the decontamination and invoice this work to you if you have not attached the note “Free from harmful substances” to the unit or in the accompanying documents.
- “Harmful substances” are defined in European Community Countries as:
  - “materials and preparations in accordance with the EEC Specification dated 18 September 1979, Article 2”
  - and in the U.S.A. as
  - “materials in accordance with the Code of Federal Regulations (CFR) 49 Part 173.240 Definition and Preparation”.

Technical modifications reserved.

Le respect des prescriptions d’installation, de mise en service, de fonctionnement et d’entretien du fabricant fait partie intégrante de l’utilisation conforme à la destination.

- Les conducteurs et le personnel du service d’entretien doivent avoir lu et compris les instructions de service des pompes.
- Les avertissements doivent être pris en compte et les mesures de prudence respectées.
- Le personnel de conduite et d’entretien doit être informé de tous les dangers pouvant émaner des pompes à vide à membrane. Le personnel doit être en mesure de reconnaître les dangers et d’y faire face.
1.2.1 Sicherheitshinweise zum Arbeiten mit der Membranvakuumpumpe

- Die Pumpen dürfen weder zur Förderung von Gasen, die explosions- oder zündfähige Atmosphären bil- den können, noch in solchen Atmosphären betrieben werden.
- Pumpen in genügendem Abstand zu heißen Oberflächen aufstellen und Gefahren durch elektrische Funken ausschließen.
- Der Installationsraum muß den VDE-Bestimmungen, oder den jeweiligen Landesbestimmungen entsprechen. Die Pumpe darf nur mit angeschlossenem Schutzleiter betrieben werden.
- Alle weitergehenden einschlägigen Sicherheitsbedingungen (z.B. UVV-Labor) sind einzuhalten.
- Der Installationsraum muß den
- Alle weitergehenden einschlägigen
- Unklarheiten bezüglich Sicherheit,
- Bei allen Arbeiten, die Installation,
- Die Pumpen dürfen weder zur För- derung von Gasen, die explosions- oder zündfähige Atmosphären bil- den können, noch in solchen Atmosphären betrieben werden.
- Pumpen in genügendem Abstand zu heißen Oberflächen aufstellen und Gefahren durch elektrische Funken ausschließen.
- Der Installationsraum muß den
- Alle weitergehenden einschlägigen
- Sicherheitsbedingungen (z.B. UVV- Labor) sind einzuhalten.

or careless handling may increase the potential danger.

- The procedures described in the attached operating instructions must be observed in all installation, commissioning, operating and maintenance work.
- No operating modes must be used which may affect the safety of the operator and the pump.
- All unauthorized modifications and alterations affecting safety are prohibited and would cause any liability or guarantee claims to be repudiated.
- Only genuine parts and accessories may be used in service and maintenance work.
- All safety protection measures must be tested on completion of electrical installation and electrical maintenance work (e.g. earthing resistance test).
- All relevant local safety and accident prevention regulations apply for operation of the system.
- Any unclear points with regard to safety, operation and maintenance should be clarified with your nearest Balzers agency or subsidiary company.

1.2.1 Working with Diaphragm Vacuum Pumps; Safety Information

- Pumps must not be used for pumping gases which can cause explosive or inflammable mixtures, nor should they be used where such gaseous mixtures are present.
- Where hot surfaces are involved, allow sufficient space between the position of the pump and such surfaces and protect against the danger of electric sparks.
- The area in which the pump is installed must conform to the official regulations. The pump may only be operated provided protective earthing has been connected.
- All further relevant safety requirements (e.g. accident prevention regulations for laboratories) must be complied with.

- L'utilisation par du personnel non autorisé ou un maniement imprudent peuvent accroître le danger potentiel.
- Pour tous les travaux, l'installation, la mise en service, le fonctionnement et l'entretien, les informations de déconnexion indiquées dans les instructions de service ci-jointes doivent être respectées.
- Il faut s'abstenir de travailler d'une façon qui porte atteinte à la sécurité du conducteur et de la pompe.
- Des transformations et modifications de votre propre chef ayant une influence la sécurité ne sont pas autorisées. Les droits à la responsabilité et à la garantie du constructeur sont exclus.
- Pour les travaux de maintenance et d'entretien, il ne faudra utiliser que des pièces et des accessoires originaux.
- Après des travaux de montage et d'entretien en électricité, toutes les mesures de protection doivent être testées (par exemple conducteur de terre).
- Les prescriptions locales de sécurité et de prévention des accidents sont dans tous les cas valables pour le fonctionnement de l'installation.
- Les questions relatives à la sécurité, au maniement et à la maintenance peuvent être résolues avec le représentant ou la filiale Balzers les plus proches.
- Les questions relatives à la sécurité, au maniement et à la maintenance peuvent être résolues avec le représentant ou la filiale Balzers les plus proches.

1.2.1 Instructions de sécurité pour le travail avec les pompes à vide à membrane

- Les pompes ne doivent être utilisées ni pour l'exploitation de gaz, qui pourraient former un atmosphère d'explosion ou d'amorçage, ni être utilisées dans de telles atmosphères.
- Distancer suffisamment les pompes des surfaces chaudes afin d'éviter les dangers d'étincelles électriques.
- Le local d'installation doit correspondre aux prescriptions VDE (organisme allemand d'homologation électrique), ou les prescriptions nationales d'électricité du pays correspondant. La pompe ne doit être mise en service que seulement lorsque le conducteur de terre est branchée (mise à la terre).
- Toutes les prescriptions de sécurité professionnelles spécifiques en vigueur sont à respecter (par ex. UVV-Laboratoire).
- Das Verbinden der Auspuffseite der Pumpe mit einem geschlossenen System (z.B. der Vakuumkammer) ist unbedingt zu verhindern, da die Gefahr für unkontrollierten Überdruck und somit Berstgefahr der Pumpe besteht.
- Für das Pumpen von aggressiven Medien (z.B. korrosive Gase) nur Pumpen in "C"-Ausführung einsetzen.
- Bei stationärem Einbau in einer Anlage ist die mechanische Stabilität des Vakuumsystems sicherzustellen.
- Verbindungsleitungen nur bei Stillstand der Anlage lösen um Kontakt mit Prozeßgasen auszuschließen.
- Hinweise auf Gefahren, die durch Kontakt mit gefährlichen Pumpmedien entstehen können, sind vom Betreiber entsprechend mitzuteilen. Entsprechende Schutzmaßnahmen sind vorzuschreiben.

- Connecting the exhaust side of the pump with a closed system (e.g. the vacuum chamber) must be avoided at all costs otherwise there is a danger of uncontrollable overpressures arising; this could cause the pump to explode.
- Where the pumping of aggressive media is involved (e.g. corrosive gases), use only “C” model pumps.
- Mechanical stability of the vacuum system must be ensured if the pump has been installed in a fixed position in the system.
- Only detach connection lines when the system is non-operational to prevent contact with process gases.
- The user is required to provide information on dangers which can arise from coming into contact with hazardous media. The necessary protective measures must be stipulated.

1.3 Einsatz

1.3 Application
Diaphragm pumps are noted for their easy servicing, completely oil-free pumping of gases and quiet running.

1.3 Utilisation
Les pompes à membrane se caractérisent particulièrement par l’entretien facilité, le pompage de gaz absolument sans huile et le fonctionnement silencieux.
Die Pumpen in “C” -Ausführung sind für den Betrieb mit korrosiven Gasen einzusetzen.

1.4 Ausführung

Die Pumpenaggregate sind direkt mit dem Antriebsmotor verbunden.

Alle Lager der Pumpe sind außerhalb der Arbeitsräume angeordnet, gekapselt und auf Lebensdauer geschmiert. Bei normaler Belastung arbeiten die Pumpen wartungsfrei.

Die Membranpumpe MD 4TC unterscheidet sich von den vorgenannten Standardausführungen durch die Verwendung von korrosivgasbeständigen Werkstoffen im medienberührenden Arbeitsraum (Medienberührende Werkstoffe siehe unter 5.1).

Die MD 4TC ist serienmäßig mit einem Gasballastventil ausgerüstet. Mit diesem kann Kondensation in der Pumpe vermieden werden.

Diaphragm pumps are designed for installation in pumping stations. The vacuum connection is via a standard pneumatic hollow bolt onto which can be directly screwed e.g. the fore-vacuum connection of a turbomolecular pump. The exhaust of the standard version is provided with a silencer. Mains connection and thermal motor protection are by means of a one meter long five-core cable without switch and plug. On the 100 V and 110/115 V versions the capacitor is freely suspended on a cable of approx. length 30 cm and must be secured and protected against damage etc. when fitting into the rack.

The “C” version is designed for operations involving corrosive gases.

1.4 Design
The MD 4T is a three stage and the MZ 2T a two stage dry compressing diaphragm vacuum pump which means that the pumped medium does not come into contact with any lubricants. The pumps are of the displacement type where the movement of the diaphragm causes a periodic change in the size of the working chamber. The flow of gas causes the self-acting valves to open and close.

The pumping units are directly connected to the drive motor.

All pump bearings are arranged outside the working chamber, are enclosed and have lifetime lubrication. Under normal operating conditions the pumps need no servicing.

The MD 4TC Diaphragm Pump is distinguished from the aforementioned standard version by the use of corrosive gas resistant materials in the working chamber which comes into contact with the media (see Section 5.1 for such materials).

To avoid condensation in the pump, the MD 4TC is fitted with a gas ballast valve as standard.

Elles sont spécialement conçues pour être intégrées dans un groupe de pompage. Le raccord du vide est constitué par une vis creuse pneumatique standard, qui peut être par ex. directement vissée au raccord de vide primaire d’une pompe turbomoléculaire. L’échappement du modèle standard est muni d’un silencieux. L’alimentation du secteur et la protection moteur thermique sont effectuées avec un câble à cinq conducteurs (1 m) sans interrupteur ni connecteur. Pour le modèle 100 V et 110/115 V, le condensateur est connecté sur un câble d’environ 30 cm de long et doit être fixé sur le châssis au montage et protégé contre les endommagements etc.

Les pompes en modèle “C” sont à utiliser pour le fonctionnement avec des gaz corrosifs.

1.4 Modèle
La MD 4T est une pompe à vide à membrane à trois étages et la MZ 2T une pompe à 2 étages, à compression à sec. C’est pourquoi, l’agent débité ne sera pas mis en contact avec un lubrifiant. Ces pompes sont des pompes volumétriques avec une modification périodique de la grandeur de la chambre de détente créée par le mouvement de la membrane. Les soupapes s’ouvrent et se ferment automatiquement par le flux de gaz. Les composants de pompage sont directement reliés au moteur d’entraînement.

Tous les paliers de la pompe sont placés en-dehors de la chambre de travail, étanchés et lubrifiés à vie. Pour une charge normale, les pompes fonctionnent exemptées d’entretien.

La pompe à membrane MD 4TC se distingue par rapport aux modèles standard cités précédemment, par l’utilisation de matériaux résistants au gaz corrosif qui sont contactés par des agents dans la chambre de travail (matériaux en contact avec des agents voir dans 5.1).

La MD 4TC est équipée en série avec une soupape à lest d’air. Avec celle-ci, la condensation dans la pompe peut être évitée.
2 Installation

2.1 Standort/Standfläche
- Pumpen auf einer ebenen, waagerechten Fläche aufstellen.
- Befestigung der Pumpe auf der Standfläche nicht erforderlich.
- Bei stationärem Einbau Pumpe auf der Standfläche verankern.
- Maximale Umgebungstemperatur +40°C.
- Beim Einbau in geschlossene Gehäuse für ausreichende Luftzirkulation sorgen.

Achtung!
Sicherheitshinweise unter 1.2.1 beachten!

2.2 Schaltung der Pumpstufen
Bevor die Pumpe an die Apparatur angeschlossen wird, sind die Schlauchverbindungen auf richtigen Anschluß zu überprüfen.

Die Sauganschlüsse der Pumpe sind mit “IN” und die Auslässe mit “EX” gekennzeichnet.

Achtung!
Bei Verwechslung der Anschlüsse entsteht eine unzulässige Überdruckbelastung.

2.1 Base and Location
- Position the pump on an even, horizontal surface.
- Fixing to the surface is unnecessary.
- Anchor when fitting in a rack or frame.
- Sight glass 40 must be visible.
- When installing the pump in a closed housing, ensure there is sufficient air circulation.

Caution!
Observe the safety instructions in Section 1.2.1.

2.2 Connection of Pumping Stages
Check the hose connections for the correct type of connecting pieces before connecting the pump to the vacuum chamber.

The intake connections of the pump are marked with “IN” and the outlets with “EX”.

Caution!
Interchanging the connections will result in impermissibly high over-pressure levels.

2 Installation

2.1 Emplacement, surface de pose
- Poser la pompe sur une surface plane et horizontale.
- La fixation de la pompe sur la surface de pose n’est pas nécessaire.
- Pour une mise en place stationnaire, ancrer la pompe sur la surface de pose.
- Température ambiante maximum +40°C.
- Pour la mise en place dans un boîtier fermé prendre garde à ce qu’une circulation d’air suffisante soit assurée.

Attention!
Veuillez considérer les instructions de sécurité dans 1.2.1!

2.2 Raccordement des étages de pompes
Avant que la pompe soit raccordée au groupe, les raccords flexibles seront à contrôler sur leur raccordement correct.

Les raccords d’aspiration de la pompe sont indiqués avec “IN” et les échappements avec “EX”.

Attention!
Une inversion des raccordements peut provoquer une charge de surpression inadmissible.
Die Pumpe ist mit vier einzeln arbeitenden Membranpumpen A, B, C, D ausgerüstet, die über Schlauchverbindungen zu einer dreistufigen Vakuumpumpe geschaltet sind.

- Der Sauganschluß Apparatur 1 ist an A-IN und an B-IN angeschlossen.
- C-EX ist an D-IN angeschlossen. Die Auslaßseite 3 der MD 4TC ist mit einer Schlauchwelle DN 10 ausgerüstet und die MD 4T ist am Auslaß mit einem Schalldämpfer versehen.

Auch die Auslaßseite 3 der MD 4TC ist mit einer Schlauchwelle DN 10 ausgerüstet und die MD 4T ist am Auslaß mit einem Schalldämpfer versehen.

2.3 Sauganschluß
- Verschlußkappe am Sauganschluß entfernen.
- Verbindung zwischen Pumpe und Vakuumsystem so kurz wie möglich ausführen.
- Pumpe mit Sauganschluß an Apparatur anschließen.
- Befindet sich im zu evakuierenden System Flüssigkeit, so daß beim Evakuieren Dämpfe frei werden, ist zwischen Apparatur und Pumpe ein Kondensatabscheider einzusetzen.

The MZ 2T is a two-stage pump. The intake connection is marked with “IN” and the exhaust connection with “EX” so as to avoid the connections getting mixed up. The outlet side of the MZ 2T is provided with a silencer.

2.3 Intake Connection
- Remove the locking cap from the intake connection.
- Make the connection between pump and vacuum system as short as possible.
- Connect pump to the vacuum system via the intake connection.
- If a vapour releasing liquid is present in the system to be evacuated, a condensate separator must be fitted between pump and pumping system.

La pompe travaille à deux étages. Le raccord d’aspiration est indiqué avec “IN” et le raccord d’échappement avec “EX”. De cette manière, une inversion de raccordement n’est pas possible. Le côté échappement de MZ 2T est muni d’un silencieux.

2.3 Raccordement d’aspiration
- Enlever le capuchon de fermeture au raccord d’aspiration.
- Effectuer le raccordement entre la pompe et le système de vide aussi court que possible.
- Raccorder la pompe avec le raccord d’aspiration à l’appareillage.
- Si du liquide se trouve dans le système à évacuer, qui pourrait provoquer des vapeurs libres pendant l’évacuation, il faudra monter entre l’appareillage et la pompe, un séparateur de condensat.
2.4 Exhaust Connection

Important:
Overpressure on the exhaust side must be avoided at all costs (see Section 5, Technical Data for maximum permissible counter pressures at the outlet).

- Lay the exhaust line without shut-off devices.
- If a shut-off device has to be fitted for operating reasons, or if there is a danger that overpressure could build up in the line, official accident prevention regulations must be observed.
- The line from the pump should be laid sloping downwards so that condensate cannot flow back into the pump, otherwise a trap must be fitted.
- Connecting the exhaust side of the pump with a closed system (e.g. the vacuum chamber) must be avoided at all costs otherwise there is a danger the pump could explode.

Caution!
Expelled gases and vapours can represent a health hazard and/or be damaging to the environment.

Achtung!
Die ausgestoßenen Gase und Dämpfe können sich gesundheitsschädigend und/oder umweltverschmutzend auswirken.

2.5 Electrical Connections

Diaphragm pumps are driven by alternating current motors.

Important:
Electrical connections must comply with local regulations.

- Ensure that the mains voltage level is compatible with voltage and frequency values information stated on the rating plate.
- The pump may only be connected to mains supply systems which incorporate earthing protection.
- Pumps are equipped with a free embedded thermostatic cut-out in the winding.

Caution!
If the thermostatic cut-out has not been properly wired, the pump has no motor protection.

2.4 Auspuffanschluß

Hinweis:
Einen auspuffseitigen Überdruck unbedingt vermeiden. (Maximaler Gegendruck am Auslaß siehe unter 5 Technische Daten).

- Auspuffleitung ohne eingebaute Absperrogane verlegen.
- Wird aus betriebsspezifischen Gründen ein Absperrogan eingebaut, oder besteht die Gefahr, daß sich in der Leitung ein Überdruck aufbauen kann, sind die behördlichen Vor- schriften der Unfallverhütung zu beachten.
- Das Verbinden der Auspuffseite mit einem geschlossenen System (z.B. Vakuumkammer), ist unbedingt zu vermeiden (Berstgefahren).

Achtung!
Die ausgestoßenen Gase und Dämpfe können sich gesundheitsschädigend und/oder umweltverschmutzend auswirken.

2.5 Elektrischer Anschluß

Die Membranpumpen werden von Wechselstrommotoren angetrieben.

Hinweis:
Der elektrische Anschluß ist nach den örtlich geltenden Bestimmungen auszuführen.

- Spannungs- und Frequenzangabe auf dem Typenschild muß mit der Netzspannung übereinstimmen.
- Die Pumpe darf nur am Stromnetz angekoppelt werden.
- Die Pumpen haben einen herausgeführten thermischen Wicklungs- schutz.

Achtung!
Ohne geeignete Verdrahtung des herausgeführten Wicklungsschutzes besitzt die Pumpe keinen Motorschutz.

Der Anschluß der Membranpumpe in den Pumpstand ist nach den Schaltplänen PM 021 557 -S oder PM 031 475 -S auszuführen.

Diaphragm pumps should be connected in the pumping station as per Wiring Diagram PM 021 557 -S or PM 031 475 -S.

2.4 Raccordement d’échappement

Remarque:
Eviter absolument une sur-pression du côté échappement. (Contre pression maximum à la sortie voir dans 5 Fiche technique).

- Poser la conduite d’échappement sans éléments de fermeture intégrés.
- Au cas où, pour des raisons inter- nes de fonctionnement un élément de fermeture est à monter ou que le danger de sur-pression dans la conduite ne soit pas exclu, veuillez suivre les prescriptions locales de la prévention d’accidents.
- Poser la conduite de la pompe en pente pour assurer le non-retour de la condensation dans la pompe. Dans le cas contraire il faudra monter un séparateur.
- La liaison du côté échappement de la pompe avec un système fermé (par ex. chambre à vide) est absolument à éviter (danger d’éclatement!).

Attention!
Les gaz et les vapeurs refoulés peuvent nuire à la santé et provoquer une pollution de l’environnement.

2.5 Branchement électrique

Les pompes à membrane seront entrainées avec des moteurs à courant alternatif.

Remarque:
Le branchement électrique du moteur est à effectuer suivant les prescriptions locales en vigueur.

- Les indications de tension et de fréquence sur la plaque signalétique doivent correspondre à la tension et à la fréquence du secteur.
- La pompe doit seulement être raccordée au réseau avec un conducteur de terre.
- Les pompes possèdent une sortie de protection de bobinage thermique.

Attention!
Sans raccordement adéquate de la sortie de la protection thermique du bobinage, la pompe ne possède aucune autre protection de moteur.

Le raccordement de la pompe à membrane au groupe de pompage est à effectuer suivant les schémas électriques PM 021 557 -S ou PM 031 475 -S.
Legend for Wiring Diagram PM 021 557 -S
1 TCW Cooling Water Monitor
2 Diaphragm vacuum pump
3 Air cooling or TZK Cooling Unit
4 Heating
8 Cable, TCP turbomolecular pump
17 Turbomolecular pump
18 Electronic drive unit
19 Venting Valve TSF

Legend for Wiring Diagram PM 031 478 -S
2 Backing pump
3 Air cooling
18 Electronic drive unit
19 Venting valve
X1 Connection, venting valve
X2 Connection, air cooling
X5 Output socket strip TCP
X8 Mains connection for Electronic Drive Unit TCP 015
X12 Connection, backing pump
X25 Connection, electronic drive unit (control signals)
X26 Connection, backing pump safety valve

Legende zum Schaltplan PM 021 557 -S
1 Kühlwasserwächter TCW
2 Membranvakuumpumpe
3 Luftkühlung oder Kühlaggregat TZK
4 Heizung
8 Kabel TCP-Turbopumpe
17 Turbopumpe
18 Antriebselektronik
19 Flutventil TSF

A Netzanschluß
B Netzanschluß für Fernbedienung
S1 Pumpstand
S2 Heizung
S4 Pumpstand (in Fernbedienung)
S5 Heizung (in Fernbedienung)
S6 Reset (in Fernbedienung)
S9 Stand-by
S10 Stand-by extern

1) Beim Anschluß eines TCW, Brücke entfernen.
2) Bei Raumtemperatur P 24˚C, 1 - 3 geschlossen.
3) Bei Fernbedienung, Brücke entfernen.
8) Bei Anschluß einer Membranpumpe ohne Temperaturschalter, gebrückt.

Legend for Wiring Diagram PM 031 478 -S
2 Vorvakuumpumpe
3 Luftkühlung
18 Antriebselektronik
19 Flutventil
X1 Anschluß Flutventil
X2 Anschluß Luftkühlung
X5 Ausgangsbuchsenleiste TCP
X8 Netzanschluß für Antriebselektronik TCP 015
X12 Anschluß Vorvakuumpumpe
X25 Anschluß Antriebselektronik (Steuersignale)
X26 Anschluß Vorvakuum-Sicherheitsventil

A Mains connection
B Mains connection for remote control
S1 Pumping station
S2 Heating
S4 Pumping station (in remote control)
S5 Heating (in remote control)
S6 Reset (in remote control)
S9 Stand-by
S10 Stand-by, external

1) Remove bridge when a TCW is connected.
2) 1 - 3 closed when the ambient temperature ≥ 24°C.
3) Remove bridge for remote control operations.
8) Bridged if a diaphragm vacuum pump is connected without temperature switch.

Legende schéma électrique PM 021 557 -S
1 Contrôleur d’eau de refroidissement TCW
2 Pompe à vide à membrane
3 Refroidissement par air et groupe réfrigérant TZK
4 Chauffage
8 Câble pompe turbo-TCP
17 Pompe turbo
18 Electronique d’entraînement
19 Soupape de remise à l’air TSF

A Raccord au réseau
B Raccord au réseau pour commande à distance
S1 Groupe de pompage
S2 Chauffage
S4 Groupe de pompage (en commande à distance)
S5 Chauffage (en commande à distance)
S6 RAZ (en commande à distance)
S9 Stand-by
S10 Stand-by externe

1) Pour un raccordement de TCW, enlever le pontage.
2) Pour température ambiante ≥ 24°C, 1 - 3 fermé.
3) Pour commande à distance, enlever le pontage.
4) Pour raccordement d’une pompe à membrane sans interrupteur de température, ponté.

Légende schéma électrique PM 031 478 -S
2 Pompe à vide primaire
3 Refroidissement par air
18 Electronique d’entraînement
19 Soupape de remise à l’air
X1 Raccord soupape de remise à l’air
X2 Raccord refroidissement par air
X5 Connecteur sortie femelle TCP
X8 Raccord au réseau pour l’électronique d’entraînement TCP 015
X12 Raccord pompe à vide primaire
X25 Raccord de l’électronique d’entraînement (signaux de commande)
X26 Raccord de soupape de sécurité-vide primaire
3 Betrieb

Hinweis:
Bevor die Pumpe in Betrieb genommen wird unbedingt sicherstellen, daß sich auf der Druckseite kein unzulässig hoher Druck aufbaut.

- Die Pumpe kann zu jeder Zeit eingeschaltet werden.
- Die Sauganschlüsse sind mit “IN” und die Ausgänge mit “EX” gekennzeichnet.

Vorsicht!
Bei Verwechslung der Anschlüsse entsteht eine unzulässige Überdruckbelastung.

- Wurde die Pumpe mit Kondensat belastet, muß sie vor dem Abschalten noch einige Minuten unter Atmosphärendruck nachlaufen.
- Weiterhin gelten die unter 1.2.1 gegebenen Sicherheitshinweise zum Arbeiten mit der Membranvakuumpumpe.

4 Wartung


3 Operations

Important:
Before putting the pump into operation it is essential to ensure that impossibly high pressures cannot arise on the pressure side.

- The pump can be switched on and off at any time.
- Intake and outlet connections are marked with “IN” and “EX” respectively.

Caution!
Interchanging the connections will result in impossibly high over-pressure levels.

- The pump should be allowed to continue running under atmospheric pressure for several minutes before switching off if it has been subjected to the action of condensates.
- The safety instructions regarding working with diaphragm vacuum pumps contained in Section 1.2.1 continue to apply.

4 Maintenance

Under normal operating conditions the pump requires no maintenance. Pump fluid checks are unnecessary. Valves and diaphragms suffer from the effects of wear and tear. At the latest when the attained pressure values begin to decline, the working chamber, the diaphragms and valves should be cleaned and checked for cracks (see Section 8, Inspection).

3 Fonctionnement

Remarque:
Avant de mettre la pompe en service, il faudra absolument s’assurer que du côté pression aucune haute pression inadmissible ne se développe.

- La pompe peut être mise en marche et arrêtée à tout moment.
- Les raccords d’aspiration sont indiqués avec “IN” et les échappements avec “EX”.

Attention!
Une inversion de raccordement peut provoquer une charge de sur-pression inadmissible.

- Si la pompe a été chargée avec du condensat, elle doit, avant la mise à l’arrêt, marcher quelques minutes à la pression atmosphérique.
- De plus, les indications de sécurité citées dans 1.2.1 pour le travail avec la pompe à vide à membrane sont valables.

4 Entretien

La pompe est exempte d’entretien en fonctionnement normal. Les contrôles de fluide moteur ne sont pas nécessaires. Les soupapes et les membranes sont des pièces d’usure. Au plus tard, lorsque les valeurs de pression atteintes baissent, la chambre de détente, la membrane et la soupape devront être nettoyées et contrôlées sur d’éventuelles fissures (voir 8 Inspection).
<table>
<thead>
<tr>
<th>Technische Daten</th>
<th>5 Technical Data</th>
<th>5 Fiche technique</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pumpe/Pump/Pompe</strong></td>
<td><strong>MZ 2T</strong></td>
<td><strong>MD 4T</strong></td>
</tr>
<tr>
<td>Anschluss/Connection/Raccord</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Einlauf/Inlet/Entrée</td>
<td>DN 16</td>
<td></td>
</tr>
<tr>
<td>Auslaß/Outlet/Sortie</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schalldämpfer/ Silencer/ Silencieux</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zylinderzahl/Nr. of cylinders/Nombre de cylindres</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Max. Saugvermögen 50/60 Hz/Max. volume flow rate 50/60 Hz/ Capacité aspir. max. 50/60 Hz</strong></td>
<td>m³/h</td>
<td>2,3,3</td>
</tr>
<tr>
<td><strong>Enddruck (absolut)/Final pressure (absolute)/Pression finale (absolue)</strong></td>
<td>mbar</td>
<td>5</td>
</tr>
<tr>
<td><strong>Max. zulässiger Druck am Auslaß/Max. permissible pressure at outlet/Pression max. admise à la sortie</strong></td>
<td>bar</td>
<td>1,1</td>
</tr>
<tr>
<td><strong>Motorleistung/Motor power/Puissance moteur</strong></td>
<td>kW</td>
<td>0,18</td>
</tr>
<tr>
<td><strong>Nenndrehzahl 50/60 Hz/Rated rotation speed 50/60 Hz/Vitesse rotat. nomin. 50/60 Hz</strong></td>
<td>1/min</td>
<td>1500/1800</td>
</tr>
<tr>
<td><strong>IP 54</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Stromaufnahme bei/Current take-up at/Consommation de courant pour</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>110-115 V 50/60 Hz</td>
<td>A</td>
<td>2,9/3,1</td>
</tr>
<tr>
<td>220-240 V 50/60 Hz</td>
<td>A</td>
<td>1,4/1,6</td>
</tr>
<tr>
<td><strong>Motorschutz/Motor protection/Protection moteur</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperaturschalter/ Temperature switch/ Interrupt. thermique</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gewicht/Weight/Poids</strong></td>
<td>kg</td>
<td>10,1</td>
</tr>
</tbody>
</table>

### 5.1 Substances in Contact with the Media

#### Standardausführung

**MZ 2T und MD 4T**

<table>
<thead>
<tr>
<th>Pumpeneinzelteile/Pump components/Pièces de la pompe</th>
<th>Medienberührende Werkstoffe/Substances in contact with the media/Matériaux en contact avec des agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doppelmembran (1,6 mm dick)/Double diaphragm (1.6 mm thick)/ Membran double (épaisseur 1,6 mm)</td>
<td>PTFE beschichtetes gewebeverstärktes Neopren/PTFE coated, reinforced Neoprene/ PTFE à couche renforcée avec tissu Neophrène</td>
</tr>
<tr>
<td>Membranspannscheibe/Diaphragm spring washer/Rondelle à ressort de membrane Kopfdeckel/Head cover/Couvercle chapeau</td>
<td>ECTFE (Halar) beschichteter Edelstahl/ECTFE (Halar), coated stainless steel/ECTFE (Halar) Inox recouvert</td>
</tr>
<tr>
<td>Ventile/Valves/Soupape</td>
<td></td>
</tr>
<tr>
<td>Gehäusedeckel/Housing cover/Carter du boîtier Verschraubungen/Fittings/Raccords filetés</td>
<td></td>
</tr>
<tr>
<td>Verbindungsschlauch/Connecting hose/Flexible Schalldämpfer/Silencer/Silencieux</td>
<td></td>
</tr>
<tr>
<td>Saugstutzen/Intake port/Tubulures d’aspiration</td>
<td></td>
</tr>
</tbody>
</table>

### 5.1 Matières en contact avec des agents

#### Modèle standard MZ 2T et MD 4T

<table>
<thead>
<tr>
<th>Pumpeneinzelteile/Pump components/Pièces de la pompe</th>
<th>Medienberührende Werkstoffe/Substances in contact with the media/Matériaux en contact avec des agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membran (1,2 mm dick)/Diaphragm (1.2 mm thick)/ Membrane (épaisseur 1,2 mm)</td>
<td>PTFE beschichtetes gewebeverstärktes Neopren/PTFE coated, reinforced Neoprene/ PTFE à couche renforcée avec tissu Neophrène</td>
</tr>
<tr>
<td>Membranspannscheibe/Diaphragm spring washer/Rondelle à ressort de membrane Kopfdeckel/Head cover/Couvercle chapeau</td>
<td>ECTFE (Halar) beschichteter Edelstahl/ECTFE (Halar), coated stainless steel/ECTFE (Halar) Inox recouvert</td>
</tr>
<tr>
<td>Ventile/Valves/Soupape</td>
<td></td>
</tr>
<tr>
<td>Gehäusedeckel Innentel/Housing cover, inner part/Couvercle de carter partie int. Verschraubungen/Fittings/Raccords filetés</td>
<td></td>
</tr>
<tr>
<td>Verbindungsschlauch/Connecting hose/Flexible Schalldämpfer/Silencer/Silencieux</td>
<td></td>
</tr>
<tr>
<td>Saugstutzen/Intake port/Tubulures d’aspiration</td>
<td></td>
</tr>
</tbody>
</table>
Fig. 5
MD 4T
Klammerwert gilt für MD 4TC
Values in brackets valid for MD 4TC
Valeur entre parenthèses valable pour MD 4TC
6 Service Hinweise
6.1 Einsendung zur Reparatur ins Service-Center
Verständigen Sie bitte bei auftretenden Schwierigkeiten Ihren zuständigen PFEIFFER-Service.

Reparaturaufträge werden ausschließlich aufgrund unserer allgemeinen Lieferungsbedingungen durchgeführt. Für Reparaturen gilt eine Gewährleistungszeit von 6 Monaten. Reparaturen werden ohne Rückfrage ausgeführt, wenn die Reparaturkosten nicht mehr als 50 % des Artikel-Neuwertes betragen.

Bitte beachten Sie:
Das in der Pumpe befindliche Betriebsmittel und/oder Schmiermittel muß vor der Einsendung zur Reparatur abgelassen werden.

Unsere Empfehlung:
Wir empfehlen Ihnen entsprechende Wartungsverträge mit Ihrer zuständigen PFEIFFER-Servicestelle abzuschließen, damit Ihnen keine größeren Schäden entstehen, die an der Pumpe unangenehme Ausfallzeiten verursachen.

Haben Sie Fragen, wenden Sie sich bitte an unsere Vertriebsgesellschaften oder Vertretungen. Sie werden Ihnen gerne helfen.

Anschriften auf der Rückseite des Einbandes.

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6 Servicing Information
6.1 Returning to Service Center for Repair
We request that you contact your local PFEIFFER Service Center should problems arise.

All repair orders are carried out on the basis of our General Terms of Delivery only. For repairs, the warranty period is 6 months. Repair work is performed without checkback if the repair costs do not exceed 50 % of the nominal value of the article.

Please note:
The operating medium in the pump must be drained before you return the pump for repair. When returning for repairs, the important introductory notes contained in these instructions must be observed.

Recommendation:
We recommend that you take out a service contract with your local PFEIFFER Service Center, thereby avoiding possible extended periods of inactivity which could be caused by major damage to the pump.

Should you have any questions, please contact our sales companies or agencies which will be pleased to assist you.

Please see back cover for addresses.

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6 Service après-vente
6.1 Expédition et réparation dans notre centre de service après-vente
Si des difficultés se manifestent, veuillez informer les services PFEIFFER concernés.

Les commandes de réparation seront exclusivement faites selon nos conditions générales de livraison. La garantie est de 6 mois pour les réparations. Les réparations seront faites sans accords préliminaires quand les frais ne dépassent pas 50% du prix de la pièce neuve.

Veuillez noter:
Le fluide moteur se trouvant dans la pompe doit être vidé avant l’expédition pour la réparation.
Avant d’envoyer la pompe pour la réparation, veuillez lire les indications importantes dans cette instruction de service.

Notre recommandation:
Nous vous recommandons de faire avec notre service après-vente PFEIFFER concerné des contrats d’entretien pour éviter d’éventuels dommages importants qui pourraient causer des temps d’arrêts prolongés et inutiles de la pompe.

Pour tout renseignement complémentaire, veuillez vous adresser à notre société ou nos représentants, qui se mettront volontiers à votre service.

Adresses sur le dos du livre.
7 Troubleshooting
Troubleshooting can be divided into four main categories. The sources of malfunction can be ascribed to a number of possible causes. Malfunction corrective measures depend on the cause.
Pumpe läuft nicht an

- keine Netzspannung vorhanden
  - nein
  - Netzstecker einstecken
  - ja
- Phasenausfall
  - nein
  - Sicherung kontrollieren
  - ja
- Schutzschalter Motorschütz hat ausgelöst
  - nein
  - Abkühlung Motor abwarten und Schutzschalter drücken
  - ja

Pumpe blockiert

- Schöpfraum verschmutzt
  - ja
  - Schöpfraum reinigen
  - nein
- Membranspannscheibe lose
  - ja
  - Membranspannscheibe anziehen
  - nein
- Membranen gerissen
  - ja
  - Membranen austauschen
  - nein
- Auspuff verschlossen
  - ja
  - Auspuffkanäle reinigen
  - nein
- Querschnitt Auspuff zu klein
  - ja
  - größeren Querschnitt wählen
  - nein
- zu hohe Umgebungstemperatur, über +40 °C
  - ja
  - für ausreichende Belüftung sorgen
  - nein
- Pleuel- oder Motorlager festgelaufen
  - ja

Balzers-Service benachrichtigen
**Pumpe läuft, kein Enddruck, keine Leistung**

- Leck im Saugschlauch  
  - nein
  - lange dünnere Leitungen  
    - nein
  - Membrane gerissen  
    - nein
  - Ein- und Auslaßventil defekt  
    - nein
  - Schöpfraum verschmutzt  
    - nein
  - Schläuche und Schlauchverbindungen undicht  
    - nein

**Pumpe ist zu laut**

- Saugschlauch überprüfen  
  - ja
  - größeren Querschnitt wählen  
    - nein
  - Membranen auswechseln  
    - nein
  - neue Ventile einbauen  
    - nein
  - Ventile reinigen bzw. austauschen  
    - nein

- Schmutz im Schöpfraum  
  - ja
  - Membrane gerissen  
    - nein
  - Schalldämpfer lose oder fehlt  
    - ja

- Ein- und Auslaßventil defekt  
  - ja
  - Ventile reinigen  
    - nein
  - Motorlüfter defekt  
    - ja

- Motorlüfter austauschen  
  - ja

- Schalldämpfer überprüfen, ggf. erneuern  
  - ja

- Pumpe ist zu laut  
  - ja
Pump doesn't start

- No mains power
- Phase failure
- Motor protection switch has tripped

Connect mains plug

Check fuse

Wait for motor to cool and activate protection switch

Pump blocked

- Working chamber dirty
- Diaphragm spring washer loose
- Diaphragm torn
- Exhaust closed
- Cross section of exhaust too small
- Too high an ambient temperature, over +40 °C
- Con-rod or motor bearing jammed

Clean working chamber

Tighten diaphragm spring washer

Replace diaphragms

Clean exhaust channels

Select greater cross section

Ensure adequate ventilation

Inform Balzers Service
Pump runs, no final pressure, no power

- Leak in intake hose
  - yes: Check intake hose
  - no
- Long thin lines
  - yes: Select greater cross section
  - no
- Diaphragm torn
  - yes: Replace diaphragms
  - no
- Inlet and outlet valves defective
  - yes: Fit new valves
  - no
- Inlet and outlet valves stuck
  - yes: Clean or replace valves
  - no
- Working chamber dirty
  - yes: Clean working chamber
  - no
- Hoses and hose connections not tight
  - yes: Check and seal
  - no

Pump is too loud

- Dirt in the working chamber
  - yes: Clean working chamber
  - no
- Diaphragm torn
  - yes: Fit new diaphragms
  - no
- Silencer loose or missing
  - yes: Check silencer and replace as necessary
  - no
- Valves defective
  - yes: Replace valves
  - no
- Motor fan defective
  - yes: Replace motor fan
  - no
- Con-rod or motor bearing defective
  - yes

Check intake hose
Select greater cross section
Replace diaphragms
Fit new valves
Clean or replace valves
Clean working chamber
Check and seal
Replace motor fan
La pompe ne démarre pas

Pas d'alimentation du secteur présente

Absence d'une phase

Protection thermique a déclenchée le contacteur moteur

non

oui

Connecter connecteur de réseau

non

Contrôler fusible

oui

Attendre refroidissement moteur et réarmer protection thermique

non

Chambre de détente colmatée

non

Rondelle à ressort de membrane non-serrée

oui

Visser la rondelle à ressort de membrane

non

non

Membrane défectueuse

oui

Remplacer membrane

non

Echappement bouché

non

Choisir un diamètre plus grand

oui

Nettoyer les canalisations d'échappement

Diamètre de l'échappement trop petit

non

non

Température ambiante trop élevée au-dessus de +40 °C

oui

Aérer suffisamment

non

Palier de bielle ou de moteur bloqué

oui

Nettoyer chambre de détente

non

Prière de se mettre en rapport avec le service après-vente Balzers
Pompe marche, pas de pression finale, pas de puissance

- Fuite dans le flexible d'aspiration
  - non
  - oui

- Conduites longues et étroites
  - non
  - oui

- Membrane défectueuse
  - non
  - oui

- Soupapes d'aspiration et d'échappement défectueuses
  - non
  - oui

- Soupapes d'aspiration et d'échappement collées
  - non
  - oui

- Chambre de détente colmatée
  - non
  - oui

- Flexibles et raccords flexibles non étanches
  - non

Pompe trop bruyante

- Contrôler le flexible d'aspiration
  - oui
  - non

- Choisir un diamètre plus grand
  - non

- Membrane défectueuse
  - non
  - oui

- soupapes d'aspiration et d'échappement défectueuses
  - non
  - oui

- Soupapes d'aspiration et d'échappement collées
  - non
  - oui

- Chambre de détente colmatée
  - non
  - oui

- Nettoyer les soupapes et évent. les remplacer
  - non
  - oui

- Ventilateur moteur défectueux
  - non
  - oui

- Palier de bielle ou de moteur défectueux
  - non
  - oui

Nettoyer la chambre de détente

- Colmatage dans la chambre de détente
  - oui
  - non

- Remplacer la membrane
  - oui
  - non

- Silencieux non-serré ou absent
  - oui
  - non

- Contrôler le silencieux évent. le remplacer
  - oui
  - non

- Remplacer les soupapes
  - oui
  - non

- Remplacer le ventilateur moteur
  - oui
  - non

- Contrôler et rendre étanche
  - oui
  - non
Fig. 6 bis Fig. 8

– Bevor die Pumpe demontiert wird, ist zu prüfen ob für die Störung nicht äußere Einflüsse maßgebend sind.
– Motor bei jeder Inspektion gegen Einschalten sichern.
– Pumpe, wenn erforderlich, zur Inspektion aus der Anlage demonstrieren.
– Zur Beseitigung der Fehler Pumpe nur so weit wie nötig demontieren.

Achtung!
Die gesetzlichen und lokalen Bestimmungen im Umgang mit Lösungsmitteln sind einzuhalten.

– Zur Inspektion sind nur Originalteile entsprechend Ersatzeiliste zu verwenden.

8 Inspection
Fig. 6 to Fig. 8

– Before dismantling the pump, check that the malfunction has not been caused by external factors.
– Whenever performing inspection work, make sure the motor cannot get switched on.
– Where necessary, detach pumps from the system before performing inspection work.
– Only dismantle the pump as far as is necessary in order to correct faults.
– Only use benzine or similar agents for cleaning pump parts. Do not use soluble washing agents.

Important:
Ensure compliance with local regulations when working with solvents.

– Only use genuine parts as per the spare parts list when carrying out inspection work.
– Toxic gases and vapours can arise when carrying out inspection work on corrosive gas version pumps ("C"). Pumps must be decontaminated before inspection. Only qualified personnel are permitted to carry out maintenance and repair work and the regulations must be observed.

8 Révision
Fig. 6 à Fig. 8

– Avant de démonter la pompe, il faut s’assurer que la panne n’est pas de source extérieure.
– Condamner la mise en marche du moteur avant chaque révision.
– Si nécessaire, sortir la pompe de l’installation pour la révision.
– Démonter la pompe au minimum afin d’effectuer le dépannage.
– Nettoyer les pièces de la pompe seulement avec de l’essence ou un produit semblable. Ne pas employer de produits de nettoyage.

Attention!
Les prescriptions locales en vigueur sont à observer pour l’usage de produits solubles.

– Pour la révision, seulement les pièces d’origine correspondantes à la liste de pièces de rechange sont à utiliser.
– Pour la révision de pompe en modèle à gaz corrosif ("C") des gaz toxiques et des vapeurs peuvent s’échapper. Les pompes sont à décontaminer avant la révision. L’entretien et la réparation, ne seront à effectuer que par du personnel formé en observant les prescriptions en vigueur.
1 Gehäusedeckel
2 Kopfdeckel
3 Membranspannscheibe
4 Pleuel
5 Gehäuse
6 Gehäuseblech
7 Exzenterbuchse mit Gegengewicht
8 Zylinderschraube
9 Membranstückscheibe
10 Doppelmembrane
11 Ein- und Auslaßventil- und -dichtung
12 Bügelgriff
13 Rillenkugellager
15 Schalldämpfer
16 Senkschraube
17 Senkschraube
18 Zylinderschraube
19 Toleranzring
22 Dichtung
23 Motor
24 Sechskantschraube
25 Distanzring
26 Zylinderschraube
27 Anschluß Ansaugflansch
32 Gehäuseblech
33a Abdeckblech, unten
33b Abdeckblech, oben
34 Linienblechschraube
35 Fächerscheibe
36 Linenschraube
37 Sechskantmutter
38 Lüfter
39 Lüfterschutz
40 Abdeckblech

1 Gehäusedeckel
2 Kopfdeckel
3 Membranspannscheibe
4 Pleuel
5 Gehäuse
6 Gehäuseblech
7 Exzenterbuchse mit Gegengewicht
8 Zylinderschraube
9 Membranstückscheibe
10 Doppelmembrane
11 Ein- und Auslaßventil- und -dichtung
12 Bügelgriff
13 Rillenkugellager
15 Schalldämpfer
16 Senkschraube
17 Senkschraube
18 Zylinderschraube
19 Toleranzring
22 Dichtung
23 Motor
24 Sechskantschraube
25 Distanzring
26 Zylinderschraube
27 Anschluß Ansaugflansch
32 Gehäuseblech
33a Abdeckblech, unten
33b Abdeckblech, oben
34 Linienblechschraube
35 Fächerscheibe
36 Linenschraube
37 Sechskantmutter
38 Lüfter
39 Lüfterschutz
40 Abdeckblech

1 Housing cover
2 Head cover
3 Diaphragm spring washer
4 Con-rod
5 Housing
6 Housing panel
7 Excenter bushing with counterweight
8 Cheesehead screw
9 Diaphragm support washer
10 Double diaphragm
11 Inlet and outlet valve seal
12 Bow-shaped handle
13 Grooved ball bearing
15 Silencer
16 Countersunk screw
17 Countersunk screw
18 Cheesehead screw
19 Tolerance ring
22 Seal
23 Motor
24 Hexagonal screw
25 Spacer
26 Cheesehead screw
27 Connection, intake flange
32 Housing panel
33a Cover panel, lower
33b Cover panel, upper
34 Raised sheet metal screw
35 Serrated lock washer
36 Raised cheesehead screw
37 Hexagonal nut
38 Fan
39 Fan protection
40 Cover panel

1 Carter du boîtier
2 Couvercle chapeau
3 Rondelle à ressort de membrane
4 Bielle
5 Boîtier
6 Tôle boîtier
7 Coussinet excentrique avec contre-poids
8 Vis cylindrique
9 Rondelle d’appui de membrane
10 Membrane double
11 Joints de soupape d’aspiration et d’échappement
12 Poignée de transport
13 Roulement à billes rainuré
15 Silencieux
16 Vis à tête fraisée
17 Vis à tête fraisée
18 Vis cylindrique
19 Anneau d’ajustement
22 Joint
23 Moteur
24 Vis à tête à 6 pans
25 Bague d’entretoise
26 Vis cylindrique
27 Raccord pour bride d’aspiration
32 Tôle boîtier
33a Tôle de recouvrement, inférieur
33b Tôle de recouvrement, supérieur
35 Rondelle en éventail
36 Vis à tête fraisée bombée
37 Ecrou à 6 pans
38 Ventilateur
39 Protection de ventilateur
40 Tôle de recouvrement
Fig. 9
Ventildichtungen
Valve seals
Joints de soupape
<table>
<thead>
<tr>
<th>Number</th>
<th>German Description</th>
<th>English Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gehäusedeckel</td>
<td>Housing cover</td>
</tr>
<tr>
<td>2</td>
<td>Kopfdeckel</td>
<td>Head cover</td>
</tr>
<tr>
<td>3</td>
<td>Membranspannscheibe</td>
<td>Diaphragm spring washer</td>
</tr>
<tr>
<td>4</td>
<td>Pleuel</td>
<td>Con-rod</td>
</tr>
<tr>
<td>5</td>
<td>Gehäuse</td>
<td>Housing</td>
</tr>
<tr>
<td>6</td>
<td>Gehäuseblech</td>
<td>Housing panel</td>
</tr>
<tr>
<td>7</td>
<td>Exzenterbuchse mit Gegengewicht</td>
<td>Excenter bushing with counterweight</td>
</tr>
<tr>
<td>8</td>
<td>Zylinderschraube</td>
<td>Cheesehead screw</td>
</tr>
<tr>
<td>9</td>
<td>Membranstückscheibe</td>
<td>Diaphragm support washer</td>
</tr>
<tr>
<td>10</td>
<td>Membrane</td>
<td>Diaphragm</td>
</tr>
<tr>
<td>11</td>
<td>Ein- und Auslaßventildichtung</td>
<td>Inlet and outlet valve seal</td>
</tr>
<tr>
<td>12</td>
<td>Bügelgriff</td>
<td>Bow-shaped handle</td>
</tr>
<tr>
<td>13</td>
<td>Rillenkugellager</td>
<td>Grooved ball bearing</td>
</tr>
<tr>
<td>14</td>
<td>Verbindungsschraube</td>
<td>Connecting screw</td>
</tr>
<tr>
<td>15</td>
<td>Senkschraube</td>
<td>Countersunk screw</td>
</tr>
<tr>
<td>16</td>
<td>Zylinderschraube</td>
<td>Cheesehead screw</td>
</tr>
<tr>
<td>17</td>
<td>Toleranzring</td>
<td>Tolerance ring</td>
</tr>
<tr>
<td>18</td>
<td>Zylinderstift</td>
<td>Cylinder bolt</td>
</tr>
<tr>
<td>19</td>
<td>21a Gehäusedeckel (innenteil) links</td>
<td>Housing cover (inner part) left</td>
</tr>
<tr>
<td>20</td>
<td>21b Gehäusedeckel (innenteil) rechts</td>
<td>Housing cover (inner part) right</td>
</tr>
<tr>
<td>21</td>
<td>Motor</td>
<td>Motor</td>
</tr>
<tr>
<td>22</td>
<td>Seckskantschraube</td>
<td>Hexagonal screw</td>
</tr>
<tr>
<td>23</td>
<td>Distanzring</td>
<td>Spacer</td>
</tr>
<tr>
<td>24</td>
<td>Zylinderschraube</td>
<td>Cheesehead screw</td>
</tr>
<tr>
<td>25</td>
<td>32 Gehäuseblech</td>
<td>Housing panel</td>
</tr>
<tr>
<td>26</td>
<td>33a Abdeckblech, unten</td>
<td>Cover panel, lower</td>
</tr>
<tr>
<td>27</td>
<td>33b Abdeckblech, oben</td>
<td>Cover panel, upper</td>
</tr>
<tr>
<td>28</td>
<td>Linsenblechschraube</td>
<td>Raised sheet metal screw</td>
</tr>
<tr>
<td>29</td>
<td>35 Fächerscheibe</td>
<td>Serrated lock washer</td>
</tr>
<tr>
<td>30</td>
<td>36 Linsenschraube</td>
<td>Raised cheesehead screw</td>
</tr>
<tr>
<td>31</td>
<td>37 Sechkantmutter</td>
<td>Hexagonal nut</td>
</tr>
<tr>
<td>32</td>
<td>Lüfter</td>
<td>Fan</td>
</tr>
<tr>
<td>33</td>
<td>39 Lüfterschutz</td>
<td>Fan protection</td>
</tr>
<tr>
<td>34</td>
<td>Schwesterblech</td>
<td>Cover panel</td>
</tr>
<tr>
<td>35</td>
<td>39 Schwarzeblech</td>
<td>Tôle de recouvrement, inférieur</td>
</tr>
<tr>
<td>36</td>
<td>39b Tôle de recouvrement, supérieur</td>
<td>Tôle de recouvrement, supérieur</td>
</tr>
<tr>
<td>37</td>
<td>39c Tôle de recouvrement, egalement</td>
<td>Tôle de recouvrement, egalement</td>
</tr>
<tr>
<td>38</td>
<td>Lüfterschutz</td>
<td>Ventilateur</td>
</tr>
<tr>
<td>39</td>
<td>39b Protection de ventilateur</td>
<td>Protection de ventilateur</td>
</tr>
<tr>
<td>40</td>
<td>Abdeckblech</td>
<td>Tôle de recouvrement</td>
</tr>
</tbody>
</table>
8.1 Reinigen und Überprüfen des Schöpfraumes

8.1.1 MZ 2T
Fig. 6
- Pumpe von der Apparatur trennen und Motor gegen Einschalten sichern.
- Schlauchverbindung zwischen den Pumpenstufen abschrauben.
- Entfernen der Zylinderschrauben 20 (pro Pumpenstufe 4 Stück).
- Gehäusedeckel 7 mit Kopfdeckel 8 abnehmen. Dabei das Herausfallen des Kopfdeckels aus dem Gehäusedeckel verhindern.
- Membranenpaar 16 auf Beschädigung kontrollieren ggf. Wechsel der Membrane (siehe 8.2).
- Zur Überprüfung der Ventildichtungen 17 Kopfdeckel 8 von Gehäusedeckel 7 abnehmen.
- Auf Lage der Ventildichtungen 17 achten (Fig. 9) und herausnehmen. Bei Beschädigung erneuern.
- Alle Teile reinigen.
- Pumpe in umgekehrter Reihenfolge montieren.

8.1.2 MD 4T, MD 4TC
Fig. 7, Fig. 8
- Pumpe von der Apparatur trennen und Motor gegen Einschalten sichern.
- Verbindungschläuche an der betreffenden Pumpenstufe abschrauben.
- Schrauben 26 herausschrauben und Gehäusedeckel 1 abnehmen.
- Auf Lage der Ventildichtungen 11 achten (Fig. 9) und herausnehmen. Bei Beschädigung erneuern.
- Kopfdeckel 2 abheben und Membrane 10 auf Verschleiß untersuchen ggf. Wechsel der Membrane (siehe 8.2).
- Alle Teile reinigen.
- Pumpe in umgekehrter Reihenfolge montieren. Bei der Montage sollte die Pumpe so gestellt werden, daß die zu montierende Pumpenstufe oben ist. Die Teile werden dann aufgelegt und können sich nicht verschieben.

8.1 Cleaning and Checking the Working Chamber

8.1.1 MZ 2T
Fig. 6
- Detach the pump from the pumping system and ensure the motor cannot get switched on.
- Screw off hose connection between the pump stages.
- Remove the cheesehead screws 20 (four per pump stage).
- Remove housing cover 7 with head cover 8 taking care to prevent head cover 8 falling out of housing cover 7.
- Check diaphragm pair 16 for damage and replace as necessary (see Section 8.2).
- Remove head cover 8 from housing cover 7 to check valve seals 17.
- Taking care with the position of valve seals 17 (Fig. 9), remove and check for damage, and replacing if necessary.
- Clean all parts.
- Re-assemble pump in reverse order.

8.1.2 MD 4T, MD 4TC
Fig. 7, Fig. 8
- Detach the pump from the vacuum system and ensure the motor cannot get switched on.
- Unscrew connecting hose between the respective pump stages.
- Remove screws 26 and take off housing cover 1.
- Taking care with the position of valve seals 11 (Fig. 9), remove and check for damage, and replacing if necessary.
- Lift up head cover 2 and check diaphragms 10 for wear and tear and replace as necessary (see Section 8.2).
- Clean all parts.
- Re-assemble pump in reverse order. When assembling, the pump should be positioned so that the pump stage to be fitted is on top. The parts are then placed on top into position.

8.1 Nettoyage et contrôle de la chambre de détente

8.1.1 MZ 2T
Fig. 6
- Séparer la pompe de l’appareillage et condamner le moteur contre la mise en marche.
- Dévisser les raccords flexibles entre les étages de la pompe.
- Enlever les quatre vis cylindriques par étage de pompe.
- Soulever le couvercle du carter.
- Soulever le couvercle chapeau 8 et contrôler la paire de membranes 16 sur le endommagements, éventuellement remplacer la membrane (voir 8.2).
- Faire attention à la position des joints de soupapes 17 (Fig. 9) et les enlever. Remplacer en cas d’endommagement.
- Nettoyer toutes les pièces.
- Effectuer le montage de la pompe dans le sens contraire du démontage.

8.1.2 MD 4T, MD 4TC
Fig. 7, Fig. 8
- Séparer la pompe de l’appareillage et condamner le moteur contre la mise en marche.
- Dévisser les raccords flexibles à l’étage de la pompe concernée.
- Dévisser les vis 26 et enlever le carter du boîtier 1.
- Faire attention à la position des joints de soupape 11 (Fig. 9) et les enlever. Remplacer en cas d’endommagement.
- Soulever le couvercle chapeau 2 et contrôler l’usure de la membrane 10, éventuellement la remplacer (voir 8.2).
- Nettoyer toutes les pièces.
- Effectuer le montage de la pompe dans le sens contraire du démontage. Pendant le montage, la pompe devra être placée de telle manière, que l’étage de la pompe à monter soit en haut. Puis les pièces seront placées et ne pourront plus se décaler.
8.2 Changing the Diaphragm

8.2.1 MZ 2T

Fig. 6

- Dismantle pump stage as per Section 8.1.1.
- Remove screw 19. Caution, this screw has been stuck to make secure against loosening.
- The underlying diaphragm support washer 10 must be removed with the utmost care.

Caution!

It is possible that spacers have been fitted between the drive con-rod and the diaphragm support washer for the purpose of compensation. These spacers must be re-fitted at the same height.

- If it is difficult to part the old diaphragm from support washer 10, apply e.g. naphtha or paraffin.
- If necessary, re-fit spacers under the lower diaphragm support washer 10. Fix in place with a little grease to prevent them falling down.
- Fit new diaphragm 16 and diaphragm support washer 10.

Please note:
The diaphragm is a double diaphragm of total thickness 1.6 mm. The diaphragms are specially selected and are supplied in pairs with a maximum tolerance of 1.6 ± 0.05 mm. Replacement diaphragms must be selected on the same basis.

Attention!
Entre la bielle d’entraînement et la rondelle d’appui de membrane, des rondelles d’entretoise peuvent être placées pour l’équilibre. Ces rondelles d’entretoise doivent être réutilisées à la même hauteur.

- Si la membrane usée se laisse difficilement séparer de la rondelle d’appui 10, l’enlever avec par ex. de l’essence ou du pétrole.
- Placer les rondelles d’entretoise éventuellement présentes de nouveau sous la rondelle d’appui de membrane 10. Les fixer au montage contre la chute avec de la graisse.
- Insérer la nouvelle membrane 16 et la rondelle d’appui de membrane 10.

Remarque!
La membrane est une membrane double, d’une épaisseur totale de 1,6 mm. Les membranes seront sélectionnées par paire à l’usine, afin qu’une tolérance maximum de 1,6 ± 0,05 mm soit conservée. Les membranes de rechange doivent être choisies de la même manière.
- Membranspannscheibe 9 einlegen.
- Unter den Schraubenkopf der Schraube 19 etwas Klebstoff (z.B. Loctite 601) geben und Membrane und Spannscheibe verschrauben.
- Weitere Montage im umgekehrten Sinn der Demontage.

8.2.2 MD 4T
Fig. 7
- Pumpstufen wie unter 8.1.2 demonstieren.
- Schraube 16 herausschrauben. Achtung! Diese Schraube ist mit Klebstoff gesichert und abgedichtet.
- Schrauben 17 herausschrauben und Gehäuseblech 6 abnehmen.
- Membrane 10 abnehmen. Die Membranen hängen meist am Gehäuse fest und sollten vorsichtig von Hand vom Pleuelraum her herausgedrückt werden.

Achtung! Zwischen Antriebspleuel und Membranenstützscheibe können Distanzscheiben eingelegt sein. Diese Distanzscheiben müssen in gleicher Höhe wiederverwendet werden. Sie dürfen mit einer anderen Stufe nicht vertauscht werden!

- Lässt sich das alte Membranenpaar 10 nicht von der Membranenstützscheibe 9 trennen, in Benzin oder Petroleum lösen.
- Teile in Benzin reinigen und auf Verschleiß untersuchen. Gegebenenfalls defekte Teile austauschen.
- Eventuell vorhandene Distanzscheiben wieder unter Membranenstützscheibe 9 legen. Mit etwas Fett gegen Herunterfallen bei der Montage fixieren.
- Membranenstützscheibe 9 auf Pleuel 4 legen.
- Neues Membranenpaar 10 einlegen.

- Fit diaphragm support washer 9.
- Place some adhesive (e.g. Loctite 601) under the head of screw 19 and screw in diaphragm and spring washer.
- Further assembly in reverse order.

8.2.2 MD 4T
Fig. 7
- Dismantle pump stages as per Section 8.1.2.
- Remove screw 16. Caution, this screw has been stuck into position and sealed.
- Screw off screws 17 and remove housing panel 6.
- Remove diaphragm 10. The diaphragms are usually stuck to the housing and should be carefully pushed out from the con-rod space by hand.

Caution! It is possible that spacers have been fitted between the drive con-rod and the diaphragm support washer for the purpose of compensation. These spacers must be re-fitted at the same height. They must not be interchanged with another stage.

- If the old pair of diaphragms 10 cannot be parted from diaphragm support washer 9, apply naphtha or paraffin.
- Clean the parts in naphtha and check for wear and tear, replacing defective parts as necessary.
- If necessary, re-fit spacers under the lower diaphragm support washer 9. Fix in place with a little grease to prevent them falling down.
- Fit diaphragm support washer 9 onto con-rod 4.
- Fit new pair of diaphragms 10.

- Monter la rondelle à ressort de membrane 9.
- Mettre un peu de colle (par ex. Loctite 601) sous la tête de la vis 19 et visser la membrane et la rondele à ressort.
- Le montage suivant sera effectué dans le sens contraire du démontage.

8.2.2 MD 4T
Fig. 7
- Démonter les étages de pompe comme dans 8.1.2.
- Dévisser la vis 16. Attention! la vis est bloquée et étanchée avec de la colle.
- Dévisser les vis 17 et enlever la tête boîtier 6.
- Enlever la membrane 10. Les membranes adhèrent souvent fortement au boîtier, et devront être sorties avec précaution à la main de la chambre de bielle.

Attention! Entre la bielle d’entraînement et la rondelle d’appui de membrane, des rondelles d’entretoise peuvent être placées. Ces rondelles d’entretoise doivent être réutilisées à la même hauteur. Elles ne devront pas être interverties avec celles d’un autre étage!

- Si la paire de membrane 10 usée se laisse difficilement séparer de la rondelle d’appui 9, l’enlever avec par ex. de l’essence ou du pétrole.
- Placer les rondelles d’entretoise éventuellement présentes de nouveau sous la rondelle d’appui de membrane 9. Les fixer au montage contre la chute avec de la graisse.
- Monter la rondelle d’appui de membrane 9 sur la bielle 4.
- Monter la nouvelle paire de membrane 10.
Hinweis:
Bei der Membrane handelt es sich um eine Doppelmembrane, die insgesamt 1,6 mm dick ist. Die Membranen werden werkseitig so gepaart, daß eine maximale Toleranz von 1,6 ± 0,05 mm eingehalten wird. Ersatzmembranen müssen in gleicher Weise ausgesucht werden.

- Membranspannscheibe 9 einlegen.
- Unter den Schraubenkopf der Schraube 16 etwas Klebstoff (z.B. Loctite 601) geben und Membrane und Spannscheibe verschrauben.
- Weitere Montage wie unter 8.1.2 vornehmen.

8.2.2.1 MD 4TC
Fig. 8
- Pumpstufen wie unter 8.1.2 beschrieben demontieren.
- Zusätzlich muß die vordere Gehäuseabdeckung demontiert werden.
- Mit handelsüblichem Gelenk-Stirnlochschlüssel (Größe 40/4) die Membranstützscheibe 9 drehen und so die Membrane 10 lösen.
- Membranspannscheibe 3 mit Vierkant-Verbindungsschraube 14, Membrane 10 und Stützscheibe 9 entnehmen.
- Kontrollieren ob die Vierkant-Verbindungsschraube 14 noch einwandfrei fest in der Membranspannscheibe 3 sitzt, ggf. nachziehen (Linksgewinde).
- Neue Membrane 10 zwischen Membranspannscheibe 3 und Stützscheibe 9 einlegen.
- Membrane 10 mit Spann- und Stützscheiben in umgekehrter Reihenfolge der Demontage montieren.
- Gehäuseabdeckung montieren.
- Zur Montage des PTFE-Verbindungsschlauches die Metallüberwurfmutter mit der Hand und danach noch 1/2 Umdrehung mit einem Sechskantschlüssel anziehen.

Please note:
The diaphragm is a double diaphragm of total thickness 1.6 mm. The diaphragms are specially selected and are supplied in pairs with a maximum tolerance of 1.6 ± 0.05 mm. Replacement diaphragms must be selected on the same basis.

- Fit diaphragm support washer 9.
- Place some adhesive (e.g. Loctite 601) under the head of screw 16 and screw in diaphragm and spring washer.
- Further assembly as per Section 8.1.2.

8.2.2.1 MD 4TC
Fig. 8
- Dismantle pump stages as per Section 8.1.2.
- In addition, the front housing cover panel must be dismantled.
- Using a standard trade face spanner (size 40/4) turn diaphragm support washer 9 thereby loosening diaphragm 10.
- Remove diaphragm spring washer 3 with square connecting screw 14, diaphragm 10 and diaphragm support washer 9.
- Check that square connecting screw 14 is still firmly positioned in diaphragm spring washer 3 and tighten if necessary (left-hand thread).
- Fit new diaphragm 10 between diaphragm spring washer 3 and diaphragm support washer 9.
- Refit diaphragm 10 with spring washer and support washer in reverse order.
- Fit housing cover.
- To fit the PTFE connecting hose, tighten the metal lock nut by hand and then by a half a turn with an Allen key.

Remarque!
La membrane est une membrane double, d’une épaisseur totale de 1,6 mm. Les membranes seront sélectionnées par paire à l’usine, afin qu’une tolérance maximum de 1,6 ± 0,05 mm soit conservée. Les membranes de rechange doivent être choisies de la même manière.

- Monter la rondelle à ressort de membrane 9.
- Mettre un peu de colle (par ex. Loctite 601) sous la tête de la vis 16 et visser la membrane et la rondelle à ressort.
- Effectuer le montage suivant comme dans 8.1.2.

8.2.2.1 MD 4TC
Fig. 8
- Démonter les étages de pompe comme décrit dans 8.1.2.
- De plus, le recouvrement de boîtier de devant devra être démonté.
- Tourner les rondelles d’appui de membrane 9 avec une clé à ergots articulé (Grandeur 40/4) de vente courante dans le commerce et enlever la membrane 10.
- Enlever la rondelle à ressort de membrane 3 en dévisant la vis de jonction à entraînement carrée 14, ainsi que la membrane 10 et la rondelle d’appui 9.
- Contrôler si les vis de jonction à entraînement carré 14 sont fixées encore correctement dans la rondelle à ressort de membrane 3, éventuellement revisser (filetage à gauche).
- Monter la nouvelle membrane 10 entre la rondelle à ressort de membrane 3 et la rondelle d’appui 9.
- Monter la membrane 10 avec les rondelles à ressort et les rondelles d’appui dans le sens contraire du démontage.
- Remonter le recouvrement de boîtier.
- Pour monter le flexible-PTFE, visser l’écrou à chapeau métallique manuellement et ensuite le serrer encore 1/2 tour avec la clé à 6 pans.
### 9 Accessories

<table>
<thead>
<tr>
<th>Description</th>
<th>Pump Type</th>
<th>Order No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kleinflanschanschluß DN 16</td>
<td>MZ 2T</td>
<td>P0 990 775</td>
</tr>
<tr>
<td>Kleinflanschanschluß DN 10</td>
<td>MD 4TC</td>
<td>P0 988 087</td>
</tr>
<tr>
<td>Schlauch Ø 10 mm</td>
<td>MZ 2T</td>
<td>P0 988 088</td>
</tr>
<tr>
<td>Flexible Ø 10 mm</td>
<td>MD 4TC</td>
<td>P0 988 734</td>
</tr>
</tbody>
</table>

### 10 Spare Parts

Please note: When inquiring about or ordering spare parts, please indicate product type and serial number.

<table>
<thead>
<tr>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schalldämpfer/Silencer</td>
<td>P0 920 412 E</td>
</tr>
<tr>
<td>PVC-Dichtung/PVC-seal/Oint of PVC</td>
<td>P0 920 409 E</td>
</tr>
<tr>
<td>Doppelmembrane/Double diaphragm/Membrane double</td>
<td>P0 920 407 E</td>
</tr>
<tr>
<td>Ventildichtung/Valve seal/Oint of soupape</td>
<td>P0 920 408 E</td>
</tr>
<tr>
<td>Schlauchverbindung/Hose connection/Raccord pour tuyau</td>
<td>P0 920 416 E</td>
</tr>
</tbody>
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### 9 Zubehör

<table>
<thead>
<tr>
<th>Description</th>
<th>Order No.</th>
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<tbody>
<tr>
<td>Kleinfanschanschluss DN 16</td>
<td>P0 990 775</td>
</tr>
<tr>
<td>Kleinfanschanschluss DN 10</td>
<td>P0 988 087</td>
</tr>
<tr>
<td>Schlauch Ø 10 mm</td>
<td>P0 988 088</td>
</tr>
<tr>
<td>Flexible Ø 10 mm</td>
<td>P0 988 734</td>
</tr>
</tbody>
</table>

### 10 Ersatzteile

Achtung! Bei Ersatzteilanfrage bzw. Bestellung unbedingt Gerätetyp und -nummer angeben.

Please note: When inquiring about or ordering spare parts, please indicate product type and serial number.

### 10 Pièces de rechange

Attention! Pour les commandes de pièces détachées, il est indispensable de nous communiquer le matricule et le type de modèle utilisé.

### Ersatzteilliste/Spare parts list/Pièces de rechange

**MZ 2T Standardausführung/Standard model/Modèles standard**

<table>
<thead>
<tr>
<th>Position</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Schalldämpfer/Silencer/Siècles</td>
<td>P0 920 412 E</td>
</tr>
<tr>
<td>4</td>
<td>PVC-Dichtung/PVC-seal/Oint of PVC</td>
<td>P0 920 409 E</td>
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<tr>
<td>16</td>
<td>Doppelmembrane/Double diaphragm/Membrane double</td>
<td>P0 920 407 E</td>
</tr>
<tr>
<td>17</td>
<td>Ventildichtung/Valve seal/Oint of soupape</td>
<td>P0 920 408 E</td>
</tr>
<tr>
<td>23</td>
<td>Schlauchverbindung/Hose connection/Raccord pour tuyau</td>
<td>P0 920 416 E</td>
</tr>
</tbody>
</table>

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### Ersatzteilliste/Spare parts list/Pièces de rechange

**MZ 4T Standardausführung/Standard model/Modèles standard**

<table>
<thead>
<tr>
<th>Position</th>
<th>Description</th>
<th>Part No.</th>
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<tbody>
<tr>
<td>10</td>
<td>Doppelmembrane/Double diaphragm/Membrane double</td>
<td>P0 920 407 E</td>
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<tr>
<td>11</td>
<td>Ventildichtung/Valve seal/Oint of soupape</td>
<td>P0 920 408 E</td>
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<tr>
<td>15</td>
<td>Schalldämpfer/Silencer/Siècles</td>
<td>P0 920 412 E</td>
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<tr>
<td>22</td>
<td>PVC-Dichtung/PVC-seal/Oint of PVC</td>
<td>P0 920 409 E</td>
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<tr>
<td>27</td>
<td>Ansaugflansch/Intake flange/Bride d’aspiration</td>
<td>P0 988 086</td>
</tr>
<tr>
<td>28</td>
<td>Satz-Schlauchverbindung/Set of hose connection/Jeu de raccord pour tuyau</td>
<td>P0 920 410 E</td>
</tr>
<tr>
<td>38</td>
<td>Lüfter/Fan/Ventilateur</td>
<td>P0 920 416 E</td>
</tr>
</tbody>
</table>

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### Ersatzteilliste/Spare parts list/Pièces de rechange

**MD 4TC Korrosivgasausführung/Corrosive gas model/Technique de gaz corrosif**

<table>
<thead>
<tr>
<th>Position</th>
<th>Description</th>
<th>Part No.</th>
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<tbody>
<tr>
<td>10</td>
<td>Doppelmembrane/Double diaphragm/Membrane double</td>
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<td>11</td>
<td>Ventildichtung/Valve seal/Oint of soupape</td>
<td>P0 920 408 E</td>
</tr>
<tr>
<td>28</td>
<td>Satz-Schlauchverbindung/Set of hose connection/Jeu de raccord pour tuyau</td>
<td>P0 920 410 E</td>
</tr>
<tr>
<td>38</td>
<td>Lüfter/Fan/Ventilateur</td>
<td>P0 920 416 E</td>
</tr>
</tbody>
</table>
## Erklärung über Kontaminierung von Vakuumgeräten und -komponenten

Die Reparatur und/oder die Wartung von Vakuumgeräten und -komponenten wird nur durchgeführt, wenn eine korrekt und vollständig ausgefüllte Erklärung vorliegt. Ist das nicht der Fall, kommt es zu Verzögerungen der Arbeiten.

Diese Erklärung darf nur von autorisiertem Fachpersonal ausgefüllt und unterschrieben werden:

1. **Art der Vakuumgeräte und -komponenten**
   - Typenbezeichnung: __________________________
   - Artikelnummer: __________________________
   - Seriennummer: __________________________
   - Rechnungsnummer: __________________________
   - Lieferdatum: __________________________

2. **Grund für die Einsendung**

   - ..............................................................
   - ..............................................................
   - ..............................................................
   - ..............................................................

3. **Zustand der Vakuumgeräte und -komponenten**
   - Waren die Vakuumgeräte und -komponenten in Betrieb?  ja □  nein □
   - Welches Betriebsmittel wurde verwendet? __________________________
   - Sind die Vakuumgeräte und -komponenten frei von gesundheitsgefährdenden Schadstoffen?  ja □  nein □

4. **Einsatzbedingte Kontaminierung der Vakuumgeräte und -komponenten**
   - toxisch  ja □  nein □
   - ätzend  ja □  nein □
   - mikrobiologisch *)  ja □  nein □
   - explosiv *)  ja □  nein □
   - radioaktiv *)  ja □  nein □
   - sonstige Schadstoffe  ja □  nein □

*) Mikrobiologisch, explosiv oder radioaktiv kontaminierte Vakuumgeräte und -komponenten werden nur bei Nachweis einer vorschriftsmäßigen Reinigung entgegengenommen!

Art der Schadstoffe oder prozeßbedingter, gefährlicher Reaktionsprodukte, mit denen die Vakuumgeräte und -komponenten in Kontakt kamen:

<table>
<thead>
<tr>
<th>Handelsname Produktname Hersteller</th>
<th>Chemische Bezeichnung (evtl. auch Formel)</th>
<th>Gefahrklasse</th>
<th>Maßnahmen bei Freiwerden der Schadstoffe</th>
<th>Erste Hilfe bei Unfällen</th>
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5. **Rechtsverbindliche Erklärung**

Hiermit versichere(n) ich/wir, daß die Angaben in diesem Vordruck korrekt und vollständig sind. Der Versand der kontaminierten Vakuumgeräte und -komponenten erfolgt gemäß den gesetzlichen Bestimmungen.

Firma/Institut: __________________________
Straße: __________________________
PLZ, Ort: __________________________
Telefon: __________________________
Fax: __________________________
Telex: __________________________
Name: __________________________
(in Druckbuchstaben)
Position: __________________________
Datum: __________________________
Firmenstempel: __________________________

Rechtsverbindliche Unterschrift: __________________________
Declaration of Contamination of Vacuum Equipment and Components

The repair and/or service of vacuum components will only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delay.

The manufacturer could refuse to accept any equipment without a declaration.

This declaration can only be completed and signed by authorised and qualified staff:

1. Description of component:
   - Equipment type/model: ___________________________
   - Code No.: ___________________________
   - Serial No.: ___________________________
   - Invoice No.: ___________________________
   - Delivery Date: ___________________________

2. Reason for return:

3. Equipment condition
   - Has the equipment been used?  yes ☐  no ☐
   - What type of pump oil was used?
     ___________________________________________
   - Is the equipment free from potentially harmful substances?  yes ☐  no ☐

4. Process related contamination of equipment
   - toxic  yes ☐  no ☐
   - corrosive  yes ☐  no ☐
   - microbiological hazard*  yes ☐  no ☐
   - explosive*  yes ☐  no ☐
   - radioactive*  yes ☐  no ☐
   - other harmful substances  yes ☐  no ☐

*) We will not accept delivery of any equipment that has been radioactively or microbiologically contaminated without written evidence of decontamination!

Please list all substances, gases and by-products which may have come into contact with the equipment:

<table>
<thead>
<tr>
<th>Tradename</th>
<th>Chemical name</th>
<th>Danger class</th>
<th>Precautions associated with substance</th>
<th>Action if spillage or human contact</th>
</tr>
</thead>
<tbody>
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5. Legally Binding Declaration

I hereby declare that the information supplied on this form is complete and accurate. The despatch of equipment will be in accordance with the appropriate regulations covering Packaging, Transportation and Labelling of Dangerous Substances.

Name of Organisation: _______________________________________________________________________________
Address: _____________________________________ Post code: _____________________________________
Tel.: ______________________________________________________________________________________
Fax: _____________________________________ Telex: ________________________________________
Name: ______________________________________________________________________________________
Job title: ______________________________________________________________________________________
Date: _____________________________________ Company stamp: ________________________________
Legally binding signature: ______________________________________________________________________
Déclaration sur l’état de contamination de matériel de technique du vide

Notre service peut intervenir et s’occuper du matériel seulement si vous l’avez envoyé avec certificat précisément rempli.

Selon l’état du matériel, nous nous réservons le droit de refuser la réparation dans notre usine.

Ce certificat doit être rempli et signé uniquement par une personne autorisée:

1. Description du matériel
   - Type: __________________________
   - Référence: __________________________
   - No. de série: __________________________
   - No. de facture: __________________________
   - Date de livraison: __________________________

2. Raison du retour:
   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________

3. État du matériel
   - Le matériel est-il utilisé? oui [ ] non [ ]
   - Type d’huile utilisé? __________________________
   - Le matériel est-il contaminé par des produits à risque? oui [ ] non [ ]
   - (voir paragraphe 5)
   - Non [ ] (voir paragraphe 4)

4. Contamination causée par le fonctionnement
   - toxique oui [ ] non [ ]
   - corrosif oui [ ] non [ ]
   - microbiologique*) oui [ ] non [ ]
   - explosif*) oui [ ] non [ ]
   - radioactif*) oui [ ] non [ ]
   - autres oui [ ] non [ ]

*) On ne peut pas intervenir sur le matériel contaminé par des produits microbiologiques, radioactifs ou explosifs qu’après une décontamination effectuée par vos soins et certifiée par écrit!

Nature des produits de contamination:

<table>
<thead>
<tr>
<th>Designation du produit</th>
<th>Formule chimique</th>
<th>Degré de danger</th>
<th>Mesures à prendre en cas d’émanation</th>
<th>Actions de 1ère urgence en cas d’accident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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</table>

5. Certificat de validité

Je soussigné, certifie que les déclarations ci-dessus sont correctes et complètes. Le transport du matériel est effectué dans le respect des prescriptions légales.

Société, Institut: ____________________________________________________________
Adresse: _________________________________________________________________
Téléphone: _______________________________________________________________
Telecopie: ___________________________ Telex: ___________________________
Nom: (et responsabilité dans l’entreprise) _______________________________________
Position: ________________________________________________________________
Date: ___________________________ Cachet: ___________________________
Signature: _______________________________________________________________
Konformitätserklärung im Sinne folgender EU-Richtlinien:
- Maschinen 89/392/EWG
- Elektromagnetische Verträglichkeit 89/336/EWG
- Niederspannung 73/23/EWG


Die angewandten Richtlinien, harmonisierten Normen, nationalen Normen und Spezifikationen sind unten aufgeführt.
Vaatimustenmukaisuus vakuutus seuraavien EU-direktiivien mukaisesti:
- kondenäkölii 89/392/ETY
- sähkömagneettinen siedettävyys 89/336/ETY
- pienjännite 73/23/ETY

Vahvistamme, täten, että allamainittu tuote vastaa EU-kondenäköliiviin 89/392/ETY - liite II A, EU-direktiivin sähkömagneettinen siedettävyys 89/336/ETY ja EU-pien-

jännitetäjä 73/23/ETY vaatimuksia.

Suveltamme suuntaviitatt, kansalliset standardit ja rakenemääräykset on luteltu ailempana.

Declaração de conformidade, de acordo com as seguintes Directivas CE:
- Máquinas, na redacção 89/392/CEE
- Compatibilidade electromagnética, na redacção 89/336/CEE
- Baixa tensão, na redacção 73/23/CEE

Com a presente, declaramos que o produto abaixo indicado está em conformidade com as disposições pertinentes na Directiva CE para máquinas, na redacção 89/392/CEE - Apêndice II A, na Directiva CE sobre compatibilidade electromagnética, na redacção 89/336/CEE, e na Directiva CE sobre baixa tensão, na redacção 73/23/CEE. Abaixo, dá-se indicação das directivas aplicadas, das normas harmonizadas e das normas e especificações aplicadas no respectivo país.

Produkt/Product/Produit/Produzio/Produkt/Produto/Produkt/Produkt/Produto/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt/Produkt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Diese Kurzanleitung ist nur gültig in Zusammenhang mit der ausführlichen Betriebsanleitung.
- Blatt heraustrennen und bei der Pumpe aufbewahren.

**Erstinbetriebnahme**
*Hinweis:*
Für den Betrieb mit korrosiven Gasen nur Pumpen in "C"-Ausführung einsetzen. Sicherheitsvorschriften beachten!

**Installation**
- Standort/Standfläche und Anschlüsse sind nach Punkt 2 der ausführlichen Betriebsanleitung auszuführen.

**Achtung!**
Vor Inbetriebnahme Verschlußkappen entfernen und sicherstellen, daß sich auf der Druckseite kein unzulässig hoher Druck aufbaut.

**Abbreviated Instructions**
These abbreviated instructions are only valid together with the detailed operating instructions.
- Detach this page and place near the pump.

**Initial Operation**
*Important:*
Only “C” version pumps may be used where operations involve corrosive gases. Comply with the safety instructions.

**Installation**
- For location, surface requirements and connections please refer to Section 2 of the Operating Instructions.

**Caution:**
Before operating, remove locking cap and ensure that impermissibly high pressure cannot arise on the pressure side.

**Instructions abrégées**
Cette instruction abrégée est seulement valable avec les instructions de service détaillées.
- Détacher la page et la conserver à proximité de la pompe.

**Première mise en service**
*Remarque:*
Pour le fonctionnement avec des gaz corrosifs n’utiliser que des pompes de modèle “C”. Veuillez considérer les prescriptions de sécurité!

**Installation**
- Effectuer le placement, la surface de pose, les raccordements suivant le point 2 des instructions de service.

**Attention!**
Avant la mise en marche enlever le capuchon de fermeture et s’assurer que du côté pression aucune haute pression non admise ne puisse se développer.
**Folgebetrieb**

**Einschalten**
- Die Pumpe kann zu jeder Zeit eingeschaltet werden. Maximalen Gegen-
druck am Auslaß beachten (siehe 5 Technische Daten in ausführlicher
Betriebsanleitung).
- Pumpe läuft bei normaler Belastung wartungsfrei.
- Wurde die Pumpe mit Kondensat belastet, muß sie vor dem Abschal-
ten noch einige Minuten unter Atmosphärendruck nachlaufen.

**Schaltung der Pumpstufen**
Bei den Pumpen sind vor Anschluß an die Apparatur die Schlauchverbindun-
gen auf richtigen Anschluß zu über-
prüfen.

Die Sauganschlüsse der Pumpe sind mit “IN” und die Auslässe mit “EX” gekennzeichnet.

Die Schaltung ist nach Punkt 2.2 der ausführlichen Betriebsanleitung vor-
zunehmen.

**Achtung!**
Bei Verwechslung der Anschlüsse ent-
stehst eine unzulässige Überdruckbela-

**Elektrischer Anschluß**
- Die Angaben auf dem Typenschild müssen mit den Netzanschußwer-
ten übereinstimmen.
- Der elektrische Anschluß des Motors ist nach den örtlich geltend-
den Bestimmungen auszuführen.

---

**Subsequent Operations**

**Switching On**
- The pump can be switched on at any time. Observe maximum coun-
ter-pressure values at the outlet (see Section 5, Technical Data in the
operating instructions).
- Under normal operating conditions the pump requires no maintenance.
- If the pump has been subjected to the action of condensates it should
be allowed to continue to run at atmospheric pressure for several
minutes before switching off.

**Connection of the Pump Stages**
Check hoses for the correct connections before connecting pumps to the
installation.

The intake connections of the pump are marked with “IN” and the outlets
with “EX”.

Connection must be carried out as per Section 2.2 of the operating instruc-
tions.

**Caution !**
Interchanging the connections will result in impermissibly high over-
pressure levels.

**Electrical Connections**
- Ensure compliance with voltage and frequency information on the
rating plate.
- The motor must be connected in compliance with local electrical
regulations.

---

**Opération en continu**

**Mise en marche**
- La pompe peut être mise en marche à tout moment. Faire attention à la
centre-pression maximum à l’échappement (voir 5 fiche techni-
que des instructions de service détaillées).
- La pompe fonctionne à charge nor-
malement exemptée d’entretien.
- Si la pompe a été chargée avec du
condensat, elle doit, avant la mise à
l’arrêt, marcher quelques minutes à
la pression atmosphérique.

**Raccordement des étages de pompes**
Il faudra contrôler avant de raccorder les pompes au groupe, les raccorde-
ments corrects des flexibles.

Les raccords d’aspiration de la pompe sont indiqués avec “IN” et les échap-
pements avec “EX”.

Le raccordement est à effectuer sui-
vant le point 2.2 des instructions de service détaillées.

**Attention!**
Une inversion de raccordement peut provoquer une charge de sur-pression inadmissible.

**Branchement électrique**
- Les valeurs inscrites sur la plaque signalétique du moteur doivent cor-
respondre avec les valeurs de l’ali-
mentation du secteur.
- Le branchement électrique du
moteur est à effectuer suivant les
prescriptions locales en vigueur.
Operating Instructions

DCU 001
DCU 100
DCU 200
DCU 300
DCU 600

Display Control Unit

Pfeiffer Vacuum GmbH
Emmeliusstrasse 33
D-35614 Asslar
Germany
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1. Safety Instructions

Read and follow all instructions in this manual.
Inform yourself regarding
- Dangers which can arise from the unit;
- Dangers which can arise from the system;
Follow the safety and accident prevention instructions.
Check regularly that all safety and protection requirements are being observed.
When installing the DCU, take account of the ambient conditions. The protection type is IP 20. The units DCU 100 to DCU 600 are protected against the ingress of foreign bodies ≥ ø 12 mm. Since water protection is not provided, the unit should be mounted in a suitable housing (see Section 3. “Installation”).
Do not carry out any unauthorised modifications or alterations to the Display Control Unit DCU.
Do not open the housing cover when the unit is connected to the mains nor during pumping operations.
Take account of the prescribed mains voltage values when connecting units DCU 100 to DCU 600.
When shipping, please note the instructions in Section 7.

Pictogram definitions:

![DANGER](image)
There is danger of an electric shock if the contacts are touched.

![BEWARE](image)
There is danger of personal injury.

![CAUTION](image)
There is danger of damage to the unit or to the system.
2. Understanding The Display Control Unit DCU

2.1. For Your Orientation

Symbols used
The following symbols will be used in the illustrations throughout the manual:

Electrical connection

Abbreviations used
TMP = Turbomolecular Pump
DCU = Display Control Unit
TC = Turbo Electronic Unit
TPS = Mains Unit

Position numbers
The same accessory parts have the same position numbers in all illustrations.

In the Text
Operation instruction: Here, you must do something.

2.2. Product Description

The Display Control Unit DCU is an operating unit for PFEIFFER drive units. It enables control over all the main parameters of the unit. Additionally, the connection of a vacuum gauge is possible.

DCU 001 = Basic unit without mains power unit
DCU 100/200/300/600 = Unit with mains power unit.

Mechanical design
The DCU is fitted in a housing suitable for mounting in a 19”/3HE.

Connection options:
The DCU provides the following connection options:
- TMP Heating (HEAT/TMS).
- TMP Air Cooling (FAN).
- TMP Venting Valve (VENT).
- RS 485 for communicating with the DCU or PC.

The Turbo Electronic TC contains the following function units:
- Power supply for and monitoring of the turbopump.
- Connection options for:
  - TMP Heating (HEAT/TMS).
  - TMP Air Cooling (FAN).
  - TMP Venting Valve (VENT).
  - RS 485 for communicating with the DCU or PC.

The units DCU 001, DCU 100 - DCU 600 have been tested and passed by the authorities in accordance with EN 61010/VDE 0411 “Safety Equipment For Electrical Units”.

Proper use:
- The Display Control Unit DCU may only be used to control PFEIFFER Turbo Electronic Units TC and their peripheral units.
- The operations unit TC- turbopump may only be operated together with a backing pump.
- Instructions concerning installation, start-up, operating and maintenance must be observed.

Improper use:
Improper is:
- Uses not covered above, especially:
  - Connection to pumps and units which is not permitted in their operating instructions.
  - Connection to units which contain touchable and voltage carrying parts.

Improper use will cause any rights regarding liability and guarantees to be forfeited.
2.3 Front Panel

The front panel contains all the operating and display elements.

1. LCD display
2. Status display
3. “Error acknowledgement” key
4. Key “Left”
5. Key “Right”
6. “Pumping Station ON/OFF” key
7. Red illuminating diode for error status
8. Green illuminating diode for operating status

2.4 Rear Panel

DCU with 100/200/300W-
Mains power unit

DCU with 600W-
Mains power unit

DCU without Mains power unit

S1  Mains switch
F1  Fuse
F2  Fuse
X1  Mains connection 90-265 V-
X2  Output for voltage supply, Turbo Electronic TC
X3  Vacuum gauge connection
RS 485 Communication with Turbo Electronic TC
3. Installation

3.1. Preparations For Installation

Unauthorised modifications or alterations to the Display Control Unit are not allowed. The unit must be fitted in a housing taking account of the ambient conditions (see Section 9, “Technical Data”).

Refer also to the operating instructions for TMP with TC.

- Disconnect mains power plug before installation work.

3.2. Rack Fitting

The units DCU 001, DCU 100 - DCU 600 are designed to be fitted into a 19”/3HE rack. For installation the front panel should be secured to the rack using four fixing screws. Space between the DCU and other components is not necessary.

The ambient temperature in the rack housing must not exceed 40°C.

Depending on the version, various connections are provided on the DCU.

3.3. Connecting Diagram

3.4. Making The Connections

- The units DCU 100 - DCU 600 have been designated protection class 1 and must always be connected with the earthed conductor (PE) via the mains cable.

- Mains connection must be made in accordance with the local regulations.

- Make the connection X2 - TC in accordance with Section 3.3. “Wiring Diagram”

- Make the connection pressure gauge to X3 as required.

- Make connection RS 485/TC via 8 pole cable.

The DCU 001 is re-supplied with its operating voltage via the Serial Interface RS 485 cable from the TC. As soon as the TC is switched on, the DCU is supplied with voltage.

Mains voltage

- DCU 001: 7 - 24V
- DCU 100: 90 - 265V, 100W
- DCU 200: 90 - 265V, 200W
- DCU 300: 90 - 265V, 300W
- DCU 600: 90 - 265V, 600W
4. Operation

4.1. General

All function relevant aspects of the turbo electronics are illustrated in the form of parameters. Each parameter has a number and a clear text designation (for example, "720: Vent frequency"). The value of the parameter is always readable, in some cases also modifiable. In the base parameter set (pre-set on delivery) the following parameters can be attained.

<table>
<thead>
<tr>
<th>Setting Command</th>
<th>Status Request</th>
<th>Set Value Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter 0xx</td>
<td>Parameter 3xx</td>
<td>Parameter 7xx</td>
</tr>
<tr>
<td>001: Heating(ON/OFF)</td>
<td>308: Set rotation speed TMP (in Hz)</td>
<td>700: Maximum run-up time (in min)</td>
</tr>
<tr>
<td>002: Stand-by (ON/OFF)</td>
<td>309: Actual rotation speed TMP (in Hz)</td>
<td>701: Switchpoint (in %)</td>
</tr>
<tr>
<td></td>
<td>310: TMP Motor current (in A)</td>
<td>794: Parameter set</td>
</tr>
<tr>
<td></td>
<td>311: Operating hours TMP (in h)</td>
<td></td>
</tr>
</tbody>
</table>

On delivery parameter set 794 is pre-set to the value "0" (base parameter set). The extended parameter set is attained by setting the value to "1". Please refer to "Parameters In The Base Parameter Set" for an overview of the parameters and their meaning. Turbo pump heating can be pre-selected. Once the rotation speed switchpoint is attained, the heating is switched on automatically.

4.2. Switching On The Control Unit

➡ Make the connection to the Serial Interface RS 485.

DCU 001:
➡ Switch on the external voltage supply to the TC.
In the event of an error message: depress ⚫.

DCU 100/200/300/600:
➡ Switch on the DCU with switch S1 on the rear panel.

Self-Testing

After switching on, the DCU performs a self-test and also a test on the connected turbo electronics. During the test a bar appears in the display in line 4 and this shows the progress of this procedure.

- **Display test**: All signs in the LC display are shown for a short time in black.
- **LED test**: During the whole testing process the red and the green LEDs illuminate.
- **DCU test**: The DCU hardware tests itself.
- **Connection to the turbo electronics test**: The correct connection to the turbo electronics and their identity are examined.
- **Parameter test**: Information regarding the parameters is loaded.
- **Identification of the connected components**: The designation of the drive unit is displayed.

Providing there are no errors the DCU is now ready to operate.

4.3. Pumping Station, Switching ON/OFF

Please take the following action if the pumping station is to be switched ON/OFF via the front panel of the DCU:

➡ Remove the bridges 1-4 on the TC.
➡ Switch on switch S1 on the mains power unit.
➡ Switch the pumping station ON/OFF with the key ⚫.

4.4. Short Overview, Operating

Selecting the parameters

➡ Select the parameter numbers with the keys (back) oder (forward) (keeping the key depressed enables rapid scrolling).

Setting parameters

➡ Selecting parameters

➡ Depress keys ⚫ and ⚫ simultaneously.
- ➡ The arrow (---->) appears in the second line from the top.

➡ Reduce and increase the values with the keys ⚫ and ⚫ respectively.

➡ Depress keys ⚫ and ⚫ simultaneously.
- ➡ The arrow (---->) disappears.
4.5. Functions Of The Keys

The four keys on the front panel have the following functions:

<table>
<thead>
<tr>
<th>Key</th>
<th>Application/Example</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Key 1]</td>
<td>![App/Ex 1]</td>
<td>![Ex 1]</td>
</tr>
<tr>
<td>![Key 2]</td>
<td>![App/Ex 2]</td>
<td>![Ex 2]</td>
</tr>
<tr>
<td>![Key 3]</td>
<td>![App/Ex 3]</td>
<td>![Ex 3]</td>
</tr>
<tr>
<td>![Key 4]</td>
<td>![App/Ex 4]</td>
<td>![Ex 4]</td>
</tr>
</tbody>
</table>

4.6. LC-Display

The functions are displayed via a four line LC display. During normal operations a special function is assigned to each line:

- **Line 1**: Number and name of the selected parameter (for example “701: Switch pnt”).
- **Line 2**: Relating value. If an arrow (--->) is displayed, the displayed value is accessed.
- **Line 3**: Two functions
  - Function 1: Messages relating to operations and operating are displayed.
  - Function 2: An optional second parameter in the form of

“Parameter number: Value” is displayed. The function of this line enables setting via parameter 795 “Servicelin”: The value “795” allows the display of actual messages and every other value stands for the number of the second parameter.

Error messages are displayed independent of the selected function.

- **Line 4**: An arrow which points to the underlying symbol.
  - This restores the unit status.

Please note:

Prolonged depressing of the keys ![Key 1] and ![Key 2] enables rapid scrolling and/or alterations to the data.

The data mode (arrow “--->” wird angezeigt) is displayed) is automatically relinquished, without taking over the values to be altered, under the following conditions:

- Do not depress any key for longer than 10 minutes.
- The occurrence of an error.
- The key ![Key 4] has been depressed.
Symbol-Definitions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Arrow</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump accelerates</td>
<td>▼</td>
<td>yes</td>
</tr>
<tr>
<td>Heating</td>
<td>▼</td>
<td>Pre-selection heating, but switchpoint not attained</td>
</tr>
<tr>
<td>Heating</td>
<td>▼</td>
<td>Heating ON, switchpoint attained</td>
</tr>
<tr>
<td>Stand-by</td>
<td>▼</td>
<td>yes</td>
</tr>
<tr>
<td>Unit under remote control</td>
<td>▼</td>
<td>yes</td>
</tr>
<tr>
<td>Switchpoint attained</td>
<td>▼</td>
<td>yes</td>
</tr>
<tr>
<td>Excess temperature</td>
<td>▼</td>
<td>Excess temperature TMP</td>
</tr>
<tr>
<td>Excess temperature</td>
<td>▼</td>
<td>Excess temperature turbo-elektronik</td>
</tr>
<tr>
<td>Excess temperature</td>
<td>▼</td>
<td>Excess temperature TMP and Turbo-Electronics</td>
</tr>
<tr>
<td>Final rotation speed attained</td>
<td>▼</td>
<td>Yes</td>
</tr>
</tbody>
</table>

4.7. LED Display

The red LED (error status) and green LED (operations status) on the front panel can take on the following conditions:

**Red LED**
- Illuminates: Collective error message
- Flashes: Warning

**grüne LED**
- Illuminates: Mains power unit OK, switchpoint attained
- Flashes: Mains power unit OK, switchpoint not attained
- Blinks: Mains power failure
4.8. Parameters When Connecting To The TC 600

Dependent on the setting of parameter 794 “Parameter set”, various parameters are available for selection:

- 794 - "0" = base parameter set
- 794 - "1" = extended parameter set

Parameters denoted with "[ ]" are saved internally and are available when the unit is switched on again.

**Base Parameter Set**

**Setting commands**

<table>
<thead>
<tr>
<th>Displayed in the display</th>
<th>Possible value</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>ON/OFF</td>
<td>Parameter name Heating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ON: Heating Ein</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OFF: Heating Aus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- This command is inoperative when a bridge is plugged into the remote input “Heating” on the TC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The conventional heating is activated only once the rotation speed switchpoint is exceeded. The TMS heating is not affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The status of the heating is displayed by an arrow on the symbol on the front panel.</td>
</tr>
</tbody>
</table>

| Stand-by                  | ON/OFF         | Parameter name Stand-by |
|                          |                | ON: Stand-by ON |
|                          |                | OFF: Stand-by OFF |
|                          |                | - When stand-by mode operations are activated the set rotation speed goes to 66% of the final rotation speed of the TMP. |
|                          |                | - This command is inoperative when a bridge is plugged into the remote input “Standby” on the TC |
|                          |                | - The status of the stand-by mode operations is displayed by an arrow on the symbol on the front panel. |
|                          |                | - This command is inoperative in rotation speed setting operations. |

**Status requests**

<table>
<thead>
<tr>
<th>Displayed in the display</th>
<th>Possible value</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set rotspd</td>
<td>x Hz</td>
<td>Parameter name Set rotation speed TMP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The set rotation speed is the set rotation speed in rotation setting mode, the stand-by rotation speed or the final rotation speed of the TMP, depending on the operations mode of the pump.</td>
</tr>
</tbody>
</table>

| Actual rotspd             | x Hz           | Parameter name Actual rotation speed TMP |

| TMP I-Mot                | x A            | Parameter name TMP Motor current |
|                          |                | - Displayed is the effective value of the motor current. |

| TMP Op hrs               | x h            | Parameter name Operating hours |

**Set value standards**

<table>
<thead>
<tr>
<th>Displayed in the display</th>
<th>Possible value</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMP RUTime</td>
<td>1 ... 120 min</td>
<td>Parameter name Maximum run-up time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- If after the run-up time has elapsed, the switchpoint is not exceeded or is non-attained during operations, an error message is triggered.</td>
</tr>
</tbody>
</table>

| Switch pnt               | 50 ... 90 %    | Parameter name Rotation speed switchpoint |
|                          |                | - The switchpoint is measured in % of the final rotation speed of the TMP. |
|                          |                | - This value is only valid in final rotation speed and stand-by operations. |
|                          |                | - In rotation speed setting mode, the switchpoint is fixed on 20%. |

| Param. set               | 0, 1           | Parameter set |
|                          |                | 0: Base parameter set. |
|                          |                | 1: Extended parameter set. |
## Extended Parameter Sets

### Setting Commands

<table>
<thead>
<tr>
<th>Possible Values</th>
<th>Comments</th>
<th>Parameter Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>001: Heating</strong></td>
<td></td>
<td>Heating</td>
</tr>
</tbody>
</table>
| on, off         | • This command is ineffective when there is a bridge on the remote input "heating" of the TC 600.  
• The housing heating and the TMS heating are only activated once the rotation speed switchpoint has been exceeded.  
• The status of the heating is shown by an arrow on the symbol \[\rightarrow\] on the front panel. |

| **002: Standby** | on: stand-by operations activated  
off: no stand-by operations  
• If stand-by is activated the set rotation speed goes to 66% of the final rotation speed of the TMP.  
• This command is ineffective when there is a bridge on the remote input "standby" of the TC 600.  
• The status of stand-by is shown by an arrow on the symbol \[\leftarrow\] on the front panel.  
• This command is ineffective in rotation speed setting operations. |

| **004: Runtime ctr** | on: start-up time monitoring activated.  
off: start-up time monitoring inactive.  
• If, after the pump has started and the start-up time has elapsed the switchpoint has not been exceeded, an error is triggered providing the monitoring is active. |

| **009** | This parameter is not visible in the display, it is only operable via the serial interface: “111111” = acknowledgment malfunction.  
Acknowledging a malfunction is equivalent to activating push-button \[\circ\] on the front panel. |

| **010: Pump stat.** | on: Pumping station on  
off: Pumping station off  
• This command is ineffective when there is a bridge on the remote input "Pumping Station" of the TC 600.  
• Activating the push-button \[\circ\] on the front panel is equivalent to altering the parameter. |

| **023: Motor TMP** | on: motor Turbopump on.  
off: motor Turbopump off.  
• This command is ineffective when there is a bridge on the remote input "Motor TMP" of the TC 600. |

| **024: Conf. Out1** | 0: Rotation speed switchpoint attained  
1: TMS regulator engaged (actual value = set value) |

| **025: OpMode BkP** | 0: non-stop operations  
1: intermittent operations  
At interval operations the backing pump is switching off, if the motor current underflows \(I_{\text{min}}\) and switching on, if the motor current overflows \(I_{\text{max}}\). |
**Operations mode TMP**

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Possible Values</th>
<th>Comments</th>
</tr>
</thead>
</table>
| 026: OpMode TMP | **0, 1** | 0: final rotation speed operations  
1: rotation speed setting operations  
• If there is a signal on the remote input "PWM-fSoll" of the TC 600 this value is set to "1".  
• Stand-by mode is ineffective in rotation speed setting operations with the rotation speed switch point fixed at 20%.  
• Rotation speed setting operations are available if 60% of the final rotation speed are attained. |
| 027: gas mode | **0, 1** | 0: Characteristics for heavy inert gases.  
1: Characteristics for all other gases. |
| 030: Vent mode | **0, 1, 2** | 0: automatic venting  
• If, after attainment of 15% of the rated rotation speed, the pumping station is switched off, venting will take place if the venting frequency (P:720) is non-attained after the expiry of 6 seconds and for the duration of the venting time (P:721).  
• After mains power has been restored the venting valve is closed.  
1: do not vent  
2: venting on  
• If the pumping station is switched off, the venting valve opens after 6 seconds and remains open. |
### Status requests

#### Shown in the display

<table>
<thead>
<tr>
<th>Possible Values</th>
<th>Comments</th>
<th>Parameter Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>(only readable) • This parameter is not visible in the display but is represented by an arrow on the symbol on the front panel.</td>
<td>Unit is remote controlled via X16</td>
</tr>
<tr>
<td>301 Oil defic.</td>
<td>yes: Oil deficiency no: no oil deficiency</td>
<td>Oil deficiency</td>
</tr>
<tr>
<td>302</td>
<td>(only readable) • This parameter is not visible in the display but is represented by an arrow on the symbol on the front panel.</td>
<td>Switchpoint attained</td>
</tr>
<tr>
<td>303: Error code</td>
<td>Wrnxxx: Warning xxx is present Errxxx: Error xxx is present</td>
<td>Actual error code</td>
</tr>
<tr>
<td>304</td>
<td>(only readable) • This parameter is not visible in the display but is represented by an arrow on the symbol on the front panel.</td>
<td>Excess temperature, electronic drive unit</td>
</tr>
<tr>
<td>305</td>
<td>(only readable) • This parameter is not visible in the display but is represented by an arrow on the symbol on the front panel.</td>
<td>Excess temperature, TMP</td>
</tr>
<tr>
<td>306</td>
<td>(only readable) • This parameter is not visible in the display but is represented by an arrow on the symbol on the front panel.</td>
<td>Set rotation speed attained</td>
</tr>
<tr>
<td>307</td>
<td>(only readable) • This parameter is not visible in the display but is represented by an arrow on the symbol on the front panel.</td>
<td>TMP accelerates</td>
</tr>
<tr>
<td>308: Set rotspd</td>
<td>x Hz (only readable) • The set rotation speed is the set rotation speed in rotation speed setting operations, stand-by rotation speed or the final rotation speed of the TMP, dependent of the operating mode of the pump.</td>
<td>Set rotation speed, TMP</td>
</tr>
<tr>
<td>309: Act rotspd</td>
<td>x Hz (only readable)</td>
<td>Actual rotation speed, TMP</td>
</tr>
<tr>
<td>310: TMP l-Mot</td>
<td>x A (only readable) • The effective value of the motor current is displayed.</td>
<td>TMP motor current</td>
</tr>
<tr>
<td>311: TMP Op hrs</td>
<td>x h (only readable)</td>
<td>Operating hours TMP</td>
</tr>
<tr>
<td>312: Drv Softw.</td>
<td>Vxxx (only readable)</td>
<td>Software version, Electronic drive unit</td>
</tr>
<tr>
<td>313: TMP Dlink</td>
<td>xx V (only readable)</td>
<td>Intermediate circuit voltage, TMP</td>
</tr>
<tr>
<td>314: Drv Op hrs</td>
<td>xx V (only readable)</td>
<td>Operating hours, Electronic drive Unit</td>
</tr>
<tr>
<td>315: TMP finspd</td>
<td>x Hz (only readable) • The final rotation speed is dependent on the type of pump in use.</td>
<td>Final rotation speed, TMP</td>
</tr>
<tr>
<td>316: TMP power</td>
<td>x W (only readable)</td>
<td>power reduced</td>
</tr>
</tbody>
</table>
### Status requests

#### Shown in the display

<table>
<thead>
<tr>
<th>Possible Values</th>
<th>Comments</th>
<th>Parameter Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>317: power red</td>
<td>(only readable)</td>
<td>Motor power reduced</td>
</tr>
</tbody>
</table>
| x W | yes: TMP motor power reduced  
no: TMP motor power not reduced |

<table>
<thead>
<tr>
<th>319: Cycl count</th>
<th>(only readable)</th>
<th>Cycle counter</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>&quot;Pumping station ON&quot; is counted</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>331: TMS ActTmp</th>
<th>(only readable)</th>
<th>Actual value, TMS heating</th>
</tr>
</thead>
<tbody>
<tr>
<td>x ºC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>333: TMS steady</th>
<th>(only readable)</th>
<th>TMS regulator engaged</th>
</tr>
</thead>
</table>
| yes, no | yes: regulator engaged  
no: regulator not engaged  
• The regulator is engaged when the TMP temperature = set temperature (parameter 704) ±2%.

<table>
<thead>
<tr>
<th>334: TMS maxTmp</th>
<th>(only readable)</th>
<th>Maximum TMS temperature concerning</th>
</tr>
</thead>
<tbody>
<tr>
<td>x ºC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>335: Heat type</th>
<th>(only readable)</th>
<th>Type of heating</th>
</tr>
</thead>
</table>
| 0, 1, 2 | 0: conventional heating  
1: TMS heating  
2: Cooling |

<table>
<thead>
<tr>
<th>340: Pressure</th>
<th>(only readable)</th>
<th>Actual pressure value</th>
</tr>
</thead>
<tbody>
<tr>
<td>x mbar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Display (Example):
- shown at:
  - no pressure gauge connected
  - remaining measuring range (corresponding to the gauge type)
  - exceeding measuring range (corresponding to the gauge type)
  - measured pressure value
  - gauge type not identified (see. P 738)
  - error in the pressure gauge

<table>
<thead>
<tr>
<th>349: Drv Name</th>
<th>(only readable via serial interface)</th>
<th>Unit type, electronic drive unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC600</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>360: Past Err1</th>
<th>(only readable)</th>
<th>Error history, position 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>s. Parameter 303</td>
<td>The last error which occurred</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>361: Past Err2</th>
<th>(only readable)</th>
<th>Error history, position 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>s. Parameter 303</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>362: Past Err3</th>
<th>(only readable)</th>
<th>Error history, position 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>s. Parameter 303</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>363: Past Err4</th>
<th>(only readable)</th>
<th>Error history, position 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>s. Parameter 303</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>364: Past Err5</th>
<th>(only readable)</th>
<th>Error history, position 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>s. Parameter 303</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>365: Past Err6</th>
<th>(only readable)</th>
<th>Error history, position 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>s. Parameter 303</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>366: Past Err7</th>
<th>(only readable)</th>
<th>Error history, position 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>s. Parameter 303</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>367: Past Err8</th>
<th>(only readable)</th>
<th>Error history, position 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>s. Parameter 303</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>368: Past Err9</th>
<th>(only readable)</th>
<th>Error history, position 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>s. Parameter 303</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>369: Past Err10</th>
<th>(only readable)</th>
<th>Error history, position 10</th>
</tr>
</thead>
</table>
### Set values

#### Shown in the display

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Possible Values</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum start up time</td>
<td>1 ... 120 min</td>
<td>- If the switchpoint has not been exceeded when the start-up time has elapsed an error is triggered (see Section 7 “Errors And Warnings”).</td>
</tr>
<tr>
<td>Rotation speed switchpoint</td>
<td>50 ... 90 %</td>
<td>- The switchpoint is measured as a % of the final rotation speed of the TMP.</td>
</tr>
<tr>
<td>TMS heating temperature set value</td>
<td>30 ... 100 ºC</td>
<td></td>
</tr>
<tr>
<td>Rotation speed setting in rotation speed setting operations</td>
<td>20,0 ... 100,0 %</td>
<td>- Stated as a % of final rotation speed, TMP.</td>
</tr>
<tr>
<td>Venting frequency</td>
<td>40 ... 80 %</td>
<td>- Only valid in “automatic venting” mode (see parameter 030).</td>
</tr>
<tr>
<td>Venting time</td>
<td>6 ... 3600 s</td>
<td>- Only valid in “automatic venting” mode (see parameter 030).</td>
</tr>
<tr>
<td>Type of pressure gauge</td>
<td></td>
<td>- Step by step ±1 at &lt;100s, ±10 at ≥100s.</td>
</tr>
<tr>
<td>Parameter set</td>
<td>0, 1</td>
<td>- 0: Basic parameter set (see Section 3.1. “Parameter in basic parameter set”).</td>
</tr>
<tr>
<td>Content of the service line</td>
<td>x</td>
<td>- When containing “795” actual messages which relate to operations are displayed.</td>
</tr>
<tr>
<td>Unit adress</td>
<td>x</td>
<td>- Content ≠ “795” allows the parameter with this name to appear in the service line (third line from the top in the LC display).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- is equivalent to the logical address under which the TCM 1601 can be accessed via the serial interface.</td>
</tr>
</tbody>
</table>
5. Error Codes

5.1. General

Errors ("Errxxx" oder "Error Exxx") always causes to shut-down of the TMP, the fan, the heating and the backing pump.

➡ After the error is removed depress key .

> The unit is again ready to operate.

Warnings ("Warrxxx" oder "Warning Fxxx") are only displayed and do not cause components to be shut down.

5.2. Errors During Self-Testing

The following errors can occur during self-testing performed when the DCU is switched on:

<table>
<thead>
<tr>
<th>Display</th>
<th>Error Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>** Error E040 **</td>
<td>Hardware error: external RAM defective</td>
</tr>
<tr>
<td>** Error E042 **</td>
<td>Hardware error: EPROM checksum</td>
</tr>
<tr>
<td>** Error E090 **</td>
<td>Insufficient RAM</td>
</tr>
<tr>
<td>** Error E698 **</td>
<td>The DCU is connected to the wrong turbo electronics</td>
</tr>
</tbody>
</table>

5.3. Errors During Operations With The TC 600

During operations, errors and warnings which occur are, independent of the function of the service line, always shown in the display and can be additionally requested in parameter 303 “actual error code”. In addition, parameters 360 to 369 retain the last ten errors or warnings which occurred.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E001</td>
<td>TMP excess rotation speed&lt;br&gt;Actual rotation speed of the turbopump &gt; 105% of the pump specific final rotation speed.</td>
</tr>
<tr>
<td>E002</td>
<td>Power pack unit error&lt;br&gt;The voltage of the TC power pack unit is outside the valid tolerances.</td>
</tr>
<tr>
<td>E006</td>
<td>Run-up time expired&lt;br&gt;The maximum run-up time value set in parameter 700 has been exceeded.</td>
</tr>
<tr>
<td>E007</td>
<td>Operating fluid deficiency.</td>
</tr>
<tr>
<td>E008</td>
<td>Faulty connection between TC and pump.</td>
</tr>
<tr>
<td>E021</td>
<td>Programmer voltage image impedance.&lt;br&gt;Supply voltage defective or undefined image impedance in the TMP.</td>
</tr>
<tr>
<td>E032</td>
<td>Electronics supply voltage.&lt;br&gt;Internal voltage supply for the TC electronics defective.</td>
</tr>
<tr>
<td>E037</td>
<td>Motor end stage.&lt;br&gt;Short circuit in the end stage, motor leads or coils.</td>
</tr>
<tr>
<td>E039</td>
<td>Protective earth error, TC</td>
</tr>
<tr>
<td>E104</td>
<td>Backing pump&lt;br&gt;Excess temperature in the backing pump or not connected.</td>
</tr>
<tr>
<td>E698</td>
<td>TC does not respond&lt;br&gt;Communication between TC and DCU defective.</td>
</tr>
</tbody>
</table>
5.4. Warnings

When an error has occurred all parameters are still visible but can no longer be altered. Exception: Error 698: “TC does not respond”. No actualisation of the parameter is possible here until the communication has been restored.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>F001</td>
<td>TMS heating start up time elapsed</td>
<td>TMS heating start-up timer elapsed</td>
</tr>
<tr>
<td>F002</td>
<td>TMS limit temperature</td>
<td>TMP temperature &gt; 100ºC</td>
</tr>
<tr>
<td>F003</td>
<td>TMS heating circuit temperature sensor</td>
<td>TMP temperature not within the range 5ºC and 120ºC</td>
</tr>
<tr>
<td>F007</td>
<td>Mains power failure</td>
<td>Operations voltage has failed</td>
</tr>
<tr>
<td>F110</td>
<td>Pressure gauge defective</td>
<td></td>
</tr>
</tbody>
</table>

Check the fuses

In case of a error:

- Loosen F1/F2 with a screwdriver and check fuses. Replace if defective. The safety values are stated on the rear panel of the DCU.

6. What To Do In Case Of Breakdowns?

Removing fuses F1/F2
7. Maintenance And Service

The unit requires no maintenance. A damp cloth can be used to wipe away any dirt which has collected on the front panel. Ensure that the unit is first disconnected from the mains power supply.

Do Make Use Of Our Service Facilities
In the event that repairs are necessary a number of options are available to you to ensure any system down time is kept to a minimum:
- Have the unit repaired on the spot by PFEIFFER Service Engineers;
- Return the unit to the manufacturer for repairs;
- Replace with a new value unit.

Local PFEIFFER representatives can provide full details.

When carrying out their own repairs customers must bear in mind that dangerous voltage levels are present. When carrying out own repairs or maintenance work on the units which are in contact with hazardous substances it is important to comply with all relevant safety regulations.

Please note:
Units returned to us for repair or maintenance are covered by our general conditions of sale and supply.

Contact addresses and telephone hotline:
Please refer to the back cover of this manual for contact addresses and telephone hotline numbers.

8. Technical Data

8.1. Data List, Display Control Unit DCU

<table>
<thead>
<tr>
<th></th>
<th>DCU 001</th>
<th>DCU 100</th>
<th>DCU 200</th>
<th>DCU 300</th>
<th>DCU 600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection voltage:</td>
<td>V DC</td>
<td>-</td>
<td>90-264</td>
<td>90-264</td>
<td>185-264</td>
</tr>
<tr>
<td>Connection voltage:</td>
<td>V AC</td>
<td>-</td>
<td>90-264</td>
<td>90-264</td>
<td>90-264</td>
</tr>
<tr>
<td>Frequency Hz</td>
<td>50-60</td>
<td>-</td>
<td>50-60</td>
<td>50-60</td>
<td>50-60</td>
</tr>
<tr>
<td>Power consumption:</td>
<td>VA ≤ 5</td>
<td>≤ 125</td>
<td>≤ 230</td>
<td>≤ 350</td>
<td>≤ 600</td>
</tr>
<tr>
<td>Output voltage X2</td>
<td>VDC 24</td>
<td>-</td>
<td>48</td>
<td>72</td>
<td>140</td>
</tr>
<tr>
<td>Output current X2, max.</td>
<td>A 4,2</td>
<td>-</td>
<td>4,2</td>
<td>4,2</td>
<td>4,3</td>
</tr>
<tr>
<td>Output power X2, max.</td>
<td>W 100</td>
<td>-</td>
<td>200</td>
<td>300</td>
<td>600</td>
</tr>
<tr>
<td>Permissible ambient temperature °C</td>
<td>0 - 40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum relative humidity: % (at 35 °C)</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum relative humidity: % (at 40 °C)</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection type:</td>
<td>IP 20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight: kg</td>
<td>0,4</td>
<td>1,6</td>
<td>1,9</td>
<td>2,2</td>
<td>2,6</td>
</tr>
</tbody>
</table>

8.2. Dimensions

DCU 001/100-600

<table>
<thead>
<tr>
<th></th>
<th>DCU 100/200/300</th>
<th>DCU 600</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>234</td>
<td>229,5</td>
</tr>
<tr>
<td>B</td>
<td>222</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>128,5</td>
<td>128,5</td>
</tr>
<tr>
<td>D</td>
<td>106</td>
<td>111</td>
</tr>
<tr>
<td>E</td>
<td>105</td>
<td>140,4</td>
</tr>
<tr>
<td>F</td>
<td>106,3</td>
<td>141,9</td>
</tr>
</tbody>
</table>

D 106,3
C 40,516
A
B

Contact addresses and telephone hotline:
Please refer to the back cover of this manual for contact addresses and telephone hotline numbers.
Operating Instructions

**TMH 071 P / TMU 071 P**

Turbomolecular Drag Pumps
With Electronic Drive Units
# Index

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</tr>
</thead>
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<td>3.10. Connecting The Remote Control Unit</td>
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<td>Declaration of Contamination</td>
<td>23</td>
</tr>
<tr>
<td>Manufacturer’s Declaration</td>
<td>(last page)</td>
</tr>
</tbody>
</table>
1. Safety Instructions

- Read and follow all instructions in this manual.
- Inform yourself regarding:
  - Hazards which can be caused by the pump;
  - Hazards which can be caused by your system.
  - Hazards which can be caused by the media being pumped.
- Avoid exposing any part of the body to vacuum.
- Observe the safety and accident prevention regulations.
- Regularly check that all accident prevention measures are being complied with.
- Do not operate the turbopump with open high vacuum flange.
- Do not carry out any unauthorised conversions or alterations to the turbopump with TC 600.
- When returning the turbopump observe the shipping instructions.
- Use at least 4 bracket screws to connect the high vacuum flange.
- The turbopump must be anchored in accordance with the installation instructions.
- Do not disconnect the plug between the TC 600 and accessory components during operations.
- When the turbopump is open disconnect the voltage supply to the TC 600.
- When working on the turbopump, the high vacuum flange should only be opened once the rotor is at rest.
- When using sealing gas, the pressure in the hose connection should be limited to 2 bar via the overpressure valve.
- If a heater is in use temperatures of up to 120 °C can be present in the area of the high vacuum flange. Take care to avoid burns!
- During operations, temperatures of up to 65 °C can arise in the lower part of the turbopump. Take care to avoid burns!
- Operate the turbopump with TC 600 only in conjunction with the relevant power pack unit (accessory).
- The unit has been accredited protection class IP 30. When the unit is operated in environments which require other protection classes, the necessary measures must be taken.
- The mains connection must be subject to a safe connection to the PE (protection class 1).
- If the turbopump and the TC 600 are operated independently of each other (only permissible with the agreement of the manufacturer) the turbopump must be connected to the PE.
- The cause of any operating voltage leakage to earth (red LED flashes) must be eliminated to avoid the danger of an electric shock.

Modifications reserved.

---

Pictogram-Definitions

- **Danger of burns from touching hot parts.**
- **Danger of an electric shock.**
- **Danger of personal injury.**
- **Danger of damage to the pump or to the system.**
- **Danger of injury from rotating parts.**
2. Understanding The Pumps TMH/TMU 071 P

2.1. Main Features

Turbopumps TMH/TMU 071 P with the TC 600 form a complete unit. Voltage is supplied by the power pack unit (see “Accessories”).

Cooling
Water cooling or air cooling is required (“Accessories”). Integrated protective measures against excess temperatures: The Electronic Drive Unit TC 600 reduces the rotor rotation speed.

Bearings
High vacuum side: wear free permanent magnetic bearing.
Fore-vacuum side: oil circulatory lubricated ball bearing with ceramic balls.

Proper use
– The Turbomolecular Pumps TMH 071 P/TMU 071 P may only be used for the purpose of generating vacuum.
– The turbopump must be connected to a backing pump in accordance with Section 3.3.
– Only PFEIFFER power pack units may be used to operate the TC 600. These power pack units guarantee voltage which is safely separated from the mains accordance with Standard EN 60742. The use of other power pack units requires the express agreement of the manufacturer.

Improper use
The following is regarded, inter alia, as improper:
– The pumping of explosive or corrosive gases.
– Operating the pumps in areas where there is a danger of explosion.
– Operating the pump in environments which require a protection class superior to IP 30.
– The use of other power pack units or accessories which are not named in this manual or which have not been agreed by the manufacturer.
– The connection to power pack units with earthing of a direct voltage pole.

Improper use will cause all claims for liability and guarantees to be forfeited.

2.2. Differences Between The Pump Types

<table>
<thead>
<tr>
<th>Feature</th>
<th>TMH 071 P</th>
<th>TMU 071 P</th>
</tr>
</thead>
<tbody>
<tr>
<td>High vacuum flange</td>
<td>ISO-KF / ISO-K</td>
<td>CF-F</td>
</tr>
<tr>
<td>High vacuum seal</td>
<td>Viton</td>
<td>Metal</td>
</tr>
<tr>
<td>Attainable final pressure</td>
<td>&lt; 1 \cdot 10^6 mbar (without baking-out)</td>
<td>&lt; 1 \cdot 10^10 mbar (with baking-out)</td>
</tr>
</tbody>
</table>

2.3. For Your Orientation

On page 22 of this operating manual you will find a pull-out drawing showing the connection options for the power pack unit and accessories.

In the text
➡ Working instruction: here, you have to do something.

Symbols used
The following symbols are used throughout in all illustrations.

- High vacuum flange
- Fore-vacuum flange
- Venting connection
- Cooling water connection
- Air cooling
- Electric connection
- Sealing gas connection

Abbreviations used
DCU = Operating and display control unit
TC = Electronic drive unit, turbopump
TPS = Power pack unit

Position numbers
The same pump and accessory parts have the same position numbers in all illustrations.
3. Installation

3.1. Preparations For Installation

**BEWARE**
Do not carry out any unauthorised conversions or alterations to the turbopump.

- Only remove the blank flange from the high and fore-vacuum side immediately before connection.
- On Turbopumps TMH 071 P/TMU 071 P the lubricant reservoir is already fitted and filled.
- Where magnetic fields of > 4 mT are involved suitable shielding must be provided (available on request).
- If the pump is baked out, the heating sleeve and the body of the pump must be insulated to prevent burns from accidental contact.
- In the event of a sudden standstill of the rotor, torques of up to 297 Nm can arise and these must be taken up by the turbopump and frame. Pumps must be anchored as follows:
  - ISO flange with 4 bracket screws,
  - or
  - CF flange with the complete set of M8 screws,
  - or
  - Underside of the pump with 4 screws M5, screws quality 8.8.

3.2. Installing The Pump, Connecting The High Vacuum Side

**Important**
The utmost cleanliness must be observed when fitting all high vacuum parts. Unclean components prolong the pumping time.

**Using the splinter shield**
The use of a splinter shield in the high vacuum flange protects the turbopump against foreign bodies coming from the vacuum chamber but does reduce the volume flow rate of the pump by approximately 15%.
For fitting splinter shields please refer to “Fitting the splinter shield”

The high vacuum side can be flanged onto the vacuum chamber either directly or via a bellows (please see “Accessories”).

---

**Directly Flanging The Pump**

**Permissible installation positions for the turbopump**

1. Vacuum chamber

**CAUTION**
The maximum loading capacity of the high vacuum flange is 200 N (equivalent to 20 kg). Assymetric loading on the high vacuum flange must be avoided.

With horizontal pump installation and oil-sealed backing pumps (e.g. rotary vane pumps) the fore-vacuum flange of the turbopump must be aligned vertically downwards (maximum deviation ±20°), otherwise the turbopump could become dirty.

**Installation position with oil-sealed backing pump**

**CAUTION**
No forces from the piping system must be allowed to act on the pump where turbopumps are anchored.
Suspend or support all pipes to the pump.
Fitting The Splinter Shield

Insert the splinter shield in the high vacuum flange in such a way that the corrugation of the strainer points outwards.

- Bend the clamping lugs slightly outwards so that subsequently the splinter shield is seated firmly in the high vacuum flange (to avoid noise).
- Insert the splinter shield in the high vacuum flange while pressing the clamping lugs slightly inwards.
- Press the outer ring of the splinter shield up to the limit stop point in the high vacuum flange.

3.3. Connecting The Fore-Vacuum Side

Backing pump: Vacuum pressure ≤ 10 mbar
Recommendation: Oil-Free Diaphragm Pump or Rotary Vane Vacuum Pumps from the PFEIFFER range (note installation position, turbopump, see Section 3.2.).

Connecting the backing pump

All connections of the fore-vacuum line: with the usual small flange components or hose screw connections.

Be sure to conduct away the exhaust gases from the backing pump. Do not reduce the free cross section of the fore-vacuum flange with following components. The exhausted process gases and vapours can represent a health hazard and can also be environmentally damaging.

- With rigid pipe connections: fit a bellows in the connecting line to reduce vibration.
- The electrical connection of the backing pump is made via a relay box whose control line is connected to “FV PUMP” on the TC 600.

Please refer to Operating Instructions PM 800 544 BN for details on the relay box, backing pump and its installation.

Please note:
Where a Diaphragm Pump MVP 015 T is being operated, the connection is made, without the relay box, via a control lead directly from the diaphragm pump to the TC 600. Please refer to “Accessories” for the relevant control lead.

3.4. Connecting The Cooling Unit

The Turbopumps TMH 071 P/TMU 071 P must be water or air cooled.
Air cooling may only be used where the ambient temperature is < 35 °C.

Use and installation:
- For water cooling please refer to Operating Instructions PM 800 546 BN.
- For air cooling please refer to Operating Instructions PM 800 543 BN.

3.5. Connecting The Venting Valve

The venting valve provides automatic venting in the event of a power failure and switching off.

Fitting the venting valve

- Unscrew the venting screw from the venting connection of the turbopump.
- Screw in venting valve 42 with seal (USIT ring) on hexagonal SW 14.

Electrical connection

- Plug control lead 42a into the connection “VENT” of the TC 600 (8) on the turbopump.

The venting mode of the venting valve is selected via the DCU or Serial Interface RS 485.

Connecting the venting valve

8 Electronic Drive Unit TC 600
42 Venting valve
42a Control lead venting valve/TC 600
42b Plug

The maximum pressure at the venting valve is 1.5 bar absolute.

Please refer to Operating Instructions PM 800 507 BN for details on Venting Valve TVV 005.
3.6. Connecting The Casing Heating Unit

The attainment of final pressures is accelerated when turbo-pumps and vacuum chambers are baked out. The heating duration is dependent on the degree of dirt and on the required final pressure level. The heating duration should be at least 4 hours.

Please note:
Where casing heating is involved the turbopump must be water cooled.

High temperatures are generated when turbopumps and vacuum chambers are baked out. There is a danger of burns resulting from touching hot parts, even after the casing heating has been switched off.

Ideally, the heating sleeve, pump casing and vacuum chamber should be insulated during installation. Do not touch the heating sleeve, pump casing and vacuum chamber during the baking out process.

If the vacuum chamber itself is baked out:
The temperature of the high vacuum flange must not exceed 120 °C.
If the vacuum chamber is heated to temperatures in excess of 200 °C:
A heat radiation shield should be fitted to the pump rotor.

Please refer to Operating Instructions PM 800 542 BN for details on the casing heating unit and its installation.

3.7. Connecting The Electronic Drive Unit TC 600

Please note:
The turbopump and the Electronic Drive Unit TC 600 are connected and together form a single unit. Connecting cable 8a has to be ordered separately (see “Accessories”).

- Connect plug X4 on connecting cable 8a with connection X4 on the TC 600 and secure with screw 8b.
- Connect plug X2 on connecting cable 8a with Power Pack Unit TPS 100/DCU 100 (“Accessories”) on connection X2.

3.8. Installing The Power Pack Unit

Voltage may only be supplied with the PFEIFFER power pack units (Accessory). These power pack units guarantee voltage which is safely separated from the mains (in accordance with Standard EN 60 742). The use of other power pack units requires the express agreement of the manufacturer.

Please refer to Operating Instructions PM 800 521 BN for details on power pack unit TPS 100.

3.9. Connecting The Sealing Gas Valve

An inert sealing gas can be connected to the turbopump to protect bearings, lubricant and drive. For this, a sealing gas valve is necessary (see “Accessories”).

Please refer to Operating Instructions PM 800 229 BN for details on installing the sealing gas valve and adjusting the sealing gas flow.
3.10. Connecting The Remote Control Unit

Remote control options for various functions are provided with the connection “REMOTE” on the TC 600 via the 10 pole screw connector plug (maximum cable cross section 0.14-1.5 mm²/connection). Shielded cable should be used. Shielding is with the cable clamp on the plug side of the TC 600 connected to the TC casing.

The inputs 2-6 are activated by connecting them to the + 24 V on pin 1 (active high) (please see Section 3.12. “Connection Diagram”).

**Pin occupancy and remote plug functions**

(please see following table).

---

---

<table>
<thead>
<tr>
<th>Pin nr.</th>
<th>Input open (low)</th>
<th>Input closed (high) on + 24V (pin 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+24 V</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>venting blocked (see Section 3.5.)</td>
<td>venting released (see Section 3.5.)</td>
</tr>
<tr>
<td>3</td>
<td>motor, turbopump off</td>
<td>motor, turbopump on: the turbopump is driven, current flows through the motor coils</td>
</tr>
<tr>
<td>4</td>
<td>pumping station off</td>
<td>pumping station on: the turbopump is driven, backing pump is started via the relay box</td>
</tr>
<tr>
<td>5</td>
<td>heating off</td>
<td>heating on: the heating is switched on once the rotation speed switchpoint is attained and off when the rotation speed switchpoint is unattained</td>
</tr>
<tr>
<td>5</td>
<td>reset: by supplying a pulse (T &lt; 2s) with an amplitude of 24V a malfunction acknowledgement can be processed</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>standby off</td>
<td>standby on: pump is accelerated to 86% of its nominal rotation speed</td>
</tr>
<tr>
<td>7</td>
<td>rotation speed setting mode off</td>
<td>the rotation speed can be changed by feeding a PWM signal to this pin or via Serial Interface RS 485 (see Section 4.6. “Rotation Speed Setting Mode”)</td>
</tr>
<tr>
<td>8</td>
<td>Output (low)</td>
<td>Output (high)</td>
</tr>
<tr>
<td></td>
<td>rotation speed switchpoint not attained</td>
<td>rotation speed switchpoint attained; output can be loaded with 24 V/50 mA</td>
</tr>
<tr>
<td>9</td>
<td>Output (low)</td>
<td>Output (high)</td>
</tr>
<tr>
<td></td>
<td>Collective malfunction message; output can be loaded with 24 V/50 mA</td>
<td>malfunction-free operations</td>
</tr>
<tr>
<td>10</td>
<td>Mass (ground)</td>
<td>-----------------</td>
</tr>
</tbody>
</table>

---

---

---
3.11. Connecting The Serial Interface RS 485

An external operating component (DCU 001/DCU 100) or an external computer can be connected via the connection “RS 485” on the TC 600 with the use of an 8 pole modular connecting cable.

The serial interface is galvanically and safely separated from the maximum supply voltage from the TC 600.

**Connection**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial interface type:</td>
<td>RS 485</td>
</tr>
<tr>
<td>Baud rate:</td>
<td>9600 Baud</td>
</tr>
<tr>
<td>Data file word length:</td>
<td>8 bit</td>
</tr>
<tr>
<td>Parity:</td>
<td>no parity</td>
</tr>
<tr>
<td>Start bits:</td>
<td>1</td>
</tr>
<tr>
<td>Stop bits:</td>
<td>1..2</td>
</tr>
</tbody>
</table>

The electrical connections in the TC 600 are optically decoupled.

**Pin Occupancy**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Occupancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>not connected</td>
</tr>
<tr>
<td>2</td>
<td>+ 24 V output (loadable with ≤ 210 mA)</td>
</tr>
<tr>
<td>3</td>
<td>not connected</td>
</tr>
<tr>
<td>4</td>
<td>not connected</td>
</tr>
<tr>
<td>5</td>
<td>RS 485: D+ (DO / RI)</td>
</tr>
<tr>
<td>6</td>
<td>Gnd</td>
</tr>
<tr>
<td>7</td>
<td>RS 485: D- (DI / RI)</td>
</tr>
<tr>
<td>8</td>
<td>not connected</td>
</tr>
</tbody>
</table>

Please note:

It is possible to connect an RS 232 (e.g. PC) via a level converter (please see "Accessories").

**Connecting The RS 485**

**Connection to a fixed bus system**

- Connect all units with D+ (pin 5 / RS 485) and D- (pin 7 / RS 485) to the bus.
- The bus must be closed at both ends.

The connections should be made in accordance with the specification of the Serial Interface RS 485.

**Designation Value**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial interface type:</td>
<td>RS 485</td>
</tr>
<tr>
<td>Baud rate:</td>
<td>9600 Baud</td>
</tr>
<tr>
<td>Data file word length:</td>
<td>8 bit</td>
</tr>
<tr>
<td>Parity:</td>
<td>no parity</td>
</tr>
<tr>
<td>Start bits:</td>
<td>1</td>
</tr>
<tr>
<td>Stop bits:</td>
<td>1..2</td>
</tr>
</tbody>
</table>

All units connected to the bus must have differing serial interface addresses (parameter 797).

The group address of the TC 600 is 960.

Only SELV may be connected to the Serial Interface RS 485.

All switched on remote functions have priority over the serial interface functions.

**Please note:**

Please refer to Operating Instructions PM 800 488 BN for detailed operating procedures and electrical data in respect of the Serial Interface RS 485.
3.12. Connections Diagram, TMH/TMU 071 P

- TC 600
  - 1 n.c.
  - 2 +24 VDC*/max. 200 mA (supply voltage, DCU)
  - 3 n.c.
  - 4 n.c.
  - 5 RS 485+/DO/RI
  - 6 GND* (mass connection, DCU)
  - 7 RS 485-/DO/RI
  - 8 n.c.

- REMOTE
  - 1 +24 VDC*/max. 50 mA
  - 2 Venting release
  - 3 Motor, turbopump
  - 4 Pumping station
  - 5 Heating/Reset
  - 6 Standby
  - 7 PWM ON (touch relation 25%–75%)
  - 8 Switching output 1 (24 VDC/max. 50 mA)
  - 10 Switching output 2 (24 VDC/max. 50 mA)

- HEAT/TMS
  - 1 Relay box
  - 2 mains input, heating (115/208/230) VAC
  - 3 PE
  - 4 PE
  - 5 PE
  - 6 PE

- VENT
  - 1 TVF 005
  - 2 mains input, backing pump (115/208/230) VAC

- FV PUMP
  - 1 relay box
  - 2 mains input, backing pump (115/208/230) VAC

- FAN
  - 1 mains input power pack unit
  - 2 X2
  - 3 Supply voltage, TC
  - 4 GND

- X2
  - 1 Protection conductor (PE)
  - 2 TPS XXX/DCU XXX
  - 3 (90-132/
  - 4 185-265) VAC
4. Operations

4.1. Before Switching ON
Sections 4.1. to 4.3. refer only to operating the pump in its condition on delivery, without the DCU operating unit. The bridges “venting release”, “motor, TMP ON” and “pumping station ON” are fitted in the remote control plug.

![BEWARE]

Turbopump rotors rotate at high speed. When the high vacuum flange is open there is a danger of injury and of damage to the pump caused by objects falling into the pump. Therefore never operate the pump with open high vacuum flange.

- With water cooling: Open cooling water supply and check flow.
- Plug connecting cable 8a (“Accessory”) into the TC 600 and connect with Power Pack Unit TPS 100 on X2 (please see Section 3.7.).

Please note:
The following pre-settings have been programmed:
- Running up time 8 min
- Rotation speed switchpoint 80%
- Automatic venting 50%

These settings can only be altered via Serial Interface RS 485 (DCU or PC); please refer to the respective operating instructions.

4.2. Switching ON:

- Switch on the turbopump with switch S1 on the power pack unit.
- With air cooling the cooling fan is also switched on via Electronic Drive Unit TC 600.
- Once the self test has been successfully completed on the TC 600 (duration approximately 10 seconds), both the turbopump and the backing pump (if connected) begin operating.

Take care when pumping hazardous gases and observe the safety precautions of the gas manufacturer.

4.3. Switching OFF And Venting
Before coming to rest after switching off, the turbopump must be vented in order to prevent contamination.

- Switch off both turbopump and backing pump with switch S1 on the power pack unit.
- Open the venting screw (on delivery, screwed in) on the venting connection slowly about one turn.

![CAUTION]
The minimum venting time to atmospheric pressure is 30 seconds.

- Where water cooling is involved shut off the supply of water.

4.4. Shutting Down For Longer Periods
If aggressive or hazardous gases are pumped there is a danger of personal injury resulting from coming into contact with process gases. Before removing a turbopump from the system, first:

- Vent the turbopump with a neutral gas or dry air.
- Ensure that there is no residual process gas in the system nor in the feeder lines.

If the turbopump is to be shut down for more than a year:

- Remove turbopump from the system.
- Change the lubricant reservoir (see Section 7.1.).

Please note: Lubricant TL 011 should not be used when there have been no operations for 2 years.

- Close the high vacuum flange and evacuate the turbopump via the fore-vacuum flange.
- Vent turbopump via the venting connection with nitrogen or dry air.
- Close fore-vacuum and venting connection by blank flanging.
- Place the pump vertically on its rubber feet.
- In rooms with moist or aggressive atmospheres, the turbopump must be air-sealed in a plastic bag together with a bag of dessicant, e.g silicagel.

Important:
If the pump has been shut down for 3 years, the bearing must be changed (please contact PFEIFFER Service).

4.5. Operations With The DCU 001/DCU 100
Operations with the DCU 001 or DCU 100 should be carried out in accordance with the relevant Operating Instructions PM 800 477 BN (DCU description) and PM 800 547 BN (operating the pump with the DCU).
4.6. Operations With The Remote Control

(please refer to the table in Section 3.10.)

Remote control operations can be performed via the connection with the designation “REMOTE” on the TC 600.

The connection is via a 10 pole screwed connector plug with the following occupancy:

1 – + 24 V
2 – Input, venting release
3 – Input, turbopump motor
4 – Input, pumping station
5 – Input, heating/reset
6 – Input, standby
7 – Input, PWM
8 – Switching output 1: Rotation speed switchpoint
9 – Switching output 2: Collective malfunction message
10 – Mass

Inputs 2 - 6 are activated if they are connected with the 24 V on pin 1 (active high).

On delivery there is a bridge between Pin 1, Pin 2, Pin 3 and Pin 4 on the TC 600 mating plug.

Once operating voltage has been supplied and on successful completion of the self-test on the TC 600, the turbopump and any possible connected backing pump is started.

Venting Release (Optional)

Automatic venting:

When turbopump or pumping station is switched off, the venting valve opens for 0.3 seconds when the venting frequency drops below 50% of the final rotation speed (1200 Hz); it then closes for 10 seconds and opens again for the venting duration of 3600 seconds (1h).

In the event of a mains power failure the venting valve opens for 0.3 seconds when the venting frequency drops below 50% of the nominal rotation speed.

Venting blocked:

Venting does not take place.

Other venting modes can be selected via the DCU.

Motor, Turbopump

When the pumping station is switched on and once the self test has been successfully completed (duration approximately 10 seconds), the turbopump is set in operation.

During operations, the turbopump can be switched on and off while the pumping station is switched on.

Pumping Station

Any connected pumping station components are started up (e.g. backing pump, venting valve, air cooling) and with simultaneous activation of the input “motor, turbopump” the turbopump is set in operation once the self test has been successfully completed (duration approximately 10 seconds).

Heating/Reset

Heating (optional)

Once the rotation speed switchpoint is attained the heating unit is switched on; when the rotation speed switchpoint is fallen below the heating unit is switched off.

Reset

The heating input has two functions (please see Section 3.10., point 5 “Reset”).

Standby

The pump can be operated optionally at 66% of its nominal rotation speed (standby ON) or at its nominal rotation speed (standby OFF).

Rotation Speed Setting Mode Via Input PWM

The supply of pulse width modulated signals (PWM) with a ground frequency of 100 Hz ±20% with an amplitude of maximum 24 V and a key ratio of 25-75% enables the rotation speed to be set in the range 20-100% of the nominal rotation speed.

If no signal is present the pump accelerates up to its final rotation speed.

A PWM box for rotation speed setting operations for the turbopump is available as an option (please see “Accessories”).

Switching Outputs

Switching outputs 1 and 2 can be loaded with a maximum 24 V / 50 mA per output. The following functions are assigned to the switching outputs:

Switching output 1: Active high when the rotation speed switchpoint is attained. The switchpoint for the turbopump is set at 80% of the nominal rotation speed. It can be used, for example, for a message “pump ready to operate”.

Switching output 2: Active low with a malfunction - collective malfunction message

The connection of a relay is made between pin 10 (mass) and the respective switching output pin 8 or pin 9 (see Section 3.12. Connections Diagram).
5. Monitoring Operations

5.1. Operations Display Via LED

Certain operations modes of the turbopump and the TC 600 can be ascertained via the two integrated LEDs located on the front panel of the TC 600. The following operations modes are displayed:

<table>
<thead>
<tr>
<th>LED</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glows green</td>
<td>– Power pack unit OK&lt;br&gt;– Function “pumping station ON” carried out</td>
</tr>
<tr>
<td>Flashes green</td>
<td>– Power pack unit OK&lt;br&gt;– Pumping station OFF</td>
</tr>
<tr>
<td>Blinks green</td>
<td>– Mains power supply failure</td>
</tr>
<tr>
<td>Glows red</td>
<td>– Collective malfunction (for example, run-up time error, over-temperature, turbopump or TC 600)&lt;br&gt;– Switching output 2 active (low)</td>
</tr>
<tr>
<td>Blinks red</td>
<td>– Warning (e.g. supply voltage short circuit to earth, mains power failure)</td>
</tr>
</tbody>
</table>

5.2. Turbopump Temperature Management

Where impermissible motor temperatures are involved or the temperature of the TC 600 casing is too high, the motor current is reduced. This can lead to dipping below the set rotation speed switchpoint and results in the turbomolecular pump being switched off.

LED on the TC 600 glows red: Collective malfunction.
## 6. What To Do In Case Of Breakdowns?

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Causes</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| Pump doesn’t start; None of the integrated LEDs glow on the TC 600 | • Power supply interrupted  
• Incorrect operations voltage supplied  
• Pins 1-3 and 1-4 on the remote plug not connected  
• No supply of operations voltage  
• Defect TC 600  
• Reduction in the voltage in the cable | • Check fuse in the power pack unit  
• Check plug contacts on the mains power pack unit  
• Check power pack unit feeder line  
• Check voltage on the power pack unit (24 VDC) at connection X2  
• Supply correct operations voltage  
• Connect pins 1-3 and 1-4 on the remote plug  
• Check plug contacts on the power pack unit  
• Inform PFEIFFER Service of need for repair  
• Use suitable cable |
| Pump doesn’t attain nominal rotation speed within the set run-up time  
Pump cuts out during operations | • Fore-vacuum pressure too high  
• Leak or too much gas  
• Rotor sluggish caused by defective bearing  
• TC run-up time too short  
• Thermal overloading caused by  
  – Water flow insufficient  
  – Insufficient air supply  
  – Fore-vacuum pressure too high  
  – Ambient temperature too high | • Check backing pump function  
• Check seals  
• Seek leak and repair  
• Supply of process gas too high; reduce  
• Check bearing (noises?): Request PFEIFFER Service to replace  
• Set longer start-up time with the DCU or PC  
• Ensure free flow  
• Ensure adequate air supply  
• Reduce fore-vacuum pressure  
• Reduce ambient temperature |
| Pump doesn’t attain final pressure | • Pump dirty  
• Leak in vacuum chamber, lines or pump | • Bake out pump  
• If seriously contaminated: Request PFEIFFER Service to clean  
• Seek leak starting with vacuum chamber  
• Repair leak |
| Unusual operating noises | • Bearing damaged  
• Rotor damaged  
• Splinter shield (if fitted) not seated firmly | • Inform PFEIFFER Service of need for repair  
• Inform PFEIFFER Service of need for repair  
• Check seat of splinter shield (see Section 3.2.) |
| Red LED on the TC 600 glows | • Collective malfunction | • Reset via mains OFF/ON or remote pin 5  
• Different malfunction display with the DCU possible |
| Red LED on the TC 600 flashes | • Warning through:  
  – Mains power failure  
  – Supply voltage short circuit to earth | • Different warning message with the DCU possible  
• Check power pack unit voltage  
• Check power pack unit mains connection  
• Check power pack unit voltage for short circuit to earth |
7. Maintenance

Important

No liability for personal injury nor material damage will be accepted for damages and operational interruptions which have been caused by improper maintenance; in addition, all guarantees become invalid.

- You can change the lubricant reservoir yourself (please see Section 7.1.).
- Your pump can be cleaned on the spot if it is not very dirty. Your local PFEIFFER Service can advise you regarding cleaning procedures and any other maintenance and service work.

Apply no mechanical stress to the TC 600.

7.1. Changing The Lubricant Reservoir

The lubricant reservoir should be replaced at least once a year. Where extreme operating conditions or unclean processes are involved, the replacement interval should be checked with your PFEIFFER Service Center.

- Switch off the turbopump, vent to atmospheric pressure (see Section 4.3.) and allow to cool as necessary.
- If necessary, remove the turbopump from the system.
- Unscrew rubber feet 6 from the underside of the pump.
- Remove the locking cover 90 on the underside of the pump with suitable tool (adjusting tool order number PM 013 211 AX or adjusting pin key); take care with the O-ring 91.
- Lever out the lubricant reservoir with the help of two screwdrivers.

Lubricants can contain toxic substances from the medium pumped. Lubricant must be disposed of in accordance with the respective regulations.

➡ Clean off any dirt on the pump and locking cover with a clean, fluff-free cloth.
➡ Insert new lubricant reservoir 92 which is already filled with Lubricant TL 011 up to the O-ring 93 in the pump.
➡ Screw in locking cover 90 with O-ring 91. The lubricant reservoir is brought into the correct axial position with the locking cover.
➡ Screw the rubber feet 6 back in.
8. Service

Do Make Use Of Our Service Facilities
In the event that repairs are necessary a number of options are available to you to ensure any system down time is kept to a minimum:
– Have the pump repaired on the spot by our PFEIFFER Service Engineers;
– Return the pump to the manufacturer for repairs;
– Replace with a new value pump.

Local PFEIFFER representatives can provide full details.

The operating parameters set in the works are effective for all PFEIFFER exchange pumps. If your application requires different parameters, please modify accordingly.

Please note:
The turbopump and the Electronic Drive Unit TC 600 form a single unit and must therefore be returned complete for repair purposes. Before returning the unit it should be ensured that the power pack unit is not the cause of the malfunction (please see Section 5. for checking the power pack unit).

Before Returning:
➡ Please attach a clearly visible notice “Free of harmful substances” (both on the unit and also on the delivery note and any accompanying letters).

“Harmful substances” are substances and preparations as defined in the current, local, dangerous substances regulations; in the U.S.A. as “materials in accordance with the Code of Federal Regulations (CFR) 49 Part 173.240 Definition and Preparation”. We will carry out the decontamination and invoice this work to you if you have not attached this note. This also applies where the operator does not have the facilities to carry out the decontamination work. Units which are contaminated microbiologically, explosively or radioactively cannot be accepted as a matter of principle.

Fill Out The Declaration Of Contamination
➡ In every case the “Declaration of Contamination” must be completed diligently and truthfully.
➡ A copy of the completed declaration must accompany the unit; any additional copies must be sent to your local PFEIFFER Service Center.

Please get in touch with your local PFEIFFER representatives if there are any questions regarding contamination.
### 9. Technical Data

<table>
<thead>
<tr>
<th>Feature</th>
<th>Unit</th>
<th>TMH 071 P</th>
<th>TMH 071 P</th>
<th>TMU 071 P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Connection nominal diameter</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inlet</td>
<td></td>
<td>DN 40 ISO-KF</td>
<td>DN 63 ISO-K</td>
<td>DN 63 CF-F</td>
</tr>
<tr>
<td>Outlet</td>
<td></td>
<td>DN 16 ISO-KF/G 1/4&quot;</td>
<td>DN 16 ISO-KF/G 1/4&quot;</td>
<td>DN 16 ISO-KF/G 1/4&quot;</td>
</tr>
<tr>
<td>Venting connection</td>
<td></td>
<td>G 1/8&quot;</td>
<td>G 1/8&quot;</td>
<td>G 1/8&quot;</td>
</tr>
<tr>
<td>Nominal rotation speed</td>
<td>1/min</td>
<td>90 000</td>
<td>90 000</td>
<td>90 000</td>
</tr>
<tr>
<td>Standby rotation speed</td>
<td>1/min</td>
<td>60 000</td>
<td>60 000</td>
<td>60 000</td>
</tr>
<tr>
<td>Start-up time</td>
<td>min</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Noise level</td>
<td>dB (A)</td>
<td>&lt; 45</td>
<td>&lt; 45</td>
<td>&lt; 45</td>
</tr>
<tr>
<td>Final pressure, backing pump</td>
<td>mbar</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td><strong>Volume flow rate for</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen N₂</td>
<td>l/s</td>
<td>33</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Helium He</td>
<td>l/s</td>
<td>38</td>
<td>55</td>
<td>55</td>
</tr>
<tr>
<td>Hydrogen H₂</td>
<td>l/s</td>
<td>37</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td><strong>Compression ratio for</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N₂</td>
<td></td>
<td>&gt; 1 · 10¹²</td>
<td>&gt; 1 · 10¹²</td>
<td>&gt; 1 · 10¹²</td>
</tr>
<tr>
<td>He</td>
<td></td>
<td>2 · 10⁷</td>
<td>2 · 10⁷</td>
<td>2 · 10⁷</td>
</tr>
<tr>
<td>H₂</td>
<td></td>
<td>3 · 10⁵</td>
<td>3 · 10⁵</td>
<td>3 · 10⁵</td>
</tr>
<tr>
<td><strong>Maximum fore-vacuum pressure for</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N₂</td>
<td>mbar</td>
<td>18</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>He</td>
<td>mbar</td>
<td>17</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>H₂</td>
<td>mbar</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>**Maximum gas throughput¹)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With water cooling</td>
<td>N₂</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>He</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>**Final pressure²)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With rotary vane pumps</td>
<td>mbar</td>
<td>1 · 10⁻¹⁰</td>
<td>1 · 10⁻¹⁰</td>
<td>1 · 10⁻¹⁰</td>
</tr>
<tr>
<td>With diaphragm pumps</td>
<td>mbar</td>
<td>5 · 10⁻¹⁰</td>
<td>5 · 10⁻¹⁰</td>
<td>5 · 10⁻¹⁰</td>
</tr>
<tr>
<td><strong>Lubricant</strong></td>
<td></td>
<td>TL 011</td>
<td>TL 011</td>
<td>TL 011</td>
</tr>
<tr>
<td>Maximum cooling water consumption with water at 15 °C³)</td>
<td>l/h</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Cooling water temperature</td>
<td>°C</td>
<td>5 - 25</td>
<td>5 - 25</td>
<td>5 - 25</td>
</tr>
<tr>
<td>Permissible ambient temperature with air cooling</td>
<td>°C</td>
<td>0 - 35</td>
<td>0 - 35</td>
<td>0 - 35</td>
</tr>
<tr>
<td>Heating power consumption</td>
<td>W</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>kg</td>
<td>2.8</td>
<td>2.8</td>
<td>3.5</td>
</tr>
<tr>
<td>Permissible magnetic field</td>
<td>mT</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td><strong>Operating voltage</strong></td>
<td>VDC</td>
<td>24 ± 5%</td>
<td>24 ± 5%</td>
<td>24 ± 5%</td>
</tr>
<tr>
<td>Duration³) / max. current consumption</td>
<td>A</td>
<td>4.1 / 4.6</td>
<td>4.1 / 4.6</td>
<td>4.1 / 4.6</td>
</tr>
<tr>
<td>Duration³) / max. power</td>
<td>W</td>
<td>100 / 110</td>
<td>100 / 110</td>
<td>100 / 110</td>
</tr>
<tr>
<td>Protection class</td>
<td></td>
<td>IP 30</td>
<td>IP 30</td>
<td>IP 30</td>
</tr>
</tbody>
</table>

¹) Until frequency fall-off; higher gas throughputs with reduced rotation speed.

²) In accordance with German Industrial Standard 28428 the final pressure which is attained in a measuring dome 48 hours after baking out.

³) At maximum gas throughput.
9.1. Dimensions Diagram
### 10. Spare Parts

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Description</th>
<th>Pieces</th>
<th>Size</th>
<th>Number</th>
<th>Comments</th>
<th>Ordering Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spare Parts TMH/TMU 071 P</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Set of seals</td>
<td>1</td>
<td></td>
<td>PM 087 077 -T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Rubber feet</td>
<td>4</td>
<td></td>
<td>P 3695 700 ZE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>USIT ring</td>
<td>1</td>
<td></td>
<td>P 3529 133 -A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>91</td>
<td>Locking cover</td>
<td>1</td>
<td>68x3</td>
<td>PM 083 021 -X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>O-ring</td>
<td>1</td>
<td>68x3</td>
<td>P 4070 972 PP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lubricant reservoir</td>
<td>1</td>
<td>68x3</td>
<td>PM 073 073 -T</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Spare parts**

![Spare parts diagram](C40-930/1)
<table>
<thead>
<tr>
<th>Description</th>
<th>Size</th>
<th>Number</th>
<th>Comments/Order Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Components for cooling</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dirt trap</td>
<td>R 3/8”</td>
<td>P 4161 300 2R</td>
<td>PM 800 369 BN</td>
</tr>
<tr>
<td>Recycled Water Cooling Unit TZK 400</td>
<td>230 V, 50 Hz</td>
<td>PM Z01 245</td>
<td>PM 800 543 BN</td>
</tr>
<tr>
<td>Air cooling</td>
<td>24 VDC</td>
<td>PM Z01 253</td>
<td>PM 800 546 BN</td>
</tr>
<tr>
<td>Water cooling</td>
<td></td>
<td>PM 016 000 -T</td>
<td></td>
</tr>
<tr>
<td><strong>Components for venting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venting Valve TVF 005, without current closed</td>
<td>24 VDC</td>
<td>PM Z01 135</td>
<td>PM 800 507 BN</td>
</tr>
<tr>
<td>Drying Unit TTV 001</td>
<td></td>
<td>PM Z00 121</td>
<td>PM 800 022 BN</td>
</tr>
<tr>
<td>(filled with zeolite)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venting flange</td>
<td>DN 10 ISO-K</td>
<td>PM 033 737 -T</td>
<td></td>
</tr>
<tr>
<td><strong>Components for heating</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Casing heating</td>
<td>230 V, Schuko plug</td>
<td>PM 041 900 -T</td>
<td>Water cooling erforderlich/PM 800 542 BN</td>
</tr>
<tr>
<td></td>
<td>208 V, UL-plug</td>
<td>PM 041 901 -T</td>
<td>PM 800 542 BN</td>
</tr>
<tr>
<td></td>
<td>115 V, UL-plug</td>
<td>PM 041 902 -T</td>
<td>PM 800 542 BN</td>
</tr>
<tr>
<td><strong>Other accessories</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecting cable TC 600 – TPS/DCU</td>
<td>3 m</td>
<td>PM 051 103 -T</td>
<td>Other lengths on request</td>
</tr>
<tr>
<td>power pack unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– TPS 100; for fitting to walls</td>
<td></td>
<td>PM 041 827 -T</td>
<td>PM 800 521 BN</td>
</tr>
<tr>
<td>or standard runners</td>
<td></td>
<td>PM 041 828 -T</td>
<td>PM 800 521 BN</td>
</tr>
<tr>
<td>– DCU 100; 19” insert unit</td>
<td></td>
<td>PM C01 694</td>
<td>PM 800 477 BN</td>
</tr>
<tr>
<td>– Casing heating with operating and Display Control Unit (DCU)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mains cable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schuko plug</td>
<td>230 V</td>
<td>P 4564 309 2A</td>
<td></td>
</tr>
<tr>
<td>UL plug</td>
<td>208 V</td>
<td>P 4564 309 2F</td>
<td></td>
</tr>
<tr>
<td>UL plug</td>
<td>115 V</td>
<td>P 4564 309 ZE</td>
<td></td>
</tr>
<tr>
<td>Operating and Display Control Unit DCU 001</td>
<td></td>
<td>PM 041 816 -T</td>
<td>PM 800 477 BN</td>
</tr>
<tr>
<td>Relay box, backing pump</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schuko plug</td>
<td>230 V</td>
<td>PM 041 920 -T</td>
<td>PM 800 544 BN</td>
</tr>
<tr>
<td>UL plug</td>
<td>208 V</td>
<td>PM 041 921 -T</td>
<td>PM 800 544 BN</td>
</tr>
<tr>
<td>UL plug</td>
<td>115 V</td>
<td>PM 041 922 -T</td>
<td>PM 800 544 BN</td>
</tr>
<tr>
<td>Control lead MVP 015 T / TC 600</td>
<td></td>
<td>PM 041 959 -X</td>
<td>length 0.5 m PM 800 563 BN</td>
</tr>
<tr>
<td>PWM box</td>
<td></td>
<td>PM 051 028 -U</td>
<td>PM 800 563 BN</td>
</tr>
<tr>
<td>Level Converter RS 232/485</td>
<td></td>
<td>PM 051 054 -X</td>
<td>PM 800 549 BN</td>
</tr>
<tr>
<td>Vibration compensator, TMH</td>
<td>DN 63 ISO-K</td>
<td>PM 006 800 -X</td>
<td></td>
</tr>
<tr>
<td>TMH</td>
<td>DN 40 ISO-KF</td>
<td>PM 006 799 -X</td>
<td></td>
</tr>
<tr>
<td>TMU</td>
<td>DN 63 CF-F</td>
<td>PM 006 801 -X</td>
<td></td>
</tr>
<tr>
<td>Splinter shield</td>
<td>DN 83 ISO-K</td>
<td>PM 006 375 -X</td>
<td></td>
</tr>
<tr>
<td>Protective grill</td>
<td>DN 63 ISO-K</td>
<td>PM 006 376 -X</td>
<td></td>
</tr>
<tr>
<td>Sealing ring, TMH</td>
<td>DN 63 ISO-K</td>
<td>BP 213 195 -T</td>
<td></td>
</tr>
<tr>
<td>Cu seal (10 pieces), TMU</td>
<td>DN 63 CF</td>
<td>BN 845 037 -T</td>
<td></td>
</tr>
<tr>
<td>Set of screws, TMU</td>
<td>DN 63 CF</td>
<td>BN 845 012 -T</td>
<td></td>
</tr>
<tr>
<td>Sealing gas valve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hose nipple for the sealing gas valve</td>
<td>DN 16 ISO-KF-10</td>
<td>BP 217 453</td>
<td></td>
</tr>
</tbody>
</table>

When ordering accessories and spare parts please be sure to state the full part number. When ordering spare parts please state additionally the unit type and unit number (see rating plate). Please use this list as an order form (by taking a copy).
3 Water cooling
3a Cooling water connection
8 Electronic Drive Unit TC 600
8a Connecting cable, TC 600 – TPS/DCU
20 Relay box, backing pump
20a Control lead, relay box/TC 600
20b Connecting cable, backing pump
20c Mains cable
36 Air cooling
36a Control lead, air cooling/TC 600
36b Mounting bracket
36c Screw
36d Compression spring
42 Venting valve
42a Control lead, venting valve/TC 600
42b Plug
46 Heating sleeve
46a Control lead, heating unit/TC 600
46b Heating unit relay box
46c Mains cable
66 Sealing gas valve
105 Power Pack Unit TPS 100
105a Wall mounting plate
105b Front panel
106 Operating and Display Control Unit DCU 100
107 Operating and Display Control Unit DCU 001
X2 Connection TC 600
X3 Vacuum gauge connection
**Declaration of Contamination of Vacuum Equipment and Components**

The repair and/or service of vacuum components will only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delay.

This declaration can only be completed and signed by authorised and qualified staff:

1. **Description of component:**
   - Equipment type/model: ______________________
   - Code No.: __________________________
   - Serial No.: __________________________
   - Invoice No.: __________________________
   - Delivery Date: _________________________

2. **Reason for return:**
   _________________________________________
   _________________________________________
   _________________________________________
   _________________________________________
   _________________________________________

3. **Equipment condition**
   - Has the equipment been used? yes ☐ no ☐
   - What type of pump oil was used? ______________________________________________________________________________________
   - Is the equipment free from potentially harmful substances?
     yes ☐ (go to section 5)
     no ☐ (go to section 4)

4. **Process related contamination of equipment**
   - toxic ☐ no ☐
   - corrosive ☐ no ☐
   - microbiological hazard*) ☐ no ☐
   - explosive*) ☐ no ☐
   - radioactive*) ☐ no ☐
   - other harmful substances ☐ no ☐

*) We will not accept delivery of any equipment that has been radioactively or microbiologically contaminated without written evidence of decontamination!

**Please list all substances, gases and by-products which may have come into contact with the equipment:**

<table>
<thead>
<tr>
<th>Tradename</th>
<th>Chemical name (or Symbol)</th>
<th>Danger class</th>
<th>Precautions associated with substance</th>
<th>Action if spillage or human contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. **Legally Binding Declaration**

I hereby declare that the information supplied on this form is complete and accurate. The despatch of equipment will be in accordance with the appropriate regulations covering Packaging, Transportation and Labelling of Dangerous Substances.

Name of Organisation: ________________________________________________________________
Address: ___________________________________________________________________________
Tel.: _____________________________________________________________________________
Fax: ______________________________________________________________________________
Name: ______________________________________________________________________________
Job title: _________________________________________________________________________
Date: _____________________________________________________________________________
Legally binding signature: ____________________________________________________________

*Company stamp: ________________________________
Herstellererklärung im Sinne folgender EU-Richtlinien:
- Maschinen 89/392/EWG
- Elektromagnetische Verträglichkeit 89/336/EWG
- Niederspannung 73/23/EWG
Hiermit erklären wir, daß das unten aufgeführte Produkt zum Einbau in eine Maschine bestimmt ist und daß deren Inbetriebnahme so lange untersagt ist, bis festgestellt wurde, daß das Endprodukt den Bestimmungen der EU-Richtlinie 89/392/EWG, Anhang II B entspricht.
Tillverkarens förklaring enligt följande EG-direktiv:
- Maskindirektiv 89/392/EEC
- Elektromagnetisk tolerans 89/336/EEC
- Lågspänning 73/23/EEC

Härmed förklarar vi, att den nedan nämnda produkten är avsedd för inmontering i en maskin och att denna maskin inte får tas i drift förrän det har konstaterats, att slutprodukten stämmor överens med EG’s direktiv 89/392/EEC, annex II B.

Vi bekräftar konformiteten med EG’s-direktiv om elektromagnetisk tolerans 89/336/EEC och EG’s lågspänningsdirektiv 73/23/EEC.

De riktlinjer, anpassade standarder, nationella standarder och specificeringar som har blivit accepterade, anges här nedan.

Valmistajan vakuutus seuraavien EU-direktiivien mukaisesti:
- konedirektiivi 89/392/EY
- sähkömagneettinen siedettävyys 89/336/EY
- pienjännite 73/23/EY

Vakuutame tätä, että allamainittu tuote on tarkoitus asennettavaksi koneeseen ja sen käyttöön on kielletty kunnes on todettu, että lopullinen tuote vastaa EU-direktiivin 89/392/EY vaatimuksia.

We declare that the above-mentioned product is intended to be installed and that the final product is compliant with the requirements of Directive 89/392/EEC.

Declaración do fabricante, de acordo com as seguintes Directivas CE:
- Máquinas, na redacção 89/392/CEE
- Compatibilidade electromagnética, na redacção 89/336/CEE
- Baixa tensão, na redacção 73/23/CEE

Com a presente, declaramos que o produto abaixo indicado se destina à montagem numa máquina e que é proibida a colocação em serviço da mesma antes de se ter declarado, que o produto final está em conformidade com o disposto na Directiva CE, na redacção 89/392/CEE, Apêndice II B.

Certificamos haver conformidade com o disposto na Directiva CE sobre compatibilidade electromagnética, na redacção 89/336/CEE, e o disposto na Directiva CE sobre baixa tensão, na redacção 73/23/CEE.

Abaxo, dá-se indicação das directivas aplicadas, das normas harmonizadas e das normas e especificações aplicadas no respetivo país.

Angewendete Richtlinien, harmonisierte Normen und angewendete, nationale Normen in Sprachen und Spezifikationen:
- EN 292-1
- EN 294
- EN 61010
- EN 292-2
- EN 1012-2

Unterschriften/Signatures/Signature/Firme/Firmas/Handtekeningen/Underskrifter/Underskrift/Allekirjoitukset/Assinaturas:

Geschäftsführer (W. Dondorf)  Administrerende Direktør
Managing Director  Verkställande Direktör
Gérant d’affairs  Directeur
Compact FullRange™ Gauge
Viton sealed
PKR 251
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<td>5.2.2 Cleaning the gauge</td>
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<td>B: Gas type dependence</td>
<td>26</td>
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</table>

For cross references within this document, the symbol (→ ☐ XY) is used, for references to other documents, the symbol (→ ☐ [Z]).
In all communications with Balzers, please specify the information given on the product nameplate.

Typ: PKR 251
No: ************
F-No: ************
15 ... 30 V 2 W

This document applies to products with part number
BG G26 000 (DN 25 ISO-KF flange)
BG G26 001 (DN 40 ISO-KF flange)
BG G26 002 (DN 40 CF-F flange)

The part number can be taken from the product nameplate.
We reserve the right to make technical changes without prior notice.

The PKR 251 Compact FullRange™ Gauge has been designed for vacuum measurement in the pressure range of $5 \times 10^{-9}$ ... 1000 mbar.

The PKR 251 can be used with a Balzers measurement unit for Compact Gauges or with another evaluation unit.

Over the whole measurement range, the measuring signal is output as a logarithm of the pressure.

The PKR 251 gauge consists of two separate measurement systems (the Pirani and the cold cathode system according to the inverted magnetron principle). They are combined in such a way that for the user, they behave as one single measurement system.
1 Safety

1.1 Symbols used

**DANGER**
Information on preventing any kind of physical injury.

**WARNING**
Information on preventing extensive equipment and environmental damage.

**Note**
Information on correct handling or use. Disregard can lead to malfunctions or minor equipment damage.

1.2 Personnel qualifications

**Skilled personnel**
All work described in this document may only be carried out by persons who have suitable technical training and the necessary experience or who have been instructed by the custodian of the product.

1.3 Safety information

- Adhere to the applicable regulations and take the necessary precautions for the process media used.
  Consider possible reactions between the materials (→ 7) and the process media.
  Consider possible reactions of the process media due to the heat generated by the product.
- Adhere to the applicable regulations and take the necessary precautions for all work you are going to do and consider the safety information in this document.
- Before you begin to work, find out whether any vacuum components are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

Pass on the safety information to other users.

1.4 Liability and warranty

Balzers assumes no liability and the warranty becomes null and void if the custodian or third parties
- disregard the information in this document
- use the product in a non-conforming manner
- make any kind of changes (modifications, alterations etc.) to the product
- use the product with accessories not listed in the corresponding product documentation.

The custodian assumes the responsibility in conjunction with the process media used.
2 Technical data

Admissible temperatures

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>-40 °C ... +65 °C</td>
</tr>
<tr>
<td>Operation</td>
<td>+5 °C ... +55 °C</td>
</tr>
<tr>
<td>Bakeout</td>
<td>+150 °C (without electronics unit and magnetic shielding)</td>
</tr>
</tbody>
</table>

Relative humidity

- Max. 80% at temperatures ≤ +31 °C decreasing to 50 % at +40 °C

Use

- indoors only
- altitude up to 2000 m (6600 ft)

Measurement range (air, N₂)

- 5×10⁻⁹ ... 1000 mbar

Accuracy

- ≈ ± 30 % in the range 1×10⁻⁸ ... 100 mbar

Reproducibility

- ≈ ± 5 % in the range 1×10⁻⁸ ... 100 mbar

Gas type dependence

- → Appendix B

Adjustment

- (→ 14)

Pirani measurement circuit

- <HV> trimmer potentiometer at < 1×10⁻⁴ mbar
  (while depressing the pin)
- <ATM> trimmer potentiometer at atmospheric pressure

Cold cathode measurement circuit

- no adjustment (the gauge is adjusted at the factory and requires no maintenance)

Type of protection

- IP 40

Maximum pressure (absolute)

- 10 bar
  - only for inert gases < 55 °C

Supply

**DANGER**

The gauge may only be connected to supply or measurement units that conform to the requirements of a grounded protective extra-low voltage (SELV-E according to EN 61010). The connection to the gauge has to be fused.¹)

- Voltage at the gauge: 15.0 ... 30.0 V= (max. ripple 1 Vpp)
- Power consumption: ≤ 2 W
- Fuse¹): ≤ 1 AT

The minimum voltage of the power supply must be increased proportionally to the length of the measuring cable.

- Voltage at the supply unit with maximum cable length: 16.0 ... 30.0 V= (max. ripple 1 Vpp)

¹) Balzers measurement and control units for Compact Gauges fulfill these requirements.
<table>
<thead>
<tr>
<th><strong>Electrical connection</strong></th>
<th>Hirschmann compact connector type GO 6, 6 pins, male</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cable</strong></td>
<td>5 poles plus screening</td>
</tr>
<tr>
<td><strong>Maximum cable length</strong></td>
<td>75 m (0.25 mm² conductor cross-section)</td>
</tr>
<tr>
<td></td>
<td>100 m (0.34 mm² conductor cross-section)</td>
</tr>
<tr>
<td></td>
<td>300 m (1.0 mm² conductor cross-section)</td>
</tr>
</tbody>
</table>

| **Operating voltage**    | (in the measuring chamber) ≤ 3.3 kV               |
| **Operating current**    | (in the measuring chamber) ≤ 500 µA              |

<table>
<thead>
<tr>
<th><strong>Output signal (measuring signal)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage range</td>
<td>≈ 0 V ... ≈ +10.5 V</td>
</tr>
<tr>
<td>Relationship voltage-pressure</td>
<td>logarithmic, increase 0.6 V / decade (→ Appendix A)</td>
</tr>
<tr>
<td>Error signals</td>
<td>&lt;0.5 V (no supply)</td>
</tr>
<tr>
<td></td>
<td>&gt;9.5 V (Pirani measurement element defective; filament rupture)</td>
</tr>
</tbody>
</table>

| **Output impedance** | 2×10 Ω |
| **Minimum load**     | 10 kΩ, short-circuit proof |
| **Response time**    | pressure dependent |
| p > 10⁻⁶ mbar        | ≈ 10 ms |
| p = 10⁻⁸ mbar        | ≈ 1 s  |

<table>
<thead>
<tr>
<th><strong>Gauge identification</strong></th>
<th>→ Figure 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pirani-only mode</td>
<td>11.1 kΩ resistor referenced to supply common</td>
</tr>
<tr>
<td>Combined Pirani / cold cathode mode</td>
<td>9.1 kΩ resistor referenced to supply common</td>
</tr>
</tbody>
</table>

The following conditions must be fulfilled:

<table>
<thead>
<tr>
<th>Polarity</th>
<th>The polarity of pin 1 referenced to supply common is always positive.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement</td>
<td>measurement current within range 0.2 ... 0.3 mA</td>
</tr>
<tr>
<td>with constant current</td>
<td>measurement voltage within range 2 ... 3 V</td>
</tr>
<tr>
<td>with constant voltage</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Grounding concept</strong></th>
<th>→ Figure 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum flange-measurement common</td>
<td>connected via 10 kΩ</td>
</tr>
<tr>
<td>(max. voltage differential with respect to safety ±50 V with respect to accuracy ±10 V)</td>
<td></td>
</tr>
<tr>
<td>Supply common-signal common</td>
<td>conducted separately; differential measurement recommended for cable lengths ≥6 m</td>
</tr>
</tbody>
</table>
### BG G26 000 (DN 25 ISO-KF)

**Materials exposed to the vacuum**

<table>
<thead>
<tr>
<th>Component</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flange</td>
<td>stainless steel (1.4104)</td>
</tr>
<tr>
<td>Measuring chamber</td>
<td>stainless steel (1.4104)</td>
</tr>
<tr>
<td>Feedthrough isolation</td>
<td>ceramic (Al₂O₃), glass</td>
</tr>
<tr>
<td>Internal seals</td>
<td>Viton</td>
</tr>
<tr>
<td>Anode</td>
<td>Mo</td>
</tr>
<tr>
<td>Ignition aid</td>
<td>stainless steel (1.4310/AISI 301)</td>
</tr>
<tr>
<td>Pirani measuring tube</td>
<td>Ni, Au</td>
</tr>
<tr>
<td>Pirani filament</td>
<td>W</td>
</tr>
</tbody>
</table>

**Internal volume**  
≈ 20 cm³

**Dimensions [mm]**

[Diagram of the device]

**Weight**  
700 g

### BG G26 001 (DN 40 ISO-KF)  
BG G26 002 (DN 40 CF-F)

**Materials exposed to the vacuum**

<table>
<thead>
<tr>
<th>Component</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flange</td>
<td>stainless steel (1.4306/AISI 304L)</td>
</tr>
<tr>
<td>Measuring chamber</td>
<td>stainless steel (1.4104)</td>
</tr>
<tr>
<td>Feedthrough isolation</td>
<td>ceramic (Al₂O₃), glass</td>
</tr>
<tr>
<td>Internal seals</td>
<td>Viton</td>
</tr>
<tr>
<td>Anode</td>
<td>Mo</td>
</tr>
<tr>
<td>Ignition aid</td>
<td>stainless steel (1.4310/AISI 301)</td>
</tr>
<tr>
<td>Pirani measuring tube</td>
<td>Ni, Au</td>
</tr>
<tr>
<td>Pirani filament</td>
<td>W</td>
</tr>
</tbody>
</table>

**Internal volume**  
≈ 20 cm³

**Dimensions [mm]**

[Diagram of the device]

**Weight**  
700 g (DN 40 ISO-KF flange)  
950 g (DN 40 CF-F flange)
3 Installation

3.1 Installation

Note

Caution: vacuum component
Dirt and damages impair the function of the vacuum component.
When handling vacuum components, take appropriate measures to ensure cleanliness and prevent damages.

The gauge can be mounted in any orientation. However, it should be mounted so that any particles present cannot penetrate into the measuring chamber (→ 13).
See “Technical data” (→ 7) for space requirements.

Procedure

1. Remove the protective cap.

   The protective cap will be needed for maintenance work.

2. Make the flange connection.

   When making a CF flange connection, it can be advantageous to temporarily remove the magnet unit (→ section 3.1.1).

   If it should be possible to adjust the gauge while it is connected to the vacuum system, make sure the two <HV> and <ATM> trimmer potentiometers are accessible for a screw driver.

DANGER

Caution: overpressure in the vacuum system > 4 bar
KF flange connections with elastomer sealing rings (e.g. O-rings) cannot withstand such pressures. Process media can thus leak and possibly damage your health.
Use sealing rings provided with an outer centering ring.

DANGER

Caution: overpressure in the vacuum system > 1 bar
If clamps are opened unintentionally injury can be caused by catapulted parts.
Use the type of clamps which can only be opened and closed by means of a tool (e.g. hose clip clamping ring).

DANGER

The gauge must be electrically connected to the grounded vacuum chamber. The connection must conform to the requirements of protective connection according to EN 61010:
- CF flanges fulfill this requirement
- For gauges with KF flanges, use a conductive metallic clamping ring.
3.1.1 Removing the magnet unit (only for gauges with CF flanges)

Tools required
- Allen wrench 1.5 mm
- Open-end wrench 7.0 mm

Procedure

a) Unfasten the hexagon socket set screw (1) on the side of the electronics unit (2).
b) Remove the electronics unit without twisting it.
c) Unfasten the hexagon head screw (3) on the magnet unit (4) and remove the magnet unit.

[Note]
The magnetic force and the tendency to tilt make it more difficult to separate the magnet unit and the measuring chamber (7).

d) Make the flange connection between the gauge and the vacuum system.
e) Remount the magnet unit and lock it with the hexagon head screw (3).
f) Carefully mount the electronics unit (2). (Make sure the pin of the Pirani element is properly plugged into the corresponding hole of the electronics unit.)
g) Push the electronics unit up to the mechanical stop and lock it with the hexagon socket set screw (1).

3.2 Electrical connection

3.2.1 Use with a Balzers measurement unit

If the gauge is used with a Balzers measurement unit for Compact Gauges, a corresponding connection cable is required (→ 21).

- Secure the connector on the gauge with the screw.
3.2.2 Use with another evaluation unit

The gauge can also be operated with other evaluation units. In this case, an individual connection cable must be made.

For cable lengths up to 6 m (with a conductor cross-section of 0.34 mm²), the measuring signal can be read directly between the positive signal output (pin 2) and the supply common (pin 5) without the degree of accuracy being lowered. For longer measurement cable lengths, we recommend a differential measurement between the signal output and the signal common (pin 3) (as a result of the voltage drop along the supply cable ground lead, the common mode signal is approx. 1.0 V at the maximum admissible cable length).

1. Prepare the connector (ordering number → 21).

2. Solder the connection cable according to the diagram.

Figure 1: Electrical connection

- Pin 1: identification
- Pin 2: signal output (measuring signal)
- Pin 3: signal common
- Pin 4: supply
- Pin 5: supply common
- Pin 6: screen

WARNING

The supply common (pin 5) and the screen (pin 6) must be connected to the supply unit with protective ground. Incorrect connection, incorrect polarity, or inadmissible supply voltages can damage the gauge.

3. Reassemble the connector.
4 Plug in the connector.
Secure the connector on the gauge with the screw.
4 Operation

As soon as the required voltage is applied, the measuring signal is available between pins 2 and 3. (→ Appendix A for the relationship between the measuring signal and the pressure).

Allow for a stabilizing time of approx. 10 min. Once the gauge has been switched on, permanently leave it on irrespective of the pressure.

4.1 Measurement principle, measuring behavior

The PKR 251 consists of two separate measurement systems (Pirani and cold cathode system according to the inverted magnetron principle). They are combined in such a way that for the user, they behave as one single measurement system.

The optimum measurement configuration for the particular pressure range, in which measurement is performed, is used:

<table>
<thead>
<tr>
<th>Pressure</th>
<th>Cold cathode</th>
<th>Pirani</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5 \times 10^4$ mbar</td>
<td>$10^2$ mbar</td>
<td></td>
</tr>
</tbody>
</table>

- The Pirani measurement circuit is always on.
- The cold cathode measurement circuit is controlled by the Pirani circuit and is activated only at pressures $<1 \times 10^{-2}$ mbar.

The identification output (pin 1) indicates the current status of the gauge:

<table>
<thead>
<tr>
<th>Pressure</th>
<th>Green lamp on the gauge</th>
<th>Operating mode</th>
<th>Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p &gt; 1 \times 10^{-2}$ mbar</td>
<td></td>
<td>Pirani-only mode</td>
<td>11.1 kΩ (Pirani)</td>
</tr>
<tr>
<td>$p &lt; 1 \times 10^{-2}$ mbar</td>
<td></td>
<td>Pirani-only mode (cold cathode measurement circuit not ignited)</td>
<td>11.1 kΩ (Pirani)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combined operation</td>
<td>9.1 kΩ (combined)</td>
</tr>
</tbody>
</table>

As long as the cold cathode measurement circuit has not ignited, the measurement value of the Pirani is output as measuring signal (if $p < 5 \times 10^{-4}$ mbar, “Pirani underrange” is displayed).

Gas type dependence

The measuring signal depends on the type of gas being measured. The curves are accurate for $N_2$, $O_2$, dry air and CO. They can be mathematically converted for other gases (→ Appendix B).

If you are using a Balzers measurement unit for Compact Gauges, you can enter a calibration factor to correct the measurement value displayed (→ of that measurement unit).

Ignition delay

When cold cathode measurement systems are activated, an ignition delay occurs. The delay time increases at low pressures and is typically:

- $10^5$ mbar $\approx$ 1 second
- $10^7$ mbar $\approx$ 20 seconds
- $5 \times 10^8$ mbar $\approx$ 2 minutes
As long as the cold cathode measurement circuit has not yet ignited, the measurement value of the Pirani is output as measuring signal ("Pirani underrange" is displayed for pressures $< 5 \times 10^{-4}$ mbar). The identification output (pin 1) indicates the Pirani-only mode.

---

**Note**

If the gauge is activated at a pressure $p < 3 \times 10^{-9}$, the gauge cannot recognize whether the cold cathode system has ignited. It indicates "Pirani-Underrange".

---

**Note**

Once flanged on, permanently leave the PKR 251 gauge in the operating mode irrespective of the pressure range. Like this, the ignition delay of the cold cathode measurement circuit is always negligible ($< 1$ s), and thermal stabilizing effects are minimized.

---

**Contamination**

**Note**

Gauge failures due to contamination are not covered by the warranty.

---

Gauge contamination is influenced by the process media used as well as any present or new contaminants and their respective partial pressures. Continuous operation in the range of $10^{-4}$ mbar ... $10^{-2}$ mbar can cause severe contamination as well as reduced up-time and maintenance cycles. With constantly low pressures ($p < 1 \times 10^{-6}$ mbar), the gauge can be operated for more than one year without cleaning (cleaning the gauge $\rightarrow$ G50 17).

Contamination of the gauge generally causes a deviation of the measured values:

- In the high pressure range ($1 \times 10^{-3}$ mbar ... 0.1 mbar), the pressure indication is too high (contamination of the Pirani element). Readjustment of the Pirani measurement system $\rightarrow$ 14.
- In the low pressure range ($p < 1 \times 10^{-3}$ mbar), the pressure indication is usually too low (contamination of the cold cathode system). In case of severe contamination, instabilities can occur (layers of the measuring chamber peel off). Contamination due to insulation layers can even lead to a complete failure of the discharge ("Underrange" is displayed).

Contamination can to a certain extent be reduced by:

- geometric protection measures (e.g. screenings, elbows) for particles that spread rectilinearly
- mounting the flange of the gauge at a place where the partial pressure of the pollutants is particularly low.

Special precautions are required for vapors deposited under plasma (of the cold cathode measurement system). It may even be necessary to temporarily switch off the gauge while vapors occur.
5 Maintenance

**5.1 Adjusting the gauge**

The gauge is factory-calibrated. Reducing the gauge can become necessary due to use under different climatic conditions, aging, or contamination \( \rightarrow \) 13).

The cold cathode measurement circuit, which is dominant for low pressures \(<1 \times 10^{-3}\) mbar), is factory-calibrated and cannot be adjusted. By way of contrast, the Pirani measurement circuit can be adjusted. Any adjustment has a negligible effect on the pressure range between approx. \(10^{-2}\) mbar and \(10^2\) mbar.

**Tools required**
- Screwdriver No. 0
- Cylindrical pin \( \varnothing \approx 3\) mm

**Procedure**

1. Put the gauge into operation (if possible, in the position, in which it will be used later on).

2. Evacuate the vacuum system to \(p \ll 10^{-4}\) mbar, and then wait 10 minutes.

3. Turn the nameplate counter-clockwise until the mechanical stop is reached.

4. While depressing the pin with the cylindrical pin, adjust the \(<HV>\) potentiometer
   \[ \text{... to } 5 \times 10^{-4} \text{ mbar} \]  
   \[ \text{or... to } 4.2 \text{ V} \]
   Then turn the potentiometer counter-clockwise by \(1/2\).

5. Vent with air or nitrogen to atmospheric pressure and then wait 10 minutes.

6. Turn the nameplate clockwise until the mechanical stop is reached.
7 Adjust the <ATM> potentiometer ...
... to $1 \times 10^3$ mbar or
... or to 8.6 V.

8 Turn the nameplate back to its original position (it will catch).

5.2 Cleaning the gauge / replacing parts

**STOP**

**DANGER**

Caution: cleaning agents
Cleaning agents can be detrimental to health and environment.
Adhere to the relevant regulations and take the necessary precautions when handling and disposing of cleaning agents.

**Note**

We recommend to replace the Pirani element when cleaning the gauge.

**Tools / material required**

- Allen wrench 1.5 mm
- Allen wrench 3.0 mm
- Open-end wrench 7.0 mm
- Pliers for circlip
- Polishing cloth (400 grain) or Scotch-Brite
- Tweezers
- Cleaning alcohol
- Mounting tool for ignition aid
- Ignition aid
- Pirani element (13) incl. Viton seal (13a)
- Viton seal (11) for anode feedthrough
5.2.1 Disassembling the gauge

Procedure

a) Remove the gauge from the vacuum system (→ § 20).

b) Unfasten the hexagon socket set screw (1) on the side of the electronics unit (2) (→ Figure 2).

c) Remove the electronics unit without twisting it.

![Note]

The cover of the electronics unit cannot be removed.

![Note]

The magnetic force and the tendency to tilt make it more difficult to separate the magnet unit and the measuring chamber (7).

d) Unfasten the hexagon head screw (3) on the magnet unit (4) and remove the magnet unit.

e) Remove the circlip (5) and the polarity insert (6) from the measuring chamber.

f) Remove the three hexagon socket screws (8) incl. lock washers (8a) on the back of the measuring chamber.

g) Carefully remove the following parts in this order (without exerting stress on the Pirani element (13)); pressure piece (9), complete anode (10), Viton seal (11) incl. support ring (12), Pirani element (13) incl. Viton seal (13a).

The parts can now be cleaned or replaced individually.
5.2.2 Cleaning the gauge

Cleaning the measuring chamber and the polarity insert:

a) Using a polishing cloth rub the inside walls of the measuring chamber and the polarity insert to a bright finish.

<table>
<thead>
<tr>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>The sealing surfaces must only be worked concentrically.</td>
</tr>
</tbody>
</table>

b) Rinse the measuring chamber and the polarity insert with cleaning alcohol.

c) Allow both to dry.

Cleaning or replacing the anode:

a) Remove the used ignition aid (10a) with pliers (→ Figure 2).

b) Using a polishing cloth rub the anode pin to a bright finish.

<table>
<thead>
<tr>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not bend the anode. Do not carry out mechanical work on the ceramic part.</td>
</tr>
</tbody>
</table>

c) Rinse the anode with cleaning alcohol.

d) Allow the anode to dry.

e) Insert a new ignition aid (10a) into the mounting tool.

f) Carefully press the anode (clean or new) centered and parallel to the tool axis into the ignition aid and insert it to a depth of approx. 15 mm. The final positioning is established after the anode is installed.

Cleaning the Pirani element:

a) Remove the Viton seal (13a) from the Pirani element (13).

b) Fill the Pirani measuring tube with cleaning alcohol and let it work.

c) Pour the alcohol out of the tube.

d) Dry the tube (e.g. with a blow dryer <150°C).

e) Slide a new Viton seal over the Pirani element and insert it into the corresponding groove.

f) Remount the Pirani element (→ section 5.2.3).

Replacing the Pirani measurement element:

(If it is severely contaminated or defective)

a) Slide a new Viton seal (13a) over the Pirani element (13) and insert it into the corresponding groove.

b) Mount the Pirani element (→ section 5.2.3).
5.2.3 Reassembling the gauge

Procedure

a) Insert the Viton seal (11) with the support ring (12) centered into the measuring chamber (7). The sealing surface, seal, and ceramic part must be clean (→ Figure 2).

b) Carefully insert the anode (10) incl. ignition aid (10a) into the measuring chamber.

c) Insert the Pirani element (13) with the Viton seal (13a) slid over it into the corresponding bore hole.

d) Carefully place the pressure piece (9) on the measuring chamber and tighten them with the three hexagon socket screws (8) incl. lock washers (8a) uniformly until the stop position is reached.

e) Position the ignition aid (10a) by pushing the mounting tool over the anode pin until the mechanical stop is reached.

f) Blow the particles in the measuring chamber with dry nitrogen (be careful to hold the measuring chamber with the flange pointing downwards).

j) Mount the magnet unit (4) and lock it with the screw (3).

k) Carefully mount the electronics unit (2). (Make sure the pin of the Pirani element is properly plugged into the corresponding hole of the electronics unit.)

l) Push the electronics unit up to the mechanical stop and lock it with the hexagon socket set screw (1).

m) Adjust the gauge (→ 14).

Note

Visually check that the anode pin is centered over the middle hole of the polarity insert (max. eccentricity = 0.5 mm).

i) If possible perform a leak test (leak rate <10⁻⁹ mbar l/s).

j) Mount the magnet unit (4) and lock it with the screw (3).

k) Carefully mount the electronics unit (2). (Make sure the pin of the Pirani element is properly plugged into the corresponding hole of the electronics unit.)

l) Push the electronics unit up to the mechanical stop and lock it with the hexagon socket set screw (1).

m) Adjust the gauge (→ 14).
5.3 What to do in case of problems

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring signal continually &lt; 0.5 V &quot;Error low&quot;.</td>
<td>No supply voltage.</td>
<td>Turn on the power supply.</td>
</tr>
<tr>
<td>Measuring signal continually &gt; 9.5 V &quot;Error high&quot;.</td>
<td>Pirani measurement element defective (filament rupture).</td>
<td>Replace the Pirani element (→ G50 17).</td>
</tr>
<tr>
<td>Measuring signal continually &lt; 0.5 V &quot;Error low&quot;.</td>
<td>No supply voltage.</td>
<td>Turn on the power supply.</td>
</tr>
<tr>
<td>Measuring signal continually &gt; 9.5 V &quot;Error high&quot;.</td>
<td>Pirani measurement element defective (filament rupture).</td>
<td>Replace the Pirani element (→ G50 17).</td>
</tr>
<tr>
<td>Measuring signal continually &gt; 9.5 V &quot;Error high&quot;.</td>
<td>Pirani measurement element defective (filament rupture).</td>
<td>Replace the Pirani element (→ G50 17).</td>
</tr>
<tr>
<td>Measuring signal continually &gt; 5 V or display &gt; 10⁻⁵ mbar although vacuum pressure is OK.</td>
<td>Pirani measurement circuit not adjusted, e.g. due to severe contamination.</td>
<td>Readjust the Pirani measurement circuit (→ G50 14). If adjustment is impossible, replace the Pirani element.</td>
</tr>
<tr>
<td>Measuring signal continually &gt; 9.5 V &quot;Error high&quot;.</td>
<td>Pirani measurement element defective (filament rupture).</td>
<td>Replace the Pirani element (→ G50 17).</td>
</tr>
<tr>
<td>The green lamp is ON and the identification indicates Pirani-only mode (measuring signal continually &gt; 4.0 V) &quot;Pirani underrange&quot;.</td>
<td>The cold cathode discharge has not ignited.</td>
<td>Wait until the gas discharge ignites (in case of contamination with insulation layers, the cold cathode may completely fail to ignite). (Cleaning → G50 17).</td>
</tr>
<tr>
<td>The PKR has only been activated with p &lt; 3×10⁻⁹ mbar</td>
<td>The PKR has only been activated with p &lt; 3×10⁻⁹ mbar</td>
<td>Slightly increase the pressure.</td>
</tr>
<tr>
<td>Measuring signal unstable.</td>
<td>Gauge contaminated.</td>
<td>Clean the gauge (→ G50 17).</td>
</tr>
</tbody>
</table>
6 Removing the gauge from the vacuum system

**DANGER**
Caution: contaminated parts
Contaminated parts can be detrimental to health.
Before you begin to work, find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

**Note**
Caution: vacuum component
Dirt and damages impair the function of the vacuum component. When handling vacuum components, take appropriate measures to ensure cleanliness and prevent damages.

**Procedure**

1. Deactivate the gauge.

2. Unplug the connector.

3. Remove the gauge from the vacuum system.

4. Place the protective cap.
7 Returning the product

**WARNING**

Caution: forwarding contaminated products
Products returned to Balzers for service or repair should, if possible, be free of harmful substances (e.g. radioactive, toxic, caustic or microbiological). Otherwise, the type of contamination must be declared.
Adhere to the forwarding regulations of all involved countries and forwarding companies and enclose a completed contamination declaration.

Products that are not clearly declared as “free of harmful substances” are decontaminated at the expense of the customer.

8 Accessories

<table>
<thead>
<tr>
<th>Connection cable for Balzers measurement unit for Compact Gauges</th>
<th>Ordering number</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 m</td>
<td>BG 448 250 -T</td>
</tr>
<tr>
<td>6 m</td>
<td>BG 448 251 -T</td>
</tr>
<tr>
<td>10 m</td>
<td>BG 448 252 -T</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connection socket Hirschmann GO 6 WF 6 contacts, angled, female</th>
<th>BG 4707 283 MA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic shielding</td>
<td>BG 443 155 -X</td>
</tr>
</tbody>
</table>
When ordering spare parts, always indicate:

- the type of product
- the manufacturing number given on the product nameplate
- the position, description, and ordering number according to the spare parts list

The following parts are available as spare parts sets:

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Description</th>
<th>Ordering number</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Maintenance set, consisting of:</td>
<td>BN 846 239 -T</td>
</tr>
<tr>
<td></td>
<td>1× support ring</td>
<td></td>
</tr>
<tr>
<td>13a</td>
<td>1× O-ring Viton 3.69 × 1.78</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1× O-ring Viton 10.82 × 1.78</td>
<td></td>
</tr>
<tr>
<td>10a</td>
<td>3× ignition aid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Repair set, consisting of:</td>
<td>BN 846 238 -T</td>
</tr>
<tr>
<td>13</td>
<td>1× Pirani measurement element, cpl.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>1× support ring</td>
<td></td>
</tr>
<tr>
<td>13a</td>
<td>1× O-ring Viton 3.69 × 1.78</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1× O-ring Viton 10.82 × 1.78</td>
<td></td>
</tr>
<tr>
<td>10a</td>
<td>3× ignition aid</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1× anode, complete</td>
<td></td>
</tr>
<tr>
<td>10a</td>
<td>Set of ignition aids, consisting of:</td>
<td>BN 845 995 -T</td>
</tr>
<tr>
<td></td>
<td>10× ignition aid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mounting tool for ignition aid</td>
<td>BG 510 600</td>
</tr>
<tr>
<td>2</td>
<td>Electronics unit PKR 251</td>
<td>BN 846 468 -T</td>
</tr>
<tr>
<td></td>
<td>Measuring system, complete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DN 25 ISO-KF flange</td>
<td>BN 846 469 -T</td>
</tr>
<tr>
<td></td>
<td>DN 40 ISO-KF flange</td>
<td>BN 846 470 -T</td>
</tr>
<tr>
<td></td>
<td>DN 40 CF-F flange</td>
<td>BN 846 471 -T</td>
</tr>
<tr>
<td></td>
<td>Exchange gauge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(return defective gauge to Balzers)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DN 25 ISO-KF flange</td>
<td>BG G26 000 #A</td>
</tr>
<tr>
<td></td>
<td>DN 40 ISO-KF flange</td>
<td>BG G26 001 #A</td>
</tr>
<tr>
<td></td>
<td>DN 40 CF-F flange</td>
<td>BG G26 002 #A</td>
</tr>
</tbody>
</table>
10 Disposal

WARNING

Caution: substances detrimental to the environment
Products, operating materials etc. may have to be specially disposed of.
For environmentally compatible disposal, please contact your nearest Balzers Service Center.
Appendix

A: Relationship between measuring signal and pressure

Conversion formulae

\[ p = 10^{1.667 \times U - d} \quad \Leftrightarrow \quad U = c + 0.6 \times \log_{10} p \]

<table>
<thead>
<tr>
<th>Unit</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>mbar</td>
<td>6.8</td>
<td>11.33</td>
</tr>
<tr>
<td>µbar</td>
<td>5.0</td>
<td>8.333</td>
</tr>
<tr>
<td>Torr</td>
<td>6.875</td>
<td>11.46</td>
</tr>
<tr>
<td>mTorr</td>
<td>5.075</td>
<td>8.458</td>
</tr>
<tr>
<td>micron</td>
<td>5.075</td>
<td>8.458</td>
</tr>
<tr>
<td>[Pa]</td>
<td>5.6</td>
<td>9.333</td>
</tr>
<tr>
<td>[kPa]</td>
<td>7.4</td>
<td>12.33</td>
</tr>
</tbody>
</table>

where \( U \) measuring signal
\( p \) pressure
\( c, d \) constant (pressure unit dependent)

valid in the range

- \( 5 \times 10^{-9} \text{ mbar} < p < 1000 \text{ mbar} \)
- \( 3.8 \times 10^{-9} \text{ Torr} < p < 750 \text{ Torr} \)
- \( 5 \times 10^{-7} \text{ Pa} < p < 1 \times 10^5 \text{ Pa} \)

Conversion curves
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.5</td>
<td>Sensor error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5 ... 1.82</td>
<td>Underrange</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.82</td>
<td>$5.0 \times 10^{-9}$</td>
<td>$3.8 \times 10^{-9}$</td>
<td>$5.0 \times 10^{-7}$</td>
</tr>
<tr>
<td>2.0</td>
<td>$1.0 \times 10^{-8}$</td>
<td>$7.5 \times 10^{-9}$</td>
<td>$1.0 \times 10^{-6}$</td>
</tr>
<tr>
<td>2.6</td>
<td>$1.0 \times 10^{-7}$</td>
<td>$7.5 \times 10^{-8}$</td>
<td>$1.0 \times 10^{-5}$</td>
</tr>
<tr>
<td>3.2</td>
<td>$1.0 \times 10^{-6}$</td>
<td>$7.5 \times 10^{-7}$</td>
<td>$1.0 \times 10^{-4}$</td>
</tr>
<tr>
<td>3.8</td>
<td>$1.0 \times 10^{-5}$</td>
<td>$7.5 \times 10^{-6}$</td>
<td>$1.0 \times 10^{-3}$</td>
</tr>
<tr>
<td>4.4</td>
<td>$1.0 \times 10^{-4}$</td>
<td>$7.5 \times 10^{-5}$</td>
<td>$1.0 \times 10^{-2}$</td>
</tr>
<tr>
<td>5.0</td>
<td>$1.0 \times 10^{-3}$</td>
<td>$7.5 \times 10^{-4}$</td>
<td>0.1</td>
</tr>
<tr>
<td>5.6</td>
<td>$1.0 \times 10^{-2}$</td>
<td>$7.5 \times 10^{-3}$</td>
<td>1.0</td>
</tr>
<tr>
<td>6.2</td>
<td>0.1</td>
<td>$7.5 \times 10^{-4}$</td>
<td>10</td>
</tr>
<tr>
<td>6.8</td>
<td>1.0</td>
<td>0.75</td>
<td>100</td>
</tr>
<tr>
<td>7.4</td>
<td>10</td>
<td>7.5</td>
<td>1000</td>
</tr>
<tr>
<td>8.0</td>
<td>100</td>
<td>75</td>
<td>$1.0 \times 10^4$</td>
</tr>
<tr>
<td>8.6</td>
<td>1000</td>
<td>750</td>
<td>$1.0 \times 10^5$</td>
</tr>
<tr>
<td>8.6 ... 9.5</td>
<td>Overrange</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5 ... 10.5</td>
<td>Sensor error (Pirani defective)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
B: Gas type dependence

Indication range above $10^{-2}$ mbar
(Pirani only mode)

Pressure indicated (gauge calibrated for air)

Indication range
$10^{-6} ... 0.1$ mbar

Pressure indicated (gauge calibrated for air)
In the range below $10^{-5}$ mbar, the pressure indication is linear. For gases other than air, the pressure can be determined by means of a simple conversion formula:

$$p_{\text{eff}} = K \times \text{pressure indicated}$$

<table>
<thead>
<tr>
<th>gas type</th>
<th>$K$</th>
</tr>
</thead>
<tbody>
<tr>
<td>air (N(_2), O(_2), CO)</td>
<td>1.0</td>
</tr>
<tr>
<td>Xe</td>
<td>0.4</td>
</tr>
<tr>
<td>Kr</td>
<td>0.5</td>
</tr>
<tr>
<td>Ar</td>
<td>0.8</td>
</tr>
<tr>
<td>H(_2)</td>
<td>2.4</td>
</tr>
<tr>
<td>Ne</td>
<td>4.1</td>
</tr>
<tr>
<td>He</td>
<td>5.9</td>
</tr>
</tbody>
</table>

These conversion factors are average values.

**Note**

A mixture of gases and vapors is often involved. In this case, accurate determination is only possible with a partial pressure measurement instrument, e.g. a Balzers quadrupole mass spectrometer.
Embedded Secure Document

The file http://topaz/data/datasheets/vacuum%20equipment/EVI%20105p.pdf is a secure document that has been embedded in this document. Double click the pushpin to view EVI%20105p.pdf.
Operation Manual

LABOVAC®

Electromagnetic
high-vacuum valves

with the nominal widths
DN 6, 10, 16

SASKIA Hochvakuum- und
Labortechnik GmbH
Am Vogelherd 20
D-98693 Ilmenau

phone (0 36 77) 60 40
fax (0 36 77) 60 41 10
1. **Introduction**

Before the valve is being connected to the vacuum plant, it is necessary to study this Operation Manual.

2. **Application**

The valves VA 6 ... 16 M are intended to open and close the flow paths of gases and vapours in vacuum plants. They may be used for the ventilation of recipients, too. The moisture contained shall not exceed 40%. If the valves are used in aggressive gases, the resistance of their surface layers will have to be clarified in advance (chemically nickel-plated).

The valves are manufactured in the "currentless closed" execution.

Protection degree: IP10 without screwed cable gland
IP44 with screwed cable gland

3. **Technical Data**
<table>
<thead>
<tr>
<th>Electric connection</th>
<th>VA 6 M</th>
<th>VA 10M</th>
<th>VA 16M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak rate (mbar \cdot s^{-1})</td>
<td>&lt;1x10^{-8}</td>
<td>&lt;10^{-8}</td>
<td>&lt;10^{-8}</td>
</tr>
<tr>
<td>Conductance (s^{-1})</td>
<td>1.0</td>
<td>1.6</td>
<td>3.0</td>
</tr>
<tr>
<td>Angle measure (mm)</td>
<td>40/20</td>
<td>40/20</td>
<td>40/20</td>
</tr>
<tr>
<td>Throughput (DN)</td>
<td>6</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Flange connections (mm) (small flange)</td>
<td>DN 16 KF</td>
<td>DN 16 KF</td>
<td>DN 16 KF</td>
</tr>
<tr>
<td>Dimensions (mm) (A / B / C)</td>
<td>40 / 20 / 80</td>
<td>40 / 20 / 80</td>
<td>40 / 40 / 105</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>0.430</td>
<td>0.430</td>
<td>0.500</td>
</tr>
<tr>
<td>Valve durability (Number of switches)</td>
<td>&gt;200 000</td>
<td>&gt;200 000</td>
<td>&gt;200 000</td>
</tr>
<tr>
<td>Ordering no.</td>
<td>700189</td>
<td>700055</td>
<td>700076</td>
</tr>
</tbody>
</table>
4. **Design and function**

All the valves are closed in the currentless execution. Closing of the valves is guaranteed by a strong readjusting spring. The very short closing times are within a range of <25 ms. The indicated connections for small flange connections acc. to DIN 28 403 allow for shortest assembly times. All the construction materials have low degassing factors. The operating position is optional. The maximum counterpressure is 50 mbar.

5. **Preparation for operation**

The valve has to be unpacked first of all. Then it has to be checked for completeness and external damages. The protecting caps have to be removed as well as to be attached to the vacuum plant using the fixing elements acc. to DIN 28 403. (Please consider the flow direction!) If the vacuum plant is equipped with other flanges, special transition pieces will have to be used. The electric connection has to be realized acc. to the coil type. This should be done only by an electrician acc. to the valid VDE 0105 - standards and regulations of CEI and VDE.

6. **Elimination of failures**

<table>
<thead>
<tr>
<th>Failure</th>
<th>possible reason</th>
<th>Elimination of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve does not open.</td>
<td>• Valve not being under pressure.</td>
<td>• Check electric connection.</td>
</tr>
<tr>
<td></td>
<td>• Counterpressure too high.</td>
<td>• Lower the pressure.</td>
</tr>
<tr>
<td>Valve does not close</td>
<td>• Spring pressure too low.</td>
<td>• Change spring.</td>
</tr>
<tr>
<td>properly.</td>
<td>• Sealing edge damaged.</td>
<td>• Change component.</td>
</tr>
<tr>
<td></td>
<td>• Sealing edge contaminated.</td>
<td>• Clean component.</td>
</tr>
<tr>
<td></td>
<td>• Valve disk damaged.</td>
<td>• Change component.</td>
</tr>
<tr>
<td></td>
<td>• Counterpressure too high.</td>
<td>• Lower the pressure.</td>
</tr>
</tbody>
</table>
7. **List of spare parts**

<table>
<thead>
<tr>
<th>consec. no.</th>
<th>name</th>
<th>no. of pcs.</th>
<th>for VA 6 M</th>
<th>for VA 10 M</th>
<th>for VA 16 M</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ordering no.</td>
<td>Ordering no.</td>
<td>Ordering no.</td>
</tr>
<tr>
<td>1</td>
<td>magnetic coil</td>
<td>1</td>
<td>827450/0-4</td>
<td>827450/0-4</td>
<td>827450/0-4</td>
</tr>
<tr>
<td>2</td>
<td>connection no. 1</td>
<td>1</td>
<td>720307</td>
<td>710244</td>
<td>720098</td>
</tr>
<tr>
<td>3</td>
<td>connection no. 2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>720099</td>
</tr>
<tr>
<td>4</td>
<td>O-ring</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>829291</td>
</tr>
<tr>
<td>5</td>
<td>valve head</td>
<td>1</td>
<td>720305</td>
<td>-</td>
<td>720100</td>
</tr>
<tr>
<td>6</td>
<td>valve disk</td>
<td>1</td>
<td>720101/1</td>
<td>720101/2</td>
<td>720101</td>
</tr>
</tbody>
</table>

**Diagram:**

1. Magnetic coil
2. Connection no. 1
3. Connection no. 2
4. O-ring
5. Valve head
6. Valve disk
Installation, Operating, and Maintenance Instructions
Series 26.3, DN 16 - 63 (5/8“ - 2""

HV Angle Valve
• with manual actuator
• with pneumatic actuator
  single acting with closing spring (NC)

This manual is valid for the valve ordering numbers:
26324-KA/E01/11/21/31/41/71/81
26328-KA/E01/11/21/31/41/71/81
26332-KA/E01/11/21/31/41/71/81
26334-KA/E01/11/21/31/41/71/81
26336-QA/E01/11/21/31/41/71/81

The respective product identification is given on each valve in the following or similar way:

STOP
Read these «Installation, Operating and Maintenance Instructions» and the enclosed «General Safety Instructions» carefully before you start any other action.

Intended Use of Product

Use product for vacuum applications under the conditions indicated in chapter «Technical data» only!
Other applications are only allowed with the written permission of VAT.
Installation, Operating, and Maintenance Instructions
Series 26.3, DN 16 - 63 (5/8" - 2 1/2")

Technical data

Pressure range: open and closed in closing direction 1 x 10⁻⁸ mbar to 5 bar (abs)

Differential pressure on the plate in opening direction
Valve with manual actuator
DN 16 - 25: ≤ 5 bar
DN 40 - 50: ≤ 3 bar
DN 63: ≤ 2 bar

Valve with pneumatic actuator
DN 16 - 63: ≤ 2 bar

Differential pressure at opening
≤ 1.2 bar in either direction

Admissible Temperature
Valve body ≤ 150°C
Actuator ≤ 150°C
Position indicator ≤ 80°C (option: 150°C)
Solenoid ≤ 80°C

Position indicator Contact rating 5 A / 250 V AC, 3 A / 50 V DC
Solenoid Voltage see tag on solenoid

Further data according to catalogue «VAT Vacuum Valves 2000».

Installation

Admissible forces

<table>
<thead>
<tr>
<th>DN (nom. I.D.)</th>
<th>Axial tensile or compressive force «F_A»</th>
<th>Bending moment «M»</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>inch</td>
<td>N</td>
</tr>
<tr>
<td>16</td>
<td>5/8</td>
<td>25</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td>70</td>
</tr>
<tr>
<td>40</td>
<td>1 1/2</td>
<td>100</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
<td>150</td>
</tr>
<tr>
<td>63</td>
<td>2 1/2</td>
<td>200</td>
</tr>
</tbody>
</table>

A combination of both forces «F_A» and «M» is not allowed. Please contact VAT in this case.

Compressed air connection

Connect compressed air only if
- valve is installed into the vacuum system
- moving parts cannot be touched

Valve is closed by a spring if air pressure is lost.

Connection: internal thread R 1/8" (1/8" NPT for USA)
Compressed air pressure (min. - max. overpressure): 4 - 8 bar / 60 - 115 psig
Use only clean, dry or slightly oiled air!
Electrical connection

Do not touch electrical parts under voltage!

Connect electrical power only if
- valve is installed into the vacuum system
- moving parts cannot be touched

Verify that control voltage matches voltage stated on the solenoid!

Sockets for position indicator and solenoid are supplied with the valve.

Wiring diagrams:

**Solenoid**

![Solenoid Wiring Diagram]

MV = coil of solenoid

**Common plug for solenoid and position indicator (option)**

![Common Plug Wiring Diagram]

Lo = position indicator «open»
Lg = position indicator «closed»
MV = coil of solenoid

**Position indicator «open/closed»**

![Position Indicator Wiring Diagram]

Lo = position indicator «open»
Lg = position indicator «closed»

**Position indicator «closed»**

Prepare cable:

1. Slide pull relief on cable
2. Join strands by soldering
3. Slide pull relief on position indicator and tighten
4. Screw pull relief with position indicator on valve

Connect cable:

![Connect Cable Diagram]
Installation, Operating, and Maintenance Instructions

Series 26.3, DN 16 - 63 (5/8“ - 2 1/2“)

Operation

Normal operation
Valve with manual actuator: by turning the knob
Valve with pneumatic actuator: - valve is closed by a spring (NC)
- valve is opened pneumatically

Admissible temperature
See «Technical data»!

Compressed air failure
Valve closed: Valve remains closed and leaktight
Valve open: Valve closes

Power failure
Valve is closed by a spring.

Emergency operation at power failure
Option: Solenoid with emergency operation (slotted screw)
Compressed air must be available!

To open valve: Turn slotted screw clockwise to its stop

Attention!
Remote operation is only possible if the slotted screw is turned counter-clockwise to its stop

Preventive Maintenance
Under clean operating conditions, the valve does not require any maintenance during the specified cycle life.

Trouble Shooting
Valve does not open: Power available?
Compressed air available?
Check voltage!
Check air pressure!

Valve does not close: Emergency operation (slotted screw) turned counter-clockwise to its stop?
Spare Parts / Accessories

Solenoid kit: **standard**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>43/81</td>
<td>Solenoid</td>
<td>N-7501-312-</td>
</tr>
<tr>
<td>43/82</td>
<td>Nipple R 1/8&quot;</td>
<td>N-7604-110</td>
</tr>
<tr>
<td>43/83</td>
<td>Plug</td>
<td>N-8501-300</td>
</tr>
<tr>
<td>43/84</td>
<td>Coil</td>
<td>N-7510-</td>
</tr>
</tbody>
</table>

Solenoid kit: **with emergency operation (option)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>43/81</td>
<td>Solenoid</td>
<td>N-7501-311-</td>
</tr>
<tr>
<td>43/82</td>
<td>Nipple R 1/8&quot;</td>
<td>N-7604-110</td>
</tr>
<tr>
<td>43/83</td>
<td>Plug</td>
<td>N-8501-300</td>
</tr>
<tr>
<td>43/84</td>
<td>Coil</td>
<td>N-7510-</td>
</tr>
</tbody>
</table>

Position indicator kit: **open/closed (standard)**

<table>
<thead>
<tr>
<th>DN</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Kit</td>
<td>80419-R1</td>
</tr>
<tr>
<td>25</td>
<td>Kit</td>
<td>80529-R1</td>
</tr>
<tr>
<td>40</td>
<td>Kit</td>
<td>80530-R1</td>
</tr>
<tr>
<td>50</td>
<td>Kit</td>
<td>80531-R1</td>
</tr>
<tr>
<td>63</td>
<td>Kit</td>
<td>80532-R1</td>
</tr>
<tr>
<td>all</td>
<td>Plug (42/76)</td>
<td>N-8504-002</td>
</tr>
</tbody>
</table>

Position indicator kit: **closed**

<table>
<thead>
<tr>
<th>DN</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>all</td>
<td>Kit</td>
<td>80591-R1</td>
</tr>
</tbody>
</table>

Position indicator kit: **open/closed with common connector for position indicator and solenoid (option)**

<table>
<thead>
<tr>
<th>DN</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Kit</td>
<td>82575-R1</td>
</tr>
<tr>
<td>25</td>
<td>Kit</td>
<td>82576-R1</td>
</tr>
<tr>
<td>40</td>
<td>Kit</td>
<td>82569-R1</td>
</tr>
<tr>
<td>50</td>
<td>Kit</td>
<td>82577-R1</td>
</tr>
<tr>
<td>63</td>
<td>Kit</td>
<td>82578-R1</td>
</tr>
<tr>
<td>all</td>
<td>Plug (42/76)</td>
<td>N-8504-002</td>
</tr>
</tbody>
</table>

*Specify voltage! (e.g. 81737-R1-220 V, 50 Hz)
Installation, Operating, and Maintenance Instructions
Series 26.3, DN 16 - 63 (5/8" - 21/2")

The item numbers refer to the drawing on page 6

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>DN</th>
<th>Part No.</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>28/21</td>
<td>Bellows complete for valve with manual actuator</td>
<td>16</td>
<td>79308-R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>79321-R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>79257-R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>50</td>
<td>79129-R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>63</td>
<td>79204-R1</td>
<td></td>
</tr>
<tr>
<td>28/21</td>
<td>Bellows complete for valve with pneumatic actuator</td>
<td>16</td>
<td>79068-R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>79296-R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>79260-R1</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>50</td>
<td>79126-R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>63</td>
<td>79203-R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seal kit, consisting of:</td>
<td>16</td>
<td>82058-R1</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>- Item 28/51 (plate seal)</td>
<td>25</td>
<td>81775-R1</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>- Item 60 (bonnet seal)</td>
<td>40</td>
<td>81771-R1</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td></td>
<td>50</td>
<td>81767-R1</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td></td>
<td>63</td>
<td>81763-R1</td>
<td></td>
</tr>
<tr>
<td>28/51</td>
<td>Plate seal (O-ring)</td>
<td>16</td>
<td>N-5100-112</td>
<td>12.37 x 2.62</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>N-5100-211</td>
<td>20.22 x 3.53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>N-5100-220</td>
<td>34.52 x 3.53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50</td>
<td>N-5100-327</td>
<td>43.82 x 5.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>63</td>
<td>N-5100-331</td>
<td>56.52 x 5.33</td>
</tr>
<tr>
<td>60</td>
<td>Bonnet seal (O-ring)</td>
<td>16</td>
<td>N-7100-022</td>
<td>25.12 x 1.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>N-7100-028</td>
<td>34.65 x 1.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>N-7100-033</td>
<td>50.52 x 1.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50</td>
<td>N-7100-037</td>
<td>63.22 x 1.78</td>
</tr>
<tr>
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Replacement of vacuum seals
The item numbers refer to the drawing on page 6

Removal of "actuator/plate assembly"
- Remove screws (28/42) and cover (28/33)
  - Do not loosen the nut (28/44). ! Loaded spring !
- We recommend to open the valve by means of compressed air, if available.
- Loosen screws (28/41) uniformly in crosswise order and remove the screws.
- Withdraw "actuator/plate assembly" carefully from the valve body.
- The "actuator/plate assembly" from valves with manual actuator can be withdrawn after the screws (28/41) have been removed.

Replacement of plate seal
Stick a needle in to the O-ring (28/51) at the slot of the groove and withdraw the O-ring from the groove
  - Be careful not to damage the sealing surface !
Check the sealing surface and clean it with alcohol
Put the new O-ring on to the groove an press it at four places, crosswise in to the groove
Press the whole o-ring uniformly into the groove

Installation of "actuator/plate assembly"
- Check and clean sealing surfaces of bonnet and seat
- Put bonnet seal (O-ring 60) into the body
- Insert the "actuator/plate assembly" carefully centered. Do not tilt the insert.
- Tighten screws (28/41) uniformly in crosswise order in 2 or 3 steps
- Close the valve now if you had opened it by means of compressed air.
- Reassemble cover (28/33) and screws (28/42). (For valves with pneumatic actuator only.)
- Perform function and leak test

Repairs
Contact VAT for repairs or maintenance. The fabrication No. (263 . . . . . . . . . . . . . . . . / . . . . ) given on the valve has always to be specified. It is individually decided whether the repair can be performed by the customer or has to be carried out by VAT.

Disconnect all supplies (e. g. compressed air, electrical power) for removal/installation of the valve from/into the system before doing any repair.

Even with disconnected supply, loaded springs and/or air cushions in cylinders are potential hazards.

Keep fingers and objects away from the valve openings!

Products returned to VAT for repair have to be free of harmful substances such as e.g. toxical, caustic or microbiological ones. For radioactively contaminated products fill in the VAT form «Contamination and Radiation Report» and send it with the product. The form is available at VAT. The maximum permissible values indicated in the form must not be exceeded.
Warranty

Each product sold by VAT Vakuumventile AG (VAT) is warranted to be free from the manufacturing defects that adversely affect the normal functioning thereof during the one-year period immediately following delivery thereof by VAT, provided that the same is properly operated under conditions of normal use and that regular, periodic maintenance and service is performed or replacements made, in accordance with the instructions provided by VAT. The foregoing warranty shall not apply to any product or component that has been repaired or altered by anyone other than an authorized VAT representative or that has been subject to improper installation or abuse, misuse, negligence or accident. VAT shall not be liable for any damage, loss, or expense, whether consequential, special, incidental, direct or otherwise, caused by, arising out of or connected with the manufacture, delivery (including any delay in or failure to deliver), packaging, storage or use of any product sold or delivered by VAT shall fail to conform to the foregoing warranty or to the description thereof contained herein, the purchaser thereof, as its exclusive remedy, shall upon prompt notice to VAT of any such defect or failure and upon the return of the product, part or component in question to VAT at its factory, with transportation charges prepaid, and upon VAT's inspection confirming the existence of any defect inconsistent with said warranty or any such failure, be entitled to have such defect or failure cured at VAT's factory and at no charge therefor, by replacement or repair of said product, as VAT may elect. VAT MAKES NO WARRANTY OR REPRESENTATION OF ANY KIND, EXPRESS OR IMPLIED, (INCLUDING NO WARRANTY OR MERCHANTABILITY), EXCEPT FOR THE FOREGOING WARRANTY AND THE WARRANTY THAT EACH PRODUCT SHALL CONFORM TO THE DESCRIPTION THEREOF CONTAINED HEREIN, and no warranty shall be implied by law.

Furthermore, the «Terms of sale» at the back of the price list are applicable.
EVG 501 Uni Maryland
SN:S020013

Exploding Plans EVG 501

Table of Contents

Universal cover EV501
Handling tool with safety lock
Tool kit for 6" pin exchange
6" Heater Exchange Unit - 4 circuits
Clamping unit for EV501
Base unit for EV501
Flag pulling mechanism
4" Bond chuck Top
6" Bond chuck Top
4" Field electrode
6" Field electrode
Backview
Footprint
Bond chuck anodic
vacuum groove 92.5mm
glass clamping (soft spring)
flags 50microns
electrode CU5000114 (stainless steel)
electrode CU5000113 (graphite)
Bondglass 2060575

PROPRIETARY AND CONFIDENTIAL

BILL OF MATERIALS: CU5000107

EV Group E. Thallner GmbH
A-4780 Schärding, St. Florian

BOND CHUCK 4" W.
FLAGS - STAINLESS
Bond chuck anodic
vacuum groove 139.0mm
direct clamping (soft spring)
flags 50microns
electrode CU5000117 (stainless steel)
electrode CU5000116 (graphite)

PROPRIETARY AND CONFIDENTIAL

BOND CHUCK 6'' W.
FLAGS - STAINLESS

EV Group E. Thallner GmbH
A-4780 Schärding, St. Florian

BILL OF MATERIALS: CU5000115
060675 (4pcs)
11050149 (4pcs)
061617 (2pcs)
060876
060911
Topside View of EV501 Base Unit

- Levelling feet
- Free area for vacuum equipment
- Control unit height 12 units

Dimensions:
- 1160.0 mm (45.6"")
- 550.0 mm (21.6"")
- 480.0 mm (18.1"")
- 400.0 mm (15.7"")
- 300.0 mm (11.8"")
- 550.0 mm (21.6"")
- 394.0 mm (15.5"")
- 1710 mm (67.3"")
- 14.00 mm (0.55")

EV Group E. Thallner GmbH
A-4780 Schärding, St. Florian

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