NGISE 10
Ion Source Power Supply

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Please note: Some components described in this manual may be optional. The delivery volume depends on the ordered configuration.

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Please note: This documentation is available in English only.

Attention: Please read the safety information on pages 7 and 8 before using the instrument.

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<th>Related Manuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISE 10 Sputter Ion Source</td>
</tr>
<tr>
<td>ISE RC IEEE Interface</td>
</tr>
</tbody>
</table>

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1. Introduction

NORMAL USE

The NGISE 10 control unit supplies all voltages necessary for operating the sputter ion source ISE 10.

The NGISE 10 shall always be used in combination with an ISE 10 system consisting of

ISE 10 sputter ion source
NGISE 10 ion source power supply

The NGISE 10 shall always be used

- with original cable sets which are explicitly specified for this purpose
- with all cabling connected and secured, if applicable
- with all electronics equipment switched on
- in an indoor research laboratory environment
- by personnel qualified for operation of delicate scientific equipment
- in accordance with all related manuals.

Please note: CE compliance for a combination of certified products can only be guaranteed with respect to the lowest level of certification. Example: when combining a CE-compliant instrument with a CE 96-compliant set of electronics, the combination can only be guaranteed CE 96 compliance.

Warning: Lethal Voltages!!

Adjustments and fault finding measurements as well as installation procedures and repair work may only be carried out by authorised personnel qualified to handle lethal voltages.

All connectors which were originally supplied with fixing screws must always be used with their fixing screws attached and tightly secured.

Attention: Please read the safety information in the relevant manual(s) before using the instrument.
CONDITIONS OF CE COMPLIANCE

OMICRON instruments are designed for use in an indoor laboratory environment. For further specification of environmental requirements and proper use please refer to your quotation and the product related documentation (i.e. all manuals, see individual packing list).

The OMICRON NGISE 10 complies with CE directives as stated in your individual delivery documentation if used unaltered and according to the guidelines in the relevant manuals.

Limits of CE Compliance

This compliance stays valid if repair work is performed according to the guidelines in the relevant manual and using original OMICRON spare parts and replacements.

This compliance also stays valid if original OMICRON upgrades or extensions are installed to original OMICRON systems following the attached installation guidelines.

Exceptions

Omicron cannot guarantee compliance with CE directives for components in case of

- changes to the instrument not authorised by OMICRON, e.g. modifications, add-on's, or the addition of circuit boards or interfaces to computers supplied by OMICRON.

The customer is responsible for CE compliance of entire experimental setups according to the relevant CE directives in case of

- installation of OMICRON components to an on-site system or device (e.g. vacuum vessel),
- installation of OMICRON supplied circuit boards to an on-site computer,
- alterations and additions to the experimental setup not explicitly approved by OMICRON even if performed by an OMICRON service representative.

Spare Parts

Omicron spare parts, accessories and replacements are not individually CE labelled since they can only be used in conjunction with other pieces of equipment.
2. Safety Information

Important:

- Please read this manual and the safety information in all related manuals before installing or using the electronics equipment.
- The safety notes and regulations given in this and related documentation have to be observed at all times.
- Check for correct mains voltage before connecting any equipment.
- Do not cover any ventilation slits/holes so as to avoid overheating.
- The NGISE 10 may only be handled by authorised personnel.

Warning: Lethal Voltages!!

Adjustments and fault finding measurements may only be carried out by authorised personnel qualified to handle lethal voltages.

- Lethal voltages may present at open output connectors during operation.
- Lethal voltages are present inside the power supply.

Always

- All connectors which were originally supplied with fixing screws must always be used with their fixing screws attached and tightly secured.
- Always disconnect the mains supplies of all electrically connected units before
  - opening the vacuum chamber or a control unit case,
  - touching any cable cores or open connectors.
- Leave for a few minutes after switching off for any stored energy to discharge.
This product is only to be used:

- indoors, in laboratories meeting the following requirements:
  - altitude up to 2000 m,
  - temperatures between 5°C / 41°F and 40°C / 104°F (specifications guaranteed between 20°C / 68°F and 25°C / 77°F)
  - relative humidity less than 80% for temperatures up to 31°C / 88°F (decreasing linearly to 50% relative humidity at 40°C / 104°F)
  - pollution degree 1 or better (according to IEC 664),
  - overvoltage category II or better (according to IEC 664)
  - mains supply voltage fluctuations not to exceed ±10% of the nominal voltage
3. Technical Description

Front Panel

![Front Panel Diagram]

Figure 1. Front panel layout, schematically.

<table>
<thead>
<tr>
<th>MAINS ON</th>
<th>Push-button switch with optical status indicator.</th>
</tr>
</thead>
<tbody>
<tr>
<td>REMOTE (optional)</td>
<td>Indicates remote control when lit (optional).</td>
</tr>
</tbody>
</table>

| ELECTRON EMISSION | 2 push-buttons: UP and DOWN Arrows. Depression of the push-button UP selects the next higher emission current value. Depression of the push-button DOWN selects the next lower emission current value. If one of the two push-buttons is held down, the instrument automatically steps through all possible emission current values until it reaches the maximum or the minimum value. The two push-buttons are effective only in the mode OPERATE. The selected value of the emission current is indicated: 0 mA)*, 0.01 mA, 0.03 mA, 0.04 mA, 0.1 mA, 0.3 mA, 0.4 mA, 1 mA, 3 mA, 4 mA, 10 mA. *) Note: 0 mA only available via IEC bus. |

<table>
<thead>
<tr>
<th>FIL</th>
<th>FAIL</th>
<th>The LED flashes if the connection to the filament of the ion source is interrupted, if the filament itself is defective and in STANDBY mode.</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE LIMIT</td>
<td>The LED flashes if the set emission current cannot be reached.</td>
<td></td>
</tr>
</tbody>
</table>

| FILAMENT CONTROL | 4 push-buttons with LEDs: STANDBY, OPERATE, DEGAS and HV ON. The required operation mode can be selected by depressing one of the 4 push-buttons. |
### DEGAS
Starts the automatic degas program. In DEGAS mode a voltage of about +700 V is connected to the anode of the ion source. During the program the ↑ and ↓ buttons as well as HV ON are disabled. To interrupt the degas program press STAND BY. Note that the DEGAS mode is not suitable for continuous operation.

### HV ON
This push-button switches on or off the high voltages. It is not effective in the operating mode DEGAS.

### STAND BY
Switches off all high voltages and sets the filament current to \( I_{\text{FIL}} = 3 \, \text{A} \). The FIL FAIL button flashes as long as the instrument is in the STANDBY mode.

### OPERATE
Increases the filament current until the preset emission current is reached. The FIL FAIL button flashes if the emission regulator reaches the filament current limit in the mode OPERATE.

### ENERGY
Ten-turn potentiometer for the selection of the ion energy. Range: 0 to 5 keV. The current \( I_E \) supplied by the ENERGY power supply is equal to the sum of the ion current and the leakage current through the insulators. Therefore for low leakage currents, \( I_E \) gives information about the pressure \( p_{\text{ISE}} \). \( I_E \) can be read from the panel meter of the ion source power supply ENERGY (V / µA button in position µA, i.e. LED on).

### EXTRACTOR
Ten-turn potentiometer for the selection of the EXTRACTOR voltage. Range: 0% to 100% of the voltage selected with potentiometer ENERGY.

### FOCUS
Ten-turn potentiometer for the selection of the FOCUS voltage. Range: 0% to 100% of the voltage selected with potentiometer ENERGY.

### EXTRACTENERGY
One of the 3 HV modules (ENERGY, EXTRACTOR or FOCUS) can be connected to the digital display. The buttons start flashing if the output voltage of the corresponding HV module cannot be reached (mismatch > 50 V).

### V/µA
The switch V/µA is used to select whether the output voltage or the output current of the previously selected HV module is to appear on the digital display. Position is "V" if the LED is off, position is "µA" if the LED is on.
**Back Panel**

![Back Panel Diagram](image)

Figure 2. Back panel layout, schematically. The IEC Bus board is optional.

Inputs/Outputs at the back panel:

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>POWER</td>
<td>Mains input socket and fuses (1 A for 230 V, 2 A for 115 V).</td>
</tr>
<tr>
<td>C</td>
<td>High-voltage socket. A1 = FOCUS, A2 = EXTRACTOR, B1 = REPELLER, B2 = ANODE,</td>
</tr>
<tr>
<td>B</td>
<td>C1 = FILAMENT (-), C2 = FILAMENT (+).</td>
</tr>
</tbody>
</table>
4. Module Specifications

The module positions are counted from left to right when the instrument is viewed from the rear. Positions 1 to 4 carry the HV modules, position 5 holds the emission regulation module. The computer interface can be inserted in position 6. Position 7 holds the power supply module.

![Diagram of NGISE 10 layout, top view, schematically.]

Figure 3. NGISE 10 layout, top view, schematically.

<table>
<thead>
<tr>
<th>1 (empty)</th>
<th>2 (empty)</th>
<th>3 FOCUS voltage.</th>
<th>4 EXTRACTOR voltage.</th>
<th>5 ENERGY HV = ion acceleration voltage.</th>
<th>6 EMISSION REGULATION module.</th>
<th>7 computer interface (optional).</th>
<th>8 POWER SUPPLY module.</th>
<th>9 BUS board</th>
<th>10 CONTROL board.</th>
</tr>
</thead>
</table>

Table 2. NGISE 10 slot definition.
**CONTROL, BUS**
The CONTROL and BUS boards provide the contact between the front panel and the other modules.

**ENERGY, EXTRACTOR, FOCUS**
Output voltage 0.5 V to +5 kV with respect to ground. Maximum output current 300 µA. Stability 0.1 %/°C. Reproducibility 1 %, meter accuracy ±1 digit. Ripple < 0.1 V eff.

**EMISSION REGULATION**
Reference voltage: -10.00 V with respect to filament centre voltage, max current 2 mA.
Anode voltage: -120 V with respect to energy, max current 12 mA.
Repeller voltage: -80 V with respect to negative output of the anode voltage supply, current max 1 mA.
Filament supply: max +13.5 V, filament centre voltage with respect to the negative output of the anode voltage supply. Maximum current 5.5 A. The filament heating power is regulated via the emission current regulator (IC201) and the opto-coupler (IC103).
Stability: ±2% / h

**INTERFACE**
Slot for optional computer interface with IEC-BUS socket.

**POWER SUPPLY**
Input: 200 - 240 V / 100 - 120 V / 150 VA, 50 - 60 Hz

**Housing**
19" chassis, 82 units wide, 3 units high, 430 mm deep, weight: 12 kg.

**Fuses**

<table>
<thead>
<tr>
<th>Fuses, back panel (MAINS supply)</th>
<th>2 x 1 A, slow, for 230 V</th>
<th>2 x 2 A, slow, for 115 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuses EMISSION REGULATION board</td>
<td>1 x 50 mA, medium-slow</td>
<td>1 x 6.3 A slow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 x 500 mA slow</td>
</tr>
<tr>
<td>Fuses POWER SUPPLY board</td>
<td>2 x 2 A, slow</td>
<td>4 x 1 A slow</td>
</tr>
</tbody>
</table>

**Figure 4.** Socket and connections of ISE 10 as seen from atmospheric side. 1: Repeller, 2: Focus, 3: Extractor, 4: Anode, 5: Filament(-), 6: Filament (+).
5. Electronics

The ion source power supply can be divided into 8 modules, see figure 3. The functions of the various modules are described in the following sections.

POWER SUPPLY Board

The POWER SUPPLY board (figure 3, position 7) generates all DC voltages delivered to the other boards. It contains fixed voltage regulators.

The power supply delivers the following DC voltages:

<table>
<thead>
<tr>
<th>DC Voltage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+24 V (IC1)</td>
<td>Supply for HV modules.</td>
</tr>
<tr>
<td>+15 V (IC2)</td>
<td>Supply for HV modules and operational amplifiers on the CONTROL board.</td>
</tr>
<tr>
<td>-15 V (IC3)</td>
<td>Supply for HV modules and for operational amplifiers on the CONTROL board.</td>
</tr>
<tr>
<td>+5 V (IC4)</td>
<td>Supply for digital display.</td>
</tr>
<tr>
<td>+5 V (IC5)</td>
<td>Supply for digital electronics.</td>
</tr>
<tr>
<td>+5 V (IC6)</td>
<td>Supply for computer interface.</td>
</tr>
</tbody>
</table>

CONTROL Unit

The CONTROL Unit consists of a digital section and an analogue section and is located on the CONTROL board behind the front panel of the ion source power supply, see figure 3 (position 8).

Analogue Control

One functional element of the analogue control part is the +10 V reference voltage source (IC4). Switching the high voltage off or on leads to the following connections:

| HIGH VOLTAGE OFF | relay K1 is not energised | potentiometer ENERGY is short-circuited |
| HIGH VOLTAGE ON  | relay K1 is energised      | reference voltage is connected to potentiometer ENERGY |

The signal extracted at the wiper of potentiometer ENERGY (ENERGY setpoint) is available at the output of buffer IC5 (Tp2) for control of the HV module ENERGY and as an input to the potentiometers EXTRACTOR and FOCUS.

The voltages available at the wipers of potentiometers EXTRACTOR and FOCUS are available at the outputs of the buffers (Tp3, Tp4) as the signals EXTRACTOR setpoint and FOCUS setpoint for driving the corresponding HV modules. The range of the control
voltages is 0 to +10 V, where +10 V corresponds to an output voltage of +5 kV from the HV module.

The digital displays receive the necessary +5 V supply voltages via the ribbon cable St1.

The HV modules provide **monitor voltages (0 to +10 V) which are proportional to their output voltages**. With the switch (V / µA) in position "V" (LED off) these can be connected to the input of the digital display using the front panel buttons ENERGY, EXTRACTOR and FOCUS.

The HV modules also provide **monitor voltages (0 to +10 V) which are proportional to their output currents**. With the switch (V / µA) in position "µA" (LED on) these can be connected to the input of the digital display using the front panel buttons ENERGY, EXTRACTOR and FOCUS.

**Analogue Control Signals**

The analogue setpoints for the 3 HV modules (ENERGY, EXTRACTOR and FOCUS) are connected to the corresponding connection sockets of the various HV modules via socket Bu II. The two monitor voltages of each of the 3 HV modules are also connected to socket Bu II and passed on to the digital display via the CONTROL board.

**EMISSION REGULATION Unit**

The EMISSION REGULATION Unit is a fan-assisted plug-in module inserted in position 5 of the ion source power supply, see figure 3 on page 12.

The electronics circuits are located on three boards, the POWER board, the EMISSION REGULATION board and the PROTECTION board.

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Please note: disconnect all cables from the HV modules before pulling out the EMISSION REGULATION module.

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**The POWER Board**

The POWER board carries a mains transformer (Tr1) for supplying the various functional groups of the emission regulation. It provides isolation for 5 kV, i.e. the secondary windings are isolated accordingly with respect to the grounded screen winding (transformer pin 6).

The POWER board also carries the power supply circuit for the filament output stage (Gl1, C1) together with the output stage transistor T1.

- The filament voltage is available at pins 1 and 2. The reference potential for the emission regulator (located on the EMISSION REGULATION board) is generated using a voltage divider (resistors R1, R2).
- The filament current flows through resistor R3 and the resulting voltage drop is available at ribbon cable connector St3 (pins 1 and 2) as the actual value of the filament current for the filament current limiter located on the EMISSION REGULATION BOARD.
In the operation mode DEGAS:

- Triac T2 is activated.
- Relay K1 is energised.
- The power supply output voltage is connected to the repeller electrode of the ion source.
- DEGAS power supply circuit (consisting of transformer Tr2, diodes D1 to D4 and capacitor C3 to C4) generates a voltage of approximately +700 V. This voltage is connected to the anode of the ion source via diode D6.

The two 18 V windings of mains transformer supply the ±15 V power supply circuits for the emission regulator (IC3, IC4) and the filament regulator (IC1, IC2). These power supplies are located on the EMISSION REGULATION board.

**The EMISSION REGULATION Board**

The EMISSION REGULATION board carries the ±15 V power supplies for the emission regulator (St5 = +15 V, St6 = -15 V) and for the filament regulator (St3 = +15 V, St4 = -15 V). The -10 V reference voltage is generated with operational amplifier IC5 and can be adjusted with trim potentiometer P1.

As the reference potentials of the filament regulator and emission regulator are not identical, the reference potential of the filament regulator and all voltages which are referred to this are designated with "x". The reference potential of the emission regulator and all voltages which are referred to this are designated with "xx". The EMISSION REGULATION board also carries opto-couplers for the transfer of control signals from the internal control bus (BUS BOARD, see figure 3) to the emission regulation electronics.

The emission regulator consists of

- operational amplifier IC16 (isolating amplifier),
- operational amplifier IC17 (5, 6, 7) which acts as a proportional amplifier,
- operational amplifier IC17 (1, 2, 3) which acts as an integrator and
- operational amplifier IC17 (12, 13, 14) which acts as a summing amplifier.

**In the operation mode STANDBY**

- the proportional amplifier is switched to 0 V by transistors T10 and T19 and
- the integrator is switched to an output voltage of 0 V by transistors T10 and T20;
- the control signals arrive via the opto-coupler and transistor T8.
In order to permit the filament regulator to provide a filament current of 3 A,

- a positive current is connected to the input of the summing amplifier via transistor T9 and resistor R25, such that the output of the summing amplifier has a voltage of about -12 V.
- This drives the diode of opto-coupler IC19 via resistor R48.
- The transistor of the opto-coupler fully activates the output stage transistor via isolating amplifier IC20 (8, 9, 10) and driver transistor T21.
- As the setpoint of the filament current limiter is set to 3 A (P6), the base potential of the driver transistor is stabilised via the output of operational amplifier IC20 (12, 13, 14) and diode D20, such that the filament current is limited to 3 A.

The setpoint for the emission current is provided by appropriate control signals from the internal control bus via opto-couplers IC9 to IC15, driving transistors T12 to T18.

As the emitters of these transistors are connected to the -10 V reference voltage, activation of the transistor causes a negative current to be connected to the sum point of the emission regulator (via the resistor connected to the collector of the transistor). This current represents the setpoint.

**In the operation mode OPERATE**

- the supply voltage for the POWER board is switched on by energising relay K1.
- It generates the anode voltage and the repeller voltage.
- The anode voltage is adjusted using trim potentiometer P2 (+120 V) and the repeller voltage using trim potentiometer P3 (-80 V).
- At the same time, the proportional amplifier and the integrator are enabled and the control signal STANDBY is simultaneously switched off. This means that the input of the summing amplifier no longer receives a current via R25.
- A setpoint for the emission current is also supplied, which means that the sum point at the input of the isolating amplifier IC16 becomes negative. As a result the negative output potential of the isolating amplifier (Tp2) leads to positive output voltages of the proportional amplifier (Tp3) and of the integrator (Tp4).
- The output of the summing amplifier (Tp6) becomes negative and causes the filament regulator to supply a higher filament current (via opto-coupler IC19). As a result the emission current from the ion source filament also increases (= actual value).

When the emission current setpoint is identical to the actual emission current value

- the filament current no longer increases
- 0 V is present at the output of the isolating amplifier (Tp2) and
• the output of the proportional amplifier (Tp3) and the integrator
generate a positive output voltage of a few volts (i.e. the required
control signal for the filament regulator).

If the emission current setpoint differs from the actual emission current value the error
voltage occurring at the output of the proportional amplifier

• activates the threshold detector IC17 (8, 9, 10) as soon as the
threshold value of approximately +6 V is exceeded.

• The threshold value then drives transistor T24 (via opto-coupler
IC18) and the error signal REGULATION appears on the internal
control bus.

• In the operation mode OPERATE the setpoint of the filament
current limiter is increased to 5.5 A (adjustable with trim
potentiometer (P5) via opto-coupler IC21).

When the maximum allowed filament current of 5.5 A is reached

• operational amplifier IC20 (12, 13, 14) is activated and limits the
base potential of the driver transistor T21 such that the output drops
from approximately 13.5 V to a lower value.

• The reduction of the output voltage is detected by the threshold
detector IC20 (1, 2, 3).

• The output of this threshold detector drives transistor T23 via opto-
coupler IC23 such that the error signal CURRENT LIM appears on
the internal control bus.

• The error signal CURRENT LIM is also generated in the operation
mode STANDBY as the operational amplifier IC20 (12, 13, 14) in
this case limits the filament current to 3 A.

If the filament of the ion source is defective or if the connection between the filament
regulator output and the filament is interrupted

• the filament regulator output voltage increases to the maximum
value as there is no emission current.

• This is detected by the threshold detector IC20 (5, 6, 7) the output
of which drives transistor T22 via opto-coupler IC22.

• The error signal CATHODE FAIL appears on the internal control
bus.

In the operation mode DEGAS,

• relay K1 and triac T2 (POWER board) are activated via opto-
coupler IC6 and transistor T7 (EMISSION REGULATION board).

• The contact of relay K1 connects the DEGAS voltage to the repeller
electrode of the ion source.
• Triac T2 switches on transformer Tr2, thus activating the DEGAS voltage of approximately +700 V.

• This connects the anode of the ion gun to a potential of approximately +700 V via diode D6.

The ion source is degassed by slowly increasing the emission current of the ion source. After about three minutes, the DEGAS operation is terminated and the emission current regulation returns to the operation mode STANDBY.

The HV Boards ENERGY, EXTRACTOR and FOCUS

The ion source power supply contains 3 modules for generating the high voltages: ENERGY, EXTRACTOR and FOCUS, see figure 3. The HV modules are plug-in units which are inserted into the instrument from the rear. They are identical except for the clock generator, which is fitted only to the board in position 4 (normally the ENERGY board).

The electronics of the HV module consists of eight functional groups:

Clock Generator

The high voltage clock generator operates as a "step-up converter": it generates a high voltage of up to +5 kV from a regulator adjusted DC input. It is only fitted to one of the HV boards to make it the so-called MASTER MODULE. This must be inserted in position 4 of the instrument. The clock generator is implemented as timer circuit IC8 and supplies a clock frequency of approximately 30 kHz. This clock signal is available at "clock out" for the other 2 HV modules, which have no clock generators.

Push-Pull Output Stage for Driving Transformer Tr1

If the short-circuit plug J1 is inserted

• the respective HV module operates as the MASTER MODULE.

• The clock signal from the clock generator is connected to the input of the flip-flop (IC9).

• This divides the clock frequency by two, which means that a symmetrical clock signal of 15 kHz is available at the flip-flop output (pins 1 and 2) for driving the MOS-FET transistors T6 and T7.

These transistors

• alternately connect the two ends of the primary winding of transformer Tr1 to ground,

• generating an alternating magnetic field in the transformer and

• causing a current to flow (via series transistor T5) in the central tap of the primary winding of Tr1.
**Clock Signal Monitoring**

- The clock signal is connected to transistor T4 via capacitor C16. As long as the clock signal is present the transistor is cut off. If the clock signal disappears T4 conducts and cuts off the series consisting of transistor T5 and driver transistor T3 so that no further energy is connected to the transformer.

- This control circuit prevents the destruction of the transformer in case of a missing clock signal as one of the transistors (T6 or T7) would otherwise conduct continuously and cause a high current to flow through the transformer.

**High-Voltage Multiplier and Filter**

- The high-voltage multiplier consists of diodes D14 to D16 together with capacitors C23 to C28. It magnifies the output voltage from the secondary winding of Tr1 by a factor of 3.

- Coil L1, capacitors C29 to C38 and resistors R92 to R95 smooth the high voltage signal and reduce the residual ripple on the output voltage to a few mV.

- Resistor R96 is connected as an initial load for the high-voltage multiplier in order to improve the regulation characteristics of the HV module.

**High-Voltage Measurement**

- Resistors R72 to R91 and operational amplifier IC3 with the components C5, R12 and R13 form a circuit which supplies a proportional monitor voltage at test point Tp2 (-10 V for an output voltage of +5000 V).

- Operational amplifier IC2 inverts this monitor voltage, so that the signal $U_{mon}$ (+10 V for an output voltage of +5000 V) is available for further processing at ribbon cable connector St1/14a,c.

- The zero point of the monitor voltage is adjusted with trim potentiometer R11.

- The proportionality factor between the HV output and the monitor voltage is adjusted with trim potentiometer R12.

**Regulation Unit**

- The operational amplifier IC1 operates as an error amplifier with a PI characteristics. It compares the output voltage from IC2 to the control voltage at ribbon cable connector St1/6a,c, taking into account the different polarities.

- If there is a deviation between the setpoint and the monitored voltage the error amplifier drives the central tap of transformer Tr1
via IC7, T2, IC6, T3 and T5 such that the difference between the setpoint and the monitor voltage becomes zero.

- The opto-coupler IC6 provides a DC isolation between the output stage and the measuring and regulation unit.

**Error Monitor**

The error monitor is implemented with the two operational amplifiers IC7. It monitors the input of error amplifier IC1.

- If the setpoint and the actual output value are equal the input voltage to the error amplifier is 0 V.
- If the setpoint and the actual value do not agree (e.g. due to rapid setpoint change, high-voltage breakdown, a short circuit at the high-voltage output of the HV module, or a defective regulator), the input voltage of the error amplifier is no longer 0 V.
- If the error input voltage exceeds 100 mV the output HV-FAIL is connected to 0 V by a transistor T1 and the front panel LED of the respective HV board lights up (from 50 V output voltage).

**Current Monitor and Current Limiting**

The HV modules have facilities for measuring and limiting their output current.

- The current through the high-voltage filter (C29 to C38), the measuring resistors (R72 to R91) and the connected load (Bu1) is connected back to transformer Tr1 via resistor R30.
- The voltage drop across R30 is proportional to the current flow. This signal is amplified and inverted by the operational amplifiers IC5 and IC4.
- The zero-level can be adjusted with trim potentiometer R26.
- The gain has been adjusted (trim potentiometer R27) such that a current output monitor voltage of +2 V (ribbon cable connector St1/18a,c) corresponds to an output current of 200 µA (Bu1).
- As the monitor voltage is intended to correspond to the actual current flow at socket Bu1 only, compensation for the current flow through the measuring resistors R72 to R91 is provided by trim potentiometer R19 (adjusted to give a monitor voltage 0 V for an output voltage of +5000 V).
- The current limiting circuit protects the HV module from overloads and short circuits at the output socket and is implemented through operational amplifier IC7. This operational amplifier reads the current output monitor voltage and compares it to a reference voltage (adjustable with trim potentiometer R36). If the monitor voltage reaches the preset threshold the output of IC7 drives the transistor via R38 and D5 such that the output current at socket Bu1
remains constant, i.e. the HV module then operates as a constant current source.
6. Fault Finding Guide

The following sections list some possible faults and describe localisation of the defective components.

**Warning: Lethal Voltages!!**

Adjustments and fault finding measurements as well as installation procedures and repair work may only be carried out by authorised personnel qualified to handle lethal voltages.

As the HV modules in the power supply unit have a maximum output voltage of 5 kV, the +24 V supply of the HV modules is switched off, for safety reasons, by micro switch S1 when the cover of the instrument is removed. The output stages of the HV modules then no longer receive the necessary voltage and supply no high-voltage output. The supply voltages of all other electronic assemblies are still present in order to allow fault finding to be carried out.

If a defect in the ion source power supply is suspected

- Check that the power supply is connected correctly to the ion source.
- Check if mains voltage is present (might be switched off due to interlocks).
- Check the fuses in the fuse holders F1 and F2 (on the rear of the power supply) and the fuse in the EMISSION REGULATION module, see page 13.
- If discharge noise can be heard in the power supply: disconnect the cable from the ion source to make sure the noise is not caused by discharges in the ion source.

**Flashing Buttons at the NGISE 10**

Flashing of the push-buttons on the NGISE 10 front panel may indicate the following faults:

- the respective module cannot reach its preset value.
- the respective module oscillates or sparking occurs (HV short circuits).

**LEDs Do Not Light Up When Push-Buttons Are Pressed**

If depression of a push-button does not cause the instrument to switch to the corresponding state

- Check the push-button and its corresponding inverter (IC2).
If the voltage is present check the outputs of the processor for the selected function.

- A voltage of 0 V must be present at the corresponding output.

If these voltages are not present at the outputs check the processor.

- Measure the voltage at pins 2 and 3 of the processor with an oscilloscope (TP: "ALE").
- There must be a sinusoidal voltage (frequency = 2.5 MHz) with an amplitude of 1.5 Vpp at these pins, the central line of this voltage having a DC voltage level of approximately 2 V.

If this voltage is not present or not correct

- coil L1 or the processor itself is defective.

If the voltages at the processor outputs are correct

- the fault is located in the interface multiplexer (IC8 and IC9 on the BUS BOARD) or one of the LEDs on the FRONT PANEL board is defective.

In order to determine which of the above possibilities is true

- measure the voltage on the corresponding control line (BUS BOARD).
- If there is a voltage of approximately 0 V on the control line the LED is defective.
- Otherwise the fault is located in the respective integrated circuit of the interface multiplexer.

**EMISSION Does Not Operate Correctly**

If the EMISSION REGULATOR does not operate correctly this is signalled by flashing of one of the 3 LEDs IE LIMIT, FIL. FAIL and OPERATE.

If one or more of these LEDs light up

- Disconnect the 6-pin special plug from the ion source power supply.
- Check the voltages and currents at the 6-pin HV socket on the NGISE 10 backpanel.
- The pin assignment of this plug is shown on page 11.

**Attention:** Ensure that all high voltages are switched off before measuring. (LED HV ON must be off and the digital display must indicate 0 V for the HV modules.)

If checks indicate that there is a fault in the EMISSION REGULATOR this module must be removed from the instrument and its top and side covers removed.
• Remove the mounting screws of the upper bar to which the EMISSION REGULATION is connected.

• Loosen the fixing screws on the lower bar to permit the EMISSION REGULATION to be pulled out sideways permitting access for further fault finding.

• Connect the EMISSION REGULATOR via two extension cables to the instrument.

**Checking the Filament Current**

• Depress push-button STANDBY.

• Measure the filament current between socket contacts 5 (FILAMENT -) and 6 (FILAMENT+) with an ammeter (range up to 6 A).

• There must be a filament current of 3 A and the IE LIMIT must be flashing while Fil. FAIL must be off.

• Depress push-button OPERATE.

• The filament current must now rise to 5.5 A, and I_E LIMIT must stop flashing after a few seconds.

**Check of Filament Regulator Output Voltage**

• Depress push-button STANDBY.

• Measure the voltage between socket contacts 5 and 6 with a voltmeter.

• This voltage must be between +10 V and +13.5 V and FIL. FAIL must be flashing.

**Checking the Anode Voltage**

• Depress push-button OPERATE.

• Measure the voltage between socket contact 4 (ANODE) and socket contact 5.

• This voltage must be slightly more than +120 V.

• If the voltage is not present, check the anode power supply on the EMISSION REGULATION board.

**Checking the Repeller Voltage**

• Depress push-button OPERATE.
• Measure the voltage at socket contact 1 (REPELLER) and socket contact 5.

• This voltage should be slightly less than -80 V.

• If the voltage is not present, check the repeller power supply on the EMISSION REGULATION board.

Checking the Degassing Voltage

⚠️ **Warning: Lethal Voltages!!**
Fault finding measurements may only be carried out by authorised personnel qualified to handle lethal voltages.

• Depress push-button DEGAS.

• Measure the voltage between socket 4 (ANODE) or socket 1 (REPELLER) and ground as soon as the LED DEGAS lights up.

• A voltage of approximately +700 V should be present at both output contacts (1 and 4 with respect to 5 and 6)

• If these voltages are not present, check the anode power supply on the POWER board.

HV Modules do not Operate Correctly

If the output voltage of the selected HV module (ENERGY, EXTRACTOR or FOCUS) does not correspond to the actual output voltage (difference larger than 50 V) the corresponding meter select button starts flashing.

• If none of the HV modules operates correctly check the supply voltages (+24 V, +15 V, -15 V) and the voltage setpoints.

• If only one HV module does not operate correctly carry out the following checks on this module.

⚠️ **Warning: Lethal Voltages!!**
Adjustments and fault finding measurements as well as installation procedures and repair work may only be carried out by authorised personnel qualified to handle lethal voltages.
Functional Tests

- Depress the meter select button for the corresponding HV module (e.g. ENERGY) and set the V / µA button to µA (LED on).

If the digital display starts to flash the output current is more than 200 µA and the current limiting circuit has reacted. In order to determine whether there is an external short circuit,

- disconnect the high-voltage cable from the output socket.

If the LED and the digital display continue to flash

- a component in the high-voltage generator is defective.

In order to check this,

- remove the top and bottom covers of the HV module
- and visually inspect the components and the printed circuit board for burnt out resistors or black spots from sparking.

Change from 230 V to 115 V

To change from 230V to 115V two switches and two fuses have to be changed.

1. Remove the top cover (4 screws)

2. Note the micro switch behind the front panel which cuts off the high voltage supply, see page 12.

3. Seven modules are positioned inside the NGISE 10. On module 7 (POWER SUPPLY) a switch is positioned near the bus board. Change the switch setting from "front side" (230V) to "back side" (115V).

4. Unscrew and remove the left back panel cover with the High Voltage sign from the back of the NGISE 10 (4 screws), see figure 2.

5. Unscrew the EMISSION REGULATION module (with the fan and 6-pin socket) (4 screws).

6. Pull out but do not remove the three HV modules and the EMISSION REGULATION module simultaneously.

7. Slide back the top cover of the EMISSION REGULATION module (you may have to remove the two top screws at the back of the module as the spring washers may prevent the lid from sliding back).

8. A switch is positioned near the transformer. Change the switch setting from "back-position" (230V) to "front-position" (115V).

9. Replace the top cover. (If removing all modules from the case in order to facilitate replacing the two back screws: make sure to refit the modules to their initial positions!)
10. Push all modules back in and refit the backpanel covers.

11. Refit the top cover.

12. Remove both 1 A fuses (230V) on the back side of the power supply board and replace with 2 A fuses (115V).

Please note: To change from 115 V to 230 V use the respective switch settings and fuses adopting the procedure above.

Default Status

- Switch on the ISE 10 power supply.
- For about 3 seconds all lights will be switched on.
- The left display shows "8.8.8.8." and the right display shows "8.8.8".
- Subsequently (for another 5 seconds) the left display shows the version number of the power supply, e.g. "1.00". The right display shows whether the supply is dedicated for the ISE 10 ("10") or the ISE 100 ("100").
- If no ion source is connected the push-button lights for ENERGY and STANDBY are on. The button FIL FAIL is flashing.
- If a filament is simulated by connecting pins C1 and C2 at the output connector the push-button IE LIMIT will be flashing.
  This is a normal status. It is not an error signal.
  It only serves as an optical indication for the STANDBY mode. The "filament"-dummy is heated with 3 A.
- If the cover of the power supply is not fitted or by some other reason the micro-switch below the cover does not act properly the high voltage cannot be switched on.
- In this case: if you turn the ENERGY knob by more than "0.2" to the right the light "HV ON" will start flashing.

Attention: Do not forget to restore the HV micro-switch to its proper functionality. Make sure the high voltage is switched off when the lid is removed.
Circuit Diagrams

see pages 30 to 38
Service at Omicron

Should your equipment require service

- Please contact Omicron headquarters or your local Omicron representative to discuss the problem. An up-to-date address list is available on our website under http://www.omicron.de/om-adr.html or via e-mail reply service under contact.info@omicron.de.

- Make sure all necessary information is supplied. Always note the serial number(s) of your instrument and related equipment (e.g. head, electronics, preamp...) of your instrument or have it at hand when calling.

If you have to send any equipment back to Omicron

- Please contact Omicron headquarters before shipping any equipment.

- Place the instrument in a polythene bag.

- **Reuse the original packaging and transport locks.**

- Take out a transport insurance policy.

For ALL vacuum equipment:

- Include a filled-in and signed copy of the "Declaration of Decontamination" form which can be found at the back of the equipment manual.

**STOP**

No repair of vacuum equipment without a legally binding signed decontamination declaration!

- Wear suitable cotton or polythene gloves when handling the equipment.

- **Re-insert all transport locks** (if applicable).

- Cover the instrument with aluminium foil and/or place it in a polythene bag. Make sure no dust or packaging materials can contaminate the instrument.

- Make sure the **plastic transport cylinder** (if applicable) is clean.

- Fix the instrument to its plastic cylinder (if applicable).
Service FAX Reply

To
OMICRON NanoTechnology GmbH
Test and Service Department
Limburger Straße 75
65232 Taunusstein
Germany
Tel: +49 - 61 28 - 987 230
FAX: +49 - 61 28 - 987 33 230

From
......................................................
......................................................
......................................................
......................................................
......................................................
......................................................
......................................................
Tel: ...............................................
FAX: ..............................................

Type of Instrument .................................................................
Serial Number .................................................................
Purchasing Date .................................................................
(Last Service Date .................................................................)

Problem:

Date: .................................................
Signature: ..............................................
Useful OMICRON Contacts

An up-to-date address list is available on our website under

http://www.omicron.de/om-adr.html

or via e-mail reply service under

contact.info@omicron.de.
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