SPECS®

Surface Analysis and Computer Technology

# PU - IQE 12/38

## Manual

Art.No10 995 100

**Version1.4.2**

controller sn = 0038

Manual for the PU- IQE 12/38, model 10 995 100
Version of 15. June 2000
SPECS order for this manual: 78 0000 47.

Chapter

T

# Table of Contents


**1 Introduction 1**

**2 Quick Start 3**

2.1 Preparations ..... 3
2.2 Switching On ..... 4
2.3 Switching Off ..... 4

**3 Description 5**

3.1 System Description PU IQE 12/38 ..... 5
3.1.1 Standard Package List ..... 5
3.1.2 Options List ..... 5
3.1.3 Geometrical Dimensions ..... 5
3.1.4 Operation Conditions ..... 6
3.1.5 Electrical Description ..... 6
3.1.5.1 Input ..... 6
3.1.5.2 Output ..... 6

**4 System Operation 9**

4.1 Frontpanel Operation ..... 9
4.1.1 Display ..... 11
4.1.2 Operation Modes ..... 11
4.1.2.1 First Operation ..... 11
4.1.2.2 Standby Mode ..... 12

4.1.2.3 Degas Mode ..... 12
4.1.2.4 Operate Mode ..... 12
4.1.2.5 The OFF Mode ..... 13
4.1.3 Parameter Menus ..... 13
4.1.3.1 Energy ..... 14
4.1.3.2 Extractor ..... 14
4.1.3.3 Focus1 and Focus2 ..... 15
4.1.3.4 Emission ..... 15
4.1.3.5 POSition X and POSition Y ..... 16
4.1.3.6 Width X and Width Y ..... 16
4.1.3.7 Timer ..... 16
4.1.3.8 Store and Recall ..... 17
4.1.4 Setting up the Power Unit ..... 18
4.1.4.1 Blanking X and Blanking Y ..... 19
4.1.4.2 Time per Dot ..... 19
4.1.4.3 Angles Phi and Theta ..... 20
4.1.4.4 Distances L and M ..... 21
4.1.4.5 Deflection Sensitivities Deflect X and Deflect Y ..... 22
4.1.4.6 Blank Level ..... 22

4.2 Remote Operation ..... 22
4.2.1 RS 232 ..... 23
4.2.2 IEC 488 ..... 23
4.2.3 Commands ..... 23

4.3 Cabling ..... 26

**5 Troubleshooting Procedure 29**

5.1 Possible Problems ..... 29
5.2 Needed Tools ..... 31
5.2.1 Measuring of Output Voltages ..... 31
5.2.1.1 Energy ..... 31
5.2.1.2 Extractor ..... 32
5.2.1.3 Focus 1 ..... 32
5.2.1.4 Focus 2 ..... 32
5.2.1.5 Deflection X1, X2, Y1, Y2 ..... 32
5.2.1.6 Anode, Repeller, Degas ..... 33
5.3 Error Messages and Warnings ..... 33

**6 Electronic Block Diagram 35**

# Chapter 1 Introduction

The Power Unit PU - IQE 12/38 is designed to supply the SPECS ion gun IQE 12/38 or other ion guns based on the same physical working principle. It supplies all voltages necessary for operation of the ion gun, including the scan and deflection voltages. All operational parameters can be controlled with keyboard and jog shuttle as well as via different remote interfaces. These are an IEEE- and a RS 232 - bus interface.
Several sets of operational parameters and setup parameters can be stored and recalled.
The power unit is equipped with mathematical algorithms controlling the positioning of the ion beam to avoid uneven irradiation of oblique sample areas. The parameters are adaptable to a wide range of different experimental conditions.

# Safety Hints

***Before any electric or electronical operations please consult „SPECS Safety Instructions" and follow them strictly.***

The unit supplies high voltages danger to life! You have to respect the following safety hints:

- Check whether your main voltage is the same as adjusted at the main in socket of the Power Unit (visible at the fuse box).
- Use only original cables and connectors from SPECS. Pay attention that no cable has mechanical defects. In case of doubt the cable has to be replaced by a original SPECS cable.
- Before switching on the Power Unit all plugs have to be connected to the corresponding socket.
- After switching off the Power Unit you have to wait at least one minute before opening connections.
- Replace cable or ion source only with the Power Unit switched off.
- Never operate the Power Unit with opened cover.
- If you use cable, ion sources or further equipment other than delivered by SPECS no warranty about the function and safety can be given. In case of doubt please contact the SPECS service department.

Some tests which might have to be carried out according to this manual are hazardous. At each such a point there is a warning label:

*Attention*

***The tests described in the following have to be performed at connectors of the electronic not plugged into the source. Hazardous voltage are present, therefore only persons with the appropriate training are allowed to do the job.***

***Make measurements only with special insulated tools releases for voltages higher that 5 kV.***

# Chapter 2 Quick Start

The Power Unit can be installed in a very easy and straightforward way allowing to see the first results. Nevertheless taking advantage of all benefits supplied of the Power Unit will take more time and requires a careful adjustment of all parameters. The explanation of this more extended way in done in the following chapters. Here the short way is described.

## 2.1 Preparations

1. Mount the source to the vacuum system.
2. Set up Power Unit on a secure place preferable in a 19 inch rack.
3. Connect the ground connector to the other vacuum components or to the rack.
4. Connects and fix all cables:
   - Filament and ionization voltages (plug with 6 connectors)
   - Deflection voltages (plug with 4 connectors)
   - Focus 1 voltage (single line plug)
   - Focus 2 voltage (single line plug)
   - Connect the two HV bridge cable at the back of the Power Unit (no. 11 with no. 13 and no. 10 with no. 12 on page 26.
5. *Check that the adjusted main in of the Power Unit and the present main voltage are identical.*
6. Check the vacuum.
7. Check the parameters as described in "Setting up the Power Unit" on page 18 especially "Angles Phi and Theta" and "Distances L and M" for first operation.

## 2.2 Switching On

If during the following actions an error message appears stop starting the Power Unit immediately. Try to find out what 's wrong with the help of section 5 or contact the SPECS service department.

1. Switch on the Power Unit. Wait some seconds. The Power Unit comes up in the STANDBY mode.
2. Press the EMISSION key to check the filament. The filament currents will regulate to 3 A.
3. All parameters should set to enable the first operation.
   Use stored parameters or set your own. To recall a data set press RECALL followed by a number key 1 to 0.
   If you want to check them press the parameter name parallel to the key 0 to 9. There will be no change by doing it.

   **Attention: If you do not run the source before, please see the instruction "First Operation" on page 11 before you press OPERATE or DEGAS.**

4. Press the OPERATE key. Wait until the emission regulation is stable. This is indicated by a change from the BUSY status to the OPERATE.
5. Open the gas valve in accordance to your ion source manual.
6. An ion current is now leaving the ion source having an energy of 5 keV. With a suitable method to measure the ion current (Faraday cup, positive biased conducting sample etc.) this can be checked.

## 2.3 Switching Off

1. Press OPERATE. The OPERATE mode is left to the STANBY mode.
2. Close the gas valve.
3. Switch off the main switch.

# Chapter 3 Description

## 3.1 System Description PU IQE 12/38

### 3.1.1 Standard Package List

1. This manual, no. 78 0000 47
2. Main cable (german standard), length 250 cm, no. 31 049 105
3. 2 × HV focus cable, length 500 cm, no. 81 000 020
4. 2 × HV bridge cable, length 10 cm, no. 81 000 019
5. Ground cable, length 50 cm, no. 81 000 018

### 3.1.2 Options List

1. US standard options, no. 81 000 01
   consisting of:
   - Main cable (US standard), length 250 cm (98 inch), no. 73 000 042
   - Fuse: 2 × 2.5 A slow blow, no. 52 025 319
2. RS 232 remote cable, length 300 cm, no. 73 000 045
3. IEEE 488 remote cable, length 100 cm, no. 73 000 046

### 3.1.3 Geometrical Dimensions

The PU IQE 12/38 housing is sized for use in a standard 19 inch rack:

- Width: 483 mm
- Height: 132.5 mm (3 HE)
- Length: 494.5 mm
- Weight: approx. 20 kg incl. cable

### 3.1.4 Operation Conditions

- Storage temperature range: -50° C to +70° C
- Operation temperature range: 0° C to +45° C
- Relative humidity: up to 90%
- Warming up time: < 1 min

### 3.1.5 Electrical Description

#### 3.1.5.1 Input

- Main: 230 V AC or 115 V AC ± 10 % (can be switched at the Main plug), 50 / 60 Hz
- Power consumption: < 250 VA
  Fuses:
  - 2 × 1 A slow blow (for 230 V Main)
  - 2 × 2.5 A slow blow (for 115 V Main)

#### 3.1.5.2 Output

The following table shows all voltages generated by the Power Unit and limiting values:

**Table 1: Limiting Values**

| Parameter | $U_{max}$ | $I_{max}$ | Error[a] | Ripple[b] | Settling Time |
|---|---|---|---|---|---|
| Energy | +5kV | 0,2mA | < 1V | 0,25Vss | < 10s |
| Extractor | +5kV | 0,2mA | < 1V | 0,25Vss | < 10s |
| Focus1 | +5kV | 0,2mA | < 1V | 0,25Vss | < 10s |
| Focus2 | +5kV | 0,2mA | < 1V | 0,25Vss | < 10s |
| Repeller | -80V | 1mA | < 5V | 1Vss | < 1s |
| Anode | +120V | 10mA | < 5V | 1Vss | < 1s |
| Degas | +560V | 15mA | < 50V | 50Vss | < 1s |
| Filament | +12V[c] | 5,5A | | 1Vss | |
| Emission | | 15mA[d] | < 5% | | < 1min |
| X-Deflection | +/-650V | 15mA | < 5% | 0,5Vss | |
| Y-Deflection | +/-650V | 15mA | < 5% | 0,5Vss | |
| X-Monitor | +/-10V | 10mA | < 5% | 7mVss | |

**Table 1: Limiting Values**

| Parameter | $U_{max}$ | $I_{max}$ | Error[a] | Ripple[b] | Settling Time |
|---|---|---|---|---|---|
| Y-Monitor | +/-10V | 10mA | < 5% | 7mVss | |
| Blanking | TTL-Signal | | e | | |

a. | actual value- desired value | (statistical deviation)
b. interference voltage + hunting (elec.) (dynamical deviation)
c. depending on the emission current
d. current emitted from the filament
e. position error of the blanking signal which is depending on the number of pixel

The application of the voltages listed in table 1 to the ion source is shown schematically in figure 1.

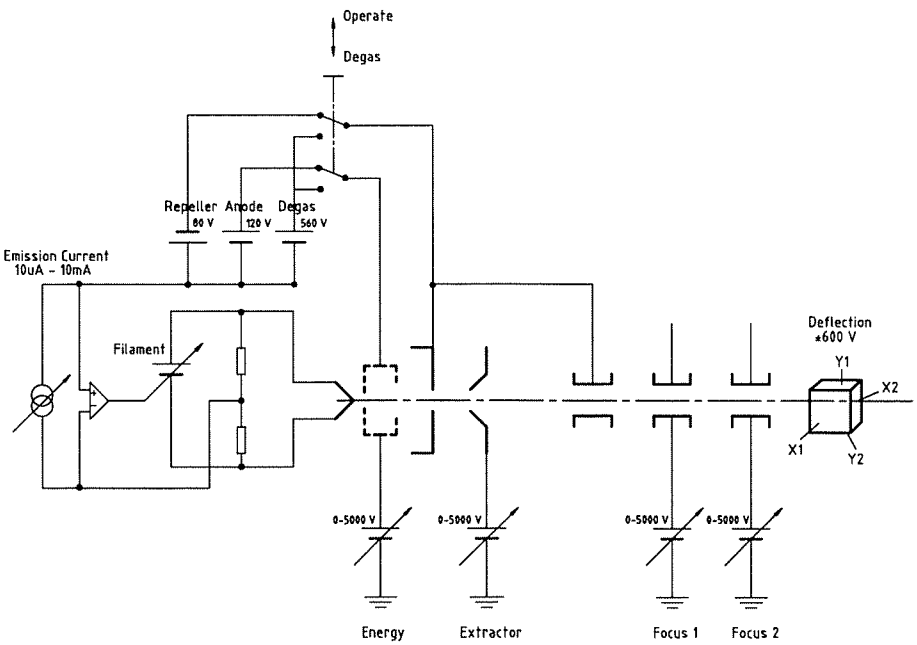



**FIGURE 1** The values of the voltages for repeller, anode and degas are fixed.
Overview of the voltages generated by the PU - IQE 12/38

The voltages applied to the source are connected by two shielded single line high voltage cable for the focus voltages and by two special plugs. The pin assignment of these two plugs is depicted in figure 2 and in figure 3.

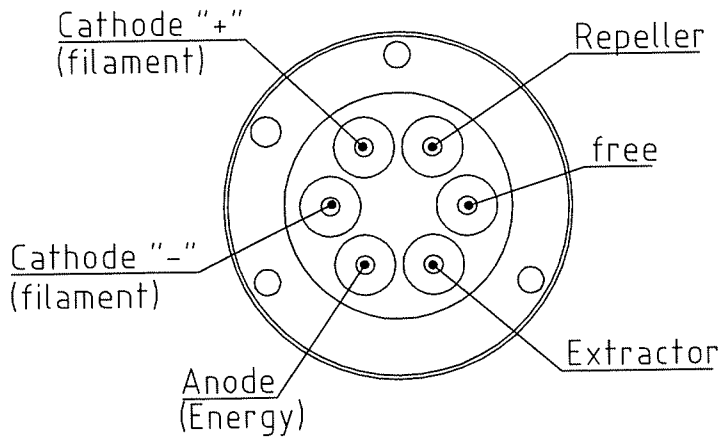



**FIGURE 2** Pin assignment of the HV plug. Shown is the view into the plug at the cable (female) on scale of 1:1.

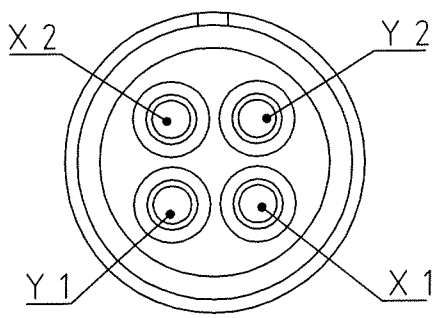



**FIGURE 3** Pin assignment of the deflection plug. Shown is the view into the plug at the cable (female) on scale of 2:1.

# Chapter 4 System Operation

The Power Unit can be operated either directly via frontpanel keyboard or remote via one of two possible remote interfaces.

## 4.1 Frontpanel Operation

The frontpanel is consisting of different operating elements

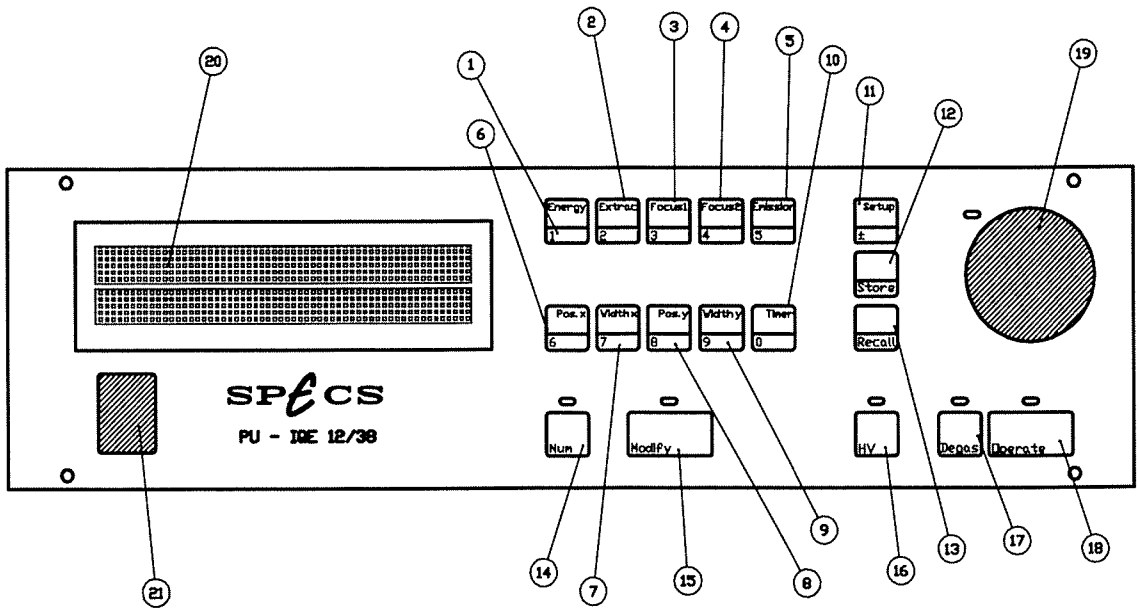



**FIGURE 4** Frontpanel of the PU IQE - 12/38

The meaning of the elements can be outlined as follows:

1. Key with double function: Selection of parameter ENERGY or numerical input of "1"
2. Key with double function: Selection of parameter EXTRACTOR or numerical input of "2"
3. Key with double function: Selection of parameter FOCUS1 or numerical input of "3"
4. Key with double function: Selection of parameter FOCUS2 or numerical input of "4"
5. Key with double function: Selection of parameter EMISSION or numerical input of "5"
6. Key with double function: Selection of parameter POSition X or numerical input of "6"
7. Key with double function: Selection of parameter WIDTH X or numerical input of "7"
8. Key with double function: Selection of parameter POSition Y or numerical input of "8"
9. Key with double function: Selection of parameter WIDTH Y or numerical input of "9"
10. Key with double function: Selection of parameter TIMER Y or numerical input of "0"
11. Key with double function: Selection the SETUP menu or numerical sign change
12. Store of a a parameter set. 9 sets can be stored (and one set for machine parameter). Pressing this key must be followed by a numerical value.
13. Recall a parameter set. 10 sets can be recalled (and one set for machine parameter). Pressing this key must be followed by a numerical value.
14. Key to activate the second (numerical) function of the keys 1 to 11, 12, 13, 18.
15. Key to activate the modify mode.
16. Key to switch off or on the high voltages which was switched on initially by OPERATE.
17. Activation of the degas mode to clean the ion source.
18. Activation of the operate mode where the ion source generates ions. This is the normal working mode.
19. Jog shuttle. It provides two input possibilities:
    - The inner wheel which enables fine adjustment in smallest steps of the parameters.
    - The outer wheel which enables coarse adjustment as well as fine adjustment. Turning it more or less in the desired direction defines the "speed" of change.
20. Display
21. Main power switch. A red mark on the switch indicates that the Power Unit is switched on.

### 4.1.1 Display

The display is a vacuum fluorescence display consisting of two rows with 20 characters. It is divided into four regions:

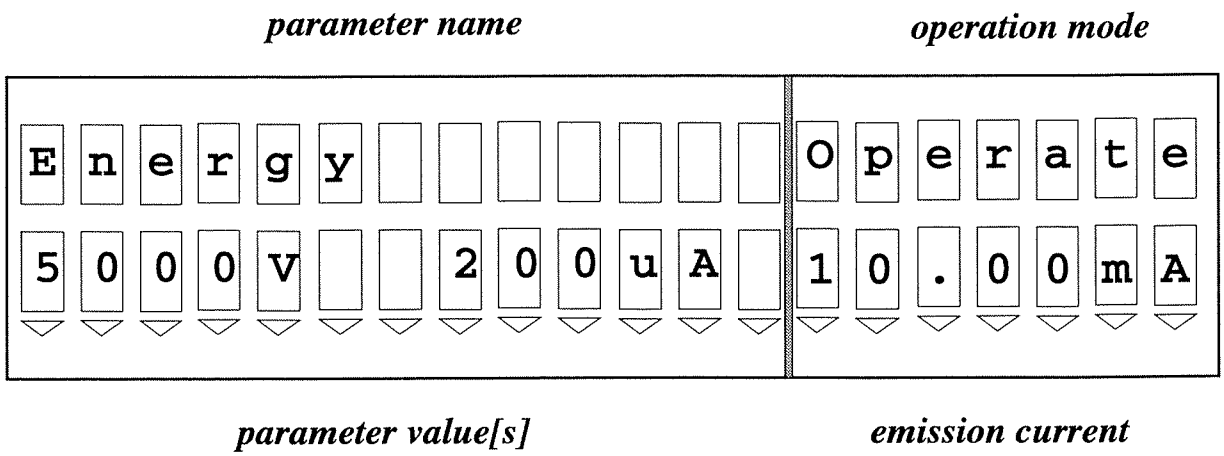



**FIGURE 5** Display of the IQE - 12/38

The desired parameter (name and value) can be selected by the appropriate key of the front panel. The operation mode as well as the emission current are displayed always in normal operation. This provides a permanent overview of the ion source status. Note that "u" is used instead of a "µ" to indicate a scaling factor of $10^{-6}$.

### 4.1.2 Operation Modes

The ion source runs in four modes used for different purposes. To explain them a simplified display is sketched here showing the region of interest in bold letters. The four modes are:

- The Standby Mode
- The Degas Mode
- The Operate Mode
- The OFF Mode

#### 4.1.2.1 First Operation

Each source is tested and specified by SPECS. Nevertheless **before the first operation** (include "DEGAS" also) after installation or the use of a new cathode, the filament should be prepared as described in section 4.2 in the source manual.
**After every system venting** the ion source should be baked with your system, **second** operated in low voltage low current mode about 10 min and **at last** internally cleaned by using the "DEGAS" function from the power supply.

**See "Setup for First Operation" in the source manual!**

#### 4.1.2.2 Standby Mode

| Energy | Standby |
|---|---|
| 0V 0uA | 0.00mA |

This mode is activated usually when the source is not used to save the filament and power consumption. The filament current is dropped to 3 A. There will be no filament emission current. If no red light at the front panel is visible the Power Unit is in STANDBY mode or OFF mode.

This mode is activated

- after switching ON the Power Unit,
- after you leave the OPERATE mode,
- after the DEGAS mode is left.
- after the OFF mode is left.

#### 4.1.2.3 Degas Mode

| Energy | Degas |
|---|---|
| 0V 0uA | 15.00mA |

This mode is used for backing out the electrodes of the ion source to clean them. The emission current is rising slowly to avoid fast pressure increases in the vacuum chamber. The final value is 15 mA. The filament current will not exceed 5.5 A even if 15 mA emission current are not reached to avoid a filament burn out. This case is accompanied by an error message on the display. A working DEGAS is indicated by the red light above the DEGAS key and a "Degas" in the upper right area of the display.

The degas mode is selected by pressing the key DEGAS. It can not be switched on when the source is in OPERATE mode. This is indicated by a beep. This mode can be switched off by pressing the DEGAS key once more or automatically three minutes after the final emission current was reached.

#### 4.1.2.4 Operate Mode

| Energy | Operate |
|---|---|
| 0V 0uA | 10.00mA |

In this mode the ion source can generate ions and accelerate them. Assumption is the gas valve is opened and there are proper voltages applied. The OPERATE mode is indicated by a red light above the OPERATE key.

This mode is selected by pressing the key OPERATE. Parallel to OPERATE mode the high voltage is applied to the ion source indicated by a red light above the HV key. By pressing the key once more the

mode is left to the STANDBY mode. Of course the high voltage is switch off too. For the meaning of the timer in this mode please note section 4.1.3.7 .

The high voltage power supply delivers the acceleration voltages for the ions and supplies the electrodes EXTRACTOR, FOCUS1 and FOCUS2 for beam adjustment. The high voltage is switched on and off parallel with the OPERATE key. If the OPERATE mode is selected the high voltage can be switched off and on separately by pressing the HV key. Applying a high voltage outside of the OPERATE mode is impossible.

#### 4.1.2.5 The OFF Mode

| Energy | Off |
|---|---|
| 0V 0uA | 0.00mA |

The OFF mode is mainly designed to provide switching off the source remote after a an experiment is done. Therefore entering this mode by keyboard is a little bit hidden.

NUM key is held down and OPERATE key is hit

If the ~~NUM key is pressed when pressing the OPERATE key~~ the Power Unit will be switched off. In that case all output voltages will be 0 V. If the source is switched off an extended range of setup parameters is available providing a more general setup as described in section 4.1.4 . The source will be switched on again by pressing OPERATE. A source switched off is indicated by an OFF as operation mode on the display.

### 4.1.3 Parameter Menus

The parameter menus (key 1 to 11 of figure 4) are used to show the current applied values and to adjust the parameters of the Power Unit. The parameter to change or to observe is selected directly by pressing the key with the parameter name written on it. The name of the selected parameter appears on the display as depicted in figure 5.
This keys are used also for entering numerical values of the parameters.

To change a parameter you first have to press MODIFY. The modify mode is indicated by the green light above the MODIFY key. On the display the changeable parameter is underlined by blinking triangles. Now there are two ways to enter a new value.

1. The first using the jog shuttle. This allows a quasi analog input.
2. The second is to keep the NUM key pressed and type the desired value directly by the keys representing the numbers 0 to 9. A sign change is also possible by NUM SETUP

After changing one parameter the next one can be selected directly without leaving the MODIFY mode. The MODIFY mode can be left by pressing MODIFY again. A blinking parameter indicates the changed value isn't stable at the moment. Some parameters need a settling time to become stable. Value change is done immediately when using jog shuttle. When typing in values with numeric keys the value is applied on release of the NUM key. After leaving the MODIFY mode the realized instead of the desired value is displayed.

#### 4.1.3.1 Energy

| **Energy** | Standby |
|---|---|
| **0V 0uA** | 0.00mA |

The parameter ENERGY defines the energy of the accelerated ions. The actually kinetic energy is calculated by $E_{kin} = -U \cdot n \cdot e$. Therefore the displayed value is valid only for single charged ions (n = 1, e = charge of electron). For multiple charged ions the proper energy is a multiple of the displayed energy. Usually the amount of multiple charged ions is only a few per cent of all ions.
The energy range is from 0eV to 5000eV for single charged ions. [1] After high voltages are switched on by pressing OPERATE the high voltage increases to the desired value. After switching off it drops slowly to 0V.

*Don't open connections without switching off the main power switch of the Power Unit. Wait at least 30 seconds after switching off before opening connections. Danger to life!*

#### 4.1.3.2 Extractor

| **Extractor** | Standby |
|---|---|
| **0V 0uA** | 0.00mA |

| **Extractor** | Standby |
|---|---|
| **100.00% 0uA** | 0.00mA |

This voltage is responsible for extracting the ions out of the ionization region. The information shown on the display is different in the MODIFY mode from the other modes[2]. In the MODIFY mode you see a percentage value which is related to the parameter ENERGY. The selectable range is from 60% to 99.99%. If you leave the MODIFY mode the real applied voltage is shown. In both cases the extractor current is displayed.

*Don't open connections without switching off the main power switch of the Power Unit. Wait at least 30 seconds after switching off before opening connections. Danger to life!*

1. The most sputter gun like for example the SPECS IQE - 12/38 works reasonable with energies higher than 100 V.

2. The reason is as follows: If the voltages EXTRACTOR, FOCUS1, FOCUS2 are adjusted to a good performance of the ion source a change of the voltage ENERGY would require a readjustment of the voltages. To avoid this work a scaling of the voltages EXTRACTOR, FOCUS1, FOCUS2 proportional to ENERGY is performed.

#### 4.1.3.3 Focus1 and Focus2

| Focus1 | Standby |
|---|---|
| 0V 0uA | 0.00mA |

| Focus2 | Standby |
|---|---|
| 0V 0uA | 0.00mA |

In the FOCUS menus for the two Lens elements FOCUS1 and FOCUS2 voltage and the current of this electrodes is displayed. The voltages are related to the value ENERGY like described for the parameter EXTRACTOR. Therefore different information are visible in and outside of the MODIFY mode, too. The selectable range is from 0% to 99.99%. After switching off ENERGY or the HV the EXTRACTOR voltage drops slowly to 0V.

*Don't open connections without switching off the main power switch of the Power Unit. Wait at least 30 seconds after switching off before opening connections. Danger to life!*

#### 4.1.3.4 Emission

| Filament | Operate |
|---|---|
| 6.3V 4.9A | 10.00mA |

The EMISSION menu provides the control of the filament function. The filament voltage and filament current are displayed[1]. The filament voltage depends on the adjusted emission current and can not be changed directly. The filament current will not exceed 5.5 A even if the desired emission current is not reached to avoid a filament burn out. This case is accompanied by an error message on the display.

In the MODIFY mode the emission current can be adjusted from 0.01 mA to 10 mA.

1. The filament current is the current driven through the filament when the filament voltage is applied. The emission current is current emitting from the heated filament in direction of the gas atoms to ionize them.

#### 4.1.3.5 POSition X and POSition Y

| X Position | Standby |
|---|---|
| 5.00mm | 0.00mA |

| Y Position | Standby |
|---|---|
| -5.00mm | 0.00mA |

This parameter defines the middle of the area scanned by the ion beam. The range is from -5 mm to 5 mm. For the position only values are valid for which the selected area does not extend the 10 mm × 10 mm maximum area centered at the zero position of the ion beam. If this area is extended in X-direction this is indicated by a blinking →□← sign right of the position value. The corresponding Y break is indicated by an blinking ↓□↑ sign. To remove it select a smaller area or move the area in direction of the center of the 10 mm × 10 mm maximum area.

#### 4.1.3.6 Width X and Width Y

| X Width | Standby |
|---|---|
| 10.00mm | 0.00mA |

| Y Width | Standby |
|---|---|
| 10.00mm | 0.00mA |

This parameter defines the area scanned by the ion beam. The range is from 0 mm up to 10 mm. For the selectable area there are the same restrictions as described for the beam position in section 4.1.3.5 .

#### 4.1.3.7 Timer

| Timer | Operate |
|---|---|
| 1:23:43 | 10.00mA |

The timer is used to perform a time limited ion sputtering. The TIMER function is activated by selecting a TIMER value larger than 0. After starting the OPERATE mode with an activated timer this mode will run for the selected time. After ending the OPERATE mode the source is switched back to STANDBY. During this limited OPERATE mode the TIMER displays the remaining sputter time.
Leaving the OPERATE mode by pressing once more OPERATE switches the source to the STANDBY mode and resets the timer to 0.
Pressing the HV key during the OPERATE mode stops the timer until the high voltage is applied again

by pressing HV once more. If the OPERATE mode was terminated by the timer this is indicated by an acoustic signal.

If the timer function is not used during OPERATE mode another value in the parameter field displayed. It can be seen the time passed since starting OPERATE.

#### 4.1.3.8 Store and Recall

| Store | Standby |
|---|---|
| 9 | 0.00mA |

| Recall | Standby |
|---|---|
| 9 | 0.00mA |

Two different types of data which can be stored and recalled. An overview of this data is to see in table 2 .

1. The *user data* includes the standard setup parameters i.e. the parameters in double function with the keys 1 to 10 in figure 4. Parameters may differ from sample to sample or from the goal of the sputter process.
2. The *machine data* includes all parameters which can be viewed as general setup parameters. The data in table 2 on grey background are available in the OFF mode of the source only. This parameters should remain unchanged for a fixed experimental environment of the source.

**Table 2: Data Set of the Types to Store and Recall**

| USER DATA | | MACHINE DATA | |
|---|---|---|---|
| Parameter | Factory Setting (Recall 0) | Parameter | Factory Setting (Num Recall 0) |
| Energy | 5000 V | Blanking X | 1% |
| Extractor | 95.39% | Blanking Y | 1% |
| Focus 1 | 77.29% | Time per Dot | 30 µs/dot |
| Focus 2 | 77.29% | Phi | 0° |
| Emission | 10 mA | Theta | 30° or 0° |
| Position X | 0 mm | L | 31.5 mm |
| Position Y | 0 mm | M | 11.5 mm |
| Width X | 0 mm | Deflect X | 48V/° |
| Width Y | 0 mm | Deflect Y | 67V/° |
| | 0 mm | Blank Level | 0 |

Storing and Recalling User Data:

Nine different user data sets can be stored and recalled. One machine data set can be stored and recalled. For both data types additionally a factory setting is stored in STORE 0. The factory setting can not be changed by the user. The factory setting is valid when the Power Unit drives the SPECS ion source IQE 12/38 mounted on a SPECS REZ 12 chamber. These parameter values are listed in table 2 .

A user data set can be stored by pressing STORE followed by a number key from 1 to 9. The NUM function of the keys is activated automatically after pressing STORE.
If you for example want to keep a parameter set you can store it by pressing STORE 5 in the fifth user data set. That will be confirmed by the message "Store done 5" on the display. *The data present in that store before are lost!* The command STORE 0 is not allowed because the factory setting can not be overwritten. Trying it will result in the message "Can't overwrite factory setting".
To recall a data set press RECALL followed by a number key 1 to 0. The NUM function of the keys is activated automatically after pressing RECALL. That will be confirmed by the message "Recall done N" on the display where N is the number of recalled data set. *The parameters adjusted at the source before recalling a new data set are overwritten and lost if not saved to another store before.* Pressing STORE or RECALL by fault can be undone by pressing the same key again. Recalling a data set during the OPERATE mode applies the data immediately.

Storing and Recalling Machine Data:

Storing and recalling machine data is handled like user data with the exception that the key NUM has to be pressed while pressing STORE or RECALL. There is just one store available to write (STORE 1) and two for read (RECALL 1 for the user defined machine data set and RECALL 0 for factory setting). Trying to recall another data set results in the message "Only two machine parameter sets".

### 4.1.4 Setting up the Power Unit

The set up parameters have two different purposes:

- To adapt the PU - IQE 12/38 to an ion source other than the SPECS IQE 12/38 but basing on the same working principle.
- To configure the PU - IQE 12/38 allowing an adoption of the ion source to a wide range of geometrical and experimental setups.

The menus used for entering the setup parameters are selected by pressing SETUP button. By multiple pressing the menu toggles cyclic through all available parameters. The meaning of each parameter is explained in the following subchapter.

Not all of the parameters are needed for standard operation when the Power Unit is properly installed. **The parameters used for performing a general setup are visible only if the Power Unit is in the OFF mode** to increase life time of Power Unit and ion gun. If the NUM key is pressed when pressing the OPERATE key the Power Unit will be switch off (see also section 4.1.2.5 ).

### 4.1.4.1 Blanking X and Blanking Y

| Blanking X | Standby |
|---|---|
| 30% | 0.00mA |

When the ion beam is rastering an area for a longer time a crater is generated. Collecting data in situ for a depth profile (for example SIMS or ISS) from the sputtered area may result in an interference of data of different layers originating from the crater region edge. To avoid this so called "crater edge effect" the PU - IQE 12/38 provides a TTL output indicating whether the beam is in crater edge region. Input is a percentage value relating to the scanned area.
If you select for example a BLANKING X and BLANKING Y of 10% for an area of WIDTH X = 7 mm and WIDTH Y = 5 mm the edge is defined as 0.35 mm for each edge in X and 0.25 for each edge in Y direction.

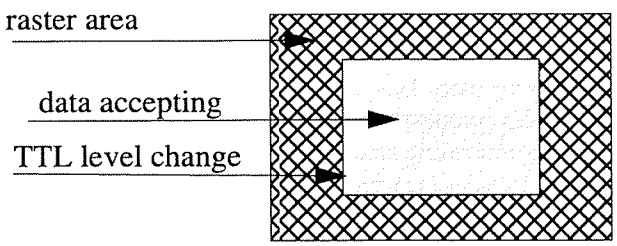



**FIGURE 6** Scheme of the BLANKING function

Values from 1% to 30% will be accepted.

### 4.1.4.2 Time per Dot

| Time per Dot | Standby |
|---|---|
| 30us | 0.00mA |

During rastering the beam position on the sample is given by grid corner points having line spacings of 100 µm. This holds independently of the incident angle or sample rotation if the geometrical parameter are adjusted properly. The beam stays for a time on a dot which can be adjusted. Rastering for example an area of 4 x 4 mm staying 30 µs per dot results in a frequency of 20.8 Hz for the complete area.

The range of this parameter can be varied from 30 µs to 30 ms.

### 4.1.4.3 Angles Phi and Theta

| Phi | Standby |
|---|---|
| 0 ° | 0.00mA |

| Theta | Standby |
|---|---|
| 35 ° | 0.00mA |

When the ion beam rasters the sample area usually different current densities will sputter the sample depending on the angle of incidence[1]. To reduce an uneven erosion the ion beam controlled by the PU - IQE 12/38 always rasters on equidistant points of a grid. To make this possible the variation of the deflection angle to step the beam from one grid point to the next depends on the position of the beam on the rastered area.
By this method homogeneous irradiation is reached. Moreover a trapezoidal shape of the rastered area instead of a rectangular is avoided. This occurs usually in case of oblique angle of incidence[2].
For a proper function of this compensations the position of the source relatively to the sample has to be known. In figure 7 the corresponding angles are shown.

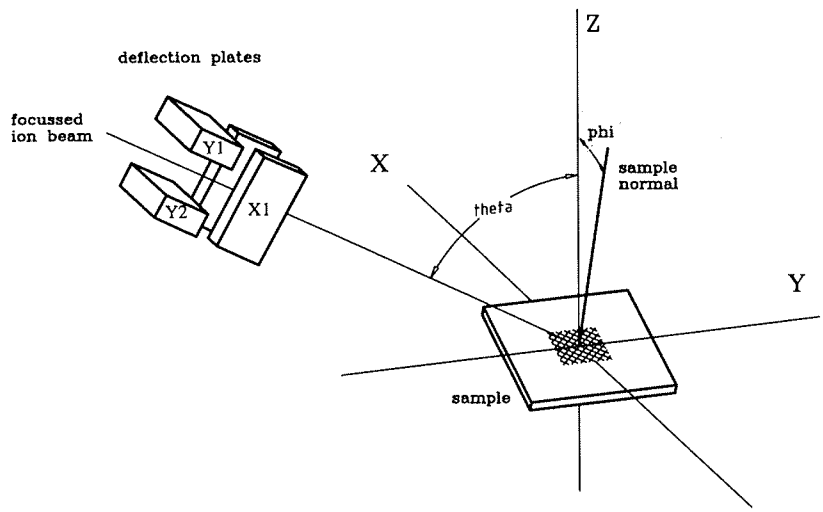



**FIGURE 7** Definition of the angles theta and phi

1. The physical background is explained for example in

U. Kaiser et al.
in SIMS V, ed. by A. Benninghoven et al., Springer Verlag, Berlin Heidelberg New York Tokio (1986) p. 232

B. Bilger, J. E. Fischer
in SIMS VII, ed. by A. Benninghoven et al., John Wiley & Sons, (1990) p. 639

2. In literature it is sometimes called "keystone correction".

If the sample is not tilted the angle theta is the inclination angle of the source flange (Theta is positive if X and Y deflection plates index is given as shown in figure 7. Please check the orientation of the plates when the source is load to the system.). In that case the angle phi is 0°. If the sample is tilted the angles have to be estimated by the operator to provide an optimum performance.

The range of theta is from -85° to 85°, that of phi from -90° to 90°.

### 4.1.4.4 Distances L and M

| L | Standby |
|---|---|
| 31.5mm | 0.00mA |

| M | Standby |
|---|---|
| 11.5mm | 0.00mA |

This parameters is accessible only if the source is switch to the Off mode (section 4.1.2.4 ).

To ensure a proper rastering of the sample for different sources and different experimental setups some geometrical parameters of the ions source have to be entered. The deflection in a source is generally performed by two pairs of deflection plates. The planes where these two pairs are positioned are perpendicular to the non-deflected beam[1]. The first parameter is the distance between beam position on the sample and deflection plane nearest to the sample. The second is the distance between the two deflection planes. The parameters are called in figure 8 L and M respectively. Please note that the distance L is respectively the distance sample to *plates* not sample to top of the *source housing*. This is generally different.

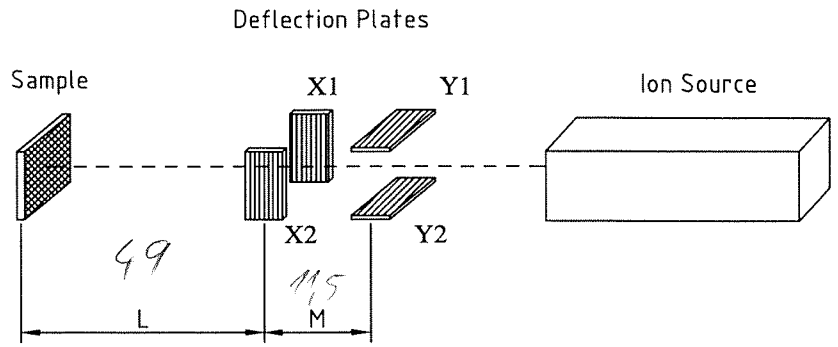



**FIGURE 8** Meaning of the geometrical parameters L and M.

The range of the value M is 0 mm to 99.9 mm and 1 mm to 99.9 mm for L.

1. For short plates the middle of the plates can be regarded as reference plane in a good approximation.

#### 4.1.4.5 Deflection Sensitivities Deflect X and Deflect Y

| Deflect X | Standby |
|---|---|
| 48V/° | 0.00mA |

| Deflect Y | Standby |
|---|---|
| 67V/° | 0.00mA |

This parameters is accessible only if the source is switch to the Off mode (section 3.1.2.3 ).

The angle an ion is deflected for a fixed voltage applied to the deflection plates is depending on the geometry of the source. They may be different for the X and Y deflection. The parameters Deflect X and Deflect Y that into consideration. *Changing this value should only be done for calibration purposes.*

The range of these parameters is from 1 V/° to 200 V/°.

#### 4.1.4.6 Blank Level

| Blank Level | Standby |
|---|---|
| 0 | 0.00mA |

This parameters is accessible only if the source is switch to the Off mode (section 3.1.2.3 ).

It can be selected in which region of the sample the TTL is active low respectively where it is active high. 1 means the TTL output signal is 0 V if the ion beam is in the "data accepting" area of figure 6 and 5 V if it is in the rest of the "raster area". 0 means just the other way round.

There are just two values 0 and 1 that can be entered. Using the NUM key results in 0 for entering a 0 and a 1 for others. The jog shuttle gives a 1 for turing clockwise, 0 otherwise.

## 4.2 Remote Operation

The PU - IQE 12/38 can be controlled remote. Two different remote control interfaces are supported:

- IEC 488 (IEEE 488HPIB, GPIB)
- RS 232

For all interfaces the Power Unit is working as slave.

### 4.2.1 RS 232

The RS 232 parameters are:

| | |
|---|---|
| Baud rate: | 1200 |
| Parity: | none |
| Bits: | 8 |
| Stop bits: | 1 |
| Handshake: | none |

The pin assignment of the DB 9 connector (No. 17 in figure 9):

| | |
|---|---|
| 2: | Receive data |
| 3: | Transmit data |
| 5: | Ground |

Each command that sets a parameter is acknowledged with the string "OK". The echo of all characters received by the PU could be enabled or disabled by the commands "e1" and "e0".

### 4.2.2 IEC 488

The IEC 488 address of device could be changed in the setup menu. After changing the address, the machine parameters must be save and the PU must be switch off and on again.

Each command that sets a parameter is acknowledged by the PU with the string "RDY". If the usage of service request is enabled, each change in the operating status immediately leads to a service request.

### 4.2.3 Commands

The following table shows the commands supported by the PU - IQE 12/38[1].

For all commands that have a parameter the current value can be obtained by replacing the parameter by a question mark.

Commands can be grouped into one line by separating single commands with a ";". Grouped commands are acknowledged by a single "RDY" or "OK". All commands can be sent either in capital or in non capital letters.

1. The set of commands supported for predecessor model of the PU - IQE 12/38 the PS - IQE 12/38 is a subset of the present commands and therefore valid here, too.

All ASCII strings followed by question mark are a status request or value request for the respective parameter.

**Table 3: Command without parameter**

| Command | ASCII String | Timeout (sec) min - max |
|---|---|---|
| remote enable | RE | - |
| local | LO | - |
| enable local | EL | - |
| operate | OP | 1 - 2 |
| standby | SB | 1 - 10 |
| degas | DG | - |
| HV on | HE | 2 - 10 |
| HV off | HA | 2 - 30 |
| operating status | OS | - |
| error status | ES | |
| Off | OF | |
| | | |
| echo on (RS 232) | e1 | |
| echo off (RS 232) | e0 | |
| use service request (IEC 488) | srqon | |
| don't use service request (IEC 488) | srqoff | |
| | | |
| Reset PU | res | |

**Table 4: Commands with Parameter**

| Command | ASCII String | Range | Unit |
|---|---|---|---|
| emission current | EC | 10 .. 10000 | µA |
| Energy | EN | 0 .. 5000 | eV |
| Extractor Voltage | EX | 60 .. 100 | % |
| Focus 1 Voltage | F1 | 0 .. 100 | % |
| Focus 2 Voltage | F2 | 0 .. 100 | % |
| | | | |
| Position X | X0 | -5000 .. 5000 | µm |
| Position Y | Y0 | -5000 .. 5000 | µm |

**Table 4: Commands with Parameter**

| | | | |
|---|---|---|---|
| Width X | WX | 0 .. 10000 | µm |
| Width Y | WY | 0 .. 10000 | µm |
| Blanking X | BX | 0 .. 100 | % |
| Blanking Y | BY | 0 .. 100 | % |
| Blanking Level | bl | 0 .. 1 | |
| Time per Dot | td | 30 .. 30000 | µs |
| | | | |
| Angle Phi (rotation) | ph | -90 .. 90 | ° |
| Angle Theta (tilt) | th | -85 .. 85 | ° |
| L | l | 1 .. 999 | 1/10 mm |
| M | m | 1 .. 999 | 1/10 mm |
| Deflection X | vx | 1 .. 200 | V / ° |
| Deflection Y | vy | 1 .. 200 | V / ° |

**Table 5: Requests**

| Command | ASCII String | Unit |
|---|---|---|
| energy current | eni | µA |
| temperature of energy module | ent | C |
| extractor current | exi | µA |
| focus 1 current | f1i | µA |
| temperature of focus modules | f1t | |
| focus 2 current | f2i | µA |
| filament voltage | fu | V |
| filament current | fi | A |

**Table 6: Results for Operating Status**

| Command | ASCII String | Value | Range |
|---|---|---|---|
| current limit error | CL | B | B = T (true) or F (false) |
| cathode fail error | VL | B | B = T (true) or F (false) |
| regulation error | RE | B | B = T (true) or F (false) |
| "energy" error | EN | B | B = T (true) or F (false) |

**Table 6: Results for Operating Status**

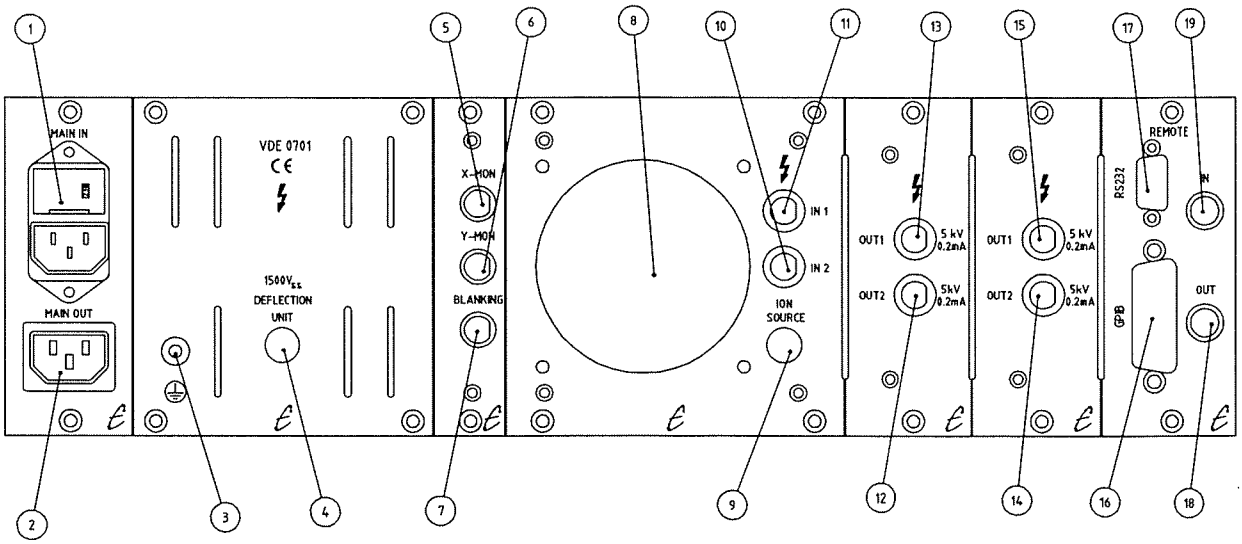
| | | | |
|---|---|---|---|
| "extractor" error | EX | B | B = T (true) or F (false) |
| "focus 1" error | F1 | B | B = T (true) or F (false) |
| "focus 2" error | F2 | B | B = T (true) or F (false) |

Illegal commands or requests will result in a syntax error. This is indicated by "SY" followed by the faulty part of the command.

The firmware version of the modules could be obtained by sending a request to that module with the character "v" between the command and the question mark. For example the version of the focus module could be obtained by sending "f1 v ?".

## 4.3 Cabling

**FIGURE 9** View on the back of the PU - IQE 12/38




Main Input:

1. Main In plug. The upper part of this plug can be removed to change the fuses (⇒ page 6 for values). The proper main in voltage can be selected by removing and turing an inner white case. The selected voltage can be seen in a small window in the plug from outside.
2. Main Out plug. This plug must be used only for the SPECS[1] Wien filter supply PS-WF SPECS (no. 10867945). *If you connect other electronic devices there is the danger of destroying the PU-IQE 12/38 because the available current is limited to 1 A and not fused!*

1. Older PS - WF built by Leybold are allowed, too.

Deflection Amplifier:

3. This ground connector is connected directly with the housing of the PU-IQE 12/38. It has to be connected with other electronic devices or the rack to minimize the influence of electronic disturbance.[1]
4. The cable output to the connector to the deflection plates ⇒ figure 3. The cable is fixed to the PU-IQE 12/38.

Deflection Generator:

5. This socket supplies a monitor voltage to control the X deflection. It can also be used to have a signal necessary for ion mapping applications ⇒ Table 1 on page 6.
6. This socket supplies a monitor voltage to control the X deflection. It can also be uses to have a signal necessary for ion mapping applications ⇒ Table 1 on page 4.
7. TTL output signal for blanking ⇒ Table 1 on page 4 and section 4.1.4.6 .

Emission Regulation:

8. Temperature regulated fan.
9. Cable output to the HV plug ⇒ figure 2. The cable is fixed to the PU-IQE 12 / 38.
10. Second high voltage input socket. It has always to be connected to OUT 2 of the HV module 1 by the HV bridge cable ⇒ "Standard Package List" on page 5 and ."Cabling" on page 26
11. First high voltage input socket. It has always to be connected to OUT 1 of the HV module 1 by the HV bridge cable ⇒ "Standard Package List" on page 5 and "Cabling" on page 26.

HV Module 1:

12. **Second Out2 HV output. It has always to be connected to IN 2** of the Emission Regulation by the HV bridge cable ⇒"Standard Package List" on page 5 and "Cabling" on page 26 .
13. **First Out 1 output. It has always to be connected to IN 1** of the Emission Regulation by the HV bridge cable ⇒ "Standard Package List" on page 5 and "Cabling" on page 26 .

HV Module 2:

14. Socket for the HV focus cable (⇒ section 2.1.1 ) to focus 2 of the ion source.
15. Socket for the HV focus cable (⇒ section 2.1.1 ) to focus 1 of the ion source.

Main CPU:

16. Remote Control Socket IEEE 488 ⇒ figure 4.2.
17. Remote Control Socket RS 232 ⇒figure 3.2.
18. Remote Control Socket SPECS internal interface IN for Wien filter
19. Remote Control Socket SPECS internal interface OUT for Wien filter

1. A grounding bar (copper, brass) with a minimum cross section of 6·6 $mm^2$ has to be installed inside the cabinet. All electronic units have to be connected to this grounding bar by means of flat braided grounding ribbons, which are connected to the back panels of the electronic units.

# Chapter 5 Troubleshooting Procedure

The Power Unit PU - IQE 12/38 is usually used together with an ion source. This chapter helps to find out whether a problem in this unit is originating from the ion source or in the Power Unit and shows a way how to handle the problems.

In all tests it is assumed the problem occurs after the source and Power Unit were installed successfully.

## 5.1 Possible Problems

**Table 7: Dark Display**

| Possible Cause | Perform Check, Test or Troubleshooting |
|---|---|
| No main voltage | Check cabling of main in. |
| Fuses blown | Check fuses ⇒ section 3.1.5.1 |

**Table 8: No Ion Current on the Sample**

| Possible Cause | Perform Check, Test or Troubleshooting |
|---|---|
| Current measurement not working | Check measurement setup and method. |
| No emission current | Adjust emission current section 4.1.3.4 . If problems arise perform check |
| No high voltage | Adjust energy ⇒ section 4.1.3.1 . If problems arise perform check |
| No extractor voltage | Adjust energy ⇒ section 4.1.3.2 . If problems arise perform check |
| No or wrong anode voltage | Perform check in |

### Table 8: No Ion Current on the Sample

| | |
|---|---|
| No or wrong repeller voltage | Perform check in |
| No sputter gas | Check valves or replace gas bottle. |

### Table 9: Low Intensity

| Possible Cause | Perform Check, Test or Troubleshooting |
|---|---|
| Current measurement not working | Check measurement setup and method. |
| To low sputter gas pressure | Check valves or replace gas bottle. |
| Misadjusted focus voltages | Adjust focus voltage in accordance to your ion source manual. |
| Too small emission current | Emission regulation module defective ⇒ contact SPECS service department. |

### Table 10: Intensity Fluctuations

| Possible Cause | Perform Check, Test or Troubleshooting |
|---|---|
| Intensity measurement not working | Check measurement setup and method. |
| Dirty sample or insulating sample | Clean the sample by sputtering for some minutes or replace the sample. |
| Unstable sputter gas pressure | Check valves or replace gas bottle. |
| Unstable emission current | Emission regulation module defective ⇒ contact SPECS service department. |
| Unstable energy voltage or focus voltage | HV module defective ⇒ contact SPECS service department. |

### Table 11: Beam Size too Large

| Possible Cause | Perform Check, Test or Troubleshooting |
|---|---|
| Beam size measurement not working | Check measurement setup and method. |
| Misadjusted focus voltages | Adjust focus voltage in accordance to your ion source manual. |
| Defective focus voltage supplies | HV module defective ⇒ contact SPECS service department. |
| To high sputter gas pressure | Check valves |
| Size defining aperture in the ion source enlarged | Replace responsible aperture in accordance to your source manual |

**Table 12: Unexpected Raster Area / Shape**

| Possible Cause | Perform Check, Test or Troubleshooting |
|---|---|
| Wrong angle adjustment of theta and / or phi | Enter correct angles in setup menu ⇒ section 4.1.4.3 |
| Wrong geometrical setup of the ion source | Enter correct values ⇒ section 4.1.4.4 |
| Wrong deflection sensitivity adjusted | Enter correct values ⇒ section 4.1.4.5 |

## 5.2 Needed Tools

Digital voltmeter (DVM), 3 1/2 digit.

High voltage probe (HVP) (Voltage Divider 1:1000, at least 100 MOhm).

### 5.2.1 Measuring of Output Voltages

***All the measurements described in this chapter are extremely dangerous!***

***Mind the safety hints given on page 2!!!***
***Read carefully the manual of your high voltage probe***

All cables have to be disconnected from the back of the Power Unit. For this purpose the Power Unit has to be switched off. After one minute waiting all cables can be removed before it can be switched on again.

The voltages adjusted at the source are measured and displayed internally. The measured values can differ from the values measured with the external method like described here.
The displayed current corresponds to the current consumption of the HVP (e.g. R = 200MOhm, U= 5000V results in 25 µA).
The voltages can be measured by performing the steps of the following subchapter

#### 5.2.1.1 Energy

***Mind the safety hints given on page 2!!!***
***Read carefully the manual of your high voltage probe***

1. Connect the HVP with the DVM (range 20V) to connector 13 of figure 9.
2. Adjust the ENERGY to 5000 V. Press OPERATE and HV (the blinking warning message "check filament" has no meaning in this case).
3. The DVM should show the value of 5.000 V (± 0.01V)
4. Adjust the ENERGY to 100 V.
5. The DVM should show the value of 0.100 V (± 0.01V)

### 5.2.1.2 Extractor

*Mind the safety hints given on page 2!!!*
*Read carefully the manual of your high voltage probe*

1. Connect the HVP with the DVM (range 20V) to connector 12 of figure 9.
2. Adjust the EXTRACTOR to 99.99%. Press OPERATE and HV (the blinking warning message "check filament" has no meaning in this case).
3. The DVM should show the value of 5.000 V (± 0.01V)
4. Adjust the ENERGY to 100 V.
5. The DVM should show the value of 0.1 V (± 0.01V)

### 5.2.1.3 Focus 1

*Mind the safety hints given on page 2!!!*
*Read carefully the manual of your high voltage probe*

1. Connect the HVP with the DVM (range 20V) to connector 15 of figure 9.
2. Adjust the FOCUS 1 to 99.99%. Press OPERATE and HV (the blinking warning message "check filament" has no meaning in this case).
3. The DVM should show the value of 5.000 V (± 0.01V)
4. Adjust the ENERGY to 100 V.
5. The DVM should show the value of 0.1 (± 0.01V)V

### 5.2.1.4 Focus 2

*Mind the safety hints given on page 2!!!*
*Read carefully the manual of your high voltage probe*

1. Connect the HVP with the DVM (range 20V) to connector 14 of figure 9.
2. Adjust the FOCUS 2 to 99.99%. Press OPERATE and HV (the blinking warning message "check filament" has no meaning in this case).
3. The DVM should show the value of 5000 V (± 0.01V)
4. Adjust the ENERGY to 100 V.
5. The DVM should show the value of 0.1 V (± 0.010V)

### 5.2.1.5 Deflection X1, X2, Y1, Y2

*Mind the safety hints given on page 2!!!*

1. Load the factory setting of the machine data (section 4.1.3.8 ).
2. Adjust the angles theta and phi to 0°(section 4.1.4.3 .).
3. Set Width X = 0.00mm, Width Y = 0.00mm, Energy = 5000V
4. Switch Operate and HV on (the blinking warning message "check filament" has no meaning in this case).
5. Set POSition X and POSition Y on the values listed in table 13 .
6. Check the voltages at the pins X1, X2, Y1, Y2 of the plug depicted in figure 3 on page 8. Measure with the DVM (range 1000V, against ground).

Measure with the DVM (range 20 V, against ground) output X-MONitor and Y-MONitor (plug no. 5 and no. 6 in figure 10).

**Table 13:**

| Pos.X | X-Mon. | X1 | X2 |
|---|---|---|---|
| -5.00mm | -10V± 0.1V | -650V± 10V | +650V± 10V |
| +5.00mm | +10V± 0.1V | +650V± 10V | -650V± 10V |

**Table 14:**

| Pos.Y | Y-Mon. | Y1 | Y2 |
|---|---|---|---|
| -5.00mm | -10V± 0.1V | -650V± 10V | +650V± 10V |
| +5.00mm | +10V± 0.1V | +650V± 10V | -650V± 10V |

### 5.2.1.6 Anode, Repeller, Degas

*Mind the safety hints given on page 2!!*

***The two HV bridge cables must be removed from the back of the Power Unit (connection no. 11 with no. 13 and no. 10 with no. 12 in figure 9 on page 25) before performing this measurement!***

***Danger of life!***

The measurement of this voltages are made against the cathode potential (pin cathode "-" of the plug shown in figure 2)

The measurements of anode repeller should show the results listed in table 15 (range of DVM 1000V). The corresponding current also measured with the DVM is shown too (range of DVM 20A)

**Table 15:**

| Mode | Anode | Repeller | Cathode+ |
|---|---|---|---|
| Standby | 0V±10V | 0V±10V | 3A±0.1A |
| Operate | 120V±5V | -80V±5V | 5.5A±0.1A |
| Degas | 600V±50V | 600V±50V | 5.5A±0.1A |

## 5.3 Error Messages and Warnings

>>>>>PU 12-38<<<<<: The coming up display of the PU - IQE 12/38. It is visible for more than a second only if there are difficulties to initialize the Power Unit. If the initialization of a module fails at least one the following five messages appears. If all modules are in the corresponding slots a serious error is probable. Please contact the SPECS service department.

| | |
|---|---|
| Module not found: 5 kV - 1 | ⇒ first error message |
| Module not found: 5 kV - 2 | ⇒ first error message |
| Module not found: Emission | ⇒ first error message |
| Module not found: Scan Generator | ⇒ first error message |
| Module not found: Scan Power | ⇒ first error message |
| I2C error | If during operation a fatal communication error in the Power Unit appears this message is displayed. If the problems stays after switching off and on the Power Unit or it happens often please contact the SPECS service department. |
| Only two machine parameter sets | ⇒ section 4.1.3.8 |
| Can't write factory settings | ⇒ section 4.1.3.8 |
| Check filament | If the resistance between the two filament pins of the connector depicted in figure 2 is infinite this blinking message appears. Mostly the reason is a broken filament in the ion source. A bad contact in the plug or a defective cable can also be the origin. |
| Busy | This message appears in the following cases:<br>1. During the initial regulation of the emission current to the desired value this message appears. This can take some seconds.<br>2. During the calculation of the parameters for the corrected beam positions depending of the adjusted angles theta and phi ⇒ section 4.1.4.3 .<br>For that time the Power Unit is busy the high voltage is switched off. |
| Current Limit | If the adjusted emission current is not reached in spite of driving the filament by 5.5 A this blinking message appears. That can appear during normal operation ⇒ section 4.1.2.3 or during degas of the ion source ⇒ section 4.1.2.3 . |
| ■ | The blinking box on the display right of the parameter name indicates that a beam raster parameter is adjusted out of range. The range is depending on the energy of the ions. If a certain area is selected using a low energy the box can appear when the Energy is increased ⇒ section 4.1.3.5 or section 4.1.3.6 . |
| ↓ | The blinking arrow on the display right of the parameter name indicates the limitation of the deflection voltages. The result is a raster area which is smaller than desired with a emphasized current density in the edge region of the sputtered area. |

Chapter

# 6

# Electronic Block Diagram

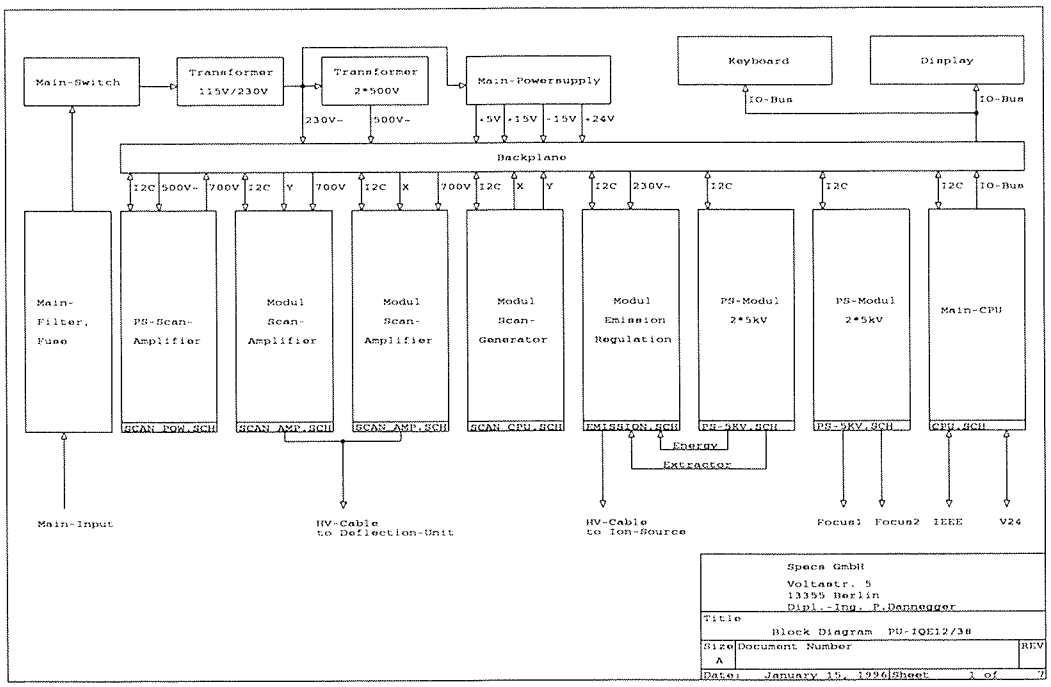



**FIGURE 10** Overview block diagram of the PU - IQE 12/38 electronics