SPECS®

Surface Analysis and Computer Technology

Digital Power Supply

ErLEED 3000D

User Manual

2.0.2

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User manual for the ErLEED 3000D digital power supply.

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Chapter 1

General Information

1 General information

1.1 Introduction

The ErLEED 3000D unit supports LEED optics. It supplies the supply voltages for the LEED mode as well as the supply to run the unit as retarding field analyzer (RFA) and is operated by the front-panel AND the serial interface.

To this end the software packages RFA-PC and can be used. Customers with LEED operation only receive a restricted version of RFA-PC called ErLEED-PC. With this (freeware) version all voltages can be controlled with the PC but no data can be acquired. Please refer to the *ErLEED RFA-PC* user manual.

The following user handbook describes how to operate the ErLEED 3000D unit with front-panel operation, variant LEED / AES.

1.2 Safety

It is important to read this user handbook carefully before starting to work with the device, as well as to become familiar with its features. This is necessary in order to ensure well functioning of the device and the connected optics equipment and to avoid any danger to the user and damage of the device through inappropriate operation.

1.3 General safety rules

Attention has always to be drawn to the following points:

- Follow safety rules and regulations for precautionary measures
- You should provide for electrostatic discharge of body and clothing in case there is any electrostatic charge before working with the device
- The device may be opened only by authorized specialists
- Please note that even after the mains plug has been plugged out it is possible that individual parts of the device are still charged.

!!ATTENTION!!

There may be dangerous high voltages in the device or the connected cables during operation or even long after having been switched off.

1.4 Usability

The usage of the device is limited to normal environmental conditions, without vibrations, dust or dampness and an environmental temperature of up to 40° C.
There must be unrestricted air circulation in the area of the ventilation slits.
Do never use this device in rooms that contain gases that are highly inflammable or evaporate easily (danger of explosion!).

1.5 Connecting the devices

We recommend to adhere to the following connection instructions in order to secure optimal functioning of the system.
First group the electric consumers according to their function type in order to separate function-related units (FU) from auxiliary generators (AG).

Examples of FU: PCs, control units, x-ray sources, ion sources, manometers, ...
Examples of AG: vacuum pumps, cooling generators, ...

Equipment of these groups should be connected to the device according to the following rules:

- Mains power supply of all FU and AG from a central mains connection point
- If possible connect all FU and AG to the same power supply phase (protector)
- If there is insufficient protection connect only AG to another phase
- Lay cables clustered
- Supply for protective earthing from the mains connection point to the FUs and then to the device
- Protective earthing of the AG, if existing, must be laid also from a central mains connection point
- Protective earthing to the FUs must be laid clustered and with the according network cables
- Signal cables to the device must be laid separately from the network cables
- Protective earthing from the FUs to the device must be laid clustered and with appropriate signal cables
- Earthing cables should be large in diameter, e. g. a 4-6 mm copper line

The following figure shows a schematic possible cable layout :

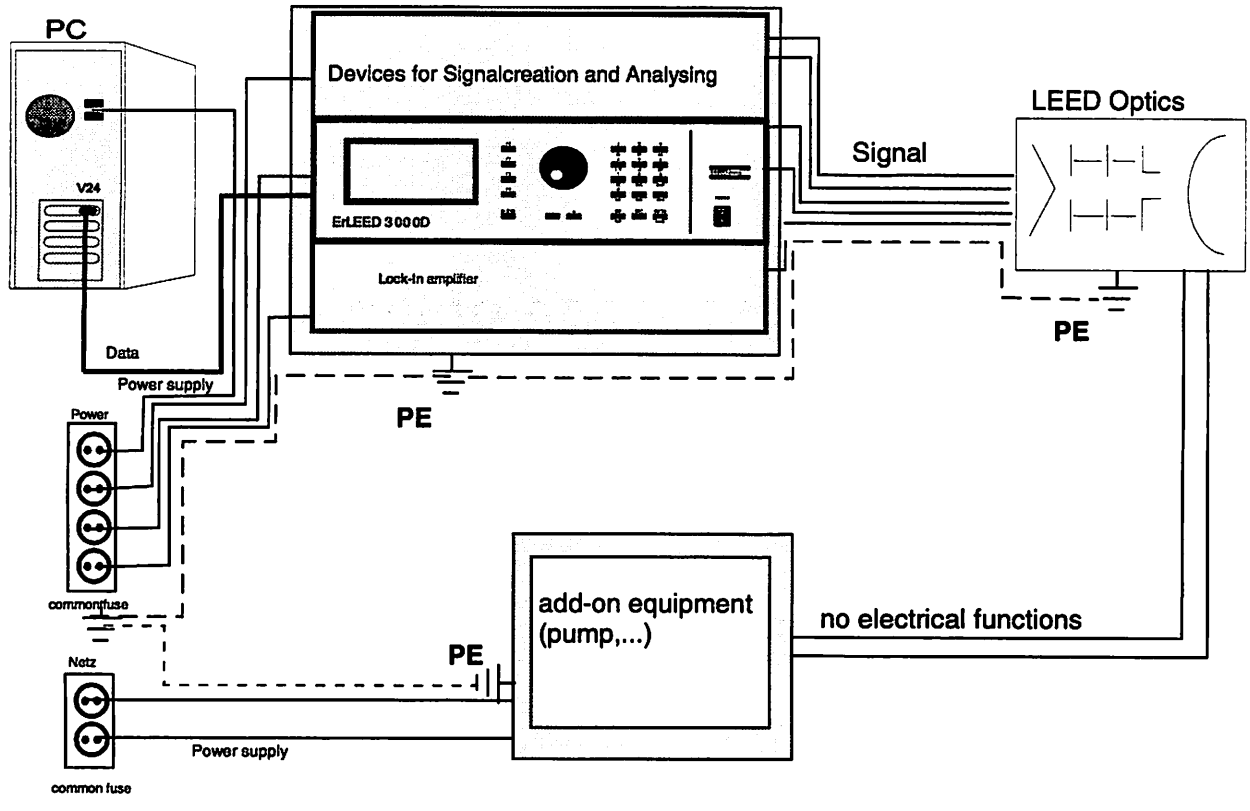


***Figure* 1: Connecting the devices**

1.6 Electrical operating conditions

The device can be operated with a mains voltage ranging from 85 to 264 volt (AC) and a mains frequency of 47 to 440 Hz.
Before switching on the device check whether the mains voltage is in accordance with the device voltage. More recent units are provided with a wide range power supply.

A mains voltage being not in accordance with the requirements of the device may result in damage, as the defined function is not ensured. This damage is not a case of guarantee.

Chapter 2

Description of the mechanics

2 Description of the mechanics

2.1 The front panel

The front panel serves to operate the ErLEED DIGITAL Unit. There is a LCD-display that shows and accepts parameters, a block of function keys, a rotary wheel, two keys for altering input parameters and a keypad.

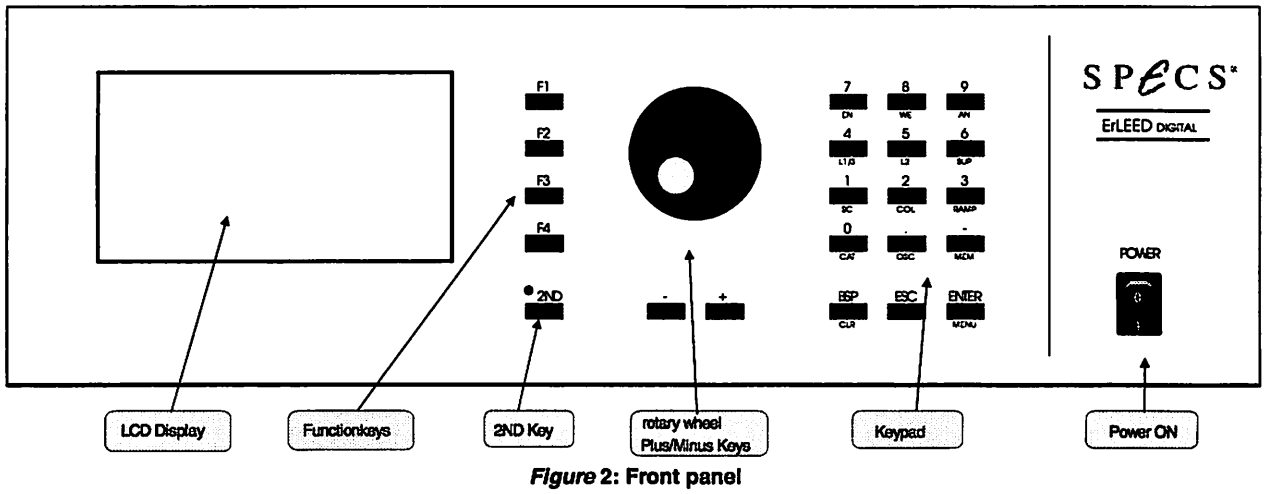


***Figure* 2: Front panel**

The LCD-screen serves to show and to accept module voltages and other system parameters. Brightness and contrast are default values and cannot be modified by the user.
The function keys serve to operate a maximum number of four keys (input fields) shown on the LCD -screen with varying functions.
Every raster step of the rotary wheel generates an increment or decrement in the active input window. In this way a numerical value can be altered by one step with each raster of the rotary wheel, or the next or previous entry, respectively, can be selected from an entry list.
The plus- and minus keys have the same function as the rotary wheel. These keys have an *Autorepeat*-function.
The keypad serves either to put in directly numerals and editing functions or, together with the 2^{ND}-key, to select input screens directly.

The functions of the individual keys of the keypad are altered by the 2^{ND}-key. When the 2^{ND}-key is not active the value written on top of the key is valid, when it is active the lower value. The 2^{ND}-key is a SHIFT- key, i. e. it must be pressed once to be activated. Pressed again it is deactivated. When it is active the red LED is illuminated.
With the 2^{ND}-key being active the increment is increased tenfold when the values are altered by the rotary wheel or the plus/minus key.

2.2 The rear view

The back plate of the ErLEED DIGITAL looks like Figure 3.

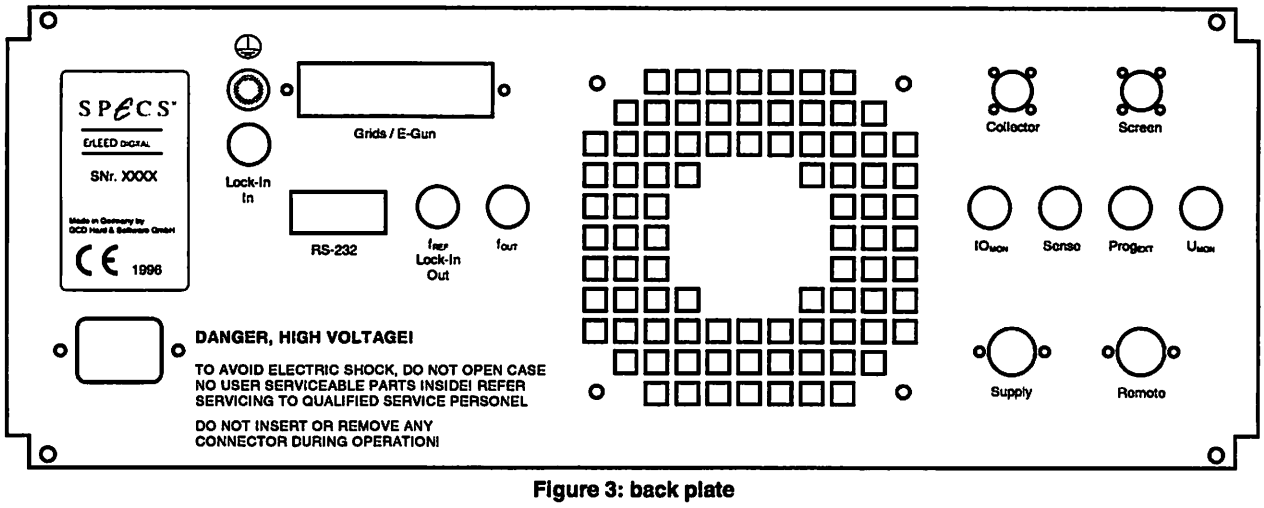


Figure 3: back plate

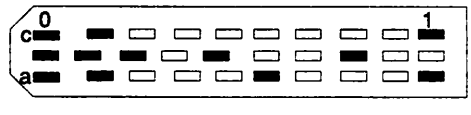
This is the location of all outputs and inputs of the device for supply and return measurement of the optics, PC- interface and mains supply.

2.3 Outputs and inputs

This chapter describes the individual connections and signals at the back plate of the unit:

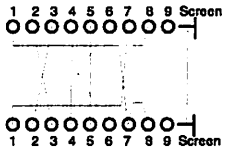
Grids / E-Gun
Most of the supply voltages for the LEED -optics are applied to this plug and the control cable is connected here. The pin layout of the plug is shown in the following figure

Pin	Signal
A0	Filament +
B0	Anode
C0	Filament -
A9	L4
C9	L2
B9	Wehnelt
B6	L1/3
A5	G1/4
B3	G2/3
A1	Sense
C1	Sense



Collector and Screen
These two supply voltages of the LEED-optics are connected separately to the optics and not via the main plug. The collector voltage is connected to the high voltage BNC plug of the filter unit.

RS-232
The unit is supplied with a standard RS232 for the connection to a PC. Use a RS232 connecting cable with two nine-contact female plugs as shown in the accompanying figure.



f_{REF} and f_{OUT}
These two jacks supply the output of the oscillator. The output f_{OUT} is entered by the parameters of the oscillator (see *The Oscillator page* 17).
If a lock-in amplifier is integrated into your unit, the f_{REF} jack is labeled with Lock-In Out.

IO_{MON}
This jack serves to measure the *Beam Current* as a return measurement voltage. The measured value is shown in a ratio of 1mV = 1µA.

Sense
By plugging the sense plug included in the delivery into the sense jack, the unit is activated in the last mode selected. Without a sense plug the unit is in an inactive state. All voltages of the control cable are in the range of 0 volt (see *table 1 page 10*).
This jack can be used, for example, to connect a manometer for a cooling equipment or similar devices and hence ensures that the optics will not be operated with insufficient vacuum.

$PROG_{EXT}$
This jack is for an input of 0 to 10 volt. By this input the energy and the ramp can be controlled externally (see *Special functions for energy and ramp page 12*)

U_{MON}
This jack has an output in the range of 0 to 10 volt that is a function of the energy or the ramp depending from the mode selected.

LEED mode: $U_{MON} = 10.0V * \frac{|Uenergy|}{-1000.0V}$

AES mode: $U_{MON} = 10.0V * \frac{|Uramp|}{-2000.0V}$

Supply
This jack provides the supply of the LEED / AUGER filter unit.

Remote
The remote jack has a 10 volt output and an input in the range of 0 to 10 volt. With this input a remote control of the energy is possible (see *Special functions for energy and ramp page* 12).
A remote control box is supplied with units delivered after 2001.

PE-jack
The green-yellow jack serves for protective earthing (PE). It has to be connected in any case.

Lock-In In
This jack is for the input signal of the integrated Lock-In Amplifier (coming from the BNC connection of the filter unit)

Lock-In Out
This jack gives the output signal of the integrated Lock-In Amplifier. The signal is defined in the range of +/-10 Volt.

Chapter

3

The integrated lock-in amplifier

3 The integrated lock-in amplifier

A LIA-BV-120 lock-in amplifier can be integrated into the unit. For further detail of this lock-in amplifier as an example see the following table:

Frequency Range: 10Hz .. 20 kHz

Phase:

Range:	0 .. 360^0, 8Bit
Drift	< 0.01^0 / K
Accuracy	10Hz .. 10kHz ±1Bit
	10kHz .. 20kHz ±3Bit

The phase is switchable in steps of 1.41^0 over the full range of 360^0. This results out of the 8-Bit accuracy (=256 steps) over the 360^0 by using the following formula:

$$Phase = 360.0 * \frac{BITcode}{360.0}.$$

Sensitivity:

Ranges (full-scale)	10µV_{eff} to 100mV_{eff} switchable 1-10-100
Gain drift	< 100ppm / K

Dynamic: 50 dB

Output:

Voltage Range	±10V full scale , > 2kΩ load
Impedance	50Ω
DC-drift:	< 50ppm / K (low drift setting)
	< 500 ppm / k (high dynamic setting)
Basic accuracy	2%

Time Constants:

Range	3ms to 10s (switchable 1-3-10)
Filter-characteristics	6 or 12 dB / Octave switchable

Gain and sensitivity:
The sensitivity means that the selected value gives the full scale output related to the RMS - Voltage of a sinusoidal signal at the input. Using easier words: selected sensitivity of 1 mV

leads with 1mV RMS input signal to 10V output-DC-signal, changing sensitivity to 10mV leads with exactly the same input-signal to 1 Volt output-DC-signal.
The gain setting the amplifier mainly influences the dynamic- and drift performance of the lock-in amplifier. You can choose between high stability (called LOW) and high overload capability (called HIGH). In most case, the low drift mode should be favorite; only if the signal is disturbed by very high level noise you may have to use the high dynamic mode.

Time constants and filter characterisitcs:
Usually the 12 dB / oct. characteristics should be used because of the much better noise performance. Only in closed-loop systems, where stability is very important and may be negative influenced by the phase margin of the second order filter, the 6 dB / oct. characteristics is more useful.
The choice of the time-constant is always a compromise between the noise suppressing and measurement-time. The time-constant is not equal to the measurement-time, they are proportional the each other. After one time-constant, the output-signal is only at 37% of the end-value, a measurement-time o two time-constants duration means 14% error. The accuracy depending of the measurement-time is: $Error(\%) = 100 * e^{-\frac{meas-time}{time-constant}}$

Signal Offset
A signal offset in the range of -50% to +50% or -500% to +500% of the input sensitivity can be added to the input signal of the lock-in amplifier. The range of signal offset depends on the range of the gain. If LOW is chosen the range is -50% to 50%, in case of HIGH Gain the range is -500% to 500%.

Connection:
If you have a ErLEED 3000D unit with integrated lock-in amplifier such as LIA-BV-120, you must connect the output signal of the filter unit (BNC plug) with the Lock-In In jack. The Lock-In Out jack gives you the output signal of the lock-in amplifier in the defined range (see *Output*). The sensitivity of the signal can be switched from 'Normal' to a lower sensitivity labeled EP by a factor of about 15 at the filter unit. This allows measuring stronger signals such as the peak of the elastically scattered electrons with primary energy. Further details of connecting the device can be found in chapter 2.3 'Outputs and Inputs'.

Chapter

4

The modes of the unit

4 The modes of the unit

The ErLEED DIGITAL unit can be operated in two different modes. In addition it can be in OFF-state.

The modes (LEED, AES) are selected with the system menu of the unit. The state *OFF* is taken automatically when the sense plug or the control cable is not plugged in.

To switch the mode you need not to turn off the unit or change any signal cable.

Please refer to chapter 7 on how to operate the unit.

Chapter 5

Supply voltages of the optics

5 Supply voltages of the optics

5.1 Overview

The ErLEED DIGITAL Unit contains high voltage modules for every supply voltage of the optics. They are controlled digitally by the integrated 16Bit D/A converter. An additional 18Bit A/D converter serves for a return measurement of the energies and voltages actually existing at the output.
The following voltages can be controlled separately:
energy, anode, Wehnelt, lens 1+3, lens 2, suppressor, screen, collector, ramp and cathode
In addition there is an oscillator that is controlled separately.
The set of active voltage modules and the ranges depend on the selected mode of the unit. (see *table 2 page 10*).

5.2 Active voltage modules depending on the mode of the unit

There is no supply voltage in the OFF-state. All voltages are then as follows:

	Energy	Anode	Wehnelt	L1+3	L2	Suppr.	Screen	Collector	Cathode	Ramp
Volt	0	-30 .. 0	0..+20	-30 .. 0	-30 .. 0	-30..0	0	0	0 A	0..+30

table 1: Module voltages in the MODE=OFF

The following table shows which voltages exist in the two modes:

	Energy	Anode	Wehnelt	L1+3	L2	Suppr.	Screen	Collector	Cathode	Ramp
LEED	YES	YES	YES	YES	YES	YES	YES	NO	YES	NO
AES	YES	YES	YES	YES	YES	NO	NO	YES	YES	YES

table 2: Modules depending on the mode

All modules apart from cathode and screen are active automatically. These two must be activated separately by the user.

5.3 Voltage ranges of the supply voltages

There are two different voltage ranges for the supply voltages, one for input and one for control of the modules, which can be different ones. Some output voltages are composed of two input values; Gain and Offset with respective separate limits. A limit check is included in the calculation of the output voltage depending on the input parameters.
All voltages stated here are defined in volt, apart from the cathode. The cathode current is defined in ampere.
The following table shows the voltage ranges for the LEED mode:

	GAIN	OFFSET	VALUE	OUTPUT
Energy	not defined	not defined	0.. 1000 eV	0..-1000 V
Wehnelt	0 .. -150 V	0 .. -150 V	not defined	0 .. -150 V
Anode	0 .. 500 V	0 .. 500 V	not defined	0 .. 1000 V
L1+3	0 .. 3000 V	-100 .. 100 V	not defined	-20 .. 2000 V
L2	0 .. 3000 V	- 100 .. 100 V	not defined	-20 .. 3000 V
Suppressor	0 .. 500 V	not defined	not defined	0 .. 500 V
Screen	constant -1000 V	0 .. 10000 V	not defined	0 .. 10000 V
Cathode	not defined	not defined	0 .. 3 A	0 .. 3 A

table 3: Voltage ranges in the LEED mode

The next table shows the voltage ranges for the AES mode:

	GAIN	OFFSET	VALU E	OUTPUT
Energy	not defined	not defined	0..3000 eV	0..-3000 V
Wehnelt	0 .. -150 V	0 .. -150 V	not defined	0 .. -150 V
Anode	0 .. 1000 V	0 .. 1000 V	not defined	0 .. 2000 V
L1+3	not defined	not defined	-20 .. 2000 V	-20 .. 2000 V
L2	not defined	not defined	-20 .. 3000 V	-20 .. 3000 V
Collector	not defined	not defined	0 .. 500 V	0 .. 500 V
Ramp	not defined	not defined	-20 .. 2000 eV	20 .. -2000 V
Cathode	not defined	not defined	0 .. 3 A	0 .. 3 A

table 4: Voltage ranges in the AES mode

5.4 Voltage dependencies on energy

The output voltages of the modules Anode, Wehnelt, L1+3, L2 and Screen depend on the value of the energy module. It is calculated as follows:

$$Uout = OFFSET + GAIN * \frac{|Uenergy|}{|Uenergy\ max|}$$

The range of the energy ($U_{energymax}$) depends on the selected mode of the unit:

$|U_{energymax}|$ = 1000V in LEED; 3000V in AES mode

5.5 Special functions for energy and ramp

The output voltages of the modules *Energy* and *Ramp* can be controlled by the control panel or externally with the *Control* parameter. It can take three states (for the energy) or two (for the ramp):

- In the state *intern* the voltage is entered via the front panel.
- In the state *extern* the value of *Energy* and *Ramp* depend on the external Voltage from the $prog_{ext}$ jack and is calculated as follows:

  Energy LEED Mode: $Uenergy = \frac{-1000V}{10V} * Uprogext$

  Ramp AES Mode: $Uramp = \frac{-2000V}{10V} * Uprogext$

  This state does not exist for *Energy* in AES-mode.

- In the state *remote* the value of the energy depend on the external Voltage from the *remote* jack and is calculated as follows:

  Energy LEED Mode: $Uenergy = \frac{1000V}{10V} * Uremote$

  Energy AES Mode: $Uenergy = \frac{3000V}{10V} * Uremote$

  This state does not exist for the *ramp.*

Chapter

6

Starting-up the unit

6 Starting-up the unit

After starting-up the unit or after a reset all voltages having been active in the last selected mode are set back at their value set last . Cathode and screen are switched off and the ramp is in the state *internal.* All voltages and the selected mode are stored in an internal memory backed up by a battery.

If a spark-over at the optics caused by the set voltages triggers a reset there will be a second spark-over when the unit is started-up again as the same voltages will be set again.
In this case the control cable must be plugged out . Now all voltages can be set at 0 volt by the system menu (see The System screen *page* 17).

Chapter 7

Operating the unit

7 Operating the unit

7.1 Screen structure

The screen is composed of four fields:

- display of the active module and the return measurement of the actual values of voltage and current flow of the module
- display of system relevant return measurement values that should be always visible
- display of mode and remote state information
- Input fields. They offer three fields for putting in parameters of the active module as well as a field to switch from one module to the next.

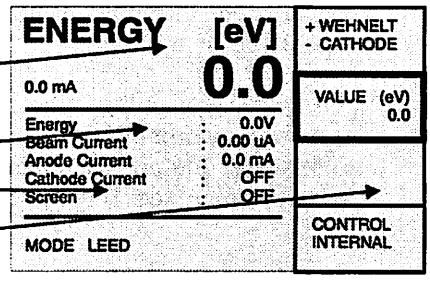


Figure 4: Screen structure

7.2 Basics of the operation

The four input fields are activated by the four function keys besides the window. The active input field is marked by a frame. All actions to alter values refer always to the active input field.

7.2.1 The four input fields

An input field can have four different functions:

Value input
A value can be put in directly by the keyboard or alternatively altered by one step with the plus- or minus key or the rotary wheel.
Input by keyboard takes place with the numeric keypad and inactive 2ND key. Every input of numerals must be confirmed with *Enter*. Input can be interrupted with *ESCAPE*. Then the last active value is taken again. The *BSP* (backspace) key cancels the last character in the entry line.
After input a check on the range of the measured values is implemented. If the set value is beyond the limits it is set at the respective limit value and there is a warning sound.
Together with the 2ND key the *BSP (*then *CLR)* can set the current value at 0.
The current value is increased or decreased by one step with the plus- or minus key or the rotary wheel and the range of measured values is checked again. The value that is directly altered, however, must be within its range of values. In the case of modules whose output

voltage is calculated from two values (Gain and Offset) the result is checked on the range of the output value. Leaving this range is permitted, but announced by a signal sound. There is only a signal when leaving the value range, i. e. when the difference between nominal value and actual value is increasing.

function
A function, e. g. a ramp start, is triggered by pressing the key that has already been activated.

Switch
To switch over press the activated field again. Moving the rotary wheel clockwise deactivates a switch, anti-clockwise it is activated. The plus key activates the switch, the minus key deactivates it.

List
The next value of a list is selected by pressing the already activated field. Selection can take place also by the rotary wheel or the plus- or minus key. Then the 2ND key is ignored, i. e. there is always a progress only by one step.

Menu
A menu field switches from the active list to an other list of functions. There is a change-over immediately after activating the switch. A menu is always called *NEXT* or *HOME*. The text *HOME* indicates being in the last menu of the list and hence reaches the basic menu again. The text *NEXT* indicates that there is a further menu.

7.2.2 Selecting a module screen

There is a screen for each module, a screen for system parameters, memory functions and the oscillator.
All screens apart from the system and memory screen can be selected sequentially with the list of the modules in the top input field. They can also be selected directly with the numeric keypad together with the 2nd key. This is also how to select the system screen (2nd MENU) and the memory screen (2nd MEM).

7.3 The screen in LEED-mode

Figure 5 shows the screen structure of the energy as an example.

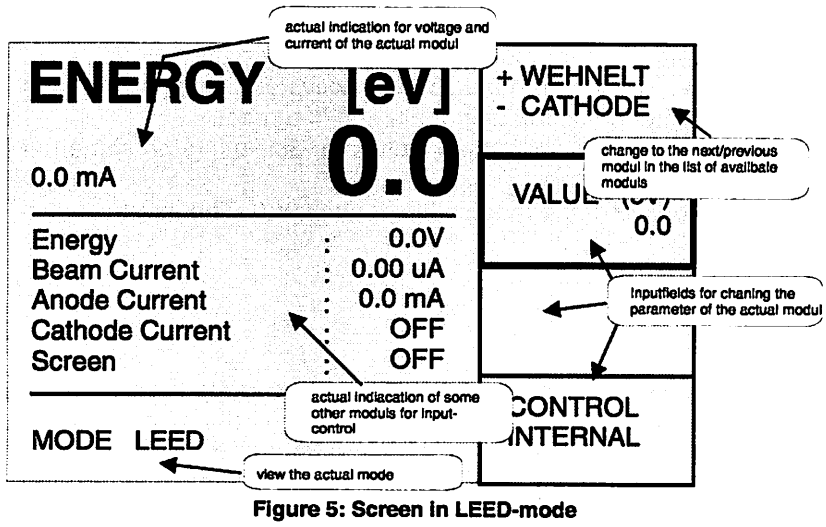


Figure 5: Screen in LEED-mode

7.4 The screen in AES-mode

Figure 6 shows the screen structure of the energy as an example.

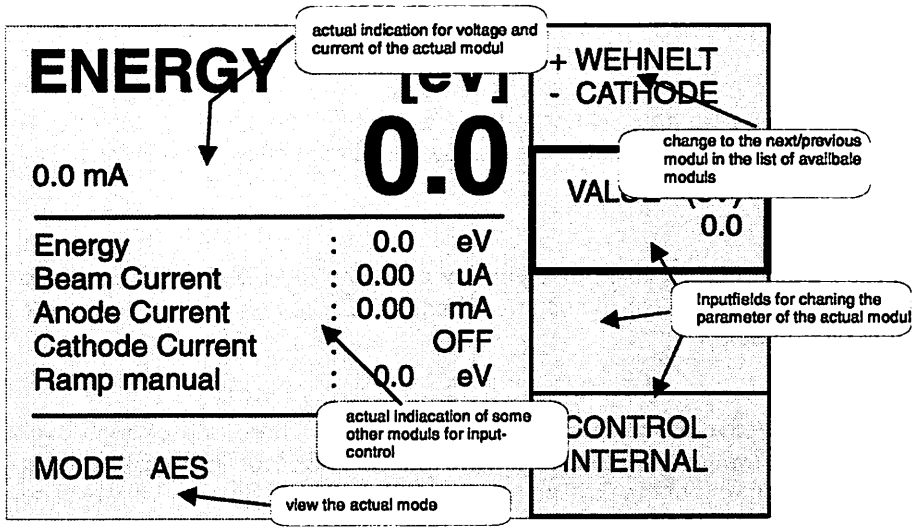


Figure 6: Screen in AES mode

7.5 The Cathode

The cathode differs from the other modules as it is not automatically active but has to be activated by the user with the *Switch* Parameter which activates or deactivates the cathode. The cathode is switched off when starting-up the unit again and after a reset.
When the cathode has been activated the parameter is set at 0 ampere. Now a value can be put in. If the value is being altered via the keyboard it is increased by 0,2 ampere per second in a ramp and not set at the module value immediately.
Entries via the rotary wheel or the plus- or minus key are accepted and set immediately. Value decreasing entries via the keyboard are also taken immediately.
If the cathode is switched off the value is set back to 0 ampere.

7.6 The Screen

Like the cathode, the screen differs from the other modules as it is not automatically active but has to be activated by the user with the *Switch* parameter, which activates or deactivates the screen. The screen is deactivated when starting-up the unit again and in a reset.
In contrast to the cathode the indicated voltage is set immediately after activating the screen. It is not set at 0 first and not increased in a ramp.
If the screen is switched off the output voltage of the module is set back at 0. The input value is saved.

7.7 The Ramp

There are three different ways of setting the value of a ramp. If the ramp is in the *manual* mode its value is set in the same way as the values of the other modules. If it is in the *extern* mode it is controlled via the input $Prog_{EXT}$.
The third mode is the *AUTO-mode.* In this mode the module is executed internally as a ramp from a *start value* to a *stop value* in a defined time. The following four parameters can be defined to this end:

- *Start value* in eV. If it is greater or equal the *stop value* this one will be set at *start value* + 1.

- *Stop value* in eV must always be greater than the *start value.*
- *Time* defines the time in which the ramp is to be executed from the *start value* to the *stop value.*
- *single/continuous* indicates whether the ramp is to stop after reaching the *stop value* (*single*) or whether it is to start again automatically (*continuous*)

The ramp is started with the *Start/Stop* key. It is now *running.* By the pause key the ramp can be stopped and then continued again from that point onwards. The pause time is not included in the duration of the ramp.
The ramp is stopped by pressing again the *Start/Stop* key. The last value of the ramp remains and the labeling of the key changes to *SET BEGIN* and the ramp is set at the start value again.
If the ramp stops automatically when the time has expired it remains at the *stop value.* Also in this case the labeling *SET BEGIN* appears.

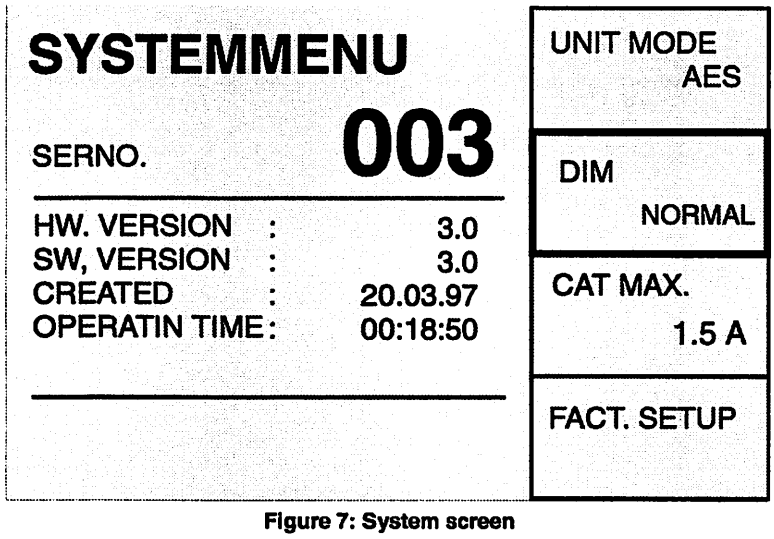
7.8 The Oscillator

Voltage and frequency of the oscillator can be set on the oscillator screen. The kind of energy- and ramp coupling of the oscillator is also defined here. The following parameters are available:

- *Value* indicates the value of f_{OUT} in V_{pp}.
- *Frequency* indicates the value of the frequency depending on the mode of f_{REF} and f_{OUT}.
- *Mode single* defines that f_{REF} equals the set frequency and f_{OUT} equals double the set frequency. Mode *double* defines that f_{REF} and f_{OUT} equal double the set frequency.
- *Output* defines the module f_{OUT} is to be coupled to. *Output1* couples the value to the ramp module, *Output2* to the energy module.

7.9 The System screen

Pressing the 2ND MENU key results in the screen shown in *Figure 7.*
The following parameters are defined here:



- *UNIT MODE* switches over between *AES* and *LEED* mode.
- *DIM* switches off the background illumination of the LCD-screen. Pressing any key turns it on again .
- *CAT. MAX.* is a maximum input value for the cathode defined by the user.
- *FACT SETUP* sets on request all modules at 0 volt and switches off cathode and screen.

Figure 7: System screen

The values *UNIT MODE* and *CAT MAX.* are taken over only if the screen has been left with *ENTER.* If the screen is left with *ESCAPE* both values are set at their previous values again.

7.10 The Memory screen

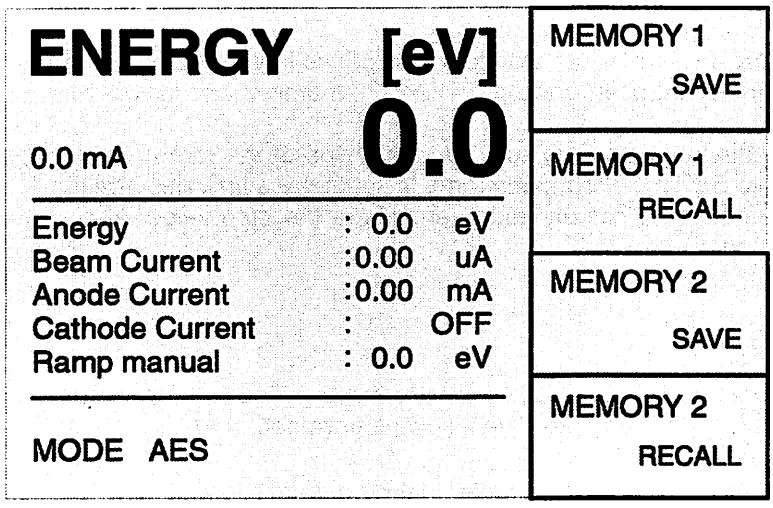


Figure 8: Memory screen

Pressing the 2ND MEM key results in the screen shown in *figure 8*. To this end only the function keys are exchanged. The rest of the screen remains the same.
Here you can dispose of two memories. Each module can have a separate data record with the cathode, however, being neither saved nor loaded.
The function is triggered immediately by pressing the desired key and the screen is left again.
With the *ESCAPE* key the screen can be left without triggering any action.

Chapter

8

Description of the RS232 interface

8 Description of the RS232 interface

8.1 Parameters and protocol

The ErLEED DIGITAL Unit is equipped with an standard RS232 interface. The parameters are defaults and cannot be altered. They are defined as follows:
baudrate=9600; data bits=8; Stop bits=1; parity=none; protocol=none;
The protocol of the interface is plain text. All commands must end with the ASCII-Code 13 (CR) as end label and are acknowledged with echoplexing with end label.
Result strings of inquiries have an end label, too.
After the completion of each transaction the character „>" is sent as a prompt. This is the acknowledgment that the command is accepted and going to be executed. The prompt does not state whether the command has already been completed or not. There is no synchronisation of the complete execution of commands.
All voltages of the modules can be set by this interface and also read-in again. In addition there are commands to read-out status and system information.

8.2 Syntax of commands

All functions can be remote controlled via the RS232 interface. Control is effected with command strings terminating with <CR> or <LF>. The structure of the syntax permits simple remote control, e. g. by a terminal or a terminal program or control by an appropriate control program There is no differentiation between capitals and small letters.
The prompt <CR> LF> ">" is given out as soon as the control unit is ready. After that a command can be put in. The command is returned (echo) and can be edited with <BS>. The command is interpreted as soon as it is complete. If there is no error a new prompt is given out, otherwise there is an error message and a prompt. If the command requests an output this is put out before the promt.

A command line has got the following structure:
<command>[<module|function>[[ ]<float number|parameter>]]<CR|LF>

<command>	:	an ASCII-character, explained below
<module|function>	:	two ASCII-characters, defines the module or the function that is to be controlled. Explained below. Applicability depends on operating mode and command.
<float number|parameter>	:	Value to be set or function parameter.

The control unit can be operated by the keyboard even if the remote control via the RS232 interface is being applied.

8.3 Syntax elements

<module\|function>
The following module and function labels are possible depending on the command and operating mode:

EN	module Energy
WE	module Wehnelt
AN	module Anode
L1	module Lense 1/3 (only in LEED-mode)
L2	module Lense 2
SU	module Suppressor (only in LEED-mode)
CA	module Cathode
SC	module Screen (only in LEED-mode)
CO	module Collector (only in AES-mode)
RA	module Ramp (only in AES-mode)
SI	module Sinus (only in AES-mode)
IO	module In / Out
M1	function MEM 1
M2	function MEM 2
DI	function DIM
MO	operating mode (LEED, AES, OFF)
I0	Beam Current
RP	Ramp Parameter
EP	Energy Parameter
ER	Set at zero
O1	function Sinus at Output 1 (only in AES-mode)
O2	function Sinus at Output 2 (only in AES-mode)
2F	function double sine frequency (only in AES-mode)

<float number\|parameter>
A float number must have a format that can be interpreted by the C-function "**atof**". During input there is no check on the allowed range of values. The module control accepts the values put in and, if necessary, restricts them to the limits permitted in the respective operating mode. There is no error message in the case of overfloat. If requested, the command "Read" serves to realize if the set value is allowed and has been accepted.

The following parameters are possible:

parameter	general	for energy	for ramp
I[ntern]		internal control	internal control
E[xtern]		external control	automatic control
R[emote]		remote control	external control
ON	module or function on		
OFF	module or function off		

8.4 Commands of the RS232

Information on the device
Syntax: IDN<CRILF>
supplies serial number of the device, hardware variant, firmware version and date of firmware generation in the shape

	SNR	VAR	VERSION	DATE
example	0003	3	3.0	20.03.97

Information on calibration
Syntax: INF<CRILF>
supplies date of calibration and serial number of CPU and modules of the device in the shape

	SNRCPU	CALANZCPU	DATECPU	SNRMAIN	CALANZMAIN	DATEMAIN
example	0003	1	20.03.97	0003	1	20.03.97

Help
SYNTAX: H<CRILF>
or ?<CRILF>
supplies an overview on the commands.

Set Value
Syntax: V<module>[[ ]<float number>]<CRILF>

Sets the nominal voltage of the module at the value put in. Default is 0.
Possible modules: EN, CA
in LEED SC
in AES CO, RA, SI

Set Gain
Syntax: G<module>[[ ]<float number>]<CRILF>
Sets the gain of the module control at the value put in, default is 0.
Possible modules: WE, AN
in LEED L1, SU, L2

Set Offset
Syntax: O<module>[[ ]<float number>]<CRILF>
Sets the offset of the module control .at the value put in, default is 0.
Possible modules: WE, AN, L1, L2

Set Frequency
Syntax: F<module>[[ ]<float number>]<CRILF>
Sets the frequency of the sine module at the value put in, default is 1000.
Possible modules:
in AES SI

Set Cathode Maximum
Syntax: SCR <float number><CRILF>
Sets the maximum value of the Cathode.

Switch On/Off
Syntax: S <modulelfunction>[[ ]<parameter>]<CRILF>
Switches a module function on or off. Parameters permitted: On, Off. default is Off.
Possible modules or functions: CA
in LEED SC
in AES O1, O2, 2F

Switch Control
Syntax: S<module>[[ ]<parameter>]<CRILF>
Switch of the module control. Parameters permitted: Internal, External, Remote. default is Internal.
Possible modules: EN I, EN R
in LEED EN E
in AES RA I, RA E, RA R

Set Rampparameter
Syntax: SRP <control> <stop> <start> <time>
Sets the current paramters of the ramp for the AUTO-mode.
The parameter *control* is a dual coded value.
BIT 0 always 1
BIT 2..3 always 0
BIT 4 ramp is active
BIT 5 0 -> single, 1->continuous
BIT 6 0 -> ramp is active, 1->ramp pause
BIT 7 0 -> ramp at start value, 1 -> ramp at last value

Read Rampparameter
Syntax: RRP
supplies the current parameter of the ramp for the AUTO-mode:
RP <control> <stop> <start> <time>
All numerical values are put out in the format "+.5G" and are separated by blanks. The parameter *control* is explained under *Set Rampparameter.*

Read Control
Syntax: R<module>[[ ]<parameter>]<CRILF>
Reads the module control of a module.
Possible modules: EP for energy

Switch Display Intensity
Syntax: SDI[[ ]<float number>]<CRILF>
Switch of the display intensity of the value put in. Parameters permitted: 0 .. 1 (0=off, 1=on).
Default is 1.

Store Memory
Syntax: S<function><CRILF>
Stores the values put in immediately.
Possible functions: M1, M2

Recall Memory
Syntax: R<function><CRILF>
Reads out a memory and re-writes all control values.
Possible functions: M1, M2

Read Mode
Syntax: RMO<CRILF>
indicates the present operating mode (LEED, AES, OFF).

Read Display Intensity
Syntax: RDI<CRILF>
indicates the present display intensity.

Read Module Values
Syntax: R<module><CRILF>
Indicates current module control values and measured values in the following format:
If the last module is not being used
<module> off
If the module is being active:
<module> <gain> <offset> <value> <Umon> <Imon>
All numerical values are put out in the format "+.5G" and separated by a blank, respectively.
Possible modules: EN, WE, AN, L1, L2, SU, CA, SC, CO, RA, SI, IO, I0
Modules with special significance
: EN : Gain is always 0
SU : Offset always 0
CA : Gain always 0
CO : Gain always 0
RA : Gain = ramp-stop

SI : Gain = frequency
I0: Imon = Beam Current
IO: Gain, Offset always 0, Umon = Uextern, Imon = Uremote

Set Lockin Values

If an lock-in amplifier is integrated the following commands are implemented
Syntax: VL<function><value><CRILF>
Possible function:

- O set the *offset* parameter of the lock-in in the range of -10.0 to +10.0.
- T set the *time* parameter of the lock-in
  The parameter is a zero based index into the following list: 3ms, 10ms, 30ms, 100ms, 300ms, 1s, 3s, 10s
- G set the *gain* parameter of the lock-in
  The parameter is a zero based index into the following list: 10µV High, 100µV high, 1mV high, 10mV high, 100µV low, 1mV low 10 mV low 100 mV low
- S set the *slope* parameter of the lock-in
  The parameter is a zero based index into the following list: 6dB / octave, 12 dB / octave
- P set the *phase* parameter of the lock-in
  The parameter is an integer value between 0 and 255. The unit will calculate the phase with the following formular: $phase = 360.0 * \frac{value}{256}$.

Starting the peak finder
Syntax: SPF ON<CRILF>
Possible function:

Read Lock-in Values

If an lock-in amplifier is integrated the following commands are implemented
Syntax: R<function><CRILF>
Possible function:

- LK reads the parameters of the lock-in
  result: *LK time gain phase offset status.*
  The parameters *time, gain, offset* and *phase are* described in *Set Lockin Values.* The Status defines some states of the lock-in and is send as a binary value (xxx), where zero meas OFF and one meas ON.
  Bit0: Peakfinder Aktiv, Bit1: Overload, Bit2: Slope (6dB, 12dB)
- PF reads the state of the peak finder
  result: *PF ON* or *PF OFF*

Set all modules at zero

Syntax: ZER<CRILF>

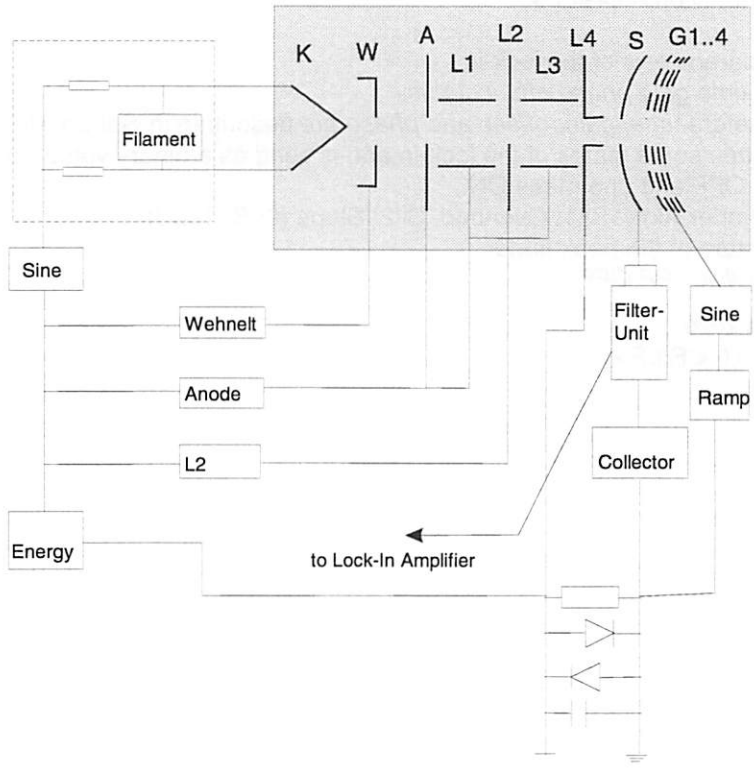
Chapter

9

Appendices

9 Appendices

9.1 Schematics of the LEED Optics in AES - Mode



9.2 Schematics of the LEED Optics in LEED - Mode