ION GETTER PUMP SUPPLY

IPS-04

OPERATING INSTRUCTIONS

delong
instruments

Supply IPS-04 serves for operating an ion getter pump and is supposed to be used in laboratory conditions.

WARNING

After transportation, the device has to be left idle without mains voltage for at least 3 hours at the laboratory temperature.

APPLICATION

The supply IPS-04 is designed for operating ion getter pumps with a pumping speed of 20 to 80 ls^{-1} and with negative operation voltage.

DESCRIPTION

The device is based on the principle of the "flyback" type voltage converter which works at a frequency of 20 kHz and is supplied with a directly rectified mains voltage. The converter operation principle together with the circuit configuration of the power supply produce V–A characteristics suitable for supplying the ion getter pumps. The current flowing through the ion pump is digitally displayed with an automatic range switching over.

The front panel contains:

- the mains voltage switch **ON**,
- key and light indicator **OVERLOAD**,
- key **SET**,
- keys **I** / ⮝ and **U** / ⮟,
- light indicators **MIN** and **MAX**,
- three-digit display with visualisation of the units.

On the rear panel:

- **HIGH VOLTAGE** connector,
- earth terminal **GROUND**,
- mains fuse **F1** T2,5A,
- mains voltage connector **MAINS**,
- **CON1** connector (connection of the RS232 communication port),
- **CON2** connector (connection of some output and control signals).

PUTTING INTO OPERATION

The ion getter pump is connected to the device by means of the high-voltage cable. The appropriate cable terminal is inserted into the **HIGH VOLTAGE** connector and by rotating the ring, the cable is locked against a spontaneous disengagement. When connecting, it is necessary to carefully check whether a reliable contact is secured between the frame of the pumping system and the outer electrode of the **HIGH VOLTAGE** connector (by means of the screening braid of the high-voltage cable). If this is not the case, it is necessary for security reasons to interconnect the pumping system frame with the supply earth terminal **GROUND** by using a separate cable. Such a connection is recommendable in any case.

The device is supplied from the 220 VAC mains by means of the mains cable. The protective mains wire and the earth terminal **GROUND** or the outer electrode of the **HIGH VOLTAGE** connector are not mutually galvanically interconnected but they are separated by means of protective diodes which become conductive if the voltage between the protective wire and the **GROUND** terminal exceeds 0.5 to 0.7 V.

OPERATION HINTS

The supply is switched on by pushing the **ON** switch into the position directed toward its label; the connection is signalised by the red light of the switch. The device should be switched on only when we are sure that the desired starting pressure is achieved inside the pump.

The current flowing through the pump can be read from the front panel display. Some time after switching-on, a character in the form ▲ or ▼ may light up on the left hand side of the display. This symbol expresses a systematic trend in the pump current variation – increasing or decreasing. If no arrow is alight, it means that the current is more or less stable. The pump voltage is shown on the display after the **U** button is pressed. After simultaneous pressing the **U** and **I** button there is displayed the output power of the source in W (when mA and kV light) or in mW (when μA and kV light). Return to the current measurement mode is by pressing the I button.

The device is equipped with an automatic overcurrent protection which switches the supply off (the high-voltage part) after the pump current exceeds a value adjusted under **CURRENT LEVELS – 1 – MAX**, which is indicated by burning the appropriate indicator light and at the same time the **OVERLOAD** indicator light starts to blink. After 1 to 3 seconds, the supply switches automatically on again. If the overcurrent protection level is exceeded once again, the device switches off repeatedly. When more than 3 attempts to switch the supply on automatically are unsuccessful within a short time period, the supply remains off permanently and the **OVERLOAD** indicator lights up while none of the **MAX** and **MIN** indicators is on. The repetition of the supply switching-on and its operation at a load above a value adjusted under **CURRENT LEVELS – 1 – MAX** is brought about by longer

pressing the **OVERLOAD** key. Nevertheless, we do not recommend exceeding the output current of 400 mA. The **OVERLOAD** key must be held pressed until the current decreases below the current level set in **CURRENT LEVELS – 1 – MIN** (when the **OVERLOAD** indicator also stops blinking and the **1 – MIN** light indicator burns). If the **OVERLOAD** key is briefly pressed when the **OVERLOAD** light indicator is continuously on, the supply makes one attempt to switch itself on. If we release the **OVERLOAD** key before the **OVERLOAD** light indicator stops blinking, the supply switches off and makes two more attempts to switch on. This function protects the supply against an excessive load but also protects your pump against an uncontrolled operation which could damage it or shorten its lifetime.

The supply is equipped with three comparators of the pump current – the **CURRENT LEVELS**. The function of the first, labelled **1**, is described in the previous paragraph. The other two, **2** and **3**, serve the needs of customers who are not going to use a computer to control the pumping process. Their outputs are led to the **CON2** output connector and their function is simultaneously indicated by the **MIN – 2 – MAX** and **MIN – 3 – MAX** indicator lights. The **MIN** indicator lights when the pump current is lower than the adjusted value while the **MAX** indicator lights if the current exceeds the preselected value. If the current magnitude falls between both these limits, no indicator light corresponding to the given comparator is burned on. The output signal of the comparator in question has the L level as long as the current is lower than the chosen **MIN** limit and it takes the H level while the current exceeds the adjusted **MAX** value.

To prevent an excessive heating of the pump during pumping the supply is equipped by output power limitation function.

When this function is active the displayed unit is blinking and it means that average output power of the supply is not greater then the pre-set one.

Changing the comparison levels

The comparison levels for the overcurrent protection circuits and of the additional two comparators are adjustable by the user according to his needs. Pressing the **SET** key makes the **1 – MIN** comparator light blink while the all remaining indicator lights are switched off. Every time the **SET** key is pressed after this, it moves the state of blinking to the next indicator light of a comparator. The state of output power limitation set is indicated by simultaneous blinking of the lamps **1 – MAX** and **1 – MIN**. At the same time, the magnitude of the adjusted current level of the relevant comparator is shown on the display. If this magnitude has to be changed, we use the ⮝ and ⮟ keys to do it. The maximum adjustable current value is 300 mA. The minimum adjustable current value is 0.10 μA except for **1 – MIN** level where it is 10 mA and **1 – MAX** 11 mA. The limitation of the output power may be set within the range 10 ÷ 350 W. Return to the measurement mode is possible either by stepping through with the help of the **SET** key behind the latest comparator value or by leaving any value unchanged for longer than 5 seconds. Pre-set values are stored if the device is switched off.

The output connector functions

The output connectors serve for a possible connection of a device designed to monitor or to control the supply activity. The **CON1** connector can be utilised for communication purposes via the RS232 interface, **CON2** is intended for connection of a simple or analogue equipment.

CON1

Pin	Signification	
3	TxD	transmitter
2	RxD	receiver
5	GND	earth conductor

Remote control of the supply using the serial channel will be described in the next chapter.

CON2

a) **The current comparators** *logical output signal*

Pin	Signification	
	L	H
8	proud < MIN1	proud > MAX1
4	proud < MIN2	proud > MAX2
9	proud < MIN3	proud > MAX3

b) **The current output** *analogous output signal*

Pin	Signification	
2	OUT	0 to 1 V for each current range, minimum load impedance 5 kΩ

c) **The range of the measured current** *logical output signal*

Pin	Signification		
	range		
	10 ÷ 1000 mA	0,1 ÷ 10 mA	0 ÷ 100 µA
3	H	L	L
7	L	H	L

Max load: 5 TTL

d) **The activity reporting** *logical output signal*

Pin	Signification
1	L – supply active

Max load: 5 TTL

e) **Remote control** *logical input signal*

Pin	Signification
6	L – supply switched off

f) **Common terminal**

Pin	Signification
5	Earth conductor

CONTROL VIA A SERIAL CHANNEL

Definition

For communication, the RS232 standard serial interface is used in three-wire connection. The signals TxD and RxD are utilised only. The rate is 9600 Baud, 8 data bits, 1 stop-bit, without a parity bit.

In the below, the following symbols and abbreviations are used:

Symbol	Signification
PC	computer PC/AT
IPS	ion getter pump supply IPS-04
Transmission	communication from PC into IPS
Reception	communication from IPS into PC
[ ]	optional parameter in a command
<ETX>	reset of the serial interface (ASCII 3)
<CR>	carriage return (ASCII 13)
<LF>	line feed (ASCII 10)
<ENQ>	communication poll (ASCII 5)
<ACK>	acknowledgement (ASCII 6)
<NAK>	negative acknowledgement (ASCII 21)

Communication protocol

All commands are sent in the form of ASCII strings terminated with <CR>, <LF> characters. After every command transmitted from PC, an acknowledgement has to be waited for (<ACK>, <NAK>). Spaces inside the string are ignored. <ETX> cancels a command under transmission.

The transmission protocol

PC →	← IPS-04	Signification
Mnemonics, parameters <CR><LF>		IPS receives the command with the termination
	<ACK><CR><LF>	Reception acknowledgement

The reception protocol

On request, IPS sends into the PC its operation parameters. Before the request is issued, the contents of the transmission have to be defined. The request is realised by transmitting of <ENQ>. On a repeated transmission of <ENQ>, the requested parameter is repeatedly transmitted. When no valid request precedes <ENQ>, a failure report is transmitted.

PC →	← IPS-04	Signification
Mnemonics, parameters <CR><LF>		IPS receives the command with the termination
	<ACK><CR><LF>	Reception acknowledgement
<ENQ>		Data communication request
	Measured values or parameters <CR><LF>	Data transmission with the termination
<ENQ>		Data communication request
	Measured values or parameters <CR><LF>	Data transmission with the termination

Service of failures

PC →	← IPS-04	Signification
Mnemonics, parameters <CR><LF>		IPS receives the command with the termination
Programmer error or communication failure		
	<NAK><CR><LF>	Negative acknowledgement of the receipt

The commands used

The software version

Transmission: V<CR><LF>

Reception: IPSx.y<CR><LF>

x, y number of the version and subversion

The IPS status

Transmission: S<CR><LF>

Reception: xxx<CR><LF>

xxx a hexadecimal number in the binary representation of which the signification of the individual bits is as follows:

- 7 1 / 0 … supply works / is off
- 6 1 … current overload
- 5 1 … supply switched off due to overcurrent
- 4 1 … supply switched off due to a low mains voltage or overheating
- 3 1 … writing into the EEPROM
- 2 1 … threshold switch 3 closed
- 1 1 … threshold switch 2 closed
- 0 1 … threshold switch 1 closed

The pump current

Transmission: I<CR><LF>

Reception: xxxx<CR><LF>

xxxx is a hexadecimal representation of a hexadecimal number. The two most significant bits are the range *rr*, the remaining bits are the current *i*. The expression of the current for the possible ranges is as follows:

rr	*i*	
	current	step
00	0 to 100 µA	0,01 µA
01	100 µA to 10 mA	1 µA
10	10 mA to 1000 mA	0,1 mA

The pump voltage

Transmission: U<CR><LF>

Reception: uuuu<CR><LF>

uuuu is the voltage in Volts

Operation under overcurrent conditions

Transmission: O<CR><LF>

Reception: If the supply is in the state of current overload, after this command is received the supply is switched on for approx. 2 seconds. If the current drops during this time below the preselected limit or if the command is repeated, the supply remains on.

Operation under power limitation conditions

Transmission: Z<CR><LF>

Reception: xx<CR><LF>

xx is a hexadecimal number, *xx* > 0 – the power is limited

Switching the supply off

Transmission: B<CR><LF>

Reception: Using this command, the supply can be switched off temporarily. Re-starting is possible by means of the Switching the supply on command or by supply disconnection from the mains and re-connection.

Switching the supply on

Transmission: G<CR><LF>

Reception: This command switches on the supply, provided it is not prevented owing to overheating, low mains voltage or a failure.

The current comparators

Transmission: Pn[xxxx]<CR><LF>

n 0 … the lower level of 1. comparator
1 … the upper level of 1. comparator
2 … the lower level of 2. comparator
3 … the upper level of 2. comparator
4 … the lower level of 3. comparator
5 … the upper level of 3. comparator
6 … the power limitation level

xxxx has the same signification as for the current reading

Reception: xxxx<CR><LF>

xxxx has the same signification as for the current reading.

Note

The serial channel RS232 is galvanically connected to the circuitry of the supply. On a special user's request it can be galvanically separated.

MAINTENANCE AND TROUBLESHOOTING

The supply needs minimum maintenance. Depending on the dust levels in the environment where the device is being operated, a periodic check of the air filter conditions is desirable (the air filter forms the rear case wall) and if necessary the filter should be cleaned or replaced. After 12 to 18 months of operation, it is recommended to remove the case covers and to remove the dust by compressed air. **Before removing the covers, the device has to be switched off for at least 5 minutes.**

The only repair left for the user is the replacement of the mains fuse **F1** on the rear panel. It is easy to recognise when a fuse has blown because the display light do not come on, nor does the device ventilator start operating. In a normal operation, such a failure can be caused by a higher incidental mains voltage peak or a short-time mains fall-out. If the fuse blows even after having been substituted several times, some more serious failure is involved and the supply should be shipped for a repair.

Some failures and/or actions of the protection circuits in the supply are indicated by means of the failure reports.

List of the failure reports

Er1 – the high-voltage supply does not work

Switch the supply off, disconnect the HV cable and switch the supply again on – if the failure persists, the high-voltage converter has broken down. Otherwise there is probably a short circuit in the HV cable or inside the pump.

Note: The report can be displayed when the output power is high and simultaneously the mains voltage is low.

Er2 – the mains voltage is too low

Check the mains voltage, ensure its proper magnitude.

Er3 – supply overheating

- Too high ambient temperature.

  Lower the ambient temperature or the supply loading.
- Failure of the ventilator.

  See to a repair.
- The dust filter is choked up.

  Clean or replace it.
- The air flow through the ventilation openings is blocked.

  Ensure unobstructed flowing, keep the supply on and after it cools down by means of its own ventilator the HV supply will start running again.

Er4 – the current of 420 mA overstepped

Switch the supply off and after restarting it, limit the pump current by creating a better rough vacuum.

Er5 – remote switch off

Indicates HV converter switching off by means of remote control input on CON2.

Er6 – remote switch off

Indicates HV converter switching off by means of serial channel RS232.

Er9 – unknown error

Switch the supply off, disconnect the HV cable and switch the supply on again – if the failure persists, it is due to an internal breakdown of the high-voltage converter. Please contact your dealer.

SECURITY PROVISIONS

ATTENTION

Inside the instrument and also in the connector and cable for the ion pump connection, a high voltage is present which is capable of causing a casualty even without any direct touch.

Manipulation of the high voltage cable and also with the grounding wire is prohibited in the course of the supply operation.

Likewise, the supply operation without protective covers is prohibited.

Protect the device against humidity and against penetration of conductive objects into the ventilation slots.

The device fully complies with the Czech Standard ČSN 332200 and is capable of secure and reliable operation.

SPECIFICATIONS

Output voltage (at I_{out} = 0 to 25 mA and mains voltage of 220 V)	6 kV ± 2 %
Output voltage polarity	negative
Output voltage undulation	approx. 1.5 V_{p-p} / 50 Hz at $I_{výst}$ = 0.5 mA approx. 60 V_{p-p} / 100 Hz at $I_{výst}$ = 100 mA approx. 35 V_{p-p} / 20 kHz at $I_{výst}$ = 250 mA
Maximum output current	400 mA
Maximum power	approx. 300 W
Output current indication within the range	0.00 µA to 999 mA
Output voltage indication within the range	0.00 to 9.99 kV
Output power indication within the range	0.0 mW to 999 W
Outputs:	3 current comparators (overload = H), reporting the HV converter function (off = H), indication of the current measurement range (2 bits), analog output of the current measurement 0 to 1 V for each range.
Inputs:	remote control of the HV converter function.
Communication interface	RS232
Mains voltage	220 V $^{+10\%}_{-15\%}$ / 47 ÷ 63 Hz
Maximum power consumption	450 W
Protection	F1 T2,5 A
Weight	7.5 kg
Dimensions (W × H × D)	482 × 133 × 300 mm
Ambient temperature at operation	+5 °C to +35 °C
Relative humidity	20 % to 80 %
Air pressure	> 90,000 Pa
Operating position	arbitrary, enabling a forced air movement

THE DELIVERY CONTENTS

IPS-04 supply	1 piece
Mains cable	1 piece
High voltage cable	1 piece
T2,5 A fuse	3 pieces
Instruction guide	1 piece

WARRANTY CONDITIONS

The producer provides a warranty for the faultless function of the product within a 12 months period from the delivery date. The warranty does not refer to any failures caused by incompetent manipulation or interference on the device.

SERVICE

In case of a failure, please check if the fuse **F1** located on the supply rear panel is not blown. If the failure persists after the fuse has been replaced, inform the producer who will repair the supply:

Delong Instruments s.r.o.
Bulharská 48
612 00 Brno
Czech Republic
phone +420–5–41210691
fax +420–5–41217976

The producer will be grateful to a users for comments on the operation of the device.