LAMBDA PHYSIK®

SITE PREPARATION

LPX® 200i/300i

(04/00)

Part Number: 263 747

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1 System Description

1.1 Overview

Figure 1 and Figure 2 show the exterior design of a LPX® 200i laser.

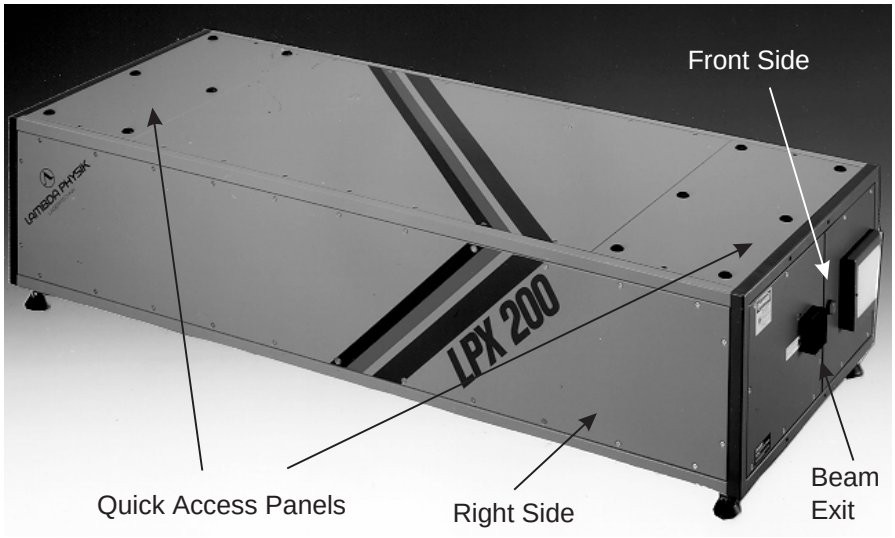

Figure 1 : Front View

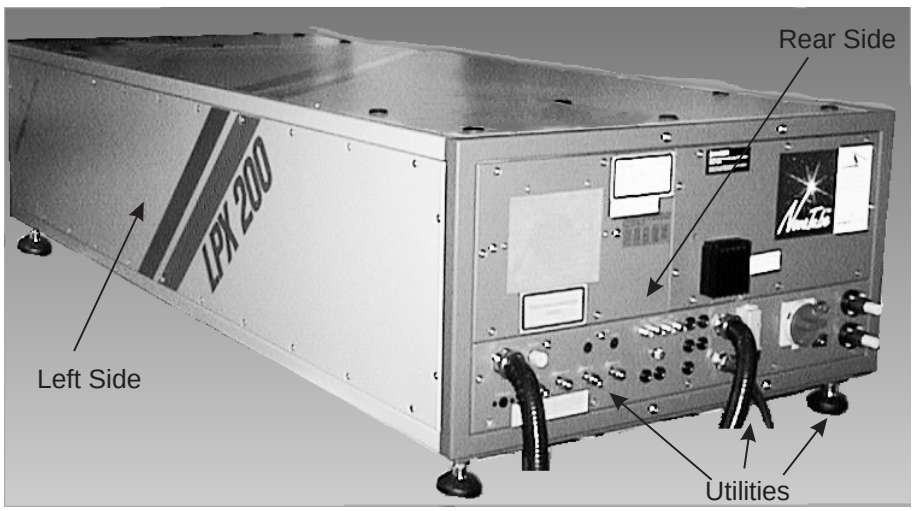

Figure 2 : Rear View

The laser device is subdivided into the modules shown in Figure 3.

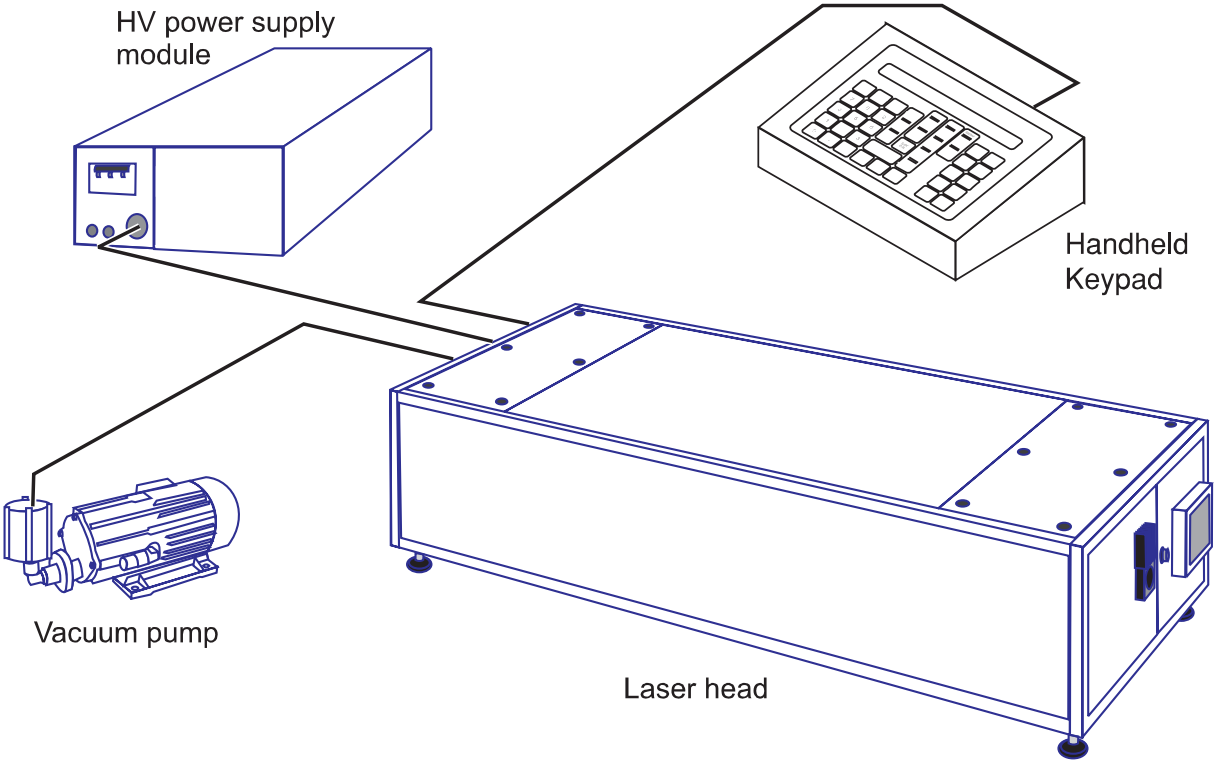

Figure 3: Modules of the LPX Laser device

The HV power supply module transforms mains voltage into the high voltage required for the high voltage discharge. The vacuum pump enables evacuation of the gas system, e. g. for a new gas fill.

1.2 LPX® Excimer Laser

LPX® is an acronym for the *L*ambda *P*hysik e*X*cimer laser. LPX® lasers are designed for scientific and industrial use and meet now a variety of applications.

The LPX-series is applicable for medium to high power and also high energy requirements. All LPX® lasers are equipped with Lambda Physik's new NovaTube® technology. Multigas operating lasers are available as well as specially optimized configurations for operation with either fluorine or chlorine (HCl) gas mixtures.

A personal computer or a handheld keypad are used as standard controller for all LPX® lasers. The software provides a variety of algorithms to stabilize the laser power. A standard for LPX® lasers are software-controlled automatic self-diagnostics as well as automatic logbook generation, too. Connected via optical fibers the computer can operate even in another room than the laser (special safety features, such as two warning lights etc., are required). For system integration all LPX® lasers offer a RS 232C remote interface.

The LPX® lasers meet the European CE-standard, a must since 1996. The demands of electrical safety, radiation, EMI emission and susceptibility as well as pressure vessel regulation and x-ray emission certification are all fulfilled by these lasers.

Figure 5 (Appendix) shows the layout of the LPX® 200i/300i laser.

1.3 The New Concept

Technical innovations coming along with the LPX® are e. g. the Magnetic Switch Control technology MSC®, metal ceramic technology NovaTube® and the on-site halogen generator HaloSafe®

In order to simplify the routine maintenance of the LPX® lasers in productive applications, new features are now available as a standard. These consist of window Slide Valves with an extra set of spare optics mounts and quick access panels in the top cover of the LPX®.

1.4 The NovaTube® Innovation

The essence of NovaTube® is the elimination of contamination effects through careful design and material optimization. All laser tube components are assembled in a clean-room. Optimized electrode materials combined with an improved preionization scheme lead to minimum erosion of the electrodes. The superior Lambda Physik gas flow system allows stable operation of the laser even at a high repetition rate. These major improvements of the laser tube lead to a considerable increased laser tube lifetime and gas lifetime.

By this, the need of cryogenic gas purification is limited to rare cases using very high duty cycles with high power levels.

1.5 The HaloSafe® Innovation

The halogen generator from Lambda Physik eliminates the need for handling toxic gases. This system generates ultra-pure halogen just in time, eliminating the need for an external halogen cylinder.

The generator is built-in an external cabinet.

The LPX® features the halogen generator, Halo Safe® as an option.

2 Safety Aspects

Lasers and laser systems are classified according to their relative hazards, and these classifications can be found in the American National Standards for the Safe Use of Laser (ANSI Z 136.1-1986), FDA 21 CFR 1040.10 and 1040.11, and IEC-825. Within this classification, the LPX® excimer laser is a Class IV laser. It must be regarded as a potential hazard to the human operator.

Observe the accident and safety precautions as established by professional associations and unions. In Germany:

“Unfallverhütungsvorschrift ”Lasertrahlung” (VBG 93) der Berufsgenossenschaft der Feinmechanik u. Elektro-technik”

Make sure that laser warning labels are fixed according to local safety regulations.

All installation work, maintenance, repair, modification and all other activities involving the LPX® laser must only be carried out by authorized, fully qualified personnel.

WARNING:
Work on the electrical system and equipment must be carried out only by a skilled electrician or by instructed persons under the supervision and guidance of a skilled electrician and in accordance with electrical engineering rules and regulations.

Work on gas equipment must be carried out by specially trained personnel only.

A warning light can be connected to the LPX® laser to give a remote indication of the state of the laser. The burning light indicates that the laser is emitting radiation.

It is possible to connect one external EMO (Emergency OFF Switch) to switch off the laser remotely, e. g., when the door of the laser room is opened.

2.1 Primary Safety Hazards

1. High intensity ultraviolet radiation of 193 nm, 248 nm, 308 nm and 351 nm.

WARNING:
The ultraviolet radiation of an excimer laser represents a special source of danger since the radiation lies outside the visible range. Make sure that suitable protective eye-wear is available for putting the laser into operation.

For further information see Section 17.

2. The alignment laser emits radiation at a wavelength of 670 nm.
3. Gases, including the toxic fluorine or hydrogen chloride.

   The MAK values according to the German publication:

   "Technische Regel (TRGS 900) des Ausschuß für Gefahrstoffe des Bundesministeriums für Arbeit und Soziales"

   are as follows:

   Limits F_2:

   0.1 ppm (0.2 mg/m³)

   Limits HCl:

   5.0 ppm (7 mg/m³)
4. High voltage electricity, up to 26 kV.

2.2 Secondary Safety Hazards

1. Ozone may be generated by high intensity radiation at 193 nm.

   The MAK values according to the German publication

   "*Technische Regel (TRGS 900) des Ausschuß für Gefahrstoffe des Bundesministeriums für Arbeit und Soziales"*

   are as follows:

   Limit O_3:

   0.1 ppm (0.2 mg/m³)

2. Ionizing radiation is generated by the HV switch used (thyratron).

   Limit Radiation:

   0.2 µSievert/h at 10 cm distance

2.3 Constructive Safety Features

The laser is equipped with the following constructional safety features:

2.3.1 Radiation Safety Features

- Appropriate Class IV label affixed to laser enclosure.
- All parts of the laser where radiation may possibly escape are marked with the appropriate danger signs (according to IEC 825).
- A red Laser ON warning light is located next to the beam exit aperture on the laser housing front panel. The warning light illuminates when the laser is emitting radiation.
- Each beam exit from the laser housing can be closed by a manually operated baem shutter.
- LPX® series lasers are provided with a connector (”Remote”) on the connection panel of the HV power supply module. This enables connection to external electrical circuits for a warning light and an interlock switch (the appropriate plug is included in the service box)

  The warning light signals that the laser is operating and therefore warns of the risk of laser radiation.

  The interlock switch shuts down the laser externally, for instance if a door connected with the switch is opened.

- All service panels on the LPX® are equipped with interlock switches which shut off the high voltage if a panel is opened during operation.

2.3.2 Electrical Safety Features

The follwing safety features protect the user from the potentially lethal hazards associated with high voltage power sources.

- Incorporated in the main switch is an Emergency Off (EMO) function. The main switch is located on the operating panel of the LPX®.
- All potentially lethal voltages are contained in fully protected and grounded enclosures.
- Openeing a service panel triggers an interlock switch that shuts off the high voltage and, consequently, the laser radiation.
- High voltage warning labels are prominently displayed on all three high voltage modules: the High Voltage Power Supply (external), the Gas Processor Power Supply, and the High Voltage Circutiry.
- For servicing, the capacitors can be discharged to ground through a safety stick.
- All AC power wiring is UL- or VDE-recognized and rated at 600 V. Brown, black and black are used for line phases, yellow-green is used for ground and blue for neutral.
- Each AC power module has a yellow-green grounding connector. All power connectors have grounding pins that make first and break last.
- The Power Module shielding encloses the HV parts of the laser to protect the surroundings from the ionizing radiation and electromagnetic interference.
- A fully enclosed laser housing shields the surroundings from the ionizing radiation. The emission of ionizing radiation has been checked by the official institute in Germany responsible for radiation control (Physikalisch Technische Bundesanstalt - PTB). No radiation beyond background radiation was detected with the covers closed.
- Fast acting magnetic circuit breakers with at least 10,000 ampere interrupting capacity, a lockable disconnect means, and an emergency-off function are supplied in an Emergency Off module.
- All AC power connectors are labeled for identification. AC power and signal lines are never combined in the same connector.

2.3.3 Gas Handling Safety features

The Lambda Physik Excimer Laser incorperates the following pressure and gas handling safety features:

- The laser tube is designed in accordance with the official German pressure vessel regulations, the Druckbehälterver-ordnung (Allgemeine Vorschrift, DruckbehV"; edited by the "Bundesministerium für Arbeit und Soziales"; Germany). Every tube is tested up to 4.5 bar (abs).
- If the tube pressure exceeds 4.3 bar, a safety valve opens and leads the gas via halogen filter into the exhaust.
- Gas valves are automatic and electrically operated.
- All utilities connections are located at one end of the laser.
- The main enclosure is fully interlocked.
- All gas fittings are 6 mm Gyrolok™.
- A powerful ventilation system causes continuous underpressure in the laser housing during laser operation. This prevents toxic gas from escaping into the ambient air in case of a leak.
- The exhaust is designed to ensure ventilation of all components.
- The optional VUV-adapter enables the beam path of the laser to be continously purged with nitrogen. The beam path has to be purged if the laser operates with ArF (wavelength: 193 nm). A fully nitrogen-purged beam path prevents the formation of ozone.

2.3.4 Fire Safety Features

The fire safety features designed into Lambda lasers eliminate the use of materials which are combustible or produce toxic vapours as well as preventing flames from spreading or burning materials from dripping. The design incorporates the following specific fire safety features:

- Polyvinyl chloride (PVC) is not used, except for electrical wire insulation.
- No ventilation holes in fire break enclosures are in excess of 5 mm (0.20") in diameter. Hole arrays are used as required.
- Material meeting or exceeding UL 94-V0 is used.

2.3.5 Mechanical Safety Features

The mechanical design provides protection against any hazards which could cause physical injury or burns. Specific mechanical safety features are listed below.

- Air fans have grill guards with less tham 6.4 mm (0.25”) access.
- No high temperature components are accessible to touch.
- The LPX® enclosure has been designed with a low center of gravity to minimize the tipping hazard.

2.3.6 General Safety Features

- The laser can only be switched on with the key switch. This prevents inadvertant or unauthorized starting of the laser. It cannot be operated with the key in OFF position and the key cannot be removed in the ON position.
- No polychlorinated biphenyl (PCB) is used.
- No asbestos is used.

3 Physical Dimensions

CAUTION:
Due to the weight of the laser, make sure that for installation appropriate means of transport (e. g. a forklift) are available.

LPX® 200i/300i:

Laser (l × h × w)	1966 × 473.5 (+40*) × 800 mm^3 77.4” × 18.6” (1.57”) × 31.5”
Weight LPX 200i	370 kg / 814 lbs
Weight LPX 300i	400 kg / 880 lbs

(Appendix Figure 5)

Power Supply:

Length × height × width	750 × 460 × 185 mm^3 29.5” × 18.1” × 7.3”
Weight	50 kg / 110 lbs

Vacuum Pump:

Length × height × width	230 × 450 × 240 mm^3 9.1” × 20.9” × 9.4”
Height (filter included)	530 mm
Weight	23 kg / 51 lbs

*) the lasers have adjustable feet (see Figure 6, Appendix)

4 Electrical Requirements

400 VAC ±10 %,
3 phase,
50 Hz

or:

208 VAC ±10 %,
3 phase,
50/60 Hz

Power consumption:

LPX® 200i:	8 kVA
LPX® 305i:	6 kVA

Current:

Laser Type	**400 V version**	**208 V version**
LPX® 200i:	12 A	24 A
LPX® 305i:	9 A	18 A

Cable:

A 5-wire cable (3P + N + PE) connects the power supply to the mains voltage. Two cable connect the HV power supply module to the laser head. The vacuum pump is connected to the laser head by a 3 m long cable.

The vacuum pump is connected to the laser head with a 3 m long cable and does not require an additional current supply.

Connector:

CEE-Plug (3P + N + PE, 32 A), according to VDE 0623, DIN 49 465, CEE 17, IEC 309-1/-2 (for Germany).

5 Remote Control Interlock

The number and location of external interlock switches must be determined by the safety requirements at the laser installation site. Typically, each installation has a unique configuration.

The external interlock switches get connected to the laser by means of a the remote interlock connector. The remote interlock connector for LPX® lasers is situated on the rear side of the HV power supply.

The connector is an 4 pin EMI-filtered female connector. Pins 1 and 4 serve as connection for an external laser radiation lamp (24 VAC/100 mA max.) Pins 2 + 3 serve as connection for the remote interlock short circuit (Figure 4).

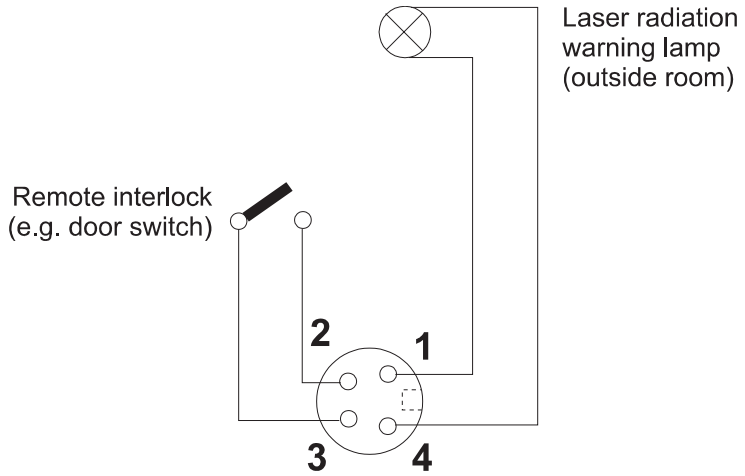

Figure 4: Remote Control Interlock

To ensure laser operation it is necessary to shorten pin 2 and 3 via a bridge (the appropriate plug is enclosed in your tool box) or an external switch. If not, the laser will shut down immediately with an interlock message.

6 Serial Interface (RS232C)

The laser can be controlled by an external PC. For the information transfer between the external computer system and the local PC an RS232 interface is used. The data format for this transfer is:

data bits	**8**
parity	**OFF**
stop bit	**1**
baud rate	**9600**

The connector is a 25 pole D-type female or a 9 pole D-type male connector with M3 lockings.

9 pole D-type male connector:

PIN	Signal	Specific.	Descripion
2	RXD	I, RS232	Receive Data
3	TXD	O, RS232	Transmit Data
5	GND		Signal Ground
9	+15 V from Communication Interface		

25 pole D-type female connector:

PIN	Signal	Specific.	Descripion
1	NC		shield
3	RXD	I, RS232	Receive Data
2	TXD	O, RS232	Transmit Data
7	GND		Signal Ground
9	+ 15 V for Handheld Keypad		

All signals are compatible to the standard RS232 levels:
+5 to +15V for SPACE and -5 to -15V for MARK.

7 Specification: External Trigger In and Sync. Out Signal

7.1 External Trigger In

It is possible to trigger the LPX® laser with an external source (trigger generator). This source has to be connected to the ‘EXT. TRIG.’ socket at the rear side of the PC-controller. The specifications of this input are as follows:

Voltage:	+3.3 V.....+5 V
Impedance:	≥ 10 kΩ
Duration:	≥ 15 µs.....1 ms
	triggered on positive slope
Connector:	BNC

7.2 Sync. Out Signal

The trigger generator sends a pulse to the laser to fire.

At the same time a trigger pulse is sent to the ‘SYNC. OUT’ BNC socket at the PC-controller.

Voltage:	+3.3 V.....+5 V
Impedance:	≥ 1 kΩ
Duration:	≥15 µs
	triggered on positive slope
Connector:	BNC

8 Cooling Water

The LPX® 200i/300i are fully water-cooled.

CAUTION:
Do not use distilled or deionized water! (Danger of corrosion!)

Note:
Suspended particles in the cooling water can cause sedimentation or even clog in the cooling circuit. Thus, the installation of a particle filter which is available in every installation store is strongly recommended.

Note:
More than 2000 liters of water are consumed a day during intensive use of the excimer laser. Because of cost and environmental factors we recommend the installation of a water chiller.

Please contact Lambda Physik for further information.

Specifications:

Temperature range (at water inlet)	10 °C to 20 °C for 100% duty cycle
Flow	depends on the temperature of the water: about 4 l/min for LPX 200i series, about 6 l/min for LPX 305i
Pressure	2 bar < p ≤ 4 bar abs.
Heat transfer to water	≤ 3 kW
Connectors In /Out	½ inch pipe (outer diameter)

9 Gases

9.1 Gas Manufacturers

Recommended Gas Suppliers, Germany:

Spectra Gases GmbH

Ostheimer Allee 3-7
D - 64832 Babenhausen

Tel.: (06078) 6 20 01
Fax.: (06078) 6 20 08

AGA Gas GmbH

Postfach 201954
D - 20209 Hamburg

Tel.: (040) 42 10 50
Fax: (040) 42 105-342

Linde AG

Technische Gase, Seitnerstraße 70
D - 82049 Höllriegelskreuth

Tel.: (089) 74 46 10 72
Fax: (089) 74 46 16 59

Messer Griesheim GmbH

Industrial Gases Division, Fütingsweg 34
D - 47805 Krefeld

Tel.: (02151) 37 90
Fax: (02151) 37 91 15

Recommended Gas Suppliers, USA:

Spectra Gases, Inc.

277 Coit Street
Irvington, NJ 07111

phone: 201-372-2060
fax: 201-372-8551/0811

Air Products

Air Products + Chemicals Inc.
7201 Hamilton Blvd.
Ellentown, PA 18195

phone: 215-481-7728
fax: 215-481-7728

Recommended Gas Suppliers, Japan

Tomoe Shokai Co. Ltd.

1-1-25 Minami-Kamata
Ohta-ku, Tokyo 144 Japan

phone: 03-3734-1111
fax: 03-3739-1070

Iwantani Sangyo Ltd.

3-21-8 Nishishinbashi
Minato-ku, Tokyo 105 Japan

phone: 03-5405-5915
fax: 03-5405-5636

9.2 Gas Requirements

The active medium of an excimer laser is a mixture of a rare gas, a halogen and a buffer gas. The gases are mixed in the laser itself.

You need different gas mixtures for operating an LPX® laser on different wavelengths:

Gas Mixture	Wavelength
Ar, He, F_2 and Buffer (Ne [1)])	193 nm
Kr, He, F_2 and Buffer (Ne)	248 nm
Xe, He [2)] , HCl, H_2 and Buffer (Ne)	308 nm
Xe, He, F_2 and Buffer (Ne)	351 nm

Normally an LPX® laser is prepared for operating at one wavelength only.

It is possible to operate LPX® on up to four different wavelengths (193, 248, 308 and 351 nm) if the laser is prepared for multigas and up to three wavelengths (193, 248 and 351 nm) if optimized for fluorine operation.

Ensure that appropriate single gases and gas mixture(s) are available.

For low duty cycle applications that consistently use the same wavelength, a premix gas cylinder operation can be recommended. In this case one cylinder of premix gas and another one with inert gas (Helium) for flushing is required.

Using Lambda Physik´s halogen source Halo Safe® reduces gas installation.

1) Lambda Physik is the owner of US Patent # 4,393,505. This patent covers neon as a buffer gas to enhance excimer laser performance.

2) Lambda Physik is the exclusive licensee under US Patent # 4,340,968. This patent covers hydrogen as an additive to improve XeCl laser performance.

9.3 Pressure Regulators

Pressure regulators are delivered by gas manufacturers. Lambda Physik recommends pressure regulators which operate up to 5 bar (abs.) minimum. The joints for the gas pipes have to be provided with Gyrolok™-fittings for 6 mm pipe diameter.

CAUTION:
Stainless steel regulators are required for halogen gases.

9.4 Gas Cabinets

Gas cylinders, especially those containing fluorine or hydrogen chloride gas mixtures are in principal a safety hazard because of the risk of leakage. In order to diminish this risk safety gas cabinets are available. Please contact the gas manufacturers for further information.

CAUTION:
Especially for halogen gases a maximum of cleanness is required for the gas tubings.

Connections and Tubing:

Gas Connections:	6 mm Gyrolok™
Gas Tubing:	stainless steel 316 L, degreased and inside electropolished, 6 mm outer diameter

Note:
The halogen supply line, using the external gas cylinder, is recommended to be a double wall tubing.

9.5 Gases Required

The performance of the excimer laser depends on:

- quality of the gases used
- tightness of the gas installation
- cleanness of the gas equipment

Gas purity and gas mixture have a decisive influence on :

- pulse energy of the laser
- laser power
- gas lifetime
- energy and pulse-to-pulse stability

Fluorine (only required without the optional halogen generator)

Type of gas	5 % F_2 / 95 % He mix
Purity of Helium	99.995 %
Purity of Fluorine	for excimer laser, HF-free
Pressure regulator	$3.5 < p \leq 5$ bar abs.
Flow	0.3 < flow < 3 l/s
RCS [3)]	10 l, 28 bar, 400 psi

Hydrogen Chloride (in a gas mixture)

Type of gas	5 % HCl/1 % H_2 in He
Purity of the mixture	99.995 %
Pressure regulator	$3.5 < p \leq 5$ bar abs.
Flow	0.3 < flow < 3 l/s
RCS [3)]	10 l, 100 bar, 1400 psi

3) RCS = Recommended Cylinder Size expressed as internal water volume and initial pressure.

Argon

Purity	99.995 %
Pressure regulator	3.5 < p ≤ 5 bar abs.
Flow	0.8 < flow < 3 l/s
RCS [3]	50 l, 200 bar, 2800 psi

Krypton

Purity	99.99 %
Pressure regulator	3.5 < p ≤ 5 bar abs.
Flow	0.8 < flow < 3 l/s
RCS [3]	10 l, 100 bar, 1400 psi

Xenon

Purity	99.99 %
Pressure regulator	3.5 < p ≤ 5 bar abs.
low	0.8 < flow < 3 l/s
RCS [3]	2.5 l, 50 bar, 700 psi

Neon [4]

Purity	99.995 %
Pressure regulator	3.5 < p ≤ 5 bar abs.
Flow	0.8 < flow < 3 l/s
RCS [3]	50 l, 200 bar, 2800 psi

Helium (flushing gas for the laser tube)

Purity	99.995 %
Pressure regulator	3.5 < p ≤ 5 bar abs.
Flow	0.8 < flow < 3 l/s
RCS [3]	50 l, 200 bar, 2800 psi

4) Lambda Physik is the owner of US Patent # 4,393,505. This patent covers neon as a buffer gas to enhance excimer laser performance.

Nitrogen (purge gas for the beam path, especially for operation at 193 nm)

Purity	99.999 % or boil off
Pressure regulator	$2 < p \leq 2.5$ bar abs.
Pressure regulator (for halogen source)	$6.5 < p \leq 7$ bar abs.
Flow	1 < flow 12 l/min)
RCS [3)]	50 l, 200 bar, 2800 psi

Note:
Buy only as much gas as required for one year, especially F_2 and HCl, because these gases decay in the cylinders by wall reaction.

9.6 Optimum Gas Mixture (November 1996)

LPX®210i	Wavelength	Pressure [mbar]	Gas	Pressure [%]	Total Pressure
	ArF (193 nm) for LPX® 210i Multigas	80 170 2750	F_2/He Ar Ne	0.13/2.53 5.67 91.67	3000 mbar
	ArF (193 nm) for LPX® 210i Fluorine	100 150 2750	F_2/He Ar Ne	0.17/3.17 5.00 91.67	3000 mbar
	KrF (248 nm) for LPX® 210i Multigas	70 100 2830	F_2/He Kr Ne	0.12/2.22 3.33 94.33	3000 mbar
	KrF (248 nm) for LPX® 210i Fluorine	80 150 3030	F_2/He Kr Ne	0.12/2.33 4.60 92.94	3260 mbar
	XeCl (308 nm) for LPX® 210i Multigas and XeCl	80 60 2760	HCl/H_2/He Xe Ne	0.14/0.03/2.59 2.07 95.17	2900 mbar
	XeF (351 nm) Multigas- and XeCl-Version	220 15 2265	F_2/He Xe Ne	0.18/8.45 0.30 96.06	3300 mbar

LPX®220i	Wavelength	Pressure [mbar]	Gas	Pressure [%]	Total Pressure
	ArF (193 nm)	130	F_2/He	0.20/3.86	
		250	Ar	7.81	
		2920	Ne	91.25	3200 mbar
	KrF (248 nm)	80	F_2/He	0.13/2.45	
		110	Kr	3.55	
		2910	Ne	93.87	3100 mbar
	XeCl (308 nm) **only** f. LPX® 220i XeCl Version	60	HCl/H_2/He	0.09/0.02/1.66	
		50	Xe	1.47	
		3290	Ne	96.76	3400 mbar
	XeF (351 nm)	220	F_2/He	0.37/6.97	
		15	Xe	0.5	
		2765	Ne	92.17	3000 mbar

LPX®305i	Wavelength	Pressure [mbar]	Gas	Pressure [%]	Total Pressure
	ArF (193 nm)	100	F_2/He	0.14/2.71	
		140	Ar	4.00	
		3260	Ne	93.14	3500 mbar
	KrF (248 nm)	70	F_2/He	0.10/1.85	
		100	Kr	2.78	
		3430	Ne	95.38	3600 mbar
	XeCl (308 nm) **only** f. LPX® 305i XeCl Version	80	HCl/H_2/He	0.12/0.02/2.28	
		60	Xe	1.82	
		3160	Ne	95.76	3300 mbar
	XeF (351 nm)	120	F_2/He	0.16/3.08	
		10	Xe	0.27	
		3570	Ne	96.49	3700 mbar

10 Air Intake and Exhaust

The laser has one air intake and one air exhaust (see Fig. 5 in the Appendix). The intake air of the laser is the ambient air. Under normal operating conditions the exhaust air does not contain any toxic gases or by-products. Nevertheless, for certain failure scenarios the exhaust air may include halogen gas or ozone in a small concentration and shall be treated accordingly. An effective protection is only guaranteed if the hose is led to an appropriate ventilation.

CAUTION:
Lead the exhaust of the laser and the vacuum pump into an appropriate exhaust.
Make sure that the exhaust of the laser and the vacuum pump is not connected to the duct system of systems used for the processing of breathing air (e. g. air conditioning or ventilating systems).

Specifications:

Air Flow	minimum ≈ 160 m³/h recommended ≈200 m³/h maximum ≈250 m³/h
Diameter	150 mm Hose length 3 m max. If the distance to the ventilation is more than 5 m, an additional blower has to be installed.
Heat transfer to exhaust	< 1 kW

11 Vacuum Pump

Connections:

The vacuum pump is connected to the laser by a 2 m long vacuum hose. The voltage supply is provided by a 3 m long cable which is attached to the laser.

Note:
The vacuum pump is a dry-running pump.

Clearance between the vacuum pump and adjacent walls should not be less than 10 cm of free space in order to ensure sufficient air flow for cooling. Ambient temperatures should not exceed 40 °C.

The user should provide a flexible 3/4” hose for the connection of the pump exhaust to the main ventilation.

CAUTION:
Lead the exhaust of the vacuum pump into an appropriate exhaust.
Make sure that the exhaust of the vacuum pump is not connected to the duct system of systems used for the processing of breathing air (e. g. air conditioning or ventilating systems).

12 Beam Exit Position

The laser beam exit position is shown in Figure 5 in the Appendix. The laser is equipped with height-adjustable feet (Figure 6 Appendix). Therefore, the beam exit can be varied up to 40 mm in the vertical position.

13 Maintenance / Installation Area

The required space for the installation is represented in the maintenance area (Figure 7 in the Appendix).

The installation and connection of the gas lines need a space of at least 80 cm at the rear side of the laser.

For maintenance and service actions a space of at least 80 cm at the left side of the laser is required (Figure 7 in the Appendix).

For maintenance or service actions which can be done by removing the quick access service panels of the LPX® 200i/300i a clear height of at least 60 cm above the laser is required.

14 Transport and Storage Conditions

Temperature range	-20 ...50 °C
Max. temperature gradient	5 °C/h
Ambient air pressure	650...1070 mbar
Max. pressure gradient	75 mbar/h
Humidity	< 50 % RH

15 Operational Environmental Conditions

Temperature range	5 - 25 °C
Max. temp gradient (after warm up)	2 °C/h
Altitude	0 ... 2000 m above sea level
Humidity	30 - 70 % RH

CAUTION

Make sure that the air is free of dust, oil, organic particles, corroding substances and photochemical decompositables or depositable compounds.
It is required to protect the beam path and the laser optics with a purgeable shield at critical environmental conditions.

Cleanliness	class 10,000 or better

Please contact Lambda Physik for more information.

16 Specifications

All specifications are subject to change without notice in order to provide the best product possible. All data are measured with an energy monitor and optimized gas mixtures.

LPX® 200i series	Type of Laser	ArF	KrF	XeCl	XeF	Units
Wavelength		193	248	308	351	nm
Pulse Energy [1]	LPX® 210i (Multigas, XeCl)	400	600	400	320	mJ
	LPX® 210i F-Version	450	700	—-	400	mJ
	LPX® 220i F-Version	275	450	—-	200	mJ
	LPX® 220i XeCl-Vers.	—-	—-	250	—-	mJ
Max. Rep. Rate	LPX® 210i	100	100	100	100	Hz
	LPX® 220i	200	200	200	200	Hz
Average Power [2]	LPX® 210i (Multigas, XeCl)	32	56	38	28	W
	LPX® 210i F-Version	35	65	—-	35	W
	LPX® 220i F-Version	45	80	—-	35	W
	LPX®220i XeCl-Vers.	—-	—-	45	—-	W
Pulse Duration (nominal)	LPX® 210i	20	25	28	25	ns, FWHM
	LPX® 220i	15	20	18	18	ns, FWHM
Beam Dimensions [3]	LPX® 200i series	5-12 x 23	5-12 x 23	5-12 x 23	5-12 x 23	mm² (V x H)
Beam Divergence [3]	LPX® 200i series	1 x 3	1 x 3	1 x 3	1 x 3	mrad (V x H)

1) measured at low repetition rate
2) measured at max. repetition rate
3) typical value, FWHM

LPX 305i	ArF	KrF	XeCl	XeF	Units
Wavelength	193	248	308	351	nm
Pulse Energy [1)]	650	1200	600	400	mJ
Max. Rep. Rate	50	50	50	50	Hz
Average Power [2)]	25	50	25	15	W
Pulse Duration (nominal)	20	25	28	30	ns, FWHM
Beam Dimensions [3)]	10-15 x 30	10-15 x 30	10-15 x 30	10-15 x 30	mm² (V x H)
Beam Divergence [3)]	1 x 3	1 x 3	1 x 3	1 x 3	mrad (V x H)

1) measured at low repetition rate
2) measured at max. repetition rate
3) typical value, FWHM

17 Recommendations

Safety

As a standard on laser safety we recommend the publication:

"Safety with Laser and other Optical Sources"; D.H. Sliney and M.L. Wolbarsht; Plenum Press, New York, London.

Safety Glasses

Make sure that appropriate safety glasses for the UV-spectral range are available. For USA and Canada all eyewear has to meet or exceed ANSI 136.1 (1993) requirements. For Germany and the European Union all eyewear has to meet or exceed EN 207 and therefore the CE standard. For other regions the eyewear has to meet or exceed regional and/or local requirements.

Gas Cabinets

Please be aware of the fact that gas cylinders, especially those which contain fluorine- and hydrogen chloride-gas mixtures are in principal a safety hazard because of the risk of leakage. In order to diminish this risk safety gas cabinets are available. Please contact the gas manufacturers for further information.

Table

Depending on the model, the laser weighs up to 500 kg. Therefore a stable support or suitable table is necessary. However, the vibration-cushioned laser tables commonly used for continuously operated lasers are not required for the operation of a LPX excimer laser.

Energy Meter

Single pulses can be measured with a pyroelectric joule meter.

For further information please call:

Coherent Auburn Group,
Bld.1: 2301 Lindbergh St.,
Auburn, CA 95602-9595

fax: (916) 823-9550
phone: (916) 888-5107

or:

Coherent GmbH,
Dieselstrasse 5b,
D - 64807 Dieburg, Germany

fax: +49 6071 968-499
phone: +49 6071 968-0

Energy Meter Display

In order to display the detector signal during measurements we recommend the read-out unit of Coherent or a simple oscilloscope, e. g. TEK 2213.

For the installation procedure the equipment of our service engineer includes a detector.

The oscilloscope has to be provided by the customer.

For further information please call Coherent (Address see above).

Power Meter

Thermopile power meters are suitable for measuring the average power output.

For higher demands we recommend the FIELDMASTER or LABMASTER of Coherent.

For further information please call Coherent (Address see above)

Alignment

For alignment procedures Lambda Physik offers Diode Laser (670 nm) and alignment mechanics. These tools can be adapted to all LPX® lasers which include dielectrically coated rear mirror optics.

Unstable Resonator Optics

Unstable resonator optics allow generation of a low divergent laser beam of high focusability. For further information please call Lambda Physik.

Tools

A tool kit which includes all necessary parts for routine operation is provided free with the laser.

Water Filters

Suspended particles in the cooling water can cause sedimentation or even clog in the cooling circuit. Therefore, we recommend the installation of a filter which is available in every installation store.

Please contact Lambda Physik for further information.

Cooling

More than 2000 liter water are consumed a day during intensive use of the excimer laser. Due to cost and environmental factors we recommend the installation of a closed cycle heat exchanger.

Please contact Lambda Physik for more information.

18 Checklist

- The laser system is delivered by a forwarding company. Please see the order confirmation for the planned date of delivery.
- Even with the most careful packing, damages during transport can not be excluded. Therefore, please check after receiving if the content is complete and undamaged.
- Before you finally contact our service department for installation of the laser, please check the following:
  - ☐ support/table
  - ☐ gases (see Section 9), term of delivery: 4-6 weeks!
  - ☐ power supply (see Section 4)
  - ☐ water supply (see Section 8)
  - ☐ air intake and exhaust (see Section 10)
  - ☐ exhaust vacuum pump (see Section 11)
  - ☐ safety (see Section 2)
  - ☐ appropriate protective eyewear (see Section 17)

CAUTION:
Due to the weight of the laser, make sure that for installation appropriate means of transport (e. g. a forklift) are available.

19 Service

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20 Appendix

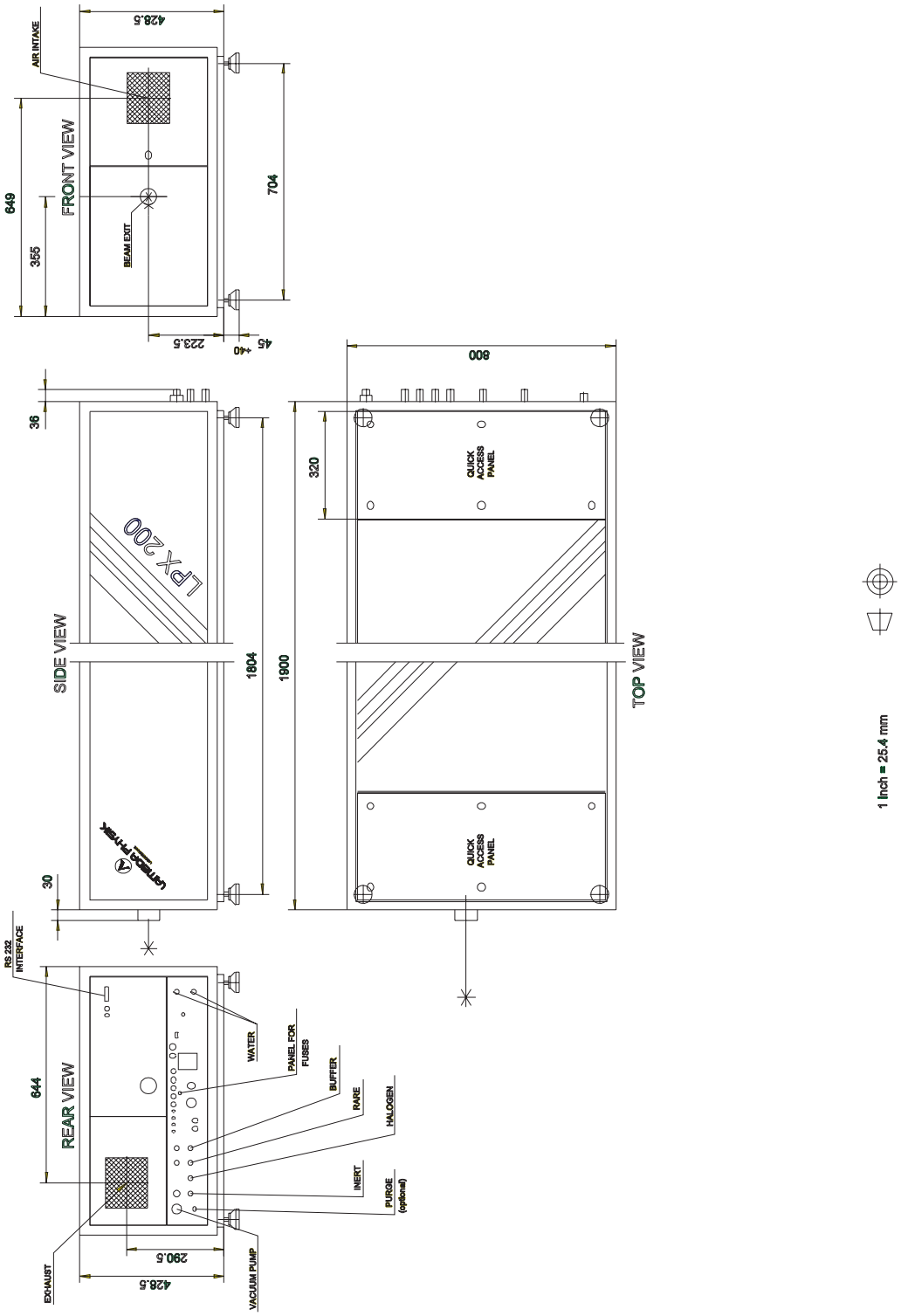

Figure 5 : Dimensions LPX 200i/300i

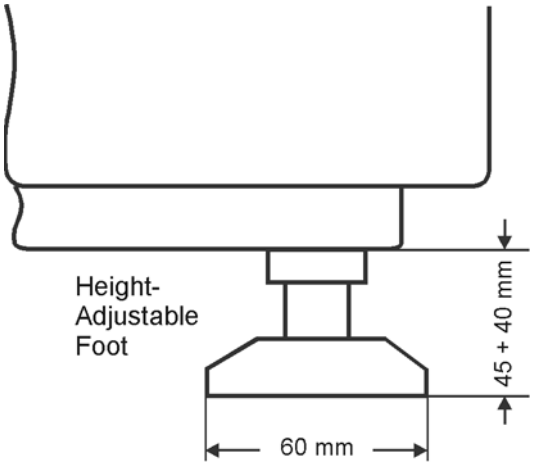

Figure 6 : Height-Adjustable Feet of LPX® series

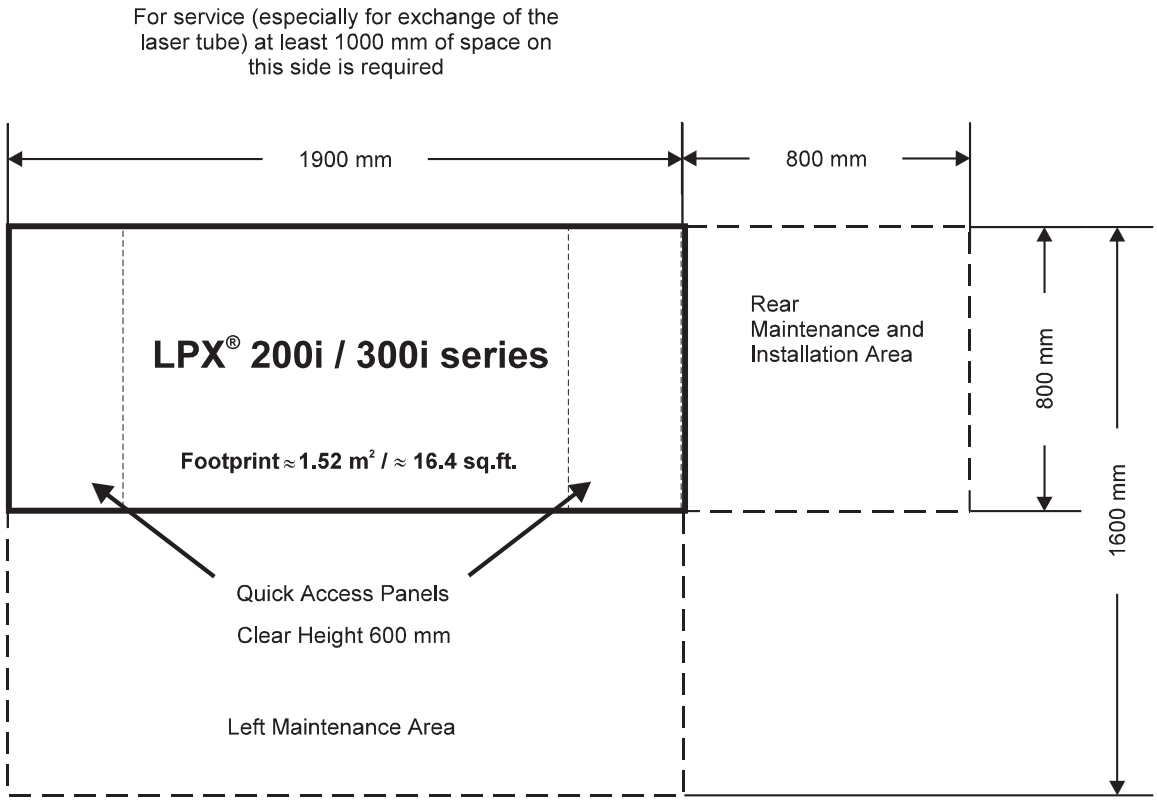

Figure 7: Maintenance Area LPX 200i/300i