User Manual

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Diode Laser
LU0980D100 and LU0808D070

Figure 1: Image of the LU0980D100 and LU0808D070 diode laser

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Short description:
This document describes how to put the LU0980D100 and the LU0808D070 into operation. Special care must be taken to ensure that during handling and operation of diode laser proper ESD/EOS practices are followed, and that the optical fiber pigtail is suitable protected from physical and thermal damage.

Lumics GmbH shall not be liable for errors in this manual or damages in connection with the use of this material. The information contained in this manual is subject to change with prior notice.

Read this operating instruction manual carefully before putting the LU0980D100 or the LU0808D070 into operation.

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1. Preface

1.1 Laser Safety

The LU0980D100 and the LU0808D070 are CLASS 4 laser products.

Avoid any eye or skin exposure to direct or scattered radiation light emitted form the optical fiber output of the LU0980D100 and the LU0808D070 diode laser module

Always use protective eyewear during operation of the laser. For guidance please consult user standards such as ANSI, ACGIH, or OSHA. Never open the protective housing of this laser. The diode laser is a class 4 laser product with invisible infrared laser radiation, and a class 3R laser product with visible radiation.

The LU0980D100 and the LU0808D070 are OEM products for incorporation into other equipments and are only to be used as component. The equipment integrator is responsible for CDRH (center for devices and radiological health) certification of all systems sold with this product. He is also responsible for the certification and use of this diode laser according to EN60825-1 and its appendices.

Do not open the diode laser. All the service and maintenance work should be performed by Lumics employees only.

1.2 Optical Safety

The laser is a source of intense light having characteristics that are very different from the light emitted from conventional light sources. Therefore, before attempting to operate the laser, the user must be aware of these characteristics of laser light and the proper safety precautions. The energy level of the laser beam is high enough to cause serious injury to the eye with probable loss of vision if the beam were to pass directly into the eye. When the laser beam is collimated, the energy in the beam remains high and dangerous even at great distances form the laser.

1.3 Electrical Safety

The LU0980D100 and the LU0808D070 is operated using a DC power supply. The voltage involved and the current available have the potential to cause fatal electric shock. Do not switch on the unconnected and /or unprotected power supply.

1.4 Safety Recommendations for using the Laser

Review the following safety precautions before operating the laser system:

NEVER LEAVE THE LASER ON, OPEN, AND UNATTENDED!

1. Never open the laser cover.
2. Remove the power supply when not operating the diode laser.
3. Do not allow untrained and not experienced personnel to handle the laser.

4. When the laser is on, and the output beam is not being terminated an experiment or optics system. The beam should be blocked.
5. NEVER LOOK DIRECTLY INTO THE MAIN LASER BEAM
6. Remove the power supply when inspection or cleaning the fiber connector
7. Always avoid placing reflective objects in the laser beam. Laser light scattered from a reflective surface can be as damaging as the original beam.
8. Post warning signs when laser is in operation, limit access to the laser area.

1.5 Check the contents / required equipment

When you open your package you will find the following items:
1) Black plastic box with your diode laser including mounted short circuit bridge.
2) Transparent document case including:

- ✓ 10 pcs of mounting screws M3
- ✓ Plastics washers
- ✓ Power Cables 0.5 m
- ✓ Cable shoes
- ✓ Signal cable with 16 pin connector
- ✓ Test report
- ✓ User manual
- ✓ Invoice and delivery note

Comment:
If you have just received the LU0980D100 or the LU0808D070 diode laser please wait at least 3-4 hours at room temperature, before operating the device. This is simply to balance any temperature variations which might have occurred during transportation.

In order to install and operate your LU0980D100 or the LU0808D070 you need the following equipment:

a) Optical fibre multi mode SMA905 core 200µm diameter, and 220, 240 or 280µm cladding or larger. The fibre centricity should < +/-10µm. The fiber connector should be designed as shown in Fig. 2. Reference: A.R.T. Photonics, Germany or Richard Losch, USA. Fibre microscope to inspect the facet of the optical fibre / Reference: Laser 2000, Germany or Roithner Lasertechnik, Austria.

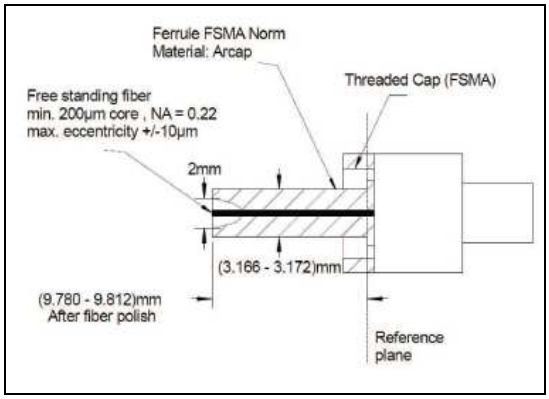

Figure 2: Drawing of the SMA connector

b) Power supply for the red pilot laser diode with up to 13A and 3V DC with all its protection against current and voltage spikes. Reference: OSTECH or Schulz Elektronik, Germany
c) Power supply with up to 12V to operate the features such as power monitor diode or fiber detection sensor
d) Heat sink, or cooling block of aluminium or copper including fan with sufficient air flow to ensure, that the base temperature of the diode laser does not exceed its max operating temperature during operation. The cooling plate should have a finish roughness of 0.5µm and the thermal resistance should be <0.1K/W. Reference: Fischer Elektronik, Germany or DAU, Austria.
e) Peltier elements with modulation possibilities. Standard size 40x40mm. Reference: Uwe Electronic, Germany or Melcor, USA
f) Temperature sensor control unit for the high-power diode laser

1.6 Warranty

Lumics warrants the LU0980D100 and the LU0808D070 to be free from defects in material and workmanship for 24 months from the date of shipment. If any item of the laser fails during the warranty period specified above, return the item freight prepaid to Lumics. Lumics will, at its option, repair or replace the defective item and return it freight prepaid to your facility. Any attempt by the user to repair any LU0980D100 and the LU0808D070 during the above warranty will void the warranty.

After the expiration of the warranty period, Lumics will, provided the defective item is returned to Lumics, repair the item on a time and material cost basis

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When you return products to Lumics, please ask for the RMA number. Lumics does not accept any returns without an RMA number, and/or if the products are mechanically damaged, scratched, burned or insufficiently and inappropriately packaged and especially if opened by unauthorised persons.

2. Installation

2.1 Mechanical mounting on heat sink

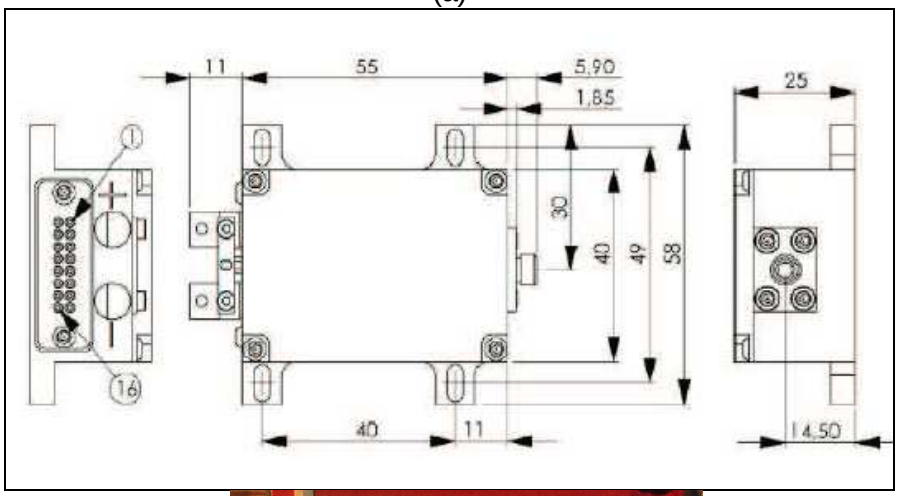
When mounting the LU0980D100 or the LU0808D070 Diode Laser please consider the following information:

Take the diode laser module out of its black transport box. Be sure that the short circuit bridge is still in position between the anode and cathode contact. Keep in mind, that an ESD shock could destroy the laser diode.

Prior to putting the LU0980D100 or the LU0808D070 diode laser into operation mount the laser onto a heat sink capable of cooling up to 20W heat away from the base of the diode laser case. For the heat-sink design the user may adapt the laser mechanical drawing. The four mounting holes are provided on the base plate as shown in Figure 3. M3 screws are recommended for mounting to the heat sink.
For adequate thermal contact to the heat-sink, the surface must be planar and clean. It should be completely free of scratches and dust. Do not use any heat conductive paste, indium foil or carbon foil. It is not necessary if the surface of the heat sink is clean and planar. The heat-sink must be capable of dissipating up to 20 watts, while maintaining the bottom surface within the operating temperature range as specified in the specification sheet. Forced air cooling with a fan, or water cooling should be provided.

Take 4 washers and 4 M3x10mm screws to mount the diode laser module tightly onto your heat sink. Ensure that the base part of the diode laser has tight contact to the heat sink.

(a)



(b)

Figure 3: (a): mechanical drawing, which shows the mounting 4 wholes: 40 x 49 mm
(b) mounting of the diode laser onto the heat sink

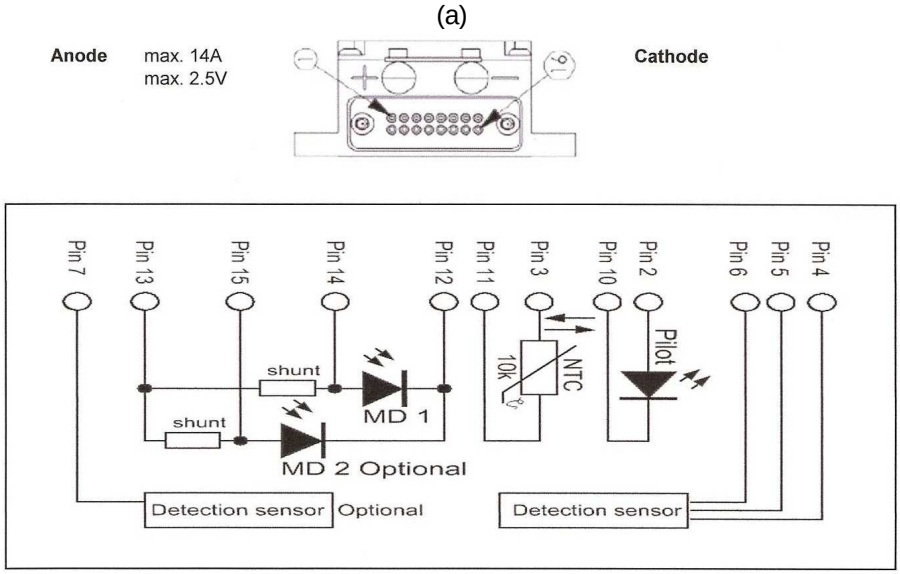
2.2 Connecting the optical output fiber

Before inserting the optical output fiber cable check the facet of the fiber connector as follows:
Use a fiber microscope with 200-400x magnification to check the input and output facets of the optical fiber cable. Make sure, that the facets are clean and free of any damages or scratches. Contaminated or damaged fiber could destroy the Laser modul, for example, by burning of particles. Remove the SMA dust cap, insert the optical fiber and tighten the screw nut. The SMA905 connector of the laser module allows to exchange the optical fiber cable in service cases, but, it is not designed for high frequent exchange. Every time you insert a new optical fiber you have to check the facets of the fiber in order to avoid damage of the laser module and/or the fiber.

2.3 Wiring

The diode laser LU0980D100 and the LU0808D070 are very sensitive to over current and static discharge. Operate the module only in an environment with appropriate grounding and antistatic precautions. Do not exceed the maximal allowed operation current.

(a)



(b)

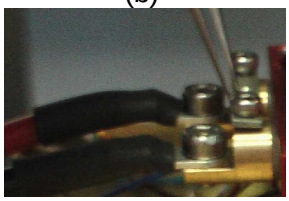


Figure 4: (a) Electrical wiring for the case with NTC temperature sensor.
(b) View of the power line connection

Connect the “anode” (+) and the “cathode” (-) contact with red and black 2.5mm² power cables. Ensure, that the power supply is switched off before connecting the cables. The (+) and (-) power contacts are above the signal connector (see figure 4). Remove the short circuit bridge by loosing the M2 screws (see Figure 4 b).
Warning: Do not cross the polarity; this can cause irreversible damage to the diode laser.

Connect the signal cable with the 16-pin connector and plug the 16-pin connector into the 16-pins of the diode laser module. The electronic circuit is show in Figure 4. The pin connections are shown in Table 3 in the attachment below. Do not solder directly onto the 16-pin connector.
Note: The laser diode is electrically insulated from the diode laser module case.

The pin connections are as follows:

Pilot laser:
Connect the red pilot laser onto pin 2 (+) and pin 10 (-)

Fiber sensor:
The fiber sensor is an Inductive proximity switch. A second fiber sensor is optionally offered. The sensor should be supplied with 12 V on the pins 4 (+) and 5 (- / ground). The same pins provide the voltage supply for the second optionally installed fiber sensor. The signal line for the sensor one and two are provided on pin 6 and 7, respectively.
The voltage between pin 5 (ground) and pin 6 (and optionally pin 7) should be 12V if the SMA connection is plugged in, and close to 0 V if there is no SMA connector in the fiber output plug.

Temperature sensor (two types of temperature sensores are offered):
(a) To the NTC:
The first one is a 10kOhm NTC. It is connected to pin 3 and pin 11.
The sensor is mounted onto the base of the laser module close to the laser diode. Depending on the base temperature the NTC resistance changes as shown in Table 4 shown in the attachment.
(b) To the LM35:
The LM35 is directly calibrated in ℃elsius. It pro vides a 10mV/℃ scale factor. 0.5℃ accuracy is pro vided at 25℃. It operates for supply voltage range from Vs = 4V to 20V. The temperature range fully covers the maximum operating temperature range of the diode laser. The resistance R1 may be chosen as suggested in the Figure 5.
Pin 3 (+ Vs) and pin 11 (ground) are used to apply the supply voltage to the LM35. The signal line (V-out) is provided on pin 7.
Remark: The LM35 is only used if there is only one fiber sensor in the diode laser module.

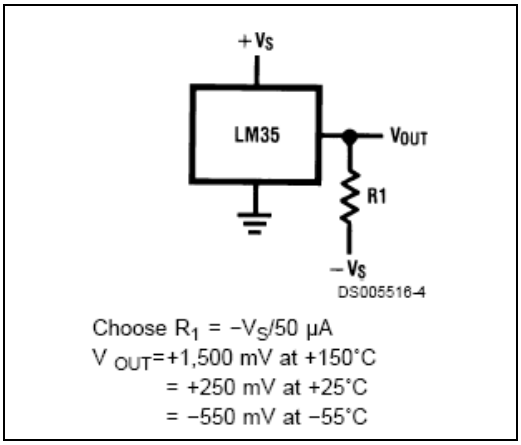


Figure 5: Thermometer circuit for LM35 temperature sensor operated with the supply voltage Vs.

Monitor diode (photo diode):
The two monitor diodes are connected on pin 12 (+) and pin 13 (-). The supply voltage should be about 5 V. The signal line is on pin 14 for the first photo diode, and on pin 15 for the second photo diode.

Now the laser module is ready to be put into operation.

Important note:
The customer has to ensure, that the operation circuit provides protection against over current, device heating above max operating temperature and interlock for the fiber connection. Operation without the fiber connected into the SMA connector must be avoided.

3. Operation

Read the safety precautions in section 3.2 carefully before putting the diode laser into operation.

Warning:
Make sure that the facet of the output fiber exit is absolutely clean and free of particles grease or any other contamination. Use a clean-room compatible tissue, put some Isopropyl alcohol onto it and carefully clean the facet of the fiber facet or connector facet, or use special fiber cleaning tools. For more details see section 3.3.
Strong back reflection, originating for example from metal targets, absorbed by the connector will cause strong overheating with possible damage if the temperature exceeds 40℃. The user must design an optical system in a way to avoid harmful back reflection targeting the fiber or the connector.

3.1 Putting the diode laser into operation

Perform the following steps in order to put the diode laser module into operation:

Turn-on the heat sink operation: powered air cooling, TEC cooling or water cooling.

Before you turn on the power supply of the diode laser ensure, that to operating current is in 0A position. Turn the power supply on. Slowly increase the operating current from I = 0 to the operating current specified in the test report of each individual diode laser.

Comments:

- Adjust the output power by tuning the current limit, not the voltage. Voltage limit of 3V should be sufficient for a normal operation.
- Do not exceed the maximal allowed operation current. See the test report for the individual device for power, voltage vs. injection current characteristic of the diode laser.
- Check the polarization of the + and – pole carefully. Do not apply reverse voltage to the laser, since it can damage laser diodes.
- Do not operate the laser without watching the temperature using the temperature sensor of the laser module. Always ensure operation within the operating temperature range.
- Do not allow the temperature of any parts of laser exceed 50℃, during storage, and 35℃ during operation.
- Do not operate the laser module without proper connection of the output fiber. Provide an interlock using the fiber sensor to avoid operation without the fiber fully connected.
- To reduce possible contaminations do not leave the fiber connector without protective cap.

3.2 Warning / Laser Safety

1. The LU0980D100 and the LU0808D070 diode laser emit very high optical output power and therefore can cause serious damage.
2. The LU0980D100 and the LU0808D070 should only be operated by personnel experienced or trained in high power laser system operation and safety measures.
3. Do not allow access to the diode laser to personnel who are inexperienced or untrained.
4. The laser beam must always be blocked when the diode laser is in operation with the output not being terminated in an experiment or optics system.
5. Never look directly into the laser beam.
6. Always avoid looking down along the laser beam towards the direction where the source of the laser light is.
7. Do not allow reflective objects to be placed in or close to the laser beam. Laser light scattered from a reflective surface can be just as dangerous as the original beam. Even objects such as rings, watches

and metal pens or pencils can be hazardous.

8. Attenuate the laser power to a low level in order to minimize intensity if accidental stray reflections during the alignment of optical components in the laser beam.

9. Do not set up Laser experiments with the laser beam close to the eye level.

10. Use eye protection.

11. Post warning signs and limit access to the laser area when the laser is in operation.

12. Never leave the diode Laser unattended when it is in operation.

General Note:
During installation, operation, maintenance or service of the diode laser – ALWAYS avoid unnecessary exposure to laser light or collateral in excess of the accessible emission limits listed in Performance Standards for Laser Products, such as 21CFR 1040.10 (d).

For further information see the following laser safety information sources:

Deutsche Elektrotechnische Kommission im DIN und VDE (DKE)
Stresemannallee 15; D- 60 596 Frankfurt am Main; www.dke.de

CEN Central Secretariat
36, rue de Stassart; B-1050 Brussels; Fax: + 32 2 550 08 19
E-mail: infodesk@cenorm.be

Union Technique de l'Elecricite (UTE)
33, Av. General Lectrec – BP 23; F- 92262 Fontenay-aux-Roses Cedex; www.ute-fr.com

Director (HFX-400), Division of compliance
Bureau of Radiological Health
5600 Fishers Lane; Rockville, MD 20857; (Regulations and Requirements)

Laser Institute of America
400 Excecutive Park Drive; Cincinnati, OH 45241; (Safety Guide)
American National Standard Insitute, Inc.
1430 Broadway; New-York, NY 10018; (Safety Guide)

3.3 Fiber Connector Handling

Dust, grease and other contaminations of the fiber facet cause light absorption and local overheating. In some cases it can cause a fiber degradation making a laser operation impossible. Operate laser only with clean fiber facet.

- Avoid dusty enivrements.
- Do not touch the fiber front facet and not allow it contacts with other surfaces.
- Periodically control the fiber and clean if necessary.
- Do not expose the fiber to temperature higher than 80℃ during storage or operation.
- Do not pull the fiber.
- Do not bend a fiber with a radius smaller than 8 cm.
- Avoid strong back reflection targeting the connector.

Use a clean-room compatible tissue, put some Isopropyl alcohol onto it and carefully clean the facet of the fiber facet or connector facet, or use special fiber cleaning tools. Perform cleaning only with power supply switched off!

Important. *Used SMA fiber connector has a special high power design where a fiber tip do not have a physical contact with a ferrule, therefore do not apply much force by cleaning, it can broke the fiber tip.*

Remark:
There are many materials commercially available for fiber optic cleaning. Some are marketed specifically for the fiber optic industry. Isopropyl alcohol is the most commonly used one. Isopropyl alcohol will loosen particular contaminants and allows to remove oil or grease from the fiber. It is used on swabs and wipes, by directly spraying, in soaking tubs, and in ultrasonic cleaners.
Adhesive type cleaners are used to remove particle contamination. It is important to select an adhesive in-line with the particular application so that the adhesive itself does not create a new source of contamination or damage to the fiber.

Generally: In case of any failure you may contact us for service.
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4. Attachments

Table (1): Electrical and optical characteristics of the LU09xxD100 / e.g.: 980nm diode laser:

Parameter	Symbol	LU09xxD100	Unit
Optical			
Output power	P_{op}(c.w.)	10.0	W
Peak Wavelength (at P_{op})	λ_{peak}	980+/-10	nm
Spectral Width (fwhm)	λ_{rms}	<5	nm
Spectral Shift with Temp.	λ_{T_Shift}	0.3	nm/K
Fiber core diameter		200/400	µm
Fiber centricity		<10	µm
NA		0.22	
Fiber connector type		SMA905	
Electrical			
Typical forward current	I_{op}	12.5	A
Maximum forward current c.w.	I_{op}	14.0	A
Typical treshold current	I_{th}	1.1	A
Maximum forward voltage	V_{op}	2.5	V
Typical slope efficiency	η_{diff}	0.86	W/A
Typical conversion efficiency		30.0	%
Features			
Pilot beam output power		<1.0	mW
Pilot beam wavelength		635 +/-5	nm
Pilot beam operating voltage		3.0	V
Pilot beam operating current		<60	mA
Power monitor operating voltage		5	V
Power monitor signal voltage		0-4	V
Fiber detection sensor operating voltage		12	V
Fiber detection sensor signal voltage		12 / 0	V
Temperature sensor / energy constant		NTC 10k, 3988K	

Table (2): Electrical and optical characteristics of the LU0808D070 / 808nm diode laser

Parameter	Symbol	Min	Typ	Max	Unit
Optical					
Output power	P_{op}(c.w.)		7.0		W
Peak Wavelength (at P_{op})	λ_{peak}	798	808	818	nm
Spectral Width (fwhm)	λ_{rms}			5	nm
Spectral Shift with Temp.	λ_{T_Shift}		0.3		nm/K
Fiber core diameter			200/400		µm
Fiber centricity			<10		µm
NA			0.22		
Fiber connector type			SMA905		
Electrical					
Forward current	I_{op}		8.8	9.6	A
Treshold current	I_{th}		1.8	2.1	A
Forward voltage	V_{op}		1.9	2.4	V
Slope efficiency	η_{diff}		1.0		W/A
Conversion efficiency			40.0		%
Features					
Pilot beam output power				1.0	mW
Pilot beam wavelength		630	635	640	nm
Pilot beam operating voltage			3.0	3.3	V
Pilot beam operating current			40	50	mA
Power monitor operating voltage			5		V
Power monitor signal voltage			0-4		V
Fiber detection sensor operating voltage			12		V
Fiber detection sensor signal voltage			12 / 0		V
Temperature sensor / energy constant			NTC 10k, 3988K		

Table 3: Pin connections for NTC and for LM35 temperature sensor.

PIN	Configuration
1	n.c.
2	Pilot Laser + 3V
3	NTC or LM35 +12/5V
4	Fiber Sensor +
5	Fiber Sensor -
6	Fiber Sensor Signal 1
7	Fiber Sensor Signal 2 or LM35 Voltage Signal
8	n.c.
9	n.c.
10	Pilot Laser -
11	NTC or LM35 -
12	Monitor Diode +
13	Monitor Diode -
14	Monitor Signal 1
15	Monitor Signal 2 / Optional
16	n.c.

Table 4: Characteristics of the monitor photo diode:

ELECTRO-OPTICAL CHARACTERISTICS AT 25°C

CHARACTERISTIC	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Dark Current, I_D	V_R = 5 V		0.9	2.5	na
Shunt Resistance, R_{SH}	V_R = 10 mV		300		MΩ
Junction Capacitance, C_J	V_R = 0 V, f = 1 MHz		30		pF
Junction Capacitance, C_J	V_R = 10 V, f = 1 MHz		7.5		pF
Spectral Application Range, λrange	Spot Scan	250		1100	nm
Responsivity, R	λ = 633 nm, V_R = 0 V	0.32	0.36		A/W
Responsivity, R	λ = 900 nm, V_R = 0 V	0.50	0.60		A/W
Breakdown Voltage, V_R	I_R = 10 μA		75		V
Noise Equivalent Power, NEP	V_R = 0 V, λ = 950 nm		2.5×10^{-14}		W/√HZ
Response Time, t_r[1]	RL = 50 Ω, V_R = 0 V		190		nsec
Response Time, t_r[1]	RL = 50 Ω, V_R = 10 V		8		nsec

[1]Response time of 10% to 90% is specified at 660 nm.

Table 5: Resistance vs. temperature for the NTC 10kOhm

R [kOhm]	T [°C]
15,7	15
15	16
14,2	17
13,7	18
13,1	19
12,5	20
12	21
11,4	22
11	23
10,4	24
10	25
9,6	26
9,1	27
8,8	28
8,4	29
8,1	30
7,7	31
7,4	32
7,1	33
6,8	34
6,5	35

5. Trouble shooting

Laser does not emit

Check current and voltage settings
Check short circuit possibility
Check with current pliers if the set current and voltage is flowing
Check if the cables are correctly connected, and if the short circuit bridge is removed

Output power or other specifications cannot be reached

Check if the optical fiber is bent, damaged or dirty, Use Isopropanol, lens paper and a fibre microscope to clean the optical fibre
Check if the laser protection window is dirty or damaged
Ensure the laser is sufficiently cooled
Consider long usage leads to premature aging of the laser diode, especially the operation outside of the stated standard specifications
Check the monitor diode for correct calibration
Check with current plier if the set current and voltage is following

Laser temperature too hot

Check the thermal contact of the diode laser to the heat sink
Check if air fan, peltiers and heat sink are sufficiently dimensioned
Check if the wavelength is similar to the data delivered (a higher wavelength can be a sign of bad thermal contact
Check the settings of the temperature sensor, recalibrate it if necessary

Fibre sensor does not detect

Only use SMA905 optical fibres with metal ferrules
Check if the SMA905 connector specifications and tolerances are correct
Check if the cables are correctly connected

Pilot laser power too low

Change your frequency settings in case of TTL pulse regime
Check the current and voltage supply
Check your optical fiber for damages or tolerance problems