

RG Spectrometer



User Manual

Version 001

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Overview

RG Raman spectrometer perfectly suits for any kind of demanding Raman spectroscopy applications that require high spectral resolution, extremely stable laser power, high sensitivity and broad spectral range (from low frequency to high frequency Raman shift). Technology is based on high throughput transmittance diffraction optics with up to 85% efficiency from sample to detector.

Instruments description

The RG spectrometer is a handheld/portable Raman spectrometer. Physical dimensions of the spectrometer are approximately 257 x 110 x 61 mm, and the weight is approximately 1.5 kg. The instrument has one port on the top for laser excitation and Raman signal collection. The instrument has a barrel port and USB-C port on the bottom for charging and communication, respectively. The instrument has a LCD display screen and five buttons on the front for instrument operation.



LCD display



warning labels



optical port



USB-C port

Figure 1. Front, back, top and bottom view of RG Raman spectrometer

General specifications

Table 1. Typical values for the specifications of the RG spectrometer.

Feature versus model	RG Raman 405	RG Raman 532	RG Raman 638	RG Raman 785	RG Raman 830
Laser wavelength	405 nm	532 nm	638 nm	785 nm	830 nm
Power on sample *	10-70 mW 0.01-60 mW (LPR)	10-100 mW 0.01-90 mW (LPR)	5-75 mW 0.01-65 mW (LPR) 5-330 mW (Power) 0.1-280 mW (Power LPR)	5-95 mW 0.01-80 mW (LPR) 5->500 mW (Power) 0.1->500 mW (Power LPR)	5-70 mW 0.01-65 mW (LPR) 10->500 mW (Power) 0.1-400 mW (Power LPR)
Spectral Range	90-3700 cm ⁻¹	80-3700 cm ⁻¹ 80-2040 cm ⁻¹ (HR)	70-3700 cm ⁻¹	70-2500 cm ⁻¹	70-2400 cm ⁻¹
Spectral Resolution**	4 / 5 / 6 cm ⁻¹	4 / 5 / 6 cm ⁻¹ 2.3 / 3 / 3.7 cm ⁻¹ (HR)	4 / 5 / 6 cm ⁻¹	3 / 4 / 5 cm ⁻¹	3 / 4 / 5 cm ⁻¹
Signal-to-noise ratio at***	1000:1 800:1 (LPR)	1200:1 1000:1 (LPR) 800:1 (HR) 600:1 (HR LPR)	1000:1 800:1 (LPR) 2500:1 (Power) 2000:1 (Power LPR)	1000:1 800:1 (LPR) 3000:1 (Power) 2500:1 (Power LPR)	900:1 800:1 2500:1 (Power) 2000:1 (Power LPR)

* Actual laser power range can differ $\pm 2\%$ per device. Please contact us if you need specific laser power range values.

** Slit size dependent; slit size can be customized (20,35,50 μm slits).

*** Determined as peak signal-to-noise ratio of polystyrene spectrum at maximal laser power, integration time 0.3s, number of repetitions 10.

Configuration options

Slit sizes

The spectrometer's slit can be 1 of 3 sizes. By default, 35 μm slit width is installed. Either a 20 μm or 50 μm slit can be installed to improve the resolution or the throughput respectively, at the expense of the other parameter.

Operator

The Operator configuration adds water and dust proofing, as well as drop resistance to the instrument.

Low Power Range (LPR)

The LPR configuration uses filters that stably reduce laser power to analyse laser sensitive samples. There are two versions available, one using only one filter (LPR) to adjust the laser power, the other using two filters (LPRp) with the second filter maintaining the laser's polarisation.

Power

The Power configuration installs a higher powered laser into the spectrometer to increase signal generated from weak Raman scatterers.

Power LPR

This is a combination of the LPR and Power configuration options on one instrument.

High Resolution (HR)

The HR configuration changes the grating inside the spectrometer to improve the resolution, but limiting the spectral range observed.

Line focus

The Line focus changes the analysis area from a spot to a line, to get more representative spectra of samples which are homogenous on the macro scale, but heterogenous on the micro scale.

Configuration matrix

The following table explains which configuration options are compatible with which laser versions on the RG spectrometer.

	405 nm	532 nm	638 nm	785 nm	830 nm
Operator	Yes	Yes	Yes	Yes	Yes
Power	No	No	Yes	Yes	Yes
High Resolution	No	Yes	No	No	No
Line focus	Yes	Yes	Yes	Yes	Yes
LPR	Yes	Yes	Yes	Yes	Yes
LPRp	Yes	Yes	Yes	Yes	Yes
20 µm slit	Yes	Yes	Yes	Yes	Yes
50 µm slit	Yes	Yes	Yes	Yes	Yes

Application of use

The RG spectrometer is a general-purpose handheld Raman analysis instrument for qualitative and semi-quantitative analysis of liquids and solids. It is intended for laboratory, industrial and field environments. Raman spectroscopy is non-destructive technique and can be performed without contact with the sample. This versatile instrument can be used for identification, verification, and screening of a wide variety of samples, using onboard library searching. Semi-quantitative and quantitative measurements can be performed using chemometric analysis on Lightnovo's computer software.

Note

In Raman spectroscopy, sample fluorescence can yield a much more intense signal than the Raman scattering signal of the sample, masking any Raman bands in the spectrum. Therefore, Raman spectroscopy is normally not a suitable analysis technique for fluorescent samples.

Safety information

Read the following safety information carefully before operating the Lightnovo instrument and keep this manual for future reference available at any time. Always follow the instructions described in this manual to ensure safety operation and to avoid property damage. Improper use or failure to follow these safety instructions can result in serious injuries and/or property damage. Any non-observance of the precautions will infringe the intended use (i.e. performing measurements by Raman spectroscopy) of the instrument. In this case Lightnovo ApS will not assume any liability. It is the operator's duty to plan and implement all necessary safety measures and to supervise their observance. Moreover, the operator must ensure that the instrument is in proper functioning condition. A safe and faultless operation can only be guaranteed if the Lightnovo instrument is transported, stored, installed, operated and maintained properly according to the procedures described in this manual. Never remove or deactivate any safety systems during the instrument's operation. Ensure that objects and/or material not required for the measurement is out of the instrument operating area.

Qualified Personnel

Primary installation, maintenance and repair works not described in this manual should only be performed by Lightnovo approved service personnel. Only authorized operating personnel that have been briefed about the instrument operation and all relevant safety aspects should operate and maintain (i.e. only maintenance works that are described in this manual) the instrument. It is the duty of the instrument owner to ensure users have proper training for use of a laser instrument and relevant risk assessments are in place. All repairs, adjustments and alignments on any instrument component must be performed in accordance with the safety regulations and standards applied in the country in which the instrument is installed.

Warning labels

This warning symbol indicates the existence of laser radiation.



Class 3B lasers are hazardous for eye exposure. They can heat skin and materials but are not considered a burn hazard. For visible-light lasers, Class 3B lasers' output power is between 5 and 499 milliwatts. Class 3B lasers are normally hazardous under direct beam viewing conditions, but are normally safe when viewing diffuse reflections.

Warning label positions

A warning label can be found on the rear of the RG spectrometer. A warning symbol can also be found next to the port on the top of the instrument where the laser radiation exits the instrument.



Figure 2. Back and top view of RG Raman spectrometer

Safety

The following chapters describe all relevant safety aspects of the instrument operation. Depending on the degree of hazard the safety instructions are classified as follows:



Danger

indicates that death, severe personal injury or substantial property damage WILL result if proper precautions are not taken.



Warning

indicates that death, severe personal injury or substantial property damage CAN result if proper precautions are not taken.



Caution

indicates that minor personal injury or property damage CAN result if proper precautions are not taken. Important draws your attention to a particularly important information.



Note

draws your attention to useful information on the product, e.g. product operation or to a special part of the manual.

The safety instructions Danger, Warning and Caution are marked by the corresponding warning labels.

General instrument information

The RG spectrometer uses a laser with 405, 532, 638, 785 and/or 830 wavelengths. The used laser diodes used in the spectrometer emit continuous visible and partially visible laser radiation in the near infrared region.

According to the standard EN 60825-1:2014, RG spectrometer is Class 3B laser product. Therefore, it is normally hazardous under direct beam viewing conditions but is normally safe when viewing diffuse reflections.

Safety Instructions

In addition to the safety instructions given below, one should also comply with all local regulations concerning laser safety.

The analysis system is specified as a laser Class 3B product, i.e. it is considered safe if handled carefully, with restricted beam viewing. It is advised that laser safety goggles that meet the specifications for the laser your system uses are worn by the user and others within the vicinity. Laser glasses should have an LB rating above 3 for code D.

Warning



Avoid eye and skin exposure to direct or scattered laser radiation under all circumstances! Failure to do so can cause permanent and irreversible eye damage and/or serious skin injuries!

Below is a table of the nominal ocular hazard distance (NOHD) values for the notable configurations at maximum laser power.

Table 2. NOHD values the RGs spectrometer standard configuration for different laser configurations (columns) using different probes (rows) at max laser power. Note that the actual maximum laser power of the instrument may differ from these values.

RGs wavelength	405 nm	532 nm	638 nm	785 nm	830 nm
Maximum power	80 mW	110 mW	75 mW	95 mW	70 mW
Long WD	0.59 m	0.7 m	0.57 m	0.86 m	0.65 m
Mid WD	0.24 m	0.28 m	0.23 m	0.35 m	0.26 m
Contact 2	0.04 m	0.04 m	0.04 m	0.05 m	0.04 m
Contact 3	0.04 m	0.04 m	0.04 m	0.05 m	0.04 m
Contact 4	0.04 m	0.05 m	0.04 m	0.06 m	0.04 m
10x objective	0.26 m	0.31 m	0.25 m	0.38 m	0.29 m
20x objective	0.09 m	0.1 m	0.08 m	0.13 m	0.1 m
50x objective	0.25 m	0.3 m	0.24 m	0.37 m	0.28 m
100x objective	0.05 m	0.06 m	0.05 m	0.07 m	0.05 m
100x NIR objective	0.06 m	0.07 m	0.05 m	0.08 m	0.06 m

Table 3. NOHD values the RGs spectrometer with LPR configuration for different laser configurations (columns) using different probes (rows) at max laser power. Note that the actual maximum laser power of the instrument may differ from these values.

RGs wavelength	405 nm	532 nm	638 nm	785 nm	830 nm
Maximum power	70 mW	100 mW	65 mW	80 mW	65 mW
Long WD	0.55 m	0.66 m	0.52 m	0.78 m	0.63 m
Mid WD	0.22 m	0.27 m	0.21 m	0.32 m	0.25 m
Contact 2	0.03 m	0.04 m	0.03 m	0.05 m	0.04 m
Contact 3	0.03 m	0.04 m	0.03 m	0.05 m	0.04 m
Contact 4	0.04 m	0.04 m	0.03 m	0.05 m	0.04 m
10x objective	0.24 m	0.29 m	0.23 m	0.35 m	0.28 m
20x objective	0.08 m	0.1 m	0.08 m	0.12 m	0.09 m
50x objective	0.23 m	0.28 m	0.22 m	0.33 m	0.27 m
100x objective	0.05 m	0.06 m	0.04 m	0.07 m	0.05 m
100x NIR objective	0.05 m	0.06 m	0.05 m	0.08 m	0.06 m

Table 4. NOHD values the RGs spectrometer with Power configuration for different laser configurations (columns) using different probes (rows) at max laser power. Note that the actual maximum laser power of the instrument may differ from these values.

RGs wavelength	638 nm	785 nm	830 nm
Maximum power	330 mW	490 mW	380 mW
Long WD	1.25 m	2.01 m	1.59 m
Mid WD	0.51 m	0.82 m	0.64 m
Contact 2	0.08 m	0.13 m	0.1 m
Contact 3	0.08 m	0.13 m	0.1 m
Contact 4	0.08 m	0.13 m	0.1 m
10x objective	0.55 m	0.89 m	0.7 m
20x objective	0.19 m	0.3 m	0.24 m
50x objective	0.53 m	0.86 m	0.68 m
100x objective	0.1 m	0.17 m	0.13 m
100x NIR objective	0.12 m	0.19 m	0.15 m

Table 5. NOHD values the RGs spectrometer with Power & LPR configuration for different laser configurations (columns) using different probes (rows) at max laser power. Note that the actual maximum laser power of the instrument may differ from these values.

RGs wavelength	638 nm	785 nm	830 nm
Maximum power	280 mW	490 mW	330 mW
Long WD	1.14 m	2.01 m	1.47 m
Mid WD	0.46 m	0.82 m	0.6 m
Contact 2	0.07 m	0.13 m	0.09 m
Contact 3	0.07 m	0.13 m	0.09 m
Contact 4	0.07 m	0.13 m	0.1 m
10x objective	0.51 m	0.89 m	0.65 m
20x objective	0.17 m	0.3 m	0.22 m
50x objective	0.49 m	0.86 m	0.63 m
100x objective	0.1 m	0.17 m	0.12 m
100x NIR objective	0.11 m	0.19 m	0.14 m

Installation

Scope of Delivery

Standard Components

- RG spectrometer (including user manual and quality test report)
- Accessories (includes spares, adaptors, objective lenses, sample preparation tools etc.) typically:
 - Universal, middle or long distance probe
 - Calibration tool
 - Laser safety goggles
- USB-C cable
- Power cable

Inspecting the Packaging

After having received RG spectrometer, inspect the packaging for damages. If there are any signs of damage, contact your local shipping representative before opening the shipping box.

Warning



Do not put RG spectrometer into operation if there are signs of damage. Failure to do so may result in severe personal injuries and/or property damage.

Transportation

When transporting the spectrometer, use the original case to avoid damages.



Figure 3. Transportation case for RG spectrometer.

Site requirements

Space Requirements

RG spectrometer requires a space of 40 cm² benchtop space and 65 cm in height (For the exact instrument dimensions refer to Specification.) At the rear instrument side, take a clearance of at least 10 cm into account.

Environmental Requirements

To ensure optimal instrument performance and long-term reliability the following environmental conditions are essential:

- Ambient temperature range: 18 - 35°C (64 - 95°F)
- Humidity (non-condensing): ≤ 70% (relative humidity)



Note

RG spectrometer is an instrument of protection class I (electric safety).

Accessories

One will receive in the package a set of accessories. Depending on the order each accessory is recommended to be used for a particular type of measurement and test.

The probes for contact and non-contact measurements should be oriented by the upper side as shown in Table 6.

Table 6. Accessories for Lightnovo spectrometers

Accessory	Description	Type of measurement and test
	Long distance probe, NA=0.1, WD=0-25mm	Liquids in glass bottles, vials
	Middle distance probe, NA=0.2, WD=0-10mm	Liquids in glass bottles, vials

	<p>Contact sapphire probe - (NA=0.64, WD=0-20μm depth of focus)</p>	<p>Powders in plastic bags, solids, for tissue and scattering media</p>
	<p>Contact sapphire probe- fixed (NA=0.64, WD=40-60μm depth of focus)</p>	
	<p>Contact sapphire probe- fixed (NA=0.64, WD=80-100μm depth of focus)</p>	
	<p>Contact sapphire probe- adjustable (NA=0.64, WD=0-2500μm)</p>	<p>Powders in plastic bags, solids, for tissue and scattering media</p>
<p>It can be adjusted manually by using the LN probe tool delivered with the spectrometer. The adjustment is done by connecting the spectrometer to Miraspec and checking the signal after each adjustment</p>		
	<p>Short distance probe (without sapphire), adjustable NA=0.64, WD=0-2500μm</p>	<p>Powders in plastic bags, solids, for tissue and scattering media</p>
<p>It can be adjusted manually by using the LN probe tool delivered with the spectrometer. The adjustment is done by connecting the spectrometer to Miraspec and checking the signal after each adjustment</p>		

	<p>Universal probe (middle distance probe + fused silica glass), NA=0.2, WD=0-10mm</p>	<p>Liquids in glass bottles, vials</p>
	<p>Variable contact probe WD=0-300mm</p>	<p>Skin Powders in plastic bags Multi-layer polymers Minerals</p>
	<p>Calibration tool with polystyrene</p>	<p>Checking laser performance</p>
	<p>Silicone probe cover</p>	<p>Protects against environmental light</p>
	<p>Disposable silicone probe covers</p>	<p>Protect contact probe from contamination by sample</p>

Software installation

1. Download Miraspec software package from the Lightnovo website:
<https://lightnovo.com/miraspec/>
2. Open the manual inside for detailed installation and instrument connection instructions.

Operation

Attaching & removing probes

To attach a probe, align the bottom of the probe with the flange on the laser port.



Rotate the probe clockwise until the base is flush with the lip of the flange.



To remove the probe, grab the base of the probe and rotate anti-clockwise.



Standalone operation

To start the instrument push and release the button on the front side.



Wait for a couple of seconds, the screen will light up and the menu will be displayed.

Confirm the details displayed are appropriate for your sample.

Confirm the details displayed are appropriate for your sample.



When the LED indicator will be blinking blue, now the instrument is ready for operation.



Briefly push the button once again to start the laser. The LED indicator will light up red.



Place the sample in the laser beam. Live spectrum of the sample will be displayed on the screen.



Briefly push the button one more time, the scan will start.



After the scan the instrument display will automatically show the best match, if case spectral libraries are embedded on the instrument software



To begin a new scan press the middle button again to repeat, or scroll through best matches by pushing left and right buttons.

In order to switch off the instrument push and hold the button until the LED indicator lights up amber.

Release the button, the instrument should automatically switch off.



LED guide

Amber

The system is loading or ready to turn off.



Blue

System is ready for use and laser is off.

Blinking when in standalone mode.

Solid when connected to a computer/ instrument.



Red

Laser is on.



Purple

Firmware read failure.

Instrument needs disconnecting and rebooting.



Hardware connection

To connect the instrument to a computer, turn on the instrument.



Plug the USB- C cable into the USB- C port on the bottom of the instrument.



Plug the other end of the USB-C cable into the computer.



Open the Lightnovo software on the computer USB port.



Press the connect button on the software to begin communication with the instrument. (see software manual for details).



Technical drawings

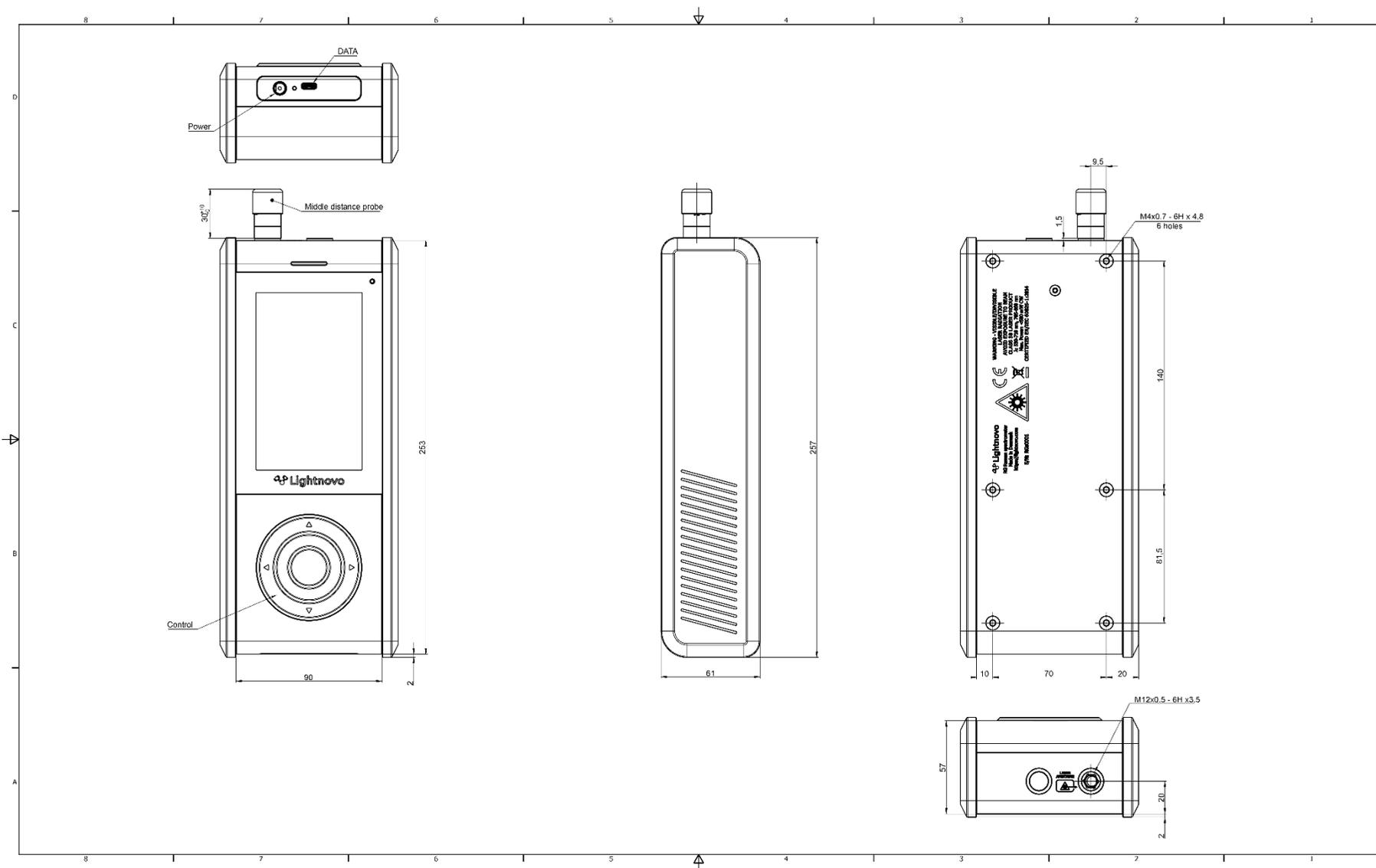


Figure 4. RG Raman spectrometer drawing with dimensions

Service

Recommended care

Switching the system ON/OFF

When the instrument is not used for a longer period of time, it is highly recommended to switch off the Raman excitation laser. This action will prolong the service lifetime of the laser.

Warning



Do not work with RG Raman spectrometer at laser power that is higher than specified for particular model. This could lead to the decreased life time of the laser diode or laser damage.

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