

doric

★LISER™ & LED/LD Light Source

User Manual

Version 1.0.4

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Important Safety Information

1.1 General Safety Information

The \star LISER™ & LED/LD Light Source combines the laser-pumped Ce:YAG crystal fluorescence spectral output with spectrally different LED or laser diode outputs in a connectorized form. This new type of hybrid light source is not explicitly considered by international safety committees such as the IEC1 and the FDA2. However, the user should follow all safety procedures related to the worst-case scenario, either in working or failure conditions. Considering the high fluorescence output power level of the \star LISER™ & LED/LD Light Source, we recommend Class 3B laser's product safety rules even though purely LISER's output does not contain any laser radiation. The following section on laser safety information should thus be **read and carefully followed**.

1.2 Laser Safety Information

If you are not familiar with laser light sources, seek advice from qualified personnel **BEFORE FIRST USE** and **READ CAREFULLY Important Laser Safety Information** in Application Note provided on the USB key. A copy of the Application Note is available from Doric Lenses on the website or by contacting (sales@doriclenses.com).



DANGER!

**The \star LISER™ & LED/LD Light Source is a Class 3B laser product.
Read Important Laser Safety Information in the Application Note
BEFORE FIRST USE.**



The \star LISER™ & LED/LD Light Source is equivalent to a Class 3B laser product emitting high power levels of visible light that can **PERMANENTLY DAMAGE THE EYES**. **NEVER LOOK** directly into the optical beam exiting from the output FC connector or any optical fiber connected to it. **NEVER LOOK** directly at specular or diffuse reflections of the output beam. Even when wearing laser safety glasses, **NEVER LOOK** directly into the optical beam exiting from the \star LISER™ & LED/LD Light Source output FC connector, an optical fiber connected to it, or its specular reflections. It is essential to **WEAR LASER SAFETY GLASSES** certified for the wavelength and power level of the light source. Follow all safety procedures to protect anyone working in the area. The \star LISER™ & LED/LD Light Source is provided with a safety interlock connector on the rear panel. Its driver is enabled when the interlock circuit is shorted and the power key inserted (see Section 1.4). For safe use of the \star LISER™ & LED/LD Light Source, the safety interlock connector should be connected to the laser safety interlock circuit of the laboratory. You should contact the laser safety officer (LSO) of your institution or company to set a proper laser safety interlock circuit for your application and laboratory installation. The \star LISER™ & LED/LD Light Source emits light over a large portion of the visible light spectrum. Since its output spectrum power level is model and output filter dependent, the corresponding safety procedures are specific to each application.

1.3 Safety Labels

The laser class labels are provided with the system and the laser aperture is clearly identified by laser warning label and/or the text *LASER APERTURE*.



(a) Laser Classification Label Example



(b) Laser Warning Label

LASER APERTURE

(c) Laser Aperture Identification

Figure 1.1: Safety Labels

1.4 Activation Safety Features

The drivers for all Doric Lenses light sources come with a number of safety features. These are built into the driver circuits, as shown in the block diagram (Fig. 1.2).

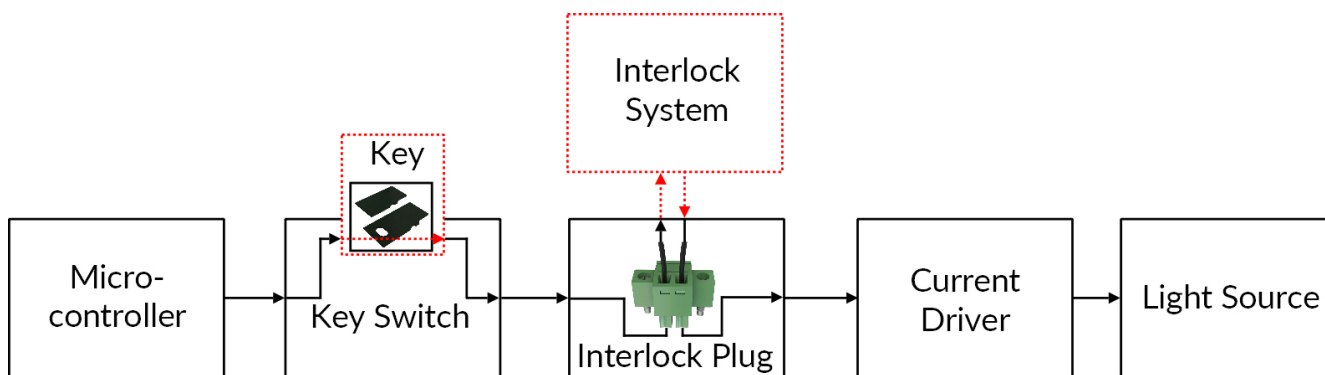
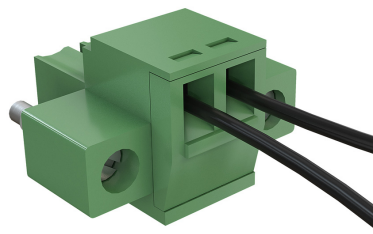


Figure 1.2: Safety feature block diagram

- The **Micro-controller**, **Key Switch**, **Interlock Plug** and **Current Driver** are connected in series. This means that if any single safety feature is not properly in place, the light source cannot be activated.
- The **Micro-controller** is used to control the light source driver.



(a) Key Switch



(b) Interlock Plug

Figure 1.3: Safety Feature Elements

- The **Key Switch** (Safety feature 1) (Fig. 1.3a), located on the left side of the driver, is required to activate any light source. If removed, no data can be sent from the micro-controller to the **Current Driver**.
- The **Interlock plug** (Safety feature 2) (Fig. 1.3b) is used to integrate the driver into an **Interlock Circuit**.
 - The **Interlock Plug** comes with a small wire short-circuiting it. This wire must be removed before integrating it into an **Interlock Circuit**.

- Connect the **Interlock Circuit** in series with the **Interlock Plug** so the circuit may function properly.
- The **Current Driver** sends current to any connected light source. If the **Key** is absent or the **Interlock Plug** has an open circuit, it cannot receive signals from the micro-controller, preventing it from sending out current.

2.1 Operating Principle

The Doric \star LISERTM light source is inspired by the “white” LED concept. LEDs (Light Emitting Diodes) are solid state light sources emitting light by the direct conversion of an electric current passing through a semiconductor junction. LEDs are now available at many central wavelengths and bandwidths. Properly speaking, no LEDs can emit over the entire visible spectrum to produce white light. Many so-called “white” LEDs are in fact a combination of a blue LED and a fluorescent crystal. A part of the blue LED light is absorbed by a Cerium doped Yttrium Aluminum Garnet crystal (shortly: Ce:YAG crystal) which, after absorption of blue light, spontaneously re-emits over a significant part of the visible spectrum, mostly green, yellow and red light. The combination of the green-yellow-red fluorescence and the unabsorbed blue light from the pumping LED results in white light.

“White” LEDs are designed for energy efficient white lighting applications. For scientific applications involving optical fiber coupling, high spectral brightness ($\text{W}/\text{mm}^2/\text{sr}/\text{nm}$) sources are required. In order to increase the spectral brightness, the “white” LED operating principle must be scaled in term of pump power. The power scaling first requires a higher brightness pump source emitting blue light. In the Doric \star LISERTM light source, high power blue laser diodes (LDs) emitting at 450 nm are used to provide a much smaller pumped volume of the Ce:YAG crystal. Such a direct power scaling of the pumping source leads to thermal failures. Indeed, a high brightness pumping leads to a local heating of the Ce:YAG crystal. When the crystal temperature locally reach about 400°C, a phenomenon called “temperature quenching” leads to a significant drop of the fluorescent emission due to non radiative relaxation of blue-light excited Ce^{3+} ions. The temperature increase ultimately leads to a catastrophic failure of the crystal. Heat generated by high brightness pumping thus have to be managed properly using passive/active cooling and crystal geometry.

The \star LISERTM light source emits over a broad and continuous visible light spectrum. A typical fluorescence spectrum of a Ce:YAG crystal is shown in Fig. 2.1. The source thus provides a speckle-free light beam at the output of multimode optical fibers. Also, direct modulation of the emitted light intensity is easily achieved through the modulation of the injection current of all pump laser diodes, and this, without any detrimental spiking like with diode-pumped solid-state (DPSS) laser systems.

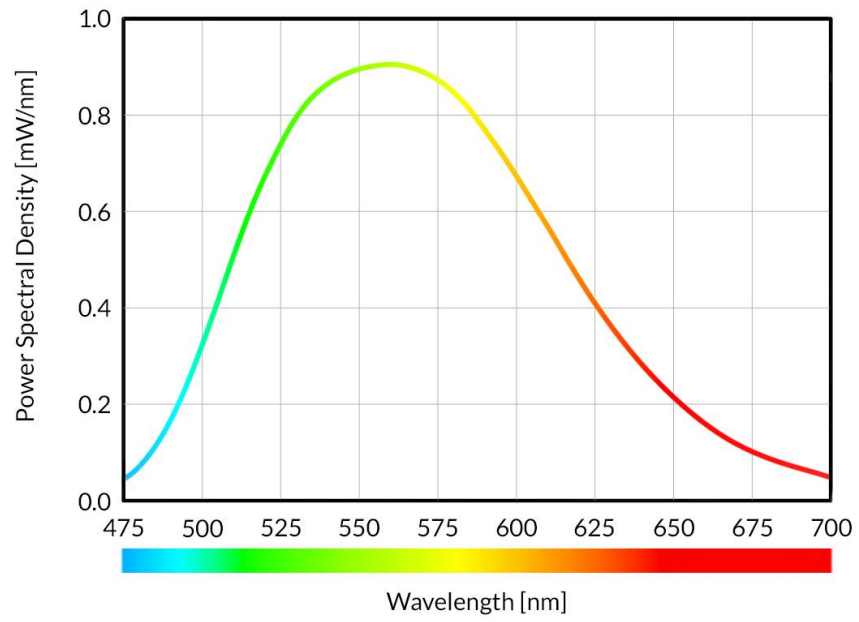


Figure 2.1: Output Power Spectral Density of a \star LISERTM Fiber Light Source using 200 μ m, 0.53 NA Fiber

2.2 Overview of the ✱LISER™ & LED/LD Light Source

The Doric ✱LISER™ & LED Light Source includes a LED light source combined with the ✱LISER™ source (Fig. 2.2). The light from both sources are mixed using an optical combiner. The ✱LISER™ & LED/LD Light Source is considered as a Class 3B laser product. It is critical to follow the safety instructions stated in this manual. The device has the following elements.

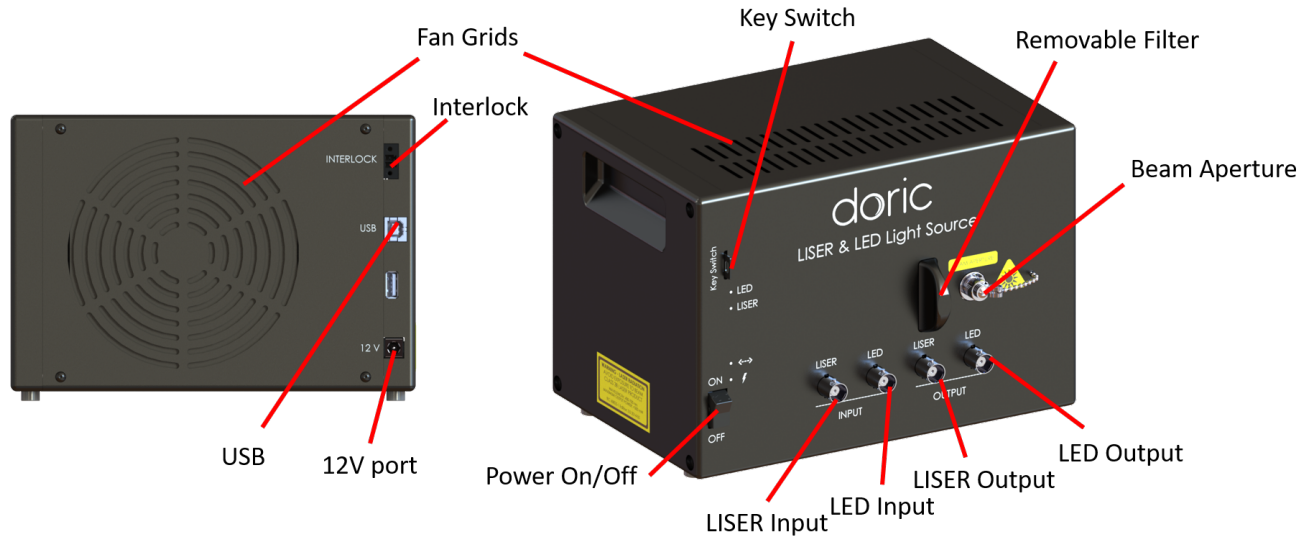


Figure 2.2: ✱LISER™ & LED/LD Fiber Light Source

- The **Beam Aperture** is where the light exits the light source. The aperture is composed of a fiber coupling assembly that injects the emitted light into an optical fiber. The standard model uses an FC fiber connector. A safety FC metal cap is attached to the optical head to block the output light beam in absence of optical fiber.
- The **Fan Grids** are found on the top, rear and side of the light source. They must be kept clear at all times to avoid overheating the system.
- The **Removable Filter Holder** is used to insert an optical bandpass filter in the system, allowing the selection of a narrow part of the broad Ce:YAG spectrum of emission. The filter holder can accept any filter up to a 25.4 mm diameter and a maximum 5 mm thickness.
- The BNC **LISER Input** Port is used to command the ✱LISER™ source.
- The BNC **LED Input** Port is used to command the LED/LD source.
- The BNC **LISER Output** Port is used to monitor the ✱LISER™ source.
- The BNC **LED Output** Port is used to monitor the LED/LD source.
- The **Power On/Off** switch turns on/off the driver.
- The **Key Switch** must be in place to enable light emission. Note that, despite its similar form factor, the power key **is not a standard micro SD card** such as those used in some digital cameras. Do not attach the **Key** to a key fob or similar holder; this may prevent proper insertion of the **Key Switch**.
- The **12 V** port connects the ✱LISER™ to its 12 VDC power supply.



For safety precautions, the ✱LISER™ must be powered only by the power supply provided with the product.



- The **USB** port allows the user to connect the \star LISER™ to a computer using a USB-A/USB-B cable. This allows the driver to be controlled using *Doric Neuroscience Studio*.
- The **Interlock** connector plug allows the user to connect the \star LISER™ to a safety interlock system. It is recommended to connect the interlock plug to a laboratory interlock system (See chapter 1).

2.3 Overview of the Bandpass Filter for \star LISER™

Considering the very broad spectrum of the \star LISER™ fluorescence, it is often required to select a specific part of the output spectrum using an optical bandpass filter. The light source contains a **Removable Filter Holder** that can accept filters with an outside diameter of 25.4 mm and maximum thickness of 5 mm. The filter is placed between the \star LISER™ light source and the combiner, and is held in place magnetically. A wide variety of filters are available in our [Website](#).

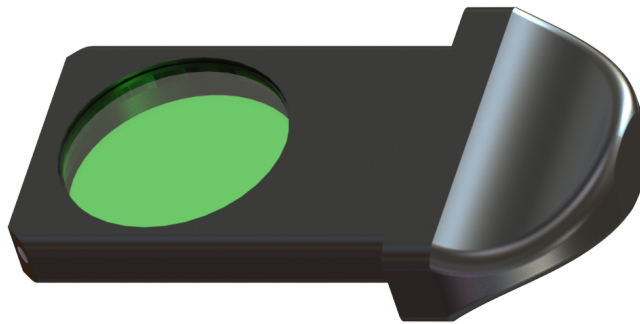


Figure 2.3: Bandpass Filter for the \star LISER™ in its holder

Operations Guide

3.1 Getting Started

The procedure below should be followed carefully. There are several safety measures to take into account to ensure safe and proper use of the *★LISER™ & LED/LD Light Source*.

1. Connect the **Interlock plug** to the driver. The system CANNOT be operational if the safety interlock circuit is open.
 - When unpacking, a temporarily shorted interlock plug is already secured in place. It is highly recommended to remove the shorting electrical wire and connect the interlock plug to a proper interlock circuit of the laboratory.
 - See the Important Safety Information section (Chapter 1) for more information.



WARNING!

Be aware that a shorted interlock plug DISABLES this safety feature AT YOUR OWN RISKS. A proper safety interlock circuit is highly recommended.



2. Ensure that the **ON/OFF switch** of the driver is set to OFF.
3. Connect the *★LISER™ & LED/LD Light Source* to the power outlet with the included 12 V AC-DC adapter.



WARNING!

DO NOT OPEN the enclosure of the driver. Electrical hazards may result. The driver does not contain any user-serviceable components.



4. The optical head is sensitive to electrostatic discharges, use proper grounding techniques.
5. Unscrew the metal safety cap from the **Beam aperture**.
6. Connect the *Optical fiber patch-cord* to the *★LISER™ & LED/LD Light Source* (see the section 3.2).
7. Ensure that a proper laser beam block is ready at the output of the optical fiber.



DANGER!

The light beam exiting the *★LISER™ & LED/LD Light Source* or any connected optical fiber should be confined properly BEFORE turning ON the device. Use a proper beam block. Read the application note *Important Laser Safety Information* BEFORE FIRST USE.



8. Ensure that all laser safety procedures are followed.
9. Insert the power key into its receptacle.

10. Set the power switch to ON.
11. Connect the **USB-A/USB-B cable** between the **★LISER™ & LED/LD Light Source** and the computer.
12. Install the **Doric Neuroscience Studio** on the computer. To install the software, double-click on the DoricNeuroscienceStudioSetup_vX.X.exe file located on the Doric USB memory stick supplied with the **★LISER™ & LED/LD Light Source** and follow the on-screen instructions (help is also available in the **Doric Neuroscience Studio User Manual**, which can be downloaded on our [Website](#), section **SUPPORT**).
13. If needed, connect an external device to the **★LISER™ & LED/LD Light Source** by using one of the input BNC port. In this configuration, the driver will wait the signal from another device, consequently the light source will be triggered. To follow an external device, select the external TTL or the external analog mode for the desired channel.
14. If needed, connect a data acquisition system or an external device to the **★LISER™ & LED/LD Light Source** by using the output BNC port of the desired channel. A data acquisition system enables the viewing and the recording of the signal generated by an external device connected to the light source. The output BNC can also be used to connect an external device that will be triggered by the light source.

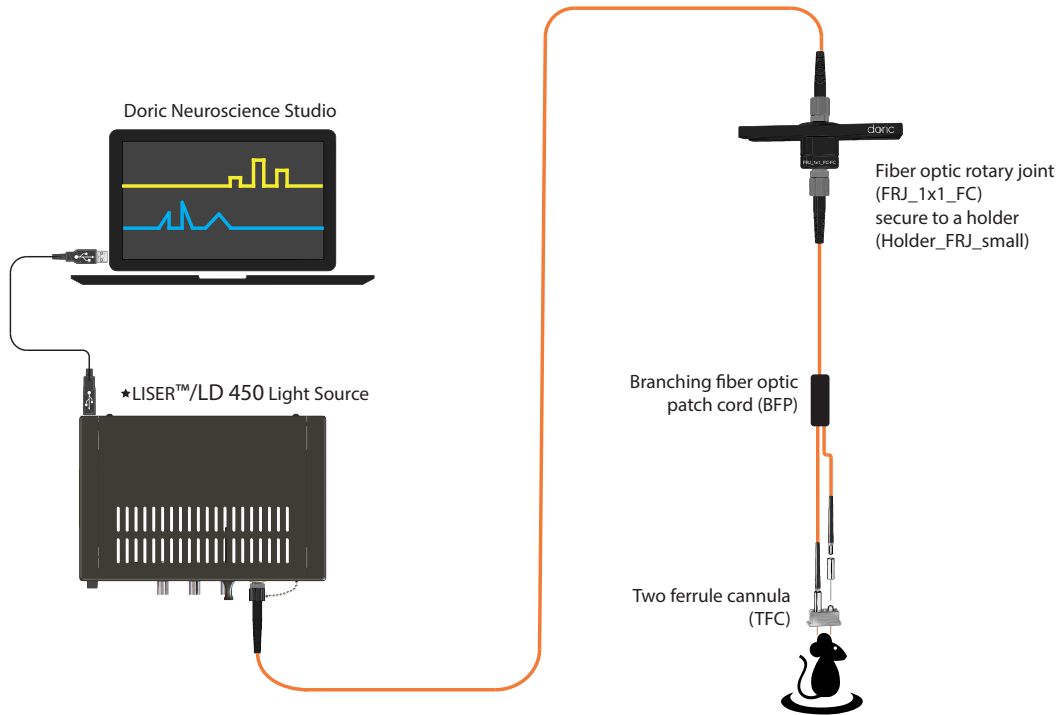


Figure 3.1: System using a ★LISER™ & LED/LD Light Source

3.2 FC Connector Installation

1. Clean the optical fiber connector before insertion. Use isopropanol and a lint-free wipe.
2. With an FC connector, the connector key must be oriented to enter within the receptacle slot to ensure proper connection (Fig. 3.2).

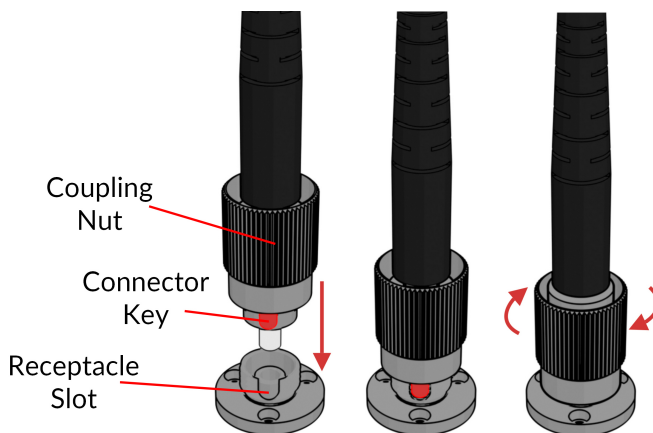


Figure 3.2: FC connector, Fiber Installation



To reduce the risk of eye injury, it is sound practice to NOT CONNECT/DISCONNECT OPTICAL FIBERS when the light source is turned on



Specifications

Table 4.1: Specifications of the ✪LISER™ & LED/LD Light Source

Specification	Value	Note
Power supply	110 - 240 VAC, 50 - 60 Hz	
DC Power supply	12 VDC, 110 W	
Mass	2.6 kg	
Dimensions		
Width	20 cm	Including connectors
Depth	15 cm	Including connectors
Height	14 cm	Including connectors
TTL input voltage	0 to +5 V	
Display current accuracy	<5% @ maximum rated current	Error increases at lower current.
✪LISER™ Analog input voltage	240 mA/V (typical)	See data sheet
✪LISER™ Monitor output voltage	4.17 V/A (typical)	See data sheet
✪LISER™ Maximum output current range	1200 mA	See data sheet
✪LISER™ Maximum forward voltage	6 V typical	See data sheet
✪LISER™ Rise/Fall time	<10 μ s	
LED Analog input voltage	400 mA/V 40 mA/V	Standard 1 A LED Driver Low power mode enabled
LED BNC output voltage	2.5 V/A	
LED Maximum output current range	200, 2000 mA	
LED Maximum forward voltage	7 V	
LED Minimum output current	2.5 mA	Low power mode enabled
LED Rise/Fall time	<10 μ s Typical	
LD Analog input voltage	80 mA/V light source current	If applicable: see datasheet
LD BNC output voltage	12.5 V/A	
LD Maximum output current range	LD Model dependent	
LD Maximum forward voltage	10 V	
LD Minimum output current	25 mA	Low power mode enabled
LD Display current accuracy	2% at maximum rated current	Error increases at lower current
LD Rise/Fall time	<10 μ s Typical	
Output NA	0.63	
Output Optical Fiber Core Size	<600 μ m	Power scales up to this core size

Table 4.2: Software Specifications of the \star LISER™ & LED/LD Light Source

Specification	Value	Note
Current adjustment steps	1 mA	
Modulation minimum frequency	0.01 Hz ¹	
Modulation maximum frequency	10 kHz	-3 dB attenuation
Minimum ON or OFF time	50 μ s ¹	
Maximum ON or OFF time	100 s ¹	
Maximum number of pulses per sequence	65 535 ¹	
Maximum number of sequences	65 535 ¹	

Table 4.3: Recommended Environmental Specifications

Specification	Operation	Storage
Use	Indoor	Indoor
Temperature	20 °C to 30 °C	-20 °C to 60 °C
Humidity	40 - 60 % R.H., non condensing	40 - 60 % R.H., non condensing

¹For all operation modes, except the internal complex mode

Support

5.1 Maintenance

The product does not require any maintenance. Do not open the enclosure. Contact Doric Lenses for return instructions if the unit does not work properly and needs to be repaired.

5.2 Warranty

This product is under warranty for a period of 12 months. Contact Doric Lenses for return instructions. This warranty will not be applicable if the unit is damaged or needs to be repaired as a result of improper use or operation outside the conditions stated in this manual. For more information, see our [Website](#).

5.3 Disposition



Figure 5.1: WEEE directive logo

According with the directive 2012/19/EU of the European Parliament and the Council of the European Union regarding Waste Electrical and Electronic Equipment (WEEE), when the product will reach its end-of-life phase, it must not be disposed with regular waste. Make sure to dispose of it with regards of your local regulations. For more information about how and where to dispose of the product, please contact Doric Lenses.

5.4 Contact us

For any questions or comments, do not hesitate to contact us by:

Phone 1-418-877-5600

Email sales@doriclenses.com

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