

Fiber-coupled light sources

The fiber optic circuits are driven by light and hence the need to couple the light sources into the optical fiber. The most common sources used to couple the light into the fibers are the laser diodes and LEDs, while the miniature incandescent lamps are used only when broad and smooth spectrum is needed. The incandescent lamps can be used as primary sources from which different spectral bands and profiles can be extracted.

The light sources like LEDs or laser diode require specific drivers that are either integrated within the light source or they are made and sold separately. We offer stand alone LED drivers for one or several diodes, or connectorized LEDs packages for up to 4 different wavelength LEDs and the fiber-optic light-sources that integrate up to four connectorized LED(s) with their respective drivers within one box.

Our drivers can be used within wide range of inputs, 100–240 VAC, 50–60 Hz. The power cord terminations or plugs toward wall socket are selected to match the destination country standard.

LED drivers

Depending of the number of channels, our LED drivers support manual CW operation of up to four independent high brightness LED modules. For each driver's channel, there is a BNC connector that allows independent TTL or analog modulation of respective LED with an input amplitude from 0 to 5V and the frequency of up to 10kHz. Another



Single channel LED driver

BCN connector gives feedback of the LED signal with an oscilloscope. To avoid potential LED damage, the maximum current is factory limited to 1A or to customer selected maximum value. When drivers are used for implantable LEDs the maximum current is limited to 0.35 A or 0.5 A.

ORDERING CODE: LEDRV_ CH_

Number of channels 1, 2 or 4

I_{max} (mA) 350, 500, 1000

For each LED channel, there is a M8-4pin female receptacle on the front panel of the LED driver. The electrical connection to our LEDs is via 1.5 meter long cable with corresponding M8-4pin male and female connectors.



Two channel LED driver

Two channel LED driver powers-up one or two single LED modules of our *dual connectorized high brightness LED module*. To put it simply, this driver is like two single channel drivers in one box.

The four channel LED driver provides tunable DC current to four individual LEDs or clusters of two, three or four diodes combined into single optical output. The 4 channel LED driver is more silent and more compact by volume per channel than its 1 and 2 channel brethren.



Four channel LED driver

Connectorized single LED

Our robust and compact modules couple high brightness LEDs into different types of optical fibers via FC receptacle that allows change or replacement of the fiber-optic patch cord. The novelty is an optimized heat sink design with active cooling that enhances LED's longevity as well as thermal and spectral stability.

Our micro-optic approach provides maximum coupling possible efficiency and is well-suited for coupling LEDs into multimode optical fibers. The coupling efficiency depends on LED emitter size, fiber core diameter and fiber's numerical aperture. The factory testing of the optical coupling is with 1 mm plastic optical fiber. Refer to *Table 1* for detailed LED specifications.



Connectorized High brightness single LED

The module features M8-4pin male connector. The electrical connection to our LED driver is via 1.5 meter long cable with corresponding M8-4pin male and female connectors normally provided with the driver.

ORDERING CODE: LEDC1-B_FC

LED Color code _____

Other colors from Table 1 available as custom product

Receptacle code _____

FC is stock item, SMA available as custom product.

Connectorized dual LEDs

This package combines the light from two LEDs of different color into a single output fiber and uses patent pending regular pentagon mirrors configuration. The coupling efficiency for respective colors is nearing those of our single LED sources. Refer to *Table 1* for details. The LEDs are driven independently from each other via two M8 connectors when connected to any of our drivers like two Single channel LED drivers, Two Channel LED driver or Four channel LED driver. The electrical connection to our LED drivers is via two 1.5 meter long cables with corresponding M8-4pin connectors.

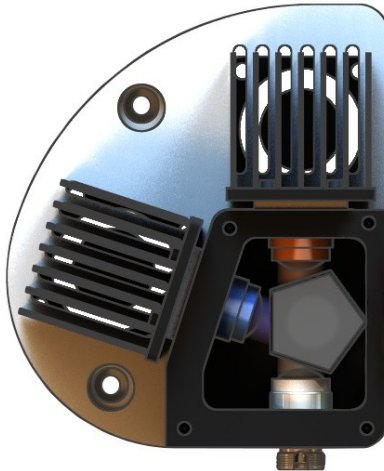
ORDERING CODE : LEDC2-B/A_FC

LED Color Codes

Other colors from Table 1 available as custom product

Receptacle code

FC is stock item, SMA available as custom product.



Connectorized 3 LED clusters

Using three LEDs of different emissions spectrum coupled to the same optical fiber adds new light firing capabilities to Optogenetics toolbox. The package uses compact and efficient patent pending regular pentagon mirror configuration. The LEDs are driven independently from each other via our Four Channel LED driver.

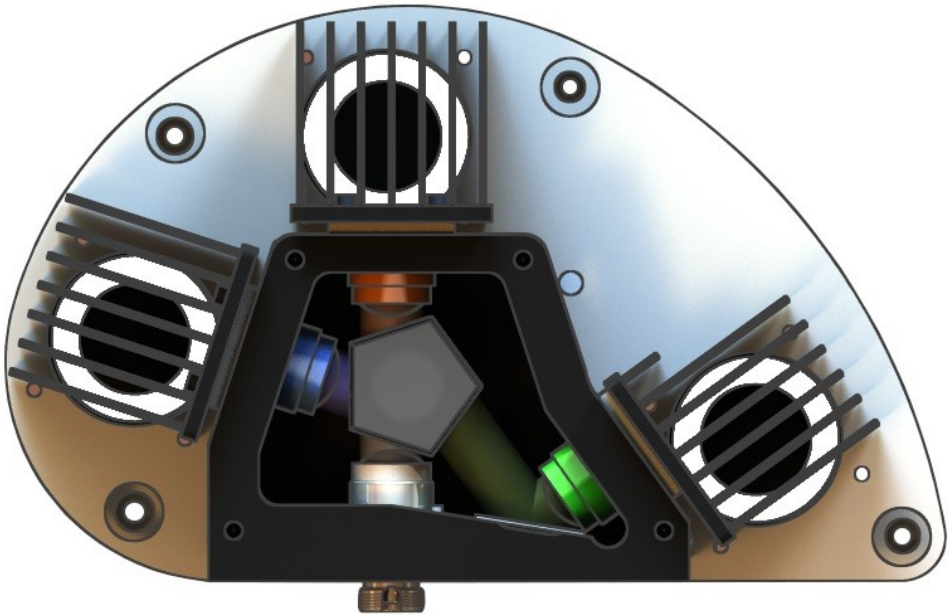
ORDERING CODE : LEDC3-B/G/A_FC

LED Color Codes

Other colors from Table 1 available as custom product

Receptacle code

FC is stock item, SMA available as custom product.



Connectorized 4 LED clusters

Using four spectrally different LEDs coupled to the same optical fiber further enhances light firing capabilities to Optogenetics toolbox. The package uses compact and efficient patent pending regular pentagon mirror configuration.

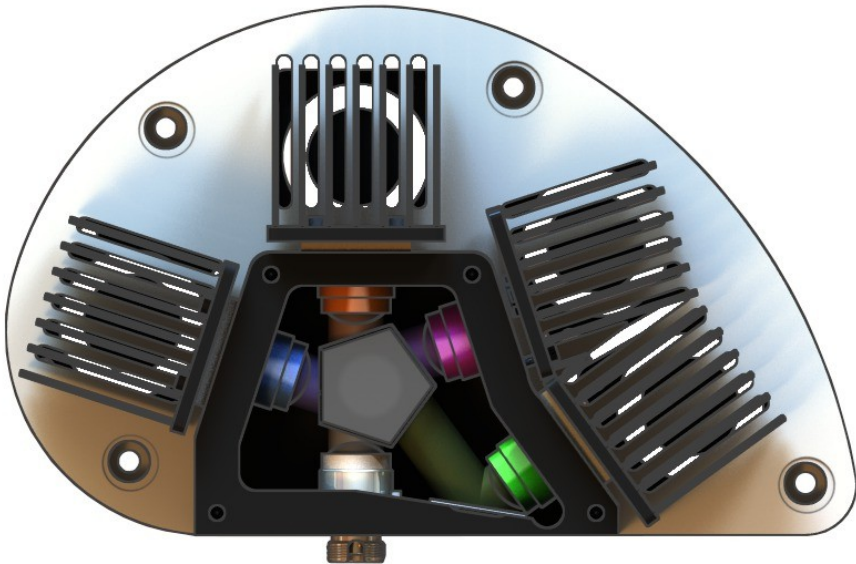
ORDERING CODE : LEDC4-U/B/G/A_FC

LED Color Codes

Other colors from Table 1 available as custom product

Receptacle code

FC is stock item, SMA available as custom product.



LED Fiber-optic Light-sources

To operate pigtailed or connectorized LEDs, one needs appropriate drivers. We offer fiber-ready LEDs and LED drivers as separate packages that need to be connected with electrical cables. However, for those who prefer *plug and play* approach, we have introduced the fiber-optic LED light-sources featuring the driver and connectorized LED within a same box. While preserving all functionalities of the LED drivers and connectorized LEDs, our fiber-optic LED sources offer simplicity of one box design, improved thermal management, patented coupling assembly and more informative and user-friendly interface.

Single LED fiber-optic light-source

When only one color LED source is needed, this union of LED driver and connectorized LED is the least expensive and most compact option that provides full control over CW operation and modulation of the light signal.



Single LED fiber-optic light-source

ORDERING CODE: LEDFL_B_FC

LED Color code

Other colors from *Table 1* available as custom product

Receptacle code

FC is stock item, *SMA* available as custom product.

Dual LED fiber-optic light-source

When two LEDs of different colors need to be coupled into one fiber, one can use two channel LED driver and connectorized dual LED or this Dual LED fiber-optic source which, as a single package, provides unsurpassed simplicity, patented coupling assembly, low cost and space saving option.

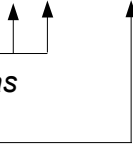
ORDERING CODE: LEDFL_B/A_FC

LED Color Codes _____

Other colors from *Table 1* available as
custom product

Receptacle code _____

FC is stock item, SMA available as custom product.



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4 LED fiber-optic light-source

This is our top of the line light source that provides unprecedented light coupling efficiency based on our patented regular pentagon assembly of dichroic filters. Each LED has independent current modulation and can work in analog, digital and manual mode. The output of all LEDs is combined into one fiber connector.

ORDERING CODE: LEDFL_U/B/G/A_FC

LED Color Codes

Other colors from *Table 1 available as custom product*

Receptacle code

FC is stock item, SMA available as custom product.



Four channel LED fiber-optic light source

8 blue LED fiber-optic light-source

This product consists of 8 independent blue LED sources connectorized to optical fiber with FC connector. Each source can be individually powered and modulated to different pulsing pattern.

The device can be used with a wide range input voltage 100-240 (V) AC, 50-60 Hz.



8 blue LED fiber-optic light-source

ORDERING CODE: LEDFL_8B_FC

LED Color Codes _____

Other colors from *Table 1* available as custom product

Receptacle code _____

FC is stock item, SMA available as custom product.

Application: The product can be used to illuminate fiber cannula arrays up to 1x8

Single LED + Fiber-optic cannula

We have developed an assembly where the LED is the integral part of the fiber-optic cannula thus providing an lightweight optical source attached to the head of the animal suitable for deep brain illumination. The protruding optical fiber is implanted into the skull.

In order to keep the assembly small and light there is no heatsink. To limit the heat generation, only medium brightness LEDs are used. Maximum current should be limited to 150mA.

The electrical connector is so called Header with 3 positions 0.050" gold wire Male Pins (Sullins part # GRPB031VWVN-RC).



LED + Fiber-optic cannula

ORDERING CODE : LFC-B -

LED color code

B or A are stock items

Other colors from *Table 1* available as custom product

Fiber-optic code

200-0.53 for glass fiber 200 um core - NA=0.53

240-0.63 for plastic fiber 240 um core - NA=0.63

Fiber length "L" (mm)

Accessories

Due to the lack of standard use of those implants, we provide 3 wires 15 cm long (or longer if needed) electrical cable with stripped wires on an end and Female socket connector header (Sullins part # LPPB032CFFN-RC) on the other end.

LEDs + FRJ

It is a common practice to connect LED light sources or connectorized LEDs with rotary joints via fiber-optic patch cord. If that patch cord has uncoated fiber ends, which is often the case due to the extra cost and complexity, at least 8% of the light is lost to Fresnel reflection, not to mention other possible connection losses. One way of getting around this avoidable loss is to integrate the LED or LEDs within the fiber-optic rotary joint, thus eliminating that fiber patch cord all-together. That is exactly what we did by joining our legendary fiber-optic rotary joint and equally well known LED sources.



LED+FRJ

The surface of LED emitters is typically larger than the diameter of the optical fibers commonly used in optogenetics experiments and that leads to more uniform optical coupling. All our LED assemblies with integrated rotary joints have M8 connectors for each LED in the package.

Single Led + Fiber-optic Rotary Joint

ORDERING CODE: LEDFRJ-B_FC

LED Color code _____

B or A are stock items

Other colors from *Table 1* available as custom product

Receptacle code _____

FC is stock item, SMA available as custom product.



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Dual Led + Fiber-optic Rotary Joint

This patent pending assembly is perfect for light activation of Channelrhodopsin-2 (ChR2) with 473 nm blue light and Halorhodopsin inhibition with 589 nm yellow light. However, other LED wavelength combinations are also possible as long as they are not overlapping.

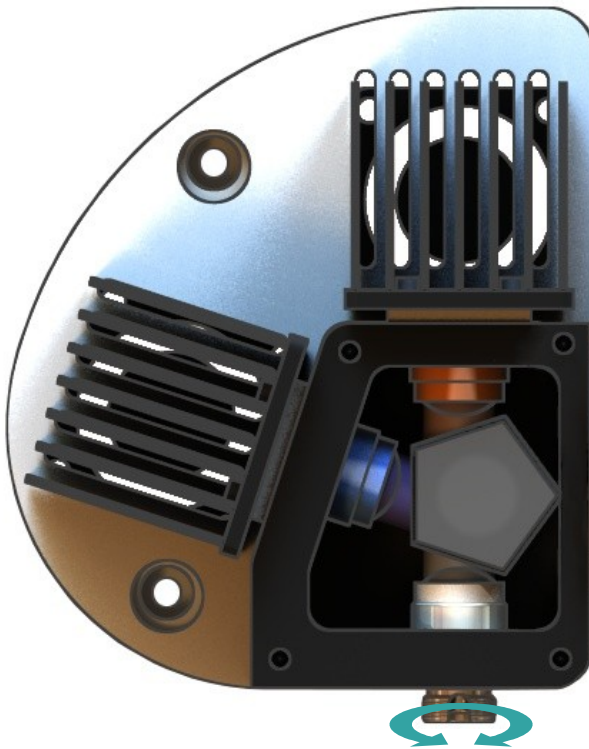
ORDERING CODE: LEDFRJ-B/A_FC

LED Color Codes _____

Other colors from *Table 1* available as
custom product

Receptacle code _____

FC is stock item, SMA available as custom product.



3 Leds + Fiber-optic Rotary Joint

Combining three different colors is very old problem and has been tried in numerous ways when synthesizing the “white light” or making high quality color cameras. With new type of opsins emerging on a daily bases, it is very likely that a new wavelengths will be needed within standard activation set. This patent pending assembly provides possibility to combine three distinct wavelengths and couple them to rotating optical fiber.

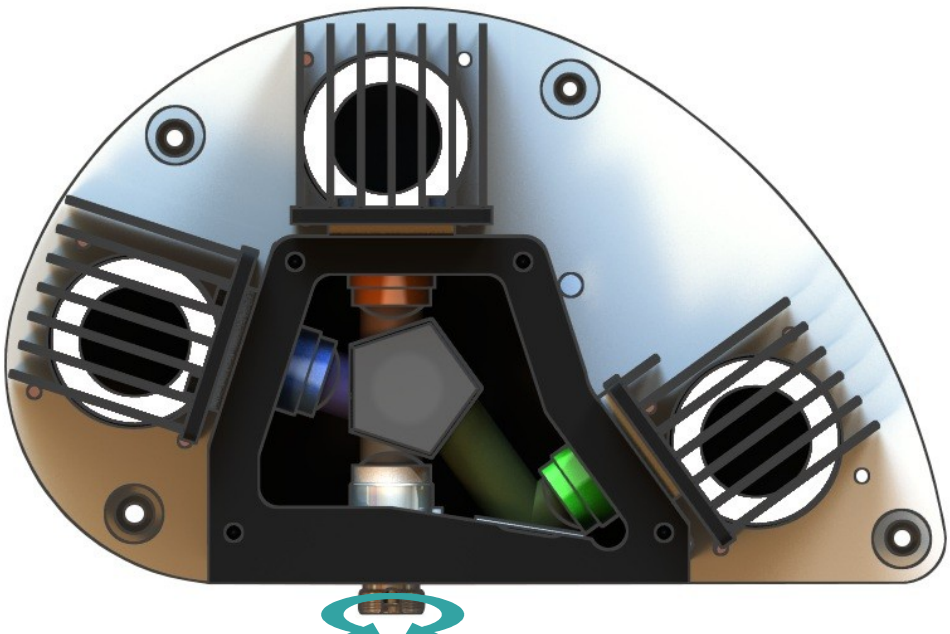
ORDERING CODE: LEDFRJ-B/G/A_FC

LED Color Codes

Other colors from *Table 1* available as *custom product*

Receptacle code

FC is stock item, SMA available as custom product.



4 LEDs + Fiber-optic Rotary Joint

Using four spectrally different LEDs coupled to the same optical fiber further enhances light firing capabilities to Optogenetics toolbox. The package uses compact and efficient patent pending regular pentagon mirror configuration.

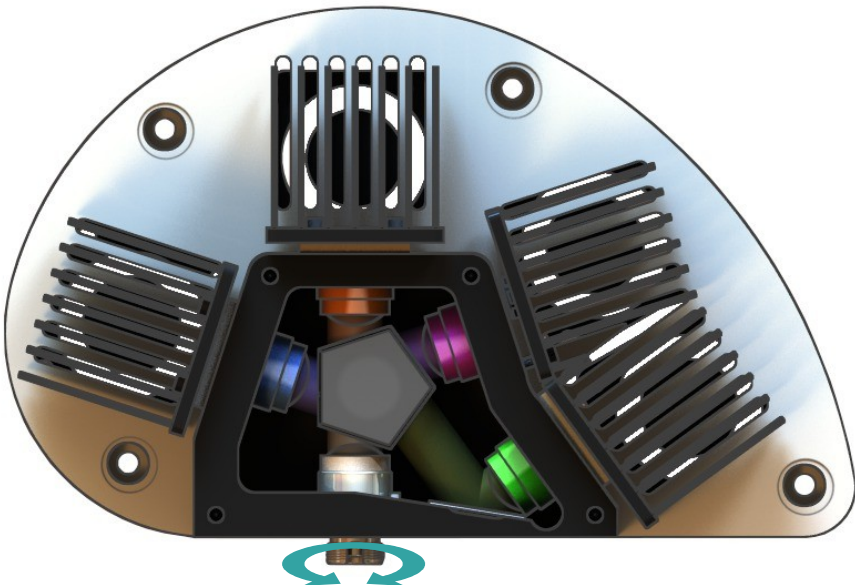
ORDERING CODE: LEDFRJ-U_B_G_A_FC

LED Color Codes

Other colors from *Table 1* available as custom product

Receptacle code

FC is standard, SMA available as custom product.



LED specifications

Table 1: LED color code and main specifications

LED				FIBER OUTPUT POWER @1000mA			
Color	Code	Wavelength	Bandwidth FWHM	core 200µm NA = 0.48	core 240µm NA = 0.63	core 400µm NA = 0.48	core 960µm NA = 0.50
Near UV	385	385 nm	15 nm	2.0 mW	2.2 mW	8.0 mW	25 mW
	U	405nm	-	-	-	-	-
Royal	Y	455 nm	25 nm	3.0 mW	3.5 mW	16 mW	65 mW
Blue	B	465 nm	25 nm	5.0 mW	5.6 mW	22 mW	80 mW
Cyan	C	505 nm	30 nm	2.0 mW	2.2 mW	8.0 mW	25 mW
Green	G	515 nm	35 nm	2.0 mW	2.2 mW	8.0 mW	25 mW
Amber	A	595 nm	20 nm	0.8 mW	1.0 mW	3.0 mW	12 mW
Orange	H	625 nm	20 nm	3.5 mW	3.5 mW	13 mW	35 mW
Red	R	635 nm	20 nm	3.5 mW	4.0 mW	16 mW	40 mW
Infrared	850	850 nm	45 nm	3.0 mW	3.0 mW	16 mW	20 mW
Infrared	940	940 nm	35 nm	2.0 mW	2.0 mW	9.0 mW	20 mW
White	W45	4500 K	250 nm	2.5 mW	3.0 mW	8.0 mW	35 mW
White	W55	5500 K	250 nm	3.5 mW	4.0 mW	12 mW	55 mW