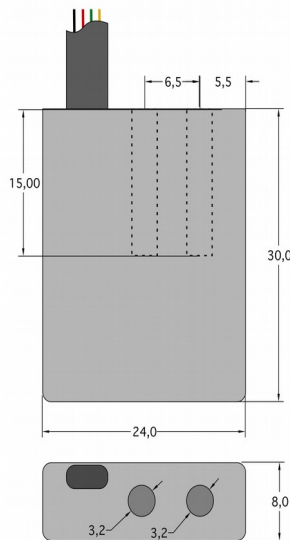


# Textile LED module – light source for side light fibres integrated into textiles

## Description:

This power LED module is developed as an LED light source in textiles with integrated side light fibers. This application requires

- a flat housing construction that can be easily placed under the textile surface,
- an internal optical coupling mechanism suitable for fiber bundles and thick core fibers as well,
- 2 power LED to illuminate 2 separate fibers,
- a fiber coupling concept for various diameter fibers,
- the option of a waterproof and washable housing,
- integrated LED driver electronics for each LED offers the option to embed the module to an electrical wiring harness in the textile with the possibility of controlling the brightness of each LED from a central switchboard.



*Design textile LED module*



*Textile LED module with and without fiber alignment ferrules*

The aluminium housing serves as heat sink. It distributes thermal energy generated by the LED. Since the module is enclosed from all sides it can be built waterproof.

## Optical connection:

The module is designed to illuminate various types of side light or end light fibers:

- 2.5mm and 3.0mm massive fibers (PMMA or casted acrylate),
- 1x7 fiber bundles of 1mm POF (fiber bundle with 3mm diameter),
- 1x7, 1x19 fiber bundles of 0.5mm POF (side light or endlight) with a bundle diameter of 1.5mm and 2.5mm, respectively, (space for ferrule connector not included).

If fibers with an outside diameter of 3mm are connected, they are introduced directly to the module. If smaller diameter fibers shall be used, fiber alignment ferrules with an inside diameter of 2.9mm are inserted to the module. The ferrules are precrimped to the required diameter and fix the <2.9mm fiber/fiber ferrule with a second crimp.

In case that thick fibers (4mm up to 6mm diameter) shall be connected, a special version is available with 40mm long, 3mm diameter PMMA fiber pigtailed for external connection.

## Electric connection:

Each module comprises a 4 electric wire connection to a central switchboard.

In the textile unit the central switchboard unit supplies all LED modules with electric power, generally sourced from an USB powerbank or another USB power source, and controls the LED brightnesses. The central switchboard may be a passive device with no active electronics or a microcontroller unit, that is connected via Bluetooth or WiFi.

The 4 electric wires are connected as follows:

- wire 1 (colour black or white): ground,
- wire 2 (colour red or brown): positive supply voltage
- wire 3 (colour green): multi purpose control pin LED 1 (middle) [see dimming options]
- wire 4 (colour yellow): multi purpose control pin LED 2 (side) [see dimming options]

Attention! Voltage on pin MUST NOT exceed 6V! A higher voltage will disturb the internal regulation and might destroy the module!

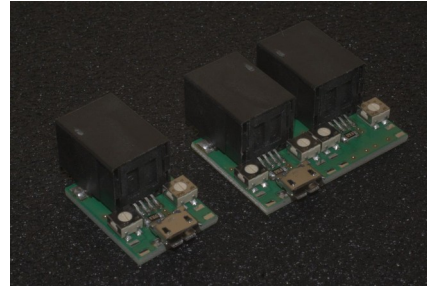
Attention! To ensure safety (e.g. against short circuits on the wire) we recommend using a fuse or polyfuse directly after the battery!

In addition a resistor of 4.7k $\Omega$  to 20k $\Omega$  in each of the control pins is recommended.

Dimming options:

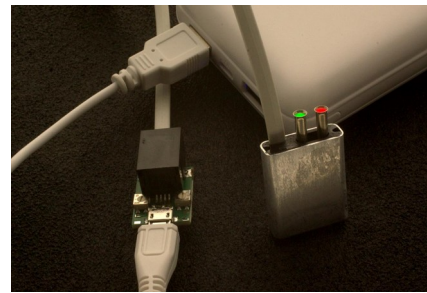
Option	Remarks
No dimming	Leave control pins open
Resistive dimming	A variable resistor of 0 .. 2 M $\Omega$ to GND can be used to control the brightness from 0 to 100%
PWM dimming	Connect 3.3 or 5V PWM signal on input Attention! Voltage on pin MUST NOT exceed 6V! Attention! Internal over-temperature limit will be overruled!
Voltage dimming (not recommended)	Connect voltage to control brightness: 0 .. 0.3V: LED off 0.3 .. 2.5V: brightness from 0 to 100% 2.5 .. 5V: LED on Attention! Voltage on pin MUST NOT exceed 6V! Attention! Internal over-temperature limit will be overruled!

4P4C connectors (RJ-10) are an option for connecting the 4 electric wire cable with the central switchboard. The photo below show a central switchboard comprising one or two RJ-10 jacks, a micro usb connector for the USB power bank, a potentiometer per LED for brightness control and a current fuse to limit maximum cable current.



**Central switchboard comprising:**

- potentiometer for LED dimming,
- current fuse



**Central switchboard in operation**

**Electrical wiring harness system consisting of:**

- textile LED modules electrically connected with RJ-10 connectors,
- central switchboard with 1 or 2 RJ-10 jacks,
- micro USB power supply (e.g. USB powerbank).

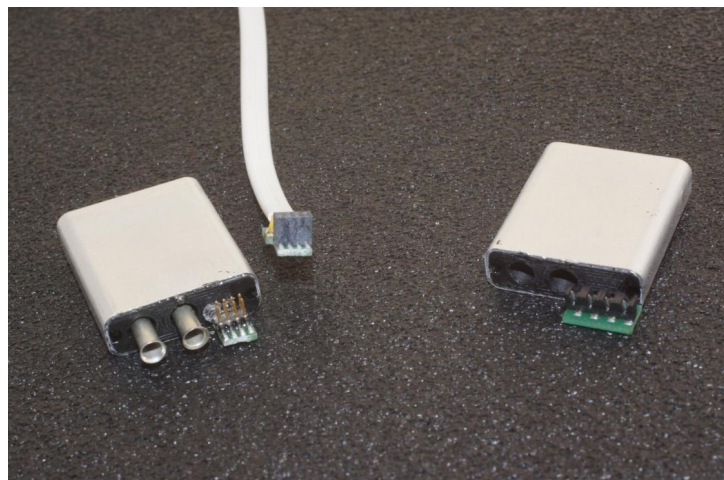
The RJ-10 connector system isn't the only applicable system to setup a textile wire harness. Depending on the special requirements a cutting clamp connector with a non-releasable can be appropriate. Corresponding products are in preparation.

On request alternative cable connection options are available:

Instead of a cable fixed to the module a cut-and-grip connection (right part) or the connection via a pin header (left part) is feasible.

The cut-and-grip connector requires special electrical cables, the pin header a soldered cable end comprising a suitable jack interface.

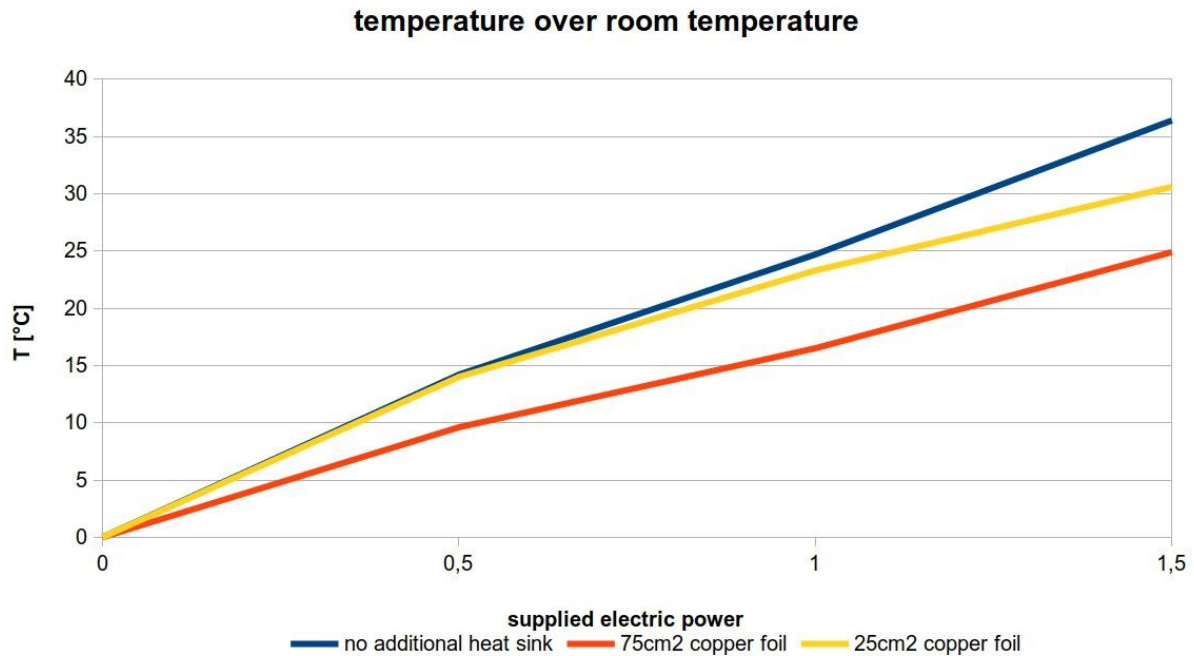
As a standard solution the version with a fixed cable is recommended.



### Thermal aspects:

Power consuming electronic devices in wearable textiles must be controlled with respect to temperature and a potential excessive temperature increase. A total power consumption of up to 2W per LED module comprising 2 power LED chips with a typical current of 350mA generate temperatures that may affect the state of human well-being and health.

Depending on the electric power consumption the corresponding temperature increase over room temperature is measured with the following results:

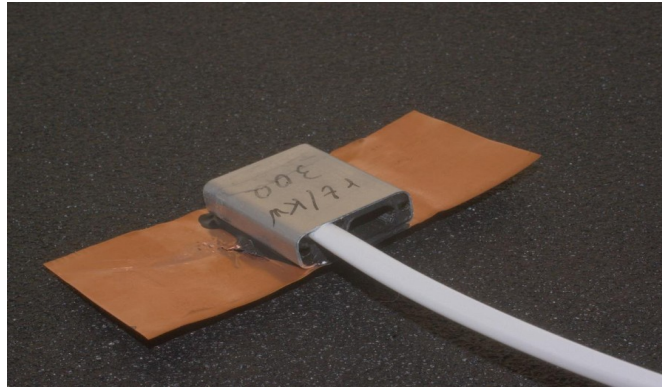


At full power (device under test 1,5W, 5V and 200mA) the module warms up by 37°C over room temperature.

If room temperature is 30°C or more, the temperature of more than 67°C on top of the module's aluminium surface is too high for contact with human skin. In this case either the supplied electric power must be reduced to 1W or even less, or a copper or aluminium foil has to be fixed as an additional heat sink at the module.

In any case, the user must check which temperature increase his application permits and reduce the maximum supplied electrical power accordingly.

The photo below shows the module with a 25cm<sup>2</sup> copper foil.



The size of the heat sink foil can be varied. Depending on the article of clothing's design, the foil integration is more or less easy to achieve.

**Electric parameters:**

	min.	typ.	max.
Power supply voltage [V]:	4,7	5	18
Max. LED current [mA]:		200	
DC DC efficiency [%]:		85	
(5V supply, 2x white LED)			
Control pin input voltage [V]	0		6
(absolute maximum)			

**Attention:**

**PowerLEDs generate light with an optical intensity that can be harmful to the human eye.**

**Therefore, never look into the opening of the textile LED module during operation!**

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