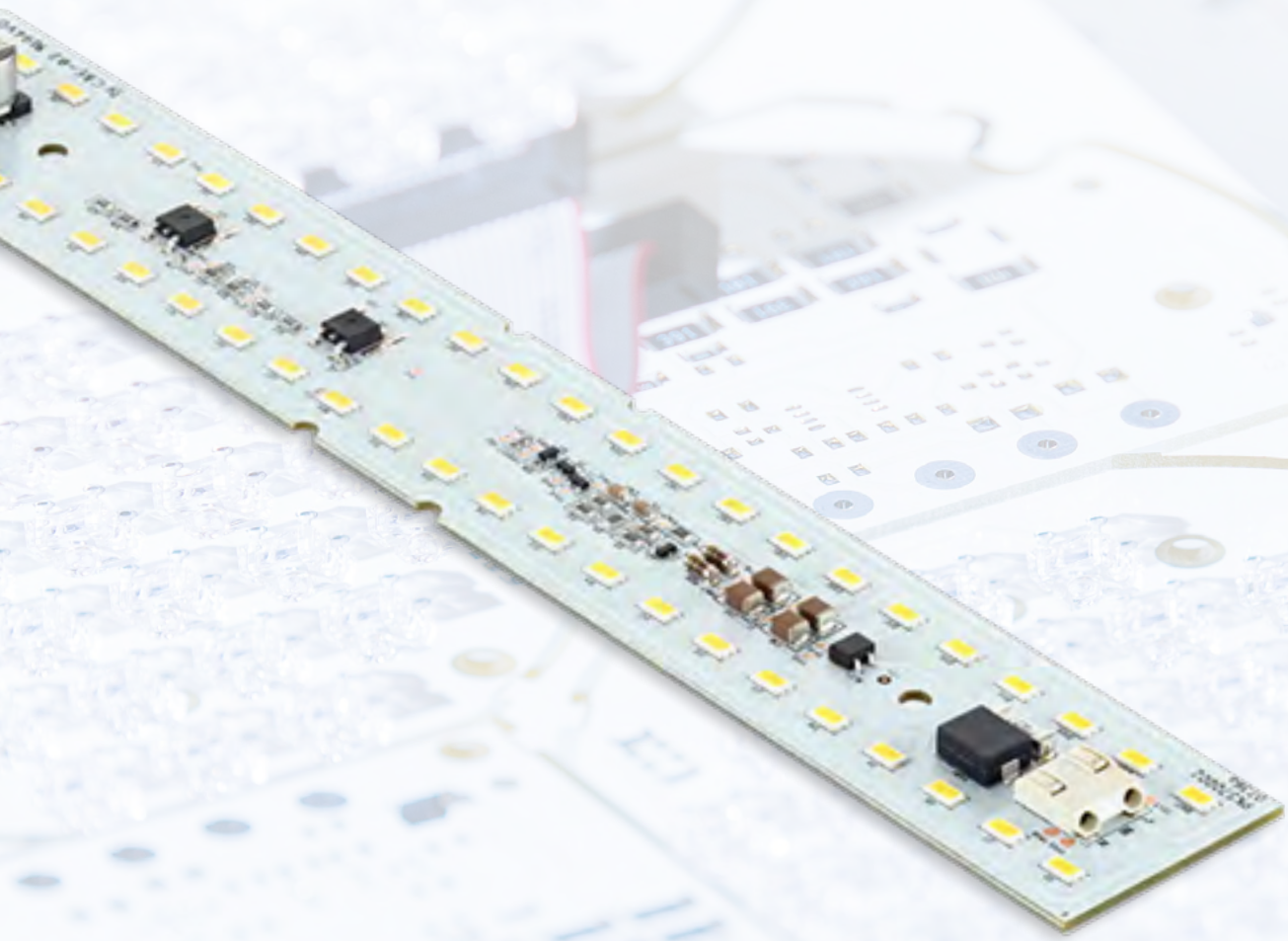
DA GROUP



DESIGN-IN GUIDE

ActivePAQ linear LED module

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INTRODUCTION & DISCLAIMER

This document is intended to provide guidance to OEM's and luminaire designers to integrate the ActivePAQ LED module into their products. Besides from mechanical conditions this document will also clarify the electrical- and environmental boundaries or attention points. By no means this design-in guide is intended to limit our customers in the options, nor can it be used to claim warranty. The design-in guide cannot be regarded as a document for official release of the luminaire. Specifically mentioned materials and/or tools from third parties are only indicative, other equivalent equipment may be used.

With the ActivePAQ LED modules DA-Group is introducing light sources that facilitate integral cost effectiveness. While the driver is integrated with the LED module no separate bulky components need to be hosted in the luminaire and wiring can be limited to a minimum. ActivePAQ LED modules offer good quality of light and therefor can be used in various type of applications.

MECHANICAL DIMENSIONS & CONNECTIONS

Products described in this document:

Description	Length (mm)	Width (mm)	Height (mm)
ActivePAQ Linear performer 2Ft 3.000lm	560	40	< 17
ActivePAQ Linear performer 2Ft 4.000lm	560	40	< 17

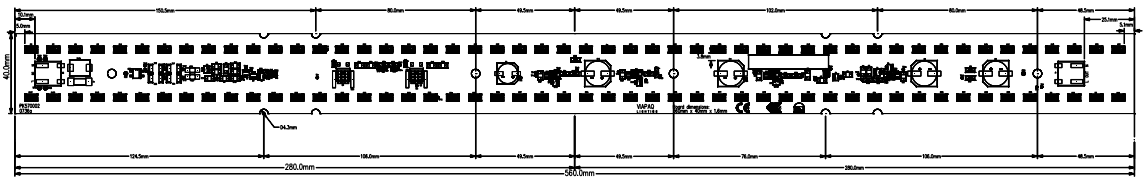
Note that the above listed products are available for order at the time of writing this document.
Visit www.da-group.fi for possible additional ActivePAQ LED module products released after the release of this document. Guidelines and principles explained in this document can be applied to other ActivePAQ LED modules as well, since the content of this document is mostly general in nature for all ActivePAQ modules.

Using Zhaga book 7 as guideline for the hole definition even existing luminaire designs can benefit from the advantages of the ActivePAQ LED module.

When mounting ActivePAQ modules to the luminaire mechanics, special attention must be paid to the application specific creepage distance requirements. ActivePAQ modules inherently have a creepage distance of at least 2.5 mm which consists of > 1.4 mm board thickness and > 1.1 mm distance from the board edge to the tracks.

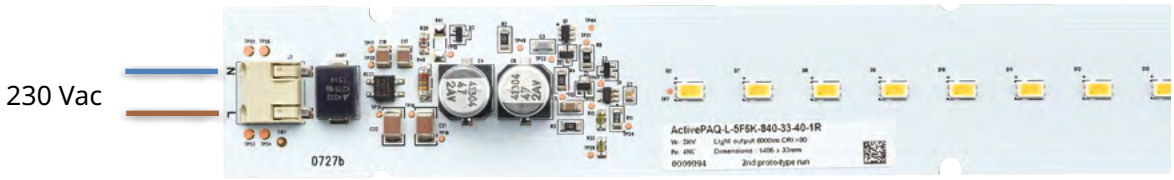
Mounting of ActivePAQ modules can be done for example by using non-conductive plastic rivets or plastic screws to maintain the inherent creepage distance of the module. Another possible option is to use insulating but still heat conductive paste between the board and the luminaire mechanics. It is highly recommended in all cases to efficiently conduct the heat from the board to the luminaire mechanics, because this will have a positive effect to the performance of the ActivePAQ module. If for example conductive screws are used for mounting the ActivePAQ modules, then the necessary insulating layers must be added to fulfil the application specific creepage distance requirements.

ActivePAQ Linear Performer 2t 3.000lm and 4.000lm dimensions



ELECTRICAL INTERFACE

The ActivePAQ modules have Wago 2060-852 or similar connectors on board to connect the module to mains voltage (230 Vac). Note that the different ActivePAQ modules may look somewhat different than the below photo as the photo below is for illustration purposes only.



Two voltage windows have been specified:

1) Nominal voltage window: 220-240 Vac (within this range the module will fullfil to its specification)

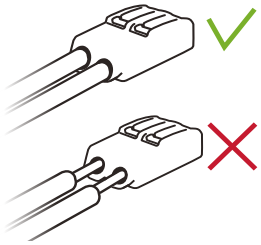
2) Maximum voltage window: 230 Vac ± 10% (within this range the module will not fail, though performance within specification is no longer guaranteed)

Inserting the wires

All wires must be pushed firmly into the contact wire opening. They can be released by pushing the release button. It's important to strip the cable wire 7-9 mm. Make sure that the wires are fully inserted such that the wire insulation is surrounded by the connector housing. This prevents it can be pulled out of the connector (during operation). Note that the different ActivePAQ modules may have different connectors than the below illustration has. In such case use the connector specific tool and stripping length.

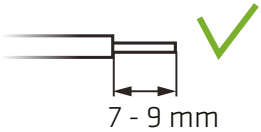
inserting solid conductors via push-in termination

inserting/removing fine-stranded conductors by lightly depressing the push-button (e.g. using the optional 206-860 Operating Tool).



strip length:

- For manual and automated Wiring systems
- Terminate conductors from 24 to 18 AWG (0.2 - 0.75 mm^2)
- Simple push-in termination of solid conductors



INRUSH CURRENT

Main reason for inrush current in ActivePAQ is the EMC filter capacitors. ActivePAQs inrush current is always less than 5A (50% pulse width 50µs). This low inrush current means that the only limiting factor on how many ActivePAQs can be mounted behind a single MCB is the rated current of the MCB. Below table shows an example of calculation results for number of ActivePAQs per MCB when calculated with the following formula. Note that temperature derating and general MCB derating factors have been considered in the formula. In this example it is assumed that a single ActivePAQ module is taking 35 W of input power.

$$\frac{\text{Rated input voltage} * \text{MCB rated current} * \text{MCB deratings}}{\text{ActivePAQ power}}$$

Rated input voltage = 230V
MCB derating = 0,5 (include temperature and side by side assembling effects)

$$\frac{230\text{V} * \text{MCB rated current} * 0{,}5}{\text{ActivePAQ power}}$$

MCB Rated [A]	# of ActivePaqs	MCB Types
6	19	Z, B, C, D
10	32	Z, B, C, D
13	42	Z, B, C, D
16	52	Z, B, C, D
20	65	Z, B, C, D
25	82	Z, B, C, D

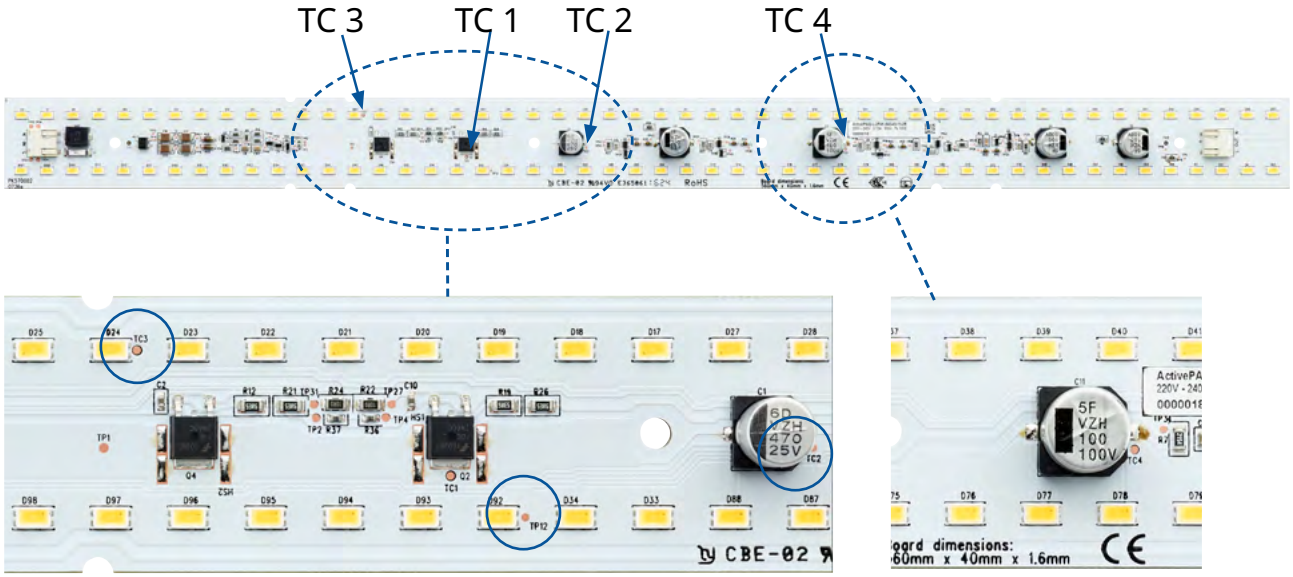
TEMPERATURE MANAGEMENT & -MEASUREMENT

In order to meet the expected lifetime of the ActivePAQ LED module one of the critical aspects to manage is temperature. The relation of Tc (temperature reference point) to other component temperatures on the ActivePAQ module is depending on external conditions such as the material- and / or structure of the material where the product is mounted to. Therefore, DA-Group has identified a few lifetime critical components on the ActivePAQ module that should be measured during design-in. As long as the maximum specified temperatures of those components are not exceeded the specified lifetime will be within reach. To accomplish this a careful thermal design of the luminaire is needed to conduct the heat from the ActivePAQ module to luminaire mechanics.

Note that the below measurement results are based on 230V input voltage. When increasing the input voltage, the component temperatures will rise. Also the ambient temperature of the module (so inside the luminaire and in the application) is an important factor to be taken into account.

Temperature indication points ActivePAQ Linear Performer 2Ft 3.000lm and 4.000lm

As shown in the pictures below, TC2 and TC4 are used for reading the temperatures from the electrolytic capacitors C1 and C11, while the FET Q2 temperature is read from TC1, and LED D24 from TC3 correspondingly. The recommended maximum temperatures for the TC points are the following: TC1 is +100 C, TC2 and TC4 are +80C and TC3 is +85C.



Temperature table ActivePAQ Linear Performer 2Ft 4.000lm

ActivePAQ 560mm, 4.000lm	FETs temp reference point	ELCAPs temp reference points		LED solder joint	Environmen-tal temperature
	Tc1	Tc2	Tc4	Tc3	Ta
Lifetime temp (°C)	**+100**	**+80**	**+80**	**+85**	**NA**
Measured on a solid aluminium strip* @ 230Vac	+60	+48	+46	+52	+22

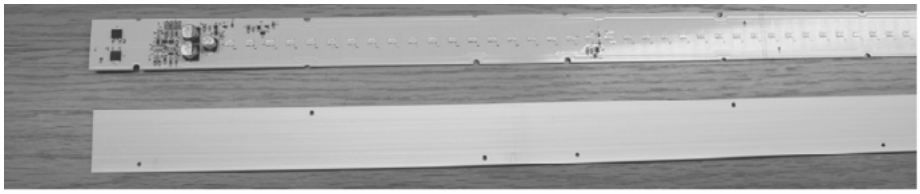
Aluminium strip of 1.500 x 46 (L x W) mm with a material thickness of 1.5 mm tightly secured to the bottom of the two daisy chained modules using thermal paste with thermal resistance of 8.5 W/mK.

CONNECTING THE ACTIVEPAQ MODULE TO A LUMINAIRE BODY OR HEATSINK

In order to control the temperature of lifetime critical components on the ActivePAQ module DA-Group strongly advices use of an aluminium heatsink in the luminaire, if the luminaire body itself cannot be used as a cooling element. Important factors are the size of the surface area contacting the ActivePAQ module and the quality of the connection between both components. It is highly important to select materials in the luminaire that don't have any negative effect on the LED performance or lifetime (e.g. don't use any outgassing types of tape / glue).

The below illustration describe how the ActivePAQ modules can been connected to a very compact aluminium strip or the luminaire body. The use of the thermal paste between the ActivePAQ and aluminium strip is not mandatory, and, in many cases, it is possible to manage the thermals without it. However, using thermal paste or similar material between the LED module and the heatsink or luminaire body, can have a positive effect on the thermal performance of the final product.

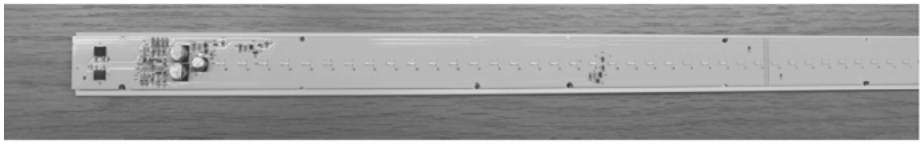
1) ActivePAQ module & aluminium strip (heatsink)



2) Line of thermal paste over the middle line of the heatsink

3) Firmly push the module on the heatsink to spread out the thermal paste

4) Fix the module to aluminium heatsink (screw connection)



LIGHT OUTPUT & OPTICS

By using best in class LED components, ActivePAQ modules are designed to support ultimate design flexibility and luminaire performance. Good thermal management however is not only essential secure the product lifetime, but to maximize the lumen output of the ActivePAQ module as well. Wide beam LED's have been implemented for superb light distribution. The ActivePAQ module is supplied without any additional optical components, because we believe that this is one of the particular area's where OEM's add significant value. For optimal light mixing and uniform colour over angle performance DA-Group advises use of a diffuse cover.

Below depicted, self made profiles are solely used by DA-Group for demonstration purposes. They give an impression of the ActivePAQ performance on a simple heat distributing profile with diffuse cover.

DAISY CHAINING THE ACTIVEPAQ 2 FT. BOARDS

Up to 6 pcs of ActivePAQ 2 ft. 3.000 lm or 4.000 lm modules can be chained in series by utilizing the input and output connectors for easy 230V loop through. This means that you can power 12 modules from one mains input point if for example you wire 6 modules both ways in a rail from one mains input point.

For visualization purposes, a chain of 3 modules is shown in figure 1 below. Additionally, an example of the ease of seamlessly connecting multiple modules together in order to build longer luminaires is shown in figure 2 below. It is recommended to leave 2 mm gap between the two boards when daisy chaining two modules due to dimensional tolerances and for
Zhaga screw hole compliancy.

AC mains 230Vac

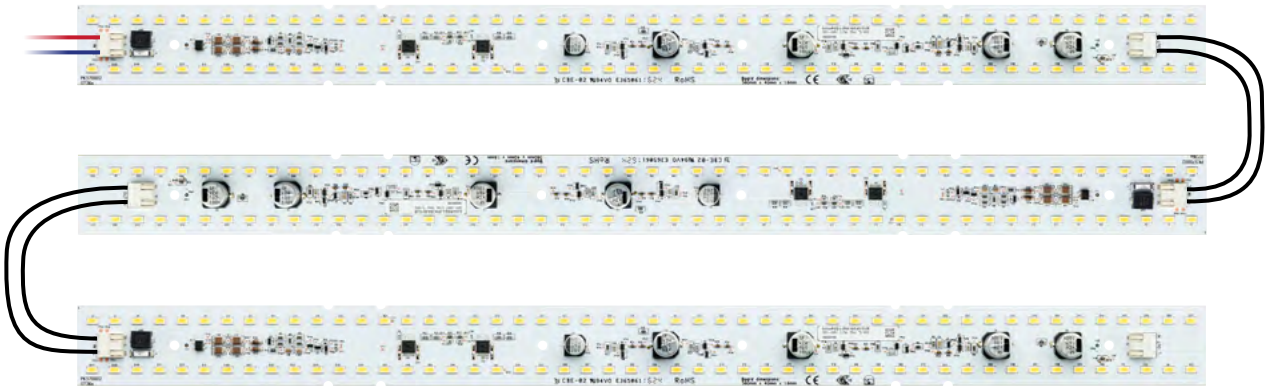
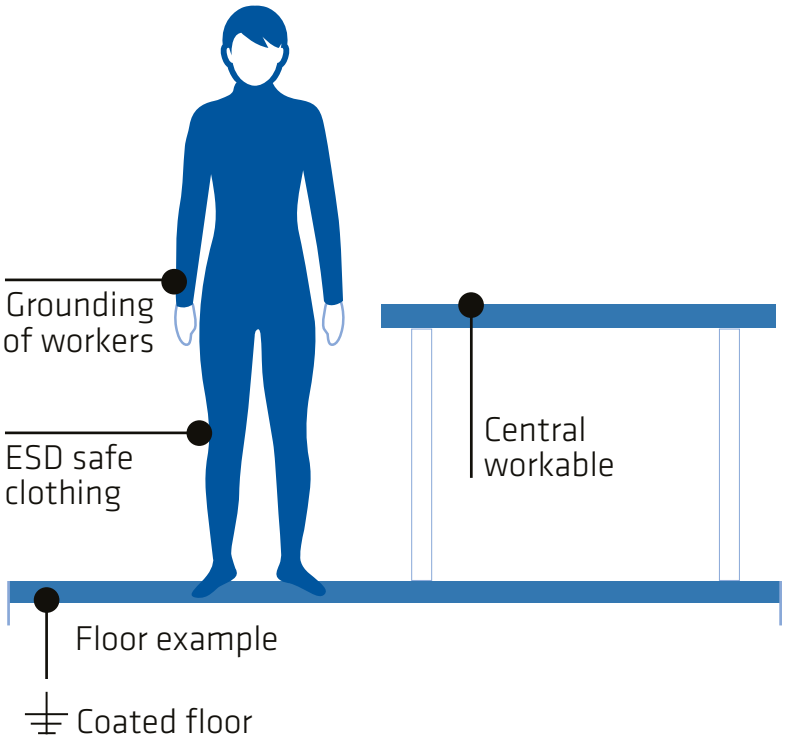


Figure 1: A chain of 3 ActivePAQ modules

Figure 2: Easy and minimal wiring between 2 modules

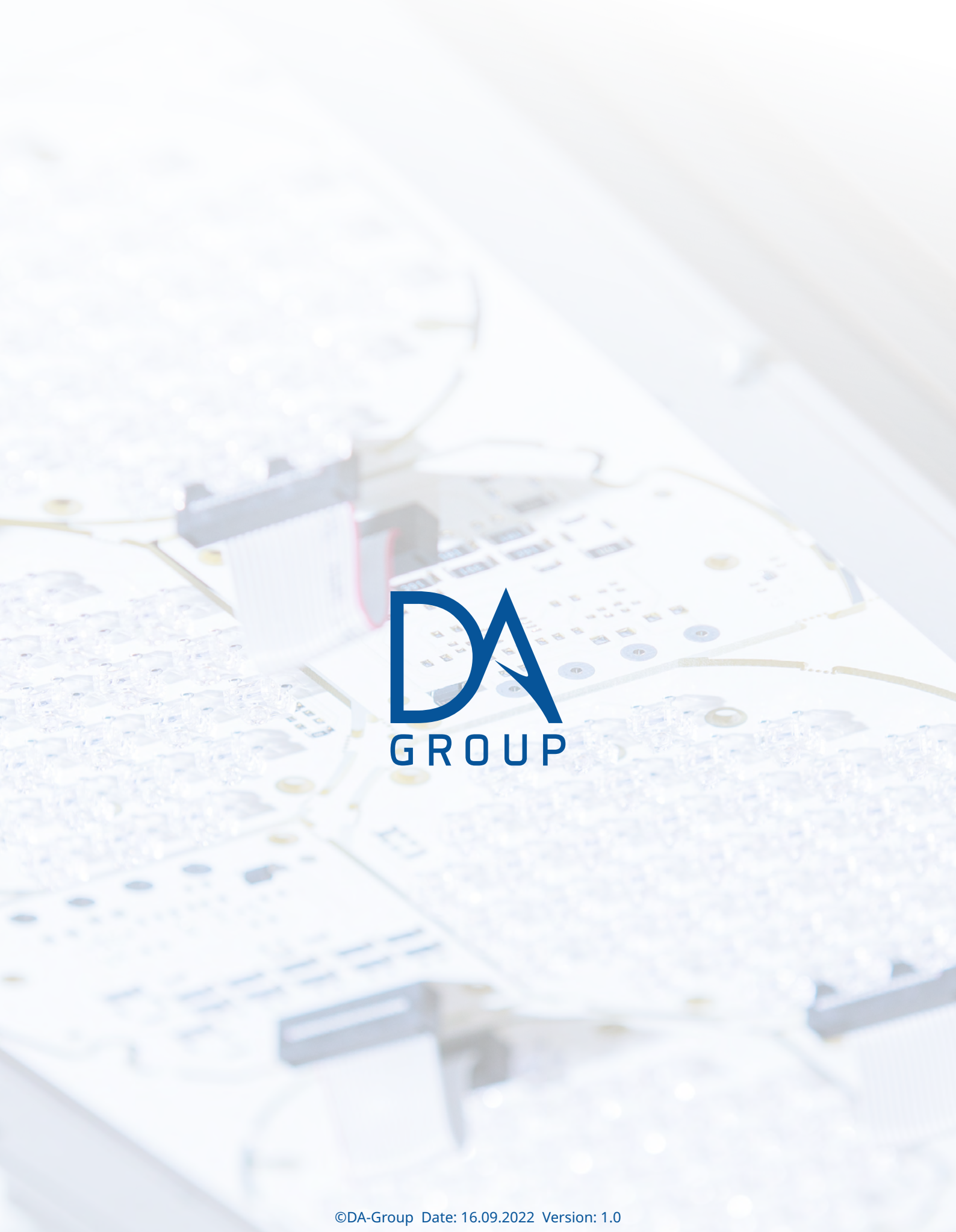
ELECTROSTATIC DISCHARGE (ESD) SAFETY

It is generally recognized that electrostatic discharge can damage electronic components such as LED chips, IC's etc., potentially resulting in early product failures. Though our ActivePAQ modules have been designed as robust as possible, still a set of measures have to be taken into account when handling the products. Not only those ESD protective measures are important to be taken in the production environment, but also packing and shipping are critical processes in this aspect. Air humidity for example has an important influence on electrostatic charge build-up. In order to meet the ESD safety requirements DA-Group advices to contact an external consultancy office. Furthermore, it is highly recommended that installers are pre-informed not to touch the LED's while handling the ActivePAQ module during installation of the luminaire.



HANDLING

ActivePAQ light engines require careful transportation and handling. Bending of the PCB (/module) may cause visible or invisible damage which can result in 0-hour defects or early failures over lifetime. In DA-Group's factory the boards are always in straight position, from the moment of unpacking the bare PCB's until the tested Active-PAQ light engines are slid into their final box packing. This packaging has been designed in such a way that the products fit right in with sufficient margin, though tight enough to protect the module against shocks during transportation. After arrival in the OEM factory it's evenly important to handle those boards with care during the built-in process.



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