

CUSTOMIZED **OLED** LIGHTING DESIGN

PROJECT MONARCH
OLED DESIGN SAMPLE KIT



CUSTOMIZED OLED LIGHTING DESIGN

PROJECT MONARCH - INTRODUCTION

The Fraunhofer FEP, a research and development service provider in the field of organic electronics, is specialized in the development and manufacture of cutting-edge Organic Light Emitting Diode (OLED) designs.

Fraunhofer FEP offers its customers the realization of customer-specific OLED modules with a wide range of features and materials for converting design ideas into luminous objects using OLED technology. We utilize latest technologies and materials, and apply our extensive know-how to produce prototypes and small series for the desired applications of our customers.

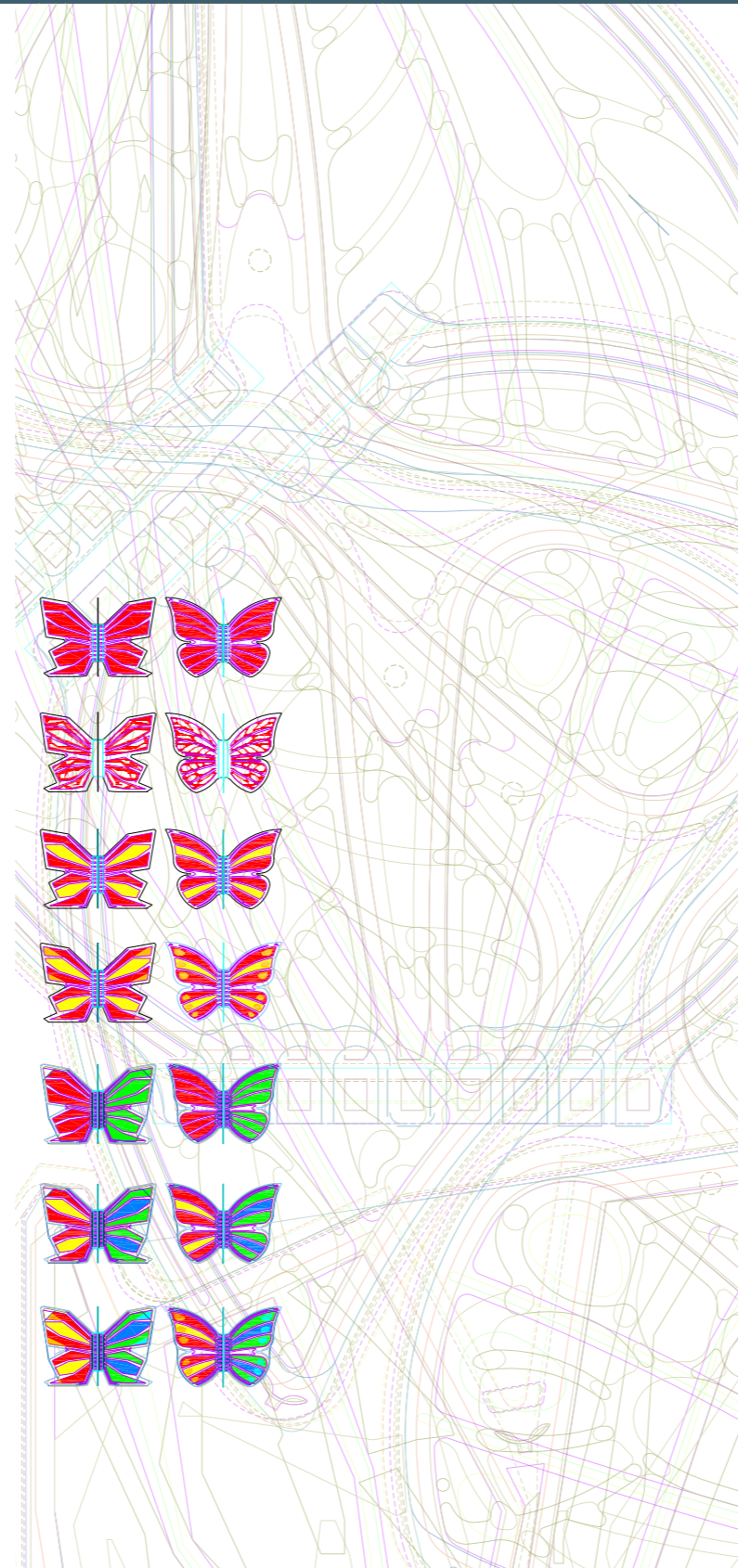
PROJECT MONARCH

Flexible OLEDs present designers a practically unlimited tool for creating new OLED-based luminous objects. In order to inspire lighting designers and product engineers and to explain the basic design options for OLED elements for creating their own unique lighting designs or installations, Fraunhofer FEP launched Project Monarch, an OLED Design Sample Kit. It highlights in a non-technical way the exceptional properties and features of OLED technology such as their flexibility, transparency, the segmentation of the luminous area, and the opportunity to realize multicolored and color-variable surfaces and patterns - all in one single OLED design in the shape of a butterfly.

This brochure gives an **overview** of available **design options for OLED lighting design**. As a physical demonstrator for the various design options the **OLED Design Sample Kit** is available for purchase, and contains either a single or three different **OLED butterflies** in two different design styles. Please contact us for a quotation.

WHAT ELSE?

Fraunhofer FEP works closely together with well-known OLED manufacturers in scaling up to full serial production. Moreover, we also demonstrate the range of possibilities as well as the application requirements for a given OLED design through exclusive OLED-specific design workshops for designers. Finally, our institute is an experienced partner for integrating OLED elements into your product.



TECHNICAL FUNDAMENTALS

Fraunhofer FEP focuses on **small-molecule OLED** systems that are manufactured in a **clean room** using state-of-the-art **vacuum deposition tools**, starting with bare plastic barrier film or glass substrates to the final encapsulated OLED lighting module with integrated electrical contacts. All OLED module structures are created by masking the deposition area with high-precision shadow masks.

Our vacuum deposition tool handles mother **substrates with 200 x 200 mm²**, which can be populated with multiple modules having different or the same shapes and sizes.

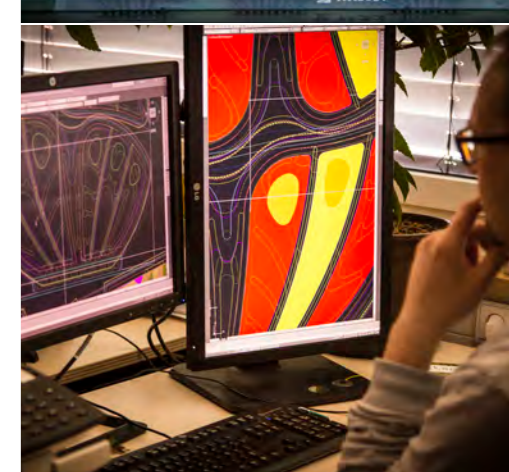
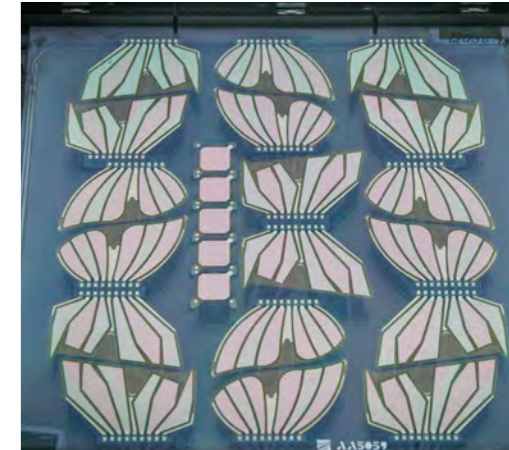
OLED DESIGN PROCESS

Fraunhofer FEP's OLED design process starts with a customer's sketch or a CAD model of the final lighting sculpture. Based on this aesthetic design our designers create a technical layout of the complete OLED design containing all necessary layers and masking steps, taking specific tool and technology design rules into account.

The technical layout is the basis for the manufacturing of the shadow mask setup and all the necessary manufacturing steps.

EXPLAINING OLED DESIGN OPTIONS

To lend inspiration and give an overview of all the possible design options and features for realizing your individual OLED lighting design, this brochure lists and explains these options in detail on the following pages.



CUSTOMIZED OLED LIGHTING DESIGN



VARIOUS DESIGN OPTIONS FOR OLED LIGHTING MODULES



SHAPE OF EMISSION AREA AND MODULE SHAPE

Did you already know? OLED modules can take any shape with nearly no limits. They are cut out with high precision from the plasticbased mother substrate by laser.

However, some basic design restrictions exist especially for glass substrates. Nonetheless, glass is not restricted to just geometrical shapes.

The emission area can also take any shape but needs a margin of at least 1.5 mm for reliable encapsulation.

SEGMENTATION

Not only the active area of an OLED module can take on any shape. It could also be divided into separate parts or segments. As each segment has its own electrode, they can light up and be dimmed independently.

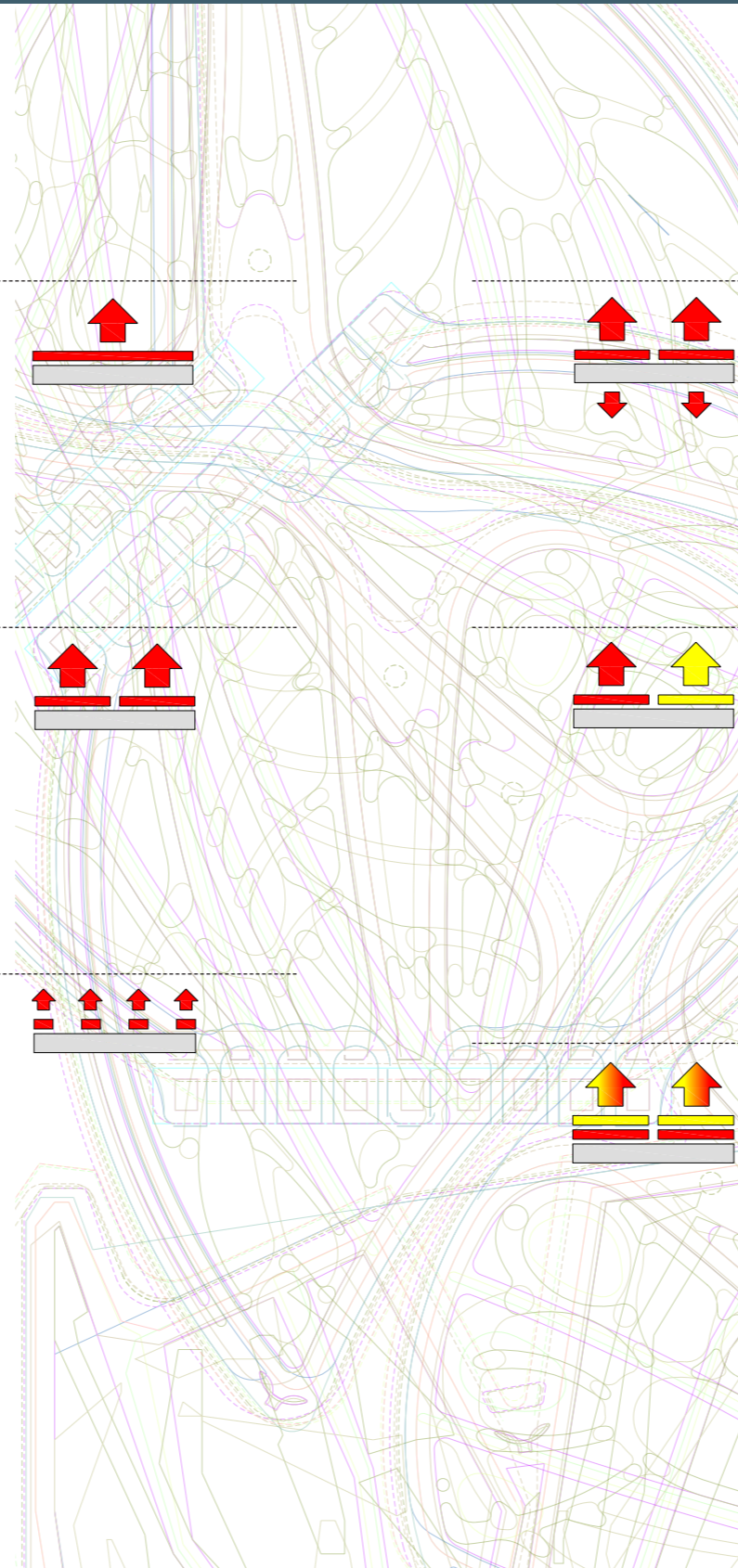
As a result, segmented OLED modules facilitate dynamic lighting effects on a single OLED module.

PATTERNS + LOGOS

The active area can also be populated in a way that only a mesh or grid lights up, while the interspaces between the active areas remain completely transparent.

This feature allows completely new designs not expected to be realizable with shadow mask structuring. However, with a smart shadow mask design developed by Fraunhofer FEP's process engineers it becomes feasible.

Another option is the laser inscription of logos, text or simply patterns into the active area. This can be combined with transparent and also with color-variable areas.



TRANSPARENCY

Since silver or aluminium is used as top electrode material, this electrode appears as reflective or mirrored surface on standard (opaque) OLED modules. The thickness of this electrode can be reduced to a few nanometers to produce a semi-transparent electrode for a semi-transparent OLED device with a transparency of 50%. This means the OLED is transparent when off, but emits the light on both sides when switched on.

AREA COLOR + MIXED COLOR

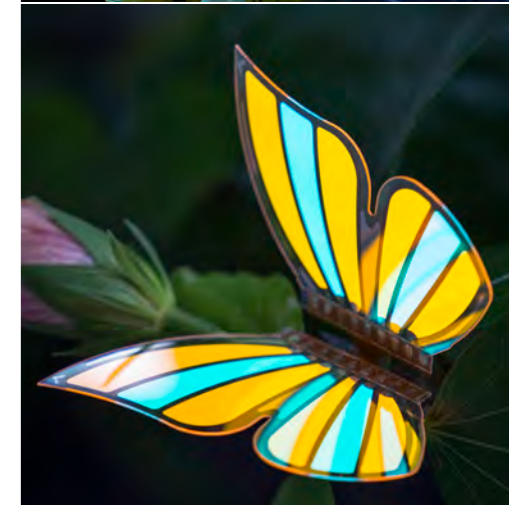
If your segmented OLED design requires different colors on different segments of a single OLED module, it is possible to deposit up to three different emission colors in different areas of one OLED module.

This is a powerful feature especially for dynamic signage applications.

There is also the possibility to mix two colors by stacking two different emitters on parts of the active area. This produces a mixed emission color (e.g. blue + yellow = white).

VARIABLE COLOR

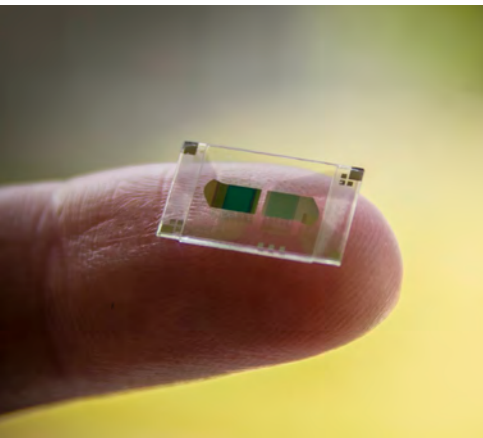
If two different OLED units (colors) are stacked on top of each other and all electrodes remain separated, each color can be controlled independently. A mixture of both colors could be realized by dimming each one. This is also applicable to a three color system, with the result that true RGB-OLED can be realized on the same area without resorting to sub-pixelation. This technology can be applied to a single active area as well as to a segmented layout.



CUSTOMIZED OLED LIGHTING DESIGN



TECHNICAL DESIGN OPTIONS



COMBINING OLED & OPD/OPV

For specific applications especially in the medical and agricultural business a combination of OLED and OPD (organic photodiodes) can be very useful to realize integrated active sensors in the same device.

Also the combination of OLED and OPV (organic photovoltaics) can also be implemented as a wearable electronic system for integration into textiles in the fashion industry.

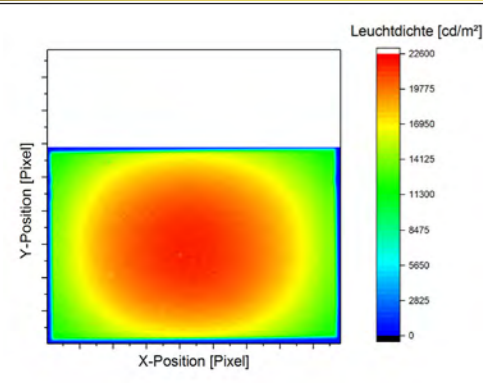
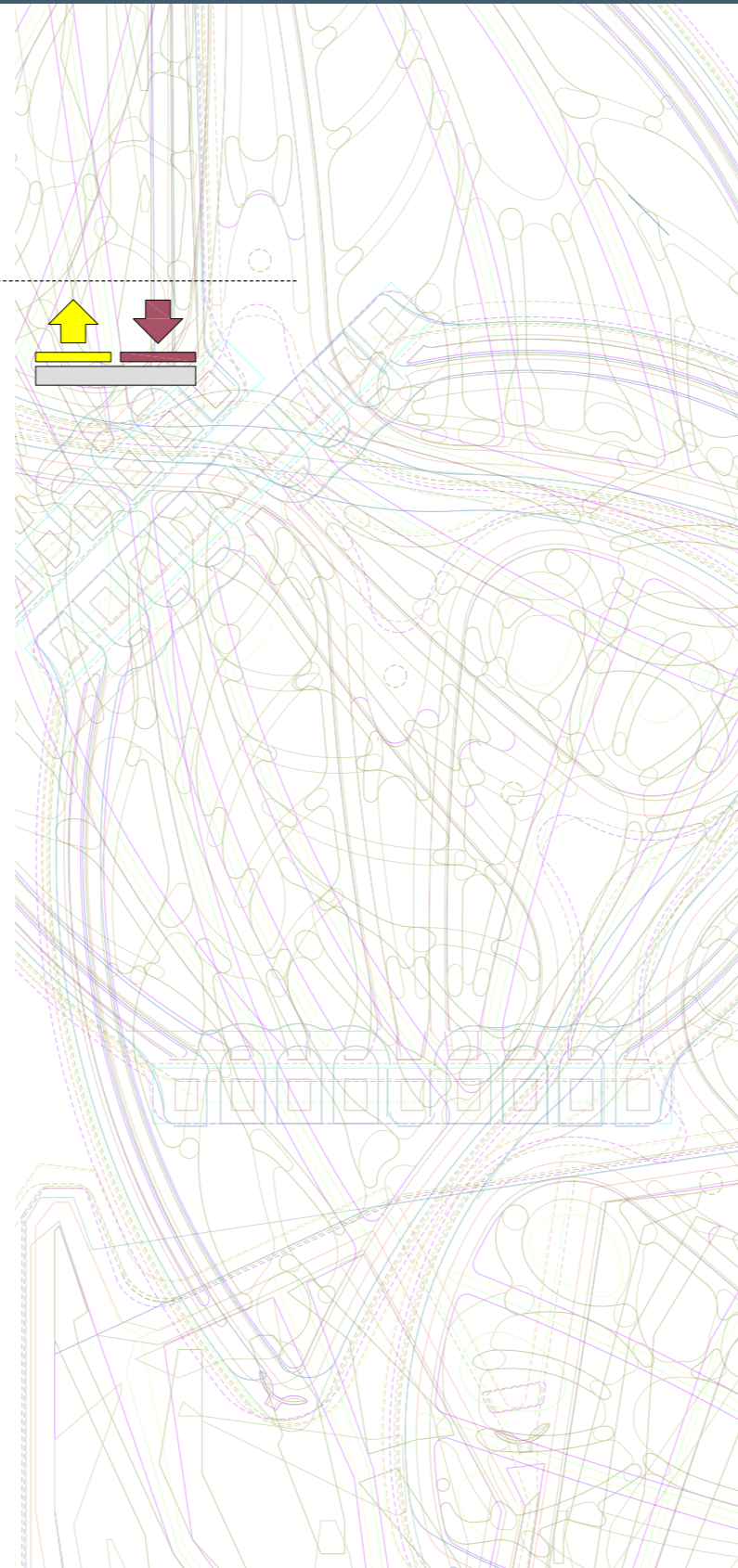
HIGH BRIGHTNESS / HIGH HOMOGENEITY

Standard luminance or brightness of OLED lighting modules is $\sim 1,000 \text{ cd/m}^2$, depending on the OLED stack and color. For certain applications, higher brightness is required.

To realize a brightness of up to $10,000 \text{ cd/m}^2$, a dedicated OLED stack with special layout and heat management techniques, using thermally conductive elements integrated in the OLED module, prevents damage to the OLED module and ensures good homogeneity of the active area at high brightness. Fraunhofer FEP has developed and uses a flexible encapsulation process that meets all technological requirements to realize high-brightness OLED modules with an acceptable lifetime.

SPECIAL FEATURES

Many further specific features for customized OLED modules are realizable, ranging from biodegradability and biocompatibility of the complete device for medical applications, over short-lifetime systems for low cost, short-term or single-use applications, up to low-voltage stack systems for autonomous applications.



DESIGN KIT | SAMPLES | CONSULTING

PROJECT MONARCH DESIGN SAMPLE KIT

Fraunhofer FEP is offering an **OLED Design Sample Kit** consisting of either a single sample (Single kit) or three samples (Triple kit) of different **butterfly-shaped OLED module** pairs. Each butterfly comprises two OLED modules (mirrored design). In the case of the Triple kit, each butterfly implements and demonstrates a different design feature described in this brochure. The two different styles of demonstrator butterflies are the „Constructa“ style, a geometrical, edged design and the „Naturalis“ style, a more natural, organic design. Both styles offer the same set of design feature options. Please contact us for a quotation.

OLED SAMPLE MANUFACTURING

Besides our OLED Design Sample Kit, Fraunhofer FEP is your partner of choice in realizing your own exclusive OLED lighting design either as prototypes or in small production quantities. Do you have a particular design in mind that you would like to realize? Please get in touch with us for further details.

OLED DESIGN WORKSHOPS

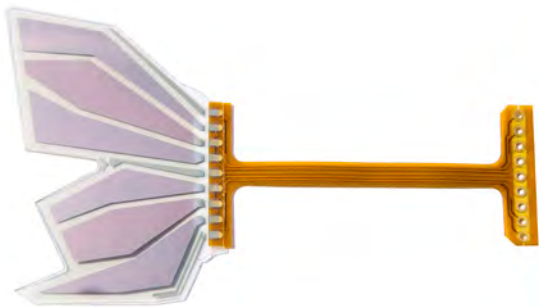
By means of exclusive workshops and consulting activities, we transfer our extensive experience and know-how in OLED design and manufacturing, that we have developed through numerous industrial and government-funded projects with our partners over more than a decade.

Topic-oriented workshops are offered in-house and also in combination with a detailed site visit and introduction to the manufacturing facilities at our campus in Dresden, Germany.



PROJECT MONARCH - OLED DESIGN SAMPLE KIT

TECHNICAL SPECIFICATIONS



Size:

OLED only (one wing): 50 × 35 mm²
OLED w/ PCB: 50 × 85 mm²

Power consumption:

8 mA @ 5 V per segment (6 segments per wing)
Power supply unit (per sample kit): 30 W DC

Electrical connection:

OLED side:

custom FlexPCB with ACF bonding

Controller side:

1/10" (2.54 mm) socket connector (max. 9 contacts)

Controller (Project Monarch Sample Kit):

1× Arduino Nano (or similar) per wing pair

Sample Kit Dimensions

(may change slightly):

Triple kit: 450 × 300 × 80 mm³ (three Monarchs)

Single kit: 300 × 200 × 80 mm³ (one Monarch)

CONTACT

For additional information about OLED technology, customized OLED design or the availability of our „Project Monarch“ OLED Design Sample Kit please contact us:

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*We focus on quality
and the ISO 9001.*