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Ultra-low power microdisplays – growing out of the prototype stage

The OLED microdisplays developed at the Dresden Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP are offered to customers as evaluation kits for more than five years already. Thanks to their long-standing know-how, the IC designers have now made the leap from laboratory prototypes to sample production of higher quantities with the ultra-low power microdisplays, while optimizing costs. A standardized test board for delivery and incoming goods inspection at the customer will be presented for the first time at embedded world 2023, at the Fraunhofer joint booth (Hall 4, No. 422).

The rapidly growing adoption and improved user experience of AR and VR systems, smartwatches, and fitness trackers has been driving the microdisplays market for years. According to various studies¹, it is expected to reach around USD 3,032 million by 2030 with an average growth rate of 13.5% from 2022 to 2030.

Fraunhofer FEP in Dresden has been developing application-specific OLED microdisplays and sensors with OLED-on-silicon technology for years. Recently, a new organic-on-silicon photonics platform was presented, on which a wide variety of designs from OLED microdisplays to photodiodes and sensors – also in combination – can be developed and manufactured in a timely manner. They are optimized for the respective application: e. g. in full color for augmented reality (AR) applications or ultra-low power consuming for wearables.

Due to the rising demand, yields and need-based quantities at adequate prices are also playing an increasing role at Fraunhofer FEP. In recent years, it has already been possible to reliably offer evaluation kits in small quantities for in-house testing and development purposes. Now, the technologists, scientists and IC designers at the institute have optimized the processes and procedures to such an extent that OLED microdisplays and, in the future, sensor chips can now be supplied beyond the prototype stage.

Martin Rolle, engineer in IC and system design, explains: "We have been able to significantly expand and optimize our manufacturing processes in the clean room and with our external partners in recent years. This has enabled us to make the leap out from laboratory scale. This is also underpinned by our capabilities in IC design. Here, standardized processes now contribute to the fact that we can, for example, offer new

test boards equipped with 64 microdisplay chips each for initial evaluation as a standard delivery size."

At embedded world 2023, the scientists will not only show the range of microdisplays and sensors, but also the latest test board, which is equipped with 64 extremely power-saving displays. In addition to this standard delivery size, up to small and medium quantities will also be possible in the future. "The accordingly more attractive pricing than for single evaluation kits shall enable and support new development ideas and their faster implementation at SMEs and industry," Martin Rolle continues.

The new test boards from Fraunhofer FEP not only represent an expansion of the device range, but also serve to simplify and secure the transport of the displays to the customer. In addition, the client has the possibility to test up to 64 microdisplays on the test board directly via the corresponding control electronics. This also facilitates the incoming goods inspection at the customer's premises. The test board is controlled as standard via an SPI interface (FPGA-based) and can also be controlled via a customer-specific solution or customer-specific electronics developed by Fraunhofer FEP and its partners.

Currently, the test boards are equipped and offered with the latest low-power versions of OLED microdisplays. These displays have a resolution of 320 × 240 pixels with a minimum power consumption of typically 1...3 mW in the monochrome version. Starting in the middle of this year, multi-color microdisplays and versions with ultra-bright setup will also be available. These are particularly suitable for use in data glasses.

In addition to the manufacturing of previously developed microdisplays, of course the scientists of Fraunhofer FEP also develop new customer-specific microdisplays and transfer them to pilot-fabrication at small to medium quantities. Thanks to many years of collaborative projects, there is already a strong network available for our customers. Furthermore, the IC and system designers offer the development of customer-specific drive electronics.

At embedded world 2023, Fraunhofer FEP scientists will present the standardized test board with 64 OLED microdisplays for the first time. At the same time, the institute is already working towards transfer of further display variants to pilot-manufacturing. Thus, the researchers want to meet the worldwide trend and provide attractive opportunities for interested parties and customers to develop new wearables, HMDs and other applications with OLED microdisplays.

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¹ <https://www.finanznachrichten.de/nachrichten-2022-08/56823609-microdisplay-market-size-worth-dollar-3032-million-globally-by-2030-at-13-5-cagr-verified-market-research-008.htm>

Fraunhofer FEP at embedded world:

March 14 – 15, 2023, Nuremberg, Germany
Fraunhofer joint booth no. 4-422

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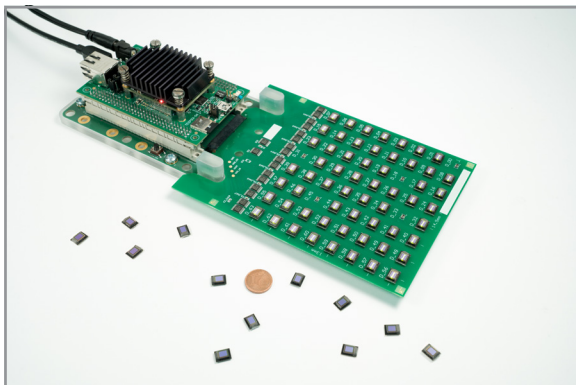
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electronic displays conference 2023

March 16, 2023
Session 9: OLEDs, 11:00 – 11:20 a.m.:
OLED-on-Silicon Platform for High-resolution and Ultra-low Power Microdisplays
Dr. Uwe Vogel,
Head of Business Unit Microdisplays and Sensors, Deputy Director, Fraunhofer FEP

Further publications:

- Organic-on-silicon photonic platform for advanced imagers, microdisplays and sensors
Wartenberg, Philipp et al., SPIE Photonics West 2023, Paper 12425-38
- New ultra-low power OLED microdisplays for slim near-to-eye visualization
Wartenberg, Philipp et al., 2022, Advances in Display Technologies XII
- New Ultra Low-Power High Brightness Microdisplays Enabling Broad Applications
Wartenberg, Philipp et al., 2022, Society for Information Display. SID Symposium
Digest of Technical Papers



Test board for up to 64 OLED microdisplays

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Picture in printable resolution: www.fep.fraunhofer.de/press

The **Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP** works on innovative solutions in the fields of vacuum coating, surface treatment as well as organic semiconductors. The core competencies electron beam technologies, roll-to-roll technology, plasma-activated large-area and precision coating as well as technologies for organic electronics and IC design provide a basis for these activities. Thus, Fraunhofer FEP offers a wide range of possibilities for research, development and pilot production, especially for the processing, sterilization, structuring and refining of surfaces as well as OLED microdisplays, organic and inorganic sensors as well as optical filters. Our aim is to seize the innovation potential of the electron beam, plasma technology and organic electronics for new production processes and devices and to make it available for our customers.