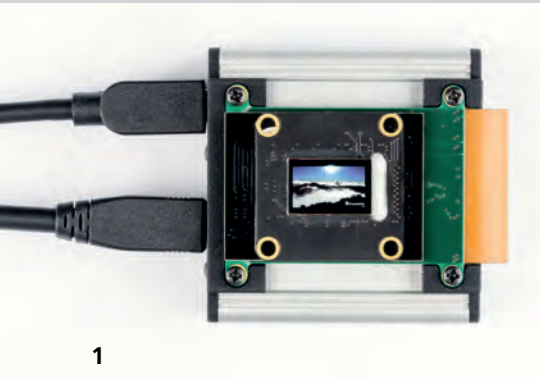
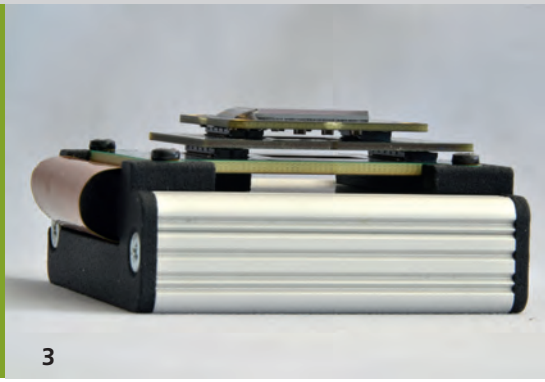
Fraunhofer
FEP

FRAUNHOFER INSTITUTE FOR ORGANIC ELECTRONICS, ELECTRON BEAM AND PLASMA TECHNOLOGY FEP


1


2


3

1 720p OLED microdisplay evaluation kit and driving electronics
2 AR data glasses developed within BMWi-funded project Glass@Service
3 Side view 720p microdisplay with controller box

720p OLED MICRODISPLAYS FOR INDUSTRIAL SEE-THROUGH AR-HMDs

Motivation and Technology

Microdisplays are tiny displays providing very high resolutions at the same time. Typically they are based on CMOS back-plane technology, which is able to provide the necessary pixel densities and circuitry performance. For more than 10 years, the Fraunhofer FEP has been developing specific display solutions, that are predestined for use in data glasses and head mounted displays (HMDs).

Each display is application-specific, because parameters such as brightness, resolution, framerate, power consumption, screen size, contrast ratio, color and complexity of the electronics play a major role in the increasingly professional and demanding requirements.

Based on the requirements, two separate display types can be considered in general: Information displays and conventional video displays. Most industrial use-cases require focused information rather than a running video stream. Furthermore other parameters play an important role such as ergonomics, compactness and a battery runtime of more than one shift for the complete system. Augmented Reality (AR) in industrial applications is often used for real-time overlay of design data or assistance scenarios.

The existing portfolio of Fraunhofer FEP is complemented by a new generation of OLED microdisplays, that are perfectly adapted to the requirements of industrial AR data glasses – the 0.64“ 720p microdisplay, which features high frame rates, high contrast ratio and low power consumption.

Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP

Maria-Reiche-Str. 2
01109 Dresden, Germany

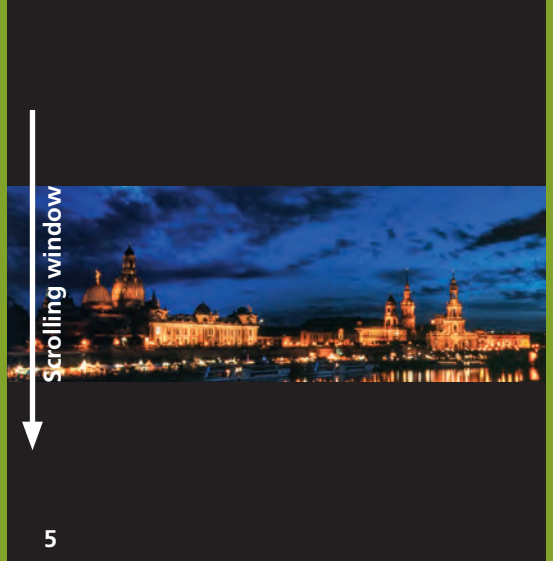
Contact persons

Philipp Wartenberg
Phone +49 351 8823-386
philipp.wartenberg@fep.fraunhofer.de

Ines Schedwill
Phone +49 351 8823-238
ines.schedwill@fep.fraunhofer.de

www.fep.fraunhofer.de

4



5

6

Technical data

The new 720p OLED microdisplay provides a nominal **resolution of 1280 × 720 pixels** plus additional 10 pixels in each direction for display image adjustment, summing up in a total resolution of 1300 × 740 pixels. Based on a **sub-pixel size of 5.5 µm × 5.5 µm** and four sub-pixels, which are configured in a RGBW setup for the initial prototype, the nominal active area of 14.1 mm × 7.92 mm results in a **screen diagonal of 0.64''**. Using a four sub-pixel arrangement also enables a monochrome version of that backplane with four times higher resolution, i. e. 2560 × 1440 pixels. The backplane already provides all necessary driver circuitry to operate the displays from a standard 24 Bit parallel RGB interface using well known synchronization signals vertical synchronization (VS), horizontal synchronization (HS) and data enable (DE).

Evaluation Kit HUCW1010

The OLED microdisplays of Fraunhofer FEP could be purchased for evaluation purposes. Therefore we offer an evaluation kit as follows:

- Full color display with 24 Bit color depth
- Packaged as COB (chip-on-board) on a rigid PCB
- Driving electronics
- HDMI and USB cable
- Configuration GUI (for Windows based systems only)
- Documentation

Key features of the driving circuitry

Gamma Adjustment:
The gamma of the display can be adjusted individually for each of the four data pipelines related to each of the sub-pixels. This is realized by a chip internal resolution of 10 Bit and an 8 Bit/10 Bit mapping.

White Calculation:
The value of the fourth (white) sub-pixel can be calculated inside the backplane based on the red, green and blue color values. It can also be provided externally, which enables a separate high-lighting data channel to provide additional information such as focus-peaking information in electronic viewfinders.

Emit Mode:
To reduce perceived motion blur the timing of the light emission can be controlled. Typically two modes can be distinguished: hold mode and impulse mode (also called rolling emit). The latter can be controlled in a wide range.

Pixel Current Adjustment:
The pixel current and thus overall brightness can be controlled in a wide range to support different OLED stacks as well as to provide enough headroom for the backplane IC to drive impulse mode.
Typically the current density of the pixel is set to 20 mA/cm² … 30 mA/cm². Sub-pixel currents up to 550 nA have been characterized, which corresponds to a current density of 1.8 A/cm².

Our offer

Fraunhofer FEP is ready to provide customer specific developments, prototyping and the manufacturing of small series.

Parameter	Value
Nominal Display Res.	1280 × 720 (720p)
Total Display Res.	1300 × 740
Number of Sub-pixels	3.85 million
Active Area	14.1 mm × 7.92 mm
Chip Size	16.9 mm × 10.4 mm
Display Diagonal	0.64"
Frame Rate	60, 75, 90 and 120 Hz
Contrast Ratio	> 100 000:1
Uniformity	> 95% typ. viewing angle is 0°/ perpendicular to display
Pixel Setup	RGBW
Pixel Pitch (RGBW)	11 µm × 11 µm
Pixel Pitch (Sub-pixel)	5.5 µm × 5.5 µm
Color Depth	24 Bit (32 Bit incl. white)
Display Interface	24 Bit RGB digital, parallel + synchronization signals CLK, VS, HS and DE
Display Brightness	300 cd/m² (typ.)
Typ. Power Consumption	100 mW@60 Hz
Config. Interface	TWI (two-wire-interface)
I/O Voltage	3.3 V (1.6 V ... 5.5 V)
Core Voltage	1.8 V (1.6 V ... 2.0 V)
Cathode Voltage	-1 V ... -6.5 V (depending on OLED)
Temperature Range	-40°C ... +65°C

4 *Global emit*
5 *Rolling emit*
6 *Various OLED microdisplays of Fraunhofer FEP*

TÜVRheinland ZERTIFIZIERT
Management System
ISO 9001:2015
ISO 50001:2011
www.tuv.com
ID 9105050079

We focus on quality and the ISO 9001.