LCOS

Microdisplay Technology

HOLOEYE **Systems, Inc.**

LCOS Microdisplays

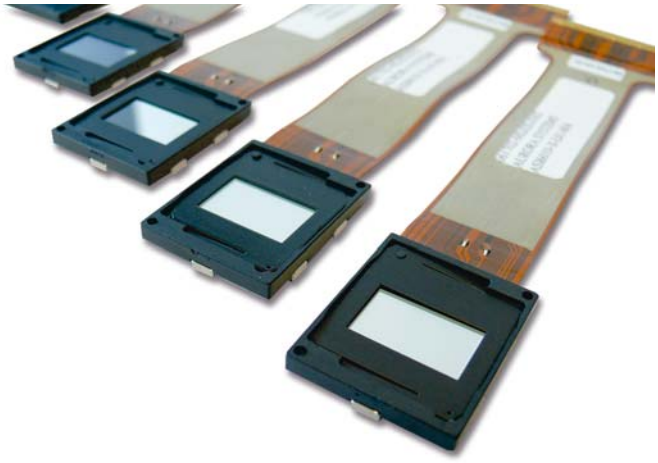
LCOS (Liquid Crystal on Silicon) is a reflective microdisplay technology based on a Silicon backplane. The electronic circuits controling the liquid crystals are fabricated on a silicon chip, which is coated with a highly reflective surface. This results a very high fill factor (image is less pixilated) because the circuitry is behind the pixel (compared with transmissive LC, electronics surround the pixels) and does not create an obstruction in the light path (“screen door” effect).

Using standard CMOS processes, microdisplays with extremely small pixels, high fill factor (pixel aperture ratio) and low fabrication costs can be created.

LCOS microdisplay technology can compete and in some cases even outperform all other display technologies with respect to resolution, size, ease of use, quality and price. HOLOEYE Systems´s OEM LCOS microdisplay service includes basic implementation assistance and performance specification for specialized applications. HOLOEYE Systems offers modification of driver parameters for customer specific requirements resulting in low-cost intelligent driver boards ready for mass production.

This positions HOLOEYE Systems to be a key-supplier accross numerous markets and to be the very first company to market a “complete solution” to the end-user, whether they are in the defense, medical or aerospace industry. Even the highly cost-sensitive automotive industry is able to develop HUD systems based on high resolution HDTV LCOS microdisplay technology.

+ LCOS is highly scalable and can create very small pixels, also well suited for laser projection (since a laser is already polarized and requires the smallest possible display)
+ LCOS via HSI is cost effective and readily available for niche markets
+ HSI offers an open technology platform to allow LCOS to adapt to various applications
+ LCOS can modulate amplitude, polarization and phase



LCOS Microdisplays offered by HOLOEYE Systems:

+ Microdisplay size from 0.177” to 0.7”
+ Resolution from 640x480 (VGA) to 1920x1080 (HDTV)
+ Frame rate from 60 Hz to 180 Hz
+ Digital drive schemes
+ Monochrome and Color-Field-Sequential LCOS microdisplays
+ Amplitude and Phase modulating LCOS microdisplays

Development Services

HOLOEYE´s engineering services include optical, mechanical, and illumination design. Our experience with optics, microdisplays, and illumination systems allows us to quickly develop products with complex optical systems without the need to reinvent system architectures.

By leveraging proven technology, supply chains, and processes, your development risks are minimized and your product plans realized.

Technical Expertise

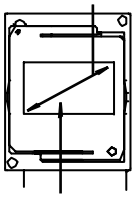
- See-Through and Occluded HMD’s
- HUD’s
- High Resolution Viewfinders
- Virtual Control Panels
- Spatial Light Modulators (Amplitude & Phase)
- Wavefront Correction
- Beam Shaping and Beam Steering
- Holographic Projection
- Fringe Projection
- High Frequency FPGA & ASIC Design

HDTV Resolution

HED-6001 Microdisplay (1920 x 1080 Pixel) - 0.7”

+ **Display Type:**	Reflective LCOS
+ **Dynamic Range:**	10 bit grey level*
+ **Resolution:**	1920 x 1080 (HDTV)
+ **Device Diagonal:**	0.7”
+ **Display Mode:**	VAN, Normally black
+ **Active Area:**	15.36 x 8.64 mm
+ **Aperture Ratio / Fill Factor:**	>87%
+ **Pixel Pitch:**	8.0 µm
+ **Frame Rate:**	60 Hz
+ **Contrast Ratio:**	2500:1 typical
+ **Reflectance:**	55 % (typ.)
+ **Weight:**	12 grams
+ **Operating Temperature:**	+10°C to +70°C
+ **Recommended Operating Waveband:**	420 - 700 nm
+ **Lifetime (RPTV Application):**	> 20,000 hours

Device Diagonal: 0.7”

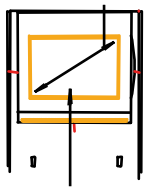


Active Area: 15.36 x 8.64 mm

HED-6201 Microdisplay (1920 x 1080 Pixel) - 0.55”

+ **Display Type:**	Reflective LCOS
+ **Dynamic Range:**	10 bit grey level*
+ **Resolution:**	1920 x 1080 (HDTV)
+ **Device Diagonal:**	0.55”
+ **Display Mode:**	VAN, Normally black
+ **Active Area:**	12.29 x 6.91 mm
+ **Aperture Ratio / Fill Factor:**	>89 %
+ **Pixel Pitch:**	6.4 µm
+ **Frame Rate:**	60 Hz
+ **Contrast Ratio:**	2500:1 typical
+ **Reflectance:**	60 % (typ.)
+ **Weight:**	9 grams
+ **Operating Temperature:**	+10°C to +70°C
+ **Recommended Operating Waveband:**	420 - 700 nm
+ **Lifetime (RPTV Application):**	> 20,000 hours

Device Diagonal: 0.55”



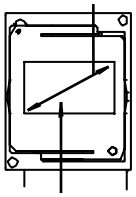
Active Area: 12.29 x 6.91 mm

WXGA Resolution

HED-5001 Microdisplay (1280 x 768 Pixel) - 0.7”

+ **Display Type:**	Reflective LCOS
+ **Dynamic Range:**	10 bit grey level*
+ **Resolution:**	1280 x 768 (WXGA)
+ **Device Diagonal:**	0.7”
+ **Display Mode:**	VAN, Normally black
+ **Active Area:**	15.36 x 9.22 mm (WXGA) 15.36 x 8.64 mm (720p)
+ **Aperture Ratio / Fill Factor:**	>91%
+ **Pixel Pitch:**	12.0 µm
+ **Frame Rate:**	60 Hz
+ **Contrast Ratio:**	2500:1 typical
+ **Reflectance:**	60 % (typ.)
+ **Weight:**	12 grams
+ **Operating Temperature:**	+10°C to +70°C
+ **Recommended Operating Waveband:**	420 - 700 nm
+ **Lifetime (RPTV Application):**	> 20,000 hours

Device Diagonal: 0.7”

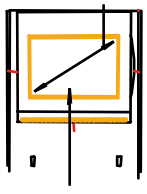


Active Area: 15.36 x 9.22 mm

HED-5201 Microdisplay (1280 x 768 Pixel) - 0.55”

+ **Display Type:**	Reflective LCOS
+ **Dynamic Range:**	10 bit grey level*
+ **Resolution:**	1280 x 768 (WXGA)
+ **Device Diagonal:**	0.55”
+ **Display Mode:**	VAN, Normally black
+ **Active Area:**	12.29 x 7.37 mm (WXGA) 12.29 x 6.91 mm (720p)
+ **Aperture Ratio / Fill Factor:**	>89 %
+ **Pixel Pitch:**	9.6 µm
+ **Frame Rate:**	60 Hz
+ **Contrast Ratio:**	2500:1 typical
+ **Reflectance:**	66 % (typ.)
+ **Weight:**	9 grams
+ **Operating Temperature:**	+10°C to +70°C
+ **Recommended Operating Waveband:**	420 - 700 nm
+ **Lifetime (RPTV Application):**	> 20,000 hours

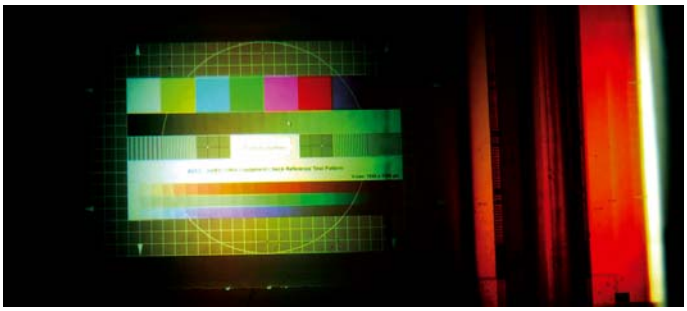
Device Diagonal: 0.55”



Active Area: 12.29 x 6.91 mm

Color-Field-Sequential

A liquid crystal color field sequential (CFS) display presents three monochromatic images corresponding to the three primary colors (RGB) in a repetitive sequence and at a frame rate greater than the flicker fusion frequency for the human eye (180 Hz). Using 1 panel color field sequntial solutions it is possible to build much smaller color projection engines compared to 3 panel soultions. CFS panels are mainly used in color projection applications were space is limited (Head mounted displays - HMD; Heads-up-Displays - HUD; ...).

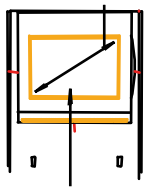


WXGA Resolution

HED-5216 Microdisplay (1280 x 768 Pixel) - 0.55" - CFS

+ **Display Type:**	Reflective LCOS
+ **Dynamic Range:**	8 bit per color
+ **Resolution:**	1280 x 768 (WXGA)
+ **Device Diagonal:**	0.55"
+ **Display Mode:**	VAN, Normally black
+ **Active Area:**	12.29 x 7.37 mm (WXGA) 12.29 x 6.91 mm (720p)
+ **Aperture Ratio / Fill Factor:**	>89 %
+ **Pixel Pitch:**	9.6 µm
+ **Frame Rate:**	180 Hz CFS
+ **Contrast Ratio:**	2500:1 typical
+ **Reflectance:**	66 % (typ.)
+ **Weight:**	9 grams
+ **Operating Temperature:**	+10°C to +70°C
+ **Recommended Operating Waveband:**	420 - 700 nm
+ **Lifetime (RPTV Application):**	> 20,000 hours

Device Diagonal: 0.55"



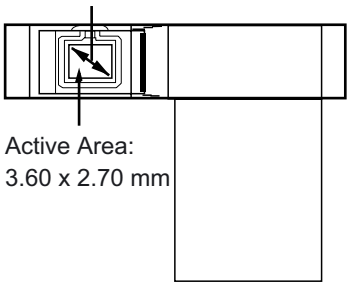
Active Area: 12.29 x 7.37 mm

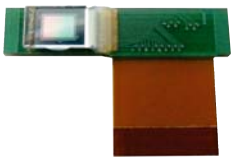
VGA Resolution

HED-1016 Microdisplay (640 x 480 Pixel) - 0.177" - CFS

+ **Display Type:**	Reflective LCOS
+ **Dynamic Range:**	8 bit per color
+ **Resolution:**	640 x 480 (VGA)
+ **Device Diagonal:**	0.177"
+ **Display Mode:**	VAN, Normally black
+ **Active Area:**	3.60 x 2.70 mm
+ **Aperture Ratio / Fill Factor:**	>88 %
+ **Pixel Pitch:**	5.625 µm
+ **Frame Rate:**	180 Hz CFS
+ **Reflectance:**	53 % (typ.)
+ **Weight:**	3.5 grams
+ **Operating Temperature:**	+10°C to +70°C
+ **Recommended Operating Waveband:**	420 - 700 nm
+ **Lifetime (RPTV Application):**	> 20,000 hours

Device Diagonal: 0.177"



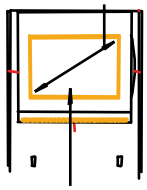


HDTV Resolution

HED-6216 Microdisplay (1920 x 1080 Pixel) - 0.55" - CFS

+ **Display Type:**	Reflective LCOS
+ **Dynamic Range:**	8 bit per color
+ **Resolution:**	1920 x 1080 (HDTV)
+ **Device Diagonal:**	0.55"
+ **Display Mode:**	VAN, Normally black
+ **Active Area:**	12.29 x 6.91 mm
+ **Aperture Ratio / Fill Factor:**	>89 %
+ **Pixel Pitch:**	6.4 µm
+ **Frame Rate:**	180 Hz CFS
+ **Contrast Ratio:**	2500:1 typical
+ **Reflectance:**	60 % (typ.)
+ **Weight:**	9 grams
+ **Operating Temperature:**	+10°C to +70°C
+ **Recommended Operating Waveband:**	420 - 700 nm
+ **Lifetime (RPTV Application):**	> 20,000 hours

Device Diagonal: 0.55"



Active Area: 12.29 x 6.91 mm

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