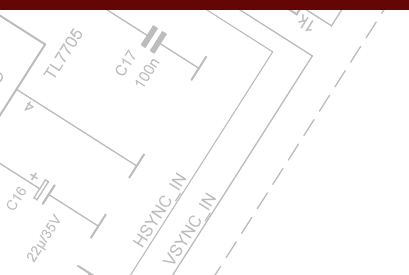
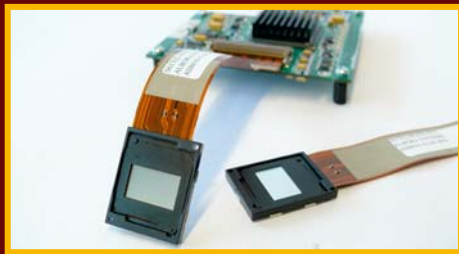


# LCOS

Microdisplay Technology



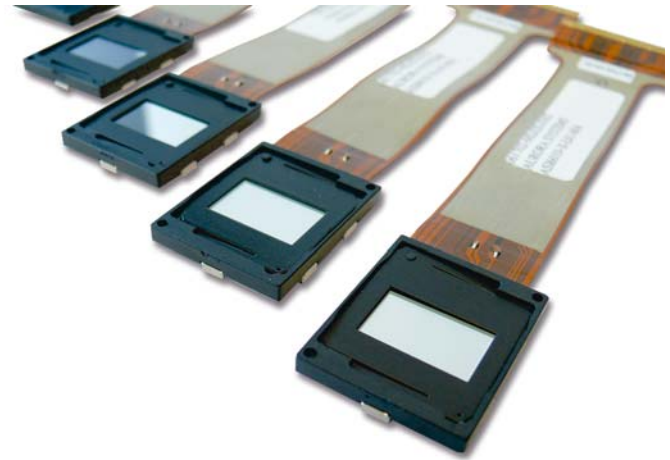
**Systems, Inc.**

# LCOS Microdisplays

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

Using standard CMOS processes, it is possible to produce microdisplays with extremely small pixels, high fill factors (pixel aperture ratio) and low fabrication costs.

LCOS microdisplay technology can compete and, in some cases, outperform all other display technologies with respect to resolution, size, ease of use, quality and price. HOLOEYE Systems' engineering services include 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.



## 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 electronic, optical, mechanical, and illumination design. Our experience in providing customized designs in drive boards, 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 are realized.

This positions HOLOEYE Systems as a key supplier across numerous markets and to offer a cost effective "complete solution" to the end-user, whether they are in the defense, medical, automotive or aerospace industry.

- + LCOS is highly scalable and results in 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

### Technical Expertise

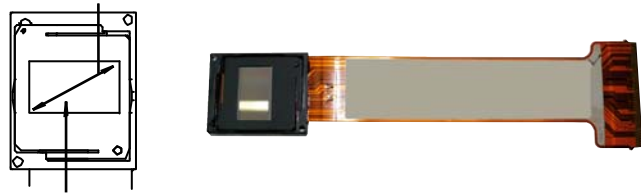
- See-Through and Occluded HMD's
- HUD's
- High Resolution Viewfinders
- Virtual Control Panels
- Spatial Light Modulators (Amplitude & Phase)
- Wavefront Correction
- Beam Shaping and Beam Steering
- Holographic Projection
- Fringe Projection
- Custom Drive Board Designs for specific Video Inputs

# 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 (with compensator)
- + 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

# WXGA Resolution

## 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 (with compensator)
- + 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

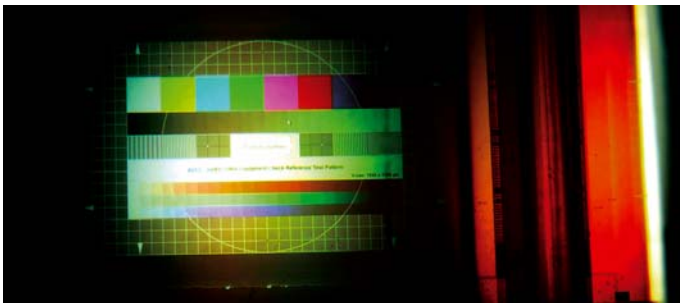
Device Diagonal: 0.55"



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 sequential solutions it is possible to build much smaller color projection engines compared to 3 panel solutions. CFS panels can be used in color projection applications where space is limited, such as head mounted displays and near to eye applications.



# 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: 1000:1 (with compensator)
- + 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

# SVGA Resolution

## HED-8621 Microdisplay (800 x 600 Pixel) - 0.463" - CFS

+ Display Type:	Ferroelectric LCOS
+ Dynamic Range:	8 bit per color
+ Resolution:	800 x 600 (SVGA)
+ Device Diagonal:	0.463"
+ Display Mode:	VAN, Normally black
+ Active Area:	9.4 x 7.05 mm
+ Aperture Ratio / Fill Factor:	91.7 %
+ Pixel Pitch:	11.75 $\mu$ m
+ Frame Rate:	180 Hz CFS
+ Contrast Ratio:	500:1 (with compensator)
+ Reflectance:	60 % (typ.)
+ Weight:	5 grams
+ Operating Temperature:	- 10°C to +70°C
+ Recommended Operating Waveband:	420 - 700 nm
+ Lifetime (RPTV Application):	> 20,000 hours

Device Diagonal: 0.463"



Active Area: 9.4 x 7.05 mm

# SVGA Resolution

## HED-1316 Microdisplay (800 x 600 Pixel) - 0.364" - CFS

+ Display Type:	Reflective LCOS
+ Dynamic Range:	8 bit per color
+ Resolution:	800 x 600 (SVGA)
+ Device Diagonal:	0.364"
+ Display Mode:	VAN, Normally black
+ Active Area:	7.04 x 5.28 mm
+ Aperture Ratio / Fill Factor:	95 %
+ Pixel Pitch:	8.8 $\mu$ m
+ Frame Rate:	180 Hz CFS
+ Contrast Ratio:	1000:1 (with compensator)
+ Reflectance:	60 % (typ.)
+ Weight:	0.85 grams
+ Operating Temperature:	+10°C to +70°C
+ Recommended Operating Waveband:	420 - 700 nm
+ Lifetime (RPTV Application):	> 20,000 hours

Device Diagonal: 0.364"



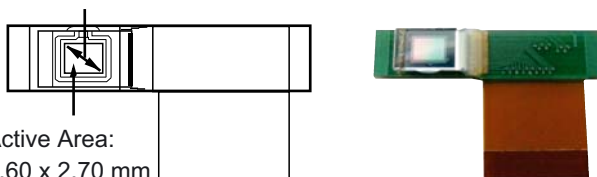
Active Area: 7.04 x 5.28 mm

# 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 $\mu$ m
+ Frame Rate:	180 Hz CFS
+ Reflectance:	1000:1 (with compensator)
+ 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"



Active Area:  
3.60 x 2.70 mm

# Phase Modulating LCOS

## HED-6010 HDTV Phase Modulating Microdisplay

+ Display Type:	Reflective LCOS
+ Dynamic Range:	8 bit
+ Resolution:	1920 x 1080 (HDTV)
+ Device Diagonal:	0.7"
+ Active Area:	15.36 x 8.64 mm
+ Aperture Ratio / Fill Factor:	>87 %
+ Pixel Pitch:	8.0 $\mu$ m
+ Frame Rate:	60 Hz
+ Weight:	12 grams
+ Non-addressed display 0th Order:	60 %

The displays provide  $2\pi$  phase shift up to 1550 nm. Versions optimized for the visible, for a broad wavelength band centered at 850 nm, for the near infrared around 1064 nm and for typical telecommunication wavelengths around 1550 nm.

