Enable, Inc.

Imaging Innovations

novel micro-imaging & illumination technologies for medical & industrial applications

Q1-2017

Enable Inc. introduction

- **core competencies in:**
  - optics, optical design, solid state light sources (LED's and Lasers), lighting-illumination, electronics, medical software development, fiber optic technologies, catheter engineering, medical disposables
- **numerous consultants and special vendor relations**
  - custom lens design & manufacturing, custom micro-wiring design & manufacturing, custom fiber designs, fiber drawing, polymer blending, optical design of imaging and non-imaging optics
- **innovate in micro-imaging technologies in 3 ways:**
  - digital imaging with CMOS microcameras
  - novel illumination sources and light coupling
  - truly disposable solutions (in high volumes)

imaging innovations from Enable Inc.

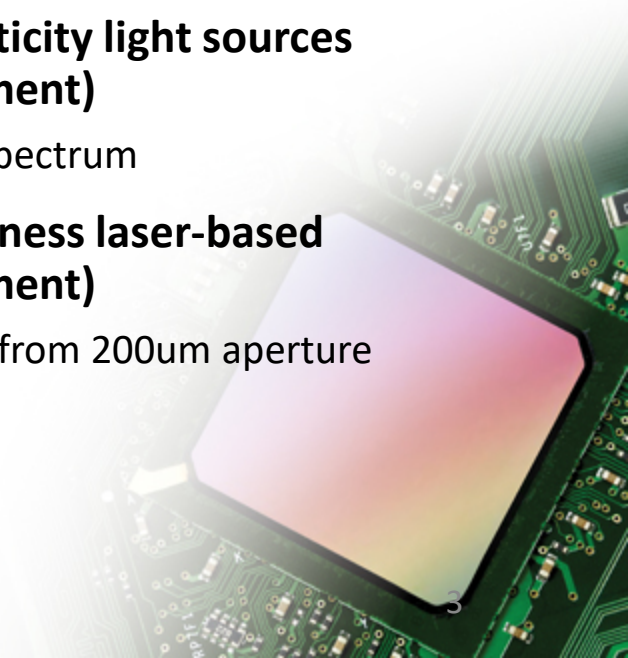
Enable, Inc.

digital imaging: CMOS sensor

- **smallest available OD complete digital-scope (imaging & illumination) with highest resolution (minnieScope™-XS)**
  - currently max OD < 1.4mm
  - max resolution up to 1Mpixel
- **smallest available OD microcamera (imaging only- no illumination) with highest resolution (minnieCam™-XS)**
  - currently max OD < 1.35mm
  - max resolution up to 1Mpixel truly disposable
- **truly disposable pricing: pricing follows economies of semiconductor manufacturing**

novel illumination architectures for white-light sources

- **efficient coupling into waveguides**
- **ultra-high output NA**
  - NA>0.66
- **wide-angle diffuse illumination**
  - Lambertian source
- **variable chromaticity light sources (under development)**
  - engineered spectrum
- **ultra-high brightness laser-based (under development)**
  - up to 300 lm from 200um aperture

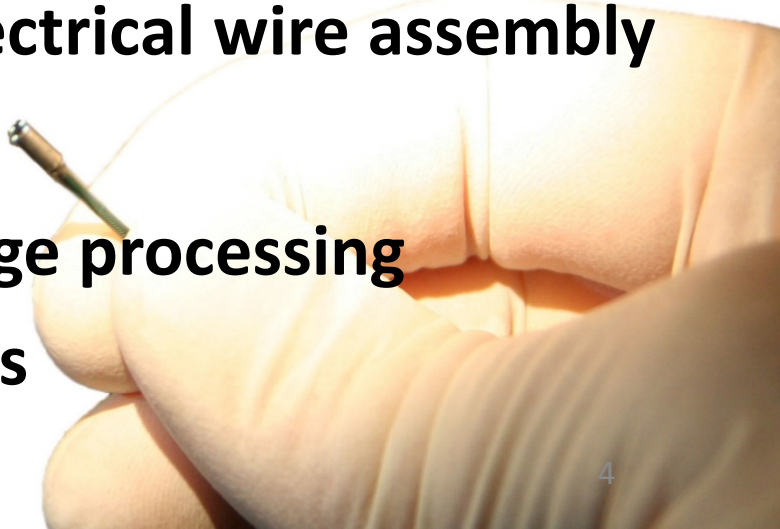


customize all aspects of a videoscope design

application with severe “real-estate” restrictions demand customization of all aspects of an imaging solution

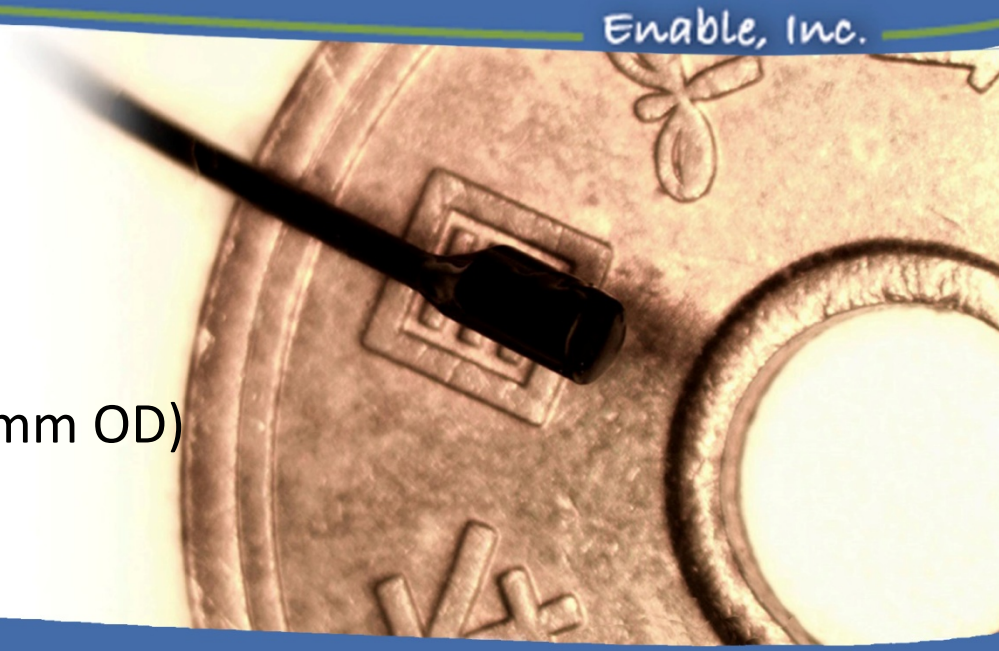
Enable offers:

- **custom lens design and fabrication**
- **custom cmos sensor assembly**
- **custom scope shaft design and fabrication with engineered mechanical properties**
- **custom design and fabrication of electrical wire assembly**
- **custom light sources and drivers**
- **custom electronic hardware for image processing**
- **custom light guides and fiber designs**



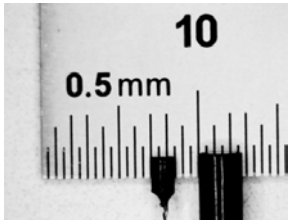
digital solutions: cmos camera (camera only no illumination)

- **minnieCam™-XS; (ENA-10002-AS)**
  - 160,000 pixels native resolution
  - up to 1Mpixel output available
  - 950um x 950um footprint (<1.35mm OD)
  - extremely high pixel gain



- **minnieCam™-L; (ENA-10006-AS)**
  - 160,000 pixels native resolution
  - up to 0.5Mpixel output available
  - 1.8mm x 1.8mm (<2.6mm OD)
  - 3x the pixel gain of the –XS model

digital solutions: cmos videoscopes (camera+illumination)



- **minnieScope™-XS; (ENA-10005-AS)**
  - minnieCam-XS with Enable's novel fiber illumination embedded in tip
  - <1.4mm tip diameter

- **minnieScope™-L; (ENA-10007-AS)**
  - minnieCam-L with Enable's novel fiber illumination embedded in tip
  - <2.7mm tip diameter

video processing units (VPU) for the –L models

VPU's for the large cmos sensor (-L models)

- more mature product
- either camera or camera+illumination assemblies have several different video processing units available

- **HDMI output, VPU-HDMI-L; (ENA-10008-AS)**
  - 720p output
  - output resolution enhanced from native 400x400 up to 720x720

- **USB output, VPU-USB-L; (ENA-10009-AS)**
  - compatible with any webcam software
  - UVC compatible device

- **Wifi output, VPU-WIFI-L**

video processing units (VPU) for the –XS models

VPU's for the small cmos sensor (-XS models)

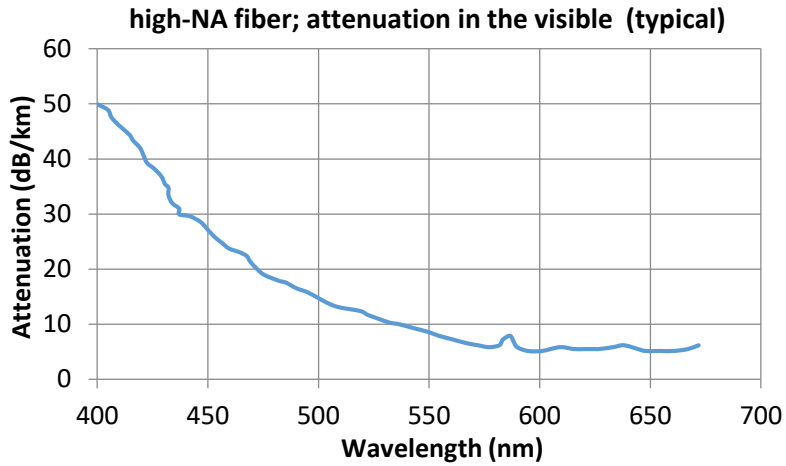
- newly released product with 1080p 60fps HDMI output
- autogain and autoexposure built in
- Enhanced resolutions available (from 400x400 pixels to 1,000x1,000) with no pixelation effects

- **HDMI output (ENA-10017-AS):**
  - 1080p 60fps for –XS models

- **USB3 AND HDMI output (ENA-10011-AS):**
  - 1080p 60fps on HDMI output port
  - YUV422 format on USB3 output
    - UVC compatible device
  - autogain ON/OFF function

high-NA, hard polymer-clad, silica-core fibers

- **lightPort™ (ENA-10043-AS)**
  - step-index fiber
  - all silica core
  - fluorinated polymer cladding
  - nominal NA ~ 0.68
  - full acceptance angle 85 deg
  - proof test 100% at 95kPSI
  - custom core diameters available in the range of 50µm - 500µm
  - attenuation coefficient <10dB/Km @ 550nm
  - fluoroacrylate jacket at custom thicknesses
    - other jacketing materials are under development as well



white-light sources: LED-based (medium output)

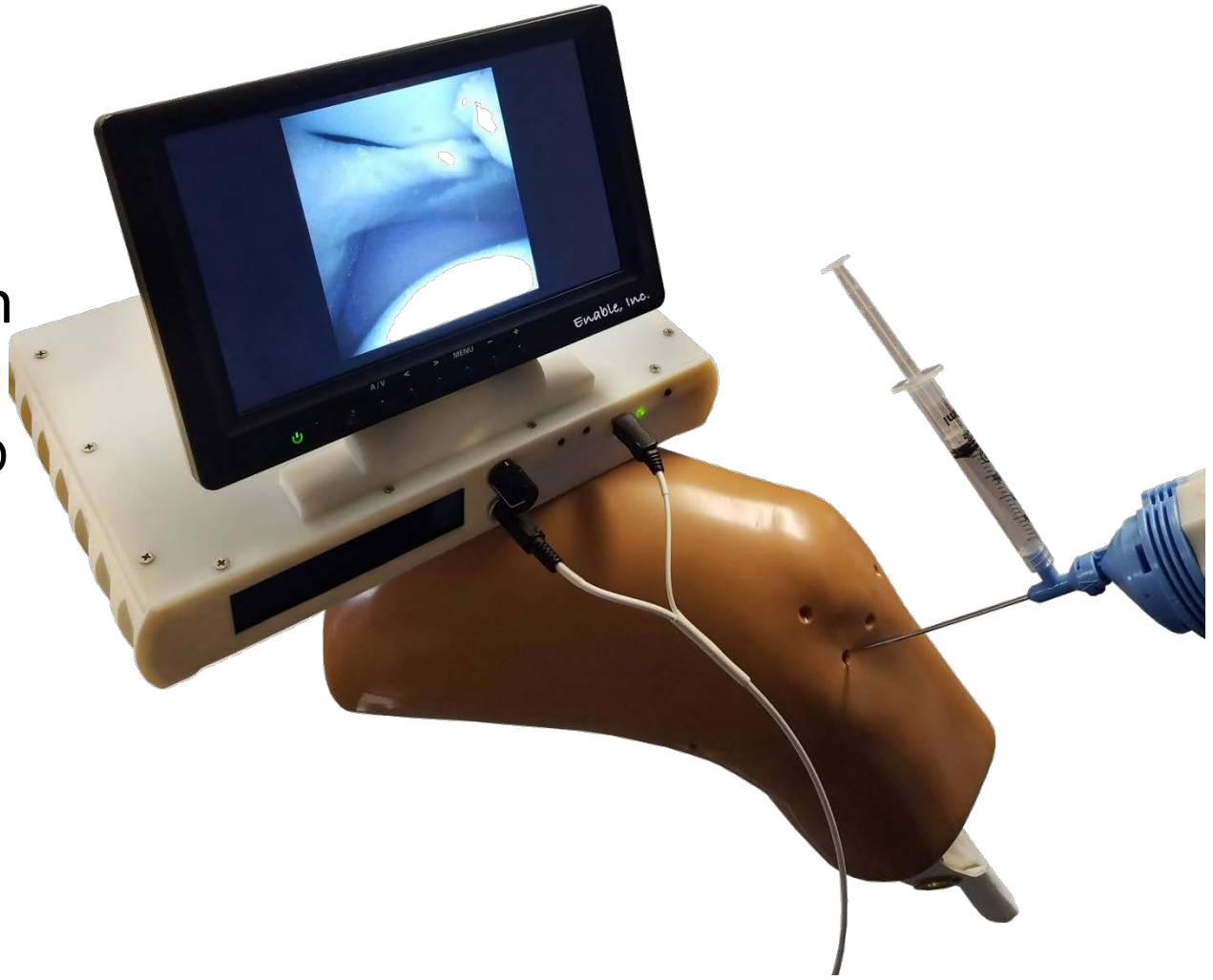
- **lightLume™-M; (ENA-10101-AS)**
  - LED based architecture
  - different chromaticity LED's available
  - modulation input and LED current monitor available
  - Up to 25-30 lumens max out of some minnieScope™-M models

industrial kit version

- **minnieScope-XS-IND-kit; (ENA-10070-AS)**
  - all components packed in a convenient pelican case
  - monitor and storage of video or pictures by 11” laptop
  - software pre-installed on Win10 OS with ability to save in variety of file formats
  - external monitor video output also available
  - steerable versions soon to be available as well

MIDAScope

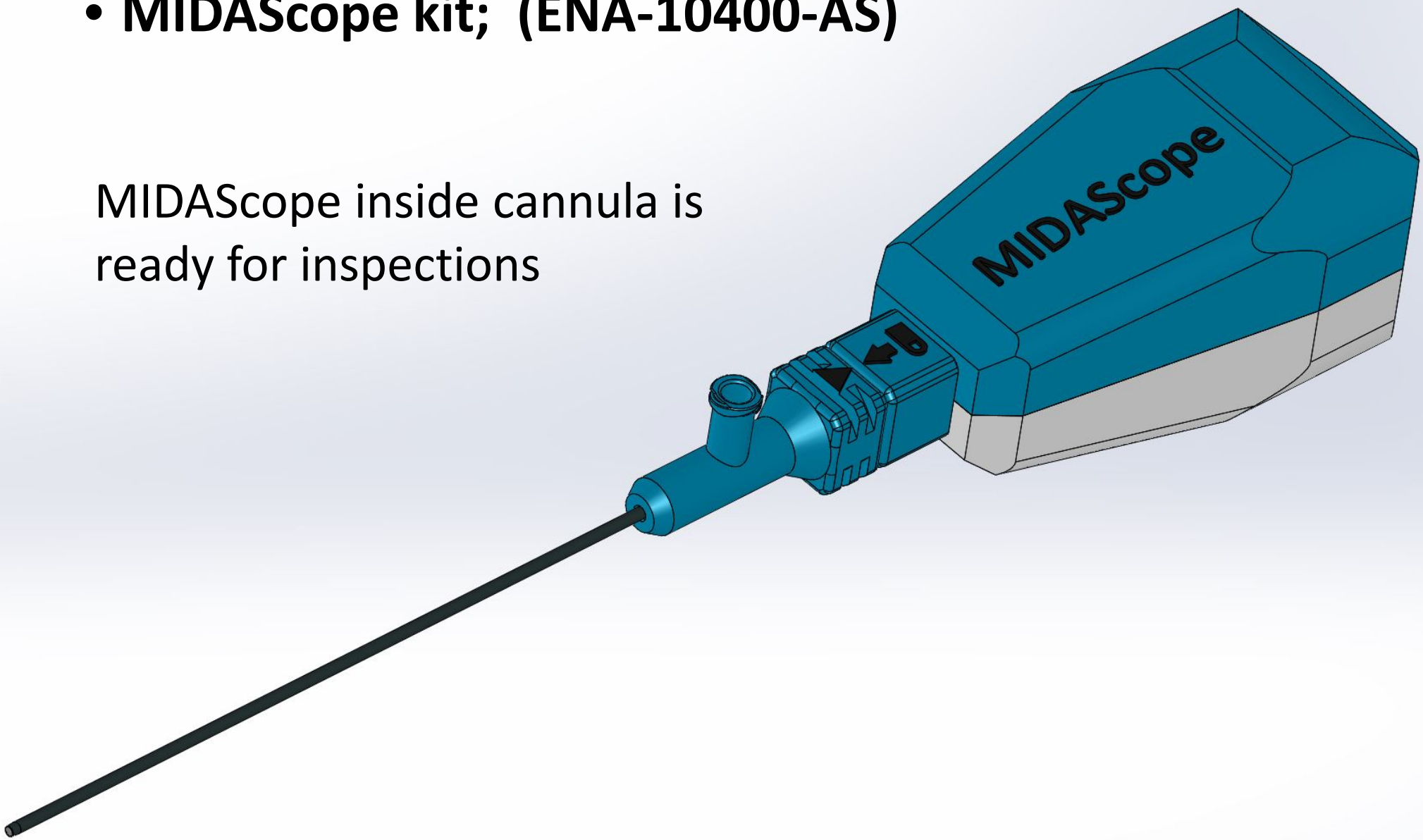
- **MIDAScope kit; (ENA-10400-AS)**
  - integrate light-source into handle
  - hardware combines in one chassis:
    - Video processing; LED driver; AND monitor
  - introducer (cannula and trocar) designed for accessing areas to deliver the Scope
  - luer port allows for simultaneous liquid flushing



MIDAScope (cont)

- **MIDAScope kit; (ENA-10400-AS)**

MIDAScope inside cannula is ready for inspections



white-light sources: laser-based (under development)

- **lightEngine™-L**
  - Laser-based architecture
  - Up to 150 lumens of
    - highly diffuse
    - engineered-spectrum white light
    - out of 200um aperture
    - at extremely high NA (>0.6)

- **lightEngine™-H**
  - Laser-based architecture – same as –L model
  - Up to 300 lumens output under same conditions as –L model