DATA SHEET

minnieScope™ -XS - videoscope with illumination; up to 1Mpixel resolution, under 1.4mm OD for medical or industrial applications

introduction:

With a distal tip diameter of less than 1.4mm, the minnieScope™ -XS is the world's smallest videoscope (imaging sensor and illumination) with up to 1Mpixel output resolution when used with Enable's Video Processing Units (VPUs).

It is an ideal solution for imaging applications that require good image quality within less than 1.4mm outside diameter at the distal end: For example medical devices where clinical use could be greatly enhanced with the addition of embedded real-time, low-cost, miniature size optical imaging. Or industrial application for accessing narrow conduits or passages while not compromising image quality or mechanical flexibility.

The minnieScope™ -XS assembly includes the CMOS image sensor, imaging optics (µObjective™ lens), illumination fibers (lightPort™ high-NA fibers), a highly-flexible and miniature multi-conductor cable, and two proximal connections: electrical and optical; all in an incredibly compact cross-sectional footprint.

Still images or live video can be captured by connecting the proximal electrical connector into Enable's proprietary VPUs. The hardware is available with HDMI or USB3.0 output for displaying an image on a monitor or a computer.

The optical connector is compatible with Enable's white-light sources or any other fiber-coupled light source with a multimode SMA-905 female port.

product features:

- Up to 1Mpixel resolution in an extremely small footprint.
- highly-flexible and miniature cabling including fiber illumination.
- sterilizable design.
- low-cost for use with disposable products, yet durable enough to withstand multiple sterilization cycles for re-usable devices.
- custom optical designs for µObjective™ lens for different imaging needs.
- custom cable and fiber sizes and designs available.
- custom videoscope shafts with different mechanical properties also available.
- video outputs include HDMI/DVI or USB 3.0.
- 360 degree steerable conduits with single-hand operation in the smallest possible OD profile are also available. Ideal for demanding endoscopic procedures.

The unique architecture of the minnieScope™ -XS design allows for combined ultra-low power consumption with high sensitivity rolling shutter pixel and large full-well capacity, for applications where high SNR is mandatory.

In order to address a broad array of imaging needs, Enable can design and procure custom lenses tailored to your specific imaging requirements without compromising the miniature footprint of the sensor. Same customizing goes for the electrical conductors.

Patented steering conduits are also available. They can provide full 360 degree steerability with single hand operation, in the smallest possible shaft profile, in a varying array of sizes and stiffness.

Custom arrangements can be made based on project and volume requirements.

Contact us to discuss your imaging and illumination needs.

product specifications: ENA-10005-AS

camera specifications:	
native resolution	160,000
effective pixels	400H x 400V
frame rate	60 fps full resolution
electrical connector	Mini-B USB, 5pin[1]
optical connector	SMA-905 multimode[2]
color mosaic	RGB Bayer pattern
scan mode	progressive
optical size	1/25.7"
field of view (diagonal in air)	90 deg or 100 deg[3]
device profile, **D1**, (mm)	1.39mm to 1.62mm[3]

optical & electrical cable:	
electrical cable diameter, **D2**, (mm)	<0.56 to <0.79[4]
lightPort™ fiber diameter, **D3**, (µm)	160 to 250[4]
length (optical or electrical) (m)	2.0 typ. - 5.0 max[5]
video processing unit (VPU):	
voltage input	12VDC typ. 400mA max
system functions	Custom[6]
signal output	HDMI/DVI (1080p)
	400x400 to 1000x1000[7]
	or
	USB 3.0 (400x400)

1 Compatible with Enable's Video Processing hardware. Enable Inc VPUs **ARE REQUIRED** to get an image out of the minnieScope™ -XS sensor. Two different types of VPUs are available: **ENA-10017-AS** (HDMI output only) and **ENA-10011-AS** (HDMI and USB 3.0 output).

2 Compatible with Enable's LED-based fiber-coupled light sources **ENA-6010-xxx-AS** or **ENA-10025-AS** or **ENA-10101-AS** or any other fiber coupled white-light source with a multimode-fiber SMA-905 connection.

3 See in the "mechanical dimensions" and "part number and configuration ordering" sections for specific sizes under different configurations.

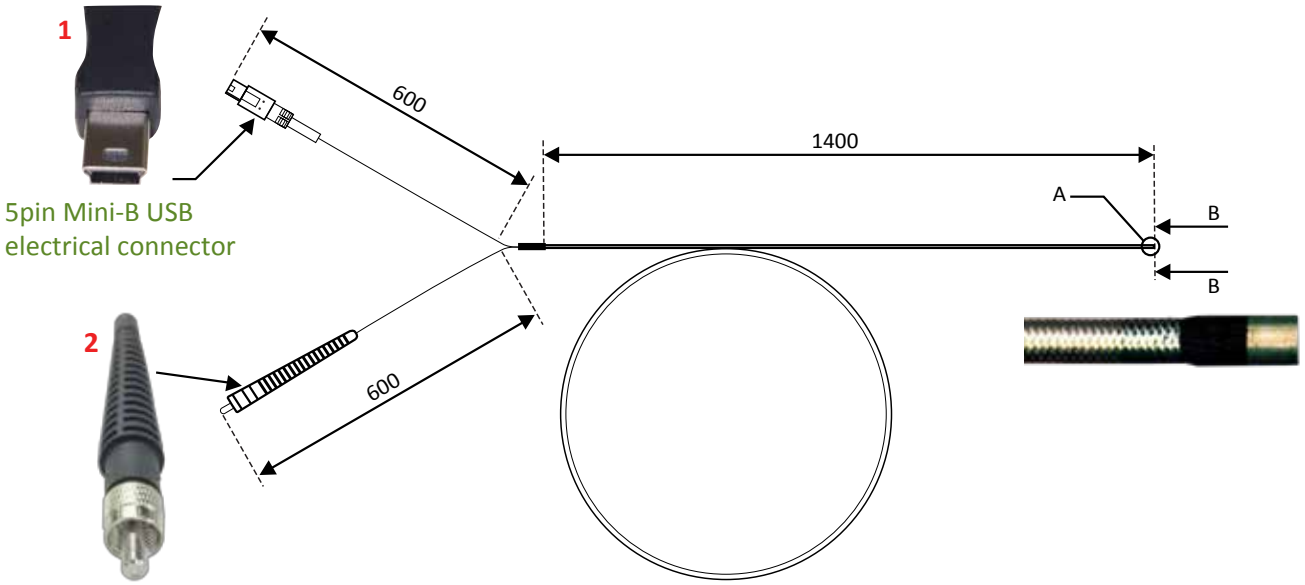
4 The minnieScope™ -XS is available in 4 different sizes of electrical cables and 3 different fiber types and sizes. The electrical cable and fibers are all contained within a custom flexible shaft with a 1.3mm OD. Any other custom size of optical fiber or electrical cable can be designed and constructed as per customer's specifications.

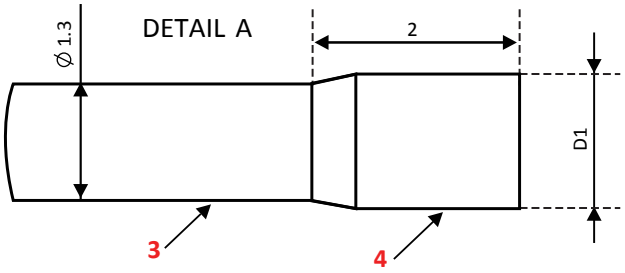
5 Shielded cable assemblies (**EC1** or **EC3** style cable from the configuration table) must be selected for applications that require minnieScope™-XS lengths longer than 2m.

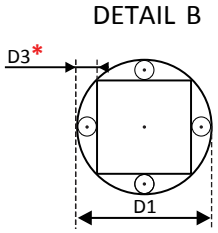
6 System functions and signal output format vary depending on VPU model. Custom solutions for the VPUs can also be designed and made to specific customer needs.

7 Interpolation algorithms allow increasing the output resolution of the HDMI output port of the VPU from half-VGA to XGA+ while maintaining sharp images and suppressing pixilation of the enlarged image. Both VPU models can step the resolution of the output image from 400x400 to 1,000x1,000 pixels in steps of 200 pixels. The USB3.0 output remains unchanged and always equal to 400x400.

mechanical dimensions (all dimensions in mm):







* D3 is defined in the "part number and configuration ordering" section.

Tip diameter, D1, for different assembly configurations

Configuration[1]	D1 (mm)
MSXS-ECx-L02-F1	1.62 ± 0.01
MSXS-ECx-L02-F2	1.52 ± 0.01
MSXS-ECx-L02-F3	1.44 ± 0.01
MSXS-ECx-L03-F1	1.57 ± 0.01
MSXS-ECx-L03-F2	1.47 ± 0.01
MSXS-ECx-L03-F3	1.39 ± 0.01

1 See "part number and configuration ordering" section for further explanation

1 MUST connect electrical connector to either **ENA-10017-AS** or **ENA-10011-AS** Video Processing Unit to get signal.

2 SMA-905 multimode fiber port. MUST be connected to any of Enable's fiber-coupled white-light sources such as **ENA-06010-XXX-AS** or **ENA-10025-AS** or **ENA-10101-AS** or any other compatible fiber-coupled light source.

3 Flexible shaft of the minnieScope™ -XS. Contains both the illumination fibers and electrical cable. See tables in "part number and configuration ordering" section for more details on the dimensions of the subcomponents. This is a highly customizable portion of the design. Standard offering includes a thin-wall braided shaft with minimal kinking and some amount of torquability.

4 Rigid portion of the distal tip of the assembly.

electrical connector wiring instructions:

CIB pin assignment[1]	EC2 or EC4 cable wires	EC1 or EC3 cable wires
1	brown	brown+outside shield[2]
2	red	red
3	white coax core (trim back cable shielding)	white coax core (trim back cable shielding)
4	black coax core (trim back cable shielding)	black coax core (trim back cable shielding)

1 See **Figure 1** for pin numbering assignment of the CIB board.
2 Outside shield refers to the overall outside shield of the multiconductor cable.

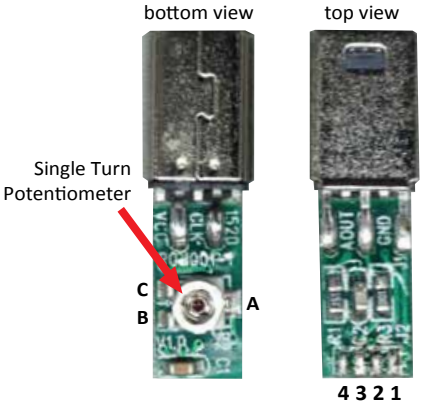


Figure 1: CIB board assembly, ENA-10004-AS

The resistance value between terminals A-C in the CIB board (see Figure 1 above) is a function of the length of the electrical cable assembly. For the standard 2m long unshielded EC4 type cable (see in the "part number and configuration ordering" section for details on the different available electrical cable configurations) this value is typically set at:

A-C ≈ 90 Ω.

NOTE: The actual resistance of a given assembly may be slightly different from the above value.

NOTE: The output image can be completely lost or appear severely noisy and unstable if the potentiometer has been changed OR if the cable length has been modified from its factory setting. If you need to shorten the length of the electrical cable from the factory-shipped standard length, do so from the proximal end by un-soldering the wire from the CIB board first. After you re-solder the wires back onto the CIB board (as per table above) adjust the potentiometer of the CIB board in the middle of a range for which you get a good stable image.

minimum bend radius considerations for minniScope™ -XS assemblies:

The minnieScope™-XS assembly can be permanently damaged by excessive bending of the fibers embedded in it. The minimum bend radius of the shaft and fiber section of the assembly is described below (function of the fiber type chosen during ordering). Care must be taken to not damage the optical fibers by complying with the following rules:

A. LONG TERM; for storage or transportation of assembly: **Minimum Bend Radius = 100mm**
B. SHORT TERM; during use: **Refer to table below for instructions:**

fiber type	minimum bend radius (mm)
F1	5.5
F2	9.0
F3	7.5

part number and configuration ordering information:

minnieScope™ -XS ordering Part Number: ENA-10005-AS

electrical cable specifications

Code A	Shield	D2 (mm)
EC1	Yes	0.79 ± 0.1
EC2	No	0.66 ± 0.1
EC3	Yes	0.69 ± 0.1
EC4	No	0.56 ± 0.1

D2: diameter of electrical cable Note 3 in mechanical dimensions section.

µObjective™ lens specifications

Code B	FOV	F#	DF (mm)
L01	90	4.0	3-20
L02	90	4.0	5-80
L03	100	3.6	5-100

FOV: Field of View; **DF:** Depth of Field

lightPort™ fiber specifications[1]

Code C	Core (mm)	D3 Clad (mm)	NA
F1	0.240	0.250	0.60
F2	0.180	0.200	0.68
F3	0.150	0.160	0.68

[1] See "bend radius considerations" section for minimum bend radius requirements of the different fiber types. D3 is defined in mechanical dimensions section

Custom cable sizes, fiber sizes, and lenses can be designed and manufactured upon customer's request.

Indicates the standard product configuration.

configuration: MSXS - EC☐ - L☐☐ - F☐
Code A Code B Code C

For example when you order Part Number: **ENA-10005-AS** with configuration **MSXS-EC3-L02-F3**: It is a minnieScope™ -XS assembly with a 0.69 mm OD multiconductor cable with outside shielding, a 90deg FOV F#4 micro objective lens, and a 150µm core diameter high-NA fiber.

ENA-10001-PP: Is the plastic connector shell for the mini-B USB electrical connector. If the connector shell needs to be opened to gain access to the potentiometer, shown in Figure 1, the tabs that hold it together may get broken. **That is why an extra ENA-10001-PP is shipped with every minnieScope™-XS order.** This way if you need to modify the length of the electrical cable or need to change the resistance between terminals A-C in the CIB board (see Figure 1), you can use the extra connector shell to cover back up the CIB board.

accessories:

ENA-10001-PP: Mini-B USB connector shell.
ENA-10004-AS: CIB PC board assembly (inside connector shell).
ENA-10017-AS: VPU-HDMI-XS; HDMI only output Video Processing Unit for all minnieScope™ -XS configurations.
ENA-10011-AS: VPU-USB3-HDMI-XS; USB3 and HDMI output Video Processing Unit for all minnieScope™ -XS configurations.
ENA-10020-AS: is the ENA-10017-AS without the chassis. Just the PC board assemblies for direct integration into your products.
ENA-10021-AS: is the ENA-10011-AS without the chassis. Just the PC board assemblies for direct integration into your products.
ENA-6010-xxx-AS: LightLume-L; low-power LED-based, fiber-coupled, white-light source (older model).
ENA-10101-AS: LightLume-M; medium-power LED-based, fiber-coupled, white-light source.

maintenance, cleaning, and handling instructions:

ONLY use water or soft alcohols like Isopropanol to rinse the distal tip of the minnieScope™ -XS assembly. Harsh chemicals (like acetone) will permanently damage the distal tip, lens, and illumination fibers.

After some use, debris may attach onto the distal surface of the µObjective™ at the distal end of the minnieScope™ -XS assembly and impede the view or degrade the image quality. Ensure that you blow-off the distal end first with clean air BEFORE you rub it with soft tissue. Use ONLY soft tissue (such as lens tissue paper) to rub debris off of the distal tip of the assembly, making sure that you do not come in contact with the black masking coating.

NOTE: Ensure that the SHORT-TERM minimum bend-radius for the different fiber type offerings is not violated at any time. Otherwise permanent damage will occur to the illumination fibers. **NOTE:** Always ware a grounding strap when handling the minnieScope™ -XS while not connected to a VPU. **NOTE:** The distal end-face of the assembly may get permanently damage if harsh tissue is used or is rubbed hard (even with soft tissue). **NOTE:** The distal surface of the µObjective™ distal tip, or the illumination fibers of the minnieScope™ -XS may get permanently damaged if the above instructions are not followed correctly.

disclosures:

All units are tested 100% at the factory for image quality and functionality before shipping. Enable Inc. is not responsible for any damage or malfunction of the minnieScope™ -XS assembly as a result of mishandling after shipping to the customer. Shipping cost of all returns is the customer's responsibility.