

## Particle Imaging and Classification

### Overview:

Our Continuous Particle Imaging and Classification Sensor (CPICS) provides unprecedented *in situ* aquatic microscopy of seawater, freshwater and laboratory samples. Using darkfield illumination, the CPICS-1000-e captures high-resolution color images, showing features as small as 0.04 mm and as large as 12 mm. Research has shown that color information is key to high-accuracy automated classification while also providing important physiological information such as pigmentation due to grazing on phytoplankton. Because of its open-flow approach to water sampling, delicate structures of plankton and particles remain completely intact as do predator-prey interactions.

### Applications:

The CPICS-1000-e is the ideal choice for imaging particles and plankton in a stand-alone package that may be deployed on a CTD rosette or autonomous vehicle. The CPICS-1000-e configuration provides embedded Region of Interest (ROI) extraction, and optional ROI classification while cabled to shore and an external computer via Ethernet. Additional environmental sensors can be interfaced with CPICS-1000-e for a complete stand-alone package.

Combined with other sensors in our OceanCube® multi-instrument observatory, and using our ROI-CLASS® analysis software with state-of-the-art classifiers such as Convolutional Deep Neural Networks (CDNN), the CPICS-1000-e can provide scientists with greater insight into the aquatic environment. This can be used to investigate distributions of plankton species as a function of time, temperature, or other observational data.

Whether for scientific research, aquaculture, or municipal drinking water health and safety, the CPICS-1000-e is the tool that can help get results quickly and accurately.

### Specifications:

Illumination	
Source:	High output LED ring array
Duration:	50 $\mu$ s
Pressure Rating	
Model CPICS-1000-e:	1000 m
Camera system	
Color resolution:	24-bits
Image resolution:	6 Megapixels (2736 x 2192)
Maximum frame rate:	Up to 10 fps
Target acquisition and storage (software included)	
Camera control:	Exposure and frame rate
Target extraction:	Focus and size thresholds
Embedded processor:	NVIDIA TX2
Image analysis (requires ROI-CLASS® software)	
Classification:	Taxon level (e.g. copepod)
Hardware:	DICE
Data communication	
Medium:	Ethernet, RS232 (for additional sensors)
Power	
DC input:	12 V cabled or battery
Current/Power:	1 A / 12 W
Battery Life:	Std. battery: 6 h (1.6 Ah)
Test cable:	Custom (1m long)
Connector on housing:	SubConn DBH13M
Dimensions	
Length x Diameter:	74 cm x 12 cm
Weight	
In air:	5.4 kg
In water:	4.3 kg



Lens Selection Guide									
Magnification	NA	WD	Image Height (mm)	Image Width (mm)	Depth of Field (mm)	Liquid Sample			
						Volume ( $\mu$ L)	Rate (fps)	Hourly Volume (L)	Daily Volume (L)
.16x	0.008	180	40	44	19.7	34672	10	1248.192	29,956 (L)
.9x	0.045	175	11	15	2	330	10	11.88	285 (L)
10x	0.210	51	0.6	0.8	0.006	0.00288	10	0.00010368	2.4 (mL)
20x	0.600	11	0.2	0.13	0.001	0.000026	10	0.000001000	0.013 (mL)