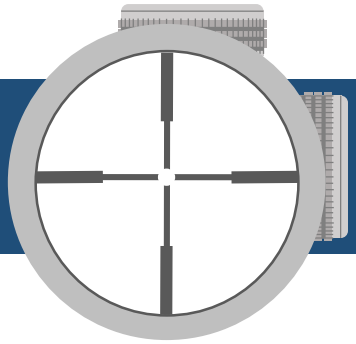
CI SYSTEMS
Setting New Standards In Electro-Optical Testing



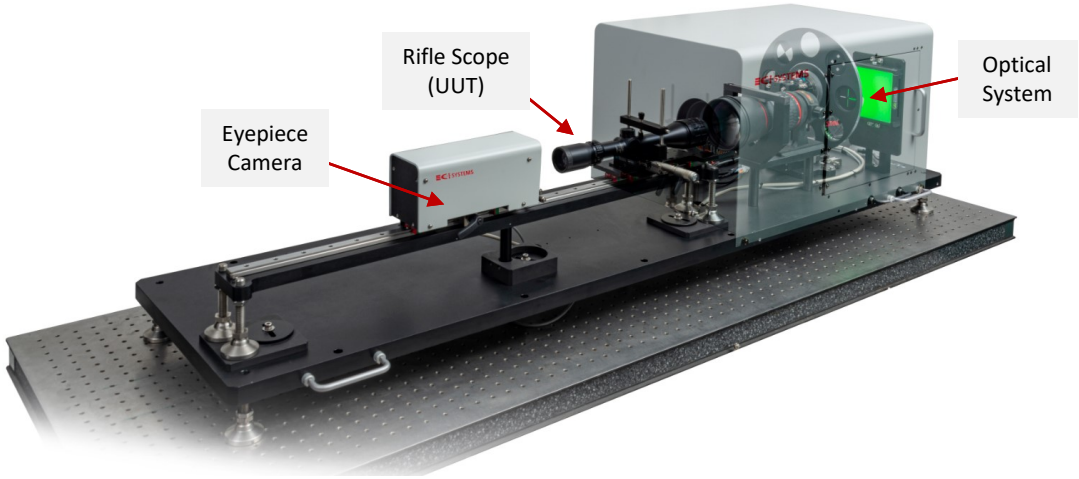
Application Note:

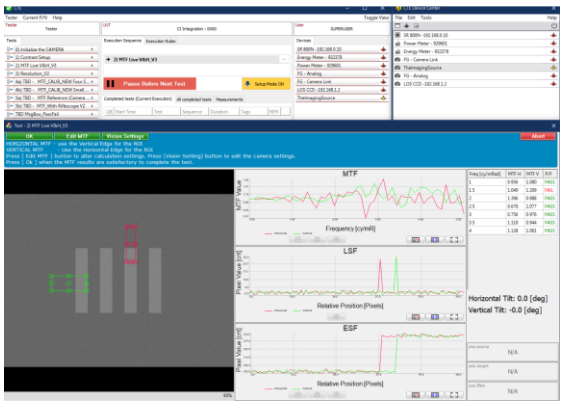
Rifle Scope Test System

CI Systems has been a leading designer and builder of instruments and turnkey stations for testing and aligning electro-optical (EO) systems, facilitating measurements in both visible and thermal bands. This includes target projectors for laboratory, depot, and field applications.

The CI Systems Riflescope Tester is a compact, user-friendly system. It is designed for production testing, alignment and focusing of Vis riflescopes with collimator optics optimized for the Vis spectral wavelength band of 400-700nm.

The Perfect Tool for Testing and Calibrating Your Rifle Scope





Friendly user software for automatic testing

FEATURES:

- Eyepiece camera used to simulate the human eye
- Quick-mount Clip-On fixture for the Rifle Scope
- High-quality optical system with wide FOV collimator and a visible radiation source.
- Motorized target wheel with various target plates and a mechanism for variable distance projection.
- User-Friendly CTE Software for automatic testing
- Simulation of target distances from 50m to infinity
- Adaptation to NVG (Night Vision Goggle) – Optional
- Real-time contrast and MTF measurements
- Live contrast module displays reticle sharpness

CI # 21OR16908 – App. Note

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SR-800N

Extended Area Blackbody ControlMaster

CI Systems' advanced architecture **ControlMaster SR-800N** sets a new standard for **accuracy and uniformity in blackbody technology.**

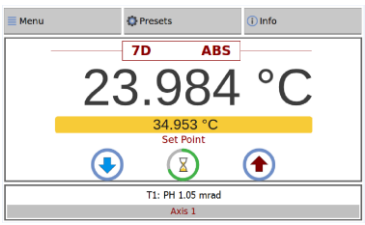
Temperature measurement and calibration are performed in the radiation head and then transferred digitally to the **ControlMaster controller**. The result is accurate, stable, reliable and **NIST-traceable** *(*)*.

FEATURES

- Standard blackbody emitter sizes ranging from 2" to 40". Other sizes are available upon request
- Superior accuracy
- High-uniformity emitting surface
- Wide range of radiation temperatures
- Operates at a wide range of ambient temperatures
- Interchangeability between head and controller
- Resolution in millidegree-Kelvin
- Configurable resolution and stability
- Low acoustic noise
- Nitrogen inlet for inert atmosphere on LT models
- **Dual-head option** available (one controller with two blackbodies)

Controller features:

- Large color LCD display with touch screen user interface
- Ability to control up to four motorized devices
- Certified to MIL-T-28800D, CE, and FCC
- Compact, portable controller
- 19" rack-mount kit included
- Communication ports: Ethernet, RS-232 (optional GPIB)



Intuitive touch screens for controlling the system

SYSTEM CALIBRATION

Temperature is controlled by easily-removable sensors which the user can replace in just minutes. Our factory-supplied replacement sensors provide an efficient means for recalibrating the system, providing an additional 12 months of service.
Alternatively, customers may recalibrate the blackbody with our optional **CK-800R calibration kit**.

- Quick calibration by replacing the removable sensor
- NIST-traceable calibration
- Remote control software included

*(*) "**NIST**": National Institute of Standards and Technology*

CI SYSTEMS
www.ci-systems.com

» SR-800N Extended Area Blackbody ControlMaster

» SPECIFICATIONS

	Model: SR-800N-									
	2A 2D	4A 4D	7A 7D	8A 8D	10A 10D	12A 12D	14A 14D	16A 16D	20A 20D	40A 40D
Blackbody Emitter Size, inches	2 dia.	4x4	7x7	8x8	10x10	12x12	14x14	16x16	20x20	40x40
Absolute Temp. Range, °C	0 to 125					10 to 80				15 to 80
Differential Temp. Range, °C	-25 to 100					-15 to 55				-10 to 55
Uniformity, °C (2)	±0.005	±0.010					±0.015			±0.030
Set Point Resolution, °C	0.001									
Absolute Temp. Accuracy, °C (3)	0.015 @ T< 0 , 0.007 @ 0 < T < 50 , 0.015 @ T > 50									
Differential Temp. Accuracy, °C (3)	0.008 @ ΔT ≤ 25 , 0.015 @ ΔT > 25									
Stability, °C	±0.003 @ ΔT ≤ 10 , ±0.008 @ ΔT > 10									±0.010
Emissivity	0.98 ± 0.02									
Settling Time (@ 0.01°C) , Sec.	15									
Operating Voltage, VAC	95 to 240 (50/60 Hz)									
Power Consumption, W	100	200	600	1000	1000	1200	1800	1800	3000	7000
Size, BB Head, HxWxD, cm (8)	Ø6.5x10	20x16x16	27x23x23	35x31x16	35x31x16	40x36x16	59x46x17	59x46x17	71x62x20	128x76x160
Weight, BB Head, kg (8)	1	5	11	16	16	21	50	50	86	450
Size, Controller, HxWxD, cm (8)	15x34x35 (3U)						18x45x60 (4U)			
Weight, Controller, kg (8)	10						15	15	20	60
Operating Temp. Head, °C	-20 to +70									
Operating Temp., Controller, °C	0 to 50									
Storage Temp., °C	-20 to +70									

Notes *(for pages 2-3):*

1) All values are valid at an ambient temperature of 22°C, and in a non-condensing environment
2) Uniformity values are for a ±1°C step from ambient Temp @ 80% of the central area. For other Temp. multiply by ΔT
3) Accuracy is referenced to a NIST-calibrated CI Systems master sensor
4) LT models include refrigerator (power consumption depends on model)
5) Typical yearly drift: 0.02°C
6) Total system uncertainty: 0.02°C @ ΔT < ±25°C and 0.03°C @ ΔT > ±25°C
7) Differential temperature range is limited to absolute temperature range, and absolute temperature range is limited to differential temperature range
8) All mechanical sizes are approximate. Please contact CI Systems for ICD drawing with the accurate sizes.
9) For mechanical characteristics of optional models please contact CI Systems

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www.ci-systems.com

» SR-800N Extended Area Blackbody ControlMaster

» OPTIONS for Room Temperature Environment

Option:		Model: SR-800N-								
		2A 2D	4A 4D	7A 7D	8A 8D	10A 10D	12A 12D	14A 14D	16A 16D	20A 20D
ET	Absolute temp. range, °C Differential temp. range, °C	0 to 175 -25 to 150					0 to 125 -25 to 100	10 to 125 -15 to 100		
LT *(4)*	Absolute temp. range, °C Differential temp. range, °C		-40 to 150 -65 to 125			--- ---	-40 to 150 -65 to 125	--- ---		
WTR	Absolute temp. range, °C Differential temp. range, °C	-40 to 150 -60 to 125	-20 to 150 -45 to 125		-15 to 150 -40 to 125	--- ---		--- ---		
HE		0.99 ± 0.01						---		

» OPTIONS for Chamber Environment

Option:		Model: SR-800N-								
		2A 2D	4A 4D	7A 7D	8A 8D	10A 10D	12A 12D	14A 14D	16A 16D	20A 20D
CH-STD	Chamber temperature, °C Absolute temp. range, °C Differential temp. range, °C	-30 to 70 -40 to 80 -10 to 40								
CH-ET	Chamber temperature, °C Absolute temp. range, °C Differential temp. range, °C	-40 to 80 -40 to 150 -20 to 125					-40 to 80 -40 to 150 -20 to 100	-40 to 80 -40 to 150 -15 to 100		
CH-LT *(4)*	Chamber temperature, °C Absolute temp. range, °C Differential temp. range, °C	--- --- ---	-40 to 80 -40 to 150 -65 to 125			--- --- ---	-40 to 80 -40 to 150 -65 to 125	--- --- ---		
CH-WTR	Chamber temperature, °C Absolute temp. range, °C Differential temp. range, °C	-40 to 80 -40 to 150 -60 to 125	-40 to 80 -40 to 150 -45 to 125		-40 to 80 -40 to 150 -40 to 125	--- --- ---				

Notes for Chamber Environment systems:

- Differential accuracy (°C): 0.020 (*at -20 < T ambient < 80*), 0.040 (*at T ambient < -20*). Referenced to a NIST-calibrated CI Systems master sensor.
- Stability (°C): 0.005 at ΔT<10, 0.010 at ΔT>10

» ABBREVIATIONS

A	Absolute Blackbody model	**LT**	Low Temperature
D	Differential Blackbody model	**HE**	High Emissivity
BB	Blackbody	**CH**	Chamber Environment
Temp.	Temperature	**STD**	Standard Temperature Range
ET	Extended Temperature Range	**HxWxD**	Height x Width x Depth
WTR	Wide Temperature Range		

» ORDERING INFORMATION

Model: SR-800N - [1] [2] - [3]

1) Blackbody Emitter size
2) A (Absolute) or D (Differential)
3) Option

Examples:
SR-800N-4D
SR-800N-2D-CH-ET
SR-800N-8A-WTR

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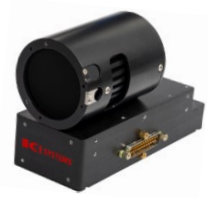
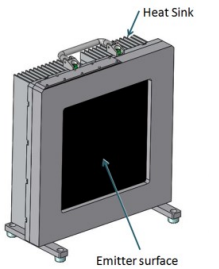
» Examples for systems and Special Applications





SR-800N Controller

NUC Tower System (with 15 controlled temperature blackbodies)

The NUC (Non-Uniformity Correction) Tower is ideal for testing multiple cameras or detectors for fast NUC tables, including ambient temperature reference.

The system delivers a fast NUC process at three different temperatures.

It is used for enhancing the throughput of mass production cameras and detectors inside or outside an environmental chamber.

The system consists of ten high emissivity and uniformity blackbodies and five high emissivity and uniformity surfaces at ambient temperature.

The high-accuracy controllers ensure that all surfaces are within an accuracy better than 0.015°C.

The blackbody controllers are mounted in a standard rack mount and communicate with one central PC.

T1	T2	T(ambient)
5.00	60.00	25.15
5.00	60.00	25.82
5.00	60.00	24.98
5.00	60.00	24.86
5.00	60.00	24.61

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CI SYSTEMS
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FIRST LIGHT
ADVANCED IMAGERY

C-RED 2 ER

Product Datasheet / June 2022

1.9 µm & 2.2 µm EXTENDED InGaAs SWIR CAMERA

1.1 - 1.9 µm
or
1.3 - 2.2 µm

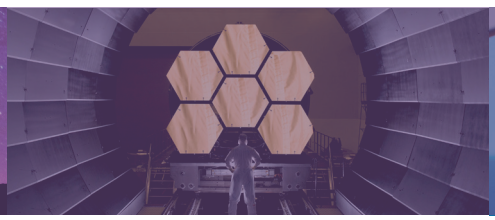
FULL FRAME
600 FPS

< 45 e⁻ RON
or
< 50 e⁻ RON

InGaAs 640x512
15 µm pixel pitch

SDK compatible with µManager, LabVIEW, MatLab,

HIGH SPEED EXTENDED SWIR



ASTRONOMY:
Adaptive Optics
Hyperspectral Imaging
Laser Communications

SURVEILLANCE:
LiDAR
Long Range Imaging

INDUSTRY:
Multispectral Imaging
Quality/Production Control
Laser beam characterization

LIFE SCIENCES:
Spectroscopy
Fluorescence Microscopy

C-RED 2 EXTENDED RANGE 1.9µm & 2.2µm PERFORMANCES

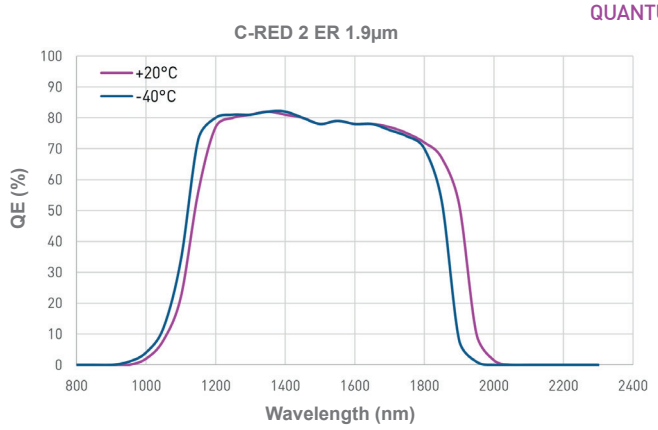
TEST MEASUREMENT*	C-RED 2 ER 1.9µm	C-RED 2 ER 2.2µm	
	Result	Result	Unit
Full sensitivity range (QE >10%)	1100 - 1900	1300 - 2150	nm
Quantum Efficiency >70%	1150 - 1800	1380 - 2050	nm
Maximum speed Full Frame	600		FPS
Readout Noise at high gain, Tint @ 50µs, 600 FPS Full Frame	<50 (@ -40°C)	<40 (@ -55°C)	e-
Dark Current + background	20 (@ -40°C)	120 (@ -55°C)	ke/p/s
Quantization	14		bit
Operability	> 95 (@ -40°C)	contact us	%
Image Full well capacity at low gain, 600 fps	1500		ke-
Image Full well capacity at med gain, 600 fps	130		ke-
Image Full well capacity at high gain, 600 fps	34		ke-
Maximum speed in 32 x 4 (min)	**32066**		**FPS**
Maximum speed in 320 x 256	1779		FPS

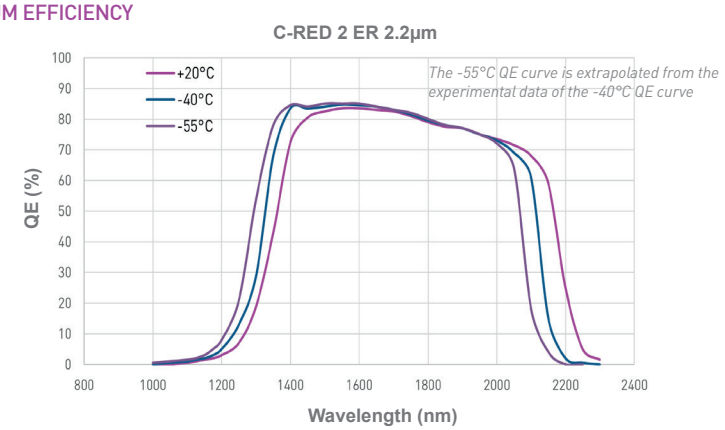
** Average values observed*

ADDITIONAL FEATURES

- Outputs: USB 3.1 Gen 1 or CameraLink®
- Up to 5 µs electronic shutter
- Optical interface: C-Mount
- LVTTL/LVDS synchronization
- Software: **GUI**: First Light Vision - **SDK**: (C, C++, Python) / LabVIEW / µManager/ MatLab

QUANTUM EFFICIENCY

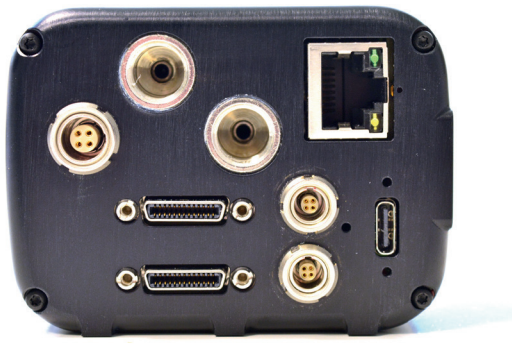




FRAME RATE TABLE AT 600 FPS READOUT SPEED CAMERA LINK® OUTPUT

Lines \ Columns	32	64	128	256	512	640
4	32 066	31 512	30 458	28 548	25 367	24 029
8	28 108	27 348	25 945	23 532	19 840	18 397
16	22 542	21 631	20 015	17 413	13 819	12 526
32	16 147	15 254	13 736	11 455	8 599	7 646
64	10 302	9 596	8 440	6 801	4 898	4 297
128	5 975	5 509	4 765	3 752	2 632	2 291
256	3 247	2 975	2 547	1 978	1 367	1 184
512	1 697	1 549	1 319	1 016	697	602

For USB 3 Output: Max 9999 FPS



SWaP : H55 x W75 x L140 mm, 0.9 kg

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FIRST LIGHT ADVANCED IMAGERY

FIRST LIGHT
ADVANCED IMAGERY

C-RED 2 LITE

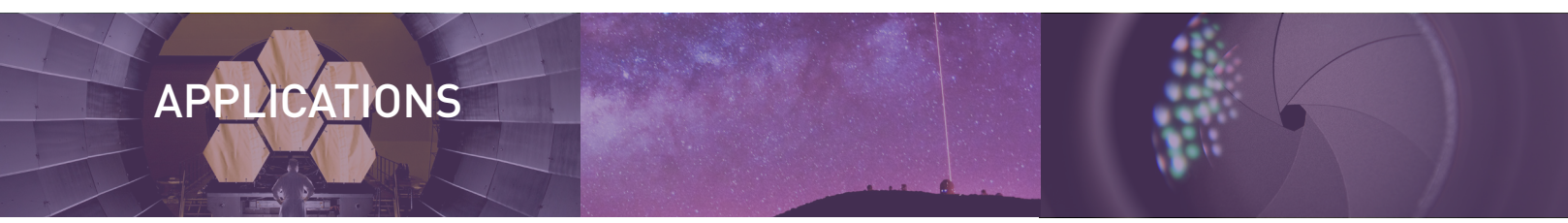
Datasheet / December 2022

VERY HIGH SPEED COMPACT STABILIZED SWIR CAMERA

- SWIR
  0.9 - 1.7 µm
- FULL FRAME 600 FPS
- <30 e- RON
- 640 x 512 InGaAs,
  15 µm pixel pitch
- HDR 93 dB and true 16 bits
  High Dynamic Range
- SDK compatible with µManager,
  LabVIEW, MatLab,

STABILIZED InGaAs CAMERA
WITH INDUSTRIAL DESIGN

Smart algorithm for temperature stabilization



INDUSTRY:
Non-destructive inspection
Quality and production control
Waste sorting
Welding control
Additive manufacturing
Laser beam profiling

SCIENCE & ASTRONOMY:
Hyperspectral and multispectral imaging
Microscopy
Free Space Optics

SURVEILLANCE:
Thermography
Unmanned aerial vehicle
Maritime surveillance
Security / night vision

C-RED 2 LITE PERFORMANCES

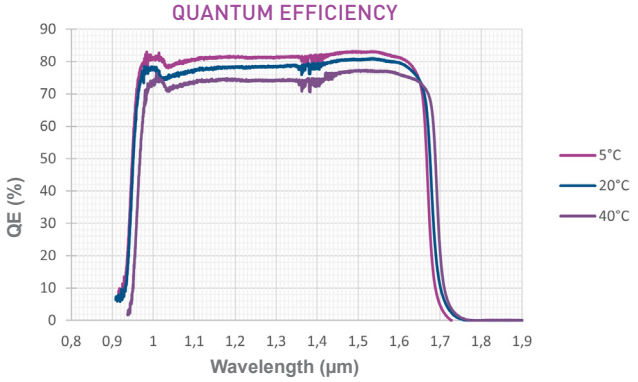
FEATURES*		Result	Unit
Sensor size		640 x 512	pixels
		0.3	Mp
Pixel pitch		15	µm
Maximum speed Full Frame		600	FPS
Readout Noise at high gain, Tint at 50 µs, 600 FPS Full Frame at 5°C		<30	e-
Quantization		14	bit
Flat Quantum Efficiency 1.0 to 1.65 µm		> 70	%
Operability due to signal response / pixels with signal ± 0.3*median at 35°C		> 99.8	%
Operating Temperature (case)		-40 to +70	°C
Detector Operating Temperature (depending on setup and environment)		-40 to +60	°C
Max ΔT° between case and sensor		25	°C
Image Full well capacity	low gain	1.4	Me-
	med gain	115	ke-
	high gain	34	ke-
Maximum speed in 32 x 4 (min) pixels		**32066**	**FPS**
Maximum speed in 320 x 256 pixels		1779	FPS

** Typical values*

ADDITIONAL FEATURES

- Data interface: USB 3.1 Gen 1 or CameraLink®
- Possible optical interface: C-Mount, CS-Mount
- LVTTL synchronization (5 V tolerant)
- High Dynamic Range mode: 93 dB and true 16 bits
- **Industrial design: TEC stabilized camera, no fan**
- **Software: Graphical User Interface**: First Light Vision - **Software Development Kit**: (C, C++, C#, Python, MatLab) / LabVIEW / µManager / Halcon

QUANTUM EFFICIENCY



OPTIMIZED THERMAL DISSIPATION OPTIONS

Passive heat sinks (left) and hydraulic cooling plate (right)

FRAME RATE TABLE CROPPING MODE CAMERA LINK® OUTPUT

Lines \ Columns	32	64	128	256	512	640
4	32 066	31 512	30 458	28 548	25 367	24 029
8	28 108	27 348	25 945	23 532	19 840	18 397
16	22 542	21 631	20 015	17 413	13 819	12 526
32	16 147	15 254	13 736	11 455	8 599	7 646
64	10 302	9 596	8 440	6 801	4 898	4 297
128	5 975	5 509	4 765	3 752	2 632	2 291
256	3 247	2 975	2 547	1 978	1 367	1 184
512	1 697	1 549	1 319	1 016	697	602

For USB 3 output: max 9999 FPS

BACK VIEW WITH CAMERA LINK® OUTPUT

(Also available in USB 3 Output)

SWaP : H65 x W65 x L78.1 mm, 460 g, 20W Max

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FIRST LIGHT ADVANCED IMAGERY

SR-300N Integrating Sphere

Standard Integrating Sphere

CI Systems offers a cost effective highly uniform integrating sphere for the VIS-SWIR wavelength range.

The system provides uniform radiance for testing of cameras that operate in a wide spectral range.
Now offering three standard sizes: 1",2" and 4" output port diameters.

Using a highly reflective internal coating the system is able to produce uniformity of over 98% at its output port.

A continuous variable output is achieved using an high resolution motorized attenuator. Increased dynamic range can be achieved using optional neutral density filters.

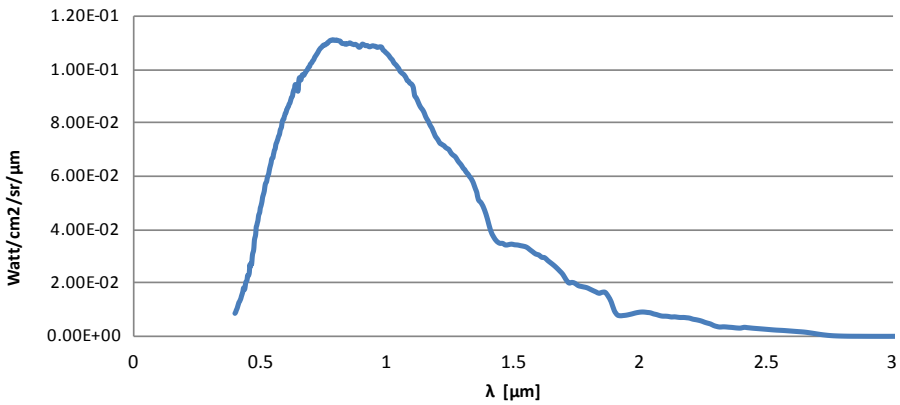
Using a variety of light sources the system can be adapted to provide higher Luminance intensities and a wider dynamic range.

Low Light Integrating Sphere

CI Systems offers a cost effective highly uniform low light integrating sphere for the VIS-SWIR wavelength range.

The system provides uniform low light radiance for testing of night vision cameras that requires extremely low radiance.
Now offering two standard sizes: 2" and 4" output port diameters.

Integrating Sphere Typical Spectrum



Note: Spectrum graph depends on the light source. There may be changes in spectrum when integrating other light sources.

» SR-300N Integrating Sphere

» FEATURES

- Modular design
- High uniformity
- VIS to SWIR radiation
- Wide dynamic range
- ft-L or W/sr-cm2 calibration
- Friendly user interface

» SPECIFICATIONS

MODEL	SR300N - 1 Standard	SR300N - 2 Standard	SR300N - 4 Standard	SR300N -L-2 Low Light	SR300N - L-4 Low Light
Diameter of exit aperture	1" (25.4mm)	2" (50.8mm)	4" (100mm)	2" (50.8mm)	4" (100mm)
Diameter of sphere	4" (100mm)	8" (200mm)	12" (300mm)	8" (200mm)	12" (300mm)
Diameter of top sphere	–	–	–	4" (100 mm)	4" (100 mm)
Light source (default) (2)	halogen	halogen	halogen	halogen	halogen
Color temperature (3)	2856°K	2856°K	2856°K	2856°K	2856°K
Luminance (standard)	1000 ft-L	1000 ft-L	1000 ft-L	1 ft-L	1 ft-L
Luminance (minimum)	0.1 ft-L	0.1 ft-L	0.1 ft-L	1*10^-5 ft-L by default; other optional	1*10^-5 ft-L by default; other optional
Luminance (maximum)	10,000 ft-L	10,000 ft-L	3000 ft-L	10 ft-L by default; other optional	10 ft-L by default; other optional
Luminance uniformity	> 98%	> 98%	> 98%	> 98%	> 98%
Spectral range (4)	0.44 to 1.9µm	0.44 to 1.9µm	0.44 to 1.9µm	0.44 to 1.9µm	0.44 to 1.9µm
Resolution	15bit	15bit	15bit	15bit	15bit
Input ports	Up to 3	Up to 3	Up to 3	Up to 2	Up to 2
Detector type (default) (5)	Silicon detector	Silicon detector	Silicon detector	Silicon detector	Silicon detector
Controller size & weight	350X233X125mm (5Kg)	350X233X125mm (5Kg)	350X233X125mm (5Kg)	350X233X125mm (5Kg)	350X233X125mm (5Kg)
Sphere weight	2.5Kg	3.5Kg	5.5Kg	9.5Kg	22Kg
Line voltage	110/220 VAC, 50/60Hz	110/220 VAC, 50/60Hz	110/220 VAC, 50/60Hz	110/220 VAC, 50/60Hz	110/220 VAC, 50/60Hz

» OPTIONS

(1) Option for manual or fully automated motorized illumination control
(2) Optional light source: LED's
(3) Other color temperatures are optional
(4) Option for enhanced spectral range for SWIR up to 2.5 µm
(5) Optional InGaAs detector
(6) Optional motorized filter wheel for additional calibrated spectral output, up to 8 filters
(7) Option for radiometric calibration: Multiple calibrations at spectral bands upon request
(8) Increased dynamic range by adding ND filters at the sphere's output aperture
(9) Low cost version: Standalone Integrating sphere without controller

Motorized filter wheel

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