SYDOR

TECHNOLOGIES

ROSS 2000 STREAK CAMERA SYSTEM

COMPLEX MEASUREMENTS—CRITICAL RESULTS

A streak camera is a powerful scientific instrument used to study ultra-fast phenomena, ideal for high-bandwidth recording of optical events. It efficiently converts fast optical signals to a spatial signal that can be read out with a conventional camera, resulting in a record of the light intensity versus time. They are used to study optical events in the visible spectrum spanning from a single nanosecond to multiple milliseconds.

Streak cameras play a critical role in physics, life sciences, fusion research, and advanced technology industries. The components and systems are delicate and extremely complex to manufacture. Because of the complexities, Sydor is one of the very few worldwide manufacturers of streak cameras, and the leading supplier to critical US and European laboratories.

APPLICATIONS

- Detonics/Shock Breakout
- Fusion Research (Temperature & Shock Physics)
- Hypergolic Research (Liquid Rocket Propellent Studies)
- Emission and Absorption vs Time when coupled to a spectrometer
- Can be used to image spatially directly or coupled to a spectrometer

BENEFITS

- Compact & modular design
- Custom sweep timing modules for every system built ensure optimal temporal & spatial resolution are achieved
- Modular design allows swappable sweep modules to allow continued use despite evolving experimental requirements
- Gated Photocathode
- An External Gated image intensifier provides signal gain & prevents stray electrons from contaminating the swept image.
- An all-reflective Offner input optic eliminates chromatic aberrations
- Includes ROSSApp software that automates trigger synchronization, displays real-time profile & statistical data, applies corrections, & provides corrected lineouts
- Built-in protective features prevent image intensifier and streak tube damage

ABOUT THE ROSS 2000 STREAK CAMERA

The ROSS 2000 Streak camera provides a larger photocathode than the 1000 and has photocathode gating, which is needed for experiments that produce large extraneous signals. It is primarily intended for single shot experiments that generate pre- or post- signal and is typically used in detonics, explosives, plasma generation, and other long duration-bright sources.

CUSTOM RAMP MODULES

The ramp modules of every ROSS 2000 system are customized in collaboration with the customer, with sweep speeds being tailored to the intended use-case. By hand-selecting each sweep speed on a case-by-case basis, users are provided with a balance between the best temporal resolution and spatial resolution possible. The number of sweep speeds on each board is dependent on the speeds that are selected. Possibilities are commented on in the table below. Experienced users can select their desired sweep speeds at initial inquiry or application calls can be scheduled to determine the best speeds given the experiments being performed.

ROSS 2000 SWEEP MODULES

For the ROSS 2000, up to 12 speeds can be chosen, either 4 from 10 ns to 80 ns, and 8 from 100 na to 30 us OR 12 speeds in the 100 ns to 50 ms range. Gating on the ROSS 2000 should be kept below 100 µs

	ns									µs									ms					
Speeds	1	2	5	10	20	50	100	200	500	1	2	5	10	20	50	100	200	500	1	2	5	10	20	50
Options	**Custom**			**Fast Board**			**Slow Board**																	
	Faster sweep speeds possible, inquire for more information																							
Res	3.33	6.67	16.67	33.33	66.67	166.67	333.33	666.67	1.67	3.33	6.67	16.67	33.33	66.67	166.67	333.33	666.67	1.67	3.33	6.67	16.67	33.33	66.67	166.67
Res Units	**ps**								**ns**									**µs**						
Rep Rate	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1Hz	1Hz

EXPERMIMENTAL FLEXIBILITY

The ROSS 2000 Streak Camera System is engineered for facilities performing diverse experiments with a range of temporal requirements. The ROSS 2000 is a portable system that can accommodate up to 12 sweep windows per sweep module. Unlike other manufacturers, Sydor's sweep modules are each custom designed to meet the timing requirements presented by the user's experimental needs. These modules can be swapped out as experimental requirements evolve, for additional timing flexibility. This capability is particularly useful for multi-user facilities and universities.

SUPERIOR PERFORMANCE

Traditional refractive optics are lossy and introduce undesirable aberrations. Sydor couples an Offner input optic as standard to its ROSS 2000 streak camera to remove chromatic aberrations, resulting in superior performance compared to traditional refractive optics. The ROSS 2000 includes a periscope input with an option to add a second one. The periscope has a fiber input and is used to mark a timing fiducial on the shot. It images on to the Photocathode without clipping the clear aperture of the input beam which allows for superimposing a timing fiducial or timing calibration pulses over the data.

PROTECTION FEATURES

The 2000 series comes equipped with built-in features that prevent damage to the system's components. The CCD shutter is normally closed and forms a light-tight seal around the Photocathode. By default, the shutter is set to be closed, opening momentarily to acquire an image, providing protection to the streak tube, image intensifier, and the CCD. Additionally, the cathode is gated and protects the streak tube from damage- removes stray signal from interfering with the data. There is an image intensifier, outside the tube, that is in direct contact with the phosphor-end of the streak tube. It is gated on for ~5 ms to integrate the entire signal produced by the streak tube phosphor.

SPECTROSCOPY-SPECIFIC CONFIGURATIONS

For spectroscopy applications, Sydor can supply a spectrometer for use with the streak camera. This can either be directly coupled or mated using the Sydor-exclusive Spectrometer Interface Module (SIM). The light-tight module allows for fine positioning control and securely couples the two instruments in a manner that protects the photocathode, while maintaining the fidelity and alignment of the input signal. These are significant time-saving features that ensure ease of repeatability and alignment between the input signal and the ROSS system.

POWERFUL SOFTWARE

Each ROSS System is supplied with the highly interactive ROSSApp software, which provides complete control of the streak camera, and can be setup to control the customer's spectrometer. ROSSApp employs an easy to use interface designed for basic users, with optional tabs and menus for more advanced users. This powerful tool collects data, performs image analysis, and is capable of scripting for easy automation of repetitive tasks. It can display intensity profiles along multiple regions and perform curve fits to the profiles within the application. The application provides image statistics, histogram displays, and has an adjustable color Look Up Table for seeing details in the image data. To ease data analysis, the software comes preprogrammed with background subtraction, flatfield, geometric distortion correction, and time correction to enable immediate analysis.

CALIBRATION & ACCESSORIES

All ROSS Streak Cameras built by Sydor Technologies are rigorously tested and shipped with a factory-standard calibration. The calibration performed on each ROSS Streak Camera includes a Geometric Correction, a Temporal Calibration for each unique sweep speed, a Flatfield Correction and calibration for best focus voltage. To preserve the fidelity of the user's streak camera's calibration, an external calibration package is available that allows users to calibrate in-situ on the ROSS 5800.

COMPONENTS FOR OPTICAL CALIBRATION

- Optical Comb Generator: The Sydor Optical Comb Generator can be used as both a timing reference and a temporal calibration source. The comb generator features two calibrated pre-set frequencies that are set at the factory. The Comb Generator can be imaged through the input slit or routed through the external periscope.
- Reticle Nest and Reticles: The Sydor Reticle nest is designed to mate directly to the front of the Offner Input Optics slit assembly. It provides the user a highly repeatable and convenient method for imaging reticle patterns onto the photocathode of the streak tube by mounting the reticle pattern at the focal plane of the input slit. By mapping the distortions of streak tube, users will easily be able to correct for these distortions in ROSSApp. It is recommended that the user backlight the reticle patterns with a Flatfield Illuminator.
- Flatfield Illuminator: The Sydor Flatfield Illuminator features <1% peak to valley illumination uniformity and three internal illumination LEDs: Red (630 nm), Green (517 nm), Blue (472 nm). The Flatfield Illuminator provides even illumination of the photocathode and allows the user to correct for illumination response at the edges of the field of view.
- Fiberized Laser Pulser (FLP): The Sydor FLP is a compact VCSEL connected to a fiber output and is designed to be driven with an external pulse generator at frequencies from DC to 10MHz. The FLP is ideal for determining the delay-to-center time for each sweep speed and can be used to simulate a timing set-up prior to experiment. Use of the FLP requires a digital delay/pulse generator such as the Stanford Research Systems DG 645 which Sydor can provide.
- Fiberized Laser Pulse Generator (FLPG): The Sydor FLPG is a compact, VCSEL-based, optical pulse generator that delivers a triggered laser pulse capable of repetition rates ranging from single shot to 300 kHz for the most demanding applications. It is ideal for accurate, time base calibration and may be used as a single pulse fiducial. The standard FLPG emits a 650 nm pulse with a pulse width of 40 ps.

TIMING

- Temporal Resolution: Down to 33 ps
- Repetition Rate: 1 Hz
- Sweep Window Customization: Every Sweep window duration is custom, for the best temporal resolution and total data acquisition duration optimized to a customer's experimental timing needs. See separate sweep window configuration diagram for options and total data acquisition duration optimized to a customer's experimental timing needs. See separate sweep window configuration diagram for options.
- Trigger Jitter: <25 ps
- Photocathode Gating: Extinction Ratio >10^4; Delay <100 ns, Rise Time: <10 ns, Fall Time <30 ns
- Image Intensifier Gating: Extinction Ratio >10^6, 3 ns FWHM @ 200 kHz max
- Trigger Signals: 5 V TTL (50 Ω)
- Master Trigger Options: The user may supply a single trigger, which is then used to trigger all the other components of the system, such as sweeps, gating, shutter, and CCD, with the appropriate timing.

STREAK TUBE

- Photocathode Materials: S20B, Low Noise S20, S20 (others possible dependent on spectral response requirements)
- Photocathode Size: 18x3 mm
- Input Windows: Fused Silica, MgF2, or Sapphire
- Static Spatial Resolution: >10 LP/mm with contrast up to 50%
- Accelerating Electrode Configuration: Single slot aperture standard (mesh available upon request)
- System Magnification: 0.37
- Tube Magnification: 2:1 typical
- Image Intensifier: Single stage external image intensifier with adjustable gain
- Shielding: Mu metal shielding to prevent EMC interference

INPUT OPTIONS & OPTICS

- Offner Input Optics: Included as standard - works for all wavelengths from UV to Near IR and removes any chromatic aberrations
- Spectrometer Options: Sydor can supply spectrometers or can integrate ROSS systems with customer-supplied spectrometers. Units may be coupled to ROSS systems by a custom Spectrometer Interface Module which ensures alignment of all components for optimum imaging, repeatability, and reduction of shot set-up time. Commonly provided with Teledyne Princeton Instruments SpectraPro HRS300 or HRS500.
- Calibration Inputs: Bench top calibration equipment such as fiberised laser pulsers, comb generators, and resolution reticles available on request
- Slit Adjustment: Micrometer for adjustment of slit opening between 50 µm and 1 mm

READOUT CAMERAS

- Camera Resolution: 2452x2056
- Temporal Dark Noise: 2 e-
- Max resolution rep rate: 23 fps @ full resolution (faster rates available when binning)
- Pixel Size: 3.45 µm x 3.45 µm

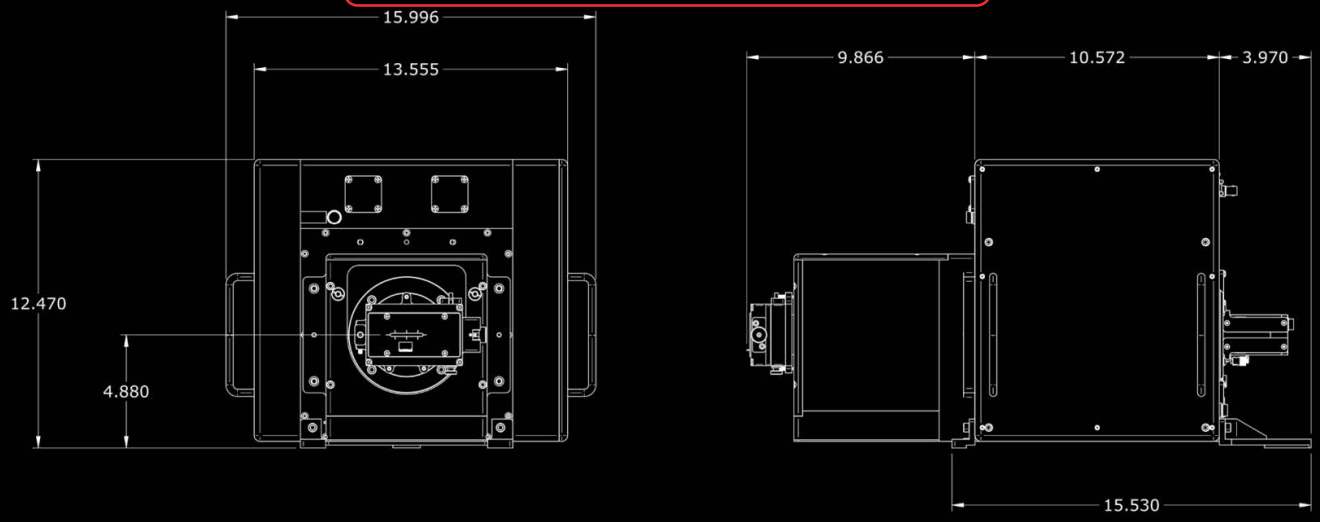
BUILT-IN PROTECTIONS

- Gated Photocathode: Prevents damage to streak tube
- Shutter Defaults to Closed: Prevents damage to CCD
- Control Phtocathode Gain in ROSSApp to Verify Light Levels: Prevents damage to image intensifier & streak tube

PC & SOFTWARE

- Software: ROSSApp software lifetime license included with system. Controls complete camera system either locally or remotely for acquisition and image processing
- Calibration Features: Calibration routines for spatial AND temporal non-linearity corrections. Factory generated calibration files included at shipment, plus re-calibration options accessible in software
- Interface: Ethernet
- Power: Standard mains supply (120/240V)
- Operating System: Windows

PRODUCT DIMENSIONS (INCHES)



BENEFITS OF WORKING WITH SYDOR TECHNOLOGIES

- Trusted and proven supplier to major US and worldwide labs running critical experiments
- Offer inclusive support from our PhD support staff via telephone and email for the life of the system
- Factory calibration and QA of all systems for ultimate confidence in performance.
- Recommended operating parameters provided with every system
- Annual on-site, hybrid, or remote maintenance plans
- Accessory packages for table-top calibration
- Turnkey VISAR optical systems
- Complete design & integration services

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