



# Acton Research SpectruMM™ Complete Spectroscopic- Acquisition Systems

A fully integrated spectroscopy lab is as easy as 1, 2, 3 . . .

1. High-Resolution CCD Detectors
2. Industry-Standard Acton Research SpectraPro® Spectrometers
3. Powerful Acton Research SpectraSense™ Software

# Acton Research SpectruMM™ Systems...

## Your One-Stop Full-Integration Spectroscopy Solution

From single photon events to intense sources, the SpectruMM systems provide state-of-the-art detection for demanding spectroscopy applications. Each system is outfitted with a high-resolution detector, a high-performance spectrometer, and a powerful data-acquisition and enhancement software package. Moreover, within this simple one-two-three configuration, you can customize for your specific application from a large selection of highly specialized components. The individual components, designed and manufactured by Roper Scientific/Acton Research, have become industry-standard products. We have brought these products together into a line of fully integrated systems for one-stop spectroscopy solutions.

The SpectruMM GS, SpectruMM HP, and SpectruMM LN multichannel systems provide you with a large selection of CCDs, including a number of exclusive sensors designed specifically for spectroscopy. A choice of cooling options and camera heads delivers even greater flexibility to your research. Each system comes complete with your choice of high-performance Acton Research SpectraPro® spectrometers (see pages 4 and 5) and the powerful Acton Research SpectraSense™ software (see page 6). If you desire single-channel detection, the Acton Research NCL™ can be outfitted with the same spectrometers and software as the SpectruMM systems (see page 7). To complete your system, be sure to see our Spectroscopy Accessories catalog for a full line of sources, adapters, sample holders, and fiberoptic probes.

### SpectruMM GS . . .

Fast, Sensitive, and Economical

The SpectruMM GS systems are ideal for most general-purpose spectroscopy applications, and with the back-illuminated sensor, they can perform analytical Raman and weak fluorescence as well. The GS series features back-illuminated and UV-coated, front-illuminated Hamamatsu CCDs in 1024 x 256 and 1024 x 128-pixel formats. The standard system delivers rapid kinetics and fast system alignment with either its 100-kHz, 16-bit analog-to-digital converter (ADC) or its 1-MHz, 12-bit ADC. With its -30°C cooling, the SpectruMM GS is ideal for applications that require exposures ranging anywhere from milliseconds to 15 minutes.



### SpectruMM GS Specifications

CCDs*	
Full well capacity	550,000 e <sup>-</sup>
Dynamic range	16 bits
Readout noise	<10 e <sup>-</sup> @ 100 kHz
Dark signal	<5 e <sup>-</sup> /p/s @ -30°C
Controller	
Data resolution	16 bits @ 100 kHz; 12 bits @ 1 MHz
Readout noise	<2 ADC counts
Nonlinearity	1%
Shutter control	10-Hz repetition rate
I/O ports	4 inputs; 4 outputs
Cooling	≤-30°C ±0.05°
Interface	PCI bus
Performance (with 1024 x 256 format)	
Maximum scan rate (no shutter):	
Full bin @ 100 kHz	55 spectra/sec
Full bin @ 1 MHz	220 spectra/sec
Maximum image capture:	
Full image @ 100 kHz	0.38 fps
Full image @ 1 MHz	3.8 fps
Power	
100/110/220/240 VAC; 200 W	
Camera head dimensions	
5.08 in (12.9 cm) diameter;	
4.21 in (10.69 cm) length;	
2.9 lb (1.32 kg) weight	
Controller dimensions	
5.25 in (13.34 cm) width;	
13.63 in (34.62 cm) length;	
8.75 in (22.23 cm) height;	
15.43 lb (7 kg) weight	
Regulatory	
CE mark	

\*See individual CCD datasheets for more information.

## SpectruMM HP Specifications

### CCDs\*

Full well capacity	250,000 e <sup>-</sup>
Dynamic range	16 bits
Readout noise	<4 e <sup>-</sup> @ 100 kHz
Dark signal	<1 e <sup>-</sup> /p/s @ -45°C

### Controller

Data resolution	16 bits @ 100 kHz; 16 bits @ 1 MHz (optional)
Readout noise	<1 ADC count
Nonlinearity	1%
Shutter control	10-Hz repetition rate
I/O ports	4 inputs; 4 outputs
Cooling	≤-45°C ±0.05°
Interface	PCI bus

### Performance (with 1340 x 400 format)

Maximum scan rate (no shutter):	
Full bin @ 100 kHz	50 spectra/sec
Full bin @ 1 MHz	135 spectra/sec
Maximum image capture:	
Full image @ 100 kHz	0.2 fps
Full image @ 1 MHz	2 fps

### Power

100/110/220/240 VAC; 200 W

### Camera head dimensions

4.63 in (11.76 cm) width;  
6.92 in (17.58 cm) length;  
4.63 in (11.76 cm) height;  
7 lb (3.18 kg) weight

### Controller dimensions

5.25 in (13.34 cm) width;  
13.63 in (34.62 cm) length;  
8.75 in (22.23 cm) height;  
15.43 lb (7 kg) weight

### Regulatory

CE mark

\*See individual CCD datasheets for more information

## SpectruMM LN Specifications

See SpectruMM HP for all specifications except the following:

### Cooling

≤-120°C ±0.05°

### Camera head dimensions

6.125 in (15.56 cm) width;  
9.24 in (23.47 cm) length;  
14.56 in (36.98 cm) height;  
9 lb (4.2 kg) weight, with shutter,  
when empty



### SpectruMM HP . . .

#### Low Noise, Long Integration, and Higher Sensitivity

The SpectruMM HP systems feature the exclusive Roper Scientific 1340 CCD devices. The combination of these extremely low-noise sensors and three-stage thermoelectric cooling provides superior performance in low-light applications. The proprietary antireflection coatings improve sensitivity and reduce etaloning at longer wavelengths, which is critical for Raman spectroscopy employing diode-laser excitation. The standard SpectruMM HP cameras are supplied with an ultra-quiet, 16-bit, 100-kHz ADC and optionally, an additional faster 16-bit, 1-MHz ADC. Both 1340 x 400 and 1340 x 100-pixel arrays with 20 x 20- $\mu$ m pixels are available in either front- or back-illuminated versions in the SpectruMM HP.

### SpectruMM LN . . .

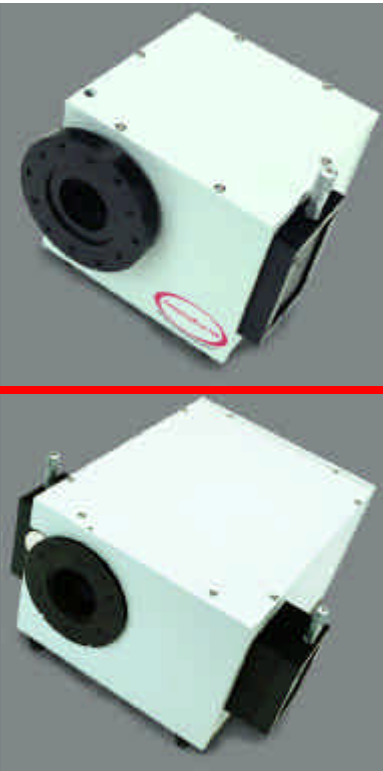
#### Lowest Noise, Longest Integration, and Highest Sensitivity

The SpectruMM LN systems are ideal for extremely low-light applications. Through the use of liquid nitrogen, deep cooling of between -70 and -120°C is achieved. At these levels the dark signal is less than 1 electron per pixel per hour, making this virtually a noiseless system. The LN series utilizes the exclusive Roper Scientific 1340 CCD devices. Both 1340 x 400 and 1340 x 100-pixel arrays are supported. The CCDs incorporate 20 x 20- $\mu$ m pixels and are available in standard front- or back-illuminated, deep-depletion, or red-enhanced back-illuminated versions. The SpectruMM LN cameras are supplied with a 16-bit, 100-kHz ADC and optionally, an additional faster 16-bit, 1-MHz ADC.



# The Acton Research SpectraPro Automated Scanning Monochromators and Flat-Field Imaging Spectrographs

Each SpectruMM system comes with your choice of spectrometer. The SpectraPro series of monochromators and spectrographs are recognized as industry standards for rugged, high-performance operation and versatility. Each features an automated, multiple-grating turret for extended spectral coverage. Positrack operation precisely maintains wavelength calibration of the spectrometer from grating to grating interchange. Four standard focal lengths and a host of unique, customized features make SpectraPro spectrometers an essential component in tailoring the SpectruMM system to your research. Our sales engineers and technical specialists can assist you in selecting the appropriate spectrometer(s) for your application.



## SpectraPro 150

The SpectraPro 150 is a 150-mm, f/4-aperture imaging monochromator and spectrograph that features a high-throughput imaging optical system, interchangeable dual-grating turrets, and easy computer control. The SpectraPro 150 is ideal for a wide range of CCD and scanning applications, including illumination, absorption/transmission, fluorescence, reflection, and source characterization.

## SpectraPro 300i

The SpectraPro 300i is a 300-mm, f/4-aperture, triple-grating monochromator and spectrograph that features dual exit ports for maximum versatility and convenience, a large 14 x 27-mm focal plane, and an imaging optical system designed for multichannel CCD spectroscopy. Polished aspheric mirrors are used to achieve superior imaging with low scatter. Excellent spatial resolution allows for multiple fiberoptic inputs. This spectrometer is ideal for CCD applications, including Raman, fluorescence, emission, and absorption/transmission.

Dispersion (nm/mm) and Coverage (nm) on a 1-inch Focal Plane for Specific Gratings (g/mm) in SpectraPro Spectrographs\*

Model	150 g/mm	300 g/mm	600 g/mm	1200 g/mm	1800 g/mm	2400 g/mm	3600 g/mm
<b>SP-150</b>	40 nm/mm 1000 nm	19 nm/mm 483 nm	9 nm/mm 229 nm	4 nm/mm 100 nm	2.2 nm/mm 56 nm	1.2 nm/mm 30 nm	1.1 nm/mm 28 nm
<b>SP-300i</b>	21 nm/mm 533 nm	11 nm/mm 279 nm	5 nm/mm 127 nm	2.3 nm/mm 58 nm	1.4 nm/mm 36 nm	0.85 nm/mm 22 nm	0.7 nm/mm 18 nm
<b>SP-500i</b>	13 nm/mm 330 nm	6.5 nm/mm 165 nm	3.2 nm/mm 81 nm	1.5 nm/mm 38 nm	0.9 nm/mm 23 nm	0.6 nm/mm 15 nm	0.45 nm/mm 11.5 nm
<b>SP-750</b>	8.8 nm/mm 224 nm	4.4 nm/mm 112 nm	2.2 nm/mm 56 nm	1 nm/mm 25 nm	0.6 nm/mm 15.2 nm	0.4 nm/mm 10 nm	0.3 nm/mm 7.6 nm

\* All specifications are nominal.

## SpectraPro 150 Specifications

(1200-g/mm grating)	
Focal length	150 mm
Aperture ratio	f/4
Optical design	imaging Czerny-Turner with aspheric mirrors
Scan range	0 to 1400-nm mechanical range
Resolution	0.4 nm @ 435.8 nm, 10- $\mu$ m slits
Dispersion	5 nm/mm (nominal)
Accuracy	$\pm$ 0.25 nm
Repeatability	$\pm$ 0.05 nm
Drive-step size	0.005 nm
Focal-plane size	25 mm wide x 10 mm high
Standard slits	manual; adjustable from 10 $\mu$ m to 3 mm wide; 4- or 14-mm slit heights
Grating size	32 x 32 mm
Grating mount	dual-grating turret
Grating turrets	interchangeable (standard)
Size	7 in (178 mm) long; 7 in (178 mm) wide; 6.5 in (165 mm) high; 4-in (102-mm) optical axis height
Weight	10 lb (4.5 kg)

## SpectraPro 300i Specifications

(1200-g/mm grating)	
Focal length	300 mm
Aperture ratio	f/4
Optical design	imaging Czerny-Turner with aspheric mirrors
Scan range	0 to 1400-nm mechanical range
Resolution	0.1 nm @ 435.8 nm, 10- $\mu$ m slits
Dispersion	2.7 nm/mm (nominal)
Accuracy	$\pm$ 0.2 nm
Repeatability	$\pm$ 0.05 nm
Drive-step size	0.0025 nm
Focal-plane size	27 mm wide x 14 mm high
Standard slits	adjustable from 10 $\mu$ m to 3 mm wide; 4- or 14-mm slit heights; motorized (optional)
Grating size	68 x 68 mm; 68 mm x 84 mm (optional)
Grating mount	triple-grating turret
Grating turrets	interchangeable (optional)
Size	13.25 in (337 mm) long; 10 in (254 mm) wide; 8 in (203 mm) high; 4.875-in (123.8-mm) optical axis height
Weight	35 lb (15.9 kg)

## SpectraPro 500i Specifications

(1200-g/mm grating)

Focal length	500 mm
Aperture ratio	f/6.5
Optical design	imaging Czerny-Turner with aspheric mirrors
Scan range	0 to 1400-nm mechanical range
Resolution	0.05 nm @ 435.8 nm, 10- $\mu$ m slits
Dispersion	1.7 nm/mm (nominal)
Accuracy	$\pm$ 0.2 nm
Repeatability	$\pm$ 0.05 nm
Drive-step size	0.0025 mm
Focal-plane size	27 mm wide x 14 mm high
Standard slits	adjustable from 10 $\mu$ m to 3 mm wide; 4- or 14-mm slit heights; motorized (optional)
Grating size	68 x 68 mm; 68 x 84 mm (optional)
Grating mount	triple-grating turret
Grating turrets	interchangeable (optional)
Size	21 in (534 mm) long; 11 in (280 mm) wide; 8 in (203 mm) high; 4.875-in (123.8-mm) optical axis height
Weight	40 lb (18 kg)

## SpectraPro 750 Specifications

(1200-g/mm grating)

Focal length	750 mm
Aperture ratio	f/9.7
Optical design	computer-optimized Czerny-Turner
Scan range	0 to 1400-nm mechanical range
Resolution	0.023 nm
Dispersion	1.1 nm/mm
Accuracy	$\pm$ 0.1 nm
Repeatability	$\pm$ 0.05 nm
Drive-step size	0.0025 mm
Focal-plane size	27 mm wide x 14 mm high
Standard slits	adjustable from 10 $\mu$ m to 3 mm wide; 4- or 14-mm slit heights; motorized (optional)
Grating size	68 x 68 mm; 68 x 84 mm (optional)
Grating mount	triple-grating turret
Grating turrets	interchangeable (standard)
Size	30 in (762 mm) long; 11 in (280 mm) wide; 8 in (203 mm) high; 4.12-in (105-mm) optical axis height
Weight	45 lb (20.5 kg)

## SpectraPro 500i

The SpectraPro 500i is a 500-mm, f/6.5-aperture, triple-grating monochromator and spectrograph that features a high-throughput imaging optical system for multichannel spectroscopy, optional dual entrance and exit ports for maximum versatility, and easy-to-use computer control. The SpectraPro 500i combines high spectral resolution with exceptional imaging capabilities, making it an ideal choice for multichannel CCD applications. The SpectraPro 500i works especially well for Raman, laser fluorescence, atomic emission, absorption/transmission, and photoluminescence.

## SpectraPro 750

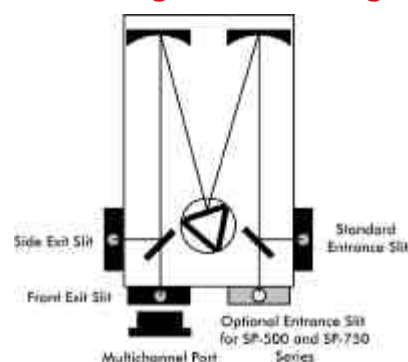
The SpectraPro 750 is a 750-mm f/9.7-aperture triple-grating monochromator and spectrograph that features a versatile multiport optical system, 0.0025-nm drive-step size, built-in computer compatibility, and a wide scanning range. As a monochromator, it offers built-in stepping-motor scanning and 0.023-nm resolution, plus easy integration into automated spectral-data-acquisition systems. As a spectrograph, the SpectraPro 750 provides 1.1-nm/mm dispersion, a large 14-mm-high by 27-mm-wide focal plane, and interchangeable turrets. The SpectraPro 750 is ideal for Raman, laser fluorescence, atomic emission, and photoluminescence.



## Spectrometer Configurations and Options

Model #	Configuration	Options
SP-150M	Monochromator with side entrance slit and front exit slit	
SP-150S	Spectrograph with side entrance slit and front exit multichannel-detector port	
SP-305 SP-555 SP-755	Monochromator with side entrance slit and front exit slit	Optional front entrance slit available on SP-555 and SP-755
SP-306 SP-556 SP-756	Spectrograph with side entrance slit and multichannel-detector port on front exit	Optional front entrance slit available on SP-556 and SP-756
SP-307 SP-557 SP-757	Dual-exit-port monochromator with side entrance slit and side and front exit slits	Optional front entrance slit available on SP-557 and SP-757
SP-308 SP-558 SP-758	Monochromator/spectrograph with side entrance slit, side exit slit and front exit multichannel-detector port	Optional front entrance slit available on SP-558 and SP-758

## Port Configuration Diagram



# Acton Research SpectraSense Software

## Integrated Acquisition Versatility

SpectraSense spectral-acquisition and manipulation software seamlessly integrates interactive control of the SpectruMM system components with powerful real-time and post-acquisition data processing. An extremely intuitive interface allows easy access to change or verify any instrumental parameter, including switching between multichannel and single-channel detection systems. It is preconfigured to acquire data for Raman, fluorescence, percent-absorption, and percent-reflection measurements on the fly. A unique process-monitoring interface employing real-time chemometrics makes SpectraSense the most versatile spectral-acquisition software available.

## Incredible Ease of Use

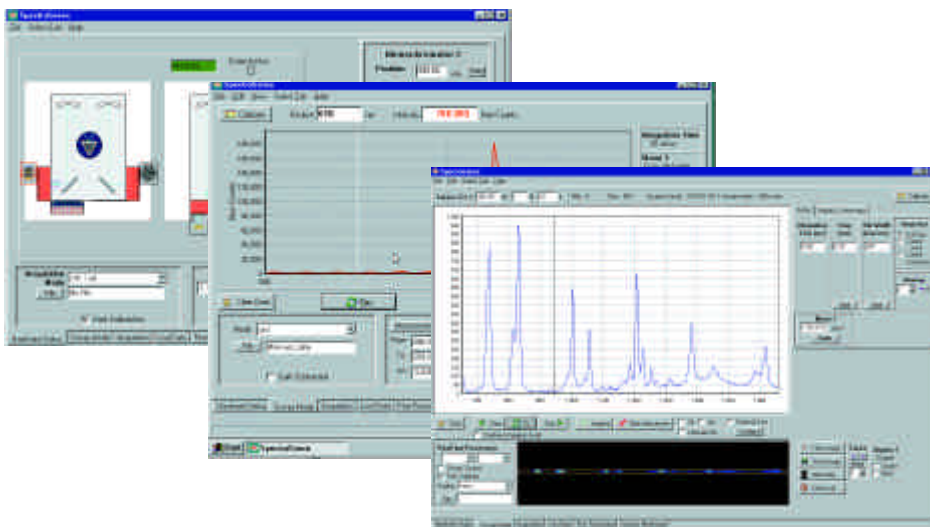
Configuring your system with SpectraSense is as simple as dragging detector and accessory icons on the system diagram. Once they are in place, you can simply click on a port or turning mirror to activate the appropriate detection system and input accessories. Click on the turret to change gratings. All acquisition modes and parameters are automatically updated to reflect the instrumental set up.

## Interactive Spectral Optimization

Every parameter that affects the quality of your spectra can be interactively optimized and the results seen in real time. Integration time, slit width, high voltage (in single-channel operation), and binning and area-size modification (in CCD mode), as well as spectrometer positioning are all instantly modifiable as the results constantly update on the screen.

## Powerful Real-Time Analysis

Ratioing, normalization, source compensation, percent absorption, percent transmission, and percent reflection can be done in real time using multiple detectors in single-channel mode and multiple areas with CCD detection. Data-acquisition routines can be created for kinetic and repetitive analyses. An optional run-time chemometrics package can be used with the Galactic Industries Corporation's PLSplus/IQ™ software.



## SpectraSense Features

- Single-point and CCD-detectors compatibility
- Integrated acquisition and analysis functions
- Single-click experimental configuration
- Full integration with Grams/32®
- Process monitoring interface
- Windows® 95/NT operation

## SpectraSense Specifications

### Acquisition

With NCL electronics (single-point mode):  
3 single-channel inputs  
(2 standard, 1 optional);  
Ch1 and/or Ch2 and/or Ch3;  
Ch1/Ch2 or Ch3;  
Ch1 or Ch2 or Ch2/file;  
Ch1 or Ch2/file/Ch3;  
%T, %R, absorbance;  
Intensity vs time at one wavelength;  
Automatic background subtraction

With SpectruMM CCD:  
Spectrum;  
Spectrum/file;  
Spectral area/spectral area;  
%T, %R, absorbance;  
Integrated peak intensity vs time;  
Ratio of peak areas vs time;  
Automatic background subtraction;  
Automatic cosmic ray correction

Control of two spectrometers:  
Wavelength (nm, Å) scanning;  
Wavenumber (cm<sup>-1</sup>) scanning;  
Energy (eV) scanning;  
Acquisition modes—  
single spectrometer,  
synchronous scanning  
(single point),  
excitation/emission,  
excitation/emission matrixed,  
step and glue (CCD);

Interactive S/N optimization

Accessory automation:  
Automated filter insertion;  
Control of two shutters via positional,  
intensity, and start/end-point criteria;  
Single-point operation triggers  
(4 inputs, 4 outputs)—  
via timing,  
@ real-time calculated value,  
@ real-time conditional criteria,  
start/end positional criteria;  
CCD triggers (1 input; 1 output)—  
start of scan,  
end of scan;  
Automated slit control in mm and  
bandpass increments

## Data Analysis

Basic package:

Scalar math: +, -, x, /, ^ ;

File math: +, -, x, / ;

Smoothing: Multipoint Savitsky Golay;

Area;

Join, truncate, shift;

Peak find/label;

Historic log of all acquisition parameters and manipulations stored with file

Grams/32 integrated package (optional):

All data is automatically storable in ".SPC" or ASCII formats;

Acquisition routines are recallable in

Grams macro and Array Basic programs;

A run-time chemometrics routine is included with Galactic's PLSplus/IQ program

## Hardware Requirements

IBM-compatible computer with

Pentium® processor;

32 MB RAM;

800 x 600 display (SVGA);

One serial port;

One PCI slot (for SpectraMM CCD);

Windows 95 or higher or Windows NT 4.0 or higher

## NCL Specifications

### Hardware control

Control of 2 spectrometers and all associated motorized accessories;

Filter wheel;

2 security shutter circuits;

4 input and 4 output trigger lines;

±15 V output for biasing

### Data acquisition

2 signal inputs (3<sup>rd</sup> optional);

Works with:

PMTs,

solid-state detectors,

photon counting;

Sensitivity:

current: ±10 nA to 1 µA full scale,

voltage: ±100 mV to 10 V full scale;

Integration time: 5 ms to 64 sec

High voltage control circuits:

0 to 1250 V,

12-bit resolution for PMT housings

with built-in power supplies;

Internal memory: 8000 data points

### Communications

RS232C standard; IEEE488 optional

### Power

12 V;

750 mA DC via external power supply;

Rechargeable battery pack available

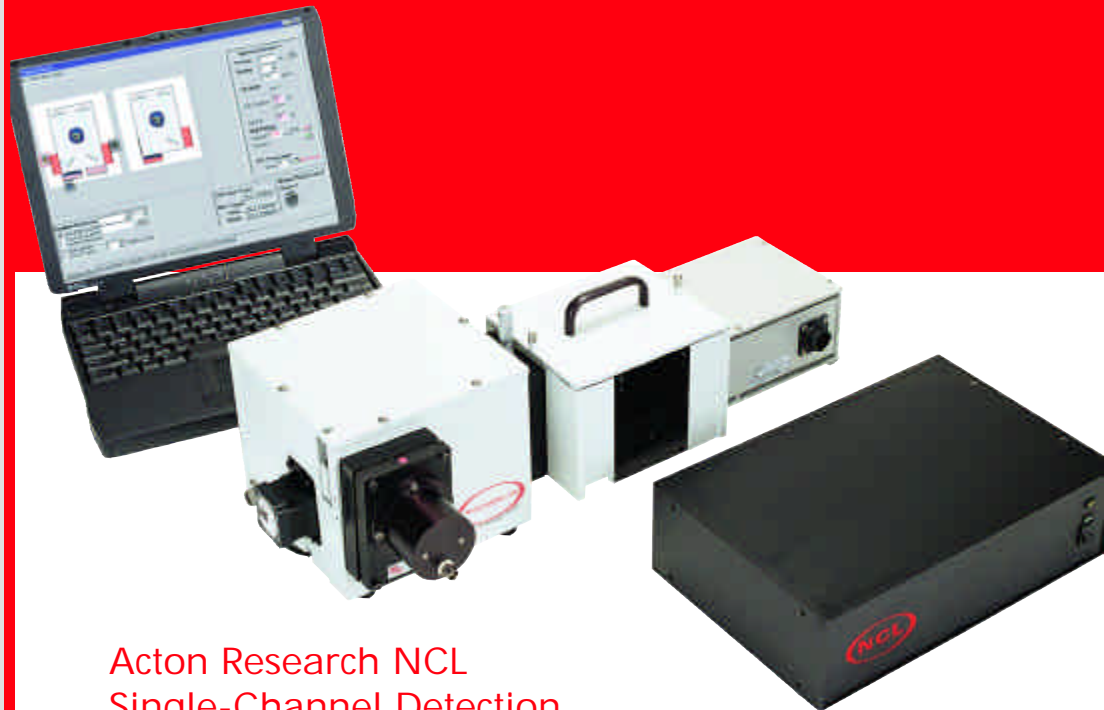
### Dimensions

8.07 in (20.5 cm) width;

12.2 in (31 cm) length;

3.15 in (8 cm) height;

5 lb (2.27 kg) weight



## Acton Research NCL Single-Channel Detection

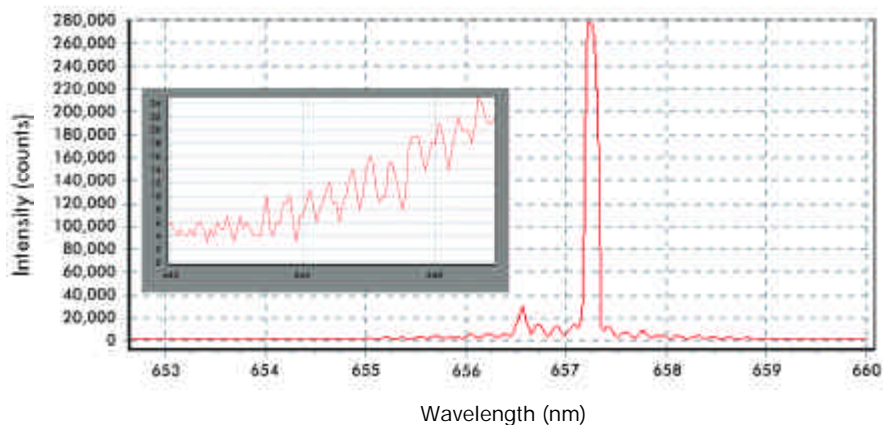
### Unsurpassed Sensitivity and Dynamic Range

The NCL is a complete spectral measurement system designed to give the ultimate performance in single-channel detection. It features a 32-bit microprocessor and 20-bit ADCs. It also delivers true signal integration, which is critical for measurement of weak signals and can extend the useful operation range of silicon and other solid-state detectors.

### Unmatched Versatility

The NCL comes standard with two signal-input channels. A third channel can be added as an option. All channels are read simultaneously and the data manipulated on the fly via SpectraSense software. The NCL can control two monochromators, a filter wheel, two shutters, four input lines, and four output lines. Virtually any experimental configuration from dual-beam absorption to excitation/emission matrices in fluorescence can be controlled through the NCL. Internal buffering of up to 4000 data points per channel allows 5-ms kinetic measurements.

The NCL's unsurpassed dynamic range can be seen in this spectrum of a laser with intensities from 2 counts to 270,000 counts are recorded.



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For the latest product and technical information visit us at

[www.roperscientific.com](http://www.roperscientific.com)





# Roper Scientific / Acton Research

## Product Literature

## Data sheets

### Brochures

*SpectraPro monochromators*

*Spectrum Acquisition Systems*

*Spectroscopy accessories*

*Guide to system configuration*



*Gratings*

*CCD Chips*

*GS 1024 x 128 Front*

*GS 1024 x 128 Back*

*GS 1024 x 256 Front*

*GS 1024 x 256 Back*

*S 1340 x 100 Front*

*S 1340 x 100 Back*

*S 1340 x 100 Red*

*S 1340 x 100 Back Red*

*S 1340 x 400 Front*

*S 1340 x 400 Back*

*S 1340 x 400 Red*

*S 1340 x 400 Back Red*

*S 1024 x 256 Front*

*S 1024 x 256 Open Elect.*

*S 1024 x 256 Back*