

# Smart Spectrograph SD1024 Series

Production will shift from the SD1024DL and SD2048DL  
to the SD1024FL and SD2048FL in Q3 2008



Super High Performance  
SD1024FH

High-Performance  
SD1024F

General Purpose  
SD1024FL  
SD2048FL

**Verity**  
INSTRUMENTS, INC.



## Summary

### SD1024F

- For demanding applications
- Single or multi-fiber input
- Scientific grade CCD

### SD1024FH

- Same as SD1024F, except:
  - Higher throughput optics
  - Lower noise electronics

### SD1024FL

- For general purpose applications

### SD2048FL

- For high resolution applications
- Bright source emission required

## Features and Benefits

- Provides robust endpoint determination
- SpectraView™ software provides:
  - Variety of algorithms
  - Open algorithms and sequences for flexibility
  - Tool integration via Ethernet, RS232, and DI/O
- Use for endpoint detection, fault detection, and process diagnostics
- 200–800nm range
- RoHS Compliant

## Description

The SD1024F Series spectrographs are optical emission monitors that integrate sophisticated embedded processors and software designed to provide intelligent instrument control, data acquisition and endpoint interface capabilities. The SD1024F Series uses common electronics, application software and enclosures. The differences between the SD1024F, the SD1024FL, and the SD2048FL are the charge coupled device (CCD), optical platform and embedded software parameters.

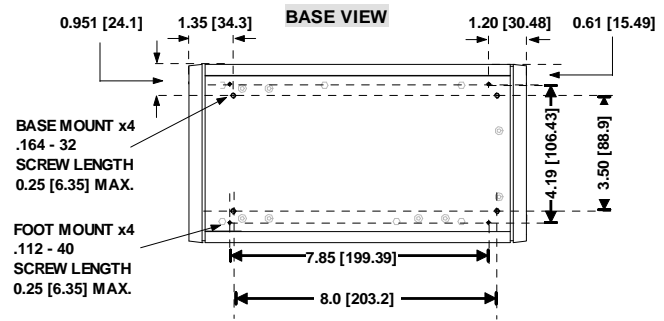
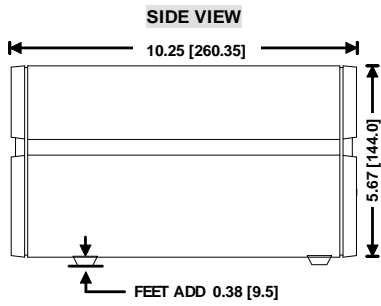
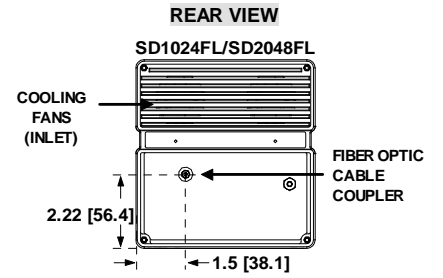
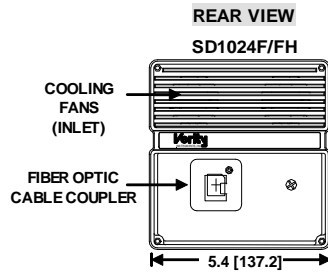
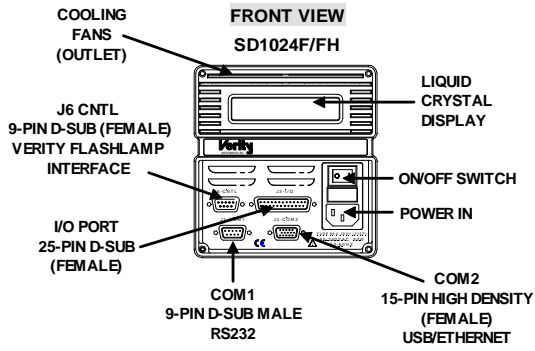
The **SD1024F** was designed for demanding semiconductor process applications. Its optical system employs a 1024-element, scientific-grade CCD array specifically designed for multi-channel spectroscopy, offering high performance at a moderate cost. The advantages of the SD1024F include excellent ultraviolet (UV) response (down to 200nm), stability against degradation under UV exposure, high sensitivity, wide dynamic range and superior output linearity. The unique optical platform results in highly efficient imaging of spectral information at the element of the two-dimensional detector array.

The **SD1024FH** was designed for the most demanding applications. Signal to Noise performance is achieved via a ~ 75% greater optical throughput, proprietary data acquisition scheme, novel signal processing methods, and superior system noise control.

The **SD1024FL** was designed for general purpose semiconductor process applications. It uses a 2048-element CCD. The CCD is backthinned for UV sensitivity. The SD1024FL uses the same 16-bit A/D electronics as the SD1024F.

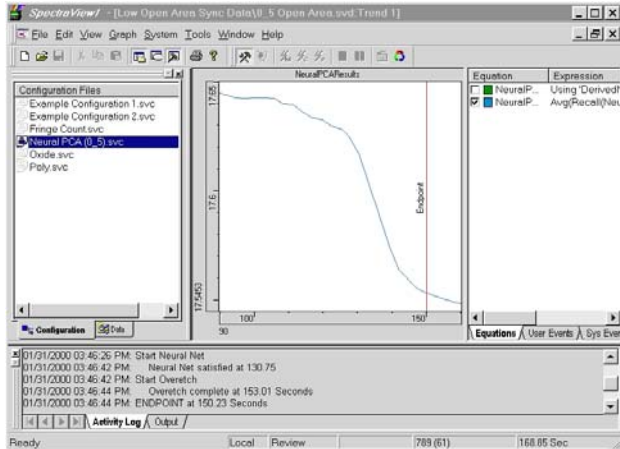
The **SD2048FL** is nearly identical to the SD1024FL, but reports spectral data in 0.25nm increments instead of 0.5nm readings as in the SD1024F and SD1024FL. This is done by using a narrower inlet slit and modified embedded software parameters. Although the SD2048FL has better resolution than the SD1024FL, its sensitivity is diminished by about one order of magnitude.

# Dimensions



# Algorithms for Endpoint Detection

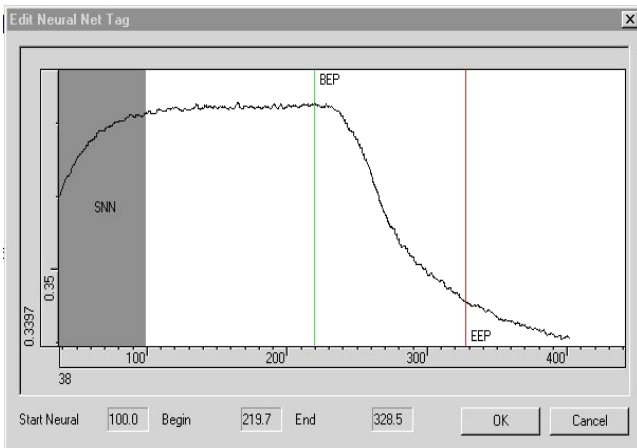
Verity Instruments provides a powerful suite of endpoint algorithms, including the multivariate Neural PCA algorithm, which can be processed with Verity's proprietary Neural Network pattern recognition software.



## Neural PCA™ Multi-Wavelength Algorithm

Verity's endpoint-detection computations can employ robust algorithms such as the patent pending Neural PCA™ for multivariate, full-spectrum analysis.

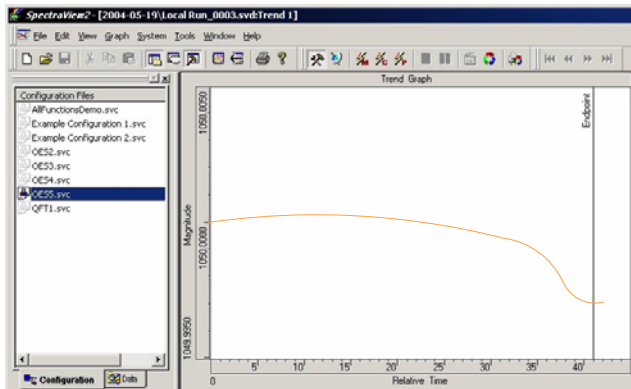
Data represented at left apply to a 0.5% exposed area contact etch using Verity's Neural PCA™ algorithm. Within the SpectraView™ endpoint software application, the Neural PCA endpoint trace can be processed using Neural Network or threshold-based methods.



## Neural Network Algorithm

The Neural Network algorithm is used to analyze endpoint traces. The Neural Network uses proprietary techniques to recognize characteristic endpoint shapes in the trend line. This is performed in real time and the pattern recognition algorithm adapts to expected amplitude and duration changes in the endpoint trace during successive runs.

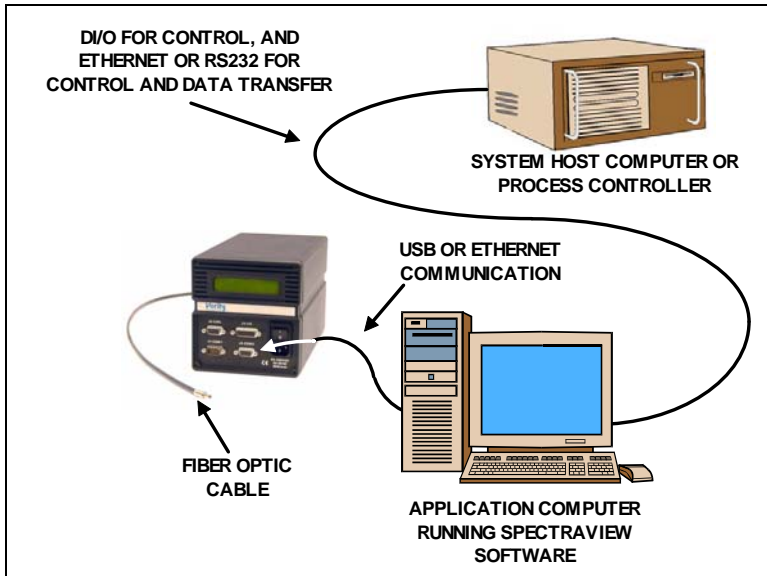
Unlike other types of neural networks, Verity's algorithm can be set up with only a few training runs. If a false positive or negative is found, it can easily be added to the training set for improved robustness. Process engineers using Verity's Neural Net software are freed from the burden associated with developing and testing threshold-based algorithms. In addition, data can be analyzed "on-the-fly" or replayed, reviewed, or reprocessed with SpectraView™.



## Threshold-Based Algorithm

Using threshold-based algorithms, endpoint recognition is based upon the output rising above or below a preset level for a predetermined length of time. However, for demanding applications, the Neural Network algorithm is commonly selected over the threshold-based algorithm.

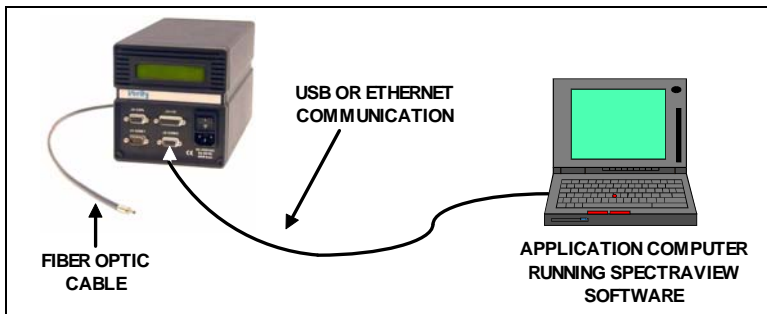
# System Schematic



## Partially Integrated Within a System

In a partially integrated configuration, an application computer is used to provide the user interface and data storage. Communication from the spectrograph to the application computer includes Ethernet or USB

Control between the application computer and the system host computer can be via DI/O and/or RS232, or DI/O and/or Ethernet. In some cases, it may be desirable to use DI/O for control communication and RS232 or Ethernet to provide a data stream of trend points to the system host computer.



## Non-Integrated Configuration

When used for troubleshooting or plasma diagnostic applications, the spectrograph is frequently not integrated with the process tool. Communication to the application computer includes Ethernet or USB.

## Specifications

Model Number	SD1024F/SD1024FH	SD1024FL	SD2048FL
Type	High Performance/Super High Performance	General Purpose	High Resolution
<b>Performance/Optics</b>			
Range	200–800nm	200–800nm <sup>3</sup>	200–800nm <sup>3</sup>
Resolution <sup>1</sup>	<2.0nm	<2.0nm	<1.0nm
CCD	TE cooled - low noise Backthinned - UV sensitive Deep well - dynamic range	Not TE cooled Backthinned - UV sensitive Deep well - dynamic range	Not TE cooled Backthinned - UV sensitive Deep well - dynamic range
Saturation (counts) <sup>2</sup>	40,000 to 65,536	40,000 to 65,536	40,000 to 65,536
<b>Mechanical</b>			
Slit Width	25 microns	25 microns	5 microns
Dimensions - inches (mm)	10.25 (260.0) x 5.4 (137.2) x 6.05 (153.5)	10.25 (260.0) x 5.4 (137.2) x 6.05 (153.5)	10.25 (260.0) x 5.4 (137.2) x 6.05 (153.5)
Weight	7 lbs (3.2 kg)	6 lbs (2.7 kg)	6 lbs (2.7 kg)
<b>Integration</b>			
Fiber Optic Connection	Custom Design	SMA905	SMA905
Power	95–250VAC, 50/60Hz 35W typical – 45W Max.  20-28VDC, 45W max. Optional	95–250VAC, 50/60Hz 35W typical – 45W Max.  20-28VDC, 45W max. Optional	95–250VAC, 50/60Hz 35W typical – 45W Max.  20-28VDC, 45W max. Optional
<b>Standards</b>			
Compliance	CE, RoHS, Semi S2 and S8	CE, RoHS, Semi S2 and S8	CE, RoHS, Semi S2 and S8
<b>Environmental</b>			
Operating Temperature Range	32 (0°C) — 104 (40°C)		
Storage Temperature Range	-4 (-20°C) — 140 (60°C)		
Max. Humidity (Operation and Storage)	85% Non condensing		

<sup>1</sup> Resolution — full width at half of maximum peak height, the maximum average of several measurements taken across the spectrum.

<sup>2</sup> Saturation – based on using standard calibration method, consult factory for alternate calibration methods.

<sup>3</sup> Spectral Range - consult factory for range to 1100 nm.

## Application Computer Software

Algorithms	Algebraic, trigonometric, Boolean logic functions Threshold-based Multi-Wavelength Algorithm (Neural PCA) Neural Network Pattern Recognition
Application Software	SpectraView™
Com OS	Windows 2000® SP4, Windows XP SP2
Comm. from Application to Spectrograph	RNDIS USB Driver or TCP/IP over Ethernet (TCP/IP preferred)
Comm. from Tool to Application Software	ASCII or Proprietary Serial (RS232) and/or DI/O, Proprietary TCP/IP and/or DI/O

## Recommended Application Computer Requirements

Attribute	Specification
Platform	Windows 2000® SP4, Windows XP SP2
Processor	Pentium 4 class CPU, 1.0GHz or faster (minimum, some advanced algorithms may require more processing power)
Memory	512MB or greater, 300Mhz DDR RAM (minimum, some advanced algorithms may require more memory)
Hard Drive	40GB minimum Spectral and trend data storage; 20GB- Trend data only storage
Graphics	XGA (1024x768, 256Colors)
COM Port(s) to SD1024 COM Port (s) to Tool Com Port to LAN Optional	USB or 10/100Ethernet (preferred) RS232, Digital I/O or 10/100Ethernet Additional 10/100 Ethernet (for data uploading) PCI card slot(s) for DIO and/or analog output card installation

## Ordering Information – SD1024FL and SD2048FL

Spectrograph Description	Model	Part Number
General Purpose – AC Power	SD1024FL	1007702
General Purpose – DC Power	SD1024FL	1008715
High Resolution – AC power	SD2048FL	1007703
High Resolution – DC Power	SD2048FL	1008714

### Fiber Optic Cables

**Fiber Optic Cables** — SMA905 on instrument end to standard Verity spot on chamber end (0.157" / 4.7mm)

Standard Temperature Rating (for usage to 100 C)		
Description	Model Number	Part Number
50 cm plastic jacket	SMP-DUV04-020	1003139-020
100 cm plastic jacket	SMP-DUV04-040	1003139-040
200 cm plastic jacket	SMP-DUV04-079	1003139-079
250 cm plastic jacket	SMP-DUV04-099	1003139-099
300 cm plastic jacket	SMP-DUV04-119	1003139-119

High Temperature Rating (for usage to 250 C)		
Description	Model Number	Part Number
50 cm stainless steel jacket	SMPXHT-DUV04-020	1005656-020
100 cm stainless steel jacket	SMPXHT-DUV04-040	1005656-040
200 cm stainless steel jacket	SMPXHT-DUV04-079	1005656-079

## Ordering Information – SD1024F/SD1024FH

Description	Model No.	Part Number
High Performance- AC power	SD1024F	1007554
High Performance- DC power	SD1024F	1008054
Super High Performance - DC power	SD1024FH	1008646

### Fiber Optic Cables

**Fiber Optic Cables**

Description	Model Number	Part Number
50 cm stainless steel jacket <sup>1</sup>	SGXHT-DUV02-020	1002727-020
100 cm stainless steel jacket <sup>1</sup>	SGXHT-DUV02-040	1002727-040
200 cm stainless steel jacket <sup>1</sup>	SGXHT-DUV02-079	1002727-079
300 cm stainless steel jacket <sup>1</sup>	SGXHT-DUV02-119	1002727-119

<sup>1</sup> These fiber optic cables are designed for use to 250C.

### Hardware for Partially Integrated Application

**Digital I/O Card for Use in Application Computer**

Description	Model Number	Part Number
Digital I/O Card (ISA bus type, 8 inputs/8 outputs)	DAS-725	1000964
Digital I/O Breakout Box and Cable for use with DAS-725	N/A	1002881
Digital I/O Card (PCI type, 16 inputs/16 outputs)	DAS-7230	1005418

# Communication Options

## CABLES

For Single Spectrograph to Computer	Length	Part Number
Ethernet Cable <sup>1</sup>	14' (4.5m)	1004358-168
	20' (6m)	1004358-240
	50' (15m)	1004358-600
USB Cable	9' (2.6m)	1003275-108
	16' 5" (5m)	1003275-197

For Multiple Spectrographs to Computer	Length	Part Number
Ethernet Cable – PC to Switch: <i>Select only one</i>	1' (0.3m)	1004442-012
	7' (2m)	1004442-084
	14' (4m)	1004442-168
Ethernet Cable(s) – Switch to Spectrograph: <i>Select one per spectrograph</i>	6' (1.8m)	1004351-072
	14' (4m)	1004351-168
	20' (6m)	1004351-240
	25' (7.5m)	1004351-300
	30' (9m)	1004351-360
Ethernet Switch, including: 8 ports 10/100 Auto-sensing 12VDC Adapter to 120VAC & USA plug	Not applicable	1005879

<sup>1</sup> Ethernet Cable — each Spectrograph is shipped with a 9' (2.6m) Ethernet crossover cable (1004358-108) for updating of the embedded software. This same cable can be used for Spectrograph to Host PC communications, if desired.



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