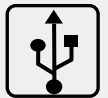
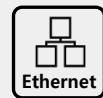


# Preconfigured High-Resolution Ethernet Communication Spectrometer

## SM445N



**SP SPECTRAL PRODUCTS**

# SM445N

## High-Speed Ethernet Communication Spectrometer

- Wide Spectral Range (up to 200~1050 nm)
- High Optical Resolution by 3K array CCD
- Extremely Low Light Exposure Time up to 10  $\mu$ sec
- **Communication over long distance**
- **OnBoard averaging - average up to 65,535 spectra**
- **OnBoard Memory(Volatile) 17,000 spectra**
- **Interface - Ethernet, USB, RS232(Custom)**



### Excellent choice for high speed data acquisition and various applications.

Spectral Products is offering the new ethernet communication **SM445N** Toshiba TCD1304 spectrometer. Thanks to the enhanced design on the electronic board of the **SM445N**, the dark current noise level as well as the data acquisition speed have been improved.

Based on special optical bench design, it supports various applications where spectral or color measurements are required, including high speed data acquisition. The **SM445N** can accept light directly through its built-in slit or via optical fiber. The durable mechanical housing that encloses the **SM445N** provides stable optical bench operation over a wide range of temperatures.

Our array detector (in conjunction with our special UV coating process and customized order sorting filters) allows up to a 1050 nm measurement range from 200 nm to 1050 nm (smaller measurement range mix increase spectral resolution and light sensitivity).

**SM445N** delivers acquisition communications via **USB** and **Ethernet**. Our USB board can support up to 8 multi-channel configurations, which allows a wide range of high-resolution or dual spectrometer systems (one for measurement and the other for reference). Applying a new UV-enhanced coating to the CCD increases UV sensitivity below 450 nm compared to conventional UV coatings widely used in CCD spectrometers. Thanks to this new UV coating, signal sensitivities below 450 nm can generally be improved up to ~2-3 times more.

Software support includes **SDKs** and **DLLs** for developing dedicated applications and Windows OS-based spectrum acquisition and analysis software (**SMPProMX**).

# Specifications :

Physical Dimension	
Dimensions (Inches)	90 mm X 70 mm X 44 mm (3.54 x 2.76 x 1.73)
Weight	0.4 kg (0.9lbs)
Fiber Optic Connector	SMA905 N.A.=0.22 Optical Fiber Input
Detector	
Detector	Toshiba TDC 1304 (UV Enhanced Coated)
Cooling	None
Windows Material	Quartz or Glass
Spectral Response Range	200-1050 nm
Pixels	3648 (Effective)
Pixel Size	8 μm X 200 μm
Well Depth	100,000 e-
Optical Specification	
Wavelength Range	Full Range : ~200-1050 nm Other user customized ranges are possible
Optical Resolution	~0.10-10 nm, dependent on spectral range, slit width, and fiber core diameter
Dark Noise RMS	< 50 in 16 bit @ 35 msec integration time
Signal to Noise Ratio (SNR)	> 300 : 1
Stray Light	<0.1 % AVG.
<b>OnBoard Memory (Volatile)</b>	<b>17,000 spectra</b>
<b>OnBoard averaging</b>	<b>Up to 65,535 spectra</b>
Filter	Second Order Blocking Filter Installed
Electronics Specification	
ADC Sampling Rate	500 kHz
ADC resolution	16 bit (0-65535)
Minimum Integration Time	0.01 msec
<b>Data Transfer Speed</b>	<b>Up to 250 Spectra Per Second Via Ethernet and USB2.0</b>
<b>Computer Interface</b>	<b>Ethernet, USB, RS232(Custom)</b>
Trigger Mode	Free Run Mode
	Software Trigger Mode
	External trigger mode (20-pin connector): TTL Edge trigger input
Software	
Operating System	Windows 7/8.1/10 (32/64 bit)
Software	SMPProMX
Software Development Kit	Visual C++ DLL /LabVIEW VI SDK

# Applications

## Multichannel Optical Monitoring and Diagnostics of Plasma

- Real time optical monitoring and diagnostics of plasma process in semiconductor fabrications
- Multichannel based OES (optical emission spectroscopy) sensors in plasma process diagnostics

**1. Viewport Mount**  
- Mounted on Process Chamber viewport

**2. Optical Fiber and OES Sensor**

**3. Controller**  
- Controller configuration for IP information and network (FDC)  
- Customized Spectral Calculation Data

**SPECTRAL PRODUCTS**  
Statistical Analysis  
Spectrum Database [ FDC ]

**EPD of Etch & Cleaning**

- Optimal End Point Detection in Etch and Chamber Cleaning Processes

**Leak Detection**

- Real-time monitoring and detection of leakage caused by outside air inflow

**Process Condition Monitoring**

- Real-time process gas behavior and process status monitoring as process conditions change

**Plasma Information**

- Automatic Measurement of Spatial Uniformity with Plasma Key Factors (PI)

## End Point Detection of Etching Process & Chamber Cleaning

- End point detection (EPD) of plasma etching and cleaning process in semiconductor fabrications
- Saving production cost and time loss by optimization of EPD with statistical algorithms

**Etch Depth: 100nm**

Ultra thin layer of SiO<sub>2</sub>, F+ ions, SF<sub>6</sub>, SiF<sub>4</sub>, Mask, Si, plasma

**SF<sub>6</sub>/O<sub>2</sub> Mixture plasma**

Intensity vs Wavelength (nm) graph showing peaks for SiF<sub>4</sub>, F, and F<sub>2</sub>.

**Etch Depth: 100nm**

Intensity vs Etched Time (sec) graph showing process gas (F) and by-product (SiF<sub>4</sub>) signals.

**RF ON** → **START OF ETCH** → **FILM CLEARS** → **ETCHANT** → **SUBSTRATE PRODUCT** → **FILM PRODUCT** → **RF OFF**

**Fig. 3. Time trace data of (a) process gas species and (b) by-product species.**

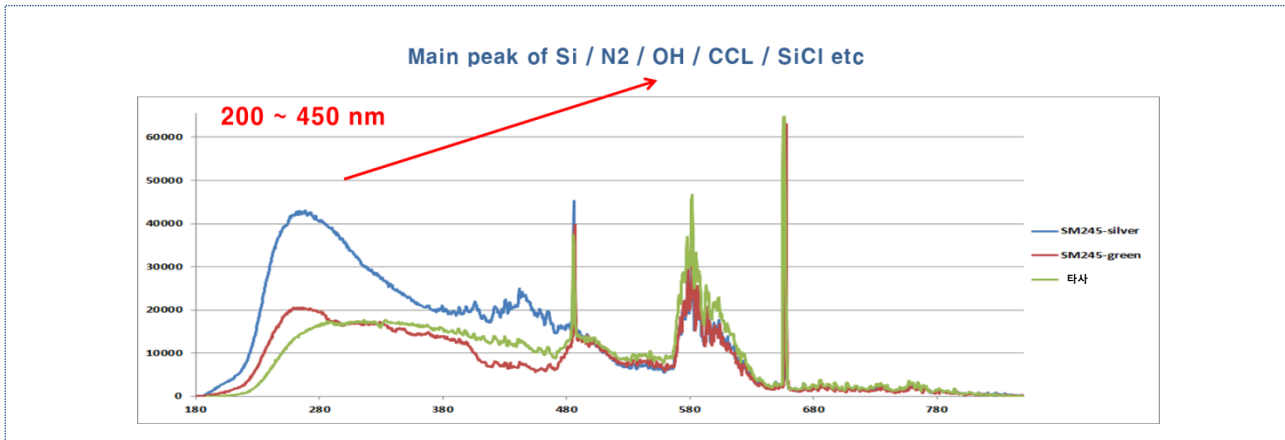
**Fig. 4. Generated end-point detection signals; tp (process gas species) and tb (by-product).**

Intensity (A.U.) vs Time (sec) graph showing tp and tb signals.

Sang Jeen Hong et. al. (2013)

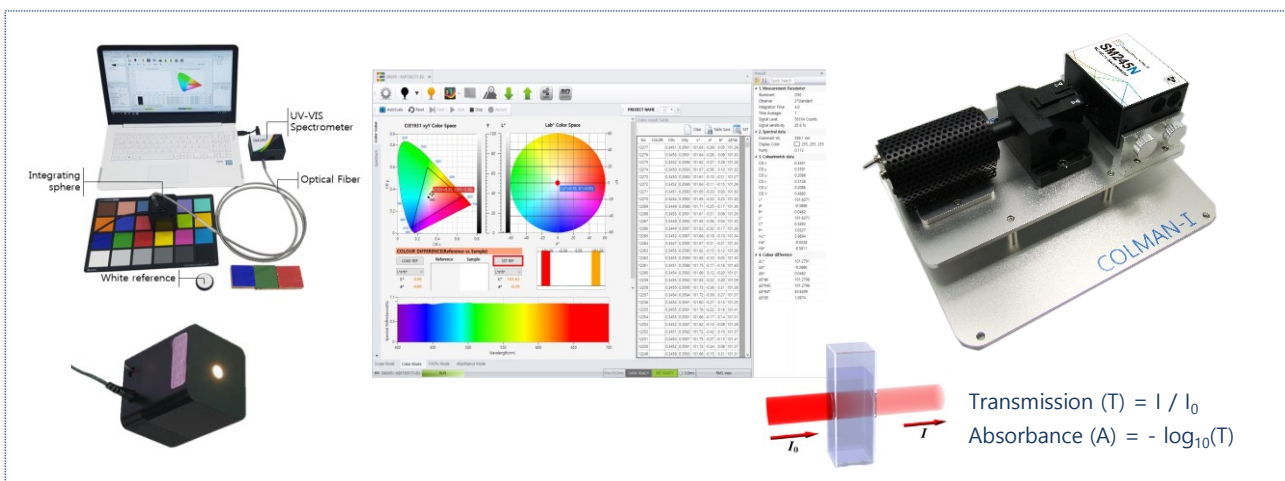
## Highly Sensitive Deep UV Enhanced Coated CCD

- High sensitive deep UV responsivity (200-450 nm) 2-3 times more than general UV enhanced spectrometers
- High signal-to-noise ratio and more accurate UV spectrum measurement results



## Compact Color and Absorbance Measurement System (COLMAN)

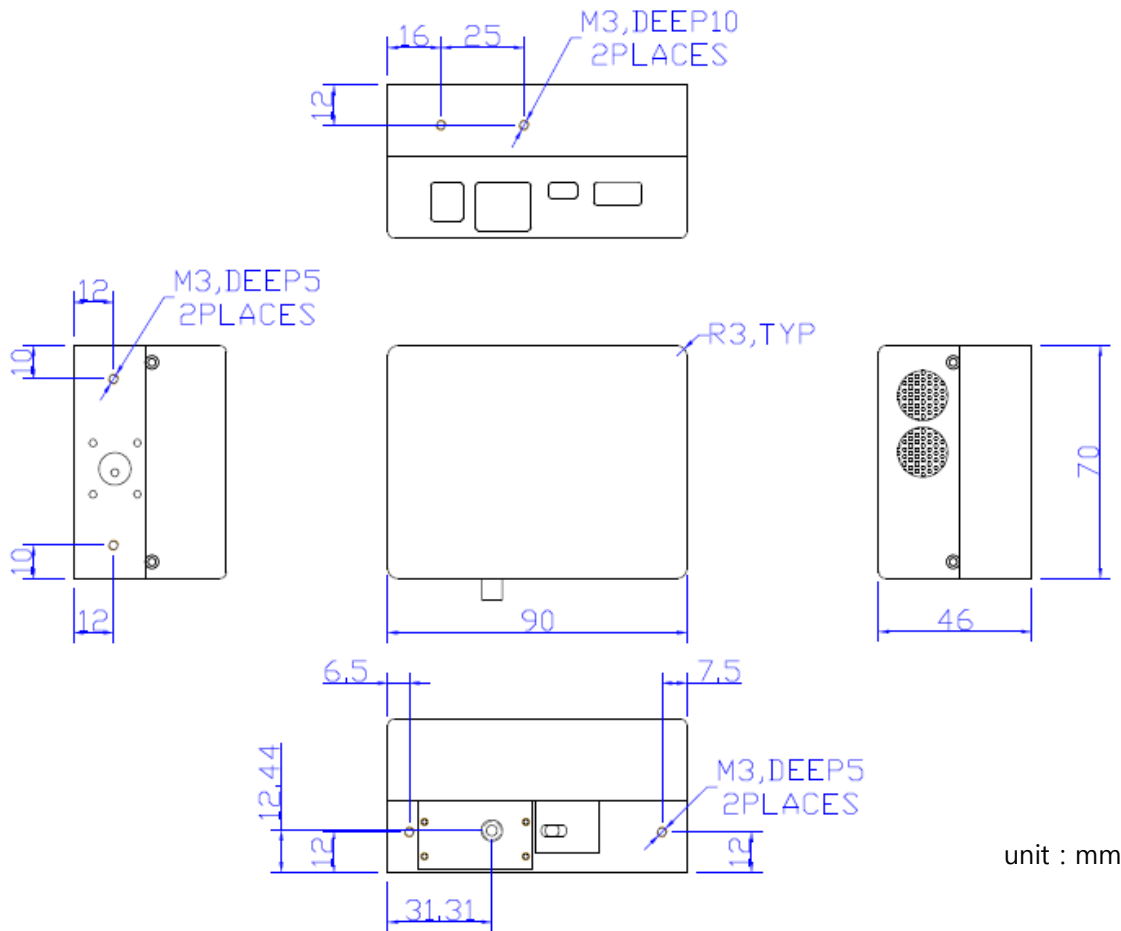
- Color measurement with photometric and radiometric values in reflectance and transmittance mode
- Compact real time spectrophotometer for analysis of chemical and optical properties of samples



Integrating sphere, UV-VIS Spectrometer, Optical Fiber, White reference, COLMAN-I

Transmission (T) =  $I / I_0$   
Absorbance (A) =  $-\log_{10}(T)$

## Case Dimension :



unit : mm

**Ordering Information :** Please indicate product number plus description when ordering  
**SM445N** Preconfigured High-Resolution Ethernet Communication Spectrometer