PENDOTECH
Leading Process Analytics

PendoTECH® Single Use UV Flow Cells and PM2 Photometer

Background

In bioprocess operations, measuring the UV absorbance of a liquid solution is a commonly used method to identify the absence or presence of a particular molecule of interest. This measurement is typically made at a wavelength of 280nm and is done using a spectrophotometer or photometer, either in-line or offline in a cuvette. Traditionally, a collimated beam of light passes through a sample with a defined path length, and the absorbance is determined as the ratio of the light applied from the source to what passed through the sample.

PendoTECH® Single Use UV Flow Cell and UV PM2 Photometer offers a non-invasive way to make this measurement. The flow cell is connected to the PM2 system with fiber optic cables, which connect to a flow cell holder, or optical couplers that integrate directly with the flow cell. It also contains special silica glass lenses to pass the photometer's light source through the sample and to the detector. The stream to be measured flows between the lenses through tubing attached to the hose-barb ends of the flow cell. This flow cell is low-cost for single-use applications and can be repeatedly cleaned and re-used.

In conclusion, the PendoTECH® Single Use UV Flow Cell and PM2 Photometer, provide innovative and cost-effective solutions for measuring UV absorbance in bioprocess operations.

Dual Wavelength Photometer PM2

PendoTECH® offers a Dual Wavelength version of the PM2 Photometer, which is equipped with two LED light sources. This system is available to output 260nm, 280nm, 300nm or 880nm, and measures two wavelengths simultaneously. Measuring the absorbance of two wavelengths in the same sample has many advantages in biopharmaceutical development and manufacturing. For instance, the user could detect protein, and measure turbidity simultaneously in the same sample by using a system at 280 and 880nm. Likewise, a photometer with two wavelengths in the UV range can detect binary mixtures if the products have different absorption spectra. For example, measuring the absorbance of a sample at 280nm to detect proteins, as well as at 260nm to detect nucleic acids, and then taking the ratio, to provide an estimate of the purity of the solution.

Benefits:

- Dual functionality for lab and benchtop uses or panel mount installations
- Non-invasively measure UV absorbance inline and in real time
- Reliably identify the absence or presence of a molecule of interest
- Monitor changes in concentration and easily determine absorbance peaks
- Low cost for single-use applications, but flow cells are robust enough to be repeatedly cleaned and reused
- Variety of flow cell sizes and path lengths to support different applications and process scales

Overall, the benefits of using these instruments include improved efficiency, cost-effectiveness, and increased information about the sample being measured, which can be especially useful in biopharmaceutical development and manufacturing.

Technical Details and Integration

The PM2 Photometer is a versatile instrument for lab and process applications. It can be used in both benchtop and panel mount versions, making it suitable for integrating into different systems. It can be factory configured with seven different wavelength combinations: 260nm, 280nm, 300nm, 880nm, 260-280nm, 280-300nm, and 280-880nm.

The photometer is designed to be integrated into a monitor with data acquisition capability. PendoTECH offers PM2 photometer solutions, such as PressureMAT PLUS models, which can be used with a PC for data logging, and PendoTECH Process Control Systems.

The transmitter's output is two 4-20mA signals spanning 0 to 3AUs. This means that the instrument provides two output signals that can be used to monitor the readings from the photometer. The transmitter also has a local display to view the readings directly from the instrument. Other data acquisition devices with analog inputs may be used to collect the data from the photometer. These devices can be connected to the output signals of the transmitter to collect and store the data. Higher-level control systems like PLCs and HMIs can also be used to integrate the photometer into a more extensive control system.

The PM2 Photometer can also be integrated with control systems with its built-in digital communication protocols. The photometer supports Modbus communication over RS485, as well as Modbus-TCP over Ethernet. These protocols can be used to monitor and control the device, as well as communicate with other systems or a network.

Overall, the PM2 Photometer is a versatile instrument that can be integrated into different types of systems. Its output signals and compatibility with different data acquisition devices and control systems make it a flexible solution for monitoring bioprocesses.

Single-Use UV Flow Cell Technical Details

The single-use UV flow cell is a device used for measuring the sample flowing through it. It comes in multiple sizes, including a 1/8inch hose barb with a 2mm path length, a 1/4inch hose barb with a 0.5cm path length, and a 1/2inch hose barb with a 1cm path length. The device consists of polymeric materials in the fluid path that meets USP Class VI standards and is assembled in an ISO 9001 facility. The flow cell can be gamma and x-ray irradiated up to 50KGy and autoclaved up to 121°C.

The flow cell has receptacles where the optical interface couplers are inserted to connect the fiber optic cables that measure the sample flowing through the cell. Alternatively, the device can be placed into PENDOTECH's Flow Cell Stand with integral couplers to connect to the PM2 Photometer.

Flow Cell Shown
1/2 in hosebarb with
1 cm path length

Optical Couplers Installed to
Flow Cell

Flow Cell Installed with Tubing

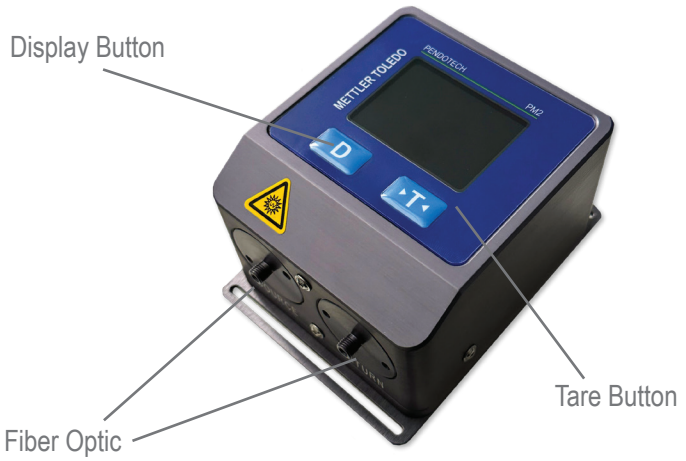
Flow Cell Installed in the
Optional Stand

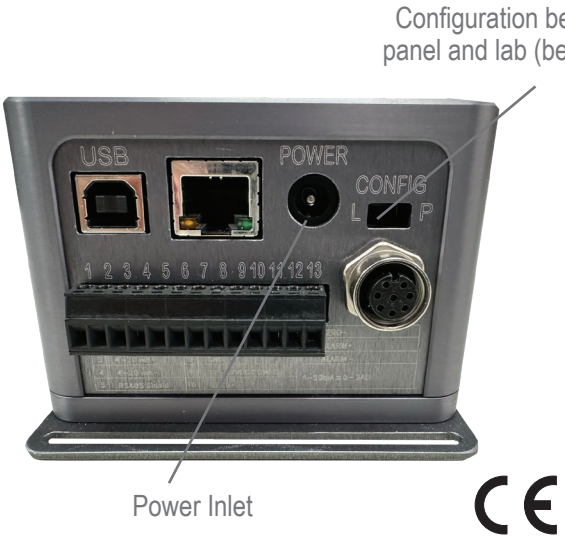
1/8 inch hose barb
2 mm path length
PART #: SPECPS-N-012

1/4 inch hose barb
0.5 cm path length
PART #: SPECPS-N-025

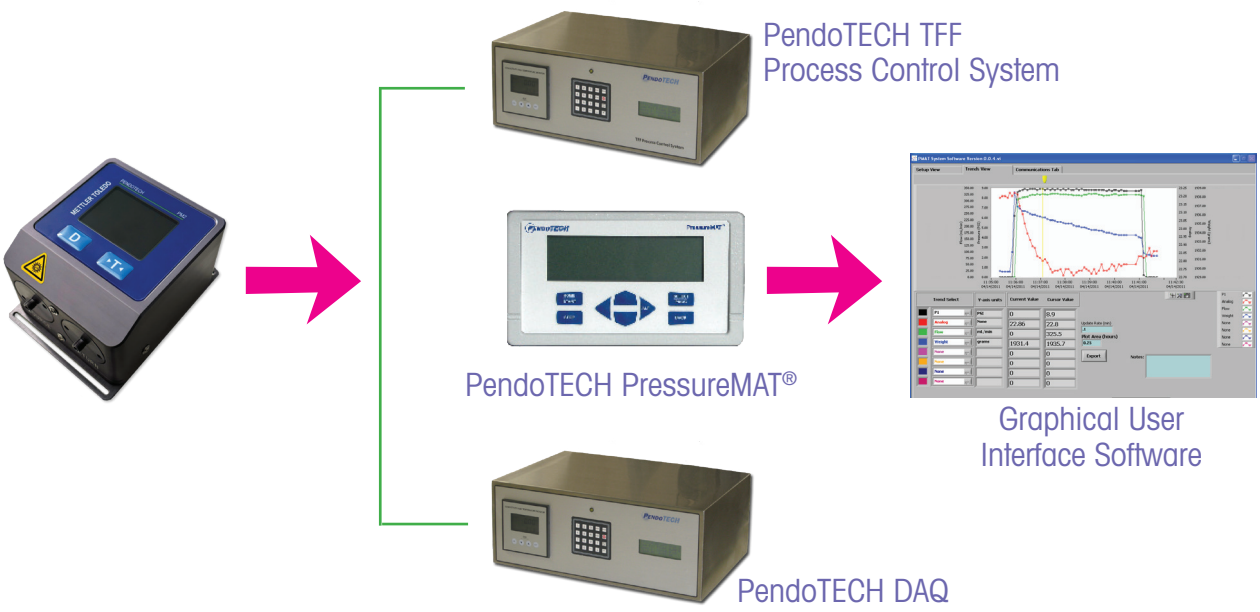
COMING SOON!:
1/8 inch hose barb
0.5 mm path length

Photometer:





The Photometer is designed to be integrated to a monitor with data acquisition capability. PendoTECH offers solutions for using the photometer such as PressureMAT® PLUS models (which can in turn be used with a PC for datalogging) and PendoTECH Process Control Systems. Other data acquisition devices with analog inputs may be used, as well as higher level control systems like PLCs and HMIs.



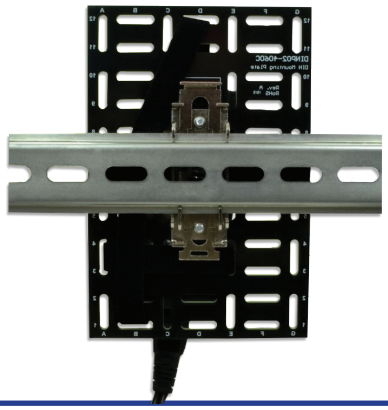
DIN Rail Adapter Mounting Plate

PART #: PHOTO-DR

The PendoTECH Photometer is available as a standalone bench top unit or in a panel mount model. When integrating the PendoTECH Photometer into an electrical cabinet there are several mounting options available (See Technical Note: PendoTECH Dual Wavelength Photometer Monitor/Transmitter Mounting Instructions). For mounting on a DIN rail installed in a cabinet there is a customized accessory available to steamline this process. It comes with the required hardware to mount the photometer:

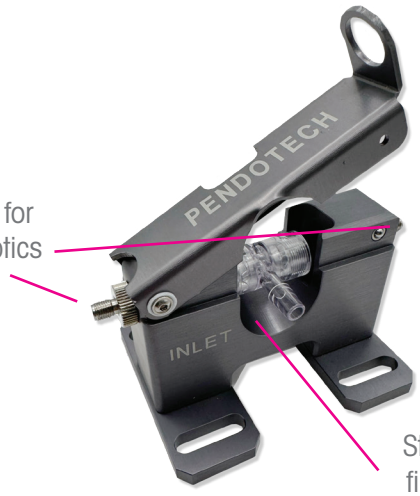
- 4x #6 - 32 x 3/8inch Philips pan head machine screws
- 4x #6 - 32 Hex nuts

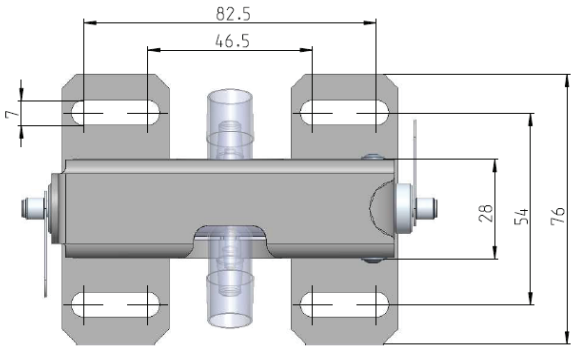
Spring loaded latch for easy removal



Flow Cell Stand Details:

SMA905 connectors for connection of fiber optics





Stand features a compartment to place light filters for photometer calibration verification

PART #: 30849505

UV/VIS Photometer PM2 Test Rig

The PendoTECH Photometer Test Rig and Standards is designed for quick and easy accuracy verification of PendoTECH's PM2 Photometers. The test kit includes one blank, and 5 NIST Traceable filters, a test rig for holding the filters and for connecting the photometer, and a convenient holder. See the datasheet for further details.

PART #: 30849507

Photometer Specifications:

Optical Configuration	LED light source
Optical Connectivity	SMA-905
Mechanical	4 in (10.2 cm) W x 4 in (10.2 cm) L x 2.5 in (6.4 cm) H Weight: ~1.5 lbs.
Power Requirement	24VDC nominal, 2.7W max power
Output	4-20mA (Active/sourcing) spanned 0-3AU
Analog Loop Resistance	500 ohms at 24VDC
Operating Temperature	41 to 122°F (5 to 50°C)
Storage Temperature	-4 to 122°F (-20 to 50°C)
Measurement Range	0.000-3.00AU
Response Time	1 second

Maximum Zero Shift	±0.1% full scale (±0.002AU)
Accuracy*	0-2AU ±1%FS (±0.03AU) ; 2-3AU ±2%FS (±0.06AU)
Long Term Output Drift	±0.1% full scale (±0.002AU)
Repeatability	±0.5% full scale (±0.015AU)
LED Lifetime	> 5 years
Available Wavelengths	240-1000 nm

* Accuracy is dependent on system arrangement and proper tare

The Photometer's LED provides a specific wavelength (or wavelengths for dual channel models) range for measurement, selected to coincide with analyte-specific molecular absorbance.Shown below are three example LED spectrum profile graphs, for typical LED light source wavelengths 260/280/880nm (Figures 1-3).

- **CWL (Center Wavelength):**
  The wavelength of an optical source that is considered its' middle. The wavelength of the peak of the spectral density curve.
  - **Important:**
    If measurements are attempted on a shoulder/slope of the molecule's absorption profile, the absorption measurement can change dramatically over the span of a few nanometers. Absorbance may never saturate as a portion of the LED's output is outside of the molecule's absorbance profile. Minute Photometer unit-to-unit absorption variations exist due to CWL tolerance.

- **FWHM (Full Width Half Maximum):**
  A measure of the range of light the LED generates. The width of an optical signal at half its maximum intensity.
  - **Important:**
    If the light source FWHM width is wider than the molecule's absorption peak, that will produce false, low absorption values.

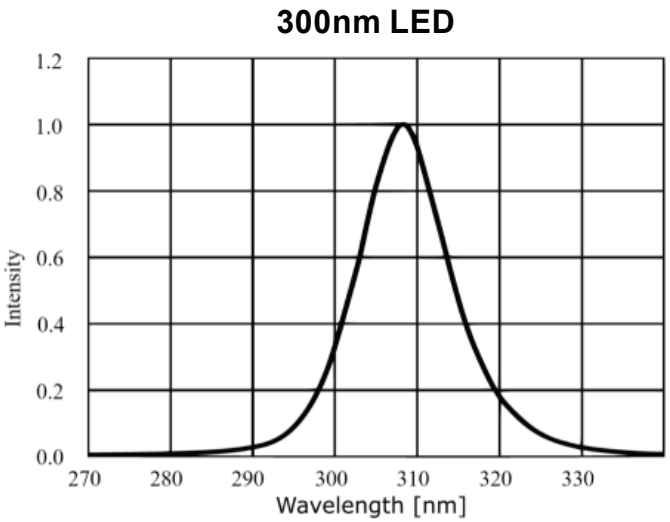


Fig. 1: LED wavelength spectrum example for 300 nm UV PM2 Photometer

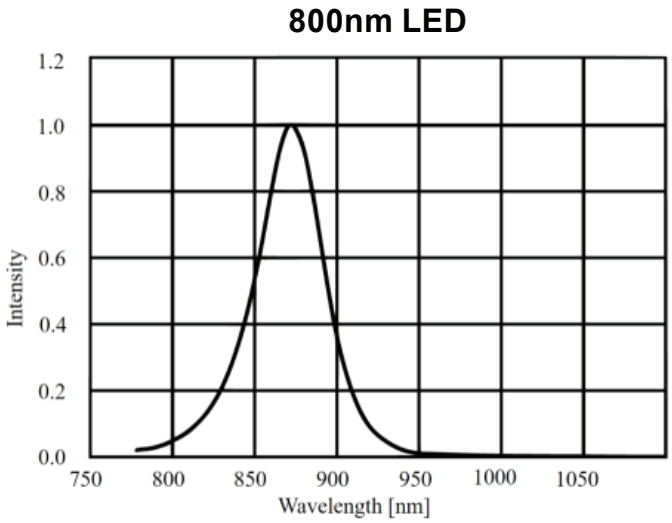


Fig. 2: LED wavelength spectrum example for 800 nm UV PM2 Photometer

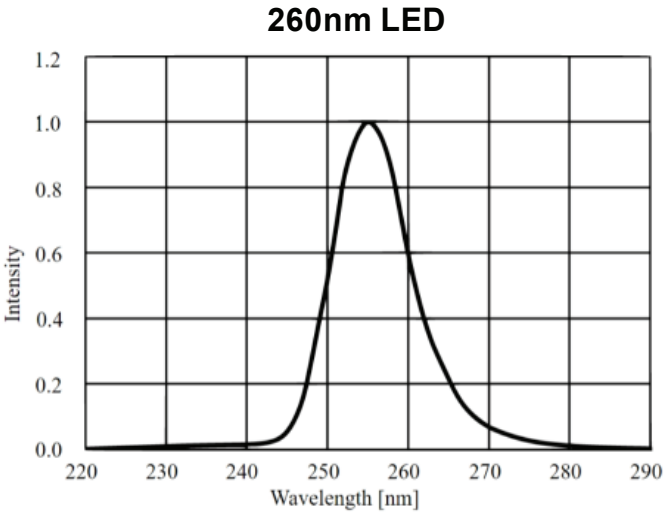


Fig. 3: LED wavelength spectrum example for 260 nm UV PM2 Photometer

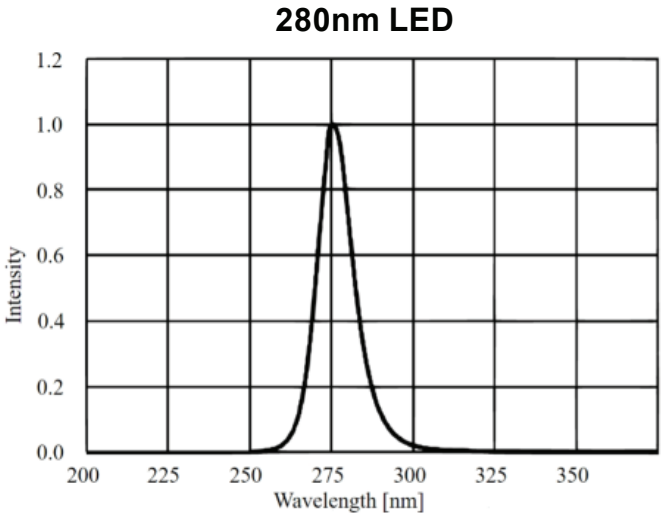


Fig. 4: LED wavelength spectrum example for 280 nm UV PM2 Photometer

Single Use Flow Cell Specifications

Material	Polysulfone and fused silica with silicone O-ring
Pressure range	Rated for pressure up to 75psi (5bar)
Biocompatibility	All materials in contact with product fluid path meet USP Class VI requirements
Manufacturing Environment	FDA Registered, ISO 7 clean room
Gamma Irradiation	Up to 50 kiloGrays
X-ray Irradiation	Up to 50 kiloGrays
Operating temperature	2°C to 50°C (other ranges with process qualification)
Storage temperature	-25°C to 65°C
Shelf Life	>5 years

Ordering Information

****Please note that all photometers come with power supply, however country specific power cord is sold separately, please specify on purchase order.**

Photometers	
30849447	Photometer PM2 260 nm
30849498	Photometer PM2 280 nm
30849499	Photometer PM2 300 nm
30849500	Photometer PM2 880 nm
30849501	Photometer PM2 260-280 nm
30849502	Photometer PM2 280-300 nm
30849503	Photometer PM2 280-880 nm
Single Use Flow Cells	
SPECPS-N-012	Single use UV flow cell, 0.08 in (2 mm) path length, non-sterile, polysulfone, 1/8 in (0.318 cm) hose-barb
SPECPS-N-025	Single Use UV Flow Cell, 0.2 in (0.5 cm) path length, non-sterile, polysulfone, 1/4 in (0.64 cm) hose-barb
SPECPS-N-050	Single Use UV Flow Cell, 0.4 in (1 cm) path length, non-sterile, polysulfone, 1/2 in (1.28 cm) hose-barb
SPECPS-880-6CM	Single Use Flow Cell, 2.5 in (6.5 cm) path length, non-sterile, polysulfone, 3/4 in (6.5 cm) Sanitary Flange Inlet/Outlet
Couplers, Cables & Power Cords	
30849506	Optical Couplers SU Flow Cell Pair
30830317	Optical Fiber Photometer 1.64 ft (0.5 m)
30830318	Optical Fiber Photometer 3.28 ft (1 m)
30830319	Optical Fiber Photometer 6.56 ft (2 m)
30830320	Optical Fiber Photometer 9.84 ft (3 m)
SPEC-OC-PANEL	Panel mount SMA-905 connector (for pass through)
30305179	Power Cord CN 3 Prong
30305178	Panel Cord EU 3 Prong
30305174	Panel Cord UK 3 Prong
30305173	Panel Cord US 3 Prong

Accessories	
30849507	Calibration Kit with Standards 3AU
30849508	Replacement Standards for Calibration Kit
30849504	SU Flow Cell Stand 2.5 in (6.5 cm) path length
30849505	SU Flow Cells Stand 0.4 in (1 cm) path length
PMAT-DAQ	Analog display with 4 inputs with alarm inputs and serial port for data collection
PMAT-DAQ-A	Analog display with 4 inputs, 4 analog outputs, alarms, and serial port for data collection
PHOTO-DR	PendoTECH Photometer DIN Rail mounting kit, includes mounting plate and mounting hardware
PHOTO-PNL	Photometer Panel Mount Support Bracket, with 2x 1/4 in (1.28 cm) - 20 X 1/2 in (1.28 cm) bolts
Interface Cables	
PDKT-PM2-1-PMAT	Cable from single channel PM2 photometer to PendoTECH PressureMAT analog input, 6ft
PDKT-PM2-2-PMAT	Cable from dual channel PM2 photometer to PendoTECH PressureMAT analog input, 6ft
PDKT-PM2-1-PCS	Cable from single channel PM2 photometer to PendoTECH PCS Control System (DAQ/TFF), mA, 6ft
PDKT-PM2-2-PCS	Cable from dual channel PM2 photometer to PendoTECH Gen 2 TFF Control System, mA, 6ft
PDKT-PM2-1-NFFSSB	Cable from single channel PM2 photometer to PDKT-BOX-NFFSS breakout box, M8 male, mA signal, 6ft
PDKT-PM2-2-NFFSSB	Cable from dual channel PM2 photometer to PDKT-BOX-NFFSS breakout box, 6ft
PDKT-PM2-FL	Cable from dual channel/turbidity photometer to flying leads, 6ft