WM200 Series
Wavemeters

User Guide



Table of Contents

Chapter 1 Introduction 1
- **1.1 Intended Use 1**
- **1.2 Explanation of Safety Warnings 1**
- **1.3 Description 2**
- **1.4 Operating Principle 2**
- **1.5 Measurement Precision 3**
- **1.6 External Reference Laser 3**
- **1.7 Technical Data 4**
  - **1.7.1 Definitions 4**
  - **1.7.2 Specifications 5**
  - **1.7.3 Input Fiber 6**
  - **1.7.4 Graphs 7**
  - **1.7.5 Mechanical Drawings 9**
  - **1.7.6 Front Panel 10**
  - **1.7.7 Back Panel 11**
- **1.8 Simplified Declaration of Conformity 11**
- **1.9 FCC Designation 11**

Chapter 2 Safety 12

Chapter 3 Installation 13
- **3.1 Warranty Information 13**
- **3.2 Return of Devices 13**
- **3.3 Packing List 13**

Chapter 4 Operation 14
- **4.1 Direct Operation 14**
  - **4.1.1 Main View 15**
  - **4.1.2 Long Term View 17**
  - **4.1.3 Statistics View 20**
  - **4.1.4 Menus and Configuration 21**
- **4.2 Remote PC Operation with Software 28**
  - **4.2.1 Installing the OPM Software 28**
  - **4.2.2 Measurement View 29**
  - **4.2.3 Statistics View 30**
  - **4.2.4 Monitoring Chart View 30**
- **4.3 Web Viewer 31**
- **4.4 Advanced Remote Operation 31**
  - **4.4.1 Python SCPI Example 31**
  - **4.4.2 SCPI Commands Reference Table 34**

Chapter 5 Maintenance and Cleaning 37

Chapter 6 Disposal 37

Chapter 7 Thorlabs Worldwide Contacts 38

Chapter 1 Introduction

1.1 Intended Use

This product is intended to be used to measure wavelength of coherent light in photonics laboratory or production environments. It should stand on a horizontal table or shelf without large vibration or strong heat sources close to it.

The specifications on power and wavelength accuracy is based on the assumption that the measurement is conducted with a single mode fiber with FC/APC connector.

The absolute wavelength accuracy and long term stability can be improved with an external locked reference in the 1520 - 1550 nm wavelength range.

1.2 Explanation of Safety Warnings

⚠WARNING Warning indicates a hazard with a medium level of risk that, if not avoided, could result in death or serious injury.

⚠CAUTION Caution indicates a hazard with a low level of risk that, if not avoided, could result in minor or moderate injury.

NOTICE Indicates information considered important, but not hazard-related, such as possible damage to the product.

CE UKCA The CE/UKCA markings on the product are the manufacturer's declaration that the product complies with the essential requirements of the relevant European health, safety, and environmental protection legislation.



The WEEE symbol on the product, the accessories or packaging indicates that this device must not be treated as unsorted municipal waste but must be collected separately.

1.3 Description

The WM200 Series Wavemeters / Wavelength Meters are compact, general-purpose wavelength meters with high accuracy over a wide wavelength range. The temperature-stabilized internal DFB reference laser enables ease of use and quick start-up. For improved wavelength accuracy, these instruments can be used with an external reference laser in the 1520 - 1580 nm wavelength range, like the Thorlabs LLD1530 frequency-locked laser.

In addition to the wavelength, the power and single longitudinal mode behavior of the source (indicated by a coherence length value below 10 mm) can also be monitored. The instruments have a slow mode (1 Hz) for maximum accuracy and a fast mode (10 Hz) for alignment or other applications where speed can be traded against accuracy.

The high-resolution, backlit, color touchscreen gives the devices a clear interface with many different ways to monitor the wavelength, such as the number of digits, averaging, or graph options.

There is also an analog output that can be configured to give a signal proportional to the deviation from a chosen reference wavelength, for use in feedback loops.

The WM200 series wavelength meters can be remotely controlled via three different interfaces: the high-speed USB interface, the built-in Ethernet, or the serial RS232 interface.

The WM200 series wavelength meters' remote operation can be integrated into custom-made systems with the help of the provided SCPI commands and drivers. In addition, the WM20x wavelength meter has a built-in web server that enables monitoring of the most interesting functions within a local area network.

1.4 Operating Principle

The WM200 series wavelength meters operate based on a scanning Michelson interferometer (see Figure 1). The incoming light is first collimated, after which a beam splitter divides it into two beams of equal intensity. These beams are then reflected by a fixed and a moving mirror, respectively. Upon returning to the beam splitter, the beams recombine and interfere at the detectors. As the moving mirror changes position, constructive or destructive interference occurs, producing a sinusoidal fringe pattern.

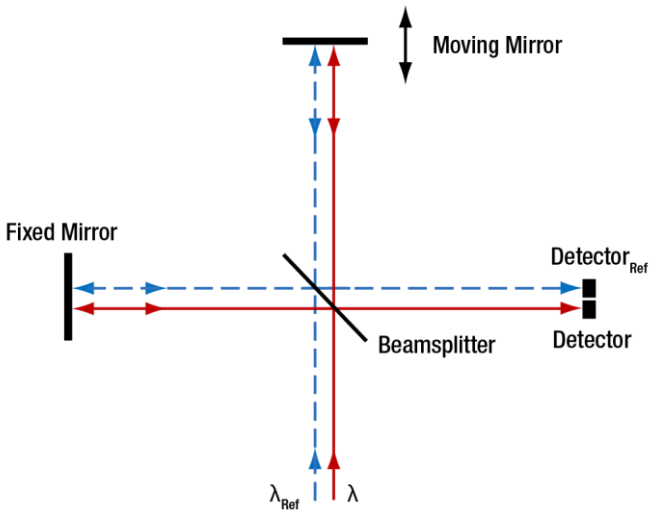


Figure 1 Schematic of a Michelson interferometer. A beamsplitter splits the incoming beams from the unknown source (solid) and the reference laser (dashed) into two arms. After reflection from fixed and moving mirrors, the beams interfere and are detected by their respective detectors.

When the moving mirror travels a distance d, a total of m fringes are detected by the photodetector. The number of fringes is related to the wavelength by:

$$m\lambda = 2n(\lambda)d. \quad (1)$$

Here, λ is the wavelength of the unknown laser, and $n(\lambda)$ is the refractive index of air inside the interferometer at that wavelength.

To determine d precisely, the WM20x instrument uses a reference laser for which a similar expression applies:

$$m_{Ref}\lambda_{Ref} = 2n(\lambda_{Ref})d, \quad (2)$$

where m_{Ref} is the number of fringes detected from the reference laser, λ_{Ref} is its wavelength, and $n(\lambda_{Ref})$ is the corresponding refractive index of air at the reference wavelength.

By combining equations (1) and (2), we obtain an expression for the unknown wavelength:

$$\lambda = \frac{n(\lambda)}{n(\lambda_{Ref})}\frac{m_{Ref}}{m}\lambda_{Ref}. \quad (3)$$

Since the refractive index of air depends on both the wavelength and the environmental conditions, the wavelength meter actively measures temperature, pressure, and relative humidity inside the interferometer to ensure accuracy.

During a fast measurement, the number of fringes, m, of the unknown laser is recorded as an integer. For high precision, slow measurement, m_{Ref} is determined as a fractional number of fringes, corresponding to the exact optical path change associated with the m fringes of the unknown source.

1.5 Measurement Precision

The precision of the wavelength measurement is primarily determined by how accurately the WM200 series wavelength meters can measure the number of interference fringes: m for the unknown source and m_{Ref} for the reference laser. Small errors in the refractive index values and $n(\lambda)$ and $n(\lambda_{Ref})$ are negligible and do not significantly affect the result. However, the accuracy of the reference wavelength λ_{Ref} plays a critical role and directly influences the overall measurement precision.

The determination of m and m_{Ref} involves two main steps: first, accurately identifying the start and stop positions of the interference pattern; second, counting the number of fringes between these points. Most of the measurement error arises in the first step: locating the start and stop positions. The relative error increases when m and m_{Ref} are small.

In all cases, the maximum values of m and m_{Ref} are limited by the scan length of the interferometer. For broadband or multimode sources, the usable fringe count may be further reduced, as fringes are typically only visible over part of the interferometer's scan range due to the limited coherence length of the source.

As an indication of the current measurement precision, the WM200 series wavelength meters display the uncertain digits in a darker color. These darker digits indicate the limit of the instrument's precision for that specific reading. However, if the instrument is not properly calibrated, the displayed value may still deviate from the true wavelength, even if all the digits appear valid.

Another source of error arises from any slight misalignment between the unknown and reference beams. This pointing error can vary each time the optical fiber is reinserted into the wavelength meter, leading to small differences in the measured optical paths. Minimizing this alignment error by ensuring consistent fiber insertion and beam alignment is important for maintaining high measurement accuracy.

1.6 External Reference Laser

As explained in Chapter 1.5, the wavelength accuracy depends on the stability of the reference laser. The internal laser is a distributed-feedback (DFB) laser with well-controlled current and temperature that keep it stable over time. To increase the measurement accuracy, an external reference laser with higher accuracy,

like Thorlabs' LLD1530 frequency-locked laser, can be used in place of the internal reference laser. Recommended input laser wavelength and power ranges can be found in the specifications, in Section 1.7.2, and instructions on how to set up an external reference wavelength can be found in Section 4.1.4.

1.7 Technical Data

1.7.1 Definitions

All wavelength accuracy specifications are the maximum wavelength/frequency error given according to the 3σ criterion for the slow measurement mode[1].

The laser being measured must be input with an FC/APC single mode fiber and have maximum bandwidth of 10 GHz to achieve the specified wavelength accuracy. However, a measurement of the center wavelength of broadband sources, like superluminescent diodes, can be performed using multimode fibers at a reduced absolute accuracy.

The wavelength unit of nm (Air) is based on the definition by Peck & Reeder (T = 15.0 °C, P = 1013.25 hPa, 330 ppm CO_2, and 0% relative humidity). This is the same definition that NIST uses in their Atomic Spectra Database (ASD)[2].

[1] *The 3σ criterion indicates that the wavelength measurement is expected to be within the specified error of the wavelength with 99.7% confidence. More details can be found here* ***https://en.wikipedia.org/wiki/68%E2%80%9395%E2%80%9399.7_rule****.*

[2] *More details can be found in* ***http://dx.doi.org/10.1364/JOSA.62.000958****.*

1.7.2 Specifications

Item #	WM201	WM202	WM203
Measurement Specifications			
Wavelength Range	350 - 1100 nm	600 - 1700 nm[a]	1000 - 2500 nm[b]
Minimum Required Input Power[c]	2 - 30 µW	2 to 40 µW	6 - 50 µW
Maximum Input Bandwidth	10 GHz		
Maximum Input Power	10 mW		
Wavelength Measurement Absolute Accuracy, Internal Reference	5 ppm (7.5 pm at 1500 nm, 1 GHz at 200 THz)[d] 1 ppm (1.5 pm at 1500 nm, 200 MHz at 200 THz)[d,e] 0.3 ppm (0.45 pm at 1500 nm, 60 MHz at 200 THz)[d,e,f]		
Wavelength Measurement Absolute Accuracy, External Reference	0.3 ppm (0.45 pm at 1500 nm, 60 MHz at 200 THz)[d,e,g]		
External Reference Laser Input	Wavelength Range: 1520 - 1580 nm Input Power Range: 0.2 - 5 mW Required Accuracy: ±25 MHz (±0.2 pm at 1550 nm) Maximum Bandwidth: 1 GHz		
External Calibration Laser Wavelength Range[h]	350 - 1100 nm	600 - 1700 nm	1000 - 2500 nm
External Calibration Laser Input	Input Power Range: 2 µW - 10 mW Required Accuracy: ±25 MHz (±0.2 pm at 1550 nm) Maximum Bandwidth: 1 GHz		
Recommended Calibration Period	≤1 Year		
Coherence Length Measurement[i]	<10 mm / <1 mm		
Measurement Speed[i]	1 Hz / 10 Hz		
Scanning Length[i]	>10 mm / >1 mm		
Power Measurement Accuracy[j]	±1 dB		
Optical Power Damage Threshold	20 mW		
Optical Return Loss	>50 dB		

a. The WM202 instrument can give a wavelength reading down to 500 nm if the input power is high enough.
b. The WM203 instrument can give a wavelength reading down to 800 nm if the input power is high enough.
c. See the graphs in Figure 3, Figure 4, or Figure 5 for the wavelength dependence of the minimum input power.
d. The instrument must have been calibrated within the recommended period of 1/year.
e. After 15 Minutes Warm-Up
f. This specification is valid within 1 hour after recalibration with an external stable laser in the external calibration laser wavelength range (accuracy ±25 MHz), if the wavelength meter temperature is stable within ±3 °C after calibration.
g. An external reference source (1520 - 1580 nm, accuracy ±25 MHz) must be coupled to the reference input.
h. Same Wavelength Range as Instrument
i. Slow / Fast Mode
j. For Single Mode Input Fiber with an FC/APC Connector Within the Specified Wavelength Range

Item #	WM20x
General Specifications	
Display Resolution	9 digits
Operating Environment	15 - 35 °C, ≤90% RH
Storage/Transport Environment	-20 - 70 °C (Non-Condensing)
Dimensions	291.2 mm x 253.2 mm x 110.6 mm (11.47" x 9.97" x 4.35")
Weight	3.45 kg
Power Supply	Line Voltage: 100 - 240 V Line Frequency: 50 - 60 Hz Maximum Power Consumption: 30 W
Fiber Connector Type	Front/Input: FC/APC, Wide Key (2.2 mm) Rear/External Reference Input: FC/APC, Narrow Key (2.0 mm)
Analog Output Voltage	0 - 5 V
Analog Output Impedance	50 Ω
Analog Output-Load Impedance	High Impedance
Analog Output-Connector	BNC Female, Rear
Interface	USB 2.0 Type-B, Rear Ethernet RJ45, Rear Serial RS232 DE-9 Female, Rear

1.7.3 Input Fiber

The instrument is designed for single mode fibers with FC/APC connectors.

FC/PC connectors can be used with reduced absolute accuracy, but the repeatability will be the same.

Multimode fibers can also be used, but both the wavelength and power accuracy will be reduced. If a multimode fiber input is required for the application, use the smallest possible fiber core diameter and NA.

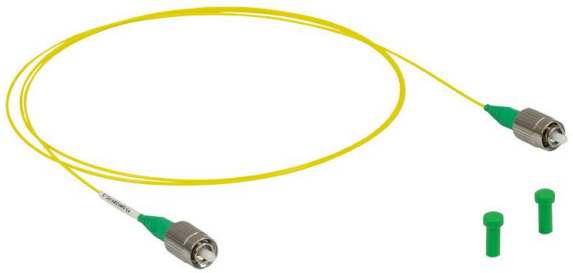


Figure 2 A typical FC/APC single mode fiber that can be used with the instrument. The yellow jacket and green boot typically indicate the fiber is single mode and FC/APC connectorized, respectively.

1.7.4 Graphs

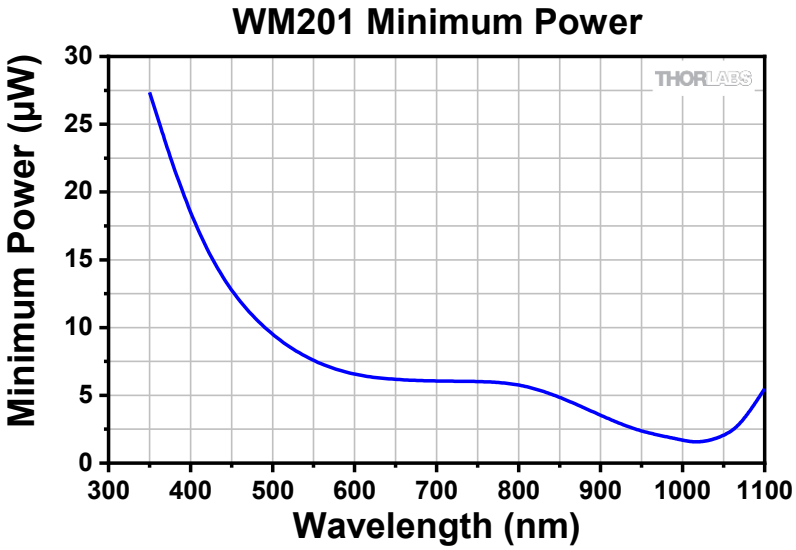


Figure 3 A graph of the minimum input power of the WM201 wavelength meter.

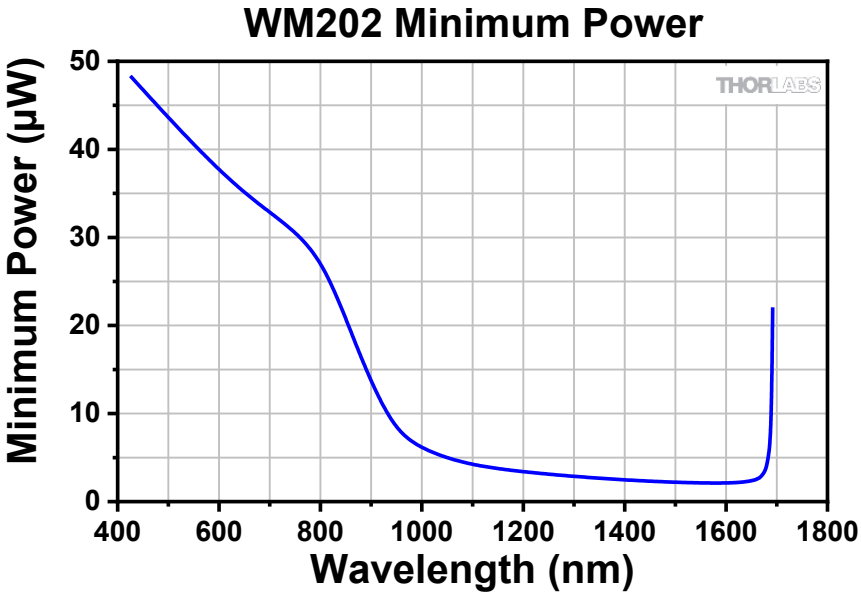


Figure 4 A graph of the minimum input power of the WM202 wavelength meter, showing measurements are possible down to 500 nm, if the input power is high enough.

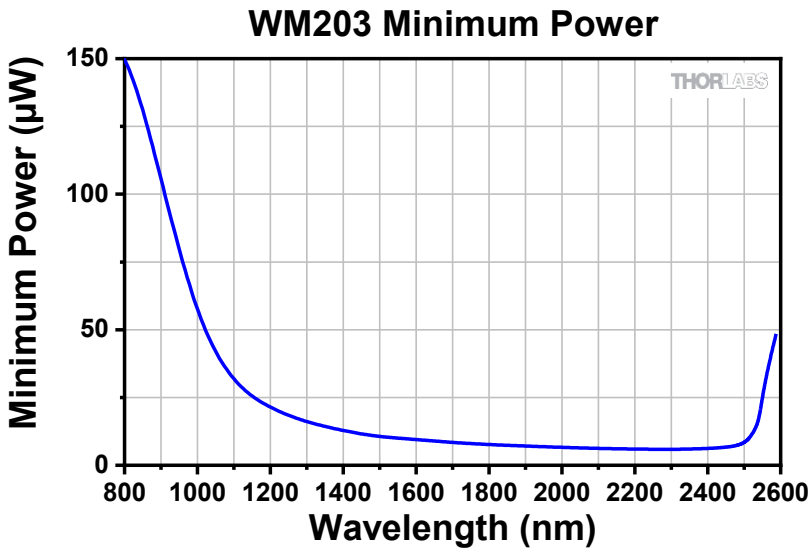


Figure 5 A graph of the minimum input power of the WM203 wavelength meter, showing measurements are possible down to 800 nm, if the input power is high enough.

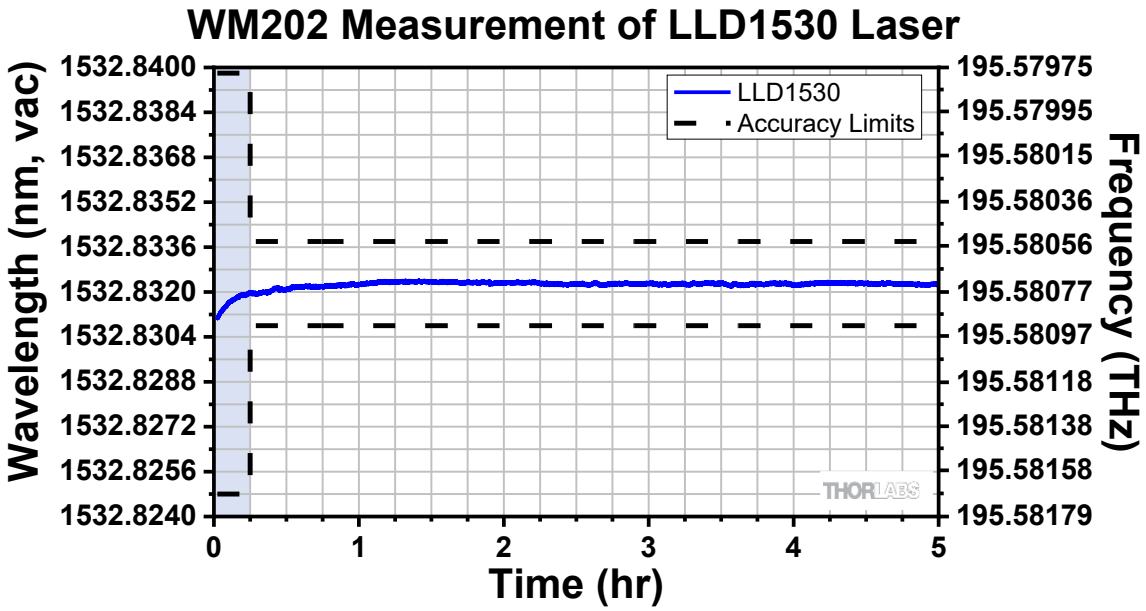


Figure 6 Wavelength stability measurement with the WM202 wavelength meter on an LLD1530 frequency-locked laser from a cold start, using the internal reference. The blue region in the graph is the 15-minute warm-up period, during which the accuracy specification is reduced.

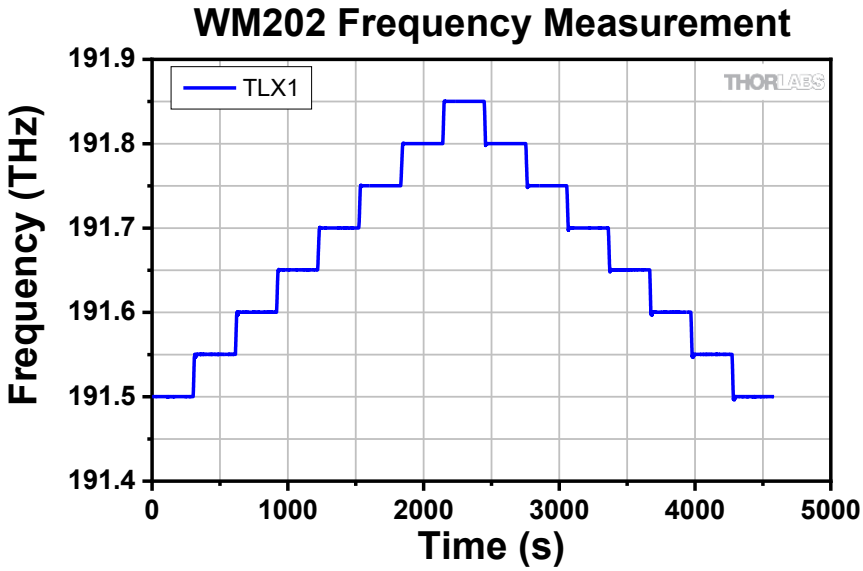


Figure 7 Measured Frequency of a TLX1 Tunable Laser Stepping Through 50 GHz ITU Grid Steps with the WM202 Wavelength Meter Using an LLD1530 Frequency-Locked Laser as an External Reference

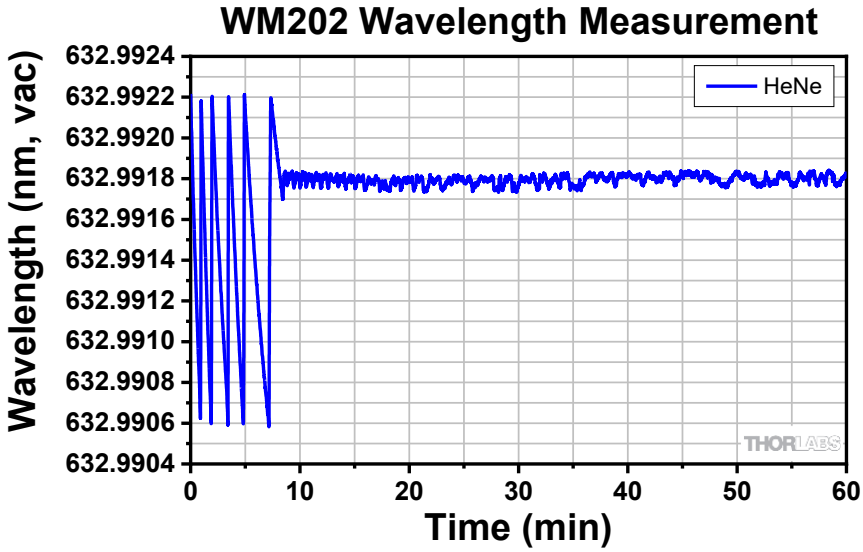


Figure 8 Measured Wavelength of an HRS015B HeNe Laser with the WM202 Wavelength Meter Using an LLD1530 Frequency-Locked Laser as an External Reference

1.7.5 Mechanical Drawings

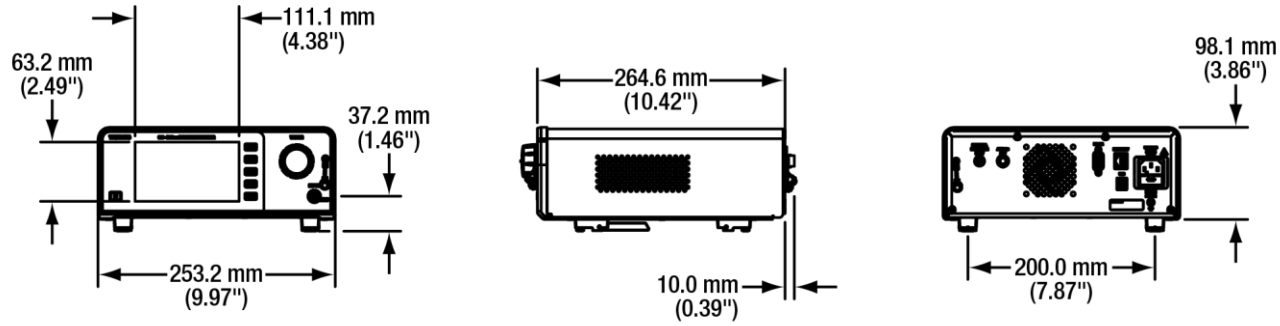
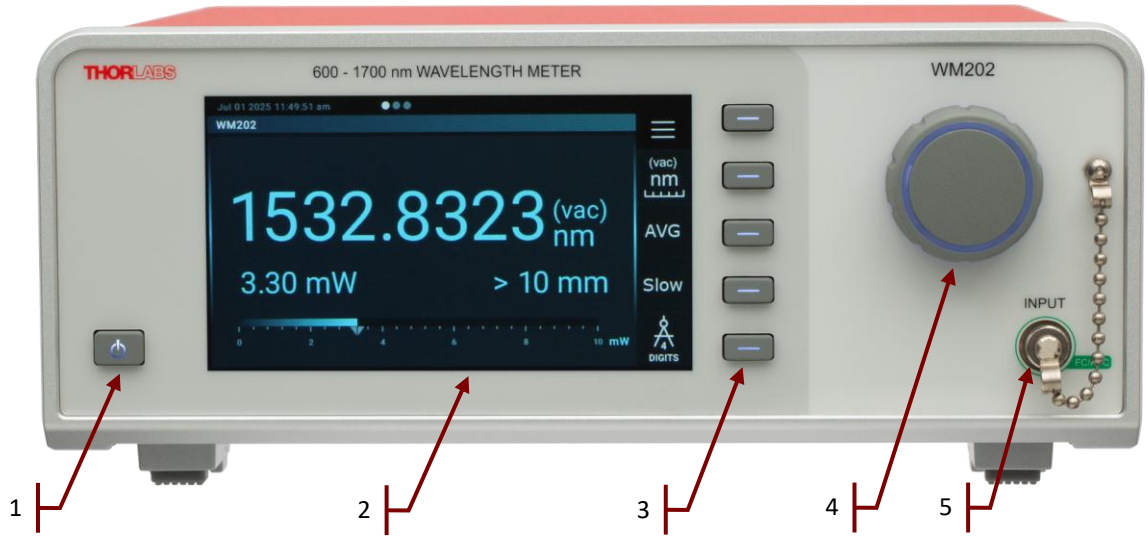


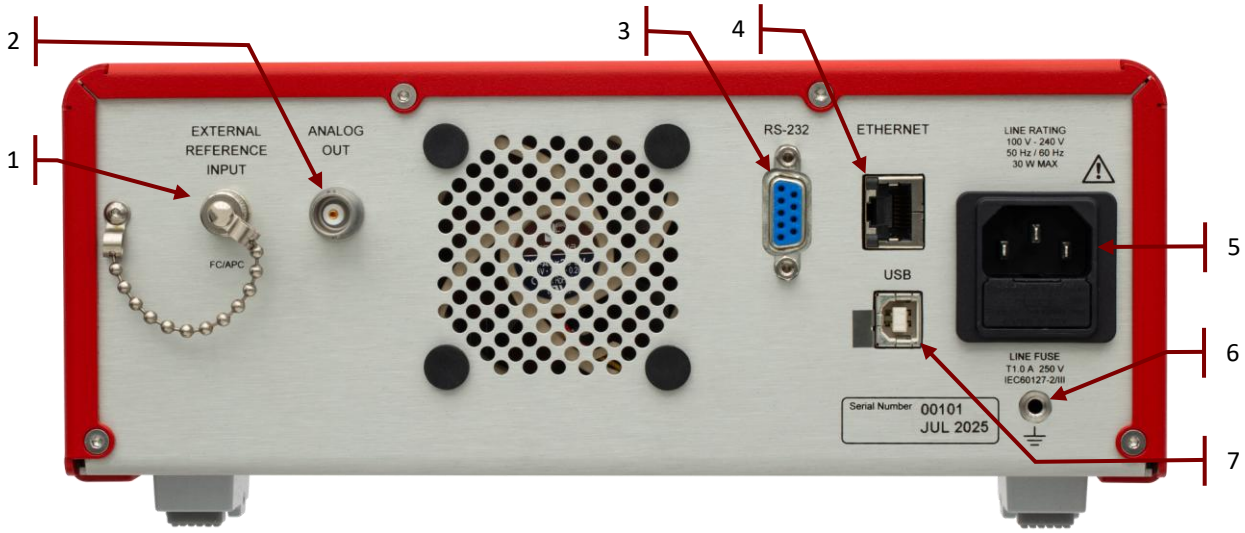
Figure 9 Mechanical Drawing

1.7.6 Front Panel



Front Panel	
Callout	**Description**
1	Power Button
2	LCD Screen
3	Five Dynamic Side Menu Buttons
4	Rotary Navigation and Control Knob
5	Wide Key (2.2 mm) FC/APC Input

1.7.7 Back Panel



Back Panel	
Callout	**Description**
1	External Reference Input Narrow Key (2.0 mm) FC/APC
2	BNC Female Wavelength Error Analog Output
3	RS232 DE-9 Connector for Remote Operation
4	Ethernet RJ45 Connector for Remote Operation
5	AC Power Cord Connector
6	4 mm Banana Socket Ground Terminal
7	USB 2.0 Type-B Connector for Remote Operation and Transferring Data Saved on the Device to a PC

1.8 Simplified Declaration of Conformity

The full text of the EU declaration of conformity is available at the following internet address: **https://www.thorlabs.com/f331010**

1.9 FCC Designation

Class B FCC Designation

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: Reorient or relocate the receiving antenna.—Increase the separation between the equipment and receiver.—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.—Consult the dealer or an experienced radio/TV technician for help.

Chapter 2 Safety

⚠WARNING

Risk of Laser Emission if Enclosure is Opened
The instrument contains an invisible reference laser of class 1M.
The classification of these lasers follows the European Standard IEC 60825-1:2014.
No laser light is radiated from the instrument.



⚠WARNING

General Warnings
The safety of any system incorporating the equipment is the responsibility of the assembler of the system.
All statements regarding the safety of operation and specifications in this instruction manual will only apply when the unit is operated correctly as it was designed for.
The WM20x must not be operated in explosion-endangered environments!
Do not obstruct the air ventilation slots in the housing!
Do not remove covers!
Do not open the cabinet. There are no user-serviceable parts inside!
This precision device is only serviceable if returned and properly packed into the complete original packaging, including the cardboard inserts. If necessary, ask for replacement packaging.
Refer servicing to qualified personnel!
Changes to this device cannot be made, nor may components not supplied by Thorlabs be used without written consent from Thorlabs.
Prior to applying power to the WM20x, make sure that the protective conductor of the 3 conductor mains power cord is correctly connected to the protective earth ground contact of the socket outlet! Improper grounding can cause electric shock resulting in damage to your health or even death!
Make sure that the line voltage range marked on the power supply agrees with your local supply.

⚠CAUTION

Risk of High Intensity EMF Exposure
Mobile telephones, cellular phones or other radio transmitters are not to be used within the range of three meters of this unit since the electromagnetic field intensity may then exceed the maximum allowed disturbance values according to IEC 61326-1.
This product has been tested and found to comply with the limits according to IEC 61326-1 for using connection cables shorter than 3 meters (9.8 feet).

NOTICE

Notice of the Possibility of Interference

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules and meets all requirements of the Canadian Interference-Causing Equipment Standard ICES-003 for digital apparatus. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna. ·
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/T.V. technician for help.

Users that change or modify the product described in this manual in a way not expressly approved by Thorlabs (party responsible for compliance) could void the user's authority to operate the equipment. Thorlabs is not responsible for any radio television interference caused by modifications of this equipment or the substitution or attachment of connecting cables and equipment other than those specified by Thorlabs. The correction of interference caused by such unauthorized modification, substitution or attachment will be the responsibility of the user.

The use of shielded I/O cables is required when connecting this equipment to any and all optional peripheral or host devices. Failure to do so may violate FCC and ICES rules.

Chapter 3 Installation

3.1 Warranty Information

Thorlabs warrants material and production of the WM20x wavelength meter for a period of 24 months starting with the date of shipment in accordance with and subject to the terms and conditions set forth in Thorlabs' General Terms and Conditions of Sale which can be found at:
https://www.thorlabs.com/legal

3.2 Return of Devices

This precision device is only serviceable if returned and properly packed into the complete original packaging. If necessary, ask for replacement packaging. Refer servicing to qualified personnel.

3.3 Packing List

Please inspect the shipping container for damage. Please do not cut through the cardboard, as the box might be needed for storage or returns.

If the shipping container appears to be damaged, keep it until you have inspected the contents for completeness and tested the WM20x device mechanically and electrically. Verify that you have received the following items within the package:

1. WM20x Wavelength Meter

2. USB 2.0 Type-A to Type-B Cable, 2 m

4. Power Cord, Country Specific, 1.8 m

5. Quick Reference

6. Certificate of Calibration

Chapter 4 Operation

The wavelength meter can be operated in four different ways:

- Direct Operation: by using the buttons and touch screen, as described in Section 4.1.
- Remote PC Operation with Software: from a Windows PC using the Thorlabs Optical Parameter Monitor (OPM) software, as described in Section 4.2.
- Web Viewer: by using a web browser (only for reading values), described in Section 4.3.
- Advanced Remote Operation: by using custom-made software, as described in Section 4.4.

The different ways of operating the instrument are described in this chapter.

4.1 Direct Operation

All the functionality of the wavelength meter can be controlled by using the buttons and the touchscreen interface.

The wavelength meter is turned on or off by clicking the power button located on the bottom left corner of the front of the device. In normal operation it is clicked shortly for turning on or off; the button can also be held for a longer duration to force a shutdown in case of issues.

The wavelength meter has five dynamic “sidebar buttons”, located to the right of the touchscreen, whose functionality is indicated by the symbol next to them on the screen.

There are three different views available on the screen: main, long term, and statistics. One can change between them either by swiping left or right on the touchscreen, or by using the rotary knob to first select the three dots on the top of the screen, then click to select it, then rotate the knob to change screen.

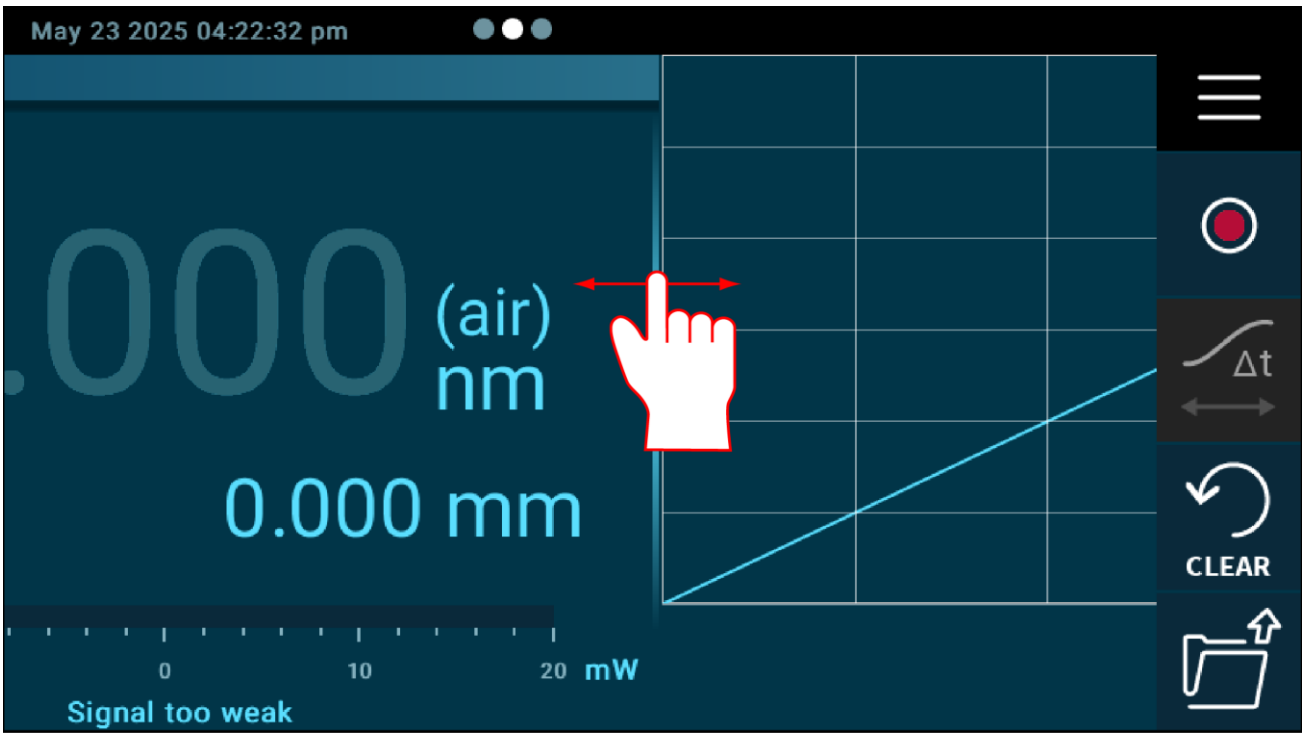


Figure 10 Swipe horizontally to change between views.

4.1.1 Main View

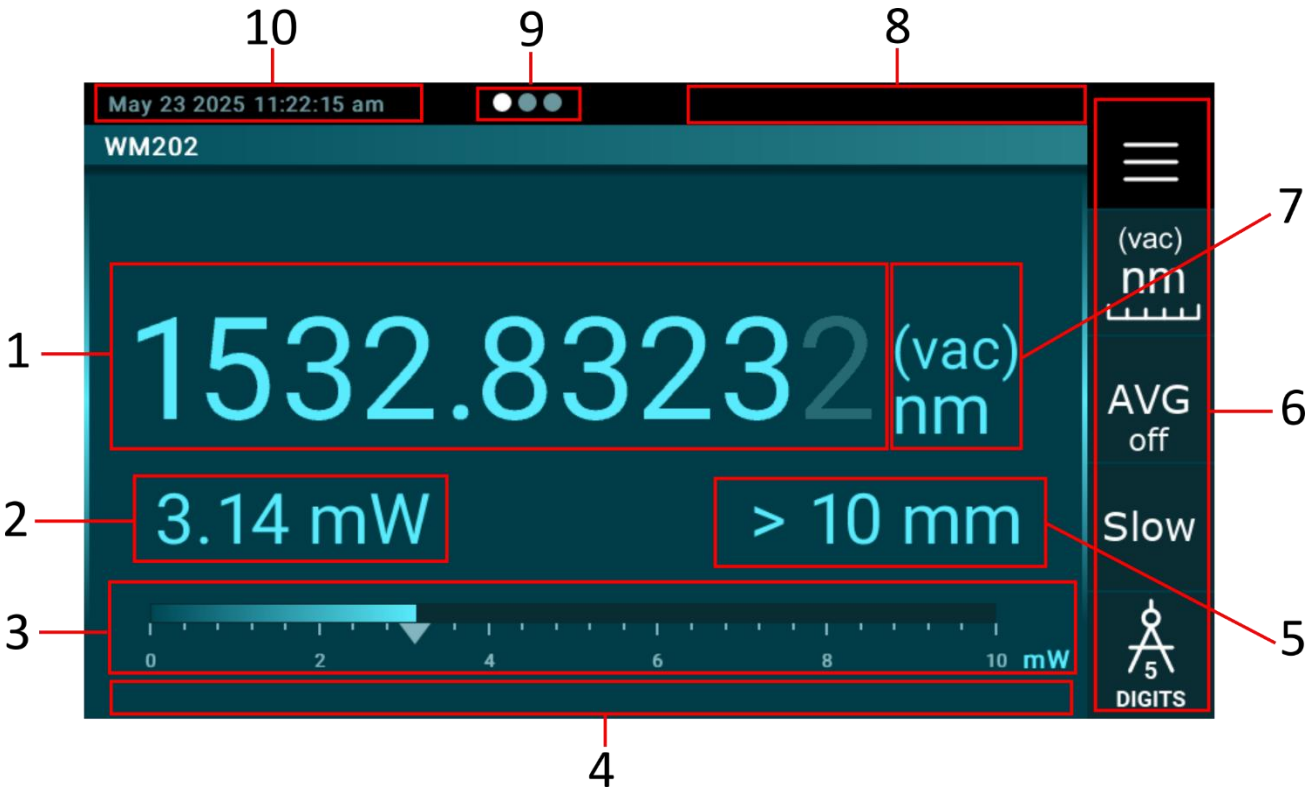


Figure 11 Main View

Main View	
Callout	**Description**
1	The wavelength is displayed in the currently selected unit. The wavelength meter repeatedly takes measurements and the result is updated on the display. Any greyed digits, in this example the last digit, are outside the measurement precision. See more details about the grey digits in Section 1.5, Measurement Precision.
2	The estimated input power value is displayed. Click this area on the touchscreen to toggle power units between mW and dBm.
3	The estimated input power is displayed as a bar graph.
4	Area reserved for status messages, see the list in this section for example messages.
5	The estimated coherence length value, if it can be calculated.
6	Sidebar buttons can be clicked on the touchscreen or the physical button next to it. Their functions are listed in the chart below.
7	The unit of the current wavelength value is displayed.
8	Area at the top of the screen reserved for status icons. The different icons are listed in the chart in this section.
9	Dots representing the currently displayed view.
10	The current date and time are displayed.

The sidebar buttons displayed depend on the currently open view. Here are descriptions of the buttons available on the main view.

Main View Sidebar Buttons	
Button	**Description**
	Opens the menu, see Section 4.1.4.
	Displays the currently selected wavelength unit. Click to cycle through the different units. The available options for the units are nm (vac), nm (air), cm^{-1}, and THz.
	Displays the current state of the averaging function; clicking it will switch it on or off. See the description of the averaging functionality in Section 4.1.4.
	Displays the current interferometer mode. Click to switch between fast and slow mode, where the slow mode has higher accuracy. For details regarding measurement speed and accuracy, see the specifications in Section 1.7.2.
	Displays the number of digits currently shown on display. Click to cycle from zero to six decimal places.

Status icons are shown on the top of the screen, see Figure 11. Here are descriptions of the icons.

Main View Status Icons	
Icon	**Description**
	USB is connected.
	Ethernet is connected.
	The device is mounted as a USB drive on a personal computer.
	The device has received invalid SCPI commands.

The following status messages may be seen at the bottom of the screen.

Main View Status Messages	
Status Message	**Description**
Signal too weak	The input power is too low to calculate a wavelength value.
Signal too strong	The input power is too high; please attenuate it.
Reference signal too weak	The signal on the reference detector is too weak. If you are using an external reference laser, please confirm its wavelength and output power. If you are using the internal reference laser, please check the settings for the external reference laser and make sure it has the correct settings.
Reference signal too strong	If you are using an external reference laser then you need to attenuate it.
Error saving	There was an issue recording to the internal memory.
Internal memory is full	The internal memory is full, please make room for saving your files either by mounting the wavelength meter on to a PC, or by using the “File manager” on the touchscreen to delete excess saved files.
Warning: Multimode source	The wavelength value cannot be accurately determined for a multimode source.
Fatal internal error (0001,0000,0000)	A fatal error has occurred, please note the numbers after the error and contact tech support.
Starting	The device will soon record to a .csv file.
/RECORDS/2025_04_16_20_29_50.csv	Indicates that the device is currently recording to a .csv file with the specified filename. The name is the starting date and time of the recording.
Stopping	The device is saving the last data points to the .csv file.

4.1.2 Long Term View

The second view available is the long term view. It shows a graph of the wavelength value in the selected unit as a function of time. Data can be recorded to a .csv file to the onboard memory by clicking the record button

on the sidebar. Please note that the wavelength unit cannot be changed while a recording is in progress.

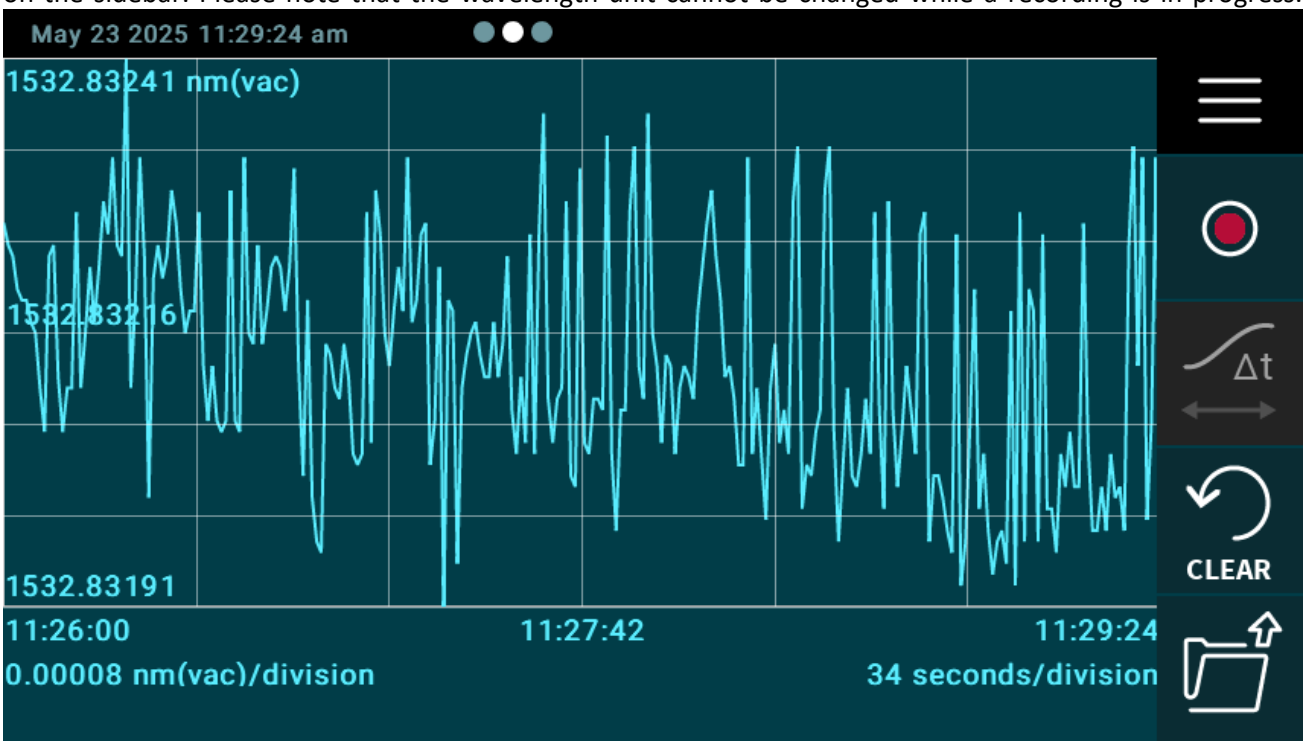
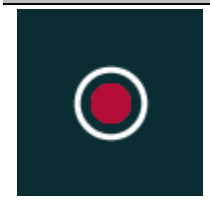


Figure 12 Long Term View

If it is not currently recording, the graph will show the last 256 wavelength values in a rolling buffer, where the oldest values are discarded when new ones are added. When a recording is started the data currently in the rolling buffer will be kept, and new data will be added. When a recording is running, the status text at the bottom of the screen will show the filename of the .csv file.

Long Term View Sidebar Buttons	
Button	**Description**
	Start and stop recording to .csv file.
	When recording, this button can be used to toggle between displaying the rolling buffer and displaying all the data taken since the measurement started. Note that longer data series are averaged to fit on the screen. To view the entire, unaveraged dataset, you need to load the saved file to a PC.
	Clear all data in the rolling buffer. If graph is currently displaying a loaded file, this button will unload the data and go back to live mode. **Please note the clear button on the long term view will not reset the statistics on the statistics view. See Section 4.1.3.**
	Clicking this button will open a file browser that allows you to load and graph a previously measured .csv file.

Here is an example of the CSV format from a recording performed on the device.

#Recorded on Thorlabs WM202 SN=000001

#2025_06_12_11_32_10

#t_0=1749727930.020,opd=10.4mm,ref=ext,ref_lbd=1532.8323,c=-2288,c_lbd=1532.8323,t_c=1748432161,i_vers=0.52

time_unix(s),time_since_start(s),frequency(THz),power(mW),coherence(mm),ambienttemperature(deg_C),humidity(rel),pressure(mbar),statusbits

1749727926.817,-3.203,191.500135,4.110352,-1.000000,24.89,29.46,1022.75,16
1749727927.618,-2.402,191.500146,4.042969,-1.000000,24.89,29.46,1022.75,16
1749727928.418,-1.602,191.500150,4.177734,-1.000000,24.89,29.46,1022.75,16
1749727929.219,-0.801,191.500135,4.065430,-1.000000,24.89,29.46,1022.75,16
1749727930.020,0.000,191.500151,4.110352,-1.000000,24.89,29.46,1022.75,16
1749727931.219,1.199,191.500146,4.087891,-1.000000,24.89,29.46,1022.75,16
1749727932.020,2.000,191.500139,4.222656,-1.000000,24.89,29.46,1022.75,16
1749727932.817,2.797,191.500157,4.042969,-1.000000,24.89,29.46,1022.75,16

The header shows:

- Serial number of the device
- Start time of the recording
- t_0 is the start time of the recording as a Unix timestamp.
- opd is the optical path difference.
- ref can be either ext or int, ext if an external reference is used, or int if the internal reference is used.
- ref_lbd is the reference wavelength in nm (vac). This is only available if an external reference is used.
- c is the wavelength calibration coefficient.
- c_lbd is the wavelength, in nm (vac) that was used for calibrating the instrument.
- t_c is the Unix timestamp of the calibration.
- i_vers is the version number of the interferometer module.

The columns are:

- time_unix(s) is the Unix timestamp of the measurement point.
- time_since_start(s) is the relative time since start. Please note that negative numbers indicate the values that were in the rolling buffer before the record button was clicked. 0.00 s is the first value after the record button was clicked.
- wavelength(nm_vac) is the wavelength value. The unit will be the same as selected on the main view, for example, the .csv text above is in frequency(THz).
- power(mW) is the estimated power value, which is always in mW.
- coherence(mm) is the estimated coherence length value.
- ambienttemperature(deg_c) is the temperature inside the wavelength meter enclosure.
- humidity(rel) is the relative humidity inside the wavelength meter.
- pressure(mbar) is the atmospheric pressure inside the wavelength meter.
- statusbits is the status message displayed on the screen encoded as bits, see the documentation of the SCPI command `SENS:STAT:COND?` for more details.

Transferring the Data to a PC

The .csv files can be transferred to a PC by connecting the PC and the wavelength meter with a USB cable, then going to the menu and clicking on “USB Transfer”, the wavelength meter will show up as a normal USB

memory stick on the PC, no special driver is needed. The .csv files can then be copied from the /RECORDS/ folder on the wavelength meter to the PC.

4.1.3 Statistics View

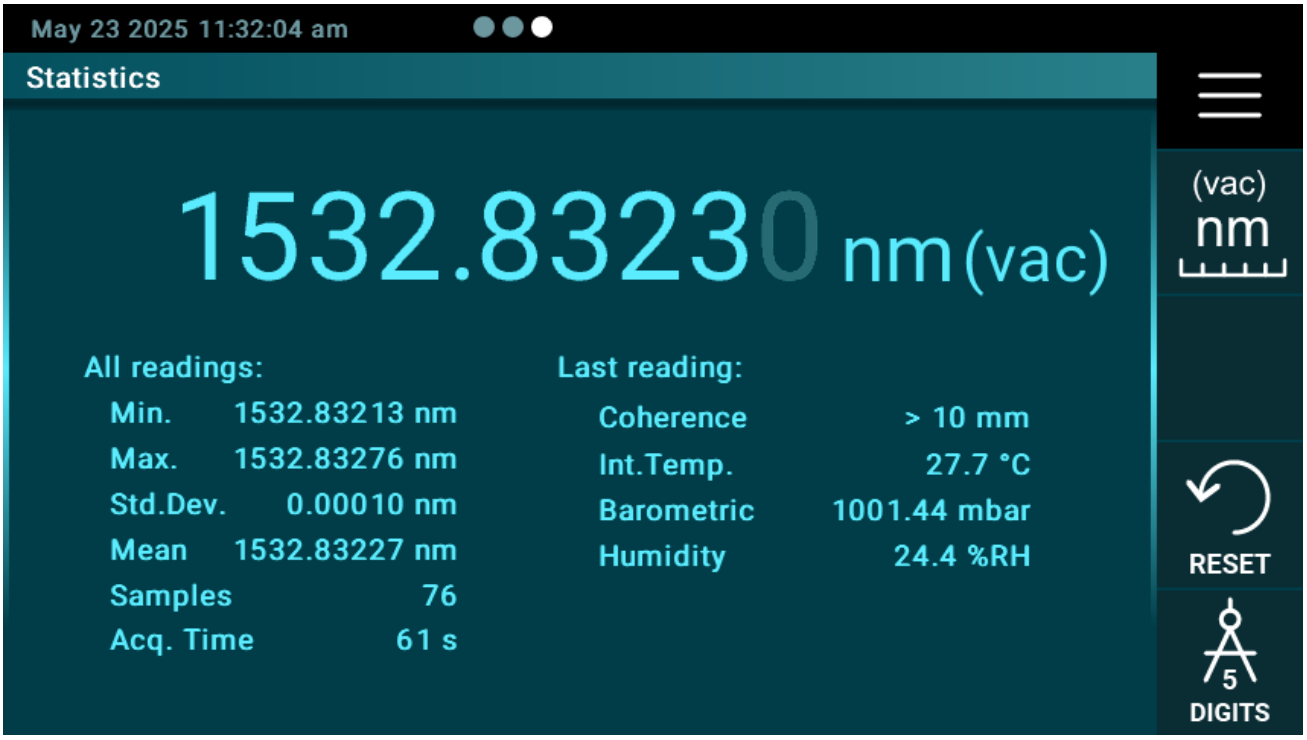


Figure 13 Statistics View

The statistics view displays analytical data from past measurements, collected since the last time the instrument was Reset. The standard deviation and mean are calculated using "Welford's online algorithm"[3].

The following metrics are available:

- Minimum (lowest recorded value)
- Maximum (highest recorded value)
- Standard Deviation (measurement variation from the mean)
- Mean (average of all measurement values)
- Samples (total count of measurements taken)
- Acq. Time (duration since statistics were last cleared)

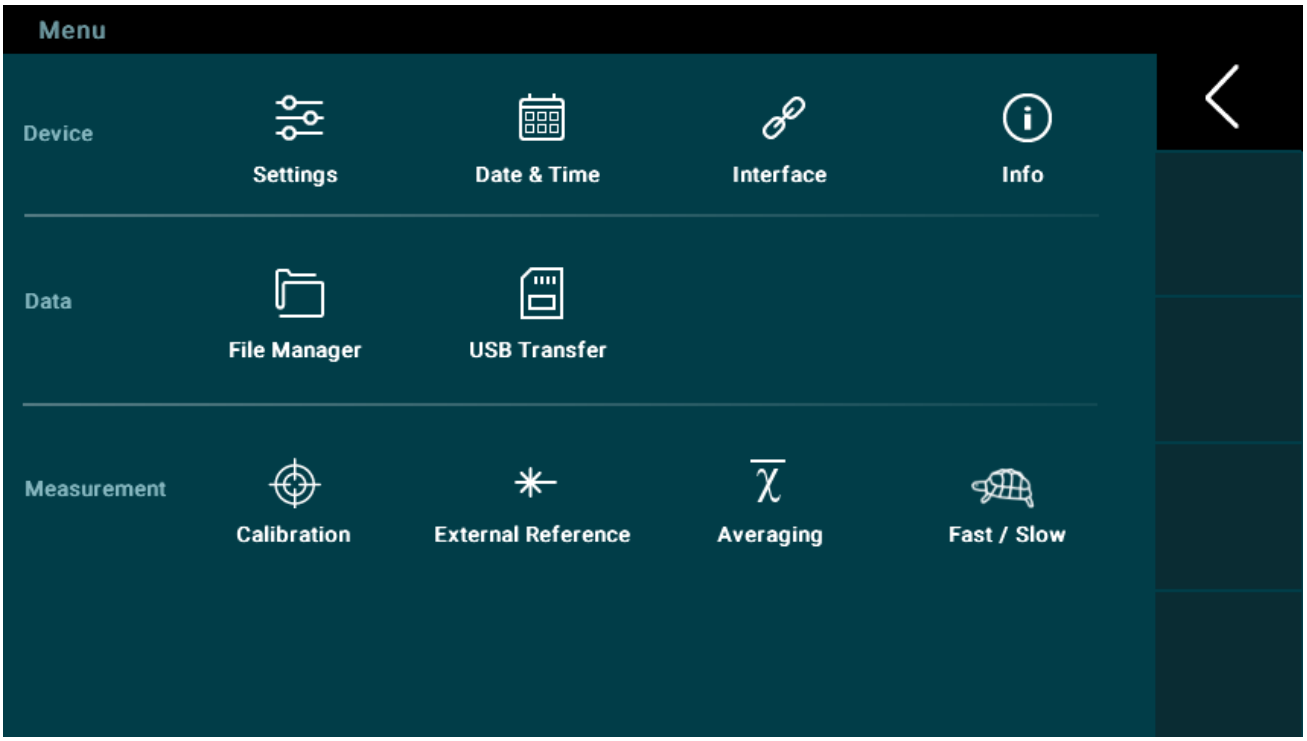
To clear all statistics and begin a new collection period, use the Reset button on the sidebar**. Please note that this does not clear the graph in the long term view, as discussed in Section 4.1.2.**

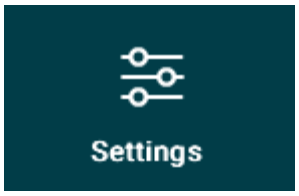
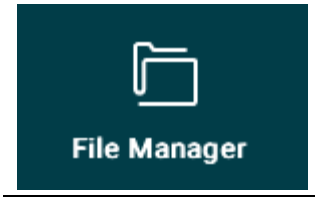
Statistics View Sidebar Button	
Button	**Description**
	Reset all statistics and begin collecting again; please note that this does not clear the graph in the long term view.

[3] *For additional information please see https://doi.org/10.1080/00401706.1962.10490022*

4.1.4 Menus and Configuration

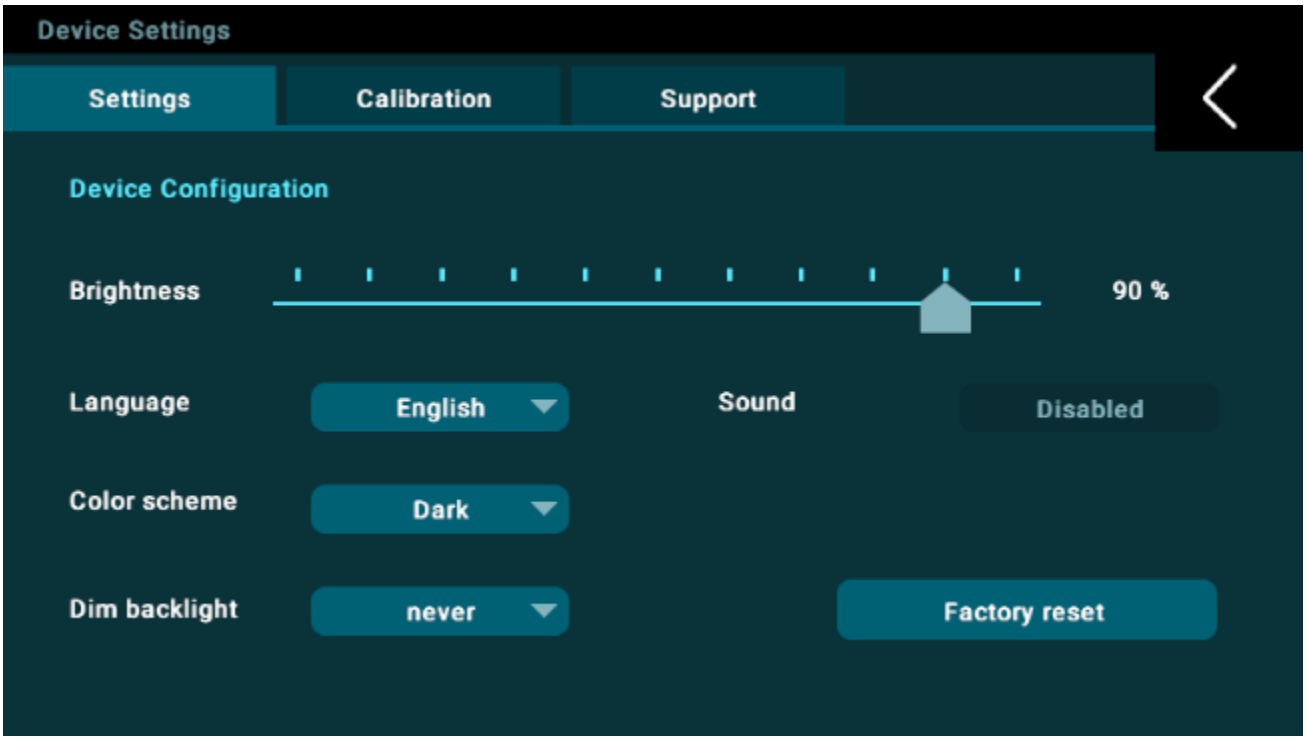
The menu can be opened from all the views using the  button. Here is a brief description of the different items accessible.



Menu Buttons	
Menu item	**Description**
	Device settings: language, color scheme, backlight, button sound, screensaver, and factory reset.
	Set the current date and time.
	Ethernet settings, USB information, RS232 baud rate, and Analog Output.
	Displays version number and serial number. Platform firmware version number and interferometer firmware version are found here.
	Browse the internal filesystem, delete files, and load measurement files into the graph.
	Click to toggle if a PC should be able to access the files as a USB drive.
	Wavelength calibration.
	Control settings for external reference.
	Configure settings for wavelength averaging.

	Toggle Fast or Slow mode.

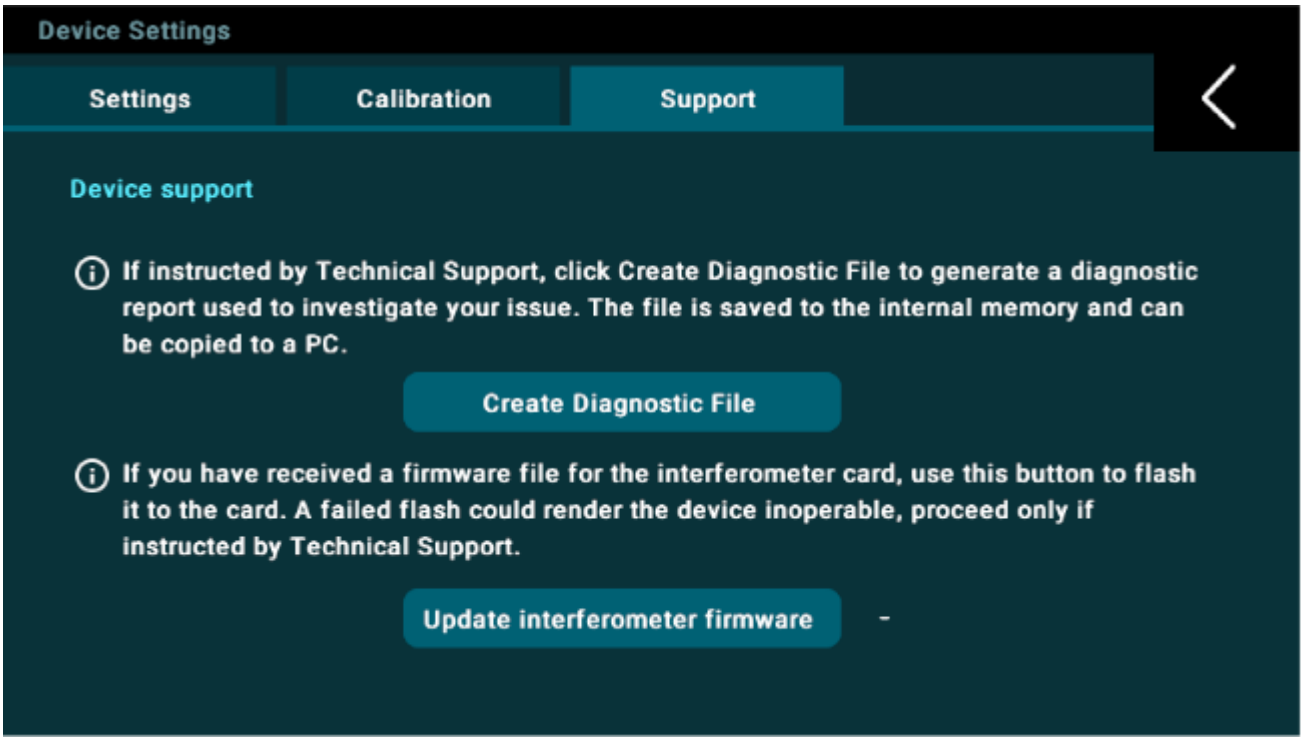
Settings



The settings menu is used to change brightness, language, color scheme, and the screen saver.

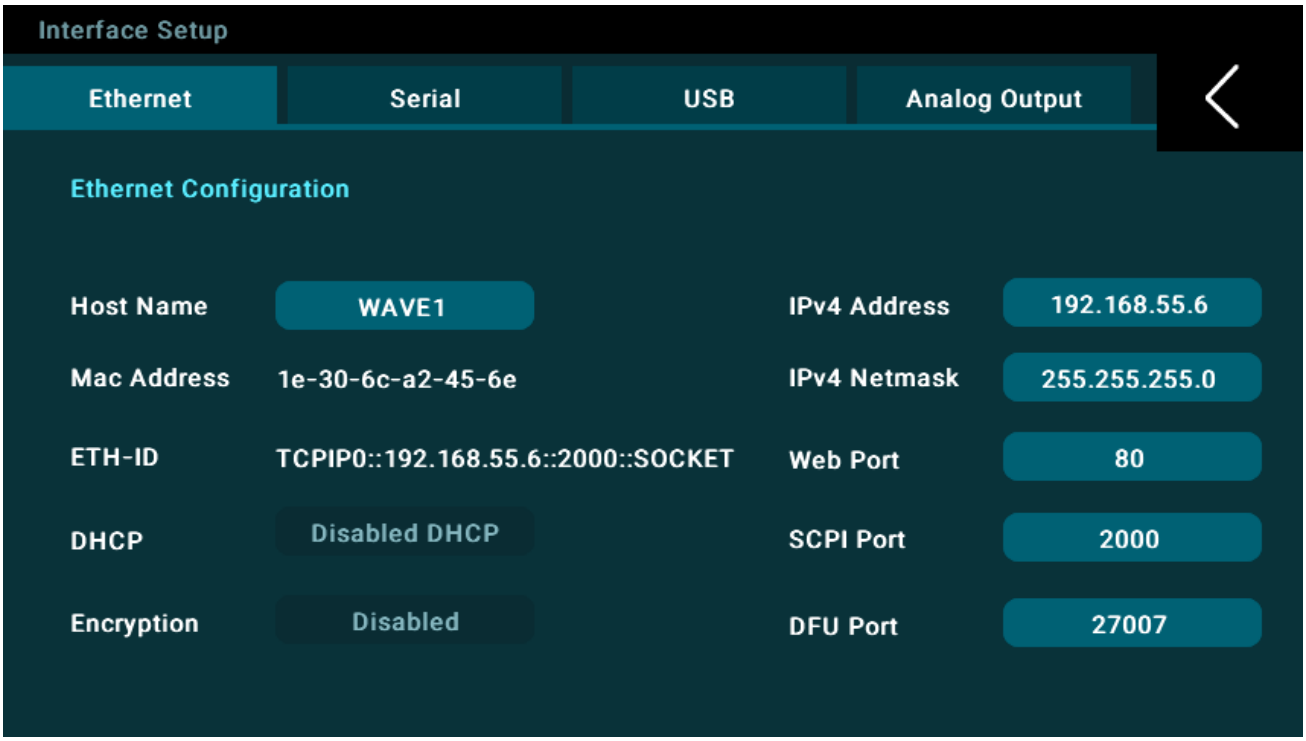
Factory reset will clear all user settings and revert the calibration parameters to the factory default. From here you can also reach the support tab.

Support

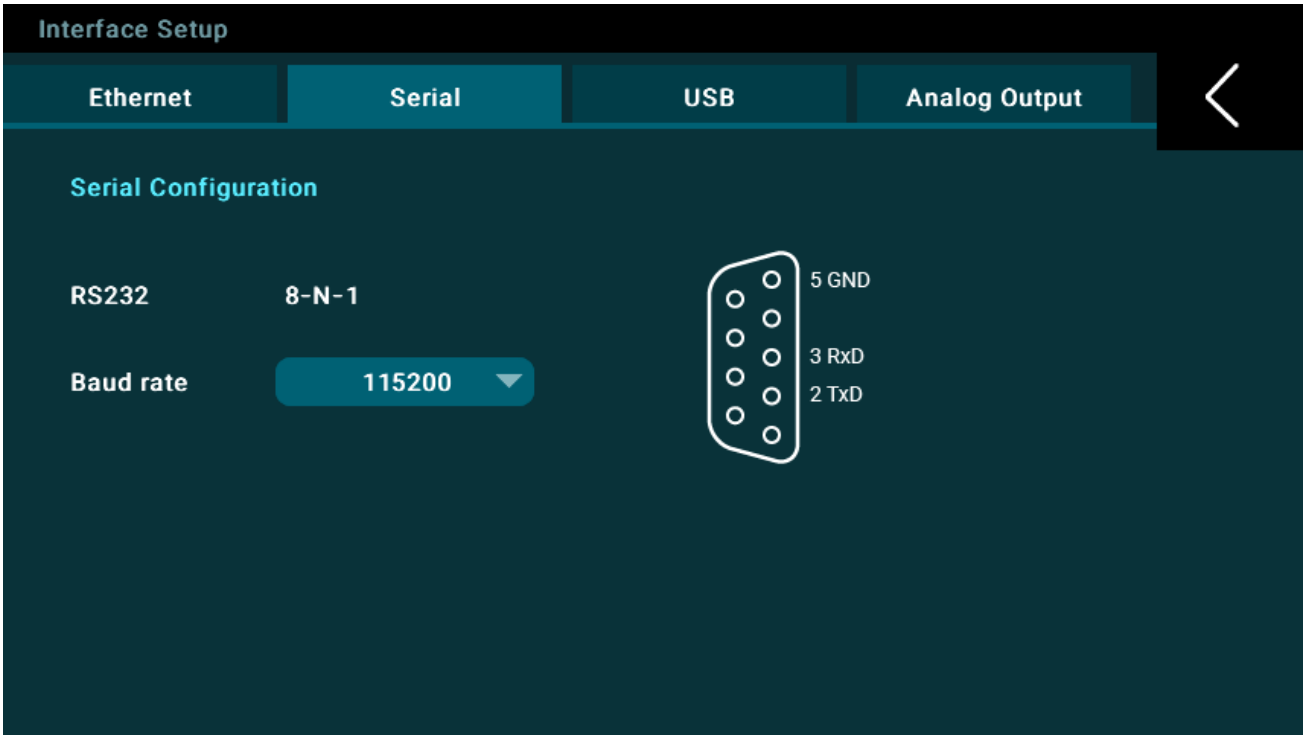


In the Support tab, you can generate a diagnostic file. It will perform a measurement using the current settings and save it, along with other relevant diagnostic information, to a file on the SD card. The file will be placed in the root of the filesystem; an example filename is “WM_DIA_2025_08_21_15_21_42.txt”. When you start creating a diagnostic file, its file size will be shown next to the button. When the file size stops increasing, the file is ready. This may take around 2 - 10 minutes, please wait around one minute after the file size has stopped increasing to ensure it is ready. The file can then be copied to a PC by connecting a USB cable to the wavemeter, clicking the USB Transfer button, and then using the PC’s file system to copy it.In the support tab you can also if instructed update the firmware of the internal interferometer card, you will receive instructions with the new firmware. Please not that this is a different firmware than the platform card, which can be updated from the OPM software.

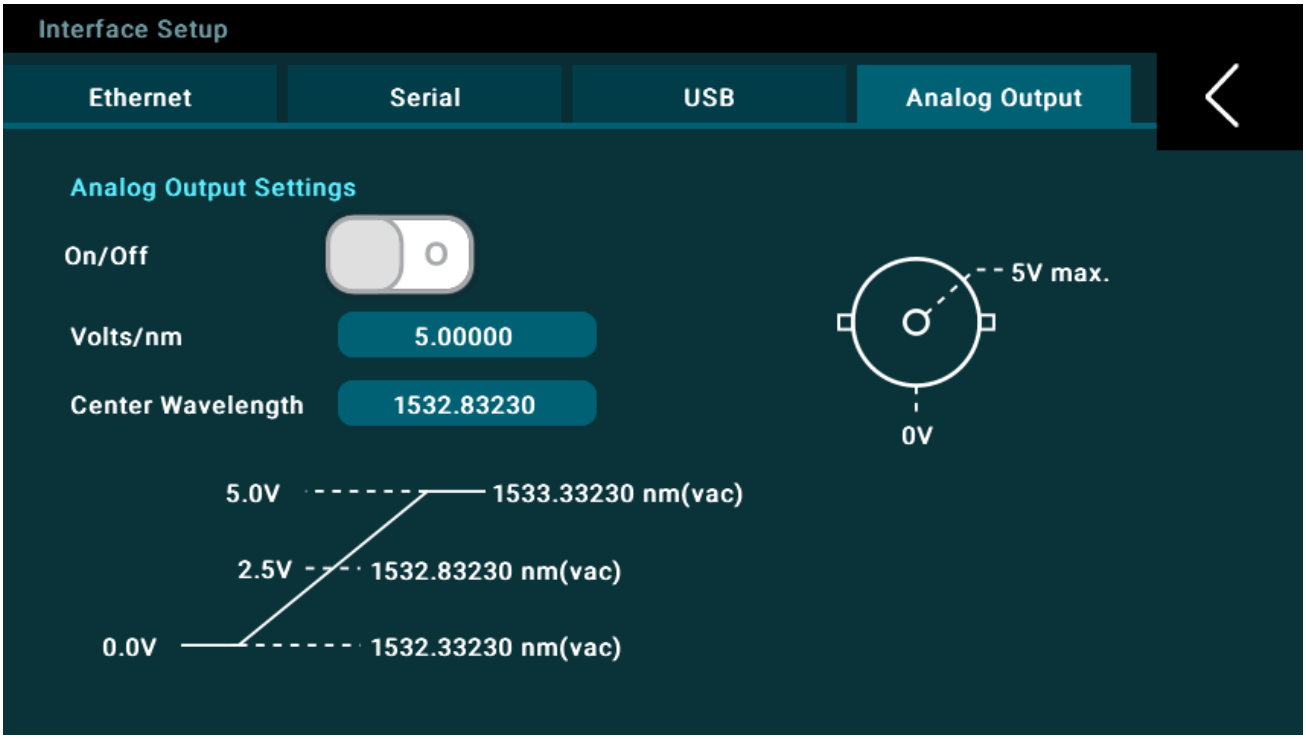
Interface



In the interface panel the ethernet settings can be changed, web port used for the web viewer, SCPI port for remote commands, and DFU port for firmware update over TCP. Set any port number to 0 to disable that service.

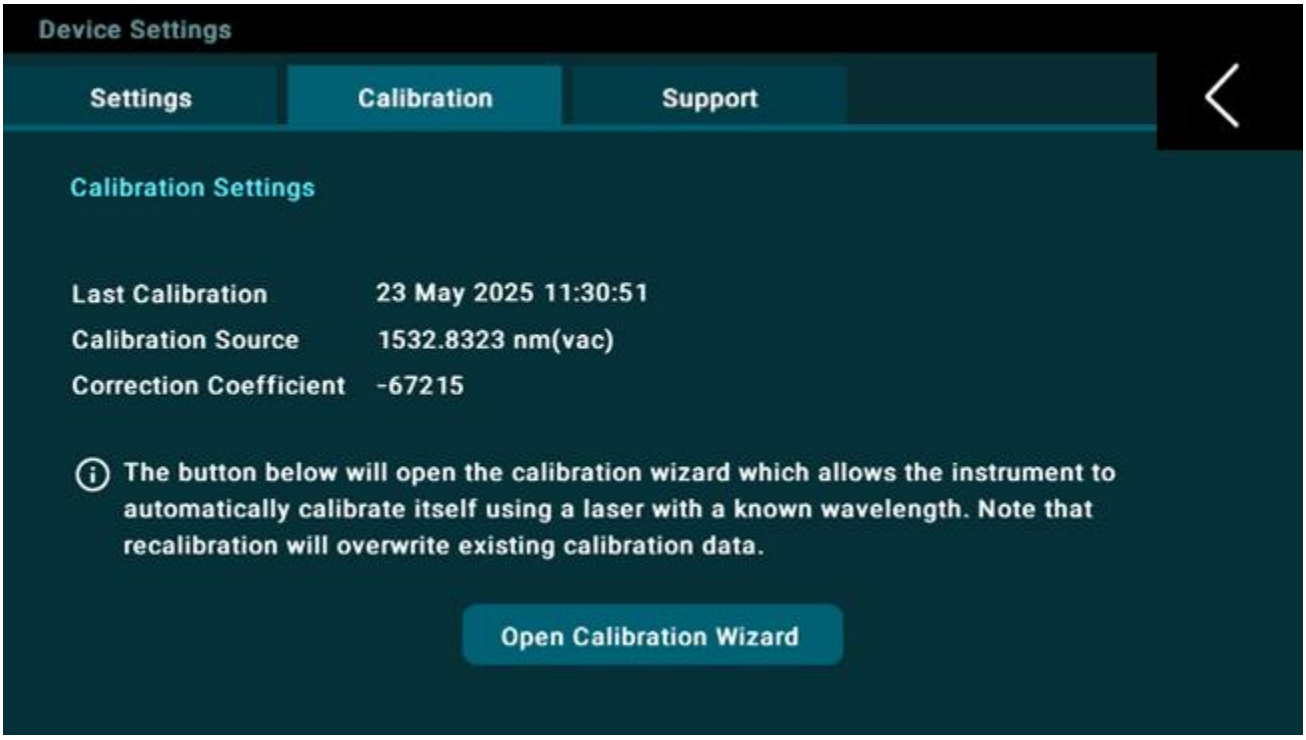


In Serial configuration you can view the Dsub-9 pinout and configure the RS232 baud rate for serial SCPI commands.



In analog output, the center wavelength and slope can be configured. See more details about the analog output in the Specifications in Section 1.7.2.

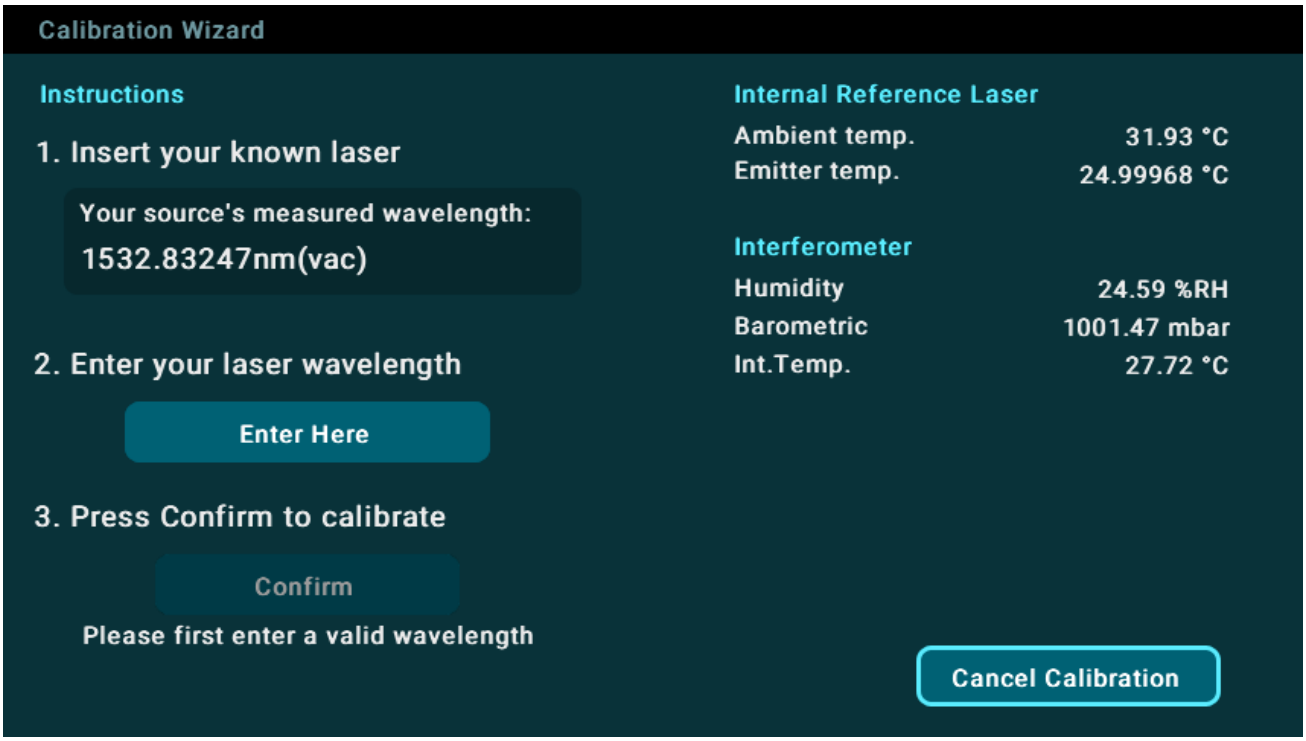
Calibration



In the calibration panel, the last calibration date, the calibration wavelength used, and the coefficient currently used are displayed. The values shown on this screen will depend on whether an external or internal reference is used.

To perform a wavelength calibration, click “Open Calibration Wizard”.

Calibration Wizard

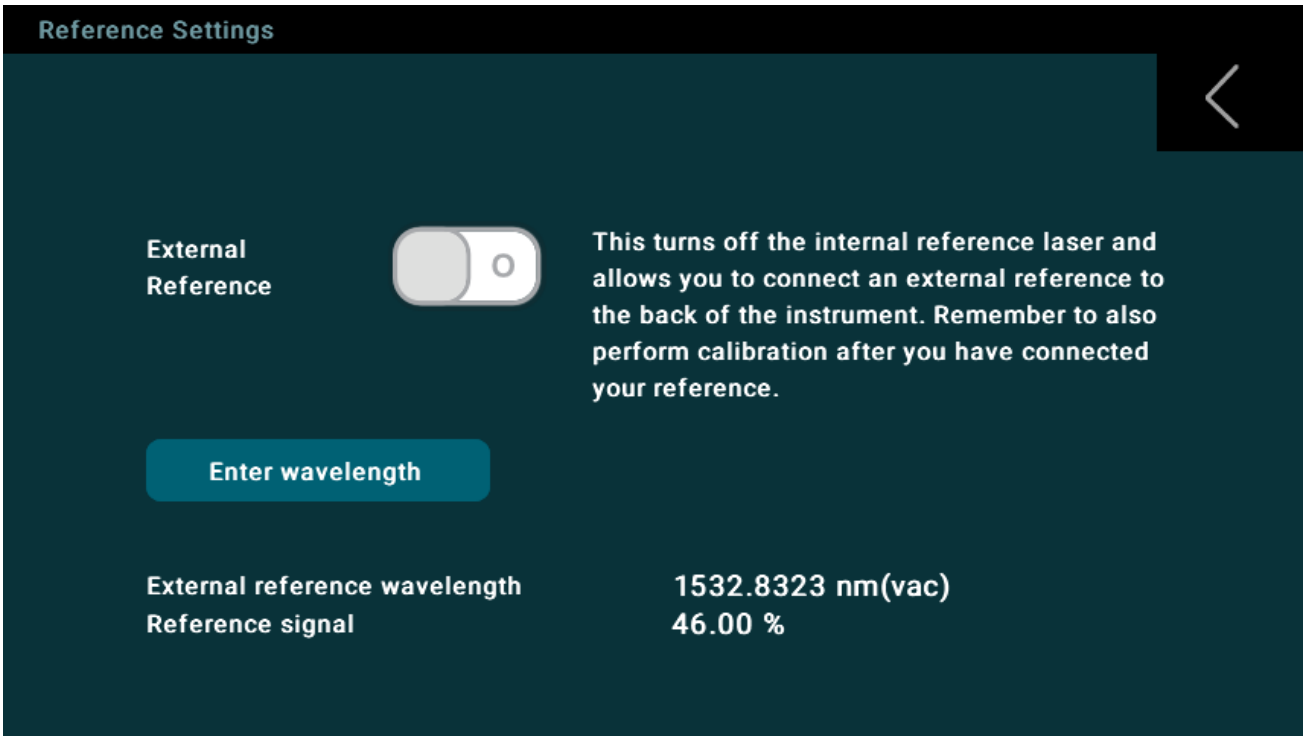


Follow the instructions to perform a wavelength calibration.

The calibration will fail if the entered laser wavelength is very far from the measured.

Please note that the known laser wavelength needs to be entered in nm (vac).

External Reference

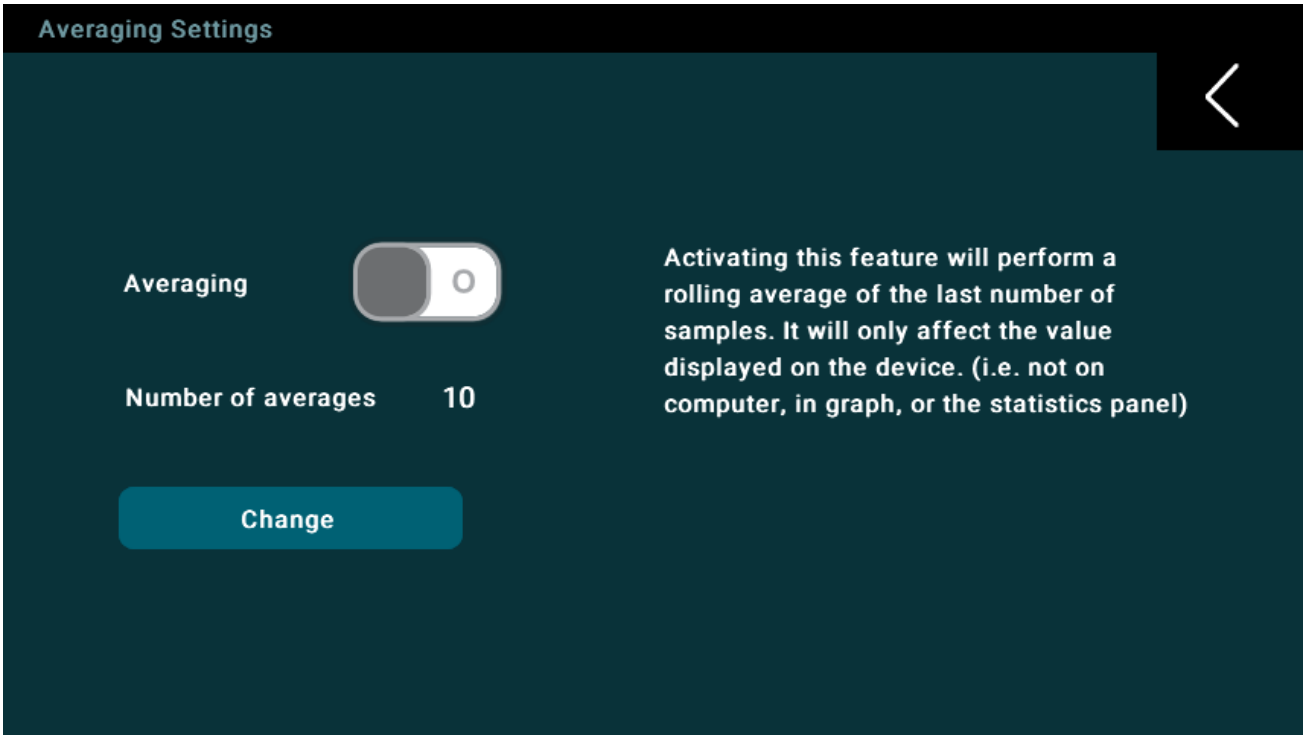


In this panel the internal reference laser can be turned on or off. Turning the internal reference laser off allows an external reference laser to be connected to the back of the instrument. You can monitor the signal on the reference detector to be sure that the signal level is good. A recalibration is recommended after activating an external reference to achieve the specified resolution. If using the LLD1530 frequency-locked laser as an

external reference, a fiber optic splitter can be used to send a portion of the light to both the input and external reference ports to calibrate the WM202 or WM203 wavemeters.

Please note that the External reference wavelength needs to be entered in nm (vac).

Averaging



The averaging function reduces apparent noise by calculating a rolling average of recent wavelength measurements. You can adjust how many wavelength readings are used in this average.

The device maintains an internal buffer of recent readings and displays their average value, resulting in a smoother, more stable number while maintaining the same update rate.

Important notes: The averaging only affects the wavelength shown on the main display and the top number in the statistics view. The averaging does not affect the graph view, statistical calculations, or data displayed on the PC or remote operation.

4.2 Remote PC Operation with Software

The wavelength meter can be operated from a Windows PC using Thorlabs' Optical Parameter Monitor (OPM) software. Here we briefly describe how to install and use the OPM Software with the WM20x wavelength meter; for general information on the OPM Software please see **the manual**.

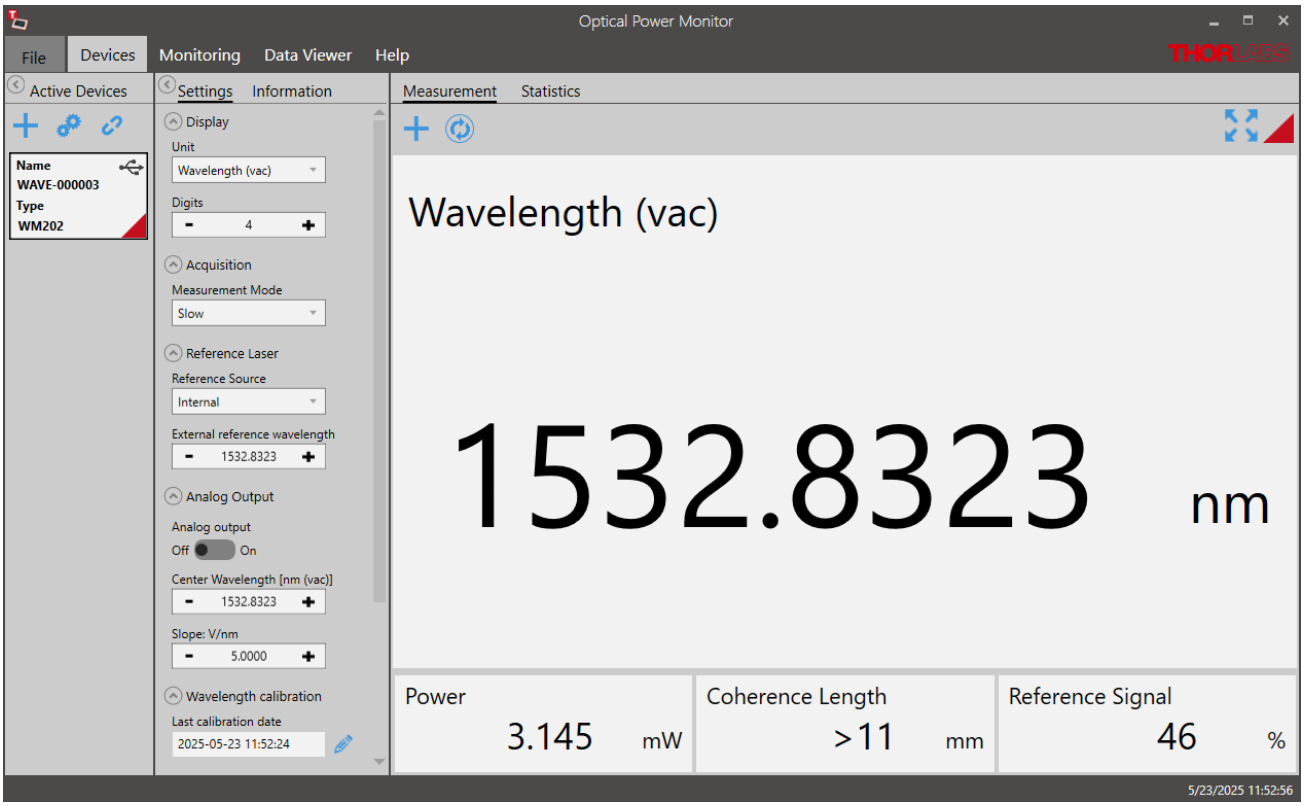
4.2.1 Installing the OPM Software

The Optical Parameter Monitor Software can be downloaded from the Thorlabs website:

https://www.thorlabs.com/software_pages/ViewSoftwarePage.cfm?Code=OPM

Download the software and follow the installation instructions. Then, connect the wavelength meter either via USB cable or to the network. Power on the wavelength meter. The OPM software automatically searches for connected devices. If your device is on the network but not detected, you can manually enter its IP address.

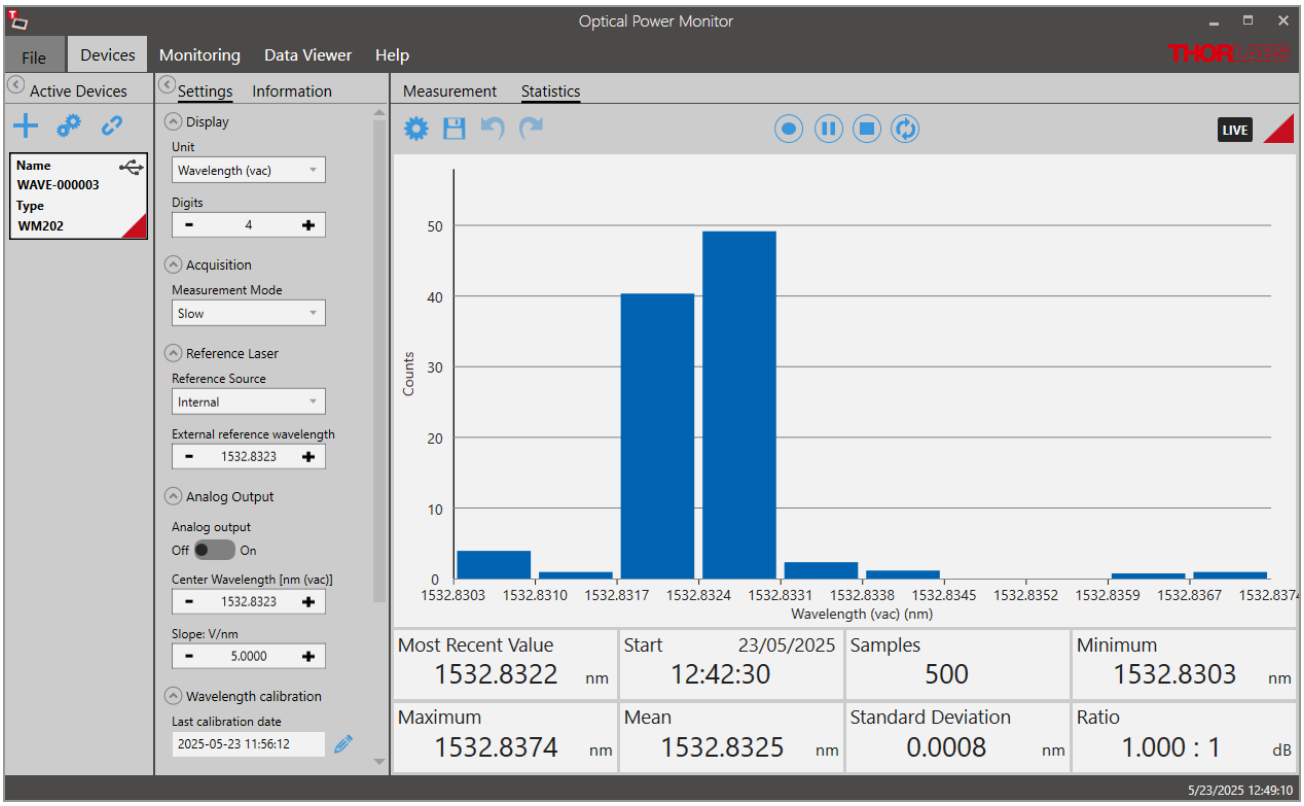
4.2.2 Measurement View



The main view shows the current wavelength value, the power value, the coherence length value, and the signal on the reference detector. If all the numbers are not visible, or if you want to remove some of the values displayed, please click the + located on the top left above the wavelength value.

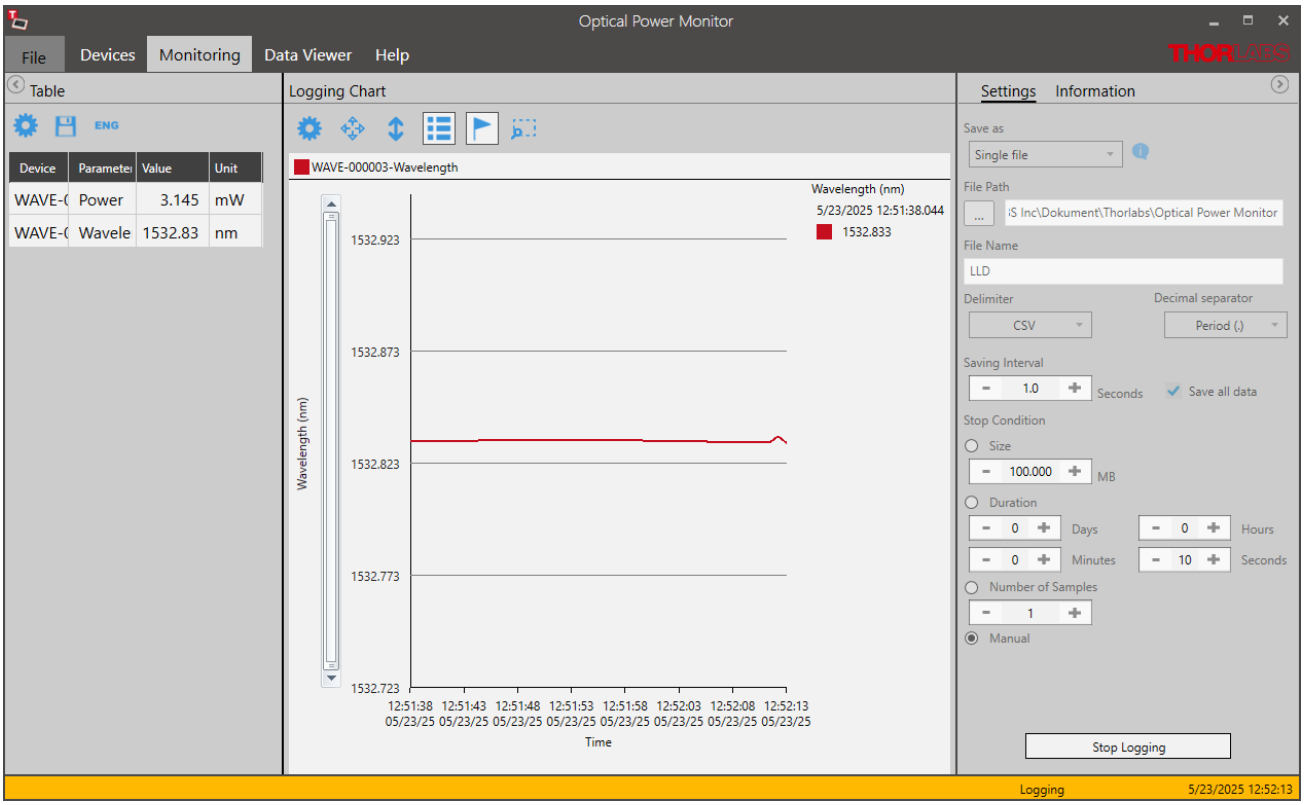
To the left you will find a list of all active devices, then you will find “Settings” and “Information”. In “Settings” you can control Slow/Fast mode, External/Internal reference laser, the analog output and you can initiate a wavelength calibration. In “Information” you can view the serial number and adjust Ethernet settings.

4.2.3 Statistics View



Next to the “Measurement View” you can view and see statistics on a rolling buffer, adjust the acquisition time or the number of samples by clicking on the cogwheel in the top left corner.

4.2.4 Monitoring Chart View



To record data to a .csv file and monitor the wavelength, go to the “Monitoring” section. First, select the parameters you wish to monitor, then choose the destination file for saving the data. If you want to save every data point, make sure to check the “Save all data” box.

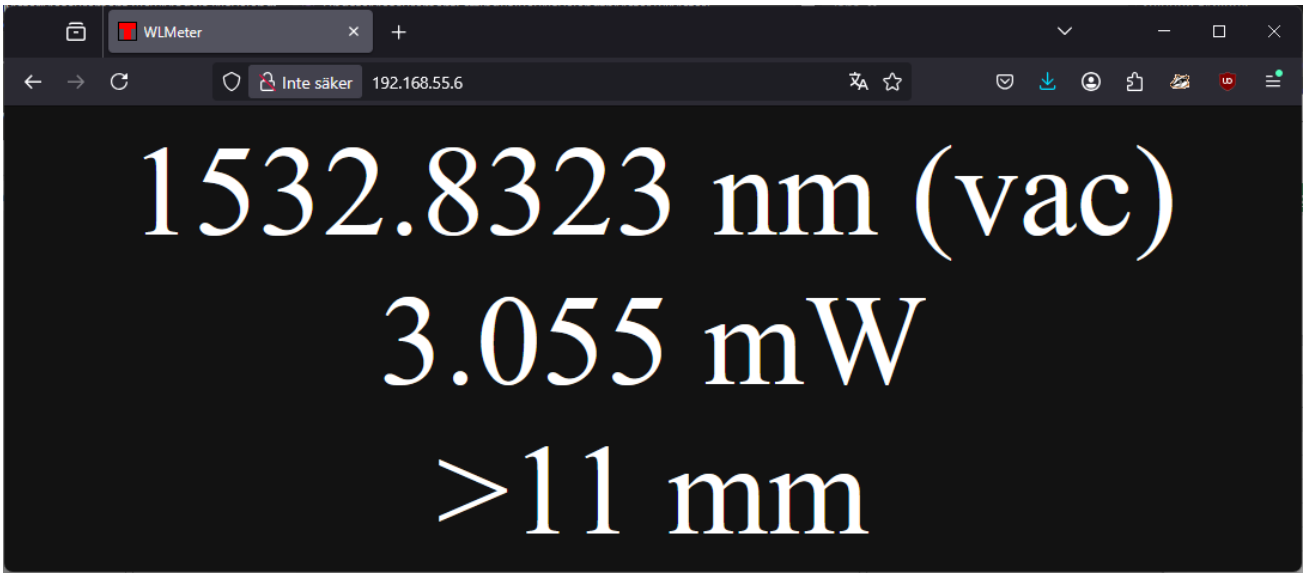
The OPM software can be used to update the platform firmware of the device, please follow the instructions in the OPM manual.

For more information about the OPM-software please download the OPM manual.

4.3 Web Viewer

If the device is connected to the network, the current wavelength, power, and coherence length can be displayed in any web browser by navigating to the configured IP number. Navigate to the URL **http://192.168.55.6** if the IP number is 192.168.55.6.

No settings or configurations can be modified in the web view. The wavelength unit, and the number of digits will be the same as shown on the touch screen in direct operation.



4.4 Advanced Remote Operation

The wavelength meter can be remotely operated by writing custom software that uses SCPI commands. The commands can be used over USB, ethernet, or RS232. A LabView interface is supplied together with the OPM software. USB control requires the drivers that are supplied with the OPM software. RS232 and ethernet can be used from any platform and operating system that supports them.

4.4.1 Python SCPI Example

Here follows a basic example on how to acquire wavelength measurement data from the wavelength meter with Python using RS232 or ethernet and the SCPI commands. This is a summarized proof of concept, full examples can be found on the **Thorlabs github page**.

For RS232

```
import time
import serial

ser = serial.Serial("COM7", 115200, timeout=2)

def request_response(cmd):
   ser.write(cmd.encode())
   response = ser.readline().decode('utf-8')
   return f"{response}"

while True:
   try:
      response = request_response("MEAS:WAV?\n")
      wavelength = float(response.strip())
      print(wavelength)
   except Exception as e:
      print(e)
      time.sleep(1)
```

For TCP

```
import time
import socket
import struct

def build_request_frame(cmd):
   # The basic example only supports single frame requests
   payload = cmd.encode()
   FRAME_START = 0xCA
   return struct.pack('<BBH', FRAME_START, 0, len(payload)) + payload

def recv_response(sock):
   data = b''
   seq = 0
   HEADER_SIZE = 4
   while True:
      # Loop because response might be multi frame
      hdr = sock.recv(HEADER_SIZE)
      if len(hdr) < HEADER_SIZE:
         break
      start, cnt, plen = struct.unpack('<BBH', hdr)
      if cnt != seq:
         break
      part = sock.recv(plen)
      data += part
      if start != 0xCB:
         break  # no more frames
      seq += 1
   return data.decode(errors='ignore')

def request_response(sock, cmd):
   sock.sendall(build_request_frame(cmd))
   return recv_response(sock)

with socket.create_connection(("192.168.55.6", 2000), timeout=2) as s:
   while True:
      try:
         response = request_response(s, "MEAS:WAV?\n")
         wavelength = float(response.strip())
         print(wavelength)
      except Exception as e:
         print(e)
         time.sleep(1)
```

4.4.2 SCPI Commands Reference Table

The SCPI commands can be sent over Ethernet, RS232, or USB. The full command listed can be used, or the shortened version shown in the Request row, using only the capitalized letters in the full command, can be used.

SCPI Commands	
MEASure:WAVelength?	
Description	Waits for the next measured wavelength then returns it, always in nm (vac). Returns -1 if there is no new wavelength within one second.
Request	MEAS:WAV?
Response	"1574.91035"
FETCh:WAVelength?	
Description	Returns the last measured wavelength, always in nm (vac).
Request	FETC:WAV?
Response	"1574.91035"
FETCh:COHErence:LENgth?	
Description	Returns that last measured coherence length, and returns -1 in case it can't be estimated. The result is in millimeters.
Request	FETC:COHE:LEN?
Response	"0.006303"
FETCh:POWer?	
Description	Returns the last estimated power value in mW, returns -1 in case it couldn't be estimated.
Request	FETC:POW?
Response	"5.9432"
STATus:OPERation:CONDition?	
Description	Returns the contents of the operation condition register. This is information encoded in bits.
Request	STAT:OPER:COND?
Response	"0","256","512"
Bit 9	If high, then new data is available to fetch using: FETC:WAV? If low, then the data has already been fetched.
Bit 10	If high, then new status code is available to fetch using SENS:STAT:COND? If low, then the status code has not changed since the last time it was fetched.
SENSe:STATus:CONDition?	
Description	Returns the status code encoded as bits. These are the messages displayed on the status bar on the screen.
Request	SENS:STAT:COND?
Response	"22"

Bit 0	Signal is too weak.
Bit 1	Signal is too strong.
Bit 2	Reference signal is too weak.
Bit 3	Reference signal is too strong.
Bit 4	Coherence length is longer than OPD.
Bit 5	Source is multimode.
Bit 6	Any save error from long term.
Bit 7	Internal memory is full.
Bit 8	Invalid configuration.
Bit 9	Fatal error, **contact tech support**.
SENSe:WAVElength:RATE?	
Description	Queries whether the wavelength meter is in fast mode or slow mode.
Request	`SENS:WAVE:RATE?`
Response	`"SLOW" / "FAST"`
SENSe:WAVElength:RATE	
Description	Request the wavelength meter to change speed. Argument can be "`SLOW`" or "`FAST`"
Request	`SENS:WAVE:RATE FAST`
Response	*no response*
SENSe:WAVElength:REFerence:SOURce?	
Description	Queries whether the internal or external reference is being used currently.
Request	`SENS:WAVE:REF:SOUR?`
Response	`"EXT" / "INT"`
SENSe:WAVElength:REFerence:SOURce	
Description	Request the internal or external reference be used. Argument can be "`EXT`" or "`INT`"
Request	`SENS:WAVE:REF:SOUR EXT`
Response	*no response*
SENSe:WAVElength:REFerence:WAVElength?	
Description	Queries the configured wavelength of the external reference laser. This is always in nm (vac).
Request	`SENS:WAVE:REF:WAVE?`
Response	`"1551.5500"`
SENSe:WAVElength:REFerence:WAVElength	
Description	Set the wavelength of the external reference laser. This is always in nm (vac).
Request	`SENS:WAVE:REF:WAVE 1551.5500`

Response	*no response*
SENSe:WAVElength:CALibrate:STATe?	
Description	Queries the state currently running, or last calibration.
Request	SENS:WAVE:CAL:STAT?
Response	"ERROR"/"OK"/"INIT"/"RUNNING"
SENSe:WAVElength:CALibrate	
Description	Start a calibration with a known wavelength. Please be aware that the calibration settings are dependent on if the external or internal reference laser is used. This is always in nm (vac).
Request	SENS:WAVE:CAL 1532.8323
Response	*no response*
SENSe:WAVElength:CALibrate:TIME?	
Description	Queries the timestamp of the last time the wavelength meter was calibrated. Format is a Unix timestamp in a 64-bit integer.
Request	SENS:WAVE:CAL:TIME?
Response	"1746543935" (which translates to Tue May 06 2025 15:05:35)
SENSe:WAVElength:CALibrate:WAVElength?	
Description	Queries the wavelength of the last calibration. This is always in nm (vac).
Request	SENS:WAVE:CAL:WAVE?
Response	"1532.8323"
OUTPut:ANALog:STATe?	
Description	Queries the state of the analog output.
Request	OUTP:ANAL:STATE?
Response	"ON" / "OFF"
OUTPut:ANALog:STATe	
Description	Set the analog output on or off. Argument can be: "ON" or "OFF"
Request	OUTP:ANAL:STATE ON
Response	*no response*
OUTPut:ANALog:CENTer?	
Description	Queries the center wavelength of the analog output. This is always in nm (vac).
Request	OUTP:ANAL:CENT?
Response	"1551.5500"

OUTPut:ANALog:CENTer	
Description	Set the analog output center wavelength. This is always in nm (vac).
Request	`OUTP:ANAL:CENT 1551.5500`
Response	*no response*
OUTPut:ANALog:SLOPe?	
Description	Queries the slope of the analog output. This is always in volt/nm (vac).
Request	`OUTP:ANAL:SLOP?`
Response	`"5.000"`
OUTPut:ANALog:SLOPe	
Description	Set the analog output slope. This is always in volt/nm (vac).
Request	`OUTP:ANAL:SLOP 5.000`
Response	*no response*
FETCh:OPD?	
Description	Returns the optical path difference of the interferometer, which can be used to display "`>OPD`" when the coherence length is indicated as longer than OPD by the status bits. This is always in mm.
Request	`FETC:OPD?`
Response	`"10.729"`

Chapter 5 Maintenance and Cleaning

Protect the WM20x wavelength meter from adverse weather conditions. The WM20x wavelength meter is not water resistant.

If the instrument does not turn on, please check the fuse.
Fuse type: 5 x 20mm, 1.0A, time-lag, 250V (T1A250V)
The fuse must meet IEC specification 60127-2/III, time characteristic: time-lag (T).

NOTICE To avoid damage to the instrument, do not expose it to spray, liquids or solvents! The unit does not need regular maintenance by the user. It does not contain any modules and/or components that could be repaired by the user himself.

If a malfunction occurs, please see the Return of Devices section and contact Thorlabs for return instructions.

Do not remove covers!

Chapter 6 Disposal

Thorlabs verifies our compliance with the WEEE (Waste Electrical and Electronic Equipment) directive of the European Community and the corresponding national laws. Accordingly, all end users in the EC may return "end of life" Annex I category electrical and electronic equipment sold after August 13, 2005 to Thorlabs, without incurring disposal charges. Eligible units are marked with the crossed out "wheelie bin" logo (see right), were sold to and are currently owned by a company or institute within the EC and are not dissembled or contaminated. Contact Thorlabs for more information. Waste treatment is your own



responsibility. “End of life” units must be returned to Thorlabs or handed to a company specializing in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site. It is the user’s responsibility to delete all private data stored on the device prior to disposal.

Chapter 7 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.



Corporate Headquarters
Thorlabs, Inc.
43 Sparta Ave
Newton, New Jersey 07860
United States

sales@thorlabs.com
techsupport@thorlabs.com

Product Manufacturer
Thorlabs Sweden AB
Bergfotsgatan 7
431 37 Mölndal
Sweden

scandinavia@thorlabs.com
techsupport.se@thorlabs.com

EU Importer
Thorlabs GmbH
Münchner Weg 1
D-85232 Bergkirchen
Germany

sales.de@thorlabs.com
europe@thorlabs.com

UK Importer
Thorlabs Ltd.
204 Lancaster Way Business Park
Ely CB6 3NX
United Kingdom

sales.uk@thorlabs.com
techsupport.uk@thorlabs.com



THORLABS

www.thorlabs.com