P17.20

ENS LYON

435 Route 206 • P.O. Box 366
Newton, NJ 07860-0366
www.thorlabs.com

PH. 973-579-7227
FAX 973-300-3600

technicalsupport@thorlabs.c
om

SA200-Series Scanning Fabry Perot Interferometer

DESCRIPTION:

The SA200 is a high finesse Spectrum Analyzer used to examine the fine structures of the spectral characteristics of CW lasers. The spectrum analyzer consists of a confocal cavity that contains two high reflectivity mirrors; by varying the mirror separation with a piezoelectric transducer the cavity acts as a very narrow band-pass filter. Knowing the free spectral range of the SA200 allows the time-base of an oscilloscope to be calibrated to facilitate quantitative measurements of a laser line shape.

SPECIFICATIONS:

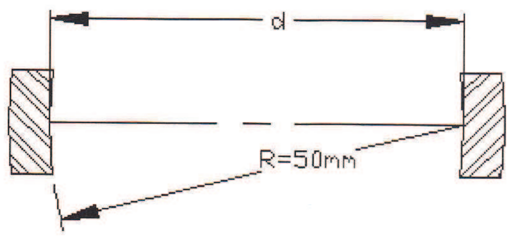
Free Spectral Range[1] (FSR) **Measured in milliseconds:**	5,4
FWHM **Measured in microseconds:**	25,8
(FSR/FWHM)	
Actual Calculated Finesse:	209
Maximum Input Voltage:	150V
Free Spectral Range:	1.5Ghz
Minimum Finesse:	>200
Resolution:	7.5MHz
Outer Housing Material:	Black Anodized Aluminum
Fabry Perot Cavity Material[2]:	Low thermal expansion Invar ®
Dimensions:	Ø 2" Flange Total Length: 5.85"

Confocal Cavity Configuration

Mirrors shown below are AR coated on the outer surfaces and HR coated on the inner surfaces.

[1] FSR is set by the length of the confocal cavity and is given by: FSR=c/4d. Where d= the radius of curvature of the mirrors; in this case d=50mm. (see drawing on next page)

[2] A thermal design balances the small coefficient of thermal expansion of the Invar body with the negative coefficient of thermal expansion of the piezo actuators.



FSR=c/4d

Other mirror sets are available for this instrument:

- **350nm - 535nm**
- **535nm - 820nm**
- **820nm - 1275nm**
- **1275nm - 2000nm**

SETUP:

- Knowing the FSR of the SA200 allows the time-base of an oscilloscope to be calibrated to facilitate quantitative measurements of laser line shape. With a resolution of 7.5MHz, the fine structure resulting from multiple longitudinal modes of a laser line can be resolved. Note: A saw tooth wave (0-20V) would provide approximately 2 Free Spectral Ranges.
- The SA200 should be mounted, so that it can be easily adjusted. It is recommended that Thorlabs 2-inch Kinematic Mount **KM200** be used to mount the interferometer at the 2-inch diameter flange.
- The apparent beam size should be approximately 4mm. It is recommended that a fold mirror be used to direct the beam into the Fabry-Perot interferometer. A lens with focal length of 250mm can be used, with the focus set roughly at the center of the housing, approximately 30mm in from the flange.
- The maximum voltage on the piezo (ramp in) is not to exceed 150V.
- If the detector is connected directly to the scope, a 5kΩ terminator is needed. Offset adjustment (SA201) is used to center the output on the scope.

OPERATION:

To set up the SA200-Series Fabry-Perot you should first mount the unit into a tip/tilt mirror mount (Thorlabs part# KM200). Attach all of the connection according the drawing on page 4. Next you should remove the detector from the back of the unit and mount it in it's own mount, this will aid in the initial alignment. Then close the input iris and center your beam on the iris opening. Leave the back iris completely open and start to scan the unit. Now using the tip/tilt adjustment until the beam is center through the body of the SA200. Adjust the scope gain to maximum sensitivity, position the detector close to the rear opening and slowly close the back iris as you correct the 2 angular adjustments on the mirror mount. Once the beam is centered you can the replace the detector on the main body and start to use the unit for measurements.

OVER VIEW:

Free Spectral Range

To scan the spectra of the laser beam entering the Scanning Fabry–Perot interferometer small displacement is applied to one of the cavity mirror mounted on piezoelectric transducers. This operation is done by fine tuning the ramp voltage applied to the Piezoelectric elements using the controller SA201. When the mirror spacing becomes equal to an integral number of half the wavelength of the laser, constructive interferences occur. That spectral response of the signal can be visualized with a scope. A series of periodical peaks appear on the screen of the scope. The distance between consecutive peaks is called the free spectral range (FSR) of the instrument.

From a users perspective a confocal cavity has a FSR that is given by c/4d instead of c/2d as would be the case for a plano-plano cavity; the factor of 2 in the denominator can be understood by inspecting the ray trace shown below in Figure II. Note that a ray entering the cavity at a height 'h' parallel to the optical axis of the cavity makes a triangular figure eight pattern as it traverses the cavity. From this pattern it is clear that the ray makes four reflections from the cavity mirrors instead of the two that would result in a plano-plano cavity. Hence the total round-trip path through the cavity is given as 4d instead of 2d.

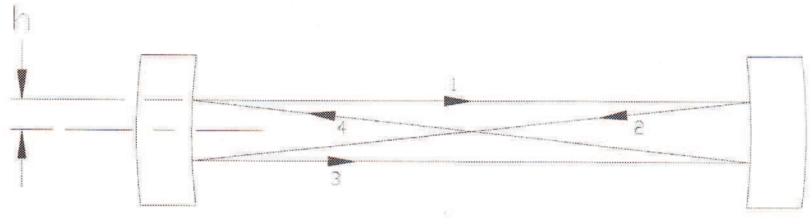


Figure II

Figure II: This figure shows a simplified ray-trace for a ray entering the cavity at height 'h'. The curvature of the mirrors 'R' and the separation being set precisely to 'R' ensures that the input ray is imaged back onto itself after traveling a distance of approximately 4R.

Additionally, in this configuration if a paraxial ray is traced through the system as shown in figure II, it is apparent that in the confocal configuration each mirror serves to image the other mirror back onto itself so that a ray entering the cavity will, after four traverses of the cavity, fall back onto itself, (note that the focal length of a spherical mirror is R/2). This imaging of the beam back onto itself greatly simplifies the alignment of the cavity; just align your input to within a few tenths of a millimeter of the center of the mirror set and restrict your input angles to less than a few degrees. The SA200 series interferometer has two iris diaphragms that simplify this alignment requirement.

Finesse

The finesse of the Scanning Fabry-Perot interferometer is a quantity which characterizes the ability of the interferometer to resolve closely spaced spectral features, it defines the resolution of the instrument. For an infinitely narrow input spectrum, the finesse determines the width of the measured spectrum.

High finesse means high resolution capability, high finesse is obtained by increasing the reflectivity of the cavity mirrors. However, high reflective mirrors reduce the transmission of the interferometer.

In a typical application the SA200 Interferometer is used in conjunction with a signal generator and an oscilloscope, as shown below in figure III. A signal generator (Thorlabs SA201 Fabry-Perot Controller is used for generating the required scan signals for obtaining the data in this document) that can produce either a triangle or saw-tooth wave with an adjustable frequency (5 to 50 Hz), an adjustable amplitude (15 to 40 volts), and an adjustable offset. The signal generator is used to repetitively scan the length of the cavity by $\lambda/4$ in order to sweep through one FSR of the interferometer. An oscilloscope is typically used to view the spectrum and make quantified measurements of spectral features.

Recommended Set-up

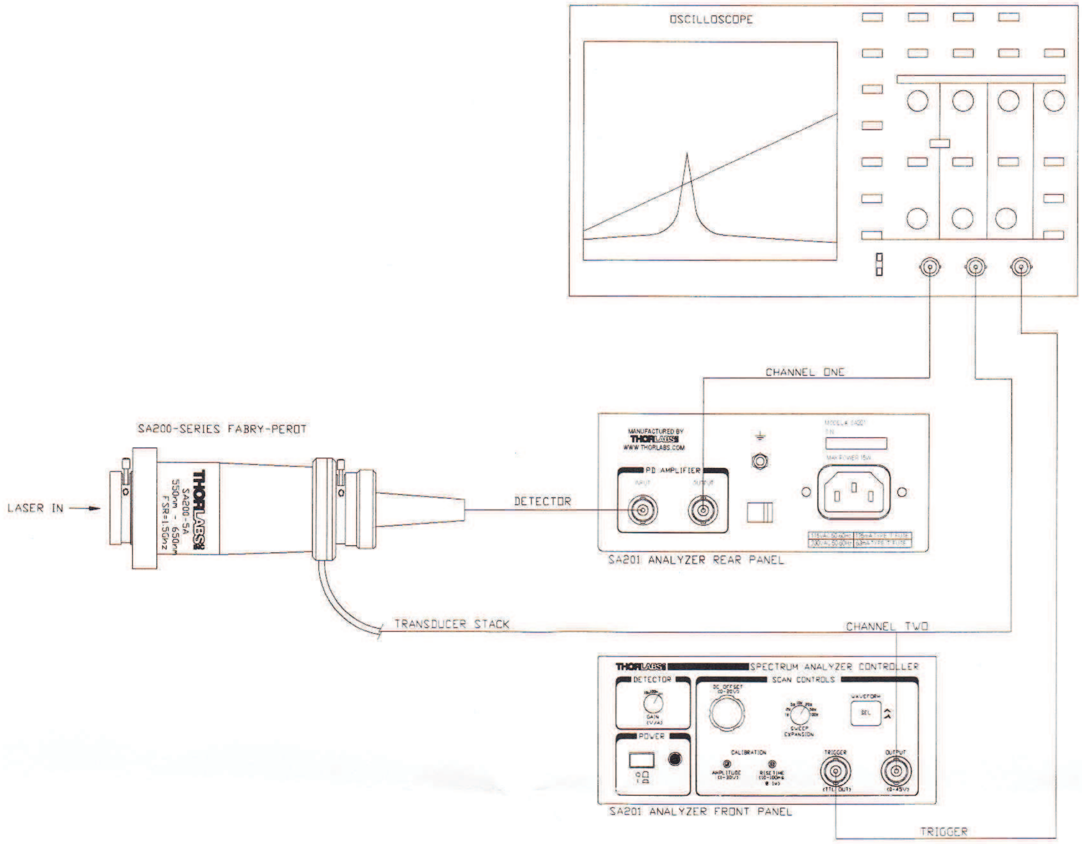


Figure III

Figure III: This figure shows a schematic diagram of a typical setup that is used to measure the spectrum of a laser source. Please note that for this device to be useful the linewidth of the source must be less than the FSR of the interferometer.

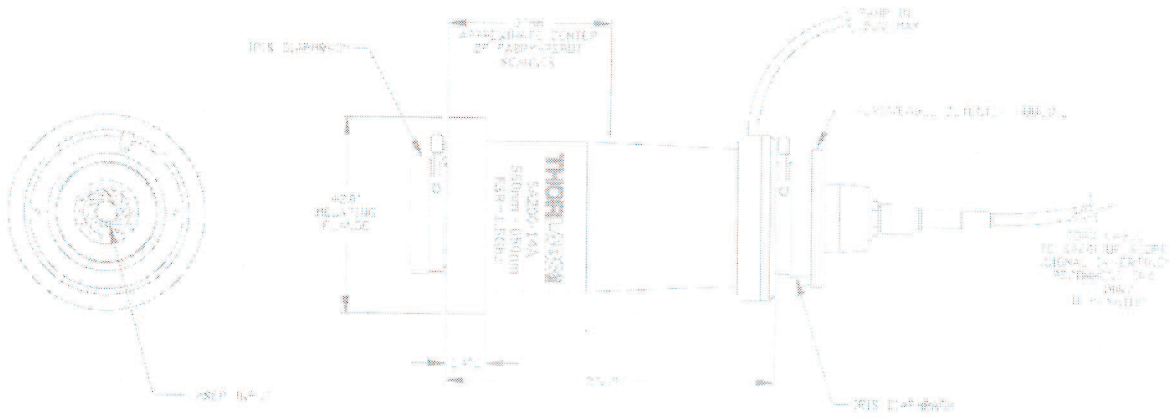
SPECTRUM ANALYZER CONTROLLER AND OTHER ACCESSORIES:

- The **SA201** controller generates a voltage ramp, which is used to scan the separation between the two cavity mirrors. A photodiode is used to monitor transmission of the cavity. Using the output sync signal from the controller, an oscilloscope can be used to display the spectrum of the input laser. The controller provides adjustment of the ramp voltage (0 to 20V) and scan-time (1ms to 5s) to allow the user to choose the scan range and speed. An offset control is provided to allow the spectrum displayed on the oscilloscope to be shifted right or left, zoom capability provides up to 100X increase in spectral resolution.
- Thorlabs' **KM200,** 2" kinematic mount can be used to mount the SA200 Scanning Fabry Perot Interferometer.

TECHNICAL SUPPORT:

For further questions, or if you suspect a problem with your SA200, please contact Tech Support. An Applications Engineer will gladly assist you.

Technical Drawing



THORLABS

SA201

Spectrum Analyzer Controller

Operating Manual

Table of Contents

Table of Figures

Part 1. Overview

The SA201 is specifically designed to control Thorlabs SA200 Series Fabry Perot Interferometers. The controller generates a voltage ramp, which is used to scan the separation between the two cavity mirrors. The controller provides adjustment of the ramp voltage and scan time, allowing the user to choose the scan range and speed. An offset control is provided to allow the spectrum displayed on the oscilloscope to be shifted right or left. Another convenient feature of the controller is a zoom capability that provides a 1X, 2X, 5X, 10X, 20X, 50X and 100X increase in the spectral display resolution. The output TTL level trigger allows the user to externally trigger an oscilloscope on either the beginning or midpoint of the ramp waveform.

The SA201 also includes a high precision photodetector amplifier circuit used to monitor the transmission of the cavity. The amplifier provides an adjustable transimpedance gain of 10K, 100K, and 1M V/A when driving a high impedance load, such as an oscilloscope. Using the output sync signal from the controller, an oscilloscope can be used to display the spectrum of the input laser. The detector circuitry incorporates a blanking circuit, which disables the photodiode response during the falling edge of the saw tooth waveform.

Parts List

Below is a list of all components shipped with the SA201 Spectrum Analyzer Controller.

- SA201 Spectrum Analyzer Controller
- Operating Manual
- US Power Supply Line Cord
- 125 mA Fuse for use at 230 VAC operation (250 mA fuse installed in unit)

Compatible Fabry-Perot Scanning Heads

This product has been designed to be used with one of our SA200 or SA210 Series Scanning Fabry-Perot Interferometers. Below is a list of available heads. Note this list is subject to change without notice. Please visit the website for the most current information.

Item #	Description
SA200-3B	350-535 nm, 1.5 GHz FSR
SA200-5B	535-820 nm, 1.5 GHz FSR
SA200-7A	780 - 930 nm, 1.5 GHz FSR
SA200-8B	820-1275 nm, 1.5 GHz FSR
SA200-9A	900 - 1100 nm, 1.5 GHz FSR
SA200-12B	1275-2000 nm, 1.5 GHz FSR
SA200-14A	1450 - 1625 nm, 1.5 GHz FSR
SA200-18B	1800-2500 nm, 1.5 GHz FSR

Item#	Description
SA210-3B	350-535 nm, 10 GHz FSR
SA210-5A	525-650 nm, 10 GHz FSR
SA210-5B	535-820 nm, 10 GHz FSR
SA210-7A	780-930 nm, 10 GHz FSR
SA210-8B	820-1275 nm, 10 GHz FSR
SA210-9A	900-1100 nm, 10 GHz FSR
SA210-12A	1250-1400 nm, 10 GHz FSR
SA210-12B	1275-2000 nm, 10 GHz FSR
SA210-14A	1450-1625 nm, 10 GHz FSR
SA210-18B	1800-2500 nm, 10 GHz FSR

Part 2. Description

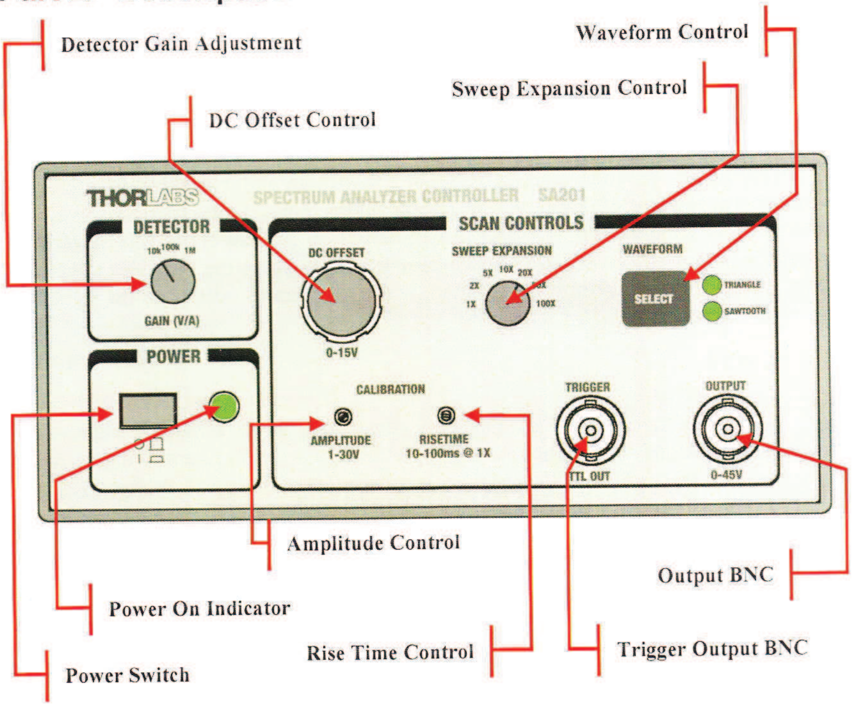


Figure 1: SA201 Front Panel Controls

Detector Gain Adjustment

The SA201 includes a built in photodiode amplifier circuit. This amplifier is designed specifically to operate with the detector provided with the SA200 series Fabry Perot Interferometer, allowing the user to monitor the transmission of the cavity. While any photodetector may be connected to the amplifier the specifications, listed in Section 1, apply only to detectors supplied with the SA200 series. The amplifier provides a transimpedance gain (current to voltage gain) of 10K, 100K, and 1M V/A while driving a Hi-Z load, such as an oscilloscope. For better noise and performance characteristics it is recommended that a 50 W coax cable with a 50 Ω terminating resistor be used. The Photodetector input and output BNC's are located on the rear panel.

DC Offset Control

The DC Offset provides a continuously adjustable offset voltage over the range of 0 to 15 V using a 10-turn potentiometer. This offset adds directly to the ramp signal. The DC offset control is used to adjust the waveform from left to right across an oscilloscope viewing window, without affecting the calibration of the cavity.

Sweep Expansion Control

The sweep expansion provides a zoom capability to increase the spectral display resolution by a factor of 1x, 2x, 5x, 10x, 20x, 50x, and 100x. This is achieved by scaling the ramp rise time to the sweep expansion.

Waveform Control

The SA201 allows the user to select between a saw-tooth and triangular waveform. The saw-tooth waveform is desirable for most applications; however the triangle waveform is useful for cavity alignment. The SA201 will default to the saw-tooth waveform during the system power-up. To change the waveform, simply press the 'WAVEFORM SEL' button. The selected waveform is indicated by the illuminated symbol to the right of the waveform select button.

Power Switch

The power switch is used to toggle the unit on and off.

Power On Indicator

The power on LED will light when the unit is powered up.

Amplitude Control

The amplitude control allows the user to adjust the ramp amplitude from 1 to 30 V peak to peak using a 10-turn trim pot. Note, the ramp signal is added to the DC offset. This means that when the offset is set to 0V, the ramp will start a 0V and increase to the amplitude limit setting. The amplitude is used to determine how far the mirror will be scanned, or to set the spectral range of the optical head.

Rise Time Control

The rise time control allows the user to continuously adjust the scan rate from 0.01 to 0.1 ms using a 10-turn trim pot. Note the rise time setting may be scaled by the sweep expansion setting. For example: If the scan rate is set to 0.05 s and the sweep expansion is adjusted from 1x to 100x then the scan rate will adjust to 5 s. The scaling error is typically less than ±0.5%, providing excellent measurement capabilities.

Trigger Output BNC

This trigger output signal may be used to externally trigger the oscilloscope. The trigger is capable of driving 50 Ω terminated cables, as well as Hi Z loads such as oscilloscopes. The trigger will provide an edge on the beginning and middle of the scanning ramp. See Figure 2 below.

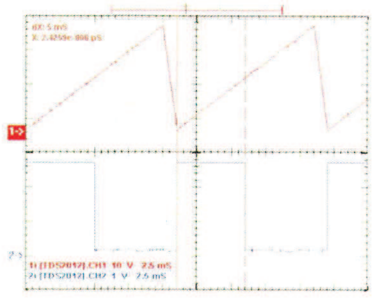


Figure 2: Trigger Logic

Output BNC

The output BNC is used to drive the SA200 scanning piezos from 1 to 45 V. The output is capable of driving 0.6 µF piezo loads at a ramp rate of 1 ms over the full voltage range. The output current is internally limited to prevent damage to the output drive. Note: the output performance specifications assume a Thorlabs Fabry Perot Interferometer module is connected.

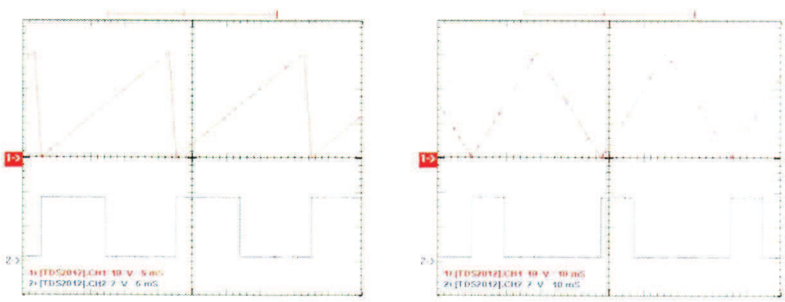


Figure 3: Saw tooth Waveform (left), Triangle Waveform (right)

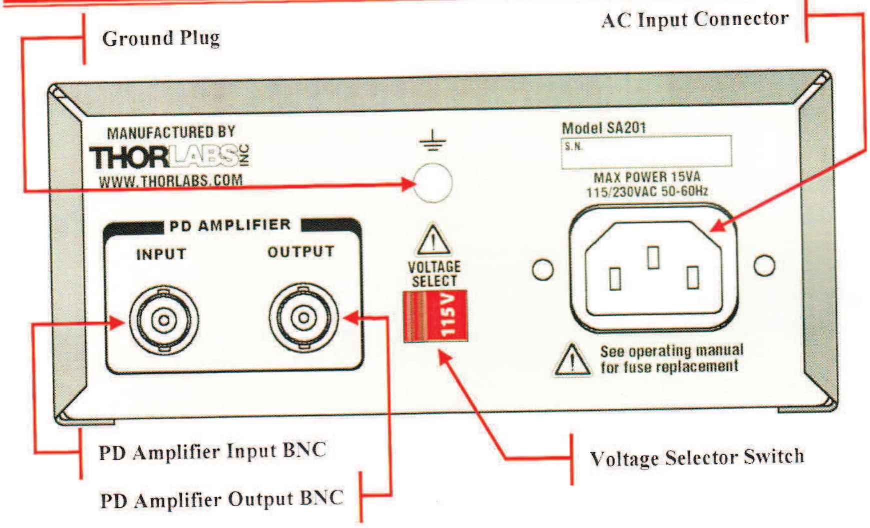


Figure 4: SA201 Rear Panel Connections

Ground Plug

This ground plug is for use as a general-purpose ground connection. It is connected directly to the earth ground connection of the input power plug.

AC Input Connector

This is the line voltage input connection. IMPORTANT: The unit is configured for 100/115 VAC, 50 – 60 Hz from the factory. To operate at 230 VAC see page 11.

PD Amplifier Input BNC

This input BNC is used to interface the photodetector, provided with the SA200 scanning heads, to the amplifier circuit. The photodiode amplifier is configured to operate with the Thorlabs supplied photo detectors; however it is possible to operate user supplied photo detectors. To do so, the BNC center contact must be connected to the photo detector cathode and the BNC shell must be connected to the photodiode anode (unbiased operation). If a biased detector is to be used the BNC shell must be connected to the bias ground and the bias voltage must be negative for the circuit to operate properly.

PD Amplifier Output BNC

This BNC is the amplifier output and may be connected directly to an oscilloscope to view the cavity spectrum. The amplifier gain will be set using the front panel 'DETECTOR' control knob. The amplifier output includes a 50 Ω series resistor to minimize noise when operating with a 50 Ω coax cable. For best results, a 50 Ω load resistor is recommended at the oscilloscope. Note, the amplifier gain will be halved with a 50 Ω load connected.

Voltage Selector Switch

The voltage selector switch allows the user to select the input line voltage. The factory default setting is 100/115 VAC as shown in figure 4. To operate at 230 VAC, this switch will have to be moved to the 230 V position. The line fuse will also need to be changed to properly protect the unit. See page 11 for detailed instructions.

Part 3. Operation

3.1. PD Blanking Circuit

The detector amplifier includes a blanking circuit, which blocks any photodetector response during the falling edge of the saw tooth waveform. This is very useful when triggering on the photodiode spectral response, because unwanted signals while the cavity resets will be removed. The blanking is not available when using the triangle waveform, since it is useful to see the rising and falling response overlapped during system alignment. This feature may be disabled as described below:

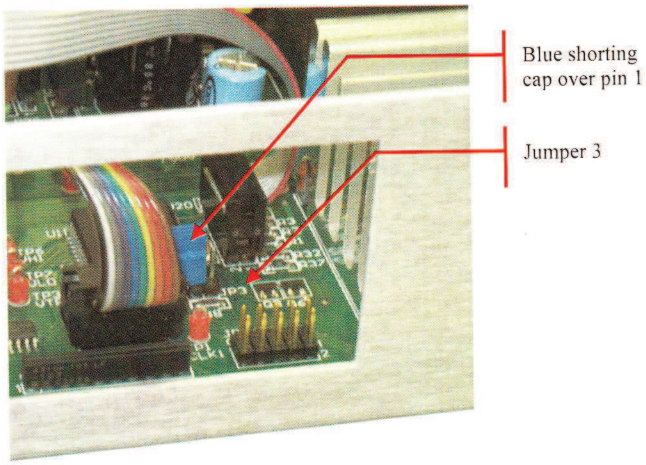
IMPORTANT

Disconnect the scanning head or any piezo device from the SA201 output. Disconnect the power cord.
Do not open the unit if the power cord is connected.

1 Remove the two screws securing the enclosure cover with a Phillips head screwdriver. The screws are located on the bottom side, rear corners of the unit. Do not lose the screws.

2 Carefully remove the cover by sliding toward the rear of the unit.

3 Locate the JP3 header. It is positioned in front of the heat sink and will have a shorting jumper on pin 1.



4 Remove the shorting jumper and place across (shorting) the JP3 pins to disable the blanking circuit. The default setting will be blanking enabled. The jumper will not be shorting the pins.

5 Replace the enclosure cover and secure with the enclosure screws.

3.2. Replacing the Fuse

DANGER!

The Thorlabs Spectrum Analyzer Controller, SA201, must be powered off, unplugged from the AC input source, and disconnected from any piezo elements prior to replacing the fuse or removal of the cover. Failure to do so may cause SERIOUS INJURY to the user, since high voltages exist within the unit.

Materials Needed

- SA201 Operating Manual – The most recent version of this operating manual will be available on the Thorlabs web site.
- 250 mA Type 'T' Slow Blow Fuse – The 250 mA fuse is installed from the factory. This must be installed when operating the unit at 100/115 VAC.
- 125 mA Type 'T' Slow Blow Fuse – The 125 mA fuse is required for 230 V operation only. Thorlabs supplies a 125 mA fuse with all of its SA201 units and must be installed when operating at 230 VAC.
- Phillips Head Screwdriver (#2 Preferred) – We do not recommend using electrically powered screwdrivers.

Fuse Replacement

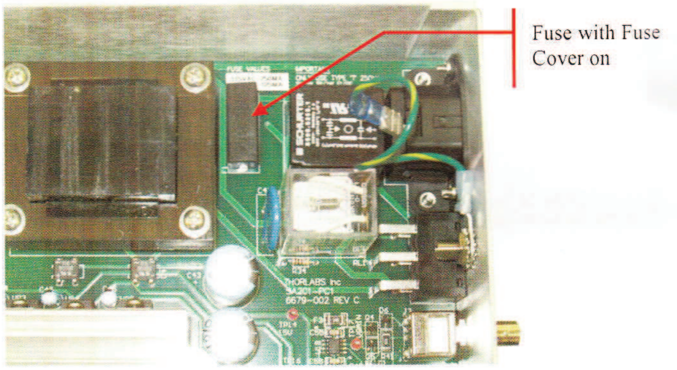
IMPORTANT

Disconnect the scanning head or any piezo device from the SA201 output. Disconnect the power cord.
Do not open the unit if the power cord is connected.

1 Remove the two screws securing the enclosure cover with a Phillips head screwdriver. The screws are located on the bottom side, rear corners of the unit. Do not lose the screws.

2 Carefully remove the cover by sliding toward the rear of the unit.

3 Locate the fuse box between the input line voltage connector and the transformer.



4 Remove the fuse cover and slide the old fuse out.

5 Install the new fuse into the fuse cover and place back into the fuse box. (250 mA for 100/115 VAC and 125 mA for 230 VAC)

6 Replace the enclosure cover and secure with the enclosure screws.

Selecting the Line Voltage

1. Replace the line fuse as described above.
2. Locate the voltage selector switch on the rear panel. See page 9.
3. Switch to the appropriate line voltage.
4. Install the appropriate line cord.

Cleaning

The SA201 should only be cleaned with a soft cloth and a mild soap detergent or isopropyl alcohol. Do not use a solvent-based cleaner.

Part 4. Recommended Setup

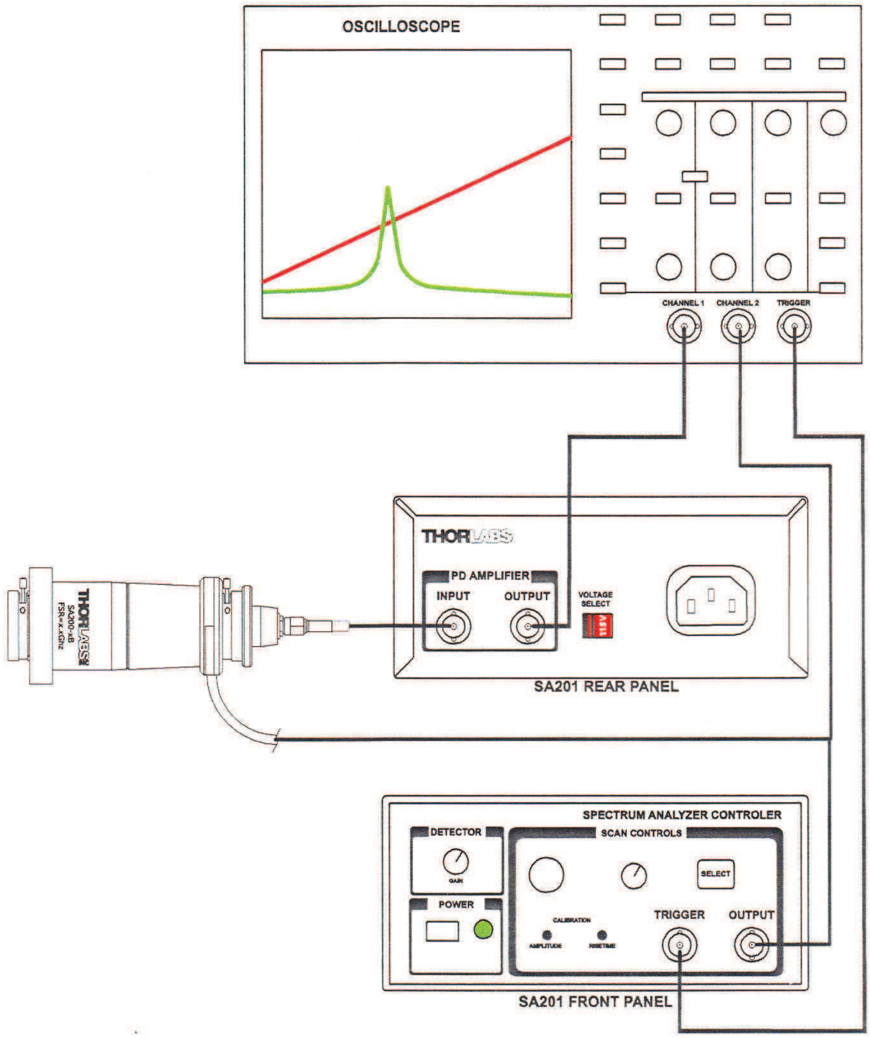


Figure 5: Recommended Setup Diagram

Part 5. Specifications

Output Characteristics

Item #	SA201
Waveforms	Saw tooth / Triangle
Default Waveform	Saw tooth
Saw tooth Fall Time	1 ms Typical
Output Voltage Range	1 to 45 V (offset + amplitude)
Max Supply Current [a]	15 mA
Short Circuit Current [b]	26 mA Max
Short Circuit Duration [b]	Continuous
Offset Adj. Range	0 to 15 VDC
Amplitude Adj. Range	1 to 30 V
Rise Time Adj. Range [c]	0.01 to 0.1 s @ 1X Sweep Exp. 1 to 10 s @ 100X Sweep Exp.
Sweep Expansion Settings	1X, 2X, 5X, 10X, 20X, 50X, 100X
Sweep Scale Error [d]	±0.5%
Output Noise [e]	1 mV_{RMS} (~6.6 mV_{PP})

Trigger Characteristics

Item #	SA201
Trigger Output Voltage	TTL levels
VOH (RL = 50 W)	2 V Min
VOL (RL = 50 W)	0.5 V Max
Trigger Load Impedance	50 W/Hi-Z
Trigger Rising Edge [f]	Ramp Start
Trigger Falling Edge [f]	Ramp Midpoint

Photodiode Amplifier Characteristics

Item #	SA201
Gain Steps	0, 10, 20 dB
Transimpedance Gain (Hi-Z)	10K, 100K, 1M V/A
Transimpedance Gain (50Ω) 7	5K, 50K, 500K V/A
Gain Error[G]	±0.1% @ 10K (±0.12%) ±0.12% @ 100K (±0.15%) ±0.14% @ 1M (±0.3%)
Output Impedance	50 Ω
Load Impedance	50 Ω/Hi-Z
Output Voltage (Hi-Z load)	0 – 10 V Min
Output Voltage (50Ω load)	0 – 5 V Min
Max Output Current [h]	100 mA
Bandwidth [h]	250KHz
Noise (RMS) [h]	<0.1 mV @ 10K 0.2 mV @ 100K 1.5 mV @ 1M
Offset [h]	±1 mV @ 10K ±5 mV @ 100K ±20 mV @ 1M

Physical Features

Item #	SA201
Dimensions (W x H x D)	5.8" x 2.8" x 12.5" (147 mm x 71 mm x 317.5 mm)
Input and Output Connectors	BNCs
Offset Control	10-turn Potentiometer
Amplitude Control	10-turn Trim pot
Rise Time Control	10-turn Trim pot
Sweep Expansion Control	7-Position Rotary Switch
Photodiode Gain Control	3-Position Rotary Switch
Waveform Select	Pushbutton w/ Illuminated Indicators
PD Amplifier Features	Blanking with Saw Tooth Waveform Falling Edge
Operating Temperature	10 to 40 °C
Storage Temperature	0 to 85 °C

Power Supply

Item #	SA201
Supply Type	Linear
Voltage Selection	Switch Selectable Between 115/230 VAC
Input Voltage	100/115/230 VAC
Line Frequency	50 – 60 Hz
Input Power	15 W Max
Fuse Ratings	250 mA @ 100/115 VAC, 125 mA @ 230 VAC
Fuse Type	Slow Blow Type 'T'

a) Achieved during the saw tooth waveform fall time. This is calculated by

$$I\ (\text{ma}) = \frac{\left(C_{piezo}(\mu\text{F})\right)(\Delta V_{max})}{\Delta t_{fall}}$$

b) The output drive amplifier will current limit the load to 26 mA max. Although the unit may operate continuously under these conditions, it is not recommended since the unit will heat up causing stress to the electronics.

c) The rise time adjustment range for each sweep setting is as follows:

$$= (0.01\ \times \text{Sweep Expansion Setting})\ \text{to}\ (0.1 \times \text{Sweep Expansion Setting})$$

d) Defined as the scaling error between 1X and any other gain settings (ex. 2X ± 0.5%).

e) Measures with SA200 series scanning head connected to output.

f) 'Ramp' refers to the rising, or scanning, edge of the 'Output' waveform.

g) The gain error does not apply when using a 50 Ω load since the user-installed output terminator will probably have a resistance tolerance greater than the gain errors above. Also note that the 50 W output series resistance is 49.9 W ± 1%. This will also factor into gain error when using a 50 Ω load.

h) Test performed with a 50 Ω terminator and a 6' (~1.8 m) 50 Ω coax cable.

Part 6. Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return "end of life" units without incurring disposal charges.

- This offer is valid for Thorlabs electrical and electronic equipment:
- Sold after August 13, 2005
- Marked correspondingly with the crossed out "wheelie bin" logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated

Wheelie Bin Logo

As the WEEE directive applies to self contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e.g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB's, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

6.1. *Waste Treatment is Your Own Responsibility*

If you do not return an "end of life" unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

6.2. *Ecological Background*

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

Part 7. Thorlabs Worldwide Contacts

USA, Canada, and South America
Thorlabs, Inc.
435 Route 206
Newton, NJ 07860
USA
Tel: 973-579-7227
Fax: 973-300-3600
www.thorlabs.com
email: feedback@thorlabs.com

Europe
Thorlabs GmbH
Hans-Böckler-Str. 6
85221 Dachau
Germany
Tel: +49-(0)8131-5956-0
Fax: +49-(0)8131-5956-99
www.thorlabs.de
email: Europe@thorlabs.com

UK and Ireland
Thorlabs LTD.
1 Saint Thomas Place, Ely
Cambridgeshire CB7 4EX
Great Britain
Tel: +44 (0)1353-654440
Fax: +44 (0)1353-654444
www.thorlabs.de
email: sales.uk@thorlabs.com

France
Thorlabs SAS
109, rue des Côtes
78600 Maisons-Laffitte
France
Tel: +33 (0) 970 444 844
Fax: +33 (0) 811 381 748
www.thorlabs.de
email: slaes.fr@thorlabs.com

Scandinavia
Thorlabs Sweden AB
Box 141 94
400 20 Göteborg
Sweden
Tel: +46-31-733-30-00
Fax: +46-31-703-40-45
www.thorlabs.de
email: scandinavia@thorlabs.com

Japan
Thorlabs Japan Inc.
5-17-1, Ohtsuka
Bunkyo-ku, Tokyo 112-0012
Japan
Tel: +81-3-5979-8889
Fax: +81-3-5979-7285
www.thorlabs.jp
email: sales@thorlabs.jp

China
Thorlabs China
Oasis Middlering Centre
3 Building 712 Room
915 Zhen Bei Road
Shanghai
China
Tel: +86 (0)21-32513486
Fax: +86 (0)21-32513480
www.thorlabs.com
email: chinasales@thorlabs.com

Thorlabs, Inc.
435 Route 206N
Newton, NJ 07860 USA

Phone: (973) 579-7227 ♦ Fax: (973) 300-3600
www.thorlabs.com