SPECTROPHOTOMETER

MODEL S-1100

Operation Manual

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General Information

The spectrophotometer described in this manual is designed to be used by properly trained personnel in a suitable equipped laboratory. For the correct and safe use of this spectrophotometer it is essential that laboratory personnel follow generally accepted safe procedures in addition to the safety precautions called for in this manual. The inside of the power supply unit is a hazardous area and its cover should not be removed under any circumstances. **ANY Servicing** must be done by an authorized person. Some of the chemicals you use in the spectrophotometer may be corrosive, flammable, radioactive, toxic, and/or potentially infective. Care should be taken to follow the normal laboratory procedures for handling chemicals and samples.

Safety

This spectrophotometer has been designed and tested in accordance with EN 61326-1: 1997 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use standard (EMC Requirements). The spectrophotometer has been tested and supplied in a safe condition. The safety statements in this manual comply with the requirements of the HEALTH AND SAFETY AT WORK ACT, 1974.

Electrical

Before switching on the spectrophotometer, make sure it is set to the voltage of the local power supply (see **Installation** section). The main plug shall be inserted in a socket provided with a protective earth grounded contact. The protective action must not be negated using an extension cord without a protective conductor.

Warning

Any interruption of the protective conductor inside or outside the spectrophotometer or disconnection of the protective earth terminal is likely to make the spectrophotometer dangerous. Intentional interruption is prohibited. Whenever it is likely that the protection has been impaired, the spectrophotometer shall be made inoperative and be secured against any unintended operation. The protection is likely to be impaired if the spectrophotometer

- Shows visible damage
- Fails to perform the intended measurements
- Has been subjected to prolonged storage under unfavorable conditions
- Has been subjected to severe transport stresses

Performance

Carry out performance checks with reference to wavelength and absorbance accuracy to ensure that the spectrophotometer is working within its specification. Some performance checks methods are detailed in this manual.

Interference

For compliance with the EMC standards referred to in the EC Declaration of Conformity, it is necessary that only shielded cables supplied by UNICO are used when connecting the instrument to computers and accessories.

Introduction

The UNICO 1100 Spectrophotometers are single beam, general purpose instruments designed to meet the needs of the conventional laboratory

Featuring a digital display of photometric result, easy operation, and wavelength range of 335 to 1000 nm, UNICO 1100 series are ideal for measurements in the visible wavelength region of the electromagnetic spectrum.

Working Principle

The spectrophotometer consists of five parts:

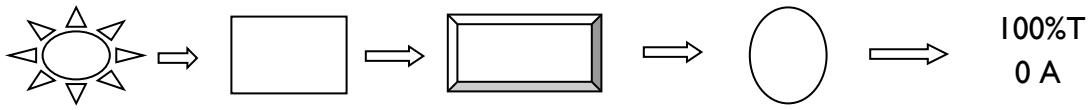
1) **Light Source** (Halogen Lamp) to supply the light;

2) **A Monochromator** to isolate the wavelength of interest and eliminate the unwanted second order radiation;

3) **A Sample Compartment** to accommodate the sample solution;

4) **A Detector** to receive and convert the transmitted light to an electrical signal;

5) **A Digital Display** to show absorbance or transmittance. Diagram below illustrates the relationship between these parts.



Light Source Monochromator Sample Compartment Detector Digital Display

The light from the Halogen Lamp is focused on the entrance slit of the Monochromator where the collimating mirror directs the beam onto the grating. The grating disperses the light beam to produce the spectrum, a portion of which is focused on the exit slit of the Monochromator by a collimating mirror. From here the beam is passed to a Sample Compartment through one of the filters, which helps to eliminate unwanted second order radiation from the diffraction grating. Upon leaving the Sample Compartment, the beam is passed to the silicon photodiode Detector and causes the Detector to produce an electrical signal that is shown on the Display

Specifications

	Model S-1100
Wavelength Range	335-1000 nm
Spectral Bandpass	20 nm
Wavelength Accuracy	± 2 nm
Wavelength Repeatability	± 1 nm
Stray Radiant Energy	< 0.5 %T at 340 and 400 nm
Photometric Range	0-125%T 0-2.0 Abs
Photometric Accuracy	± 2.0%T
Power Requirements	115/230 V ±10%, 60/50 Hz
Dimensions	408W X 308D X 185H (mm)
Net Weight	6kg (13 lbs)

Unpacking Instructions
Carefully unpack the contents and check the materials against the following packing list to ensure that you have received everything in good condition:

Packing List

Item	Quantity
Spectrophotometer	1
Power Cord	1
Cuvette (round)	Box of 12
Square Cuvette Adapter	1
Dust Cover	1
User's Manual	1
Allen Wrench	1

Installation
Place the instrument on a dry, dust free lab bench top. In order to have the best performance from your instrument, keep it as far as possible from any strong magnetic or electrical fields or any electrical device that may generate high-frequency fields. Set the unit up in an area that is free of dust, corrosive gases and strong vibrations. Remove any obstructions or materials that could hinder the flow of air under and around the instrument. Turn on your spectrophotometer and allow it to warm up for 15 minutes.

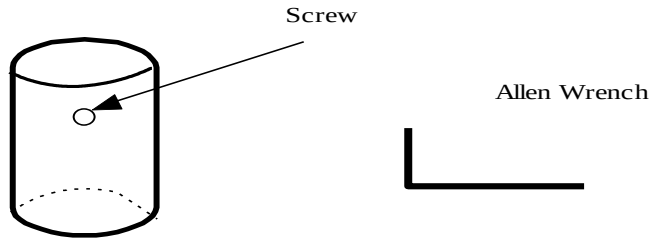
S-1100 Spectrophotometer

1100 Spectrophotometer Operation Panel

Mode Indicator: *Show the current measurement mode (**T**--%Transmittance, **A**--Absorbance)*
MODE Button: *Switch between **T** and **A** measurement modes.*
0A/100%T Button: *Adjust Digital Display reading to 100%T or 0.000A when blank reference solution is in Sample Compartment.*
Sample Compartment: *Accepts 10 mm test tube or 10 mm square cuvette (the square cuvette adapter is required).*
WAVELENGTH (Wavelength Control) Knob: *Select desired wavelength in nanometers (nm).*
Wavelength Readout Window: *Display desired wavelength.*

Changing Sample Holders
Your spectrophotometer comes standard with a 10 mm path length **Sample Holder** which will accept round tube, or square cuvets.
Follow the steps below to change the Cuvette **Sample Holder**:

- Open the lid of the **Sample Holder** and locate the **Sample Holder Locking Screw**
- Use the **Allen Wrench** (included) to loosen the **Screw** counterclockwise
- Remove the **Sample Holder** you want to change, insert the one you want to install, align it properly, and fasten the **Screw**



Basic Operation

NOTE: **OPERATING INSTRUCTIONS** are printed on the front panel of the instrument.

Sample Preparation and Analysis

A. ***Spectrophotometer Warm-up***

1. Turn on the spectrophotometer by turning on the Power Switch (**IO**). Allow a minimum 15 minutes for the instrument to warm up.
2. Select either the **T** (Transmittance Mode) or **A** (Absorbance Mode) by pressing the **MODE** button until the red light for **T** or **A** is on.
3. Select the desired wavelength by turning the **WAVELENGTH** control knob.

B. Sample Preparation

1. Make a blank reference solution by filling a clean square cuvette (or test tube) half full with distilled/de-ionized water or other specified solvent. Wipe the cuvette with tissue to remove the fingerprints or droplets of liquid.
2. Insert the blank square cuvette into the square cuvette adapter and place the adapter in the Sample Compartment (if using test tube, insert it directly into the Sample Compartment, aligning the guide mark (if present) with the guide mark at the front of the Sample Compartment). Close the lid.
3. Set 0.000A or 100%T with the **0A/100%T** button.

NOTE: This step fulfills the instructions on the front of the spectrophotometer

4. Remove the blank square cuvette or test tube. Set it aside in case you may need to adjust the 0A/100%T using **0A/100%T** button later (i.e. change the wavelength).

C. Sample Analysis

1. Rinse a second square cuvette with a small amount of the sample solution to be tested. Fill the square cuvette half full and wipe clean the exterior of the cuvette.
2. Put the sample cuvette in the Sample Compartment. Close the lid.
3. Read the **T** or **A** from the Digital Display window. Remove the sample cuvette or test tube.
4. If you are to test the same sample at other wavelengths, repeat **step 3 to B. 1 – 4** for each wavelength.
5. For each new sample you analyze, repeat **step 2 to C. 4**.

Output and Data Processing

USB Data Port

Model **1100** has a USB port which will allow you to interface with a Windows® based computer for use with optional software, contact UNICO for details.

The **Spectrophotometer Application Software** is Windows-based software designed to operate with your spectrophotometer using the USB port. The software runs on a PC with Windows® XP/7/10 operating system installed. You can export data files collected from the spectrophotometer into Excel® format if needed. The software offers two additional analytical methods: **Standard Curve** and **Absorbance vs. Time Kinetics**. It performs the following methods for analysis:

- **Absorbance/%Transmittance/Concentration** Measure the Absorbance, %Transmittance, Concentration/Standard, or Concentration/Factor at a single wavelength within the range of **335**-**1000 nm.**
- **Standard Curve** Create a calibration curve (choice of 4 curve fits) with up to 8 standard solutions at a single wavelength to determine concentrations of unknown samples.
- **Absorbance vs. Time Kinetics** Measure a sample's absorbance change over a selected period of time, store the results in a data table, and display the results graphically.

Maintenance

Bulb Replacement

1. Turn off and unplug the instrument. Carefully turn the instrument upside down, making sure no cuvette or chemicals are in the Sample Holder.
2. Remove the grill plate on bottom of the instrument by removing the screw.
3. Unplug the bulb from the white connector. Insert the new bulb by pushing it in as far as it will go.

CAUTION: DO NOT HANDLE THE BULB WITH BARE FINGERS. USE TISSUE OR CLOTH WHEN HANDLING LAMP.

4. Turn on the instrument. Set the wavelength at 340 nm, insert a test tube or an empty cuvette with cuvette adapter, and blank the instrument. If the energy is low, adjust the lamp by "pulling" or "pushing" it so that the light beam is focused on the entrance slot of the monochromator. Since the lamp socket is pre-aligned, there will be little, if any, adjustment required.
5. Re-install the grill plate.

Wavelength Calibration Check

Normally the **1100** Series spectrophotometer retains its wavelength calibration indefinitely. However if the instrument receives a severe shock, or is shaken during transit or is abused, use the following methods to check wavelength calibration. Please note that this test requires the use of a didymium filter or a holmium oxide filter. Contact Carolina for availability and pricing of these filters.

In the filter method, the didymium filter has two distinct absorbance peaks at 529 nm and 807 nm. The holmium filter has a distinct peak at 361 nm. When the instrument is calibrated properly, you will find minimum Transmittance (maximum Absorbance) at the range ± 2 nm from these peaks. Note that the specific Transmittance values are not important as you are looking only for the wavelength where the minimum Transmittance (maximum Absorbance) occurs.

Note: *If your calibration filter has a certified peak/valley curve attached, please use the peaks on the curve to verify the instrument.*

Holmium Oxide Filter Method

1. Turn instrument on and allow it to warm up for 15 minutes.
2. Select the **A** mode.
3. Set the wavelength to 350 nm.
4. Make sure the cuvette adapter is empty and place it in the Sample Compartment. Close the lid.
5. Set zero Absorbance by pressing the **0A/100%T** (Λ) button. Wait a few seconds when the display flashes. The reading should be 0.000A. If not, repeat **step 5**.
6. Remove the Cuvette Holder and insert the Holmium filter into it. Place it in the Sample

Compartment again and close the lid.
7. Record the Absorbance reading on the Digital Display window.
8. Advance the wavelength setting by 1 nm and repeat **steps 4 to 7**.
9. Repeat **step 8** until the wavelength setting reaches 370 nm.
10. Look for the maximum absorbance reading obtained, and this should be found within 359~363 nm. The wavelength accuracy of the unit is ± 2 nm.

Didymium Filter Method

1. Set the Wavelength to 800 nm.
2. Make sure the cuvette adapter is empty and place it in the Sample Compartment. Close the lid.
3. Set zero Abs by pressing the **0A/100%T** (**Λ**) button. Wait a few seconds when the display flashes. The reading should then be 0.000A. If not, repeat **step 3**.
4. Remove the Cuvette Holder and insert the Didymium filter into it. Place it in the Sample Compartment and close the lid.
5. Record the Absorbance reading on the Digital Display window.
6. Advance the wavelength setting by 1 nm and repeat **steps 2 to 5**.
7. Repeat **step 6** until the wavelength setting reaches 815 nm.
8. Look for the maximum absorbance reading obtained, it should be within 805-809 nm. The wavelength accuracy of the unit is ± 2 nm.
9. If a "middle" wavelength check is desired, set the wavelength to 522 nm (optional)
10. Make sure the cuvette adapter is empty and place it in the Sample Compartment. Close the lid.
11. Set zero Abs by pressing the **0A/100%T** (**Λ**) button. Wait a few seconds when the display flashes. The reading should then be 0.000A. If not repeat **step 11**.
12. Remove the cuvette adapter and insert the Didymium filter into it. Place it in the Sample Compartment again and close the lid.
13. Record the absorbance reading on the Digital Display window.
14. Advance the wavelength setting by 1 nm and repeat **step 10 to 13**.
15. Repeat **step 14** until the wavelength setting reaches 536 nm. Again, look for the maximum absorbance reading. It should be within 527-531 nm.

Absorbance Accuracy Check

Specification: ± 2% at 1A (**65-3303**)

The absorbance accuracy should be checked against a set of neutral density filters accurately calibrated to the NIST standards. Contact your **Carolina** representative for more information.

Stray Light Check

Specification: Less than 0.5%T at 340 nm by ASTM (American Society for Testing and Materials) E 387 (Molecular Spectroscopy and Separation Science Standards), also see www.astm.org

A good indication as to whether the stray light level is within specification may be obtained as follows:

1. Set the wavelength to 340 nm.
2. Set the **MODE** button to **T**.
3. With the square cuvette adapter in the Sample Compartment without a cuvette close the lid and press the **0A/100%T** (∧) button to set the display to 100.0%.
4. Remove the cuvette adapter from the Sample Compartment and close the lid. Make a note of the reading that should be at or near 0.00.
5. Prepare a solution containing 50 mg/L of sodium nitrite ($NaNO_2$) in distilled water and fill a square cuvette with this solution.
6. Insert the cuvette into the cuvette adapter, place it in the Sample Compartment, and close the lid. The display should read < 0.5%T. If the reading obtained in **step 4** is greater than 0.00, it should be subtracted from the displayed reading to give the correct reading for the stray light value.

Troubleshooting

PROBLEM	Possible Cause	Solution
Instrument Inoperative (Power indicator has no light)	Power cord not connected to outlet	*Plug instrument in.*
	Dead Power outlet. Wrong voltage setting.	*Change to a different outlet.*
	Internal fuse blown or defective electronic component.	*Call an authorized service engineer.*
Instrument can not set 100%T (0.000A)	No Cuvette Adapter in the Sample Compartment.	*Cuvette Adapter must be in Sample Compartment to open sample holder shutter.*
	Light beam blocked: • Holder misaligned • Shutter	*Check sample holder.*
	Lamp is old or defective.	*Replace lamp/bulb.*
	Lamp is off alignment.	*Refer to lamp Replacement instructions in this manual.*
	Defective electronic component.	*Call an authorized service engineer.*
%T can not be set to 00.0%T	Sample holder.	*Remove Cuvette Adapter or test tube.*
	Sample holder shutter.	*May be stuck open, close shutter.*
	Defective electronic component.	*Call an authorized service engineer.*
Incorrect	Bubbles or particles in solution.	*Check sample preparation*

Transmittance to Absorbance correlation		*and analytical procedure.*
	Defective electronic component.	*Call an authorized service engineer.*
Digital Display does not change	Wrong wavelength setting.	*Check sample procedure and wavelength setting.*
	Insufficient sample volume.	*Fill cuvette with more sample.*
	Stray sample preparation vapors.	*Prepare the sample away from the instrument. Use proper ventilation.*
	Bubbles or particles in solution.	*Check sample preparation and analytical procedure.*
	Defective electronic component or loose wiring.	*Call an authorized service engineer.*
Instrument drift and noise	Insufficient warm up time. Significant temperature change. Lamp not adjusted properly.	*Check if lamp has been properly installed or has moved during transit.* *Refer to lamp Replacement instructions in this manual.*
	Lamp old or defective.	*Replace with a new lamp.*
	Sample Holder Misaligned.	*Refer to Lamp Replacement instructions in this manual.*
	Unstable power supply Defective or dirty detector or defective electronic component.	*Call an authorized service engineer.*
Incorrect readings obtained	Insufficient sample volume.	*Fill cuvette with more sample.*
	Wrong wavelength setting. Failed to blank (0A/100%T). Failed to set 0%T.	*Check analytical procedure and wavelength setting.* *Check wavelength accuracy*
	Stray sample preparation vapors.	*Prepare sample away from instrument. Use proper ventilation.*
	Bubbles or particles in solution.	*Check sample preparation and analytical procedure.*
	Instrument out of electronic calibration.	*Call an authorized service engineer.*