Modulus™ Single Tube Operating Manual

Dated: 01/08/2009
Version: 1.2
Part Number: 998-9203

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I. Introduction

Description

The Modulus is a multimode laboratory instrument that can be used to measure luminescence, fluorescence, or absorbance. The instrument is modular and each detection mode can be purchased separately. The luminescence module is factory installed; the fluorescence and absorbance modules can be either factory installed or user installed. Fluorescence measurements are taken using one of 4 different optical filter kits, depending on the detection wavelengths needed. Absorbance measurements are taken using one of 3 different filters inserted into the absorbance module.

Unpacking and Inspection

Upon receiving the Modulus, please inspect it carefully and make certain all accessories are present. Refer to the checklist shipped with the instrument for order-specific items.

A typical Modulus shipment includes:

- Modulus (9200-000, 9200-001, 9200-002, or 9200-003)
- Power Supply Kit
- RS-232 Cable
- Spreadsheet Interface Software (SIS) CD-ROM
- Quick Start Guide
- 10 x 10 mm Methacrylate Cuvettes (quantity of 4)
- Warranty Registration Card
- Fluorescence Optical Kit(s) (optional)
- Luminometer Module (Models 9200-001, 9200-002 & 9200-003 only)
- Absorbance Module (Model 9200-003 only)
- Absorbance Filter Paddle(s) (Model 9200-003 only)

Precautions

The Modulus is intended for indoor use only. Wipe up spills immediately. The Modulus contains sensitive optical components and precision-aligned mechanical assemblies. Avoid rough handling. Do not leave the lid open for extended periods of time. Power OFF the Modulus to change Optical Kits or to install a different module.

Setup

Unpack the instrument

Place the Modulus on a flat, level surface. Allow at least 6 inches (16 cm) of clearance above the instrument to open and close the lid. Position the instrument so that the touchscreen faces you (Figure 1).

Figure 1

Power Supply

1. Connect the power supply into the power connection of the instrument and plug it into a wall outlet. See "Appendix – C General Specifications" for maximum wall output.
2. Turn ON the ON/OFF switch located at the back of the Modulus (Figure 2).

Serial Port- connect to the serial port of your computer

ON/OFF Switch

Power Connection
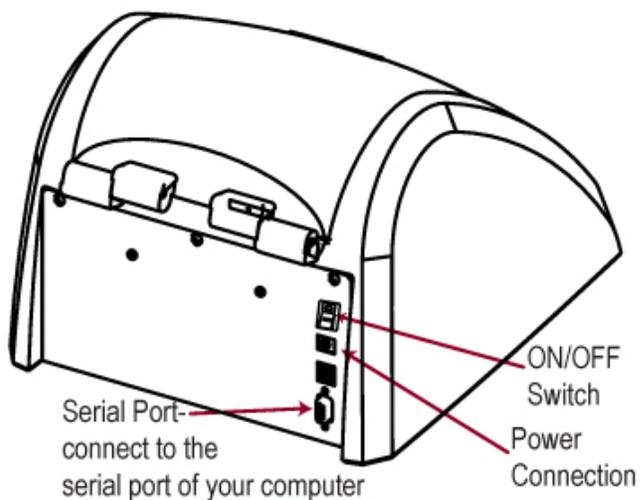
Figure 2

PC Operation (optional)

Software Installation
1. Install the Spreadsheet Interface Software (SIS) onto a PC to send data to an Excel spreadsheet.
   - The Spreadsheet Interface Software requires a PC loaded with Windows '98 or XP, an available serial port, and Excel.
2. Insert the software CD-ROM into the CD-ROM drive of the PC to initiate the installation program.
3. After the installation is complete, an SIS icon will appear on the PC desktop and in the "Programs" menu.

Connecting to a computer or thermal printer (P/N 700-919)
1. Connect the 9-pin RS-232 serial cable between the Modulus and the PC or thermal printer.
2. The male 9-pin connector attaches to the Modulus and the female connector attaches to the PC or printer.
3. If the PC does not have a serial cable port, use the enclosed USB-serial adapter.

Exporting data to Excel
1. When the Modulus is connected to a PC, open the SIS software on the PC.
2. An Excel sheet will automatically open when the software is loaded.
3. Measurements from the Modulus are automatically transferred to the Excel sheet.
Note: a PC connection is required for using the Luminescence module in kinetics mode or the Fluorescence or Absorbance modules in repeat measurement mode.

II. Touchscreen Basics

The touchscreen provides a user-friendly method to operate the Modulus. The touchscreen is sensitive to the light pressure of a fingertip. It is not necessary to use a stylus. After 20 minutes without activity or user stimulation, the touchscreen hibernates to conserve power. Lightly touch the screen once to reactivate. To select a function, touch the key corresponding to the function once.

Home Screen
See Fluorometer Operation (pg 8), Luminometer Operation (pg 13) or Absorbance Operation (pg 17 for specific details about the home screen for each module.

Tools
The Tools menu is accessible from the home screen regardless of which module is installed. Touch "Tools" to access "Settings" and "Diagnostics."

Settings
See Fluorescence, Luminescence or Absorbance sections for detection specific settings

The following general options can be found under the "Settings" menu:
- Contrast
- Reset
- Lid-Start

Contrast
Touch "Contrast" to increase or decrease the brightness of the touchscreen and enhance visibility. The arrows increase or decrease contrast. Touch "Home" to save the adjustment and return to the "Home" screen.
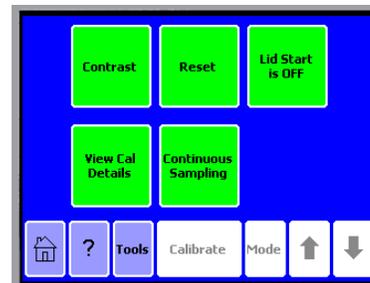
Reset
The "Reset" button restarts the Modulus. Normal operation does not require this feature. The Reset feature erases the data displayed on the "Home" screen.

Lid Start
When the Lid Start feature is ON, measurement begins as soon as the lid closes. The Lid Start feature allows for immediate measurement and eliminates the need to touch the "Measure" key. Touch "Lid Start" to turn the feature ON. While the Lid Start feature is ON, the touchscreen does not hibernate. Return to the Lid Start key under the "Settings" menu to turn the feature OFF.

Diagnostics
The following options can be found under the "Diagnostics" menu:
- Touchscreen Calibration
- Device Configuration

Touchscreen Calibration
The "Diagnostics" menu contains a method for screen calibration. Although the touchscreen is calibrated at the factory, it may need re-calibration over time.
1. Touch "Touchscreen Calibration"
2. When the screen reads "Please touch the calibration point" touch the gray box on the x with your finger or a dull object like a pen cap – do not use a pen or anything sharp as this might damage the screen.
3. A second gray box will appear when the first x has been touched. Touch this x.
4. Options for saving the calibration will appear. Touch "Apply New Calibration", "Reset To Factory Calibration", or "Abort Calibration" depending upon what you would like to do.
5. The touchscreen can also be reset to factory calibration settings by powering off the instrument and then touching the screen during power on.
6. Keep your finger on the screen until the "Home" screen appears. The touchscreen should be re-set to factory settings at this time.

Device Configuration
The "Device Configuration" key displays details about the Modulus configurations including the current GUI and firmware versions. This information may be needed if you experience a problem with your instrument or if new firmware upgrades are released.

III. Fluorometer Operation

Fluorescence Optical Kit

If the Modulus is purchased with the Fluorescence option, there are 5 fluorescence kits available for standard purchase.

Kit	Excitation wavelength	Emission wavelengths	Common Fluorophores
UV (P/N 9200-041)	365 nm	410 – 460 nm	Hoechst Dye, 4-methyl-umbelliferone (4-MU)
Blue (P/N 9200-040)	460 nm	515 – 570 nm	EGFP, rAcGFP, PicoGreen[®], RiboGreen[®], Fluroescein, Quant-iT™ Protein
Green (P/N 9200-042)	525 nm	580 - 640 nm	Rhodamine, Cy[®]3, RFP
Red (P/N 9200-043)	625 nm	660 – 725 nm	Cy[®]5, Quant-iT™ RNA
GFPUV (P/N 9200-044)	365 nm	515 – 570 nm	GFPuv

Custom optical kits may also be purchased. Contact Turner BioSystems at 1.888.636.2401 for more details.

Optical Kit Installation
1. Power OFF the Modulus.
2. Grasp the handle of the Optical Kit and align the kit with the sample compartment.
3. Press down firmly to lock the Optical Kit in place. (See Figure 3.)
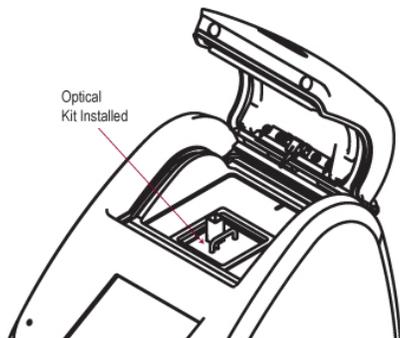
Figure 3

1. Close the lid and power ON the Modulus.
2. If you have installed a fluorescence or absorbance module, the touchscreen will display an entry screen with all of the module options. See figure 4.

Figure 4: Entry screen
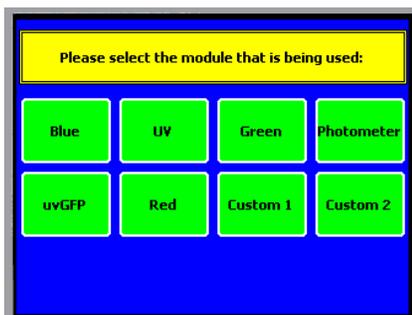
3. Select the module that you have installed.
4. Confirm the correct module has been selected.

Optical Kit Removal
1. Power OFF the Modulus before removing the Optical Kit.
2. Grasp the handle and gently pull up to release the kit from the sample compartment.
Warning: If the Modulus is also configured as a Luminometer, take care to keep the lid closed to protect the PMT from exposure to ambient light. In addition, do not leave the module slot empty; install another Fluorescence Optical kit or the Absorbance or Luminiescence Module immediately after removing the current Fluorescence Optical Kit.

Collecting Fluorescence Measurements

The Modulus accommodates 10 x 10 mm methacrylate and polystyrene cuvettes (minimum 2 mL volume). *Do not use glass or quartz square cuvettes.* The Minicell Adapter accommodates minicell cuvettes (minimum 75 µL volume). (see page X for more about the minicell adapter)

Figure 5: The Fluorescence Home Screen
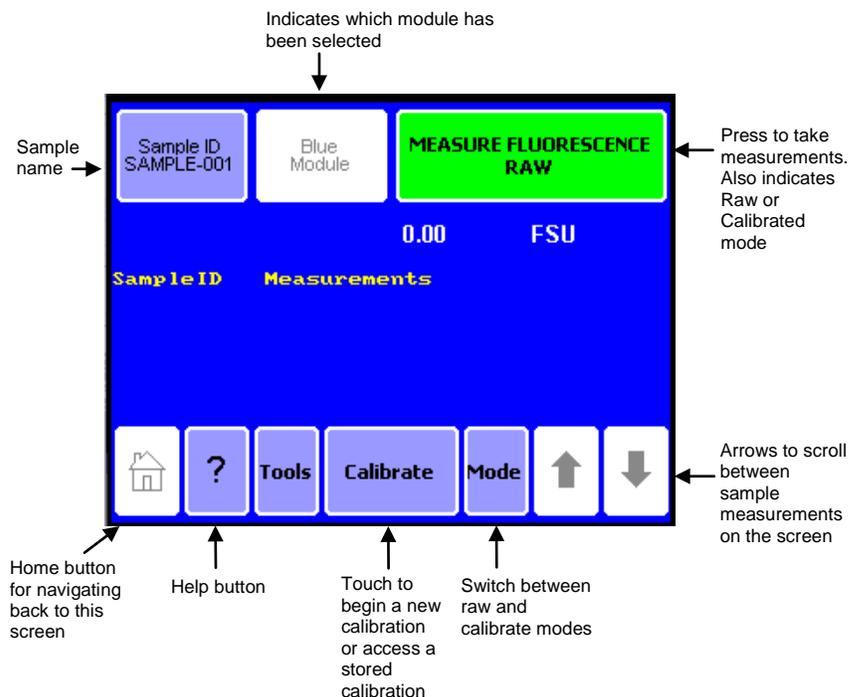
Home Screen
The "Home" screen appears after confirmation of the Optical Kit. The "Home" screen provides orientation for the multiple functions of the Modulus. From the "Home" screen, you can select "Calibrate," "Tools," "Mode," and "Help." The "Home" screen is also the measurement screen. The Modulus reports data on the "Home" screen and displays the results for the most recent 20 measurements. Use the arrow keys to scroll through the most recent measurements. The data exports to a printer or PC if properly connected.

Raw Fluorescence Mode - No Calibration Required
A calibration is not necessary to measure fluorescence with the Modulus. Simply use Raw Fluorescence Mode to obtain the fluorescent value of a sample in Fluorescence Standard Units (FSU). Use a standard curve to determine the concentration of the analyte in the samples. The Modulus does not manipulate the data in anyway while operating in the Raw Fluorescence Mode. It is not necessary to zero or blank the Modulus for Raw Fluorescence Mode.

Direct Concentration Mode - Calibration Required
The Direct Concentration Mode requires a calibration with one blank solution and between 1 – 5 standard solutions.

1. Touch "Calibrate" to begin a calibration sequence.
2. Select "Run New Calibration" to create a new calibration or "Use Stored Calibration" to access a previously saved file.
3. Select the unit of measure
4. Insert a sample blank containing water or assay buffer into the Module and press OK
5. Enter the concentration for the first standard. When using multiple standards, enter the standards in order of increasing concentration. (Use the least concentrated or lowest standard for the first standard.)
6. Insert the standard and press "Ok"
7. Either select "Enter More Standards" or "Proceed with Current Calibration"
8. Once the standards have been measured, press "Proceed with Current Calibration" and an option to save the calibration or proceed with a temporary calibration will be presented.
9. The instrument saves up to 18 calibrations
10. The Modulus calculates a point-to-point linear regression for multiple-standard calibrations.

Measuring Samples
1. Open the lid of the Modulus and insert the cuvette. Close the lid.
2. Touch "Sample ID" to name your sample (optional).
3. Using the keypad, enter the sample name into the name field. Touch "Save" to save the sample ID.
4. Touch "Measure Fluorescence" to commence measurement. The Modulus will measure the sample for 6 seconds and report the average reading per second for the sample.
5. The Modulus reports data on the "Home" screen and displays the results for the most recent 20 measurements.
6. Use the arrow keys to scroll through the measurements.
7. The data automatically exports to a printer or PC when properly connected (see page 5 for PC connection instructions).
Note: The Modulus does not store more than 20 measurements at one time. Measurements are not stored between power cycles.

Florescence Settings

Touch "Tools" to access "Settings."
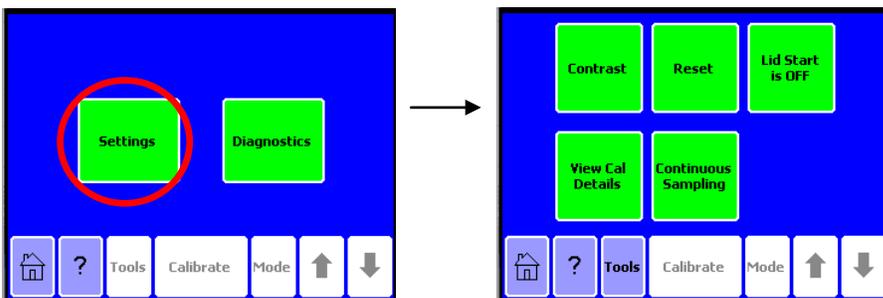
View Cal Details
Touch "View Cal Details" to see information on the current calibration for Direct Concentration Mode. "View Cal Details" specifically provides information on the raw fluorescence for each standard and the blank as well as the unit of measure and the Optical Kit.

Continuous Sampling
The Continuous Sampling feature enables repeat measurements at user-defined intervals. **Data must be collected via a PC or printer connection**.

1. Touch "Continuous Sampling" to turn the feature ON.
2. Touch "Frequency" and select a measurement frequency using the arrow buttons.
   a. Measurement frequency is in measurements/seconds and the options are 1/3 sec, 1/10 sec, 1/30 sec, 1/60 sec.
3. Touch "Total number of measurements" and select the total number of measurements using the arrow buttons. The maximum number of total measurements is 9999.
4. Touch "OK" to return to the "Home" screen.
5. Touch "Measure Fluorescence" to start the measurement.

Touching the screen repeatedly causes an early-abort of Continuous Sampling measurements.

Fluorescence Minicell Adapter Operation (P/N 9200-928)

The Minicell Adapter with two focusing lenses makes small sample volumes possible while preserving the superior sensitivity of the Modulus.

Orient the Minicell Adapter with the tab directed towards the back of the Modulus into the Optical Kit sample compartment. (See Figure 6)
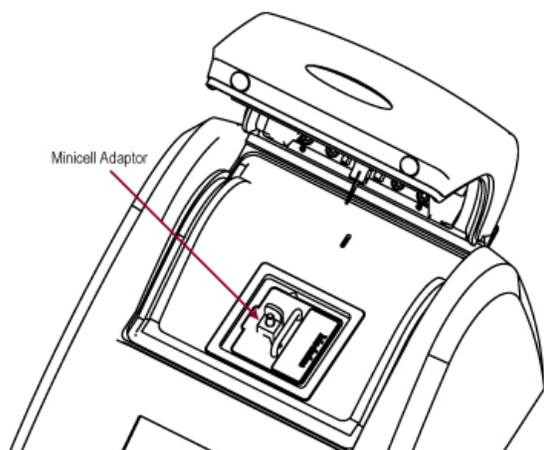
Figure 6

Transfer the sample to a minicell cuvette. The minimum volume necessary for reproducible results is 75 µL. The maximum volume is approximately 250 µL. Do not introduce air bubbles into the cuvette when transferring samples. Insert the minicell cuvette into the Minicell Adapter. Close the lid and measure the sample.

III. Luminometer Operation

Warning: Take care to keep the lid closed to protect the PMT from exposure to ambient light.

Luminescence Module

Luminescence module Installation
1. Power OFF the Modulus.
2. Before the first installation of the Luminescence Module, remove the protective label over the light detector located in the sample compartment.
3. Align the Luminescence Module with the sample compartment.
4. Press down to lock the Luminescence Module in place (See Figure 7).

Luminescence Module
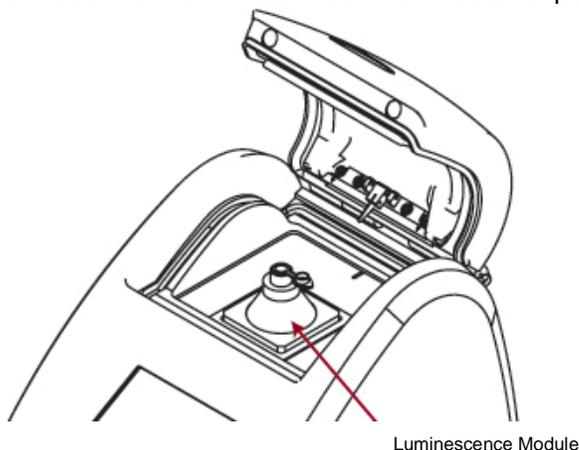
Figure 7

5. Close the lid and power ON the Modulus. A countdown of 60 seconds allows the Modulus PMT to warm-up before measuring luminescent samples.

Luminescence Module Removal

1. Power OFF the Modulus.
2. Grasp the Luminescence Module and gently pull up to release the module from the sample compartment.

Warning: Keep the lid closed to protect the PMT from exposure to ambient light. In addition, do not leave the module slot empty; install a Fluorescence Optical kit or the Absorbance Module immediately after removing the Luminescence Module.

Collecting Luminescence Measurements

The Modulus is a bottom-reading luminometer and does not require a minimum sample volume. The Modulus accommodates standard 1.5 mL microfuge tubes. Natural (clear) polypropylene microfuge tubes are suitable.

Figure 8: The Luminescence Home Screen
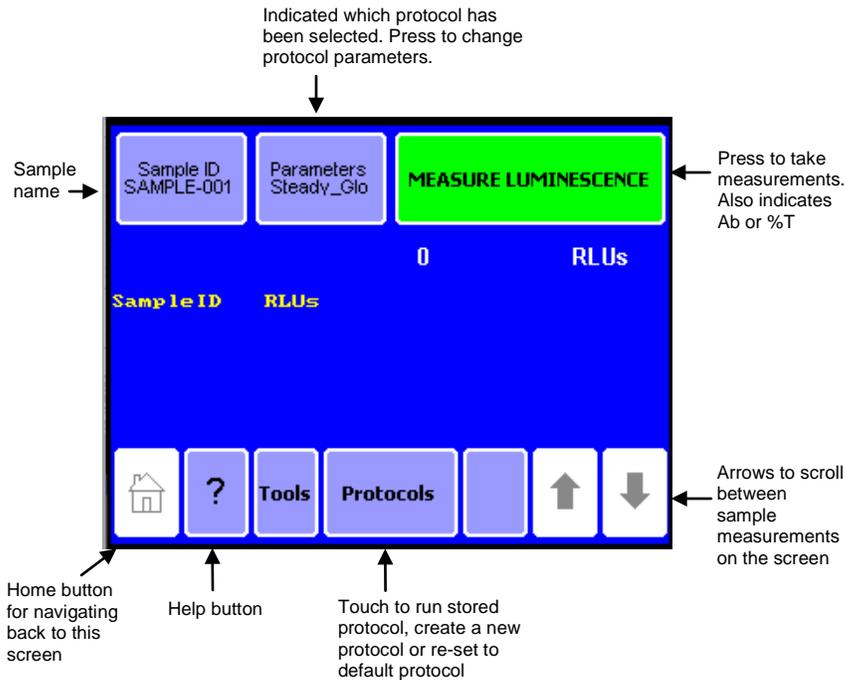
Home Screen

The "Home" screen appears after the PMT warm-up period. The "Home" screen provides orientation for the multiple functions of the Modulus. From the "Home" screen, you can select "Protocols," "Tools" and "Help." The "Home" screen is also the measurement screen. The Modulus reports data on the "Home" screen and displays the results for the most recent 20 measurements. Use the arrow keys to scroll through the most recent measurements. The data exports to a printer or PC if properly connected.

Luminescence Protocols

There are three types of protocols that can be run on the Modulus: the default protocol, custom protocols, user protocols.

Default Protocol

The default protocol loads when the instrument is turned on and provides a single measurement using a 1-second integration time. Use the default protocol for measuring when your assay does not have a specific integration requirement..

Custom Protocol
1. Touch "Protocols," then "Create New Protocol" to customize a protocol for a particular assay.
2. Use the arrow keys to adjust the integration time between 1 and 10 seconds.
3. Measuring shorter half-life luminescence may require enabling the kinetics feature.
4. Touch "Kinetics" to turn the feature ON. The integration parameter does not apply when using Kinetics. **Note: Kinetics data must be collected via a PC or printer.**
   a. Touch "Frequency" and select a measurement frequency using the arrow buttons.
      i. Measurement frequencies are listed as measurement/second(s)
      ii. Frequency options are
         1. 1 measurement/ 1 second
         2. 5 measurements/ 1 second
         3. 10 measurements/ 1 second
         4. 1 measurement/ 10 seconds
         5. 1 measurement/ 60 seconds
   b. Touch "Total number of measurements" and select the total number of measurements using the arrow buttons. The maximum number of total measurements is 9999.
5. Touch "OK" to return to the "Home" screen.
6. Alternatively, touch "Save As" to name the protocol and store the parameters for future use.

User Protocols
1. To retrieve a stored protocol, touch "Protocols," then "Run User Protocol."
2. Highlight the protocol name and touch "Show Parameters" to review the parameters for the stored protocol.
3. To measure a sample, touch "OK" to return to the "Home" screen. The Protocol name will be displayed in the upper middle button of the home screen.
4. The Modulus may store as many as 18 protocols at any given time.
   a. To delete a protocol, touch "Protocols," then "Run User Protocol."
   b. Highlight the protocol name then touch "Delete Protocol."

Measuring Samples
1. Open the lid of the Modulus and insert the sample. Close the lid.
2. Touch "Sample ID" to name the sample (optional). Using the keypad, enter the sample name into the name field. Touch "Save" to save the sample ID.
3. Touch "Measure Luminescence" to commence measurement. The Modulus measures the sample and reports the reading in Relative Light Units (RLU).
4. The Modulus reports data on the "Home" screen and displays the results for the most recent 20 measurements.
5. The newest measurement reports to the top of the list. Use the arrow keys to scroll through the most recent measurements.
6. The data automatically exports to a printer or PC when properly connected (see page X for PC connection instructions).
Note: For kinetic measurements, the Modulus only reports data to a PC or printer. The Modulus does not store more than 20 measurements at one time. Measurements are not stored between power cycles.

IV. Photometer Operation

Absorbance Module
If the Modulus is purchased with the Absorbance option, there are 3 absorbance filters that come with the absorbance module: 560 nm, 600 nm and 750 nm. Custom absorbance filters may also be purchased. Contact Turner BioSystems at 1.888.636.2401 for more details.

Absorbance Module Installation
1. Power OFF the Modulus.
2. Align the Absorbance Module with the sample compartment.
3. Press down to lock the Absorbance Module in place. (See Figure 9.)
4. Close the lid and power ON the Modulus.
5. Select "Photometer" from the list of options on the touchscreen.
6. Install the filter paddle that corresponds to the wavelength of absorbance for the assay. (See Figure 10.)
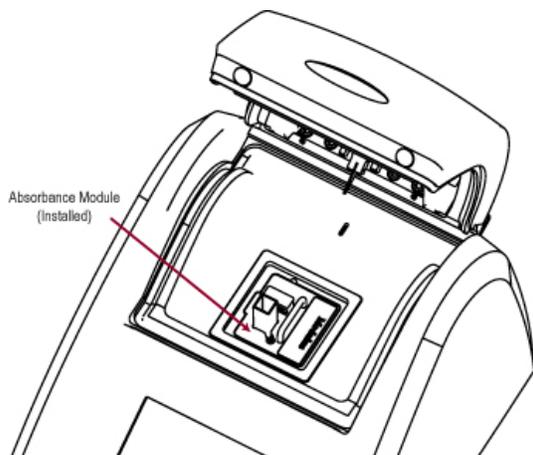
Figure 9
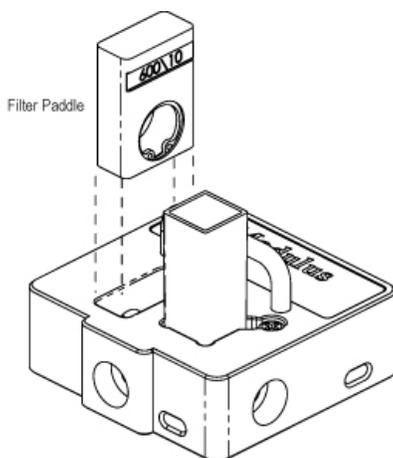
Figure 10

Absorbance Module Removal
Power OFF the Modulus.
Grasp the handle and gently pull up to release the Absorbance Module from the sample compartment.
Warning: If the Modulus is also configured as a Luminometer, take care to keep the lid closed to protect the PMT from exposure to ambient light. In addition, do not leave the module slot empty; install a Fluorescence Optical kit or the Luminescence Module immediately after removing the Absorbance Module.

Collecting Absorbance Measurements

The Absorbance Module accommodates 10 x 10 mm methacrylate and polystyrene cuvettes as well as glass cuvettes (minimum 1.5 mL volume).

Figure 11: The Absorbance Home Screen
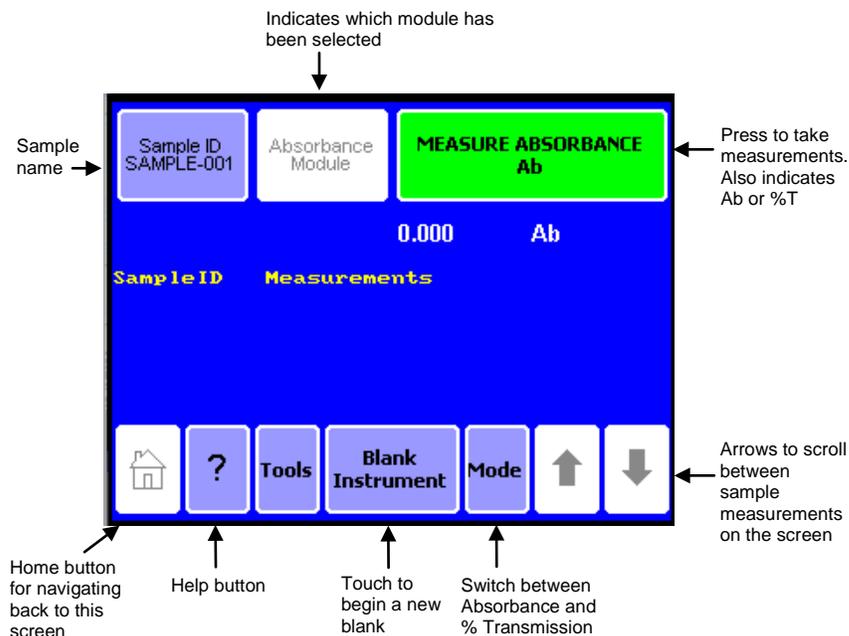
Home Screen

The "Home" screen appears after installing the Absorbance Module and choosing the photometer option. From the "Home" screen, you can select "Calibrate," "Tools," "Mode," and "Help." The "Home" screen is also the measurement screen. The Modulus reports data on the "Home" screen and displays the results for the most recent 20 measurements. Use the arrow keys to scroll through the most recent measurements. The data exports to a printer or PC if properly connected.

Blank Instrument

Blank the Modulus after powering ON and changing filters. For best results, blank the Modulus immediately before reading a series of samples and blank with a buffer that is equivalent to your sample buffer. Blanked readings are not stored between power cycles.

1. Touch "blank instrument" to update the blank.
2. Insert a 10 x 10 mm cuvette containing ultra pure water (blank).
3. Touch "OK" to complete the update.
4. Touch the "Cancel" key to abort the calibration.

Measuring Samples

1. Open the lid and insert the cuvette. Close the lid.
2. Touch "Sample ID" to name your sample (optional). Using the keypad, enter the sample name into the name field. Touch "Save" to save the sample ID.
3. Touch "Measure Absorbance" to commence measurement. The Modulus will measure the sample for 6 seconds and report the average reading for the sample.

Note: The Modulus does not store more than 20 measurements at one time. Measurements are not stored between power cycles.

Absorbance Settings

Touch "Tools" to access "Settings."
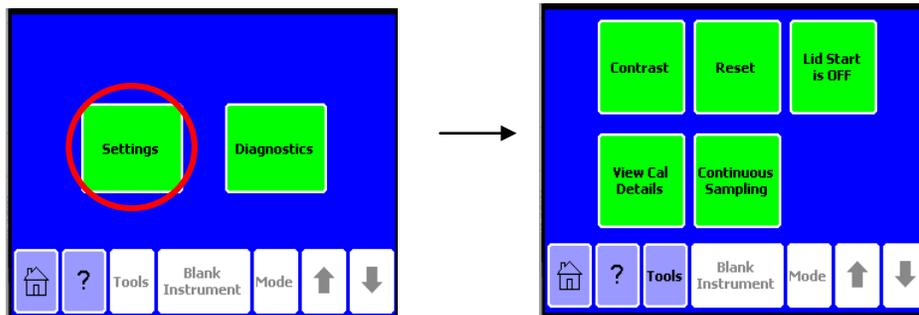
View Cal Details
Touch "View Cal Details" to see whether the Modulus has been blanked and to get the baseline and the zero values on the current blank (calibration).

Continuous Sampling
The Continuous Sampling feature enables repeat measurements at user-defined intervals.

Touch "Continuous Sampling" to turn the feature ON.
1. Touch "Frequency" and select a measurement frequency using the arrow buttons.
    a. Measurement frequency is in measurements/seconds and the options are 1 /3 sec, 1/10 sec, 1/30 sec, 1/60 sec.
2. Touch "Total number of measurements". The maximum number of total measurements is 9999.
3. Touch "OK" to return to the "Home" screen.
4. Connect the Modulus to a printer or a PC to collect the data obtained during Continuous Sampling.
5. Touching the screen repeatedly causes an early-abort of Continuous Sampling measurements.

APPENDIX A – Troubleshooting Guide

Table 1. Fluorescence Troubleshooting

Symptom	Possible Solution
Bad calibration error message	A bad calibration error message may occur if the blank is brighter than the standard. Compare the reading of the standard and the blank in the Raw mode.
Erratic reading	When direct fluorescence readings do not produce expected values, review the standard value entered during the calibration. The number of the standard value should correspond to the actual concentration of the standard.
Low readings	Check the excitation and emission wavelengths of the analyte against the specifications of the Fluorescence Optical Kit in use. Different analytes require different Optical Kits.
High Background	A wet cuvette or spill could contaminate the cuvette holder and increase the background. Carefully clean the cuvette holder with 70% ethanol.

Table 2. Luminescence Troubleshooting

Symptom	Possible Solution
Low Readings	Check the temperature of the reagent and the limit of detection for the assay on the Modulus. If measuring flash-type luminescence, use the kinetics feature to observe the rate of light production.
High Background	Reagent residue may contaminate the Modulus. Power OFF the Modulus, remove the Luminescence Module and gently clean the interior with 70% ethanol and a Kimwipe®.

Table 3. Absorbance Troubleshooting

Symptom	Possible Solution
Non-linear response	Many absorbance assays do not produce a linear response but instead produce a sigmoidal or psuedosigmoidal response. Refer to the assay application for more information.
Low readings	Check the filter installed in the Absorbance Module and make sure it is the correct filter for the assay. View the Calibration Details from the "Tools" menu.
Bad calibration error message.	Install the proper filter and use the ultrapure water in a clean cuvette to update the baseline. Use the black cuvette to update the zero. Check the Calibration Details from the "Tools" menu.

Table 4. Spreadsheet Interface Software Troubleshooting

Symptom	Possible Cause	Possible Solution
Excel does not open.	Excel is not installed on the PC.	Make sure Excel is installed on your PC.
	The software cannot find Excel.	Open Excel from the Program Menu on the PC then double click on the Spreadsheet Interface Software icon.
Both green lights are ON, but data does not appear in Excel.	Wrong COM port selected	Click "STOP" then click on the "COM" button to change the COM port.
	Luminometer not connected to PC.	Check the RS-232 connection between the Modulus and the PC.
New data does not report to Excel.	There is an editing process occurring within an Excel cell.	Wait until all the data is collected before editing the Excel spreadsheet.
The software does not install.	The PC allows only administrators to install new software.	Log in as Administrator for the PC, then install the software or contact your IT support desk.
The software does not open.	The software was not installed properly.	Log in as Administrator. Remove the software and re-install.

Table 5. Touchscreen Troubleshooting

Symptom	Possible Cause	Possible Solution
Touchscreen goes blank or is non-responsive.	Sample saturates detector.	Power OFF the Modulus. Wait 5 seconds. Power ON the Modulus.
Fingerprints appear on the touchscreen.		Power OFF the Modulus, then use a Kimwipe® dampened with 70% ethanol to clean touchscreen.
Touchscreen alignment is off		Power OFF the Modulus. Touch the modulus screen with one finger. Keeping the finger on the screen, turn the power on. Continue touching the Modulus screen until the Home screen appears.

APPENDIX B – Warranty and Obtaining Service

Warranty

Turner BioSystems warrants the Modulus and accessories to be free from defects in materials and workmanship under normal use and service for a period of one year from the time of initial purchase, with the following restrictions:
The instrument and accessories must be installed, powered, and operated in compliance with the directions in this operating manual and the directions accompanying the accessories.
- Damage incurred during shipping is not covered by warranty.
- Damage resulting from measurement of samples found to be incompatible with the materials used in the sample system is not covered by warranty.
- Damage resulting from reagent spills is not covered by warranty.
- Damage resulting from contact with corrosive materials or atmosphere is not covered by warranty.
- Damage caused by modification of the instrument by the customer is not covered by warranty.

Obtaining Service

Warranty Service
To obtain service during the warranty period, please take the following steps:

Write or call the Turner BioSystems Service Department and describe as precisely as possible the nature of the problem.
Carry out minor adjustments or tests as suggested by the Service Department.
If the instrument is still not functioning properly, YOU MUST OBTAIN A RETURN MERCHANDISE AUTHORIZARTION (RMA) NUMBER BEFORE SHIPPING the instrument to Turner BioSystems. Contact Turner BioSystems to start the RMA process.
After obtaining an RMA number, pack the instrument well (damage incurred in shipping due to improper packing is not covered), insure it, write the RMA number on the outside of the carton, and ship it to Turner BioSystems prepaid.

The instrument will be repaired and returned free of charge for all customers in the United States. Turner BioSystems will pay for return shipment and include a check to reimburse you for the cost of surface shipment to us. If you are an international customer who purchased directly from Turner BioSystems (not from a third-party distributor), contact Turner BioSystems for instructions. The instrument will be repaired at no charge if it is under warranty.

Turner BioSystems cannot, however, pay shipping, duties, or documentation costs outside the continental United States. Customers outside of the United States who have purchased our equipment from an authorized distributor should contact the distributor for further instructions.

Note: Under no circumstances should the instrument or accessories be returned without prior authorization from Turner BioSystems or our authorized distributor. Prior correspondence is needed to

- Ensure that the problem is not a minor one, easily handled in your laboratory, with consequent savings to everyone.
- Determine the nature of the problem, so that repair can be done with particular attention paid to the defect you have noted.

Out of Warranty Service
Follow the same steps as for Warranty Service. Our service department is happy to assist you by

telephone or correspondence at no charge. Repair service will be billed. Your invoice will include freight charges.

Address for Shipment:

Turner BioSystems
645 N. Mary Ave.
Sunnyvale, CA 94085
USA

Telephone: 408-636-2400
Toll-Free: 888-636-2401 (US & Canada)
Fax: 408-737-7919
Email: techsupport@turnerbiosystems.com

APPENDIX C – Specifications

Luminescence	
Detector	Photomultiplier tube (PMT)
Spectral Range	350 - 650 nm
Peak Wavelength	420 nm
Detection Limit	1×10^{-16} moles ATP
Linear Dynamic Range	5 logs
Sample adaptor	Holds 1.5ml microfuge tubes
Fluorescence	
Light Source	Wavelength-matched LED
Detector	Photodiode
Wavelength Selection	Snap-in fluorescence optical kits
Wavelengths	UV (Ex: 365 nm, Em: 410-450 nm)
	Blue (Ex: 460 nm, Em: 515-570 nm)
	Green (Ex: 525 nm Em: 580 - 640 nm)
	Red (Ex 625 nm: Em 660 - 720 nm)
	UV-GFP (Ex: 365 nm, Em: 515-570 nm)
Detection Limit	6 ppt fluorescein, 4.5 pg/100 µl DNA with PicoGreen Dye
Linear Dynamic Range	6 logs, assay dependent
sample adaptor	10 x 10 mm cuvette, 100 - 200 µl minicell vial (optional)
Read Out	Direct concentration or raw fluorescence
Calibration	1 to 5 point calibration
Discrete Sample Average	Sample readings are averaged over 5 sec to improve accuracy
Absorbance	
Light Source	LED
Detector	Photodiode
Spectral Range	400 - 800 nm
Wavelengths for Installed Filters	560, 600, 750 nm
Photometric Measuring Range	0 - 4.0 OD
Linear Dynamic Range	0 - 2.5 OD
OD Accuracy	+/- 0.7%

OD Precision	</+ 0.5% at 1.0 OD
Instrument Specifications	
Detection Modes	Luminescence, Fluorescence, and Absorbance
Read Type	Glow, Kinetic, Repeat
Sample Format	10 x 10 mm cuvette or 100 - 200 µl minicell vial (optional) or 1.5ml microfuge tube (luminescence)
User Interface	Built-in PC, touch screen navigation and operation
Data Output	Data displayed on screen or connect to PC (not included) via serial cable to download. Optional thermal printer available
External PC Requirements (optional)	Windows 98 or later
Computer Interface	100% ASCII format through a 9-pin RS-232 serial cable at 9600 baud
Power	12 V 0.84 A Max
Auto Shutoff	Touch screen hibernates after 20 min of inactivity
Dimensions	12.92" D x 10.44" W x 8.42" W (32.82 cm D x 26.52 cm W x 21.39 cm H)
Weight	8.1 lbs (3.65 kg)
Operating Temperature	60-105 ºF (15-40 ºC)
Warranty	One year
Approvals	CE

Appendix D - How to Contact Us

Turner BioSystems, Inc.
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By fax: + 1 (408) 737.7919
Or by visiting our web site: www.turnerbiosystems.com

Part Number: 998-9203
Version: 1.2

TURNER BIOSYSTEMS

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