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Stratus

Miniaturized Plate Reader

MRODx1r2

Operating Manual

Table of Contents

1. Introduction

1.1 About the Manual

The current edition of the manual applies to the following models and versions:

Product	SKU
Stratus, 600 nm	R2600
Stratus, 496 nm	R2496
Stratus, 650 nm	R2650
Stratus Adapter	R2APT

1.2 About the Stratus

The Stratus plate reader provides continuous and single-point real-time optical density measurements with 6, 12, and 96-well plates. Continuous measurements can be set at user determined time intervals. The Stratus provides single mode (absorbance) and single wavelength only and is functional in a broad range of environments including anaerobic chambers, on shakers, in remote field settings, and in heated and humidified incubators.

2. Safety Precautions

Caution!

Make sure you have fully read and understood the present manual before using the equipment.

2.1 General Safety

- Protect the unit from shocks or falling.
- Before using any cleaning or decontamination methods except those recommended by the manufacturer, check with the manufacturer that the proposed method will not damage the equipment.
- Do not make modifications in design of the unit.

2.2 Electrical Safety

- Connect only to external power supply with voltage corresponding to that on the serial number label.
- Use only the external power supply provided with this product, or one approved by the manufacturer. Always ensure compatibility of the power source.
- Ensure that the external power supply is easily accessible during use.
- Disconnect the unit before moving unless the device is connected to a battery pack.
- Turn off the unit by disconnecting the external power supply from the power source.
- Always use caution with liquid and avoid spills as they can damage the equipment. If liquid penetrates the unit, immediately disconnect it from the external power supply and let it air dry. Contact customer support in case of concerns.
- Operating conditions of the unit are defined in the specifications section (5.0).

2.3 During Operation

- Do not move the unit while it's reading. Shaking is permitted if the unit is stabilized.* Shaking should not exceed 350 RPM on large incubators or 500 RPM on a single-plate shaker.
- Do not operate the unit in environments with explosive chemical mixtures. Review section 5.2 measurement specifications for acceptable environmental conditions; otherwise please contact manufacturer for possible operation of the unit in specific atmospheres.
- Do not operate the unit if it is faulty or has been installed incorrectly.

2.4 Biological Safety

- It is the user's responsibility to carry out appropriate decontamination if hazardous material is spilled on or penetrates inside of the equipment.
- For decontamination, the manufacturer recommends using ETO gas, or wiping down the unit with up to a 75% alcohol or bleach-based solution.

*Actual RPMs cannot be guaranteed and vary per equipment used; reach out to our support team at support@cerillo.bio for specific recommendations.

3. General Information

The Stratus package includes one Stratus plate reader, one USB cable, one power adapter, one 16 GB microSD card, and 1 year of firmware upgrades.

3.1 Purpose

The unit is designed to take optical density (OD) readings with a detection range between 0.0 and 3.0.

3.2 General Use and Features

The Stratus plate reader allows for measurement collection in small spaces, on shared or modular benchtops, and restrictive environments, like anaerobic or microaerophilic chambers and incubators. It can be placed anywhere, with or without a computer.

Overall, the Stratus exploits the best of modern technology so you can spend your efforts where they matter most.

3.2.1 Features

- Continuous real-time measurements of optical density
- Available in Standard 600 nm or customized wavelength
- Standard 6, 12, and 96-well plates
- Small footprint and stackable
- No moving parts; minimal maintenance
- Functional in a broad range of environments
- Includes a free version of the user-friendly Cerillo Labrador software

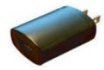
4. Getting Started & Operation

4.1 Upon Receipt

Carefully remove packing materials and retain them for future shipment or storage of the unit. Confirm receipt of all components and device and examine the unit carefully for any damage incurred during transit. The microSD card will already be installed in the Stratus.

Stratus
(with microSD card)

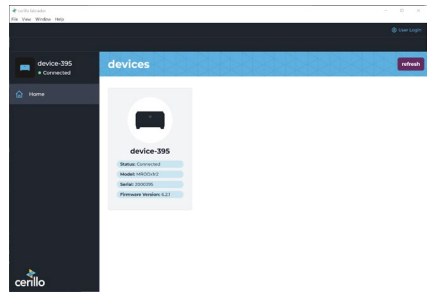
USB Cable



Power Adapter

4.2 Downloading Software and Connecting the Device

Download Cerillo's Labrador software at: https://info.cerillo.bio/labrador-download. Use the provided USB cable to connect your Stratus plate reader or Canopy device to your computer. Open Labrador and click "load devices" to detect your device. If connecting your Stratus wirelessly through a Canopy, be sure to connect the Stratus to a power source (more details in *Section 4.4 Powering the Device*). To set up your device, click on your device in Labrador and open the settings window denoted by the gear icon. Refer to *Section 4.8 Adjusting device settings* to learn more about these settings.



Note: Please only use the provided cord; not all USB cables are capable of seamless data transfer between the Alto and a computer.

4.3 Location

Place your Stratus where you'd like to collect measurements. You can collect measurements in almost any environment of interest— in an incubator, anaerobic chamber, benchtop, hood, etc. Equilibrate your Stratus to any new environmental conditions for 2 hours, while connected to power, prior to running a new experiment. For instructions on using your Stratus in different environments, refer to *Section 4.10 Using Stratus in environmental chambers*. For limitations and environmental tolerances, refer to *Section 5.2 Measurement Specifications*.

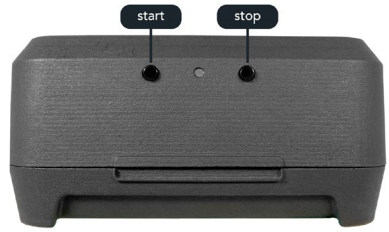
4.4 Powering the Device

Before powering your device or collecting data, first verify that the microSD card is already inserted in your Stratus plate reader. Your Stratus can be powered using the provided USB cable and connecting with your computer, a Cerillo-recommended battery pack, or the provided adapter and a standard wall outlet.

To control your Stratus through the Labrador software, refer to *Section 4.2 Downloading Software and Connecting the Device*. The software enables direct control, data access, and configuration of your Stratus.

Always insert the microSD card with the Alto unplugged; otherwise, the card can become corrupted and future data might not be recorded. Ensure the microSD card is inserted for the entire duration that the Alto is booting and powered.

4.5 Controls



To start a kinetic read, press the “start” button (left). The status light will briefly illuminate green then cyan to indicate auto-calibration. The Stratus will automatically begin taking measurements after calibration. To stop an experiment, press the “stop” button (right) until the status light turns red.

Endpoint measurements can be enabled under device settings.* If endpoint measurements are enabled (checked), the “start” button has two functions. The first function is to start an endpoint reading by quickly pressing the “start” (left) button. The second function is to start a kinetic read which requires you to hold the “start” button until the status light flashes.

The “stop” button also has two functions when endpoints are enabled. If held it will start a calibration, and if pressed it will stop an experiment.

*Please note: the Stratus is a kinetic plate reader and is not recommended for endpoint measurements.

4.6 Starting an experiment

Readings occur every 5 minutes by default but can be set as low as 3 minutes. To customize read times prior to running an experiment, select your device in Labrador and then select Settings (gear icon in the top-right corner of screen). The Stratus will retain these settings when unplugged and plugged into a wall outlet or battery source. It is recommended to use Labrador to set a plate layout after your experiment. Labrador can also be used to start and stop an experiment while the device is connected. Further instructions can be found at labradormanual.cerillo.bio.

The Stratus should remain at a constant temperature throughout the experiment, especially during calibration. Equilibrate your Stratus to new environmental conditions for 2 hours, while connected to power, prior to running a new experiment. Overnight equilibration, for example by setting the Stratus in an incubator after inoculating your starter culture, can be helpful. Once your plate is prepped, let the plate also equilibrate in the environment where you plan to run your experiment, if possible. **Your device and plate should complete both environmental equilibration and device calibration before your first measurement.**

While measurements can be taken with a plate lid, without a plate lid, or with a breathable membrane, data is most reliable when collected with a breathable membrane. Membranes (such as a Breathe-Easy membrane) most effectively prevent measurement errors due to condensation and evaporation during long experiments. The Stratus should be at a constant temperature and should not be opened or relocated for the duration of the experiment.

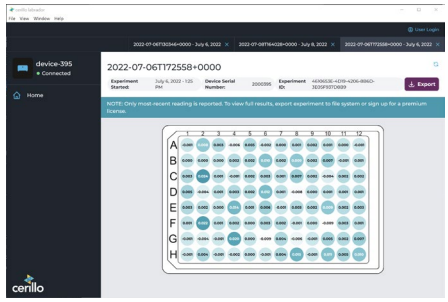
Following environmental equilibration, measurements can begin. Place your experimental plate in the Stratus. The device will auto-calibrate after the start button is pressed. Calibration is indicated by a cyan status light prior to starting the kinetic reading; calibration should take place with the plate inserted. Calibration zeros all wells. To stop a reading in progress, press the “stop” (right) button until the status light turns red. Alternatively, if your device is plugged into a computer, you can use the Cerillo Labrador Software to operate the Stratus.

Refer to section 4.8 to enable quick reads. If enabled, to start quick reads, calibrate the device manually by holding the “stop” button (right) until the status light flashes white/green. Your device should be calibrated whenever the device changes environmental conditions. Your experimental plate should

be inserted into the Stratus after the calibration step. The experiment can then be started by pressing the “start” (left) button.

4.7 Accessing data

Data collected is automatically stored on the on-board microSD card. *Inserting or removing the microSD card while the device is powered can corrupt the card, rendering it incapable of recording future data*. Data stored on the microSD card can be accessed by directly connecting the Stratus to your computer using the provided USB cable and using Labrador, plugging the card into any commercially available microSD card adapter, or wireless transfer to Labrador through Cerillo’s Canopy. When viewing data directly on the microSD card, data files are found in the “experiments'' folder, in a subfolder corresponding to the experiment name. The supplied microSD card is 16GB and is sufficient to hold 4 weeks of continuous data at the maximum sampling rate. Any standard microSD card capable of storing 32GB or less is compatible with the Alto, but it must be formatted as a FAT32 drive.



Experiment files are saved as standard .csv files on the microSD card. Data can be viewed using the Labrador software or .csv or .xlsx files can be exported and opened in any spreadsheet or data analysis software. To export a file, navigate to “Results” and wait for experiments to load. Click on the download arrow on the right for the experiment of interest. A popup window will signal that the download is complete. The figure on the right shows what an experiment looks like in the software. See labradormanual.cerillo.bio for more information.

4.8 Adjusting device settings

Use the Cerillo Labrador software to plug in your device, access device settings, and select your preferred interval time. The Stratus will recall custom measurement intervals, even when unplugged and plugged into a wall outlet or battery source, until this setting is changed in the Labrador software. Wiping the microSD card memory will revert the interval time back to 5 minutes. For further instructions on adjusting device settings, please refer to the Labrador user manual at labradormanual.cerillo.bio.

4.9 Using the Stratus with shaking

The Cerillo Microplate Shaker securely fastens to the Stratus by tightening the shaker's thumb screws into paired recesses in the Stratus's casing. The Stratus is also compatible with most commercially available shakers via the Stratus Adapter.

Ensure the device is securely affixed to avoid liquid spills. If the Stratus is not well secured to the shaker, it can move excessively or irregularly, which can disrupt the measurements. When securely fastened to the shaker, the device can measure while shaking. There is no need to program the shaker to stop shaking during measurement. Shaking should not be interrupted and shaking speed should not change during an experiment. When setting up the Stratus on a shaker, ensure that there is slack provided in the power cable to avoid the device becoming unplugged.

4.10 Using the Stratus in environmental chambers

4.10.1 Anaerobic, Microaerophilic, and CO_2 chambers

The Stratus is designed to be resistant to environmental conditions common in anaerobic, microaerophilic, and CO_2 chambers. The Stratus can be transferred through chamber airlocks (as size allows) and stored within chambers intermittently for days or weeks. While the Stratus itself is stable within an anaerobic chamber, some microbes produce gases, such as H_2S, which can deteriorate the electronics over time, so occasional removal to fresh air is recommended. Refer to *Section 5.2 Measurement specifications* for compatible gas concentrations.

4.10.2 Incubators and refrigerators

Since the Stratus does not make its own environmental conditions, it is common to place the device within the conditions of interest. The Stratus has been tested from 0° - 50˚C and is operable within that range. Note: When the device is placed in heated or cooled environments, best results will be achieved when the device is equilibrated to that environment for at least 2 hours prior to starting a measurement, as detailed in *Section 4.6 Starting an Experiment*. In some instances, equilibration can take longer, in which case the device may benefit from being left in the incubator overnight prior to the experiment.

5. Specifications

5.1 General

Measurement Mode	Absorbance
Measurement Type	Kinetic
Plate Type	6, 12, 96-well plates, Cerillo Co-culture Duet plate
Dimensions	W: 14.4 cm D: 13.0 cm H: 6.8 cm
Weight	580 g
Power	5 V, 500 mA USB-C receptacle

5.2 Measurement

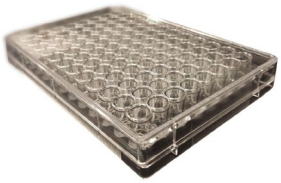
Environmental Tolerance	Temp: 0-50° C, Humidity: 0-99%, O_2 Concentration: 0-21%, CO_2 Concentration: 0-25%
Wavelength	Single Wavelength: 600 nm, 496 nm, 465 nm, or 650 nm. Custom wavelengths available.
Light Source	Monochromatic LEDs
Resolution	±0.005 OD
Detection Range	0.000 - 3.000 OD
Linearity	< ±1% (0.000 - 2.000 OD)
Accuracy	< ±1% and ±0.015 OD (0.000 - 2.000 OD)
Repeatability	< ±1% and ±0.006 OD (0.000 - 2.000 OD)
Data Storage	microSD up to 32 GB 16 GB card provided)

5.3 Software

Operating System	macOS: 11 (Big Sur), 12 (Monterey) Windows: 10, 11
Data Format	.csv (on-board), .xlsx (some Labrador exports)

5.4 Compatible Accessories

5.4.1 Multiwell Plates



The Stratus is compatible with all flat-bottom, standard well format plates, including tissue culture and non-tissue-culture treated plates (6, 12, and 96 wells), and the Cerillo Co-Culture Duet plate.

5.4.2 Power bank

The Stratus can be connected to a power bank. The Stratus operates well when connected to Anker brand power adapters. The Anker 10000 mAh batteries will power the Stratus for 48-72 hours depending on the temperature and measurement interval.

5.4.3 Plate sealing film

While a variety of plate sealing films are suitable for the Stratus, Diversified Biotech's "Breathe-Easy" brand membranes (catalog number BEM-1) have been extensively validated for use with the Stratus. If using other membranes, ensure they are transparent.

5.4.4 Cerillo Microplate Shaker

The Stratus can take readings while shaking; the instrument must be firmly secured to avoid spills and ensure there is no wobble or irregular movement, which would add variability to data. We recommend the Cerillo Microplate Shaker for Stratus shaking experiments. The Stratus is secured to the Cerillo Microplate Shaker by tightening the shaker's thumb screws into paired recesses in the Stratus casing.

5.4.5 Stratus Adapter

The Stratus is compatible with a variety of different shaking platforms, in addition to Cerillo's Microplate Shaker. Cerillo's Stratus adapter might be necessary to secure the Stratus to non-Cerillo shakers. While shaking, the device must be securely affixed to avoid liquid spills, wobble, or irregular movement around the shaking platform. When setting up the Stratus on a shaker, ensure that there is slack provided in the power cable to avoid the device becoming unplugged.

5.5 Data Storage

Data is automatically stored on the microSD card that comes with the device. Once you have copied data off of the device, either through the software or card adapter, you can safely delete the corresponding experiment folders in the "experiments" directory on the card. Please note, however, that your data will not be recoverable once deleted, and keeping a backup copy on the card may help with future troubleshooting.

5.6 Calibration

The Stratus auto-calibrates (green light) at the beginning of every kinetic read to set each value at 0 OD. It measures the net change in OD from time point 0. If endpoint readings are enabled, calibration can be done automatically by holding the right button, or interfacing with the software.

6. Resources

- Further documentation can be found at https://cerillo.bio/resources/
- The Labrador user manual can be accessed at labradormanual.cerillo.bio

7. Guarantee and Service

7.1 Guarantee

When used in laboratory conditions and according to these working instructions, this product is guaranteed for two years against faulty materials or workmanship.

7.2 Service and maintenance

There are no user-serviceable parts inside the unit. For all repairs (except as outlined below) contact our service department at support@cerillo.bio.

7.3 Cleaning and disinfection

7.3.1 Cleaning

The Stratus can be disinfected by wiping with a lint free or microfiber cloth and a 10% bleach-based solution or Cavicide followed by 70% ethanol to remove any residue. Do not spray solutions as excess liquid can enter perforations in the device. Instead, spray a lint free or microfiber cloth with the

cleaner and wipe the device. The exterior color of your device may rub off on your cloth for the first few cleanings.

Note: no parts of the unit can be safely autoclaved.

8. Compliance

The Stratus is RoHS compliant, CE certified, made in the USA, and has a two year warranty.

EU Declaration of Conformity

All the products covered by this manual comply with the requirements of the EU harmonized legislation verified using the following standards

EMC directive (2014/30/EC) for Electromagnetic compatibility	LVS EN 61326-1
RoHS Directive (Directive 2011/65/EC including 2015/863) for Hazardous substances	LVS EN 50581

9. More Information & Troubleshooting

9.1 Troubleshooting

9.1.1 Stratus device not recognized by computer

1. Restart Software
2. If the device is not responsive to pressing the buttons, follow device recovery instructions: labradormanual.cerillo.bio > Troubleshooting > Device Recovery

9.1.2 Difficulty installing software

For installation instructions, you can access the Cerillo Labrador software instructions at labradormanual.cerillo.bio or email support@cerillo.bio.

9.1.3 Stratus stops taking readings mid-way through an experiment

Primary causes:

1. Battery power ran out or device became unplugged.

2. The experiment reached this planned duration, applied under device settings, and stopped.
3. Device was in “quick read” reading mode. If “quick reads” are enabled, start button must be held until Stratus light flashes to start a continuous read.

9.1.4 Data issues or missing files

Primary causes:

1. The device was powered without the microSD card, or the microSD card was inserted while the device remained powered. If the device is powered when the microSD card is inserted, it will not recognize the microSD card, preventing recording of data.
    a. Solution: Ensure that the Stratus is unplugged whenever the microSD card is inserted into the device. When powered without a microSD card, the red status light will illuminate.
2. An incompatible microSD card is being used. Only use the supplied microSD card. If a replacement card is needed, be sure to format to FAT32 prior to using and only use cards under 32 GB capacity.
3. Corruption of the microSD card (data is unreadable).
    a. Reformat the microSD card on Windows:
        i. Insert the microSD card directly into your computer or utilize an adapter if your computer does not have a microSD card slot.
        ii. Back up any important data from the microSD card.
        iii. Open File Explorer.
        iv. Right-click on the microSD card drive, select “Format.”
        v. A formatting window will pop up. Under the file system drop down, select FAT32.
        vi. Uncheck “Perform a Quick Format.”
        vii. Select OK.
    b. Reformat the microSD card on macOS:
        i. Insert the microSD card directly into your computer or utilize an adapter if your computer does not have a microSD card slot.
        ii. Back up any data on the microSD card.
        iii. Open Disk Utility. It is available through the Applications Folder in a Utilities subfolder. You can also use Spotlight search to open it by name.
        iv. In the sidebar of Disk Utility, search for your memory card and select the volume. Typically, you'll find it under the

name of the manufacturer of the memory card, and it will have a volume title that matches the name of the drive when it mounts, as well as matching capacity.

v. Once you have established that you have selected the correct volume, click “Erase.”
vi. Enter a name for the memory card.
vii. Select the format for the memory card as FAT32.
viii. Click “Erase.”
ix. Once formatting has completed, click “Done.”

9.1.5 Increasing OD in blank samples

Increasing blank sample OD is most commonly due to temperature increase or condensation. Other possible mitigation steps include:

1. Ensure the plate reader equilibrates in experimental environment, plugged in, for 2 hours prior to starting an experiment. If readings still increase, consider overnight equilibration.
2. Minimize temperature change over the course of the experiment.
3. Prior to placing the plate in the plate reader, shake it on an orbital shaker (~1000rpm) for a few seconds. If a small shaker is not available, tap your prepared plate on the lab bench a few times to break the surface tension of the samples. While not required, this helps normalize the liquid in the wells and can lead to better results.

9.1.6 Condensation issues leading to incorrect readings

Erratic increases in OD (from condensate on the film/lid) or drops in OD (due to condensate dropping into the well) are characteristic of condensation. Try the following to resolve condensation issues:

1. Ensure the plate is equilibrated to experimental conditions. Abrupt changes in temperature can cause condensation.
2. Minimize temperature change during the experiment. Changes in temperature can increase the likelihood of condensation.
3. Try using a breathable membrane instead of a plate lid.
4. Increase ventilation in the environment.

9.1.7 How to get support

To report a software bug or get technical support, email our technical team at support@cerillo.bio.

107 east water street
charlottesville, va 22902
+1 434-218-3151
www.cerillo.bio
sales: sales@cerillo.bio
technical support: support@cerillo.bio
general information: info@cerillo.bio