Chlorophyll Content Meter

CCM-200

Unit Overview

The CCM-200 is a self-contained, handheld device powered by a 9V battery. The sample head is located at the top of the instrument. A Liquid Crystal Display (LCD) is located near the center of the unit. The power switch is at the bottom of the front panel. Four menu/control keys are used to access all program functions.

Program flow is organized into 5 menu groups. The MODE key will step through the selections. Press ENTER to accept the currently displayed mode. Remaining keys are used within each mode as later described.

An RS-232 port is located at the bottom of the case and allows the user to export data to a PC. An RS-232 cable is included with the instrument. Instructions for sending data to a PC are on page 12.

About the Instrument

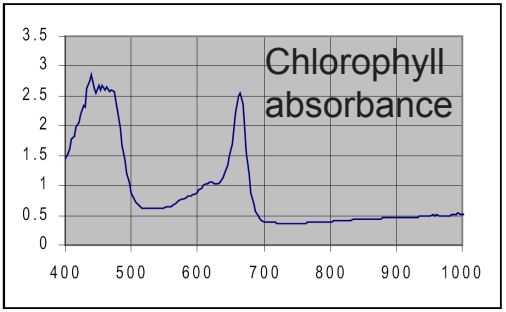
The CCM-200 Chlorophyll Content Meter is a handheld, battery operated instrument designed for the rapid, non-destructive, determination of chlorophyll content in intact leaf samples. Chlorophyll content is a direct indication of plant health and condition. Obtaining chlorophyll content via non-destructive analysis gives researchers, agronomists, and growers valuable diagnostic information. This data can then be applied to a multitude of crop production and research initiatives such as: nutrient and irrigation management, pest control, environmental stress evaluation, and crop breeding.

Measurements are instantaneous and can be done in the field under normal lighting and growing conditions. Ample on-board data-logging and simple, easy to understand measurements further enhance the user's ability to gather and interpret crop health conditions. The software and data cable included with the CCM-200 allows for data download to a PC for additional analysis.

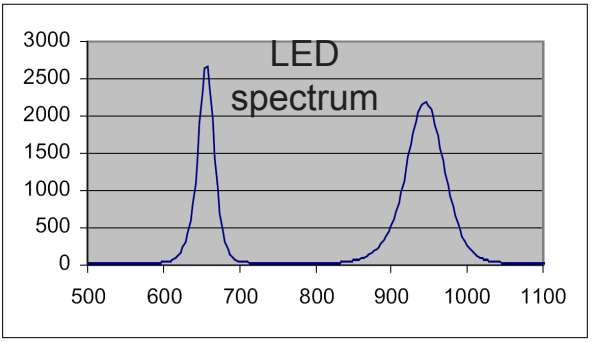
The CCM-200 is a remarkable alternative to destructive sampling techniques. It is far less time consuming and allows samples to be monitored multiple times over various stages of an entire growth cycle. The rapid test and data gathering capability is sure to provide a tremendous advantage to all types of research. This innovative pocket-sized instrument is destined to play an important role in improving crop yield and producing higher quality foods.

How It Works

Chlorophyll has several distinct optical absorbance characteristics that the CCM-200 exploits in order to determine relative chlorophyll concentration. Strong absorbance bands are present in the blue and red but not in the green or infrared bands.



The CCM-200 uses absorbance to estimate the chlorophyll content in leaf tissue. Two wavelengths are used for absorbance determinations. One wavelength falls within the chlorophyll absorbance range while the other serves to compensate for mechanical differences such as tissue thickness. The meter measures the absorbance of both wavelengths and calculates a Chlorophyll Concentration Index (CCI) value that is proportional to the amount of chlorophyll in the sample.



Note: CCI value is a relative chlorophyll value. Absolute chlorophyll content per unit area is not computed. CCM-200 measurements, however, can be correlated to ground/solvent analysis.

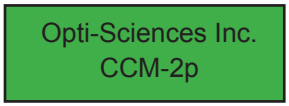
Note: The unit has a 4 minute auto-off feature. When no key is pressed or test run after 4 minutes, the unit will shut off automatically in order to conserve battery power.

Measurement & Operation

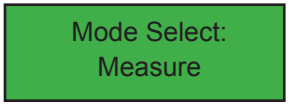
Described on the following pages are the specifics on how to obtain measurements with the CCM-200 as well as the overall instrument operation protocols. Measuring, calibration errors, memory reset, viewing data, and sending data are outlined in detail.

Mode 1 - Measure

Press power. The unit will read:



and will quickly change to:

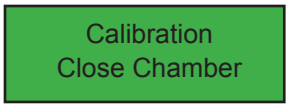


press enter.

Calibration:

The units detection system needs to check its chamber path when entering the measure mode. The user has to calibrate (“zero”) the instrument each time the unit is powered up.

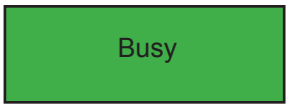
The message shown below will appear:



close the calibration chamber.

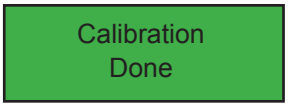
Important: make sure chamber is clear of any material.

The unit will show the message:

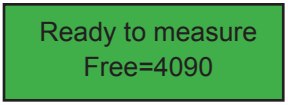


Mode 1 – Measure, continued

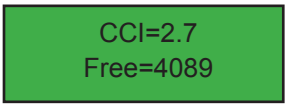
Hold closed until a beep is heard. Once the beep is heard, release the chamber arm. The unit will indicate calibration status:



After successful calibration, the unit is ready to take measurements. The screen will read:



Slide a sample into the measuring area. Press down on the sample head and hold until the beep sounds. Test data will appear as shown below.



Chlorophyll Concentration Index
Available memory

A count of available sample memory is also displayed. Measurements are automatically saved to memory, allowing the user to take rapid, successive measurements without stopping.

Note: Calibration is not needed in between measurements. The unit is ready to take another measurement once information is displayed. Whenever the unit is powered up calibration must be done. This includes after automatic shutdown (no activity after 4 minutes).

Delete Last

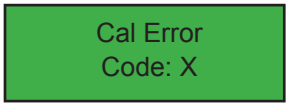
Pressing this key will delete the last measurement taken.

Group Mark

This key allows the user to segregate groups of measurements.

Calibration Errors

If there was an error in calibration, the unit will read:



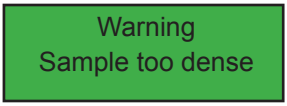
The error code number describes the problem encountered.

Code 1 - Light is leaking into the sample chamber. Make sure the chamber is closed tightly.

Note: This error may occur if the black gasket material around the chamber gets damaged or worn.

Code 4 - Low signal error. If there is debris or dirt in the chamber this error can occur. Clean out the chamber and try again. Press mode to return to the mode select menu and recalibrate the unit.

Sample too dense

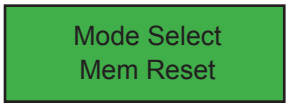


In cases where the sample tissue is too thick or too dark this message is displayed.

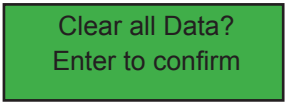
No data is recorded when this occurs. Try repositioning the sample in the chamber. Alternatively, try a thinner sample.

Mode 2 - Memory Reset

The CCM-200 stores up to 4,090 measurements. To clear all of the measurements stored press mode until it reads:



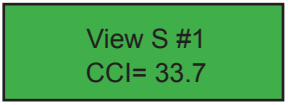
Press enter, the screen will read:



Press enter again to erase data. Press mode if you do not wish to erase data.

Mode 3 - View Data

The View Data mode allows the user to review all stored measurements. The green up and down arrows located on the right side (“Group Mark” and “Delete Last” respectively) step through all the entries. The sample number and CCI value are shown for each point; inserted group markers are also shown. Sample count will wrap both forward and backward for easy viewing of beginning and end results.



A typical screen entry in view data mode.

An inserted break displayed on screen between data sets.

Pressing mode key will return program control to the mode select screen.

Note: Transmission begins upon entering the send mode. Set up and start the host PC before entering the send mode. Sending may be canceled at any time by selecting Enter.

Mode 4 - Send Data

Send Data mode allows the user to transfer stored sample to a computer via the RS-232 port. The RS-232 jack is located at the bottom of the instrument (see diagram on back cover). Only use the RS-232 cable included with the CCM-200.

Note: Data Capture software automatically sets following parameters. If using Data Capture, Mode 4 is not needed.

To send data, first make sure the CCM-200 is connected to the computer. Then press mode key until screen reads:

Mode Select: Send Data

Next press **enter** to initiate data transfer.

Data will appear in the terminal program on the PC. Each number is a CCI value, groups of measurements can be delineated with group mark messages. Group marks appear as previously entered.

Mode 5 - Syst Diag

The diagnostics mode provides useful information to trouble-shoot the units operation in the unlikely event of a system failure. Each group of numbers describes a system function. Opti-Sciences service personnel use this number to help identify the problem.

Selecting mode will return program to the mode select screen.

Data Capture

Windows software for CCM-200.

This software allows for the easy downloading and storage of data from a CCM-200. The data is saved in ASCI text format with carriage returns separating each point. This type of file format is easily imported into most popular spreadsheet, word processor, and data analysis software packages.

Installation of CCM-200 USB Driver

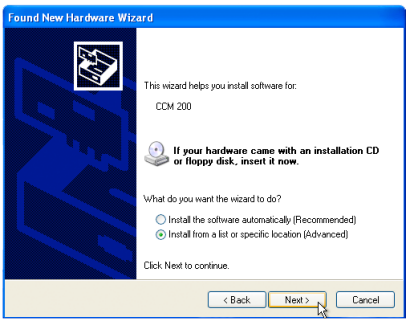
This instrument requires the installation of a computer driver to operate properly with Microsoft Windows. Data should be downloaded using Data Capture software provided on the included CD or Microsoft Windows Hyperterminal program (included with most installations of Windows).

Step 1: Insert CD into computer.

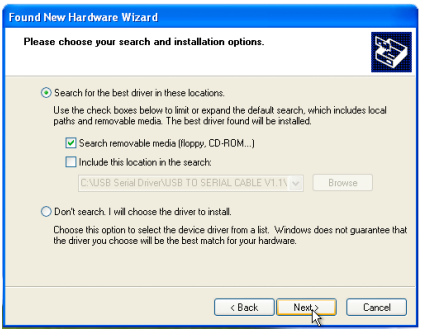
Step 2: Attach CCM-200 to computer's USB port. The Found New Hardware wizard will appear.

Step 3: Welcome window will appear. Select "No, not this time" and select Next.

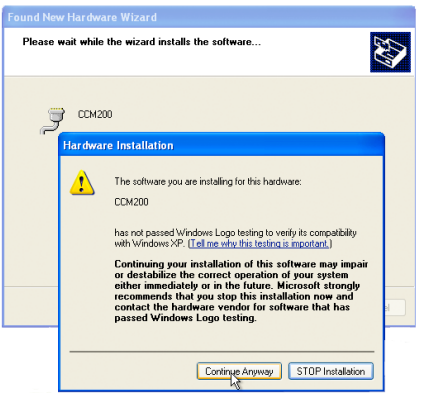
Step 4: Select "Install from a list or specific location (Advanced)" and select Next.

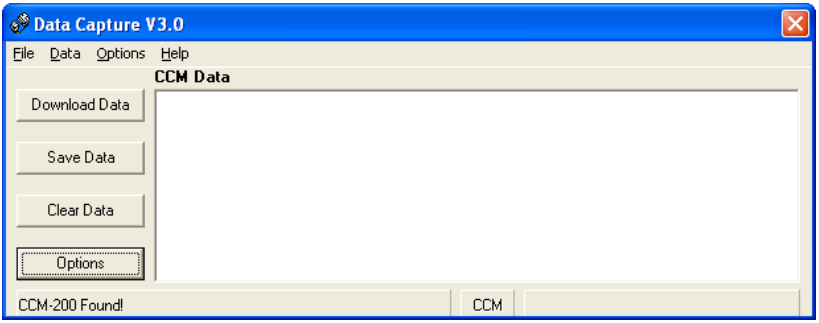


Step 5: Select "Search for the best driver in these locations". Select "Search removable media (floppy, CD-ROM...)". Click Next.



Step 6: Select Continue Anyway. Installation will complete. Select Finish. Installation of the CCM-200 USB driver is complete.





Data Capture main screen

Downloading Data

To download data, select Download Data. The status bar (located at the bottom left of the screen) will display, “Establishing communications with CCM-200” followed by “Retrieving data”.

As the data is being downloaded from the CCM-200, the progress bar (on the lower right) will display your progress. A full progress bar does not necessarily indicate a complete transfer. It is simply an indication of continued progress. If the transfer is completed successfully, the status bar will change to “Retrieval successful”. The raw data will be displayed in the “CCM Data” window. If the transfer did not complete successfully, the message “Comm port error” will be displayed and you may attempt another download. If any problems are encountered during a transfer, see the troubleshooting on page 14.

Data is sent in an ASCI text format with carriage returns separating each point. Reception can be done via any PC communications program capable of receiving unformatted text packets. The host settings are 2400 baud, 8 bit, 1 stop bit, no parity, and no handshaking. This mode is ignored if no data has been saved to memory yet.

Saving Data

After data has been downloaded, it may be saved on the host computer. This operates in a similar manner to most other Windows-compatible programs. The default extension is set by the file type (trace or calculated data) and the data saved is set by the parse data option (see parse data below).

To select the proper serial port and instrument type

There are two methods available to select these very important parameters. This software comes with an auto detect feature. When the software is installed, this feature is initially enabled. Auto detect will poll available serial ports (#1~#4) and attempt to communicate with the instrument. In order for this to work properly, the CCM-200 must be turned on and securely connected to a serial port. If the program finds an instrument, the relevant settings will be automatically saved. If it does not find one, you may manually select the proper serial port and instrument type from the Options window.

To change program settings

Program settings are changed from the Options window. Specifics on individual functions are given on the next page. It is important that the proper instrument type and serial port number are selected. If you are unsure of the correct serial port number, the auto detect feature should be able to select it for you.

Options Window Functions

Directories Tab

Sets the default temporary files and saves to directories. A temporary file is used while running the program to cache downloaded data for processing. It is important to be sure that there is sufficient room on the drive specified for proper program operation. Any less than 50 Kb of free disk space may cause program instability.

Default Calculated/Trace Extension

Most files on a computer have an extension describing the type of file it is. You may specify the default extensions for file types here. When you save data to a disk, this will be the default setting used. You may specify any extension (three characters maximum) here, or in the Save Data window.

Parse Data on Save

This option allows you to either save multiple downloads as one file or as separate files. If selected, the data will be parsed by file number used on the CCM-200.

Configuration Tab

Autodetect Instrument and serial port. When selected, the program will check available serial ports for a valid CCM-200 each time the program is run. This may take up to several minutes to complete. It is important that the CCM-200 is turned on and connected to a valid serial port. The CCM-200 should be left in its default startup screen. If this function is not selected, the program will default to the last known good instrument type and serial port. If there is a problem in auto detecting the CCM-200, deselect this option and manually select the appropriate settings.

Re-Detect

Polls available serial ports for an instrument. If one is found, the serial port number and instrument type will be automatically set.

Use Remote Control Download Command Set

Some instruments have remote host operation capability. When this is selected, the Data Capture software will allow the user to initiate transfers from the PC. To download data, simply select the data desired from the File Inventory window, and select download. This feature eliminates the need to set up and manually download data using the instrument itself.

Current Serial Port

Displays the currently selected serial port. You may manually select the proper serial port from here. If you do, be sure to disable Auto Detect, or the program may change the serial port number the next time it is run.

Instrument Model

Displays the currently selected instrument. This is important as not all functions are available (or relevant) to all instruments. You may manually select the proper instrument from here. If you do, be sure disable Auto Detect or the program may change the instrument type the next time it is run.

Main Screen Functions

Data Window - Displays the raw downloaded data received from the CCM-200.

File Inventory - Displays the file number and number of samples stored on the CCM-200. This information will only be displayed if it has been sent from the CCM-200.

Download Data - Initiates a download sequence. The status bar will indicate the actions to take, or that are being taken. It is important to click on this button before sending any data from the CCM 200. Sending the data first may result in a download error.

Save Data - Saves any downloaded data to a specified location on disk. The default directories, extensions, and formats are selected from the Options window.

Clear Data - Erases any downloaded data from the Fluorescence Data window on the host computer. This does not affect any data on the CCM-200.

Troubleshooting

In order for this software to operate properly, the correct serial port (usually 1~4) and instrument type must be selected. The software has been written to auto detect the proper settings, but this may not work in all situations. In this case, go to the Options window and manually select the appropriate settings.

Before contacting Opti-Sciences for assistance, check the following items.

- The CCM-200 is turned on and is currently in Remote mode.
- The CCM-200 is connected to the host computer with the supplied cable.
- The software has automatically detected the CCM-200, or you have manually selected the instrument type and the proper serial port number. To manually select these settings, see Options.

An error may occur during a download if you have initiated the transfer from the CCM-200 before you have selected Download Data. The sequence is very important.

Specifications

Measured Parameters

- Ratio of optical transmission at 931 nm (50 nm half-bandwidth) divided by transmission at 653 nm (25 nm half-bandwidth)

Measurement Area

- 71 mm^2
- 0.95 cm diameter

Resolution

- ± 0.1 Chlorophyll Concentration Index (CCI) unit

Range

- 0 to 200

Sample Acquisition Time

- 2 - 3 seconds

Detectors

- Two silicon photodiodes with integral amplifiers

Storage Capacity

- Internal datalogging of over 4000 measurements

Output

- RS-232 automatic transfer with PC software included

Radiation Source

- Two LEDs

User Interface

- 16 by 12 alphanumeric LCD
- 4 keys for control and data manipulation
- Beep-signal for status and warnings

Operating Temperature

- 0 - 50° C

Temperature Drift

- Temperature compensated source and detector circuitry for minimum drift over full range

Input Power

- Standard 9 V alkaline battery

Dimensions

- 15 by 8.2 by 2.5 cm

Mass

- 220 g (with battery)

Warranty

- 1 year against defects in materials and workmanship

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