



# CFX Connect™ Real-Time PCR Detection System

Instrument Guide

**BIO-RAD**



# CFX Connect<sup>™</sup> Real-Time PCR Detection System

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## Chapter 1 Introduction

Thermal cyclers are essential laboratory equipment for researchers who run polymerase chain reaction (PCR) for sequencing, cloning, gene expression studies, mutagenesis, and many other applications. Bio-Rad's CFX Connect™ real-time PCR detection system provides excellent thermal performance for two-target multiplex PCR and routine detection of single fluorophore experiments. Its fully adjustable heated lid supports a wide range of vessels and sealers, including low-profile and standard-height PCR plates.

This guide explains how to set up and use the CFX Connect to perform sensitive quantitative PCR.

### Finding Out More

**Note:** Click the Bio-Rad logo in the upper right corner of any CFX Maestro software window to launch Bio-Rad's website. This site includes links to technical notes, manuals, product information, and technical support. This site also provides many technical resources on a wide variety of methods and applications related to PCR, real-time PCR, and gene expression.





## Chapter 2 Setting Up the CFX Connect Thermal Cycler

This chapter explains how to set up the CFX Connect™ thermal cycler at your site.

**Tip:** Before setting up the thermal cycler, familiarize yourself with the thermal cycler and its optical reaction module, ports, and accessories.

### Site Requirements

The tables in this section list the room, environment, and power requirements necessary to successfully install and use the CFX Connect thermal cycler.

**Note:** Install your CFX Connect thermal cycler on a flat, dry surface with sufficient cool airflow for it to run properly.

### Benchspace Requirements

**Table 1. CFX Connect benchspace requirements**

| Item        | Specification   |
|-------------|---|
| Input power | Up to 850 W, maximum                                  |
| Frequency   | 50–60 Hz, single phase                                |
| USB ports   | 5 A, 1 B  |
| Dimensions  | W: 13 in; 33 cm<br>D: 18 in; 46 cm<br>H: 14 in; 36 cm |
| Weight      | 47 lb; 21 kg  |

## Environment Requirements

**Table 2. CFX Connect environment requirements**

| Parameter            | Range                | Humidity Range          |
|----------------------|----------------------|-------------------------|
| Operating conditions | 15–31°C<br>59–87.8°F | 0–80% RH, noncondensing |
| Storage conditions   | 15–31°C<br>59–87.8°F | 0–80% RH, noncondensing |

## Power Requirements

Power to the CFX Connect thermal cycler must be stable and within specifications to ensure proper operation. The power cable connected to the power inlet port must be rated for 7 amps or more.

**Table 3. CFX Connect power requirements**

| Item                    | Specification  |
|-------------------------|--|
| Mains input voltage     | 100–240 VAC; 50–60 Hz, single phase  |
| Maximum power usage     | <850 watts   |
| Number of power sockets | A minimum of 2 power sockets: <ul style="list-style-type: none"> <li>■ 1 socket for the thermal cycler</li> <li>■ 1 socket for the computer running CFX Maestro™ software</li> </ul> |

## System Overview

The illustrations in this section display the main components of the CFX Connect thermal cycler base.

### Front View



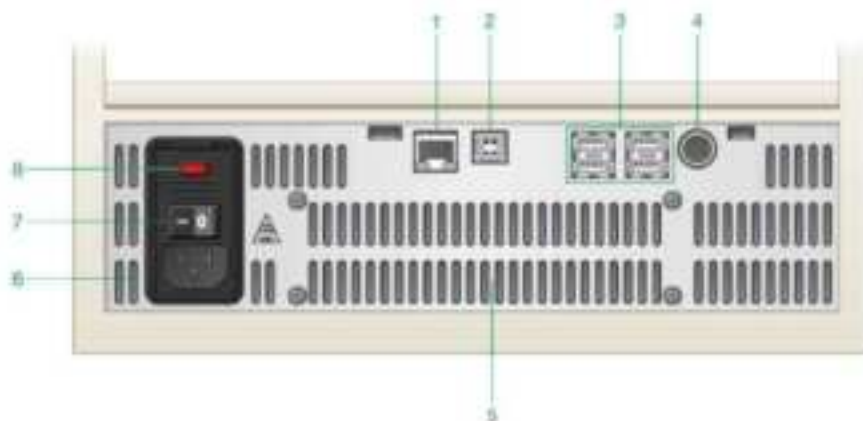
#### LEGEND

- |                        |                                |
|------------------------|--------------------------------|
| 1. Reaction module bay | 2. Reaction module locking bar |
| 3. Air intake vents    |                                |
- 

#### Details

- **Reaction module bay** — holds the inserted reaction module.
- **Reaction module locking bar** — locks reaction module in place.
- **Air intake vents** — allow the thermal cycler to heat and cool quickly.

## Back View



### LEGEND

|                     |                     |
|---------------------|---------------------|
| 1. Ethernet port    | 2. USB Type B port  |
| 3. USB type A ports | 4. Serial test port |
| 5. Cooling vents    | 6. Power input      |
| 7. Power switch     | 8. Fuses            |

### Details

- **Ethernet port** — connects the CFX Connect thermal cycler to your network.
- **USB Type B port** — connects the CFX Connect thermal cycler to a computer running CFX Maestro software.
- **USB Type A ports** — transfer data to and from a USB flash drive.
- **Serial test port** — this port is for service testing only.
- **Cooling vents** — cools thermal cycler.

**Caution:** Do not block the cooling vents. For optimal operation, ensure that air can circulate behind the thermal cycler base.

## CFX Connect Optical Reaction Module

The CFX Connect thermal cycler ships with the CFX Connect 96-well optical reaction module for real-time PCR. The reaction module includes a fully adjustable heated lid that is capable of running with a broad range of reaction vessels.

### Recommended Sample Volume

When using the CFX Connect thermal cycler, the maximum sample volume is 10–50  $\mu$ L.

## Installing the CFX Connect Thermal Cycler

The CFX Connect thermal cycler base ships separately from the reaction module. The package includes:

- CFX Connect thermal cycler base
- Power cord
- 1 USB cable

To install the CFX Connect thermal cycler:

1. Unpack and set up the CFX Connect thermal cycler base.
2. Attach the reaction module to the base.
3. Remove the shipping screw.

This section explains these tasks in detail.

### Unpacking and Setting Up the CFX Connect Thermal Cycler

**Important:** Before operating the thermal cycler, read the information in the sections [Safety and Regulatory Compliance on page 23](#) and [Instrument Safety Warning Labels on page 23](#).

**Tip:** During setup, ensure that you have sufficient space near the thermal cycler for a computer on which to run the CFX Maestro software.

#### To unpack and set up the thermal cycler base

1. Locate the package containing the thermal cycler base.
2. Remove the base from the packing material.  
**Tip:** Store the packing material for future use. If any item is missing or damaged, contact your local Bio-Rad office.
3. Place the thermal cycler base on a flat, dry surface with sufficient cool airflow to run properly.
4. Locate the power cord in the shipping package and insert one end into the power inlet port on back of the thermal cycler.

**Important:** Do not power on the instrument at this time.

5. Attach the reaction module to the base. Proceed to [Attaching the CFX Connect Optical Reaction Module on page 13](#).

## Attaching the CFX Connect Optical Reaction Module

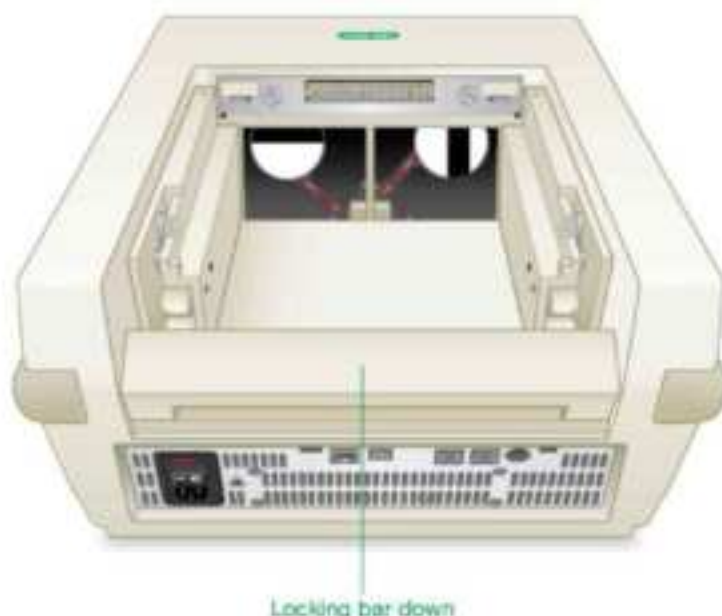
Bio-Rad ships the CFX Connect optical reaction module separately from its thermal cycler base. Carefully unpack the reaction module and verify that the power and USB cables are included in the shipping container.

**Important:** Only the CFX Connect optical reaction module can be used with the CFX Connect thermal cycler.

**Note:** Ensure that the CFX Connect thermal cycler base rests on a flat, dry surface with sufficient cool airflow to run properly.

### To attach the reaction module to the CFX Connect thermal cycler base

1. Place the CFX Connect thermal cycler in a suitable location.
2. Ensure that the locking bar, located on the back of the thermal cycler base, is pushed down.



3. Remove the reaction module from the packaging material.
4. Remove the instructions overlay from the thermal cycler's base.

**Tip:** Store the packing material and instructions for future use. If any item is missing or damaged, contact your local Bio-Rad office.

5. Lift the reaction module using the handle indents above the air vents on each side.





6. With its lid lever pointing toward the front, insert the reaction module into the reaction module bay, leaving about 2 cm of space in front of the thermal cycler.





7. Pull the locking bar up to lock the reaction module in place.

**Important:** There should be no space at the front of the module when it is locked into the CFX Connect base.



8. If you have not done so, insert one end of the supplied power cable into the base of the thermal cycler and the other end into an appropriate electrical outlet.
9. Press the power switch on the back panel to start the thermal cycler.

## Detecting Connected Instruments

During installation, the CFX Maestro software installer automatically installs the instrument drivers onto the computer running the CFX Maestro software. CFX Maestro detects connected instruments when you start the software.

**Important:** You must disconnect the thermal cycler from the CFX Maestro computer before you install the software. You do not need to turn off the thermal cycler during the software installation.

### To detect connected instruments

1. If you have not yet done so, insert the square (male) end of the supplied USB Type B cable into the USB Type B port located on the back of the CFX Connect base.
2. Insert the other (port) end into a USB port on the CFX Maestro computer.
3. If the thermal cycler is not already running, press the power switch on the back of the instrument to turn it on.
4. Start CFX Maestro software.

The software automatically detects the connected instrument and displays its name in the Detected Instruments pane in the Home window.

**Note:** If the instrument does not appear in the Detected Instruments pane, verify that the USB cable is properly installed. To reinstall drivers, select Tools > Reinstall Instrument Drivers in the Home window in CFX Maestro software.

## Removing the Shipping Screw

**Important:** Bio-Rad's optical reaction modules ship with a red shipping screw inserted in the inner lid to stabilize the reaction module during shipping. You must remove the shipping screw before you can operate the reaction module.

### To remove the shipping screw

1. The CFX Connect thermal cycler recognizes that the shipping screw is inserted in the optical reaction module.
2. After installing and starting CFX Maestro software, right-click the CFX Connect instrument in the Detected Instruments pane and select Properties.
3. Select the Shipping Screw tab and click Remove Shipping Screw.
4. Open the optical module lid.

5. Remove the shipping screw from the hole that corresponds to well A-1 in the inner heated lid and store the screw in a safe place.



**Note:** You must reinsert the shipping screw should you need to return the reaction module for any reason. Save the screw in a safe and accessible place.

6. In the Shipping Screw tab, click OK to confirm the screw status.
7. Close the Properties dialog box.

## Loading Sample Plates

To ensure uniform heating and cooling of samples, plates must be in complete contact with the reaction block. To ensure adequate contact, do the following:

- Confirm that the block is clean before loading samples.
- Firmly press the individual tubes, tube strips, or microplates into the block wells.

When using one or a few tubes, use the tube frame (catalog #1849000 or #1849001) or load at least one empty tube in each corner of the block to ensure the lid exerts even pressure on individual tubes.

## Loading Plates into the CFX Connect Reaction Module

**WARNING!** When running the CFX Connect real-time detection system, always balance the tube strips or add tube caps to the corner wells to ensure the heated lid applies even pressure across the block.

### To load plates into the reaction module

1. To open the motorized lid, do one of the following:
  - In the Detected Instruments pane in CFX Maestro software, click Open Lid.
  - On the Start Run tab in the software, click Open Lid.
  - Press the lid button on the front of the instrument.



2. Place the microplate, individual tubes, or tube strips with sealed lids in the block.

**Important:** Verify that the tubes are completely sealed to prevent leakage.

**Tip:** For optimal results, load sample volumes of 10–25  $\mu$ l for the CFX Connect system.
3. For accurate data analysis, verify that the orientation of reactions in the block is exactly the same as the orientation of the well contents in the Plate tab in CFX Maestro software.

**Tip:** You can edit the well contents using CFX Maestro software before, during, or after the run.

4. To close the motorized lid, do one of the following:

- Press the lid button on the instrument.
- In the Detected Instruments pane in the software, click Close Lid.
- On the Start Run tab in the software, click Close Lid.

**Important:** Ensure that nothing blocks the lid when it closes. Although there is a safety mechanism to prevent the lid from closing if it senses an obstruction, do not place anything in the way of the lid before closing.

## Detaching the CFX Connect Optical Reaction Module

**Important:** Power off the thermal cycler before detaching a reaction module. Cooling fins within the reaction module might be hot immediately after running a protocol or incubation. Ensure that the fins are cool before detaching the reaction module.

### To detach the reaction module from the thermal cycler base

1. On the back of the thermal cycler base, push the locking bar down to unlock and release the reaction module.



2. Carefully lift the reaction module out of the bay using the handle indents on each side.
3. Set the reaction module on a clean, flat surface where it cannot get bumped, scraped, or dropped.

## Transferring Data Files

When the run is complete, CFX Maestro™ automatically displays the fluorescence data in the Data Analysis window, which you can save to a specified folder on the CFX Maestro computer. (See CFX Maestro Software User Guide for information about saving data files.)

As well, the CFX Connect thermal cycler stores up to 100 real-time PCR runs as .zpcr files. After the run completes, you can transfer stored data files from the thermal cycler to the CFX Maestro computer through the software.

## Transferring Data Using CFX Maestro Software

### To transfer data from CFX Maestro software

- In the Detected Instruments pane on the Home window of CFX Maestro software, right-click the target instrument and select Retrieve Data Files.

The run data are saved into a folder labeled Real-Time Data as separate .zpcr files.





## Appendix A Safety and Regulatory Compliance

The CFX Connect™ thermal cycler heats and cools very quickly during operation. Bio-Rad strongly recommends that you follow the safety specifications listed in this appendix and throughout this manual.

**Note:** Use only Bio-Rad-supplied USB cables (catalog #1848000) when using the CFX Connect thermal cycler.

### Instrument Safety Warning Labels

The warning labels in [Table 4](#) appear on the CFX Connect thermal cycler and refer directly to the safe use of this instrument.

**Table 4. Instrument safety warning labels**




| Icon  | Meaning  |
|---|--|
|  | <p><b>CAUTION: Risk of danger!</b> This symbol identifies components that pose a risk of personal injury or damage to the instrument if improperly handled. Wherever this symbol appears, consult the manual for further information before proceeding.</p> <p><b>Note:</b> Operating the CFX Connect thermal cycler before reading this manual can constitute a personal injury hazard. Only qualified laboratory personnel should operate this instrument.</p>   |
|  | <p><b>WARNING! Risk of electrical shock!</b> This symbol identifies components that pose a risk of electrical shock if improperly handled.</p> <p><b>Important:</b> Never remove the outer case of a thermal cycler base. This may cause you to receive an electrical shock.</p> <p>This thermal cycler uses neutral fusing, which means that live power could still be exposed inside the instrument even when the fuse is blown or removed. Do not attempt to remove the outer case of this thermal cycler base, power supply, heat pump, or other accessories. If you open these instruments, you put yourself at risk for electrical shock and void your warranty. All repairs must be done by an authorized repair service.</p> |

Table 4. Instrument safety warning labels, continued

| Icon  | Meaning  |
|---|--|
|  | <p><b>WARNING! Hot surface!</b> This symbol identifies components that pose a risk of personal injury due to excessive heat if improperly handled.</p> <p><b>Important:</b> The sample blocks can become hot enough during the course of normal operation to cause liquids to boil and explode.</p> <p>A thermal cycler generates enough heat to cause serious burns. Wear safety goggles or other eye protection at all times during operation. Always allow the sample block to return to idle temperature before opening the lid and removing samples. Always allow maximum clearance to avoid accidental skin burns.</p> |

## Safety and Regulatory Compliance

This instrument has been designed to be safely operated under the environmental conditions listed in [Table 5](#).

Table 5. Conditions for safe use

| Usage Aspect         | Conditions for Safe Use                    |
|----------------------|--|
| Rated input power    | 100–240 VAC, 50–60 Hz, 850 W Max           |
| Overvoltage category | II   |
| Fuses                | 10 A, 250 V, 5 x 20 mm, fast blow (qty. 2) |
| Environment          | Indoor use only                            |
| Temperature          | 15–31°C                                    |
| Relative humidity    | Up to 80% (noncondensing)                  |
| Altitude             | Up to 2,000 meters above sea level         |
| Pollution degree     | 2  |

## Safety Compliance

This instrument has been tested and found to be in compliance with all applicable requirements of the following safety and electromagnetic standards:

- IEC 61010-1:2001 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements
- IEC 61010-2-010:2003 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 2-010: Particular Requirements for Laboratory Equipment for the Heating of Materials
- IEC 61010-2-081:2001+A1:2003 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 2-081: Particular Requirements for Automatic and Semi-Automatic Laboratory Equipment for Analysis and Other Purposes
- CAN/CSA-C22.2 NO. 61010-1-04 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements
- CAN/CSA-C22.2 NO. 61010-2-010-04 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 2-010: Particular Requirements for Laboratory Equipment for the Heating of Materials
- CAN/CSA-C22.2 NO. 61010-2-081-04 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 2-081: Particular Requirements for Automatic and Semi-Automatic Laboratory Equipment for Analysis and Other Purposes
- EN 61010-1:2001 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements
- EN 61010-2-010:2003 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory use, Part 2-010: Particular Requirements for Laboratory Equipment for the Heating of Materials
- EN 61010-2-081:2002+A1:2003 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory use, Part 2-081: Particular Requirements for Automatic and Semi-Automatic Laboratory Equipment for Analysis and Other Purposes
- UL 61010-1:2004 (R2008) Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements
- UL 6101A-2-010:2002 Standard for Electrical Equipment for Laboratory Use, Part 2: Particular Requirements for Laboratory Equipment for the Heating of Materials

## Electromagnetic Compatibility (EMC)

- IEC 61326-1:2005 Electrical Equipment for Measurement, Control, and Laboratory Use - EMC Requirements, Class A
- EN 61326-1:2006 Electrical Equipment for Measurement, Control, and Laboratory Use - EMC Requirements, Class A
- FCC Part 15, Subpart B, Sections 15.107 and 15.109 as a Class A Digital Device

## FCC Warnings and Notes

- **Warning:** Changes or modifications to this unit, not expressly approved by Bio-Rad, could void the user's authority to operate the equipment.
- **Note:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radiofrequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.
- **Note regarding FCC compliance:** Although this instrument has been tested and found to comply with Part 15, Subpart B of the FCC Rules for a Class A digital device, please note that this compliance is voluntary, for the instrument qualifies as an "exempted device" under 47 CFR 15.103(c), in regard to the cited FCC regulations in effect at the time of manufacture.
- **Note regarding Class A FCC limits:** Shielded cables must be used with this unit to ensure compliance with the Class A FCC limits.
- **Note regarding Canadian EMC compliance:** Le présent appareil numérique n'émet pas de bruits radioélectrique dépassant les limites applicables aux appareils numériques de class A prescrites dans le règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.
- **Note regarding cables:** Shielded cables must be used with this unit to ensure compliance with the Class A FCC limits.



## Battery

The CFX Connect thermal cycler uses a 3 V lithium-metal coin cell battery and a 4.8 V nickel-metal hydride rechargeable battery pack to maintain time settings and run data in the event of AC power loss. If the time and/or run data do not remain set after the unit is turned off, it may be an indication that the batteries are getting weak. If this occurs, contact Bio-Rad Technical Support for assistance.

**WARNING!** Do not attempt to change the batteries. Contact Bio-Rad Technical Support.

### For the State of California, USA only

- Perchlorate material – special handling may apply, see [www.dtsc.ca.gov/hazardouswaste/perchlorate](http://www.dtsc.ca.gov/hazardouswaste/perchlorate)
- Perchlorate material – lithium battery contains perchlorate

## Warranty

The thermal cycler and associated accessories are covered by a standard Bio-Rad warranty. Contact your local Bio-Rad office for the details of the warranty.



## Appendix B CFX Instrument and CFX Maestro Software Catalog Numbers

This appendix lists the catalog numbers for Bio-Rad's CFX instruments and compatible optical and traditional reaction modules, and the CFX Maestro™ software.

**Table 6. Catalog numbers for Bio-Rad's CFX instruments and modules, and CFX Maestro software**

| Catalog Number                          | Description   |
|---|---|
| <b>Instruments and Reaction Modules</b> |   |
| 184-1100                                | C1000 Touch™ Thermal Cycler Chassis                               |
| 184-2000                                | S1000™ Thermal Cycler Chassis                                     |
| 184-0148                                | Dual 48/48 Fast Reaction Module                                   |
| 184-0196                                | 96-Well Fast Reaction Module                                      |
| 184-0197                                | 96-Well Deep Well Reaction Module                                 |
| 184-0138                                | 384-Well Reaction Module  |
| 185-1196                                | C1000 Touch Thermal Cycler With 96-Well Fast Reaction Module      |
| 185-1197                                | C1000 Touch Thermal Cycler With 96-Well Deep Well Reaction Module |
| 185-1148                                | C1000 Touch Thermal Cycler With Dual 48/48 Fast Reaction Module   |
| 185-1138                                | C1000 Touch Thermal Cycler With 384-Well Reaction Module          |
| 185-2196                                | S1000 Thermal Cycler With 96-Well Fast Reaction Module            |
| 185-2197                                | S1000 Thermal Cycler With 96-Well Deep Well Reaction Module       |
| 185-2148                                | S1000 Thermal Cycler With Dual 48/48 Fast Reaction Module         |

**Table 6. Catalog numbers for Bio-Rad's CFX instruments and modules, and CFX Maestro software, continued**

| Catalog Number                              | Description  |
|---|--|
| 185-2138                                    | S1000 Thermal Cycler With 384-Well Reaction Module       |
| 184-5097                                    | CFX96™ Optical Reaction Module                           |
| 185-5195                                    | CFX96 Touch™ Real-Time PCR Detection System              |
| 184-4095                                    | CFX96 Deep Well Optical Reaction Module                  |
| 185-4095                                    | CFX96 Touch Deep Well Real-Time PCR Detection System     |
| 185-5201                                    | CFX Connect™ Real-Time PCR Detection System              |
| 184-5385                                    | CFX384™ Optical Reaction Module                          |
| 185-5485                                    | CFX384 Touch™ Real-Time PCR Detection System             |
| <b>CFX Maestro Software and Accessories</b> |  |
| 12004110                                    | CFX Maestro Software                                     |
| 12004128                                    | CFX Maestro Software for Mac                             |
| 184-5001                                    | CFX Maestro Software, Security Edition, 1 user license   |
| 184-5005                                    | CFX Maestro Software, Security Edition, 5 user licenses  |
| 184-5010                                    | CFX Maestro Software, Security Edition, 10 user licenses |
| 184-5008                                    | CFX Maestro Software, Chinese Edition                    |
| 184-5028                                    | CFX Maestro Software, Russian Edition                    |
| 184-5025                                    | Precision Melt Analysis Software, with calibration kit   |



**Table 6. Catalog numbers for Bio-Rad's CFX instruments and modules, and CFX Maestro software, continued**

| Catalog Number | Description |
|----------------|-------------|
| 184-8000       | USB Cable * |

\*To prevent interference or data loss, use a sufficiently shielded USB 2.0 cable (catalog # 184-8000) when connecting instruments to the computer or to another instrument.



## Appendix C Recommended Plastic Consumables

### Recommended Plastic Consumables for the CFX Connect System

The CFX Connect™ system accept low-profile 0.2 ml plates and tubes. Bio-Rad recommends the following consumables for optimal results:

- MLL9601 — Multiplate™ low-profile 96-well unskirted PCR plates with clear wells
- MLL9651 — Multiplate™ low-profile 96-well unskirted PCR plates with white wells
- HSP9601 — Hard-Shell® low-profile 96-well skirted PCR plates with white shell and clear wells
- HSP9655 — Hard-Shell low-profile 96-well skirted PCR plates with white shell and white wells
- TLS0801 — Low-profile 0.2 ml 8-tube PCR strips without caps, clear
- TLS0851 — Low-profile 0.2 ml 8-tube PCR strips without caps, white
- TCS0803 — Optical flat 8-cap strip, for 0.2 ml PCR tubes and plates

## Plate Seals and Plate Sealer

For optimal results, Bio-Rad recommends the following plate seals:

- MSB1001 — Microseal® 'B' adhesive seals, optically clear (strong adhesive-based)
- MSC1001 — Microseal 'C' optical seals, optically clear (pressure-activated, adhesive-based)
- 1814000 — PX1™ PCR plate sealer

## Appendix D Maintenance and Troubleshooting

This appendix explains how to clean and maintain the CFX Connect™ thermal cycler and how to troubleshoot problems that you might have.

### Cleaning and Maintaining the CFX Connect Thermal Cycler

The CFX Connect requires little maintenance for proper operation and precise thermal control. However, with long and constant use, the thermal cycler will require some cleaning and other maintenance including replacing the fuses.

The CFX Connect system includes a sensitive optical shuttle system that moves quickly during data collection and a sample block that must heat and cool very fast. Contamination of these components can interfere with thermal cycling and data collection.

**WARNING!** Never allow a reaction to run with an open or leaking sample lid. The reagents could escape and coat the block, inner lid, and optical head in the shuttle system. Excessive dirt can dim the signal, and fluorescence contamination can create excessive background signal. The shuttle system cannot be cleaned except by trained Bio-Rad service engineers.

Avoid contaminating your CFX Connect system by following these suggestions:

- Always clean the outside of any containers before placing them in the block.
- Never run a reaction with a seal that is open, loose, punctured, or otherwise damaged because you could contaminate the block, inner lid, and optical system.
- Never run a real-time PCR reaction with volatile reagents that could explode and contaminate the block, inner lid, and optical system.
- Clean the block and inner lid periodically to prevent the buildup of dirt, biohazardous material, or fluorescent solutions.
- Never clean or otherwise touch the optical system behind the heater plate holes in the inner lid.
- Clean the outer lid and CFX Connect base on a regular schedule.

## Cleaning the CFX Connect Thermal Cycler

Clean the CFX Connect thermal cycler on a regular schedule to remove any debris or dirt that might interfere with proper function (see [Table 7](#)). Clean the base to prevent damage to the air intake or reaction module bay.

**Important:** For instructions on handling and cleaning radioactive or biohazardous materials, consult the guidelines for radiation safety and biosafety provided by your institution. These guidelines also include disposal methods of hazardous materials.

**Table 7. CFX Connect thermal cycler base maintenance**

| Component                               | Action  |
|---|---|
| Air vents                               | <p>Use a soft brush, damp cloth, or vacuum cleaner to remove light dust from the air vents. Remove any heavy dust that is deep in the vents with a vacuum cleaner.</p> <p><b>Tip:</b> Cleaning the vents allows sufficient airflow for precise thermal control during a run.</p>  |
| Reaction module bay                     | <p>Use a damp soft cloth to remove debris and spilled liquids. Cleaning the bay allows precise heating and cooling of the reaction block.</p> <p><b>Caution:</b> Never use cleaning solutions that are corrosive to aluminium. Avoid scratching the surface of the bay; surface scratches can interfere with precise thermal control.</p> <p><b>Caution:</b> Never pour water or other solutions in the reaction module bay. Wet components can cause electrical shock when the thermal cycler is plugged in.</p> |
| Outside case of the thermal cycler base | <p>Use a damp cloth or tissue to clean spills off the outside case. If needed, use a mild soap solution and remove the residue completely.</p> <p><b>Tip:</b> Cleaning the outside case prevents corrosion.</p>   |

## Cleaning Reaction Modules

Clean the reaction modules on a regular schedule to prevent reagents from accumulating and interfering with the ability of the reaction block to change temperature quickly (see [Table 8 on page 38](#)).



**WARNING!** To prevent electrical shock, always remove the reaction module from the thermal cycler base before cleaning it.

**Important:** Never touch or allow solutions to touch the optical system that is located behind the lid plate holes in the inner lid:



Table 8. Reaction module maintenance

| Component                           | Action   |
|-------------------------------------|--|
| Cooling fins                        | <p>Use a soft brush or damp cloth to remove light dust from the cooling fins. Remove any heavy dust that is deep in the fins with a vacuum cleaner. Use water and a soft cloth to remove debris that is stuck to the fins.</p> <p><b>Tip:</b> Cleaning the fins improves precise sample heating and cooling.</p> <p><b>Caution:</b> Avoid scratching the surface. Never use cleaning solutions that are corrosive to aluminum, such as bleach or abrasive cleansers. If needed, use a mild soap solution and rinse well to remove the residue completely.</p>  |
| Outside cover of the reaction block | <p>Use a soft cloth and water to remove debris from the outer block.</p> <p><b>Caution:</b> Never clean the block with strong alkaline solutions (strong soap, ammonia, or highly concentrated bleach). Never use corrosive or abrasive cleaning solutions. These cleaning agents can damage the block and prevent precise thermal control.</p>  |
| Block wells                         | <p><b>Important:</b> Clean spills immediately to prevent them from drying inside wells.</p> <p>Use disposable plastic pipets with water (recommended), 95% ethanol, or a 1:100 dilution of bleach in water. Always rinse the wells with water several times to remove all traces of ethanol, bleach, or soap.</p> <p><b>Caution:</b> If left in the block wells, bleach, ethanol, or soap could corrode the block and/or destroy tubes and microplates during a run. Always rinse the block well after cleaning it with any solution other than water.</p> <p><b>Caution:</b> Never heat the block after adding a cleaning solution. Heating the block with cleaning solution damages the block, lid, and thermal cycler base.</p> <p>If oil is used, the wells must be cleaned thoroughly and often. Use of oil in the wells is not recommended. Clean the oil when it is discolored or contains dirt. Use a solution of 95% ethanol to clean oil. Do not allow oil to build up in the block.</p> |
| Inner lid of the reaction module    | <p>Use a soft cloth and water to remove debris and solutions from the inner lid surface.</p>   |



Table 8. Reaction module maintenance, continued

| Component                                | Action   |
|--|--|
|  | <p><b>Tip:</b> Cleaning the inner lid improves precise sample heating and cooling.</p> <p><b>Caution:</b> Never use abrasive detergents or rough materials that scratch the surface.</p>                       |
| Outer lid surface of the reaction module | <p>Use a damp cloth or tissue to clean spills off the outside case. If needed, use a mild soap solution and rinse the surface with a damp cloth.</p> <p><b>Tip:</b> Cleaning the cover prevents corrosion.</p> |

## Maintaining Sufficient Airflow

The CFX Connect thermal cycler requires sufficient airflow to heat and cool precisely to the correct target temperature. If the flow of air is blocked, the thermal cycler cannot ramp to the correct temperature in the specified time. This section explains how to test the airflow and how to fix low or warm airflow.

### Testing for Sufficient Airflow

The airflow is sufficient when the thermal cycler heats and cools to the correct target temperatures promptly. Bio-Rad suggests that you test the airflow when you set up the CFX Connect thermal cycler in a new location. You can also measure the air temperature at any time to ensure sufficient airflow.

#### To determine the presence of sufficient airflow

1. Set up and start the thermal cycler.
2. Adjust the local environment for typical conditions:
  - Turn on any nearby equipment, such as fans or other thermal cyclers.
  - Open any window blinds to reproduce typical conditions during a run.
3. Run a typical PCR protocol for 30 min.

If more than one thermal cycler is in the area, run a protocol on all the thermal cyclers at the same time.

**Note:** Samples are not required for the test runs. However, you must include an empty microplate or tubes. The lid does not heat correctly if it touches the hot block of the reaction module.

4. Measure the air temperature at the air intake vents of all the thermal cyclers.

If the air intake temperature increases above 31°C, see [Fixing Insufficient Airflow](#) that follows.

### Fixing Insufficient Airflow

If the air temperature near the thermal cycler is above 31°C, make one or more of the following changes to increase the flow of cooler air around the thermal cycler:

- Adjust air conditioning to lower the ambient air temperature.
- Move the thermal cycler to another location.

- Provide more space around the thermal cycler and between adjacent instruments. Arrange instruments so that the warm exhaust air from one instrument does not enter the air intake vents of another.
- Shield the thermal cycler from heat sources such as radiators, heat-producing instruments, and bright sunlight.

## Replacing Fuses

Fuses on the CFX Connect thermal cycler are designed to blow in case of severe power surges or other causes of electrical short. This protects both the user and the thermal cycler from excessive electric charge. Fuses on the thermal cycler rarely need to be replaced. However, some institutions prefer to replace fuses on a regular basis to maintain uninterrupted operation.

If the thermal cycler does not turn on, first verify that the power cord is plugged in to a functioning power source. Also, verify that the power cord and power source are within the specifications for this thermal cycler.

**Important:** Do not attempt to replace the power cord on the CFX Connect thermal cycler. Instead, contact Bio-Rad Technical Support.

Finally, verify that the fuses are intact. If the fuses are broken or burned, replace the fuses. This section explains how to view and replace fuses on the CFX Connect thermal cycler.

**Tip:** The thermal cycler has two 10 A, 250 V, 5 x 20 mm, fast blow fuses.



**WARNING!** To prevent electrical shock, always turn off and unplug the thermal cycler from the electrical outlet before checking the fuses.

### To view and replace the fuses

1. Using a small coin, open the fuse drawer on the back of the thermal cycler.
2. Pull out the fuse drawer and remove each fuse.
3. Look at the condition of each fuse.

A bad fuse shows a break or burned spot in the metal. A good fuse has intact metal.

4. Replace each damaged fuse.
5. Close the fuse drawer.



## Appendix E References

1. Breslauer KJ et al. (1986). Predicting DNA duplex stability from the base sequence. *Proc Natl Acad Sci USA* 83, 3,746–3,750.
2. Sugimoto N et al. (1996). Improved thermodynamic parameters and helix initiation factor to predict stability of DNA duplexes. *Nucleic Acids Res* 24, 4,501–4,505.

## Appendix E References







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