QX700 Droplet Digital PCR System

Instrument Guide

QX700 HT Droplet Digital PCR System
QX700 E Droplet Digital PCR System
QX700 S Droplet Digital PCR System

BIO-RAD

QX700 ddPCR System

Instrument Guide

QX700 ddPCR System Control Software

Version 1.5

For Research Use Only. Not for Use in Diagnostic Procedures.

BIO-RAD

Bio-Rad Technical Support Department

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Legal Notices

Revision History

Document	Date	Description of Change
QX700 ddPCR System with QX700 ddPCR System Control Software (Doc ID 10000258608)	April 2026	Initial release of the QX700 ddPCR System with standard features only

Table of Contents

Safety and Regulatory Compliance

This guide cites regulatory requirements for laboratory and electrical equipment, as well as requirements for working with chemicals and hazardous substances, and also explains safety precautions and recommendations.

Important: Only trained personnel should use this instrument.

Regulatory Compliance

This instrument is a CE-marked device distributed by Bio-Rad Laboratories, Inc. Stilla Technologies is the legal manufacturer responsible for regulatory compliance.

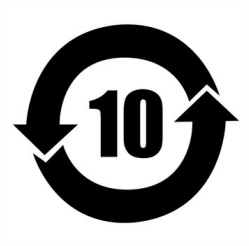
This instrument has been tested and found to comply with

- The limits for a Class A digital device pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.
- All applicable requirements of the following safety and electromagnetic standards:
  - IEC 61010-1:2010 (3rd:2016). Electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
  - IEC 61010-2-081:2019. Safety requirements for electrical equipment for measurement, control, and laboratory use. Particular requirements for automatic and semi-automatic laboratory equipment for analysis and other purposes (includes Amendment 1)
  - IEC 61326-1:2020 (Class A). Electrical equipment for measurement, control, and laboratory use. EMC requirements, Part 1: General requirements
  - Restriction of hazardous substances (RoHS) directive (European Union) 2015/863
  - Waste electrical and electronic equipment (WEEE) directive 2012/19/EU

Foreign Compliance

China

This product complies with China RoHS regulations, indicating that restricted hazardous substances are within legal limits and the Environmental Protection Use Period (EPUP) is shown on the label.



South Korea

KC certification demonstrates a product's compliance with Korean safety regulations. The KC certification's primary purpose is to identify and eliminate potential hazards to the health and safety of consumers.

Symbols Lexicon

Table 1. Labeling Symbols Lexicon

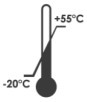
 Catalog Number	 Serial Number
 CE Marking - Directives 2014/30/EU and 2014/ 35/EU	 UK Conformity Assessment (UKCA)
 Australian Regulatory Compliance Mark	 North American CSA Compliance Mark
 Temperature Limit	 Use Caution
 Waste Electrical and Electronic Equipment (WEEE)	 Manufacturer

Table 1. Labeling Symbols Lexicon, continued

 Consult Instructions for Use	 Distributor
 Chinese Restriction of Hazardous Substances Mark	 Korean Certification Mark (South Korea)

Safety Warning Labels

Warning labels alert you about sources of injury or harm. The table below defines each safety warning label.

Table 2. Meaning of safety warning labels

Icon	Meaning
	**Warning about liquids** Prevent liquids from entering the instrument. Load samples outside of the instrument.
	**Warning about risk of electric shock** In order to prevent electric shock, use caution when plugging and unplugging the instrument. Always turn off and unplug the instrument when performing maintenance procedures. Never open the instrument housing unless instructed by a Bio-Rad technical representative. Only users trained by a Bio-Rad representative should open the instrument door. Always shut down the instrument and unplug it before opening the housing or door. Opening the instrument while it is still powered on may result in unexpected robotic movements that can cause injury. Do not start any analysis while the housing or door is open, as this poses a risk of physical contact or shock from internal robotic components.

Table 2. Meaning of safety warning labels, continued

Icon	Meaning
	**Warning about photobiological hazards** The optical module LEDs can pose a risk of eye injury if the instrument door is opened without proper precautions. Always shut down the instrument and unplug it before opening the housing or door.
	**Warning about risk of harm to body or equipment** Operating the system before reading this manual can constitute a personal injury hazard. For safe use, do not operate this instrument in any manner unspecified in this manual. Only qualified laboratory personnel trained in the safe use of electrical equipment should operate this instrument. Always handle all components of the system with care and with clean, dry hands.
	**Warning about risk of burning** Never open the instrument housing or door unless instructed by a Bio-Rad technical representative. Always shut down the instrument and unplug it before opening the housing or door. Opening the instrument while it is still operating may expose you to hot thermoblocks that can reach temperatures above 50 °C, posing a risk of burns or scalds. Only use chips and chip plates provided by Bio-Rad, as they are heat resistant up to 95 °C. A thermal cycler generates enough heat to cause serious burns. Wear safety goggles or other eye protection at all times during operation, and do not try to open the front door. Always allow maximum clearance to avoid accidental skin burns.
	**Warning about pinch or crush risk** Never open the instrument housing or door unless instructed by a Bio-Rad technical representative. Always shut down the instrument and unplug it before opening the housing or door. Opening the instrument while it is still operating may result in pinch injuries due to manual or automatic movement of the thermoblock lids.
	**Protective conductor terminal**
	**Warning about handling biohazardous materials** When handling biohazardous samples, adhere to the recommended precautions and guidelines and comply with any local guidelines specific to your laboratory and location.

Safe Use Specifications

For safe operation of the instrument, Bio-Rad strongly recommends that you comply with instructions listed in this section and in Appendix B, Cleaning and Maintaining the Instrument.

Important: This instrument is intended for laboratory use only. Bio-Rad is not responsible for any injury or damage caused by use of this instrument for purposes other than those for which it is intended, or by modifications to the instrument not performed by Bio-Rad or an authorized agent.

- This instrument is for use only by trained personnel.
- Use only the power and connection accessories supplied with the instrument, and the plug adapter corresponding to the electrical outlets in your region.
- For easy access to the back of the instrument, place the instrument on a solid, stable surface and provide adequate room at the back and on each side.
- This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the provided instructional documentation, may cause harmful interference to radio communications. Operation of the systems in a residential area is likely to cause harmful interference, in which case users will be required to correct the interference at their own expense.

Note: Bio-Rad recommends maintaining a backup power source in case of power outages. A universal power supply (UPS) can protect from brown outs and power surges, while a regular backup generator does not.

For information on environmental requirements, see Environment Requirements on page 20.

Power Requirements

Ensure that your facility meets the instrument's maximum power consumption and electrical specifications:

- For 220–240 V AC operation, a grounded electrical line rated at a minimum of 10–15 A is required.
- For 110 V AC operation, a grounded electrical line rated at a minimum of 20 A is required.

An electrical ground is mandatory. The instrument is shipped with a dedicated power cable that complies with regional standards. Always confirm that the power cable matches your country's electrical regulations during installation.

Important: If voltage fluctuations exceed ±10%, use a power line regulator.

Do not use electrical adapters.

For optimal performance, Bio-Rad recommends switching off the instrument at least once a week.

Personal Protective Equipment

Proper use of gloves is recommended with use of oils and sample plates. OSHA requirements for personal protective equipment (PPE) are set forth in the Code of Federal Regulations (CFR) at 29 CFR 1910.132 (General requirements); 29 CFR 1910.138 (Hand protection); 29 CFR 1926.95 (Criteria for standard personal protective equipment). Any gloves with impaired protective ability should be discarded and replaced. Consider the toxicity of the chemicals and factors such as duration of exposure, storage, and temperature when deciding to reuse chemically exposed gloves.

The following features aid glove selection for handling of machines, assays, oils, and cleaning solvents:

- Butyl gloves are made of a synthetic rubber and protect against peroxide, hydrofluoric acid, strong bases, alcohols, aldehydes, and ketones
- Natural (latex) rubber gloves are comfortable to wear and feature outstanding tensile strength, elasticity, and temperature resistance
- Neoprene gloves are made of synthetic rubber and offer good pliability, finger dexterity, high density, and tear resistance; they protect against alcohols, organic acids, and alkalis
- Nitrile gloves are made of copolymer and provide protection from chlorinated solvents such as trichloroethylene and tetrachloroethene; they offer protection when working with oils, greases, acids, and caustic substances

Hazards

The instrument is designed to operate safely when used in the manner prescribed by the manufacturer. If the instrument or any of its associated components is used in a manner not specified by the manufacturer, the inherent protection provided by the instrument may be impaired.

Bio-Rad Laboratories, Inc. is not liable for any injury or damage caused by the use of this equipment in any unspecified manner, or by modifications to the instrument not performed by Bio-Rad or an authorized agent. Only trained Bio-Rad personnel should perform service on the system.

Biohazards

The instrument is a laboratory product. However, if biohazardous samples are present, adhere to the following guidelines and comply with any local guidelines specific to your laboratory and location.

Note: No biohazardous substances are expended during normal operations of this instrument.

General Precautions

- Always wear laboratory coat, laboratory gloves, and safety glasses with side shields or goggles.
- Keep your hands away from your mouth, nose, and eyes.

- Completely protect any cut or abrasion before working with potentially infectious materials.
- Wash your hands thoroughly with soap and water after working with any potentially infectious material before leaving the laboratory.
- Store all infectious or potentially infectious material in unbreakable leak-proof containers.
- Before leaving the laboratory, remove protective clothing.
- Change gloves frequently. Do not use a gloved hand to write, answer the telephone, turn on a light switch, or touch anything that other people may touch without gloves. Remove gloves immediately when they are visibly contaminated.
- Do not expose materials that cannot be properly decontaminated to potentially infectious material.
- Upon completion of an operation involving biohazardous material, decontaminate the work area with an appropriate disinfectant (for example, a 1:10 dilution of household bleach).

Disposal of Biohazardous Material

Dispose of the following potentially contaminated materials in accordance with laboratory local, regional, and national regulations:

- Clinical samples
- Reagents
- Used reaction vessels or other consumables that may be contaminated

Chemical Hazards

The instrument contains no potentially hazardous chemical materials.

Explosive or Flammability Hazards

The instrument poses no uncommon hazard related to flammability or explosion when used in a proper manner as specified by Bio-Rad.

Electrical Hazards

The instrument poses no uncommon electrical hazard to operators if installed and operated properly without physical modification and connected to a power source of proper specification.

Decommissioning and Disposal

The instrument contains electrical materials that should be disposed of as unsorted waste and must be collected separately, according to European Union Directive 2012/19/EU on waste electrical and electronic equipment — WEEE Directive. The purpose of decommissioning is to make sure that the equipment is electrically and environmentally safe for disposal. Before disposal, contact your local Bio-Rad representative for country-specific instructions.

To decontaminate the instrument before decommissioning and disposal, see Cleaning and Maintaining the Instrument on page 105.

Environment Requirements

This instrument is designed to be safely operated under the environmental conditions listed in the following table.

Table 3. Instrument environment requirements

Parameter	Specification
Environment	Indoor use only (clean laboratory)
Operating altitude	Up to 2,000 meters above sea level
Ambient room temperature	15 to 25°C*
Transport and storage temperature	5° to 40°C**
Relative humidity***	Operating: 40% to 80% (noncondensing) Storage: 10% to 95% (noncondensing)
Barometric Pressure	700 hPa to 1060 hPa
Operating power	100 to 240 V~ (±10%), 50/60 Hz****
Mains supply voltage fluctuation	±10%
Maximum power usage	<850 watts
Fuses	6.3x32 T 16A. H/250V~*****
Overvoltage category	II
Power consumption max (W)***	1750W
Pollution degree	2
Noise	61dBA max

Table 3. Instrument environment requirements, continued

Parameter	Specification
* Operating the instrument at 4ºC should be limited to 18 hours at these conditions. Holds at 4ºC can be performed for up to 72 hours if humidity is 20% to 60% (noncondensing). ** Store and transport the instrument in its shipping container to meet these temperature conditions. *** Operating the instrument at 4ºC should be limited to 18 hours at these conditions. Holds at 4ºC can be performed for up to 72 hours if humidity is 20% to 60% (noncondensing). **** The facilities must be in equipped to adequately handle the maximum power consumption and wired with a minimum of: ■ 10-15 amp grounded line with 220-240 volts AC. ■ 20 amp grounded line with 110 volts AC. ***** Use 6.3 × 32 mm, T10A, 250 V~ fuses to support Type 13 (10 A) power cords for instruments installed in Switzerland and Liechtenstein.	

EMC Requirements

Table 4. Instrument EMC requirements

Item	Specification
Emission Class	Class A
Compliant with IEC 61326-1	

WARNING! Emissions exceeding the levels described above might occur if the instrument is connected to an external device such as a monitor or a USB drive.

WARNING! This instrument is not intended for use in residential environments and might not provide adequate protection against radio frequency interference in such settings.

Surface Decontamination

WARNING! To prevent electrical shock, always turn off and unplug the instrument before performing decontamination procedures.

To clean the surface of the instrument, use a lint-free tissue moistened with one of the cleaning agents listed below. Allow surfaces to air dry completely.

- 10% diluted bleach
- Diluted Sodium Hydroxide (e.g., RNAase away)
- Lab grade Water
- 70% Lab grade Ethanol
- Isopropanol

Door and Housing Decontamination

WARNING! To prevent electrical shock or to prevent accidental activation, always turn off and unplug the instrument before performing decontamination procedures.

WARNING! Do not clean the internal components of the instrument, including the optical module. Cleaning the instrument interior can damage the instrument or affect its performance.

WARNING! Do not spray cleaning agents directly onto or into the system. Avoid using spray bottles.

WARNING! Follow all safety instructions provided by the cleaning agent manufacturer.

To clean the front door and outer housing, use a lint-free tissue dampened with one of the agents listed below. Wipe the surfaces carefully, avoiding the power connector.

- 10% diluted bleach
- Diluted Sodium Hydroxide (e.g., RNAase away)
- Lab grade Water
- 70% Lab grade Ethanol
- Isopropanol

Chapter 1 Droplet Digital PCR Overview

Droplet Digital™ PCR (ddPCR™) is a digital polymerase chain reaction method based on water-oil emulsion droplet technology. Using reagents and workflows that are similar to Taqman probe-based design, ddPCR employs a combination of microfluidics and proprietary surfactant chemistries to divide each sample into a high volume of water-in-oil droplets per well.

In general, ddPCR can be performed on the instrument with all types of DNA sample. However, individual sample type compatibility for digital PCR applications might require a dedicated assay validation by the end-user. The extraction method used, as well as sample purity, can influence sample compatibility for digital PCR applications.

ddPCR Advantages

ddPCR achieves high performance in the following areas:

- Absolute quantification of target DNA copies in samples to determine precise concentrations without using standard curves; this technique is ideal for nucleic acid target sequence measurements, viral titer concentrations, or microbial load determination
- More precise measurement of differences in gene copy number to better identify genomic alterations that indicate phenotypic variability, complex behavioral traits, and disease
- Detection of rare mutations or sequences in complex samples, such as a few tumor cells in a wild-type background
- Absolute quantification of gene expression levels, particularly involving low-abundance microRNA
- Next-generation sequencing (NGS) quantification to increase sequencing accuracy, validate variations/mutations, and reduce run repeats
- Low copy number quantification and gene expression of individual cells required by the high degree (10-fold to 100-fold) of cell-to-cell variation in gene expression and genomic content among homogeneous post-mitotic, progenitor, and stem cell populations
- Fast, precise, and cost-effective assessment of HDR (Homology directed repair) and NHEJ (non-homologous end joining) generated by CRISPR-Cas9 or other genome editing tools to detect genome edits

ddPCR has the following benefits for nucleic acid quantification:

- Partitioning of the sample in ddPCR enables higher precision and more reliable measurement of small differences in the target DNA sequences.

- High-copy samples and background are diluted, effectively enriching the concentration in partitions with positive targets. Increased signal-to-noise ratio allows for the sensitive detection of rare targets and enables a ±10% precision in quantification.
- Error rates are reduced by removing the amplification efficiency reliance of qPCR, enabling accurate quantification of targets to near zero.
- For absolute quantification, there is no requirement for a standard curve.

ddPCR Workflow

The ddPCR process adheres to the following workflow:

- **Experiment preparation** — Samples are prepared by combining DNA or RNA with primers, probes dye, and Bio-Rad ddPCR supermix.
- **Droplet generation** — Samples are fractionated into thousands of droplets in each well, with target and background DNA distributed randomly into the droplets during the partitioning process.
- **Thermal cycling** — Following droplet generation, the droplets are run through the thermal cycler, which performs PCR amplification of the nucleic acid target in each individual droplet.
- **Droplet reading** — Each droplet is scanned (read) to determine the fraction of positive droplets in the original sample. Poisson statistical formulas are used to determine the absolute quantity.

  Note: Positive droplets containing at least one copy of the target DNA molecule exhibit increased fluorescence, as compared to negative droplets. Poisson statistical formulas are used to determine the absolute quantity.

Droplet Generation

Before droplet generation, ddPCR reactions are prepared in a similar manner as real-time PCR reactions that use TaqMan hydrolysis probes labeled with reporter fluorophores or an intercalating dye. ddPCR is performed with Bio-Rad's proprietary reagents that were developed specifically for droplet generation.

The instrument runs the plates containing your DNA samples as the first component in the three-part process. The instrument uses specially developed reagents and microfluidics to partition each sample between 10,000 and 17,000 nanoliter-sized droplets per well. Target and background DNA are distributed randomly into the droplets during the partitioning process. Droplet generation produces uniform droplets for the sample, enabling precise target quantification.

PCR Amplification

After droplet generation, the plates are heated and cooled repeatedly in the thermal cycler. This amplifies one or more copies of a particular DNA segment, thereby multiplying strands of DNA sequencing into the

thousands or millions.

Finding Out More

You can visit bio-rad.com to download product information, technical notes, videos, and user manuals related to ddPCR instruments and technology.

Chapter 2 Introduction

The QX700™ Droplet Digital PCR System (known in this guide as the QX700 ddPCR System) is a fully integrated platform for Droplet Digital PCR (ddPCR).

Using the QX700 ddPCR System Control Software, the QX700 ddPCR System automatically performs droplet generation, amplification, and imaging with no user intervention, in up to seven detection channels.

The QX700 ddPCR System is available in the following configurations to support different throughput needs:

- **QX700 E Droplet Digital PCR System** — Up to 48 samples per run
- **QX700 S Droplet Digital PCR System** — Up to 192 samples per run
- **QX700 HT Droplet Digital PCR System** — Up to 384 samples per run

This instrument guide provides general information for the use of the QX700 ddPCR System for ddPCR. It explains the workflow and required hardware components. Users should read the guide carefully, follow all instructions, and observe the safety information to ensure proper operation and maintenance of the instrument.

Important: The QX700 ddPCR System is a laboratory instrument intended to be used by professional users trained in molecular biological techniques. Before operating the instrument, users must receive training from a Bio-Rad representative.

QX700 ddPCR System Components

The QX700 ddPCR System includes the following items:

- **QX700 Droplet Digital PCR System** — Performs the sequential QX700 ddPCR System processes
- **Attached touch screen** — Displays the QX700 ddPCR System Control Software interface
- **QX700 ddPCR System Control Software** — Installed on either the instrument touch screen, or as a separate software component a personal computer (PC). The QX700 ddPCR System Control Software provides a user interface to:
  - Control the instrument
  - Set up assays

- Recover plates from run failures

Note: The QX700 ddPCR System is available in both Standard Edition and Premium Edition. The Premium Edition supports laboratories that must comply with Title 21 of the U.S. Code of Federal Regulations. For more information about the Premium Edition, see the QX700 ddPCR System, Premium Edition Instrument Guide.

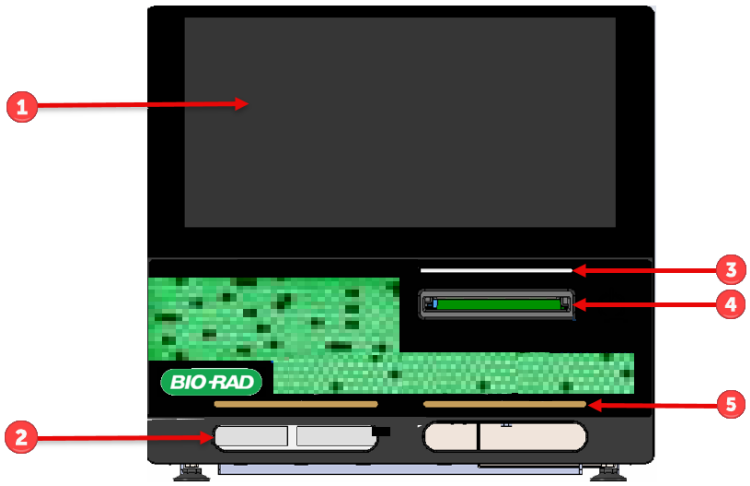
- **QX700 Analyzer**, which is installed on the instrument touch screen, or as a separate software component on a personal computer. The QX700 Analyzer provides a user interface to:
  - Collect analysis data
  - Store analysis data
  - Display analysis data

  Note: The QX700 Analyzer is available in both Standard Edition and Premium Edition. The Premium Edition supports laboratories that must comply with Title 21 of the U.S. Code of Federal Regulations

Chapter 3 Technical Specifications

This section describes the QX700 ddPCR System technical specifications.

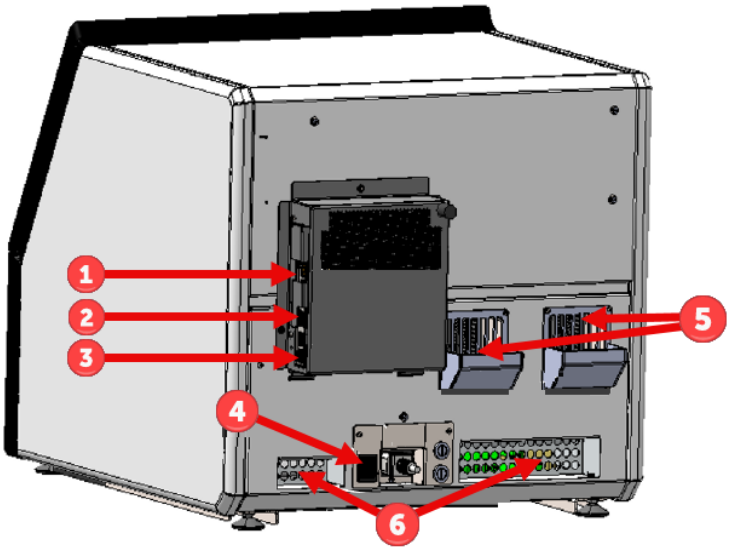
Front View



LEGEND

1. Touch screen display	2. Front ventilation and handles
3. Loading status bar	4. Chip loading
5. Status lines	

Back View



LEGEND

1. Ethernet	2. HDMI port
3. USB ports	4. Power button
5. Thermal ventilation	6. Handle and ventilation

QX700 ddPCR System Dimensions

Table 5. QX700 ddPCR System dimensions

Item	Specification
Dimensions	W: 56 cm D: 65 cm H 52 cm
Weight	61kg ± 0.5kg

Imaging System Specifications

Table 6. QX700 ddPCR System Imaging System Specifications

Item	Specification
Recommended Fluorophores	FAM, HEX, ATTO-550, ROX, ATTO-590, Cy5, Cy5.5
Data format	.niodata, .nioexperiment, .nioprotocol, .nioassay

Technical Specifications

Table 7. QX700 ddPCR System technical specifications

Item	Specification		
	QX700 E ddPCR System	**QX700 S ddPCR System**	**QX700 HT ddPCR System**
Instrument analysis capacity*	3 RDG16 Cartridges/ 1 RDG48 Plate	12 RDG16 Cartridges/ 4 RDG48 Plates	24 RDG16 Cartridges/ 8 RDG48 Plates
Thermoblock temperature range**	25°C to 100°C		
Thermoblock control accuracy	± 0.75°C		
Thermoblock control uniformity (at 72°C)	± 0.75°C		
Thermoblock adjustable ramping	1°C to 2°C/second		
Thermoblock pressuring gas	Air		
Screen	General Touch Display module BBL228 21.5"		
Functional interfaces	1 front USB3 4 rear USB3 1 rear HDMI 1 rear Ethernet		
Barcode Reader	OEM Barcode scanner RT2058 - 1D&2D barcode		

*Minimum capacity in a single run: 1 cartridge/ 1 plate (all QX700 ddPCR System configurations)

Each plate can be set up for individual experimental parameters.

After the cartridges from an individual plate are completely processed, the plate can be unloaded, and the available slot can be used to load a plate to sequence an additional experiment.

** The thermal plate inside the QX700 ddPCR System can be set to operate at temperatures ranging from 25°C to 100°C.

WARNING! Never set the thermal plate temperature below room temperature. Doing so can damage the Peltier elements that regulate temperature and may reduce the instrument's operating life.

Important: An electrical ground is required. The instrument must be ordered with the power cable in accordance with the standards in the country of use. The instrument is shipped with the dedicated power cable. During installation, ensure that the power cable meets the standards in the country of use. If the voltage fluctuates by more than 10%, you must use a power line regulator.

For optimal performance, Bio-Rad recommends switching off the instrument at least once a week.

Instrument Specifications

Table 8. QX700 ddPCR System instrument specifications

Item	Specification
Motherboard battery	ASROCK INDUSTRIAL IMB-1233-WV ■ BATT-LI CR2032 3V/220mAh/55mm ■ BATT-LI CR2032 3V/240mAh/55mm
CPU	I5-12400
RAM	32 GB
System drive (SSD)	2 TB
Operating system	■ Microsoft Windows 11 IoT Enterprise 2024 LTSC
Interfaces	■ 1 Front USB3 port + 4 Rear USB3 ports (available for mouse, keyboard or USB key/drive connection – a USB3.X external hard drive is recommended for data transfer) ■ 1 Rear Ethernet port ■ 1 Rear HDMI port

Table 9. QX700 ddPCR System recommended configuration for QX700 ddPCR System Control Software

Item	Recommended Specification
Processor	Intel Core i5 or higher, at least 2 cores of 2 GHz or higher
Graphics card	Equivalent to NVIDIA GeForce GT 1030 (or higher)
Screen	Minimum 1920 x 1080; aspect ratio 16:9

Table 9. QX700 ddPCR System recommended configuration for QX700 ddPCR System Control Software, continued

Item	Recommended Specification
RAM	At least 16 GB
Operating system	■ Microsoft Windows 10 64-bit ■ Microsoft Windows 11 64-bit

Performance Specifications

Table 10. QX700 ddPCR System performance specifications

Item	Specification
ddPCR quantification uncertainty	+/-10% on 100-25000 cp/ µL

Chapter 4 About QX700 ddPCR System Control Software

You can use the QX700 ddPCR System on the instrument touchscreen or remotely from a personal computer to:

- Design customized ddPCR experiment runs for plate workflows.
- Create and store templates for plate layouts, thermal cycling protocols, and reports.
- View experiment results during the droplet reading phase.
- Cancel runs and reorganize plates.

Note: To remotely connect from a personal computer to the QX700 ddPCR System to monitor runs on the instrument in real time, you must install the QX700 ddPCR System Control software on that computer. For more information see Installing and Updating QX700 ddPCR System Software on page 34.

Important: A Bio-Rad field service engineer must install the software when upgrading to Premium Edition.

Note: This instrument guide contains abridged information about the QX700 Analyzer. For comprehensive information on QX700 Analyzer capabilities, refer to the QX700 Analyzer Software Guide.

Installing and Updating QX700 ddPCR System Software

Depending on the system type, the QX700 ddPCR System ships with either the QX700 System Control Software Standard Edition or Premium Edition.

You can also install the software on a personal computer and remotely connect the software to the QX700 ddPCR System.

Important: For optimal performance, Bio-Rad recommends to perform the analysis of .niodata files with QX700 ddPCR System Analysis Software on a personal computer and not on the QX700 ddPCR System instrument itself, especially when it is running.

Installing the QX700 ddPCR System Control Software

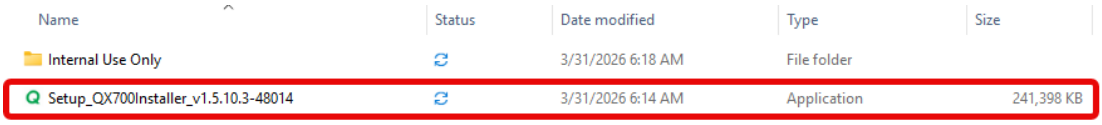
Installers of the most recent versions of the QX700 ddPCR System Control Software are available for download, free of charge, at the following link: https://www.bio-rad.com/digital-pcr/naica-systemsupport/technical-resources/.

Important: Please remove all RDG48 Plates from the instrument before updating the software.

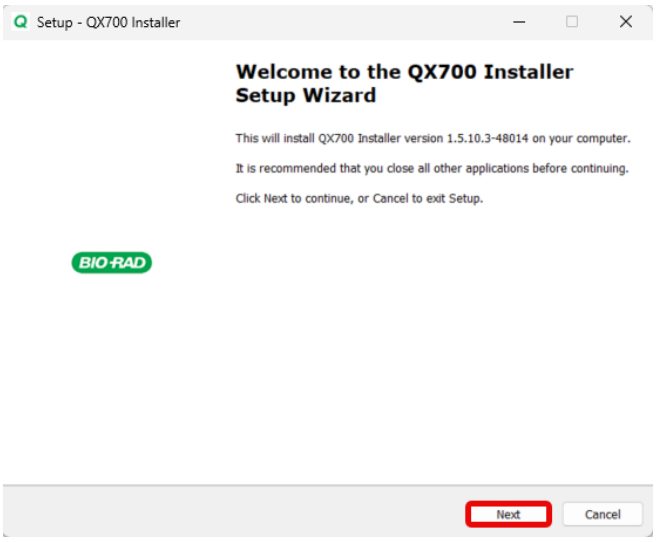
To install the software

Note: Bio-Rad recommends that you close any open applications before installing the software.

1. Launch the installer by double-clicking the Setup_QX700Installer file. The file name includes the current version of the software.



2. The setup wizard appears. Click Next to install.

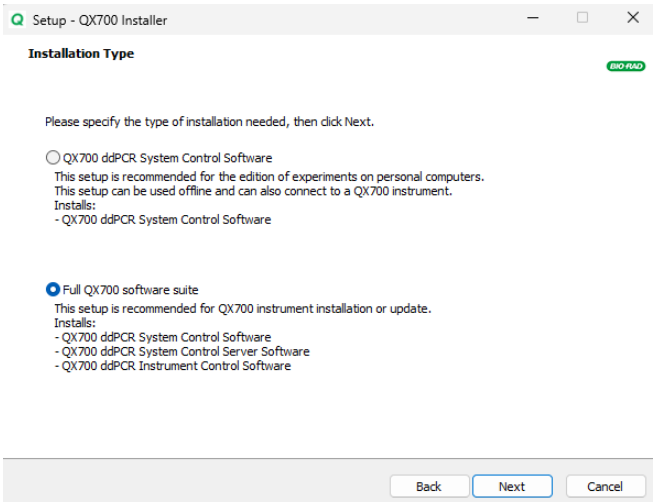


3. In the Installation type dialog, select one of the following options:

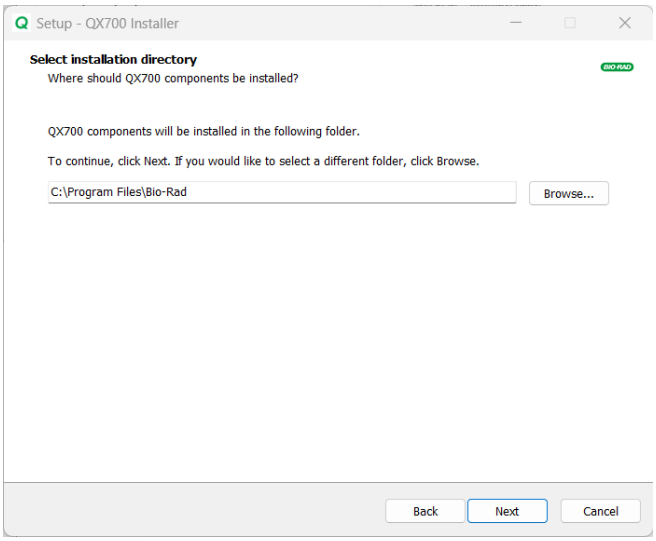
   - QX700 ddPCR System Control Software. Bio-Rad recommends this option when installing the software on a personal computer. This option installs the applications required to design and run experiments remotely and includes assays, protocols, and experiment files.

Note: Before installing the software, ensure that the network is correctly configured. For more information, see Updating Windows Defender to Enable Remote Connectivity on page 40.

- Full QX700 software suite. Bio-Rad recommends selecting this option when installing the software on the QX700 ddPCR System instrument. This option includes:
  - ☐ The QX700 ddPCR System Control Software
  - ☐ The QX700 System Control Server Software
  - ☐ The QX700 Instrument Control Software



4. Click Next.
5. The Select installation directory dialog appears. Do one of the following:
   - If the default installation directory is correct, click Next.
   - In the Select installation directory dialog, click Browse...to configure the network path to specify where the software components should be installed. Then click Next.



6. Depending on your software configuration, one of the dialogs appears:

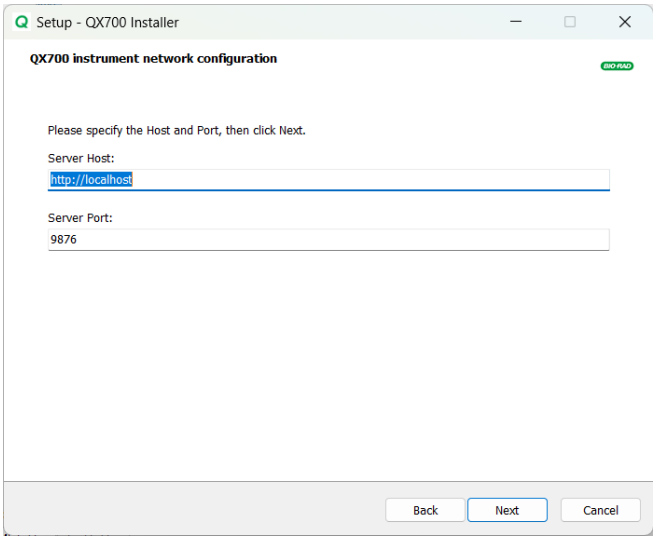


Fig. 1: QX700 ddPCR System Control Software only dialog

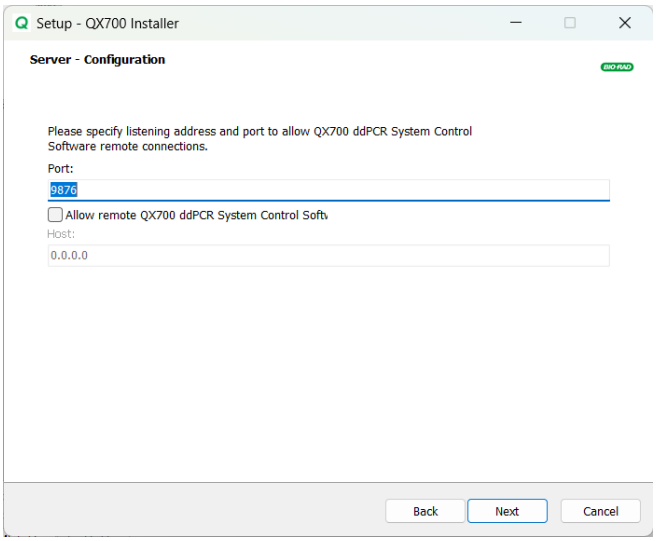


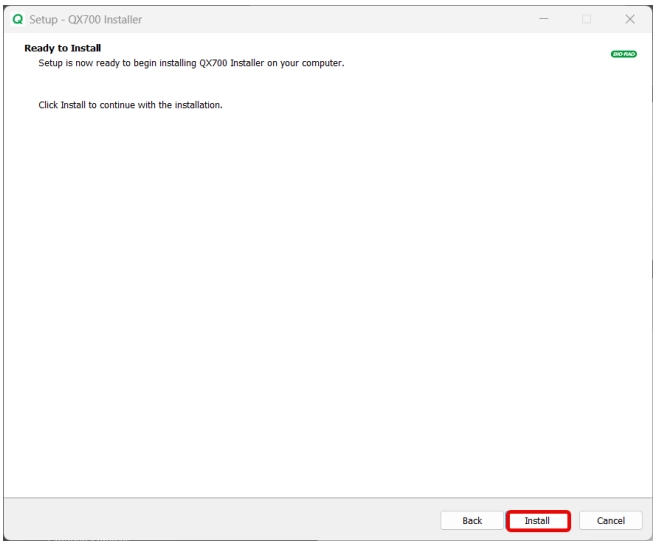
Fig. 2: QX700 ddPCR System Control Software suite configuration dialog

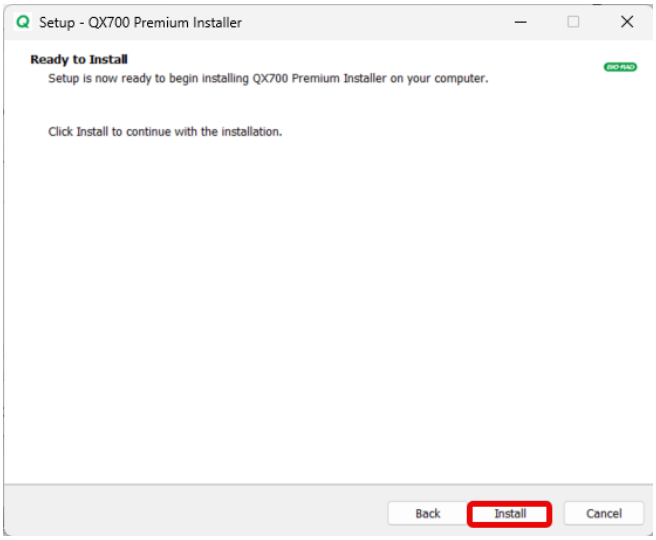
Note: Select the Allow Remote QX700 ddPCR System Control Software connections checkbox if you are also running the software on a PC.

7. Do one of the following:

   - QX700 ddPCR System Control Software **only** — Enter the server host name of the computer running the QX700 ddPCR System Control Software. If the QX700 ddPCR System Control Software will not connect remotely to a QX700 ddPCR System, do not change the default Server Host and Port settings.
   - QX700 ddPCR System Control Software **full suite** — Use the default settings to allow any input connection, provided Windows Defender is properly configured (see Updating Windows Defender to Enable Remote Connectivity on page 40). Contact your IT department to properly configure these parameters.

8. Click Next.
9. In the Ready to Install dialog, click Install.





10. The software installation completes. Restart your computer to finish the process.
11. After installing the software on a remote personal computer connected to the QX700 ddPCR System, start the QX700 ddPCR System Control Software and verify the instrument status and server connection to confirm that the installation was successful.

    Note: You can change the QX700 ddPCR System's server address and port directly on the QX700 ddPCR System Control Software's Settings page.

The QX700 ddPCR System Analysis Software requires a separate installation. Refer to the QX700 Analyzer Software User Guide to install or update the QX700 ddPCR System Analysis Software on either theQX700 ddPCR System or on a remote computer.

Updating Windows Defender to Enable Remote Connectivity

This section explains how to update Windows Defender to enable the software to connect to a QX700 ddPCR System remotely by creating an Inbound and Outbound port rule.

Important: An IT administrator should perform this procedure on the QX700 ddPCR System to allow remote connections from a remote personal computer.

Important: You must create both an Inbound and an Outbound port rule.

To create an inbound and outbound port rule

1. Open Windows Defender Firewall.
2. Click Advanced settings to open the Windows Defender Firewall with Advanced Security window.
3. Click Inbound or Outbound Rules.
4. In the left panel, click New Rule...
5. Select the Port radio button.
6. Click Next.
7. In the Inbound or Outbound field, type port.
8. Enter the rule to TCP connections and specify the port number of the QX700 ddPCR System Analysis Software server.

   Important: Enter both inbound and outbound port numbers in both the inbound and outbound port fields.
9. Click Next.
10. Click Allow the connection.
11. Select the network location types to which this rule applies.
12. Name the rule.
13. Click Finish.

Important: The procedure only applies if the QX700 ddPCR System or a remote PC uses Windows Defender as its firewall. If a different firewall is in use, apply the appropriate steps to allow external communication on the specified port between the QX700 ddPCR System Control Software (client) and the QX700 ddPCR System Control Software (server).

Chapter 5 Setting Up the QX700 Droplet Digital PCR System

This chapter explains how to set up the QX700 ddPCR System at your site.

Important: The QX700 ddPCR System must be installed and calibrated by a Bio-Rad service engineer.

Site Requirements

Install the QX700 ddPCR System in a location that meets the following requirements:

- A clean laboratory environment
- A sturdy, level surface that supports at least 65 kg and has a horizontal deviation of less than 0.3°
- A minimum of 20 cm of clearance around the QX700 ddPCR System instrument
- Room temperature between +15°C and +25°C

WARNING! The QX700 ddPCR System might consume up to 1750W. Refer to the power supply specifications in Environment Requirements on page 20 for more details about power supply requirements.

WARNING! Use the instrument only in a professional laboratory environment. It might not operate properly in a domestic setting. If electromagnetic interference affects performance, restore proper function by increasing the distance between the instrument and the source of interference.

Bio-Rad recommends evaluating the electromagnetic environment before installing the instrument.

WARNING! Do not operate this instrument near sources of high electromagnetic radiation (for example, unprotected RF sources), as they might interfere with its operation.

Unpacking the Instrument

The contents of the QX700 ddPCR System includes:

- QX700 ddPCR System instrument
- Power cable
- Certificate of conformity

  Note: The declaration of conformity can be downloaded in the Technical Resources web page.

Important: Use proper lifting techniques when moving and lifting the instrument to prevent damage to the instrument and personal injury. Bio-Rad recommends that three or more people lift the instrument. Use a pallet jack to move the instrument from the shipping dock to the laboratory.

Important: Only a Bio-Rad representative or a user that has read this unpacking procedure can unpack the QX700 ddPCR System.

Lifting the Instrument

Important: Three people are required to move the QX700 ddPCR System inside a facility.

Grip the QX700 ddPCR System by the handles shown below.

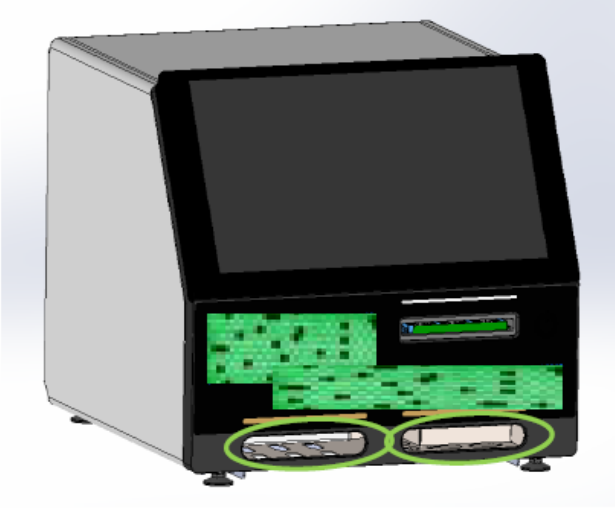


Fig. 3: Instrument Handles - Front

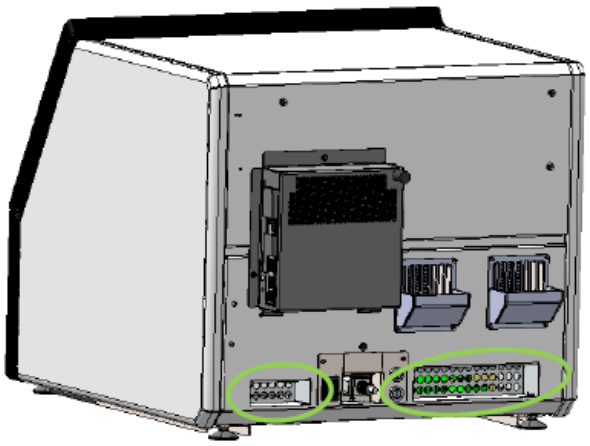


Fig. 4: Instrument Handles - Back

Instrument Setup Location

Set up the instrument in a location that supports stable operation and prevents damage by meeting the following conditions:

- Place the QX700 ddPCR System on a sturdy surface that is able to support 65 kg.
- Maintain a minimum of 20 cm of clearance around the instrument to ensure proper air circulation.
- To ensure adequate ventilation and access to all interfaces and the power cord. leave a minimum of 8 in (20 cm) of clear space behind, to the right, and to the left of the instrument.
- Ensure that the back of the instrument — especially the ventilation openings — (see Back View on page 29) is protected from light (such as sun/window or artificial light). Leave a minimum of 8 in (20 cm) of clear space to avoid compromising imaging quality.
- Place your instrument on a solid surface and away from other instruments that can cause vibration.
- Plug the QX700 ddPCR System using the power cord supplied by Bio-Rad into the rear of the instrument. Connect the cord to the rear of the instrument and ensure it is plugged into a grounded electrical outlet. This setup provides proper grounding and helps meet safety and regulatory requirements.
- Only use the power cord supplied by Bio-Rad to ensure that the QX700 ddPCR System operates properly and meets regulatory compliance standards.

Important: To relocate the instrument, contact a Bio-Rad representative.

Instrument Installation

A Bio-Rad specialist will configure the QX700 ddPCR System during the initial installation, which requires both hardware and software setup. A trained representative from Bio-Rad or an authorized distributor must perform this installation. The QX700 ddPCR System will be installed according to Bio-Rad specifications, and the process will be documented with an installation notice. This installation notice is required before operating the instrument.

Chapter 6 Getting Started

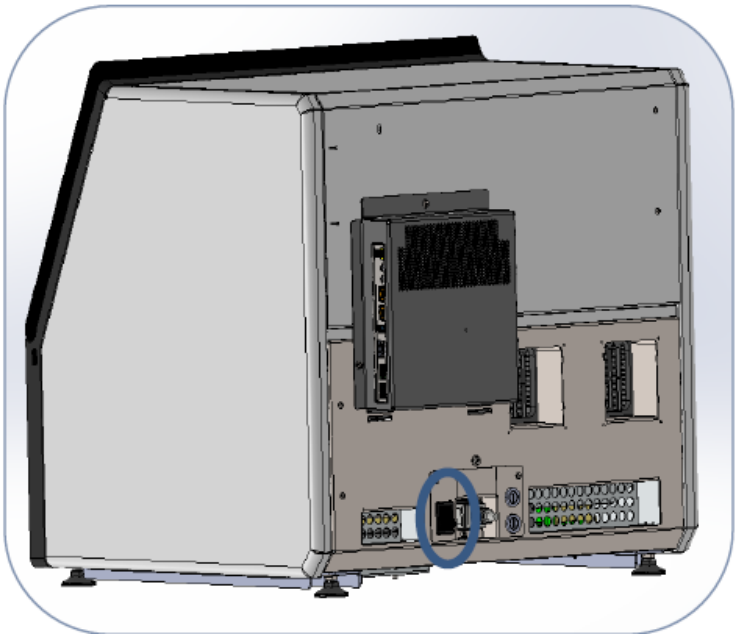
This section explains how to start the QX700 ddPCR System, how to adjust the screen, and the instrument status display.

Turning on the Instrument

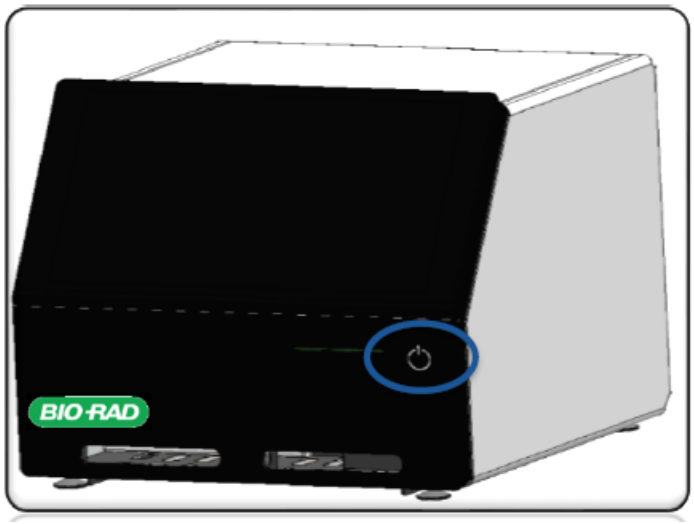
When the QX700 ddPCR System is powered off, the display is turned off, and no other illumination is visible.

To turn on the instrument

1. Press the switch on the back of the instrument to power on the QX700 ddPCR System.



2. Press the power button on the front of the instrument. The button flashes to indicate power is on and the system is initializing.

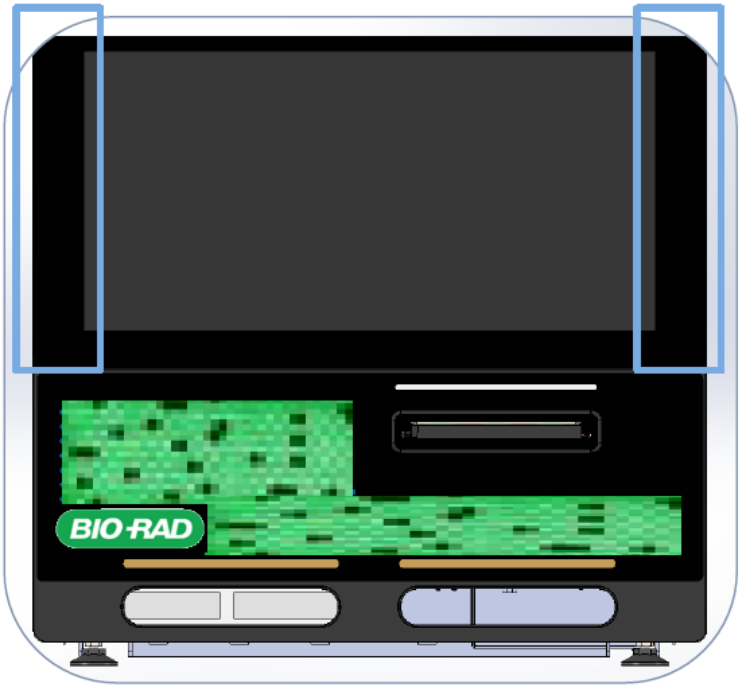


Note: During initialization, the droplet panel and the two status lines on the bottom of the front door will also continue to flash.

3. After initialization:
   - The start-up button disappears.
   - The two status lines are illuminated in gold.
   - The droplet pattern and the logo are illuminated.
   - The screen displays the QX700 ddPCR System Graphic User Interface (GUI).

Adjusting the QX700 ddPCR System Screen

You can adjust the orientation of the QX700 ddPCR System's front upper panel to improve screen positioning and ergonomic use. Always grip the panel on both sides to avoid touching the touchscreen, which may activate the interface. The non-touch areas on each side of the screen are approximately 4 cm wide, as shown below.



Adjusting the Upper Panel

You can adjust the orientation of the upper panel between two fixed positions:

- Tilted at approximately 30° from vertical, resting against the front cover of the instrument

- Fully vertical

  Note: A mechanical stop prevents adjusting the screen beyond the vertical position.

Important: Do not force the screen beyond the specified positions (30° vertical and vertical position). Doing so can damage the instrument or cause the screen to disconnect.

Important: Do not adjust the screen while anyone's hand is behind it to avoid the risk of pinching or injury.

The QX700 ddPCR System Status Display

The front panel of the QX700 ddPCR System displays the instrument's status using two types of status lights:

- **Bottom Status Lines** — Indicates the overall status of the instrument:
  - **Off** — The instrument is turned off.
  - **Solid gold** — The instrument is ready for use.
  - **Blinking gold** — The instrument starting up and initializing.
  - **Solid red** — The instrument is in alert mode.
- **Loading status lines** – These lines are located above the RDG48 Plate, indicating the plate status:
  - **Off** — No plate loading/unloading action planned.
  - **Solid light** — The QX700 ddPCR System awaiting user action to load or unload a plate.
  - **Blinking light** — Plate is currently being loaded or unloaded.

    Important: Do not obstruct the plate loading area when the light is blinking.

Logging into the QX700 ddPCR System

When the QX700 ddPCR System starts, a Windows login appears. In this screen, users can log in to the system either as a User or an Admin.

Note: Bio-Rad strongly recommends that users log in with the Windows User (non-Admin) account for daily operations to ensure cybersecurity best practices.

Time Synchronization

The ETA displayed on the QX700 ddPCR System and the timestamps recorded in the .niodata file are based on the QX700 ddPCR System local time. Modifying the system time may cause inconsistencies when connecting with other computers in different time zones.

Please refer to local IT procedure for session password updates and cybersecurity policy.

Opening the QX700 ddPCR System Software

To begin using the QX700 ddPCR System, click the QX700 System Control icon.

Note: Bio-Rad recommends running only one instance of the QX700 ddPCR System Control Software on the QX700 ddPCR System at a time. Do not launch multiple instances of the software within a single Windows session or across multiple user sessions. Running multiple instances may prevent the instrument from responding correctly.

At startup, the following warning might appear in the following cases:

- Multiple instances of the QX700 ddPCR System Control Software are open under the same user session. Only one instance should remain open.
- An instance of QX700 ddPCR System Control Software is already running under a different user session on the QX700 ddPCR System. In this case, either switch to the active session or close the other instance before continuing.

Chapter 7 Preparing a Sample Experiment

This section contains a standard protocol for sample preparation and plate setup for any assay performed on the QX700 ddPCR System. The following are recommended steps using the compatible RDG16 Cartridges and reagents.

Note: In the QX700 ddPCR System user interface, "Ruby Chip" and "chip" refer to the RDG16 Cartridge, and "chip plate" refers to the RDG48 Plate.

The QX700 ddPCR System is compatible with the following ddPCR mixes:

- naica ddPCR Mix (for experiments with DNA target(s) and fluorescent probes)
- naica ddPCR Mix (for experiments with DNA target(s) and EvaGreen® reporter) for the following references
  - naica ddPCR Mix (Blue reference)
  - naica ddPCR Mix (Infra-Red reference)
- QX700 One-Step RT-ddPCR Kit for Probes
- QX700 ddPCR Evagreen Supermix for experiments with DNA targets

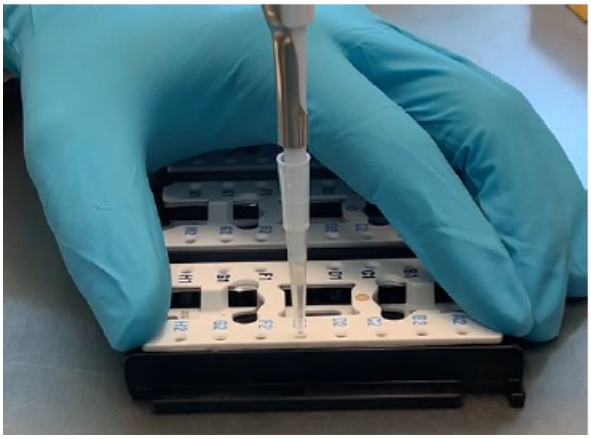
Note: Prepare the sample for the reaction mix only using validated ddPCR mix reagents to ensure quantitative results. Refer to the mix Instructions for Use for more information.

Experiment Overview

This section provides an overview of the ddPCR workflow using the QX700 ddPCR System.

To prepare, load, configure, run, and analyze a ddPCR experiment

1. Prepare a sample with a reaction mix. For more information on preparing reaction mix samples, refer to that reaction mix's instructions for use.
2. Pipette the reaction mix into the wells of the selected RDG16 Cartridge. The cartridge is supplied in a plate for transport and instrument operation.



Note: Both the cartridge and the plate are compatible with automated liquid handling systems. For detailed pipetting instructions, refer to the cartridge instructions for use.

3. Place the prepared plate into the QX700 ddPCR System. For more information, see Loading Plates and Cartridges into the QX700 ddPCR System on page 53.
4. Create the experiment. For more information, see Creating a ddPCR Experiment on page 56.
5. Run the ddPCR protocol, which combines partitioning, amplification, and readout parameters for data acquisition using up to seven fluorescent channels (FAM, HEX, ATTO-550, ROX, ATTO-590, Cy5, and Cy5.5). For more information, see Running a ddPCR Experiment on page 83.
6. Use the QX700 ddPCR System Analysis Software to perform image analysis and extract absolute quantification data. For more information, refer to the QX700 Analyzer Software User Guide.

Required Components

This section describes the required equipment and materials for creating your samples. For a list of catalog numbers, see Appendix C, Catalog Numbers for the QX700 ddPCR System and Accessories.

Required Materials

- **PCR mix** — For a list of compatible PCR mixes, see Preparing a Sample Experiment on page 51.
- **RDG16 Cartridge** — Consumable that partitions nucleic acid samples into water-in-oil droplets for ddPCR amplification and detection. For more information, see the RDG16 Cartridge instructions for use.
- **RDG48 Plate** — Plates that hold RDG16 Cartridges

Note: For more information on how to pipette samples into a cartridge, refer to the RDG16 Cartridge Instructions for Use.

Loading Plates and Cartridges into the QX700 ddPCR System

You must use RDG48 Plates and RDG16 Cartridges with the QX700 ddPCR System. Never attempt to load a cartridge directly into the instrument without the appropriate plate.

Cartridges are delivered in boxes of twelve, stacked in groups of four plates, with each plate holding up to three cartridges. These plates serve as both packaging and processing supports. Each cartridge must be placed in its designated well. Do not stack cartridges or load them incorrectly.

Plates can be reused up to three times only if fewer than three cartridges were processed previously. Reuse requires cleaning. Follow the instructions provided in the cartridge's Instructions for Use.

Do not reuse cartridges that have already been processed for thermal cycling. Also, never load a plate with a broken pin, as this can damage the instrument.

Each plate can accommodate up to three cartridges. The QX700 ddPCR System can operate with as few as one cartridge per run and accommodate varying capacities depending on the system model:

- **QX700 HT ddPCR System** — Can be loaded with up to 8 plates of 3 cartridges each (24 cartridges total)
- **QX700 S ddPCR System** — Can be loaded with up to 4 plates of 3 cartridges each (12 cartridges total).
- **The QX700 E ddPCR System** — Can be loaded with one plate of cartridges each at a time (three cartridges total).

Loading a Plate

To load a plate

1. Configure an experiment in the QX700 ddPCR System Control Software and launch the run.

   The Plan and Start page displays plate loading instructions.

2. Ensure that the loading area is available (indicated by the loading status line being steadily illuminated in white) and wait for confirmation from the GUI.
3. Insert the plate in the correct orientation and push gently until it reaches the stop position. The QX700 ddPCR System will detect the full insertion.

   After the plate is correctly seated, the instrument's loading status light will begin blinking, indicating the plate has been properly detected and processing has started according to the experiment

parameters.

Plate and Cartridge Loading Requirements

- Do not insert another plate until the first one has been fully loaded and the status light stops blinking.
- Loading two plates in succession without waiting may shift the position of a stored plate and crash the loading module.
- Only insert validated plates. No other objects should be placed in the loading area.
- Do not insert plates in the wrong orientation, as this may damage the loading mechanism.
- Do not manually remove a plate after inserting it. If you need to retrieve a plate, allow the instrument to load it fully into the storage area, then use the software to initiate unloading.
- Do not load a plate while an unloading process is active. Wait until the status light stops blinking and the loading area becomes available.
- Do not re-insert a previously processed cartridge for another thermal cycling program. Additionally, never attempt to load a plate that has a broken pin, as this can damage the instrument.
- Do not load a plate with a broken pin.

Fig. 5: Damaged plate with broken pin

Loading Cartridges with Altered Barcodes

The QX700 ddPCR System automatically reads the barcodes of up to three cartridges onto a plate.

During the cartridge loading phase, the barcode readers detect the cartridges and identify their barcodes to:

- Associate each cartridge with its assigned experiment
- Ensure full traceability of the process and results

If a barcode cannot be read, you can manually enter the barcode and associate it with the correct cartridge position and experiment. In this case:

- The instrument cannot verify the format or content of manually entered barcodes.
- You are responsible for ensuring the accuracy of the barcode information.
- The cartridge will still be processed, but the system cannot confirm that the result matches the correct cartridge during unloading.
- You must confirm that the cartridge is in the expected position and orientation in the plate as shown on the GUI.

When the system detects a missing barcode, it ejects the plate to enable you to:

- Check the position and orientation of all cartridges.
- Correct any mistakes in cartridge placement or alignment.
- Manually enter the barcode if needed.

You must completely remove the plate from the instrument before reloading it. This allows the QX700 ddPCR System to properly position the plate.

Chapter 8 Creating a ddPCR Experiment

This section explains how to create a ddPCR experiment. To create a new experiment, you must:

- Define a new or open an existing protocol
- Design a new or open an existing assay
- Configure a new or run an existing experiment

Important: Do not operate other instruments or perform any actions near the QX700 ddPCR System that could cause shocks or vibrations while it is running (especially during cartridge imaging). Vibrations can interfere with system performance and compromise results.

Important: When creating a ddPCR experiment, Bio-Rad strongly advises updating .nioprotocol files created prior to Version 1.5 to ensure use of the enhanced droplet detection algorithm. If you do not update the older files, the software will use an earlier droplet detection algorithm. For more information, see Updating .nioprotocol Files on page 62.

Note: You can import or export experiment setup information with a USB stick. Always ensure that the USB stick is free of malicious software before connecting it to the system.

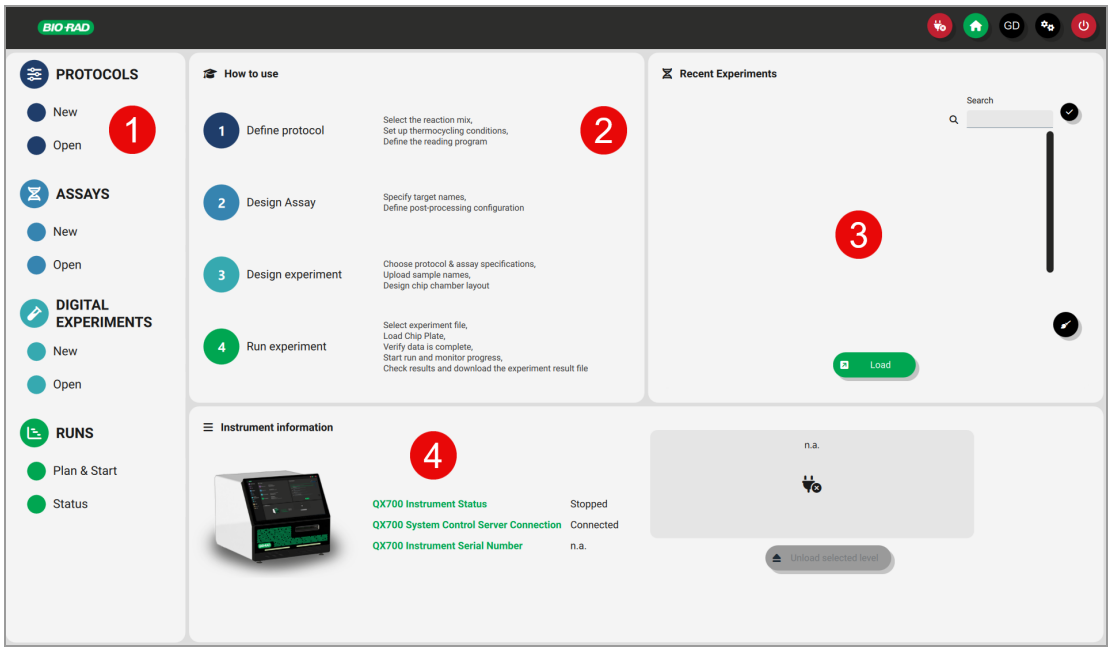
The Home Screen

The QX700 ddPCR System Control Software Home screen displays after the software launches.

On the Home screen, users can:

- Create new or open existing protocols, assays, experiments, or runs
- Access recent experiments
- Unload plates
- View the instrument status

The system provides all necessary functionality to create, run, and analyze ddPCR experiments on your samples. The following image highlights functional areas:



LEGEND

1	Left navigation bar
2	Overall experiment procedure
3	List of recent experiments
4	QX700 ddPCR System status and information pane

Home Screen Task Bar

From the home screen task bar, you can:

- Click the error message icon ( ) to view error messages. This icon does not display if there are no error messages. For more information, see Instrument Troubleshooting on page 93.
- Click the Home icon ( ) to return to the Home screen.
- Click the user icon to view user information.
- Click the Settings icon ( ) to:
  - ☐ Enable Dark Mode
  - ☐ View and update address and port connection parameters

- ☐ Customize the network path used to download .nioresult files from the QX700 ddPCR System Control Software. Click the ellipses by the Customize output path field to change the path.

  Note: You can customize this path from the instrument interface or from another computer running the QX700 ddPCR System Control Software.

Defining the Protocol

To run an experiment, you must create a new protocol or select an existing one. A protocol contains the mix type, PCR program, and scanning conditions that the instrument uses to run the experiment, including activated channels and corresponding exposure times.

Creating a New Protocol

Click New in the Protocols section of the left navigation menu to create a new protocol. This allows you to:

- Create a protocol from an existing template. For more information, see Protocol Templates on page 61.
- Create a new protocol without an existing template by clicking Start from blank.
- Create (or modify) a protocol by loading an existing protocol.

  Important: If you load a .nioprotocol file created in an earlier version of the System Control software, the system prompts you to update the protocol. Bio-Rad strongly advises updating .nioprotocol files to use the enhanced droplet detection algorithm. If you do not update the file, the software will use an earlier droplet detection algorithm.

After creating the protocol, you can configure the protocol parameters. For more information, see Configuring Protocol Parameters on page 59.

Opening an Existing Protocol

Click Open in the Protocols section of the left navigation menu to load an existing .nioprotocol file.

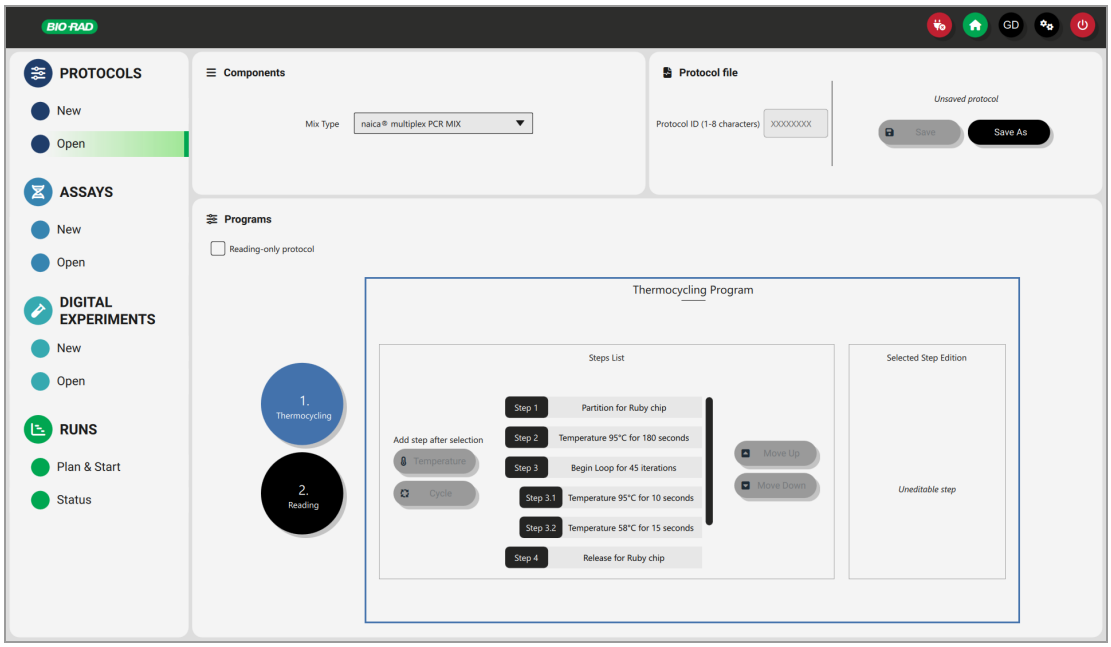
To open an existing protocol

1. Click Open in the left navigation menu.
2. Select the .nioprotocol file from list that appears in the Open protocol file menu.
3. Click Open protocol.
4. (Optional) If the .nioprotocol file was created in an earlier version of the software, the software displays an update prompt. Click Update to update the protocol, or Cancel to continue with an older version.

Important: Bio-Rad strongly advises updating .nioprotocol files to use the enhanced droplet detection algorithm. If you do not update the file, the software will use an earlier droplet detection algorithm.

Configuring Protocol Parameters

After creating a new or opening an existing protocol, the Protocol screen opens.



Note: By default, all experiments include both a thermocycling and a reading step. For read-only protocols, you can remove the thermocycling step by selecting the Reading-only protocol check box in the upper left of the Programs section.

From the Protocols screen, you can:

- Select a ddPCR mix. For more information on mixes, see Required Components on page 52.

  Note: Choosing a supermix also automatically enables and disables the fluorophore based on the supermix parameters.

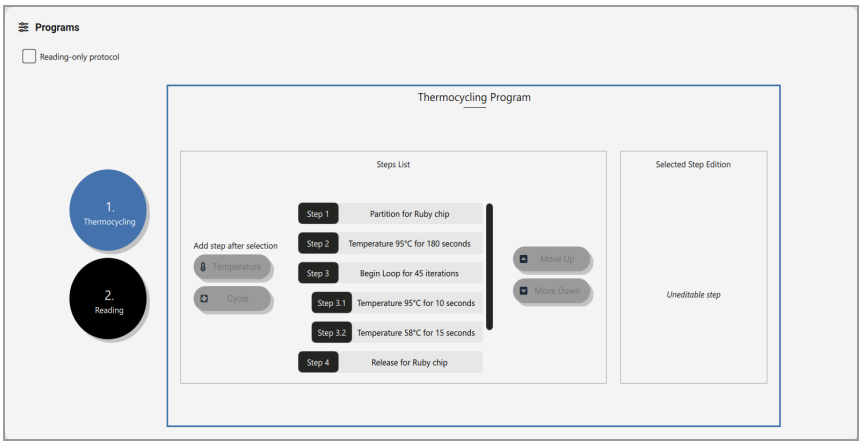
- Name or rename the protocol
- Set a protocol ID (from 1 to 8 characters). The software uses this ID to tag the protocol for easier identification on the Experiment screen and in split results (see Composite Experiments on page 76)
- Save the protocol

Note: If the system uses a protocol created with former versions of QX700 ddPCR System Control Software (v 1.0 or v1.1), a default protocol ID will be automatically assigned in the format PRT+I, where “I” is a sequential number.

Note: Use the naica ddPCR Mix for experiments with DNA target(s) and EvaGreen® reporter. Select Blue reference or Infra-Red reference to use the blue or infra-red channel, respectively, as the reference channel for droplet detection.

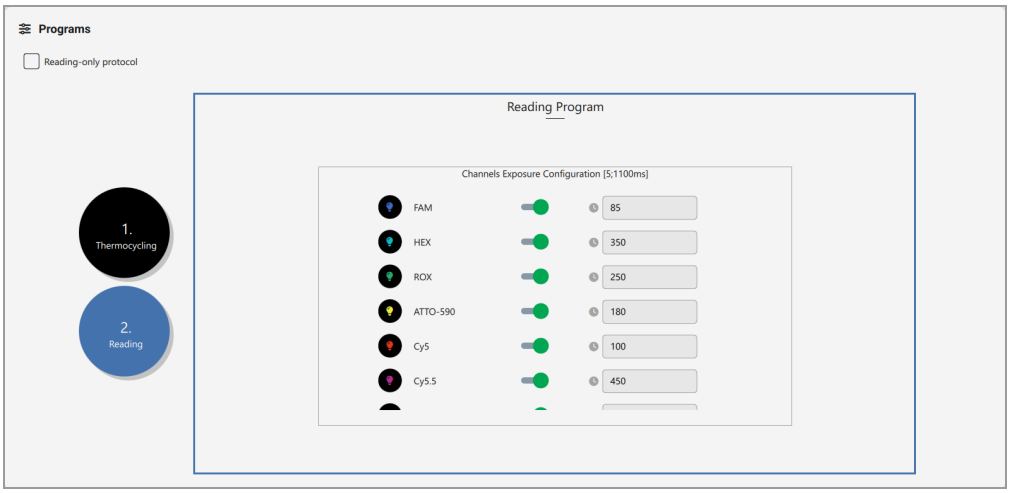
Important: The mix type defines the droplet size used by QX700 ddPCR System Control Software to calculate target concentration. It is important to select the correct mix type to match the PCR mix used in the experiment. By default, no mix type is selected. For a list of PCR mixes, see Preparing a Sample Experiment on page 51.

- Click the blue Thermocycling button, and set the following PCR run step parameters:
  - Add, move, or delete run steps
  - Set the temperature (in °C), run duration (in seconds), and ramp rate (in °C per second) for per cycle step
  - Set the number of iterations for loop step
  - Set the number of PCR cycles for each step



- Configure the Reading Program channel exposure:
  - Enable or disable channels for the FAM, HEX, ROX, ATTO-590, Cy5, Cy5.5, and ATTO-550 fluorophores.

    Note: Depending on the mix type, you cannot disable some channels.
  - Set the exposure times for each channel (in milliseconds).



Protocol Templates

When creating a new protocol, the software provides an option to start either from scratch or from an existing protocol. Four protocol templates are pre-loaded and can be used as starting points:

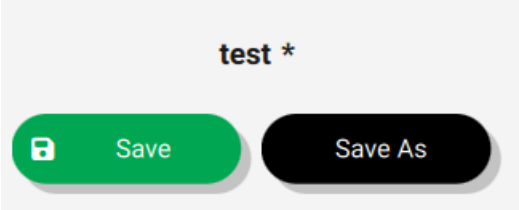
- **Template_PCR-45-cycles_7channels_naica-multiplex-PCR-MIX_RubyChip_v1.2** —for experiments targeting DNA with TaqMan probes.
- **Template_PCR-45-cycles_Evagreen-BlueDetection_naica-PCR-MIX_RubyChip_v1.2**— for experiments targeting DNA with EvaGreen and using the blue channel as reference channel for droplet recognition.
- **Template_PCR-45-cycles_Evagreen-InfraRedDetection_naica-PCR-MIX_RubyChip_v1.2** — for experiments targeting DNA with EvaGreen and using the infrared channel as reference channel for droplet recognition.
- **Template_QX700_ddPCR_Evagreen_RDG16_v1.1**— for experiments targeting RNA.
- **Template_QX700_One-Step RT-ddPCR_Probes_45-cycles_7channels_RDG16_v1.1** — for experiments targeting RNA.

Saving Protocols

After creating the protocol, click Save or Save As to store it as a .nioprotocol file, which is used in the Digital Experiments panel.

- Before saving the protocol, the label “unsaved protocol” appears above both the Save and Save As buttons.

- When editing an existing protocol, an asterisk (*) appears next to the protocol name to indicate that there are unsaved changes.



Tip: You can create a protocol definition using the QX700 ddPCR System Control Software on a personal computer without requiring a connection to the QX700 ddPCR System instrument.

Updating .nioprotocol Files

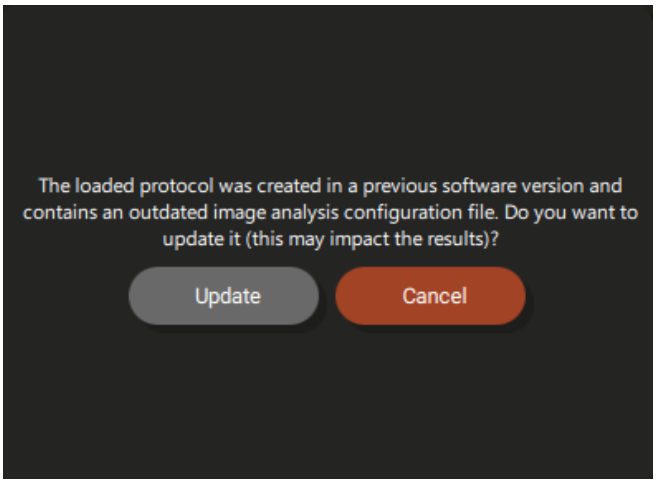
If you load an earlier version of a .nioprotocol file that contains an outdated image analysis configuration file, the software prompts you to update the protocol. Bio-Rad strongly advises updating the file to use the enhanced droplet detection algorithm. If you do not update the file, the software will use an earlier droplet detection algorithm.

You can update a .nioprotocol file in either by:

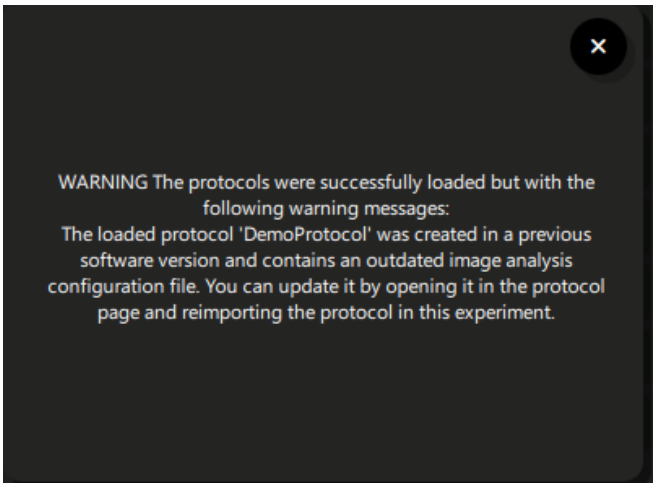
- Loading an existing protocol
- Creating a new experiment with an older protocol

To update a .nioprotocol file

1. In the Protocols area of the left navigation menu, click Open.
2. Select the .nioprotocol file.
3. Click Open protocol.
4. In the update prompt, click Update.



Note: If you are creating a new or loading an existing experiment with an older protocol, the system will generate the following message:



In this instance, open the protocol from the Protocols page, update the protocol, and add the updated protocol to the experiment.

Designing the Assay

To run an experiment, you must design a new assay or open an existing one. Assays contain information related to the targets and fluorophores, as well as the parameters used to analyze and display results in the QX700 ddPCR System Analysis Software.

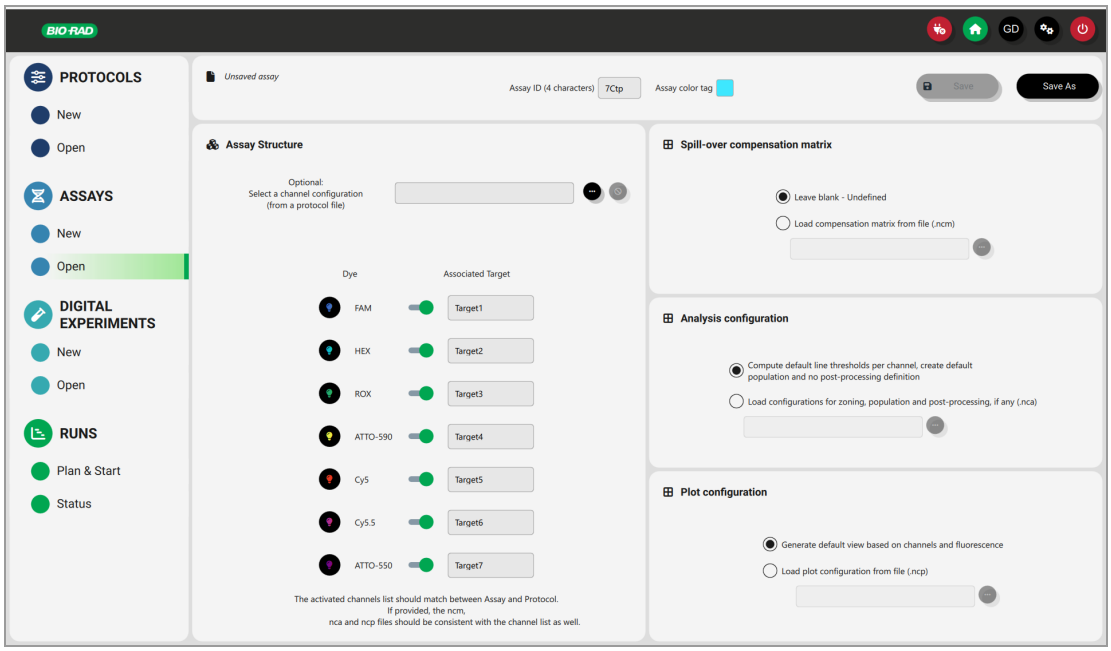
Click New in the Assays section of the left navigation menu to create a new assay. Click Open to open an existing one.

Creating a New Assay

Clicking New opens the Assay creation dialog, enabling you to:

- Create an assay from an existing template. For more information, see Assay Templates on page 66.
- Create a new assay without a template by clicking Start from blank

  Note: You can open an existing assay by clicking Start from assay.



Configuring Assay Parameters

From the Assays screen, you can:

- Assign a 4-digit assay identifier
- Apply a color tag to the assay
- Configure the assay structure:
  - Enable or disable channels for the FAM, HEX, ROX, ATTO-590, Cy5, Cy5.5, and ATTO-550 fluorophores, and rename associated fluorophores

    Note: You cannot disable the FAM fluorophore channel.
  - (Optional) Import a list of activated channels from the protocol by loading a .nioprotocol file. To do this, click the ellipses (...) button

  - Activate or deactivate targets to each channel and rename targets

- Define how to analyze and display the results in QX700 ddPCR System Analysis Software by optionally:
  - Loading a spillover compensation matrix (.ncm file), or leaving the matrix blank
  - Loading an analysis configuration file (.nca file), or computing default line thresholds per channel and create default populations without post-processing definitions
  - Loading a plot configuration (.ncp) file, or generating a default view based on channels and fluorescence

    Note: You can create or modify these configuration files in the QX700 ddPCR System Analysis Software. For more information on how to use or customize these files, refer to the QX700 Analyzer Software User Guide.

After configuring the assay, click Save or Save As in the upper right.

Assay Templates

When creating a new assay, the software provides an option to start either from scratch or from an existing assay. Two assay templates are pre-loaded and can be used as starting points:

- **Template_multiplex_7channels_RubyChip_v0.1** — Activates all seven fluorescent channels.
- **Template_naica-PCR-MIX_Evagreen_RubyChip_v0.1** — Activates the following channels:
  - Blue for Evagreen fluorescent reporters
  - Infra-red for AlexaFluor647 fluorescent reporters

  Note: The green channel does not activate fluorescent reporters.

Saving Assays

After creating or modifying an assay, click Save or Save As. This stores the assay as a .nioassay file which you can use in the Digital Experiments panel.

- While the assay is unsaved, the label “unsaved assay” appears above both the Save and Save As buttons.
- When editing an existing assay, an asterisk (*) appears next to the assay name to indicate that there are unsaved changes.

Note: You can create an assay definition using the QX700 ddPCR System Control Software on a personal computer without connecting to the QX700 ddPCR System instrument.

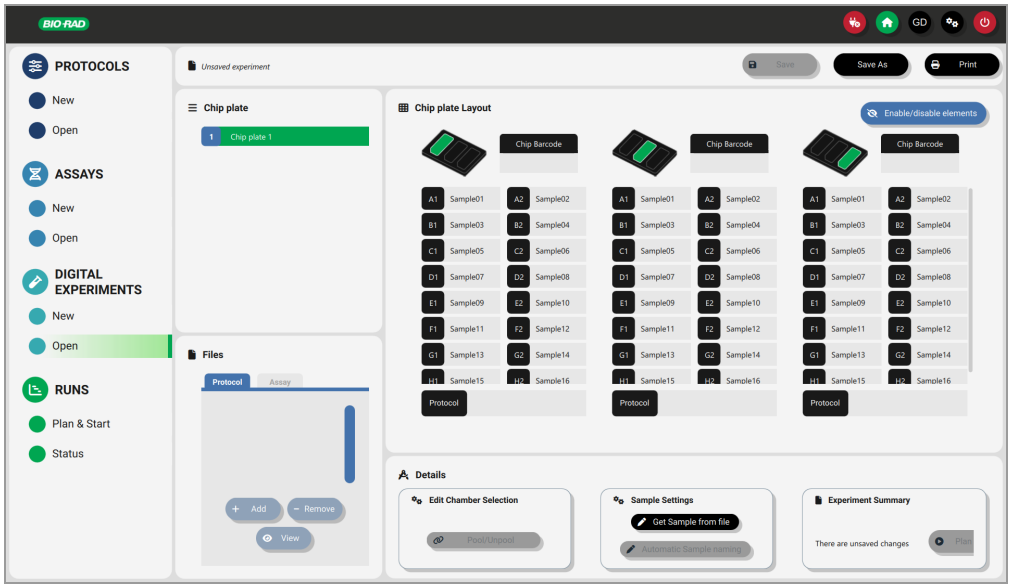
Configuring the Experiment

To run an experiment, you must configure a new experiment from scratch, upload a standard experiment file (.nioexperiment), or open an existing experiment.

Important: If you create an experiment with a .nioprotocol file created in a software version earlier than Version 1.5, the software prompts you to update the protocol. Bio-Rad strongly advises updating the file to use the enhanced droplet detection algorithm. If you do not update the file, the software will use an earlier droplet detection algorithm. To update the protocol, see See Updating .nioprotocol Files.

Click New in the Digital Experiments section of the left navigation menu to configure a new experiment. Click Open to open an existing one.

After creating a new or opening an existing experiment, the Experiment screen opens.



From this screen, you can:

- Create a blank experiment or use a template.
- Assign protocols and assays.
- Define the cartridge or well layout.
- Manually enter modify cartridge bar codes and labels as well as sample data.
  - Double-click the well ID label (next to the sample name field) to open the editor.
  - To rename a sample directly, double-click the sample field in the Chip Plate Layout.

Note: You can assign different assay files to different wells within a plate. When this occurs, the experiment is treated as a composite experiment, and the results may be split into multiple .niodata files. For more information, see Composite Experiments on page 76.

Tip: Use the Enable/disable elements button to exclude specific wells from assay assignment.

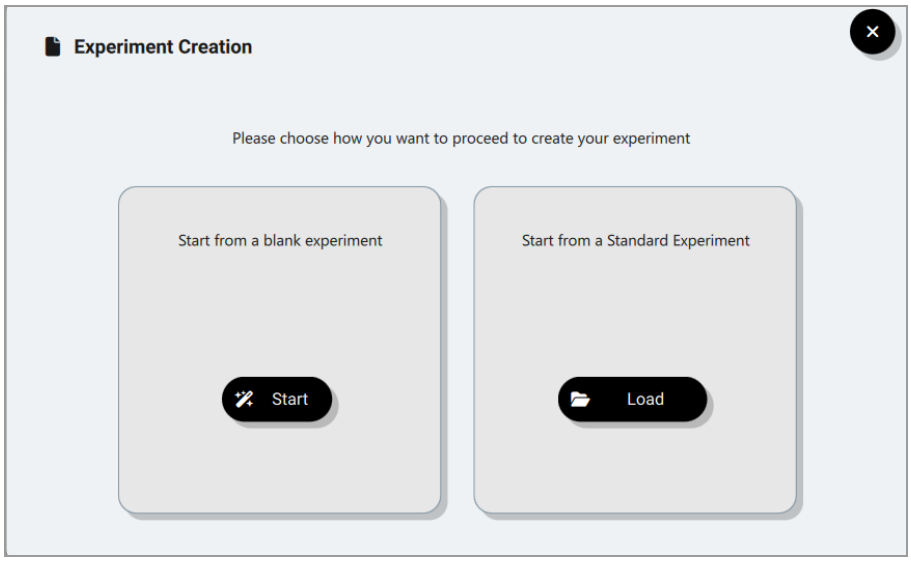
Creating a New Experiment

This section explains how to create a new experiment.

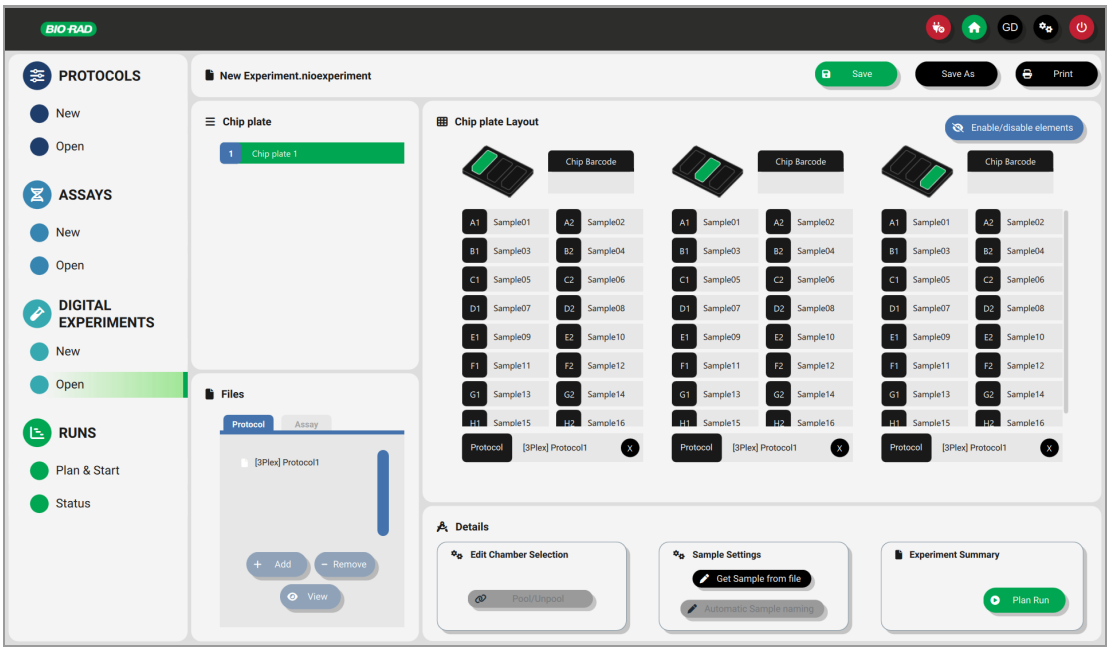
To create a new experiment

1. Click New in the Digital Experiments section of the left navigation menu.

   The Experiment Creation dialog opens.



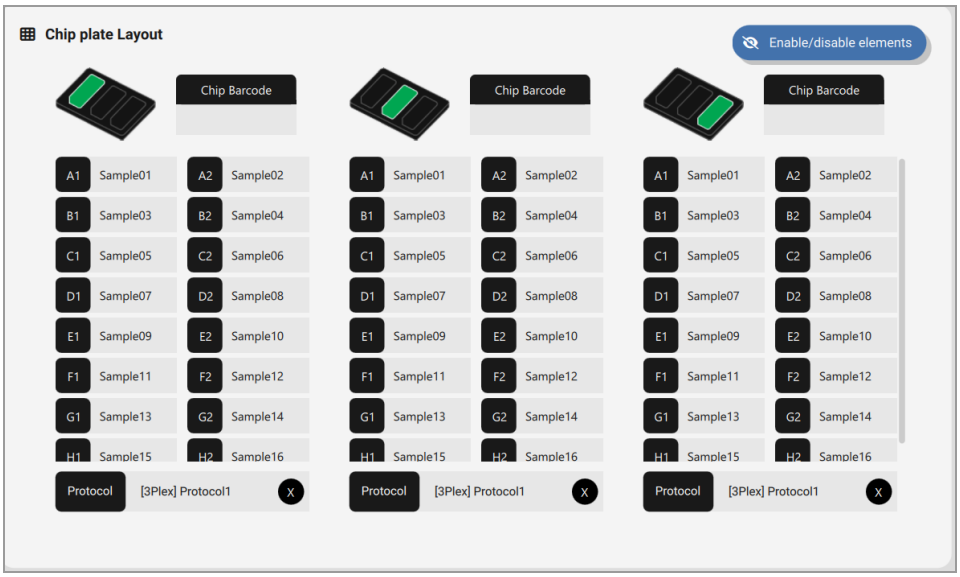
2. Do one of two things:
   - Tap Start to start from a blank experiment (no template).
   - Tap Load to load a template.
3. The screens populates with the experiment details.



In this screen you can:

- Name the experiment.
- Specify the layout of the plate:
  - At this stage, cartridge barcodes can be entered manually or left blank until scanned by the QX700 ddPCR System.
  - Use the Enable/disable elements button to activate or deactivate a custom set of wells and/or cartridges.

Important: To create an experiment you must assign at least one protocol and one assay. For more information on creating protocols and assays, see Defining the Protocol on page 58 and Designing the Assay on page 63.



- Assign a protocol (or assay) to each enabled cartridge (or well) on the plate. To do this, load the corresponding .nioprotocol (or .nioassay) files into the experiment beforehand.
- Load a protocol (or assay) by clicking Add in the Protocol (or Assay) section of Files menu.

  Important: If you create an experiment with a .nioprotocol file created with software prior to Version 1.5, the software prompts you to update the protocol. Bio-Rad strongly advises updating the file to use the enhanced droplet detection algorithm. If you do not update the file, the software will use an earlier droplet detection algorithm. To update the protocol, see See Updating .nioprotocol Files.

Click New in the Digital Experiments section of the left navigation menu to configure a new

Tip: You can import multiple protocol (or assay) files at the same time in by selecting them in your browser window.

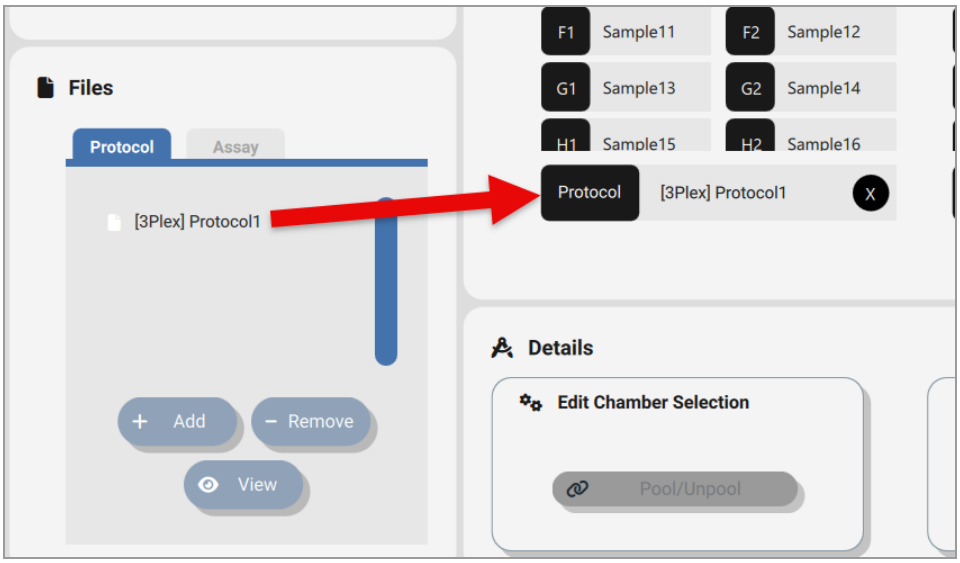
Assigning a Protocol to a Cartridge

To assign a protocol to a cartridge

1. Select a protocol from the Protocol tab of the Files section.

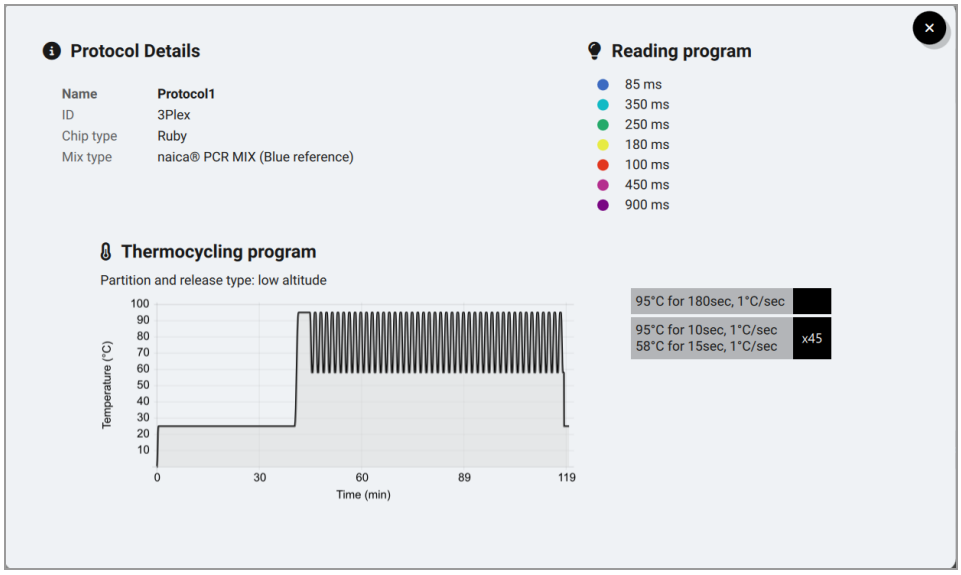
   Note: You must create a protocol before assigning a protocol to a cartridge. For more information, see Defining the Protocol on page 58.

2. Drag the protocol from the protocol library to the Protocol box under the cartridge.



Viewing Protocol Details

To view protocol details, select a protocol and click the View button. The Protocol Details windows appears, summarizing the protocol contents, including thermocycling (if applicable) and reading programs.

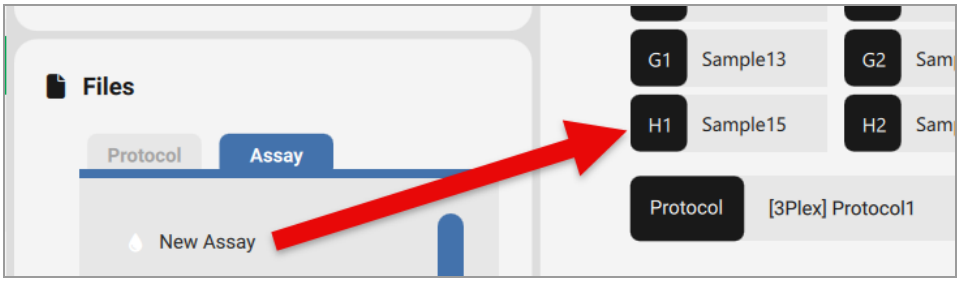


Note: Protocols can vary between cartridges on the same plate. In this case, the experiment is treated as a composite experiment, and the results may be split into multiple .niodata files. For more information see Composite Experiments on page 76

Assigning an Assay to a Cartridge

To assign an assay to a cartridge

1. Select an assay from the Assay tab of the Files section.
2. Drag the assay from the protocol library to the assay box under the cartridge .

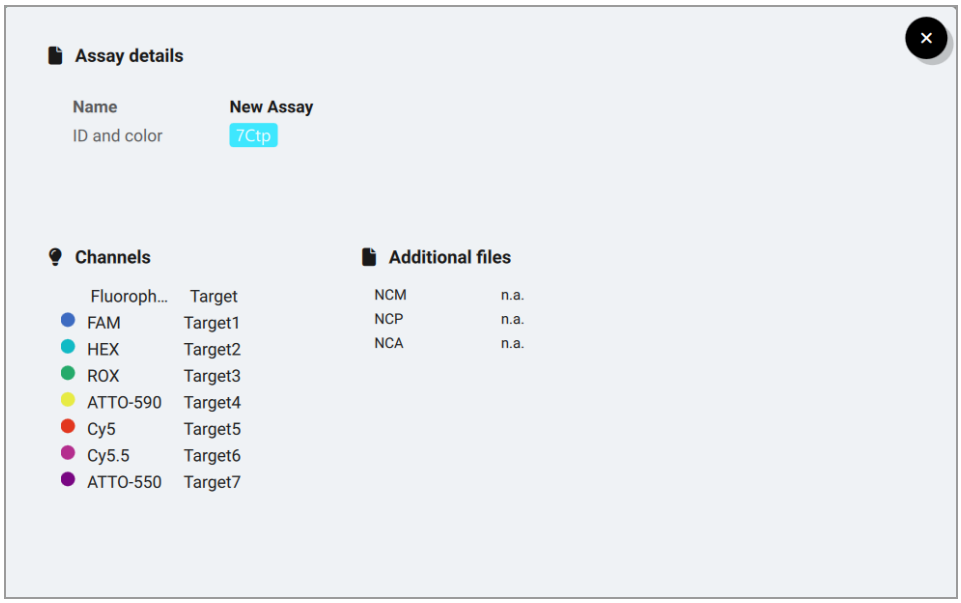


Note: When you drag and drop an assay onto a well, the assay is assigned to that well. If multiple wells are selected (including the one where the file is dropped) the assay is assigned to all selected wells.

Tip: To select all wells on a cartridge, click the cartridge icon next to the cartridge barcode field.

Viewing Assay Details

To view assay details, select an assay and click the View button. The Assay Details windows appears, summarizing the assay contents.



Note: You can assign different assay files to different wells within a plate. When this occurs, the experiment is treated as a composite experiment, and the results can be split into multiple .niodata files. For more information, see Composite Experiments on page 76.

Tip: Use the Enable/disable elements button to exclude specific wells from assay assignment.

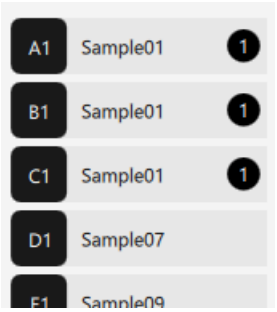
Details Panel

The Details panel of the Digital Experiments screen allows you to enter additional information about each well.

Edit Chamber Selection

In the Edit Chamber Selection menu, you can pool wells that contain the same reaction mix (for example, the same sample) for a combined analysis. To pool wells, select them and click Pool.

After wells are pooled, the software automatically assigns the same sample name with an index.



To unpool samples, select the pooled wells and tap Unpool in the Edit Chamber Selection menu.

Note: Pooled wells must share the same protocol and assay.

Sample Settings

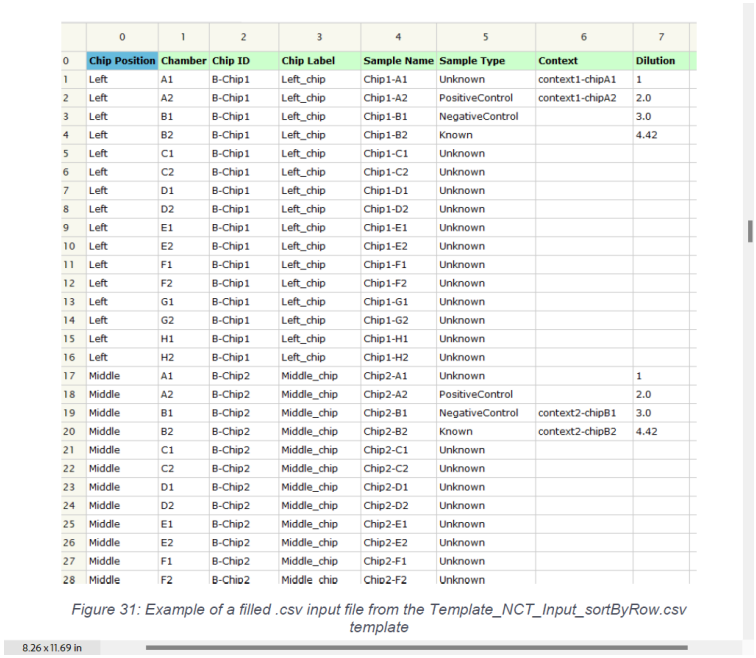
Use the Sample Settings menu to load sample information from a CSV file. The CSV file should include the following information:

- Well position
- Sample name
- Sample type (Positive Control, Negative Control, Known, or Unknown)

- Dilution factor
- Additional contextual details

Template CSV files for sample import are available at: C:\Users\Public\Bio-Rad\QX700SystemControl. Two formats are available:

- **Template_NCT_Input_sortByColumn.csv** — Wells ordered by column
- **Template_NCT_Input_sortByRow.csv** — Wells ordered by row



	0	1	2	3	4	5	6	7
0	Chip Position	Chamber	Chip ID	Chip Label	Sample Name	Sample Type	Context	Dilution
1	Left	A1	B-Chip1	Left_chip	Chip1-A1	Unknown	context1-chipA1	1
2	Left	A2	B-Chip1	Left_chip	Chip1-A2	PositiveControl	context1-chipA2	2.0
3	Left	B1	B-Chip1	Left_chip	Chip1-B1	NegativeControl		3.0
4	Left	B2	B-Chip1	Left_chip	Chip1-B2	Known		4.42
5	Left	C1	B-Chip1	Left_chip	Chip1-C1	Unknown		
6	Left	C2	B-Chip1	Left_chip	Chip1-C2	Unknown		
7	Left	D1	B-Chip1	Left_chip	Chip1-D1	Unknown		
8	Left	D2	B-Chip1	Left_chip	Chip1-D2	Unknown		
9	Left	E1	B-Chip1	Left_chip	Chip1-E1	Unknown		
10	Left	E2	B-Chip1	Left_chip	Chip1-E2	Unknown		
11	Left	F1	B-Chip1	Left_chip	Chip1-F1	Unknown		
12	Left	F2	B-Chip1	Left_chip	Chip1-F2	Unknown		
13	Left	G1	B-Chip1	Left_chip	Chip1-G1	Unknown		
14	Left	G2	B-Chip1	Left_chip	Chip1-G2	Unknown		
15	Left	H1	B-Chip1	Left_chip	Chip1-H1	Unknown		
16	Left	H2	B-Chip1	Left_chip	Chip1-H2	Unknown		
17	Middle	A1	B-Chip2	Middle_chip	Chip2-A1	Unknown		1
18	Middle	A2	B-Chip2	Middle_chip	Chip2-A2	PositiveControl		2.0
19	Middle	B1	B-Chip2	Middle_chip	Chip2-B1	NegativeControl	context2-chipB1	3.0
20	Middle	B2	B-Chip2	Middle_chip	Chip2-B2	Known	context2-chipB2	4.42
21	Middle	C1	B-Chip2	Middle_chip	Chip2-C1	Unknown		
22	Middle	C2	B-Chip2	Middle_chip	Chip2-C2	Unknown		
23	Middle	D1	B-Chip2	Middle_chip	Chip2-D1	Unknown		
24	Middle	D2	B-Chip2	Middle_chip	Chip2-D2	Unknown		
25	Middle	E1	B-Chip2	Middle_chip	Chip2-E1	Unknown		
26	Middle	E2	B-Chip2	Middle_chip	Chip2-E2	Unknown		
27	Middle	F1	B-Chip2	Middle_chip	Chip2-F1	Unknown		
28	Middle	F2	B-Chip2	Middle_chip	Chip2-F2	Unknown		

8.26 x 11.69 in

Figure 31: Example of a filled .csv input file from the Template_NCT_Input_sortByRow.csv template

Naming Samples

You can manually edit sample information in the Chip Plate Layout by:

- Double-clicking the sample name field in a chamber to edit it directly
- Double-clicking the chamber ID label (next to the sample name) to open the Chamber Editor, where you can edit sample details

For repetitive naming patterns, use the Automatic Sample Naming allows you configure naming rules, such as:

- Add a date (multiple formats available)
- Add a static sample name
- Add an index (custom start value)

- Set a separator character
- Define the order of elements
- Preview the generated names

Printing

After the experiment's assay and protocols are configured, you can print the layout by clicking Print in the top-right corner of the Digital Experiments page. This generates a printable PDF file.

Important: You can only edit .nioprotocol, .nioassay, and .nioexperiment files in QX700 ddPCR System Control Software.

Users without Admin rights should not access the ProgramData directory to avoid altering temporary run data.

Composite Experiments

A composite experiment includes multiple protocols and/or assays in a single experiment. It can include wells with varying parameters such as mix type, target names, fluorophores, etc.

Composite experiments enable you to take full advantage of the QX700 ddPCR System's high-throughput capacity and flexibility by allowing:

- Assignment of different protocols with distinct scanning conditions to cartridges on the same plate
- Assignment of different assays to different wells on the same cartridge

Important: Assays and protocols are linked by their activated channels. All assays assigned to wells on a given cartridge must match the channel configuration of the protocol assigned to that cartridge.

For wells to be analyzed together in the QX700 ddPCR System Analysis Software, they must share the following experimental parameters:

- Mix type
- Activated channels
- Exposure times of the activated channels
- Target names
- Fluorophores
- Thresholding mode
- Defined populations
- Compensation matrix

As a result, the output from a composite experiment might be split into multiple .niodata files based on the similarity of protocol and assay characteristics. When you click Get Results, the software generates separate .niodata files for wells that share the same protocol and assay layout. Each .niodata file contains wells that share both the same protocol and the same assay.

The data is split first by protocol, and then by assay.

Note: If the only difference between two protocols is the PCR program (e.g., annealing temperature), the data will not be split into separate .niodata files. This allows you to post-process assay optimization experiments run under varying thermal conditions. However, if other characteristics differ (e.g., mix type or scanning parameters), the data will be split.

When the QX700 ddPCR System Control Software splits results into multiple .niodata files, it applies a naming convention based on the plate layout defined in the experiment.

Consider a composite experiment configured as follows:

	Chip1		Chip2		Chip3	
	Column1	Column2	Column1	Column2	Column1	Column2
Protocol	1	1	1	1	2	2
Assay	1	2	1	1	1	1

Protocol Example

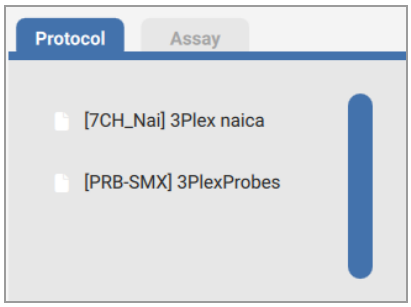
In this example, two protocols are named as follows:

- **Protocol 1** — Named “3Plex naica” with tag 3PlexNai
- **Protocol 2** — Named “3PlexProbes”, with tag 3PlexProbes

These protocols differ in mix type, which affects the analysis in QX700 ddPCR System Analysis Software and qualifies the data to be split.

Note: If the only difference between protocols were the number of PCR cycles, the software does not split data, as that does not impact analysis in the QX700 ddPCR System Analysis Software.

When loading these protocols in the Digital Experiments menu, the protocol tags are displayed before the file names.



Assay Example

In the same example, two assays are named as follows:

- **Assay 1** — Named “3Plx”, has the tag 3Plx, and is assigned the color green
- **Assay 2**— Named “3Pro”, has the tag 3PRO, and is assigned the color red

When these assays are loaded in the Digital Experiments menu, their respective tags (3Plx and 3Pro) are displayed alongside their names.

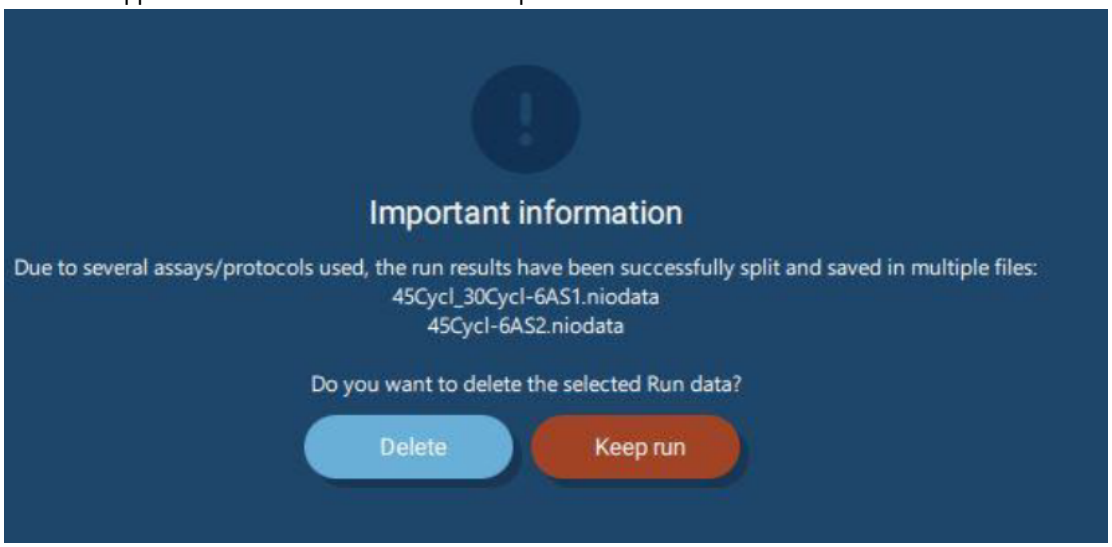
When assigning protocols and assays to the cartridges, the assay tag and its assigned color appear in each assigned well. The protocol tags are displayed below the corresponding cartridges.

Clicking Get Results in the Runs section prompts the software to scan the run data and group wells that use the same protocol–assay pair into a single .niodata output file. Each unique protocol–assay combination produces one .niodata file, so you will retrieve as many files as needed to capture all results from the experiment.

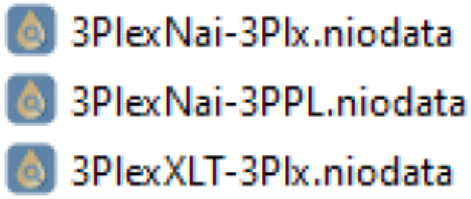
The QX700 ddPCR System Control Software splits the data into three .niodata files, as represented by gold, blue, and red colors.

	Chip1		Chip2		Chip3	
	Column1	Column2	Column1	Column2	Column1	Column2
Protocol	1	1	1	1	2	2
Assay	1	2	1	1	1	1

A window appears to inform the user of the data split.



In the .nioresults folder, three .niodata files are generated with the following naming convention:

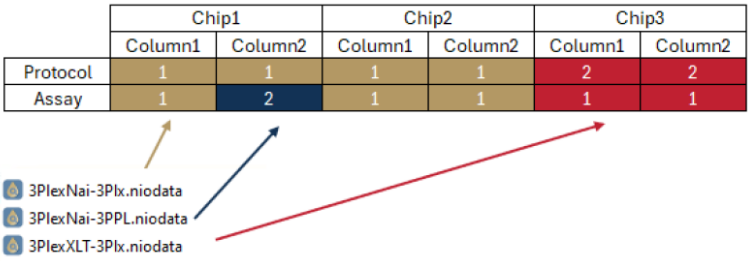


- The assay name appears directly in each .niodata filename
- The protocol name is replaced by its corresponding tag.

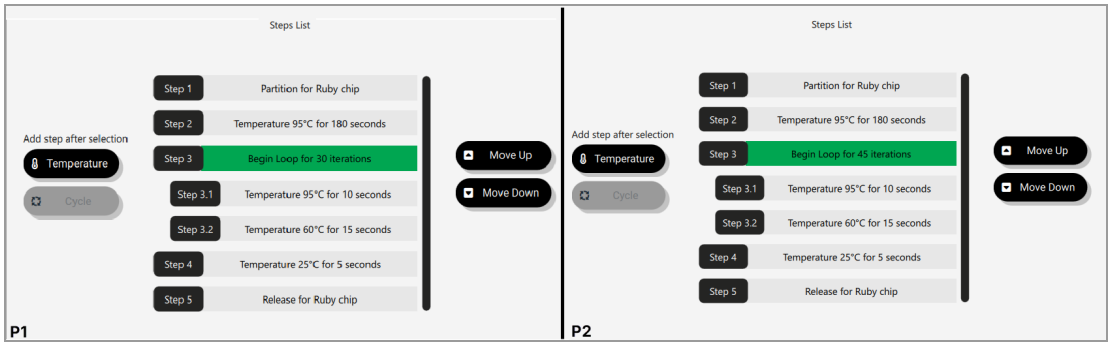
In this example:

- 3PlexNai is the tag for Protocol 1 (3plex naica)
- 3PlexXLT is the tag for Protocol 2 (3PlexXLT)

Because Protocol 1 is paired with two different assays on the left cartridge (Cartridge 1), an additional split occurs, resulting in a third .niodata file: 3PlexXLT-3Plx.

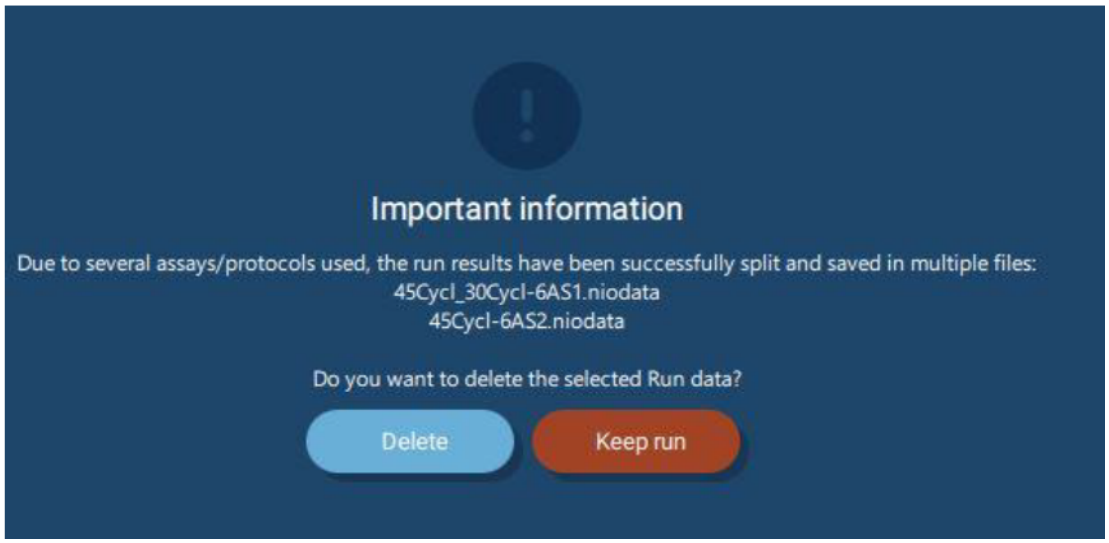


In this example, Protocols 1 and 2 differ only by the number of PCR cycles, and the same assay, “6AS1,” is assigned to every well in the experiment.

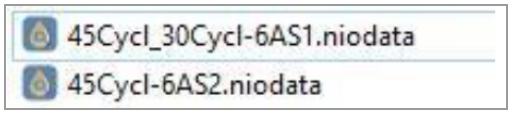


- P1 is saved as “45Cycles.nioprotocols” with the tag “45Cycles”
- P2 is saved as“30Ccycles.nioprotocols” with the tag “30Cycles”.

Clicking Get Results prompts the QX700 ddPCR System Control Software to split the data.



The generated files will display as:



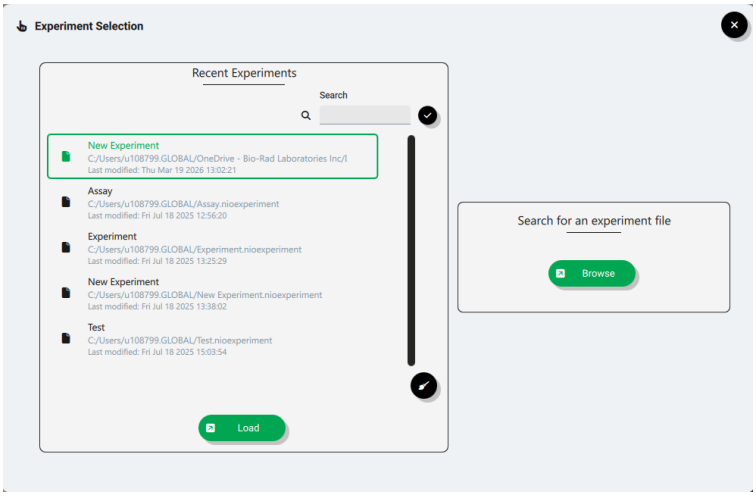
Chapter 9 Running a ddPCR Experiment

The Runs screen is used to launch and monitor experiments on the QX700 ddPCR System. This is the only step that requires a direct connection to the instrument; all previous steps can be performed on a personal computer.

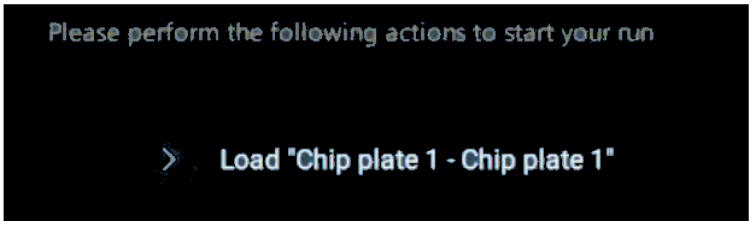
Note: When QX700 ddPCR System Control Software is not running directly on the instrument (i.e., remote access), certain features are disabled. These include instrument control actions (e.g., shutdown, unloading, failure acknowledgments) and run data handling (e.g., loading/unloading). These actions must be performed locally on the instrument.

To run a recent experiment

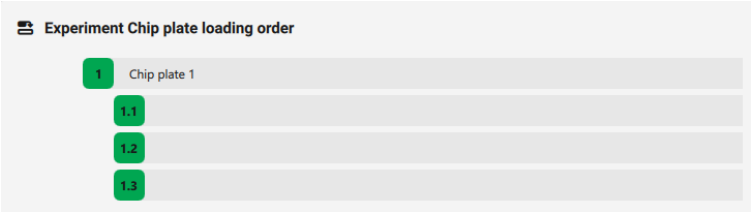
1. In the Runs section, click Plan & Start.
2. Do one of the following:
   - Select an experiment from the Recent Experiments menu and clicking Load.
   - In the Experiment Selection dialog, click Browse in the Search for an experiment File section to browse for a specific experiment.



3. Continue following the work flow instructions displayed by the software to complete the run setup steps.

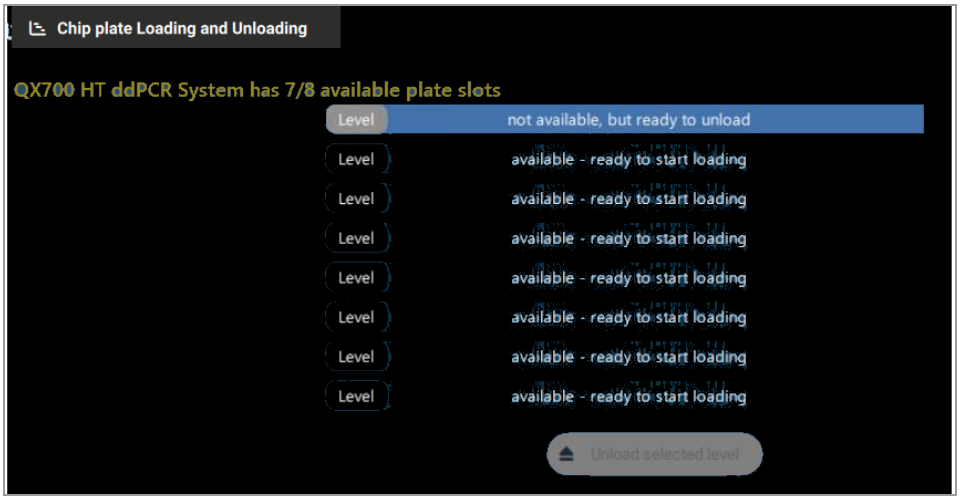


4. Load the plate. Before loading, the experiment plate loading order section displays a visual representation of the expected layout.

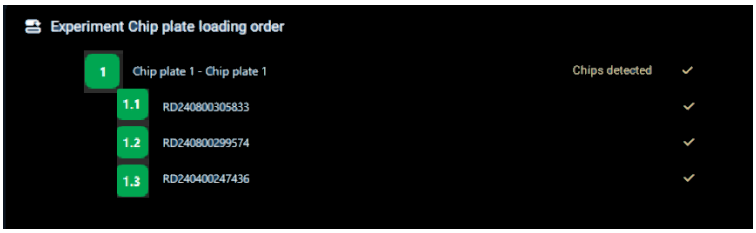


Note: If a plate lacks a specified barcode, the software reads it automatically using the barcode reader during cartridge loading through the front panel.

The plate loading and unloading menu also lets you retrieve cartridges from previous experiments. The instrument displays its current occupancy status.



After you load the cartridge, the plate displays the barcodes for each cartridge and their positions.



Note: You can also directly insert cartridges into the instrument. Since no experiment is associated, QX700 ddPCR System Control Software will prompt you to link an existing experiment, which will start automatically once the cartridges are loaded.

5. Click Start Run.
6. Navigate to the Status page.

   The Status page shows the progress and status of each cartridge for up to eight plates in the QX700 HT ddPCR System, four plates in the QX700 S ddPCR System, and one plate in the QX700 E ddPCR System.

   The Run section displays a progress bar for each experiment, with statuses indicating the current step:

   - **Queued** — Cartridges are inside the instrument and will be processed automatically. No user action needed.
   - **Thermocycling** — Partitioning, thermal cycling, and release steps are in progress.
   - **Reading** — Scanning is in progress; the counter increases as each well is read and becomes available for review.
   - **Done** — The experiment is complete.
   - **ETA** — The estimated time when data will be available for download.

   When the run is in the Queued state, the software provides an estimated starting time.

Run Information

The Selected Run Information panel displays more information about a specific experiment.

Setting Run Priority

The QX700 ddPCR System Control Software allows two priority levels for plates: Normal and High.

If multiple experiments are queued, you can change the processing order.

To change the experiment processing order

1. Select an experiment.
2. Click Set High Priority.

Note: This feature is only available while the experiments are still in the queue. After experiment processing has started, the system processes experiments based on the order in which they began. High priority does not override an experiment already in progress.

Assigning high priority changes the queue order so that the plate is processed before other queued, lower-priority experiments. You can set multiple plates to high priority; in that case, the software processes them in the order they entered the instrument, but ahead of all normal-priority plates.

Note: Changing the priority affects the Estimated Time of Arrival (ETA) for all plates. However, both those promoted to high priority and the remaining ones in the queue.

To revert the experiment processing order back to normal priority

1. Select an experiment.
2. Click Set Low Priority. The system will then process that plate according to the order it was loaded into the instrument.

After processing begins, the plate is marked In Progress and listed as on board the instrument.

Each cartridge will show one of the following real-time status indicators:

- **Thermocycling** — Indicated by a blinking thermometer icon followed by In Progress
- **Scanning**— Indicated by a blinking light bulb icon followed by In Progress

Additional details about the thermal cycling process are also displayed.

The run status updates to reflect the progress of the run. For example, it will change from Queued to Thermocycling, Reading, and then Done as the experiment advances.

Canceling a Run

You can cancel a run for a single cartridge or for the entire plate.

To cancel a run

Do one of the following:

- Cancel a single cartridge run by selecting the cartridge and clicking Cancel Selected Cartridge .

Important: Canceling a cartridge run during the thermal cycling step causes the thermal plate to stop heating or cooling immediately. This ends the PCR, and the instrument will not scan the wells on the canceled cartridge.

Note: If you cancel the run during the reading step, you can rescan the cartridge later since the PCR step has already completed.

- Cancel the run for the entire plate by selecting the plate and clicking Cancel Plate.

  Important: Canceling an entire plate run affects the cartridges the same way as canceling a single cartridge run: PCR stops for the canceled cartridges, and the system does not scan them.

  When you cancel a complete plate run, the instrument returns to atmospheric pressure, removes the cartridges from thermal cycling, and allows you to retrieve them immediately.

  When you cancel only one cartridge, the instrument continues processing the remaining cartridges. You can retrieve the canceled cartridge only after the instrument finishes the entire plate run.

Note: The cancellation is not immediate. After canceling a run, wait until the instrument indicates it is safe to unload the cartridges.

After the cancellation completes, you can retrieve the cartridges by selecting the run and clicking Unload Plate.

Appendix A Troubleshooting

This appendix explains how to troubleshoot problems that you might have.

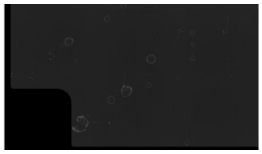
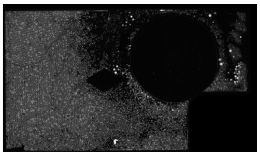
Contacting Bio-Rad Technical Support

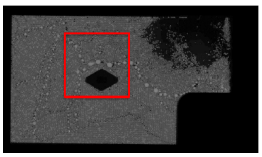
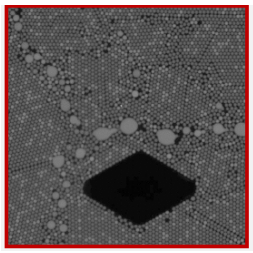
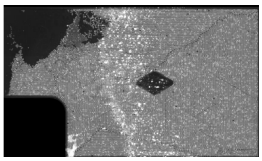
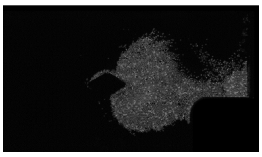
To contact Bio-Rad Technical Support, call 1-800-424-6723, option 2.

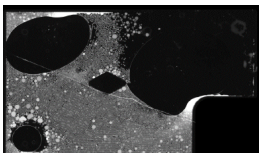
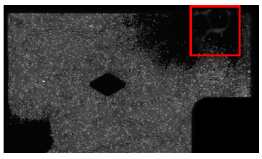
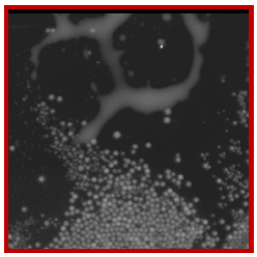
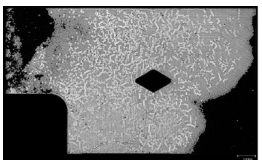
Before contacting Bio-Rad Technical Support, ensure you have the following details:

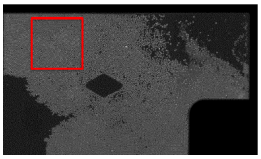
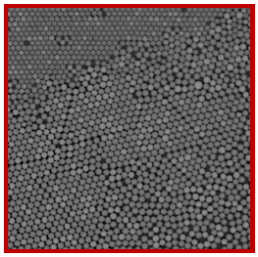
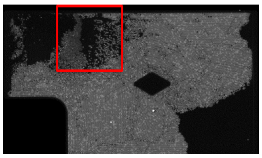
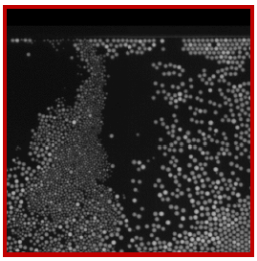
- Instrument serial number and software version
- Sample material
- Logs and .niodata

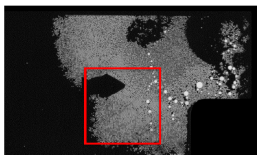
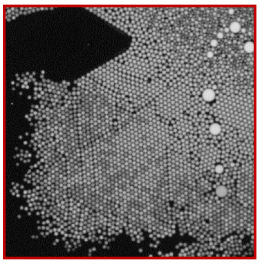
Experiment Troubleshooting

Error	Possible Causes	Troubleshooting Steps
Empty Well 	■ The sample was not pipetted into the correct well. ■ The sample was ejected from a tip. ■ The tip was introduced too deep, touching the bottom of the well, or too shallow, landing at the air-oil interface. ■ Misalignment of a multichannel pipette caused some tips to be either above the oil or touching the bottom of the well.	■ Check the numbering on the wells to ensure correct sample pipetting. ■ Stabilize the pipette tip about 1 mm above the bottom of the well. Lift slightly so it's neither touching the bottom nor out of the oil before ejecting the sample. ■ For detailed pipetting instructions, refer to the RDG16 Cartridge Instructions for Use.
Bubble 	■ Small bubbles can sometimes form during the PCR run due to heat and pressure cycles. ■ If large or frequent bubbles appear, the inflated bag containing the cartridge might have been damaged during transport.	Check that the inflated pouch is still airtight upon reception.

Error	Possible Causes	Troubleshooting Steps
Electrocoalescence  	The procedure using the antistatic wipes was omitted or not properly performed.	Apply antistatic wipes to all cartridge s as described in the instructions for use. Contact Bio-Rad Technical Support for further assistance.
Traces of antistatic product 	Residual antistatic product under the cartridge generates artifacts in the blue channel.	After applying the antistatic treatment, wipe off excess antistatic product with a Precision Wipe as instructed in the instructions for use.
Low number of droplets 	■ The sample was ejected from a tip introduced too deep (touching the bottom of the well) or too shallow (landing at the air-oil interface). ■ Misalignment in a multichannel pipette caused some tips to be above the oil or touching the well bottom.	Stabilize the pipette tip about 1 mm above the bottom of the well before ejecting the sample. Refer to the cartridge instructions for use for proper pipetting techniques.

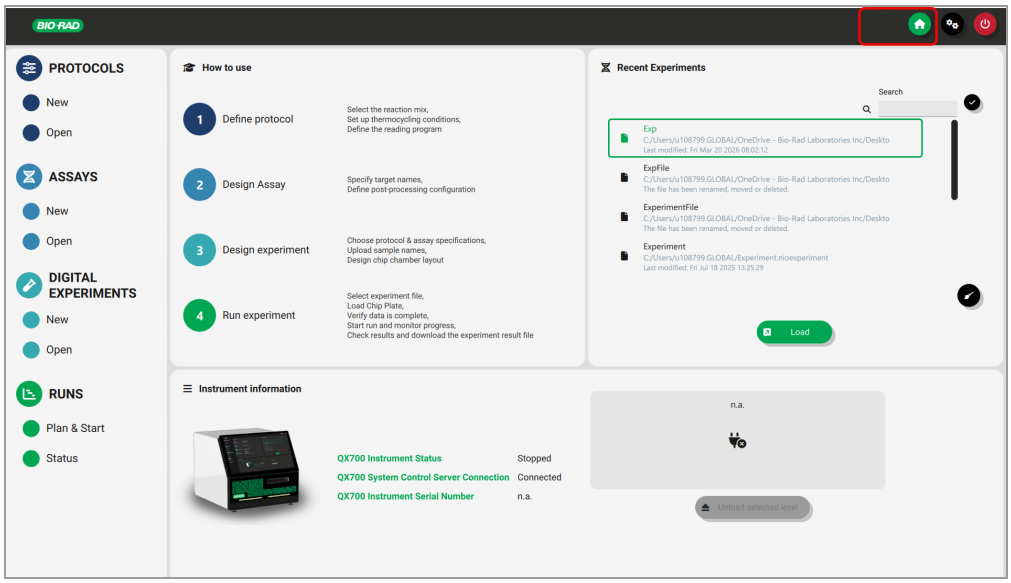
Error	Possible Causes	Troubleshooting Steps
Tension on transparent foil leading to oil traces 	■ Incorrect pipette tips were used to pierce the RDG16 Cartridge. ■ Not all 16 wells were pierced before launching the PCR program. A dust particle on the heating plate created tension on the foil. ■ The heating plate was not clean, causing a dust particle to create tension on the transparent foil.	■ Only use 10 µL and 20 µL universal pipette tips as specified in the instructions for use. ■ Always pierce all 16 wells (even empty wells) before launching the PCR program. ■ If there is oil leaking, wipe the cartridge with an antistatic wipe and then a Kimwipe (once only) before loading the cartridge and rescanning the impacted well(s). The impacted well(s) can be rescanned if needed.
Oil Traces  	The cartridge contains oil that may condense outside the wells under normal use.	Oil will evaporate naturally. No internal cleaning is required. Bio-Rad recommends yearly preventive maintenance by their technical support team, during which technicians clean the thermal cycler. Contact your local Bio-Rad representative for maintenance contracts.
Wetting Droplets 	A higher concentration of qScript XLT 1-Step RT-qPCR ToughMix can cause droplets to wet the well surface rather than remain spherical during RT-PCR experiments.	These droplets are excluded during analysis. Use the recommended XLT mix concentration (1x) and avoid leaving the RT-PCR mix exposed to air before injection.

Error	Possible Causes	Troubleshooting Steps
Bigger Droplets  	Temperature and pressure cycling can cause these artifacts in rare cases.	The software excludes these droplets during analysis and considers them as artifacts. This does not normally affect assay output.
Small Droplets  	Temperature and pressure cycling can cause these artifacts in rare cases.	The software excludes these droplets during analysis and considers them as artifacts. This does not normally affect assay output.

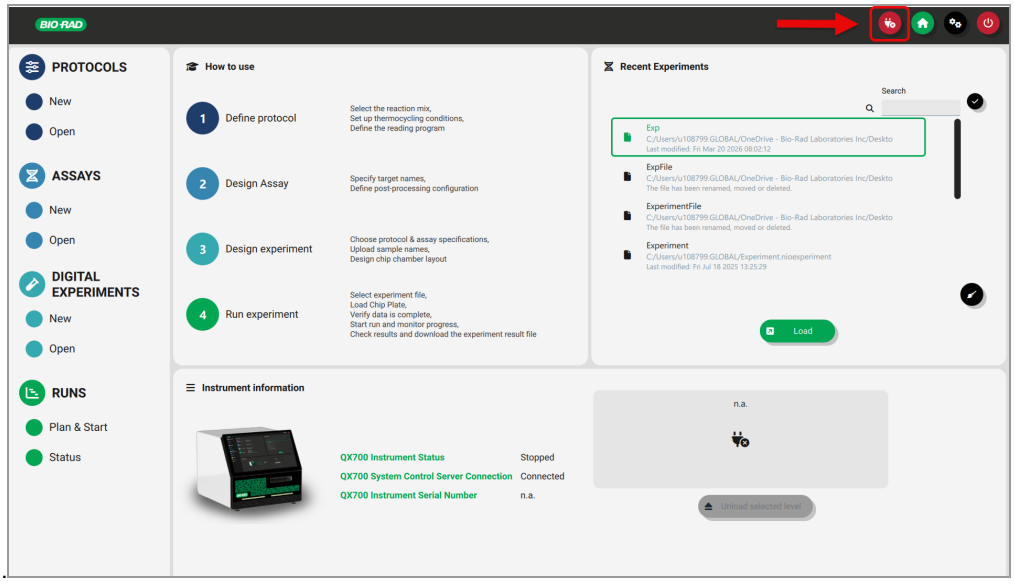
Error	Possible Causes	Troubleshooting Steps
Non-homogeneous distribution of positives  	A part of the sample was injected into the well after PCR cycles had begun, leading to bulk amplification before partitioning and a higher ratio of positive droplets. Possible reasons include: ■ The sample being ejected from a tip introduced too deep, touching the bottom of the well, or too shallow, landing at the air-oil interface. ■ Misalignment when pipetting with a multichannel pipette, causing the eight tips to be either above the oil or touching the bottom of the well.	Stabilize the pipette tip about 1 mm above the bottom of the well before ejecting the sample. Refer to the instructions for use for proper pipetting techniques in the cartridge.

Instrument Troubleshooting

Error messages for the QX700 ddPCR System will appear in the top right corner of the software interface. If the instrument is functioning without errors, this area displays only the Home and Shutdown/Restart buttons.



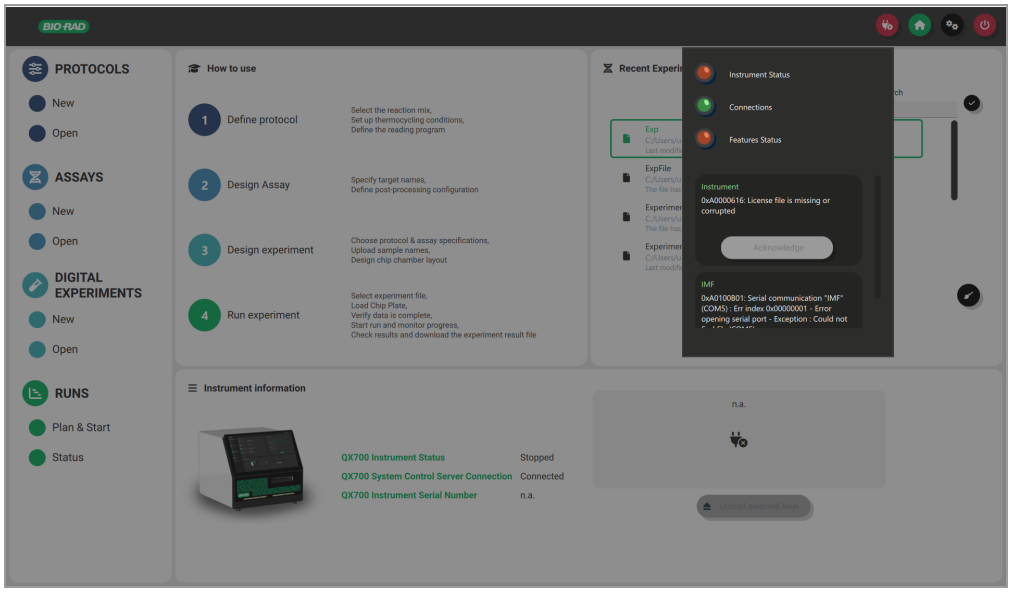
Error messages will also appear in the same area with an error icon.



Clicking the Error button opens a dropdown displaying status categories: Instrument, Connections, and Features.

- A green icon next to a status element indicates no errors.
- A red icon signals an error, with the dropdown also providing detailed error information.

Most errors can be addressed by clicking the Acknowledge button, prompting the instrument to attempt self-correction. Allow up to two minutes for this process.



If the issue persists, contact Bio-Rad Technical Support.

The table below outlines recommended actions for errors that require troubleshooting.

Error Code	Description	Troubleshooting steps
0xA0000502 0xA0050A01 0xA0050A02 0xA0050A04 0xA0060A01 0xA0060A02 0xA0060A04 0xA0070A01 0xA0070A02 0xA0070A04	Loading Module positioning error	If a power outage occurs, the instrument might require a restart. In these cases, or if the instrument stops unexpectedly, follow the procedures described in the following: ■ Unblocking the QX700 ddPCR System Loading Module on page 96 ■ Closing the QX700 ddPCR System Front Panel on page 99 If the error persists, click Acknowledge, and contact Bio-Rad Technical Support.
0xA0000503	Unexpected object insertion in Loading area.	Remove any object other than a plate from the Loading area.

Error Code	Description	Troubleshooting steps
0xA0000504	Insertion of two plates at the same time	Remove the second plate from the Loading area.
0xA0000913	Missing cartridge barcode during plate unloading	Wait for the plate to fully eject before retrieving it. Ensure the loading area status indicator has stopped blinking. Verify that the cartridge is present in the unloaded plate. If the cartridge is missing, contact Bio-Rad Technical Support.
0xA0000914	Software failure causing inversion of cartridge run results	■ Unload all cartridges from the instrument ■ Invalidate all results
0xA00A0301 0xA00A0302	Robotic error during lid opening	Close the thermal cycler lids

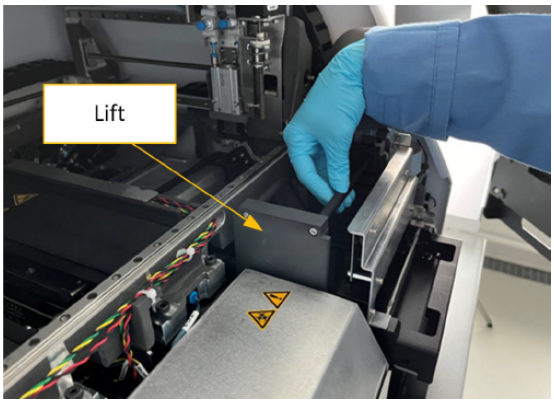
Unblocking the QX700 ddPCR System Loading Module

This procedure explains how to unblock the QX700 ddPCR System loading module.

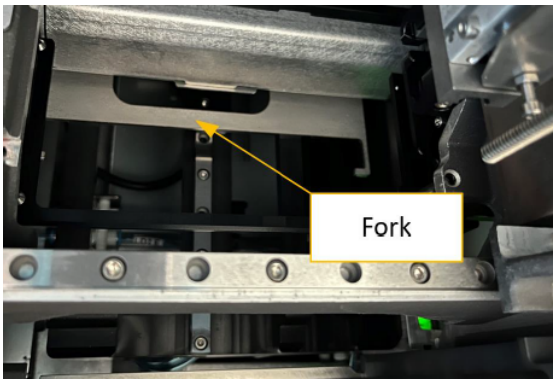
To unblock the loading module

1. Gently move the lift up and down and the fork back and forth to release the plate. You might encounter slight resistance.

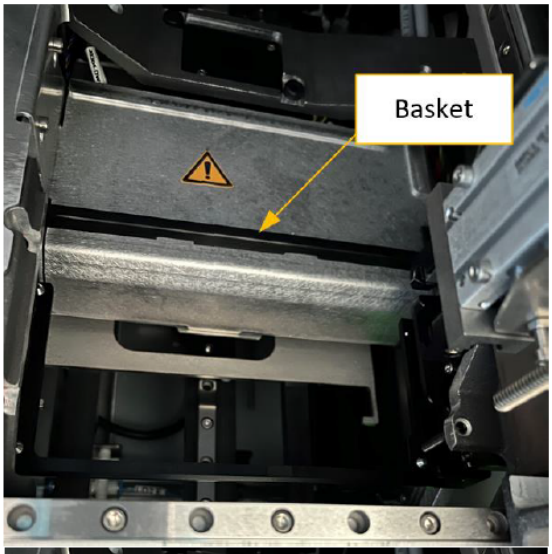
   Important: Do not force any of the instrument components if they do not move freely. For assistance with components, contact Bio-Rad Technical Support.

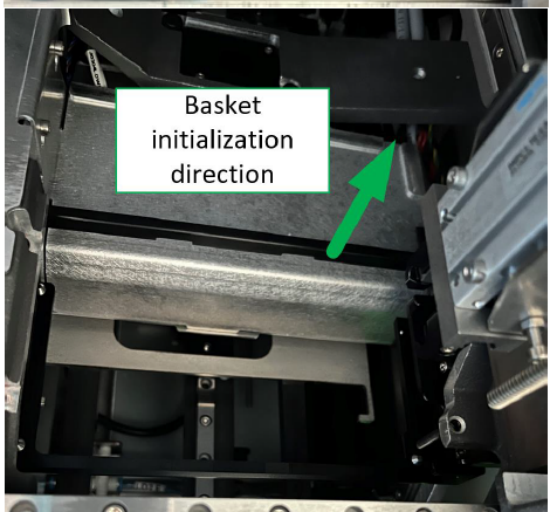


2. Gently push the fork backward to its initialization position until it locks fully in place.



3. Gently pull the basket upward to return it to its initialization (top) position.

4. 



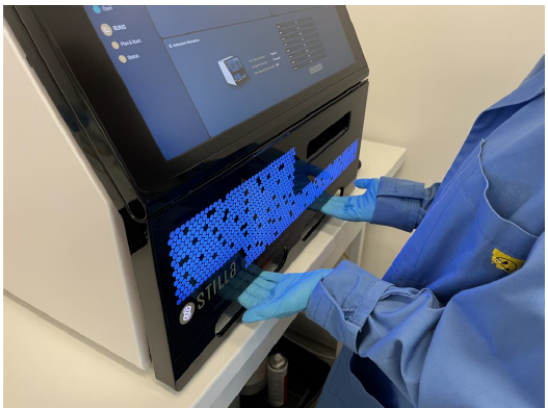
5. Close the instrument panel (see Closing the QX700 ddPCR System Front Panel on page 99).
6. Restart the instrument.
7. Unload all of the RDG16 Cartridges from the instrument.

Closing the QX700 ddPCR System Front Panel

This procedure explains how to close the QX700 ddPCR System front panel

To close the front panel

1. Push the door back until the magnetic lock secures it in the closed position.
2. Slightly lift the door while pushing, and use the two lower openings to close it more easily.



3. Place the security screw at the top of the door behind the screen cover.
4. Tighten the screw until makes contact with the door, and then turn it an additional quarter-turn to secure it.

Temperature Warnings and Errors

The QX700 ddPCR System must operate in a temperature-controlled environment to function correctly. The internal temperature is monitored continuously.

Initially, the system will issue a temperature warning. If the temperature continues to rise, the system will issue a temperature error.

Temperature Warning

The temperature does not affect instrument operation but indicates that the room temperature is too high and needs to be lowered. If the temperature continues to rise, a temperature error appears.

This warning does not affect instrument operation but indicates that the room temperature is too high and needs to be lowered

Note: . The warning cannot be acknowledged or dismissed manually. It will clear only after the internal temperature decreases.

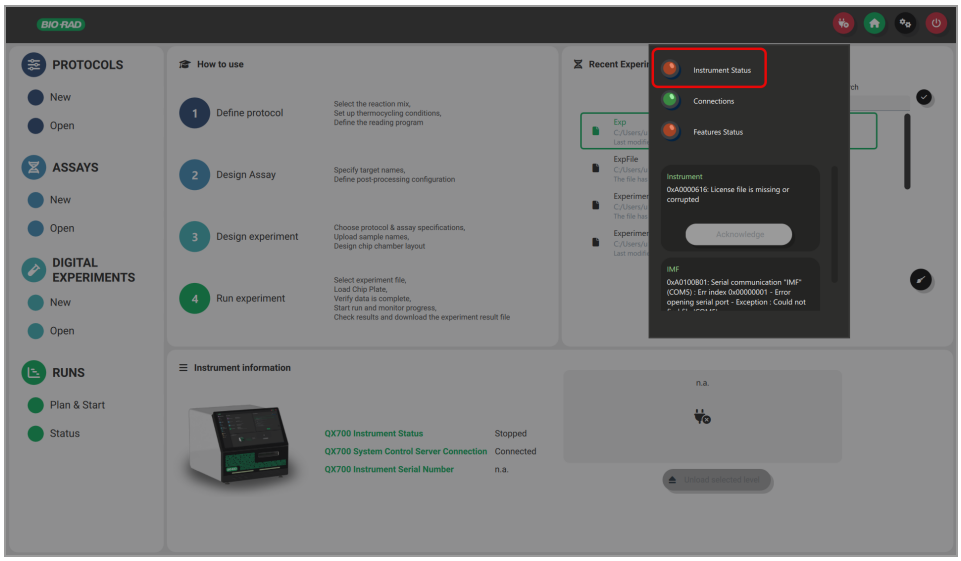
Temperature Error

If the temperature continues to rise, a temperature error appears. When this occurs, the QX700 ddPCR System Control Software allows you to stop all active experiment processing.

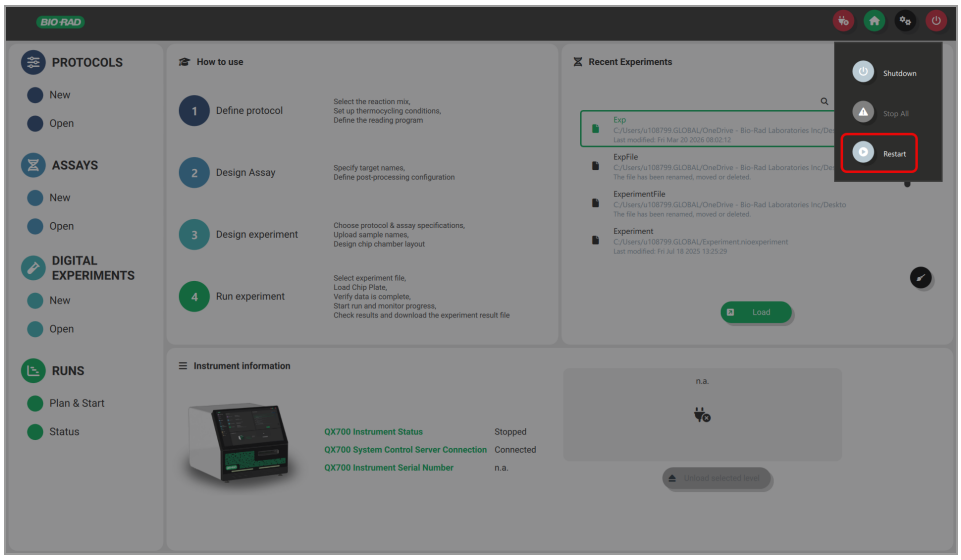
Note: This error prevents any new experiments from launching. It cannot be acknowledged or dismissed manually. It will clear only after the internal temperature decreases.

Instrument Not Ready

If the QX700 ddPCR System fails to initialize, the system displays a red Instrument Status indicator turns red.



When this occurs, tap Restart in the Power menu of the QX700 ddPCR System Control Software.



If the problem persists, contact Bio-Rad Technical Support.

Automatic and Repeated Restarts of the QX700 ddPCR System

This procedure explains how to shut down the QX700 ddPCR System if it repeatedly or automatically after shutting down the Windows session.

To shut down the instrument

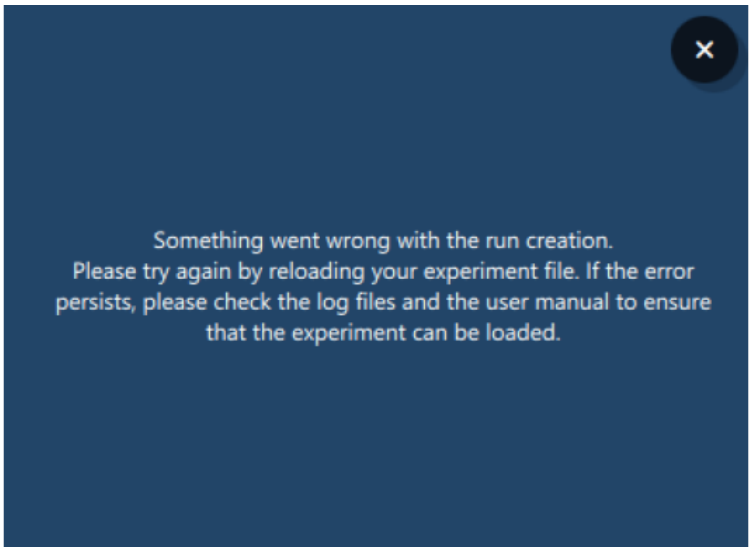
1. Shut down the QX700 ddPCR System Control Software.
2. Shut down the Windows session.

   Note: If the instrument restarts automatically again, wait for the Windows login screen to appear.
3. Then turn off the power switch at the back of the instrument.

If the problem persists, contact Bio-Rad Technical Support.

Experiment Launching Errors from a Local Area Network (LAN)

An error might occur when the system is launching a run from a file stored on a LAN location that requires different credentials from the active Windows session.



To resolve LAN errors

1. Copy the experiment file to a local folder on the QX700 ddPCR System.
2. Launch the run from the local copy.

Note: If you frequently use network-based files, contact Bio-Rad Technical Support for best practices.

Run Result Download Errors

This section explains how to resolve run result download errors both on the QX700 ddPCR System and from a remote computer.

To resolve remote computer run result download errors

1. Check the network connection for stability and speed.
2. If the issue persists, download the results directly from the instrument.

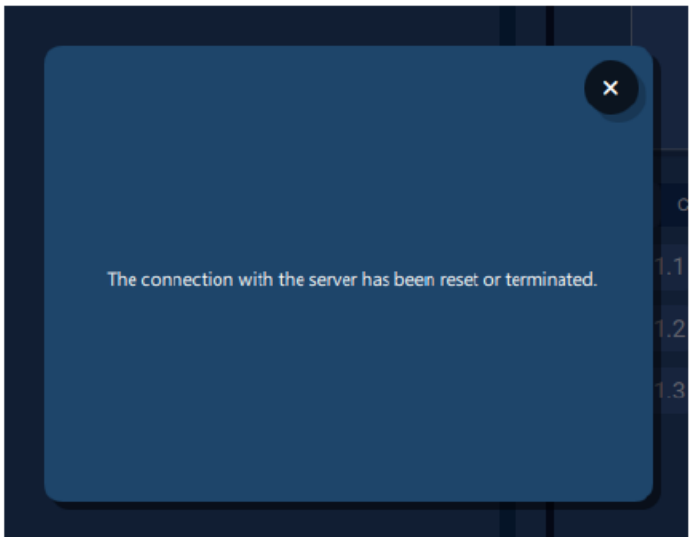


Fig. 6: Run Result Download Error (Remote Computer)

To resolve QX700 ddPCR System(local) run result download errors

1. Try retrieving the results a second time.
2. Check disk space to ensure the storage is not full.

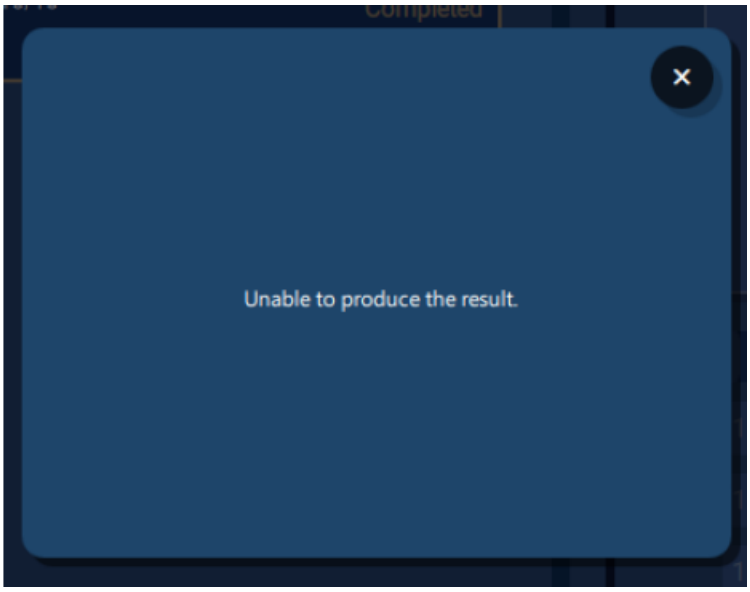


Fig. 7: Run Result Download Error (Local)

Appendix B Cleaning and Maintaining the Instrument

With long and constant use, the QX700 ddPCR System will require some cleaning and other maintenance.

QX700 ddPCR System Cleaning and Maintenance Safety Warnings

When cleaning and maintaining the QX700 ddPCR System, always consider and follow the warnings listed in Table 11 that follows.

Table 11. Cleaning and maintenance safety warnings

	Warning
	To prevent electrical shock, always turn off and unplug the instrument from the electrical outlet before cleaning it.
 	When handling biohazardous or radioactive samples, adhere to the recommended precautions and guidelines specific to your laboratory and location. These guidelines should include cleaning, monitoring, and disposal methods for the hazardous material (s) you are using.

Table 11. Cleaning and maintenance safety warnings, continued

	Warning
	Always use gloves, safety glasses, a mask, and a laboratory coat when cleaning or decontaminating the system. Do not clean internal components, including the optical module. Doing so may impair instrument performance. Do not spray cleaning agents directly onto or into the instrument. Do not use spray bottles on any part of the QX700 ddPCR System. Always follow the cleaning agent manufacturer's safety instructions.

Disposal

At the end of the instrument’s service life, dispose of the QX700 ddPCR System according to your country’s regulations for electrical and electronic waste.

- Do not dispose of the instrument in general waste.
- Take it to an authorized recycling or disposal center.
- Follow all applicable local and national guidelines

Appendix C Catalog Numbers for the QX700 ddPCR System and Accessories

This appendix lists the catalog numbers for the QX700 ddPCR Systems and accessories.

Instruments and Accessories

Table 12. Catalog numbers for the QX700 ddPCR System and accessories

Catalog Number	Description
17011036	QX700 Essential Droplet Digital PCR System
17010638	QX700 Standard Droplet Digital PCR System
17010628	QX700 High Throughput Droplet Digital PCR System
12025252	RDG16 Cartridges, Pack of 12
12025260	naica IQ/OQ kit
12025257	naica ddPCR Mix 5X
12025258	naica ddPCR Mix 10X
12025253	naica Multiplex ddPCR Mix 5X
12025255	naica Multiplex ddPCR Mix 10X
SW12	Antistatic wetted wipes (ACL Staticide)
	Precision Wipes*
	Reagents or consumables for nucleic acid purification.
	Standard consumables and equipment for PCR mix preparation.
	Assay-specific digital PCR reagents, primers and probes.
* These wipes must be purchased using the reference - Precision Wipes (Kimtech™ Science, 7552, 1 ply, 213 x 114 mm) from global standard laboratory suppliers	

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Website bio-rad.com **USA** 1 800 424 6723 **Australia** 61 2 9914 2800 **Austria** 00 800 00 24 67 23 **Belgium** 00 800 00 24 67 23 **Brazil** 55 11 3065 7550
Canada 1 800 361 1808 **China** 86 21 6169 8500 **Czech Republic** 00 800 00 24 67 23 **Denmark** 00 800 00 24 67 23 **Finland** 00 800 00 24 67 23
France 00 800 00 24 67 23 **Germany** 00 800 00 24 67 23 **Greece** 30 210 7774396 **Hong Kong** 852 2789 3300 **Hungary** 00 800 00 24 67 23
India 91 124 4029300 **Israel** 000 800 00 24 67 23 **Italy** 00 800 00 24 67 23 **Japan** 81 3 6361 7000 **Korea** 82 080 007 7373
Luxembourg 00 800 00 24 67 23 **Mexico** 52 55 5488 7670 **The Netherlands** 00 800 00 24 67 23 **New Zealand** 64 9 415 2280 **Norway** 00 800 00 24 67 23
Poland 00 800 00 24 67 23 **Portugal** 00 800 00 24 67 23 **Russian Federation** 7 495 721 14 04 **Singapore** 65 6415-3170 **South Africa** 27 21 531 7504
Spain 00 800 00 24 67 23 **Sweden** 00 800 00 24 67 23 **Switzerland** 00 800 00 24 67 23 **Taiwan** 886 2 2578 7189 **Thailand** 662 651 8311
United Arab Emirates 971 4 818 7300 **United Kingdom** 00 800 00 24 67 23

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