Bio-Rad Laboratories, Inc.

RDG16 Cartridge Automated Liquid Handling Support Device

Instructions for Use

February 2026

For research use only. Not for use in diagnostic procedures.

Contents

Purpose

This document provides information and instructions for

- Using the RDG16 Cartridge Automated Liquid Handling Support Device (hereafter called Support Device)
- Programming the liquid handling system

Intended Product Use

The Support Device is an accessory that automates the loading of consumables using standard liquid handling systems. It is compatible with the Nio™ dPCR system, naica™ System, and QX700™ Droplet Digital™ PCR (ddPCR™) System and should be used only by laboratory personnel who are trained to perform digital PCR (dPCR) procedures.

Important: The systems cited above and their associated components are intended for research use only (RUO). Do NOT use them for diagnostic procedures.

About the Support Device

The Support Device is composed of the cartridge, plus top and bottom covers, as shown in the following graphic:

Figure 1 Support device components

The bottom part holds up to three RDG16 cartridges, and the top part secures their position. The Support Device is placed in an automated liquid handling system that is programmed to pierce the foil over the wells and load sample into the wells.

Use and Safety Requirements

Required Materials (Not Provided)

The items listed below are required but not provided by Bio-Rad™:

- Automated liquid handling instrument (see System Compatibility on the following page)
- RDG16 cartridges (catalog no. 12025252)

Storage and Handling Requirements

Store and use the Support Device in a clean area at room temperature (15° C to 25° C), with standard humidity conditions (20% to 55% in controlled laboratories), and atmospheric pressure maintained between 0.9 bar to 1.1 bar.

Safety Requirements

Follow all required safety standards for your laboratory.

Cleaning and Decontamination

You can clean the surfaces of the Support Device top and bottom parts using any of the following:

- Ethanol
- Isopropanol
- Common decontaminant (such as RNAse-away) that is used for biological and medical devices and specifically targets nucleases and DNA contaminations (for example

The top and bottom parts are also compatible with standard autoclave sterilization processes.

Disposal Requirements

Dispose of the product and contaminated materials in accordance with applicable regulations.

Waste that is considered biohazardous must be disposed of according to the requirements applicable to your laboratory or location. To recycle cardboard packaging, follow the requirements applicable to your laboratory or location.

Technical Specifications

The following graphic illustrates the external dimensions and layout of the Support Device. Dimensions are shown in mm and comply with SBS standards. You can load up to three RDG16 cartridges into the support device.

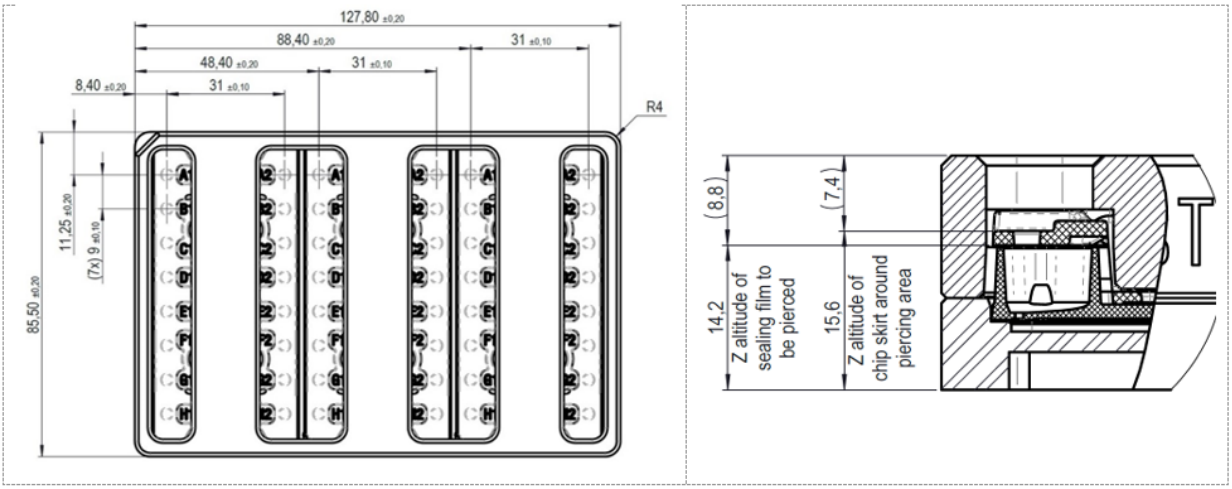

Figure 2 Support Device dimensions and layout

The following table specifies the weight of each support device component in grams, and product composition materials:

Table 1 Support Device component specifications

Support Device Component	Weight	Materials
Bottom part	105 g	Aluminum alloy; natural hard anodization
Top part	484 g	Sandblasted stainless steel
Total when loaded with three cartridges	630 g	

System Compatibility

The Support Device has been tested for hardware compatibility with the standard SBS layout on Hamilton and Opentrons automated liquid handling systems. Refer to the applicable user manual for instructions on correctly positioning standard SBS formats within the layout of the applicable instrument.

For plate compatibility outside the SBS standard, contact the manufacturer if you are using another automated liquid handling system.

Assembling the Support Device

To ensure proper handling, transportation, and anti-static preparation of the RDG16 cartridges before placing them into the Support Device, refer to the RDG16 Cartridge Instructions for Use (catalog no. 10000171484) before performing this procedure.

To assemble the Support Device with RDG16 cartridges

1. Ensure that the chamber inlet ports in the RDG16 cartridge point upwards to prevent oil leakage.
2. Position the bottom part of the support device in the liquid handling system.
3. Ensuring they are oriented correctly, place up to three RDG16 cartridges in the bottom part of the support device. The cut-out should be in the upper-left corner as shown in Figure 3:

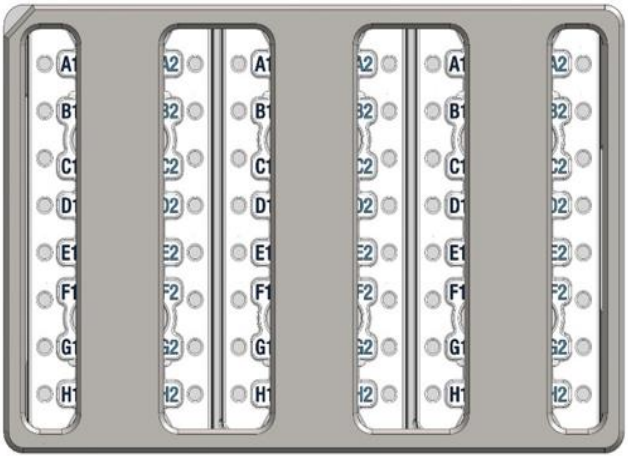

Figure 3 Positioning and orientation

4. Cover the assembly with the top part of the Support Device.
5. Run the desired RDG16 cartridge pipetting program PX.

   Important: To program the pipetting routines to use the Support Device (as described in the next section), refer to the user manuals for your liquid handling system.
6. Following the automated RDG16 cartridge pipetting program PX, lift the top part to disassemble the Support Device.
7. Place the RDG16 cartridge consumables back in the antistatic RDG16 cartridge transport tray to transfer the cartridge consumables to the digital instrument (QX700, Nio, or naica System).

Programming the Liquid Handling System

This section contains the programing information and steps to automatically pierce the foil using the proper dimensions and pipette the sample into the cartridge wells. The following programs are configured to automatically perform the processes:

- Program P0, for the free piecing of two holes per well
- Program PX, to pipet the sample mix

Important: To test the liquid handling program and verify accurate RDG16 cartridge foil piercing and sample deposition, running a test protocol on the digital instrument (QX700, Nio, or naica System) is recommended. Complete the steps in the following section.

Programming Prerequisites

Important Notes:

- Use the template specified for your instrument with RDG16 cartridges and non-template control:

QX700 ddPCR System	Template_PCR-45-cycles_7channels_naica-multiplex-PCR-MIX_Chip_**v1.1**
Nio Digital PCR System	Template_PCR-45-cycles_7channels_naica-multiplex-PCR-MIX_Chip_**v0**
naica System (Geode program)	Template Ruby PCR 45 cycles

- To ensure correct pipetting in each well of the RDG16 cartridges, the pipette must pierce, with empty tips, two holes that are larger than tips in the foil over each well, on either side of the well's center before you inject the sample mix. You must also calculate the distance between both holes, as it depends on the tip diameter and flexibility, before loading the cartridge with the mix.
- Use only the specified pipetting tips for RDG16 cartridge foil piercing and sample mix volume ejection, as described in the *Instructions* for Use of the RDG16 Cartridge.
- Ensure that the RDG16 Cartridge consumables and the RDG16 Cartridge Automated Liquid Handling Support Device do not move during the program. Visually check that the RDG16 Cartridge foil is correctly pieced in each well (Figure 5) and that no pipette tip bent, broke, or dispatched during the program.
- The $z = z_0$ corresponds to the white surface of the RDG16 cartridge skirt around and between each pipetting holes (see Figure 4).

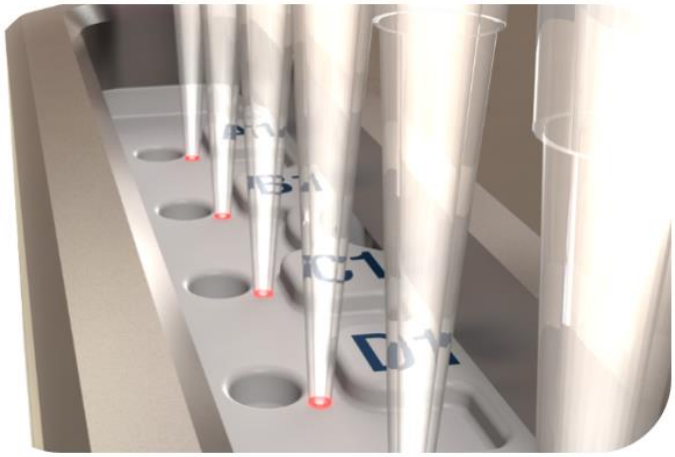

Figure 4 Retrieving the z_0 value

To perform a preliminary test of the programming steps for automated foil piercing

1. Adjust the z position of the liquid handling instrument so the pipetting tips barely touch the cartridge skirt.
2. Retrieve the z value z_0.
3. Using the dimensions shown in Figure 2, calculate the x and y values for the liquid handling system to document the dimensions for the center location of the pipetting holes for the individual RDG16 cartridge well columns.
4. With the adjusted dimensions test the complete and correct pick up of all pipette tips from the pipette tip supply area of the liquid handler.
5. Move the pipette tips to the respective x and y values of the column of wells of the first RDG16 cartridge at $z = z_0 + 7$ mm
6. Move the pipette tips to $z = z_0 - 4.3$ mm to execute the foil piercing step.
7. Move the pipette tips back to $z = z_0 + 7$ mm.
8. Move the pipette tips to the respective x/y-value of the next well column at $z = z_0 + 7$mm and repeat steps 6 and 7.
9. When done with the cartridge, discard the pipetting tips.
10. Repeat the procedure with a second series of three RDG16 cartridge consumables.

Troubleshooting Tips

If the tips hit the RDG16 cartridge skirt instead of piercing the foil: repeat the experience while reducing the 0.7 mm value by steps of 0.1 mm until the pipetting tips do not hit the RDG16 Cartridge skirt anymore.

The presence of a single circular hole indicates that the pipetting tip slipped into the first hole instead of piercing a second hole. Repeat the experience while increasing the 0.7 mm value by steps of 0.1 mm until all RDG16 Cartridge wells are correctly pierced. Incorrect piercing can lead to eject insufficient volume of sample mix and thus impact optimal droplets formation (Figure 7).

Figure 5 below shows an RDG16 cartridge with foil that is improperly pierced (circular shape) in wells A1, B1, C1, and F1.

Figure 6 shows the same wells with proper foil piercing (oblong in shape rather than circular).

Figure 5

Figure 6

Programming For Two-Hole Piercing (Program P0)

If the test foil piercing is satisfactory, complete the steps in this section to program the liquid handling system for two-hole piercing using the proper dimensions.

To program for two-hole piercing

1. Adjust the z position of the pipetting tips so that the tips barely touch the cartridge skirt and retrieve the z_0 value.
2. Calculate the $\mathbf{x_c}$ and $\mathbf{y_c}$ values of the center of each pipetting hole.
3. Retrieve and install new pipette tips from your supply.
4. Move the pipette tips to the first well column of the first RDG16 cartridge:

   Position $x = x_c + 0.7$ mm, $y = y_c + 0.7$ mm, $z = z_0 + 7$ mm
5. Pierce the first hole:

   Position $x = x_c + 0.7$ mm, $y = y_c + 0.7$ mm, $z = z_0 - 4.3$ mm
6. Lift the pipetting tip back:

   Position $x = x_c + 0.7$ mm, $y = y_c + 0.7$ mm, $z = z_0 + 7.0$ mm
7. Align for the second free piercing:

   Position $x = x_c - 0.7$ mm, $y = y_c - 0.7$ mm, $z = z_0 + 7.0$ mm
8. Pierce the second hole:

   Position $x = x_c - 0.7$ mm, $y = y_c - 0.7$ mm, $z = z_0 - 4.3$ mm
9. Lift the tip back:

   Position $x = x_c - 0.7$ mm, $y = y_c - 0.7$ mm, $z = z_0 + 7.0$ mm
10. Repeat steps 2 through 9 for the next RDG16 Cartridge well column (up to 6).
11. When done, discard the pipetting tips and continue to the next section.

Programming to Pipette the Sample Mix (Program PX)

Program PX is designed for use **after** Program 0 and sets the liquid handling system to eject 5.0 µL of sample mix in each RDG16 cartridge well. In the following sequence, the sample mix volume withdrawn in the pipette tips is called V_0 and the sample mix volume ejected into the RDG16 Cartridge well is called V_1.

To program the sample mix pipetting

1. Execute Program P0. See the previous section for instructions.
2. Retrieve and install new pipette tips from your supply.

   Important: To reduce the risk of contamination, do not use the same pipette tips that you used when executing Program P0.
3. Withdraw the sample mix (volume V_0).
4. Move the pipette tips to the first well column on the first RDG16 cartridge:

   Position $x = x_c$, $y = y_c$, $z = z_0 + 7.0$ mm
5. Move the pipette tips down into the RDG16 Cartridge skirt holes:

   Position $x = x_c$, $y = y_c$, $z = z_0 - 7.0$ mm
6. Eject the sample mix (V_1).

   Important: Air bubbles can severely impact droplet formation during ddPCR. Avoid blowout after pipetting to prevent the formation of air bubbles in the RDG16 cartridge well.
7. Slightly lift the pipette tip locations to the following position:

   Position $x = x_c$, $y = y_c$, $z = z_0$
8. Program to aspirate 0.5 µL of air to prevent contamination from sample mix or oil dropping from the pipette tip into the liquid handling system interior.
9. Move the pipette tip to the respective liquid handling system position to discard the pipette tips.
10. Repeat steps 2 through 9 for each RDG16 cartridge well column.

Important: After you program the sequence, run a test protocol on the digital instrument (QX700, Nio, or naica System) to verify that the RDG16 cartridges that were loaded with the liquid handling system performed optimally as to droplet generation and droplet numbers. For information, see the RDG16 Cartridge Instructions for Use.

Use the following template with non-template control sample mix:

QX700 ddPCR System	Template_PCR-45-cycles_7channels_naica-multiplex-PCR-MIX_Chip_**v1.1**
Nio Digital PCR System	Template_PCR-45-cycles_7channels_naica-multiplex-PCR-MIX_Chip_**v0**
naica System (Geode program)	Template Ruby PCR 45 cycles

Optimizing Sample Mix Ejection Volume

For optimal droplet formation, each RDG16 cartridge requires the pipette to eject 5.0 µL into each well. To ensure that 5.0 µL are available, Bio-Rad recommends that you program the liquid handling system to eject at least $V_1 = 5.2$ µL (as a starting point) of sample mix in each RDG16 cartridge. You might need to adjust the final ejection volume for your liquid handling system.

Ejection volumes can vary for dead volume between individual systems and some optimization of sample mix ejection volume might be required. Contact the manufacturer regarding dead volume and ejection in volume accuracy for the individual instrument. The images in Figure 7 are typical representations of the impact different ejection volumes can have on droplets formation:

- Figure 7A displays droplets with an empty area (red outline). Such empty spaces are present in the well when the ejected volume might be too low for optimal droplet formation (4.0 µL of PCR reaction mixture). You should increase the ejection volume by + 0.2 µL.
- Figure 7B represents optimal droplet formation using an ejection volume of 5.0 µL PCR reaction mixture.
- Figure 7C shows a chamber where the ejection volume might be too high (6.0µL of PCR reaction mixture), which results in appearance of packed droplets (red area). The ejection volume must be reduced You should decrease the dispensing volume stepwise to achieve an optimal droplet formation.

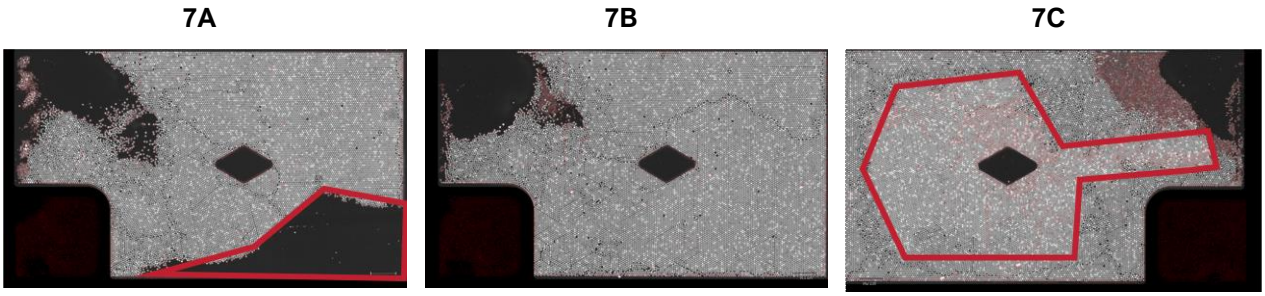

Figure 7 Impact of different ejection volumes on droplet formation

Symbols Lexicon

The following symbols appear on the product label.

 Manufacturer	 Legal Manufacturer	 Distributor
 Catalog Number	 Serial Number	 Consult Instructions for Use

Product Ordering Information

Bio-Rad Catalog No.	Product Description
12026135	Automated Liquid Handling Support Device
12025252	RDG16 Cartridges, Pack of 12

Revision History

Release Date (Month, Year)	SAP DIR and Version	Description
February 2026	10000255609 Ver A	Edit and reformat document with Bio-Rad branding

Bio-Rad Technical Support

The Bio-Rad Technical Support department in the U.S. is open Monday through Friday, 5:00 AM to 5:00 PM, Pacific time.

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