

Rapid PreCure (RPC) System User Manual

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Document Information

| Product | RPC System Kit Gen 2 |
|----------------------------|-------------------------|
| Part Number | CX2398-01A |
| Controller Model | RPC-C2424B (CX2450-01A) |
| Applicable Firmware | 0.1.6 and later |
| Document Version | 1.0 |
| Prepared by | Croxel, Inc. |

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1. About this Product

The RPC (Rapid PreCure) is a benchtop precision thermal-cycling instrument intended for use in industrial and manufacturing environments. The RPC executes a programmable, multi-phase temperature recipe automatically: it can both **heat** and **cool** through thermoelectric (Peltier) technology, holding each phase at a defined temperature for a defined duration before automatically advancing to the next.

A complete RPC system consists of two connected items: the **controller** and the **Syringe Heater/Cooler (SHC)**. The controller is the central unit with a display and a control knob. The SHC is the thermal-processing unit that accepts a 3 mL syringe into a precision thermal chamber.

This manual covers normal operation using only the on-device controls. Host-computer integration over USB is described in a separate API reference document and is not required for normal use.

2. What's in the Box

The RPC System Kit (CX2398-01A) contains:

| Qty | Part Number | Item |
|-----|-------------|---------------------------------------|
| 1 | CX2450-01A | RPC Temperature Controller Gen 2 |
| 1 | CX2451-01B | RPC Syringe Heater/Cooler (SHC) Gen 2 |
| 1 | CX2224-01A | 24 V AC/DC Power Adapter |

Inspect each item on receipt. If any item is missing or visibly damaged, contact Croxel before powering on the system.

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3. At a Glance



Figure 1. RPC system in normal operating layout.

4. Panels and Connectors

The RPC controller has a front panel and a rear panel. The front panel hosts the operator interface (display, knob). The rear panel hosts the SHC connection, power, and host-computer connections.

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4.1 Front Panel

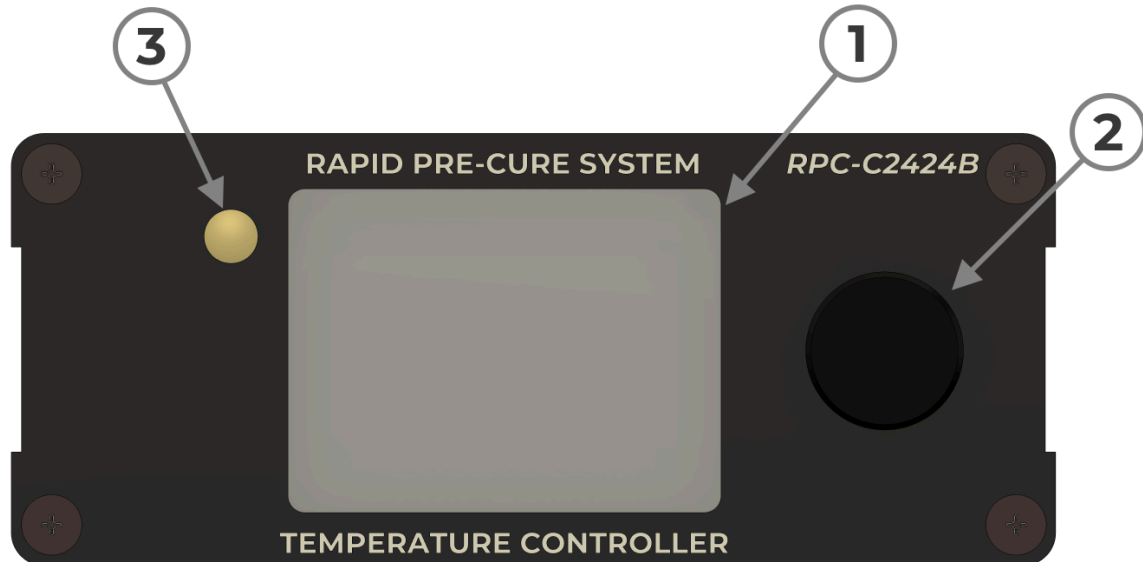


Figure 2. Front panel of the RPC controller.

| # | Feature | Purpose |
|---|---------------------|--|
| 1 | Display | 2" LCD showing status, temperature, and cycle progress. |
| 2 | Control knob | Turns and presses; the sole on-device control. See §8. |
| 3 | Status LED | Multi-color indicator showing system state at a glance. See §11. |

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4.2 Rear Panel

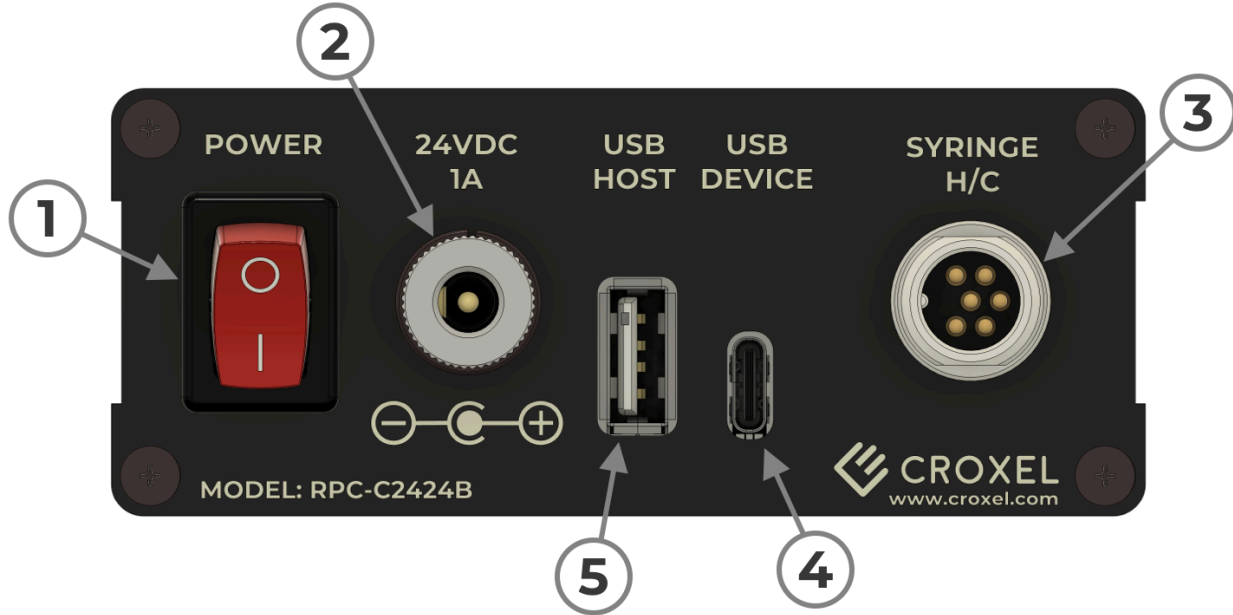


Figure 3. Rear panel of the RPC controller.

| # | Label on panel | Purpose |
|---|----------------|---|
| 1 | POWER | On/off switch. |
| 2 | 24VDC 1A | Power jack. Connect the 24 V AC/DC adapter (CX2224-01A) here. |
| 3 | SYRINGE H/C | Connect the Syringe Heater/Cooler cable. |
| 4 | USB DEVICE | Connection to a host computer. Not required for normal operation. |
| 5 | USB HOST | Reserved for future use. |

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5. First-Time Setup

1. Place the controller on a stable, flat surface with the rear panel accessible.
2. Place the SHC on the same surface, within reach of the controller.
3. Connect the SHC cable to the **SYRINGE H/C** port on the **rear** of the controller.
4. Confirm the **POWER** switch on the rear of the controller is in the **off** position.
5. Plug the AC/DC adapter into the **24VDC 1A** jack on the **rear** of the controller, then plug the adapter into a wall outlet (100–240 V AC, 50/60 Hz).
6. Set the **POWER** switch to the **on** position. The splash screen appears for approximately three seconds, then the main screen is displayed. The system is now ready for use.

6. The Splash Screen

For roughly three seconds after power-on, the controller displays a splash screen containing the **Croxel logo**, the **firmware version** and **build date**, the **last calibration date**, and the **device serial number**. The splash screen automatically transitions to the main screen; no input is required.



Figure 4. RPC splash screen at power-on.

The information on the splash screen is for identification and traceability. If you need to record the firmware version or serial number for a service inquiry, you can read it from the splash screen at any time by power-cycling the unit.

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7. The Main Screen

The main screen is the controller's normal operating display.

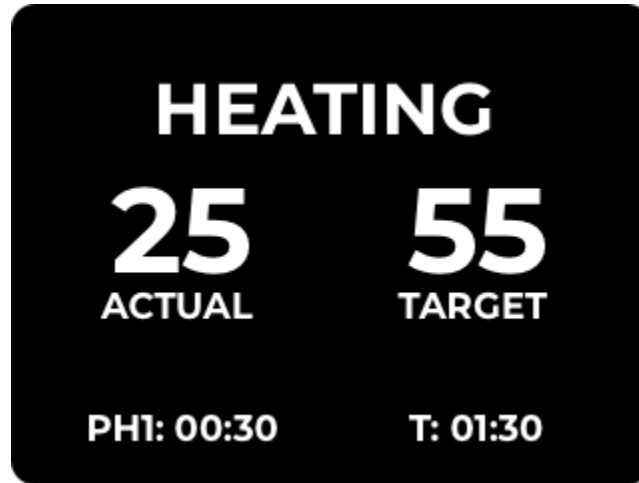


Figure 5. RPC main screen during a running cycle.

| Zone | Content | Meaning |
|--------------------|--------------------------|---|
| Header | A short status word | The current state of the controller, see the table below. |
| Left | Large number + ACTUAL | The measured temperature inside the SHC, in degrees Celsius. |
| Right | Large number + TARGET | The target temperature for the current phase, in degrees Celsius. When the cycle is not running, this shows --. |
| Lower-left | PHn: MM:SS | The current phase number (1 through 4) and the time remaining in that phase, in minutes and seconds. |
| Lower-right | T: MM:SS | The total time remaining for the entire cycle, in minutes and seconds. |

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Header states:

| Header | Meaning |
|------------------|---|
| READY | The system is idle and ready to start a cycle. |
| HEATING | A cycle is running and the SHC is being heated. |
| COOLING | A cycle is running and the SHC is being cooled. |
| ERROR | A fault has been detected. See §12. |
| POWER-CYCLE UNIT | A fault has occurred that requires the unit to be powered off and back on. See §12. |

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8. Using the Control Knob

All on-device interaction is via the single **control knob** on the front of the controller. The knob can be **turned** in either direction and **pressed** like a button. The press is interpreted differently depending on how long the knob is held down.

| Gesture | Meaning (with cycle stopped) | Meaning (with cycle running) |
|-------------------------------------|---|---|
| Turn clockwise | Start the cycle. | (no effect) |
| Turn counter-clockwise | Open the Profile Review screen (§9.1). | Stop the cycle. |
| Press and hold ~1 second | Open the Set Profile screen to edit the recipe (§9.2). | (no effect) |
| Press and hold ~3 seconds or longer | Toggle between the main screen and the Expert screen (§10). | Toggle between the main screen and the Expert screen (§10). |

9. Operating Tasks

The RPC stores **one recipe with four phases**. Each phase has a target **temperature** and a **duration**. The recipe is shipped pre-loaded from the factory and is retained through power cycles. You can review it, edit it on the device, or simply run it as-is.

9.1 Review the Stored Recipe

To check what the current recipe will do before you start a cycle:

- From the main screen with the header showing `READY`, **turn the knob counter-clockwise**.
- The **Profile Review** screen appears. The header reads `PROFILE REVIEW` and the four phases are listed:

None

```
PH1: <duration>s @ <temperature>C
PH2: <duration>s @ <temperature>C
PH3: <duration>s @ <temperature>C
PH4: <duration>s @ <temperature>C
```

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3. To leave the review, **turn the knob clockwise**, or simply do nothing for **about five seconds**, the screen returns to the main view on its own.



Figure 6. Profile Review showing the four stored phases.

The Profile Review screen is read-only. To change the recipe, see §9.2.

9.2 Edit the Recipe

The four phases can be edited directly from the controller, without a host computer.

1. From the main screen with the header showing `READY`, **press and hold the knob for about one second**, then release.
2. The **Set Profile** screen appears. The header reads `SET PROFILE`. All four phases are listed; the field currently being edited **blinks**.



Figure 7. Set Profile screen. The underlined field is the field currently being edited; it blinks on the live display.

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3. The fields are visited in this order:
 - a. **PH1 temperature** → **PH1 duration** → **PH2 temperature** → **PH2 duration** → ... → **PH4 duration**.

Within each phase, the temperature is edited first, then the duration.

4. **Turn the knob** to change the blinking value:
 - a. Turning **slowly** changes the value in fine steps (1 °C for temperature, 5 seconds for duration).
 - b. Turning **quickly** changes the value in coarse steps (1 °C for temperature, 30 seconds for duration).
5. **Press the knob** to confirm the current field and move to the next one.
6. Valid ranges per phase:
 - a. **Temperature:** -5 °C to +80 °C
 - b. **Duration:** 0 to 3600 seconds (0 to 60 minutes)
7. After you confirm the last field (PH4 duration), the recipe is saved automatically and the screen returns to the Profile Review.
8. If you do nothing for **about ten seconds** while editing, the Set Profile screen closes and any changes already confirmed are kept.

Tip: Setting a phase duration to 0s makes the cycle skip past that phase immediately. This is useful if you want to use fewer than four phases.

9.3 Run a Cycle

1. From the main screen with the header showing **READY**, confirm the recipe is what you want (review with §9.1 if needed) and that a syringe is properly seated in the SHC.
2. **Turn the knob clockwise.**
3. The cycle starts. The header changes to **HEATING** or **COOLING** (whichever direction the controller is driving toward the first phase's target temperature). The **TARGET** value updates to the current phase's target temperature. The lower-left field counts down the remaining time in the current phase as **PHn: MM:SS**, and the lower-right field counts down the total remaining cycle time as **T: MM:SS**.
4. Phases advance automatically. The **TARGET**, phase number, and time remaining update as each phase begins.

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9.4 Stop a Cycle Early

At any point during a running cycle, **turn the knob counter-clockwise**. The cycle stops immediately, the header returns to `READY`, and the `TARGET` value reverts to `--`.

9.5 End of a Cycle

When the last phase finishes, the cycle stops automatically. The header returns to `READY` and the `TARGET` reverts to `--`. The internal cooling fan continues to run for approximately **15 seconds** after the cycle ends in order to dissipate residual heat from the SHC. This is normal.

9.6 Inactivity Timeout

The RPC supports an optional inactivity timeout that automatically stops a running cycle if no operator activity is detected within a configured period. This feature is **disabled by default** and is not required for normal operation. If enabled at the factory or by a service technician for your site, the header will return to `READY` on its own when the timeout expires.

10. The Expert Screen

The Expert screen is a diagnostic view intended for service technicians. It shows detailed sensor and controller readings. Nothing on this screen can be changed from the knob; it is read-only.

To enter or leave the Expert screen: press and hold the knob for **about three seconds**, then release. The screen toggles between the main view and the Expert view.

The Expert screen displays:

- **Header** — the same status word as the main screen.
- **Process value (PV)** — measured SHC temperature in °C, shown with two decimal places.
- **Setpoint (SV)** — the current target temperature in °C.
- **Controller internals (P, I, O)** — instantaneous control values used by the temperature regulator. Provided for diagnostics only.
- **Supply readings (V, I, P)** — voltage, current, and power drawn from the AC/DC adapter.
- **Profile progress** — the current phase number and time remaining within the phase and overall.

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If a service representative asks for these values, return to the Expert screen and read them off the display. Otherwise, return to the main view.

11. Status LED

A single multi-color LED on the controller indicates system status at a glance:

| LED state | Meaning |
|---------------------|--|
| Solid green | Ready. The system is idle and no cycle is running. |
| Solid blue | A cycle is running. |
| Blinking red | A fault has been detected. See §12. |

12. Errors and Troubleshooting

When the controller detects a fault, the normal display is replaced by an error screen with the header **RPC SYSTEM** at the top and the word **ERROR:** followed by a short title. A recommended action is shown below.

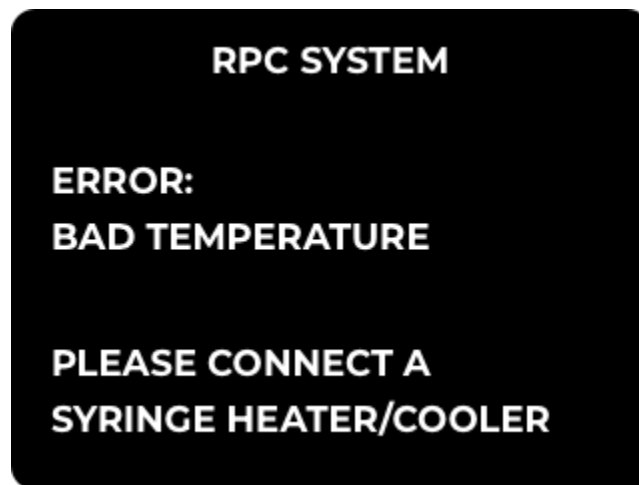


Figure 8. An example error screen ('BAD TEMPERATURE' shown).

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| Error title on screen | Likely cause | What to do |
|-----------------------|--|--|
| OVER-TEMPERATURE | Internal safety limit was exceeded. | Disconnect the power adapter, wait at least 30 seconds, then reconnect. If the error returns, stop using the system and contact Croxel. |
| INVALID POWER SUPPLY | The detected supply voltage is outside the acceptable range. | Confirm that the supplied Croxel AC/DC adapter (CX2224-01A) is connected and that the wall outlet is live. Replace the adapter if damaged. |
| OVER-POWERING | The controller drew more power than the safety threshold allows. | Power-cycle the unit. Confirm that the SHC cable is fully seated. If the error returns, contact Croxel. |
| TEMP REGULATION | The SHC failed to reach the phase target temperature within the allowed time. | Power-cycle the unit. Verify that the SHC fan and air vents are unobstructed and that the SHC cable is fully seated. If the error returns, contact Croxel. |
| OUTPUT DRIVER | A fault was detected in the controller's thermal output. | Power-cycle the unit. If the error returns, stop using the system and contact Croxel. |
| BAD TEMPERATURE | The controller cannot read a valid temperature from the SHC. The body text reads PLEASE CONNECT A SYRINGE HEATER/COOLER. | Confirm that the SHC is connected and that its cable is fully seated. |

After resolving the underlying cause, the error screen clears automatically and the main screen reappears. Most errors require a full power cycle (unplug, wait, replug) before the controller will recover.

If an error persists after troubleshooting, record the **error title from the screen** and the **firmware version and serial number from the splash screen** (§6), and contact Croxel support.

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13. Specifications

| Specification | Value |
|-------------------------|---|
| Temperature range | -5 °C to +80 °C |
| Control accuracy | ± 2.5 °C |
| Thermal method | Thermoelectric (Peltier), bidirectional (heating and cooling) |
| Cooling | Active fan with heatsink |
| Syringe capacity | 3 mL |
| Recipe capacity | 1 recipe, 4 phases |
| Phase duration range | 0 to 3600 seconds per phase |
| Phase temperature range | -5 °C to +80 °C per phase |
| Display | 2" LCD |
| User interface | Rotary knob with push button |
| Status indicator | Single multi-color LED |
| Input power | 100–240 V AC, 50/60 Hz (via included adapter) |
| Adapter output | 24 V DC, 1 A |
| Controller dimensions | 3.7 × 4.9 × 1.8 in (95 × 125 × 45 mm) |
| Compatible accessories | CX2461-01A SHC Fan Guard (replacement) |

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14. Care, Storage, and Support

Cleaning. Wipe exterior surfaces of the controller and SHC with a dry or lightly damp cloth. Do not immerse any part of the system in liquid. Do not use solvents or abrasive cleaners. Keep the SHC fan grille free of dust and debris. Allow any wiped surface to dry fully before powering the system on.

Storage. When not in use, leave the system powered off and stored indoors in a dry environment away from direct sunlight.

Service and warranty. This product contains no operator-serviceable parts. For service, warranty claims, replacement components, or technical questions, contact Croxel.

Contact: contact@croxel.com

End of manual.



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