



Gene Cyclor™ Thermal Cyclor

Instruction Manual

**Catalog Numbers
170-6700
170-6701**

BIO-RAD

Authorized Thermal Cycler

This instrument, Serial Number _____, is an Authorized Thermal Cycler. Its purchase price includes the up-front fee component of a license under the patents on the Polymerase Chain Reaction (PCR) process, which are owned by Hoffmann-La Roche Inc. and F. Hoffmann-La Roche Ltd, to practice the PCR process for internal research and development using this instrument. The running royalty component of that license may be purchased from Perkin-Elmer or obtained by purchasing Authorized Reagents. This instrument is also an Authorized Thermal Cycler for use with applications licenses available from Perkin-Elmer. Its use with Authorized Reagents also provides a limited PCR license in accordance with the label rights accompanying such reagents. Purchase of this product does not itself convey to the purchaser a complete license or right to perform the PCR process. Further information on purchasing licenses to practice the PCR process may be obtained by contacting the Director of Licensing at The Perkin-Elmer Corporation, 850 Lincoln Center Drive, Foster City, California 94404.

Perkin-Elmer does not guarantee the performance of this instrument.

Gene Cycler Instruction Manual

Read this manual carefully before installing and operating the Gene Cycler thermal cycler. This instrument contains an aluminum thermal block which is very hot during routine use and may cause skin burns if not operated properly. Read the safety section before using the Gene Cycler thermal cycler.

Warranty Information

The Gene Cycler thermal cycler is warranted for 1 year against defects in materials and workmanship. If any defects should occur during this warranty period, Bio-Rad Laboratories will replace the defective parts without charge. However, the following defects are specifically excluded:

Defects caused by improper operation.

Repair or modification performed by anyone other than Bio-Rad Laboratories or an authorized agent.

Deliberate or accidental misuse.

Damage caused by disaster.

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Safety Information

Cautions/Warnings

The aluminum sample block of the Gene Cyclor thermal cyclor can reach temperatures of 100 °C and the heated sample block cover in the sample block lid maintains a temperature of 105 °C during thermal cyclor operation. The sample block lid should remain closed at all times during instrument use to prevent accidental skin burns. Always allow the sample block temperature to return to room temperature before opening the sample block lid and removing the samples from the sample block.

Always connect the power supply to a 3-prong, grounded AC outlet, using the 3-prong AC power cord provided with the Gene Cyclor thermal cyclor. Do not use an adaptor to a two-terminal output. If an extension cord is used, use only an extension cord rated for 10 amps.

Never remove the instrument outer casing. There are no user-serviceable parts for this instrument. Call your local Bio-Rad office for instrument service.

To insure adequate cooling of the Gene Cyclor thermal cyclor, be sure that there is at least 15 cm clearance around the thermal cyclor. Do not block the fan vents at the top or bottom of the unit.

Do not operate the Gene Cyclor thermal cyclor in extreme humidity (> 80%) or where condensation can short the internal electrical circuits of the thermal cyclor.

Notice

This Bio-Rad instrument is designed and certified to meet I.E.C. 1010-1* safety standards. I.E.C. 1010-1 certified products are safe to use when operated in accordance with the instruction manual. This instrument should not be modified in any way. Alteration of this instrument will:

- Void the manufacturer's warranty
- Void the I.E.C. 1010-1 safety certification
- Create a potential safety hazard

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

Definition of Symbols



Caution : Risk of electrical shock



Caution: Refer to accompanying documents

*I.E.C. 1010 is an internationally accepted electrical safety standard for laboratory instruments.

Section 1 Introduction

1.1 Operating Features

The Gene Cyclor thermal cyclor is a microprocessor-controlled, aluminum thermal block instrument which performs rapid and reproducible heating and cooling (temperature cycling) of biochemical test samples. Multiple temperature cycles are generated through the user-programmable computer software and membrane keypad. The aluminum thermal block is rapidly, precisely, and uniformly heated using reliable, long-lasting resistors and cooled via fan-blown air. See Section 4, Specifications, for detailed information concerning thermal block temperature uniformity and accuracy, and heating and cooling rates. Rigorous testing of thermal block temperature precision, uniformity, consistency, and heating/cooling rates was conducted to insure reliable and reproducible experimental results.

The Gene Cyclor thermal cyclor was developed for oil-free operation. Oil is not needed in the thermal block wells or in the sample tubes. The sample wells are shaped to provide uniform contact with most standard 200 μ l thin wall micro test tubes. The heated sample block cover maintains a higher temperature than the sample block at all times during a thermal cycling program. This higher temperature keeps water vapor from condensing on the top of the sample tube, thereby reducing the amount of sample evaporation and eliminating the need for oil overlays in the sample tubes. For the most uniform heat transfer from the thermal block to the sample tube, Bio-Rad's 200 μ l thin wall micro test tube (catalog number 223-9473) is recommended.

The Gene Cyclor thermal cyclor does not require a sample temperature probe to monitor the internal temperature of the sample in order to determine when the steps of a cycle begin. The temperature displayed on the screen during a program run is the sample temperature. Compensation for temperature differences between the block and samples with volumes from 10–150 μ l has been determined empirically and embedded in the Gene Cyclor control software. The Gene Cyclor thermal cyclor begins counting the time of any step in a cycle when the sample temperature reaches ± 1.2 $^{\circ}$ C from the set step temperature. To insure the most accurate sample temperatures, you must specify the sample volume before a thermal cycling program run is initiated.

The user-programmable software offers simple step-by-step instructions to guide the user through temperature cycling program set-up. A total of 100 temperature cycling programs, with a maximum of 5 temperature steps per program, can be created and stored. Each program is capable of 300 cycle repeats. In addition, the programming power and flexibility are increased with the capability to create 50 Link Programs. Each Link Program can contain a maximum of 10 previously stored programs. Each program in a Link Program will automatically be run in succession. All programs are easily created and entered using the 8 membrane keypad. All programming instructions and program run conditions are displayed on the 40 character LCD display window.

A unique programming feature of the Gene Cyclor thermal cyclor is the Auto Increment/Decrement capability. This feature allows an incremental increase or decrease of temperature and/or time for any step of a particular cycle. This incremental increase or decrease in temperature over each iteration (cycle repeat) of a particular cycle is calculated by the Gene Cyclor thermal cyclor after the user enters the start and finish temperatures. For example, this feature may be useful for extending the activity of an enzyme or for optimizing the primer/template annealing conditions over the length of a cycle sequencing program.

1.2 Operating Precautions

Two configurations of the Gene Cyclor thermal cyclor are available, one for 100–120 volt power requirements and the other for 200–240 volt operation. To verify that the unit you received is of the correct line voltage, check the fuse and serial number labels on the back of the Gene Cyclor thermal cyclor.

Always operate the Gene Cyclor thermal cyclor with the thermal block lid closed. The Gene Cyclor thermal cyclor performs optimally when the lid is closed. Thermal block temperature uniformity, precision, and heating/cooling rate specifications were developed with the lid closed. Operating the instrument with the lid open may lead to sub-optimal experimental results.

Avoid spilling liquids onto the stainless steel wire mesh surrounding the thermal block. If any liquids should drip or run down through the stainless steel wire mesh into the apparatus, wait for the liquid to evaporate and dry before operating the Gene Cyclor thermal cyclor.

Do not cover the air vents in the top or bottom of the instrument. Thermal block temperature uniformity, precision, and heating/cooling rate specifications were developed based on unblocked air vents. Blocked air vents may result in slower thermal block cooling rates, or non-uniform block temperatures.

The thermal block temperature uniformity, precision, and heating/cooling rate specifications were developed based on a room temperature between 15–30 °C and humidity between 20–80%. Operating the thermal cyclor outside of these temperature and humidity parameters may provide less than optimal results.

All programs are conserved in the memory during a power failure. However, if a program is running during a power failure, when the power returns the program will not automatically continue. All thermal cycling run information is lost. You must restart the program when power has returned.

1.3 Safety

This instrument is intended for laboratory use only.

This product conforms to the “Class A” standards for electromagnetic emissions intended for laboratory equipment applications. It is possible that emissions from this product may interfere with some sensitive appliances when placed nearby or in the same circuit as those appliances. The user should be aware of this potential and take appropriate measures to avoid interference.

Section 2 Gene Cyclor Overview

2.1 Installation

Unpacking

Upon product arrival, inspect for any damage to the Gene Cyclor thermal cyclor and associated parts during shipping. Contact your local Bio-Rad office if any damage has occurred. Severe damage to the container may indicate damage to the Gene Cyclor thermal cyclor. If you suspect damage to the unit, immediately file a claim with the carrier in accordance with its instructions before contacting Bio-Rad Laboratories.

Each Gene Cyclor shipment includes:

- Gene Cyclor thermal cyclor
- Power cord
- Instruction manual
- Spare fuses, 2
- 200 µl thin wall micro test tubes, 100

Instrument Location

Place the unit in a location free of direct sunlight, and of extreme temperature variation, that maintains an ambient temperature between 15–30 °C and relative humidity between 20–80%. Free air flow to the unit is required. Allow 15 cm of unobstructed space surrounding all sides of the instrument. Place the unit on a flat and level surface capable of indefinitely supporting 5 kg.

Power Requirements and Set-up

The Gene Cyclor thermal cyclor's maximum power consumption is 550 watts. The unit operates at either 100–120, or 200–240 volts, 50/60 Hz and a maximum current of 7 amp for 100–120 V operation, and 3.5 amp for 200–240 V operation. A three-prong cord, with inlet and outlet plugs, is provided.

1. Insert the three-prong inlet plug into the power inlet receptacle on the back of the Gene Cyclor thermal cyclor.
2. The three-prong outlet plug on the cord should be inserted into a three-terminal power outlet. (For instrument protection and user safety, never bypass the three-terminal with a two-prong adaptor.) The third-prong is used to ground the instrument to earth.
3. Power is supplied to the instrument when the red toggle power switch is flipped to the on position.

2.2 Instruction Manual Conventions

The following conventions for referring to Gene Cyclor thermal cyclor software are used in this manual.

- A screen display will follow all instructions for programming.
- References to screen displays in the text will appear in **BOLD**. Actual display screen messages will appear in “**BOLD**” with quotations.
- References to instrument function keys (other than arrow keys) will appear in upper case letters.
- The cursor position will be indicated by a box (□) around the character. The instrument display indicates cursor position by flashing and underlining the chosen character.

2.3 Control Features

Power Switch

Turn on the red power switch on the rear panel on the Gene Cyclor thermal cyclor. The screen below will display for approximately 1 second, followed by the main menu.

**Gene Cyclor™
Version 1.5**

Control Panel

The Gene Cyclor control panel consists of a 40-character instrument display, four arrow keys for positioning the cursor, scrolling through menus, or designating number values for thermocyclor program parameters, and four function keys; PAUSE, STOP, MENU, and ENTER (see Figure 2.1). The function keys are used as described below.

- Pressing PAUSE will cause a running program to pause and hold the block at the current set temperature. If the key is pressed while the block is heating or cooling toward a programmed set temperature, the set temperature will be reached, and then the program (and set temperature) will hold. Pressing PAUSE again will cause the program to resume. PAUSE functions only during a program run.
- Pressing STOP will cause the program to abort. The cooling fan will return the block to ambient room temperature. STOP functions only during a program run.
- Pressing MENU will return the display to the main menu. This key does not function during a program run. For a detailed explanation of the use of MENU, see Section 3.1.
- Pressing ENTER will enable a display screen to accept modifications, accept user entries during the creation or editing of programs, or advance to the next screen. ENTER does not function during a program run.



Fig. 2.1. Gene Cyclor control panel.

Main Menu

The main menu display is shown below.



The current block temperature is always displayed at the main menu. The right/left arrow keys may be used to choose **RUN**, **PROGRAM**, or **LINK**. **RUN** is the default choice. Section 3 explains in detail how to create, edit, link, and run programs.

Section 3 Gene Cyclers Operation

The Gene Cyclers thermal cyclers rapidly heat and cool biochemical samples. The aluminum block is resistance-heated and air cooled under microprocessor control for maximum speed and accuracy in temperature adjustments. The heated tube cover eliminates the requirement for messy and cumbersome oil overlays, and minimizes sample loss to evaporation and condensation. Easy, step-by-step programming guides you in creating custom temperature cycling programs.

3.1 Creating New Programs

The Gene Cyclers software allows the creation and editing of custom programs for controlled temperature cycling regimes. The instrument can store up to 100 programs. Each program may have up to five different cycles, repeated up to 300 times each. Each cycle may contain up to five unique temperature and time steps. For example, a typical program might have these cycles and steps:

Program 001

cycle 1: Step 1: 94 °C 4m 00s

Step 2: 60 °C 4m 00s

cycle 2: Step 1: 91 °C 0m 30s

Step 2: 60 °C 4m 00s repeat cycle 2, 25 times

In addition, programs may be linked together for complex or lengthy protocols. This section provides some general guidelines for using the instrument keys, and instructions for creating standard cycling programs, programs that allow the gradual increase or decrease in step temperature or time over the iterations of a cycle (auto increment/decrement programs), and linked programs.

Instrument Key Use

1. The right/left and up/down arrow keys are used to position the cursor, choose menu items, or specify a numeric value when creating or editing programs.
 - a. When a right arrow appears on the display screen, the right arrow key may be used to position the arrow to a different menu choice. When a left arrow appears on the display screen, the left arrow key may be used to undo the last step executed when ENTER was pressed. When the cursor flashes over a menu choice, the right/left arrow keys may be used to position the cursor.

- b. When the up/down arrows appear on the display screen, the corresponding arrow keys may be used to scroll between screens. When the cursor flashes over a numerical value, the up/down arrow keys may be used to specify a particular value; the up key increases the number and the down key decreases the number.
- 3. ENTER is used to accept menu choices, to advance to the next screen, and to accept numerical entries such as step temperature or time. ENTER may also be used to move a flashing cursor to the right (in the same fashion as the right arrow key).
- 4. When ENTER is pressed at the “**PREVIOUS SCREEN**” display, the screen returns to the previous level. For example, if ENTER is pressed at the “**PREVIOUS SCREEN**” display under the step entry menus, the screen will return to the cycle entry level.
- 5. MENU returns the display to the main menu. It also may be used as a “quick exit” key during the creation or editing of programs. See Section 3.1 for detailed instructions on the use of MENU to exit programming.

Creating Standard Programs

To create a new program, follow the instructions below:

- 1. Use the right/left arrow keys to choose **PROGRAM** from the main menu and press ENTER. The next screen offers these options: **NEW**, **EDIT**, **DEL**, and **CLR**. Press ENTER to choose the default option, **NEW**.

RUN ►PROGRAM LINK
BLOCK TEMP:025.0 °C

ENTER ↓

PROGRAM
►NEW EDIT DEL CLR

ENTER ↓

NEW PROGRAM
◆001 NOT STORED

New = new program
Edit = edit existing program
Del = delete existing program
Clr = clears all programs from Gene Cycler memory

- 2. The **NEW PROGRAM** screen displays a program number and information on its storage status. If a program has already been created using the program number currently on the screen, it will be followed on the display by “**STORED**”. Use the up/down arrow keys to find a program number that is available (a program number followed by “**NOT STORED**”). The right/left arrow keys may be used to advance or go back 10 programs at a time. When an available program number is located, press ENTER.

NOTE: Stored programs may be written over by pressing ENTER and then pressing Y at the “**OVERWRITE P 001 ?**” prompt.

NP: 001 CYCLE#:1
CYCLE REPEATS 001

NP = new program

- Press ENTER to begin entering the number of cycle repeats for cycle 1. Use the right/left arrow keys to position the cursor. Use the up/down arrow keys to enter the correct number value.

**NP: 001 CYCLE#:1
CYCLE REPEATS 020**

- After entering the cycle repeats, move the cursor to the rightmost number and press ENTER to advance to the first step temperature and step time screen.

**NP:001 C: 1 CR: 020 S:1
◆ EID 000.0 °C 00m00s**

C = cycle
CR = cycle repeats
S = step
E = enter or edit
I = insert (used primarily under Edit menu)
D = delete (used primarily under Edit menu)

◆ The up/down arrow keys may be used to scroll between Steps 1-5 , and to move to the "PREVIOUS SCREEN" or "AUTO INC/DEC" screen before ENTER is pressed and the step temperature and time are entered. The AUTO increment/decrement feature is described in detail in Creating Auto Increment/Decrement Programs.

- Press ENTER to begin entering temperature and time values for step 1 in cycle 1. The cursor will move to the E (for enter or edit). Press ENTER again to move to the leftmost digit of the step temperature. Use the right arrow key to position the cursor and enter the desired temperature by using the up/down arrow keys. When finished specifying the temperature, move the cursor to the rightmost temperature position and press ENTER. The cursor will now flash on the step time entry portion of the screen. Use the arrow keys as described above to enter the desired step time. Use the right arrow key to move the cursor to the rightmost time position.

**NP:001 C: 1 CR: 20 S:1
◆ EID 094.0 °C 00m30s**

- Press ENTER to proceed to step 2 in cycle 1. Up to five steps can be created. Follow step 5 to specify temperatures and times for the desired number of steps. If all the required steps have been created, use the up arrow key to scroll past Step 5 (S:5) to the **AUTO INC/DEC** screen.

**NP:001 C: 1 CR: 20 S:2
◆ EID 000.0 °C 00m00s**

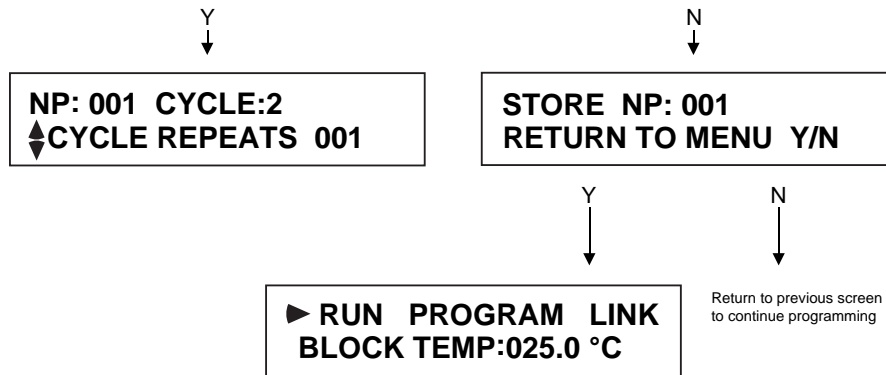


**NP:001
AUTO INC/DEC Y/N**

- Most standard thermal cycling protocols do not require changes to the set step temperature and step time over the iterations of a cycle. To bypass the Auto increment/decrement feature press ENTER, and use the right arrow key to choose **N**. Press ENTER to move to the **NEXT CYCLE** screen. For programs that require an incremental increase or decrease in the specified step temperatures or times, choose **Y** and go to Creating Auto Increment/Decrement Programs. The following screen will appear if **N** was chosen on the **AUTO INC/DEC** screen.

NP:001
NEXT CYCLE Y/N

- Use the right arrow key to choose **Y** if another cycle is desired or **N** if the programming is complete.



- Repeat instructions 1–8 until all the cycles and steps have been specified.

NOTE: When the **CYCLE REPEATS** screen appears after cycle 1 has been created, up/down arrows appear on the display screen, as shown under the **Y** choice in instruction 8. These arrows allow the user to scroll between cycles, and the “**ADD CYCLE**”, “**DELETE CYCLE**” and “**INSERT CYCLE**” screens. The add, delete, and insert options are fully explained in Section 3.3, Editing Existing Programs. To enter a cycle repeats value, press ENTER, then use the arrow keys as described in step 3.

Creating Auto Increment/Decrement Programs

For applications that require incremental increase or decrease in step temperature or step time over the iterations of a cycle, use the Auto Increment/Decrement feature. This feature can automatically increase or decrease step temperature to a trend of 0.5 °C per cycle repeat. It can automatically increase or decrease step times down to a trend of 1 second per cycle.

For example, to lower the temperature for Step 1 of Cycle 1 to gradually decrease from 94 °C to 84 °C over the 20 repeats of cycle 1, the auto inc/dec software would calculate as follows:

$$\text{Temperature trend} = (\text{Last temperature} - \text{Start temperature}) / (\# \text{ cycle repeats} - 1).$$

In the above example, the temperature trend calculation would be

$$(84 \text{ °C} - 94 \text{ °C}) / 19 = -0.5 \text{ °C/cycle. (the software rounds the number to the nearest 0.5 °C)}$$

To create an Auto increment/decrement program, follow these instructions.

1. Program all the steps in a cycle. Use the up/down arrow keys to scroll past Step 5 (S:5) to the **AUTO INC/DEC** screen. (See Creating Standard Programs to program the cycles and steps.)

NP: 001
▲AUTO INC/DEC Y/N

2. Press ENTER to enable the screen, and then ENTER again to accept the default Y choice.

NP: 001 AUTO INC/DEC
▲STEP# 1

3. Use the up/down arrow keys to choose the first (or only) step that requires the gradual change in temperature or time. Press ENTER.

NP: 001 C:1 CR:020 S:1
LAST 094.0 °C 00m30s

NOTE: The values shown on the display screen are those already specified as the start temperature and time for that particular step.

4. Use right/left arrow keys to position the cursor over the temperature display and select the desired LAST temperature by using the up/down arrow keys. Use the right arrow key to move the cursor to the rightmost position of the temperature display, and press ENTER. If desired, specify a last time by using the arrow keys as previously described, and press ENTER. If incremental change is required for only temperature or time, leave the value of the other step feature (time or temperature) unchanged by using the arrow keys to position the cursor to the rightmost position and pressing ENTER.

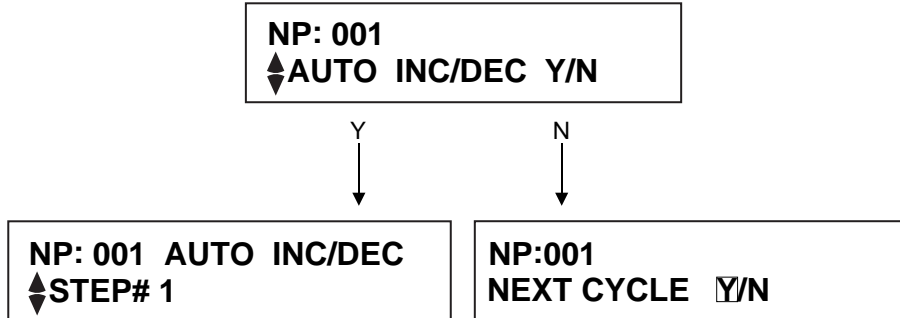
NP: 001 C:1 CR:020 S:1
LAST 084.0 °C 00m30s

ENTER ↓

NP: 001 C:1 CR:020 S:1
AUTO INC/DEC Y/N

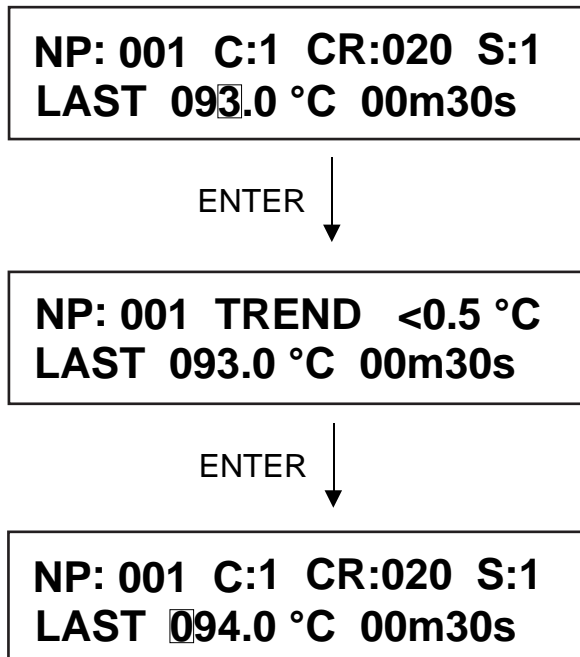
NOTE: a + will appear on any subsequent display of the step temperature and time screen for steps that have been modified to perform an automatic increment or decrement on temperature or time.

5. If the Auto inc/dec feature is required for additional steps in a cycle, use the arrow key to choose **Y** and press ENTER. Repeat instructions 3–4 to choose the step number and to specify the last temperature or time. If the Auto inc/dec feature is not required for other steps, use the arrow keys to choose **N** and press ENTER.



NOTE: If the LAST temperature or time specified at the auto inc/dec step results in a trend error (that is an increase or decrease in less than 0.5 °C per cycle, or less than 1 second per cycle), an error screen will appear prompting the user to correct the value causing the error. If only one cycle repeat is specified, an error screen will prompt the user to exit the AUTO INC/DEC program and return to the **CYCLE REPEATS** screen. These screen displays are illustrated in the examples below.

Example 1



In this example, the user specified a “LAST” temperature one degree less than the start temperature of 94 °C. Since 20 cycle repeats were defined, this caused a temperature decrease trend of less than the minimum 0.5 °C per cycle. The trend error screen appeared, and the user was returned to the previous screen, with the original start temperature displayed, and the cursor flashing on the temperature. A new last temperature should be entered.

Example 2

**NP: 001 C:1 CR:020 S:1
LAST 094.0 °C 00m31s**

ENTER ↓

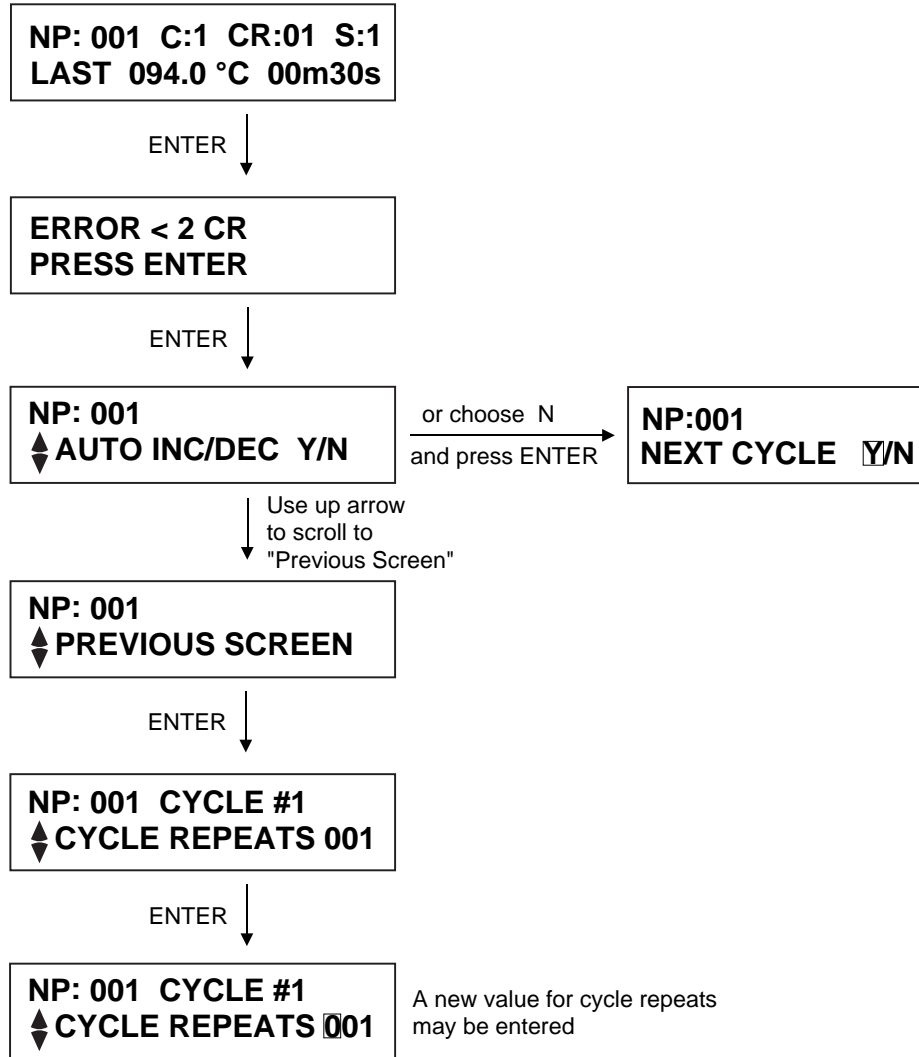
**NP: 001 TREND < 1 sec
LAST 094.0 °C 00m31s**

ENTER ↓

**NP: 001 C:1 CR:020 S:1
LAST 094.0 °C 00m30s**

In this example, the user specified a "LAST" time one second longer than the start time of 30 seconds. Since 20 cycle repeats were defined, this caused a cycle time increase trend of less than the minimum second per cycle. The trend error screen appeared, and the user was returned to the previous screen, with the original start time displayed, and the cursor flashing on the time. A new last time should be entered.

Example 3

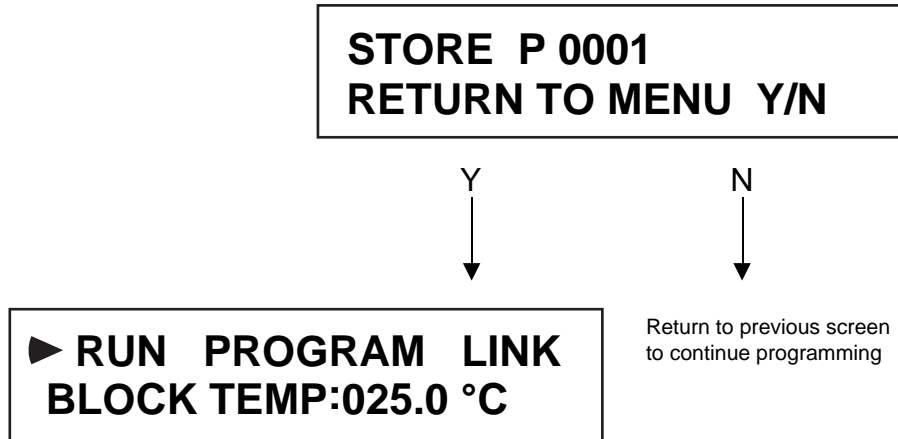


In this case, the user tried to create an AUTO INC/DEC step when only one cycle repeat was specified. The error screen indicating less than one CR (cycle repeat) appeared. After ENTER is pressed, the up arrow key may be used to scroll to the PREVIOUS SCREEN display. Pressing ENTER here will allow the user to return to the CYCLE REPEATS screen and increase the # of cycle repeats. Alternatively, the user can choose N at the AUTO INC/DEC screen and proceed to a new cycle, or scroll back to the previous cycle.

Using the MENU Key for Quick Exits

At any time after at least one step in one cycle has been defined, a program may be stored as follows:

1. If the Auto increment /decrement program is not required, press MENU after the last step of the last cycle has been programmed. It is not necessary to scroll past Step 5 (S:5). Choosing **Y** at the “**RETURN TO MENU**” screen prompt will store the program and return to the main menu.



2. If the Auto increment/decrement program is required, press MENU after the final Auto inc/dec entries are made. The same screen displays illustrated in the above instruction will appear.

Creating Linked Programs

The LINK program feature allows the user to join two or more programs for automatic sequential runs. The link feature is particularly useful when complex programs consisting of more than five cycles per program are required. In addition, it may be used to link programs that are occasionally used in combination, for example:

Program 008

cycle 1: Step 1: 80 °C 10m 00s

Program 001

cycle 1: Step 1: 94 °C 4m 00s

Step 2: 60 °C 4m 00s

cycle 2: Step 1: 91 °C 0m 30s

Step 2: 60 °C 4m 00s repeat cycle 2, 25 times

Up to 50 Link programs may be created. Each Link program may contain up to 10 Standard or Auto Inc/Dec programs. To create linked programs, follow the instructions listed below.

1. Use the right arrow key to choose **LINK** from the main menu and press ENTER. The next screen offers these options: **NEW**, **EDIT**, and **DEL**. Press ENTER to choose the default option, **NEW**.

**RUN PROGRAM ► LINK
BLOCK TEMP:025.0 °C**

ENTER ↓

**LINK
► NEW EDIT DEL**

New = new linked program
Edit = edit existing program
Del = delete existing program

ENTER ↓

**NEW LINK
◆ 001 NOT STORED**

2. The **NEW LINK** screen displays a program number and information on its storage status. If a link program has already been created using the link program number currently on the screen, it will be followed on the display by “**STORED**”. Use the up/down arrow keys to find a program number that is available (a program number followed by “**NOT STORED**”). The right/left arrow keys may be used to advance or go back 10 programs at a time. When an available program number is located, press ENTER.

NOTE: Stored programs may be written over by pressing ENTER and then pressing Y at the “**OVERWRITE P 001 ?**” prompt.

**NEW LINK:001 [P1-5]
► 000 000 000 000 000**

[P1-5] refers to the first of two link program screens with 5 possible program number entries per screen. [P6-10] refers to the second LINK screen.

3. Press ENTER and use the right arrow key to position the cursor and the up/down arrow keys to enter the number for the first program to be linked. Press ENTER twice and use the arrow keys to position the cursor and to enter the number for the second program to be linked. Repeat this step until all the programs to be linked are entered.

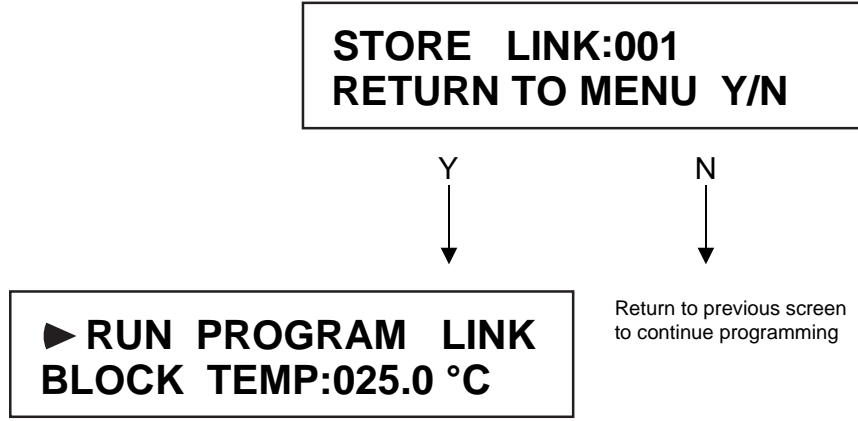
**NEW LINK:001 [P1-5]
010 002 008 035 010**

**NEW LINK:001 [P6-10]
040 009 028 035 ► 000**

NOTE: Linked programs are run sequentially in the order (from left to right) in which they are entered. If a program slot is left blank, e.g. 001 015 **000** 085 001, the Gene Cycler thermal cycler will run the programs sequentially from left to right, ignoring the blank slot.

In the this example, the Gene Cyclers thermal cycler would run programs 1, 15, 85, and 1 in sequence.

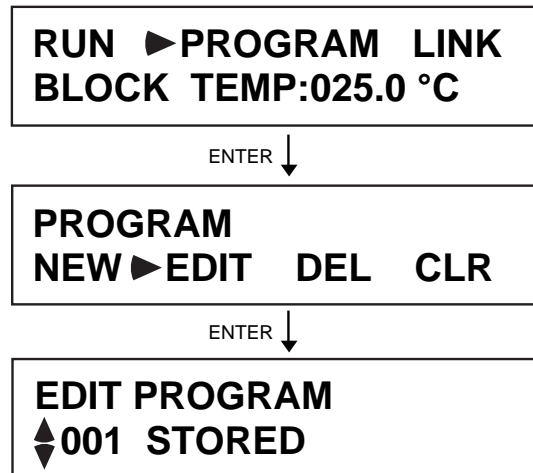
4. To exit and store the Link program, press MENU, then choose Y and press ENTER.



3.2 Reviewing Existing Programs

Existing programs may be reviewed without making any changes. This section describes how to do this. If program changes are desired, follow the instructions in Section 3.3, Editing Existing Programs.

1. Use the right arrow key to choose PROGRAM from the main menu and press ENTER. Next, use the right arrow key to choose EDIT and press ENTER.



2. Use the up/down arrow keys to scroll to the desired stored program number. The right/left arrow keys may be used to advance or go back 10 programs at a time. The display screen will show "NOT STORED" beside program numbers that have no stored programs. Attempts to edit programs that are "NOT STORED" is not permitted. When the program to be reviewed is displayed, press ENTER.

3. Reviewing pre-existing Cycles and Steps

To review a particular cycle (or steps within a cycle), use the up/down arrow keys to scroll to the desired cycle number. To view the steps comprising a particular cycle, press ENTER at that cycle. Use the right arrow key to position the cursor to the rightmost position and press ENTER. The up/down arrow keys may be used to scroll through individual steps for review. If changes are desired, follow the instructions in Section 3.3 for editing existing programs.

EP: 001 CYCLE#1
◆ **CYCLE REPEATS 020**

ENTER ↓

EP: 001 C:1 CR:020 S:1
◆ **EID 094.0 °C 00m30s**

C = cycle
CR = cycle repeats
S = step
E = edit
I = insert
D = delete

▲ up/down arrow keys may be used to scroll between Steps 1-5 before ENTER is pressed.

4. To return to the main menu after reviewing the program, press MENU after the last step of the last cycle has been programmed. It is not necessary to scroll past Step 5 (S:5). Choosing Y at the "RETURN TO MENU" screen prompt will store the program and return to the main menu.

STORE LINK:001
RETURN TO MENU Y/N

Y
↓

N
↓

▶ **RUN PROGRAM LINK**
BLOCK TEMP:025.0 °C

Return to previous screen
to continue programming

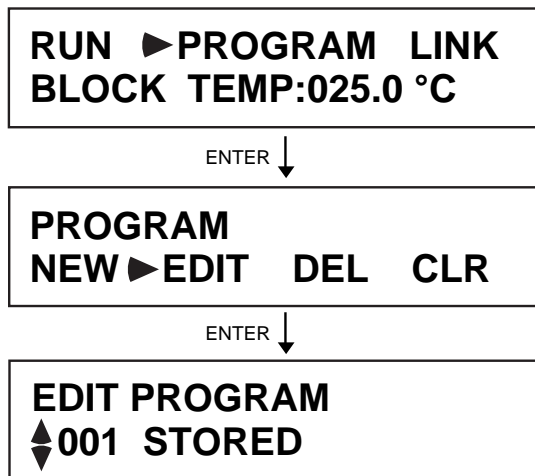
3.3 Editing Existing Programs

Existing programs may be modified under the Edit menus. All user-defined parameters can be changed. See Section 3.3, Editing Auto Increment/Decrement Programs for special considerations necessary when editing an Auto increment/decrement program.

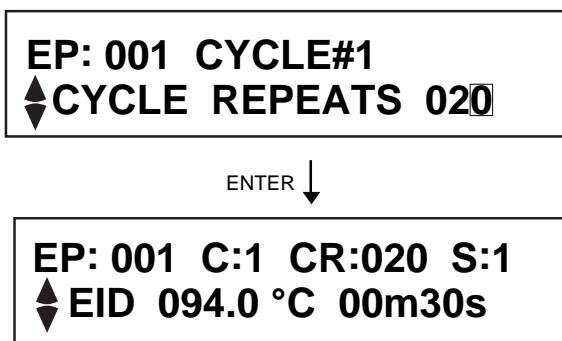
Editing Standard Gene Cyclers Programs

To edit an existing standard program, follow the instructions listed below. Instructions 1 and 2 guide you to the **CYCLE REPEATS** screen for the desired program. This is the starting point from which all edits can be made. Instructions 3a–3e describe how to make editing changes to an existing cycle, or to steps within that cycle. Instructions 4a–4c describe how to add or insert new cycles, or delete existing cycles.

1. Use the right arrow key to choose **PROGRAM** from the main menu and press ENTER. Next, use the right arrow key to choose **EDIT** and press ENTER.



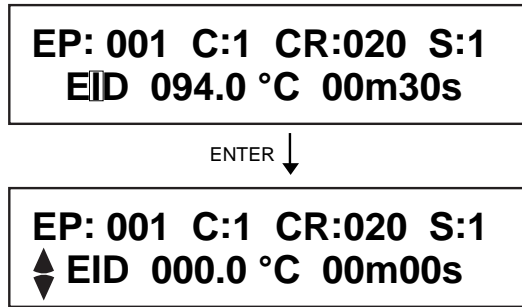
2. Use the up/down arrow keys to scroll to the desired program number. The right/left arrow keys may be used to advance or go back 10 programs at a time. The display screen will show “**NOT STORED**” beside program numbers that have no stored programs. When the program to be edited is displayed, press ENTER.
3. Editing pre-existing cycles and steps
 - a. To edit a particular cycle (or steps within a cycle), use the up/down arrow keys to scroll to the desired cycle number. Press ENTER to edit the number of cycle repeats. Use the right arrow key to position the cursor and the up/down arrow keys to enter the correct number value. If no change in the number of cycle repeats is required, use the right arrow key to position the cursor over the rightmost number and press ENTER.



C = cycle
 CR = cycle repeats
 S = step
 E = edit
 I = insert
 D = delete

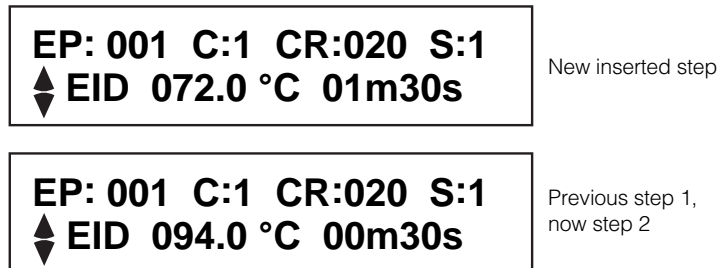
- ▲ up/down arrow keys may be used to scroll between Steps 1-5 before ENTER is pressed.
- b. To edit step temperatures or step times, use the up/down arrow keys to scroll to the step number requiring the change and press ENTER. Follow instructions 4–9 in Section 3.1 (Creating Standard Programs) to make desired changes.
- c. To insert a step into a cycle, follow instructions 1–3a above. Use the up/down arrow key to choose the desired step number and press ENTER. Use the right arrow key to position the cursor over the **I** on the display screen and press ENTER.

NOTE: The step that was on screen when the **I** command was given will follow the inserted step.

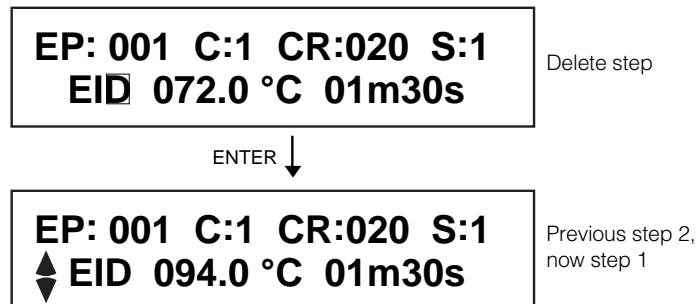


- d. Press ENTER and the cursor will flash over the **E** (for edit). Press ENTER again and use the arrow keys to position the cursor and enter a value for the new step temperature. Move the cursor to the rightmost temperature position and press ENTER. Use the arrow keys as described above to position the cursor and to specify the new step time and press ENTER. MENU may be pressed to store changes and return to the main menu. To continue editing, the up/down arrow keys may be used to scroll to other steps or return to the **CYCLE REPEATS** screen (by pressing ENTER at the **PREVIOUS SCREEN** prompt). The screen displays below illustrate the inserted step (now **S:1**), followed by the step on screen when the **I** command was given (now **S:2**).

NOTE: The **I** (insert) function is disabled until step temperature and time are entered.



- e. To delete a cycle step, follow instructions 1–3a above. Use the up/down arrow keys to choose the desired step number and press ENTER. Use the right arrow key to position the cursor over the **D** on the display screen and press ENTER. The deleted step will be replaced by the cycle step that followed it (i.e., if **S:1** is deleted, **S:2** will become **S:1**). MENU may be pressed to store changes and return to the main menu. To continue editing, the up/down arrow keys may be used to scroll to other steps or return to the **CYCLE REPEATS** screen (by pressing ENTER at the **PREVIOUS SCREEN** prompt).



4. Deleting, Inserting, and Adding Cycles

- a. To DELETE an existing cycle, follow instructions 1 and 2 in this section to get to the **CYCLE REPEATS** screen for the desired program. Use the up arrow key to scroll to the **DELETE CYCLE** screen. Press ENTER. The cursor will flash on the cycle # value, and the left arrow **UNDO** command will appear on screen.

EP: 001
◆ DELETE CYCLE #1

ENTER ↓

EP: 001 ◀ UNDO
◆ DELETE CYCLE #1

- b. Use the up/down arrow key to scroll to the desired cycle # and press ENTER. The cycle will be deleted. If the left arrow key is pressed instead of ENTER, the cursor will stop flashing over the DELETE CYCLE # value, and the up/down arrow keys may be used for scrolling between cycles, or the add, insert or delete cycles options.
- c. To INSERT a cycle, follow instructions 1 and 2 in this section to get to the **CYCLE REPEATS** screen for the desired program. Use the up arrow key to scroll to the **INSERT CYCLE** screen. Press ENTER. The cursor will flash on the cycle # value, and the left arrow **UNDO** command will appear on screen.

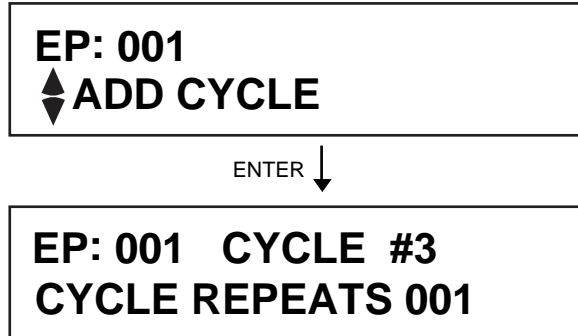
EP: 001
◆ INSERT CYCLE #1

ENTER ↓

EP: 001 ◀ UNDO
◆ INSERT CYCLE #1

- d. Use the up/down arrow key to scroll to the desired cycle # and press ENTER. A new cycle will be inserted before the cycle number on screen when ENTER was pressed. If the left arrow key is pressed instead of ENTER, the cursor will stop flashing over the INSERT CYCLE # value, and the up/down arrow keys may be used for scroll between cycles, or the add, insert or delete cycles options.

- e. To add a cycle, follow instructions 1 and 2 in this section to get to the **CYCLE REPEATS** screen for the desired program. Use the up arrow key to scroll to the **ADD CYCLE** screen. Press ENTER. The new cycle will follow the existing cycles.

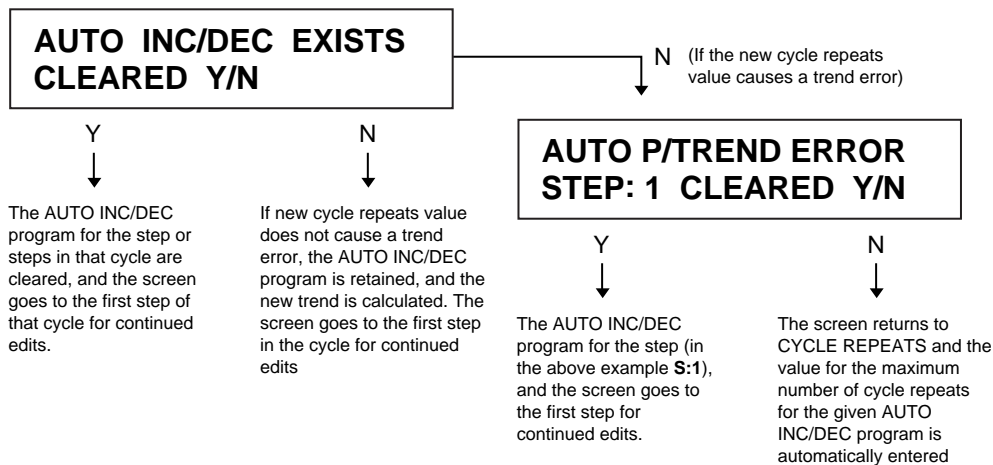


Editing Auto Increment/Decrement Programs

When editing Auto inc/dec programs, some special considerations should be made. Changing the number of cycle repeats or the starting temperature or starting time, *i.e.* the values set for the first iteration of the cycle repeats, will change the trend for incremental increase or decrease in cycle temperature and/or time. (see Section 3.1, Creating Standard Programs, for “trend” definition). The Gene Cyclers thermal cyclers will automatically calculate the new trend. If an error arises, such as only one cycle repeat is specified, or the trend is outside of the limits, an error message will be given. Editing Auto inc/dec programs is done exactly as described in 3.2, Reviewing Existing Programs, instructions 1–4. The special screens that appear when editing Auto inc/dec programs are illustrated below.

NOTE: When editing AUTO INC/DEC programs, it is best to clear the Auto inc/dec program at the “**AUTO INC/DEC EXISTS, CLEARED Y/N**” screen prompt, and enter new parameters after cycle and step edits are made.

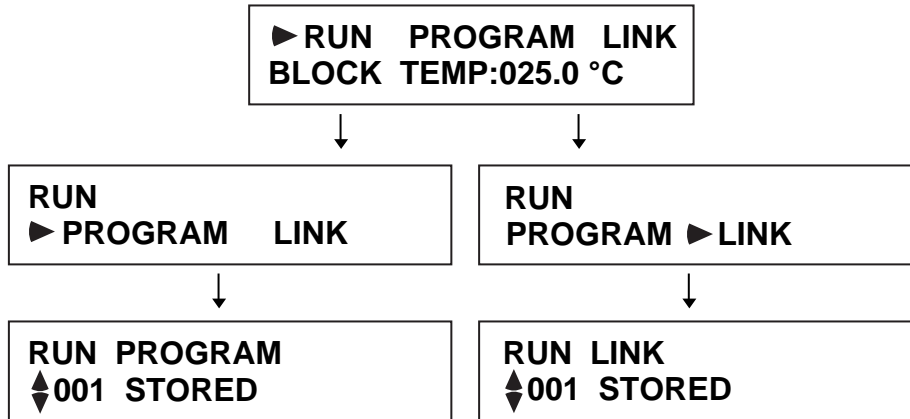
If the number of cycle repeats is changed for a cycle that has an Auto inc/dec step, the following screens appear:



3.4 Running Gene Cyclers Programs

To run Gene Cycler programs, place 0.2 ml thin-walled tubes (Bio-Rad catalog number 223-9473) containing samples into the sample block. Close the Gene Cycler lid and follow the steps below.

1. The main menu options are : **RUN**, **PROGRAM**, and **LINK**. Press ENTER to choose the default option, **RUN**. Next use the right arrow key to choose either **PROGRAM** or **LINK** and press ENTER. Choose **PROGRAM** to run stored standard or Auto inc/dec programs. Choose **LINK** to run a series of linked programs stored as a Link program.



2. Use the up/down arrow keys to scroll to the desired stored program and press ENTER. The right/left arrow keys can be used to advance or go back 10 program numbers at a time.



- Use the up/down arrow keys to specify the sample volume and press ENTER. The thermocycling program begins immediately. Use the up/down arrow keys to view the **RUN** screens illustrated below:

Run Screen #1

This screen displays information on the program and cycle status

```
RUN L/P /001 C:1
▲TC:0001 CR:001/020
```

L/P = Link/Program, the number to the left of the “/” refers to the Link program number, if any, the number to the right of the “/” refers to the standard program number.

C = cycle number

TC = the total number of cycles completed thus far in the program

CR = cycle repeats, in this example, cycle repeat #1 of 20 is running

The around RUN is shown to indicate that RUN is flashing on the display screen

Run Screen #2

This screen displays information about the current and set temperature, and the elapsed and set time.

```
RUN 000.0 °C/000.0 °C
▲00m00s/00m00s
```

The current temperature, and the time elapsed in the step appear to the left of the “/”. The set temperature and set time appear to the right of the “/”.

Run Screen #3

This screen displays information about the steps completed and the specified sample volume.

```
RUN L/P /001
▲S:1/3 SAMPLE V:050
```

S = step, in this example, step 1 of 3 is running

- The Gene Cycler thermal cycler automatically cools the sample block to ambient room temperature when the program is complete.
- PAUSE may be pressed at any time during the thermocycling program run. The program will pause until PAUSE is pressed again, at which time the program resumes. If PAUSE is pressed while the sample block is approaching a set temperature, the Gene Cycler program will continue until the set temperature is reached, and then pause.
- STOP may be pressed at any time during a program. The program will immediately stop, and the block will cool to room temperature.

Section 4 Specifications

4.1 Unit Specifications

Footprint	27 cm x 19 cm x 16.5 cm (L x W x H)
Weight	5 kg
Sample capacity	24
Sample size	0.2 ml micro test tubes (standard or thin wall)
Storage temperature	-20 to 50 °C
Storage humidity	10–95%
Operating temperature	15–30 °C
Operating humidity	20–80%
Display	2 line x 20 character back-lit LCD
Keyboard	8 key

4.2 Operational Specifications

Method of heating	Electrical resistance (resistors)
Method of cooling	Air cooled (fan)
Overall temperature range	Room temperature to 100 °C
Temperature control range	0.5 °C increments between 37–100 °C
Temperature accuracy	± 1.25 °C between 37–97 °C
Temperature over/under shoot	± 1.25 °C between 37–97 °C
Cooling rate (aluminum block)	0.8 °C/second between 50–97 °C
Heating rate (aluminum block)	1.5 °C/second between 40–97 °C
Block and tube cover temperature	105 °C (constant temperature)

4.3 Electrical Specifications

Line voltage	90–132 V; 50/60 Hz; maximum 7 amp 180–260 V; 50/60 Hz; maximum 3.5 amp Two fixed ordering configurations (100/120 and 200/240 V)
Maximum power consumption	550 watts

4.4 Software Specifications

Number of programs	100 (consisting of cycles and steps within the cycles)
Number of cycles/program	5 (<i>i.e.</i> , 5 different types of cycles/program)
Number of steps/cycle	5 (<i>i.e.</i> , 5 different temperatures/cycle)
Number of repeated cycles	300 (can repeat a cycle 300 times)
Number of link programs (LP)	50
Number of programs linked per LP	10
Temperature input range	37–97 °C at 0.5 °C increments
Maximum time input range	99 minutes, 59 seconds
Sample volume input range	10–150 µl
Program features	New/Edit/Insert/Delete Programs Pause/Stop/Clear Program or Run Capability
Temperature ramping	Automatic increment/decrement temperature ramping capabilities

Section 5 Troubleshooting

5.1 Troubleshooting Guide

Problem	Possible Cause	Solution
Power switch is on, but no characters are shown on the LCD display.	Power cord is not correctly plugged in (inlet or outlet)	Plug in the power cord into the GeneCycler thermal cycler and the power outlet.
	Power failure	After power returns restart your program
	Fuse is blown	Replace fuse (see Replacing a Fuse at the end of this section)
The cooling of the samples is too slow	Air vent(s) blocked or closed	Remove obstruction from air vent(s)
Machine turns off during a programmed run	Power failure	After power returns restart your program
	Fuse is blown	Replace fuse (see Replacing a Fuse at the end of this section)
	Power cord is unplugged	Plug in the power cord into the Gene Cycler thermal cycler and the power outlet
<p>NOTE: All programs are conserved in the memory in the event of a power failure. However, if a program is running during a power failure, when the power returns the program will not automatically continue. All thermal cycling run information is lost. You must restart the program when power has returned.</p>		
SRAM error SRAM contents are not correct	Battery failure with uncleared RAM	Turn off the Gene Cycler thermal cycler and restart the instrument

If problems arise that are not described in the Troubleshooting Section, please contact your local Bio-Rad Technical Services Department.

Section 6

Gene Cyclor Thermal Cyclor Care And Maintenance

6.1 General

The Gene Cyclor thermal cyclor should be cleaned monthly or as needed. To clean the outer casing, always unplug the unit. Use a damp cloth soaked in water to wipe down the outer case. Use **only** water to clean the outside surfaces of the Gene Cyclor apparatus.

To clean the inside (sample thermal block), always unplug the instrument and allow the thermal block to return to room temperature before attempting to clean. Use only water to clean the inside surfaces of the Gene Cyclor. Dampen a cloth to clean the sample block. A damp cotton swab can be used to clean the inside of the sample wells.

If the outer casing, sample block, or heated sample cover of the Gene Cyclor thermal cyclor become contaminated, use three different treatments of isopropanol, and water with a cloth or cotton swab to remove the contamination.

Avoid spilling any liquids onto the apparatus. **Important:** If any liquids should drip or run down through the stainless steel wire mesh and into the apparatus, wait for the liquid to evaporate and dry before operating the Gene Cyclor thermal cyclor.

Keep the instrument from direct sunlight and free from extreme humidity (> 80% relative humidity) during instrument use.

6.2 Replacing a Fuse

1. Disconnect the power cord
2. Remove the fuse holder by inserting a flat head screwdriver or similar tool and turn the fuse holder counterclockwise until the fuse holder pops out or is loose enough to be removed.
3. Pull out the fuse from its fuse holder. Replace with the appropriate fuse:
100/120 V units: 5 A/250 V/5 mm x 15 mm/AR Fast Blo
200/240 V units: 3.15 A/250 V/5 mm x 15 mm/AR Fast Blo
4. Re-insert the fuse holder and turn the fuse holder clockwise until it is secure. The unit is ready for use.

6.3 Instrument Service

There are no user serviceable parts for this instrument. Call your local Bio-Rad technical service department if your Gene Cyclor thermal cyclor needs repair.

Section 7 Product Information

7.1 Gene Cyclor Products

Catalog

Number	Product Description
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Gene Cyclor Thermal Cyclor

170-6700	Gene Cyclor Thermal Cyclor, 100/120 V
170-6701	Gene Cyclor Thermal Cyclor, 220/240 V

Gene Cyclor Accessories

223-9473	Thin Wall Micro Test Tubes, 200 µl polypropylene, natural, 1,000/box
2112001	Xcluda Aerosol Barrier Pipet Tips, Style A, 96/rack, 960/box
2112006	Xcluda Aerosol Barrier Pipet Tips, Style B, 96/rack, 960/box
2112011	Xcluda Aerosol Barrier Pipet Tips, Style C, 96/rack, 960/box
2112016	Xcluda Aerosol Barrier Pipet Tips, Style D, 96/rack, 960/box
2112021	Xcluda Aerosol Barrier Pipet Tips, Style E, 96/rack, 960/box
2112026	Xcluda Aerosol Barrier Pipet Tips, Style F, 100/rack, 1,000/box
2112031	Xcluda Aerosol Barrier Pipet Tips, Style G, 200/rack, 1,000/box
2112036	Xcluda Aerosol Barrier Pipet Tips, Style H, 100/rack, 1,000/box
2112041	Xcluda Aerosol Barrier Pipet Tips, Style J, 96/rack, 960/box

7.2 Xcluda Tip Selection Guide

Select Xcluda Style (A-J) based on pipet and µl range:

Pipet Type	Range (µl)	Recommended Xcluda Style
Benchmate	10–50	J
	40–200	C/D/G
	200–1,000	E
Eppendorf	0.5–10	F
	2–20	B
	10–100	C/G
	100–1,000	H
Finnpipette	5–40	B/C/G
	40–200	D/G
	200–1,000	E
Oxford	0.5–10	A/F
Pipetman:	P-2/P-10	A
	P-20	B
	P-100	C/G
	P-200	D
	P-1000	E
Titertek	5–50	J
	50–300	D

Xcluda tips also fit pipets and volumes not listed above. Contact your local Bio-Rad representative for more information.

BIO-RAD**Bio-Rad
Laboratories****Life Science
Group**

2000 Alfred Nobel Drive
Hercules, California 94547
Telephone (510) 741-1000
Fax: (510) 741-5800
www.bio-rad.com

Australia, Bio-Rad Laboratories Pty. Ltd., Block Y, Unit 1, Regents Park Industrial Estate, 391 Park Road, Regents Park, NSW 2143
Phone 02 9914 2800 • Fax 02 9914 2889

Austria, Bio-Rad Laboratories Ges.m.b.H., Auhofstraße 78D, A-1130 Wien • Phone (01)-877 89 01 • Fax (01)-876 56 29

Belgium, Bio-Rad Laboratories S.A.-N.V., Begoniastraat 5, B-9810 Nazareth • Phone 09-385 55 11 • Free Phone 0800/97032 • Fax 09-385 65 54

Brazil, Bio-Rad Laboratories (Brazil), Rua dos Invalidos 212 - 5 andar, Lapa - Rio de Janeiro - RJ, CEP 20331-020 • Phone 55 21 507 6191

Canada, Bio-Rad Laboratories (Canada) Ltd., 5671 McAdam Road, Mississauga, Ontario L4Z 1N9 • Phone (905) 712-2771 • Fax (905) 712-2990

China, Bio-Rad China (Beijing), Rm 615, Shang Fang Plaza, No. 27, North Third Round Center Road, West District, Beijing 100029
Phone 86-10-8201-1366/68 • Fax 86-10-8201-1367

Denmark, Bio-Rad Laboratories, Generatorvej 8 C, 2730 Herlev • Phone 45 44 52-1000 • Fax 45 44 52-1001

Finland, Bio-Rad Laboratories, Pihatörmä 1A, FIN-02240 Espoo • Phone 358 (0)9 804 2200 • Fax 358 (0)9 804 1110

France, Bio-Rad Laboratories, 3, Boulevard Raymond Poincaré, 92430 Marnes-la-Coquette • Phone 01 47 95 69 65 • Fax 01 47 41 9133

Germany, Bio-Rad Laboratories GmbH, Heidemannstraße 164, D-80939 München, Postfach 45 01 33, D-80901 München
Phone 089 318 84-177 • Fax 089 318 84-123

Hong Kong, Bio-Rad Pacific Ltd., Unit 1111, 11/F, New Kowloon Plaza, 38 Tai Kok Tsui Road, Tai Kok Tsui, Kowloon
Phone 852-2789-3300 • Fax 852-2789-1257

India, Bio-Rad Laboratories (India) Pvt. Ltd., B&B1, Enkay Towers Vanijyanikunj, Udhog Vihar Phase V, Gurgaon, Haryana 122016
Phone (91-124)-6398112/113/114 • Fax (91-124)-6398115

Israel, Bio-Rad Laboratories, Ltd., 14 Horna Street, P.O. Box 5044, Rishon Le Zion 75150 • Phone 03 951 4124 • Fax 03 951 4129

Italy, Bio-Rad Laboratories S.r.l., Via M. Peroglio 23, 00144 Rome • Phone 34 91 590 5200 • Fax 34 91 590 5211

Japan, Nippon Bio-Rad Laboratories KK, 7-18 Higashi-Nippori 5-chome, Arakawa-ku Tokyo 116-0014 • Phone 03-5811-6270 • Fax 03-5811-6272

Korea, Bio-Rad Korea Ltd., Cambridge Building, 1461-15 Seocho-Dong Seocho-Ku, Seoul 137-070 • Phone 82-2-3473-4460 • Fax 82-2-3472-7003

Latin America, Bio-Rad Latin America, 14100 Palmetto Frontage Road, Suite 101, Miami Lakes, Florida USA 33016 • Phone 305-894-5950 • Fax 305-894-5960

Mexico, Bio-Rad Laboratorios Mexico, Adolfo Prieto No. 1653, Col. De Valle, CP. 03100, Mexico D.F. • Phone 52 5 534 2552 to 54 • Fax 52 5 524 5971

The Netherlands, Bio-Rad Laboratories B.V., Fokkerstraat 10, 3905 KV Veenendaal • Phone 0318-540666 • Fax 0318-542216

New Zealand, Bio-Rad Laboratories Pty Ltd., PO Box 300-571, Albany, Auckland • Phone 64-9-4152280 • Fax 64-9-443 3097

Norway, Bio-Rad Laboratories, Johan Scharffenbergs vei 91, N-0694 Oslo • Phone 47-23-38-41-30 • Fax 47-23-38-41-39

Russia, Bio-Rad Laboratorii, ul. Butirskaya 79 "B", office 156 RF-125015 Moscow • Phone 7 095 979 98 00 • Fax 7 095 979 98 56

Singapore, Bio-Rad Laboratories, Singapore, 211 Henderson Rd. #03-02, Henderson Industrial Park, 159552 • Phone 65-2729877 • Fax 65-2734835

Spain, Bio-Rad Laboratories, S.A., Lopez de Hoyos, 245-247, 28043 Madrid • Phone 34-91-590-5200 • Fax 34-91-590-5211

Sweden, Bio-Rad Laboratories AB, Vintergatan 1, Box 1097, S-172 22 Sundbyberg • Phone 46 (0)8-55 51 27 00 • Fax 46 (0)8-55 51 27 80

Switzerland, Bio-Rad Laboratories AG, Nenzlingerweg 2, CH-4153 Reinach • Phone 061-717-9555 • Fax 061-717-9550

United Kingdom, Bio-Rad Laboratories Ltd., Bio-Rad House, Maylands Avenue, Hemel Hempstead, Hertfordshire HP2 7TD
Phone 0181 328 2000 • Free Phone 0800-181134 • Fax 01442-259118