



## **Real-time DNA Analyzer**

Operator's Manual

Version 1.1

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**Research Use Only**

This instrument is for research use only and is not intended for clinical or diagnostic applications.

**Disclaimer**

PCR and real-time PCR processes are covered by patents issued and applicable in certain countries. Spartan does not encourage or support the unauthorized or unlicensed use of PCR or real-time PCR processes. Use of this instrument is recommended for persons that either have licenses to perform PCR and real-time PCR or are not required to obtain licenses.

**Patents Pending**

The Spartan DX™ is protected by patents pending in multiple geographic areas.

**Trademarks**

Spartan DX™ is a registered trademark of Spartan Bioscience Inc. All other trademarks are the sole property of their respective owners.

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## Table of Contents

<b>Table of Contents</b> .....	<b>iii</b>
<b>General Information</b> .....	<b>1</b>
Intended Use.....	1
Contact Information.....	1
Warranty .....	1
<b>Safety and Standards Compliance</b> .....	<b>2</b>
General Instrument Safety.....	2
Symbols.....	2
<b>Electrical Safety</b> .....	<b>3</b>
<b>Chemical Safety</b> .....	<b>4</b>
Chemical Waste Hazard .....	4
Waste Disposal .....	4
<b>Biological Hazard Safety</b> .....	<b>4</b>
<b>Standards Compliance</b> .....	<b>5</b>
<b>Instrument Installation</b> .....	<b>6</b>
Unpacking .....	6
Instrument Contents .....	6
Operating Requirements .....	6
Installation .....	6
Decommissioning .....	7
<b>Operating Instructions</b> .....	<b>8</b>
Reaction Set-up .....	8
<b>Run Program</b> .....	<b>9</b>
<b>Troubleshooting</b> .....	<b>11</b>
Self Tests.....	11
<b>Cleaning and Maintenance</b> .....	<b>11</b>
Exterior.....	11
Heater Blocks .....	11
<b>Shipping</b> .....	<b>11</b>
<b>Appendix A: Program Selection Chart</b> .....	<b>12</b>
<b>Appendix B: Technical Specifications</b> .....	<b>13</b>



## General Information

### Intended Use

The Spartan DX™ is designed to analyze purified nucleic acids using nucleic acid amplification techniques such as real-time Polymerase Chain Reaction (PCR).

The Spartan DX™ is for research use only and is not intended for clinical or diagnostic applications.

### Contact Information

The Spartan DX™ was developed and is manufactured by:

Spartan Bioscience Inc.  
203-15 Grenfell Crescent  
Ottawa, ON K2G 0G3  
www.spartanbio.com

For more information: [info@spartanbio.com](mailto:info@spartanbio.com)  
For technical support: [support@spartanbio.com](mailto:support@spartanbio.com)

### Warranty

The Spartan DX™ is warranted to meet or exceed the stated specifications. Spartan's sole obligation and the customer's sole remedy is limited to replacement of instruments free of charge in the event the instrument fails to perform as warranted. Spartan makes no other warranty of any kind whatsoever, and SPECIFICALLY DISCLAIMS AND EXCLUDES ALL OTHER WARRANTIES OF ANY KIND OR NATURE WHATSOEVER, DIRECTLY OR INDIRECTLY, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, AS TO THE SUITABILITY, PRODUCTIVITY, DURABILITY, FITNESS FOR A PARTICULAR PURPOSE OR USE, MERCHANTABILITY, CONDITION, OR ANY OTHER MATTER WITH RESPECT TO SPARTAN PRODUCTS. In no event shall Spartan be liable for claims for any other damages, whether direct, incidental, foreseeable, consequential, or special (including but not limited to loss of use, revenue or profit), whether based upon warranty, contract, tort (including negligence) or strict liability arising in connection with the sale or the failure of Spartan instruments to perform in accordance with the stated specifications.

Visit [www.spartanbio.com/warranty\\_service.asp](http://www.spartanbio.com/warranty_service.asp) for complete Warranty details and Extended Warranty information.

## Safety and Standards Compliance

### General Instrument Safety



Before operating the instrument, it is important to read this Operator's Manual thoroughly and completely. Non-observance of the operating instructions and warnings contained in this manual may entail safety hazards.

The Spartan DX™ must only be used by personnel trained and skillful in nucleic acid practices.



Ensure that anyone who operates the instrument has:

- Received instructions in general laboratory safety practices and specific safety practices for the instrument.
- Read and understood all applicable Material Safety Data Sheets (MSDSs).

### Symbols

In this Operator's Manual, symbols are used as a visual signal to point out important information.



Important Note – This symbol is used to bring the user's attention to an important annotation.



Warning, Risk of Danger – This symbol is used to indicate that non-compliance with the instructions or procedures may lead to physical injury, or even death, or could cause damage to the instrument.



Biohazard - This symbol is used to indicate that certain precautions must be taken when working with potentially infectious material.



CSA International Mark with adjacent indicators 'C' and 'US'



CE Mark (European Union)



Manufacturer



DC (direct current)

## Electrical Safety

The Spartan DX™ is an electromechanical instrument. There is a potential danger to the user of an electrical shock or physical injury if the instrument is not used according to the instructions given in this manual. Observe all general safety precautions which apply to electrical instruments.

- The power supply cord must be inserted into a power outlet with a protective earth contact (ground).
- Unplug this unit from the power outlet before cleaning.
- Do not use this instrument near water.
- This instrument should be operated only from the type of power source indicated on the marking label of the power supply.
- This instrument should be used only with the supplied power supply. If the power supply becomes inoperable, please contact Spartan Bioscience for a replacement.
- Always plug the power supply into the instrument, and then plug the power supply into the power outlet.
- Do not allow anything to rest on the power cord. Do not install this instrument where the cord may be walked upon.
- To reduce the risk of electrical shock, do not disassemble this instrument. Refer servicing to Spartan Bioscience authorized service personnel.
- Do not overload power outlets as this can result in risks of fire or electrical shock.
- Unplug this power supply and refer to Spartan Bioscience authorized service personnel if one or more of the following conditions exist:
  - The power supply cord or plug is damaged or frayed.
  - If liquid has been spilled onto the instrument.
  - If the instrument has been exposed to water.
  - If the instrument does not operate normally by following the operating instructions.
- Slots in the front and back of the instrument are provided for ventilation. To protect the unit from overheating, these openings must not be blocked. Keep an unobstructed space of at least 30 cm (1 foot) in front and behind the instrument.

## Chemical Safety



Before handling any chemicals, refer to the MSDS provided by the manufacturer, and observe all relevant precautions.

### Chemical Waste Hazard



Wastes created during use of the instrument are potentially hazardous and can cause injury, illness, or death. Refer to MSDS and local regulations for handling, storage, and disposal of waste.

### Waste Disposal



Wear appropriate eyewear, clothing, and gloves when handling reagent and waste containers. Store, transport, and dispose of waste according to all local, state/provincial, and/or national regulations.

## Biological Hazard Safety




Although the Spartan DX™ works with purified nucleic acids, be aware for your own safety that all biological samples such as tissues, body fluids, and blood of humans and other animals have the potential to transmit infectious diseases. Follow all applicable local, state/provincial, and/or national regulations. Wear appropriate protective eyewear, clothing, and gloves.

Read and follow the guidelines in these publications:

- U.S. Department of Health and Human Services guidelines published in Biosafety in Microbiological and Biomedical Laboratories (Stock No. 017-040-00547-4; <http://bmbi.od.nih.gov>)
- Occupational Safety and Health Standards, Bloodborne Pathogens (29 CFR 1910.1030; [www.osha.gov](http://www.osha.gov))
- Additional information about biohazard guidelines is available at: [www.cdc.gov](http://www.cdc.gov)

If you suspect the instrument may have been exposed to any hazardous material, the instrument must be decontaminated. If you are unsure about the decontamination or cleaning agent specified in your Laboratory Decontamination Procedure, please contact Spartan by email at [support@spartanbio.com](mailto:support@spartanbio.com) or by phone from 9am-5pm EST at +1 [877] 228-7756.

## Standards Compliance

	<p>This instrument has been tested to and complies with:</p> <ul style="list-style-type: none"><li>• IEC 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 1: General Requirements.</li><li>• IEC 61010-2-010, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 2-010: Particular Requirements for Laboratory Equipment for the Heating of Materials.</li><li>• IEC 61010-2-081, Safety requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 2-081: Particular Requirements for Automatic and Semi-automatic Laboratory Equipment for Analysis and Other Purposes.</li><li>• IEC 61010-2-101, Safety requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 2-101: Particular Requirements for In Vitro Diagnostic (IVD) Medical Equipment.</li><li>• IECEE CB Scheme, including deviations from all participating countries.</li><li>• IEC 60825-1, Safety of Laser Products</li></ul>
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## Instrument Installation

### Unpacking

The Spartan DX™ is shipped in a cardboard container with molded inserts. The container should be carefully inspected for damage. Report any damage to your authorized Spartan Dealer before accepting the unit.

The instrument measures 17cm (W) x 36cm (L) x 12cm (H) and weighs 4.2 kg. It is easily handled by one person.

### Instrument Contents

Spartan DX™ Real-Time DNA Analyzer

15V Power Supply and Power Cord

Flash Memory Card

USB 2.0 cable (for software upgrades)



The Spartan DX™ should be used only with manufacturer-supplied accessories.

### Operating Requirements

This instrument is designed for indoor use only.

Operate in ambient temperature between 15 and 25°C (59 and 77°F).

Do not operate in a Cold Room or a refrigerated area.

Operate in ambient relative humidity of 20 to 80%.

These specifications have been calculated for altitudes between 0 and 2,000 meters.

Ensure adequate front and rear ventilation.

### Installation

1. Unpack and position the instrument on the workbench in the upright position. Allow 30 cm space in front and behind the instrument to ensure sufficient cooling of the electronic components.



Failure to provide ventilation space may impact the instrument's ability to maintain proper operating temperatures. This could negatively impact your reaction results and cause the instrument to overheat.

2. Select a site for the instrument where:
  - Ambient temperature is maintained at 15 to 25 °C. Avoid exposure to air conditioning, heating vents, and direct sunlight.
  - Relative humidity is 20 to 80%, non-condensing.
  - Exposure to dust and drafts is minimal.
  - There is minimal vibration to the instrument while analyzing samples.
  - An electrical outlet is available. The power supply automatically accommodates incoming voltages between 100-240 V AC and 50-60 HZ. Use of an un-interruptible power supply (UPS) is recommended.
3. Plug the power supply into the instrument and connect the power supply to power source.
4. The instrument is now operational.

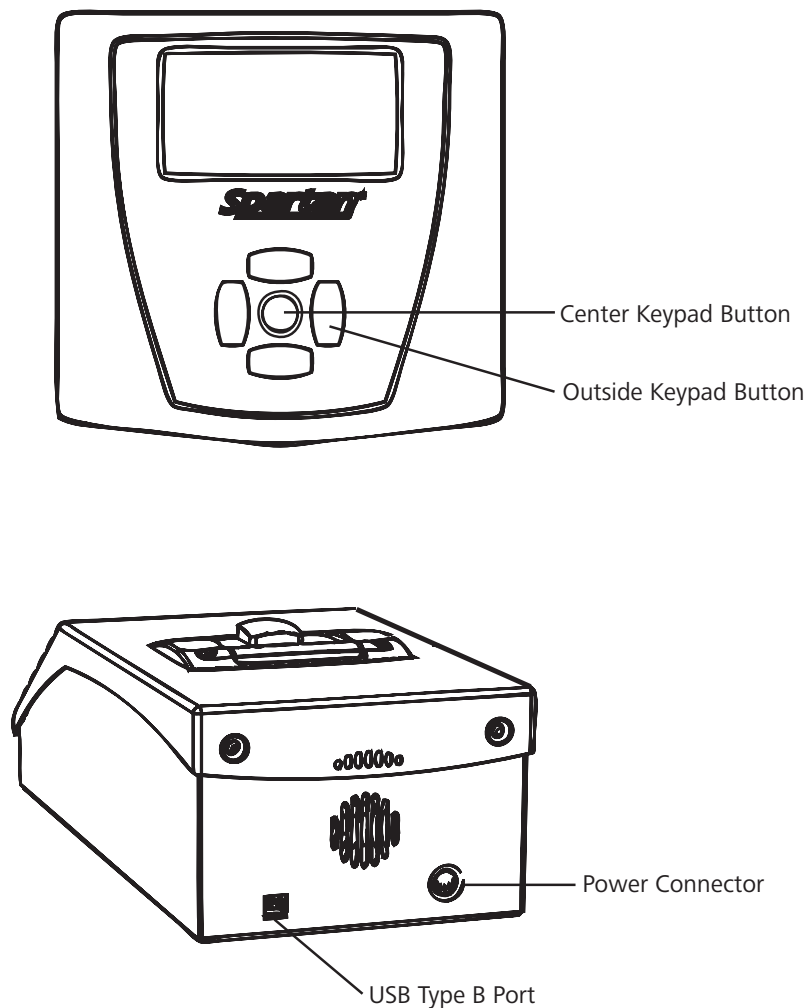
## Instrument Installation (continued)

To set time:

1. Press center button to get to the main menu.
2. Use outside keypad buttons to move to "OPTIONS" menu. Select by pressing the center keypad button.
3. Move to appropriate date field using outside buttons and select using center button.
4. Modify field using outside buttons and unselect by pressing center button.
5. Select "SAVE" to save your new time setting.

### Decommissioning

The Spartan DX™ does not require any special action to remove it from use. However, as with any electronic equipment, please follow all applicable local, state/provincial, and/or national regulations for disposal.



## Operating Instructions

### Reaction Set-up

#### A. Two-temperature thermal cycling

The Spartan DX™ contains two fixed-temperature heat blocks and is designed to run two-temperature PCR programs. A conventional three-temperature PCR protocol has three steps: denaturation, annealing, and extension. A two-temperature protocol combines the annealing and extension steps into a single step.

Each gene target is unique and may require optimization of the cycling program. To determine the appropriate two-temperature program for your application, follow these steps:

1. Design primers with matching melting temperatures ( $T_m$ ) of 60-68°C, and amplicon size of < 300 base pairs (bp). For fastest cycling speeds, the primers should have  $T_m$ 's of 65-68°C, and amplicon size < 150 bp. If primers and amplicons do not meet these criteria, then amplification may be unsuccessful.
2. Set the annealing/extension temperature at the calculated  $T_m$ .
3. Set the annealing/extension time to 45 seconds.
4. Start with the following denaturation temperatures and times:

DNA Source	Denaturation Temp	Initial Time	Cycling Time
Human/Mammalian	95°C	2.5 min	30 s
Bacterial/Viral	95°C	1 min	30 s

5. To optimize the speed of your reaction, consult the "Program Selection Chart" in Appendix A to determine the fastest dwell times to achieve different combinations of denaturation and annealing/extension temperatures.

#### B. Detection chemistries

1. For SYBR Green I (Invitrogen, Cat. No. S7563), we recommend a final concentration of 0.2-0.7X. The optimal concentration is 0.4X. For further details, see Application Note 009 ([www.spartanbio.com/application\\_notes.asp](http://www.spartanbio.com/application_notes.asp)).
2. TaqMan® probes are compatible with the Spartan DX™. We recommend using probes with BHQ-1 (Black Hole Quencher®) non-fluorescent quenchers. For further details, see Application Notes 005 and 012.

#### C. Reaction tubes

The Spartan DX™ is designed to work with standard 0.2 ml thin-wall flat cap PCR tubes. PCR tubes with thinner side walls have faster heating and cooling kinetics. We recommend thin-wall tubes from Fisher Scientific (Cat. No. 08-408-214). For further details, see Application Note 017.

**NOTE: Only use black or blue Sharpie® markers to label PCR tubes. Do not use red or green ink.**

#### D. Reaction volumes

Reaction volumes of 10-50 µl may be used. For best results, we recommend a reaction volume of 20 µl. For further details, see Application Note 008.

#### E. Reaction setup

1. Prepare real-time PCR mixture.
2. Aliquot mixture into thin-wall flat cap PCR tubes.
3. Overlay reaction mixture with mineral oil (e.g. Biotools, Cat. No. 20.032).



For faster cycling speeds, we recommend 20 µl reaction volumes with a 15 µl overlay of mineral oil.

## Run Program

### A. Warm up

1. Turn the instrument on by pressing center button on the keypad.
2. Press center button again and select "RUN/EDIT" to start the unit heating to default temperature.
3. It will take 10 minutes to warm up and equilibrate to the default block temperatures of 95°C and 37°C from room temperature.
4. Once a program is selected, the instrument will heat to the selected program's block temperatures.

### B. Program selection

1. Use outside keypad buttons to move between program numbers. Press center keypad button to select a program.

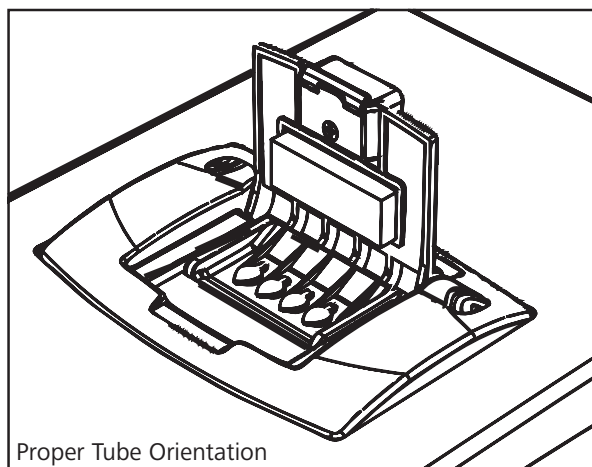
### C. Program settings

The Spartan DX™ is set up to run an initial denaturation step followed by a 2-temperature thermal cycling program. Default denaturation temperature is 95.5°C. Annealing and extension steps are combined together and performed at a default temperature of 55.5°C.

1. To modify a setting, use outside keypad buttons to move between temperatures, dwell times, and cycle number.
2. Press center keypad button to select the setting to be modified.
3. Use outside buttons to increase or decrease the setting values.
4. Press center button again to save the modified setting.
5. Save a modified program by selecting "SAVE" using center button.

### D. Run program

1. Insert reaction tubes into the device so that the tube hinge points to the rear of the instrument. Close the instrument lid.
2. Run the program by selecting "START".
3. You may select "PAUSE" or "STOP" at any time during the run. **NOTE: You may need to redo the reaction if you pause or stop for more than 5 seconds.**
4. When run is finished, select "YES" to save results to the device's Flash Card.
5. Results are saved in standard ".csv" format with a date-and-time stamp. To update the date and time, select "OPTIONS" and adjust the date and time values.
6. After 30 min of inactivity, the display screen will turn off. After 4.5 hours of inactivity, the instrument will turn off. Note that unsaved data will remain in memory until specifically canceled by the user.



## Run Program (continued)

### E. Reverse Transcription

For RNA analysis, the instrument is capable of performing an initial reverse transcription (RT) step, followed by a thermal cycling program. To set up an RT program, follow these steps:

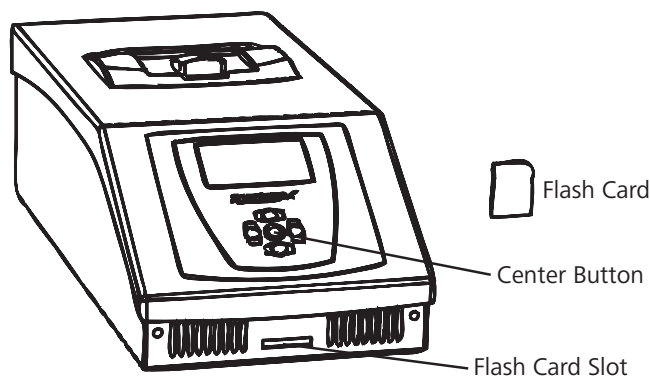
1. From the main menu, select "RUN/EDIT".
2. Select the "RT" program from the program menu.
3. In the "RT" program, set the temperature and dwell times for reverse transcription and heat inactivation of the RT enzyme.
4. Select "START" to accept the RT program. This will select the RT program, and send you back to the program menu.
5. In the program menu, the "RT\*" symbol indicates that the RT program has been selected.
6. Select the thermal cycling program to be performed after the RT program. You may select from Programs #1-8.
7. In the thermal cycling program, select "START" to begin the run. The RT program will be performed first, followed by the thermal cycling program.

### F. Data Analysis

The fluorescence intensity of each well is measured after every cycle and displayed on the screen. If you only desire fluorescence measurements for the first and last cycles (end-point detection), then select the "OPTIONS" menu and toggle the "REAL-TIME" setting to "OFF".

To plot a graph of fluorescence intensity versus cycle number:

1. At the end of the run, select "YES" when asked to "SAVE RESULTS?" to save data onto the Flash Card.
2. Eject Flash Card from front of device.
3. Insert Flash Card into appropriate slot in your computer.
4. Data is stored as a ".csv" file on the Flash Card. This data may be graphed using a Microsoft Excel® macro program which is provided with the Spartan DX™. This software is downloadable from <http://www.spartanbio.com/support.asp>.
5. In Excel®, set your macro security settings to "Medium" by going to the "Tools" menu, selecting "Macro", and then selecting "Security". Set the "Security Level" to "Medium" and click "OK".
6. Double click on the Spartan GraphApp macro software. This will launch Excel® and prompt you to "Enable Macros" to run the macro.
7. In the Spartan GraphApp software, select "Load Flash Card Data" to browse to the .csv file containing your data. The software will automatically load your data and graph your results.
8. To edit the sample names, select the "Summary" tab (Sample 1 = Well 1, numbered from left to right).
9. Save your graphed results using the "Save" or "Save As" commands in the "File" menu. Note that saving the file will not alter the Spartan GraphApp program.



## Troubleshooting

If you experience problems using the Spartan DX™ please visit the Spartan Support page (<http://www.spartanbio.com/support.asp>), or contact Spartan by email at [support@spartanbio.com](mailto:support@spartanbio.com), or by phone from 9am-5pm EST at +1 [877] 228-7756.

### Self Tests

On an ongoing basis, the Spartan DX™ performs a series of self tests. If a problem with the instrument is detected, one of the following error codes will be displayed. Should this happen, please unplug the instrument and contact Spartan by email at [support@spartanbio.com](mailto:support@spartanbio.com), or by phone from 9am-5pm EST at +1 [877] 228-7756.

Error Number	Error Description
01	Over-temperature on heater block A
02	Over-temperature on heater block B
04	Over-temperature on system
08	Motor control failure
10	System optics failure
20	System over-current
40	Heater A failure
80	Heater B failure



No user-serviceable parts are inside. Do not remove covers that require tool access.

## Cleaning and Maintenance



Never clean the instrument without disconnecting the power cord.



To prevent dust and debris from falling into the machine, keep the lid closed at all times.

### Exterior

Clean outside surfaces as necessary with 70-100% ethanol or dilute bleach solutions (up to 10%).

### Heater Blocks

It is recommended that the instrument's temperature blocks be cleaned once every 6 months. To do this, set both block temperatures at 40°C, allow 10 minutes for the blocks to reach the selected temperatures, and then pause the instrument on the hot block and unplug the instrument. Then use cotton swabs moistened with 70% ethanol to individually clean out each of the four wells. Once cleaned, dry the wells with a cotton swab.



No user-serviceable parts are inside. Do not remove covers that require tool access.



Refer servicing to Spartan Bioscience authorized service personnel.

## Shipping

For transportation or relocation of the Spartan DX™, use only the original packaging.

## Appendix A: Program Selection Chart

### Instructions

1. Calculate the melting temperature ( $T_m$ ) of your PCR primers using online software from IDT (<http://www.idtdna.com/analyzer/Applications/OligoAnalyzer/>).
2. If you know the melting curve profile of your PCR product, then choose a target denaturation temperature that is to the right side of this curve. This temperature is usually lower than 92°C. If you do not know the melting curve profile, then use 92°C as the target value for your desired denaturation temperature.
3. Use the "Program Selection Chart" below to determine the optimal temperature settings and dwell times for the Spartan DX™ based on your calculated  $T_m$  and desired target denaturation temperature.
4. For the initial denaturation temperature and dwell time, a setting of 95°C for 2.5 min is usually sufficient for human or mammalian genomic DNA. For bacterial or viral DNA, a setting of 95°C for 1 min is usually sufficient. Note that hot-start enzymes may require a longer initial denaturation time.

### Example

- If your calculated primer  $T_m$  is 61°C, then use 61°C as your desired annealing/extension liquid temperature.
- If your desired denaturation liquid temperature is 92°C, then the chart below recommends that you set the Hot Block at **95°C** with a dwell time of **30 s** and the Cold Block at **53°C** with a dwell time of **26 s**.
- These settings will result in the liquid temperature cycling between 92°C and 61°C.

		Hot Block setting of 95°C <sup>1</sup>			
Cold Block setting <sup>1</sup>	Liquid Temp <sup>2</sup>	86-87°C	88-89°C	90-91°C	92-93°C
50°C	53-54°C	20/38 s	23/29 s	27/40 s	34/42 s
	55-56°C	19/36 s	22/37 s	26/38 s	33/40 s
	57-58°C	18/20 s	21/29 s	25/31 s	31/32 s
53°C	59-60°C	17/27 s	20/28 s	24/30 s	30/31 s
	61-62°C	18/22 s	21/23 s	25/25 s	30/26 s
57°C	63-64°C	16/23 s	19/24 s	23/26 s	29/27 s
	65-66°C	15/19 s	18/20 s	22/22 s	28/23 s
	67-68°C	13/15 s	16/16 s	20/18 s	26/19 s

<sup>1</sup>Times are shown as: Dwell time on Hot Block / Dwell time on Cold Block.

<sup>2</sup>Liquid temperatures assume a reaction volume of 20 µl, a mineral oil overlay of 20 µl, and the use of thin-wall 0.2 ml flat-cap PCR tubes (Fisher Scientific, Cat. No. 08-408-214).

## Appendix B: Technical Specifications

<b>Complete system</b>	
Dimensions	17(W) x 36(L) x 12(H) cm
Total weight	4.2 kg
Voltage requirements	100-240 V, 50-60 Hz
Power consumption	15VDC, 4.3A, 65W. DIN-5 connector (female)
Accessories included	Flash Memory Card, USB cable, 15V Power Supply & Power Cord
Warranty	1-Year Standard Warranty

<b>Optical module</b>	
Excitation source	4 LEDs, 400-550 nm
Emission filter	Detects 500-560 nm
Detector	CCD camera
Fluorescence acquisition modes	Real-time (every cycle) and end-point (first and last cycle)

<b>Thermal module</b>	
Sample capacity	4 x 0.2 ml PCR tubes
Temperature control range	Block 1 : 40-110°C, Block 2 : 40-80°C
Control accuracy	±0.2°C
Warm-up time from ambient start	10 minutes

<b>Data output</b>	
LCD display	6.5(W) x 3.4(L) cm
Flash memory drive	Stores data in .csv format for easy graphing

<b>Environment</b>	
Operating temperature	15-25°C
Relative Humidity	20-80% non condensing
Operating Altitude	0-2,000 meters
Operating Environment	Indoor use only
Installation Category	II
Pollution Degree	2
Noise level	40 db