

December 2014

# artus<sup>®</sup> EBV RG PCR Kit Handbook



24 (catalog no. 4501263)



96 (catalog no. 4501265)

Version 1

**IVD**

Quantitative in vitro diagnostics

For use with Rotor-Gene<sup>®</sup> Q Instruments



**REF**

4501263, 4501265



1046897EN



QIAGEN GmbH, QIAGEN Strasse 1, 40724 Hilden, GERMANY

**R5**

**MAT**

1046897EN



Sample & Assay Technologies

## **QIAGEN Sample and Assay Technologies**

QIAGEN is the leading provider of innovative sample and assay technologies, enabling the isolation and detection of contents of any biological sample. Our advanced, high-quality products and services ensure success from sample to result.

### **QIAGEN sets standards in:**

- Purification of DNA, RNA, and proteins
- Nucleic acid and protein assays
- microRNA research and RNAi
- Automation of sample and assay technologies

Our mission is to enable you to achieve outstanding success and breakthroughs. For more information, visit [www.qiagen.com](http://www.qiagen.com).

# Contents

|  |           |
|--|-----------|
| <b>Intended Use</b>                        | <b>4</b>  |
| <b>Summary and Explanation</b>             | <b>4</b>  |
| Pathogen information                       | 4         |
| Principle of the Procedure                 | 4         |
| <b>Materials Provided</b>                  | <b>5</b>  |
| Kit contents                               | 5         |
| <b>Materials Required but Not Provided</b> | <b>5</b>  |
| <b>Warnings and Precautions</b>            | <b>6</b>  |
| General precautions                        | 6         |
| <b>Reagent Storage and Handling</b>        | <b>7</b>  |
| <b>Procedure</b>                           | <b>8</b>  |
| DNA isolation                              | 8         |
| Internal control                           | 11        |
| Protocol: PCR and data analysis            | 12        |
| <b>Interpretation of Results</b>           | <b>18</b> |
| Quantitation                               | 18        |
| Results                                    | 19        |
| Troubleshooting guide                      | 21        |
| <b>Quality Control</b>                     | <b>23</b> |
| <b>Limitations</b>                         | <b>23</b> |
| <b>Performance Characteristics</b>         | <b>23</b> |
| Analytical sensitivity                     | 23        |
| Specificity                                | 24        |
| Reproducibility                            | 25        |
| <b>References</b>                          | <b>25</b> |
| <b>Symbols</b>                             | <b>26</b> |
| <b>Contact Information</b>                 | <b>26</b> |
| <b>Ordering Information</b>                | <b>27</b> |

## Intended Use

The *artus* EBV RG PCR Kit is an in vitro nucleic acid amplification test for the quantitation of Epstein-Barr virus (EBV) DNA in human plasma, serum, CSF, or blood cells. This diagnostic test kit utilizes the polymerase chain reaction (PCR) and is configured for use with Rotor-Gene Q Instruments.

## Summary and Explanation

The *artus* EBV RG PCR Kit constitutes a ready-to-use system for the detection of EBV DNA using polymerase chain reaction (PCR) on Rotor-Gene Q Instruments. The EBV RG Master contains reagents and enzymes for the specific amplification of a 97 bp region of the EBV genome, and for the direct detection of the specific amplicon in fluorescence channel Cycling Green of the Rotor-Gene Q MDx, Rotor-Gene Q, or Rotor-Gene 6000, or Cycling A.FAM™ of the Rotor-Gene 3000.

In addition, the *artus* EBV RG PCR Kit contains a second heterologous amplification system to identify possible PCR inhibition. This is detected as an internal control (IC) in fluorescence channel Cycling Yellow of the Rotor-Gene Q MDx, Rotor-Gene Q, or Rotor-Gene 6000, or Cycling A.JOE™ of the Rotor-Gene 3000. The detection limit of the analytical EBV PCR (see “Analytical sensitivity”, page 23) is not reduced. External positive controls (EBV RG QS 1–4) are supplied, which allow determination of the amount of viral DNA. For further information, see “Quantitation”, page 18.

## Pathogen information

Transmission of the Epstein-Barr virus (EBV) occurs orally, mainly via contaminated saliva. In general, infection by EBV, especially if contracted in childhood, is asymptomatic. The clinical sign of an acute infection is infectious mononucleosis associated with fever, tiredness and angina, as well as inflammation of the lymph nodes and spleen. In some patients these symptoms reappear chronically. Severe forms of EBV infection can be seen in immunodeficient patients and people with T-cell defects.

## Principle of the Procedure

Pathogen detection by the polymerase chain reaction (PCR) is based on the amplification of specific regions of the pathogen genome. In real-time PCR the amplified product is detected via fluorescent dyes. These are usually linked to oligonucleotide probes that bind specifically to the amplified product. Monitoring the fluorescence intensities during the PCR run (i.e., in real-time) allows detection and quantitation of the accumulating product without having to re-open the reaction tubes after the PCR run.\*

\* Mackay, I.M. (2004) Real-time PCR in the microbiology laboratory. Clin. Microbiol. Infect. **10**, 190.

# Materials Provided

## Kit contents

| <b>artus EBV RG PCR Kit</b> |  |   | <b>(24)</b>      | <b>(96)</b>      |
|-----------------------------|--|---|------------------|------------------|
| <b>Catalog no.</b>          |  |   | <b>4501263</b>   | <b>4501265</b>   |
| <b>Number of reactions</b>  |  |   | <b>24</b>        | <b>96</b>        |
| Blue                        | EBV RG Master                                |   | 2 x 12 reactions | 8 x 12 reactions |
| Red                         | EBV RG QS 1* (5 x 10 <sup>4</sup> copies/μl) | <b>QS</b>   | 200 μl           | 200 μl           |
| Red                         | EBV RG QS 2* (5 x 10 <sup>3</sup> copies/μl) | <b>QS</b>   | 200 μl           | 200 μl           |
| Red                         | EBV RG QS 3* (5 x 10 <sup>2</sup> copies/μl) | <b>QS</b>   | 200 μl           | 200 μl           |
| Red                         | EBV RG QS 4* (5 x 10 <sup>1</sup> copies/μl) | <b>QS</b>   | 200 μl           | 200 μl           |
| Green                       | EBV RG IC <sup>†</sup>                       | <b>IC</b>   | 1000 μl          | 2 x 1000 μl      |
| White                       | Water (PCR grade)                            |   | 1000 μl          | 1000 μl          |
|                             | Handbook                                     |  | 1                | 1                |

\* Quantitation standard.

† Internal control.

## Materials Required but Not Provided

When working with chemicals, always wear a suitable lab coat, disposable gloves, and protective goggles. For more information, consult the appropriate safety data sheets (SDSs), available from the product supplier.

### Reagents

- DNA isolation kit (see “DNA isolation”, page 8)

### Consumables

- Sterile pipet tips with filters
- Strip Tubes and Caps, 0.1 ml, for use with 72-well rotor (cat. no. 981103 or 981106)
- Alternatively: PCR Tubes, 0.2 ml, for use with 36-well rotor (cat. no. 981005 or 981008)

## Equipment

- Pipets (adjustable)\*
- Vortex mixer\*
- Benchtop centrifuge\* with rotor for 2 ml reaction tubes
- Rotor-Gene Q MDx, Rotor-Gene Q, or Rotor-Gene Instrument\* with fluorescence channels for Cycling Green and Cycling Yellow or with fluorescence channels for Cycling A.FAM and Cycling A.JOE
- Rotor-Gene Q MDx/Rotor-Gene Q software version 1.7.94 or higher (Rotor-Gene 6000 software version 1.7.65, 1.7.87, 1.7.94; Rotor-Gene 3000 software version 6.0.23)
- Cooling block (Loading Block 72 x 0.1 ml Tubes, cat. no. 9018901, or Loading Block 96 x 0.2 ml Tubes, cat. no. 9018905)

## Warnings and Precautions

For in vitro diagnostic use

When working with chemicals, always wear a suitable lab coat, disposable gloves, and protective goggles. For more information, please consult the appropriate safety data sheets (SDSs). These are available online in convenient and compact PDF format at [www.qiagen.com/safety](http://www.qiagen.com/safety) where you can find, view, and print the SDS for each QIAGEN® kit and kit component.

Discard sample and assay waste according to your local safety regulations.

## General precautions

The user should always pay attention to the following:

- Use sterile pipet tips with filters.
- Store and extract positive materials (specimens, positive controls, and amplicons) separately from all other reagents, and add them to the reaction mix in a spatially separated facility.

\* Ensure that instruments have been checked and calibrated according to the manufacturer's recommendations.

- Thaw all components thoroughly at room temperature (15–25°C) before starting an assay.
- When thawed, mix the components (by pipetting repeatedly up and down or by pulse vortexing) and centrifuge briefly.
- Work quickly and keep components on ice or in the cooling block (72/96-well loading block).

## Reagent Storage and Handling

The components of the *artus* EBV RG PCR Kit should be stored at  $-15^{\circ}\text{C}$  to  $-30^{\circ}\text{C}$  and are stable until the expiration date stated on the label. Repeated thawing and freezing ( $>2$  x) should be avoided, as this may reduce assay sensitivity. If the reagents are to be used only intermittently, they should be frozen in aliquots. Storage at  $2-8^{\circ}\text{C}$  should not exceed a period of 5 hours.

## Procedure

### DNA isolation

The kits from QIAGEN shown in Table 1 are validated for viral DNA purification from the indicated human sample types for use with the *artus* EBV RG PCR Kit. Carry out the viral DNA purification according to the instructions in the kit handbooks.

**Table 1. Purification kits validated for use with the *artus* EBV RG PCR Kit**

| Sample material    | Sample size | Nucleic acid isolation kit                   | Catalog number (QIAGEN) | Carrier RNA  |
|--------------------|-------------|--|-------------------------|--------------|
| Serum, plasma, CSF | 200 $\mu$ l | QIAamp <sup>®</sup> DNA Mini Kit (50)        | 51304                   | Not included |
| Serum, plasma      | 1 ml        | QIAamp UltraSens <sup>®</sup> Virus Kit (50) | 53704                   | Included     |
| Blood cells        | 200 $\mu$ l | QIAamp DNA Blood Mini Kit (50)               | 51104                   | Not included |
| Plasma             | 400 $\mu$ l | EZ1 <sup>®</sup> DSP Virus Kit (48)*         | 62724                   | Included     |

\* The EZ1 DSP Virus Kit is also available as CE-IVD-marked EASYartus<sup>®</sup> EBV RG PCR Kits, combined with the *artus* EBV RG PCR Kit (see page 27 for ordering information).

**Note:** Blood collection tubes coated with anticoagulants may inhibit the PCR. However, these inhibitors will be eliminated by the use of the isolation kits listed above. We recommend to avoid the use of heparin blood.

**Note:** The *artus* EBV RG PCR Kit should not be used with phenol-based isolation methods.

### Using the QIAamp DNA Blood Mini Kit or QIAamp DNA Mini Kit

**Note:** The use of carrier RNA is critical for the extraction efficiency and, consequently, for DNA/RNA yield. Please note that the addition of carrier (RNA Homopolymer Poly[rA], not included in the QIAamp DNA Blood Mini Kit or the QIAamp DNA Mini Kit) is strongly recommended for the extraction of nucleic acids from cell-free body fluids and material with small amounts of DNA and RNA (e.g., CSF). In these cases, prepare carrier RNA as follows.

- Resuspend lyophilized carrier RNA (RNA Homopolymer Poly[rA], not included in the QIAamp DNA Blood Mini Kit or the QIAamp DNA Mini Kit) using the elution buffer (do not use lysis buffer) of the extraction kit (Buffer AE of the QIAamp DNA Mini Kit and QIAamp DNA Blood Mini Kit), and prepare a dilution with a concentration of 1  $\mu\text{g}/\mu\text{l}$ . Divide this carrier RNA solution into a number of aliquots sufficient for your needs, and store them at  $-15$  to  $-30^\circ\text{C}$ . Avoid repeated thawing ( $>2$  x) of a carrier RNA aliquot.
- Use 1  $\mu\text{g}$  carrier RNA per 100  $\mu\text{l}$  lysis buffer. For example, if the extraction protocol uses 200  $\mu\text{l}$  lysis buffer, add 2  $\mu\text{l}$  carrier RNA (1  $\mu\text{g}/\mu\text{l}$ ) directly into the lysis buffer (Buffer AL of the QIAamp DNA Mini Kit and QIAamp DNA Blood Mini Kit). Before the beginning of each extraction, a mixture of lysis buffer and carrier RNA (and internal control, where applicable, see “Internal control”, page 11) should be prepared freshly according to the pipetting scheme in Table 2.

**Table 2. Pipetting scheme for use with the QIAamp DNA Blood Mini Kit or the QIAamp DNA Mini Kit**

| <b>Number of samples</b>                   | <b>1</b>                            | <b>12</b>                                |
|--|-------------------------------------|--|
| Buffer AL (lysis buffer)*                  | e.g., 200 $\mu\text{l}$             | e.g., 2400 $\mu\text{l}$                 |
| Carrier RNA (1 $\mu\text{g}/\mu\text{l}$ ) | 2 $\mu\text{l}$                     | 24 $\mu\text{l}$                         |
| <b>Total volume</b>                        | <b>202 <math>\mu\text{l}</math></b> | <b>2424 <math>\mu\text{l}</math></b>     |
| <b>Volume per extraction</b>               | <b>200 <math>\mu\text{l}</math></b> | <b>200 <math>\mu\text{l}</math> each</b> |

\* Contains guanidine hydrochloride; see the kit handbook for safety information.

**Note:** Use the freshly prepared mixture of lysis buffer and carrier RNA immediately for extraction. Storage of the mixture is not possible.

**Note:** The internal control of the *artus* EBV RG PCR Kit can be used directly in the isolation procedure (see “Internal control”, page 11).

**Note:** We strongly recommend to perform the recommended centrifugation step 10 in the protocol (*QIAamp DNA Mini and Blood Mini Handbook*, Third Edition, April 2010, pages 29 and 32) to remove any residual ethanol. We recommend to increase the time of this centrifugation to 3 minutes.

We recommend to elute the DNA in 50  $\mu\text{l}$  elution buffer to get the highest sensitivity of the *artus* EBV RG PCR Kit.

## Using the QIAamp UltraSens Virus Kit

**Note:** The use of carrier RNA is critical for the extraction efficiency and, consequently, for DNA/RNA yield. To increase the stability of the carrier RNA provided with the QIAamp UltraSens Virus Kit, we recommend the following procedure, which differs from the instructions in the kit handbook.

- Before the first use of the kit, resuspend the lyophilized carrier RNA in 310  $\mu\text{l}$  of the elution buffer (Buffer AVE) provided with the kit (final concentration 1  $\mu\text{g}/\mu\text{l}$ , do not use lysis buffer). Divide this carrier RNA solution into a number of aliquots sufficient for your needs, and store them at  $-15$  to  $-30^{\circ}\text{C}$ . Avoid repeated thawing ( $>2$  x) of a carrier RNA aliquot.
- Before the beginning of each extraction, a mixture of lysis buffer and carrier RNA (and internal control, where applicable, see “Internal control”, page 11) should be prepared freshly according to the pipetting scheme in Table 3.

**Table 3. Pipetting scheme for use with the QIAamp UltraSens Virus Kit**

| Number of samples                          | 1                                     | 12                                       |
|--|---------------------------------------|--|
| Buffer AC (lysis buffer)*                  | 800 $\mu\text{l}$                     | 9600 $\mu\text{l}$                       |
| Carrier RNA (1 $\mu\text{g}/\mu\text{l}$ ) | 5.6 $\mu\text{l}$                     | 67.2 $\mu\text{l}$                       |
| <b>Total volume</b>                        | <b>805.6 <math>\mu\text{l}</math></b> | <b>9667.2 <math>\mu\text{l}</math></b>   |
| <b>Volume per extraction</b>               | <b>800 <math>\mu\text{l}</math></b>   | <b>800 <math>\mu\text{l}</math> each</b> |

\* Contains isopropanol; see the kit handbook for safety information.

**Note:** Use the freshly prepared mixture of lysis buffer and carrier RNA immediately for extraction. Storage of the mixture is not possible.

**Note:** The internal control of the *artus* EBV RG PCR Kit can be used directly in the isolation procedure (see “Internal control”, page 11).

**Note:** We strongly recommend to perform the additional centrifugation described in step 14 of the protocol (*QIAamp UltraSens Virus Handbook*, April 2010, page 17) to remove any residual ethanol. We recommend to increase the time of this centrifugation to 3 minutes.

We recommend to elute the DNA in 50  $\mu\text{l}$  elution buffer to get the highest sensitivity of the *artus* EBV RG PCR Kit.

The QIAamp UltraSens Virus Kit allows a sample concentration. If you use sample material other than serum or plasma, add at least 50 % (v/v) of negative human plasma to the sample.

## Using the EZ1 DSP Virus Kit

**Note:** The use of carrier RNA is critical for extraction efficiency and, consequently, for DNA/RNA yield. Add the appropriate amount of carrier RNA to each extraction following the instructions in the *EZ1 DSP Virus Kit Handbook*.

**Note:** The internal control of the *artus* EBV RG PCR Kit can be used directly in the isolation procedure (see “Internal control”, below).

**Note:** We strongly recommend using the purified viral nucleic acids for PCR immediately after extraction using the EZ1 DSP Virus Kit. Alternatively, eluates can be stored for up to 3 days at 4°C before PCR analysis.

## Internal control

An internal control (EBV RG IC) is supplied. This allows the user both to control the DNA isolation procedure and to check for possible PCR inhibition. Using the EZ1 DSP Virus Kit for extraction, the internal control has to be added following the instructions in the *EZ1 DSP Virus Kit Handbook*. Using the QIAamp UltraSens Virus Kit, the QIAamp DNA Blood Mini Kit, or the QIAamp DNA Mini Kit, add the internal control to the isolation at a ratio of 0.1 µl per 1 µl elution volume. For example, using the QIAamp UltraSens Virus Kit, the DNA is eluted in 50 µl Buffer AVE. Hence, 5 µl of the internal control should be added initially. The quantity of internal control used depends only on the elution volume.

**Note:** The internal control and carrier RNA (see “DNA isolation”, page 8) should be added only to the mixture of lysis buffer and sample material or directly to the lysis buffer.

The internal control must not be added to the sample material directly. If added to the lysis buffer please note that the mixture of internal control and lysis buffer–carrier RNA has to be prepared freshly and used immediately (storage of the mixture at room temperature or in the fridge for only a few hours may lead to internal control failure and a reduced extraction efficiency).

**Note:** Do not add the internal control and the carrier RNA to the sample material directly.

The internal control can optionally be used exclusively to check for possible PCR inhibition. For this application, add the internal control directly to the EBV RG Master, as described in step 2b of the protocol (page 13).

## Protocol: PCR and data analysis

### Important points before starting

- Take time to familiarize yourself with the Rotor-Gene Q Instrument before starting the protocol. See the instrument user manual.
- Make sure that at least one quantitation standard as well as one negative control (Water, PCR grade) are included per PCR run. To generate a standard curve, use all 4 quantitation standards supplied (EBV RG QS 1–4) for each PCR run.

### Things to do before starting

- Make sure that the cooling block (accessory of the Rotor-Gene Q Instrument) is precooled to 2–8°C.
- Before each use, all reagents need to be thawed completely, mixed (by repeated up and down pipetting or by quick vortexing), and centrifuged briefly.

### Procedure

1. Place the desired number of PCR tubes into the adapters of the cooling block.
  2. If you are using the internal control to monitor the DNA isolation procedure and to check for possible PCR inhibition, follow step 2a. If you are using the internal control exclusively to check for PCR inhibition, follow step 2b.
- 2a. The internal control has already been added to the isolation (see “Internal control”, page 11). In this case, prepare a master mix according to Table 4.

The reaction mix typically contains all of the components needed for PCR except the sample.

**Table 4. Preparation of master mix (internal control used to monitor DNA isolation and check for PCR inhibition)**

| Number of samples   | 1                           | 12                           |
|---------------------|-----------------------------|------------------------------|
| EBV RG Master       | 30 $\mu$ l                  | 360 $\mu$ l                  |
| EBV RG IC           | 0 $\mu$ l                   | 0 $\mu$ l                    |
| <b>Total volume</b> | <b>30 <math>\mu</math>l</b> | <b>360 <math>\mu</math>l</b> |

**2b. The internal control must be added directly to the mixture of EBV RG Master. In this case, prepare a master mix according to Table 5.**

The reaction mix typically contains all of the components needed for PCR except the sample.

**Table 5. Preparation of master mix (internal control used exclusively to check for PCR inhibition)**

| <b>Number of samples</b> | <b>1</b>                     | <b>12</b>                     |
|--------------------------|------------------------------|-------------------------------|
| EBV RG Master            | 30 $\mu$ l                   | 360 $\mu$ l                   |
| EBV RG IC                | 2 $\mu$ l                    | 24 $\mu$ l                    |
| <b>Total volume</b>      | <b>32 <math>\mu</math>l*</b> | <b>384 <math>\mu</math>l*</b> |

\* The volume increase caused by adding the internal control is neglected when preparing the PCR assay. The sensitivity of the detection system is not impaired.

**3. Pipet 30  $\mu$ l of the master mix into each PCR Tube. Then add 20  $\mu$ l of the eluted sample DNA (see Table 6). Correspondingly, 20  $\mu$ l of at least one of the quantitation standards (EBV RG QS 1–4) must be used as a positive control and 20  $\mu$ l of water (Water, PCR grade) as a negative control.**

**Table 6. Preparation of PCR assay**

| <b>Number of samples</b> | <b>1</b>                    | <b>12</b>                        |
|--------------------------|-----------------------------|----------------------------------|
| Master mix               | 30 $\mu$ l                  | 30 $\mu$ l each                  |
| Sample                   | 20 $\mu$ l                  | 20 $\mu$ l each                  |
| <b>Total volume</b>      | <b>50 <math>\mu</math>l</b> | <b>50 <math>\mu</math>l each</b> |

**4. Close the PCR tubes. Make sure that the locking ring (accessory of the Rotor-Gene Instrument) is placed on top of the rotor to prevent accidental opening of the tubes during the run.**

5. For the detection of EBV DNA, create a temperature profile according to the following steps.

|   |                        |
|---|------------------------|
| <b>Setting the general assay parameters</b>           | <b>Figures 1, 2, 3</b> |
| <b>Initial activation of the hot-start enzyme</b>     | <b>Figure 4</b>        |
| <b>Amplification of the DNA (touchdown PCR)</b>       | <b>Figure 5</b>        |
| <b>Adjusting the fluorescence channel sensitivity</b> | <b>Figure 6</b>        |
| <b>Starting the run</b>                               | <b>Figure 7</b>        |

All specifications refer to the Rotor-Gene Q MDx/Rotor-Gene Q software version 1.7.94, Rotor-Gene 6000 software versions 1.7.65, 1.7.87, 1.7.94, and Rotor-Gene 3000 software version 6.0.23. Please find further information on programming Rotor-Gene Instruments in the instrument user manual. In the illustrations these settings are framed in bold black. Illustrations are included for Rotor-Gene Q Instruments. Where different values are required for the Rotor-Gene 3000, these differences are described in the text.

6. First, open the “New Run Wizard” dialog box (Figure 1). Check the “Locking Ring Attached” box and click “Next”.

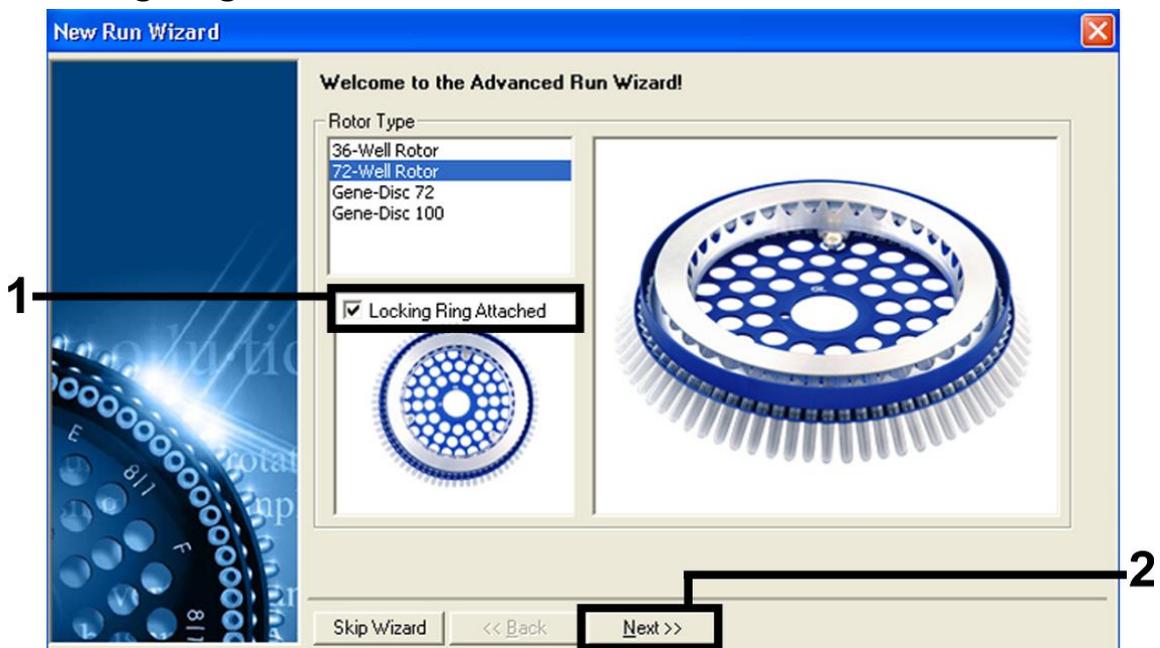


Figure 1. The “New Run Wizard” dialog box.

7. Select 50 for the PCR reaction volume and click "Next" (Figure 2).

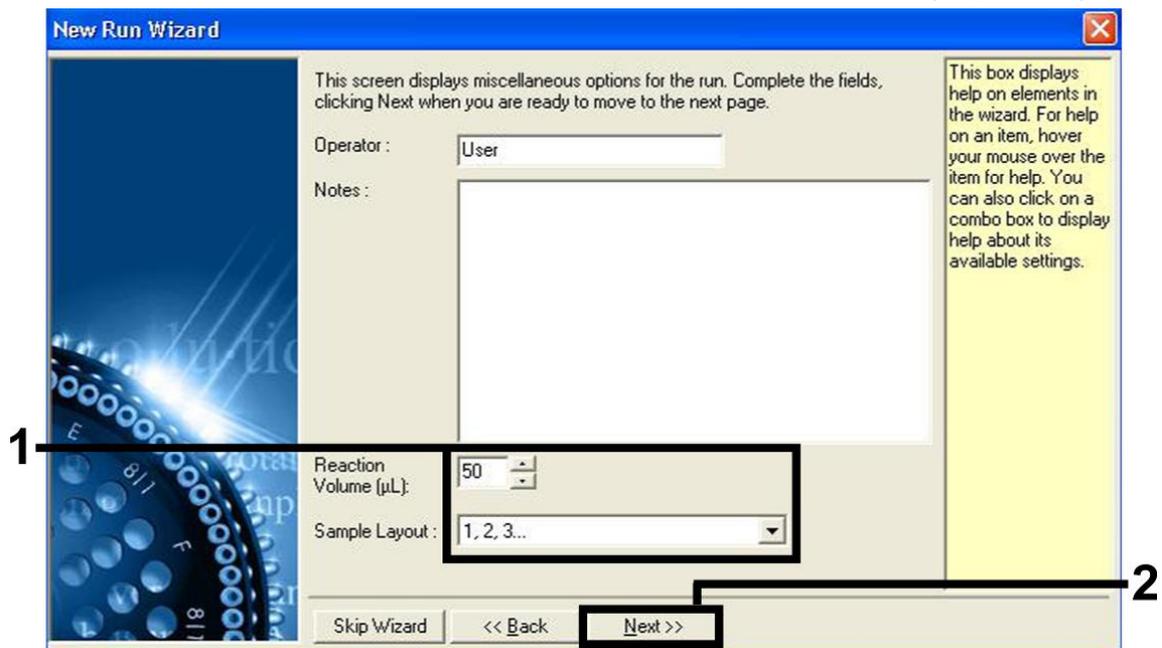


Figure 2. Setting the general assay parameters.

8. Click the "Edit Profile" button in the next "New Run Wizard" dialog box (Figure 3), and program the temperature profile as shown in Figures 3–5).

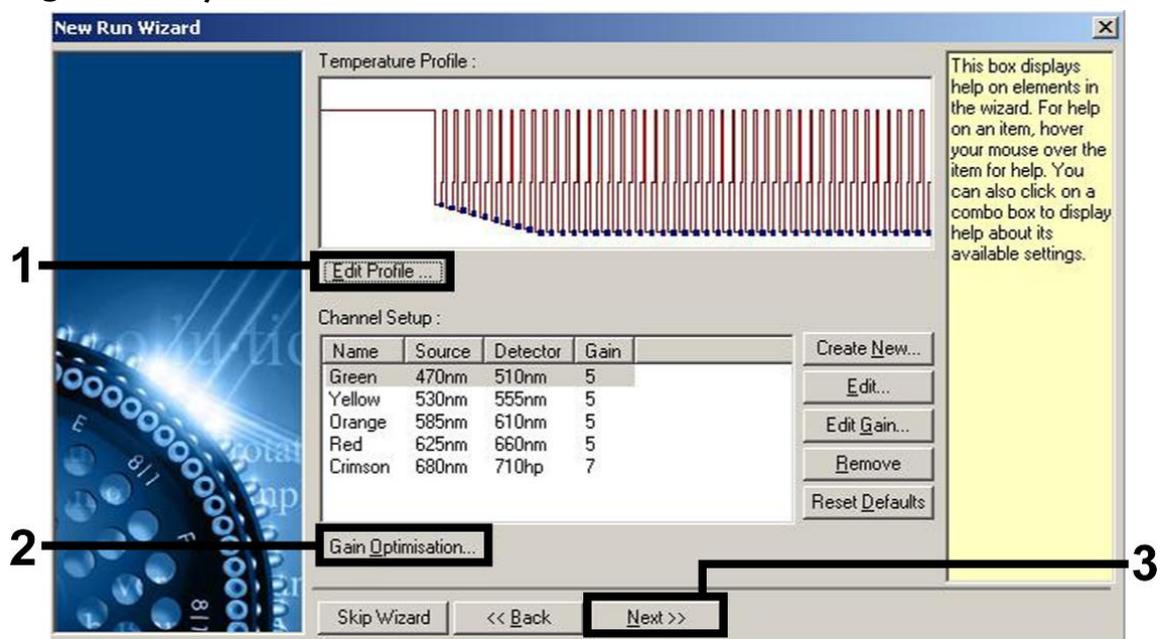
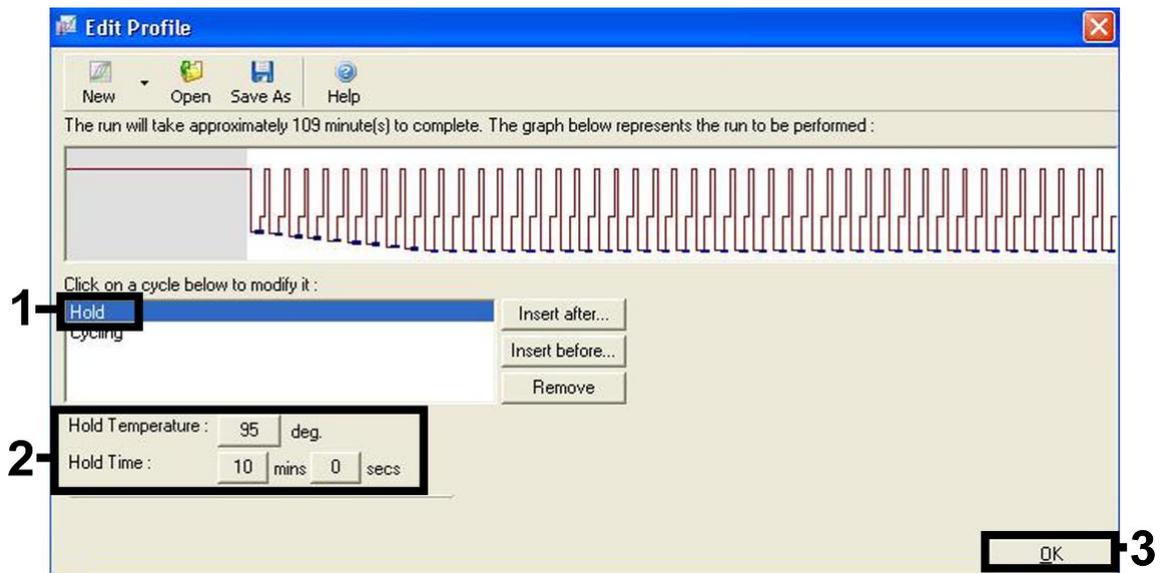
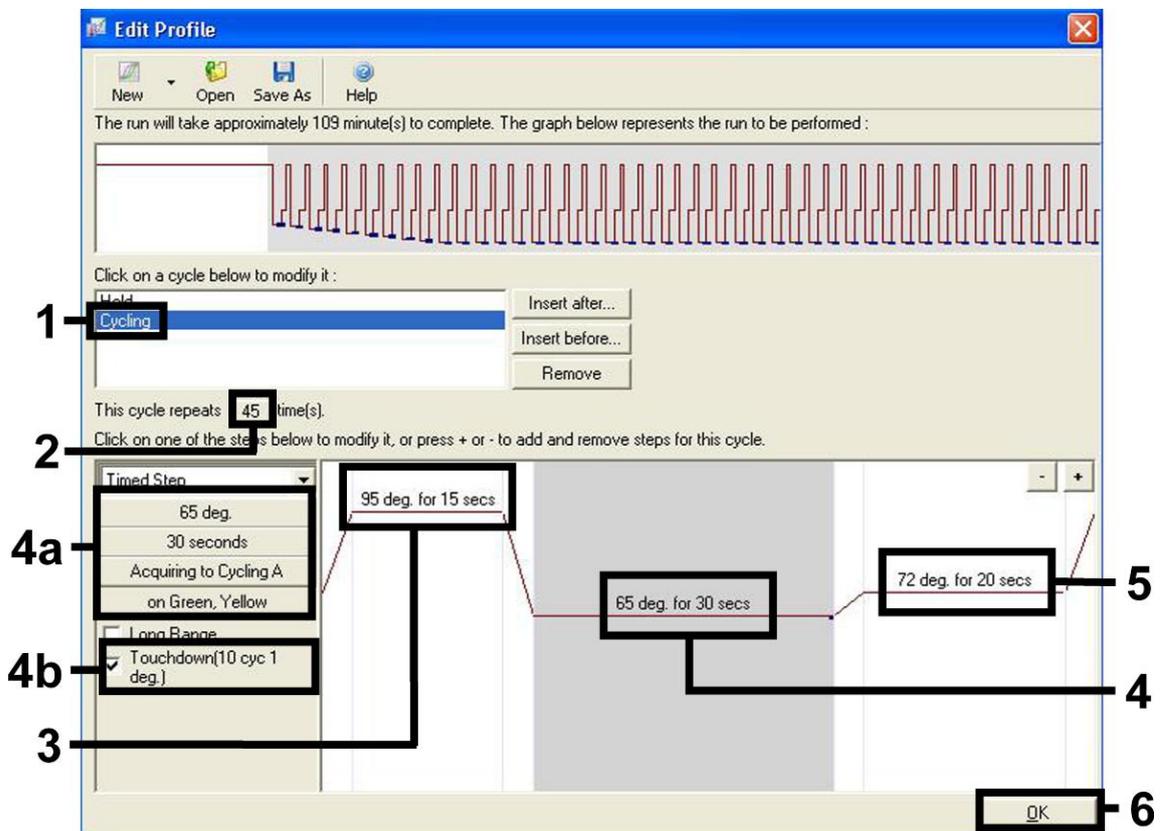


Figure 3. Editing the profile.

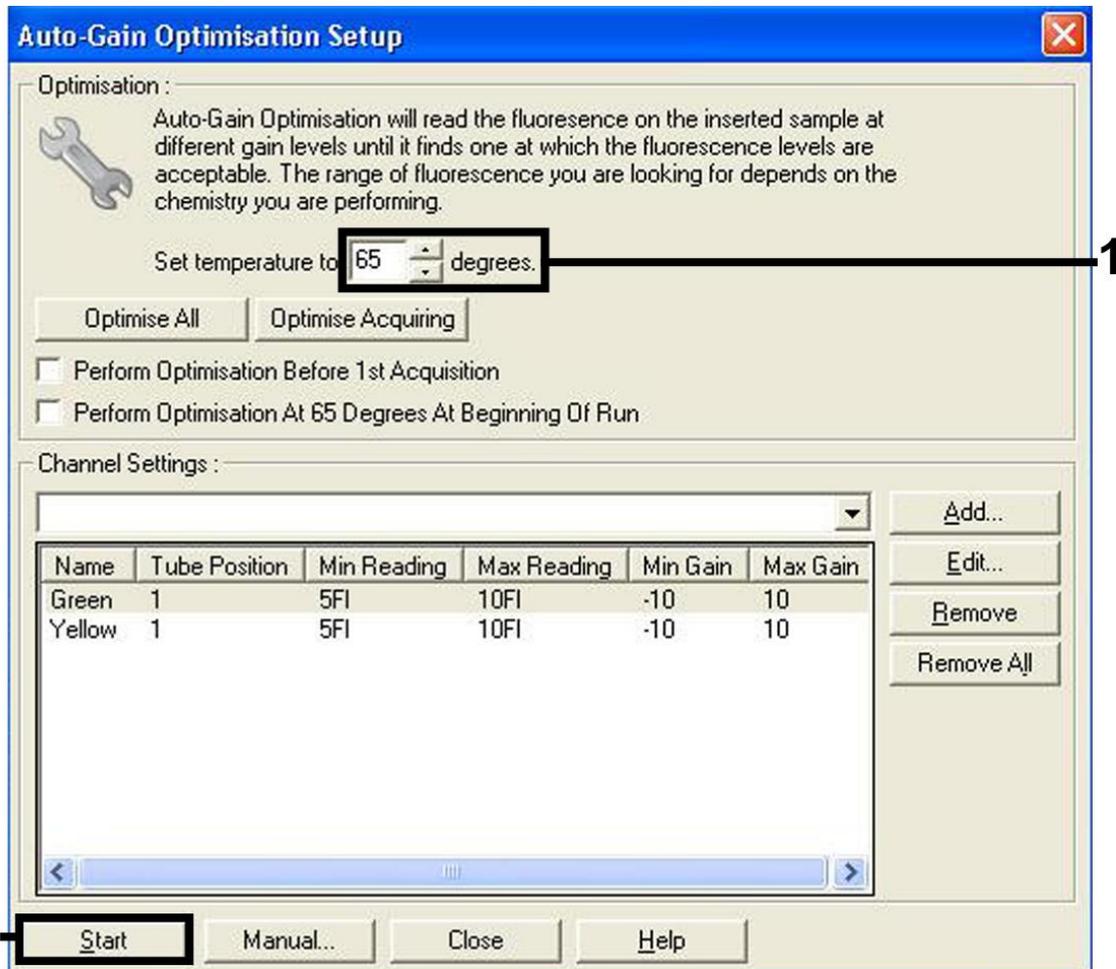


**Figure 4. Initial activation of the hot-start enzyme.**



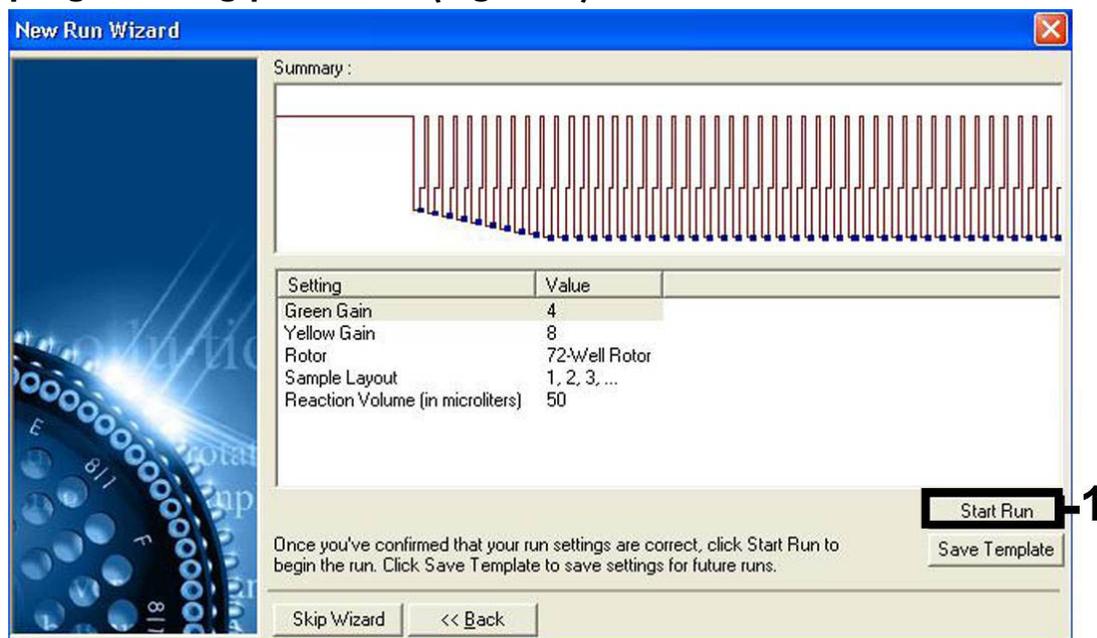
**Figure 5. Amplification of the DNA.** Make sure to activate the touchdown function for 10 cycles in the Annealing step. Note that, on the Rotor-Gene 3000, the software will define the fluorescence dyes as "FAM/Sybr, JOE".

9. The detection range of the fluorescence channels has to be determined according to the fluorescence intensities in the PCR tubes. Click "Gain Optimisation" in the "New Run Wizard" dialog box (see Figure 3) to open the "Auto-Gain Optimisation Setup" dialog box. Set the calibration temperature to 65 to match the annealing temperature of the amplification program (Figure 6).



**Figure 6. Adjusting the fluorescence channel sensitivity.** Note that, on the Rotor-Gene 3000, the software will define the fluorescence dyes as "FAM/Sybr" and "JOE".

10. The gain values determined by the channel calibration are saved automatically and are listed in the last menu window of the programming procedure (Figure 7). Click “Start Run”.



**Figure 7. Starting the run.** Note that, on the Rotor-Gene 3000, the software will define the fluorescence dyes as “FAM/Sybr” and “JOE”.

## Interpretation of Results

### Quantitation

The enclosed quantitation standards (EBV RG QS 1–4) are treated as previously purified samples and the same volume is used (20  $\mu$ l). To generate a standard curve on Rotor-Gene Q Instruments, all 4 quantitation standards should be used and defined in the “Edit Samples” dialog box as standards with the specified concentrations (see the instrument user manual).

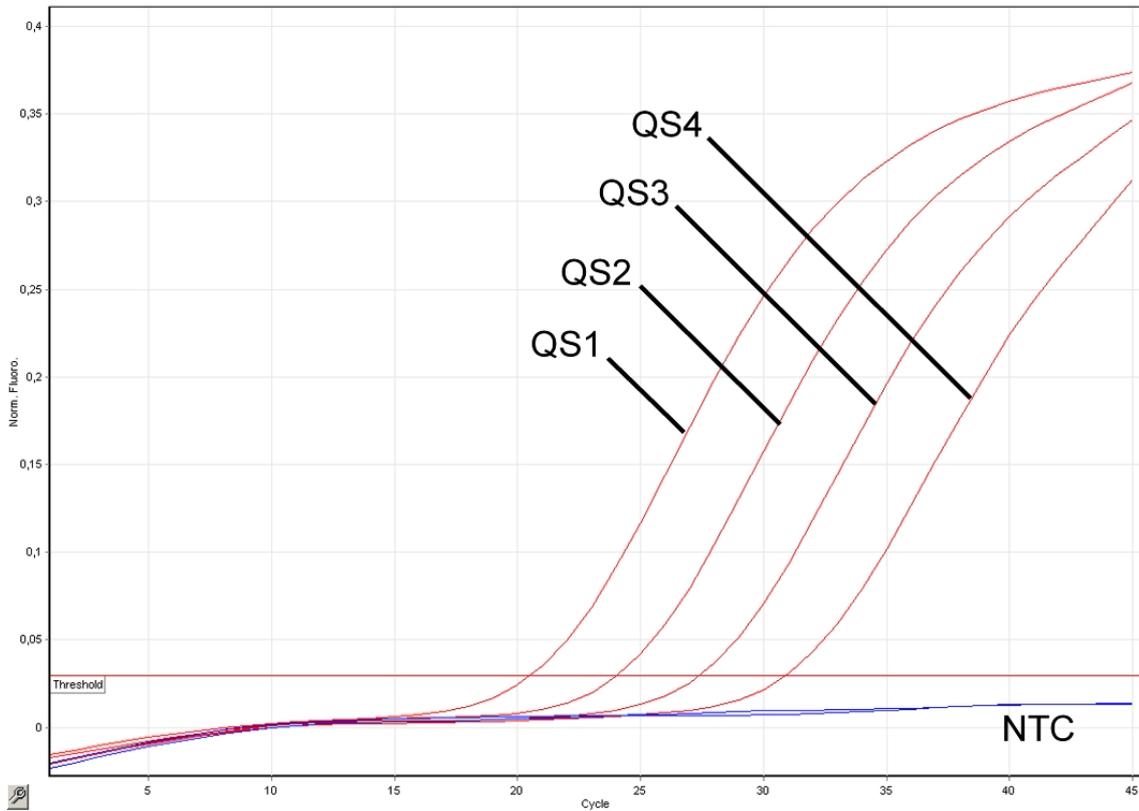
**Note:** The quantitation standards are defined as copies/ $\mu$ l. The following equation has to be applied to convert the values determined using the standard curve into copies/ml of sample material:

$$\text{Result (copies/ml)} = \frac{\text{Result (copies/\mu l)} \times \text{Elution Volume (\mu l)}}{\text{Sample Volume (ml)}}$$

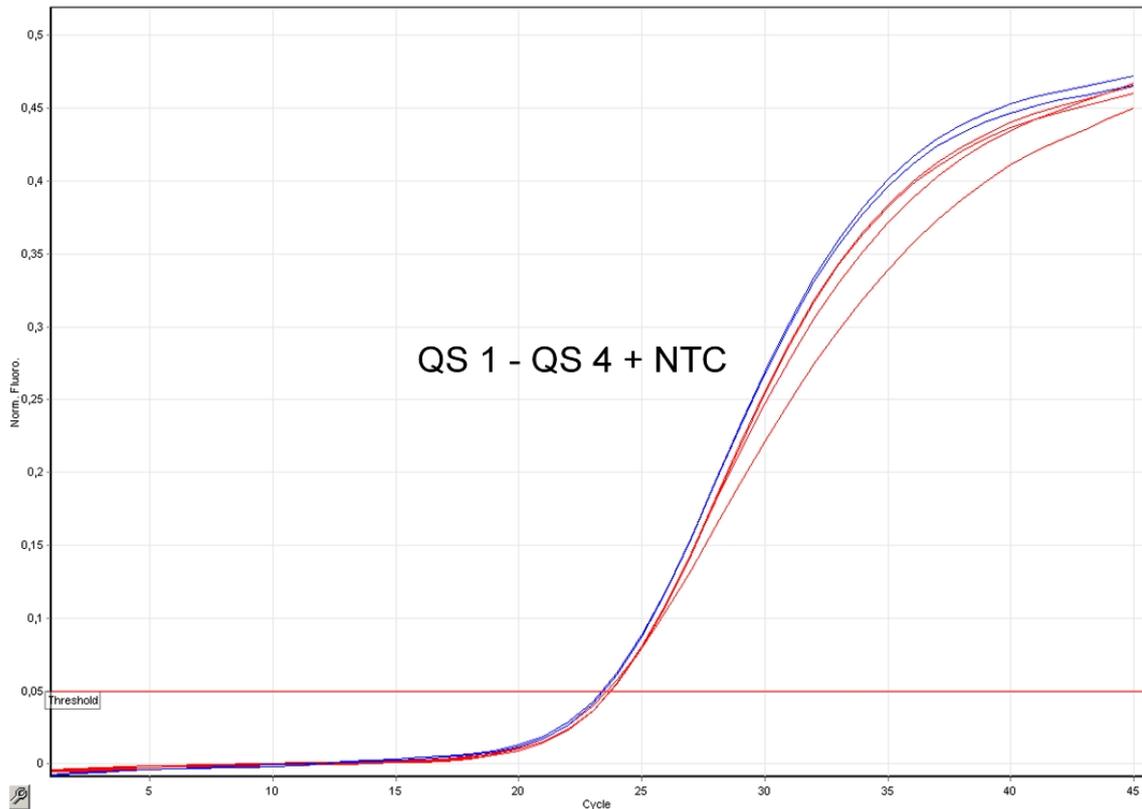
As a matter of principle the initial sample volume should be entered in the equation above. This has to be considered when the sample volume has been changed prior to the nucleic acid extraction (e.g., reducing the volume by centrifugation or increasing the volume by adding to the volume required for the isolation).

## Results

Examples of positive and negative PCR reactions are given in Figure 8 and Figure 9.



**Figure 8. Detection of the quantitation standards (EBV RG QS 1–4) in fluorescence channel Cycling Green. NTC: No template control (negative control).**



**Figure 9. Detection of the internal control (IC) in fluorescence channel Cycling Yellow with simultaneous amplification of the quantitation standards (EBV RG QS 1–4). NTC: No template control (negative control).**

**A signal is detected in fluorescence channel Cycling Green.  
The result of the analysis is positive: the sample contains EBV DNA.**

In this case, the detection of a signal in the Cycling Yellow channel is dispensable, since high initial concentrations of EBV DNA (positive signal in the Cycling Green channel) can lead to a reduced or absent fluorescence signal of the internal control in the Cycling Yellow channel (competition).

**Note:** On the Rotor-Gene 3000, the relevant channels are Cycling A.FAM for the positive signal and Cycling A.JOE for the internal control.

**In fluorescence channel Cycling Green no signal is detected. At the same time, a signal from the internal control appears in the Cycling Yellow channel.**

**In the sample no EBV DNA is detectable. It can be considered negative.**

In the case of a negative EBV PCR, the detected signal of the internal control rules out the possibility of PCR inhibition.

**Note:** On the Rotor-Gene 3000, the relevant channels are Cycling A.JOE for the internal control and lack of a signal for Cycling A.FAM.

## **No signal is detected in the Cycling Green or in the Cycling Yellow channels.**

### **No result can be concluded.**

Information regarding error sources and their solution can be found in "Troubleshooting guide", page 21.

**Note:** On the Rotor-Gene 3000, the relevant channels are Cycling A.FAM and Cycling A.JOE.

## **Troubleshooting guide**

This troubleshooting guide may be helpful in solving any problems that may arise. For more information, see also the Frequently Asked Questions page at our Technical Support Center: [www.qiagen.com/FAQ/FAQList.aspx](http://www.qiagen.com/FAQ/FAQList.aspx). The scientists in QIAGEN Technical Services are always happy to answer any questions you may have about either the information and protocols in this handbook or sample and assay technologies (for contact information, see back cover or visit [www.qiagen.com](http://www.qiagen.com)).

### **Comments and suggestions**

---

#### **No signal with positive controls (EBV RG QS 1–4) in fluorescence channel Cycling Green or Cycling A.FAM**

- |  |  |
|--|--|
| a) The selected fluorescence channel for PCR data analysis does not comply with the protocol   | For data analysis select the fluorescence channel Cycling Green or Cycling A.FAM for the analytical EBV PCR and the fluorescence channel Cycling Yellow or Cycling A.JOE for the internal control PCR. |
| b) Incorrect programming of the temperature profile of the Rotor-Gene Instrument   | Compare the temperature profile with the protocol. See "Protocol: PCR and data analysis", page 12.   |
| c) Incorrect configuration of the PCR  | Check your work steps by means of the pipetting scheme, and repeat the PCR, if necessary. See "Protocol: PCR and data analysis", page 12.  |
| d) The storage conditions for one or more kit components did not comply with the instructions given in "Reagent Storage and Handling" (page 7) | Check the storage conditions and the expiration date (see the kit label) of the reagents and use a new kit, if necessary.  |

## Comments and suggestions

---

- e) The *artus* EBV RG PCR Kit has expired      Check the storage conditions and the expiration date (see the kit label) of the reagents and use a new kit, if necessary.

### **Weak or no signal of the internal control in fluorescence channel Cycling Yellow or Cycling A.JOE and simultaneous absence of a signal in channel Cycling Green or Cycling A.FAM**

- a) The PCR conditions do not comply with the protocol      Check the PCR conditions (see above) and repeat the PCR with corrected settings, if necessary.
- b) The PCR was inhibited      Make sure that you use the recommended isolation method and closely follow the manufacturer's instructions.
- When using the QIAamp DNA Mini Kit, QIAamp DNA Blood Mini Kit, or QIAamp UltraSens Virus Kit, make sure that during the DNA isolation the recommended additional centrifugation step has been carried out before the elution in order to remove any residual ethanol (see "DNA isolation", pages 8 and 10).
- c) DNA was lost during extraction      If the internal control was added to the extraction, an absent signal of the internal control can indicate the loss of DNA during the extraction. Make sure that you use the recommended isolation method (see "DNA isolation", page 8) and closely follow the manufacturer's instructions.
- d) The storage conditions for one or more kit components did not comply with the instructions given in "Reagent Storage and Handling" (page 7)      Check the storage conditions and the expiration date (see the kit label) of the reagents and use a new kit, if necessary.
- e) The *artus* EBV RG PCR Kit has expired      Check the storage conditions and the expiration date (see the kit label) of the reagents and use a new kit, if necessary.

## Comments and suggestions

---

### Signals with the negative controls in fluorescence channel Cycling Green or Cycling A.FAM of the analytical PCR

- |   |   |
|---|---|
| a) Contamination occurred during preparation of the PCR | Repeat the PCR with new reagents in replicates.<br>If possible, close the PCR tubes directly after addition of the sample to be tested.<br>Make sure to pipet the positive controls last.<br>Make sure that work space and instruments are decontaminated at regular intervals. |
| b) Contamination occurred during extraction             | Repeat the extraction and PCR of the sample to be tested using new reagents.<br>Make sure that work space and instruments are decontaminated at regular intervals.  |

## Quality Control

In accordance with QIAGEN's ISO-certified Quality Management System, each lot of *artus* EBV RG PCR Kit is tested against predetermined specifications to ensure consistent product quality.

## Limitations

All reagents may exclusively be used in in vitro diagnostics.

The product is to be used by personnel specially instructed and trained in the in vitro diagnostics procedures only.

Strict compliance with the user manual is required for optimal PCR results.

Attention should be paid to expiration dates printed on the box and labels of all components. Do not use expired components.

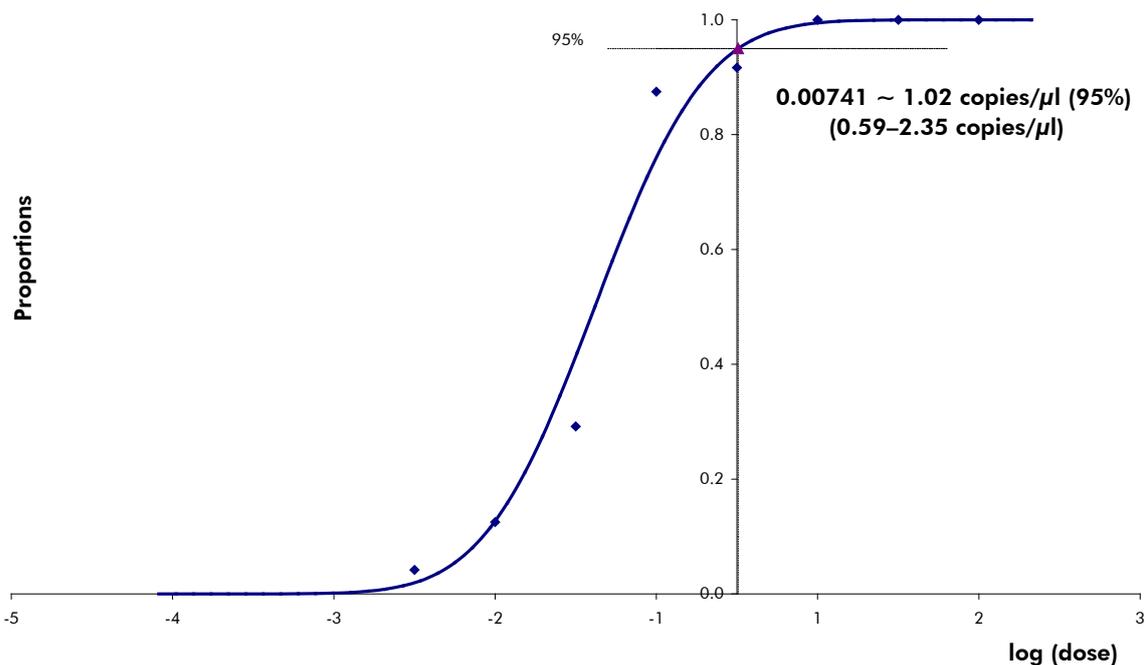
Although rare, mutations within the highly conserved regions of the viral genome covered by the kit's primers and/or probe may result in underquantitation or failure to detect the presence of the virus in these cases. Validity and performance of the assay design are revised at regular intervals.

## Performance Characteristics

### Analytical sensitivity

To determine the analytical sensitivity of the *artus* EBV RG PCR Kit, a dilution series was set up from 31.6 to 0.01 and from 100 to nominal 0.03 EBV

copy equivalents/ $\mu\text{l}$  and analyzed on the Rotor-Gene 6000 and Rotor-Gene 3000, respectively, in combination with the *artus* EBV RG PCR Kit. Testing was carried out on 3 different days on 8 replicates. The results were determined by a probit analysis. A graphical illustration of the probit analysis on the Rotor-Gene 6000 is shown in Figure 10. The analytical detection limit of the *artus* EBV RG PCR Kit in combination with the Rotor-Gene Q MDx/Q/6000 and the Rotor-Gene 3000 is 1.02 copies/ $\mu\text{l}$  ( $p = 0.05$ ) and 3.8 copies/ $\mu\text{l}$  ( $p = 0.05$ ), respectively. This means that there is a 95% probability that 1.02 copies/ $\mu\text{l}$  or 3.8 copies/ $\mu\text{l}$  will be detected.



**Figure 10. Probit analysis: EBV (Rotor-Gene 6000).** Analytical sensitivity of the *artus* EBV RG PCR Kit on the Rotor-Gene 6000.

## Specificity

The specificity of the *artus* EBV RG PCR Kit is first and foremost ensured by the selection of the primers and probes, as well as the selection of stringent reaction conditions. The primers and probes were checked for possible homologies to all published sequences in gene banks by sequence comparison analysis. The detectability of all relevant genotypes has thus been ensured.

Moreover, the specificity was validated with 6 different EBV negative serum samples. These did not generate any signals with the EBV specific primers and probes, which are included in the EBV RG Master.

A potential cross-reactivity of the *artus* EBV RG PCR Kit was tested using the control group listed in Table 7. None of the tested pathogens has been reactive.

**Table 7. Testing the specificity of the kit with potentially cross-reactive pathogens**

| <b>Control group</b>                            | <b>EBV<br/>(Cycling Green<br/>or Cycling<br/>A.FAM)</b> | <b>Internal control<br/>(Cycling Yellow<br/>or Cycling<br/>A.JOE)</b> |
|---|---|---|
| Human herpesvirus 1<br>(herpes simplex virus 1) | –   | +   |
| Human herpesvirus 2<br>(herpes simplex virus 2) | –   | +   |
| Human herpesvirus 3<br>(varicella-zoster virus) | –   | +   |
| Human herpesvirus 5<br>(cytomegalovirus)        | –   | +   |
| Human T cell leukemia virus 1                   | –   | +   |
| Human T cell leukemia virus 2                   | –   | +   |

## Reproducibility

Reproducibility data permit a regular performance assessment of the *artus* EBV RG PCR Kit as well as an efficiency comparison with other products. These data are obtained by the participation in established proficiency programs.

## References

QIAGEN maintains a large, up-to-date online database of scientific publications utilizing QIAGEN products. Comprehensive search options allow you to find the articles you need, either by a simple keyword search or by specifying the application, research area, title, etc.

For a complete list of references, visit the QIAGEN Reference Database online at [www.qiagen.com/RefDB/search.asp](http://www.qiagen.com/RefDB/search.asp) or contact QIAGEN Technical Services or your local distributor.

## Symbols



Contains reagents sufficient for <N> tests



Use by



In vitro diagnostic medical device



Catalog number



Lot number



Material number



Components



Contains



Number



Global Trade Item Number



Temperature limitation



Manufacturer



Consult instructions for use

## Contact Information

For technical assistance and more information, please see our Technical Support Center at [www.qiagen.com/Support](http://www.qiagen.com/Support) or call one of the QIAGEN Technical Service Departments or local distributors (see back cover or visit [www.qiagen.com](http://www.qiagen.com)).

## Ordering Information

| Product  | Contents   | Cat. no. |
|--|--|----------|
| <i>artus</i> EBV RG PCR Kit (24)   | For 24 reactions: Master, 4 Quantitation Standards, Internal Control, Water (PCR grade)  | 4501263  |
| <i>artus</i> EBV RG PCR Kit (96)   | For 96 reactions: Master, 4 Quantitation Standards, Internal Control, Water (PCR grade)  | 4501265  |
| <b>EASYartus EBV RG PCR Kits — for fully CE-IVD-compliant integrated automated sample purification and pathogen detection</b>    |  |          |
| EASYartus EBV RG PCR Kit 1   | For 48 viral nucleic acid preps and 24 assays: 1 x EZ1 DSP Virus Kit, 1 x <i>artus</i> EBV RG PCR Kit (24)   | EA10123  |
| EASYartus EBV RG PCR Kit 2   | For 48 viral nucleic acid preps and 48 assays: 1 x EZ1 DSP Virus Kit, 2 x <i>artus</i> EBV RG PCR Kit (24)   | EA10124  |
| <b>EZ1 DSP Virus Kit — for automated, simultaneous purification of viral DNA and RNA from 1–14 serum, plasma, or CSF samples</b> |  |          |
| EZ1 DSP Virus Kit (48)   | For 48 viral nucleic acid preps: Prefilled Reagent Cartridges, Disposable Tip Holders, Disposable Filter-Tips, Sample Tubes, Elution Tubes, Buffers, Carrier RNA | 62724    |
| <b>QIAamp DNA Mini Kit — for purification of genomic and viral DNA from tissues and other samples</b>                            |  |          |
| QIAamp DNA Mini Kit (50)   | For 50 DNA preps: 50 QIAamp Mini Spin Columns, QIAGEN Proteinase K, Reagents, Buffers, Collection Tubes (2 ml)   | 51304    |
| <b>QIAamp UltraSens Virus Kit — for concentration and isolation of viral DNA and RNA from serum and plasma</b>                   |  |          |
| QIAamp UltraSens Virus Kit (50)  | For 50 viral nucleic acid preps: 50 QIAamp Mini Spin Columns, Proteinase K, Carrier RNA, Collection Tubes (2 ml), Buffers  | 53704    |

| <b>Product</b>   | <b>Contents</b>   | <b>Cat. no.</b> |
|--|---|-----------------|
| <b>QIAamp DNA Blood Mini Kit — for purification of up to 12 µg genomic, mitochondrial, or viral DNA from blood and related body fluids</b> |   |                 |
| QIAamp DNA Blood Mini Kit (50)   | For 50 DNA minipreps: 50 QIAamp Mini Spin Columns, QIAGEN Protease, Reagents, Buffers, Collection Tubes (2 ml)  | 51104           |
| <b>Rotor-Gene Q MDx and accessories</b>  |   |                 |
| Rotor-Gene Q MDx 5plex Platform  | Real-time PCR cyclers with 5 channels (green, yellow, orange, red, crimson), laptop computer, software, accessories: includes 1-year warranty on parts and labor, installation and training not included  | 9002022         |
| Rotor-Gene Q MDx 5plex System  | Real-time PCR cyclers with 5 channels (green, yellow, orange, red, crimson), laptop computer, software, accessories: includes 1-year warranty on parts and labor, installation and training   | 9002023         |
| Rotor-Gene Q MDx 5plex HRM Platform  | Real-time PCR cyclers and High Resolution Melt analyzer with 5 channels (green, yellow, orange, red, crimson) plus HRM channel, laptop computer, software, accessories: includes 1-year warranty on parts and labor, installation and training not included | 9002032         |
| Rotor-Gene Q MDx 5plex HRM System  | Real-time PCR cyclers and High Resolution Melt analyzer with 5 channels (green, yellow, orange, red, crimson) plus HRM channel, laptop computer, software, accessories: includes 1-year warranty on parts and labor, installation and training              | 9002033         |

| <b>Product</b>                      | <b>Contents</b>  | <b>Cat. no.</b> |
|-------------------------------------|--|-----------------|
| Rotor-Gene Q MDx 6plex Platform     | Real-time PCR instrument with 6 channels (blue, green, yellow, orange, red, crimson), including laptop computer, software, accessories: includes 1-year warranty on parts and labor, installation and training not included          | 9002042         |
| Rotor-Gene Q MDx 6plex System       | Real-time PCR instrument with 6 channels (blue, green, yellow, orange, red, crimson), including laptop computer, software, accessories: includes 1-year warranty on parts and labor, installation and training                       | 9002043         |
| Rotor-Gene Q MDx 2plex Platform     | Real-time PCR cyclers with 2 channels (green, yellow), laptop computer, software, accessories: includes 1-year warranty on parts and labor, installation and training not included   | 9002002         |
| Rotor-Gene Q MDx 2plex System       | Real-time PCR cyclers with 2 channels (green, yellow), laptop computer, software, accessories: includes 1-year warranty on parts and labor, installation and training  | 9002003         |
| Rotor-Gene Q MDx 2plex HRM Platform | Real-time PCR cycler and High Resolution Melt analyzer with 2 channels (green, yellow) plus HRM channel, laptop computer, software, accessories: includes 1-year warranty on parts and labor, installation and training not included | 9002012         |
| Rotor-Gene Q MDx 2plex HRM System   | Real-time PCR cycler and High Resolution Melt analyzer with 2 channels (green, yellow) plus HRM channel, laptop computer, software, accessories: includes 1-year warranty on parts and labor, installation and training              | 9002013         |

| <b>Product</b>                         | <b>Contents</b>  | <b>Cat. no.</b> |
|--|--|-----------------|
| Loading Block<br>72 x 0.1 ml Tubes     | Aluminum block for manual reaction setup with a single-channel pipet in 72 x 0.1 ml tubes    | 9018901         |
| Loading Block<br>96 x 0.2 ml Tubes     | Aluminum block for manual reaction set-up in a standard 8 x 12 array using 96 x 0.2 ml tubes | 9018905         |
| Strip Tubes and Caps,<br>0.1 ml (250)  | 250 strips of 4 tubes and caps for 1000 reactions  | 981103          |
| Strip Tubes and Caps,<br>0.1 ml (2500) | 10 x 250 strips of 4 tubes and caps for 10,000 reactions                                     | 981106          |
| PCR Tubes, 0.2 ml<br>(1000)            | 1000 thin-walled tubes for 1000 reactions  | 981005          |
| PCR Tubes, 0.2 ml<br>(10000)           | 10 x 1000 thin-walled tubes for 10,000 reactions   | 981008          |

For up-to-date licensing information and product-specific disclaimers, see the respective QIAGEN kit handbook or user manual. QIAGEN kit handbooks and user manuals are available at [www.qiagen.com](http://www.qiagen.com) or can be requested from QIAGEN Technical Services or your local distributor.

The purchase of this product allows the purchaser to use it for the performance of diagnostic services for human in vitro diagnostics. No general patent or other license of any kind other than this specific right of use from purchase is granted hereby.

Trademarks: QIAGEN®, QIAamp®, artus®, EASYartus®, EZ1®, Rotor-Gene®, UltraSens® (QIAGEN Group); FAM™, JOE™ (Life Technologies); SYBR® (Molecular Probes, Inc.).

#### **Limited License Agreement**

Use of this product signifies the agreement of any purchaser or user of the artus EBV RG PCR Kit to the following terms:

1. The artus EBV RG PCR Kit may be used solely in accordance with the artus EBV RG PCR Kit Handbook and for use with components contained in the Kit only. QIAGEN grants no license under any of its intellectual property to use or incorporate the enclosed components of this Kit with any components not included within this Kit except as described in the artus EBV RG PCR Kit Handbook and additional protocols available at [www.qiagen.com](http://www.qiagen.com).
2. Other than expressly stated licenses, QIAGEN makes no warranty that this Kit and/or its use(s) do not infringe the rights of third-parties.
3. This Kit and its components are licensed for one-time use and may not be reused, refurbished, or resold.
4. QIAGEN specifically disclaims any other licenses, expressed or implied other than those expressly stated.
5. The purchaser and user of the Kit agree not to take or permit anyone else to take any steps that could lead to or facilitate any acts prohibited above. QIAGEN may enforce the prohibitions of this Limited License Agreement in any Court, and shall recover all its investigative and Court costs, including attorney fees, in any action to enforce this Limited License Agreement or any of its intellectual property rights relating to the Kit and/or its components.

For updated license terms, see [www.qiagen.com](http://www.qiagen.com).

© 2009–2014 QIAGEN, all rights reserved.

[www.qiagen.com](http://www.qiagen.com)

**Australia** ■ Orders 1-800-243-800 ■ Fax 03-9840-9888 ■ Technical 1-800-243-066

**Austria** ■ Orders 0800-28-10-10 ■ Fax 0800-28-10-19 ■ Technical 0800-28-10-11

**Belgium** ■ Orders 0800-79612 ■ Fax 0800-79611 ■ Technical 0800-79556

**Brazil** ■ Orders 0800-557779 ■ Fax 55-11-5079-4001 ■ Technical 0800-557779

**Canada** ■ Orders 800-572-9613 ■ Fax 800-713-5951 ■ Technical 800-DNA-PREP (800-362-7737)

**China** ■ Orders 86-21-3865-3865 ■ Fax 86-21-3865-3965 ■ Technical 800-988-0325

**Denmark** ■ Orders 80-885945 ■ Fax 80-885944 ■ Technical 80-885942

**Finland** ■ Orders 0800-914416 ■ Fax 0800-914415 ■ Technical 0800-914413

**France** ■ Orders 01-60-920-926 ■ Fax 01-60-920-925 ■ Technical 01-60-920-930 ■ Offers 01-60-920-928

**Germany** ■ Orders 02103-29-12000 ■ Fax 02103-29-22000 ■ Technical 02103-29-12400

**Hong Kong** ■ Orders 800 933 965 ■ Fax 800 930 439 ■ Technical 800 930 425

**Ireland** ■ Orders 1800 555 049 ■ Fax 1800 555 048 ■ Technical 1800 555 061

**Italy** ■ Orders 800-789-544 ■ Fax 02-334304-826 ■ Technical 800-787980

**Japan** ■ Telephone 03-6890-7300 ■ Fax 03-5547-0818 ■ Technical 03-6890-7300

**Korea (South)** ■ Orders 080-000-7146 ■ Fax 02-2626-5703 ■ Technical 080-000-7145

**Luxembourg** ■ Orders 8002-2076 ■ Fax 8002-2073 ■ Technical 8002-2067

**Mexico** ■ Orders 01-800-7742-639 ■ Fax 01-800-1122-330 ■ Technical 01-800-7742-436

**The Netherlands** ■ Orders 0800-0229592 ■ Fax 0800-0229593 ■ Technical 0800-0229602

**Norway** ■ Orders 800-18859 ■ Fax 800-18817 ■ Technical 800-18712

**Singapore** ■ Orders 1800-742-4362 ■ Fax 65-6854-8184 ■ Technical 1800-742-4368

**Spain** ■ Orders 91-630-7050 ■ Fax 91-630-5145 ■ Technical 91-630-7050

**Sweden** ■ Orders 020-790282 ■ Fax 020-790582 ■ Technical 020-798328

**Switzerland** ■ Orders 055-254-22-11 ■ Fax 055-254-22-13 ■ Technical 055-254-22-12

**UK** ■ Orders 01293-422-911 ■ Fax 01293-422-922 ■ Technical 01293-422-999

**USA** ■ Orders 800-426-8157 ■ Fax 800-718-2056 ■ Technical 800-DNA-PREP (800-362-7737)

