

SingleShot™ Probes One-Step Kit

Catalog #	Description
172-5070	SingleShot Probes One-Step Kit , 100 x 50 µl reactions

For research purposes only.

Introduction

The SingleShot Probes One-Step Kit prepares genomic DNA (gDNA)–free RNA directly from cell culture in approximately 20 min for use in reverse transcription quantitative PCR (RT-qPCR) applications. This kit is compatible with an input of 100,000–10 cells from suspension, adherent cells, or primary cells from cell cultures. With the SingleShot Probes One-Step Kit, gene expression analysis can be completed in approximately 2 hours from cell culture to quantification cycle (Cq). This kit includes reagents for one-step RT-qPCR reactions and a probe-based qPCR control assay to optimize input cell number and input lysate amount.

Kit Contents (100 reactions)

Cell Lysis Reagents	Description
SingleShot Cell Lysis Buffer	5 ml (1 x 5 ml vial)
Proteinase K Solution	100 µl (1 x 1 ml vial)
DNase Solution	100 µl (1 x 1 ml vial)

Store all components at –20°C for up to 1 year.

Controls

SingleShot RNA Control	200 reactions
SingleShot RNA Control Template	Lyophilized
SingleShot probes qPCR Control Assay	HEX labeled, 200 µl

Once resuspended, store the control template at –80°C. Store the qPCR assay at –20°C for up to 1 year.

RT-qPCR Reagents

iTaq™ Universal Probes One-Step Kit	100 reactions
iScript™ Reverse Transcriptase	50 µl (1 x 1 ml vial)
2x iTaq Universal Probes One-Step Reaction Mix	1 ml (1 x 1 ml vial)

Store the RT-qPCR products at –20°C for up to 1 year. The iTaq reaction mix may be stored at 4°C for up to 3 months.

Reagents Required but Not Provided

- Phosphate buffered saline (PBS) for washing the cells
- TE buffer (nuclease-free) pH 7.5 for resuspending the SingleShot RNA control template

Processing of Adherent Cells in a 96-Well Culture Plate

- ❗ For processing adherent cells in non-96-well cell culture plates, refer to Table 1 in Appendix A
 - ❗ For processing trypsinized adherent cells, neutralize the trypsin with culture medium. Follow instructions in Processing of Nonadherent Cells in a 96-Well PCR Plate section
1. Seed the cell culture in advance in a 96-well culture plate so that the cell numbers at harvest are in the range of 100,000–10 cells/well.
 - ❗ For adherent cells, it is important to use cells that are fully adhered to the plate to avoid cell loss during washing
 - ❗ Using too many cells may result in incomplete cell lysis and can inhibit RT-qPCR. For optimal results, we recommend using the SingleShot RNA control, included in this kit, to determine the appropriate input cell number
 2. Prepare fresh on ice the appropriate volume of SingleShot cell lysis master mix (see Table 1). Mix thoroughly and centrifuge. Use within 2 hr.

Table 1. Preparation of SingleShot cell lysis master mix for adherent cells.

Component	Volume per Well, μ l	Volume for 96-Well Plate, μ l
SingleShot Cell Lysis Buffer	48	4,608
Proteinase K Solution	1	96
DNase Solution	1	96

3. Remove cell culture medium completely by aspiration.
4. Wash cells with 125 μ l of room temperature PBS. Aspirate to remove PBS completely.
5. Add 50 μ l of SingleShot cell lysis master mix to each well.
6. Incubate without agitation for 10 min at room temperature.
 - ❗ Do not mix the cells with the solution by pipetting. For step 6, do not exceed 20 min at room temperature
7. Transfer the cell lysate to a PCR plate or microfuge tube. Incubate at 37°C for 5 min, followed by 5 min at 75°C.
 - ❗ Use a thermal cycler for best thermal uniformity
8. The cell lysate can be stored for up to 4 hr on ice, for up to 2 months at –20°C, or for up to 12 months at –80°C.
9. Go to the Preparation of One-Step RT-qPCR Reactions section.

Processing of Nonadherent Cells in a 96-Well PCR Plate

1. Prepare fresh on ice the appropriate volume of SingleShot cell lysis master mix (Table 2). Mix thoroughly and centrifuge. Use within 2 hr.

Table 2. Preparation of SingleShot cell lysis master mix for nonadherent cells.

Component	Volume per Well, μ l	Volume for 96-Well Plate, μ l
SingleShot Cell Lysis Buffer	48	4,608
Proteinase K Solution	1	96
DNase Solution	1	96

2. Count the cells. Transfer appropriate number of cells ($10\text{--}10^5$ cells per well) to a 96-well PCR plate or tube.
3. Centrifuge at 500–1,000 x g for 5 min. Remove as much of the medium as possible without disturbing the cell pellet.
4. Wash cells with 125 μ l room temperature PBS. Centrifuge at 500–1,000 x g for 5 min. Carefully remove 120 μ l of the supernatant using a pipet, leaving approximately 5 μ l PBS in each well.
5. Add 50 μ l of SingleShot cell lysis master mix to each well. Pipet up and down 5 times to ensure complete resuspension of the cell pellet.
6. Incubate for 10 min at room temperature, followed by 5 min at 37°C and 5 min at 75°C.
7. The cell lysate can be stored on ice for up to 4 hr, at –20°C for up to 2 months, or at –80°C for up to 12 months.
8. Go to the Preparation of One-Step RT-qPCR Reactions section.

Preparation of One-Step RT-qPCR Reactions

Instrument Compatibility

iTaq Universal Probes One-Step Reaction Mix is compatible with all Bio-Rad and other commercially available real-time PCR systems.

Reaction Mix Preparation and Thermal Cycling Protocol

1. Thaw iTaq Universal Probes One-Step Reaction Mix and other frozen reaction components to 4°C. Mix thoroughly, centrifuge briefly to collect solutions at the bottom of tubes, then store on ice protected from light.
2. Prepare on ice enough RT-qPCR reaction mix for all RT-qPCR reactions by adding all required components, except the cell lysate, according to the recommendations in Table 3.

Table 3. RT-qPCR reaction mix setup.*

Component	Volume per 10 μ l Reaction, μ l	Volume per 20 Reactions, μ l	Final Concentration
iTaq Universal Probes One-Step Reaction Mix (2x)	5	10	1x
iScript Reverse Transcriptase	0.25	0.5	1x
Forward and Reverse Primers	Variable	Variable	100–900 nM each primer**
Fluorogenic Probe(s)	Variable	Variable	150–250 nM each primer
Cell Lysate (add at step 4)	1–2	2–4	—
Nuclease-Free Water	Variable	Variable	—
Total reaction mix volume	10	20	—

* Scale all components proportionally according to sample number and reaction volumes.

** For duplex assays with large ΔC_q (ΔC_T) values, decreasing the primer concentrations for the higher-expressing target may help. To validate, perform a primer matrix to determine optimal final primer concentration. C_q , quantification cycle; C_T , threshold cycle.

Table 4. Thermal cycling protocol.

Real-Time PCR System	Setting/ Scan Mode	Reverse Transcription Reaction	Polymerase Activation and DNA Denaturation
Bio-Rad® CFX96™, CFX384™, CFX96 Touch™, CFX96 Touch Deep Well, CFX384 Touch™, CFX Connect™	All channels	10 min at 50°C	1–3 min at 95°C
Bio-Rad® iQ™5, MiniOpticon™, Chromo4™, MyiQ™	Standard		
Applied Biosystems 7500 and 7900 HT, QuantStudio, StepOne, StepOnePlus, ViiA 7	Fast		
	Standard		
Roche LightCycler 480	Fast		
	Standard		
QIAGEN Rotor-Gene and Stratagene Mx series	Fast		

* Shorter annealing/extension times (5–10 sec) may be used for amplicons <100 bp. Longer annealing/extension times (30–60 sec or more) may be used for amplicons >250 bp or GC- or AT-rich targets.

3. Mix the RT-qPCR reaction mix thoroughly to ensure homogeneity and dispense equal aliquots into each PCR tube or into the wells of a PCR plate. Use good pipetting technique to ensure assay precision and accuracy.
4. Add cell lysate to the PCR tubes or wells containing RT-qPCR reaction mix (prepared using Table 3), seal tubes or wells with flat caps or optically transparent film, and gently vortex to ensure thorough mixing of the reaction components. Spin the tubes or plate to remove any air bubbles and to collect the reaction mixture in the vessel bottom.
5. Program the thermal cycling protocol on a real-time PCR instrument according to Table 4.

Amplification		
Denaturation at 95°C, sec	Annealing/Extension and Plate Read at 60°C, sec*	Cycles
2–15	10–30	35–40
	15–30	
	10–30	
	60	
	10–30	
	60	
	10–30	

6. Load the PCR tubes or plate into the real-time PCR instrument and start the PCR run.
7. Perform data analysis according to instrument-specific instructions.

i Recommendations for assay design and optimization

- For best qPCR efficiency, design assays targeting an amplicon size of 70–150 bp
- The iTaq Universal Probes One-Step Kit cycling protocols have been optimized for assays with a primer melting temperature (T_m) of 60°C designed using the open source Primer3, Primer3Plus, or Primer-BLAST programs at their default settings. If primers are designed using other programs, adjust the annealing temperature accordingly
- The probe's T_m should be 8–10°C higher than the calculated primer T_m
- In a duplex reaction, for best results apply the brighter fluorophores to the lower-expressing targets and the dimmer fluorophores to the higher-expressing targets

Optimizing Input Cell Number and Input Lysate Amount

For best results the SingleShot probes qPCR control can be used to determine optimal input cell number and optimal input lysate volume.

The SingleShot probes RNA control includes a synthetic RNA template that has no homology to any known sequence and a qPCR assay specific for this RNA template.

The template RNA is shipped lyophilized. Upon resuspension, store at –80°C.

Using the SingleShot Probes qPCR Control Assay to Determine Optimal Input Cell Number

i To determine optimal input cell number, adherent cells must be trypsinized for accurate cell counting

1. Resuspend the RNA control template in 200 µl of nuclease-free TE buffer pH 7.5.
2. Prepare a tenfold serial dilution of 100,000–10 cells in PBS.
3. Prepare the SingleShot cell lysis master mix according to the directions in Table 5.

Table 5. Preparation of SingleShot cell lysis master mix for optimizing input cell number.

Reagent	Reagent per 4-log Tenfold Dilution Series in a 96-Well Plate, µl
SingleShot Cell Lysis Buffer	235
Proteinase K Solution	5
DNase Solution	5
SingleShot RNA Control Template	5
Total volume	250

4. Prepare the RT-qPCR reactions following the recommendations in Table 6. Do not add cell lysate until step 7. Maintain the same input lysate, cDNA, and RT-qPCR volumes for all reactions in this experiment.
 - ① If desired, gene expression targets of interest with non-HEX probes can be amplified in parallel with the RNA control assay. Adjust volumes in Table 6 accordingly.

Table 6. Preparation of RT-qPCR reaction mix for optimizing input cell number.*

Component	Volume per 10 μ l Reaction, μ l	Volume per 20 μ l Reactions, μ l	Final Concentration
iTaq Universal Probes One-Step Reaction Mix (2x)	5	10	1x
iScript Reverse Transcriptase	0.25	0.5	1x
SingleShot Probes qPCR Control Assay	0.5	1	1x
Fluorogenic Probe(s)	Variable	Variable	150–250 nM each primer
Cell Lysate (add at step 7)	1–2	2–4	—
Nuclease-Free Water	Variable	Variable	—
Total reaction mix volume	10	20	—

* Scale all components proportionally according to sample number and reaction volumes.

5. Mix the RT-qPCR reaction mix thoroughly to ensure homogeneity and dispense equal aliquots into each PCR tube or into the wells of a PCR plate. Use good pipetting technique to ensure assay precision and accuracy.
6. Add cell lysate to the PCR tubes or wells containing RT-qPCR reaction mix (prepared using Table 6), seal tubes or wells with flat caps or optically transparent film, and gently vortex to ensure thorough mixing of the reaction components. Spin the tubes or plate to remove any air bubbles and to collect the reaction mixture in the vessel bottom.
7. Program the thermal cycling protocol on a real-time PCR instrument according to Table 4.

8. Perform data analysis according to the following guidelines:
- RNA control: Plot the C_q values for the RNA control against the log of the number of cells used to generate the lysate (Figure 1). A constant C_q value across the input cell range indicates complete lysis and no RT-qPCR inhibition. A deviation of >1 C_q value indicates incomplete lysis and/or RT-qPCR inhibition. Input cell numbers that show such a C_q deviation should be avoided. In the example shown in Figure 1, optimal performance can be achieved with 100,000–10 input cells
 - Target gene: Plot the C_q values for the target gene against the log of the number of cells used to generate the lysate (Figure 1). A decrease in C_q value is expected as cell number increases. The decrease in C_q values should be linear for cell numbers that don't exhibit inhibitory effects. A deviation from linearity results from incomplete lysis and/or RT-qPCR inhibition.

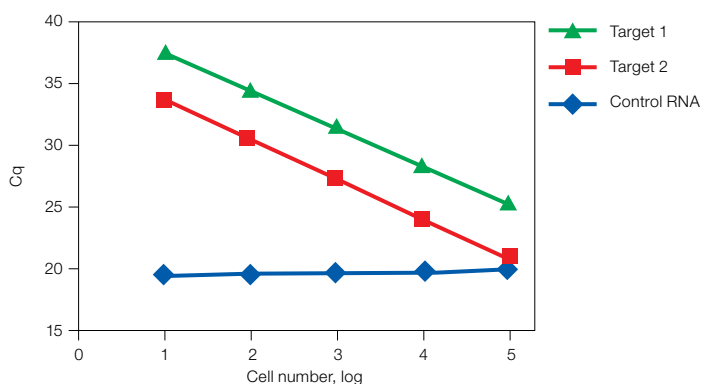


Fig. 1. Determining optimal cell input number. In this example, 10^5 input cells is the maximum input. No inhibition was noted across the input series. Target genes demonstrate linearity across all four logs.

Using the SingleShot Probes qPCR Control Assay to Determine Optimal Input Lysate Volume

1. Resuspend the SingleShot RNA control template in 200 μ l of nuclease-free TE buffer pH 7.5.
2. Prepare cell lysate from either adherent (see Processing of Adherent Cells in a 96-Well Culture Plate section) or suspension cells (see Processing of Nonadherent Cells in a 96-Well PCR Plate section) with an optimal number of input cells.
3. Vary input lysate in the RT-qPCR reactions as shown in Table 7.
4. Program the thermal cycling protocol on a real-time PCR instrument according to Table 4.

Table 7. Setup for a lysate titration for a one-step RT-qPCR reaction.

Input Lysate, %	Lysate Volume, μ l	SingleShot RNA Control Template, μ l	SingleShot Probes qPCR Control Assay, μ l	2x iTaq Universal Probes One-Step Reaction Mix, μ l	Nuclease-Free H ₂ O, μ l
10	2	1	1	10	6
40	3	1	1	10	5
45	4	1	1	10	4

5. Perform data analysis according to the following guidelines:

- RNA control: Plot the C_q values for the RNA control against the percentage input lysate (Figure 2). A constant C_q value across the input lysate range indicates no RT-qPCR inhibition. A deviation of >1 C_q value indicates RT-qPCR inhibition. Input lysate amounts that show such a C_q deviation should be avoided. In the example shown in Figure 2, optimal performance can be achieved with input lysate up to 20%.
- Target gene: If a target gene is amplified in parallel with the RNA control, plot the C_q values for the target gene against the percentage input lysate (Figure 2). A decrease in C_q value is expected as input lysate increases. Deviation in the linear response of the RNA control results from incomplete lysis and/or RT-qPCR inhibition.

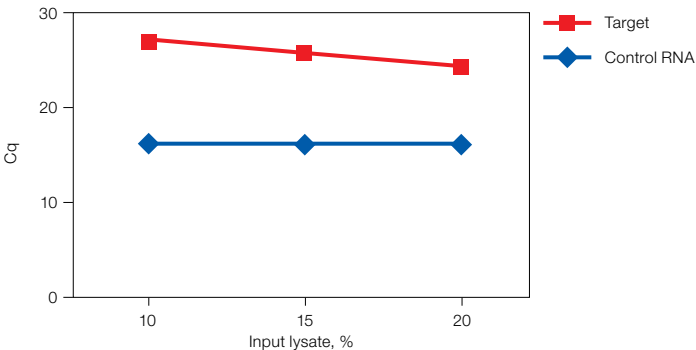


Fig. 2. Determining optimal input cell lysate amount. This one-step RT-qPCR reaction shows no PCR inhibition across all tested input lysate amounts. C_q, quantification cycle.

Appendix A

Table 1. Amount of reagents needed for different cell culture plates.*

Step	Guidelines						
	Number of wells	384	96	48	24	12	6
Preparing the cell culture	Cell numbers per well at harvest	10– 5 x 10 ⁴	10– 1 x 10 ⁵	10– 2 x 10 ⁵	10– 4 x 10 ⁵	10– 8 x 10 ⁵	10– 1 x 10 ⁶
	Washing the cells with PBS	Volume of PBS per well, μ l	30	125	250	500	1,000
Preparing the SingleShot cell lysis master mix	SingleShot Cell Lysis Buffer, μ l	12	48	96	192	384	768
	Proteinase K, μ l	0.25	1	2	4	8	16
	DNase, μ l	0.25	1	2	4	8	16
	Total volume per well, μl	12.5	50	100	200	400	800

* Prepare excess SingleShot cell lysis master mix to ensure enough reagent is available.

Troubleshooting Guide

Problem	Potential Cause	Solution
No amplification in the RT-qPCR reaction Delayed C _q values seen in RNA detection	<ul style="list-style-type: none"> ■ Cell lines may contain high levels of PCR inhibitors ■ Excess number of cells used in the lysis reaction ■ Excess cell culture medium carryover ■ Excess lysate used in the RT-qPCR reaction 	<ul style="list-style-type: none"> ■ Depending on the cell type or culture conditions, the input number of cells or percentage lysate may require optimization (see Optimizing Input Cell Number and Input Cell Lysate Amount section) ■ Generally $\leq 10^6$ cells can be used successfully in the SingleShot procedure, but if RT or qPCR fails, try using 5- to 10-fold fewer cells ■ Wash cells with PBS to remove contaminants from the culture medium ■ Wash cells twice with PBS to minimize inhibition from excess cell culture medium carryover ■ Remove as much of the culture medium and PBS as possible ■ Use a freshly prepared SingleShot cell lysis master mix; keep on ice and use within 2 hr ■ Make sure DNase and proteinase K are added in the SingleShot cell lysis master mix before cell lysis
Genomic DNA is amplified as indicated by a positive signal in the no-RT control	<ul style="list-style-type: none"> ■ Incomplete gDNA digestion ■ DNase and Proteinase K were not added to the lysis reaction 	<ul style="list-style-type: none"> ■ Repeat the lysis step. Ensure DNase is added, the thermal cycling conditions are correct, and the thermal cycler is working properly
Signal in no template control (NTC) reaction	<ul style="list-style-type: none"> ■ DNA contamination (NTC melt peak T_m is identical to the target gene melt peak T_m) ■ Primer dimers (NTC melt peak is broad with a T_m ~65–75°C) 	<ul style="list-style-type: none"> ■ Examine the workflow to identify potential contamination sources; replace reagents one by one until the contamination source is identified. Be sure to use filtered pipet tips ■ Evaluate the assay design for primer dimer formation; use gradient PCR to optimize the annealing temperature; use a primer matrix to determine the optimal primer concentration

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