

KAPA PROBE FORCE qPCR Master Mix (2X) Universal Kit

KR1140_S – v3.20

Product Description

The KAPA PROBE FORCE qPCR Master Mix Universal Kit is designed for real-time PCR using sequence-specific fluorogenic probes. This master mix is compatible with many fluorogenic probe-based technologies, including hybridization probes (e.g., FRET), hydrolysis probes (e.g., TaqMan®) and displacement probes (e.g., molecular beacons).

KAPA PROBE FORCE qPCR Master Mix is a ready-to-use cocktail containing all components except primers, probe(s), and template for probe-based real-time PCR. The 2X Master Mix contains KAPA3G HotStart DNA Polymerase, dNTPs (including dUTP), MgCl₂ (4.5 mM at 1X), ROX reference dye, and stabilizers.

The KAPA PROBE FORCE qPCR Master Mix contains the novel KAPA3G DNA Polymerase, which was engineered via a process of directed evolution for improved tolerance to common PCR inhibitors, carry-over inhibitors from crude DNA extraction methods, and high concentration of salts. The unique characteristics of this evolved enzyme result in robust amplification across a wide range of sample types, extraction and purification methods. The KAPA PROBE FORCE qPCR Master Mix is also very well suited to amplification of templates directly from cDNA synthesis reactions.

Product Applications

The KAPA PROBE FORCE qPCR Master Mix is ideally suited for:

- Direct qPCR analysis of challenging sample types without purification (e.g., crude DNA extractions from blood, tissue, and plant)
- Gene expression analysis (cDNA templates and direct carry-over from cDNA synthesis reactions)
- High-throughput workflows, such as mouse genotyping, GMO testing, and SNP detection.

Product Specifications

Shipping and storage

KAPA PROBE FORCE qPCR Master Mix Universal is shipped on ice packs or dry ice, depending on the country of shipping. Upon arrival, store the master mix at -15°C to -25°C in a constant-temperature freezer. When stored under these conditions and handled correctly, the master mix will retain full activity until the expiry date indicated on the kit label.

Kapa/Roche Kit Codes and Components*

KK4300 (100 x 20 µL reactions)	KAPA PROBE FORCE Master Mix (2X) Universal
KK4301 (500 x 20 µL reactions)	

* These kits are suitable for all ABI instruments, regardless of ROX requirements, as well as for all instruments that do not require ROX as a passive reference dye. Refer to your instrument manual to determine whether ROX normalization is required.

Quick Notes

- This kit contains the KAPA3G HotStart DNA Polymerase enzyme, enabling probe-based qPCR for both routine and challenging sample types.
- Initial denaturation of 3 min at 98°C is recommended to ensure complete denaturation of complex target DNA. A 5-min denaturation time may be required for some crude samples.
- For two-step cycling, use a 20-sec combined annealing/extension/data acquisition at 60°C as a first approach.
- A 10-sec annealing/extension/data acquisition time may be used with most assays, but this must be determined empirically.
- For crude samples, the amount of sample in the reaction may be reduced to improve performance, but this must be determined empirically.

Handling

ROX reference dye is sensitive to light exposure. Always ensure that the product has been fully thawed and mixed before use. Avoid repeated freezing and thawing.

Quality control

KAPA PROBE FORCE qPCR Master Mix Universal is subjected to stringent functional quality control, free of detectable contaminating exo- and endonuclease activities, and meets strict requirements with respect to DNA contamination.

Safety Information

Precautions

- Handle all samples as if potentially infectious, using safe laboratory procedures. As the sensitivity and titer of potential pathogens in the sample material can vary, the operator must optimize pathogen inactivation and follow the appropriate measures according to local safety regulations.
- Do not eat, drink, or smoke in the laboratory area.
- Do not pipette by mouth.
- Wear protective disposable gloves, laboratory coats, and eye protection, when handling samples and kit reagents.
- Wash hands thoroughly after handling samples and reagents.

Waste handling

- Discard unused reagents and waste in accordance with country, federal, state, and local regulations.
- Safety Data Sheets (SDS) are available online at www.sigmaaldrich.com, or upon request from www.sigma-aldrich.com/techservice.

KAPA PROBE FORCE qPCR Protocol

Any existing qPCR assay performed efficiently using standard cycling conditions may be converted to faster qPCR assays with the KAPA PROBE FORCE qPCR Master Mix. Typically, minimal re-optimization of reaction parameters is required.

Step 1: Set up the master mix

- Ensure that all reagents are properly thawed and mixed.
- Calculate the required volumes of each component based on the following table:

Component	20 μ L reaction ¹	Final conc.
PCR-grade water	Up to 20 μ L	N/A
KAPA PROBE FORCE qPCR Master Mix (2X) Universal ²	10.0 μ L	1X
10 μ M Forward Primer	0.4 μ L	0.2 μ M ³
10 μ M Reverse Primer	0.4 μ L	0.2 μ M ³
10 μ M Probe	0.4 μ L	0.2 μ M ³
Template DNA	As required	As required

¹ Reaction volumes may be adjusted between 5 – 25 μ L. Reaction volumes >25 μ L are not recommended.

² Final MgCl₂ concentration at 1X is 4.5 mM. A higher concentration should not be required for the majority of assays. See **Important Parameters: Magnesium Chloride** for further details.

³ Use the lowest primer/probe concentration that will still give optimal reaction efficiency. See **Important Parameters: Primer and Probes** for further details.

- Prepare a PCR master mix consisting of the appropriate volumes of KAPA PROBE FORCE qPCR Master Mix, PCR-grade water and any other component (e.g., primers or probes) that is common to all or a subset of the reactions to be performed. Ensure that first the reaction components, and then the qPCR master mix, are mixed properly.

Step 2: Set up individual reactions

- Transfer the appropriate volumes of qPCR master mix, template and primer to individual PCR tubes or wells of a PCR plate.
- Cap or seal the reaction tube/plate, mix and centrifuge briefly.

Step 3: Perform the qPCR reaction

- If applicable, select fast mode on the instrument.
- Confirm that the qPCR protocol to be used conforms to the following parameters:

Step	Temperature	Duration	Cycles
Enzyme inactivation/ template denaturation ¹	98°C	3 min	1
Denaturation ²	95°C	10 sec	30–45
Annealing/extension/ acquisition ³	55–65°C	10–30 sec	

¹ 20 sec at 98°C is sufficient for enzyme activation; however, optimal denaturation of complex targets may require up to 3-min denaturation. Some crude-sample templates may require 5–10 min initial denaturation for optimal results.

² Start with a 10-sec denaturation time, but 3–5 sec is sufficient for most amplicons in a 20 µL reaction.

³ A 10-sec annealing/extension time is sufficient for most assays with PCR products below 200 bp. For 3-step cycling protocols, anneal at optimal annealing temperature for 20 sec followed by the minimum time required for data acquisition at 72°C, according to instrument guidelines.

Step 4: Analyze the results

- Data analysis is dependent on experimental design. Refer to your instrument guidelines for more information on how to perform the appropriate data analysis.

Important Parameters

Primers and Probes

The use of previously-validated assays or dedicated qPCR design software, such as Beacon Designer 7 (http://www.premierbiosoft.com/molecular_beacons/index.html), is recommended when designing probe-based assays.

Lyophilized primers and probes should be resuspended in 10 mM Tris-HCl (pH 8.0–8.5). A freezer stock should be prepared at an initial concentration of 100 µM, which should be thawed only as necessary. Primers and probes should be resuspended and diluted in a nuclease-free buffer, and stored at -20°C in Low-bind tubes. Stored in this manner, they should be stable for years.

Optimal primer concentration should be determined empirically. A primer/probe concentration of 0.2–0.3 µM is recommended as a first approach. The typical concentration range is 0.1–0.5 µM for both primers and probes. To maximize the sensitivity of the assay without compromising reaction efficiency, use the lowest concentration of primers and probe(s) possible.

Purified DNA Samples

Purified DNA prepared with commercially-available extraction kits or other methods may be used at high concentrations in each KAPA PROBE FORCE qPCR reaction (efficiency and linearity have been maintained up to 200 ng DNA/20 µL reaction).

Crude-extract and Crude Samples

Crude-extract or crude samples are generally better suited for qualitative, rather than quantitative, analyses because of variations in DNA extraction efficiency, PCR inhibition, etc. Always include a positive control reaction with purified DNA in each experiment to benchmark performance.

Some crude extracts or crude samples may lead to cleavage of the probe; these samples are not suitable for qPCR.

Crude DNA extraction methods may be used in conjunction with KAPA PROBE FORCE qPCR Master Mix, including:

- KAPA Express Extract
- NaOH-based extractions for plant and mammalian DNA¹
- KAPA3G Plant Extraction Buffer²:
 - 50 mM Tris-HCl (pH 8.0–8.5)
 - 0.1 mM EDTA
 - 2% β-mercaptoethanol

¹ The KAPA PROBE FORCE qPCR Master Mix can tolerate up to 50 mM final NaOH in the reaction, allowing some samples to be added directly without neutralization.

² Dithiothreitol (DTT) may be used at a final concentration of 10 mM as an alternative should β-mercaptoethanol not be available. The stability of an extract prepared from a particular sample type should be determined empirically. Extracts prepared with this protocol using Extraction Buffer with β-mercaptoethanol are typically stable for 3–5 days at 2°C to 8°C. Extracts prepared using Extraction Buffer with DTT are generally less stable, so DTT should only be used if β-mercaptoethanol is not an option.

Sample Volume

The optimal volume of either crude DNA extract or crude sample per reaction should be determined empirically.

For crude DNA extracts, inhibition should be assessed by performing a titration of crude extract spiked into a reaction with purified DNA. Inhibition is determined by the measurement of later C_q scores compared to reactions containing only purified DNA.

For crude samples, the least amount that can be sampled reproducibly, will work best. Optimization of reaction volume may also be considered to improve performance.

For leaf tissue, a disc made by a 0.35 mm diameter punch is suggested. Other sampling devices, such as needles, have also been used with success. FTA and other blood cards work well, with the use of one or two 0.5 mm punch(es) added directly to a 20 µL reaction.

ROX Reference Dye

For certain real-time cyclers, the presence of the passive reference dye, ROX, compensates for non-PCR related variations in fluorescence detection. Fluorescence from the ROX reference dye does not change during the course of real-time PCR, but provides a stable baseline against which PCR-related fluorescent signals are normalized. Thus, the ROX dye compensates for differences in fluorescence detection between wells due to slight variations in reaction volume or differences in well position. The use of ROX reference dye is necessary for all Applied Biosystems instruments and is optional for the Agilent Mx3000P™, Mx3005P™ and Mx4000™ cyclers. Bio-Rad/MJ Research, Cepheid, Qiagen (formerly Corbett Research), Eppendorf and Roche instruments do not require ROX. The presence of the ROX reference dye in the master mix does not interfere with real-time PCR on any instrument, since the dye is not involved in the reaction and has an emission spectrum different from that of the fluorophore with which the probe is labelled.

Magnesium Chloride

The concentration of MgCl₂ affects the binding dynamics of primers and probes with regard to the template DNA. A higher final MgCl₂ concentration in the PCR reaction increases the binding affinity of the primers and probes for target DNA, but too high a MgCl₂ concentration may result in non-specific interactions.

KAPA PROBE FORCE qPCR Master Mix provides MgCl₂ at a final concentration of 4.5 mM. This is sufficient for the majority of assays, but there may be assays where increasing the MgCl₂ concentration will increase performance, and this should be kept in mind during any assay optimisation or troubleshooting.

Some sample types may contain Mg-chelating compounds. Depending on the concentration of Mg-chelating compounds and amount of sample added to a reaction, this may significantly decrease the available concentration of magnesium ions in the PCR reaction. In this case, additional MgCl₂ should be added to optimize performance (titrate in 0.5 mM increments).

Troubleshooting

Symptoms	Possible causes	Solutions
Late C _q or no amplification during cycling	Too much crude sample or crude extract in the reaction	Use less crude sample, or a smaller volume of crude extract.
	Too short an initial denaturation time for crude samples	An initial denaturation time of 10 min will improve results with many crude sample types. Some crude sample types may require an even longer denaturation time.
	Incorrect reaction setup	Verify that all the components have been added at the correct concentrations.
	Effective magnesium concentration too low	Increase magnesium concentration in 0.5 mM increments.
	Non-specific products may be amplified	Increase annealing temperature in 2°C increments.
	Incorrect cycling protocol	Verify that the correct recommended cycling conditions were used.
	Incorrect annealing temperature	Decrease annealing temperature in 2°C increments.
	Incorrect detection filter/channel	Check that the correct filters have been selected for data acquisition.
	Degraded template DNA, primers, or probe	Always store and dilute primers and DNA in 10 mM Tris-HCl (pH 8.0 – 8.5), not in PCR-grade water.
	Sub-optimal primer/probe design	We recommend using prevalidated assays or designing assays using dedicated software.
Positive signal in no-template control (NTC)	Contamination of reagents	Discard all reagents and repeat experiment with new components.
	Contamination during setup	Review setup procedure and ensure that aerosol-barrier pipette tips are used.
	Degradation of primers and probe	Always store and dilute primers and DNA in 10 mM Tris-HCl (pH 8.0–8.5), not in PCR-grade water. Use new stocks of primers and probe or redesign the assay.
Extremely high ΔR_n or R _n values	ROX was not selected as the passive reference dye at setup	Select ROX as the passive reference dye when setting up the plate.
High variability across replicates	Insufficient mixing of reaction master mix	Ensure that the reaction master mix is properly mixed by vortexing or inverting the tube a sufficient number of times, followed by brief centrifugation.
	Insufficient mixing of template samples	As above.
	Faulty pipettes or poor pipetting technique	Calibrate pipettes, and verify pipetting technique.
	Evaporation	Ensure that lids are closed properly, or sealing film is properly attached.



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