

Primerdesign

R01374

# Middle East Respiratory Syndrome Coronavirus (MERS-CoV)

**Kit version: 1**

**Target region:**

Open Reading Frame 1ab (ORF1ab) gene

Open Reading Frame 5/E (ORF5/E) gene

genesig<sup>®</sup> COMPLETE RNA Kit

150 tests

G E N E S I G

Kits by Primerdesign

For general laboratory and research use only

# Product Description

This genesig® Complete qPCR detection kit targets the open reading frame 1ab (ORF1ab) gene and open reading frame 5/E (ORF5/E) gene from Middle East respiratory syndrome coronavirus (MERS-CoV). MERS-CoV is an RNA virus which circulates widely in camels (reservoir host) with humans as secondary hosts. Infection in humans can lead to Middle East Respiratory Syndrome (MERS), which is characterized by severe respiratory symptoms including fever, cough and shortness of breath.

## Specificity

The kit is designed for the in vitro quantification of Middle East respiratory syndrome coronavirus genomes and to have a broad detection profile. Specifically, the primers will detect over 95% of sequences available on the NCBI database at the time of last review.

This kit comprises two assays, each targeting different genes within the MERS-CoV genome. If a MERS-CoV strain exhibits significant sequence variation in one of the target genes that could affect detection, the other assay should still detect the strain. This dual-target approach provides the kit with greater reliability and resilience against new circulating variants.

The dynamics of genetic variation means that new sequence information may become available after the initial design. If you require further information or have a specific question about the detection profile of this kit then please send an e-mail to [techsupport@primerdesign.co.uk](mailto:techsupport@primerdesign.co.uk) and our team will answer your question.

# Kit contents

Quantity	Component	Tube	Cap Colour
1	<b>MERS_CoV_ORF1ab primer/probe mix (150 reactions)</b> FAM labelled		BROWN
1	<b>MERS_CoV_ORF5/E primer/probe mix (150 reactions)</b> FAM labelled		BROWN
1	<b>MERS_CoV_ORF1ab positive control template</b>		RED
1	<b>MERS_CoV_ORF5/E positive control template</b>		RED
2	<b>Internal extraction control primer/probe mix (150 reactions)</b> VIC labelled as standard		BROWN
1	<b>Internal extraction control RNA (150 reactions)</b>		BLUE
1	<b>Endogenous control primer/probe mix (150 reactions)</b> FAM labelled, Target: human ACTB as standard		BROWN
6	<b>oasig®PLUS OneStep Lyophilised qPCR Master Mix (50 reactions per glass vial)</b>		GOLD
7	<b>oasig® resuspension buffer</b> For resuspension of the oasig®PLUS OneStep Lyophilised qPCR Master Mix (and lyophilised ROX, if required)		BLUE
2	<b>oasig® lyophilised ROX</b> ROX passive reference dye that (if required) can be added to oasig®PLUS OneStep Lyophilised qPCR Master Mix.		BROWN
1	<b>RNase/DNase free water</b> for resuspension of primer/probe mixes		WHITE
3	<b>Template preparation buffer</b> for resuspension of internal control template, positive control template and standard curve preparation		YELLOW

# Reagents and equipment to be supplied by the user

## Real-time PCR Instrument

### Extraction kit

This kit is recommended for use with genesig® Easy DNA/RNA extraction kit or exsig®Mag. However, it is designed to work well with all processes that yield high-quality nucleic acid with minimal PCR inhibitors.

### Pipettors and filter tips

### Vortex and centrifuge

### 1.5 ml microtubes

### qPCR plates or reaction tubes

## Kit storage and stability

This kit is stable for shipping at ambient temperature but should be stored at -20°C upon arrival. Once the lyophilised components have been resuspended, they should not be exposed to temperatures above -20°C for longer than 30 minutes at a time and unnecessary repeated freeze/thawing should be avoided. The kit is stable for six months from the date of resuspension under these circumstances.

If a standard curve dilution series is prepared this can be stored frozen for an extended period. If you see any degradation in this serial dilution a fresh standard curve can be prepared from the positive control.

Primer Design Ltd does not recommend using the kit after the expiry date stated on the pack.

## Suitable sample material

This kit can be used with all types of samples from various origins. Please ensure that the extracted nucleic acid samples are suitable in terms of purity, concentration, and RNA integrity. An internal extraction control is provided to test for non-specific PCR inhibitors.

## Dynamic range of test

Under optimal PCR conditions the kit can achieve priming efficiencies between 90-110% and detect less than 100 copies of target template. If running a positive control standard curve for a quantitative result, and an efficiency of between 90% to 110% is not achieved, then the run should be repeated with a freshly prepared standard curve.

# Principles of the test

## Real-time PCR

A target specific primer and probe mix is provided, and this can be detected through the FAM channel.

The primer and probe mix provided exploits the so-called TaqMan® principle. During PCR amplification, forward and reverse primers hybridize to the target cDNA. A fluorogenic probe is included in the same reaction mixture which consists of a DNA probe labelled with a 5'-dye and a 3'-quencher. During PCR amplification, the probe is cleaved, and the reporter dye and quencher are separated. The resulting increase in fluorescence can be detected on a range of qPCR platforms.

## Positive control

For copy number determination and as a positive control for the PCR set up, the kit contains a positive control template. This can be used to generate a standard curve of target copy number/Cq value. Alternatively, the positive control can be used at a single dilution where full quantitative analysis of the samples is not required. Each time the kit is used, at least one positive control reaction must be included in the run. A positive result indicates that the primers and probes for detecting the target gene worked properly in that particular experimental scenario. If a negative result is obtained the test results are invalid and must be repeated. Care should be taken to ensure that the positive control does not contaminate any other kit component which would lead to false- positive results. This can be achieved by handling this component in a Post PCR environment. Care should also be taken to avoid cross-contamination of other samples when adding the positive control to the run. This can be avoided by sealing all other samples and negative controls before pipetting the positive control into the positive control well.

## Negative control

To validate any positive findings a negative control reaction should be included every time the kit is used. For this reaction the RNase/DNase free water should be used instead of template. A negative result indicates that the reagents have not become contaminated while setting up the run. It is also known as a No Template Control or NTC.

## Internal RNA extraction control

When performing RNA extraction, it is often advantageous to have an exogenous source of RNA template that is spiked into the lysis buffer. This control RNA is then co-purified with the sample RNA and can be detected as a positive control for the extraction process. Successful co-purification and qPCR for the control RNA also indicates that PCR inhibitors are not present at a high concentration.

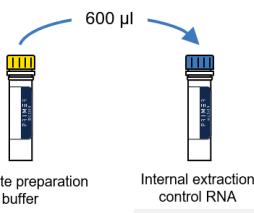
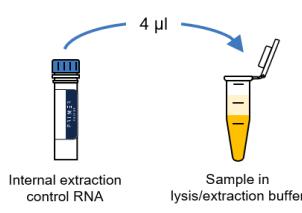
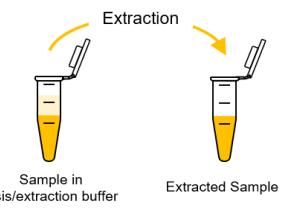
A separate primer and probe mix is supplied with this kit to detect the exogenous RNA using qPCR. The primers are present at PCR limiting concentrations which allows multiplexing with the target sequence primers. Amplification of the control RNA does not interfere with detection of the target RNA even when present at low copy number. The Internal control is detected through the VIC channel and gives a Cq value of 28+/-3 depending on the level of sample dilution.

## Endogenous control

A primer/probe mix for detection of the endogenous control gene is included in the kit, which allows confirmation of a valid biological sample from the host. Detection of the endogenous control is through the FAM channel, and it is therefore NOT possible to perform a multiplex reaction with the target specific primer/probe mix. Amplification of the endogenous control may depend on the sample type used. Please note that if samples from a different species are used, the endogenous control may not be appropriate, but the internal extraction control is advised to be used.

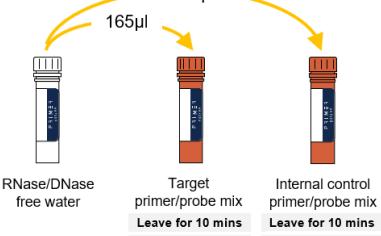
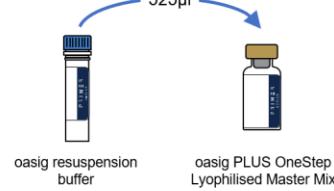
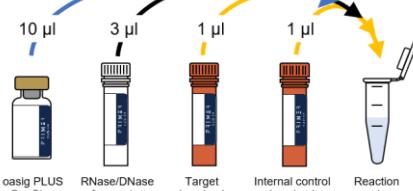
# genesig® Complete RNA Workflow

## 1. Sample Preparation

A) Resuspend the internal control	B) Add to the sample in lysis/extraction buffer *	C) Extract sample(s) with chosen protocol
 <p>Template preparation buffer Internal extraction control RNA Vortex to mix</p>	 <p>Internal extraction control RNA Sample in lysis/extraction buffer</p>	 <p>Sample in lysis/extraction buffer Extracted Sample</p>

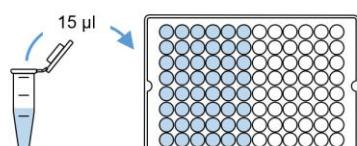
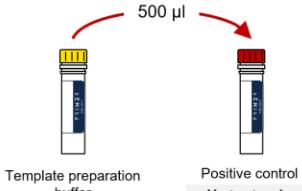
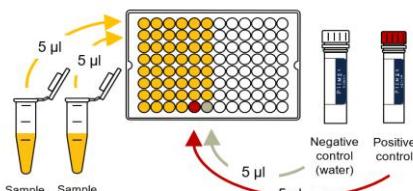
\*NOTE – DO NOT add internal extraction control RNA directly to the unprocessed biological sample as this will lead to degradation and a loss in signal.

## 2. Reaction Mix Preparation

A) Resuspend the primer/probe mix	B) Resuspend the oasig® Master Mix	C) Combine to make the reaction mix **
 <p>RNase/DNase free water Target primer/probe mix Leave for 10 mins Vortex to mix</p> <p>Internal control primer/probe mix Leave for 10 mins Vortex to mix</p>	 <p>oasig resuspension buffer oasig PLUS OneStep Lyophilised Master Mix Swirl to mix</p>	 <p>oasig PLUS OneStep Master Mix RNase/DNase free water Target primer/probe mix Internal control primer/probe mix Reaction mix</p>

\*\*NOTE – Displayed amounts are required for each reaction. Multiply each volume by the number of reactions required including overage.

## 3. Plate Setup

A) Add 15 μl of reaction mix to each well	B) Resuspend the Positive Control	C) Add 5 μl of the sample(s) to the well(s).
 <p>15 μl</p>	 <p>Template preparation buffer Positive control Vortex to mix</p>	 <p>Sample #1 Sample #2 Negative control (water) Positive control</p>

# Resuspension protocol

To minimize the risk of contamination with foreign RNA/DNA, we recommend that all pipetting is performed in a PCR clean environment. Ideally this would be a designated PCR lab or PCR cabinet. Filter tips are recommended for all pipetting steps.

## 1. Pulse-spin each tube in a centrifuge before opening.

This will ensure lyophilised primer/probe mix or template is in the base of the tube and is not lost upon opening the tube.

## 2. Resuspend the primer/probe mixes in the RNase/DNase free water supplied, according to the table below:

To ensure complete resuspension, allow primer/probe mix to rehydrate for 10 minutes at room temperature. Vortex each tube thoroughly, followed by pipetting up and down 10 times. Failure to mix well can produce poor kit performance.

Component - resuspend in water	Volume
<b>Pre-PCR pack</b>	
MERS_CoV_ORF1ab primer/probe mix (BROWN)	165 µl
MERS_CoV_ORF5/E primer/probe mix (BROWN)	165 µl
Internal extraction control primer/probe mix (BROWN)	165 µl
Endogenous control primer/probe mix (BROWN)	165 µl

## 3. Resuspend the oasis®PLUS OneStep Lyophilised qPCR Master Mix in oasis® resuspension buffer, according to the table below:

Component - resuspend in oasis® resuspension buffer	Volume
oasis®PLUS OneStep Lyophilised qPCR Master Mix (GOLD)	525 µl

**Please note:** If the kit is intended to be used with platforms that use ROX as a passive reference dye, please proceed to the **ROX Passive Reference Dye Handling Protocol** at the end of this handbook.

## 4. Resuspend the internal control template and positive control template in the template preparation buffer supplied, according to the table below:

To ensure complete resuspension, vortex each tube thoroughly.

Component - resuspend in template preparation buffer	Volume
<b>Pre-PCR heat-sealed foil</b>	
Internal extraction control RNA (BLUE)	600 µl
<b>Post-PCR heat-sealed foil</b>	
MERS_CoV_ORF1ab Positive Control Template (RED) *	500 µl
MERS_CoV_ORF5/E Positive Control Template (RED) *	500 µl

\* This component contains high copy number template and is a VERY significant contamination risk. It must be opened and handled in a separate laboratory environment, away from the other components.

# RNA extraction

The internal extraction control RNA can be added either to the RNA lysis/extraction buffer or to the RNA sample once it has been resuspended in lysis buffer.

**DO NOT add the internal extraction control RNA directly to the unprocessed biological sample as this will lead to degradation and a loss in signal.**

1. Add 4 µl of the Internal extraction control RNA (BLUE) to each sample in RNA lysis/extraction buffer.
2. Complete RNA extraction according to the manufacturer's protocols.

## OneStep RT-qPCR detection protocol

### For optimum performance and sensitivity.

All pipetting steps and experimental plate set up should be performed on ice. After the plate is prepared proceed immediately to the OneStep amplification protocol. Prolonged incubation of reaction mixes at room temperature can lead to PCR artifacts that reduce the sensitivity of detection.

1. **For each RNA sample prepare a reaction mix according to the table below:**  
Include sufficient reactions for positive and negative controls.

Component	Volume
oasisig®PLUS OneStep Lyophilised qPCR Master Mix (GOLD)	10 µl
MERS_CoV_ORF1ab <b>or</b> MERS_CoV_ORF5/E primer/probe mix (BROWN)	1 µl
Internal extraction control primer/probe mix (BROWN)	1 µl
RNase/DNase free water (WHITE)	3 µl
<b>Final Volume</b>	<b>15 µl</b>

2. **(Optional – if you wish to run an endogenous control reaction for each sample, you will need to purchase additional Master Mix for this). For each RNA sample prepare an endogenous control reaction according to the table below.**

This control reaction will provide useful information regarding the quality of the biological sample.

Component	Volume
oasisig®PLUS OneStep Lyophilised qPCR Master Mix (GOLD)	10 µl
Endogenous control primer/probe mix (BROWN)	1 µl
RNase/DNase free water (WHITE)	4 µl
<b>Final Volume</b>	<b>15 µl</b>

3. Pipette 15 µl of these mixes into each well according to your experimental plate set up.
4. Pipette 5 µl of RNA template into each well, according to your experimental plate set up.

For negative control wells use 5 µl of RNase/DNase free water (**WHITE**). For positive control wells use 5 µl of the positive control template (**RED**). The final volume in each well is 20 µl.

#### 5. (Optional) Standard curve preparation for quantitative analysis.

For quantitative analysis of the samples a standard curve dilution series can be prepared using the positive control template (**RED**). This is not required for qualitative analysis.

##### 5.1 Reaction mix preparation for the standard curve.

Include sufficient reactions for each dilution of the standard curve.

Component	Volume
oasig®PLUS OneStep Lyophilised qPCR Master Mix ( <b>GOLD</b> )	10 µl
MERS_CoV_ORF1ab <b>or</b> MERS_CoV_ORF5/E primer/probe mix ( <b>BROWN</b> )	1 µl
RNase/DNase free water ( <b>WHITE</b> )	4 µl
<b>Final Volume</b>	<b>15 µl</b>

##### 5.2 Preparation of a 10-fold standard curve dilution series.

- a. Pipette 90 µl of template preparation buffer (**YELLOW**) into 5 tubes and label them tube 2-6. The neat positive control tube (**RED**) is considered tube 1.
- b. Pipette 10 µl of positive control template (**RED**) into tube 2.
- c. Vortex thoroughly.
- d. Change pipette tip and pipette 10 µl from tube 2 into tube 3.
- e. Vortex thoroughly.

Repeat steps d and e to complete the dilution series.

Standard Curve	Copy Number
Tube 1 Positive control ( <b>RED</b> )	$2 \times 10^5$ per µl
Tube 2	$2 \times 10^4$ per µl
Tube 3	$2 \times 10^3$ per µl
Tube 4	$2 \times 10^2$ per µl
Tube 5	20 per µl
Tube 6	2 per µl

##### 5.3. Pipette 15 µl of reaction mix and 5 µl of the respective standard into each well for the standard curve according to your plate set up.

The final volume in each well is 20 µl.

# OneStep RT-qPCR Amplification Protocol

Recommended amplification conditions when using oasisig®PLUS OneStep Lyophilised qPCR Master Mix.

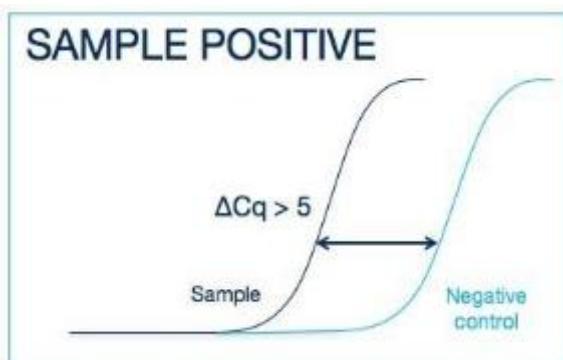
	<b>Step</b>	<b>Time</b>	<b>Temp</b>
Cycling x50	Reverse Transcription	10 min	55 °C
	Enzyme activation	2 min	95 °C
	Denaturation	10 s	95 °C
	DATA COLLECTION *	60 s	60 °C

\* Fluorogenic data should be collected during this step through the FAM and VIC channels

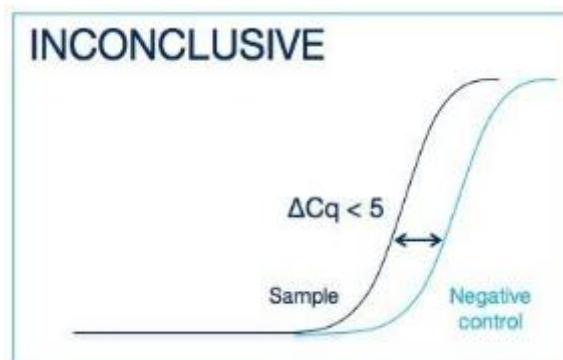
# Interpretation of results

Target (FAM)	Internal control (VIC)	Positive control	Negative control	Interpretation
$\leq 30$	+ / -	+	-	<b>POSITIVE QUANTITATIVE RESULT</b> calculate copy number
$> 30$	+	+	-	<b>POSITIVE QUANTITATIVE RESULT</b> calculate copy number
$> 30$	-	+	-	<b>POSITIVE QUALITATIVE RESULT</b> do not report copy number as this may be due to poor sample extraction
-	+	+	-	<b>NEGATIVE RESULT</b>
+ / -	+ / -	+	$\leq 35$	<b>EXPERIMENT FAILED</b> due to test contamination
+ / -	+ / -	+	$> 35$	*
-	-	+	-	<b>SAMPLE PREPARATION FAILED</b>
+ / -	+ / -	-	+ / -	<b>EXPERIMENT FAILED</b>

\*Where the test sample is positive and the negative control is positive with a Cq > 35, the sample must be reinterpreted based on the relative signal strength of the two results:



If the sample amplifies  $> 5$  Cq earlier than the negative control, then the sample should be reinterpreted (via the table above) with the negative control verified as negative.



If the sample amplifies  $< 5$  Cq earlier than the negative control, then the positive sample result is invalidated, and the result should be determined inconclusive due to test contamination. The test for this sample should be repeated.

## Positive Control

The positive control template is expected to amplify between Cq 16 – 23 in the FAM channel. Failure to satisfy this quality control criterion is a strong indication that the experiment has been compromised and should be repeated.

## Internal PCR control

The Cq value obtained with the internal control will vary significantly depending on the extraction efficiency, the quantity of RNA added to the PCR reaction and the individual machine settings. Cq values of  $28 \pm 3$  are within the normal range. When amplifying a target sample with a high genome copy number, the internal extraction control may not produce an amplification plot. This does not invalidate the test and should be interpreted as a positive experimental result.

## Endogenous control

The signal obtained from the endogenous control primer and probe set will vary according to the amount of biological material present in a given sample. An early signal indicates the presence of a good yield of biological material. A late signal suggests that little biological material is present in the sample.

## ROX Reference Dye Handling Protocol

ROX is recommended for platforms that use ROX as a passive reference dye. Use the table below to see if ROX addition is required for your hardware platform. If ROX is required, then follow the instructions below.

- Resuspend the Lyophilised ROX (**BROWN**) in the correct volume of the oasig® resuspension buffer (**BLUE**) according to the table below.
- Add resuspended ROX to each Master Mix vial at the correct level.

Real time PCR platform	ROX resuspension volume	ROX addition per Master Mix vial
Applied Biosystems 7700, 7000, and 7900, 7300 StepOne, StepOnePLUS and ViA7 platforms, Roche capillary Lightcyclers	100 µl	20 µl
All Stratagene platforms	200 µl	15 µl
Applied Biosystems 7500 platform Quantstudio™	700 µl	10 µl
All other machines	NOT REQUIRED	NOT REQUIRED

Once ROX passive reference dye has been added to the oasig®PLUS OneStep Lyophilised qPCR Master Mix (**GOLD**), proceed with the rest of the protocol.

# Notices and disclaimers

This product is developed, designed and sold for research purposes only. It is not intended for human diagnostic or drug purposes or to be administered to humans unless clearly expressed for that purpose by the Food and Drug Administration in the USA or the appropriate regulatory authorities in the country of use. During the warranty period Primer Design Ltd genesig® detection kits allow precise and reproducible data recovery combined with excellent sensitivity. For data obtained by violation to the general GLP guidelines and the manufacturer's recommendations the right to claim under guarantee is expired.

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