

Instructions for use

AltoStar[®]

MERS-CoV RT-PCR Kit 1.5

04/2022 EN

AltoStar[®]

MERS-CoV RT-PCR Kit 1.5

For use with

ABI Prism[®] 7500 SDS (Applied Biosystems)

CFX96[™] Deep Well Dx System (Bio-Rad)

CFX96[™] Dx System (Bio-Rad)

LightCycler[®] 480 Instrument II (Roche)

QuantStudio[™] 5 Real-Time PCR System (Applied Biosystems)

Rotor-Gene[®] Q5/6 plex Platform (QIAGEN)



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1. About these instructions for use

These instructions for use guide the user in utilizing the AltoStar® MERS-CoV RT-PCR Kit 1.5. Chapters 1–6 and 9–14 contain general information and instructions which apply to each workflow used with the AltoStar® MERS-CoV RT-PCR Kit 1.5. Chapter 7 gives instructions on how to use the product with the AltoStar® Automation System AM16 (Hamilton; in the following summarized as AltoStar® AM16) with the AltoStar® Connect software (Version 1.7.4 or higher, Hamilton) for automated PCR setup and on the CFX96™ Deep Well Dx System* (Bio-Rad, in the following summarized as CFX96™ DW Dx) with the CFX Manager™ Dx software (Version 3.1, Bio-Rad) for real-time PCR. Chapter 8 gives instructions regarding how to use the AltoStar® MERS-CoV RT-PCR Kit 1.5 in conjunction with other nucleic acid extraction methods and real-time PCR instruments. For details on the use of the AltoStar® AM16, the AltoStar® Connect software, the AltoStar® Purification Kit 1.5, the AltoStar® Internal Control 1.5 and the CFX96™ DW Dx, refer to the respective instructions for use listed below:

- AltoStar® Automation System AM16 Operator's Manual IVD (Hamilton)
- AltoStar® Connect Software Manual IVD (Hamilton)
- Instructions for use AltoStar® Purification Kit 1.5
- Instructions for use AltoStar® Internal Control 1.5
- CFX96™ Dx and CFX96™ Deep Well Dx Systems Operation Manual (Bio-Rad)

* "CFX96™ Deep Well Dx System" is the new brand name for the IVD version of the CFX96™ Deep Well Real-Time PCR Detection System (Bio-Rad).

Throughout this manual, the terms CAUTION and NOTE have the following meanings:

CAUTION



Highlights operating instructions or procedures which, if not followed correctly, may result in personal injury or impact product performance. Contact altona Diagnostics technical support for assistance.

NOTE



Information is given to the user that is useful but not essential to the task at hand.

Read the instructions for use carefully before using the product.

2. Intended use

The AltoStar® MERS-CoV RT-PCR Kit 1.5 is an *in vitro* diagnostic test, based on real-time PCR technology, for the qualitative detection of Middle East respiratory syndrome coronavirus (MERS-CoV) specific RNA in human nasopharyngeal swabs. It is intended to be used as an aid for diagnosis of MERS-CoV infection.

The results generated with the AltoStar® MERS-CoV RT-PCR Kit 1.5 have to be interpreted in conjunction with other clinical and laboratory findings.

The AltoStar® MERS-CoV RT-PCR Kit 1.5 is intended for use by professional users trained in molecular biological techniques and *in vitro* diagnostic procedures.

3. Kit content

The AltoStar® MERS-CoV RT-PCR Kit 1.5 contains the following components:

Table 1: Kit components

Lid color	Component	Number of tubes	Nominal volume [µl/tube]
Blue	Master A (upE + N gene) ¹⁾	4	120 ²⁾
Light blue	Master A (orf1a) ¹⁾	4	120 ²⁾
Purple	Master B (upE + N gene) ¹⁾	4	360 ³⁾
Light purple	Master B (orf1a) ¹⁾	4	360 ³⁾
Red	PC (upE + N gene) ⁴⁾	1	250
Orange	PC (orf1a) ⁴⁾	1	250
White	NTC (upE + N gene) ⁵⁾	1	250
Transparent	NTC (orf1a) ⁵⁾	1	250

¹⁾ Contains biological material of animal origin

²⁾ Contains an additional volume of 25 µl to compensate the dead volume of the AltoStar® AM16's liquid handling

³⁾ Contains an additional volume of 55 µl to compensate the dead volume of the AltoStar® AM16's liquid handling

⁴⁾ Positive Control

⁵⁾ No Template Control (Negative Control)

CAUTION



Before first use check the product and its components for completeness with respect to number, type and filling. Do not use a defective or incomplete product, product performance could be compromised.

The AltoStar® MERS-CoV RT-PCR Kit 1.5 contains enough reagents to perform 96 reactions in a maximum number of 8 runs.

The product is shipped on dry ice. Upon receipt and before first use, check the product and its components for:

- Integrity
- Completeness with respect to number, type and filling
- Correct labeling
- Expiration date
- Frozen state
- Clarity and absence of particles

If one or more product components are not frozen upon receipt, if tubes have been compromised during shipment or are missing, contact altona Diagnostics technical support for assistance (see chapter 12. Technical support).

4. Storage and handling

All reagents included in the AltoStar® MERS-CoV RT-PCR Kit 1.5 are ready-to-use solutions.

4.1 Storage

All components of the AltoStar® MERS-CoV RT-PCR Kit 1.5 must be stored at -25 °C to -15 °C upon arrival.

CAUTION



Improper storage conditions could compromise product performance.

CAUTION



Do not use products beyond the expiration date. The use of expired products could compromise product performance.

4.2 Handling

CAUTION



Do not exceed thaw-freeze-sequence and handling durations specified in these instructions for use, as this could compromise product performance.

CAUTION



Improper handling of product components and samples may cause contamination and could compromise product performance:

- Do not interchange vial or bottle caps.
- Store positive and/or potentially positive material separated from the kit components.
- Use separated working areas for sample preparation/reaction setup and amplification/detection activities.
- Always dispose gloves after handling positive and/or potentially positive material.
- Do not open the PCR plates and/or tubes post amplification.

CAUTION



Do not mix components from different kit lots. The use of different kit lots could compromise product performance.

4.2.1 Master A and Master B

After thawing, Master A and Master B are stable for 5 hours at up to +30 °C.

NOTE



If Master A and Master B were thawed but not used, they can be refrozen and thawed again once for later runs. If opened, discard the lids and use new lids to avoid contamination of the reagents.

4.2.2 Positive Controls and No Template Controls

1. After thawing, the Positive Controls (PCs) and the No Template Controls (NTCs) are stable for 5 hours at up to +30 °C.
2. Discard the lids of the PCs and NTCs tubes at each use and use new lids to avoid contamination of the reagents.
3. After use close the PCs and NTCs tubes with new lids and freeze them immediately.
4. Do not exceed the following thaw-freeze-sequence for each PC and NTC tube:
Thaw 1 → Freeze 1 → Thaw 2 → Freeze 2 → Thaw 3 → Freeze 3 → Thaw 4

5. Product description

The AltoStar® MERS-CoV RT-PCR Kit 1.5 is an *in vitro* diagnostic test for the qualitative detection of MERS-CoV specific RNA in human nasopharyngeal swabs.

It is based on real-time RT-PCR technology, utilizing reverse-transcriptase (RT) reaction to convert RNA into complementary DNA (cDNA), polymerase chain reaction (PCR) for the amplification of MERS-CoV specific target sequences and fluorescently labeled target specific probes for the detection of the amplified DNA.

The AltoStar® MERS-CoV RT-PCR Kit 1.5 consists of two independent assays, one targeting a region upstream of the E gene (upE) as well as a region of the N gene and the other targeting open reading frame 1a (orf1a) of the MERS-CoV genome.

In addition to the MERS-CoV RNA specific amplification and detection system both assays include oligonucleotides for the amplification and detection of the internal control (in the following abbreviated as IC; AltoStar® Internal Control 1.5).

In both assays, probes specific for MERS-CoV RNA are labeled with the fluorophore FAM™. The probe specific for the IC is labeled with a fluorophore (JOE™) detectable in the e.g. VIC™ channel.

Using probes linked to distinguishable dyes enables the parallel detection of MERS-CoV specific RNA and the IC in corresponding detection channels of the real-time PCR instrument used.

5.1 Background

The Middle East respiratory syndrome coronavirus (MERS-CoV) belongs to the lineage C betacoronavirus in the family *Coronaviridae*. MERS-CoV was first identified in the Kingdom of Saudi Arabia in 2012 in a patient with acute respiratory distress syndrome [1]. MERS-CoV is an enveloped, positive-sense, single-stranded RNA virus with a genome size of 30 kb [2], encoding four structural proteins [3]. MERS-CoV is a zoonotic virus with dromedary camels as reservoir hosts most likely originating from bats. Main transmission routes for the virus are from dromedary camels to humans and human-to-human [1].

The clinical spectrum of MERS-CoV infection ranges from no symptoms or mild respiratory symptoms to severe acute respiratory disease and death. A typical presentation of MERS-CoV disease is fever, cough and shortness of breath. Pneumonia and gastrointestinal symptoms, including diarrhea, may also occur [4]. Severe illness can cause respiratory failure that requires mechanical ventilation and support in an intensive care unit. The virus appears to cause more severe disease in older people, and those with chronic diseases such as renal disease, cancer, chronic lung disease, and diabetes [3,4].

For molecular diagnostics, WHO recommends a two-step diagnostic scheme firstly screening samples with the so called *upE* assay followed by a confirmatory assay targeting *orf1a*. For samples with discrepant results for *upE* or *orf1a*, WHO recommends sequencing of a third target, the *RdRp* (RNA-dependent RNA polymerase) or the N gene. The AltoStar® MERS-CoV RT-PCR Kit 1.5 was developed based on these three described assays targeting *upE* and N gene as well as *orf1a* in parallel.

5.2 Component description

5.2.1 Masters A and Masters B

The Masters A and Masters B contain all components (PCR buffer, reverse transcriptase, DNA polymerase, magnesium salt, primers and probes) to allow reverse transcription, as well as the PCR mediated amplification and target detection of MERS-CoV specific RNA and of the IC in one reaction setup.

5.2.2 Positive Controls

The PC (upE + N gene) and PC (orf1a) contain standardized concentrations of MERS-CoV specific RNA. The PCs are used to verify the functionality of the MERS-CoV specific amplification and detection systems included in the AltoStar® MERS-CoV RT-PCR Kit 1.5.

5.2.3 No Template Controls

The NTC (upE + N gene) and NTC (orf1a) contain no MERS-CoV specific RNA but do contain the IC template. The NTCs are used as negative control for the MERS-CoV RNA specific real-time RT-PCR and indicate possible contamination of the Masters A and Masters B.

5.3 Workflows

5.3.1 AltoStar® Workflow

The AltoStar® Workflow comprises the following IVD products:

- AltoStar® Automation System AM16 (Hamilton)
- AltoStar® Connect software version 1.7.4 or higher (Hamilton)
- CFX96™ Deep Well Dx System (Bio-Rad) with CFX Manager™ Dx software version 3.1 (Bio-Rad)

The workflow includes the following steps:

1. Programming an AltoStar® run.
2. Purification run on the AltoStar® AM16 using the AltoStar® Purification Kit 1.5 and the AltoStar® Internal Control 1.5.
3. RT-PCR setup run on the AltoStar® AM16 using the AltoStar® MERS-CoV RT-PCR Kit 1.5.
4. Real-time RT-PCR run on a CFX96™ DW Dx.

For further details on steps 3 and 4 of the workflow, refer to chapter 7. Using the AltoStar® MERS-CoV RT-PCR Kit 1.5 with the AltoStar® Workflow. All sample types and sample volumes specified for use with the AltoStar® Purification Kit 1.5 can be processed simultaneously on the AltoStar® AM16. Each sample can be analyzed with as many real-time PCR assays in parallel as the available eluate allows.

NOTE



Assays with differing PCR temperature profiles are automatically sorted to separate PCR plates.

5.3.2 Other workflows

The AltoStar® MERS-CoV RT-PCR Kit 1.5 can be used with compatible workflows (manual or automated). Real-time PCR instruments that have been validated for use with the AltoStar® MERS-CoV RT-PCR Kit 1.5 are listed in chapter 5.3.2.2 Real-time PCR instruments. Use of alternative extraction procedures has to be validated by the user.

5.3.2.1 Nucleic acid extraction

The AltoStar® MERS-CoV RT-PCR Kit 1.5 can be used with nucleic acid extraction systems other than the AltoStar® AM16. Alternative procedures used for nucleic acid extraction have to be validated by the user. Refer to chapter 8.2.1 Sample preparation for instructions regarding how to use the AltoStar® Internal Control 1.5 in combination with other extraction methods than the AltoStar® Purification Kit 1.5.

5.3.2.2 Real-time PCR instruments

The AltoStar® MERS-CoV RT-PCR Kit 1.5 has been developed and validated with the following real-time PCR instruments:

- ABI Prism® 7500 SDS (Applied Biosystems)
- CFX96™ Deep Well Dx System (Bio-Rad)
- CFX96™ Dx System (Bio-Rad)

- LightCycler® 480 Instrument II (Roche)
- QuantStudio™ 5 Real-Time PCR System (Applied Biosystems)
- Rotor-Gene® Q5/6 plex Platform (QIAGEN)

Using one of the real-time PCR instruments listed above (except for the CFX96™ Deep Well Dx System), the PCR setup, the programming of the instrument as well as the data analysis have to be performed manually (for details see chapters 8.2.2 Master mix setup to 8.2.5 Data analysis).

5.4 Samples

5.4.1 Sample types

The following sample type is validated for use with the AltoStar® MERS-CoV RT-PCR Kit 1.5:

- Human nasopharyngeal swabs

CAUTION



Do not use other sample types! The use of other sample types could compromise product performance.

5.4.2 Sample collection and handling

Commercially available dacron fiber- or polyester-tipped swabs with plastic shafts have to be used for sample collection. Dry swabs must be resuspended in universal transport medium (e.g. UTM® from Copan). Calcium alginate swabs, swabs with wooden shafts and/or cotton tips as well as swabs collected in agar gel must not be used. Transport should occur following the local and national instructions for the transport of biological material.

Before use human nasopharyngeal swab specimens resuspended in UTM® should not be stored for more than 48 hours at room temperature (+20 °C to +25 °C), 5 days at +2 °C to +8 °C or 2 months at -25 °C to -15 °C.

CAUTION



Always treat samples as infectious and (bio-)hazardous material in accordance with safety and laboratory procedures. For sample material spills promptly use an appropriate disinfectant. Handle contaminated materials as biohazardous.

NOTE



Frozen storage of samples does not compromise kit performance. When working with frozen samples, make sure samples are completely thawed and properly mixed before use.

NOTE



The samples must be free of solids and high-viscosity constituents. Solids and high-viscosity constituents will interfere with the sample transfer on the AltoStar® AM16 and the samples will not be processed.

NOTE



Use of calcium alginate swabs might lead to incorrect or invalid results due to PCR inhibition.

NOTE



Use of swabs with wooden shafts and/or cotton tips or swabs with agar gel as transport medium may interfere with the sample transfer on the AltoStar® AM16 due to remains of wood, cotton and/or agar and the samples will not be processed.

6. Warnings, precautions and limitations

- Before first use check the product and its components for completeness with respect to number, type and filling. Do not use a defective or incomplete product, product performance could be compromised.
- Improper storage conditions could compromise product performance.
- Do not use products beyond the expiration date. The use of expired products could compromise product performance.
- Do not exceed thaw-freeze-sequence and handling durations specified in these instructions for use, as this could compromise product performance.
- Improper handling of product components and samples may cause contamination and could compromise product performance:
 - Do not interchange vial or bottle caps.
 - Store positive and/or potentially positive material separated from the kit components.
 - Use separated working areas for sample preparation/reaction setup and amplification/detection activities.
 - Always dispose gloves after handling positive and/or potentially positive material.
 - Do not open the PCR plates and/or tubes post amplification.
- Do not mix components from different kit lots. The use of different kit lots could compromise product performance.
- Do not use other sample types! The use of other sample types could compromise product performance.
- Always treat samples as infectious and (bio-)hazardous material in accordance with safety and laboratory procedures. For sample material spills promptly use an appropriate disinfectant. Handle contaminated materials as biohazardous.
- Storage of eluates under wrong conditions may lead to degradation of the MERS-CoV target sequence and could compromise product performance.
- Do not use an assay protocol version other than the one indicated on the 2D barcodes in these instructions for use. Using an incorrect assay protocol version could compromise product performance.
- A lack of centrifugation of the product components after thawing may cause contamination with reagent residues in the lids and could compromise product performance.

- Do not reuse tube caps to avoid contamination of the reagents, as this could compromise product performance.
- As with any diagnostic test, results shall be interpreted in consideration of all clinical and laboratory findings.
- The presence of PCR inhibitors could cause false negative or invalid results.
- Do not use different volumes of Master A and Master B for master mix setup than specified in these instructions for use, as this could compromise product performance.
- Do not exceed the PCR mix storage time, as this could compromise product performance.
- Do not mix up samples or sample IDs during PCR setup or transfer to the PCR instrument. This could lead to false positive or false negative results due to incorrect assignment of the samples.
- Do not use other cycling conditions than specified in these instructions for use, as this could compromise product performance.
- Do not use other control settings for data analysis than specified in these instructions for use, as this could cause incorrect IVD examination results.
- In case the sample contains other pathogens than MERS-CoV, competition with the target amplification or cross-reactivities may occur, causing incorrect IVD examination results.
- Disposal of hazardous and biological waste shall comply with local and national regulations to avoid environmental contamination.
- Potential mutations within the target regions of the MERS-CoV genome covered by primers and/or probes used in the kit may result in failure to detect the presence of the pathogen.

7. Using the AltoStar® MERS-CoV RT-PCR Kit 1.5 with the AltoStar® Workflow

The following part of these instructions for use describes the use of the AltoStar® MERS-CoV RT-PCR Kit 1.5 in conjunction with the AltoStar® Workflow. The AltoStar® Workflow comprises different IVD products (AltoStar® AM16, the AltoStar® Connect software, the AltoStar® Purification Kit 1.5, the AltoStar® Internal Control 1.5 and the CFX96™ DW Dx). Use of those products is described in detail in the respective instructions for use.

- AltoStar® Automation System AM16 Operator's Manual IVD (Hamilton)
- AltoStar® Connect Software Manual IVD (Hamilton)
- Instructions for use AltoStar® Purification Kit 1.5
- Instructions for use AltoStar® Internal Control 1.5
- CFX96™ Dx and CFX96™ Deep Well Dx Systems™ Operation Manual (Bio-Rad)

7.1 Sample volume

The AltoStar® MERS-CoV RT-PCR Kit 1.5 is validated for nucleic acid purifications from a sample volume of 500 µl using the AltoStar® AM16. Additional sample volume has to be provided to account for the dead volume of the sample tube used (see chapter 7.2 Sample tubes).

7.2 Sample tubes

Sample tubes suitable for use on the AltoStar® AM16 can be purchased from Altona Diagnostics (7 ml tube with cap, 82 x 13 mm, VK000010). Other sample tubes can be tested for applicability by the user. For details, refer to the instructions for use of the AltoStar® Purification Kit 1.5.

7.3 Sample barcodes

For automated sample identification by the AltoStar® AM16 all sample tubes must be labeled with a suitable barcode. For details, refer to the instructions for use of the AltoStar® Purification Kit 1.5.

7.4 Material and devices required but not provided for the AltoStar® Workflow

The material and devices shown in table 2 must be ordered from altona Diagnostics.

Table 2: Required material and devices

Material	Description	Order No.
AltoStar® Molecular Diagnostic Workflow	Product bundle containing the AltoStar® Automation System AM16, the AltoStar® Connect software (Version 1.7.4 or higher) and IT hardware	AM16
AltoStar® Detection	Product bundle containing the CFX96™ Deep Well Dx System with CFX Manager™ Dx Software (Version 3.1), a barcode scanner and IT hardware	DT16
AltoStar® Purification Kit 1.5	Nucleic acid isolation and purification chemistry for use with the AltoStar® Automation System AM16	PK15-46
AltoStar® Internal Control 1.5	Nucleic acid extraction and PCR amplification and detection control	IC15-46
PCR Plate	Semi-skirted, barcoded 96 multi-well plate with white wells	VK000005
PCR Plate Sealing Foil	Sealing foil for the PCR plate	VK000006
1,000 µl CO-RE Tips	1,000 µl filter tips for use with the AltoStar® Automation System AM16	VK000007
300 µl CO-RE Tips	300 µl filter tips for use with the AltoStar® Automation System AM16	VK000008
Pooling Tube	Barcoded tube for pooling of PCR reagents	VK000002
Waste Bag	Autoclavable sterile bag for use with the AltoStar® Automation System AM16	VK000009
Screw Cap - red	Screw cap for PC (upE + N gene) tubes	VK000012
Screw Cap - orange	Screw cap for PC (orf1a) tubes	VK000014

Material	Description	Order No.
Screw Cap - blue	Screw cap for Master A (upE + N gene) tubes	VK000013
Screw Cap - light blue	Screw cap for Master A (orf1a) tubes	VK000035
Screw Cap - purple	Screw cap for Master B (upE + N gene) tubes	VK000015
Screw Cap - light purple	Screw cap for Master B (orf1a) tubes	VK000036
Screw Cap - white	Screw cap for NTC (upE + N gene) tubes	VK000016
Screw Cap - transparent	Screw cap for NTC (orf1a) tubes	VK000037

Table 3: Additional laboratory material and devices

Material	Description	Order No.
Plate Sealer	e.g. AltoStar® Plate Sealer	VK000023
	e.g. PX1 Plate Sealer (Bio-Rad)	VK000033

7.5 General material and devices

- Vortex mixer
- Powder-free gloves (disposable)
- Centrifuge for centrifugation of the AltoStar® MERS-CoV RT-PCR Kit 1.5 components
- Centrifuge for centrifugation of PCR plates

7.6 Procedure

7.6.1 Overview of the AltoStar® Workflow

The steps of the complete AltoStar® Workflow are summarized in table 4. Information on specific settings for use with the AltoStar® MERS-CoV RT-PCR Kit 1.5 are provided in chapter 7.6.2 Programming an AltoStar® run. For detailed instructions for steps 1–5, refer to the instructions for use of the AltoStar® Purification Kit 1.5, the AltoStar® Connect software and the AltoStar® AM16.

Steps 6–11 are described in more detail in chapters 7.6.3 Starting a PCR setup run to 7.6.10 Export of PCR results for manual result interpretation.

Table 4: Overview of the AltoStar® Workflow

Step	Action
1. Start the AltoStar® AM16	<ul style="list-style-type: none"> • Switch on the AltoStar® AM16. • Switch on the computer and the monitor. • Start the AltoStar® Connect software.
2. Perform maintenance	<ul style="list-style-type: none"> • In the menu bar click Application → Instrument Maintenance. <ul style="list-style-type: none"> ◦ If weekly maintenance is due, click Start Weekly Maintenance. ◦ If daily maintenance is due, click Start Daily Maintenance. • Follow the on-screen instructions for the maintenance process.

Step	Action
<p>3. Program an AltoStar® run</p>	<ul style="list-style-type: none"> • In the menu bar click Program Run → Program Run (AltoStar® Purification). Alternatively, go back to the Start screen and click the Program Run button. • Enter samples or import from the LIMS. • Select the following assays for the samples unless already imported from the LIMS: <ul style="list-style-type: none"> ◦ AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene) ◦ AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a) • Click the Create Run button in the tool bar to create the AltoStar® run.
<p>4. Start a purification run</p>	<ul style="list-style-type: none"> • In the menu bar click Purification → Start Purification. Alternatively, go back to the Start screen and click the Start Purification button. • Select the purification run to be started to display the samples included in the selected purification run. • Prepare the purification reagents: <ul style="list-style-type: none"> ◦ Ensure that the purification reagents to be used have the same loading number (except AltoStar® Internal Control 1.5) and are not expired. ◦ If precipitates are visible in the Lysis Buffer, heat it ($\leq +50$ °C) until completely dissolved. ◦ Thaw the IC (AltoStar® Internal Control 1.5) and vortex for 5 seconds. ◦ Vortex the Magnetic Beads for 5 seconds without wetting the lid. • Prepare the samples for the purification run to be started as described in the instructions for use of the AltoStar® Purification Kit 1.5. • Click the Start Run button in the tool bar. • Follow the loading dialogs and load the instrument accordingly. • Confirm the Loading complete message with OK or wait 10 seconds. <p>The system will now perform the purification run automatically.</p>

Step	Action
<p>5. Finish the purification run</p>	<ul style="list-style-type: none"> • Make sure the loading tray is empty and confirm the Run finished dialog with OK. • Follow the instructions in the Maintenance dialog and confirm with OK. • Seal and store the components of the AltoStar® Purification Kit 1.5 that can be reused. <p>The eluates in the unsealed eluate plate are stable at room temperature (max. +30 °C) for a total of 4 hours.</p> <ul style="list-style-type: none"> • If the associated PCR setup run is not started right away, seal the eluate plate with an Eluate Plate Sealing Foil and store at +2 °C to +8 °C for up to 24 hours. • View the purification run results to confirm successful processing of each sample.
<p>6. Start a PCR setup run</p>	<ul style="list-style-type: none"> • In the menu bar, click PCR Setup → Start PCR Setup. Alternatively, go back to the Start screen and click the Start PCR Setup button. • Select the PCR setup run to be started in order to display the eluate plate and reagents included in the selected PCR setup run. • Prepare the PCR reagents: <ul style="list-style-type: none"> ◦ Ensure that masters and controls to be used are from the same kit lot and are not expired. ◦ Thaw the required amount of master and control tubes, vortex briefly and spin down in a centrifuge. • If the eluate plate is sealed, briefly centrifuge the plate and unseal carefully. • Click the Start Run button in the tool bar. • Follow the Loading dialog and load the instrument accordingly. • Confirm the Loading complete message with OK or wait 10 seconds. <p>The system will now perform the PCR setup run automatically.</p>

Step	Action
7. Finish the PCR setup run	<ul style="list-style-type: none"> • Make sure the loading tray is empty and confirm the Run finished dialog with OK. • Follow the instructions in the Maintenance dialog and confirm with OK. • Close and store the components of the AltoStar® MERS-CoV RT-PCR Kit 1.5 that can be reused. • View the PCR setup run results to confirm successful processing of each sample.
8. Seal the PCR plate	<ul style="list-style-type: none"> • Seal the PCR plate with a PCR Plate Sealing Foil.
9. Start the PCR run	<ul style="list-style-type: none"> • Switch on the CFX96™ DW Dx, the attached computer and the monitor. • Start the CFX Manager™ Dx software. • Open the CFX96™ DW Dx. • Centrifuge the PCR plate and insert it into the CFX96™ DW Dx. • Select File → Open → LIMS File... from the menu bar. • Scan the barcode of the PCR plate with the handheld barcode scanner. • Close the CFX96™ DW Dx. • Click the Start Run button to start the PCR run. Name and save the PCR run file. <p>The CFX96™ DW Dx will now perform the PCR run automatically.</p>
10. Separate assays for individual analysis	<ul style="list-style-type: none"> • Separate all assays in the PCR run into distinct well groups.

Step	Action
11. Analyze the data and interpret the PCR run results	For each well group individually: <ul style="list-style-type: none"> • Perform baseline correction in all wells for all detection channels used. • Exclude wells with irregular PCR signals. • Set the thresholds of all detection channels according to the controls. • Exclude wells containing invalid data. • Generate the LIMS result file for export of results to the LIMS. • Generate the result report for manual result interpretation.

CAUTION

Storage of eluates under wrong conditions may lead to degradation of the MERS-CoV target sequence and could compromise product performance.

7.6.2 Programming an AltoStar® run

For detailed information on starting an AltoStar® run, refer to the instructions for use of the AltoStar® Purification Kit 1.5, the AltoStar® Connect software and the AltoStar® AM16. Specific settings for use with the AltoStar® MERS-CoV RT-PCR Kit 1.5 are listed below:

- PC and NTC for the upE + N gene respectively orf1a assay are selected.
- The required sample volume is 500 µl plus the dead volume for the respective sample tube (see chapters 7.1 Sample volume and 7.2 Sample tubes).
- The required eluate volume for each of the two assays of the AltoStar® MERS-CoV RT-PCR Kit 1.5 is 10 µl.
- Make sure that the correct assay protocol version is used for the run. For information on the current protocol version see chapter 16. Assay protocol for the AltoStar® Connect software and information for LIMS integration. The respective assay protocols are encoded in the 2D barcodes displayed there. For information on purification and assay protocol import into the AltoStar® Connect software, refer to the respective instructions for use.

CAUTION

Do not use an assay protocol version other than the one indicated on the 2D barcodes in these instructions for use. Using an incorrect assay protocol version could compromise product performance.

7.6.3 Starting a PCR setup run

1. Select **PCR Setup** → **Start PCR Setup** in the menu bar. Alternatively, go back to the Start screen of the AltoStar® Connect software and select the **Start PCR Setup** button. The Start PCR Setup Run screen is displayed.

The pending PCR setup runs are displayed in the Programmed PCR Setup Runs table on the left side of the screen.

2. Select the PCR setup run to be started in the Programmed PCR Setup Runs table.
 - The samples included in the selected PCR setup run are displayed in the table on the top right side of the screen (Samples in selected PCR Setup Run).
 - The controls required for the selected PCR setup run are displayed in the table on the middle right side of the screen (Controls in selected PCR Setup Run).
 - The number of master tubes required for the selected PCR setup run is displayed in the table on the bottom right side of the screen (Required master tubes for the selected PCR Setup Run).

NOTE

The number of prioritized samples in a PCR setup run is displayed in the column **No. of prioritized Samples**. Conduct PCR setup runs with prioritized samples first to facilitate fastest processing of prioritized samples.

Before clicking the **Start Run** button in the tool bar, prepare the required reagents as described in chapter 7.6.3.1 Preparing reagents for a PCR setup run. If the eluate plate required for the selected PCR setup run has been sealed for storage prepare it as described in the instructions for use of the AltoStar® Purification Kit 1.5.

7.6.3.1 Preparing reagents for a PCR setup run

1. Thaw the required controls and the required number of master tubes completely at room temperature (max. +30 °C).
2. Mix the reagents by gentle vortexing.
3. Centrifuge the tubes briefly to remove drops from the lid.

CAUTION



A lack of centrifugation of the product components after thawing may cause contamination with reagent residues in the lids and could compromise product performance.

7.6.3.2 Loading the AltoStar® AM16 for a PCR setup run

For detailed information regarding the loading process, refer to the instructions for use of the AltoStar® AM16 and the AltoStar® Connect software.

1. Click the **Start Run** button in the tool bar of the Start PCR Setup Run screen to display the Loading dialog.

The Loading dialog consists of a visual representation of the AltoStar® AM16 deck at the top and a table specifying the carriers, the respective tracks on the AltoStar® AM16 deck for each carrier, the material to be loaded onto each carrier and comments with respect to the carrier loading.

NOTE

To visualize the position of an item on a carrier and the position of the carrier on the AltoStar® AM16 deck, select the respective row of the table in the Loading dialog.



The position of the item and its carrier is visualized:

- Highlighted in red in the visual representation of the instrument deck
- On the AltoStar® AM16 by flashing loading lights above the tracks where the selected carrier must be placed

2. Load the required material, the prepared eluate plate and the prepared reagents onto the suitable carriers.
 - Exchange only **completely empty** 1,000 µl tip racks for **completely full** 1,000 µl tip racks on the tip carrier.
 - Exchange only **completely empty** 300 µl tip racks for **completely full** 300 µl tip racks on the tip and plate carrier.

NOTE

Exchange of tip racks, which are not completely empty as well as handling of individual tips may interfere with the automatic tip management and cause run aborts.

- Place the required eluate plate with well A1 to the left of the black plate position.
- Place a PCR plate with well A1 to the left of the silver front plate position.
- Load a tube carrier 24 with one unused pooling tube for each assay in the PCR setup run.
- Gently push the tubes all the way to the bottom of the carrier and rotate the tubes until the tube barcodes are visible through the carrier window.
- Load the reagent tube carrier 32 with the assay components required for the PCR setup run.
- Gently push the tubes all the way to the bottom of the carrier and rotate the tubes until the tube barcodes are visible through the carrier window.

NOTE

The position of the individual tubes on the carriers is arbitrary.

NOTE

The volume of the loaded components is not checked by the system prior to processing. Insufficient component volume will prevent successful PCR setup for the affected assay.

NOTE



Starting a PCR setup run with lids still on the tubes may cause the run to abort during processing.

3. Load the carriers with the carrier barcode towards the rear facing right.
4. Insert populated carriers into the respective tracks between the front and rear slide blocks of the loading tray until they touch the stop hooks on the far side of the loading tray.

NOTE



Pushing the carriers past the stop hooks may damage the instrument and interfere with the loading process.

5. Check that the tip eject sheet and the tip waste container are in the correct position and a new waste bag is placed in the container.
6. Click **OK** in the Loading dialog to proceed with the loading process.

NOTE



By clicking **Cancel** the PCR setup run will be canceled, but it can be started again (see chapter 7.6.3 Starting a PCR setup run).

The AltoStar® AM16 draws the carriers into the instrument and performs barcode verification.

NOTE

The AltoStar® AM16 automatically verifies:



- Correct type and localization of the loaded carriers
- Correct identity and position of the items loaded on the carriers
- Lot congruence of the components of the individual AltoStar® assay kits
- Non-expiry of all loaded AltoStar® assay components
- Correct positioning of the tip eject sheet

If any of these checks fail, the user is prompted with a message dialog specifying the problem at hand and instructions to correct the issue accordingly. For further information regarding error handling, refer to the instructions for use of the AltoStar® Connect software.

NOTE

Altering positions of any loaded item after the carrier has been drawn into the instrument may result in the abort of the PCR setup run and/or damage to the instrument.

When all checks have passed the Loading complete dialog is displayed.

7. Confirm the Loading complete dialog by clicking **OK** or wait 10 seconds for the automatic start of the process.

NOTE

By clicking **Cancel** the PCR setup run will be canceled, but it can be started again (see chapter 7.6.3 Starting a PCR setup run).

The PCR setup run is started and will be conducted without user intervention.

7.6.3.3 During the PCR setup run

No further user interaction is required until the PCR setup run has finished. The Processing Status screen is displayed showing the status of the PCR setup run and the estimated time remaining.

NOTE



Pushing or pulling carriers or the door of the AltoStar® AM16 during a PCR setup run may abort the run.

7.6.4 End of the PCR setup run

At the end of the PCR setup run the Run finished dialog is displayed.

1. Make sure that the loading tray is empty.
2. Confirm the Run finished dialog by clicking **OK**.

The AltoStar® AM16 will unload the carriers. Make sure not to stand in the way of the unloading carriers.

After unloading the Maintenance dialog is displayed.

3. Follow the instructions of the Maintenance dialog.

The table of the dialog displays the number of reactions in the master tubes that were not used in the PCR setup run.

4. If another PCR setup run using the currently loaded eluate plate is to be started right away, the eluate plate can remain unsealed on the carrier position. If this is **not** the case, seal and store the eluate plate. For further information, refer to the instructions for use of the AltoStar® Purification Kit 1.5.

NOTE



The eluates in the eluate plate are stable at room temperature (max. +30 °C) for a total of 4 hours after completion of the purification run.

- Close reagent tubes with suitable unused tube caps.

CAUTION



Do not reuse tube caps to avoid contamination of the reagents, as this could compromise product performance.

- Store reagents for reuse as described in chapter 4.2 Handling.
- Dispose of the used materials (see chapter 10. Disposal).
- Confirm the Maintenance dialog by clicking **OK**.

7.6.4.1 PCR setup run results

The PCR setup run results are saved in the AltoStar® Connect software.

- Click **PCR Setup** → **PCR Setup Results** in the menu bar to access the Results screen.

The Results screen displays a table with all samples used in the latest PCR setup run and a column **Status** at the right showing if the PCR setup process for a given sample was conducted completely (see table 5).

Table 5: PCR setup run results

Status	PCR setup run result
Processed	<ul style="list-style-type: none"> The eluate was successfully processed in the PCR setup run. The resulting RT-PCR mix is ready for use in a PCR run.
Error	<ul style="list-style-type: none"> The eluate was not processed successfully. The respective RT-PCR mix will be automatically omitted in the following PCR analysis.

- To view the results of prior PCR setup runs, click the **Load** button in the menu bar, select the desired PCR setup run from the list in the opening Load Results dialog and click **OK**.

3 PCR setup run result files are automatically generated by the AltoStar® Connect software:

- A LIMS file (.xml) to pass detailed information about the PCR setup run including results back to the LIMS
- A report (.pdf) containing detailed information about the PCR setup run including results for documentation purposes
- A cycler file (.plrn) for automatic programming of the CFX96™ DW Dx

These files are saved to the location specified in the system settings of the AltoStar® Connect software.

NOTE



PCR setup run result files can be generated again by loading the respective PCR setup run and clicking the **Create LIMS File** button to generate the LIMS file, the **Create Report** button to generate the report or the **Create Bio-Rad Cycler File** button to generate the cycler file.

7.6.5 Sealing of the PCR plate

After completion of the PCR setup run, the PCR plate must be sealed with a PCR Plate Sealing Foil. It is recommended to use the AltoStar® Plate Sealer [4s3™ Semi-Automatic Sheet Heat Sealer (4titude)] or the PX1 PCR Plate Sealer (Bio-Rad). The suitability of plate sealers other than the recommended plate sealers has to be evaluated by the user.

If one of the recommended plate sealers is used for sealing, proceed as follows:

1. Switch on the plate sealer and make sure that the plate adapter is not in the drawer.
2. Ensure that the settings of the plate sealer are as follows:

Table 6: Settings of the plate sealer

Plate sealer	Settings	
	Temperature [°C]	Time [s]
AltoStar® Plate Sealer [4s3™ Semi-Automatic Sheet Heat Sealer (4titude)]	170	2
PX1 PCR Plate Sealer (Bio-Rad)	175	3

3. Wait until the set temperature is reached. This may take several minutes.
4. Place the PCR plate on the plate adapter of the plate sealer.
5. Place one PCR Plate Sealing Foil on the PCR plate so that the print 'THIS SIDE UP' is readable. Make sure that all wells of the PCR plate are covered with foil and no well is obscured by the writing.




NOTE

Operating the plate sealer without the plate adapter placed in the drawer may render the sealer nonfunctional. In this case, contact altona Diagnostics technical support for assistance (see chapter 12. Technical support).

NOTE

If the PCR Plate Sealing Foil or the frame is placed incorrectly, the foil may stick to the heating plate within the plate sealer during sealing. This will render the sealer nonfunctional. In this case, or if the sealing step has been initiated without a PCR Plate Sealing Foil, let the plate sealer cool down to room temperature and contact altona Diagnostics technical support for assistance (see chapter 12. Technical support).

6. Assemble the sealing frame on top to hold down the sealing foil.

7. Open the drawer by pressing the **Operate***/ ** button.
8. Place the assembly consisting of the plate adapter, the PCR plate, the PCR Plate Sealing Foil and the sealing frame into the plate sealer and press the **Operate***/ ** button.
9. The drawer closes automatically, seals for the set time and reopens automatically.
10. Take the sealed PCR plate and the plate adapter out of the plate sealer and close the plate sealer by pressing the **Close***/ ** button.

* AltoStar® Plate Sealer [4s3™ Semi-Automatic Sheet Heat Sealer (4titude)]

**PX1 PCR Plate Sealer (Bio-Rad)

7.6.5.1 PCR mix stability

After completion of the PCR setup run the RT-PCR mix in the sealed PCR plate is stable at room temperature (max. +30 °C) for 30 minutes.

CAUTION



Do not exceed the PCR mix storage time, as this could compromise product performance.

7.6.6 Starting a PCR run

The PCR run is performed on a CFX96™ DW Dx under control of the CFX Manager™ Dx software.

1. Switch on the CFX96™ DW Dx, the attached computer and the monitor.
2. Start the CFX Manager™ Dx software.
3. In the menu bar of the CFX Manager™ Dx software select **File** → **Open** → **LIMS File...** to open the Open LIMS File dialog.
4. In the opening Open LIMS File dialog, make sure that the cursor is blinking in the **File name** field at the bottom. If it is not, click into the **File name** field.
5. Scan the PCR plate barcode with the handheld barcode scanner to automatically select and open the correct LIMS file. The Run Setup dialog is displayed.

NOTE



All parameters required for the start of the PCR run are transferred automatically from the AltoStar® Connect software to the CFX96™ DW Dx by means of the cyclers file.

6. Click the **Open Lid** button in the Run Setup dialog to open the lid of the CFX96™ DW Dx.
7. Briefly centrifuge the sealed PCR plate to ensure all liquid is at the bottom of the wells.
8. Insert the sealed PCR plate into the heating block of the CFX96™ DW Dx with well A1 to the left side.
9. Close the CFX96™ DW Dx by clicking the **Close Lid** button in the Run Setup dialog.
10. Start the PCR run by clicking the **Start Run** button in the Run Setup dialog.

7.6.6.1 During the PCR run

No user interaction is required until the PCR run has finished. The Run Details dialog is displayed showing the status of the PCR run and the estimated time remaining.

NOTE



Opening the lid of the CFX96™ DW Dx during a PCR run by operating the button at the front of the lid or by clicking **Open Lid** in the Run Details dialog will abort the run and void all results.

At the end of the PCR run the Data Analysis window is displayed, which shows the amplification curves, the plate layout and the results.

7.6.6.2 Assigning assays to well groups

The AltoStar® Workflow processes one or several PCR assays simultaneously on one PCR plate. However, each assay must be analyzed separately by the user according to the instructions for use of the respective assay. The AltoStar® MERS-CoV RT-PCR Kit 1.5 consists of two independent assays [AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene) and AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a)]. Both assays must be analyzed in a separate well group.

To this end, all assays on a PCR plate must be assigned to individual well groups in the CFX Manager™ Dx software by the user.

1. In the Data Analysis window click the **Plate Setup** button in the tool bar and select **View/Edit Plate**. The Plate Editor dialog is displayed (see figure 1).

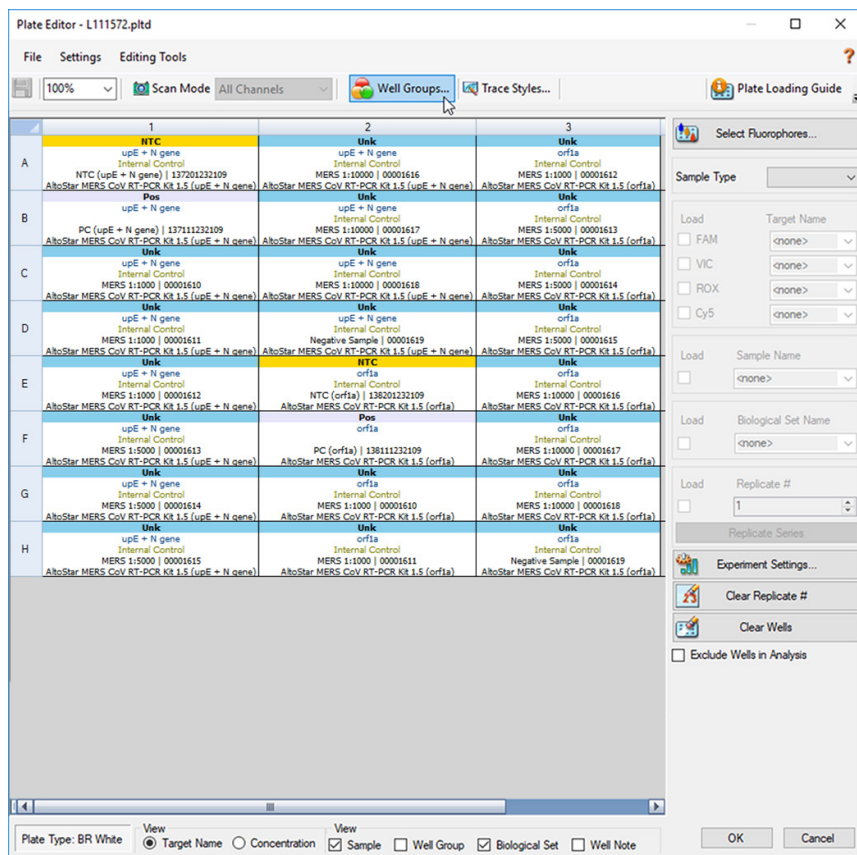


Figure 1: Plate Editor dialog

2. In the Plate Editor dialog click **Well Groups...** in the tool bar. The Well Groups Manager dialog is displayed (see figure 2).
3. Click the **Add** button.
4. Type the name of the first assay (AltoStar® MERS-CoV RT-PCR Kit 1.5 upE + N gene respectively orf1a) in the text box.

5. Select all wells in the PCR plate area that belong to the first assay (see figure 2). The wells belonging to an individual assay can be identified in the Plate Editor dialog by the entry in the **Biological Set** field.

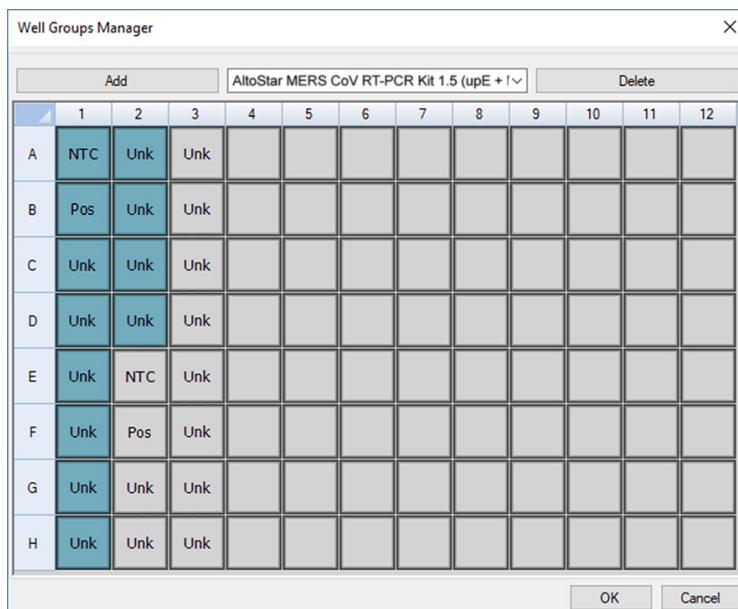


Figure 2: Well Groups Manager dialog

6. Repeat steps 3–5 for the second AltoStar® MERS-CoV RT-PCR Kit 1.5 assay (upE + N gene respectively orf1a) and for all other assays on the PCR plate.
7. Confirm well group assignment by clicking **OK**. The Well Groups Manager dialog closes.
8. Close the Plate Editor dialog by clicking **OK**.
9. Confirm to apply the changes by clicking **Yes**.

7.6.7 PCR data analysis

The results of all assays (well groups) on the PCR plate have to be analyzed in the sequence depicted in figure 3.

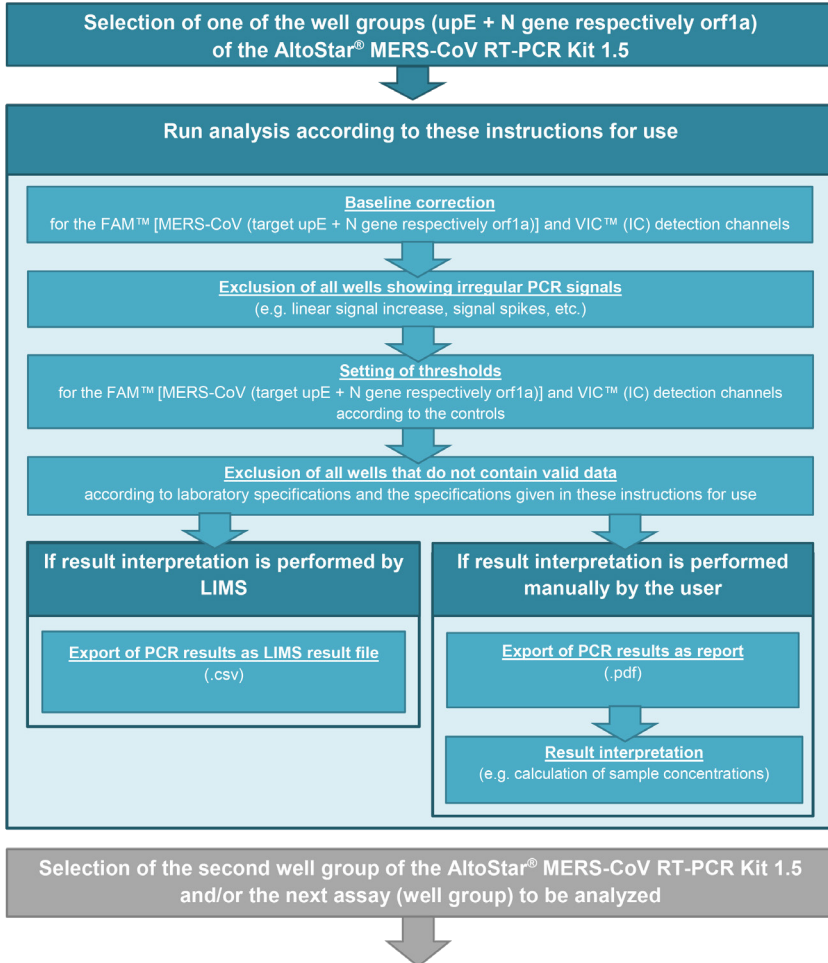


Figure 3: PCR Data Analysis process

In the Data Analysis window ensure to select the respective **Well Group** of the AltoStar® MERS-CoV RT-PCR Kit 1.5. Therefore, click on the **Well Group** drop-down menu right next to the **Well Group** button (see figure 4) of the toolbar. Do not use the “*All Wells*” **Well Group**. The selection in figure 4 is used as a general example view.

Both assays of the AltoStar® MERS-CoV RT-PCR Kit 1.5 must be analyzed in a separate well group. Before analyzing the results ensure that the well groups [AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene) and AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a)] contain all wells of the respective AltoStar® MERS-CoV RT-PCR Kit 1.5 assay and no wells of other assays.

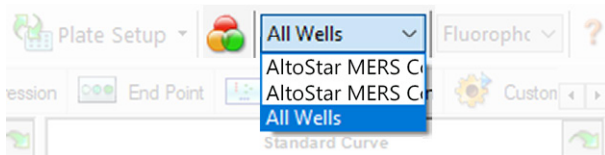


Figure 4: Well Group button and Well Group drop-down menu

NOTE



Combined analysis of more than one assay may lead to incorrect results.

CAUTION



As with any diagnostic test, results shall be interpreted in consideration of all clinical and laboratory findings.

7.6.7.1 Baseline correction

The baseline settings used by the CFX Manager™ Dx software may have to be corrected for individual wells of the assay (**Well Group**) under analysis.

1. In the Data Analysis window ensure to select the **Well Group** of the AltoStar® MERS-CoV RT-PCR Kit 1.5. Therefore, click on the **Well Group** drop-down menu right next to the **Well Group** button (see figure 4) of the toolbar.
2. At the left side of the Data Analysis window tick only the **FAM** checkbox for the MERS-CoV target detection channel.
3. In the menu bar of the Data Analysis window click **Settings** → **Baseline Threshold...** to open the Baseline Threshold dialog (see figure 5).
4. Click the \diamond symbol in the **Baseline End** column header once to sort the table by ascending **Baseline End** values.

5. Select all lines that show a **Baseline End** value of 1–9 (see figure 5).

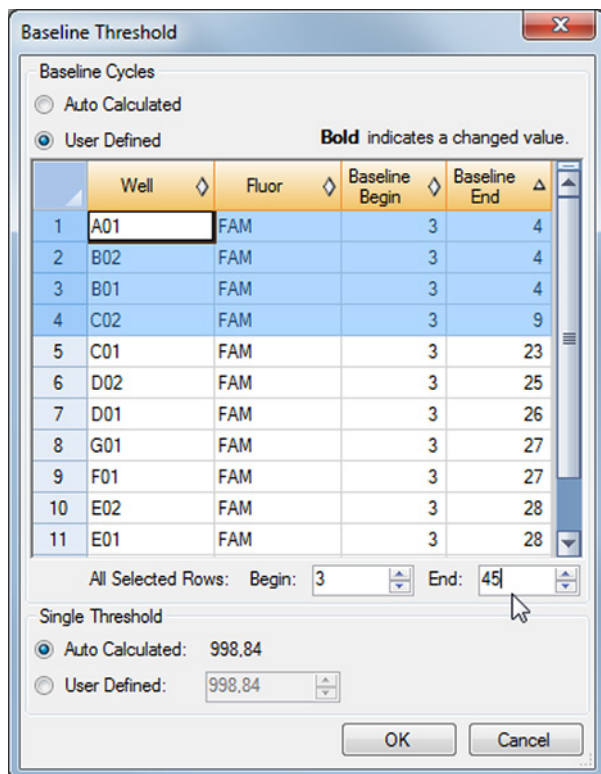


Figure 5: Baseline Threshold dialog

6. Set the value in the **End:** field to 45 for the selected lines (see figure 5).
7. Confirm the settings by clicking **OK**.
8. At the left side of the Data Analysis window untick the **FAM** checkbox and tick only the **VIC** checkbox for the IC target detection channel.
9. Repeat steps 3–7 for the VIC™ (IC) detection channel.

7.6.7.2 Exclusion of irregular PCR signals

Valid results can only be derived from PCR signals that are free of signal artefacts, which may be caused e.g. by impurities or bubbles in the RT-PCR mix. PCR signals that contain signal artefacts have to be excluded by the user.

1. In the Data Analysis window ensure to select the **Well Group** of the AltoStar® MERS-CoV RT-PCR Kit 1.5. Therefore, click on the **Well Group** drop-down menu right next to the **Well Group** button (see figure 4) of the toolbar.

- Identify wells with irregular PCR signals (linear signal increase, signal spikes, etc.) in any of the FAM™ [MERS-CoV (target upE + N gene respectively orf1a)] and the VIC™ (IC) detection channels (see figure 6).

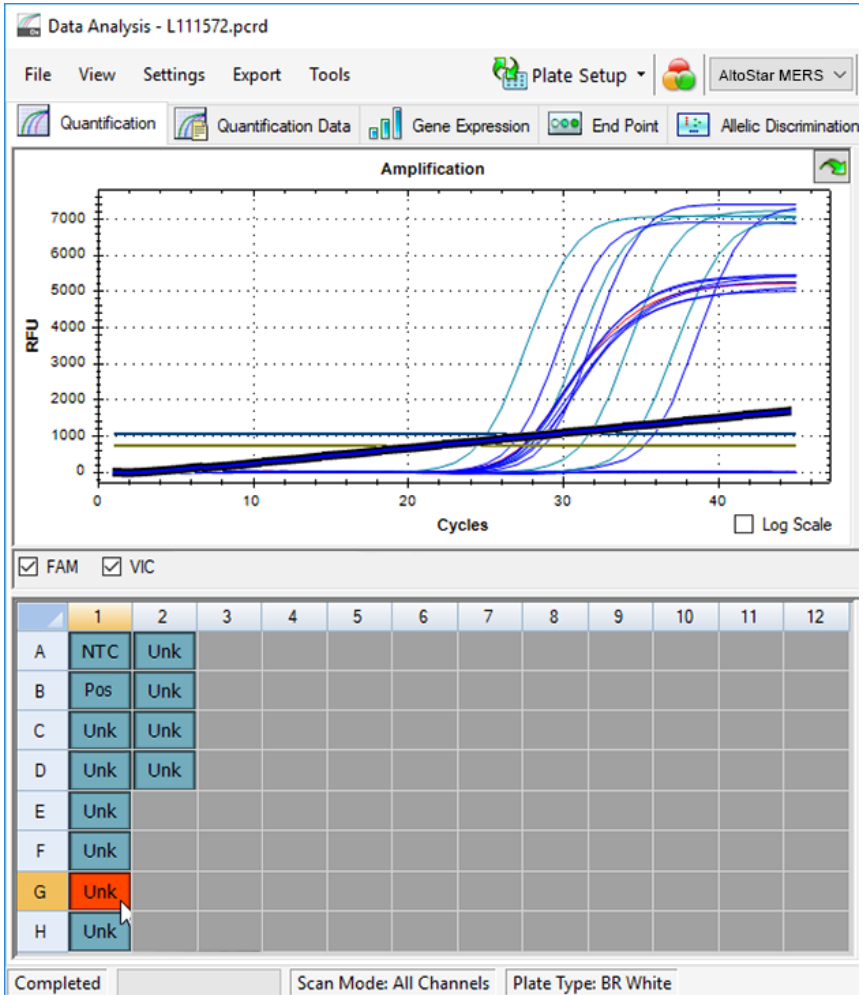


Figure 6: Data Analysis window: irregular PCR signal

- Click each affected well with the right mouse button and select **Well...** → **Exclude from Analysis** (see figure 7).

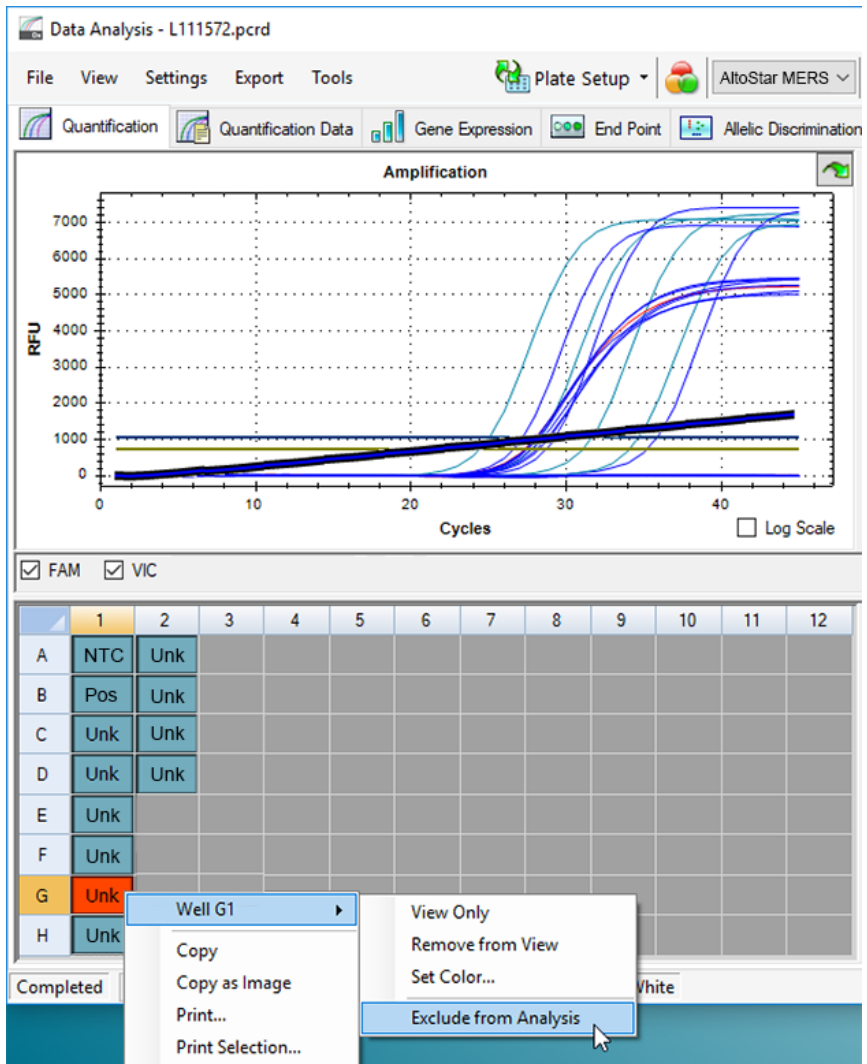


Figure 7: Data Analysis window: exclude well from analysis

4. The selected well is excluded from the analysis. No results will be generated for this well (see figure 8).

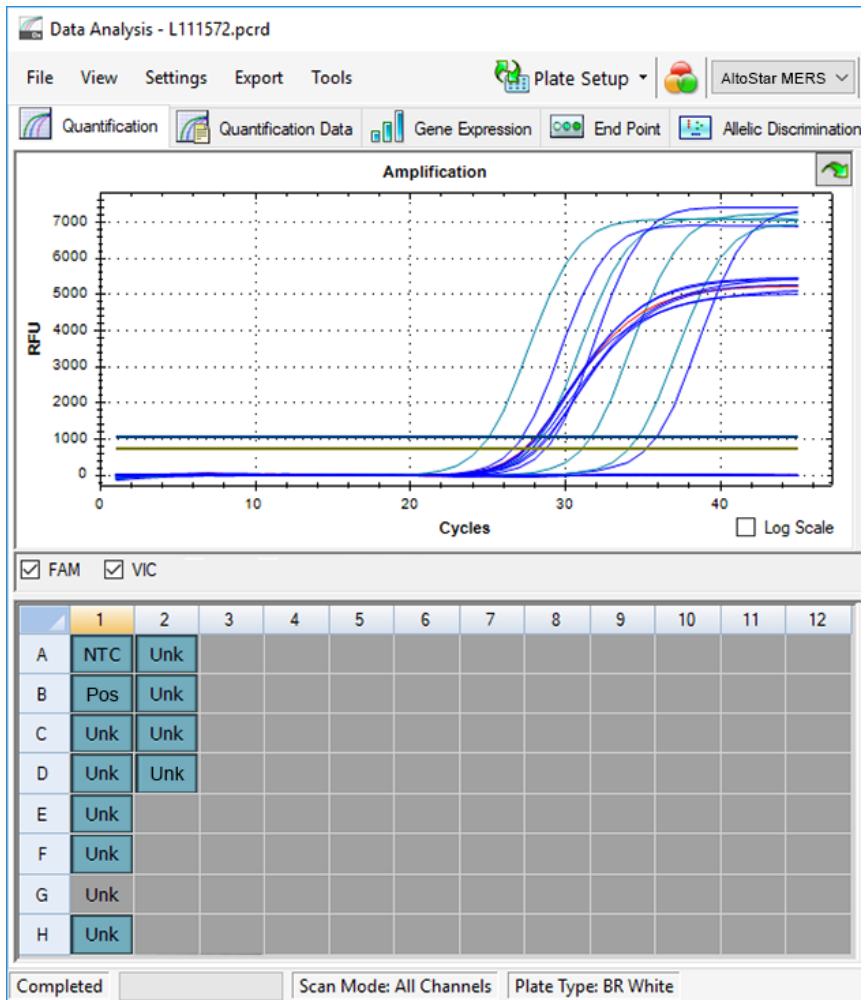


Figure 8: Data Analysis window: excluded well

7.6.7.3 Setting of thresholds

The thresholds for the FAM™ [MERS-CoV (target upE + N gene respectively orf1a)] and the VIC™ (IC) detection channels have to be set manually by the user according to the signals of the controls.

1. In the Data Analysis window ensure to select the respective **Well Group** of the AltoStar® MERS-CoV RT-PCR Kit 1.5. Therefore, click on the **Well Group** drop-down menu right next to the **Well Group** button (see figure 4) of the toolbar.

- At the left side of the Data Analysis window tick only the **VIC** checkbox for the detection channel of the IC (see figure 9).

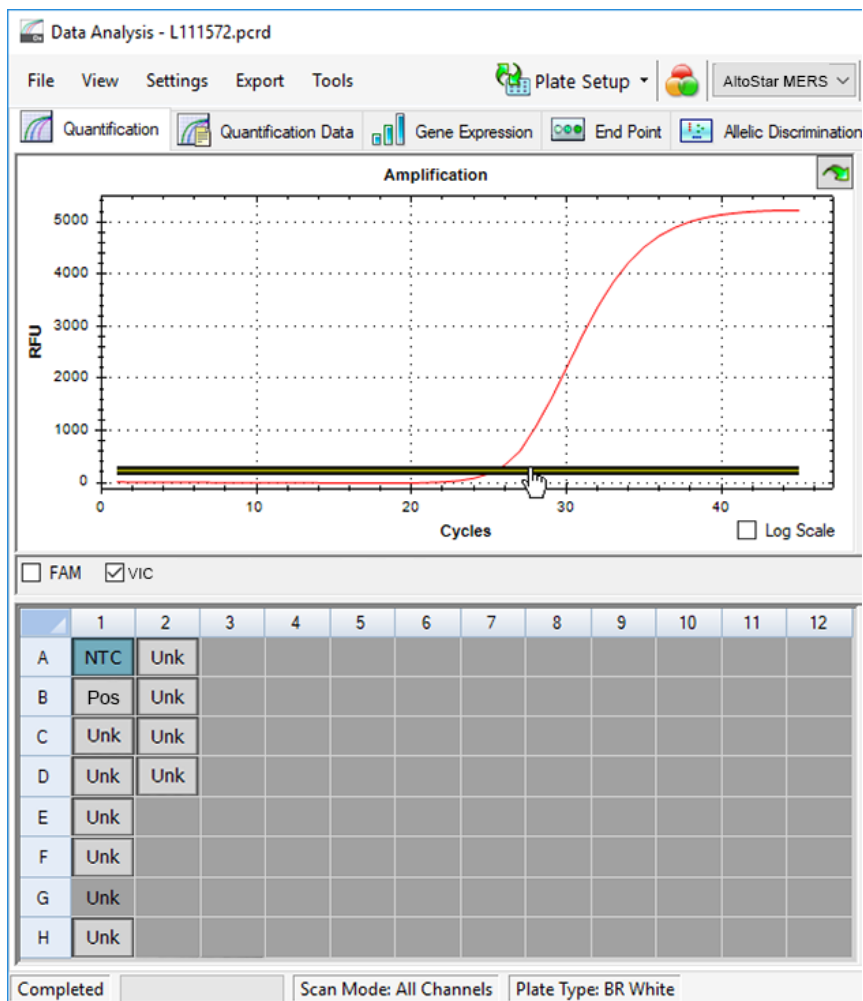


Figure 9: Data Analysis window: setting the VIC™ threshold

- Select only the NTC well in the plate view of the Data Analysis window (see figure 9).
- Drag the threshold into the exponential area of the NTC signal (see figure 9).

NOTE



The NTCs contain the IC template, which leads to an IC signal in a valid NTC well.

5. At the left side of the Data Analysis window untick the **VIC** checkbox and tick the **FAM** checkbox for the detection channel of the MERS-CoV target (see figure 10).

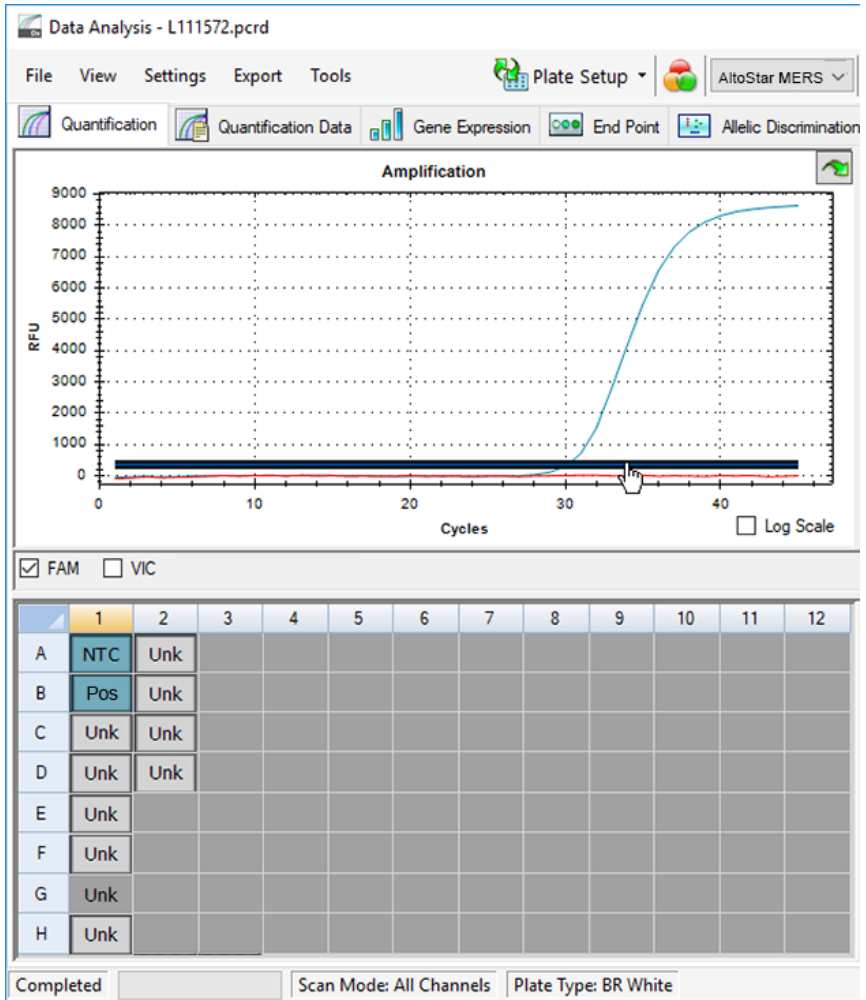


Figure 10: Data Analysis window: setting the FAM™ threshold

6. Select only the wells containing the NTC and the PC in the plate view of the Data Analysis window (see figure 10).
7. Drag the threshold well above the signal of the NTC into the exponential area of the PC signal (see figure 10).

7.6.8 Validity of PCR results

7.6.8.1 Exclusion of wells containing invalid data

Wells that do not contain valid data have to be excluded from result generation by the user.

1. In the Data Analysis window ensure to select the respective **Well Group** of the AltoStar® MERS-CoV RT-PCR Kit 1.5. Therefore, click on the **Well Group** drop-down menu right next to the **Well Group** button (see figure 4) of the toolbar.
2. Identify all wells containing invalid data. A well is invalid if any of the following conditions apply:
 - a) The complete run is invalid (see chapter 7.6.8.2 Validity of a diagnostic PCR run).
 - b) The well data does not meet the control conditions for a valid result (see chapter 7.6.8.3 Validity of results for a sample).

- Click each well containing invalid data according to chapters 7.6.8.2 Validity of a diagnostic PCR run to 7.6.8.3 Validity of results for a sample with the right mouse button and select **Well...** → **Exclude from Analysis** (see figures 11 and 12).

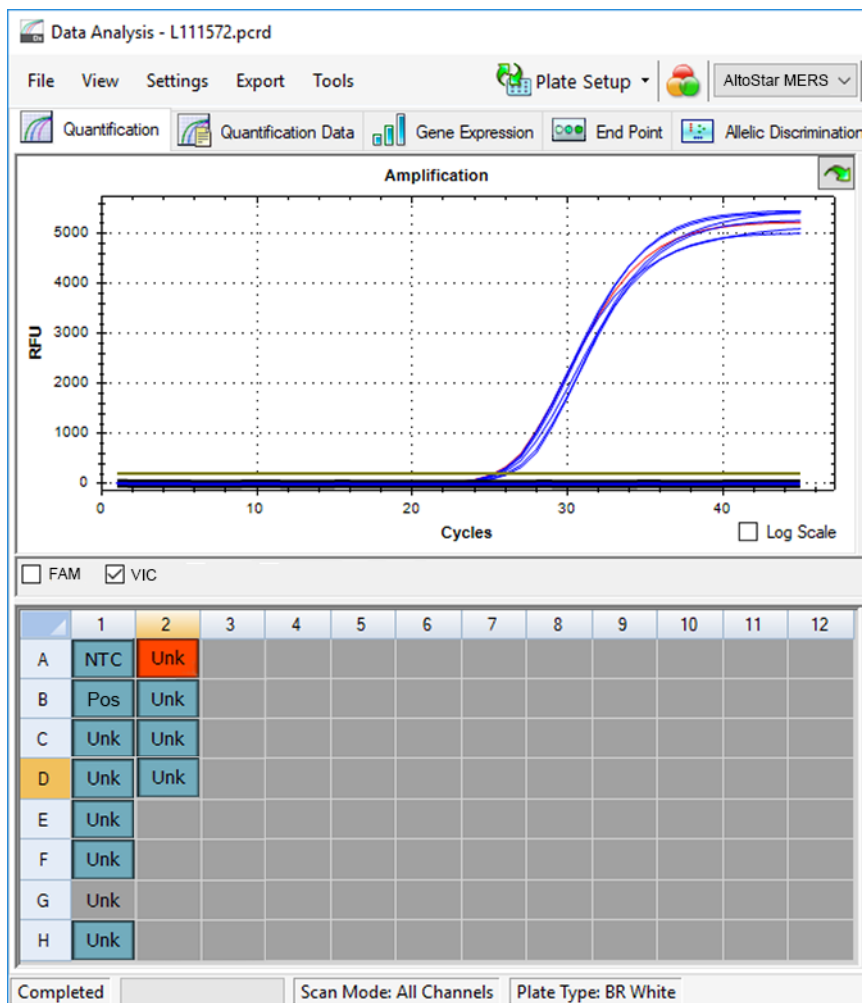


Figure 11: Data Analysis window: invalid well

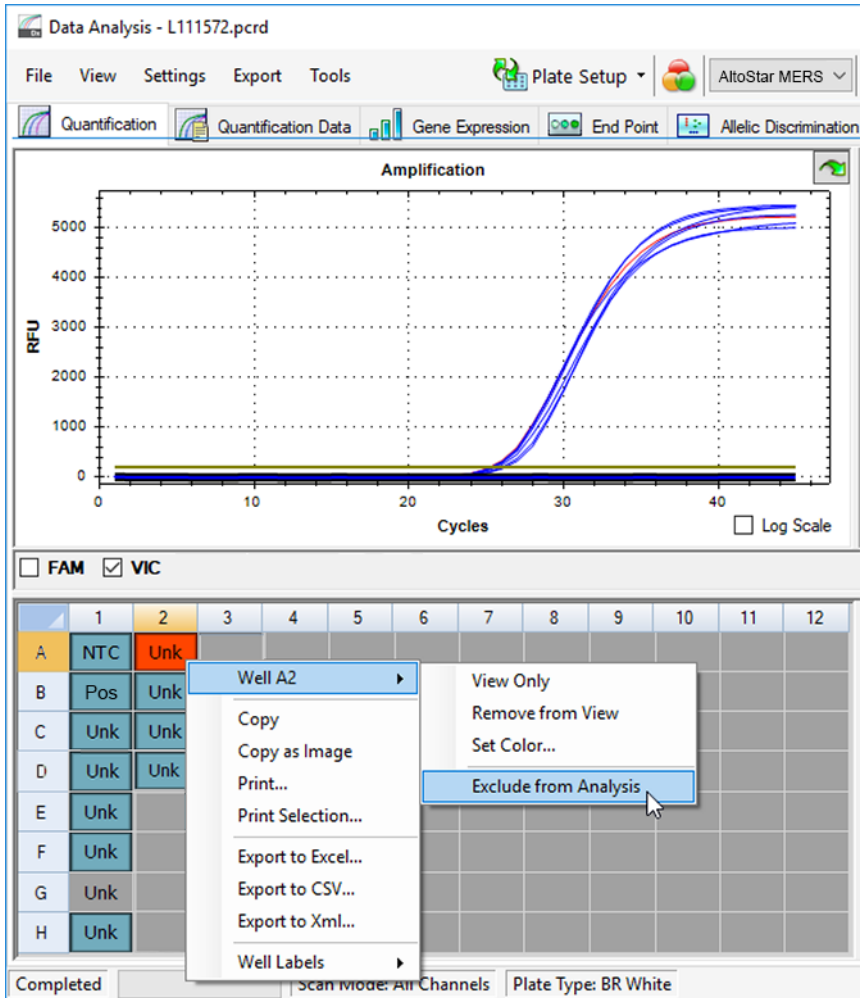


Figure 12: Data Analysis window: exclude invalid well from analysis

The selected well is excluded from the analysis. No results will be generated for this well.

7.6.8.2 Validity of a diagnostic PCR run

A diagnostic PCR run is **valid**, if the following control conditions are met:

Table 7: Control conditions for a valid PCR run

Control	Detection channel			
	upE + N gene specific assay		orf1a gene specific assay	
	FAM™ (MERS-CoV target)	VIC™ (IC)	FAM™ (MERS-CoV target)	VIC™ (IC)
PC (upE + N gene respectively orf1a)	+	Not applicable	+	Not applicable
NTC (upE + N gene respectively orf1a)	-	+	-	+

A diagnostic PCR run is **invalid**, if:

- The run has not been completed.
- Any of the control conditions for a valid diagnostic PCR run are not met.

In case of an invalid diagnostic PCR run, exclude all wells from the analysis and repeat the AltoStar® run starting from the original samples.

7.6.8.3 Validity of results for a sample

The result for an individual sample is **invalid**, if the signals in both the VIC™ (IC) detection channel and the FAM™ [MERS-CoV (target upE + N gene) and MERS-CoV (target orf1a gene)] detection channel are negative (see table 8). In case of an invalid result for a sample, exclude the well from the analysis and repeat testing from the original sample or collect and test a new sample.

Table 8: Result validity

Detection channel				Result validity
upE + N gene specific assay		orf1a gene specific assay		
FAM™	VIC™	FAM™	VIC™	
+	+*	+	+*	Valid result
+	+*	-	+	Valid result**
-	+	+	+*	Valid result**
-	+	-	+	Valid result
-	-	-	-	Invalid result

* Detection of the IC is not required when either the upE + N gene target and/or the orf1a target is detected. A high MERS-CoV RNA load in the sample can lead to a reduced or absent IC signal.

**The overall result is only valid, if the IC is detected in both assays, upE + N gene and orf1a gene. If the IC is not detected in both assays, the result is invalid and the sample has to be tested again with the assay which did not detect the IC.

7.6.9 Export of PCR results for automated result interpretation

To make the PCR run results available to a connected LIMS for automated result interpretation they need to be exported in the form of a LIMS result file (.csv).

1. In the Data Analysis window ensure to select the **Well Group** of the AltoStar® MERS-CoV RT-PCR Kit 1.5. Therefore, click on the **Well Group** drop-down menu right next to the **Well Group** button (see figure 4) of the toolbar.
2. Ensure that all steps of the analysis process (see chapters 7.6.7.1 Baseline correction to 7.6.8.1 Exclusion of wells containing invalid data) have been completed for the well group of the AltoStar® MERS-CoV RT-PCR Kit 1.5.
3. In the menu bar of the Data Analysis window click **Export** → **Export All Data Sheets** to open the Browse For Folder dialog.
4. In the Browse For Folder dialog specify the location for the LIMS result files to be generated and click **OK**.

NOTE

The LIMS integration has to be implemented according to the specifications of Altona Diagnostics. For information regarding LIMS integration, see chapter 16. Assay protocol for the AltoStar® Connect software and information for LIMS integration and/or contact Altona Diagnostics technical support (see chapter 12. Technical support).

NOTE

Saving results of more than one assay (well group) from a PCR run in the same folder leads to replacement of the LIMS result files of the first assay (well group) with the LIMS result files of the second assay (well group). In this case the LIMS result files of the first assay (well group) can be exported again.

7.6.10 Export of PCR results for manual result interpretation

If the results are not passed to a LIMS for automatic result interpretation, the result interpretation has to be performed manually by the user. To this end the analysis results of each assay (well group) need to be exported in the form of a report.

1. In the Data Analysis window ensure to select the respective **Well Group** of the AltoStar® MERS-CoV RT-PCR Kit 1.5. Therefore, click on the **Well Group** drop-down menu right next to the **Well Group** button (see figure 4) of the toolbar.
2. At the left side of the Data Analysis window tick the **VIC** checkbox as well as the **FAM** checkbox.
3. Ensure that all steps of the analysis process (see chapters 7.6.7.1 Baseline correction to 7.6.8.1 Exclusion of wells containing invalid data) have been completed for the well group of the AltoStar® MERS-CoV RT-PCR Kit 1.5.
4. In the menu bar of the Data Analysis window click **Tools** → **Reports...** to open the Report dialog.

5. Ensure that at least the following content is selected for report generation in the upper left part of the Report dialog (see figure 13):

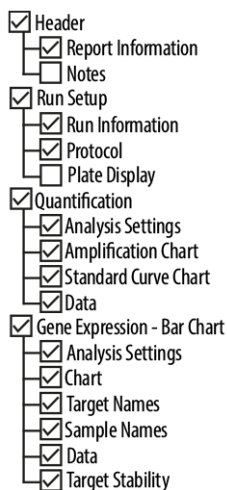


Figure 13: Report dialog

6. Select or deselect additional content of the report by ticking the respective check boxes as required.
7. In the menu bar of the Report dialog click **File** → **Save As...** to open the Save Report dialog.
8. In the Save Report dialog specify the name and location for the report file to be generated and click **Save**.

7.6.10.1 Manual interpretation of results

1. Open the report file generated for the respective well group of the AltoStar® MERS-CoV RT-PCR Kit 1.5 (see chapter 7.6.10 Export of PCR results for manual result interpretation).
2. Refer to the Quantification Data table in the report (see figure 14). The table comprises 2 rows for each **Sample** – one for the **Target MERS-CoV upE + N gene** respectively *orf1a* and one for the **Target Internal Control**.

Quantification Data

Well	Floor	Target	Content	Sample	Biological Set Name	Cq	Cq Mean	Cq Std. Dev	Well Note
A01	FAM	upE + N gene	NTC	NTC (upE + N gene) 137201232109	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	N/A	0.00	0.000	
A02	FAM	upE + N gene	Unkn	Sample 7 00000007	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	N/A	0.00	0.000	qualitative
B01	FAM	upE + N gene	Pos Ctrl	PC (upE + N gene) 137111232109	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	N/A	0.00	0.000	
B02	FAM	upE + N gene	Unkn	Sample 8 00000008	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	N/A	0.00	0.000	qualitative
C01	FAM	upE + N gene	Unkn	Sample 1 00000001	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	N/A	0.00	0.000	qualitative
C02	FAM	upE + N gene	Unkn	Sample 9 00000009	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	N/A	0.00	0.000	qualitative
D01	FAM	upE + N gene	Unkn	Sample 2 00000002	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	N/A	0.00	0.000	qualitative
D02	FAM	upE + N gene	Unkn	Sample 10 00000010	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	1.90	1.90	0.000	qualitative
E01	FAM	upE + N gene	Unkn	Sample 3 00000003	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	N/A	0.00	0.000	qualitative
F01	FAM	upE + N gene	Unkn	Sample 4 00000004	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	N/A	0.00	0.000	qualitative
G01	FAM	upE + N gene	Unkn	Sample 5 00000005	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	N/A	0.00	0.000	qualitative
H01	FAM	upE + N gene	Unkn	Sample 6 00000006	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	N/A	0.00	0.000	qualitative
A01	VIC	Internal Control	NTC	NTC (upE + N gene) 137201232109	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	29.70	29.70	0.000	
A02	VIC	Internal Control	Unkn	Sample 7 00000007	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	30.78	30.78	0.000	qualitative
B02	VIC	Internal Control	Unkn	Sample 8 00000008	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	29.89	29.89	0.000	qualitative
C01	VIC	Internal Control	Unkn	Sample 1 00000001	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	34.85	34.85	0.000	qualitative
C02	VIC	Internal Control	Unkn	Sample 9 00000009	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	29.90	29.90	0.000	qualitative
D01	VIC	Internal Control	Unkn	Sample 2 00000002	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	34.54	34.54	0.000	qualitative
D02	VIC	Internal Control	Unkn	Sample 10 00000010	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	30.11	30.11	0.000	qualitative
E01	VIC	Internal Control	Unkn	Sample 3 00000003	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	34.78	34.78	0.000	qualitative
F01	VIC	Internal Control	Unkn	Sample 4 00000004	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	32.12	32.12	0.000	qualitative
G01	VIC	Internal Control	Unkn	Sample 5 00000005	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	31.84	31.84	0.000	qualitative
H01	VIC	Internal Control	Unkn	Sample 6 00000006	AltoStar MERS CoV RT-PCR Kit 1.5 (upE + N gene)	31.23	31.23	0.000	qualitative

Figure 14: Report: Quantification Data

Qualitative results would be marked by the term *qualitative* in the **Well Note** column of the Quantification Data table.

3. Identify each row with the **Target MERS-CoV upE + N gene** respectively *orf1a* and the term *qualitative* in the **Well Note** column.
4. In these rows, refer to the **C_q** column for the result of the respective **Sample**. [Please note that the chosen term C_q is equivalent to the designation of C_t, which might be used by other cyclers than the CFX96™ Deep Well Dx System (Bio-Rad)].
5. Refer to table 9 for interpretation of results.

Table 9: Result interpretation

Threshold cycle (C_q) of the MERS-CoV targets	Result interpretation
1–45	MERS-CoV specific RNA detected.
N/A	No MERS-CoV specific RNA detected. Sample does not contain detectable amounts of MERS-CoV specific RNA.

8. Using the AltoStar® MERS-CoV RT-PCR Kit 1.5 with other real-time PCR instruments than the CFX96™ Deep Well Dx System

In addition to the CFX96™ DW Dx the AltoStar® MERS-CoV RT-PCR Kit 1.5 has been validated with other real-time PCR instruments (see chapter 5.3.2.2 Real-time PCR instruments). The following chapters 8.1 Material and devices required but not provided and 8.2 Procedure describe how to use the AltoStar® MERS-CoV RT-PCR Kit 1.5 with these instruments.

8.1 Material and devices required but not provided

The following instruments and materials are required:

- General materials and devices (see chapter 7.5 General material and devices)
- CFX96™ Deep Well Dx System (Bio-Rad)
 - 96-well PCR plates and sealing foil (details see table 2)
- CFX96™ Dx System (Bio-Rad)
 - 96-well PCR plates and sealing foil (details see table 2)
- Rotor-Gene® Q5/6 plex Platform (QIAGEN)
 - 0.1 ml strip tubes and lids [STRIP Tubes 0.1 ml for Rotor-Gene® cyclers (LTF Labortechnik) or equivalent]
- QuantStudio™ 5 Real-Time PCR System and ABI Prism® 7500 SDS (Applied Biosystems)

- 96-well PCR plates and sealing foil [MicroAmp™ Optical 96-Well Reaction Plate and MicroAmp™ Optical Adhesive Film (Applied Biosystems) or equivalent]
- LightCycler® 480 Instrument II (Roche)
 - 96-well PCR plates and sealing foil [LightCycler® 480 Multiwell Plate 96, white and LightCycler® 480 Sealing Foil (Roche) or equivalent]

NOTE



It is not recommended to use other materials or devices than specified in these instructions for use.

8.2 Procedure

8.2.1 Sample preparation

The AltoStar® MERS-CoV RT-PCR Kit 1.5 was validated using the AltoStar® AM16 in combination with the AltoStar® Purification Kit 1.5.

Alternative nucleic acid extraction systems and kits might also be appropriate. The suitability of the nucleic acid extraction procedure for use with the AltoStar® MERS-CoV RT-PCR Kit 1.5 has to be validated by the user.

The AltoStar® MERS-CoV RT-PCR Kit 1.5 has to be used with a heterologous IC (AltoStar® Internal Control 1.5), which allows to control the sample preparation procedure (nucleic acid extraction) and the following PCR.

- When using other methods for nucleic acid extraction than the AltoStar® AM16 in combination with the AltoStar® Purification Kit 1.5 the IC has to be added during the lysis step of the nucleic acid extraction procedure.
- The IC should always be added to the sample/lysis buffer mixture.
- The volume of the IC which has to be added, always and only depends on the elution volume. It represents 50 % of the elution volume. For instance, if the nucleic acid is going to be eluted in 60 µl of elution buffer or water, 30 µl of IC per sample must be added into the sample/lysis buffer mixture.

CAUTION

Storage of eluates under wrong conditions may lead to degradation of the MERS-CoV target sequence and could compromise product performance.

8.2.2 Master mix setup

All components of the AltoStar® MERS-CoV RT-PCR Kit 1.5 and samples should be thawed completely, mixed (by pipetting or gentle vortexing) and centrifuged briefly before use. Set up the master mix according to the following pipetting scheme:

Table 10: Pipetting scheme (master mix setup)

Number of reactions (rxns)	1	12
Master A	5 µl	60 µl
Master B	15 µl	180 µl
Volume master mix	20 µl	240 µl

CAUTION

Do not use different volumes of Master A and Master B for master mix setup than specified in these instructions for use, as this could compromise product performance.

CAUTION

A lack of centrifugation of the product components after thawing may cause contamination with reagent residues in the lids and could compromise product performance.

8.2.3 Reaction setup

1. Pipette 20 µl of the master mix into each required well of an appropriate optical 96-well PCR plate or an appropriate optical reaction tube.
2. Add 10 µl of the sample (eluate from the nucleic acid extraction) or 10 µl of the controls (PC or NTC).

Table 11: Pipetting scheme (reaction setup)

Reaction setup	
Master mix	20 µl
Sample or control	10 µl
Total volume	30 µl

3. Make sure that at least 1 PC and 1 NTC is used per run.
4. Thoroughly mix the samples and controls with the master mix by pipetting up and down.
5. Close the 96-well PCR plate with a PCR Plate Sealing Foil and the reaction tubes with appropriate lids (see chapter 8.1 Material and devices required but not provided).
6. Centrifuge the 96-well PCR plate in a centrifuge with a microtiter plate rotor for 30 seconds at approximately 1,000 x g (~ 3,000 rpm).

After completion of the PCR setup, the PCR mix is stable at room temperature (max. +30 °C) for 30 minutes.

CAUTION

Do not exceed the PCR mix storage time, as this could compromise product performance.

CAUTION

Do not mix up samples or sample IDs during PCR setup or transfer to the PCR instrument. This could lead to false positive or false negative results due to incorrect assignment of the samples.

8.2.4 PCR run

8.2.4.1 Programming the real-time PCR instrument

For basic information regarding the setup and programming of the different real-time PCR instruments, refer to the instructions for use of the respective instrument.

For detailed programming instructions regarding the use of the AltoStar® MERS-CoV RT-PCR Kit 1.5 on specific real-time PCR instruments, contact altona Diagnostics technical support (see chapter 12. Technical support).

8.2.4.2 Run settings

Define the following basic settings:

Table 12: Run settings

Settings	
Reaction volume	30 µl
Ramp rate	Default
Passive reference*	ROX™

* If applicable

Define the following fluorescence detectors (dyes):

Table 13: Fluorescence detectors AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene)

Target	Detector name	Reporter	Quencher
MERS-CoV	upE + N gene	FAM™	(None)
Internal control	Internal Control	JOE™	(None)

Table 14: Fluorescence detectors AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a)

Target	Detector name	Reporter	Quencher
MERS-CoV	orf1a	FAM™	(None)
Internal control	Internal Control	JOE™	(None)

Define the following temperature profile and dye acquisition:

Table 15: Temperature profile and dye acquisition

	Stage	Cycle repeats	Acquisition	Temperature [°C]	Time [min:s]
Reverse transcription	Hold	1	-	55	20:00
Denaturation	Hold	1	-	95	02:00
Amplification	Cycling	45	-	95	00:15
			Yes	55	00:45
			-	72	00:15

CAUTION



Do not use other cycling conditions than specified in these instructions for use, as this could compromise product performance.

8.2.5 Data analysis

For basic information regarding data analysis on specific real-time PCR instruments, refer to the instructions for use of the respective instrument.

For detailed instructions regarding the analysis of the data generated with the AltoStar® MERS-CoV RT-PCR Kit 1.5 on different real-time PCR instruments, contact altona Diagnostics technical support (see chapter 12. Technical support).

Criteria for validity of diagnostic PCR runs and result interpretation regardless of the real-time PCR instrument are described in chapters 7.6.8.2 Validity of a diagnostic PCR run and 7.6.8.3 Validity of results for a sample, chapter 7.6.10.1 Manual interpretation of results and table 9.

CAUTION



Do not use other control settings for data analysis than specified in these instructions for use, as this could cause incorrect IVD examination results.

CAUTION



As with any diagnostic test, results shall be interpreted in consideration of all clinical and laboratory findings.

9. Performance data

The performance of the AltoStar® MERS-CoV RT-PCR Kit 1.5 was evaluated using MERS-CoV commercially available material.

9.1 Nasopharyngeal swabs

9.1.1 Analytical sensitivity

For the determination of the limit of detection (LoD) a dilution series of MERS-CoV commercially available material diluted in universal transport medium (UTM®, Copan) containing simulated nasal matrix [5 % w/v Mucin, 5 % v/v blood, 0.8 % v/v NaCl (95 % saline) and 0.00002 % w/v human genomic DNA (510k Submission for BD MAX™ MRSA XT assay; accession number: K133605)] ranging from 1.00E+04 copies/ml to 1.00E+00 copies/ml was generated.

Each dilution was tested in 8 replicates in 3 different runs (total n = 24 per dilution) using combinations of:

- 3 AltoStar® MERS-CoV RT-PCR Kit 1.5 lots
- 3 AltoStar® Purification Kit 1.5 lots
- 3 AltoStar® Internal Control 1.5 lots
- 3 AltoStar® AM16 instruments
- 3 CFX96™ DW Dx instruments

Data from all runs were combined and a probit analysis was performed to determine the 95 % LoD value.

Table 16: PCR results used for the calculation of the analytical sensitivity of the AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene)

Concentration [copies/ml]	N [total]	N [positive]	Hit rate [%]
1.00E+04	24	24	100
3.16E+03	24	24	100
1.00E+03	24	24	100
3.16E+02	23*	23	100
1.00E+02	24	24	100
3.16E+01	24	17	71
1.00E+01	24	6	25
3.16E+00	24	1	4
1.00E+00	24	0	0

* One sample was not processed.

The LoD of the AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene) for the detection of MERS-CoV in UTM® is 72.9 copies/ml (95 % confidence interval: 47.4–152 copies/ml).

Table 17: PCR results used for the calculation of the analytical sensitivity of the AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a)

Concentration [copies/ml]	N [total]	N [positive]	Hit rate [%]
1.00E+04	24	24	100
3.16E+03	24	24	100
1.00E+03	24	24	100
3.16E+02	23*	23	100
1.00E+02	24	18	75
3.16E+01	24	10	42
1.00E+01	24	5	21
3.16E+00	24	1	4
1.00E+00	24	1	4

* One sample was not processed.

The LoD of the AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a) for the detection of MERS-CoV in UTM® is 332 copies/ml (95 % confidence interval: 186–805 copies/ml).

9.1.2 Analytical specificity

The analytical specificity of the AltoStar® MERS-CoV RT-PCR Kit 1.5 is ensured by the thorough selection of the oligonucleotides (primers and probes). The oligonucleotides were checked by sequence comparison analysis against publicly available sequences to ensure that all relevant MERS-CoV strains will be detected.

For the verification of the analytical specificity of the AltoStar® MERS-CoV RT-PCR Kit 1.5 the following experiments were performed (see chapters 9.1.2.1 Negative samples to 9.1.2.3 Cross-reactivity).

9.1.2.1 Negative samples

32 MERS-CoV negative nasopharyngeal swab samples from individual donors were tested with the AltoStar® MERS-CoV RT-PCR Kit 1.5. All (32 out of 32) samples were tested negative for MERS-CoV specific RNA and positive for the IC. The analytical specificity of the AltoStar® MERS-CoV RT-PCR Kit 1.5 for nasopharyngeal swab samples is $\geq 95\%$.

9.1.2.2 Interfering substances

To evaluate the influence of potentially interfering endogenous and exogenous substances on the performance of the AltoStar® MERS-CoV RT-PCR Kit 1.5, selected substances were spiked in UTM® containing MERS-CoV at a final concentration of the 3 x LoD ($9.96E+02$ copies/ml) and in UTM® not containing MERS-CoV.

Results obtained for samples containing potentially interfering substances were compared to results generated for UTM® containing no spiked interferent. Each sample was processed in 3 replicates.

No interference was observed for samples containing elevated levels of:

- Endogenous substances
 - Human genomic DNA
 - Human whole blood
 - Mucin
- Exogenous substances
 - Antiallergic nasal spray (containing beclomethasone dipropionate)
 - Decongestant nasal spray (containing xylometazolinhydrochloride and dexpanthenol)

CAUTION



The presence of PCR inhibitors could cause false negative or invalid results.

9.1.2.3 Cross-reactivity

The analytical specificity of the AltoStar® MERS-CoV RT-PCR Kit 1.5 with respect to cross-reactivity with other pathogens than MERS-CoV was evaluated by testing:

- Pathogens related to MERS-CoV
- Pathogens causing similar symptoms as an infection with MERS-CoV

The AltoStar® MERS-CoV RT-PCR Kit 1.5 did not cross-react with any of the following pathogens:

- Adenovirus
- *Bordetella pertussis*
- *Chlamydia pneumoniae*
- *Haemophilus influenzae*
- Human coronavirus 229E
- Human coronavirus NL63
- Human coronavirus OC43
- Human Metapneumovirus (hMPV)
- Influenza A virus
- Influenza B virus
- *Klebsiella pneumoniae*
- *Legionella pneumophila*
- *Mycobacterium tuberculosis*
- *Mycoplasma pneumoniae*
- Parainfluenza virus 1–4
- Respiratory syncytial virus A
- Respiratory syncytial virus B
- Rhinovirus
- SARS-CoV- 2
- *Streptococcus pneumoniae*
- *Streptococcus pyogenes*

CAUTION



In case the sample contains other pathogens than MERS-CoV, competition with the target amplification or cross-reactivities may occur, causing incorrect IVD examination results.

9.1.3 Precision

Precision of the AltoStar® MERS-CoV RT-PCR Kit 1.5 was evaluated using a panel consisting of:

- 1 MERS-CoV high positive [50 x LoD (1.66E+04 copies/ml)] sample in UTM® containing simulated nasal matrix
- 1 MERS-CoV low positive [3 x LoD (9.96E+02 copies/ml)] sample in UTM® containing simulated nasal matrix
- 1 MERS-CoV negative sample (UTM® containing simulated nasal matrix)

Each panel member was tested in 6 replicates per run.

5 runs were performed on 5 different days using combinations of:

- 3 AltoStar® MERS-CoV RT-PCR Kit 1.5 lots
- 3 AltoStar® Purification Kit 1.5 lots
- 3 AltoStar® Internal Control 1.5 lots
- 3 AltoStar® AM16 instruments
- 3 CFX96™ DW Dx instruments

Repeatability (intra-run variability), inter-lot variability and reproducibility (total variability) were determined based on:

- Threshold cycle (C_q^*) values for the MERS-CoV high positive samples (see table 18)
- Threshold cycle (C_q^*) values for the IC in the MERS-CoV negative samples (see table 19)

* Please note that the chosen term C_q is equivalent to the designation of C_t , which might be used by other cyclers than the CFX96™ Deep Well Dx System (Bio-Rad).

Table 18: Precision data (CV % C_q values) using the AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene) and the AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a) for MERS-CoV high positive samples

	High positive sample AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene) [CV % based on C_q values]	High positive sample AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a) [CV % based on C_q values]
Intra-run variability	0.27–0.93	0.29–0.75
Inter-lot variability	0.67	0.66
Total variability	1.29	1.59

All samples tested at 3 x LoD (low positive samples) were detected positive with the AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene) and the AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a).

Table 19: Precision data (CV % C_q values) for the IC in MERS-CoV negative samples tested with the AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene) and the AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a)

	IC AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene)	IC AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a)
Intra-run variability	0.22–0.79	0.21–0.30
Inter-lot variability	0.84	0.31
Total variability	1.05	0.63

9.1.4 Total failure rate

The robustness of the AltoStar® MERS-CoV RT-PCR Kit 1.5 was assessed by testing 32 MERS-CoV negative nasopharyngeal swab samples from individual donors spiked with MERS-CoV to a final concentration of the 3 x LoD (9.96E+02 copies/ml). All (32 out of 32) samples were tested positive with the AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene) and the AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a) in the MERS-CoV specific fluorescence detection channel (FAM™).

9.1.5 Carry over

Carry over is mostly a workflow dependent risk and independent of the PCR assay used. For the AltoStar® Workflow the AltoStar® Parvovirus B19 PCR Kit 1.5 was used as exemplary model. Potential cross-contamination through carry over from high positive samples was evaluated by testing alternating parvovirus B19 high positive (1.00E+07 IU/ml) and negative samples (n = 44 each per run; 2 runs) with the AltoStar® Parvovirus B19 PCR Kit 1.5. No carry over was observed, i.e. all parvovirus B19 negative samples were tested negative.

9.1.6 Clinical performance

The AltoStar® MERS-CoV RT-PCR Kit 1.5 was evaluated in a comparative study with the CE-marked RealStar® MERS-CoV RT-PCR Kit 1.0 (altona Diagnostics). Retrospectively, 87 nasopharyngeal swab samples were tested in parallel:

The RealStar® MERS-CoV RT-PCR Kit 1.0 (altona Diagnostics) was used in combination with the *ExiPrep*™ 96 Viral DNA/RNA Kit (Bioneer) and the *ExiPrep*™ 96 Lite (Bioneer).

The AltoStar® MERS-CoV RT-PCR Kit 1.5 was used in combination with the AltoStar® Purification Kit 1.5 and the AltoStar® Internal Control 1.5 on the AltoStar® AM16 and the CFX96™ DW Dx.

For the qualitative analysis all samples with an invalid result for one or both assays were excluded.

Results for the remaining 85 samples are shown in table 20.

Table 20: Results of the evaluation of the diagnostic sensitivity and specificity for MERS-CoV in nasopharyngeal swab samples

		RealStar® MERS-CoV RT-PCR Kit 1.0 (altona Diagnostics)	
		POSITIVE	NEGATIVE
AltoStar® MERS-CoV RT-PCR Kit 1.5	POSITIVE	40	1
	NEGATIVE	0	44

The diagnostic sensitivity and specificity of the AltoStar® MERS-CoV RT-PCR Kit 1.5 compared to the RealStar® MERS-CoV RT-PCR Kit 1.0 (altona Diagnostics) were 100 % and 97.78 %, respectively.

10. Disposal

Dispose of hazardous and biological waste in compliance with local and national regulations. Leftover product components and waste should not be allowed to enter sewage, water courses or the soil.

CAUTION



Always treat samples as infectious and (bio-)hazardous material in accordance with safety and laboratory procedures. For sample material spills promptly use an appropriate disinfectant. Handle contaminated materials as biohazardous.

CAUTION



Disposal of hazardous and biological waste shall comply with local and national regulations to avoid environmental contamination.

NOTE



The PCR plate must be disposed of in a sealed state since the PCR Plate Sealing Foil cannot be removed.

11. Quality control

In accordance with the altona Diagnostics GmbH EN ISO 13485-certified Quality Management System, each lot of AltoStar® MERS-CoV RT-PCR Kit 1.5 is tested against predetermined specifications to ensure consistent product quality.

12. Technical support

For customer support, contact altona Diagnostics technical support:

e-mail: support@altona-diagnostics.com

phone: +49-(0)40-5480676-0

NOTE



Any serious incident that has occurred in relation to this product shall be reported to altona Diagnostics and the competent authority of your country.

13. Literature

- [1] Chan, Jasper F. W., et al. "Middle East Respiratory Syndrome Coronavirus: Another Zoonotic Betacoronavirus Causing SARS-Like Disease." *Clinical Microbiology Reviews*, vol. 28, no. 2, 2015, pp. 465–522., doi:10.1128/cmr.00102-14.
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- [3] Mackay, Ian M., and Katherine E. Arden. "MERS coronavirus: diagnostics, epidemiology and transmission." *Virology Journal*, vol. 12, no. 1, 2015, doi:10.1186/s12985-015-0439-5.
- [4] Arabi, Yaseen M., et al. "Middle East Respiratory Syndrome." *New England Journal of Medicine*, vol. 376, no. 6, Sept. 2017, pp. 584–594., doi:10.1056/nejmsr1408795.
- [5] "Laboratory testing for Middle East respiratory syndrome coronavirus (MERS-CoV): Interim guidance (revised)." World Health Organization, January 2018, <https://apps.who.int/iris/handle/10665/259952>.

14. Trademarks and disclaimers

4s3™ (4titude); AltoStar®, RealStar® (altona Diagnostics); ABI Prism®, QuantStudio™ (Applied Biosystems); *ExiPrep*™ (Bioneer); CFX96™, CFX Manager™ (Bio-Rad); Rotor-Gene® (QIAGEN); UTM® (Copan); LOINC® (Regenstrief Institute, Inc.); LightCycler® (Roche); FAM™, JOE™, MicroAmp™, VIC™, ROX™ (Thermo Fisher Scientific).

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The AltoStar® MERS-CoV RT-PCR Kit 1.5 is a CE-marked diagnostic kit according to the European *in vitro* diagnostic directive 98/79/EC.



Product not licensed with Health Canada and not FDA cleared or approved.

Not available in all countries.

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15. Symbols

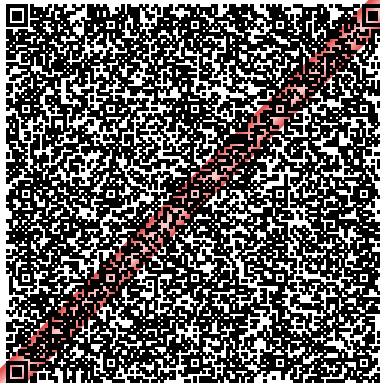
Symbol	Explanation
	<i>In vitro</i> diagnostic medical device
	Global Trade Item Number
	Batch code
	Content
	Cap color
	Catalogue number
	Number
	Component
	Consult instructions for use
	Contains sufficient for "n" tests/reactions (rxns)
	Temperature limit
	Use-by date
	Manufacturer
	Caution
	Material number

Symbol	Explanation
	Version
i	Note
	Contains biological material of animal origin

16. Assay protocol for the AltoStar® Connect software and information for LIMS integration

The 2D barcodes in figures 15 and 16 are to be used for installing the latest assay protocol for use of the AltoStar® MERS-CoV RT-PCR Kit 1.5 on the AltoStar® AM16. The barcodes can only be scanned in printed form. You can scan the barcodes directly from the manual or print it on a separate sheet. Please note that the size of the print affects the scannability of the barcode. Make sure to scale the size to 100 %. For scanning, aim the scanner to the red line on the barcode. For details on management of assay protocols, refer to the respective chapter in the instructions for use of the AltoStar® Connect software. For information for LIMS integration, see tables 22 and 23.

AltoStar® MERS CoV RT-PCR Kit 1.5 (upE + N gene)



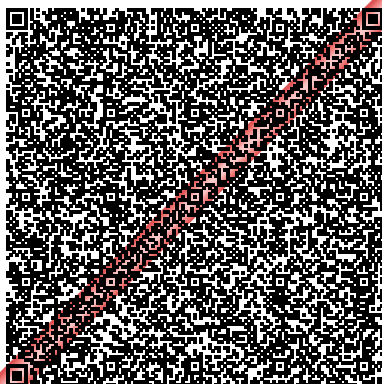
Protocol Version:

Checksum: 0668ABA766F3FC54537B5F2E96A0D0EE937FA321

1

Figure 15: Assay protocol barcode for the AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene)

AltoStar® MERS CoV RT-PCR Kit 1.5 (orf1a)



Protocol Version:

1

Checksum: B74A026D0147C4EAE079D3E07C8C50AD44C977FC

Figure 16: Assay protocol barcode for the AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a)

Table 21: Changelog for the assay protocol

Protocol version	Release updates
1	Initial version

Table 22: Information for LIMS integration AltoStar® MERS-CoV RT-PCR Kit 1.5 (upE + N gene)

Usage	Data
Test order (LIMS → AltoStar® AM16)	AltoStar MERS-CoV RT-PCR Kit 1.5 (upE + N gene)
Test result (CFX96™ DW Dx → LIMS) unit	cp/ml
Test result (CFX96™ DW Dx → LIMS) channel 1	upE + N gene
Test result (CFX96™ DW Dx → LIMS) channel 2	Internal Control

Table 23: Information for LIMS integration AltoStar® MERS-CoV RT-PCR Kit 1.5 (orf1a)

Usage	Data
Test order (LIMS → AltoStar® AM16)	AltoStar MERS-CoV RT-PCR Kit 1.5 (orf1a)
Test result (CFX96™ DW Dx → LIMS) unit	cp/ml
Test result (CFX96™ DW Dx → LIMS) channel 1	orf1a
Test result (CFX96™ DW Dx → LIMS) channel 2	Internal Control

For LOINC® (Logical Observation Identifiers Names and Codes) please refer to the altona Diagnostics GmbH website (www.altona-diagnostics.com) or contact altona Diagnostics technical support (see chapter 12. Technical support).

17. Revision history

Table 24: Revision history

Identifier	Date of issue [month/year]	Modifications
MAN-AS0391540- EN-S01	04/2022	Initial release

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