altona DIAGNOSTICS

Instructions for Use

RealStar®
Norovirus RT-PCR Kit 3.0

04/2017 EN

RealStar®

RealStar®

Norovirus RT-PCR Kit 3.0

For use with

Mx 3005P™ QPCR System (Stratagene)

VERSANT® kPCR Molecular System AD (Siemens Healthcare)

ABI Prism® 7500 SDS (Applied Biosystems)

ABI Prism® 7500 Fast SDS (Applied Biosystems)

Rotor-Gene® 6000 (Corbett Research)

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

CFX96™ Real-Time PCR Detection System (Bio-Rad)

CFX96™ Deep Well Real-Time PCR Detection System (Bio-Rad)

LightCycler® 480 Instrument II (Roche)

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IVD

REF 053013

Σ 96

04 2017

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MAN-053010-EN-S01

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1. Intended Use

The RealStar® Norovirus RT-PCR Kit 3.0 is an *in vitro* diagnostic test, based on real-time PCR technology, for the qualitative detection of RNA specific for noroviruses belonging to the genogroup I (G I) and genogroup II (G II). Furthermore, the test allows the differentiation between norovirus genogroup I and norovirus genogroup II specific RNA.

2. Kit Components

Lid Color	Component	Number of Vials	Volume [µl/Vial]
Blue	Master A	8	60
Purple	Master B	8	180
Green	Internal Control	1	1000
Red	Positive Control GI	1	250
Orange	Positive Control GII	1	250
White	Water (PCR grade)	1	500

3. Storage

- The RealStar® Norovirus RT-PCR Kit 3.0 is shipped on dry ice. The components of the kit should arrive frozen. If one or more components are not frozen upon receipt, or if tubes have been compromised during shipment, contact altona Diagnostics GmbH for assistance.
- All components should be stored between -25°C and -15°C upon arrival.
- Repeated thawing and freezing of Master reagents (more than twice) should be avoided, as this might affect the performance of the assay. The reagents should be frozen in aliquots, if they are to be used intermittently.
- Storage between +2°C and +8°C should not exceed a period of two hours.
- Protect Master A and Master B from light.

4. Material and Devices required but not provided

- Appropriate real-time PCR instrument (see chapter 6.1 Real-Time PCR Instruments)
- Appropriate nucleic acid extraction system or kit (see chapter 8.2 Sample Preparation)
- Desktop centrifuge with a rotor for 2 ml reaction tubes
- Centrifuge with a rotor for microtiter plates, if using 96 well reaction plates
- Vortex mixer
- Appropriate 96 well reaction plates or reaction tubes with corresponding (optical) closing material
- Pipettes (adjustable)
- Pipette tips with filters (disposable)
- Powder-free gloves (disposable)

NOTE	
i	***Please ensure that all instruments used have been installed, calibrated, checked and maintained according to the manufacturer´s instructions and recommendations.***

i	***It is highly recommended to use the 72-well rotor with the appropriate 0.1 ml reaction tubes, if using the Rotor-Gene® 6000 (Corbett Research) or the Rotor-Gene® Q 5/6 plex (QIAGEN).***

5. Background Information

The genus *Norovirus* (Norovirus) belongs to the family of *Caliciviridae* and is formerly known as *Norwalk-like virus*. Noroviruses are single stranded RNA viruses, discovered in 1972 by electron-microscopy. They are characterized by their high degree of genomic variability. Noroviruses have been classified into five genogroups (G I to G V) based on sequence by comparison of the RNA polymerase and capsid region of the genome. Genogroups I, II, and IV are associated with infections in humans. To date, the genogroups G I and G II are subdivided into at least 8 and 17 genotypes, respectively.

Noroviruses are responsible for the majority of non-bacterial acute gastroenteritis in humans in industrialized countries. The symptoms of vomiting and diarrhea occur after a short incubation time of 8 to 72 hours. Noroviruses are highly infectious. Infections with Norovirus can either be caused by contaminated food and/or drinking water or person-to-person virus transmission. Norovirus can cause large outbreak situations in settings of close human contact such as hospitals, nursing homes, cruise ships, etc.

In recent years, a substantial increase of norovirus outbreaks has been reported in Western Europe. To prevent further spreading of the causative agent during an outbreak situation an immediate application of hygiene measures as well as rapid and sensitive diagnostics is needed. Since norovirus of the genogroups I and II can not be grown in cell culture and since enzyme immunoassays were found to be insufficiently sensitive and/or insufficiently specific, RT-PCR has become the method of choice for the diagnosis of norovirus infections.

NOTE	
i	***Due to the relatively fast molecular evolution of RNA viruses, there is an inherent risk for any RT-PCR based test system that accumulation of mutations over time may lead to false negative results.***

6. Product Description

The RealStar® Norovirus RT-PCR Kit 3.0 is an *in vitro* diagnostic test, based on real-time PCR technology, for the qualitative detection and differentiation of norovirus genogroup I (NV G I) and norovirus genogroup II (NV G II) specific RNA.
The assay includes a heterologous amplification system (Internal Control) to identify possible RT-PCR inhibition and to confirm the integrity of the reagents of the kit.

Real-time RT-PCR technology utilizes reverse-transcriptase (RT) reaction to convert RNA into complementary DNA (cDNA), polymerase chain reaction (PCR) for the amplification of specific target sequences and target specific probes for the detection of the amplified DNA. The probes are labelled with fluorescent reporter and quencher dyes.

Probes specific for NV G I RNA are labelled with a fluorophore showing similar characteristics to Cy®5 whereas the probes specific for NV G II RNA are labelled with the fluorophore FAM™. The probe specific for Internal Control (IC) is labelled with the fluorophore JOE™.

Using probes linked to distinguishable dyes enables the parallel detection of NV G I and NV G II specific RNA as well as the detection of the Internal Control in corresponding detector channels of the real-time PCR instrument.

The test consists of three processes in a single tube assay:

- Reverse transcription of target and Internal Control RNA to cDNA
- PCR amplification of target and Internal Control cDNA
- Simultaneous detection of PCR amplicons by fluorescent dye labelled probes

The RealStar® Norovirus RT-PCR Kit 3.0 consists of:

- Two Master reagents (Master A and Master B)
- Internal Control (IC)
- Two Positive Controls:
  - Positive Control NV G I
  - Positive Control NV G II
- PCR grade water

Master A and Master B contain all components (PCR buffer, reverse transcriptase, DNA polymerase, magnesium salt, primers and probes) to allow reverse transcription, PCR mediated amplification and target detection of NV G I specific RNA, NV G II specific RNA and Internal Control in one reaction setup.

6.1 Real-Time PCR Instruments

The RealStar® Norovirus RT-PCR Kit 3.0 was developed and validated to be used with the following real-time PCR instruments:

- Mx 3005P™ QPCR System (Stratagene)
- VERSANT® kPCR Molecular System AD (Siemens Healthcare)
- ABI Prism® 7500 SDS (Applied Biosystems)
- ABI Prism® 7500 Fast SDS (Applied Biosystems)
- Rotor-Gene® 6000 (Corbett Research)
- Rotor-Gene® Q5/6 plex Platform (QIAGEN)
- CFX96™ Real-Time PCR Detection System (Bio-Rad)
- CFX96™ Deep Well Real-Time PCR Detection System (Bio-Rad)
- LightCycler® 480 Instrument II (Roche)

7. Warnings and Precautions

Read the Instructions for Use carefully before using the product.

- Before first use check the product and its components for:
  - Integrity
  - Completeness with respect to number, type and filling (see chapter 2. Kit Components)
  - Correct labelling
  - Frozenness upon arrival
- Use of this product is limited to personnel specially instructed and trained in the techniques of real-time PCR and *in vitro* diagnostic procedures.
- Specimens should always be treated as infectious and/or biohazardous in accordance with safe laboratory procedures.
- Wear protective disposable powder-free gloves, a laboratory coat and eye protection when handling specimens.
- Avoid microbial and nuclease (DNase/RNase) contamination of the specimens and the components of the kit.
- Always use DNase/RNase-free disposable pipette tips with aerosol barriers.
- Always wear protective disposable powder-free gloves when handling kit components.
- Use separated and segregated working areas for (i) sample preparation, (ii) reaction setup and (iii) amplification/detection activities. The workflow in the laboratory should proceed in unidirectional manner. Always wear disposable gloves in each area and change them before entering a different area.
- Dedicate supplies and equipment to the separate working areas and do not move them from one area to another.
- Store positive and/or potentially positive material separated from all other components of the kit.
- Do not open the reaction tubes/plates post amplification, to avoid contamination with amplicons.

- Additional controls may be tested according to guidelines or requirements of local, state and/or federal regulations or accrediting organizations.
- Do not autoclave reaction tubes after the PCR, since this will not degrade the amplified nucleic acid and will bear the risk to contaminate the laboratory area.
- Do not use components of the kit that have passed their expiration date.
- Discard sample and assay waste according to your local safety regulations.

8. Procedure

8.1 Sample Preparation

Extracted RNA is the starting material for the RealStar® Norovirus RT-PCR Kit 3.0.

The quality of the extracted RNA has a profound impact on the performance of the entire test system. It has to be ensured that the system used for nucleic acid extraction is compatible with real-time PCR technology. The following kits and systems are suitable for nucleic acid extraction:

- QIAamp® Viral RNA Mini Kit (QIAGEN)
- QIAsymphony® (QIAGEN)
- NucliSENS® easyMag® (bioMérieux)
- MagNA Pure 96 System (Roche)
- m2000sp (Abbott)
- Maxwell® 16 IVD Instrument (Promega)
- VERSANT® kPCR Molecular System SP (Siemens Healthcare)

Alternative nucleic acid extraction systems and kits might also be appropriate.
The suitability of the nucleic acid extraction procedure for use with RealStar® Norovirus RT-PCR Kit 3.0 has to be validated by the user.

If using a spin column based sample preparation procedure including washing buffers containing ethanol, it is highly recommended to perform an additional centrifugation step for 10 min at approximately 17000 x g (~ 13000 rpm), using a new collection tube, prior to the elution of the nucleic acid.

CAUTION	
	***If your sample preparation system is using washing buffers containing ethanol, make sure to eliminate any traces of ethanol prior to elution of the nucleic acid. Ethanol is a strong inhibitor of real-time PCR.***
	***The use of carrier RNA is crucial for extraction efficiency and stability of the extracted nucleic acid.***

For additional information and technical support regarding pre-treatment and sample preparation please contact our Technical Support (see chapter 14. Technical Assistance).

8.2 Master Mix Setup

All reagents and samples should be thawed completely, mixed (by pipetting or gentle vortexing) and centrifuged briefly before use.

The RealStar® Norovirus RT-PCR Kit 3.0 contains a heterologous Internal Control (IC), which can either be used as a RT-PCR inhibition control or as a control of the sample preparation procedure (nucleic acid extraction) and as a RT-PCR inhibition control.

► If the IC is used as a RT-PCR inhibition control, but not as a control for the sample preparation procedure, set up the Master Mix according to the following pipetting scheme:

Number of Reactions (rxns)	1	12
Master A	5 µl	60 µl
Master B	15 µl	180 µl
Internal Control	1 µl	12 µl
Volume Master Mix	**21 µl**	**252 µl**

► If the IC is used as a control for the sample preparation procedure and as a RT-PCR inhibition control, add the IC during the nucleic acid extraction procedure.

► No matter which method/system is used for nucleic acid extraction, the IC **must not** be added directly to the specimen. The IC should always be added to the specimen/lysis buffer mixture. The volume of the IC which has to be added, always and only depends on the elution volume. It represents 10% of the elution volume. For instance, if the nucleic acid is going to be eluted in 60 µl of elution buffer or water, 6 µl of IC per sample must be added into the specimen/lysis buffer mixture.

► If the IC was added during the sample preparation procedure, set up the Master Mix according to the following pipetting scheme:

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	
	***If the IC (Internal Control) was added during the sample preparation procedure, at least the negative control must include the IC.***
	***Never add the IC directly to the specimen.***

8.3 Reaction Setup

- ► Pipette 20 µl of the Master Mix into each required well of an appropriate optical 96-well reaction plate or an appropriate optical reaction tube.
- ► Add 10 µl of the sample (eluate from the nucleic acid extraction) or 10 µl of the control (Positive or Negative Control).

Reaction Setup	
Master Mix	20 µl
Sample or Control	10 µl
Total Volume	**30 µl**

- ► Make sure that each Positive Control and at least one Negative Control is used per run.
- ► Thoroughly mix the samples and controls with the Master Mix by pipetting up and down.
- ► Close the 96-well reaction plate with appropriate lids or optical adhesive film and the reaction tubes with appropriate lids.
- ► Centrifuge the 96-well reaction plate in a centrifuge with a microtiter plate rotor for 30 seconds at approximately 1000 x g (~ 3000 rpm).

9. Programming the Real-Time PCR Instrument

For basic information regarding the setup and programming of the different real-time PCR instruments, please refer to the user manual of the respective instrument.

For detailed programming instructions regarding the use of the RealStar® Norovirus RT-PCR Kit 3.0 on specific real-time PCR instruments please contact our Technical Support (see chapter 14. Technical Assistance).

9.1 Settings

► Define the following settings:

Settings	
Reaction Volume	30 µl
Ramp Rate	Default
Passive Reference	ROX™

9.2 Fluorescence Detectors (Dyes)

► Define the fluorescence detectors (dyes):

Target	Detector Name	Reporter	Quencher
NV G I specific RNA	NV G I	Cy®5	(None)
NV G II specific RNA	NV G II	FAM™	(None)
Internal Control	IC	JOE™	(None)

9.3 Temperature Profile and Dye Acquisition

► Define the temperature profile and dye acquisition:

	Stage	Cycle Repeats	Acquisition	Temperature [°C]	Time [min:sec]
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

10. Data Analysis

For basic information regarding data analysis on specific real-time PCR instruments, please refer to the user manual of the respective instrument.

For detailed instructions regarding the analysis of the data generated with the RealStar® Norovirus RT-PCR Kit 3.0 on different real-time PCR instruments please contact our Technical Support (see chapter 14. Technical Assistance).

10.1 Validity of Diagnostic Test Runs

10.1.1 Valid Diagnostic Test Run

For a **valid** diagnostic test run, the following control conditions must be met:

Control ID	Detection Channel		
	Cy®5	FAM™	JOE™
Positive Control NV G I	+	-	+/-*
Positive Control NV G II	-	+	+/-*
Negative Control	-	-	+

* The presence or absence of a signal in the JOE™ channel is not relevant for the validity of the test run.

10.1.2 Invalid Diagnostic Test Run

A diagnostic test run is **invalid**, (i) if the run has not been completed or (ii) if any of the control conditions for a **valid** diagnostic test run are not met.

In case of an **invalid** diagnostic test run, repeat testing by using the remaining purified nucleic acids or start from the original samples again.

10.2 Interpretation of Results

10.2.1 Qualitative Analysis

Detection Channel			Result Interpretation
Cy®5	FAM™	JOE™	
+	-	+*	NV G I specific RNA detected.
-	+	+*	NV G II specific RNA detected.
-	-	+	Neither NV G I nor NV G II specific RNA detected. The sample does not contain detectable amounts of NV G I or NV G II specific RNA.
-	-	-	RT-PCR inhibition or reagent failure. Repeat testing from original sample or collect and test a new sample.

* Detection of the Internal Control in the JOE™ detection channel is not required for positive results either in the Cy®5 detection channel or in the FAM™ detection channel. A high NV G I and/or NV G II RNA load in the sample can lead to reduced or absent Internal Control signals.

11. Performance Evaluation

Since norovirus does not grow in culture, there is no quantified standard material available. Therefore, performance evaluated of the RealStar® Norovirus RT-PCR Kit 3.0 was done by using RNA extracted from a norovirus Genogroup I isolate (G I.3) and RNA extracted from a norovirus Genogroup II isolate (G II.4).

11.1 Analytical Sensitivity

The analytical sensitivity of the RealStar® Norovirus RT-PCR Kit 3.0 is defined as the concentration (copies per µl of the eluate) of norovirus specific RNA molecules that can be detected with a positivity rate of 95%. The analytical sensitivity was determined by analysis of dilution series of the extracted RNA of a norovirus Genogroup I isolate and a norovirus Genogroup II isolate.

Table 1: RT-PCR results used for the calculation of the analytical sensitivity with respect to the detection of norovirus GI specific RNA

Input Conc. [copies/µl]	Number of Replicates	Number of Positives	Hit Rate [%]
100.000	24	24	100
50.000	24	24	100
31.62	24	24	100
10.00	24	23	98.9
5.0	24	17	70.8
3.16	24	11	24.8
1.0	24	5	20.8
0.316	24	3	12.5
0.10	24	0	0

Table 2: RT-PCR results used for the calculation of the analytical sensitivity with respect to the detection of norovirus GII specific RNA

Input Conc. [copies/µl]	Number of Replicates	Number of Positives	Hit Rate [%]
10.000	24	24	100
5.0	24	24	100
3.16	24	23	95.8
1.0	24	21	87.5
0.5	24	15	62.5
0.316	24	10	41.7
0.10	24	6	25
0.0316	24	4	16.7
0.01	24	0	0

The analytical sensitivity of the RealStar® Norovirus RT-PCR Kit 3.0 was determined by Probit analysis:

- For the detection of norovirus Genogroup I specific RNA, the analytical sensitivitiy is 16.69 copies/µl eluate [95% confidence interval (CI): 10.73 to 32.41 copies/µl]
- For the detection of norovirus Genogroup II specific RNA, the analytical sensitivitiy is 2.87 copies/µl eluate [95% confidence interval (CI): 1.74 to 5.99 copies/µl]

11.2 Analytical Specificity

The analytical specificity of the RealStar® Norovirus RT-PCR Kit 3.0 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 norovirus G I and G II genotypes will be detected.

The analytical specificity of the RealStar® Norovirus RT-PCR Kit 3.0 was evaluated by testing a panel of genomic RNA/DNA extracted from viruses related to norovirus and other pathogens causing similar symptoms.

The RealStar® Norovirus RT-PCR Kit 3.0 did not cross-react with any of the following pathogens:

- Hepatitis A virus
- Hepatitis E virus
- Rotavirus
- Sapovirus
- Astrovirus
- *Cryptococcus* spec.
- *Entamoeba* spec.
- *Entamoeba histolytica*
- *Giardia lamblia*
- *Clostridium difficile*
- *Escherichia coli*
- *Salmonella* spec.
- *Campylobacter* spec.

11.3 Precision

Precision of the RealStar® Norovirus RT-PCR Kit 3.0 was determined as intra-assay variability (variability within one experiment), inter-assay variability (variability between different experiments) and inter-lot variability (variability between different production lots). Total variability was calculated by combining the three analysis.

The variability data are expressed in terms of standard variation and coefficient of variation based on the (C_t)-values. Six replicates per sample were analysed for intra-assay variability, inter-assay and inter-lot variability.

Table 3: Precision data for NV G I and NV G II specific RNA

NV G I and NV G II		Average Threshold Cycle (C_t)	Standard Deviation	Coefficient of Variation [%]
Intra-Assay Variability	NV G I	32.08	0.05	0.10
	NV G II	29.23	0.04	0.10
Inter-Assay Variability	NV G I	31.65	0.43	1.36
	NV G II	29.35	0.12	0.41
Inter-Lot Variability	NV G I	31.49	0.28	0.89
	NV G II	30.37	0.90	2.96
Total Variability	NV G I	31.68	0.37	1.17
	NV G II	29.99	0.94	3.13

Table 4: Precision data for the detection of the Internal Control

Internal Control	Average Threshold Cycle (C_t)	Standard Deviation	Coefficient of Variation [%]
Intra-Assay Variability	30.47	0.08	0.27
Inter-Assay Variability	30.41	0.12	0.38
Inter-Lot Variability	30.77	0.25	0.83
Total Variability	30.68	0.22	0.72

12. Limitations

- Strict compliance with the instructions for use is required for optimal results.
- Use of this product is limited to personnel specially instructed and trained in the techniques of real-time PCR and in *in vitro* diagnostic procedures.
- Good laboratory practice is essential for proper performance of this assay. Extreme care should be taken to preserve the purity of the components of the kit and reaction setups. All reagents should be closely monitored for impurity and contamination. Any suspicious reagents should be discarded.
- Appropriate specimen collection, transport, storage and processing procedures are required for the optimal performance of this test.
- This assay must not be used on the specimen directly. Appropriate nucleic acid extraction methods have to be conducted prior to using this assay.
- The presence of RT-PCR inhibitors (e.g. heparin) may cause false negative or invalid results.
- Potential mutations within the target regions of the NV G I and NV G II genome covered by the primers and/or probes used in the kit may result in failure to detect the presence of the pathogens.
- As with any diagnostic test, results of the RealStar® Norovirus RT-PCR Kit 3.0 need to be interpreted in consideration of all clinical and laboratory findings.

13. Quality Control

In accordance with the altona Diagnostics GmbH EN ISO 13485-certified Quality Management System, each lot of RealStar® Norovirus RT-PCR Kit 3.0 is tested against predetermined specifications to ensure consistent product quality.

14. Technical Assistance

For technical advice, please contact our Technical Support:

e-mail: **support@altona-diagnostics.com**
phone: **+49-(0)40-5480676-0**

15. Literature

Versalovic, James, Carroll, Karen C.,Funke, Guido, Jorgensen, James H., Landry, Marie Louise and David W. Warnock (ed). Manual of Clinical Microbiology. 10th Edition. ASM Press, 2011.

Cohen, Jonathan, Powderly, William G, and Steven M Opal. Infectious Diseases, Third Edition. Mosby, 2010.

16. Trademarks and Disclaimers

RealStar® (altona Diagnostics); ABI Prism® (Applied Biosystems); ATCC® (American Type Culture Collection); CFX96™ (Bio-Rad); Cy® (GE Healthcare); FAM™, JOE™, ROX™ (Life Technologies); LightCycler® (Roche); Maxwell® (Promega); Mx 3005P™ (Stratagene); NucliSENS®, easyMag® (bioMérieux); Rotor-Gene®, QIAamp®, QIAsymphony® (QIAGEN); VERSANT® (Siemens Healthcare).

Registered names, trademarks, etc. used in this document, even if not specifically marked as such, are not to be considered unprotected by law.

The RealStar® Norovirus RT-PCR Kit 3.0 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.

17. Explanation of Symbols

IVD	*In vitro* diagnostic medical device
LOT	Batch code
CAP	Cap color
REF	Product number
CONT	Content
NUM	Number
COMP	Component
GTIN	Global trade identification number
	Consult instructions for use
	Contains sufficient for “n” tests/reactions (rxns)
	Temperature limit
	Use-by date
	Manufacturer
	Caution
	Note
	Version

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always a drop ahead.

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