

Instrument Source and Specifications— QuantStudio 1 Real-Time PCR System

Instrument model: Applied Biosystems™ QuantStudio™ 1 Real-Time PCR System
(Cat. Nos. A40426, A40427, A40428)

Instrument description: The QuantStudio 1 system offers basic features ideal for those new to qPCR or with a limited budget, while still offering the craftsmanship and superior user experience of our QuantStudio family of instruments. The system is designed for ease of use and comes with optimized design and analysis software. When used with Connect, the cloud-enabled platform from Thermo Fisher Scientific, you can remotely monitor your runs in real time, analyze sophisticated data sets in minutes, securely store data, and share results with colleagues across institutions and around the world.

The QuantStudio 1 system comes with a fixed 96-well 0.2 mL isothermal block, which is accessed with an easy-to-open manual pull drawer. The system can be used alone via the 8.5-inch touchscreen, or the system can be connected to a desktop or laptop computer. With a bright white LED and three of the most commonly used channels, the QuantStudio 1 system delivers superior data accuracy and sensitivity for a broad range of genomic applications.

Manufacturer: Thermo Fisher Scientific

Thermo Fisher Scientific is the manufacturer of the QuantStudio 1 Real-Time PCR System and is the sole supplier, by itself or through its authorized distributors, of the QuantStudio 1 system.

Technology overview

Real-time PCR overview

The polymerase chain reaction (PCR) is a powerful technology that amplifies DNA or cDNA targets a million-fold or more. Real-time PCR amplifies the target in the presence of fluorescent dyes, and the instrument captures the fluorescent signal in real time to determine how many copies of DNA are present in each cycle. The ability of the real-time PCR instrument to monitor the amount of target that is amplified over the course of the run enables very precise, sensitive, and accurate quantitative measurements to determine the number of starting copies in the reaction.

Real-time PCR amplifies DNA exponentially, doubling the number of molecules present with each amplification cycle. The increase of fluorescent signal is directly proportional to the amount of PCR product generated in the exponential phase of the reaction. The number of cycles and the amount of PCR end product can be used to calculate the initial quantity of genetic material by comparing the final quantity with that of a known standard.

The fluorescent reporters that are used include double-stranded DNA (dsDNA)-binding dyes, or dye molecules attached to PCR primers or probes that are incorporated into the product during amplification. By plotting fluorescence against the cycle number, the real-time PCR instrument generates an amplification plot that represents the accumulation of product over the duration of the entire PCR reaction.

Real-time PCR applications

Real-time PCR is very flexible and can be used for the following applications:

- Gene expression analysis
- Genotyping
- Copy number variation analysis
- Pathogen detection, strain typing, and viral load determination
- miRNA profiling
- Protein analysis with proximity ligation assays
- Quality control for detection of environmental contaminants
- Biofuel development

Real-time PCR advantages

The advantages of real-time PCR over other methods include:

- The ability to monitor the progress of the PCR reaction as it occurs in real time on both the instrument touchscreen and software client
- The ability to precisely measure the amount of amplicon at each cycle
- An increased dynamic range of detection compared to other nucleic acid detection methods
- The combination of amplification and detection in a single tube, which eliminates post-PCR manipulations

Real-time PCR has become the leading tool for the detection and quantification of DNA or RNA. Using this technique, you can achieve precise detection of gene expression differences that are accurate down to 1.5-fold, and a dynamic range of up to 10 orders of magnitude. Because of the high-quality data it generates, real-time PCR is commonly used to verify the results of other nucleic acid analysis methods, including microarray analysis.

The QuantStudio 1 system has the following differentiating features and benefits:

System

1. The system utilizes the Connect platform (up to 1 TB of storage space) for data sharing at the user's discretion.
2. The system can be used with online scientific analysis apps available through the Connect platform.
3. The system comes with desktop-based software, allowing for single-plate run setup and analysis.

Instrument

4. The instrument comes in a 96-well 0.2 mL fixed block configuration. This block has the capacity to run Fast protocols and complete runs in ~40 minutes.
5. The instrument does not require a field service engineer (FSE) visit for installation and can be set up by the end user directly out of the box. An IT checklist is provided to streamline Internet connectivity.
6. The instrument can be installed without a computer.
7. The instrument installation protocol includes an optional RNaseP verification plate run to verify performance.
8. Instrument installation does not require dye calibration.
9. The instrument's block is accessible from the front of the instrument to maximize bench space.
10. The instrument's dimensions are 40 x 27 x 50 cm (H x W x D) for maximum horizontal and vertical bench space.
11. The instrument is designed to analyze 96 samples simultaneously in any of the following formats: 96-well plate with optical adhesive cover, 96-well plate with optical flat caps, 8-tube strips with optical flat caps, or individual tubes with optical flat caps.
12. The instrument is designed to support reaction volumes of 10–100 μ L.
13. The instrument is factory-calibrated with FAM™, SYBR™, VIC™, JUN™, and ROX™ dyes.
14. The instrument's melt curve or dissociation takes place in steps ranging from $0.015^{\circ}\text{C} \leq \Delta T \leq 3.66^{\circ}\text{C}$.
15. The instrument has a maximum block ramp rate of 3.5°C/sec.
16. The instrument block has a temperature range of 4–99.9°C.
17. The instrument heated cover has a temperature range of 50–110°C.
18. The instrument includes a long-lasting bright white LED source that has a median lifetime of at least 60,000 hours.
19. The instrument uses a CMOS imager for data acquisition and collects data for each filter combination in <2 seconds.
20. The instrument can be used with 100–240 V outlets without modifications or special plug requirements.
21. The instrument includes a heated lid assembly that heats the top half of the sample plates and provides an effective seal to minimize reaction evaporation.

Instrument onboard computer

22. The instrument can run in stand-alone mode, without a computer attached.
23. The instrument includes a touchscreen interface that can store protocols for quick run starts from the instrument without the need for a computer.
24. The instrument touchscreen interface enables viewing of amplification plots and filtering by sample, target, and task.
25. The instrument touchscreen interface allows for uploading of protocols or downloading of run files using a USB interface, local area network, and the Connect platform.
26. The instrument touchscreen interface allows for uploading of protocols or run files directly to the Connect platform.
27. The instrument contains onboard storage with a memory capacity of 10 GB for storing between 1,000 and 5,000 standard absolute quantification run files, and is designed for run protection in case of network or power outages.
28. The instrument can be customized, through the touchscreen, to include the correct time zone and service/calibration notification settings.
29. The instrument touchscreen interface allows for creation of local user accounts with PIN-protected access. Individual user accounts for the Connect platform can be linked to online accounts on **thermofisher.com**.
30. The instrument touchscreen interface allows users to create and run protocols as guests.
31. The instrument touchscreen interface allows for editing of thermal protocols, including editing of individual PCR stages, individual PCR steps, programmable pause settings, temperature settings, step duration settings, reaction volume settings, heated cover temperature, and ramp rate settings.
32. The instrument touchscreen interface allows users to load template files (.edt) from a USB drive, local area network, or the Connect platform.
33. The instrument touchscreen interface allows users to designate a destination for completed run files and C_q export to a USB drive, local area network, or the Connect platform.
34. The instrument touchscreen interface allows users to enter reagent information into the run file, including reagent name, barcode, type, catalog number, lot number, and expiration date. An optional 2D barcode reader allows automatic entry of this information from Applied Biosystems™ reagents labeled with compatible 2D barcodes.
35. The instrument touchscreen interface allows a run in progress to be paused. The user can set the block temperature during the run pause. During the pause the user can open/close the block drawer to access samples. From the touchscreen, the user can resume the run from the point at which it was paused.
36. The instrument touchscreen interface allows users to edit sample and target assignments.
37. The instrument touchscreen interface allows users to repeat a previous run.
38. The instrument touchscreen interface allows users to perform dye calibrations and view results on the touchscreen.

39. The instrument touchscreen interface allows users to perform an RNaseP verification plate run and automatically provides pass/fail results.
40. The instrument touchscreen interface allows users to back up and restore data and settings.
41. The instrument touchscreen interface allows users to run a self verification test.
42. The instrument touchscreen interface allows users to view the curve QC assessment upon calibration and RNaseP plate run completion.
43. The instrument touchscreen allows users to monitor the run in progress and receive email notifications for run status.

Performance

44. The instrument is designed to complete a 40-cycle real-time PCR reaction using fluorogenic 5' nuclease assay and Fast chemistries in a standard 96-well plate in approximately 40 minutes. The instrument can also run in standard ramping mode with standard chemistry.
45. The instrument includes an OptiFlex™ system that combines three coupled excitation and emission filter sets to enable collection of up to three unique combinations of wavelengths during a single run for multiplexing.
46. The instrument supports at least two reaction chemistries: the fluorogenic 5' nuclease assay using Applied Biosystems™ TaqMan® probes, and the DNA-binding chemistry of SYBR™ Green dye.
47. The instrument has real-time quantitative PCR installation specifications that demonstrate the ability to distinguish between 5,000 and 10,000 template copies with a 99.7% confidence level.

Software

48. The instrument software allows flexible customization of run protocols.
49. The instrument software allows the creation of secure templates that are locked with a password to limit modification of the run setup.
50. The instrument software provides run monitoring of connected instruments.
51. The instrument software includes preoptimized run protocols for applications like standard curve, relative standard curve, relative quantification, gene expression, and SNP genotyping with both TaqMan and SYBR Green chemistry for quick starts of runs.
52. The instrument software provides a single metric for curve quality checks.
53. The instrument software provides a customization tool for users to apply their own QC metrics to the run.
54. The instrument software can save all graphs in .png and .svg formats.
55. The desktop version is compatible with the Microsoft™ Windows™ operating system, and the online version supports both Windows and Macintosh™ operating systems.

56. The Connect platform supports Chrome™, Internet Explorer™, Firefox™, and Safari™ browsers.
57. The instrument includes software that is designed to collect and analyze fluorescence data for the applications of absolute quantification, relative quantification, presence/absence assays, and allelic discrimination/SNP detection.
58. The instrument software collects information on both TaqMan and SYBR Green assay chemistries in the same run by collecting different filter colors for PCR versus melt curve stages.
59. The instrument software contains a genotyping optimization tool that uses real-time data to help pick the best cycle number for the genotyping call, which helps save run cycles and time.
60. The instrument software provides raw fluorescent data and multicomponent data (segregated by dye type) for troubleshooting experiments.
61. The instrument online software allows conversion of protocols for the Applied Biosystems™ StepOnePlus™ and 7500 instruments to QuantStudio 1 system protocols.
62. The instrument online software allows users to batch-analyze up to 500 experiments simultaneously.
63. The instrument software can control the instrument and analyze the instrument's data from a remote computer on the same network.
64. The instrument online software provides status monitoring of connected instruments and real-time run plots.
65. The instrument online software can send users notifications via email or text message when a run is started, stopped, or has reached an error state.
66. The instrument online software provides fast access to completed runs from any connected instrument.
67. The instrument online software allows registered users of the Connect platform to monitor any connected instrument using a compatible web browser.
68. The instrument software is designed to allow users to run an assay plate without performing plate setup prior to beginning the run.
69. The instrument software is designed to export all run results, including raw and analyzed data, to a Microsoft™ Excel™ sheet, and save all graphs as .jpg files..
70. The instrument online software provides the ability to import a standard curve from one plate for analysis of another plate of the same instrument type.
71. The instrument online software provides an endogenous control selection tool for gene expression experiments.
72. The instrument online software includes statistical analysis tools like box-whisker plots to assess C_t distribution, and scatter plots and heat maps to assess sample correlation and quality.
73. The instrument software allows users to pre-select which data to export and the location of the exported file.

- 74. The instrument software allows for command-line functions for batch exporting of analyzed run files.
- 75. The instrument software allows users to save predefined analysis settings for auto-exporting run data to QuantStudio format and RDML export formats.
- 76. Optional primer and probe design software is available for purchase.

Instrument ecosystem

- 77. The instrument is part of a desktop ecosystem that consists of a suite of qPCR applications. Instrument data can be grouped (multi-plate) for relative quantitation, SNP genotyping, standard curve, high-resolution protein melt, and presence/absence analysis.
- 78. The instrument is part of the Connect platform, which consists of a suite of qPCR analysis modules. Instrument data can be grouped (multi-plate) for relative quantitation, SNP genotyping, standard curve, high-resolution protein melt, and presence/absence analysis.
- 79. The instrument can optionally be connected to the Connect platform where run setup can be downloaded and instrument data can be uploaded automatically and shared with other authorized users of Connect.
- 80. A connected instrument run can be monitored in real time via a web browser or mobile device.
- 81. The online relative quantitation module allows users to batch-analyze up to 500 experiments simultaneously.
- 82. Both the desktop and online relative quantitation software provide an endogenous control selection tool for gene expression experiments.
- 83. Both the desktop and online relative quantitation software include statistical analysis tools like box-whisker plots to assess C_q distribution, and scatter plots and heat maps to assess sample correlation and quality. The online standard curve module provides the ability to apply standard curve metrics from another plate.
- 84. Both the desktop and online genotyping software contain a genotyping optimization tool that uses real-time data to help pick the best cycle number for the genotyping call, which helps save run cycles and time.
- 85. Both the desktop and online High Resolution Melt (HRM) software allow user to specify the number of clusters/variants and save their defined controls and analysis settings.

Design

- 86. An application programming interface (API) is included that will allow programming routines to be developed for controlling the instrument.
- 87. The instrument is cUL (tested to CAN/CSA standards), UL, CE, C-TICK, and WEEE compliant.
- 88. The instrument is developed and manufactured in a facility with quality system requirements that comply with ISO 13485 and ISO 9001 standards.

Gene expression profiling

- 89. For gene expression profiling, users can select from more than 61,000 predesigned human, mouse, and rat TaqMan Assays.

Vendor service and support

- 90. The instrument is provided with a limited warranty for a period of one year from the date of installation (or 15 months from the date of shipment—whichever is earlier). Optional post-warranty service contracts including next-business-day on-site repairs are available.
- 91. The instrument is provided with a digital self-paced eLearning system familiarization module.
- 92. The vendor is able to supply all the necessary consumables to perform real-time quantitative PCR and SNP genotyping, including PCR reagents designed for use with the fluorogenic 5' nuclease assay, PCR reagents designed for use with SYBR Green dye assay chemistry, fluorogenic probes, reaction plates, and adhesive plate-sealing covers. PCR reagents are also available with an optional ROX dye as a passive internal reference to minimize well-to-well variability.
- 93. The vendor provides comprehensive assay design and development guidelines for real-time quantitative PCR and SNP genotyping assays.
- 94. The vendor offers telephone technical support and field applications, sales, and service support to help solve chemistry and instrumentation problems encountered in real-time quantitative PCR and SNP genotyping experiments.
- 95. The vendor offers technical support through smart remote support and an augmented reality interface.