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NANOlab™-PCR

Do More with Less: Achieving High-Performance PCR at Low Reaction Volumes

Authors: Dave Pai & Chris Treble

Purpose

To demonstrate how the NANOlab™-PCR system supports automated, low-volume PCR setup using a purpose-built platform designed for reliable dispensing, simplified operation, and reduced reagent usage. The evaluation focuses on the system's ability to support nanoliter-scale PCR setup while maintaining dispensing precision, workflow usability, and compatibility with common PCR labware and chemistries.

Background

Miniaturization of PCR workflows can help laboratories reduce reagent consumption, increase throughput, and improve the efficiency of assay setup. BioDot's NANOlab™ platform introduced low-volume life science dispensing capabilities through non-contact dispensing and disposable-tip architecture. NANOlab™-PCR builds on that foundation with a purpose-built platform for automating and miniaturizing PCR reaction setup through an intuitive user interface.

By reducing reaction volumes and simplifying setup, NANOlab™-PCR is intended to support laboratories that need reliable, repeatable PCR preparation while minimizing waste and improving workflow consistency.

Challenge

Reliable PCR setup at nanoliter volumes can be difficult to achieve because small-volume dispensing places greater demands on precision, consistency, contamination control, and evaporation management. Laboratories must be able to set up reactions accurately while maintaining consistent Cq values and reliable dispensing performance.

Traditional liquid handling platforms may also introduce workflow challenges when systems are bulky, difficult to program, or require larger reaction volumes than necessary. These limitations can increase reagent waste, complicate workflows, and make low-sample-input workflows more difficult to implement.



Dave Pai

Discovery Team Manager

BioDot Inc.

Dave has built his career in customer-facing scientific roles, specializing in training, support, and troubleshooting for genomics and molecular biology platforms. He brings a strong foundation in molecular biology, biochemistry, and genomics to his role at BioDot, where he applies his expertise to optimize low-volume dispensing technologies. His focus is on helping customers improve efficiency and reduce operational costs within their existing workflows.

Solution

NANOlab-PCR addresses these challenges through a purpose-built low-volume PCR setup workflow that combines non-contact dispensing, disposable tips, environmental control, and compatibility with standard PCR labware and chemistries. These features support robust PCR setup at nanoliter scale while helping reduce contamination risk and preserve reagent integrity.

The system is designed to simplify PCR reaction setup through user-friendly software, CSV import functionality, and export files compatible with common thermocyclers. This allows users to prepare plate layouts using existing templates, import setup information into the system, and generate output files that support downstream PCR workflows.

Temperature-controlled platforms help preserve reagent integrity during setup, while the integrated immiscible-fluid dispensing capability helps reduce evaporation risk during low-volume PCR preparation.

Method

Setup

PCR reactions were prepared on the NANOlab™ system using a chilled aluminum deck maintained at 15 °C and controlled chamber humidity.

Process

Each 400 nL reaction consisted of 100 nL DNA template, 100 nL primer–probe mix, and 200 nL master mix dispensed via noncontact disposable tips into a 384-well plate.

Additional Tests and Processes

No-template controls were included to verify contamination control and system cleanliness.

Parameter	NANOlab-PCR	Manual Pipetting
Reaction Volume	400 nL	5 µL
Average Cq	~26.6	~26.4
Cq CV (%)	~1.75%	<1%
Dispense CV (%)	<2.5%	N/A
Replicates	6	3
NTC Amplification	None Detected	None Detected

Results

NANOlab™ prepared reactions demonstrated average Cq values (~26.6) comparable to 5 µL manually pipetted controls (~26.4). Dispensing CVs were below 2.5%, and no amplification was detected in no-template controls.

- >90% reduction in reagent usage.
- High dispensing precision at nanoliter scale (CV <2.5%).
- No detectable cross-contamination, supported by the use of disposable tips.
- PCR performance equivalent to conventional manual workflows.

These results confirm that PCR miniaturization using disposable tips does not compromise data integrity while enhancing contamination control.

Conclusion

This experiment demonstrates that the NANOlab™ system delivers robust, reproducible nanoliter-scale PCR using disposable-tip non-contact dispensing. Quantitative performance data show equivalence to traditional microliter workflows, while disposable tips provide enhanced contamination control and regulatory confidence. Together, these results establish NANOlab™ as a technically achievable, scalable, and commercially viable solution for next-generation genomics and diagnostics laboratories.