

# Hamilton's MagPip technology ensures high-precision and reliable low-volume pipetting, making it well-suited for assay miniaturization

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## Introduction

MagPip technology introduces a breakthrough approach to liquid handling. Instead of relying on conventional mechanical couplings such as spindles or belts, the channel's plunger is actuated magnetically: a precisely controlled coil set drives a plunger that functions as a permanent magnet. This contact-free drive principle enables exceptionally fast and accurate plunger movement, forming the basis of the innovative WhiPip liquid dispensing approach for contact-free liquid transfer.

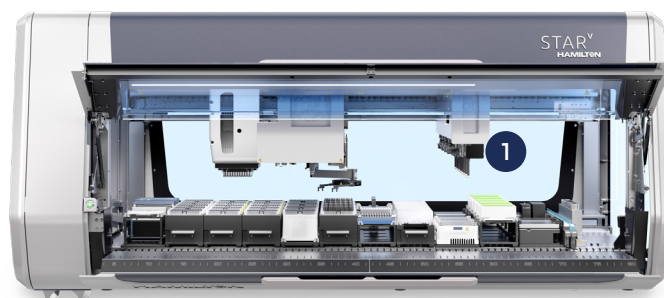
WhiPip offers two operating modes - WhiPip dispense and WhiPip on-the-fly - that deliver outstanding pipetting precision, even at ultra-low volumes, down to 0.35  $\mu\text{L}$ \*. This level of control allows users to significantly reduce sample and reagent consumption while maintaining assay integrity. In addition, the WhiPip dispensing approach streamlines workflows and reduces tip usage, enhancing both efficiency and sustainability in automated setups.

In this Application Note, the capabilities of the MagPip technology are demonstrated through low-volume qPCR experiments.

Using MagPip channels, reaction volumes were successfully miniaturized by up to 87.5%, compared to the manufacturer's recommendation - without compromising accuracy, linearity, or reproducibility.

## qPCR Volume Reduction Using MagPip

To assess the low-volume pipetting capacities of the MagPip technology, three qPCR assays were conducted using NEB's Luna<sup>®</sup> Universal qPCR Master Mix with reaction volumes set at 50%, 25%, or 12.5% of the manufacturer's recommended volume (Table 1).



**Figure 1:** Hamilton STAR V Automated Liquid Handling System with MagPip Pipetting Channels (1).

- **Unmatched Microliter Precision**  
– Accurate, reliable pipetting, down to 0.35  $\mu\text{L}$
- **Maximum Efficiency**  
– Save reagents and boost throughput
- **Sustainability**  
– Reduce plastic waste for greener automation

Reaction Volume	10 $\mu\text{L}$	5 $\mu\text{L}$	2.5 $\mu\text{L}$
Luna Universal qPCR Master Mix [ $\mu\text{L}$ ]	5.0	2.5	1.25
Forward Primer 2 $\mu\text{M}$ [ $\mu\text{L}$ ]	1.25	0.63	0.31
Reverse Primer 2 $\mu\text{M}$ [ $\mu\text{L}$ ]	1.25	0.63	0.31
DNA / NTC [ $\mu\text{L}$ ]	1.25	0.63	0.31
Water [ $\mu\text{L}$ ]	1.25	0.63	0.31
% of Recommended Total Reaction Volume	50	25	12.5

**Tab. 1:** Reaction Volumes of qPCR Components; NTC = No Template Control.

\* Although the data presented in this application note was generated using volumes of 0.3  $\mu\text{L}$ , the manufacturer's specified minimum volume for the MagPip is 0.350  $\mu\text{L}$ .

For all qPCR reactions, one single primer pair was used. The stock DNA solution (T7 Phage DNA, GeneON, #310-005) was serially diluted tenfold to yield six DNA concentrations. All assay components were sequentially pipetted directly into a 384-well plate using the MagPip's WhiPip on-the-fly mode. qPCR was performed, using the Bio-Rad CFX Opus 384 Real-Time PCR System.

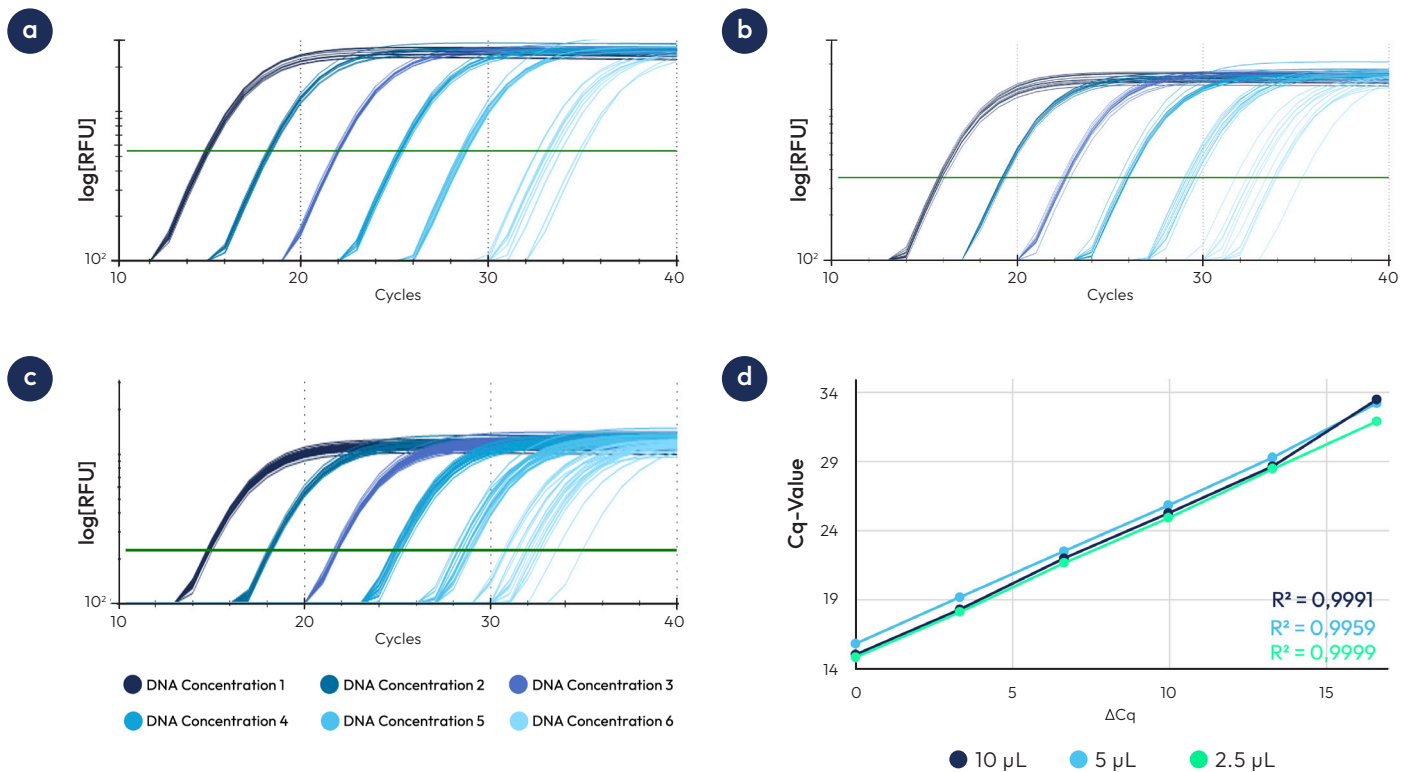
### MagPip Allows for Precise and Reliable Pipetting at Low Volumes

To confirm the precision and reliability of low volume pipetting of our MagPip technology, qPCR assays were conducted at 50%, 25%, or 12.5% of the volume according to the manufacturer's recommendation. Six different DNA concentrations – serially diluted tenfold, with DNA Conc. 1 representing the highest and DNA Conc. 6 the lowest concentration – were analyzed. Amplification Curves and Cq values are depicted in Figure 2 and in Table 2.

A tenfold difference in DNA concentration ideally results in a Cq value difference of 3.32. To demonstrate the reliability of low-volume pipetting, the Cq values of the different DNA samples were plotted against this Delta Cq ( $\Delta Cq$ , Fig. 2d). The resulting linear fit ( $R^2 > 0.99$ ) confirms excellent assay linearity across the tested concentration range.

DNA Conc.	10 $\mu$ L	5 $\mu$ L	2.5 $\mu$ L
1	15.04 $\pm$ 0.09	15.82 $\pm$ 0.12	14.38 $\pm$ 0.10
2	18.29 $\pm$ 0.08	19.18 $\pm$ 0.07	18.11 $\pm$ 0.07
3	21.99 $\pm$ 0.07	22.52 $\pm$ 0.13	21.66 $\pm$ 0.09
4	25.26 $\pm$ 0.09	25.83 $\pm$ 0.17	24.92 $\pm$ 0.18
5	28.65 $\pm$ 0.15	29.30 $\pm$ 0.23	28.47 $\pm$ 0.29
6	33.48 $\pm$ 0.84	33.22 $\pm$ 0.97	31.92 $\pm$ 1.01

Tab. 2: Cq Values Determined by qPCR Assays.



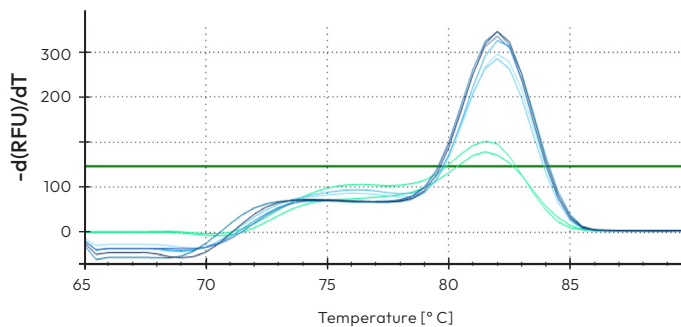
**Figure 2:** Amplification curves of DNA samples obtained from qPCR assays using (a) 50%, (b) 25%, or (c) 12.5% of the recommended reaction volume are depicted. (d) Cq values were plotted against theoretical delta Cq to evaluate qPCR linearity and pipetting accuracy. Between consecutive tenfold dilutions, a tenfold change in template concentration corresponds to a  $\Delta Cq$  of 3.32 cycles in an ideal qPCR with 100 % amplification efficiency.

### WhiPip Dispense Mode Prevents Carryover

While the WhiPip dispense on-the-fly mode enables exceptionally fast and efficient pipetting - ideal for high-throughput or time-critical applications - its rapid movement dynamics can, under certain conditions, increase the risk of droplet carryover, e.g. working with 384-well plates and ultra-low reaction volumes (Fig. 3).

To minimize carryover in contamination-sensitive workflows, the WhiPip dispense mode provides a more controlled transfer: the channel briefly pauses above each well and dispenses at a position closer to the target than in on-the-fly operation. This targeted approach ensures clean droplet release and prevents aerosol or droplet carryover between wells. The trade-off is a slightly longer cycle time compared with the on-the-fly mode.

In our 384-well TaqMan® qPCR at 25% total volume (Table 3), runs prepared with WhiPip dispense showed specific amplification only in template wells, while NTCs remained negative (Fig. 4 and 5), indicating contamination-free performance under these conditions.

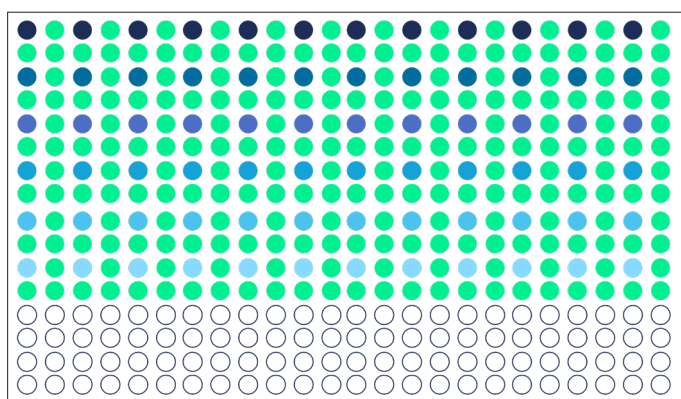


● DNA Concentration 1 ● DNA Concentration 2 ● DNA Concentration 3  
● DNA Concentration 4 ● DNA Concentration 5 ● DNA Concentration 6 ● Control

**Figure 3:** Melting curves of DNA samples and NTCs detected in the qPCR run at 25% recommended reaction volume.

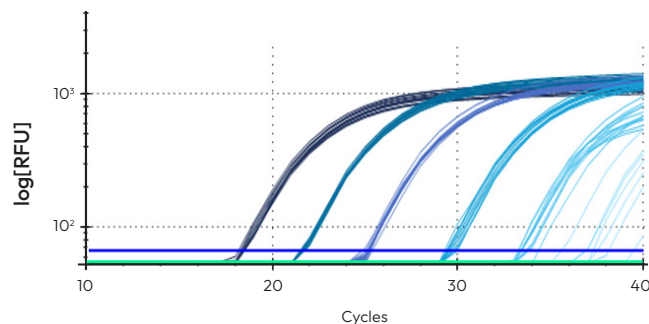
Reaction Volume	5 $\mu$ L
Luna Universal Probe qPCR Master Mix [ $\mu$ L]	2.5
Forward Primer 3.2 $\mu$ M [ $\mu$ L]	0.625
Reverse Primer 3.2 $\mu$ M [ $\mu$ L]	0.625
TaqMan Probe 1.6 $\mu$ M [ $\mu$ L]	0.625
Sample DNA / NTC [ $\mu$ L]	0.625
% of Recommended Total Volume	25

**Tab. 3:** Reaction Volumes of TaqMan qPCR.



● DNA Concentration 1 ● DNA Concentration 2 ● DNA Concentration 3  
● DNA Concentration 4 ● DNA Concentration 5 ● DNA Concentration 6 ● Control

**Figure 4:** Plate Layout of TaqMan qPCR Assay.



● DNA Concentration 1 ● DNA Concentration 2 ● DNA Concentration 3  
● DNA Concentration 4 ● DNA Concentration 5 ● DNA Concentration 6 ● Control

**Figure 5:** Amplification Curves of TaqMan qPCR Assay.

### Conclusion

Both WhiPip operation modes - on-the-fly and dispense - offer distinct advantages, depending on the application. On-the-fly mode enables extremely rapid and efficient pipetting, making it ideal for high-throughput workflows or plate layouts using technical replicates (e.g., triplicates or quadruplicates), where minor carryover effects can be statistically compensated.

In contrast, dispense mode prioritizes contamination control by pausing above each well for precise droplet release, which slightly increases cycle time but ensures maximum cleanliness.

Overall, Hamilton's MagPip technology combines precision, flexibility, and reliability for accurate low-volume liquid handling - supporting both speed-optimized and contamination-sensitive assay setups across a wide range of molecular biology workflows.

System Requirements	Part Number	Provider
Microlab STAR V, including:	818050A20	Hamilton Bonaduz AG
8x MagPip Channels	10103646	Hamilton Bonaduz AG

Labware Requirements	Part Number	Provider
10 µl CO-RE II Conductive Tips	235935	Hamilton Bonaduz AG
300 µl CO-RE II Conductive Filter Tips	235903	Hamilton Bonaduz AG
20 ml Trough	96424-02	Hamilton Bonaduz AG
2 ml Screw Cap Micro Tubes	72.694.406	Sarstedt
Hard-Shell PCR Plates 384 Well, Thin Wall	HSP3805	Bio-Rad
Adhesive Sealing Sheets	AB-0558	ThermoFisher Scientific

Reagent Requirements	Part Number	Provider
Luna Universal qPCR Master Mix	M3003	New England Biolabs
Luna Universal Probe qPCR Master Mix	M3004	New England Biolabs
T7 Phage DNA	310-005	GeneOn
Custom Forward Primer		Microsynth
Custom Reverse Primer		Microsynth
Custom TaqMan Probe		Microsynth

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