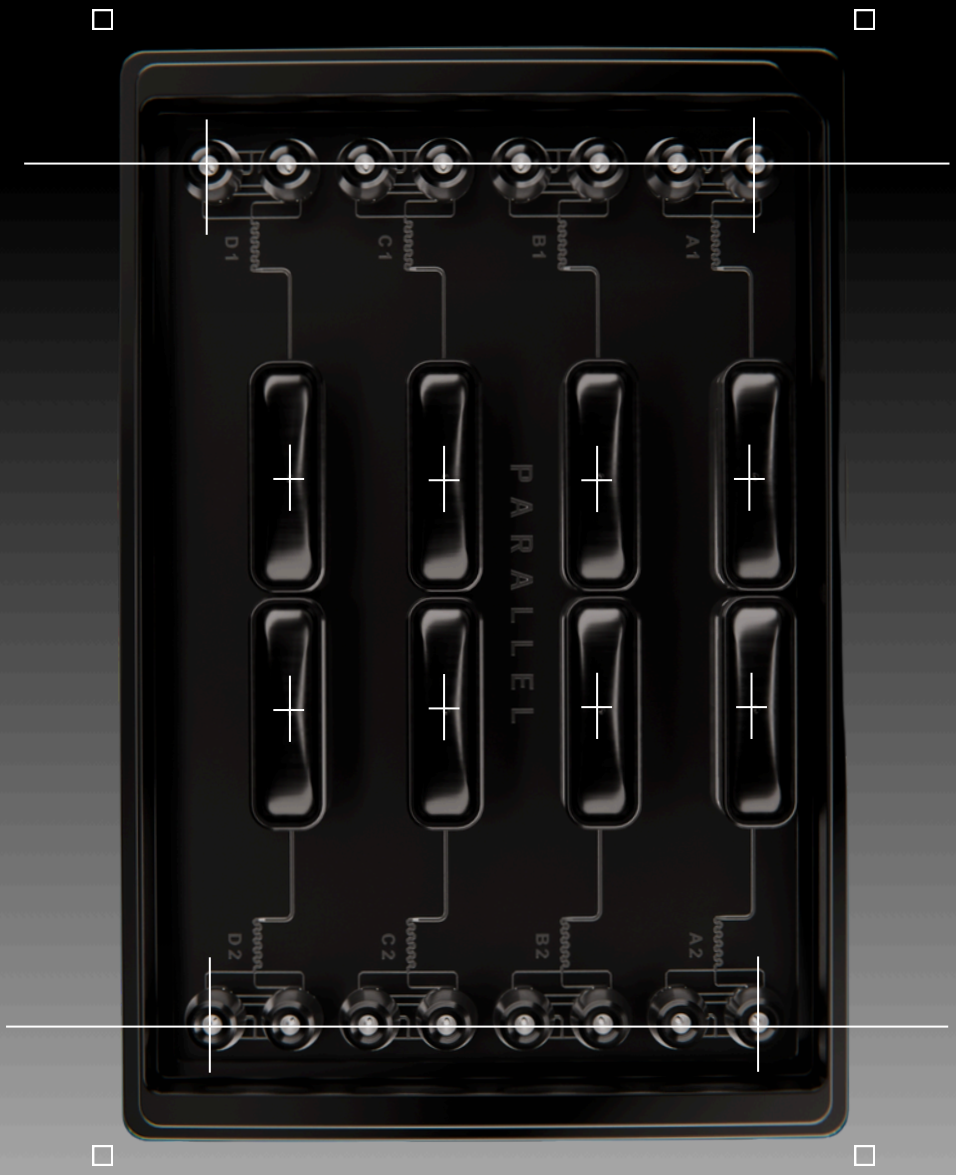
Parallel Fluidics × dynamic devices

# Automated LNP Formulation Screening on Lynx VVP




Parallel Fluidics
LNP Screening Array

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## Abstract

LNP screening has become central to early development across RNA therapeutics, gene editing, and advanced delivery programs, yet many formulation teams still rely on manual processes or dedicated systems that separate particle generation from the automated workflows used for setup, handling, and analysis.

Dynamic Devices and Parallel Fluidics bring high-throughput microfluidic formulation onto Lynx VVP, supporting 100+ formulations per hour, 10× faster LNP generation than dedicated instruments, low-dead-volume screening, and consistent particle quality for LNP formulation screening.

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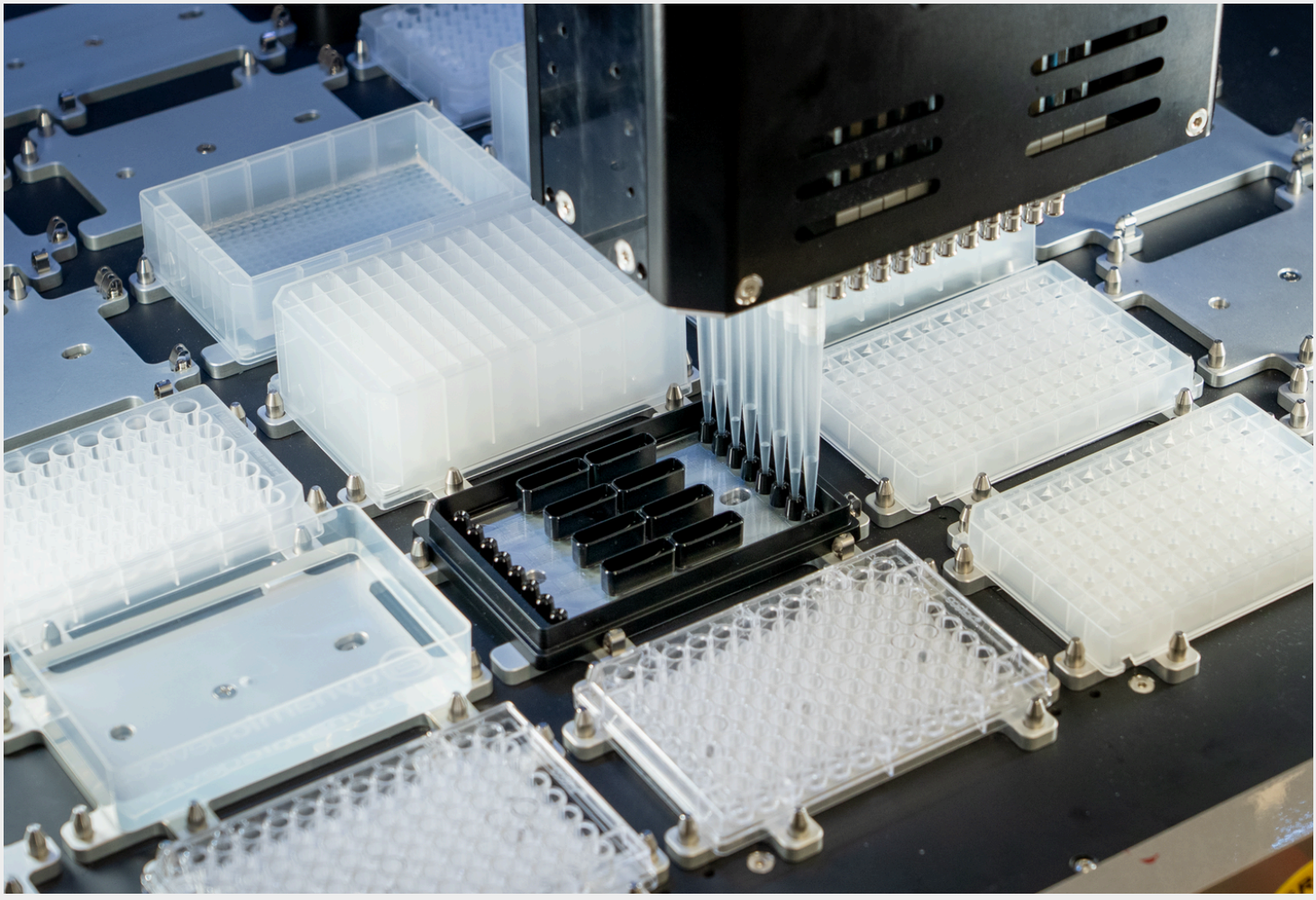
# Executive Summary

Lipid nanoparticle (LNP) formulation is a critical step in early development for RNA medicines, genetic medicines, and advanced delivery programs. As screening needs expand, formulation teams need workflows that can generate more LNPs, preserve limited lipid and RNA inputs, and produce particle data with enough consistency to guide development decisions.

Parallel Fluidics and Dynamic Devices are bringing the LNP Screening Array to Lynx VVP to support high-throughput microfluidic LNP formulation screening in an automated liquid handling workflow. The combined workflow gives formulation teams a way to generate LNPs on Lynx VVP while connecting formulation more closely to reagent setup, sample recovery, and downstream evaluation.

On Lynx VVP, the LNP Screening Array generated blank LNPs with small particle size and low PDI under standard operating conditions. With external air pressure applied, Lynx VVP generated smaller particles with improved PDI, showing how external pressure can further improve particle output within the workflow.

These results give formulation teams a practical path to evaluate microfluidic LNP generation on Lynx VVP, with an added route to smaller particle profiles when external air pressure is available.



## Where LNP Screening Workflows Break Down

LNP screening has moved beyond occasional formulation runs. Teams developing RNA therapeutics, gene editing payloads, and advanced delivery systems need to evaluate a broader formulation space across lipid composition, aqueous chemistry, cargo inputs, and process conditions.

However, the formulation workflow has not kept pace with that screening demand. Particle generation often remains tied to dedicated formulation systems that sit outside the automated workflows used for preparation, handling, and analysis.

For early development teams, the constraint is practical and immediate. Fewer conditions are evaluated per run, scientist time shifts toward workflow management, and limited lipid, RNA, and cargo inputs are consumed across fragmented steps. The path from screen design to particle data slows down at the exact point where formulation needs to move faster.

As LNP programs scale, formulation needs to operate as a high-throughput, automation-aligned step within the broader screening workflow.

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**The shift to automated LNP screening on liquid handlers**

LNP formulation screening needs to move closer to the automation infrastructure already supporting early development. Liquid handlers are already used to prepare inputs, manage samples, and connect experimental steps across screening workflows. Bringing particle generation into that environment gives formulation teams a more direct way to execute larger screens while preserving the microfluidic control required for LNP formation.

In this model, the liquid handler becomes the environment where formulation screening can run. The value is especially clear for teams that already rely on automated workflows for reagent setup, sample handling, and downstream preparation.

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# What an Automated LNP Screening Workflow Needs to Deliver

Moving LNP formulation onto a liquid handler changes the screening model when particle generation can run inside the same environment used for setup, handling, and analysis.

For formulation teams, the workflow has to support more than deck compatibility. It needs to preserve the technical rigor of microfluidic formulation while increasing throughput, reducing handling steps, and producing particle data that can guide formulation decisions.

**Requirements for automated LNP screening on liquid handlers**

- Parallel testing without serial bottlenecks
- Particle generation that keeps pace with automation
- A formulation workflow that stays on deck
- Low dead-volume screening across larger studies
- Particle data that supports next-step formulation decisions

# The LNP Screening Array

The LNP Screening Array brings microfluidic LNP formulation screening onto Lynx VVP. It gives teams a way to generate particles within the automated workflow already used for setup, handling, and sample preparation.

The result is a faster, more efficient path from formulation setup to particle data, while helping teams preserve limited inputs and reduce manual workflow burden.

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**A consumable-defined microfluidic formulation path**

The LNP Screening Array provides the controlled microfluidic environment required for LNP generation on Lynx VVP. Formulation inputs move through a defined mixing path engineered for rapid particle formation, controlled sample recovery, and compatibility with automated screening workflows.

Lynx VVP executes the automated handling around the formulation step, and the LNP Screening Array defines the formulation environment where lipid and aqueous inputs meet, mix, and form particles.

# Designed for High-Throughput LNP Screening

LNP formulation development depends on how many conditions can be generated, how quickly comparative particle data can be produced, and how efficiently limited formulation inputs are used.

The LNP Screening Array is designed for screening teams that need to evaluate more formulation conditions within a practical run window. On Lynx VVP, formulation becomes part of the automated workflow, with parallel microfluidic mixing and sample recovery built into the screening process.

**Core advantages of the LNP Screening Array**

| | |
|---|---|
| **100+** | formulations per hour |
| **10×** | faster LNP generation than dedicated instruments |
| **<25 µL** | dead volume per mixer |

# LNP Screening Array Architecture

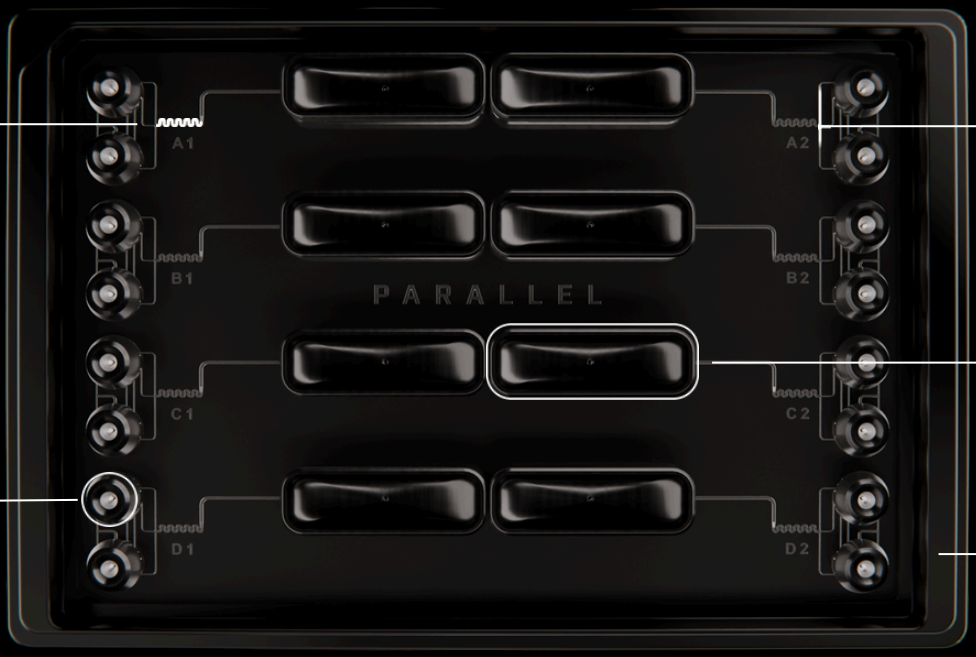
The LNP Screening Array architecture is designed to support controlled formulation, direct liquid handler engagement, and clean sample recovery within a plate-based workflow.

The table below outlines the functional elements that define the formulation path, from Lynx VVP dispense through microfluidic mixing and sample collection.

| Component | Function | Why It Matters |
|---|---|---|
| **Pipette interface** | Connects Lynx VVP dispense to the microfluidic path | Enables direct engagement without custom tubing or off-deck setup |
| **Input channels** | Route lipid and aqueous phases into the mixing region | Establish controlled fluid entry into the formulation path |
| **Junction** | Brings lipid and aqueous phases together before mixing | Defines where particle formation begins |
| **Micromixer** | Promotes rapid mixing for LNP formation | Supports controlled LNP formation across parallel screening conditions |
| **Anti-backflow output reservoir** | Collects formulated LNP samples | Recovers formulated samples and isolates path from downstream collection |
| **SLAS microplate footprint** | Fits standard plate-based automation | Allows the array to operate within existing deck layouts, plate handling practices, and automated workflows |

Table 1. LNP Screening Array functional components

# LNP Screening Array




**8 Micromixers**
for LNP formation

**16 Pipette interfaces**
connect to standard pipette tips

**Flow-focusing geometry**
guides reagent mixing

**8 Anti-backflow reservoirs**
prevent reagent backflow

**SLAS microplate format**
fits standard liquid handler decks

# How the LNP Screening Array Works on Lynx VVP

The LNP Screening Array is designed to make microfluidic formulation executable within the Lynx VVP workflow.

Lynx VVP manages the automated handling required to prepare inputs, dispense into the array, and recover formulated samples. The LNP Screening Array defines the fluidic path where lipid and aqueous streams meet, mix, and form nanoparticles.

## From setup to sample recovery

The workflow follows a direct path from prepared inputs to collected LNP samples, keeping formulation inside the Lynx VVP automation environment.

### 1 Reagent setup on Lynx VVP

Lipid and aqueous inputs are prepared within the Lynx VVP workflow for the screening run.

### 2 Dispense into the LNP Screening Array

Lynx VVP delivers formulation inputs into the LNP Screening Array for microfluidic formulation.

### 3 Microfluidic LNP formulation

Lipid and aqueous streams meet at the junction and mix through the micromixers to form LNPs.

### 4 Sample collection for characterization

Formulated LNPs collect in anti-backflow output reservoirs for DLS analysis or downstream evaluation.

## Bringing Microfluidic Particle Generation to Dynamic Devices Lynx

Lynx VVP gives the LNP Screening Array an automation environment for formulation development. The platform supports liquid handling, external pressure application, and deck-based execution around the array.

For LNP teams, the combined workflow is the point of differentiation. The LNP Screening Array defines the microfluidic formulation path, and Lynx VVP executes the automated dispense, external pressure application, and sample recovery around each formulation condition.

## Where Lynx VVP adds differentiated value

| Lynx VVP capability | Impact for LNP screening |
|---|---|
| **External pressure application** | Supports rapid fluid movement through the array and produced smaller particles with improved PDI in testing |
| **Microfluidic formulation on deck** | Moves particle generation into the Lynx workflow used for setup, dispense, and sample recovery. |
| **Consumable-defined formulation path** | Keeps the critical mixing environment inside the LNP Screening Array for controlled particle generation across screening conditions. |
| **Direct sample recovery after formulation** | Collects formulated LNPs from the array for DLS or downstream evaluation |
| **Screening-ready workflow package** | Combines the array, hold-down adapter, compatible plates, workflow guidance, and Lynx VVP protocol for a focused first evaluation |

Table 2. Lynx VVP capabilities relevant to LNP formulation screening

## Performance on Lynx VVP

The workflow was evaluated on Lynx VVP using the LNP Screening Array to generate blank LNPs across standard operation and external air pressure conditions. Blank formulations were used to focus the evaluation on platform and array performance before introducing cargo-specific effects.

Particle size and PDI were measured by dynamic light scattering. The characterization evaluated whether Lynx VVP could generate LNPs with particle attributes suitable for formulation development and whether external pressure improved particle output relative to standard operation.

| Parameter | Condition |
|---|---|
| **Liquid handling platform** | Dynamic Devices Lynx VVP |
| **Microfluidic device** | Parallel Fluidics LNP Screening Array |
| **Formulation type** | Blank LNP |
| **Lipid chemistry** | 10 mM SM-102 Lipid Mix<br>(SM-102, DSPC, Cholesterol, DMG-PEG (2000)) |
| **Lipid phase solvent** | Ethanol |
| **Aqueous phase** | 20 mM Sodium Citrate Buffer, pH 4.0 |
| **Array format** | 3:1 fluidic resistance ratio |
| **Analytical readouts** | Z-average diameter, PDI |
| **Analytical method** | Dynamic light scattering (DLS) |

Table 3. LNP characterization conditions on Lynx VVP

## Particle Size, PDI, and Pressure Response

External pressure was evaluated because Lynx VVP can drive formulation through the LNP Screening Array with external air applied to the workflow. The results showed that added pressure reduced particle size and improved PDI while preserving a distribution suitable for comparison across conditions.

Increasing pressure from 225 mbar to 1000 mbar reduced Z-average diameter from 81.9 nm to 49.6 nm, while PDI decreased from 0.16 to 0.11.

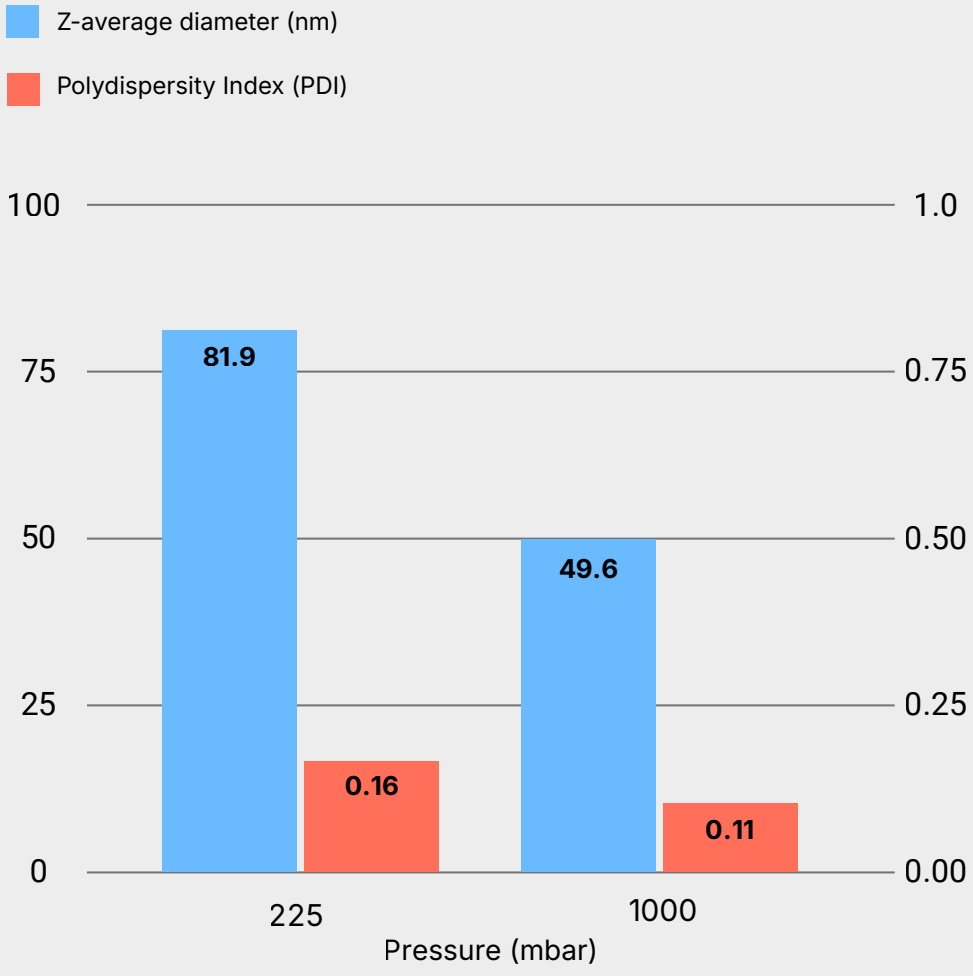


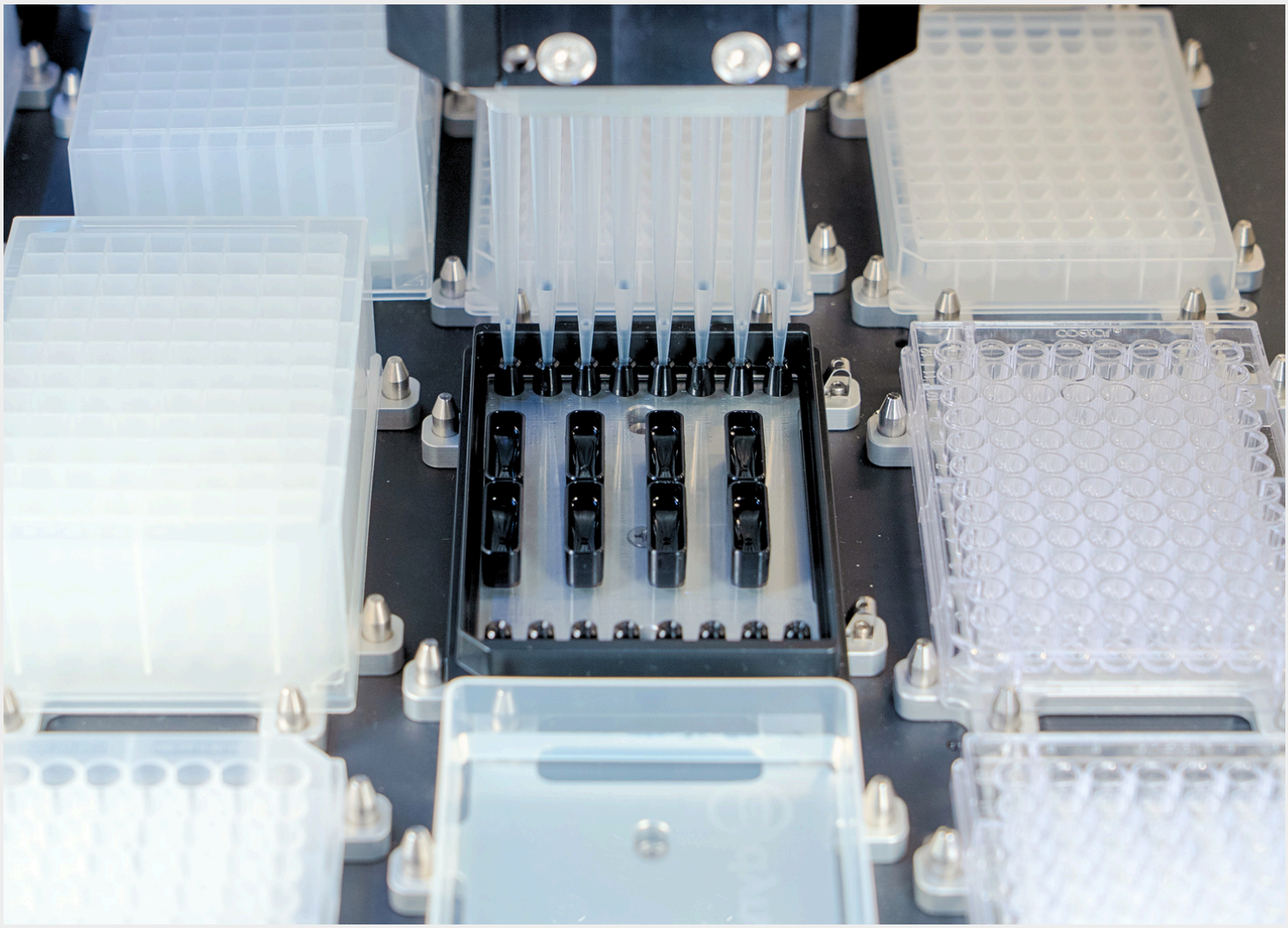

Figure 1. Particle size and PDI across tested pressure conditions

## What the Results Mean for Screening

The data connect the Lynx VVP operating configuration to measurable particle attributes.

Under standard Lynx VVP operation, the LNP Screening Array generated blank LNPs within a screening-relevant size range and low PDI. With external pressure applied, particle size decreased from 81.9 nm to 49.6 nm and PDI improved from 0.16 to 0.11.

For formulation teams, the result is a practical screening workflow that can generate early particle data on Lynx VVP and support smaller particle profiles when the external air configuration is available. This gives teams a more defined starting point for applying the workflow to cargo-loaded screens, in vitro studies, in vivo studies, or broader optimization work.



# What This Workflow Enables

The LNP Screening Array on Lynx VVP gives formulation teams a more practical way to plan and execute higher-throughput LNP screening. For teams managing broader LNP programs, the workflow creates practical gains in screening capacity, workflow continuity, and formulation output control.

### Higher formulation throughput

With 100+ formulations per hour and LNP generation that runs 10× faster than dedicated instruments, the workflow compresses the time required to generate comparative particle data. Teams can move through more formulation and process conditions within a practical screening window without making particle generation the limiting step.

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### A direct path to particle generation

Keeping reagent setup, microfluidic formulation, and sample collection on Lynx VVP reduces the handoffs that typically surround dedicated formulation systems. For automation and formulation teams, particle generation becomes part of the screening workflow rather than a separate process managed between preparation and analysis.

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### More efficient use of input materials

With less than 25 µL dead volume per mixer, the workflow reduces material loss at each formulation point. For teams working with limited lipid, RNA, cargo, or custom chemistry inputs, that efficiency helps preserve material across broader screens and makes early formulation exploration more practical.

# A New Path to Higher-Throughput LNP Screening

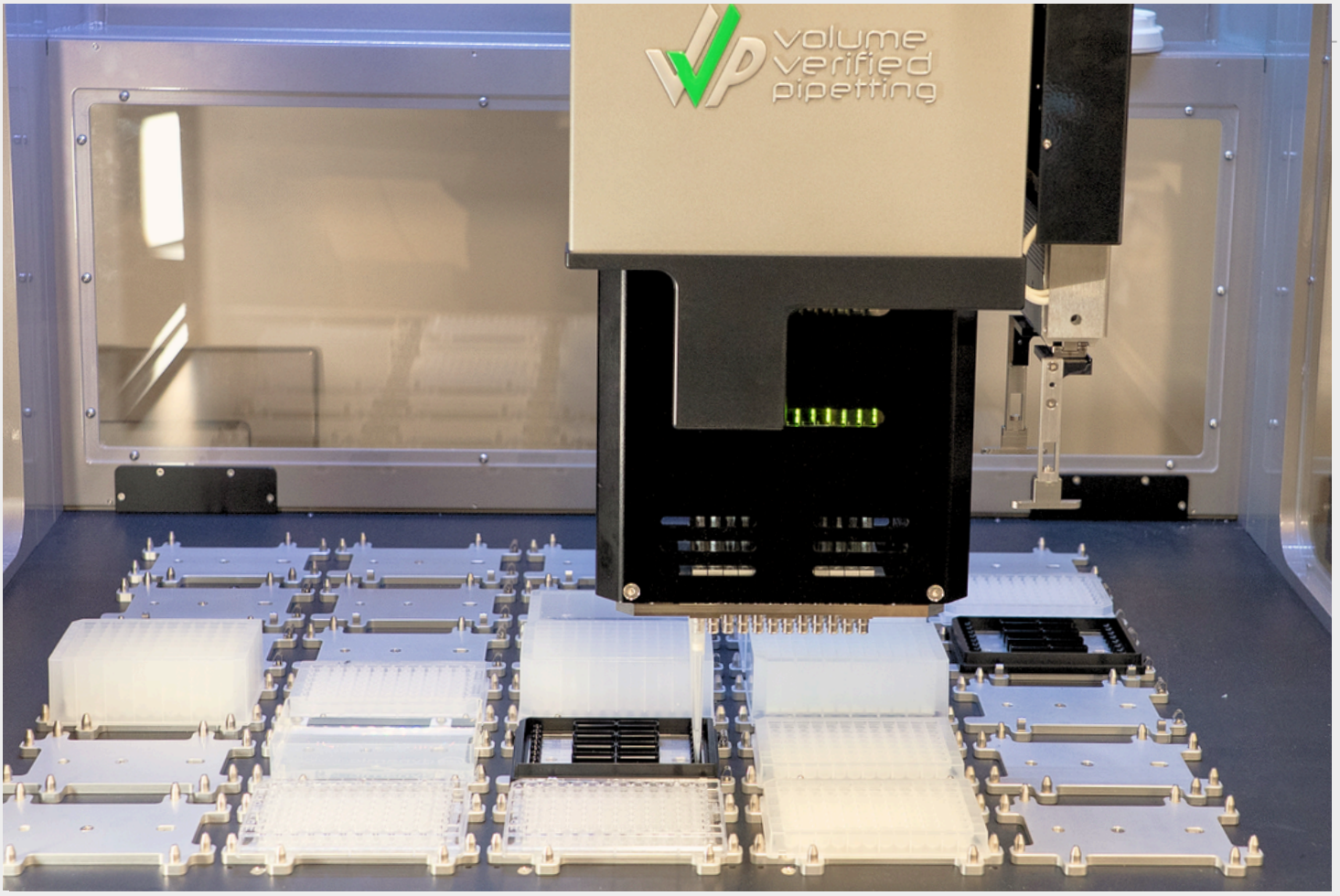
**LNP screening is moving into a new operating model.**

As formulation teams evaluate broader design space across composition, cargo, and process conditions, particle generation needs to keep pace with the automated workflows already used for setup, handling, and analysis.

The LNP Screening Array on Lynx VVP brings microfluidic formulation into the liquid handling workflow, supporting high-throughput screening, low-dead-volume particle generation, and direct sample recovery for characterization.

In testing, Lynx VVP generated blank LNPs with low PDI under standard operation. Applying external air pressure reduced particle size and improved PDI, giving formulation teams an added route to smaller particle profiles within the same workflow.

For Lynx users, this creates a practical path to evaluate automated microfluidic LNP screening with the array, protocol, adapter, compatible plates, and workflow guidance needed for a focused first run.



# Evaluate Microfluidic LNP Screening on Lynx VVP

**LNP Screening Array Starter Kit**

The Starter Kit gives Lynx VVP users a direct path to evaluate microfluidic LNP formulation in their own automation environment. It is designed to support a guided first run, with the core components and workflow guidance needed to move from workflow interest to particle data.

The Starter Kit includes:

- LNP Screening Array
- Lynx VVP automation protocol
- Hold-down adapter
- Compatible 96-well plates
- Workflow guidance

For teams evaluating fit, the Starter Kit provides a practical first step toward high-throughput LNP screening on Lynx VVP.

**Get Started**

PARALLEL

**Parallel Fluidics**

Parallel Fluidics develops microfluidic consumables for advanced liquid handling workflows. Its microplate-format devices integrate directly with standard lab automation systems, enabling controlled microfluidic processes without dedicated off-deck instrumentation. For LNP formulation teams, this supports faster screening, lower sample consumption, and consistent particle generation on existing automation systems.

www.parallelfluidics.com


**Dynamic Devices**

Dynamic Devices partners with innovative organizations worldwide to deliver integrated laboratory automation solutions that improve efficiency, scalability, and scientific outcomes. Through its Lynx® Automated Liquid Handling Platform and advanced pipetting technologies, Dynamic Devices helps researchers and laboratories automate complex workflows while maintaining the highest standards of precision, flexibility, and reliability.

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# Technical Specifications

The LNP Screening Array is a microplate-format microfluidic consumable designed to bring particle generation onto Lynx VVP. For the Dynamic Devices workflow, the array uses a defined fluidic resistance ratio and supports microfluidic LNP formulation within the Lynx VVP automation environment.

| Category | Specification |
|---|---|
| **Footprint** | SLAS microplate standard |
| **Exterior dimensions** | 127.8 mm × 85.5 mm |
| **Micromixers per array** | 8 |
| **Materials** | COP body<br>Thermally bonded COC capping layer |
| **Junction geometry** | Flow focusing |
| **Output reservoir** | 1 mL anti-backflow reservoir per mixer |
| **Fluidic resistance ratio** | 3:1 |
| **Port alignment** | Standard 96-well X/Y positions |

Table 4. LNP Screening Array specifications for Lynx VVP

# Parallel Fluidics