

sunshine



UNCHAINED  
LABS

## Scale it up

Once you've found a rock-solid formulation, Sunshine helps you tune in your LNP's size and design the perfect process to scale them up. Scout ideal flow rates, explore different mixing options, then dial in the right dilution factor to keep them stable. When you've got everything just right, Sunshine can shift into continuous mode, making tens of liters in a day. Get process development and scale-up on one platform – who would have figured?

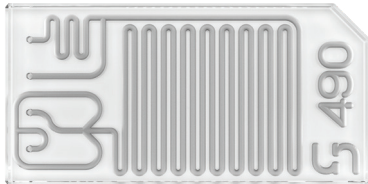
- 10 experiments in 15 minutes
- Fractional & total flow rates
- 1 mL to continuous flow
- 0.1–30 mL/min flow rates
- Reusable microfluidics
- Protocol transfer from Sunscreen



## Find your flow

Fill one syringe with payloads, the other with lipids and you're ready to mix them up with a Sunny. For a simple, well-known T-mixing approach grab a Sunny T, or to increase fluid contact area for particle formation with a cross-junction, use a Sunny X. To use Sunshine's full range of flow rates, ratios and integrated in-line dilution, choose a Sunny Trident. Sunnies can be subbed in and out of Sunshine, used over and over, and when you're ready to turn up the volume, they can run longer than you can.

**Sunny Trident**



- Reverse-angle mixing
- In-line dilution

**Sunny X**



- Cross-type mixing
- Multiple channel sizes

**Sunny T**



- T-mixing
- Multiple channel sizes

## Fine-tune it fast

Tell Sunshine's Sunny Suite Software what's in your syringes, the lipid to payload ratios, the flow rates you want to mix at, how much diluent you want to add and you're ready to go. The software checks to make sure your experiments will work, so you don't need to worry about screwing things up. Create 10 different samples in 15 minutes or let Sunshine run for hours while it makes liters of LNPs.

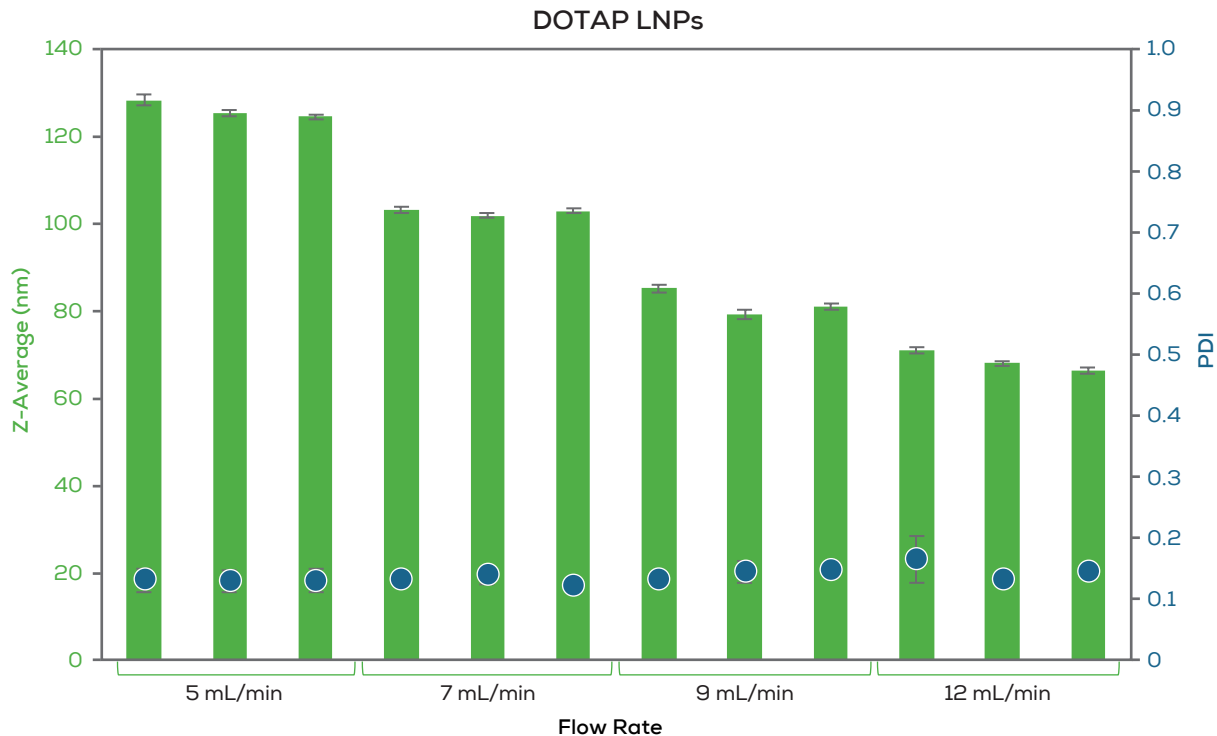
The screenshot displays the Sunny Suite Version 1.0 software interface. The main window is titled "BK Timing Test Sunshine - 22-SEP-23-1". The interface is divided into several sections:

- Protocols:** A sidebar on the left lists protocol families, including "Sunshine Development", "Sunshine Prime", and "Sunshine System Initialize".
- Configuration:** A central panel shows the protocol description and apparatus. The apparatus table is as follows:

Function	Device
Automated sample valve	ASV
Input 1 pump	Aqueous
Input 2 pump	Ethanol
Dilution pump	Dilution
Automated collector	Automated Collector
- Execution Time:** A large digital display shows "00:04:14".
- Image:** A 3D schematic of the laboratory equipment is labeled "Configuration A".
- Status:** The status is "Sunshine protocol: System Preparation".
- Execution Control:** A section with "Experiment is running" and buttons for "Start" and "Stop". Below are radio buttons for "Run all Experiments" and "Run from Experiment".
- Output:** A log of system events and descriptions, including timestamps and protocol steps like "Sunshine protocol: V0.1.0.0 Test Automated system for mixing and fractionation of lipid nanoparticle formulations".
- Manual Control:** A bottom row of six panels, each representing a device with its current status and readings:
  - Automated Collector:** Idle. Current Readings: Vial: 1, Valve: Collect.
  - ASV:** Idle. Current Readings: Valve 1 - Fill, Valve 2 - Fill.
  - Aqueous:** Idle. Current Readings: Pressure: 0.3 bar.
  - Ethanol:** Idle. Current Readings: Pressure: 0.3 bar.
  - Dilution:** Idle. Current Readings: Pressure: 0.3 bar.
  - V Quad Pump 4:** Not initialized. Current Readings: Pressure: 0.3 bar.

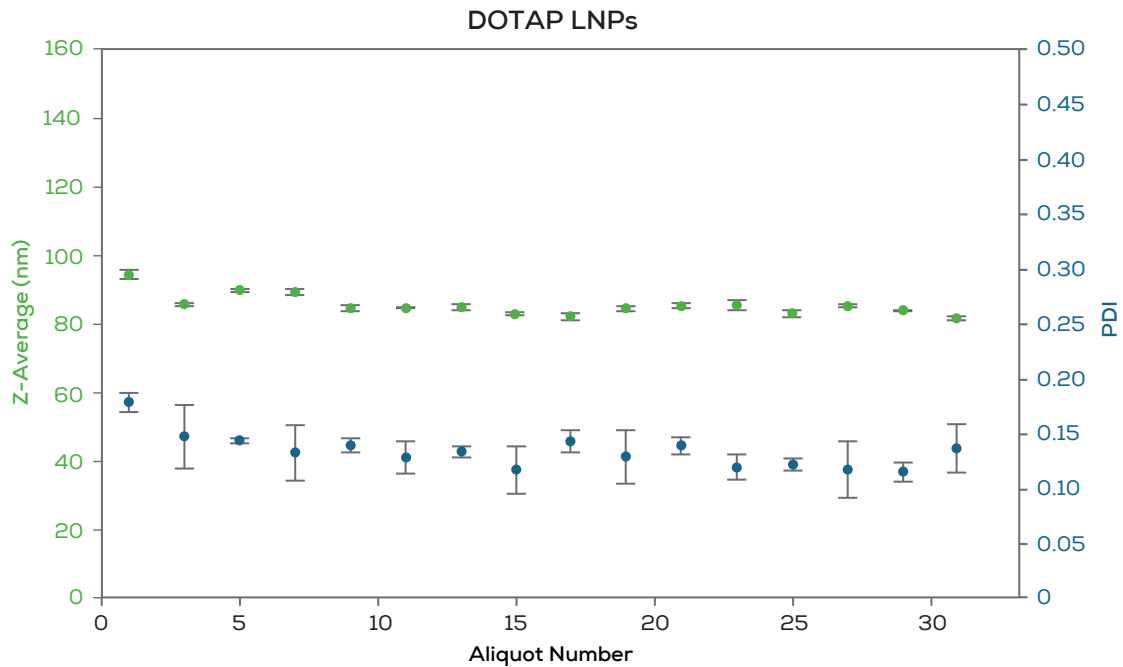
## Dial it in

From their ability to get inside of cells, to releasing their payload, size really does matter when it comes to LNPs. Sunshine fully automates the fractional flow rate, total flow rate and dilution experiments that help you size them down and keep them stable, with spot on repeatability. Tinker with up to 10 parameters per run and let Sunshine take it from there.



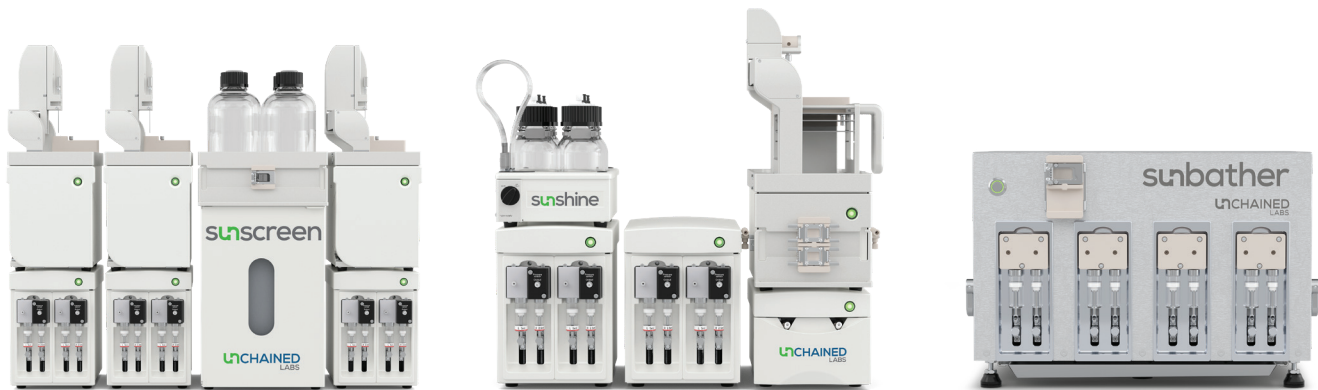
## Bulk it up

Sunshine is ready when you are to start making large volumes of LNPs. Whether you're making milliliters or liters, your sizes and PDIs will stay consistent – no matter how much you decide to make.



## The Sunny Suite

The Sunny Suite has a killer solution for every step of your LNP development. Sunscreen automates high-throughput screening of up to 96 formulations at a time to help you quickly discover your winning LNP formulations. Sunshine then takes your best formulations and hones in on the perfect mixing process conditions, with both automated experiments and continuous flow modes. When you're ready for clinical trials, Sunbather dials up your particles in a fully GMP-compliant environment.



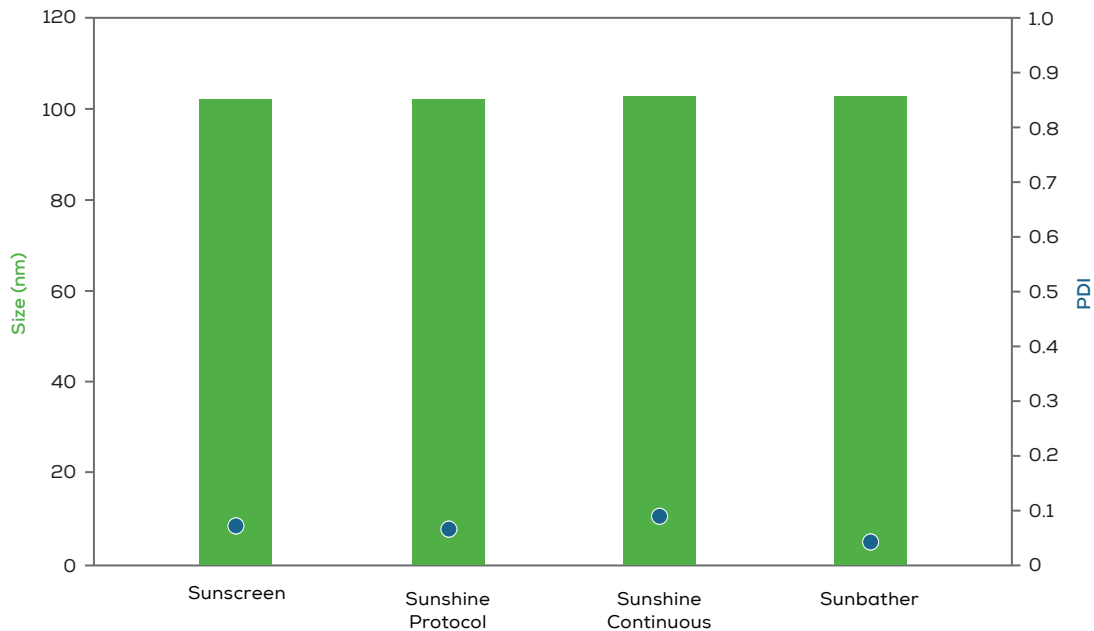
Screen

Optimize

Produce

## Trust the process

Using the same pumps for fluid delivery, and same range of Sunnies for mixing up your formulations, the Sunny Suite keeps every transition from formulation screening to process development to GMP production smooth sailing. Whether you're screening through hundreds of 200  $\mu$ L formulations or producing liters of particles for clinical trials, you can trust the Sunny Suite to deliver the same consistent results at any scale.





## Specifications

Application	
Throughput	10 samples in 15 minutes
Total flow rate range	0.1–30 mL/min (chip dependent)
Flow rate ratio (aqueous to organic) range	1:1 to 10:1
Typical sample volume range (at a 3:1 FRR)	1–6.5 mL
Minimum input volume (including dead volume)	320 µL
Continuous mode volume range	20 mL to ∞ in continuous mode
In-line dilution	Yes
Typical particle size range	40–200 nm*
PDI	<0.2*
Encapsulation efficiency	>90%*
Instrument	
Physical	
Weight and dimensions (required space)	31 kg, 53 cm H x 60 cm W x 65 cm D
Operating pressure	0–10 bar
Electrical	
Voltage input	100 V–240 V AC, 50–60 Hz
Communications	USB via Sunny Suite Software
Other information	
Fluidic port sizes	¼"–28 and 10–32 and Luer fittings
Sample loop size	1, 5 and 10 mL
Fluid store volumes	4 x 250 mL pressurizable bottles
Waste storage volume	1 L
Wetted materials	PTFE, PCTFE, FEP, ETFE, PEEK, Polypropylene, FFKM, FKM, Hastelloy C276, Stainless Steel T316, Glass, Tygon (waste tubes), PET (waste bottle)
Computer	Separate computer with Win 11, monitor, keyboard and mouse
Consumable	
Sunnies	Glass microfluidic mixing devices of various geometries and channel sizes
Available types	Sunny 490 Trident T, Sunny 100 X, Sunny 100 T, Sunny 190 X, Sunny 190 T, Sunny 275 X, Sunny 275 T, Sunny 150 3D, Sunny 50 Micromixer

\* Formulation dependent



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Rev B