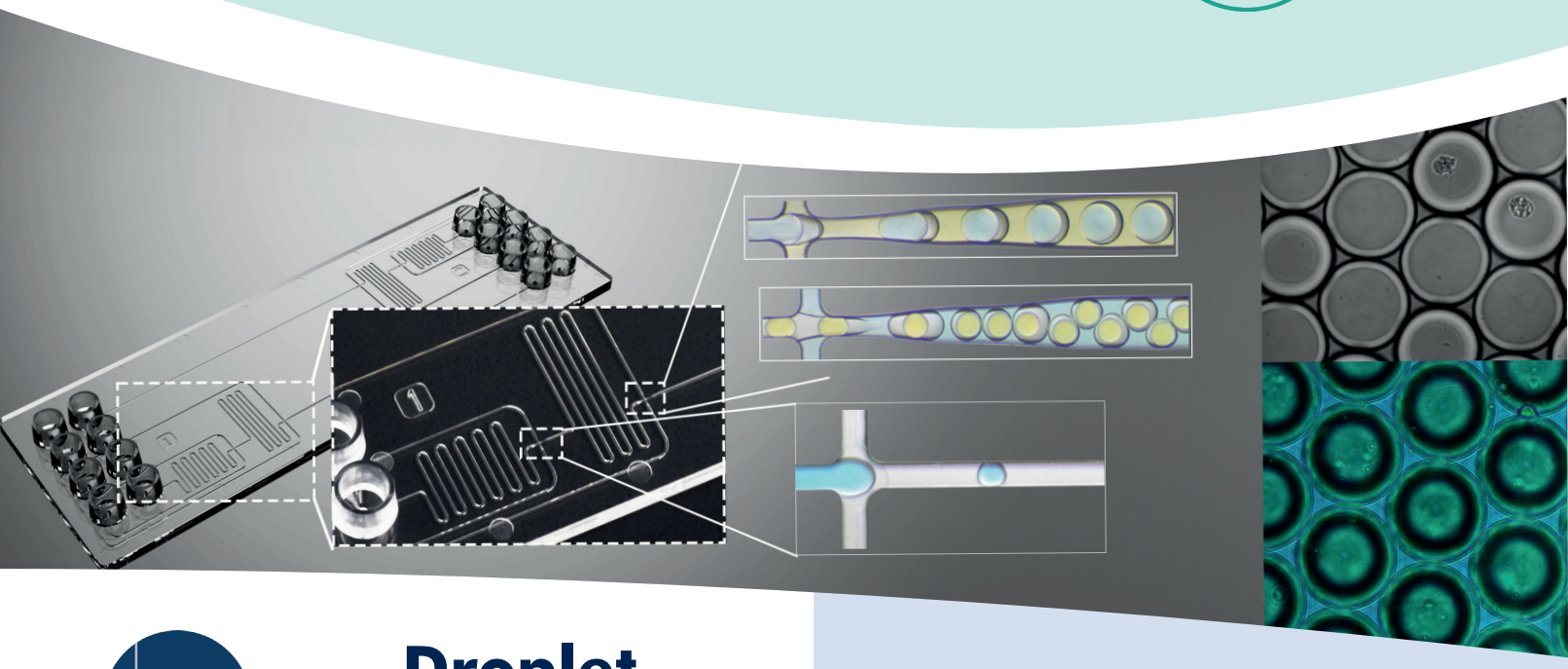
microfluidic ChipShop



Droplet Generation

Explore droplet-based microfluidic solutions

High-throughput generation of monodisperse droplets in the femto- to nanoliter scale has opened up unlimited experimental possibilities. From digital PCR and single cell experiments to particle synthesis, droplet generators have found their way into laboratories.

Find out what *microfluidic ChipShop* has to offer to help you in successfully setting up your droplet generation experiment.

Droplet Generators

- Wide selection of chip designs and channel dimensions available off-the-shelf
- Available nozzle sizes: 10 µm - 140 µm
- Multi-function chips: Droplet generation with storage unit

Pump Setups

- Pressure-driven pump and syringe pump setups, both ensuring high monodispersity & superior flow rate control are available at *microfluidic ChipShop*
- Order a complete pump setup including flow controller, flow units, software and accessories to kick-start your droplet-based experiments

Droplet Generation Kit

- Everything one needs for a successful droplet experiment
- Including accessories and droplet oil suitable for digital PCR and droplet-based cell culture

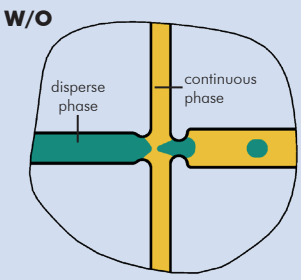
Custom Designs

- *microfluidic ChipShop* offers manufacturing services to realize your personal design

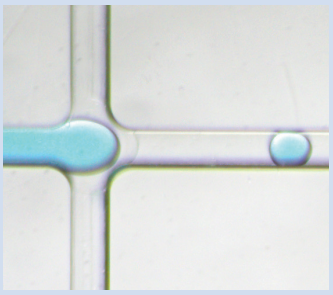
Droplet Generation in a Nutshell

One of the fields in which microfluidics has produced innovative solutions is **droplet-based microfluidics.** The ability to generate a large number of droplets of very uniform size has led researchers to many new applications. By compartmentalizing a biological sample, e.g. droplet-based or so-called digital PCR became possible. Other applications comprise the generation of extremely well-defined emulsions, the synthesis of nanoparticles or the encapsulation of single cells. As the droplet volume can be very small, concentrations of e.g. cell metabolites quickly increase and can be easily analyzed. Droplet motion in the microchannel induces streaming, which allows for a rapid mixing of reagents contained in the droplets. Since the droplet contents never come into contact with the microchannel walls, there is no contamination or carry-over from one droplet to another.

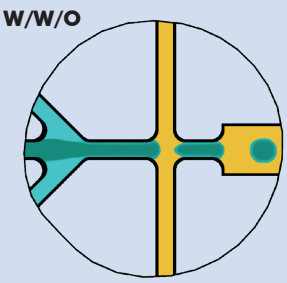
For droplet generation a defined microfluidic channel-cross design, also called nozzle, is required. At the nozzle two immiscible phases, the dispersed phase and the continuous phase, meet at an angle and droplets are generated. Typically, the continuous flow rate is higher than the disperse flow rate. The nozzle size and the ratio of sample (disperse phase) to oil (continuous phase) define the size of the droplets, while flow rates of sample and oil phase define the throughput of the system.



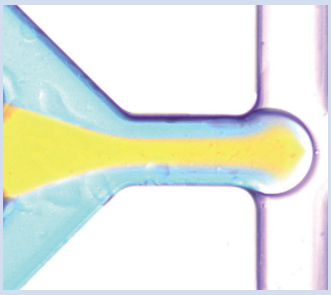
Droplet generator with single cross geometry and its working principle for water in oil droplets



Droplet generation (water in oil) at single cross flow focusing geometry of Fluidic 440



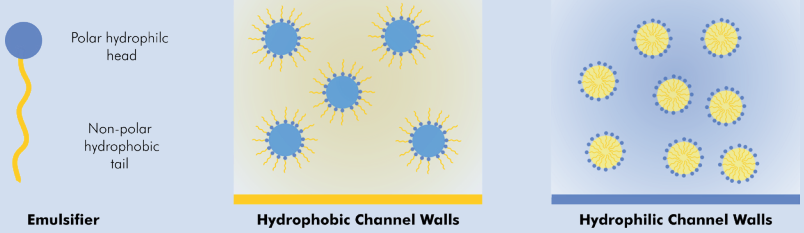
Droplet generator with double cross geometry and its working principle for water+water in oil



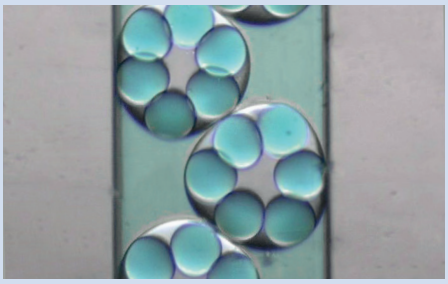
Droplet generation (water/water in oil) at double cross geometry of Fluidic 163

In order to increase the stability of the generated emulsion, emulsifiers can be used. An emulsifier is a substance that stabilizes an emulsion by increasing kinetic stability. One class of emulsifiers is known as "surface active agents" or "**surfactants**" that typically have a hydrophilic and a hydrophobic part. Surfactants have a large say in the configuration of droplets and prevent droplet coalition. Attention should also be paid to the channel surface wettability, i.e. to produce water in oil (W/O) droplets the microfluidic channel should have a hydrophobic surface. As the majority of droplet experiments in microfluidics are based on W/O, *microfluidic ChipShop*'s droplet generators possess a hydrophobic surface.

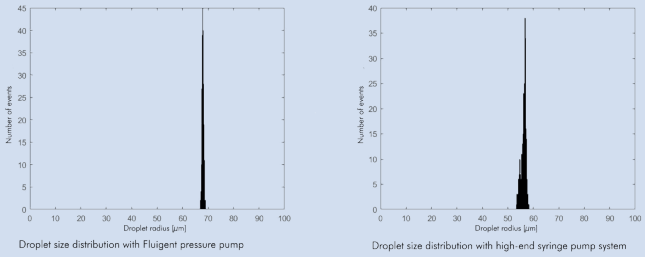
Beside the droplet generator, an appropriate **pump system** is needed for your successful droplet generation experiment. Highly monodisperse droplets (see bottom graphs) can be generated with pressure-controlled pumps as well as with high-end syringe pumps.The quality of your droplets is a function of the microfluidic chip, its design, the reagents, in particular the surfactants, the pumping system and your experimental setup. Despite having many influencing factors, droplet generation on chip is an easy task and you will have immediate success. Promise.



Principle of droplet formation with the help of an emulsifier to produce water in oil (W/O) and oil in water (O/W) droplets. Please pay attention to recommended surface wetting of microfluidic channel walls.



W/O/W (water in oil in water) droplets made possible through emulsifiers, i.e. surfactant in the oil phase



Droplet size distribution with Fluigent pressure pump

Droplet size distribution with high-end syringe pump system

Monodispersity comparison of W/O droplets generated with different pump systems at the same flowrates for disperse phase and continuous phase. Droplet Generator Fluidic 162 was used with both setups.

Experimental Setup - Overview

Successful droplet generation does not require much! Here is what you need for droplet generation experiments on chip:

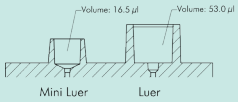
1. Microfluidic droplet generation chip
2. Fluidic accessories like
    a. Fluidic interfaces: e.g. Mini Luer or Luer fluid connectors
    b. Tubing
    c. Soft tubes (silicone) as sleevs
    d. Adapter frame for convenient handling
3. Reagents
    a. Oil
    b. Surfactant
4. Pump setup

Chip Summary

microfluidic ChipShop offers a multitude of droplet generator chips in microscope slide format. The chips vary greatly in design and complexity. The following design features should be considered when choosing the appropriate chip for your successful droplet experiment:

Interface type

All droplet generator chips either possess Mini Luer or Luer interfaces for a convenient connection of the chip with an appropriate pump system. Please ensure that you choose the adequate connectors and plugs when setting up your droplet generation experiment.

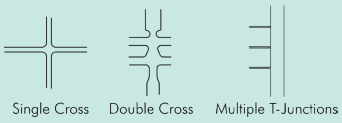


Nozzle size

Along with flowrates and the collection channel proportion, the dimension of the droplet creating cross junction is defining the droplet size. *microfluidic ChipShop* offers nozzle sizes as small as 10 µm up to 140 µm.

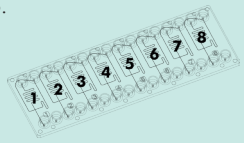
Nozzle geometry

At *microfluidic ChipShop* various channel geometies at the droplet generating side are available to enable a wide variety of options for your droplet generation experiments.



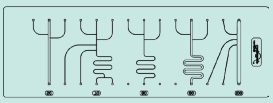
Droplet generator units per chip

One microfluidic chip in the size of a microscope slide can contain several droplet generator units. Chips with one to eight units are featured in *microfluidic ChipShop*'s portfolio.



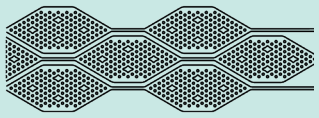
Geometries per chip

A microfluidic chip containing several droplet generator units can either feature the same unit design multiple times or nozzel size and geometry are varied to offer a greater flexibility in the evaluation of droplet generation.



Storage option

Droplet generators with storage option enable generation of droplets and storage/ capture of single droplets for optical analysis on the same device.



All chips are available in two materials, Topas and PC. Please be aware of material compatibility when setting up your droplet generation experiment. When utilizing silicone-based oils we recommend the use of Topas chips, while mineral oils require chips made from PC.

A comprehensive overview of droplet generators available at *microfluidic ChipShop* can be found in the below table.

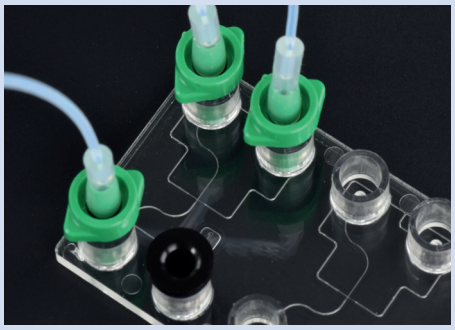
Fluidic Design	Interface Type	Nozzle Sizes [µm]	SingleCross	Double-Cross	Generator Units /Chip	Droplet Storage
162	Mini Luer	70	Yes	Yes	1	No
163	Mini Luer	140	Yes	Yes	1	No
285	Mini Luer	50; 70; 80; 100	Yes	No	5	No
440	Mini Luer	50; 60; 70; 80	Yes	No	8	No
488	Mini Luer	74	Yes	Yes	1	Yes
536	Luer	38	Yes	Yes	3	No
537	Luer	38	Yes	No	4	No
719	Mini Luer	82	Yes	Yes	1	Yes
912	Mini Luer	80	Yes	No	8	No
947	Mini Luer	10; 15; 20; 30	Yes	No	8	No
1032	Mini Luer	100	Yes	Yes	3	No
1114	Mini Luer	50; 60	Yes	No	8	Yes
1147	Mini Luer	70; 80	Yes	No	4	Yes
1480	Mini Luer	60; 80	Yes	Yes	2	No
1505	Mini Luer	50	Yes	Yes	4	No

Fluidic 537 - Single Cross Geometry

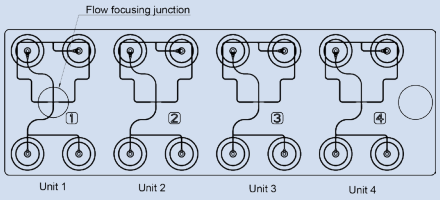
The droplet generator with design number 537 possesses a classic flow focusing geometry, perfectly suited to generate simple droplets. With four identical droplet generator units on one microfluidic chip, this device is ideal for anyone who wants to try or compare multiple experimental setups, without the need of ordering a new chip for every experiment. Please be aware that this chip is one of the few droplet generators devices with Luer interfaces and appropriate Luer compatible accessories are required.

Chip Summary Fluidic 537

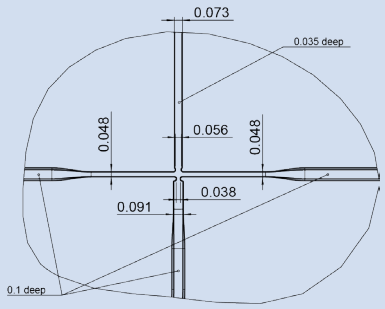
Interface type: Luer
Nozzle size: 38 µm
Nozzle type: single cross, flow focusing
Droplet generator units on chip: 4
Droplet storage: no



One functional droplet unit of Fluidic 537 with Luer fluid connectors (green) to facilitate connection to a pump/collection reservoir via tubing and a Luer plug (black) to close surplus interface



Schematic drawing of droplet generating chip Fluidic 537 with four identical droplet generation units on one chip



Detailed schematic drawing of the flow focusing region of Fluidic 537

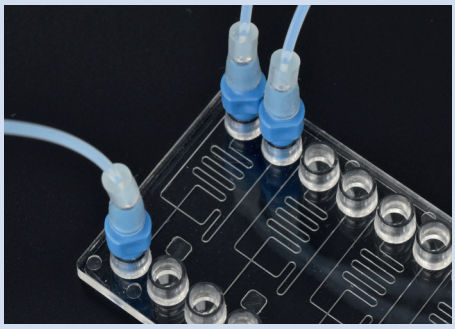
Product Code for Fluidic 537	Surface Treatment	Droplet generation	Lid Thickness [µm]	Material	Price [€/chip]		
					1+	10+	100+
10000466	Untreated - hydrophobic surface	W/O	140	Topas	42.20	34.40	26.10
10000467	Untreated - hydrophobic surface	W/O	175	PC	42.20	34.40	26.10
10002124	Treated - hydrophilic surface	O/W	140	Topas	45.20	36.40	27.80
10001535	Treated - hydrophilic surface	O/W	175	PC	45.20	36.40	27.80

Fluidic 912 - Single Cross Geometry

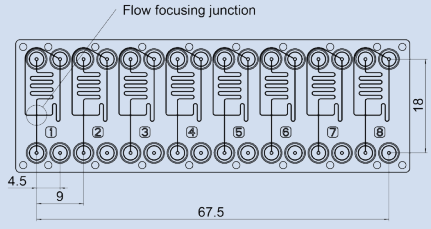
Droplet generator chips Fluidic 912 provides eight identical droplet generator units with a nozzle size of 80 µm on one chip. The continuous phase is introduced through one Mini Luer inlet, which separates into two channels. Operation of one unit of Fluidic 912 therefore requires a microfluidic pump with the ability to control two individual flows, one for the continuous and one for the disperse phase.

Chip Summary Fluidic 912

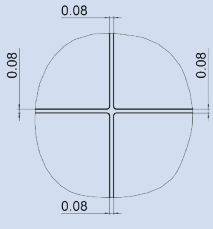
Interface type: Mini Luer
Nozzle size: 80 µm
Nozzle type: single cross, flow focusing
Droplet generator units on chip: 8
Droplet storage: no



Droplet generation chip Fluidic 912 with Mini Luer interfaces and matching Mini Luer connectors (blue) interfacing the one droplet generation unit



Schematic drawing of droplet generating chip Fluidic 912 with eight identical droplet generation units on one chip



Detailed schematic drawing of the flow focusing region of Fluidic 912

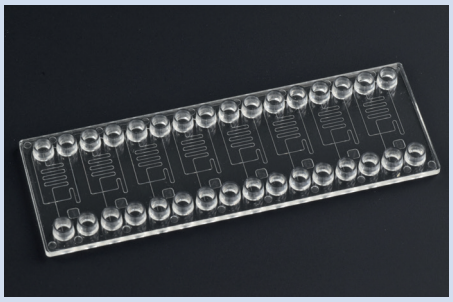
Product Code for Fluidic 912	Surface Treatment	Droplet generation	Lid Thickness [µm]	Material	Price [€/chip]		
					1+	10+	100+
10001985	Untreated - hydrophobic surface	W/O	140	Topas	42.20	34.40	26.10
10001333	Untreated - hydrophobic surface	W/O	175	PC	42.20	34.40	26.10
10002125	Treated - hydrophilic surface	O/W	140	Topas	45.20	36.40	27.80
10001688	Treated - hydrophilic surface	O/W	175	PC	45.20	36.40	27.80

Fluidic 947 - Single Cross Geometry - Multiple Nozzle Sizes

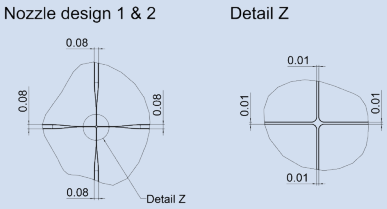
The microfluidic chip Fluidic 947 features eight flow focusing droplet generator units to evaluate the formation of various droplet sizes. With nozzle sizes as little as 10 µm, Fluidic 947 possesses the smallest nozzles within *microfluidic ChipShop*'s droplet generator portfolio. It is therefore the perfect chip for experiments that require droplets with particularly small dimensions and volumes.
The inlet channels for both continuous and disperse phase are designed to enable stable droplet generation through a certain degree of flow restriction.

Chip Summary Fluidic 947

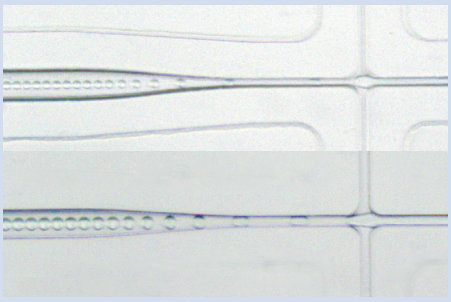
Interface type: Mini Luer
Nozzle size: 10; 15; 20; 30 µm
Nozzle type: single cross; flow focusing
Droplet generator units on chip: 8
Droplet storage: no



Chip layout of Fluidic 947. The chip with eight functional droplet generation units shares its general layout with its larger siblings Fluidic 912 and Fluidic 440.



Detailed schematic drawing of the smallest droplet generation units 1 & 2 of Fluidic 947



Droplets generated using Fluidic 947 with nozzle size 20 µm (top) and nozzle size 30 µm (bottom). Pressures applied to continuous phase were 110 mbar (20 µm nozzle) and 90 mbar (30 µm nozzle). Pressure applied to disperse phase was ~140 mbar in both cases.

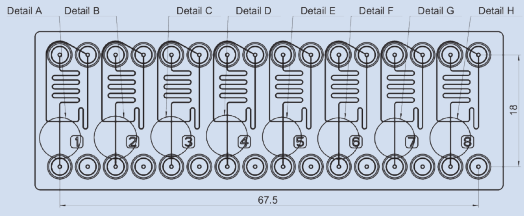
Product Code for Fluidic 947	Surface Treatment	Droplet generation	Lid Thickness [µm]	Material	Price [€/chip] 1+	10+	100+
10001972	Untreated - hydrophobic surface	W/O	140	Topas	42.20	34.40	26.10
10001337	Untreated - hydrophobic surface	W/O	175	PC	42.20	34.40	26.10
10001984	Treated - hydrophilic surface	O/W	140	Topas	45.20	36.40	27.80
10002128	Treated - hydrophilic surface	O/W	175	PC	45.20	36.40	27.80

Fluidic 440 - Single Cross Geometry - Multiple Nozzle Sizes

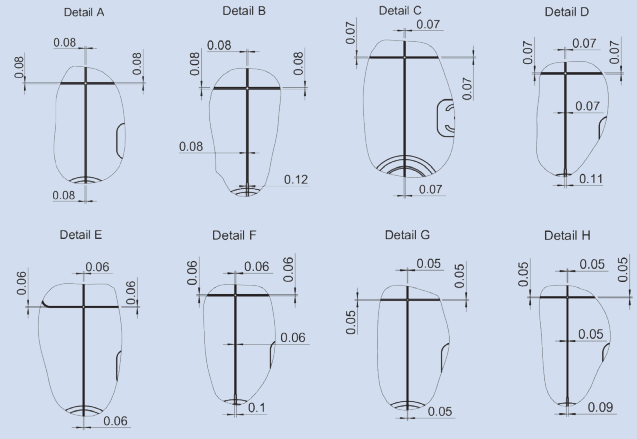
Being the larger sibling of Fluidic 947, the droplet generator chip Fluidic 440 is also perfectly suited to evaluate droplet generation with a single cross, flow focusing geometry. The nozzle sizes, however, range from 50 µm to 80 µm on this chip. With its two Mini Luer inlet and one Mini Luer outlet ports per droplet generation unit, the chip requires a two-channel microfluidic pump, just as Fluidic 912 and Fluidic 947.

Chip Summary Fluidic 440

Interface type: Mini Luer
Nozzle size: 50; 60; 70; 80 µm
Nozzle type: single cross; flow focusing
Droplet generator units on chip: 8
Droplet storage: no



Schematic drawing of droplet generating chip Fluidic 440 with eight different droplet generation units on one chip



Detailed schematic drawings for each of the eight individual droplet generator units of Fluidic 440

Product Code for Fluidic 440	Surface Treatment	Droplet generation	Lid Thickness [µm]	Material	Price [€/chip] 1+	10+	100+
10000040	Untreated - hydrophobic surface	W/O	140	Topas	42.20	34.40	26.10
10000174	Untreated - hydrophobic surface	W/O	175	PC	42.20	34.40	26.10
10002127	Treated - hydrophilic surface	O/W	140	Topas	45.20	36.40	27.80
10001631	Treated - hydrophilic surface	O/W	175	PC	45.20	36.40	27.80

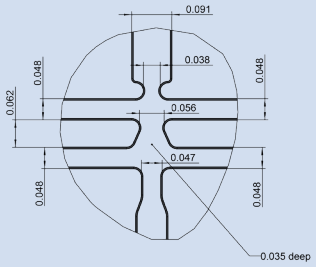
Fluidic 536 - Double Cross Geometry

Droplet generator chips with a double cross geometry allow for the generation of W/W/O droplets and are therefore ideally suited for the inclusion of particles or cells, deriving from the first channel intersection, with a further droplet shell at the second channel intersection. With 38 µm nozzle diameter, Fluidic 536 offers the smallest nozzle size with double cross geometry within *microfluidic ChipShop*'s portfolio. Please be aware of the chip's Luer interfaces, which require dedicated Luer-sized connectors and plugs.

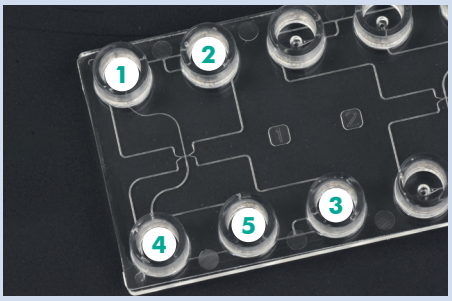
Chip Summary Fluidic 536

Interface type: Luer
Nozzle size: 38 µm
Nozzle type: double cross, flow focusing
Droplet generator units on chip: 3
Droplet storage: no

Fluidic 536 with three functional droplet generation units on one chip



Detailed schematic drawing of the droplet generation area of Fluidic 536



One droplet generation unit of Fluidic 536 with Luer inlets for aqueous disperse phases (1 & 2), continous oil phase (3) and outlets (4 & 5)

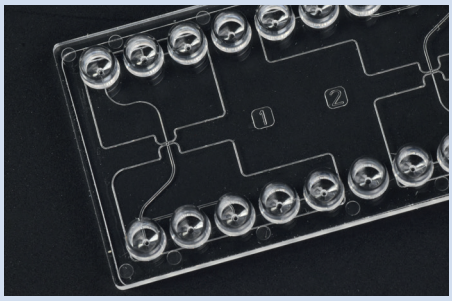
Product Code for Fluidic 536	Droplet generation	Lid Thickness [µm]	Material	Price [€/chip] 1+	10+	100+
10000433	W/W/O	140	Topas	42.20	34.40	26.10
10000509	W/W/O	175	PC	42.20	34.40	26.10

Fluidic 1032 - Double Cross Geometry

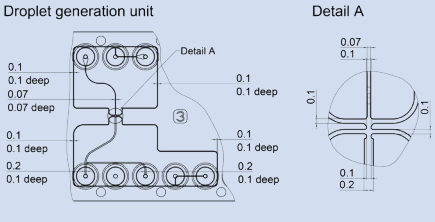
This droplet generator chip with three identical droplet generation units of double cross geometry was specifically developed for use in single cell sequencing experiments, where single cells (W) and beads/lysis buffer (W) need to be introduced into a single droplet in an oil phase (O). Fluidic 1032 features Mini Luer interfaces and its use requires a microfluidic pump setup with the ability to control three individual flows. It is, however, also possible to use this droplet generator to generate W/O droplets by simply closing one inlet and supplying only two inlets with a liquid stream.

Chip Summary Fluidic 1032

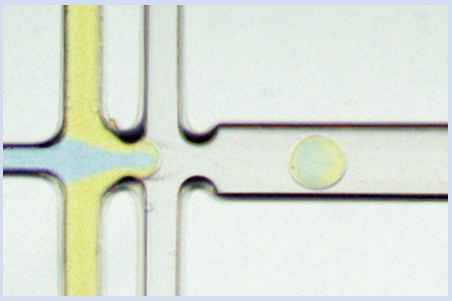
Interface type: Mini Luer
Nozzle size: 100 µm
Nozzle type: double cross, flow focusing
Droplet generator units on chip: 3
Droplet storage: no



One of the tree identical droplet generation units on Fluidic 1032 with Mini Luer interfaces



Schematic drawing of one droplet generation unit on Fluidic 1032 (left) and a detailed view on the droplet generating intersection (right)



W/W/O droplets with a diameter of 180 µm were generated by applying pressures of 12 mbar / 72 mbar / 99 mbar respectively.

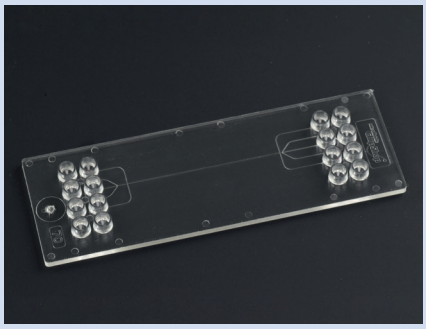
Product Code for Fluidic 1032	Droplet generation	Material	Lid Thickness [µm]	Price [€/chip] 1+	10+	100+
10001334	W/W/O	Topas	140	42.20	34.40	26.10
10001335	W/W/O	PC	175	42.20	34.40	26.10

Fluidic 162 - Double Cross Geometry

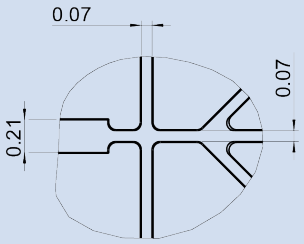
Droplet generator Fluidic 162 features a double channel crossing in the droplet generation region and one droplet collection channel. Like most droplet generators with a double cross geometry, Fluidic 162 can also be used for single cross experiments by simply not connecting respective channels but closing their interfaces with plugs. With a nozzle size of 70 µm droplet sizes between 80 µm (~260 pl) and 210 µm diameter can be realized. A constant droplet size can be generated in various flow speeds by preserving the oil to aqueous phase ratio. By increasing the oil phase flow rate at a constant aqueous flow rate, the droplet size can be varied.

Chip Summary Fluidic 162

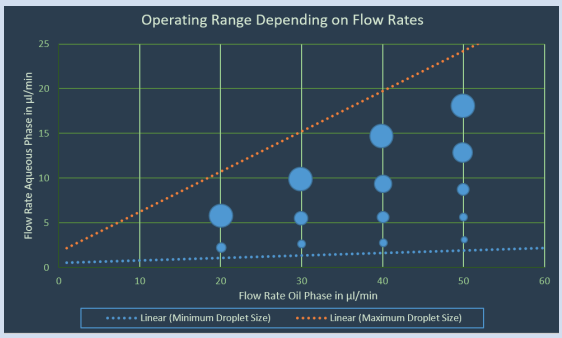
Interface type: Mini Luer
Nozzle size: 70 µm
Nozzle type: double cross; flow focusing
Droplet generator units on chip: 1
Droplet storage: no



General channel design of Fluidic 162 and Fluidic 163 is identical except for the exact channel dimensions



Schematic drawing of double cross geometry at the droplet generating region of Fluidic 162



Flow rate dependent droplet size formation utilizing Fluidic 162 to generate water in oil droplets

Product Code for Fluidic 162	Input Channel Width [µm]	Collection Channel Width [µm]	Channel Depth [µm]	Droplet generation	Lid Thickness [µm]	Material	Price [€/chip] 1+	10+	100+
10000005	70	210	70	W/W/O	140	Topas	42.20	34.40	26.10
10000003	70	210	70	W/W/O	175	PC	42.20	34.40	26.10

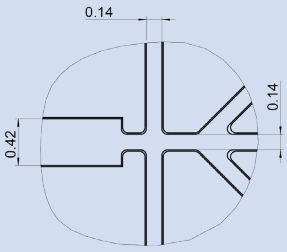
Fluidic 163 - Double Cross Geometry

Droplet generator Fluidic 163 is the larger sibling of Fluidic 162 and features a similar design with larger channel dimensions. With a nozzle size of 140 µm droplet sizes between 190 µm (~3.25 nl) and 420 µm diameter can be realized. Fluidic 163 gives the possibility to be utilized from two sides, as it features droplet generation crossings at either side of the collection channel. Both sides are similar in channel design with a slight difference in distance of the double cross intersections.

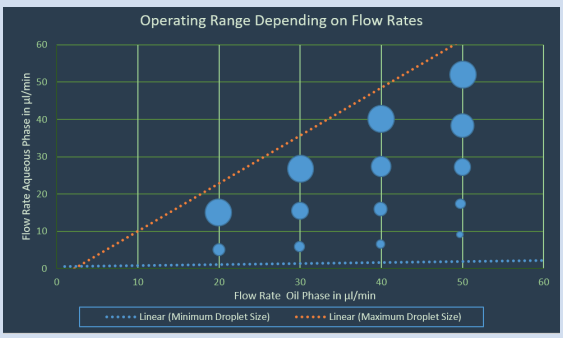
Chip Summary Fluidic 163

Interface type: Mini Luer
Nozzle size: 140 µm
Nozzle type: double cross; flow focusing
Droplet generator units on chip: 1
Droplet storage: no

Detailed inlet and channel design of Fluidic 163



Schematic drawing of double cross geometry at the droplet generating region of Fluidic 163



Flow rate dependent droplet size formation utilizing Fluidic 163 to generate water in oil droplets

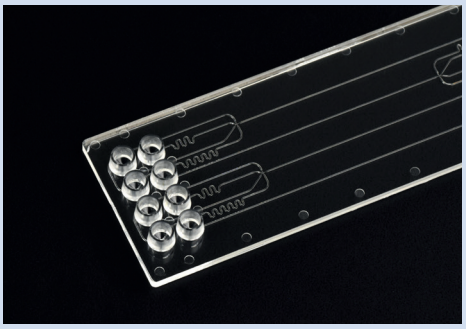
Product Code for Fluidic 163	Input Channel Width [µm]	Collection Channel Width [µm]	Channel Depth [µm]	Droplet generation	Lid Thickness [µm]	Material	Price [€/chip] 1+	10+	100+
10000006	140	420	140	W/W/O	140	Topas	42.20	34.40	26.10
10000004	140	420	140	W/W/O	175	PC	42.20	34.40	26.10

Fluidic 1505 - Double Cross Geometry

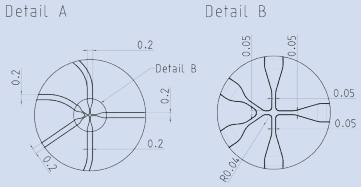
Fluidic 1505 consists of four identical droplet generator units. Each unit provides a double channel crossing, which is ideal for mixing of two aqueous phases. The mixing ratio can be regulated by adjusting the flow rate ratio. After mixing, W/W/O emulsions are generated at the downstream flow focusing junction.
Among many other applications, the chips enable the investigation of dose-dependent effects of drugs on individual cells in high throughput using million-fold small reaction spaces. The chip features performance-enhancing bubble- and particle trapping structures right at the Mini Luer interfaces.

Chip Summary Fluidic 1505

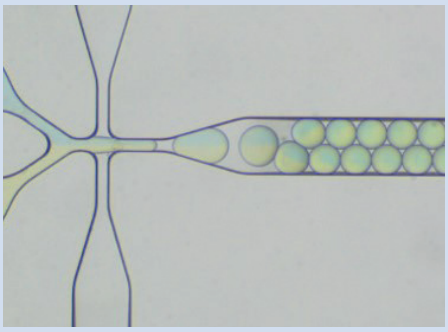
Interface type: Mini Luer
Nozzle size: 50 µm
Nozzle type: double cross
Droplet generator units on chip: 4
Droplet storage: no



Detail of the droplet generator chip Fluidic 1505



Schematic drawing of droplet generating channel intersection element of Fluidic 1505



Formation of droplets from mixed aqueous solution (W/W/O)

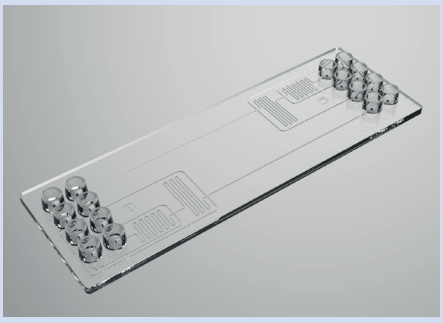
Product Code for Fluidic 1505	Droplet generation	Material	Lid Thickness [µm]	Price [€/chip] 1+	10+	100+
10002065	W/W/O	Topas	140 µm	42.20	34.40	26.10
10002066	W/W/O	PC	175 µm	42.20	34.40	26.10

Fluidic 1480 - Double Cross Geometry - Double Emulsion

The double emuslion droplet chip Fluidic 1480 provides two droplet generator units with double-cross geometry, that have varying channel/nozzle sizes at the second cross (unit 2). It comes with a specific surface coating that allows for the generation of double emulsions, such as the inclusion of droplets or cells deriving from the first channel intersection in a further droplet shell at the second channel intersection.
Each unit consists of two crossings, each with a flow-focusing geometry, that are connected by a meander channel to generate W/O/W emulsions in a single step. To generate water-in-oil droplets in an aqueous continuous liquid, the chips are provided with a partially hydrophilic coating. However, this chip can also be used without pretreatment to mix two aqueous phases through the meander structures and to generate W/W/O droplets. Fluidic 1480 features standard Mini Luer interfaces to seamlessly connect to a pump system of choice. For double emulsion experiments, at least three individual pump channels are required.

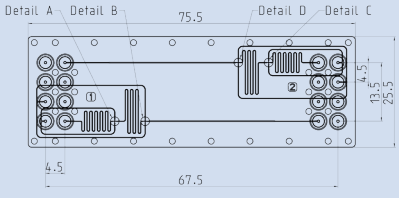
Chip Summary Fluidic 1480

Interface type: Mini Luer
Nozzle size unit 1: 80 µm
Nozzle size unit 2: 60 µm and 80 µm
Nozzle type: double cross
Droplet generator units on chip: 2
Droplet storage: no

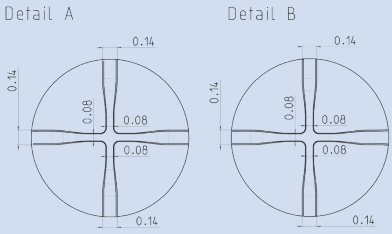


Double emulsion droplet generator chip Fluidic 1480 with Mini Luer interfaces

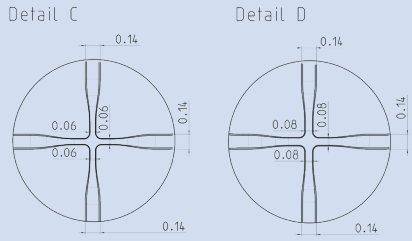
Detail of double emulsion droplet generator chip Fluidic 1480



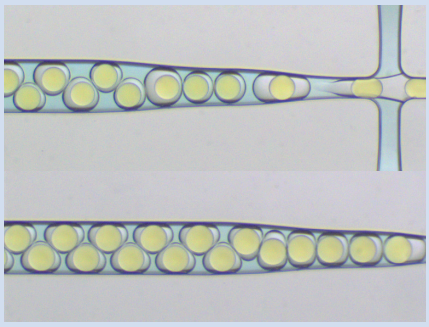
Schematic drawing of droplet generator chip Fluidic 1480



Droplet generator chip Fluidic 1480 - detail channel intersection element



Droplet generator chip Fluidic 1480 - detail channel intersection element



Formation of double emulsions (W/O/W) at the second flow focusing junction of chip Fluidic 1480

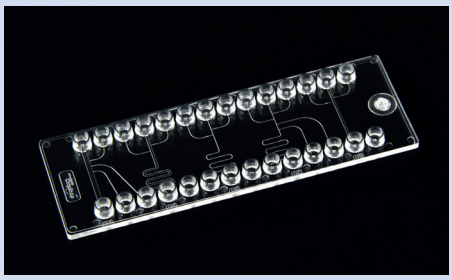
Product Code for Fluidic 1480	Surface Treatment	Droplet generation	Material	Lid Thickness [µm]	Price [€/chip] 1+	10+	100+
10002061	Untreated - hydrophobic surface	W/W/O or W/O/O	Topas	140 µm	42.20	34.40	26.10
10002062	Untreated - hydrophobic surface	W/W/O or W/O/O	PC	175 µm	42.20	34.40	26.10
10002106	Treated - partial surface treatment	W/O/W or O/O/W	Topas	140 µm	67.80	51.20	36.90
10002107	Treated - partial surface treatment	W/O/W or O/O/W	PC	175 µm	67.80	51.20	36.90

Fluidic 285 - Various Channel Designs on one Chip

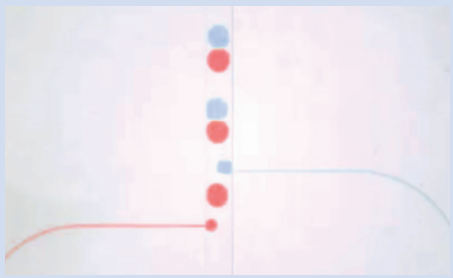
Fluidic 285 is a true playground for anyone who wants to start with droplet generation and requires a microfluidic chip with various different droplet generation units. The chip features five different droplet generation units with multiple channel designs and sizes, enabling a large set of experiments. Channels/ports not in use can easily be closed by means of Mini Luer plugs.

Chip Summary Fluidic 285

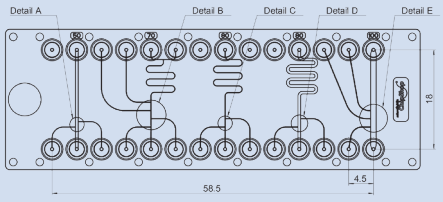
Interface type: Mini Luer
Nozzle size: 50; 70; 80; 100 µm
Nozzle type: various
Droplet generator units on chip: 5
Droplet storage: no



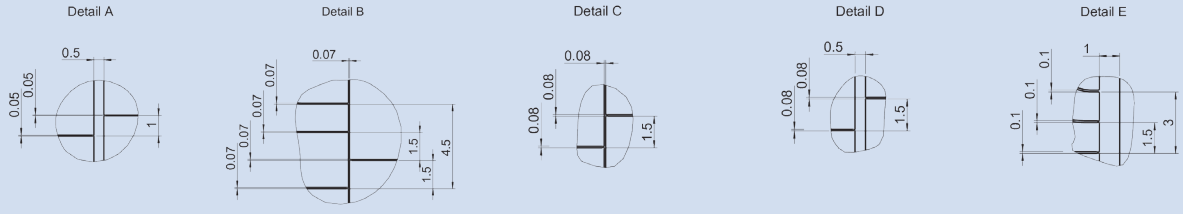
Droplet generation chip 285 features a variety of nozzle designs



Droplet generation using Fluidic 285 and its design unit 1 (Detail A)



Schematic drawing of Fluidic 285. Design details of the droplet generating units are outlined below



Detailed schematic drawings of the droplet generating regions of Fluidic 285. The device features five droplet generators with different designs and channel sizes on microfluidic chip

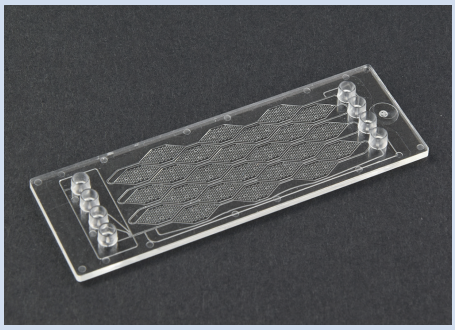
Product Code for Fluidic 285	Surface Treatment	Droplet generation	Lid Thickness [µm]	Material	Price [€/chip] 1+	10+	100+
10000175	Untreated - hydrophobic surface	W/O	140	Topas	42.20	34.40	26.10
10000176	Untreated - hydrophobic surface	W/O	175	PC	42.20	34.40	26.10
10002126	Treated - hydrophilic surface	O/W	140	Topas	45.20	36.40	27.80
10001498	Treated - hydrophilic surface	O/W	175	PC	45.20	36.40	27.80

Fluidic 488 - Droplet Generation and Storage

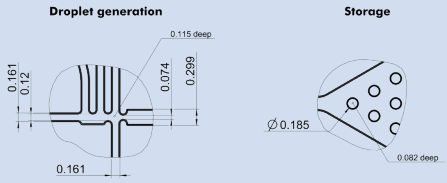
Droplet generation and storage chip Fluidic 488 was specifically designed to generate and capture droplets for on-chip optical analysis of generated single droplets. It features 24 rhombic storage units, each suitable to capture 108 individual droplets. With a combination of multiple T-junctions and a flow focusing nozzle, the channel design in the droplet generating area is a versatile tool for many different experimental settings.

Chip Summary Fluidic 488

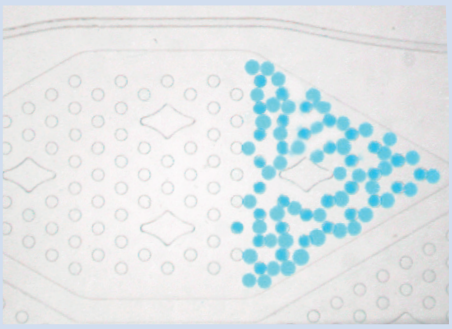
Interface type: Mini Luer
Nozzle size: 74 µm
Nozzle type: double cross
Droplet generator units on chip: 1
Droplet storage: yes



Droplet generation and storage chip Fluidic 488 with multiple droplet storing units



Schematic drawing of droplet generating area and storage unit of Fluidic 488



One droplet storing unit of Fluidic 488 being flushed with previously generated droplets

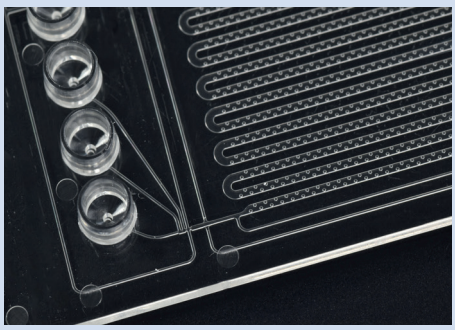
Product Code for Fluidic 488	Droplet generation	Material	Lid Thickness [µm]	Price [€/chip]		
				1+	10+	100+
10000510	W/W/O	Topas	140 µm	42.20	34.40	26.10
10000511	W/W/O	PC	175 µm	42.20	34.40	26.10

Fluidic 719 - Droplet Generation and Storage

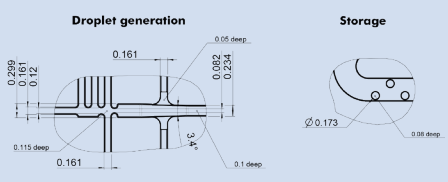
Fluidic 719 possesses a storage channel design, which is suited to be used for optical analysis. Both droplet generator region and individual storage cavities are fairly similar to the ones of Fluidic 488. However, the channel design of Fluidic 719 adds an additional flow focusing junction and droplet storage is realized in one channel, rather than in rhombic units. The chip contains 2261 storage positions and can be used for a wide-range of applications including droplet-based cell culture/monitoring.

Chip Summary Fluidic 719

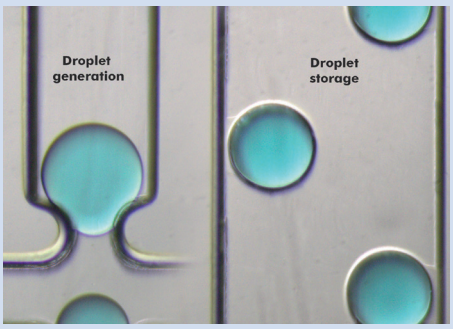
Interface type: Mini Luer
Nozzle size: 82 µm
Nozzle type: double cross
Droplet generator units on chip: 1
Droplet storage: yes



Droplet generation and storage chip Fluidic 719 possesses a complex nozzle geometry and channel with over 2000 droplet storage positions



Schematic drawing of droplet generating area and storage unit of Fluidic 719



Droplet generation of water in oil droplets at the flow focusing junction (left) and trapped droplets in the allocated storage positions (right)

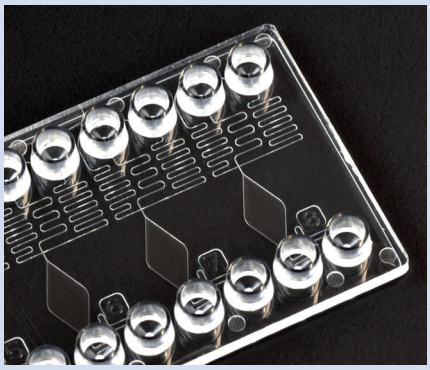
Product Code for Fluidic 719	Droplet generation	Material	Lid Thickness [µm]	Price [€/chip]		
				1+	10+	100+
10000751	W/W/O	Topas	140 µm	42.20	34.40	26.10
10000752	W/W/O	PC	175 µm	42.20	34.40	26.10

Fluidic 1114 - Droplet Generation and Storage

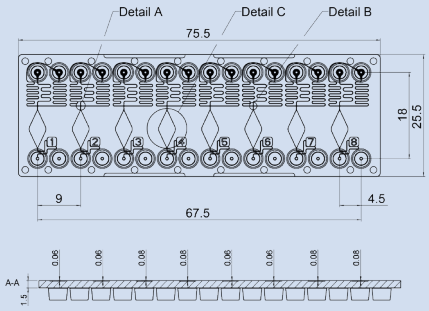
The droplet generator Fluidic 1114 features eight droplet generation units with a simple flow-focusing nozzle of 50 µm and 60 µm to generate droplets of different sizes. The Mini-Luer interfaces enable connection of continuous (oil) and a dispersive phase (water). The droplets can be captured, monitored and manipulated in the observation chambers downstream of the nozzle. The monitoring chambers come at a height of 60 µm and 80 µm, respectively.

Chip Summary Fluidic 1114

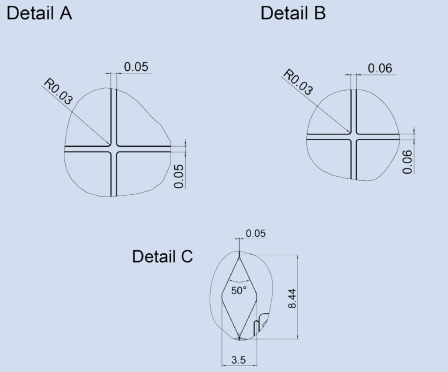
Interface type: Mini Luer
Nozzle size: 50; 60 µm
Nozzle type: single cross
Droplet generator units on chip: 8
Droplet storage: yes



Detail of doplet generation chip Fluidic 1114 with observation chambers



Schematic drawing of droplet generation chip Fluidic 1114 with observation chambers



Nozzle details of Fluidic 1114 with the two different nozzle dimensions: 50 µm and 60 µm

Product Code for Fluidic 1114	Surface Treatment	Droplet generation	Lid Thickness [µm]	Material	Price [€/chip] 1+	10+	100+
10001753	Untreated - hydrophobic surface	W/O	175	Topas	42.20	34.40	26.10
10001776	Untreated - hydrophobic surface	W/O	175	PC	42.20	34.40	26.10
10002129	Treated - hydrophilic surface	O/W	175	Topas	45.20	36.40	27.80
10002130	Treated - hydrophilic surface	O/W	175	PC	45.20	36.40	27.80

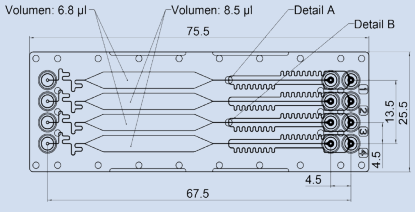
Fluidic 1147 - Droplet Generation and Storage

The droplet generator Fluidic 1147 features four functional droplet generation units with a simple flow-focusing nozzle of 70x70 µm and 80x80 µm to generate droplets of different sizes. The Mini-Luer interfaces enable connection of continuous (oil) and a dispersive phase (water). The droplets can be captured, monitored and manipulated in the observation chambers downstream of the nozzle. The monitoring chambers come at a height of 80 µm and 100 µm, with volumes of 6.8 µl and 8.5 µl, respectively. The Fluidic 1147 droplet generator is ideal for loop-mediated isothermal amplification (LAMP).

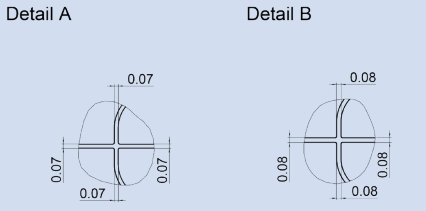
Chip Summary Fluidic 1147

Interface type: Mini Luer
Nozzle size: 70; 80 µm
Nozzle type: single cross
Droplet generator units on chip: 4
Droplet storage: yes

Droplet generation chip Fluidic 1147 with observation chambers



Fluidic 1147 possesses four functional droplet units and Mini Luer interfaces



Observation chambers of Fluidic 1147 are 80 µm and 100 µm deep, nozzles are 70 µm and 80 µm

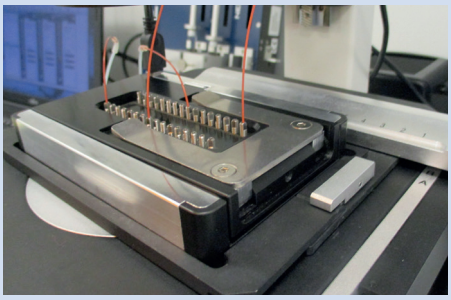
Product Code for Fluidic 1147	Surface Treatment	Droplet generation	Lid Thickness [µm]	Material	Price [€/chip] 1+	10+	100+
10001754	Untreated - hydrophobic surface	W/O	175	Topas	42.20	34.40	26.10
10001777	Untreated - hydrophobic surface	W/O	175	PC	42.20	34.40	26.10
10001927	Treated - hydrophilic surface	O/W	175	Topas	45.20	36.40	27.80
10001929	Treated - hydrophilic surface	O/W	175	PC	45.20	36.40	27.80

Accessories - Lab-on-a-Chip Handling Platform

microfluidic ChipShop's Lab-on-a-Chip Handling Platform (LOC HP) is a versatile device to enable quick and easy fluidic interface connection. The LOC HP can be obtained with adapter plates for three microfluidic interface configurations: two interface configurations with the fluidic interfaces at the shorter sides of the microfluidic chip and one at the longer sides, addressing openings with a 4.5 mm spacing. With this, the LOC HP is compatible with all our off-the-shelf droplet generator chips with Mini Luer interfaces. A heatable version for cell culture experiments is also available.

The complete setup of a LOC CCI 1 with heating elements. In contrast, the LOC HP does not include temperature control units.

LOC HP with interchangeable adapter plates to fit with all off-the-shelf droplet generators with Mini Luer interfaces.



Possesing microtiter plate format, the LOC HP fits in standard microscope stages. PEEK tubing of 1/32" (red) is use in with the platform.

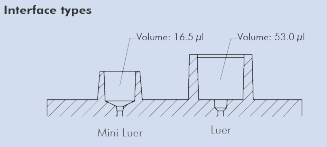
Product Code	Description	Price [€] included adapter plate 2x8	2x16
10000287	LOC HP w/o heating elements (incl. 1 adapter plate of your choice)	1,808.40	
10000743	LOC CCI 1 with heating elements (incl. 1 adapter plate of your choice)	2,371.87	
10001216	Additional adapter plate	390.00	390.00

Accessories - Connectors, Plugs and Tubing

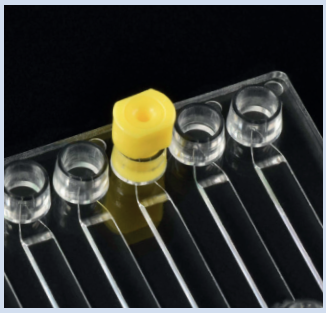
Connectors: *microfluidic ChipShop* offers a multitude of connectors, facilitating fast and convenient connection of droplet generation chips with e.g. pumps, valves or collection reservoirs via tubing. All connectors are designed to fit standard microfluidic interfaces, such as Luer and Mini Luer, while retaining a minimum dead volume. Please always double-check the interface type (Luer or Mini Luer) of your droplet generator and obtain connectors and plugs accordingly. We have recently added the Male Luer and Mini Luer tube tuck connector to the range of fluid connectors. These are even easier to handle and can withstand pressures of at least 3.2 bar. Both the Male Luer and the Male Mini Luer tube tuck connectors are available in two versions - for tubing with an OD of 1/16" or 1/32".
Alternatively, the Mini Luer or Luer fluid connectors can also be combined with a silicone sleeve and PTFE tubing.

Plugs: Oftentimes, our droplet generators possess surplus in- and outlet to ensure maximal experimental freedom. However, not in every experimental setting all interfaces need to be addressed. Mini Luer plugs and Luer plugs are the dedicated mean to securely close fluidic interfaces on your droplet generation chip, which are not in use.

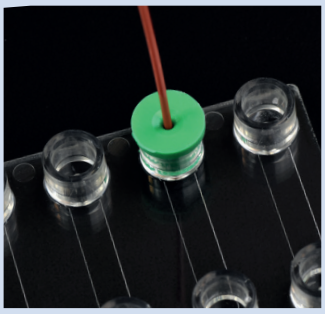
Tubing: Tubing is needed in most cases to link the droplet generator chip with an external pump, which drives removal or delivery of liquid. We offer two options for connectivity:
The first option involves PEEK tubing directly connected with our tube tuck connector. The tube tuck connector is available as Mini Luer or Luer version and connect 1/16" or 1/32" OD PEEK tubing.
The other option utilizes PFTE tubes in combination with a silicone sleeve cutted from longer silicone tubes. These sleeves create an ideal connection between relatively rigid PTFE tubing and Mini Luer or Luer fluid connectors.



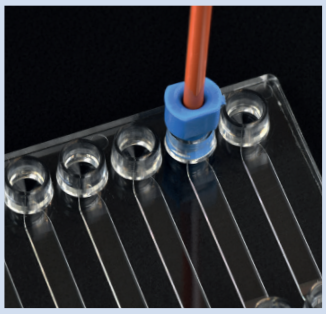
Comparison of Mini Luer and Luer interfaces, booth of which can be found on *microfluidic ChipShop*'s droplet generator chips. If used in suction rather than in pumping mode, interfaces can also serve as liquid reservoirs



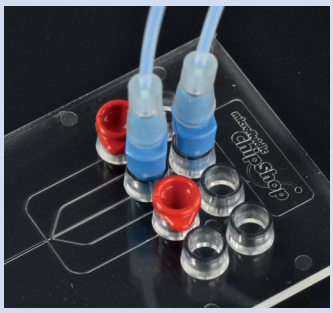
Male Mini Luer tube tuck connector for 1/32" OD tubing.



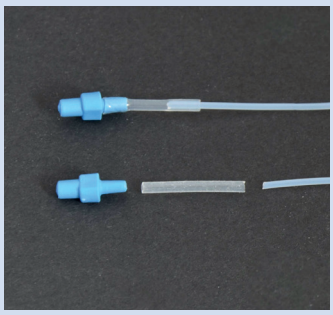
The droplet generator chips Fl. 536 and Fl. 537 features a Luer interface. For this, the Male Luer tube tuck connector (green) is well suited. It is connected to a 1/32" PEEK tubing.



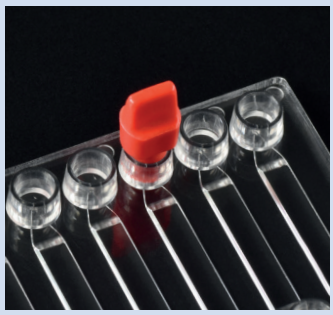
Male Mini Luer tube tuck connector for 1/16" OD tubing in conjunction with a 1/16" PEEK tubing.



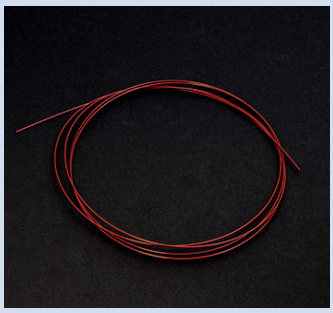
Droplet generator Fluidic 163 with tubes connected via Male Mini Luer fluid connectors to facilitate monodisperse water in oil droplets



Assembly of Mini Luer fluid connector, silicone sleeve (from product 10000031) and PTFE tubing



Single Mini Luer plug mounted on chip



Capillary PEEK tubing, 1/32''

Product Code	Description	Color	Material	Price [€/10 pieces]			
				1+	5+	10+	20+
10001764	Male Mini Luer tube tuck connector for 1/32" tubing	Green*	TPE	19.00	14.00	9.40	7.40
10002010	Male Mini Luer tube tuck connector for 1/16" tubing	Blue*	TPE	19.00	14.00	9.40	7.40
10002011	Male Luer tube tuck connector for 1/32" tubing	Green	TPE	25.00		14.40	
10002012	Male Luer tube tuck connector for 1/16" tubing	Blue	TPE	25.00		14.40	
10000116	Male Mini Luer fluid connector	Opaque*	TPE	19.00	14.00	9.40	7.40
10000081	Male Luer fluid connector	Green*	PP	25.00		14.40	
10000054	Male Mini Luer Plug	Opaque*	TPE	19.00	14.00	9.40	7.40
10000231	Male Luer plug	Black*	PP	25.00		14.40	
10002000	Capillary PEEK tubing, ID: 0.127 mm (0.005"), OD: 0.794 mm (1/32"), 1.524 m, recommended with LOC	Red	PEEK	168.35			
10002009	Capillary PEEK tubing, ID: 0.508 mm (0.02"), OD: 0.794mm (1/32") 3.048 m, recommended for tube tuck	Orange	PEEK	91.00			
10002144	Capillary PEEK tubing, ID: 0.508 mm (0.02"), OD: 1.587 mm (1/16") 1.587 m, recommended for tube tuck	Orange	PEEK	34.32			
10000032	PTFE Micro tube, ID: 0.5 mm, OD: 1.0 mm; 1 m	Opaque	PTFE	9.50			
10000031	Silicone tube, ID: 0.76 mm, OD: 1.65 mm; 1 m	Opaque	Silicone	9.50			
10000033	Silicone tube, ID: 0.5 mm, OD: 2.5 mm; 1 m	Opaque	Silicone	9.50			

* other colors and options available

Droplet Generation - Syringe Pump Setup

A successful droplet generation experiment relies not only on a premium quality droplet generator but also on the appropriate pump setup that enables pulsation-free fluid control. For the purpose of obtaining highly monodisperse droplets booth high-end syringe pumps and pressure-driven pump systems, offered by *microfluidic ChipShop*, are ideal.

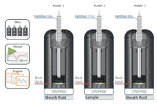
Together with our partner **Cellix,** we offer a dedicated droplet generation **syringe pump** setup for three independent flow channels. This setup is ideal to create droplets with e.g. a double-cross, flow focusing droplet generator. Here is what your droplet generation setup will contain:

ExiGo™ Syringe Pump:

- Enables pulse-free fluid control
- Response times as low as 50 ms
- Stand-alone units for use near the microfluidic setup
- Independent programming of flow profiles for disperse and continuous phases
- Compatible syringes: 100µL–5mL (glass or plastic)
- Flow rates from 10 nl / min - 13 ml / min

Flow Sensors:

- Enables active feedback
- PID (proportional, integral, differential) control
- Compatible with the ExiGo™, UniGo™ and 4U™

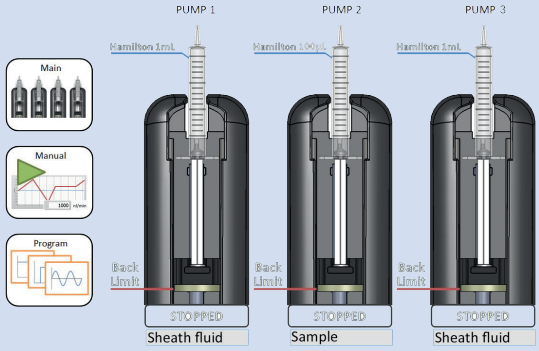


SmartFlo software:

- Available for iPAD and PC
- PID (proportional, integral, differential) control
- Modular use: mix-and-match control of ExiGo™ syringe pumps and Cellix's UniGo™ pressure pumps

Droplet Generation - Pump Setups

Three ExiGo™ syringe pumps with Flow sensors - the ideal setup for complex droplet generation experiments, like for single cell sequencing.



Independent control of multiple ExiGo™ syringe pumps is made possible with the easy-to-use SmartFlo software.

If you want to discuss the offered setups more in depth, our team at *microfluidic ChipShop* is happy to help and advise just exactly which system components are required for your droplet-based experiment. We also offer training possibilities at our site in Jena, Germany. Please contact us at inquiries@microfluidic-ChipShop.com.

Product	Content	Price [€]
Cellix syringe pump setup for droplet generation with three individual flow channels	ExiGo™ syringe pumps (3x), Cellix Flow Sensors (3x), SmartFlo software, Droplet generation - Ready-to-use-kit (product code 10002033)	12,257.25

Droplet Generation - Pressure-Driven Pump System

Together with our partner **Fluigent,** we offer everything you require for a droplet experiment with two flow channels of a **pressure-driven pump**. This setup is ideal to create droplets with e.g. a single cross, flow focusing droplet generator. Here is what your droplet generation setup will contain:

Microfluidic Pressure Pumps - LineUp Flow EZ™:

- Highly advanced system for pressure-based flow control
- Stand-alone units for use near the microfluidic setup
- Independent control flows of disperse and continuous phases
- Available in a variety of pressure ranges from - 800 to + 7 000 mbar

LINK:

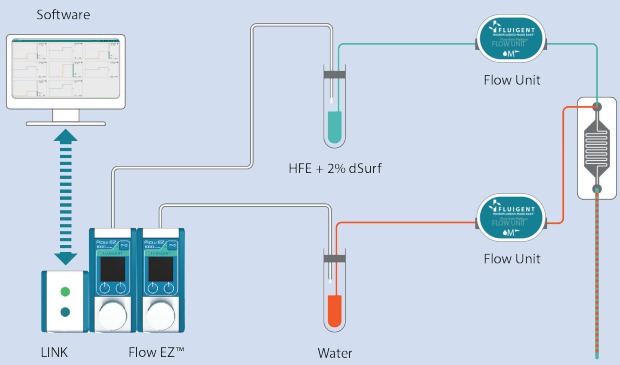
- Provides connection of LineUp Flow EZ™ series modules to a PC for software control

Flow Units:

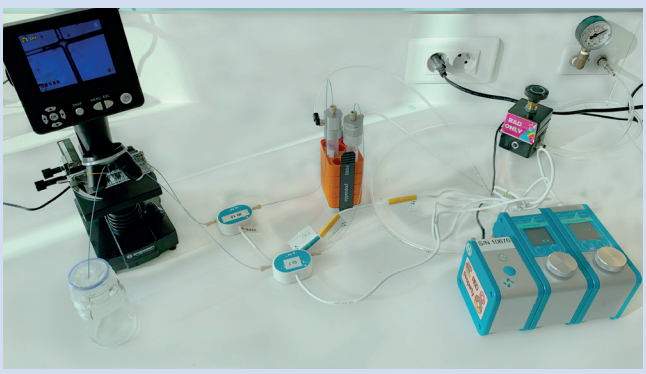
- Flow sensors that allows real-time flow rate measurements
- Enables to switch from pressure control to flow rate control
- Guarantee reproducibility of long-term droplet production

All-in-One (A-i-O) control software:

- Real-time control of pressures and flow rates
- Modular interface
- Independent monitoring of all parameters for each connected channel



Schematic drawing of a microfluidic system used for droplet generation



Droplet generation setup with droplet generator chip - on microscope - and Fluigent pressure-pump set-up

Product	Content	Price [€]
Fluigent pump setup for droplet generation with two individual flow channels	LineUP Flow EZ™ modules (2x), LineUP LINK module, LineUP power supply kit, Pressure CAP for 15 ml tubes (2x) with support rack (1x), Flow Unit S (0-7µL/min for water or 0-70µL/min for hydrocarbons) (2x), Tubing@ Connection Kit P-CAP 15 mL, A-I-O software, Droplet generation - Ready-to-use-kit (product code 10002033)	11,355.93

Droplet Oil, Surfactant and Kits

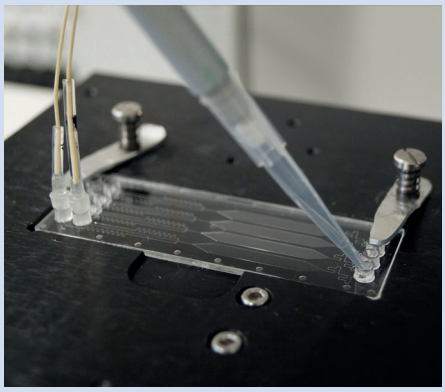
Partnering with Emulseo, we present a specialized fluorinated oil perfectly tailored for creating highly monodisperse microdroplets. Our collaboration ensures a seamless match between high-performance fluorinated oil and surfactant, meticulously designed to ensure reliable and consistent experimental results.

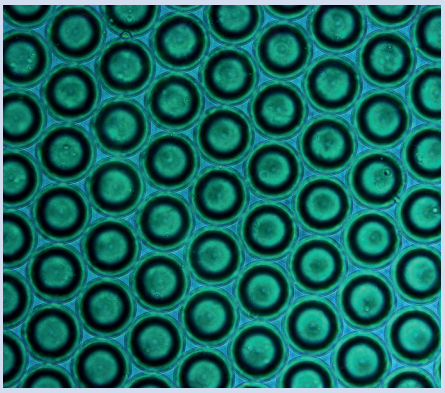
We offer various sizes of pre-mixed fluorinated oil with the matching surfactant, as well as individual components separately. Contact us for further information and options: inquiries@microfluidic-ChipShop.com

Emulseo Fluo-Oil™ 7500 and Surfactant FluoSurf™

To expand our off-the-shelf portfolio, we offer various droplet generation kits with chips of different nozzle sizes and frequencies, and/or integrated droplet storage functionas, enabling a wide variety of eperiments. Our Ready-to-Use Kit and First-User Kit offer different droplet generators and already include fluorinated oil with surfactant and accessories to get right to work with your first droplet application.

Droplet generation kit - Mini Luer kit

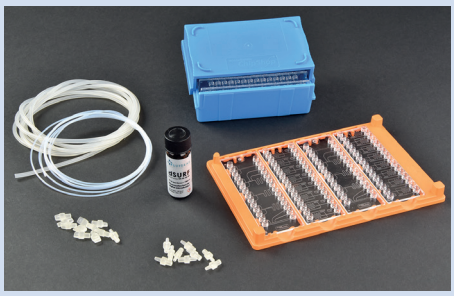

The droplet generator chip Fluidic 1147 in use


Fluorescence image showing LAMP of target genes within droplet generator

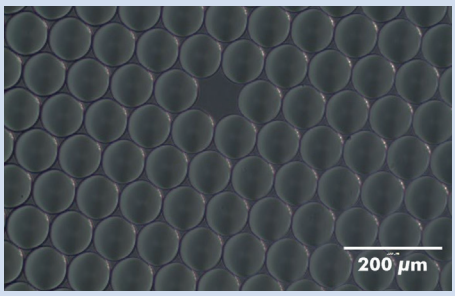
Product Code	Kit Name	Product Description	Amount	Material	Product Code	Price [€]
10002033	Droplet generation - Ready-to-use-kit	- Fluidic 440 50 - 80 µm nozzles	1	PC	10000174	785.25
			1	Topas	10000040	
		- Fluidic 947 10 - 30 µm nozzles	1	Topas	10001336	
		- Fluidic 1032 Double cross; 100 µm nozzles	1	PC	10001335	
		- Fluidic 162 Double cross; 70 µm nozzles	1	PC	10000003	
		- Fluidic 912 Single cross; 80 µm nozzle	1	PC	10001333	
			1	Topas	10001985	
		- Fluidic 163 Double cross; 140 µm nozzle	1	PC	10000004	
		- Fluidic 488 Double cross; 74 µm, storage	1	PC	10000511	
		- Fluidic 1147 Single cross; 70 µm; 80 µm	1	PC	10001777	
		- Droplet oil: Fluo-Oil™ 7500	1 x 21 mL	-	10002034	
		- Surfactant: FluoSurf™	1 x 0.5 g	-	10002035	
		- Male Mini Luer fluid connectors	2 x 10 pcs	TPE	10000116	
		- Male Mini Luer plugs	2 x 10 pcs	TPE	10000054	
		- Silicone tube, ID: 0.76 mm, OD: 1.65 mm	1 x 1 m	Silicone	10000031	
		- Micro tubes, PTFE, ID: 0.5 mm, OD:1.0 mm	2 x 1 m	PTFE	10000032	
10002037	Droplet generation - First-user-kit	- Fluidic 440 50 - 80 µm nozzles	1	PC	10001972	230.49
		- Fluidic 947 10 - 30 µm nozzles	1	Topas	10001336	
		- Fluidic 488 74 µm nozzle	1	PC	10000511	
		- Droplet oil: 2% FluoSurf™ in Fluo-Oil™ 7500	4 mL	-	10002036	
		- Male Mini Luer fluid connectors	1 x 10 pcs	TPE	10000116	
		- Male Mini Luer plugs	1 x 10 pcs	TPE	10000054	
		- Silicone tube, ID: 0.76 mm, OD: 1.65 mm	1 x 1 m	Silicone	10000031	
		- Micro tubes, PTFE, ID: 0.5 mm, OD:1.0 mm	1 x 1 m	PTFE	10000032	

Droplet Generation - Kits and Oil

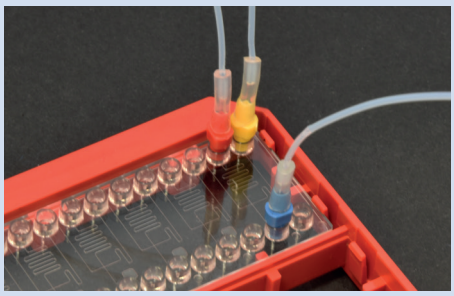
Our droplet variation kit is the perfect way to start your droplet-based experiment without further ado. The droplet variation kit contains everything needed to generate W/O droplets of multiple sizes and in various settings. The kit will help you to determine your optimal experimental layout, without the need for extensive background research. The provided items are perfectly suited to be used with a Fluigent pump setup or a high-end syringe pump, both available with *microfluidic ChipShop*.



The Droplet generation - Droplet variation kit is suitable for generating W/O droplets of different sizes and in a variety of settings



On-chip generated droplets visualized on a microscope glass slide

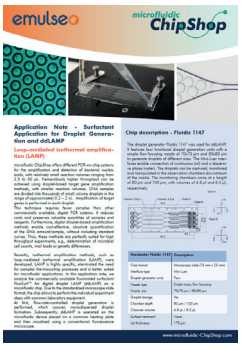


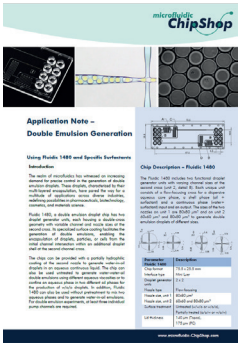
Colored connectors demonstrate inlet ports for disperse phase (red), continuous phase (yellow) and the outlet port (blue) of a droplet generation unit of Fluidic 440

Product Code	Kit Name	Contents Product Description	Amount	Product code	Color	Material	Price [€/kit]
10001653	Droplet generation - Droplet variation kit	Fluidic 440 Droplet generator - Droplet size variation	2 pcs	10000174	-	PC	501.50
		Fluidic 285 Droplet generator - Multi channel design	2 pcs	10000176	-	PC	
		Droplet Oil (2% surfactant in fluorinated oil)	3 x 4 ml	10001548	-	-	
		Transport & Storage Box, small	1 pc	10001188	Blue	-	
		Handling frame with reduced skirt height	1 pc	10000041	Orange	-	
		Male Mini Luer fluid connectors	4 x 10 pcs	10000116	Opaque	TPE	
		Male Mini Luer Plugs	1x 10 pcs	10000054	Opaque	TPE	
		Silicone tube (ID.: 0.76 mm, OD: 1.65 mm)	1 m	10000031	-	Silicone	
		PTFE tube	2 x 1 m	10000032	-	PTFE	

Did you know?
Application notes available

You want to start your droplet experiment right away, but you are looking for a little more technical information to succeed? Contact us for a application note on droplet generation or visit our website www.microfluidic-ChipShop.com





Manufacturing Services

We offer a large variety of off-the-shelf droplet generator and our team is happy to advise. Still not exactly found what you are looking for? No problem - we are specialized in custom manufacturing of microfluidic devices and can tailor custom fabrication exactly according to your experimental needs and design requirements. Contact us with your individual droplet generator specification at inquiries@microfluidic-ChipShop.com.

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EUROPEAN UNION

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