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## INFORMATION SHEET

Part name	Micromixer Chip in holder	Part number	3000002
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### Description

The Micromixer Chip is a glass microfluidic device designed for millisecond mixing of two fluid streams. Fast mixing times are required for the study of reaction kinetics, sample dilution, improving reaction selectivity, rapid crystallisation and nanoparticle synthesis. The chip can be supplied with a chip holder and a chip header to allow quick connection of fluid pipes.



Left: Micromixer Chip (3000167)

Below: Micromixer Chip in holder (3000002) and chip header (3000261)



### Benefits

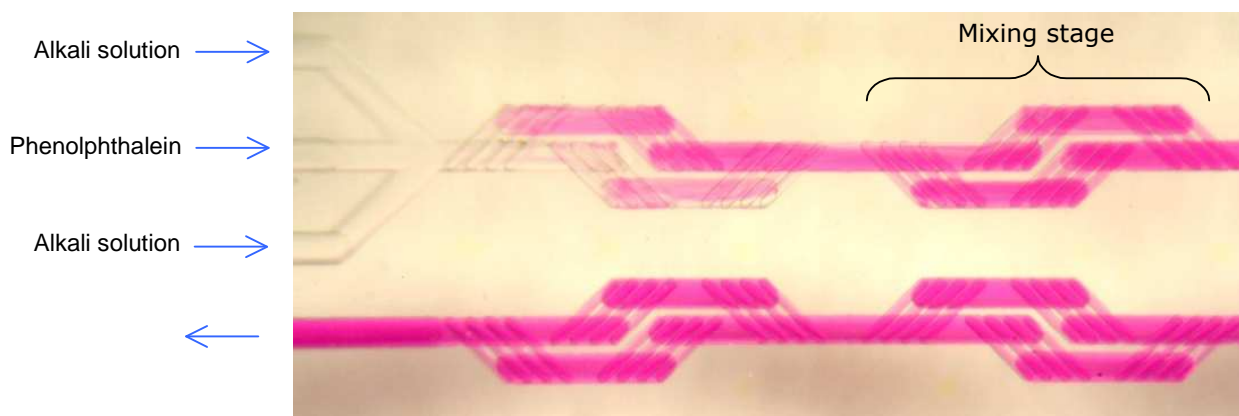
- Extremely rapid mixing across a range of flow rates
- Low dead volume
- High visibility (excellent access for optics)
- Quick connect/disconnect
- Pre-mix heating and cooling of fluid
- Wide temperature and pressure range
- Excellent chemical compatibility

	Specification	Value
1	Number of inputs	2
2	Number of outputs	1
3	Internal channel cross section	125 x 350 $\mu\text{m}$ and 50 x 125 $\mu\text{m}$ (depth x width)
4	Total internal volume	26 $\mu\text{l}$
5	Volume of mixing stage	0.35 $\mu\text{l}$
6	Back pressure with 100 $\mu\text{l}/\text{min}$ flow (water)	0.15 Bar
7	Outside diameter of connection tubing	1.6 mm (1/16 inch)
8	Inside diameter of connection tubing	0.25 mm, 0.5 mm, 0.8 mm
9	Connection tubing material	PTFE, FEP

10	Surface roughness of channels ( $R_a$ )	5 nm
11	Chip size	90 mm x 28 mm
12	Chip top layer thickness	2.3 mm
13	Chip base layer thickness	2.3 mm
14	Operating pressure	30 Bar with chip header
15	Operating temperature	300 °C
16	Material	Glass
17	Fabrication process	HF etching and thermal bonding

### Micromixer performance

To measure mixing performance a transparent phenolphthalein pH marker was mixed with an alkali solution to produce a bright pink colour. This is shown in the image below.

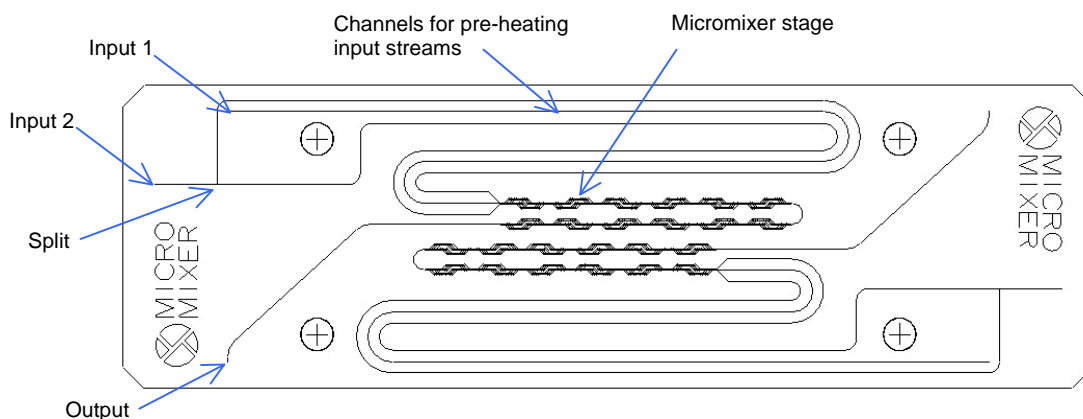


The mixing time was measured at various total flow rates, as shown in the table below. The volumetric flow rate ratio between the two input streams was 1:1.

Flow rate (microliters/min)	5	10	20	40	80	160	320	640	1200	2000	3000	4000	5000
Number of stages for mixing	1	1	2	4	6	7	7	4	4	3	3	2	2
Mixing time (milliseconds)	4200	2100	2100	2100	1575	919	459	131	70	32	21	11	8

### Micromixer chip channel layout

The channel geometry of the micromixer chip is shown below:

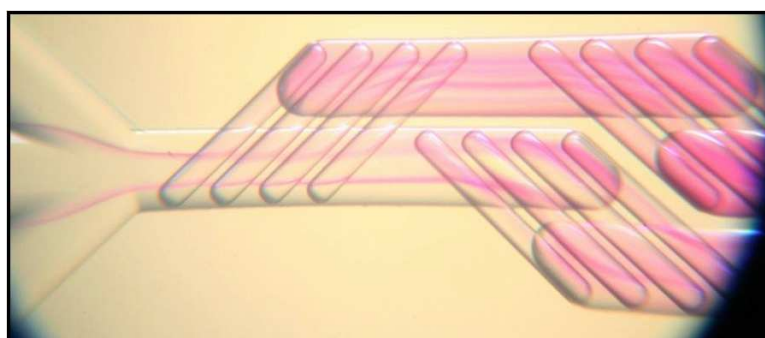
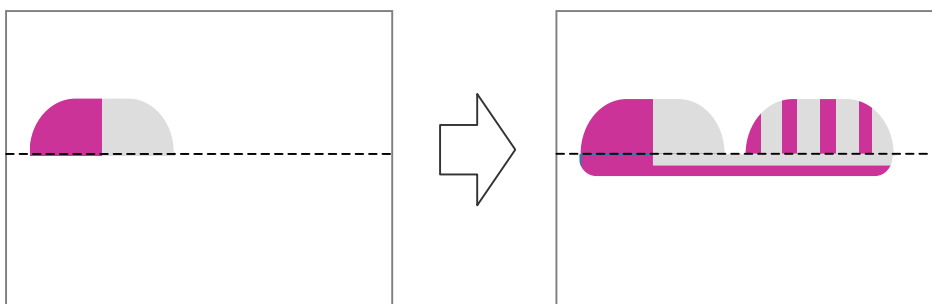


To reduce diffusion distance and improve mixing time, input stream 2 splits into two streams and recombines either side of input stream 1. Input streams 1 and 2 have some residence time on the chip before being combined at the mixing junction. This allows fluids to be pre-heated to the reaction temperature before mixing.

There is a copy of the channel structure on the other side of the chip. It is possible to disassemble the chip holder and rotate the chip by 180° to access this.

### Mixing mechanism

The Mitos micromixer is a static mixer (no moving parts), which at low flow rates creates lamination of the flow streams as shown in the diagram below:



The lamination of the streams reduces diffusion distances and hence improves mixing time. At high flow rates swirling occurs in the flow streams, reducing mixing time further.

### Mitos Reactor Chip Header (3000261) and other accessories

**Mitos Reactor Chip Header (3000261):** Enables the alignment and connection of all the input and output pipes to the Microreactor in seconds. The header is secured to the chip and holder by the two knurled thumb screws.

**Chip Header Seal (3000262):** Make the seal between the Microreactor and the input/output pipes held in the Mitos Chip Header. They are made of extremely chemically resistant fluoroelastomer (FFKM) and create a "zero" dead volume seal rated to 20bar (300psi).

**Chip Header Blanking Plug (3000263):** Used to seal off inputs to the chip. This enables a 3 input chip to be used with 1 or 2 inputs and a 2 input chip to be used with just 1 input. The blanking plug inserts into the Chip Header in place of an input pipe and should be used with a Chip Header Seal.



Left: Mitos Reactor Chip Header (3000261)

Top Right: Chip Header Blanking Plug (3000263)

Bottom Right: Chip Header FFKM Seals x10 (3000262)

The reactor chip may be mounted on the Mitos Volcano Heating Module (3000284) as shown below. This is shown on a hotplate with temperature probe (3000222(US)), (3000223(UK)). The operating temperature range is room temperature to +300°C.

