



# User Manual

## I. Specifications

SpinSplit Flow Chemistry Systems



## 1.Revision

Revision number	Certified by	Changes	Date
1.0	Ferenc Ender	Initial	January 2018

## 2.Scope of this Document

This document contains the technical specifications of Spinsplit Instruments.



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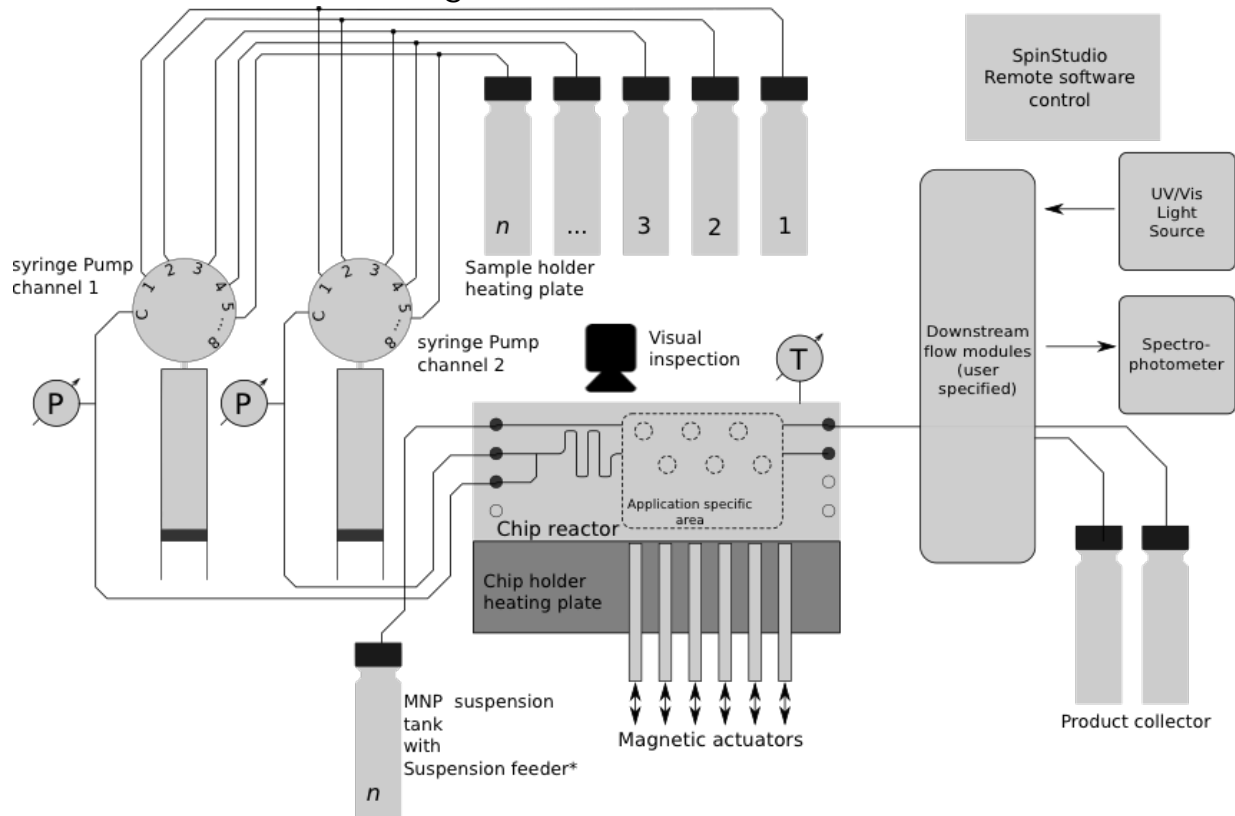
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## 3. MagneFlow Instrument

### 3.1. Overview

MagneFlow is a multifunctional reaction system for microfluidics. As main components the system consists of two syringe pumps and a chip reactor thermostat. The chip thermostat also features six magnetic reaction cell actuators.



- Each syringe pumps have a 9-way distribution valve. Through the valve sample/reagent bottles are connected to the pumps as well as the reactor chip.
- Magnetic nanoparticle (MNP) suspension is fed to the chip reactor by the suspension feeder.  
*\*The system features pneumatic feeding capability. Suspension feeding is also possible using a netPump syringe pump module. The configuration is user choice.*
- The reactor chip is housed in a thermostat chip holder. A camera provides online view of the chip during measurements.
- Magnetic reaction chambers are activated or de-activated using six independent magnetic actuators.
- User specified downstream modules can be installed in the system such as backpressure regulator, spectrophotometer etc.
- The entire system is controlled by the Spinstudio software.



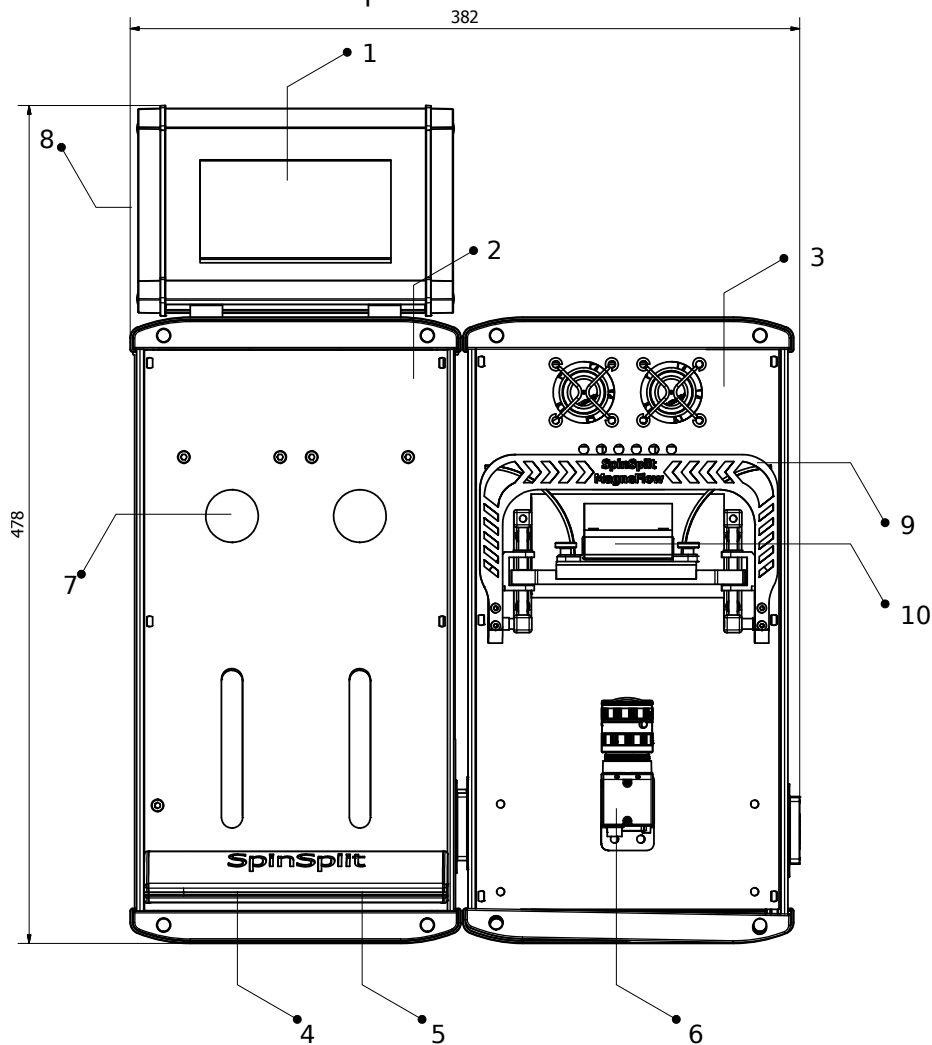
### 3.2. Modularity and Components

MagneFlow is a modular system consisting of two units:

- spFlow Dual Pump module: consisting of two absolute precision syringe pumps and the spFlow iLab automator module
- MagneFlow module: a thermostated chip reactor module with magnetic reaction cell actuators

The spFlow Dual Pump is the master module which is directly connected to the local area network (LAN). The other modules are connected to the master module through a chain link connector located on the left (uplink) and right (downlink) sides of the instrument modules.

The Instrument dimensions and components are as follows:



- 1 - spFlow iLab system automator
- 2 - spFlow Dual Pump
- 3 - spFlow MagneFlow
- 4 - Syringe Pump channel #1
- 5 - Syringe Pump channel #2
- 6 - Microreactor Chip Camera
- 7 - Syringe Pump distribution valve
- 8 - RJ45 LAN connector
- 9 - Microreactor Chip holder lever
- 10 - Microreactor chip Cassette

### 3.3. Technical specifications

#### 3.3.1. spFlow Dual Pump Module

Plunger:	stepper motor driven lead screw plunger type syringe pump
Step loss detection:	optical encoder
Distribution valve:	stepper motor driven 9-way rotary distribution valve
Position feedback:	optical encoder
Wetted materials:	Glass, PCTFE, Teflon, ceramic
Safety and regulatory:	UL recognized components

Parameter	Value			Units
	Min	Typ	Max	
No. of channels		2		-
<b>Valve</b>				
No. of ports		9		-
Fitting type	¼ - 28" tubing fittings, ¼ - 28" syringe fitting			
Switch time (adjacent ports)		250		ms
<b>Pump</b>				
Plunger travel length		60		mm
Precision		≤ 0.05 % CV <sup>1</sup>		-
Accuracy		≤ 0.5 % <sup>2</sup>		-
<b>Environmental</b>				
Operating temperature	15	25	40	°C
Operating humidity <sup>3</sup>	20	50	80	% RH

<sup>1</sup> at full stroke (500 µl syringe and above), (DI water at room temperature)

<sup>2</sup> at full stroke (DI water at room temperature)

<sup>3</sup> at 40 °C



### Available flow rates

Syringe volume		Flow rate		Units
		Min	Max	
50	μl	0.3125	3000	μl min <sup>-1</sup>
100		0.6250	6000	
250		1.5625	15000	
500		3.1250	30000	
1	ml	0.0063	60	ml min <sup>-1</sup>
2.5		0.0156	150	
5		0.0313	300	
10		0.0625	600	
25		0.1563	1500	

### 3.3.2. spFlow MagneChip Module

Chip holder	Thermostable 8 port 1/16" OD microfluidic chip holder
Microreactor chip	COC, glass or PDMS chip with internal dean type mixer and 6 magnetic nanoparticle packed bed reaction chambers
Chip interface	4 port, wetted material: FFKM
Thermostat module	Thermoelectric heat pump module with support fans
Thermostat control	Temperature feedback (PT1000) PID control

Parameter	Value			Units
	Min	Typ	Max	
Temperature stability <sup>1</sup>		±0.05		°C
Maximum heat pumping power at room temp.		100		W
Temperature range	0		100	°C
<b>Chip holder (wetted mat.: PTFE, perfluoroelastomer, PEEK, stainless steel) and Microreactor chip (wetted mat.: Glass, PDMS, COC)</b>				
Chip holder thermal resistance	0.08			K/W
Chip operating pressure	0	1	2.5	Bar
Chip slide size		75x25		mm

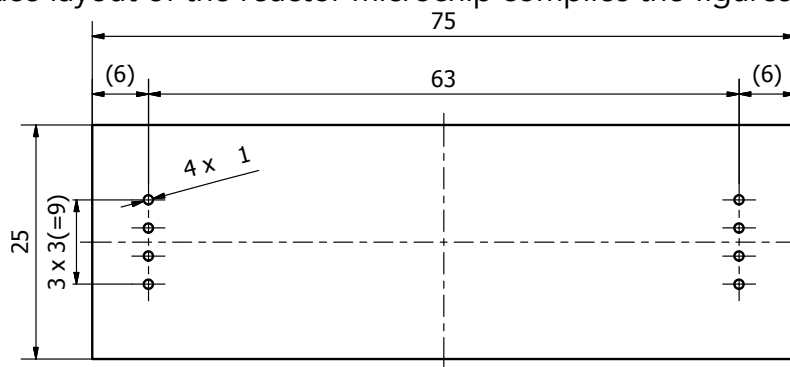


No. of reaction chambers		6		
Solid phase mass	180		250	$\mu\text{g}/\mu\text{L}$
Volume of reaction chambers			1	$\mu\text{L}$
Repeatability for the reactor fill up with MNPs	95% <sup>2</sup>			
No. of input channels on chip interface		8		

<sup>1</sup> between  $-20^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$

<sup>2</sup> particle diameter 250 nm

The port interface layout of the reactor microchip complies the figures below:





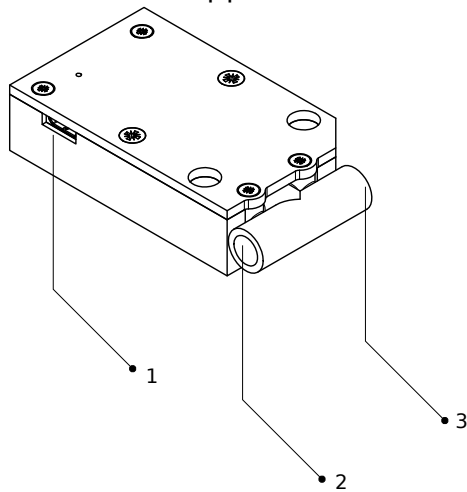
## External input and output modules

Parameter	Value			Units
	Min	Typ	Max	
<b>Analog Input Interface (Connector type: coax)</b>				
Number of differential input channels	-	2	-	
Number of asymmetrical input channels		2		
Input impedance (Each channel)	-	50	-	Ohm
Resolution (each channels)		14		bit
Time resolution		48		kSps
Internal gain	1		20	V/V
Voltage range	0	-	10	V
<b>Analog Output Interface (Connector type: header)</b>				
Number of channels	-	2	-	
Resolution (each channels)		11		bit
Maximal current draw from the channels	-	-	10	mA
Voltage range	0	-	10	V
<b>Switched Outputs (Connector type: header)</b>				
Number of channels	-	6	-	
Output voltage	11.9	12	12.1	V
<b>5 VDC power outputs</b>				
Nominal output voltage	-	5	-	V
Cumulated current draw for all power channels (incl. switched outputs)	-	-	1	A



### 3.4. Pressure sensor module

Pressure sensor module is connected directly to MagneFlow system by external connectors supplied for the sensor.



- 1 - microUSB connector \*
- 2 - Fluid Input port
- 3 - Fluid Output port

\* The unit won't work if connected to a regular USB port on a personal computer. Use only with spFlow systems.

Parameter	Value			Units
	Min	Typ	Max	
<b>Fluid interface – ¼ - 28" tubing fittings</b>				
Number of ports		2		-
Pressure range	20	-	250	kPa
Operating voltage	4.8	5	5.1	V
Output impedance		50		Ohm

### 3.5. Suspension feeder module

Installing the suspension feeder module is optional. For using this feature, one should install a pressure sensor and a pressure valve (supplied as option).

Parameter	Value			Units
	Min	Typ	Max	
<b>Suspension feeder</b>				
Suspension volume		2		mL
Operating pressure	180	200	220	mbar



### 3.6. Connection module for external units

MagneFlow is capable of controlling external instruments via RS232 and SPI interfaces.

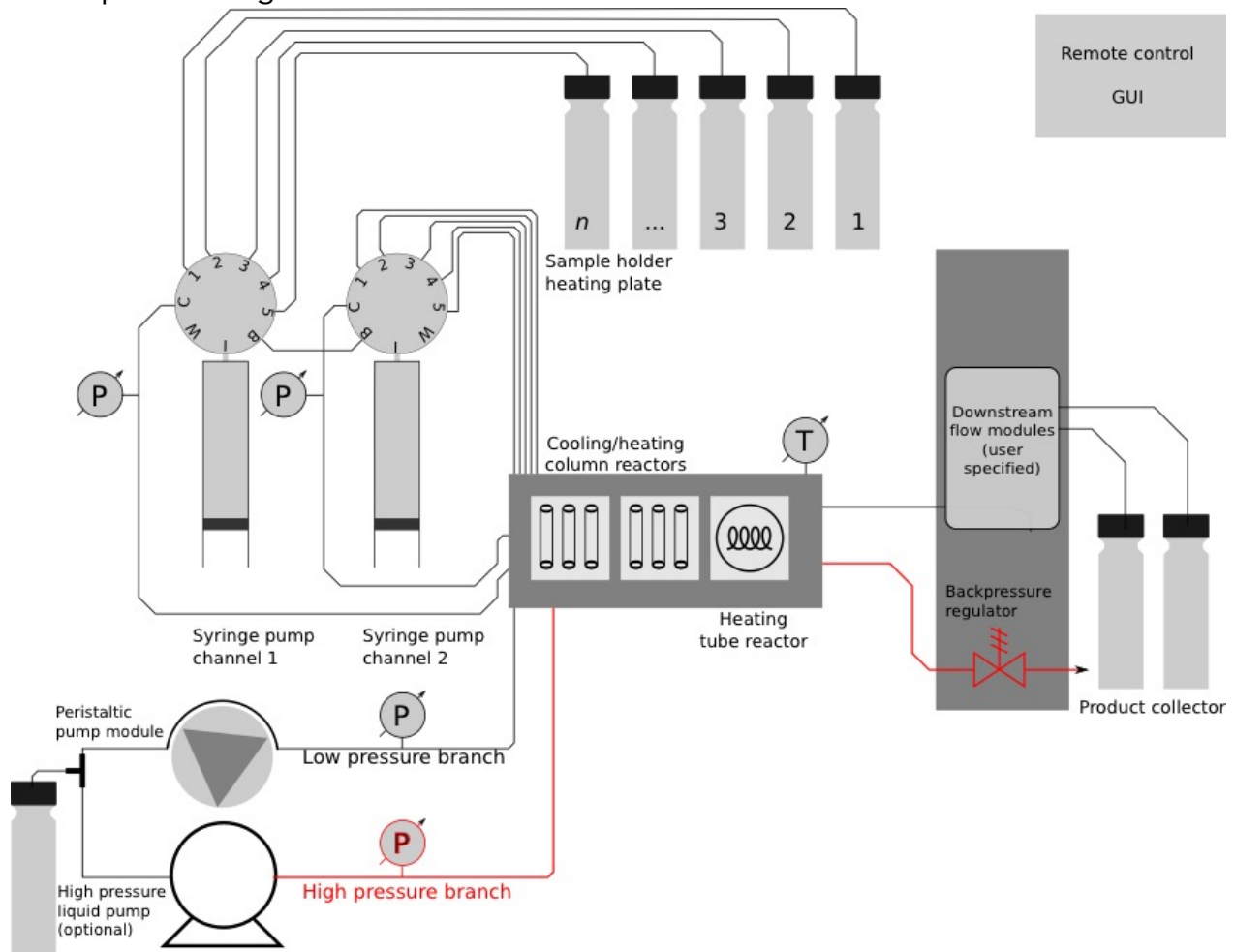
Parameter	Value			Units
	Min	Typ	Max	
<b>RS-232 interface with hardware flow control</b>				
Bitrate	400		9600	baud
<b>SPI interface</b>				



## 4. ChemFlow Instrument

### 4.1. Overview

ChemFlow is a multifunctional reaction system for flow chemistry. As main components the system consists of two syringe pumps, a peristaltic pump, a reactor thermostat and a backpressure regulator.



- Each syringe pumps have a 9 way distribution valve. Through the valve sample/reagent bottles are connected to the pumps as well as the reactors. Reactors can be operated also by the 3 channel peristaltic pump module.
- The reactor unit can be either equipped with a column reactor holder or tube reactor.
- Backpressure regulator module automatically controls the upstream pressure of the reactors.
- User specified downstream modules can be installed in the system
- The entire system is controlled by the Spinstudio software.



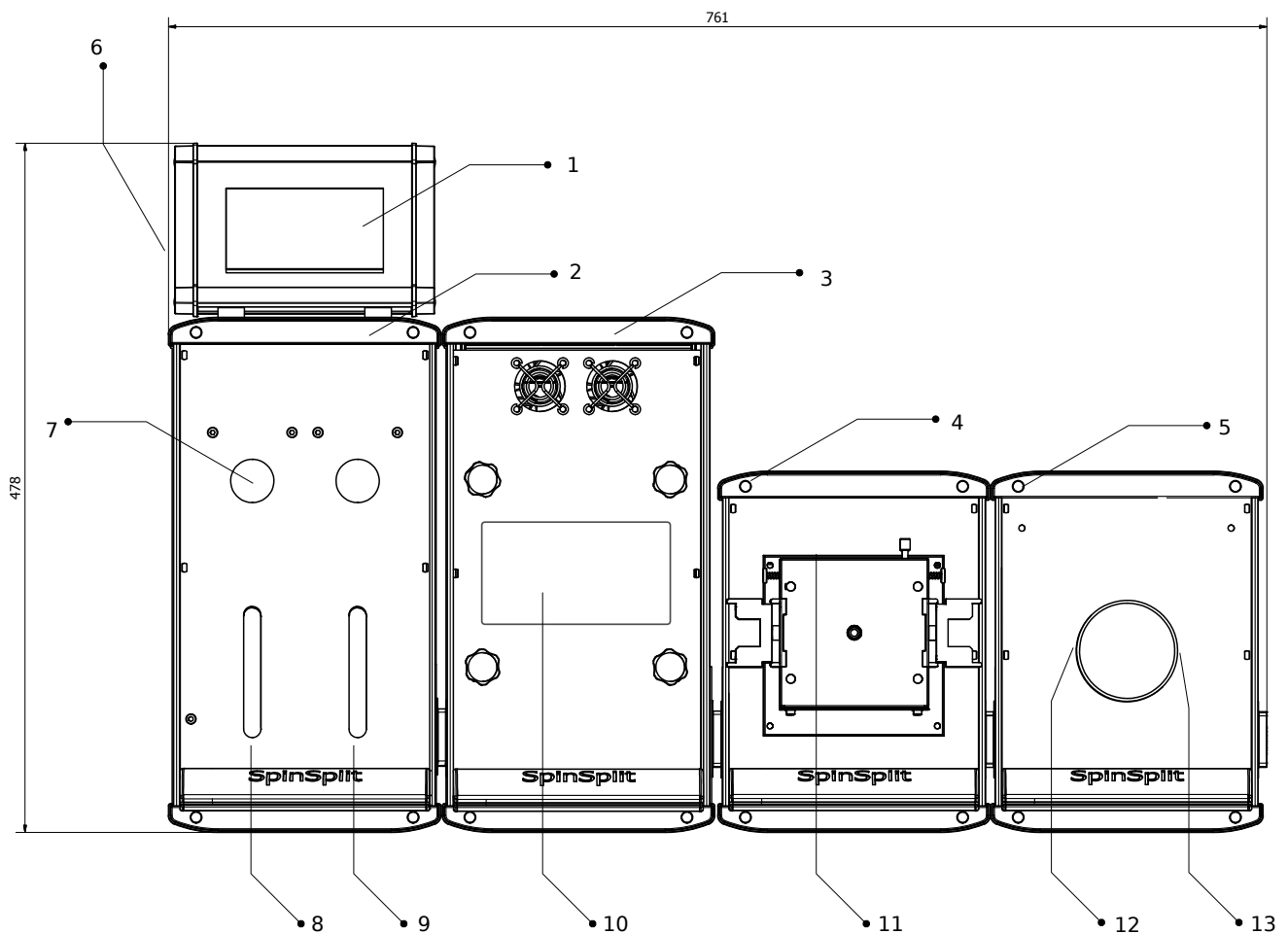
## 4.2. Modularity and Components

ChemFlow is a modular system consisting of four units:

- spFlow Dual Pump module: consisting of two absolute precision syringe pumps and the spFlow iLab automator module
- spFlow Chem module: a thermostat reactor module, capable of hosting tube or column reactors
- spFlow P module: a three channel peristaltic pump
- spFlow BPR module: a back-pressure regulator module

The spFlow Dual Pump is the master module which is directly connected to the local area network (LAN). The other modules are connected to the master module through a chain link connector located on the left (uplink) and right (downlink) sides of the instrument modules.

The Instrument dimensions and components are as follows:



- 1 - spFlow iLab system automator
- 2 - spFlow Dual Pump
- 3 - spFlow Chem
- 4 - spFlow P
- 5 - spFlow BPR
- 6 - RJ45 LAN connector
- 7 - Syringe pump distribution valve
- 8 - Syringe Pump channel #1
- 9 - Syringe Pump channel #2
- 10 - Heat spreader plate
- 11 - Tube holder assembly
- 12 - BPR Fluid Input port
- 13 - BPR Fluid Output port

### 4.3. Technical specifications

#### 4.3.1. spFlow Dual Pump Module

Plunger: stepper motor driven lead screw plunger type syringe pump  
 Step loss detection: optical encoder  
 Distribution valve: stepper motor driven 9-way rotary distribution valve  
 Position feedback: optical encoder  
 Wetted materials: Glass, PCTFE, Teflon, ceramic  
 Safety and regulatory: UL recognized components

Parameter	Value			Units
	Min	Typ	Max	
No. of channels		2		-
<b>Valve</b>				
No. of ports		9		-
Fitting type	¼ - 28" tubing fittings, ¼ - 28" syringe fitting			
Switch time (adjacent ports)		250		ms
<b>Pump</b>				
Plunger travel length		60		mm
Precision		≤ 0.05 % CV <sup>1</sup>		-
Accuracy		≤ 0.5 % <sup>2</sup>		-
<b>Environmental</b>				
Operating temperature	15	25	40	°C



Operating humidity <sup>3</sup>	20	50	80	% RH
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<sup>1</sup> at full stroke (500 µl syringe and above), (DI water at room temperature)

<sup>2</sup> at full stroke (DI water at room temperature)

<sup>3</sup> at 40 °C

#### 4.3.2. Available flow rates

Syringe volume		Flow rate		Units
		Min	Max	
50	µl	0.3125	3000	µl min <sup>-1</sup>
100		0.6250	6000	
250		1.5625	15000	
500		3.1250	30000	
1	ml	0.0063	60	ml min <sup>-1</sup>
2.5		0.0156	150	
5		0.0313	300	
10		0.0625	600	
25		0.1563	1500	

#### 4.3.3. spFlow Chem Thermostat Module

##### Thermostat with Tube reactor

Tube reactor      Coiled tubular reactor 120 mm internal diameter (PFA, copper or 316 Stainless Steel)

Parameter	Value			Units
	Min	Typ	Max	
Internal volume	5		15	mL
<b>Tube reactor holder</b>				
Temperature stability <sup>1</sup>		±0.1		°C
Maximum heat pumping power at room temp.		100		W
Cooling temperature <sup>2</sup>	5	10	25	Δ°C
Heating temperature	15	30	75	Δ°C

<sup>1</sup> between -20°C to +50°C

<sup>2</sup> Application dependent. For maximum cooling efficiency air still condensation free environment is required



## Thermostat with column reactor

Column                   Stainless steel reactor column  
 Column holder       Stainless steel thermostated holder

Parameter	Value			Units
	Min	Typ	Max	
Column length		70		mm
Outer diameter		5		mm
Volume		0.816		mL
<b>Column holder</b>				
Number of column holders		1 (per system)		
Column capacity/holder		3		
Temperature stability <sup>1</sup>		±0.1		°C
Maximum heat pumping power at room temp.		100		W
Cooling temperature <sup>2</sup>	10	15	25	Δ°C
Heating temperature	25	45	75	Δ°C

<sup>1</sup> between -20°C to+50°C

<sup>1</sup> Application dependent. For maximum cooling efficiency air still condensation free environment is required





#### 4.3.4. spFlow P Peristaltic Pump Module

Pump head	Manifold tubing pump with individual spring loaded tracks
Drive	Coreless DC motor, variable speed
Front cover	Polycarbonate
Rotor	Anodized aluminum
Rollers	Ertalyte
Tracks	Anodized aluminum
Springs and screws	Stainless steel

Parameter	Value			Units
	Min	Typ	Max	
Nominal rotor speed		60		RPM
No. of channels		3		
Number of rollers		15		
Min flow rate @ tubing bore=0.13 mm			0.00015	ml/min
Max flow rate @ tubing bore=3.2 mm			50	ml/min



#### 4.3.5. spFlow BPR Backpressure Regulator Module

Diaphragm type backpressure regulator (interchangeable) operated by high pressure electronic pressure regulator.

Parameter	Value			Units
	Min	Typ	Max	
<b>Electronic pressure regulator unit</b>				
Pressure range	0		10.34	Bar
Filtration on inlet recommended		20		Micron
Linearity/hysteresis		< ±0.15% FS		
Repeatability		< ±0.02% FS		
Accuracy		< ±0.2% FS		
Resolution		< ±0.02% FS		
Operating temperature		0-70		°C
<b>BPR unit</b> – Stainless Steel 316/316L, O ring: 031 Kalrez Grade 7075, diaphragm: PTFE glass laminate (PGL10.3)				
Maximum pressure			13.79	Bar
Flow coefficient	1E-8	-	0.07	
Temperature range	0	-	100	°C
<b>Ports</b>				
Gas Inlet	1/8" NPT female			
Gas Outlet	1/8" NPT female			
Fluid Inlet	1/4" NPT female			
Fluid Outlet	1/4" NPT female			



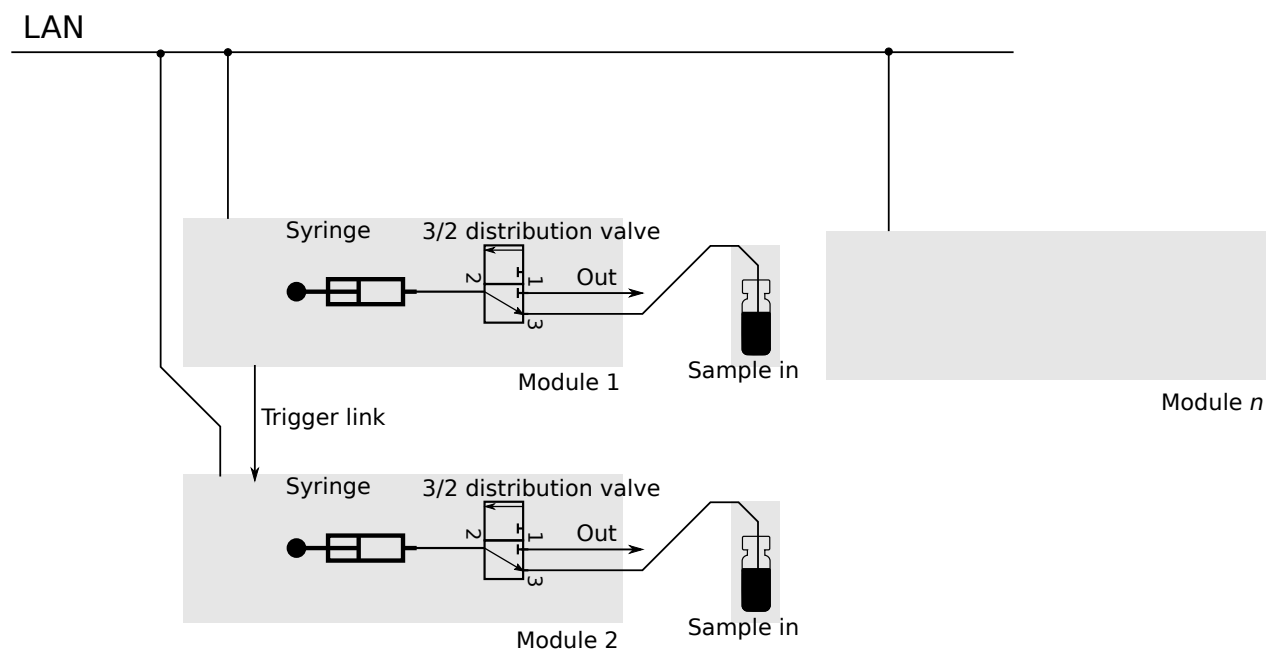
## 5.netPump Instrument

### 5.1. Overview

The modules consist of the following parts

- Linear syringe pump with universal clamp for disposable syringes
- 3 way 2 state distribution valve

The module can be controlled remotely via TCP/IP connection. Two or more modules can be connected through a chain link which enables synchronized operations for the pumps, for instance synchronous dispensing.



### 5.2. Modularity

The auxiliary modules can be operated as standalone units. However, two or more units can be connected through a chain link for triggered operations.



### 5.3. Technical specification

Plunger:	stepper motor driven lead screw plunger type syringe pump
Step loss detection:	optical encoder
Distribution valve:	solenoid driven 3/2 way valve
Position feedback:	optical encoder
Wetted materials:	disposable syringe, PEEK and FFPM (valve)
Compliance	CE, ETL, UL, CSA, RoHS, FCC, IC

Parameter	Value			Units
	Min	Typ	Max	
No. of channels		1		-
<b>Valve</b>				
No. of ports		3		-
Fitting type	¼ - 28" tubing fittings, ¼ - 28" syringe fitting			
Switch time (adjacent ports)			10	ms
Internal volume		0.48		mL
<b>Pump</b>				
Plunger travel length			200	mm
Linear force	25			lbs
Precision		≤ 0.1 % CV		-
Accuracy		≤ 1 %		-
Abs. min. flow rate <sup>1,3</sup>	0.001			µL/hour
Abs. max. flow rate <sup>2,3</sup>			90	mL/min
<b>Environmental</b>				
Operating temperature	4	25	40	°C
Operating humidity	20	50	80	% RH

<sup>1</sup> with 10 µL syringe

<sup>2</sup> with 60 mL syringe

<sup>3</sup> the minimum syringe size is 10 µL, the maximum syringe size is 60 ml



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