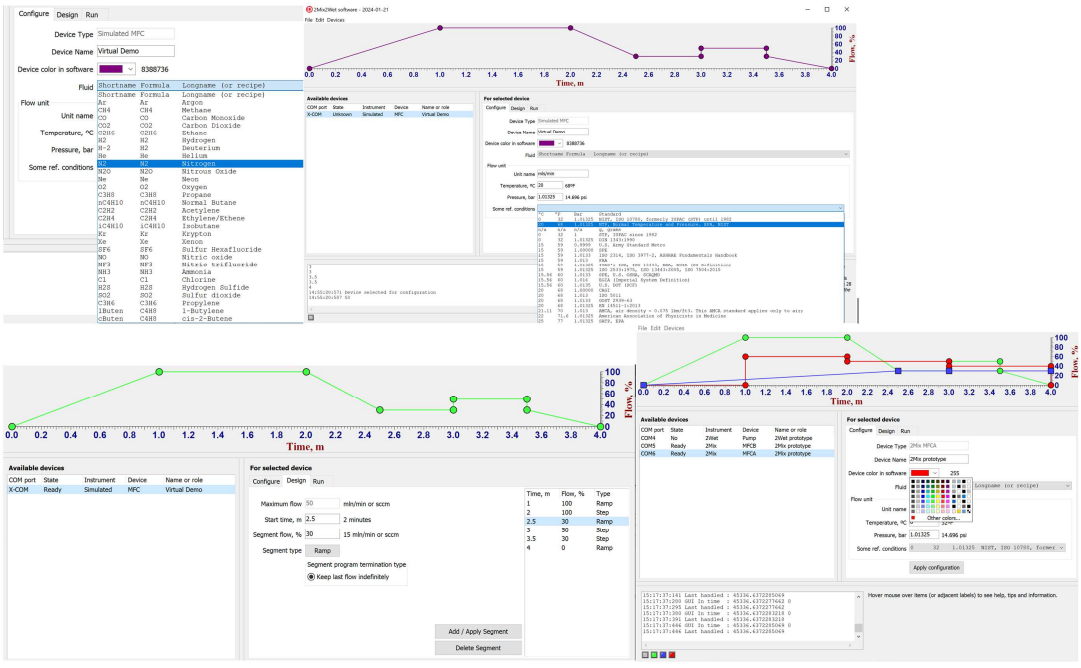
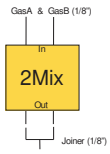
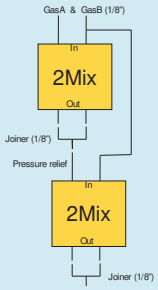
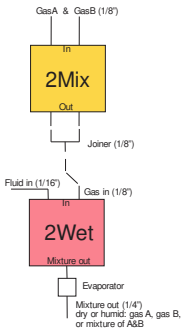
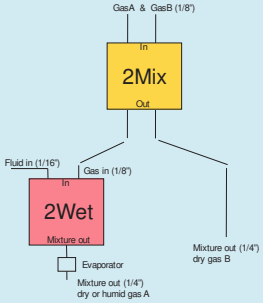
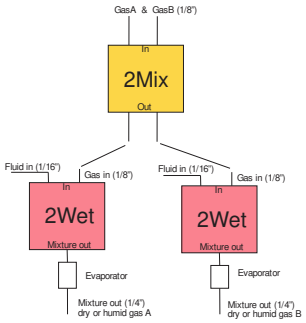
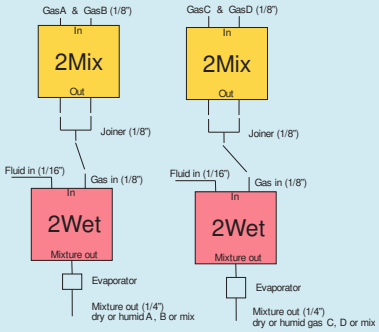
Modular gas mixing and humidification system 2Mix

2Mix	2Wet	2Mix software
Measure or Control flows of two gases separately, or mix them together Defaults: - Gas A: 0.005 – 50 mln/min - Gas B: 0.05 – 500 mln/min Flow range for both MFCs adjustable at time of order up to 20 ln/min - Any non-corrosive gas or gas mixture - Max pressure 10 bar A - Size: 11 x 20 x 22 cm, 3kg Options (surcharge): - Corrosive gases - High flows, 5000 l/min - High pressure, 20 bar - Ultra high pressure, 250 bar - Custom builds with more MFCs	Add low viscosity fluid (like distilled H2O) to passing gas stream and evaporate the fluid. Added amount is adjustable and software will show RH% and partial pressure of fluid components. Defaults: - 0 to 100% absolute humidity - 0 to 100% relative humidity RH - Evaporator 150°C - Heating power 250W - 0 to 3g H_2O/min @ ATM - Size: 16 x 22 x 27 cm, 5kg - Evaporator 1.2 m, bend radius 30 cm - Max pressure: 5 Bar A Options (surcharge): - Heating power up to 5 kW - Higher fluid throughput - Custom static evaporator shapes - Larger syringe sizes up to 60 g H_2O / min - Higher temperature evaporator	Control any amount of 2Mix and 2Wet devices from single MFC to dozens of MFCs, 2Mix and 2Wet devices. Defaults: - Manually specify device flow - Segment program with steps and ramps for any and all connected devices - Partial pressure calculations - Plot flows and mixtures on screen - Save flows and mixtures on file Options (surcharge): - High temperature equilibrium calculations - Dynamic input gas for 2Mix (allows mixture re-dilution by using 2x 2Mix in chain) - User defined custom input fluids - PLC integration (report flows via RS485/Modbus/ASCII, cut power relay)

At the simplest, the 2Mix software is an easy way to control individual mass flow controller or many mass flow controllers with simple dial, and plot the flow, and record the flow as function of time to a file. The software allows user to view flows (per minute) in their preferred unit; % of full flow, grams, or standard volumetric units mln, mls, sccm, or custom volumetric units with user defined reference conditions (temperature and pressure). For the reference conditions the software uses °Celsius and Bar A, but accommodates also for users of °Fahrenheit and PSI.



Name	Schematics	Use case	Notes
-Flow control -Flow measurement -Fuel cell without humidification		Control flow of each Gas A and Gas B individually. A & B can always be pure species or premade mixtures.	Constant flow, ramps, steps
A+B mixture		Create dynamic large range mixtures of Gas A and Gas B	Software reports partial pressures of all components at any given time
Re-dilution (A+B) + B		Take some of A+B mixture and re-dilute with large amounts of gas B for ppb levels of A in B	
Humidification pH2O of gas or gas mixture **Evaporate custom fluids in gas or gas mixture**		From bottle dry gas A, gas B, mixture of A+B to pure steam or any combination	
One sided humidification		Gas A and Gas B can be premade mixtures from bottle or from another mixer.	
Double sided humidification			
Full control of two mixtures			

2Wet throughput syringe and heating power

Syringe size µL	Resolution nL	[1]Max dispense mL/min	[2]Max power needed W	[3]Max steam volume L/min
12.5[4]	0.5	0.31	16	0.6
25	1	0.63	31	1.2
50	2	1.25	63	2.4
100	4	2.50	125	4.8
125	5	3.13	156	6
250	10	6.25	313	12
500	21	12.50	625	24
1000	42	25.00	1.25 k	48
1250	52	31.25	1.56 k	60
2500	104	62.50	3.13 k	120
5000[5]	208	125.00	6.25 k	240
12500[6]	521	312.50	15.63 k	601

[1] It is advised not to run the syringe at these maximum speeds in order to optimize for syringe lifetime. It is better to select a larger syringe and run for example at 20% of maximum speed.
[2] Energy needed per second to heat, evaporate and again heat the max flow as H_2O, from 20°C to 150°C at 1.01325 bar pressure. Some additional power is required to heat the gas flow, and to maintain evaporator temperature against heat loss through insulation. Default heating power is ~250 W.
[3] Max fluid dispense as water vapour/steam at 150°C at 1.01325 bar pressure.
[4] Default syringe size is 12.5 µL unless otherwise specified on order. Smallest syringe has least uncertainty as accuracy is calculated from full dispense volume. For syringe and syringe pump lifetime select large syringe as it requires fewer repetitions to dispense same amount.
[5] Custom fluid tubing required.
[6] Custom fluid tubing required.