Gas Mixing Unit

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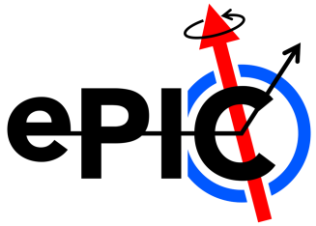
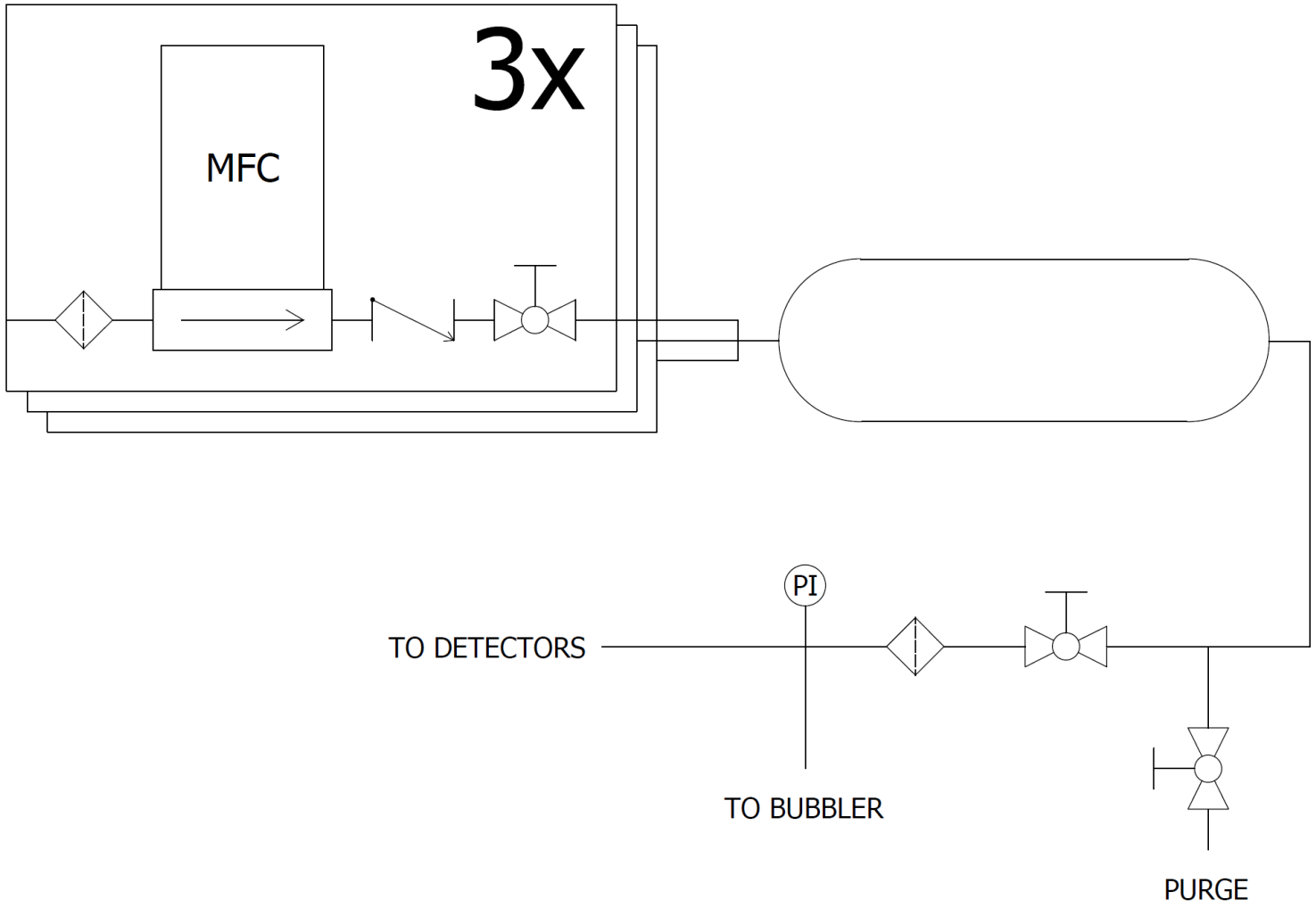
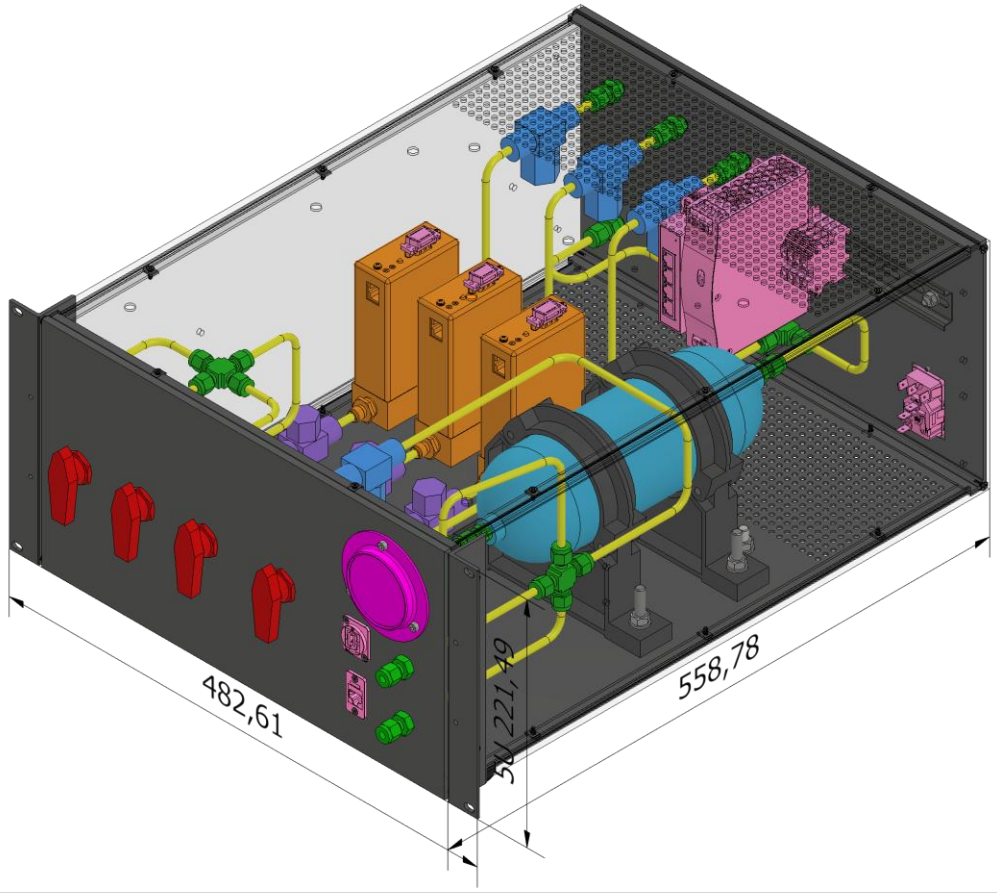
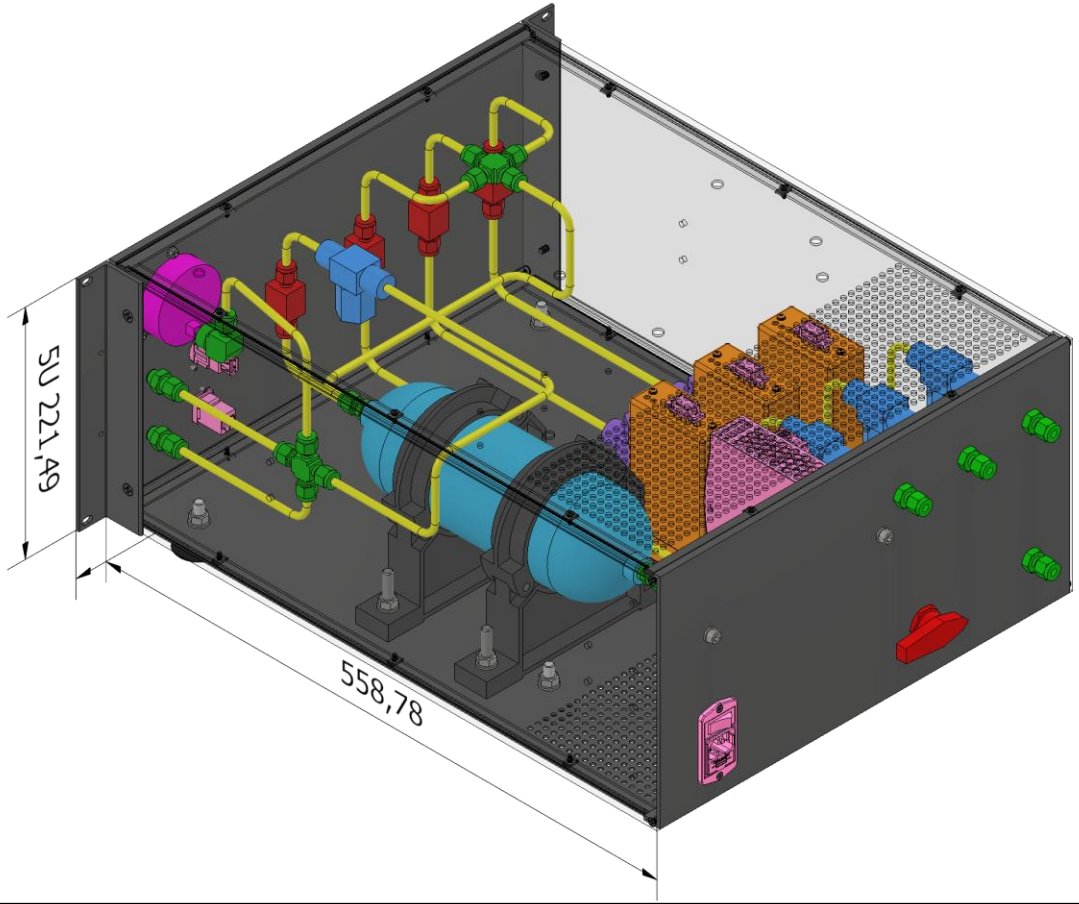


Simplified P&ID Diagram



Implementation





Color Legend								
Mass flow controllers	Filters	Check valves	Control valves	Pipes	Fittings	Mixing volume	Pressure gauge	Electrical	Mechanics

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Expected Performance

Gas	FS (sccm)	Min Flow (sccm)	FS (l/h)	Min Flow (l/h)
Ar	1000	20	60	1.2
CO2	50	1	3	0.06
iC4H10	50	1	3	0.06
CF4 from iC4H10	86.8	1.7	5.2	0.1

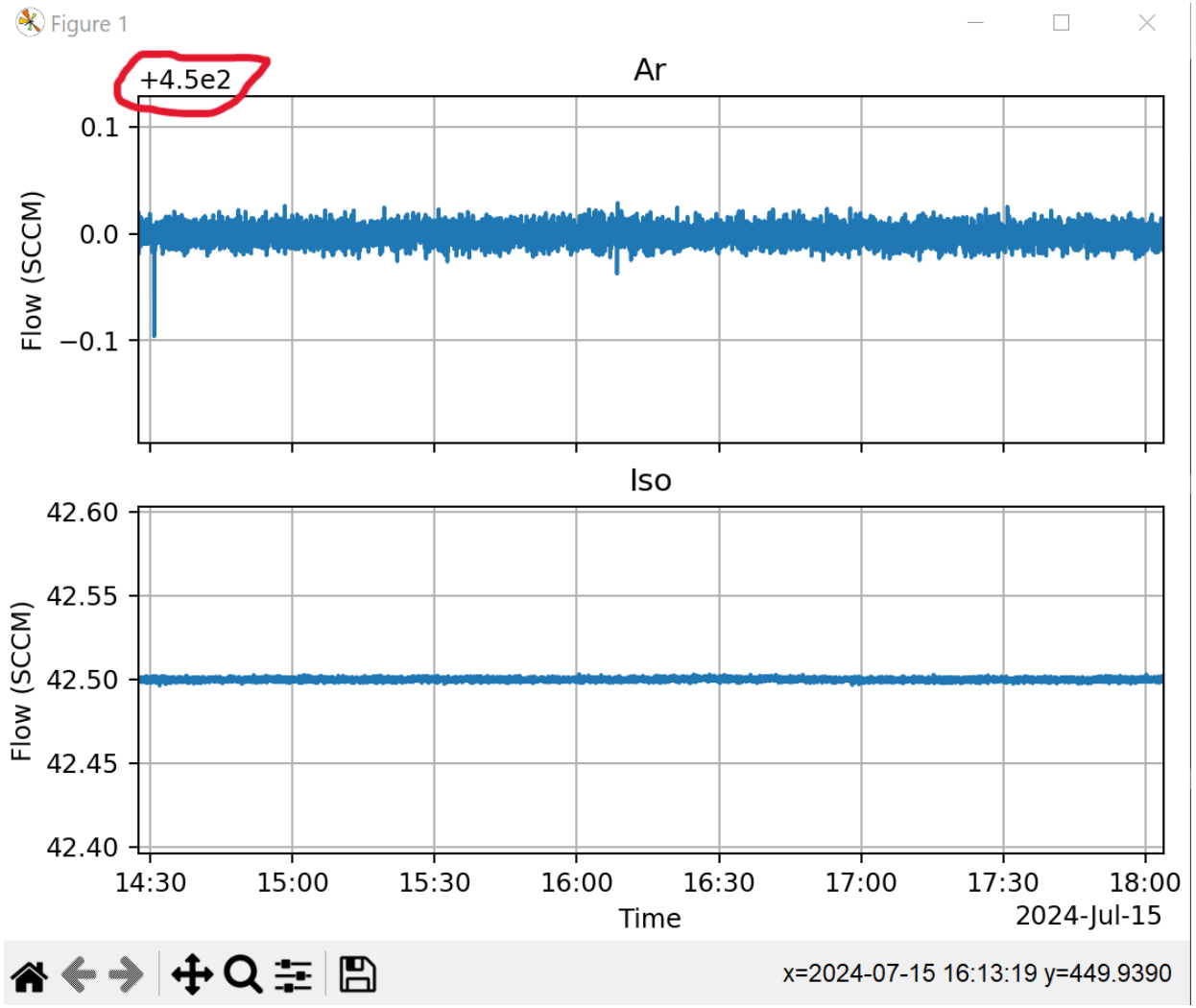
Interface	RS485 via USB / TCP-IP via RJ45
Power supply	220 V AC via IEC C14
Power consumption	< 20 W
Piping	Swagelok 6 mm all connections

Mixture	Ar	CO2	iC4H10	CF4	Max Flow (sccm)	Max Flow (l/h)	Limiting Gas	Min Flow (sccm)	Min Flow (l/h)	Limiting Gas
Ar:CO2	70%	30%			167	10.0	CO2	28.6	1.7	Ar
Ar:CO2	80%	20%			250	15.0	CO2	25.0	1.5	Ar
Ar:iC4H10	90%		10%		500	30.0	iC4H10	22.2	1.3	Ar
Ar:CO2:CF4	45%	15%		40%	217	13.0	CF4	44.4	2.7	Ar
Ar:CO2:iC4H10	93%	2%	5%		1000	60.0	iC4H10	50.0	3.0	CO2
Ar:CO2:iC4H10	93%	5%	2%		1000	60.0	CO2	50.0	3.0	iC4H10

From the instruments' datasheet:

Typical Accuracy	±1% of set point for 20 to 100% Full Scale, ± 0.2% of Full Scale for 2 to 20% Full Scale
Repeatability	± 0.3% of Reading
Resolution	0.1% of Full Scale

Typical Fluctuations in GM50A MKS MFCs



Example from BESIII CGEM-IT Gas System

Running with:
Ar:iC_4H_{10} (91.5:8.5)

Absolute Vs “Master-Slave” Approach

Premise

Typical fluctuations are of 2 kinds:

- Environmental (relatively high amplitude but slow, tackled internally by MFC via gas-dependent corrections)
- Electrical noise (very low amplitude but fast, ground dependent)

Atypical fluctuations can be fast and high amplitude, they usually can be traced back to external causes

Absolute Setting

All setpoints for MFC-1, MFC-2, and MFC-3 are set independently

Error on Flow-1 depends on MFC-1 reading

Error on Flow-2 depends on MFC-2 reading

Error on Flow-3 depends on MFC-3 reading

Master Slave Setting

Setpoints of MFC-2 and MFC-3 are set according to reading on MFC-1

Error on Flow-1 depends on MFC-1 reading

Error on Flow-2 depends on error on Flow-1 and on MFC-2 reading

Error on Flow-3 depends on error on Flow-1 and on MFC-3 reading

Final Remarks

- Possibility to mix any three gases and/or mixtures
- Min/max deliverable flow varies for different mixtures
- Single delivery outlet, no internal distribution manifolds are foreseen
- External distribution can be arranged but requires additional flow regulators
- **Completion depends strongly on the components' leading times, readiness for July is NOT guaranteed**