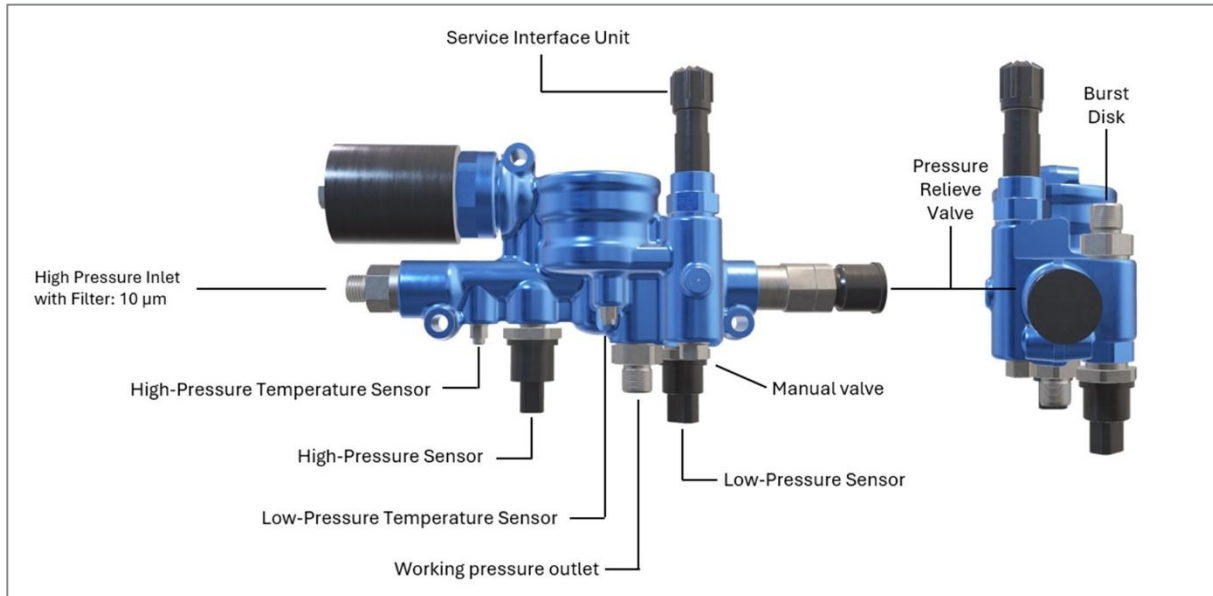




TOPAQ High Pressure Regulation Unit (HPRU) Assembly B2¹⁾

1) Item number depending on configuration. Further information on request.

Product specification



The **H**igh **P**ressure **R**egulation **U**nit (HPRU) is used to ensure safe and robust hydrogen feed to the working pressure line of stationary and mobile deployed CGH2 applications (e.g. fuel cells or internal combustion engines (PFI and DI)).

Designed for CGH2 applications with system pressures of 350 and 700 bar, its active pressure control enables the free adjustment of the outlet pressure during operation in a pressure range of 0 – 75 bar.

The outlet pressure is changed via the system's **E**lectronic **C**ontrol **U**nit (ECU) and can be implemented without any mechanical changes to the pressure regulator, thus realizing a load-dependent outlet pressure.

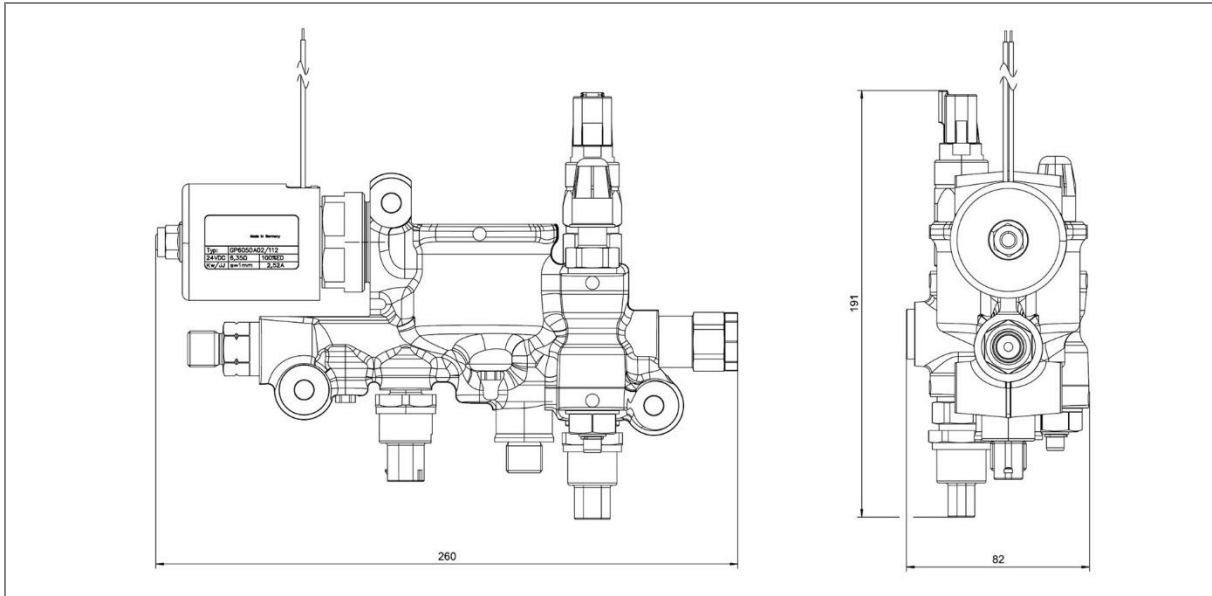
The active pressure control enables inlet pressure fluctuations and dynamic load fluctuations of the consumer under varying temperatures to be compensated and a very high control quality to be maintained, while simultaneously providing the possibility to regulate the system in advance for faster response times.

With its optimized modular design, it enables the compliance of individual customer requirements with the possibility to use different sensor options, optimized regarding pressure range and signal processing.

For installing the HPRU, only an installation space of approx. 260 mm × 191 mm × 82 mm is required. Inlet and outlet are designed for typical tube geometries of 6 mm / ¼" and 10 – 12mm / ½" made of 316L or PPH2.²⁾

2) PPH2 is a protected designation of the Poppe + Potthoff Präzisionsstahlrohre GmbH.

Technical features



Technical data | Operating conditions

General information

Design	One-stage main piston with electronically controlled proportional valve (PPV; normally closed, NC)	
Height HPRU (incl. optional attachment parts)		approx. 191 mm
Length HPRU		approx. 260 mm
Width HPRU		approx. 82 mm
Weight HPRU (incl. optional attachment parts)		approx. 3200 g
Material	Aluminum body (6061-T6), stainless steel (316L) or PPH2 ports	
Sealing type	Metal-to-metal, Polymer, O-ring	

Functional parameters

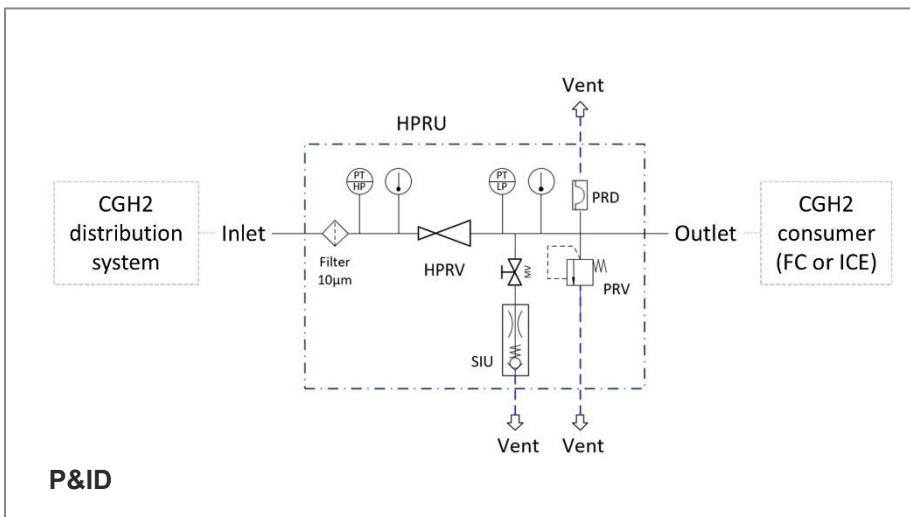
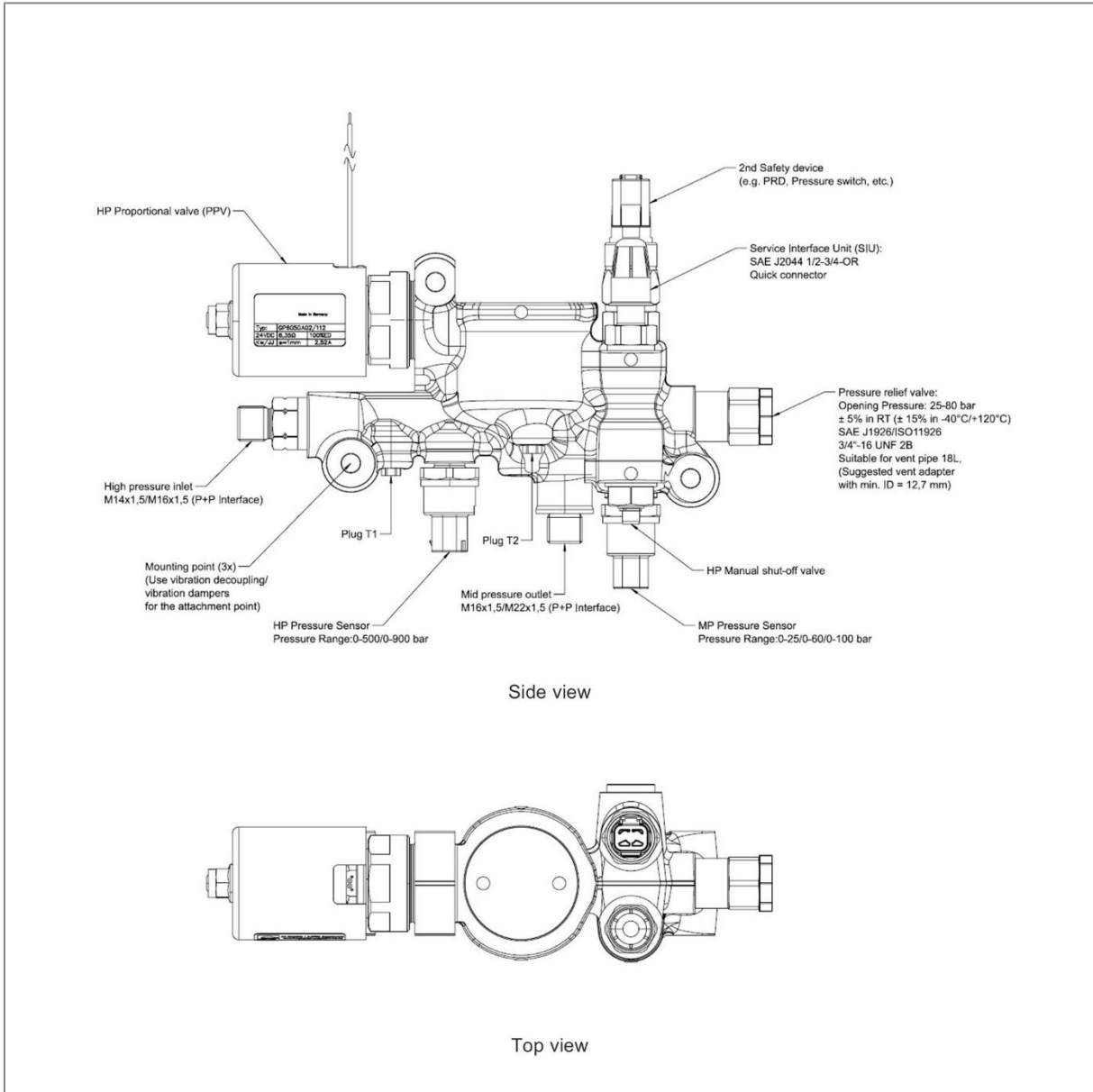
Ambient temperature		-40 to +120 °C
Gas temperature		-40 to +85 °C
Burst pressure (high pressure side)		> 1750 bar
Burst pressure (mid pressure side)		> 700 bar
Operating inlet pressure		> 20 – 875 bar
Outlet pressure	0 – 75 bar (free adjustable via ECU; with integrated PRV: 25 – 60 bar)	
Output accuracy static		< 2%
Output accuracy dynamic		<< 5%
Mass flow		Outlet pressure dependent
Medium		Hydrogen (CGH2)
Safety concept	Normally closed PPV, PRV and PRD HPRU closes with media flow (spring-loaded), opens only with power supply / PWM control	

The actual product may differ from the illustrations shown. Subject to change without notice. All rights reserved.
PD-0021 | Version 004 | 28.08.2025

Technical features

Technical data Operating conditions	
Interfaces Thread definitions	
Inlet port thread	UNF & metric (acc. customer spec.)
Inlet port	6 mm / ¼" or 10 – 12 mm / ½"
Outlet port thread	UNF & metric (acc. customer spec.)
Outlet port	10 – 12 mm / ½"
Outlet port PRV	¾"-16 UNF (SAE J1926)
Outlet port SIU	½" (SAE J2044)
Inlet (High pressure side)	
Pressure sensor (HP)	max. 900 bar
Filter pore size	10 µm
Temperature sensor (optional)	-60 to +150 °C
Outlet (Mid pressure side)	
Pressure sensor (MP)	max. 30 bar / 60 bar / 100 bar
Temperature sensor (optional)	-60 to +150 °C
Pressure Relief Valve (PRV)	acc. customer spec.; for 18L line with SAE J1926 ¾"-16 UNF 18L adapter
Rupture disc Pressure Release Device (PRD, optional)	50 or 100 bar (acc. customer spec.; for 18L line with SAE J1926 ¾"-16 UNF 18L adapter)
Service Interface Unit (SIU, optional)	½" (SAE J2044); for purging of entire system
Manual valve (optional)	shut-off function for SIU interface
Electrical control	
Type of control Signal sources	High pressure sensor (HP) / Mid pressure sensor (MP)
Signal type	PWM 100 – 600 Hz (≤ 200 Hz preferred)
Supply voltage	24 V (max. 1.65 A) 12 V (max. 3 A) development on request
Electronic Control Unit (ECU)	required to operate the HPRU (not included)
Electrical connection PPV	2x free cable ends → electrical plug acc. customer spec. (e.g. MQS, Deutsch-DT 2P)
Electrical connection Pressure sensor (HP)	(MQS-Plug Code A TE), AMP Part No.: 1-967642-1 / 3POS MQS REC SEALED COD A
Electrical connection Pressure sensor (MP, 30 bar)	(MQS-Plug Code B TE), AMP Part No.: 2-967642-1 / 3POS MQS REC SEALED COD B
Electrical connection Pressure sensor (MP, 60 & 100 bar)	(AMP SUPERSEAL 1.5 SERIES 3P PL), AMP Part No.: 282087-2 / SUPERSEAL 1.5 SERIES 3P

Technical features | Circuit diagram (P&ID)



P&ID

HPRU configurations

Available configurations

Variant	Temperature sensor 1 ³⁾	Temperature sensor 2 ³⁾	PRV ⁴⁾	PRD ⁴⁾	SIU connector ⁵⁾	Manual valve ⁵⁾
I	-	-	x	x	x	x
II	-	-	x	-	x	x
III	-	-	x	x	-	-
IV	-	-	x	-	-	-

3) Temperature sensor for B2 samples not available yet. Interfaces plugged.

4) PRV and PRD are safety-related functions. These may only be omitted if the hydrogen supply system is secured by other sufficient safety features (system safety analysis is mandatory and subject to the customer).

5) Manual valve only available in combination with SIU.

x = included, - = not included.

Safety information

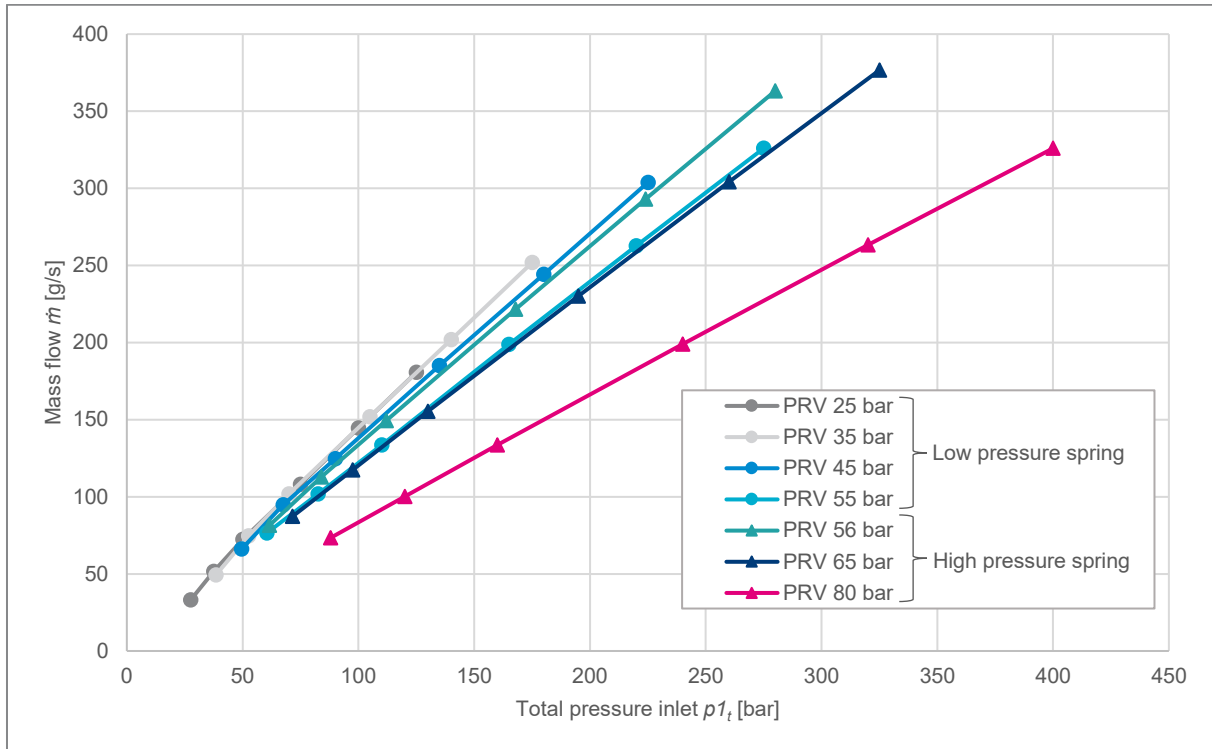
Regarding the configuration of the safety features in HPRU the following recommendations should be considered:

- According to safety analysis the HPRU (only equipped with a PRV) is not sufficient to protect the entire mid-pressure side of the hydrogen supply system from total failure. Depending on the system configuration, appropriate additional safety features must be considered in the hydrogen supply system. System safety analysis is mandatory and subject to the customer
- Suitable vent line must be connected to PRV and PRD (Rupture disc) during operation to ensure safe discharge of the H2 without building back pressure
- **HPRU Outlet NWP = 80% PRVs Opening Pressure (acc. HGV 3.1)**

Application	HPRU Outlet NWP	Recommended PRV setting
FC	≤ 20 bar	P+P integrated PRV with Opening Pressure 25 bar. Potentially economically beneficial to set adjusted standard value in conformation with HGV 3.1.
H2ICE-PFI	20 – 44 bar	P+P integrated PRV with Opening Pressure available from 25 to 55 bar. Standard P+P configuration (PRV serves FC and H2ICE-PFI application).
H2ICE-DI	45 – 64 bar	P+P integrated PRV with Opening Pressure available from 56 to 80 bar.
Higher pressures	≥ 65 bar	Heavy Duty inline PRV after HPRU outlet. Functional hydrogen supply system safety requirements need to be analyzed.

Safety information

For the purpose of system configuration and safety analysis the following values of the PRV are to be considered:



Via CFD simulations calculated mass flows \dot{m} at various inlet pressure levels p_{1t} for PRVs with different set pressures (SP) and Vent adapter (ID $\varnothing 12.7$ mm).

Via CFD simulations calculated Kv values for PRVs with different set pressures (SP) at 110% overload

PRV set pressure [bar]	PRV proof pressure [bar]	Kv value
25	27.5	0.93
35	38.5	1.01
45	49.5	1.06
55	60.5	1.01
56	61.6	1.06
65	71.5	0.98
80	88	0.68

Certification & safety information

The product may only be used after installation by qualified personnel according to the corresponding installation guide. Usage for production of commercial goods is only permitted in certified countries. Otherwise, the product may only be used for testing purposes.

Standards | Certificates of HPRU⁶⁾

North America (USA, Canada)

HGV 3.1-2022

Tests in progress

Global

ISO 19887:2024

Tests in progress

6) This information applies only to relevant tests of the HPRU main body, e.g. HGV 3.1-2022 chapter 5, 14 & 15. Pressure sensor specific information on tests and certifications are given in the following table.

Standards | Certificates of Pressure sensors

Europe

	HP sensor (max. 900 bar)	MP sensor (FC) (max. 30 bar)	MP sensor (H2ICE) (max. 100 bar)
EC79/2009, EU406/2010	Certified	Certified	Certified

North America (USA, Canada)

	HP sensor (max. 900 bar)	MP sensor (FC) (max. 30 bar)	MP sensor (H2ICE) (max. 100 bar)
HGV 3.1-2015	Certified	Certified	-

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