MAXIMATOR®
Maximum Pressure.

Technical Description

MAXIMATOR X-Tower

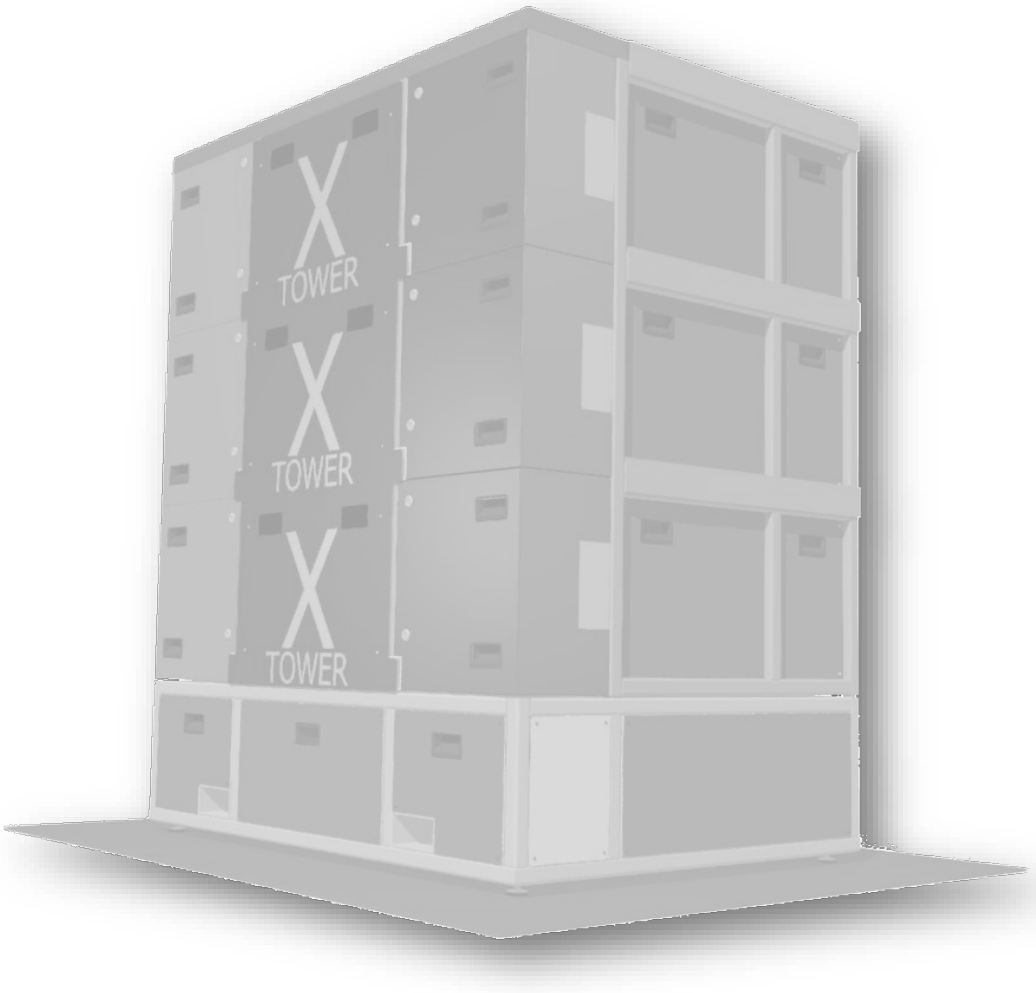

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Table of Content

Revision

Verlauf der Änderungen

Revision	Date	Author	Description
N0	15.01.22	M. Bierwisch	Initial-Version

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1 Introduction

1.1 Advantages at a Glance

With the new X-TOWER technology we are proud to offer an efficient way of Hydrogen compression. The X-TOWER solution is based on our EHB Series with all the advantages of efficiency and flexibilty. The X-TOWER is designed for integration in existsing systems and is covering nearly all requirement. The interface connection for the customer are reduced to a minimum. All other modules for a safe and efficient compression can be supplied as an option if not already integrated. An web-based access to the control system offer independant control with your mobile PC or smartphone.

Special features of our systems are:

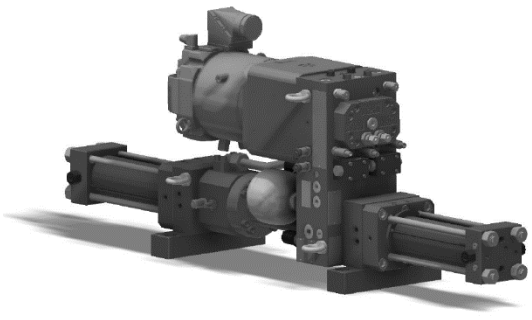
- SAFETY
- INTEGRABILITY
- EFFICIENCY
- FLEXIBILITY

1.2 MAXIMATOR's Solution

With our solution we optimize your business potential by concentrating on the capacity matter. The process is automatic. Tests, protocols, documentation of test results and the test data carried out according to current standards. The heart of the system and the center of compression is the new EHB technlogy with the following characteristics and benefits. The EHB (Electro Hydraulic Booster) as the heart of the system.

The high-pressure part of the EHB compresses gas according to the same principle as the DLE. However, its drive concept has been completely redesigned. The compressed air drive has been replaced by an electro-hydraulic drive. Here, an electric motor drives a pump, but a frequency converter enables precise speed control. In the factory, the compressor is adjusted for optimum acceleration and braking behavior of the piston.
To make a comparison, what was the throttle valve in the DLE is now the frequency converter.
This means that the output can be continuously adjusted from one stroke to 24 strokes. The EHB works with a preset stroke frequency to compress until the target pressure is reached. Target and start pressure can be set variably.
Alternatively, the EHB can also operate constantly in a preset range as a constant conveyor. In all cases, the switch-on and switch-off pressures are adjustable. Internally, the compression ratio and critical temperatures are also monitored. The application range of the EHB is approx. 4-10 times higher volume flow than with the DLE.

- Efficient hydraulic drive with less oil volume
- Direct seperation between gas and hydraulic
- Flushing concept integrated



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- Frequency converter controlled

1.3 Benefits at a Glance

Efficient		With the new frequency converter controlled complete closed hydraulic drive we are using the efficient way to compress gases.
Flexibel		With the X-Tower you are planning the future. Our solution can be adaptet to new challenges by changing, adding or removing X-Modules.
Scalable		The modular design allows countless combination of X-Modules to cover many different application and requirements.
Maintenace		The maintenance concept based on reduced down time and fast availability.
Remote support		We do not leave you allone and have te opportunity to support fast via remote.
Integration		With reduced interface connection we are proud to say "plug & boost"
Cooling		Intelligent and efficient new cooling concept keep the gas temperature under control
Safety		Purging, temperature & pressure control, gas detection, active ventillation are only some of our safety features to increase the acceptance of operator and integrator.

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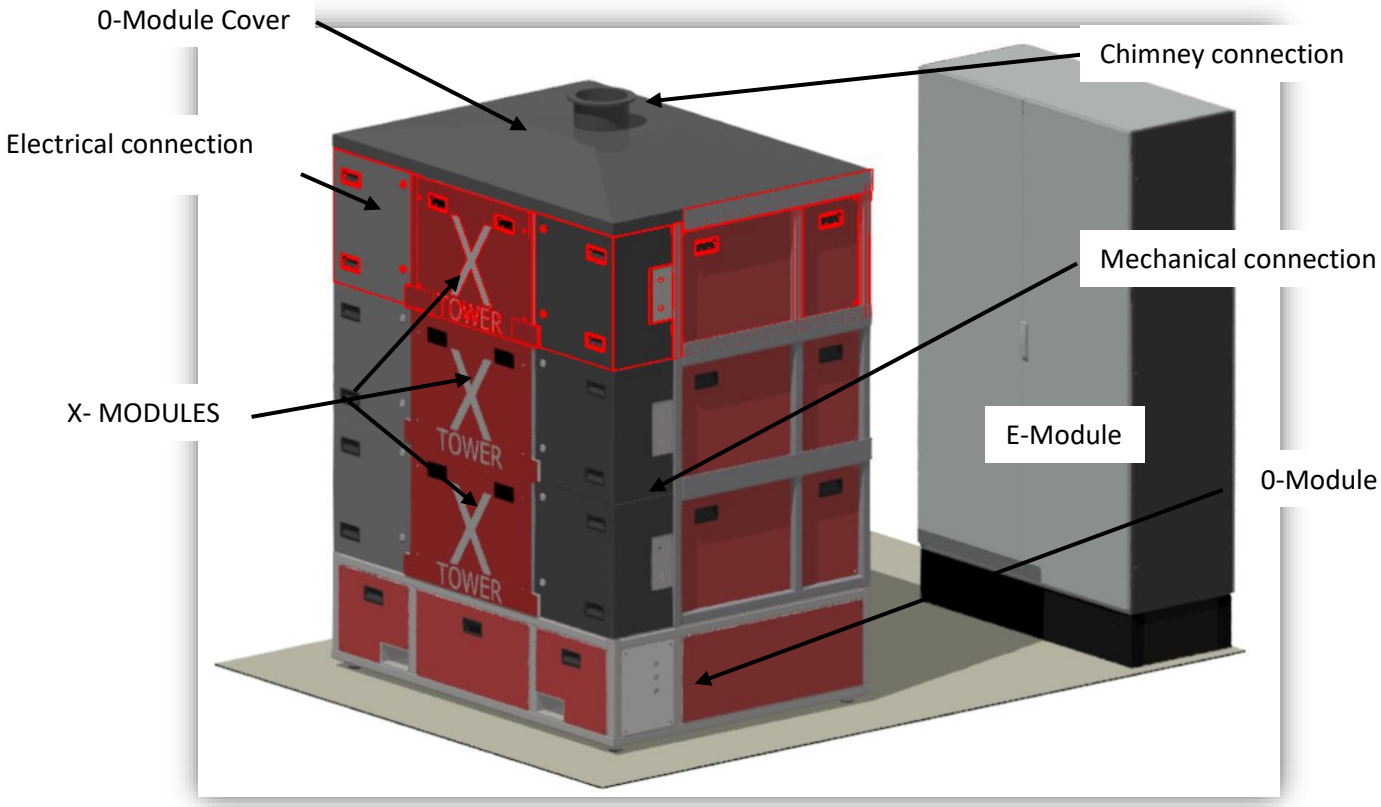
2 Technical Description

2.1 Intended Use

The X-Tower is designed to compress Hydrogen from a minimum pressure of 25 bar to a maximum pressure of 900 bar depending on the selected X-Modules.

2.2 Design Concept



The X-Tower is completely closed. Only for interface connection bulkhead plates are prepared. To provide flexibilty and modularity some connection are maybe not required for your application. This connection are plugged to provide a safe operation. The X-Tower concept require only electricity (connected to the E-Module), Cooling water (Chilling system available optional), Hydrogen supply pressure, Nitrogen supply pressure (for purging and valve actuation), freh air supply for the active ventillation system, exhaust air connection to bleed the air, purge and bleeding gas and your input about the required outlet pressure.

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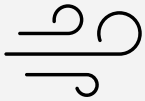
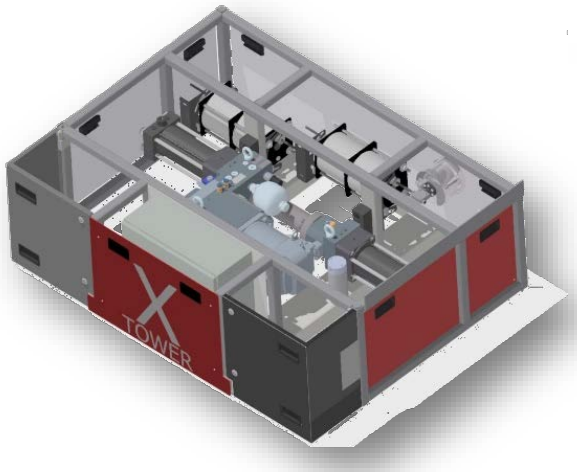
2.2.1 0-Modul

The 0-Module is the foundation of X-Tower and is consisting of many different safety features. The 0Modul can cover max. 3 x X-Modules. Please find in following some of them described.

Temperature		Temperature of fresh air intake will be measured and used for the operation.
Air flow		The volume of sucked fresh air will be measured and used for the saftey concept of the complete X-Tower.
Nitrogen pressure		Nitrogen will be used for the safety related flushing procedure of installation as well as the operation of pneumatic actuated valves. The Nitrogen supply pressure will be measured. If the pressure drops below a certain value the operatore is receiving a warning message. If the lowest set pressure will be reached the sytem will be stopped. The supply pressure will be supervised.
Fan control		Based on our safety concept the fans for fresh air supply are supervised, Rotation and function of fans will be measured and controlled by the saftey PLC



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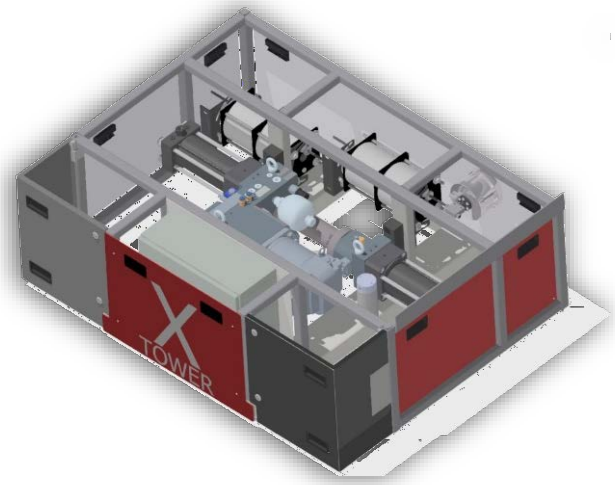
2.2.2 X-Modul

The X-Modules are available for different pressure ratings and flow application. The X-Modules can be combined in accordance to the specification and customer requirements. The E-Modul will recognize which modul is connected (key connector) and will use the right information to operate the installed X-Modul. In following you will find the relevant information about this module.

Temperature		The gas temperature upstream and downstrem the gas booster will be measure and supervised in accordance to safe operation.
Coolig water		Each X-Modul is heaving an independent cooling water controler module to split the flow of chilled water to the required position. Cooling water temperature and flow will be measured and suopervised by the PLC.
Hydrogen pressure		The gas pressure upstream and downstrem the gas booster will be measure and supervised in accordance to safe operation.
EHB Control		The EHB itself will be operated by the frequency converter (part of the E-Modul). This Frequency converter receiving the following information from the EHB. Hydraulic pressure, Hydraulic teperature, position indicatore. This information are running internally and can not be shared for further processing.



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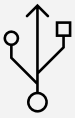
2.2.3 E-Modul

The electrical cabinet is including all relevant electrical components and need to install inside a NON-ATEX area. The interconnection between the X-Tower and the E-Modul is realized with standardized cables packages with a length of 10 meter (other length are available).

Cabinet Size		For the cabinet, we selected a standard size (for dimension and weight refer to the techniocal data chapter) with two front doors for easy access and base for cable connection.
Cooling		The E-Modul is equipped with an air conditioner modul in the front door to keep the electrical and electronic components protected against high temperature conditions.
UPS		The UPS (uninterruptable power supply) is installed to keep all safety function active for a certain amount of time, to shut down the system in a safe way in case of emergency with external power failure.
Access		The cabinet itself is not equipped with an HMI. All necessary information and data transfer will be realized via ethernet cable and PROFINET/PROFISAFE interface.
PLC		To operate the system we are using a SAFETY PLC from SIEMENS.
ENERGY meter		With this module, we are able to measure and provide electrical values like, voltage and power consumption for the main electrical supply of the X-Tower.

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Signal lamp		The installed signal lamp will show different state to inform the operator about the status of X-Tower. Red for failure, yellow for warning and green for normal operation.
Remote Access		With the option of Remote Access we are able to help and support as fast as possible via UMTS.

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2.3 Process Description

The X-TOWER was designed to compress Hydrogen. The flexibility of design allows different combination to achieve the required process parameter. The combination of X-Modules will increase the flow capacity and is creating a kind of redundance. The combination in series allows higher pressure increasing by still respecting the maximum pressure ratio of 1:4 which is an mandantory safety requirement. Additionally, the X-Tower will provide further process, safety and efficiency function:

H2 compression		The required pressure of process need to set by the operator. The X-Tower programm is acting behind to find the safetst and efficient way to reach this pressure. If the pressure is reached, the X-Module program is stopping the process and will start only if the pressure will drop below a hysteresis value.
Safety program		All necessary safety loops are running automatically and the operator will be linked through this operation to provide absolutely safety and protection of the enviromental.
By-Pass function		To increase the efficiency of the compression process the X-Module Series is equipped with the by-pass function. This function will allow to use the inlet pressure without passing the gas booster and loosing energy. This by-pass valve is operated by the saftey programm and is always comparing gas supply and working pressure to activate or de-activate the by-pass function.
Active Cooling		During the compression of Hydrogen, the gas will increase the temperature. This is reducing the efficiency, will affect the life time of installed sealing packages and could create problems for the process behind the system. The X-Tower cooling concept is based on an automatic and intelligent water distribution system which is combining the requirments of efficiency and sufficient cooling power.
SAFETY PLC		The engineering phase with the HAZOP consideration was creating safety relevant sensor and actoring modules. These modules together with the Emergency Stop signals are processed by the saftey PLC. The interfaces between the modules are realized with PROFISAFE.

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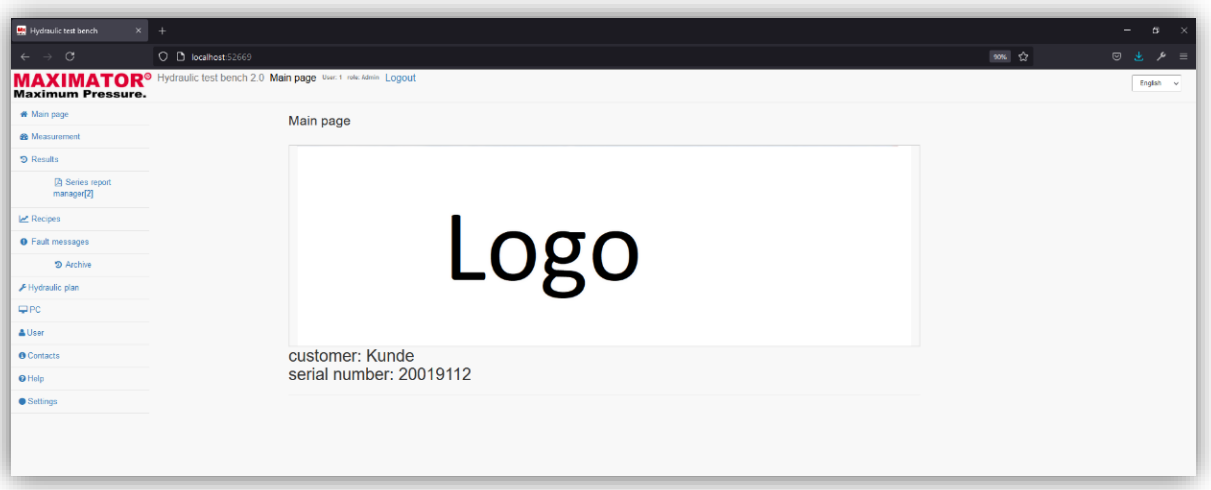
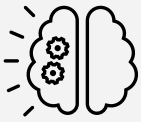
2.4 Operational Concept

Easy integration and simple operation are the main ideas for the new software concept.



Intuitive operation		Based on our long hiostory of programming industrial solution and our experince of test stand equipment our engineers using an operator friendly way to design the software and the front end solution.
Language change		English and German are pre-installed as standard language packages. Other language package available on request and optional.
IoT ready		Our X-Tower is prepared for IoT integration to improve processes and application together with the customer.
Visualization		Our software engineers designed to process of X-Tower with all relevant valves and sensors. The vizualisation is showing the position, status and value of all important process points of X-tower.

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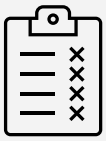
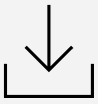
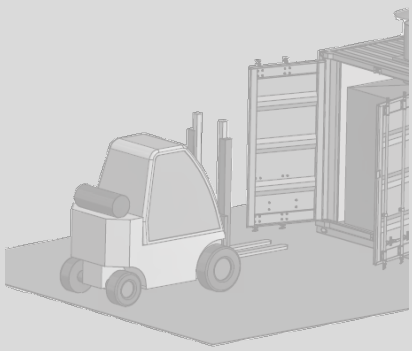
Error messages		The X-TOWER will provide all current Error messages and even an history of Error messages is available for a better trouble shooting.
User level		Different user level for graduated operator are available (small, medium, large).
Data storage		Our X-Tower is storing the last 50 pressure curves. Temperature data storage is available on request.

2.5 Service Concept

"Time is Money" was the idea behind developing a completely new series for the Hydrogen market. Reducing of downtime is one of the biggest advantage for the X-Tower concept. The modula design allow to change modules instead of maintaining components. MAXIMATOR is providing complete tested and certified modules to exchange the used module. With standardized electrical and mechanical connection the maintenance seccion can be planned in advance and realized in a short therm.



- reduced down time for maintenance
- standardized electrical and mechanical connection
- Tested and prepared modules are available in a short time

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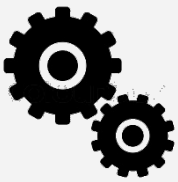
2.6 Safety Concept

ATEX		The X-TOWER Series was designed and developed to reduce the Zones inside the system by detecting and active ventillation. Independent on this, the documentation is coming with ATEX certificate and zoning plane.
Machine directive		In accordance to the machine directive the X-Tower concept is declared as a partly completed machine and will be delivered with declaration of incorporation and installation manual in englisch and german language.
Ventillation		The 0-Module of X-Tower series is equipped with the active ventillation system. The ventillation is designed as a redundant system and is running directly after starting the machine. The ventillation intake need to install by the integratopr as well as the exhaust on top of the system. For further information please refer to the GA drawing. The capacity of ventillation is specialy calculated and designed for the maximum design size of x-Tower solution.
Detection		Each X-Module of X-Tower series is equipped with two independent H2 gas sensors. The gas sensors will be controlled by the Safety PLC and detecting continously the ambient inside the module. If the H2 concentration is increasing insid the X-Tower to 20% UEG the operated will be informed by machine traffic light. By reaching 40% UEG the system will be safely switched of. Ventillation is still running and trying to reduce the concentration inside the X-Tower.
Protection		The X-Tower is completely closed to protect the operator and enviromental. Only special trained personal is allowed to open the shield around the system. For maintenance work, two independent (one for electrical installation and one for mechanical installation) shafts are integrated in front of the system.

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2.7 Technical Data

0-Module		
Medias	Cooling Water / Nitrogen / Fresh Air	
Pressure	Max. 300 bar Nitrogen / Max. 10 bar cooling water	
Dimension (lxbxh)	1.200 mm x 1.600 mm x 400 mm (without roof top)	
Weight		
Transportation	Forklift pockets	
Connection	Nitrogen supply	1/4" BSP female bulkhead coupling
	Cooling water supply	1" BSP female bulkhead coupling
	Cooling water return	1" BSP female bulkhead coupling
	Fresh air	2 x DN 100 connections
	Air / purge / reliefe exhaust	DN300 flange connection (on top)
	Electrical connection	1 cable /Power/PROFINET/SAFE
	Earthing	Bolt for connection

E-Module		
Medias	Electricity	
Voltage	400 V AC/50Hz	
Dimension (lxbxh)	500 mm x 1.200 mm x 2.000 mm	
Weight	400 kg	
Transportation	Lifting lugs	
Connection	Connection 0-Module	1 cable /Power/PROFINET/SAFE
	Connection EHB (modul X)	3x2 cable / Power Suppy / Encoder

X-Module (EHB15)		
Medias	Cooling Water / Nitrogen / Fresh Air / Hydrogen	
Pressure	300 bar Hydrogen	
Dimension (lxbxh)	1.200 mm x 1.600 mm x 500 mm	
Weight	approx. 500 kg	
Transportation	Forklift pockets	
Connection	Hydrogen inlet	9M female bulkhead coupling
	Hydrogen outlet	6M female bulkhead coupling
	Electrical connection	1 cable /Power/PROFINET/SAFE
	EHB power supply + control	2 cable / Power Suppy / Encoder
	Earthing	Bolt for connection

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X-Module (EHB30)		
Medias	Cooling Water / Nitrogen / Fresh Air / Hydrogen	
Pressure	600 bar Hydrogen	
Dimension (lxbxh)	1.200 mm x 1.600 mm x 500 mm	
Weight	approx. 500 kg	
Transportation	Forklift pockets	
Connection	Hydrogen inlet	6M female bulkhead coupling
	Hydrogen outlet	6M female bulkhead coupling
	Electrical connection	1 cable /Power/PROFINET/SAFE
	EHB power supply + control	2 cable / Power Suppy / Encoder
	Earthing	Bolt for connection

X-Module (EHB75)		
Medias	Cooling Water / Nitrogen / Fresh Air / Hydrogen	
Pressure	900 bar Hydrogen	
Dimension (lxbxh)	1.200 mm x 1.600 mm x 500 mm	
Weight	approx. 500 kg	
Transportation	Forklift pockets	
Connection	Hydrogen inlet	6M female bulkhead coupling
	Hydrogen outlet	6M female bulkhead coupling
	Electrical connection	1 cable /Power/PROFINET/SAFE
	EHB power supply + control	2 cable / Power Suppy / Encoder
	Earthing	Bolt for connection

General Information	
Temperature	-10°C … +40°C
Humidity	20 … 80 %
Cable length between X/0-Module and E-Modul	10 Meter
Location	Indoor / Container
Max. Combination	1 x 0-Module = 3 x X-Module
Design	24/7
Lifetime	15 Jears

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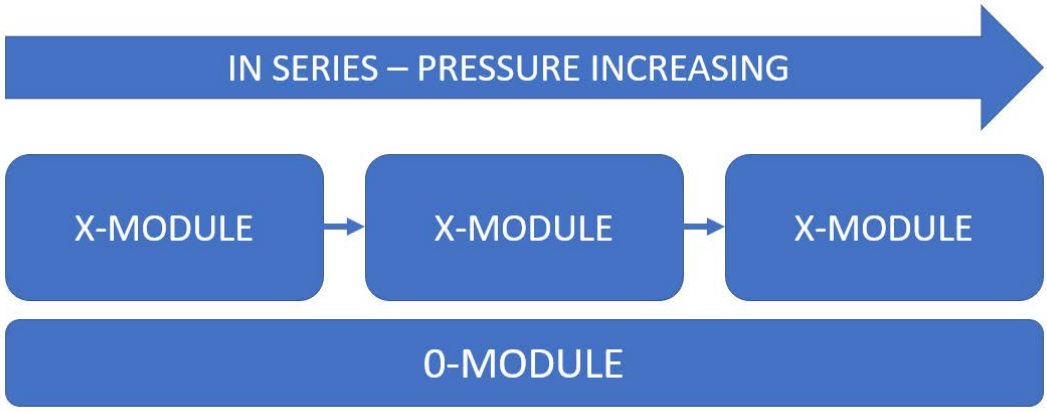
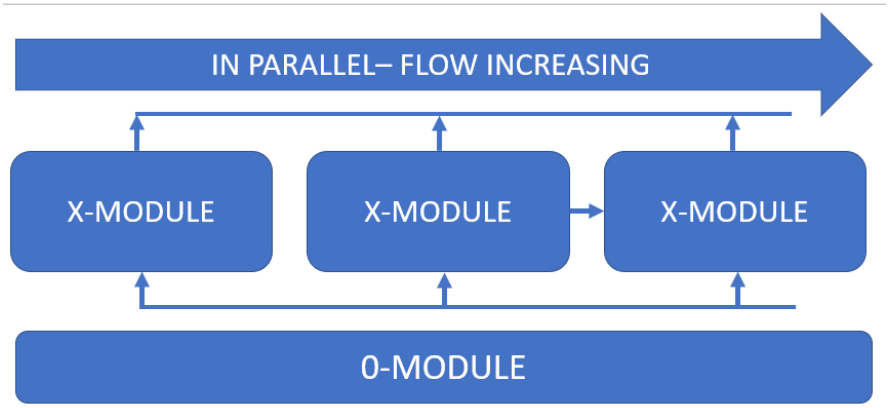
2.8 Applicable booster compinations

With the X-TOWER concept we have created endless combination of the available electro hydraulic gas booster series. By using the "serial way", we are able to reach huge pressure increasing and still covering the maximum compression ratio of 1:4 for Hydrogen.



By using the "parallel way", we are able to double or triple the flow of a single stage solution.



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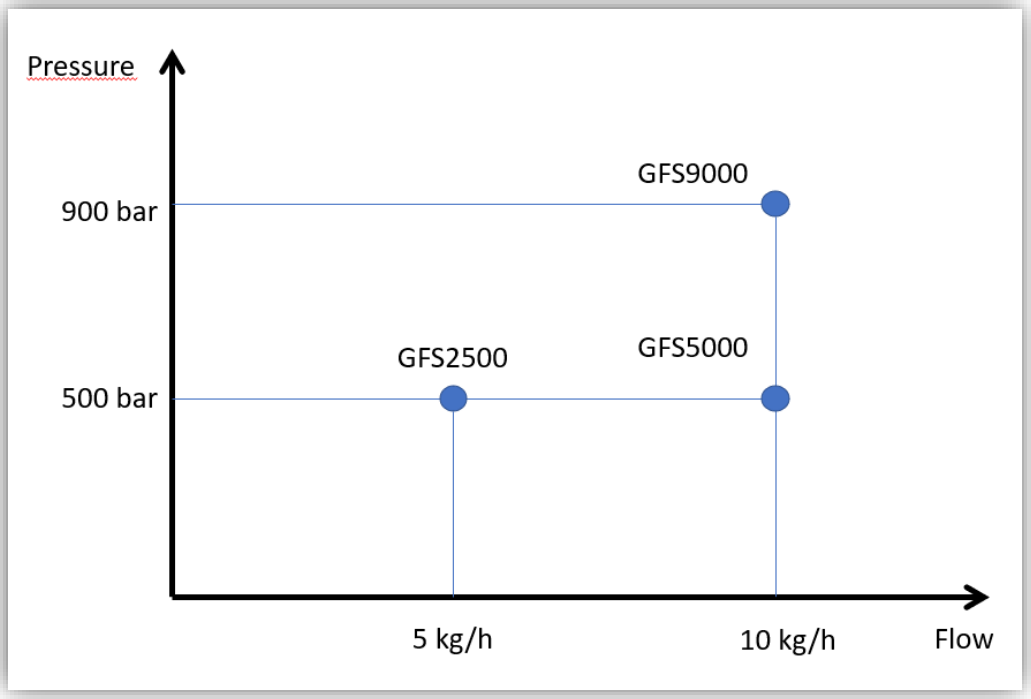
2.9 Available X-Module Solution

The combination is X-Modules is depending on the applicatio with the gas supply pressure, required working pressure and flow capacity. Please find in following several standardized solution which can be combined in parallel or in series to achieve the required process parameter. Please find in following applicable combination as an example only:



Pressure [bar]	Supply [bar]	Flow [kg/h]	X-Modul 15	X-Module 30	X-Modul 75	0-Modul	Additional requirements	Complete solution
500	40	5	1	1		1	Cooling unit	GFS2500
500		10	2	1		1	Cooling unit	GFS5000
900		10	1	1	1	1	Cooling unit	GFS9000

This combination are only examples with the indicated flow and pressure values to show the performance of X-Tower series. By changing the type of X-Modules and the way of combination we are able to cover a huge range of operation.

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2.10 Complete Solution (MAXIMATOR GAS FILLING STATION) Optional

The quoted X-Tower is designed as a modul for further integration. We are proud to even offer the complete solution. With the MAXIMATOR Gas Filling Station (GFS) you will receive an complete plug & boost solution, including all relevant modules around, like the cooling unit, the container, the integration and all relevant tests and approvals. For more information, please join our website or ask our sales engineers or technical support.

For more information

To contact us directly

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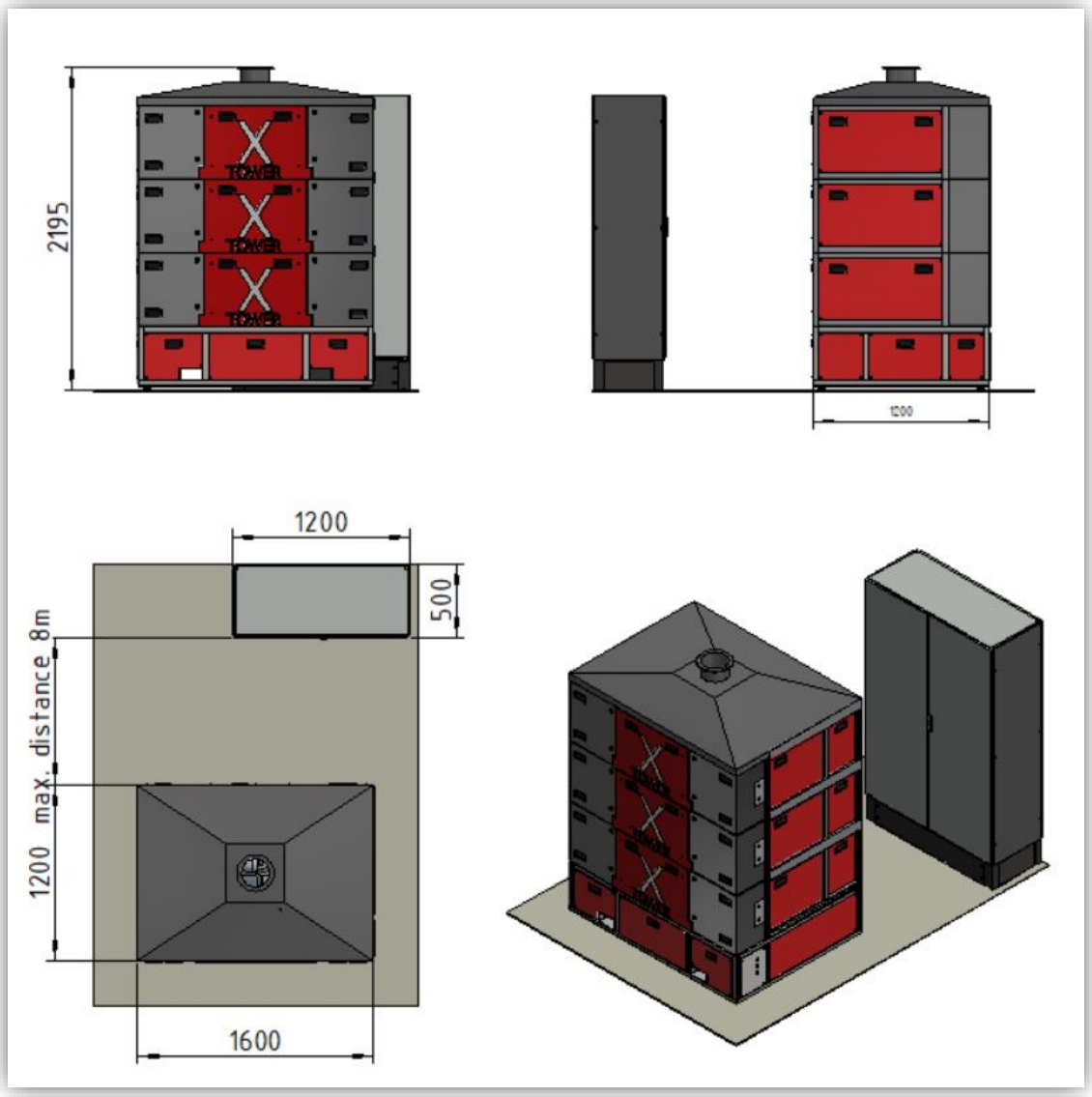
2.11 Layout



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