

1. Fuel Cell Forklift Power System

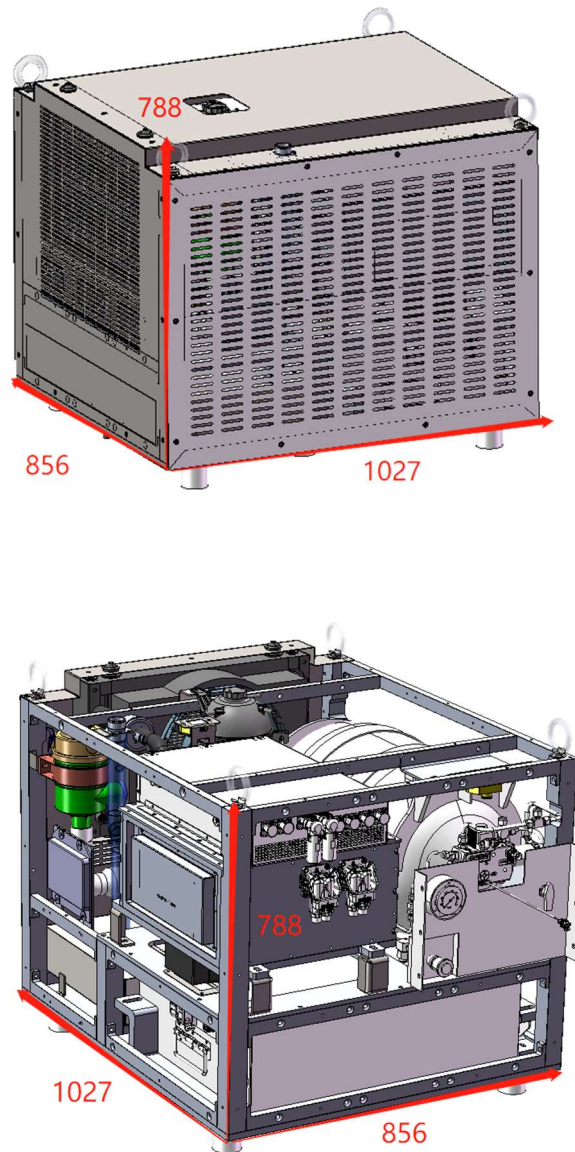


Fig. 1 Appearance of Fuel Cell Forklift Power System

Using forward development technology. And the control strategy is developed based on fuel cell and power generation system model, which could achieve better full lifecycle matching optimization for fuel cell forklift to work efficiently. The self-designed intelligent hydrogen ejection module and the stack internal state estimation strategy are adopted to improve the hydrogen utilization and system durability. This fuel cell power system platform could support 2~3.5 tons forklifts.

Table 1 Fuel Cell Forklift Power System specifications

Item	Specification	Note
Fuel type	H2	Can be replaced with methanol
Rated power	10 kW	Customized according to customer needs
Peak power	20 kW	
Peak efficiency	≥60%	
efficiency at rated power	≥46%	
Low-voltage supply	24 VDC	
Output voltage range	65-100 VDC	
Hydrogen storage pressure	35 MPa	
Hydrogen storage mass	1.2 Kg	
High-voltage supply	80 VDC	Customized according to customer needs
Operating temperature	-30°C~45°C	
Storage temperature	-30°C~60°C	
Noise level	≤75 dBA	
Hydrogen leakage	< 100 ppm	
Design lifetime	≥10000 hours	
Communication network	CAN2.0	
Communication baud rate	250/500Kbps	
Dimensions (L*W*H)	1027*856*788mm	Customized according to customer needs

2. A Grid-connected/off-grid fuel cell power generation system

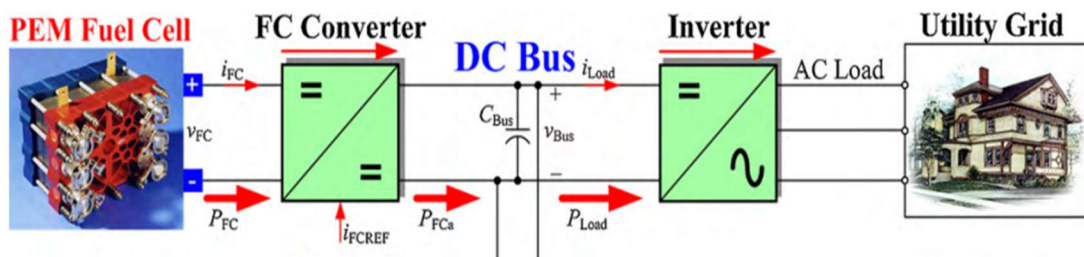


Fig. 2 Grid-connected fuel cell power generation system

Using forward development and model-based control strategy of fuel cell and power generation system, the whole life cycle matching optimization and efficient work of grid-connected fuel cell system are achieved. The self-designed intelligent hydrogen ejection module and the stack internal state estimation strategy are adopted to improve the hydrogen utilization and system durability. Using a high dynamic tracking control strategy for temperature and air supply to achieve a high dynamic response, the power range of the fuel cell is 5~80KW.

Table 2 Grid-connected fuel cell power generation system specifications

Item	Specification	Note
Fuel type	H2	Allowable customized methanol
Rated power	10 KW	Customer-specific
Peak power	20 KW	
Peak efficiency	60%	
efficiency at rated power	50%	
Response time	10s	The time required to idle to the rated power can be 3.5s
Low-voltage supply	24 VDC	
Grid voltage	220/380 VAC	Customer-specific
Operating temperature	-30 °C~45 °C	
Storage temperature	-30 °C~60 °C	
Noise	≤70 dBA	
Hydrogen leak rate	< 100 ppm	
Communication network	CAN2.0	
Communication baud rate	250/500 Kbps	
Control mode	1) Off-grid power load tracking; 2) Grid-connected; 3) Controllable load power;	

3. A FC-based CHP System

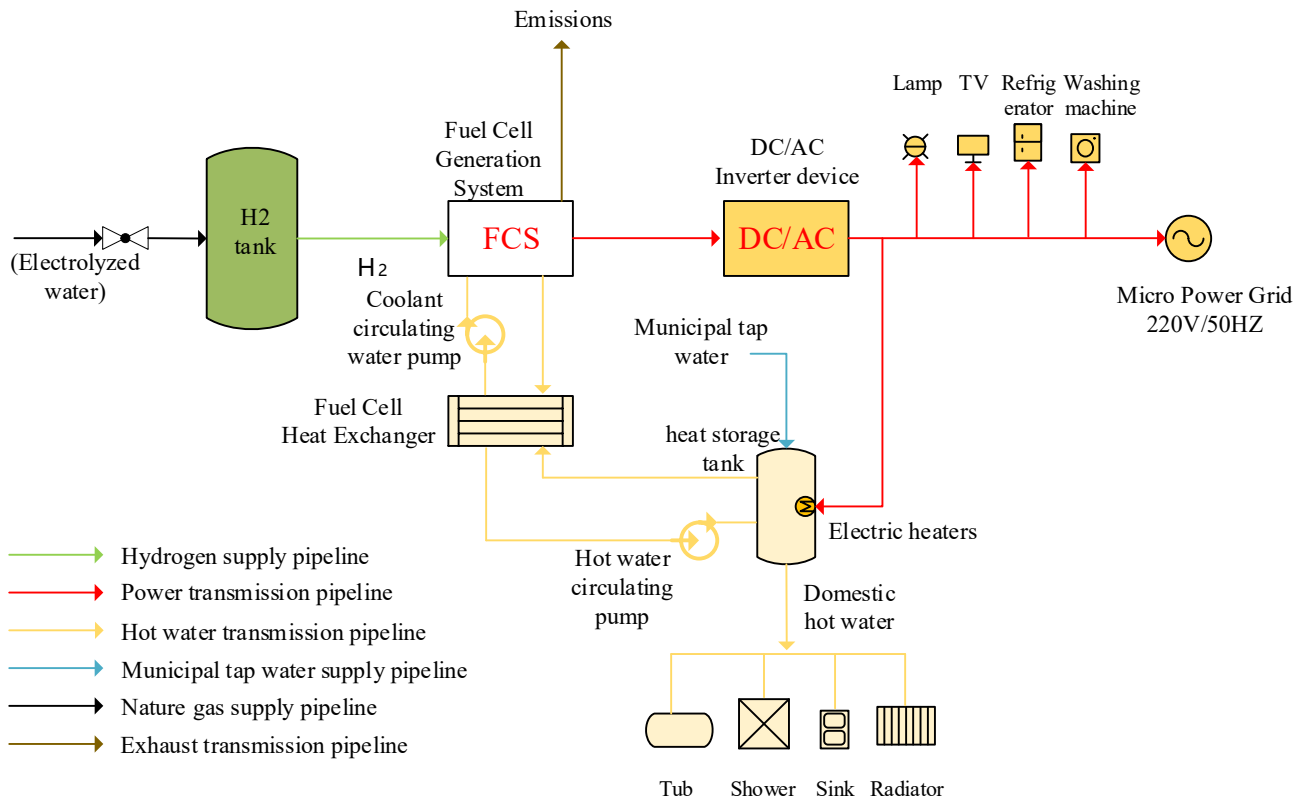


Fig. 3 The FC-based CHP system

Using the forward development technology and the model-based control strategy of fuel cell and power generation system, the FC-based CHP (combined heating and power) system is matched optimally and works efficiently in the whole life cycle. The self-designed intelligent hydrogen ejection module and the stack internal state estimation strategy are adopted to improve the hydrogen utilization and system durability. Using the predictive control method to achieve the comprehensive efficiency of CHP (combined heating and power) $\geq 88\%$, the fuel cell co-generation module could support 1~20kW FC-based CHP system.

Table 3 The FC-based CHP system specifications

Item	Specification	Note
Fuel type	H2	Methanol/Electrolyzed water is available
Rated power	5 kW	Customizable
Peak power	10 kW	
CHP efficiency	≥88%	
Rated power generation efficiency	≥50%	
Low-voltage supply	24 VDC	
Grid matching voltage	220/380 VAC	
Heat storage tank	200 L	Customizable
Operating temperature	-30 °C~45 °C	
Storage temperature	-30 °C~60 °C	
Noise level	≤65 dBA	
Hydrogen leak rate	< 100 ppm	
Hydrogen Exhaust content	< 4% LEL	
Design lifetime	≥10000 hours	
Communication network	CAN2.0	
User Interface	Yes	
Control mode	1) Off-Grid power load tracking mode; 2) Grid-connected mode; 3) Power controlled by user mode; 4) Smart co-generation mode;	

4. Unmanned PEMFC system



Fig. 4 Appearance of some components of the unmanned PEMFC system

Based on forward development techniques, using model-based fuel cell and power generation system control strategy development method as well as power system lightweight design technology, intelligent hydrogen ejection module and internal state estimation strategy of stack is designed independently, which greatly improves the system hydrogen utilization rate, lightweight and other important performance. The power level of system ranges from 2 to 10 kW.

Table 4 Unmanned PEMFC system specifications

Item	Specification	Note
Fuel medium	H2	
Rated power	10 KW	Customization
System peak power	15 KW	
Maximum efficiency	60%	
Rated point efficiency	48%	
Low voltage supply voltage	24 VDC	
System output voltage range	100 -150 V	Customization
Weight	24 Kg	
Operating ambient temperature	-20 °C—45 °C	
Storage temperature	-30 °C—60 °C	
Noise	≤75 dBA	
Hydrogen leakage	< 100 ppm	
Exhausted hydrogen content	< 4% LEL	
System lifespan	≥10000 hours	
Communication network	CAN2.0	
Communication baud rate	250/500 Kbps	