

THE DEVELOPMENT OF A 6 KW FUEL CELL GENERATOR BASED ON ALKALINE FUEL CELL TECHNOLOGY

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**VITO, Energy Technology
Belgium**

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Co-operation

- VITO, Flemish Institute for Technology Development
- Intensys, a Belgian manufacturer of alkaline fuel cells

In march 2005 Intensys and VITO signed a collaboration agreement for three years.



Co-operation

Goal:

to integrate Intensys' stack technology to a 6 kWel CHP unit with a realistic commercial perspective :

1. Design a mechanically integrated system using a maximum of **commercially** available components
2. End up with a **CE compliant** product
3. Keep costs to an **acceptable** level



Co-operation



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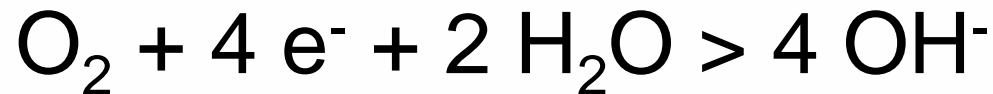
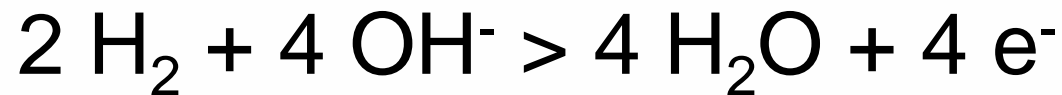
Contents

- Alkaline fuel cells
- Concept
- System design
- Safety analysis
- Performance
- Conclusion

Alkaline fuel cells

- Mobile KOH-electrolyte

- Reactions :



- Hydrophobic membranes
- Electrolyte separates the gasses
- Cells in series and parallel
- Friction welding



Alkaline fuel cells

- advantages :
 - lower quality of hydrogen
 - high efficiency
 - working at temperature below zero
 - possibility of using non-noble catalyst
- disadvantage :
 - lower power density
- former problem :
 - susceptibility for carbon dioxide :
dilutes the electrolyte and causes crystallisation

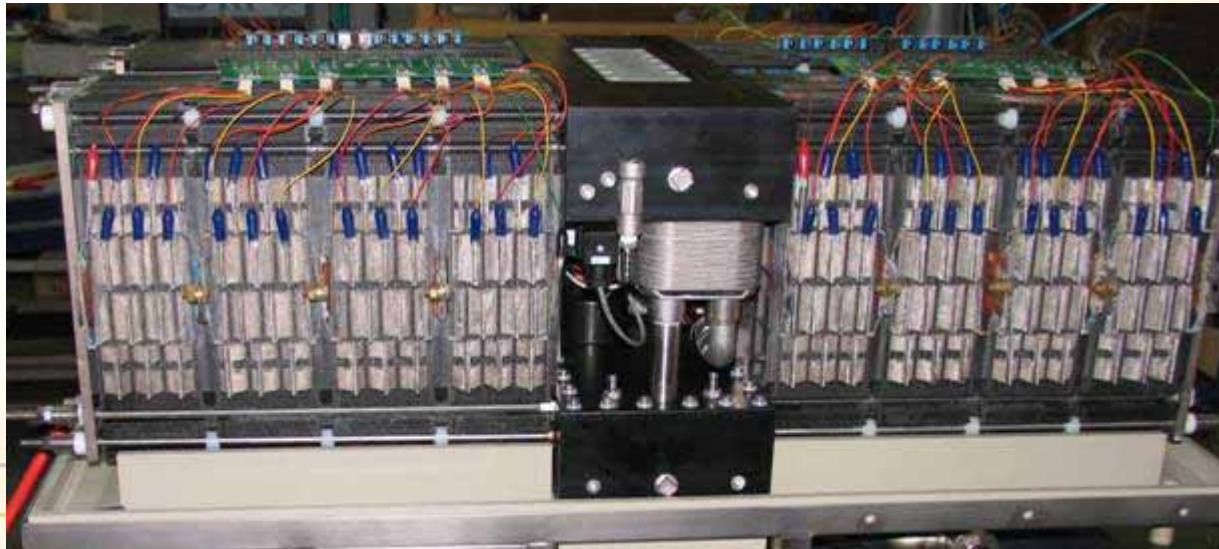


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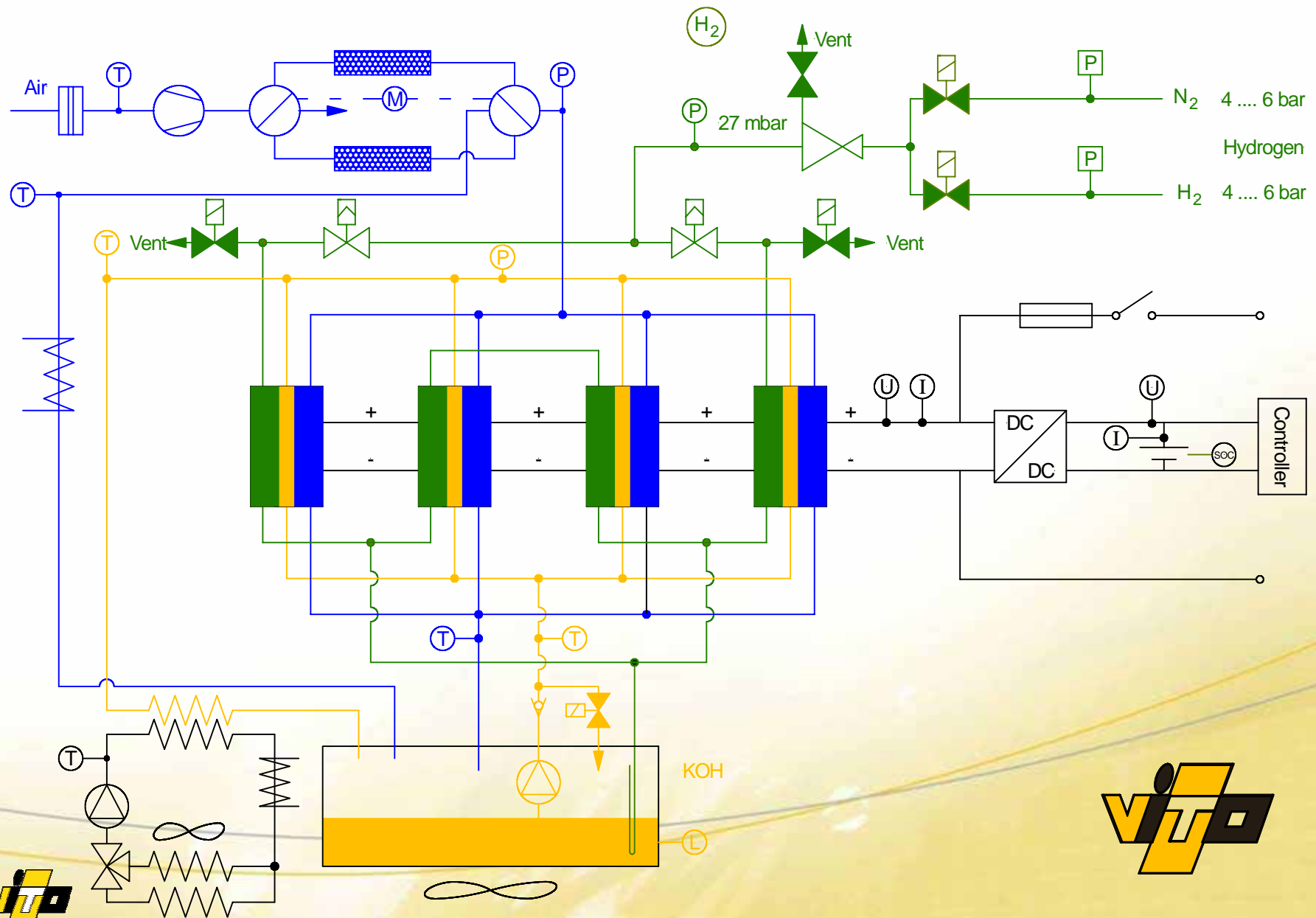
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Concept

- small number of components
- central collector block
- regenerative CO₂-scrubber
- KOH-liquid for heat and water management



System design



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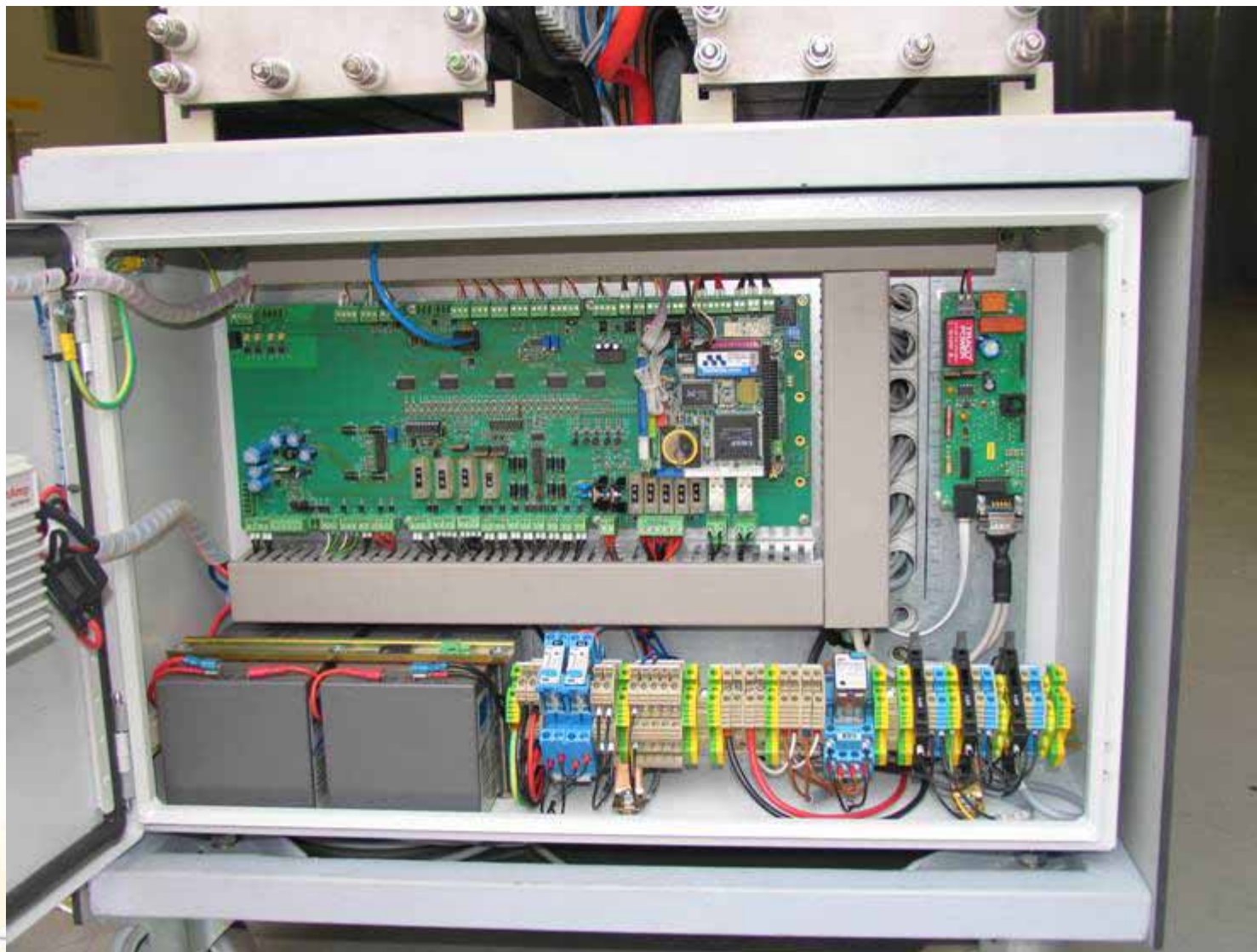


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System design



System design



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Safety analysis and CE conformity

1. machine directive (98/37/EG)
2. electromagnetic compliance directive (89/336/EG)
3. low voltage directive (73/23/EG)
4. ATEX (explosive atmospheres) directive (94/9/EG)
5. pressure equipment directive (97/23/EG and 87/404/EG)
6. gas appliances directive (90/396/EG)

Technical Construction Document



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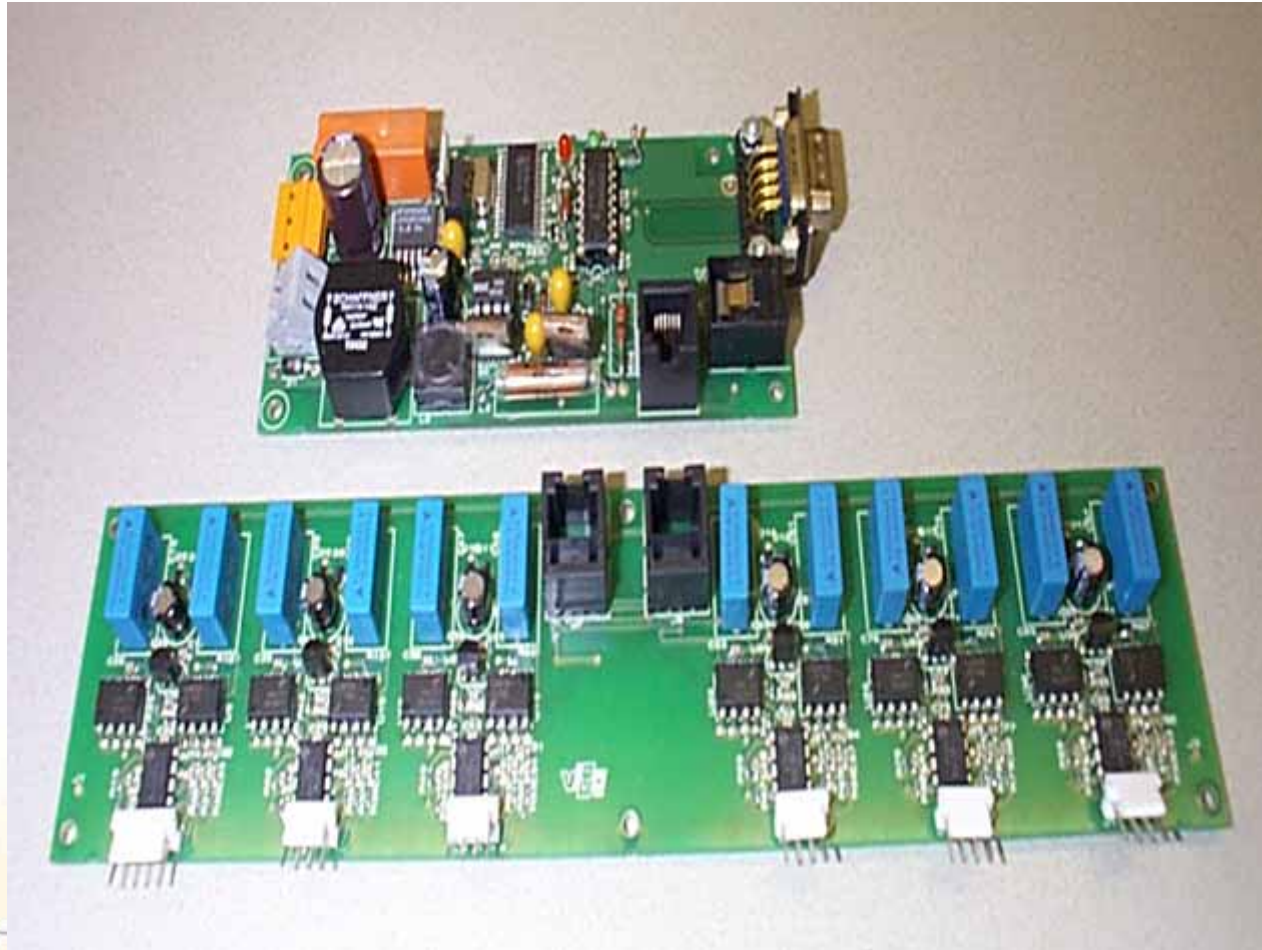
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Safety analysis and CE conformity

- Failure Mode and Effects Analysis
 - “what-if” analysis
1. absolute separation of hydrogen and air inside the stack
 2. lowest cell voltage
 3. hydrogen leakages outside stack

Safety analysis and CE conformity



Safety analysis and CE conformity

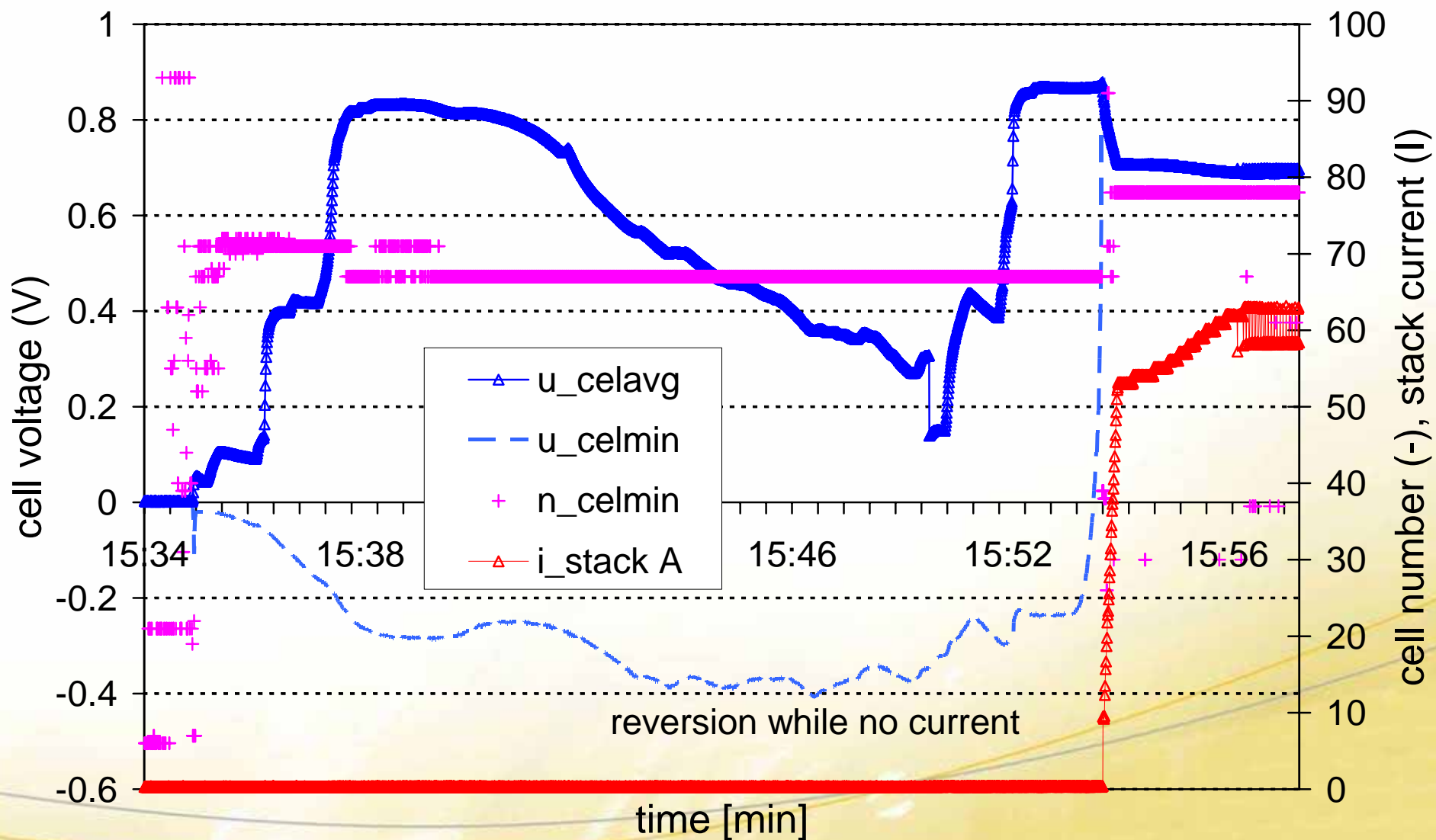
- Simple concept and very low component count to achieve low cost
- Flexible layout, adaptable to stack dimensions
- Single or double galvanic insulation (up to 3 kV)
- Configurable alarm LED and relay output (fail safe)

<i>Parameter</i>	<i>Conventional lab equipment</i>	<i>CellSense test results</i>
power requirement	no requirement	< 30 mW/ cell
conversion accuracy	1 mV	10 mV
conversion rate	80 cells / sec	500 cells / sec.
cell voltage range	-1 to 1 V	-0,15 to 1,1 V
max number of cells	160	500 cells
additional functions	yes	I,T,P,RH
ambient temperature	0..30°C	-20..80°C
weight (excl. housing)	no requirement	< 10 g /cell
hardware cost	< 100 €/cell	2 - 20 €/ cell

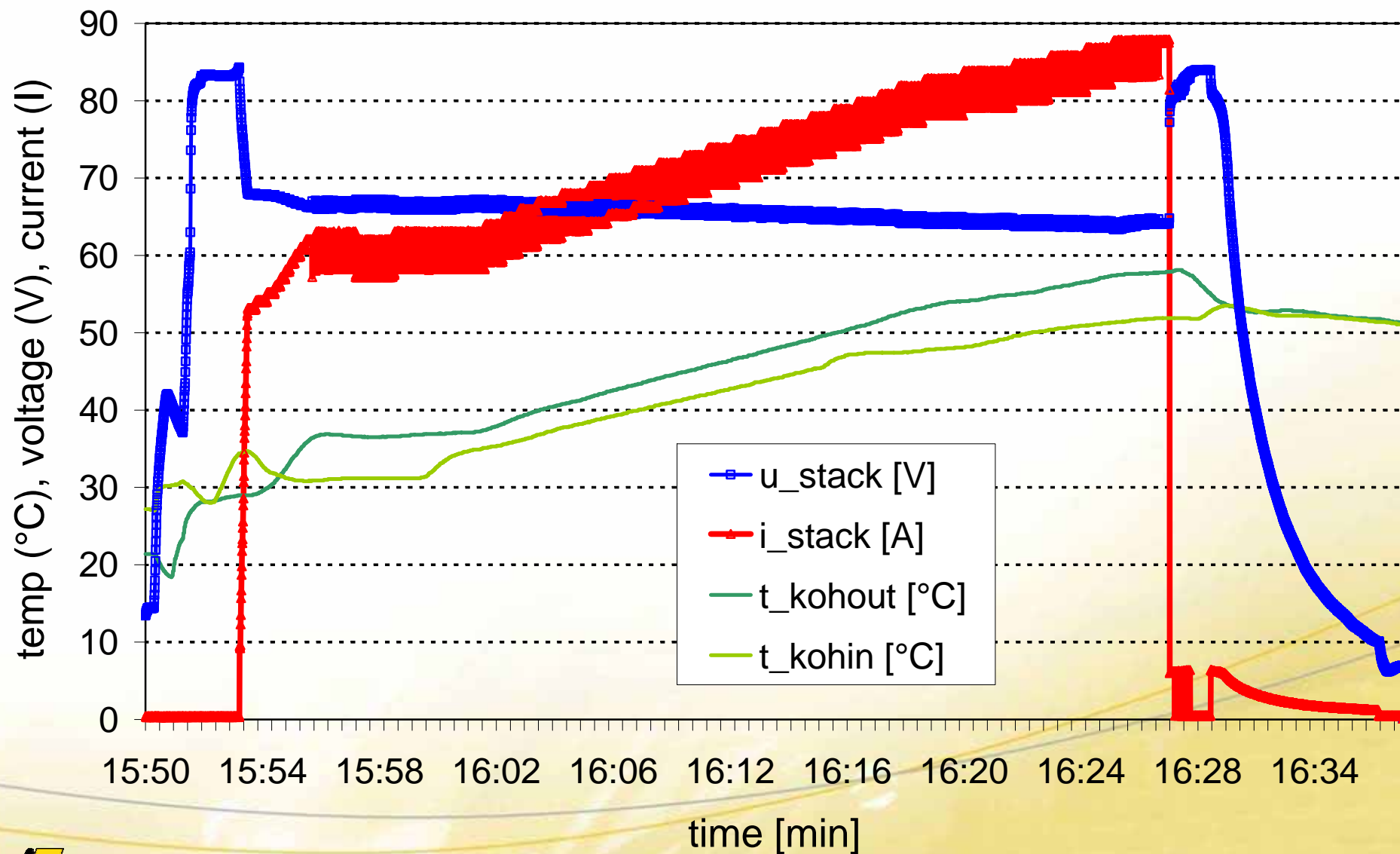
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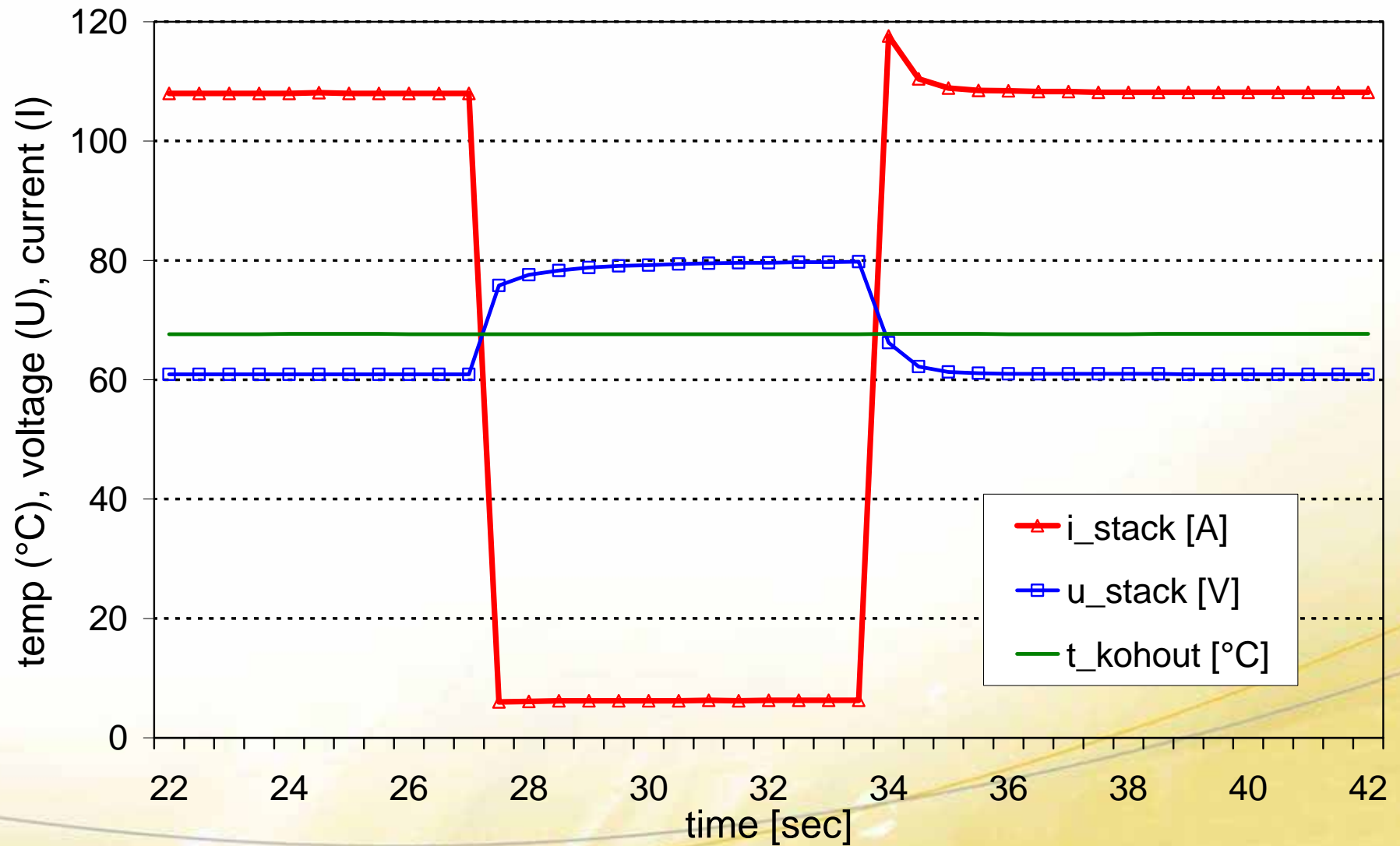
Performance



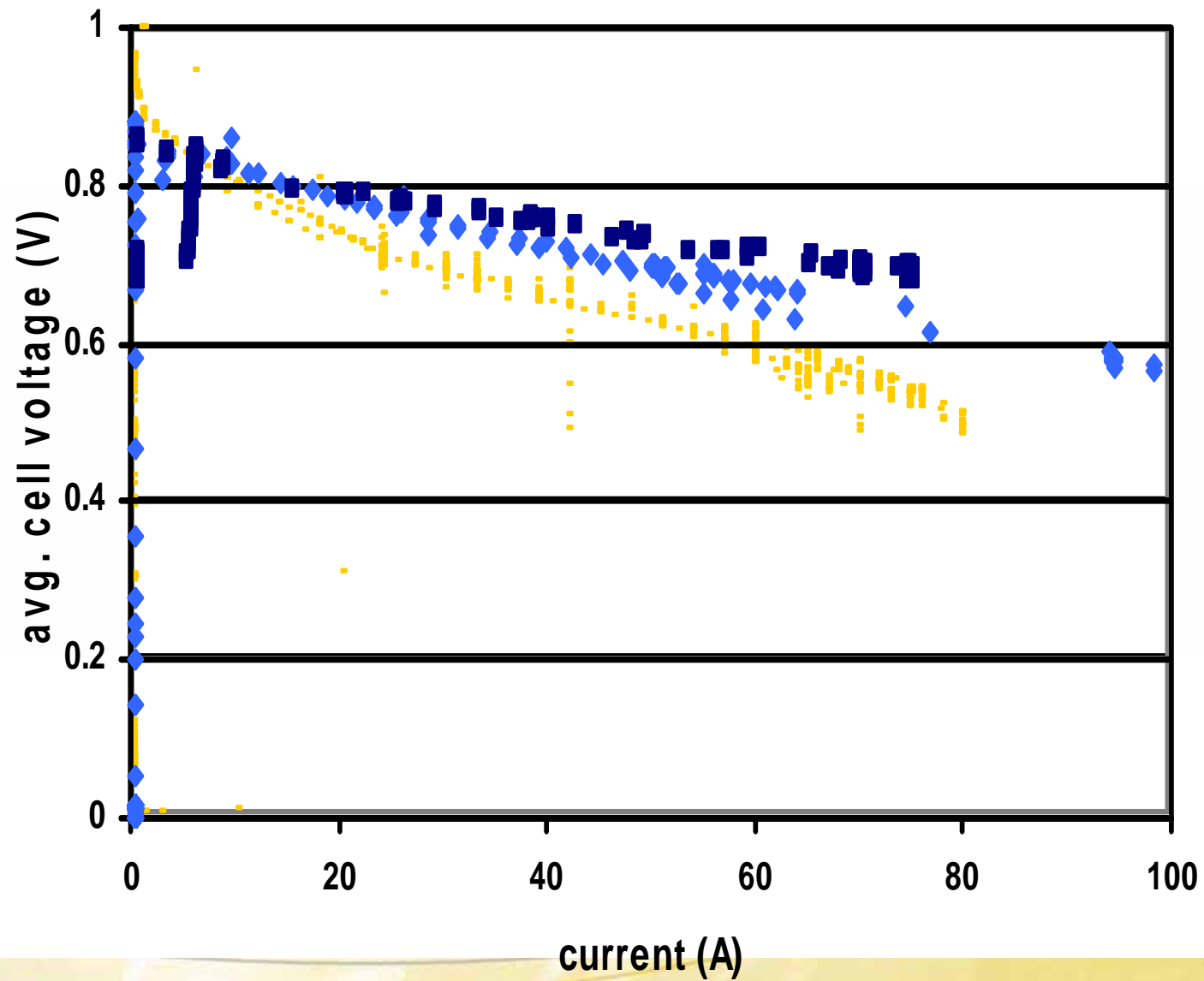
Performance



Performance

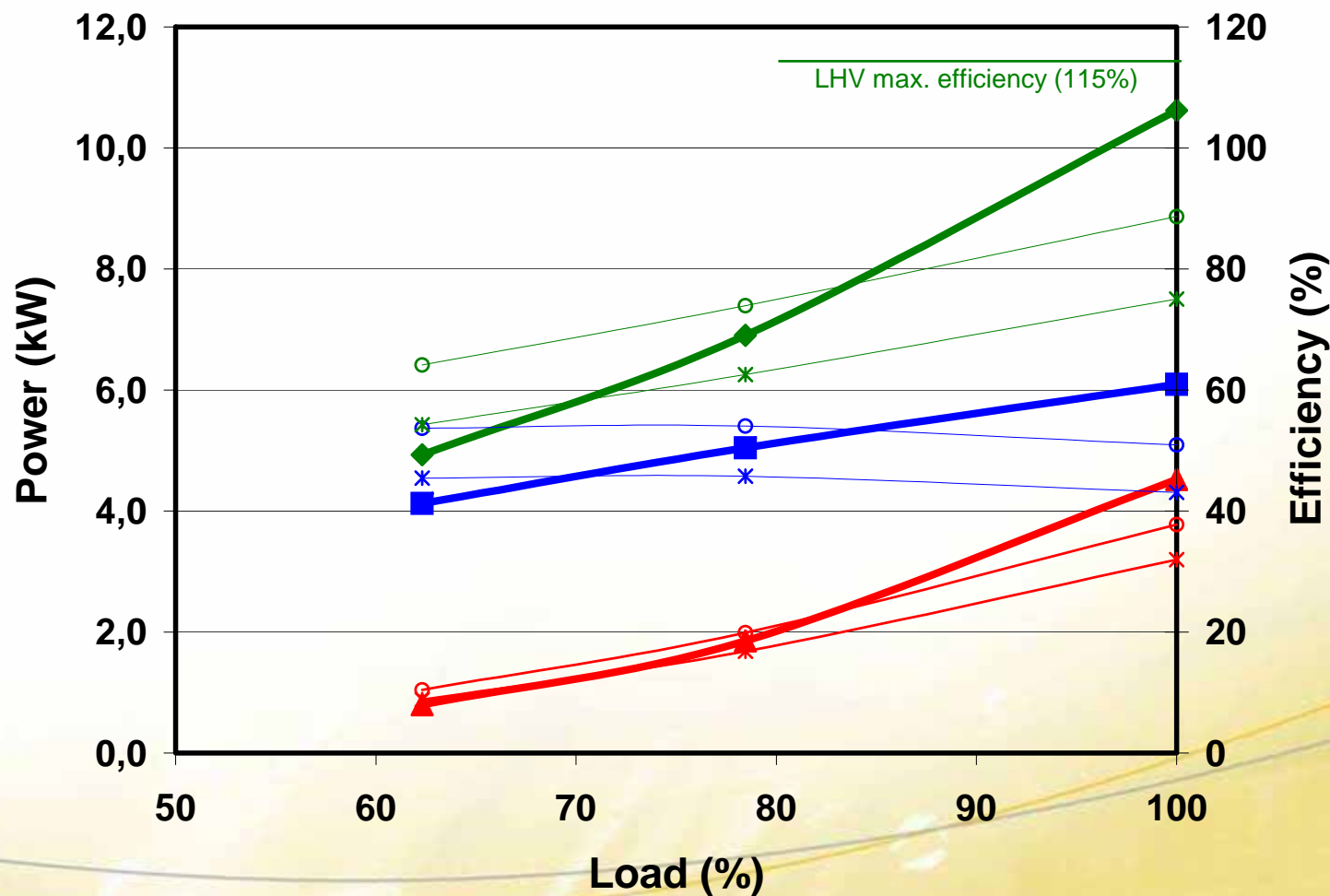


Performance



Performance

Output of PIII-generator (DC output)

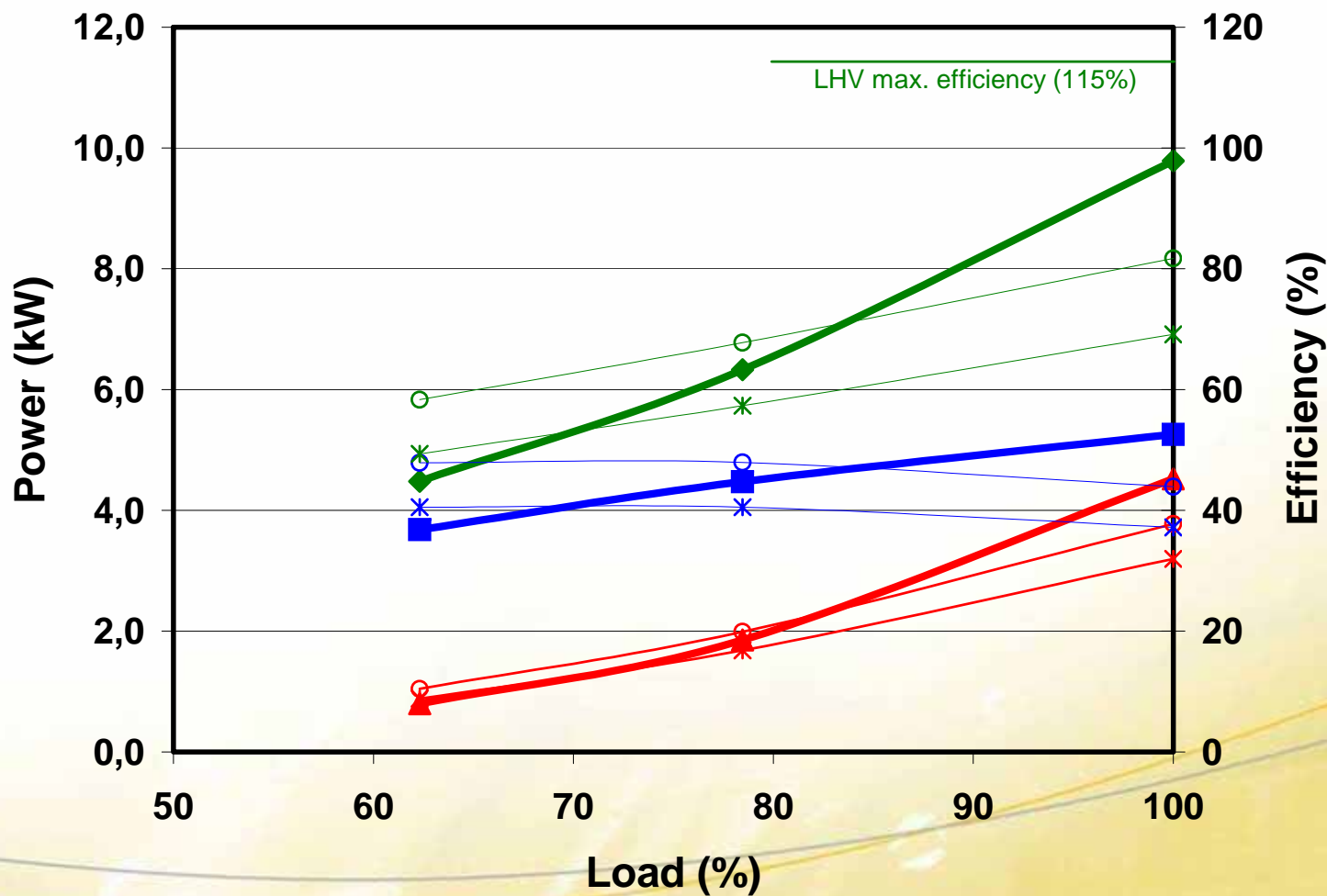


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Performance

Output of PIII-generator with inverter



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◆ P total (kW)
 ○ Eff. total (% LHV)
 * Eff. total (% HHV)

■ P electric (kW)
 ○ Eff. electric (% LHV)
 * Eff. electric (% HHV)

▲ P thermal (kW)
 ○ Eff. thermal (% LHV)
 * Eff. thermal (% HHV)

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