



Elektro-Automatik

# EV COMPONENTS TESTING USING ELEKTRO-AUTOMATIK SOLUTIONS

2024



# EA PRODUCT LANDSCAPE

From bench supply to power system

- EA offers power electronics for research and development as well as industrial applications
- Portfolio ranges from small bench supply to mega Watt class power systems
- Fully flexible and programmable
- Containing multiple options for thousands of applications





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# EA-10000 SERIES

19" Rack mount series for industry, research and development, conventional and regenerative technology

- 60V – 2000V
- 1,5K – 60kW
- 2U - 3U - 6U

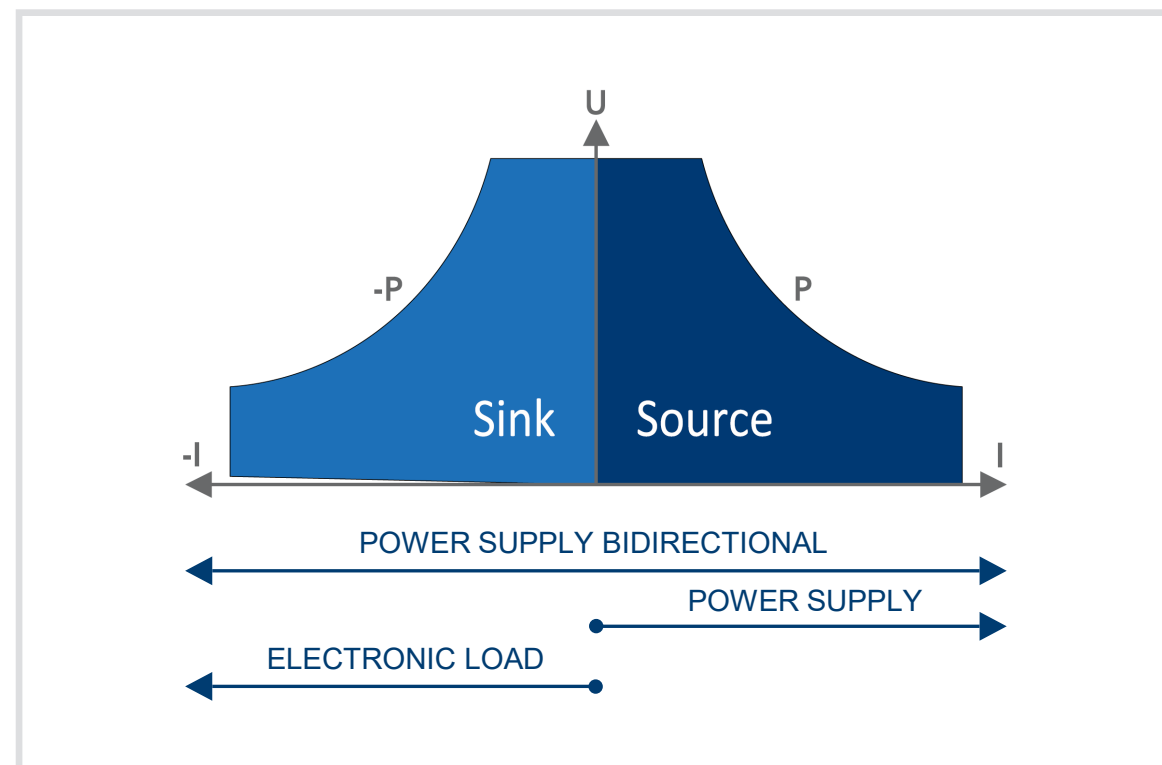




# PRODUCT LANDSCAPE

## EA-10000 Series

- **PSB** Power Supply Bidirectional
- **PSI** Power Supply Intelligent
- **PS** Power Supply
- **ELR** Electronic Load Regenerative





# PRODUCT LANDSCAPE

## EA-10000 Series by feature



\* Note: 18 kW for 208 Vac grid (relevant for US and Japan)



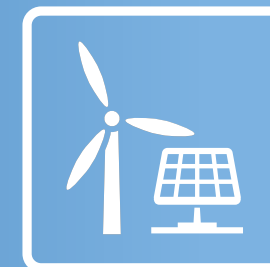
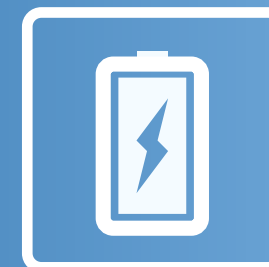
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# AUTOMOTIVE APPLICATIONS

A selection of product use-cases

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- Automotive testing
- Battery cell, module and pack testing
- Battery 2<sup>nd</sup> life and re-cycling
- H<sub>2</sub> – generation and consumption

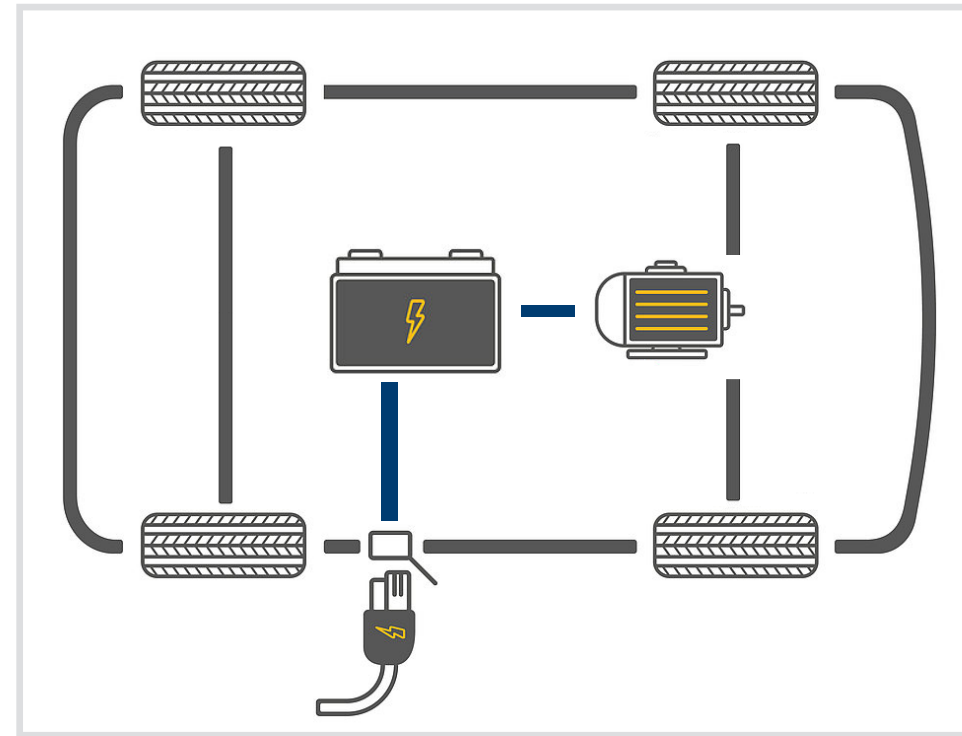




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# AUTOMOTIVE TESTING

The BEV or HEV is more than just this!

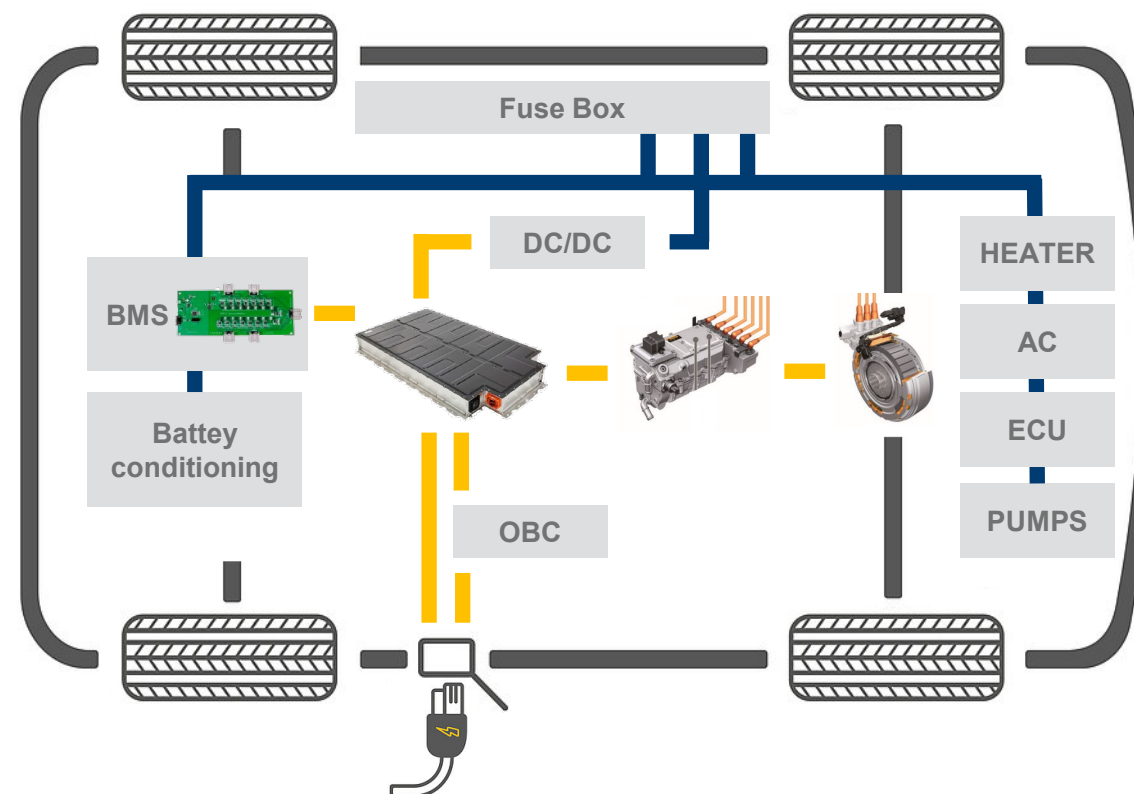


# AUTOMOTIVE TESTING

## HEV and BEV system view

HEVs and BEVs have many electrically sub systems. Even more than can be shown here:

- HV-Battery
- LV-Battery
- OBC
- Multiple DC/DC
- BMS
- Battery conditioning
  - Heater
  - Pumps and valves
  - Compressors
- Fuse and junction box
- Control Units
- Electric air-condition and brake assistance

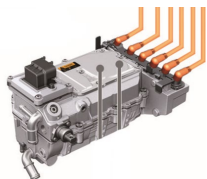

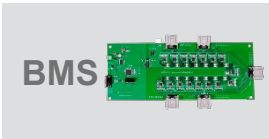






# AUTOMOTIVE TESTING

Inverter, Motor and BMS testing by EA

	KEY TESTS PERFORMED	EA PRODUCT VARIANT
	<ul style="list-style-type: none"><li>▪ General development</li><li>▪ Efficiency measurement</li><li>▪ End of line testing</li><li>▪ Durability testing</li></ul>	<ul style="list-style-type: none"><li>▪ EA-10000 Series</li><li>▪ EA-10000 Industrial Series</li><li>▪ [...]</li></ul>
	<ul style="list-style-type: none"><li>▪ General development</li><li>▪ Efficiency measurement</li><li>▪ End of line testing</li><li>▪ Durability testing</li></ul>	<ul style="list-style-type: none"><li>▪ EA-10000 Series</li><li>▪ EA-10000 Industrial Series</li><li>▪ [...]</li></ul>
	<ul style="list-style-type: none"><li>▪ Safety features</li><li>▪ Charge and discharge</li><li>▪ Efficiency</li></ul>	<ul style="list-style-type: none"><li>▪ EA-10000 Series</li><li>▪ EA-10000 Industrial Series</li><li>▪ [...]</li></ul>



# AUTOMOTIVE TESTING

Inverter, Motor and BMS testing by EA

	KEY TESTS PERFORMED	EA PRODUCT VARIANT
OBC	<ul style="list-style-type: none"><li>▪ General development</li><li>▪ Efficiency measurement</li><li>▪ End of line testing</li><li>▪ Durability testing</li></ul>	<ul style="list-style-type: none"><li>▪ EA-10000 Series</li><li>▪ EA-10000 Industrial Series</li><li>▪ [...]</li></ul>
DC/DC	<ul style="list-style-type: none"><li>▪ General development</li><li>▪ Efficiency measurement</li><li>▪ End of line testing</li><li>▪ Durability testing</li></ul>	<ul style="list-style-type: none"><li>▪ EA-10000 Series</li><li>▪ EA-10000 Industrial Series</li><li>▪ [...]</li></ul>
Fuse Box	<ul style="list-style-type: none"><li>▪ Safety features</li><li>▪ Charge and discharge</li><li>▪ Efficiency</li></ul>	<ul style="list-style-type: none"><li>▪ EA-10000 Series</li><li>▪ EA-10000 Industrial Series</li><li>▪ [...]</li></ul>



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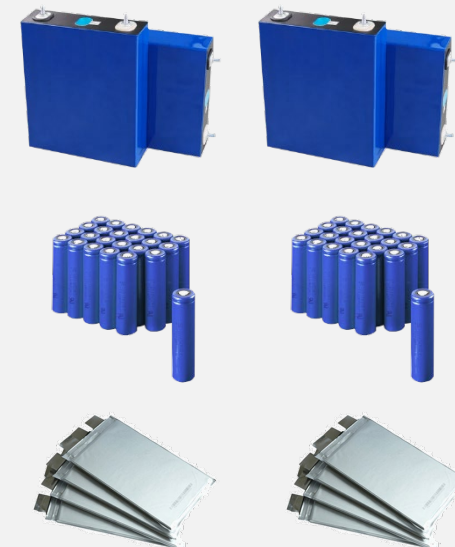
# PACK / MODULE / CELL LEVEL TEST



PACK



MODULE

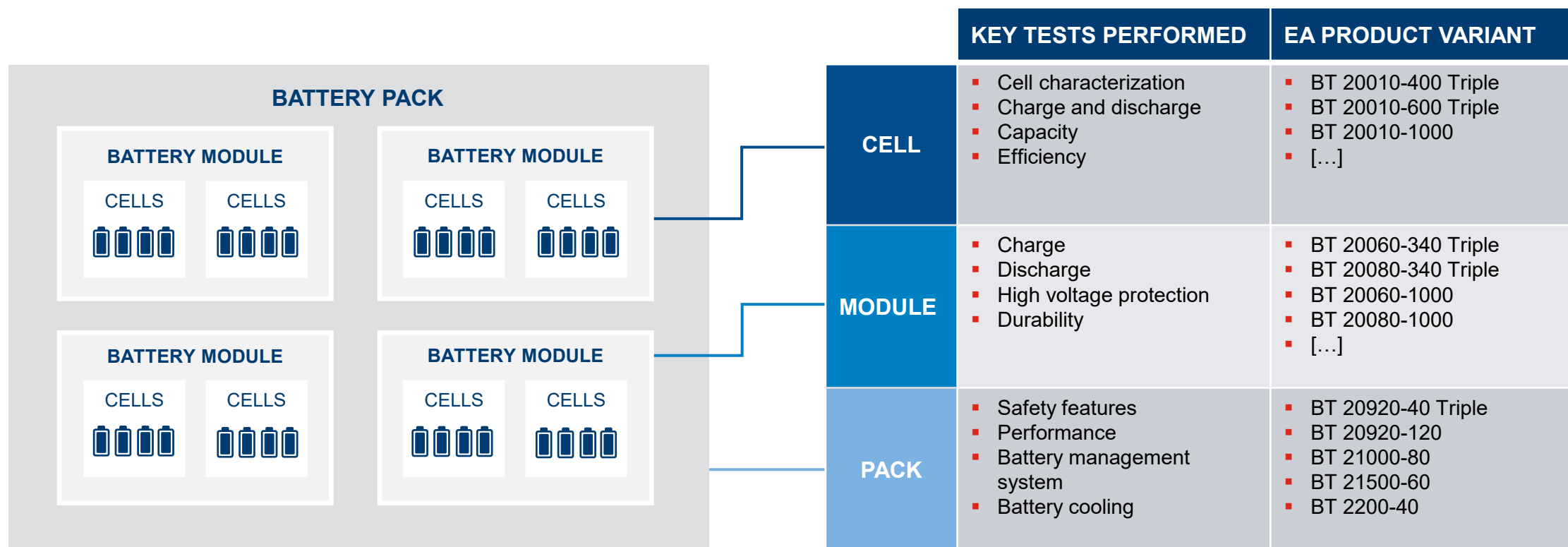


CELL



# CELL / MODULE / PACK LEVEL TEST

EA-BT 20000 Single Channel and Triple Channel Battery Testing Family





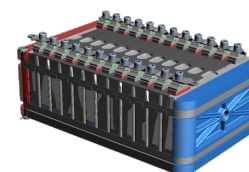
# BATTERY 2<sup>ND</sup> LIFE AND RE-CYCLING

Used battery packs contains a lot of valued material. They would get either re-cycled or qualified for a 2nd life.



Re-cycling requires safe discharge before open and dismantle

Dismantle



Re-Use requires testing on either module, pack or cell level.

Qualifying and grading



Separate and mill  
(alloy, steel, copper, black mass)



Re-group or re-use on module level



# BATTERY 2<sup>ND</sup> LIFE AND RE-CYCLING

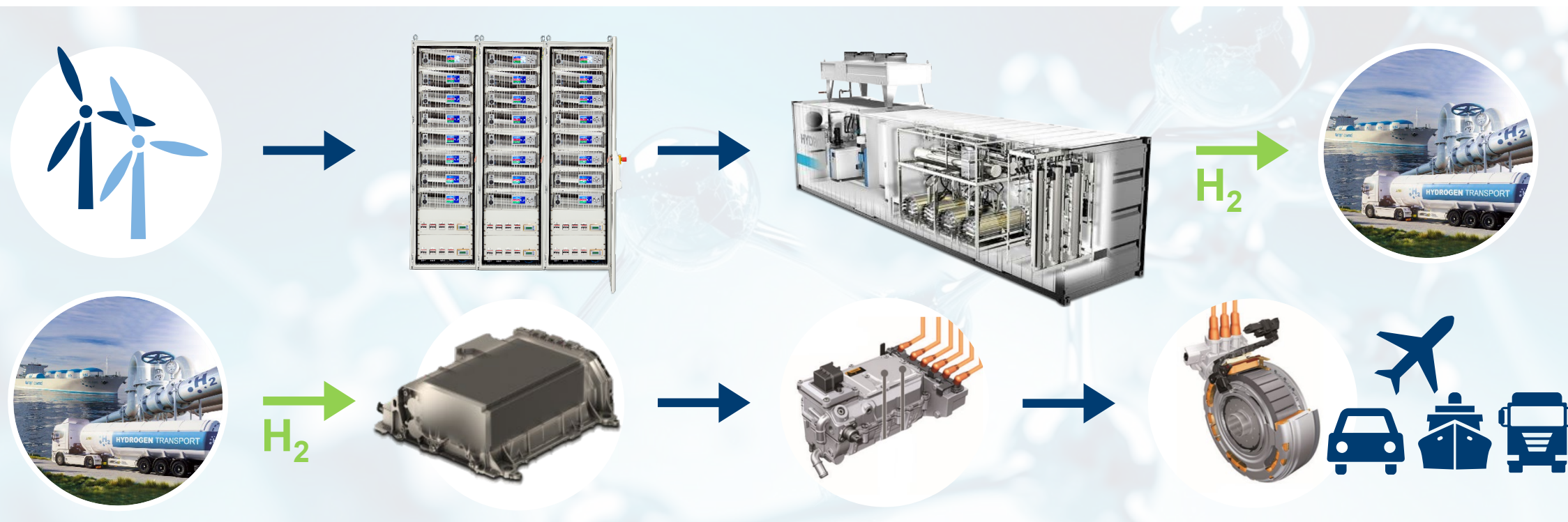
	KEY TESTS PERFORMED	EA PRODUCT VARIANT
 <p>Safe dismantling for re-cycling</p>	<ul style="list-style-type: none"><li>▪ Deep discharge</li></ul>	<ul style="list-style-type: none"><li>▪ EA-10000 Series</li><li>▪ EA-10000 Industrial Series</li><li>▪ EA Power Rack</li><li>▪ EA-BT 20000 Series</li><li>▪ [...]</li></ul>
 <p>Testing and grading for 2<sup>nd</sup> life</p>	<ul style="list-style-type: none"><li>▪ Characterization</li><li>▪ Charge and discharge</li><li>▪ Capacity measurement</li><li>▪ R<sub>dc</sub> measurement</li></ul>	<ul style="list-style-type: none"><li>▪ EA-10000 Series</li><li>▪ EA-10000 Industrial Series</li><li>▪ EA Power Rack</li><li>▪ EA-BT 20000 Series</li><li>▪ [...]</li></ul>



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# H<sub>2</sub> ECO SYSTEM


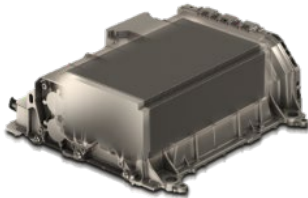
The wheel-to-wheel path of energy





# H<sub>2</sub> ECO SYSTEM

Electrolyser and fuel cell testing and operation by EA

	KEY TESTS PERFORMED	EA PRODUCT VARIANT
 <p>Electrolyser</p>	<ul style="list-style-type: none"><li>▪ General development</li><li>▪ Material characterization</li><li>▪ End of line testing</li><li>▪ Efficiency measurement</li><li>▪ Durability testing</li><li>▪ Industrial H<sub>2</sub> generation</li><li>▪ Auxiliary Supply<ul style="list-style-type: none"><li>▪ Heaters</li><li>▪ Compressors</li><li>▪ Pumps and valves</li></ul></li></ul>	<ul style="list-style-type: none"><li>▪ EA-10000 Series</li><li>▪ EA-10000 Industrial Series</li><li>▪ EA Power Rack</li><li>▪ EA-BT 20000 Series</li><li>▪ [...]</li></ul>
 <p>Fuel cell</p>	<ul style="list-style-type: none"><li>▪ General development</li><li>▪ Material characterization</li><li>▪ End of line testing</li><li>▪ Efficiency measurement</li><li>▪ Durability testing</li><li>▪ Auxiliary Supply</li></ul>	<ul style="list-style-type: none"><li>▪ EA-10000 Series</li><li>▪ EA-10000 Industrial Series</li><li>▪ EA Power Rack</li><li>▪ EA-BT 20000 Series</li><li>▪ [...]</li></ul>





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# EA-10000 SERIES

19" Rack mount series for industry, research and development, conventional and regenerative technology

- 60V – 2000V
- 1,5K – 30kW
- 2U - 3U - 4U
- 4U with water cooled option

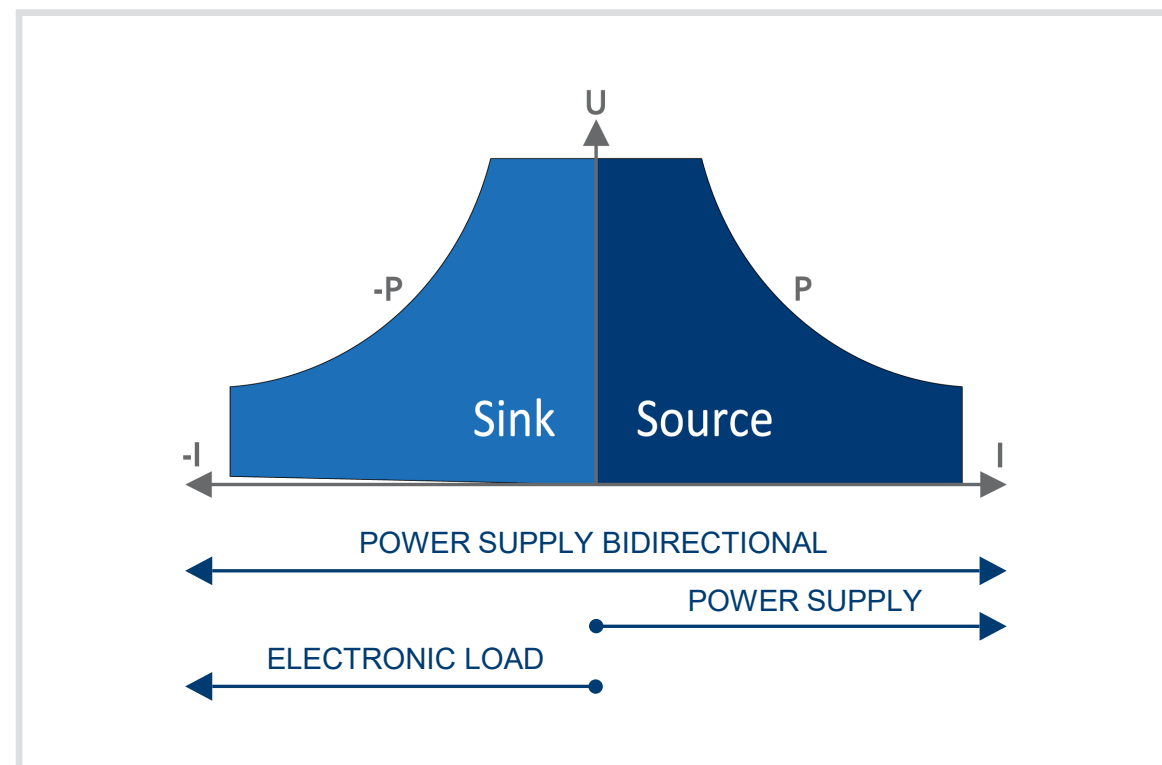




# PRODUCT LANDSCAPE

## EA-10000 Series

- **PSB** Power Supply Bidirectional
- **PSI** Power Supply Intelligent
- **PS** Power Supply
- **ELR** Electronic Load Regenerative





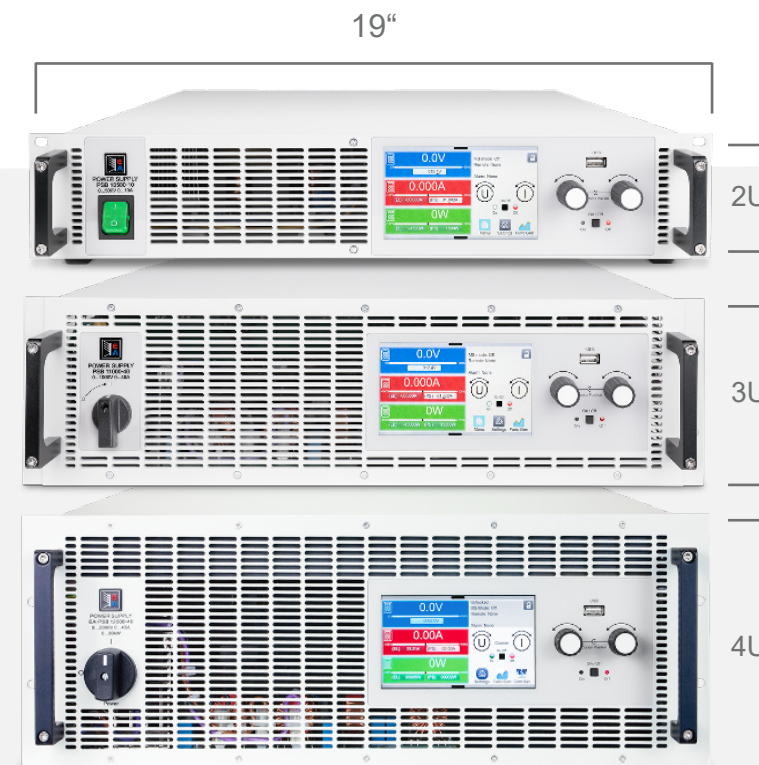
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# PRODUCT LANDSCAPE

## Product Dimensions

### EA-10000 Series Dimensions

- 19" = 482,6 mm (width)
- 2U = 88 mm 3,5" (height)
- 3U = 138 mm 5,2"
- 4U = 177 mm 7"





# PRODUCT LANDSCAPE

## EA-10000 Series by feature



\* Note: 18 kW for 208 Vac grid (relevant for US and Japan)



# PRODUCT LANDSCAPE

## EA-10000 Series by feature

Features	2U		3U			4U		6U
	1,5 kW	3 kW	5 kW	10 kW	15 kW	18 kW*	30 kW	60 kW
PSB		●	●	●	●	●	●	
ELR	●	●	●	●	●	●	●	
PSI	●	●	●	●	●	●	●	
PS	●	●	●	●	●	●	●	
PUB							●	●
PUL							●	●
PU							●	●

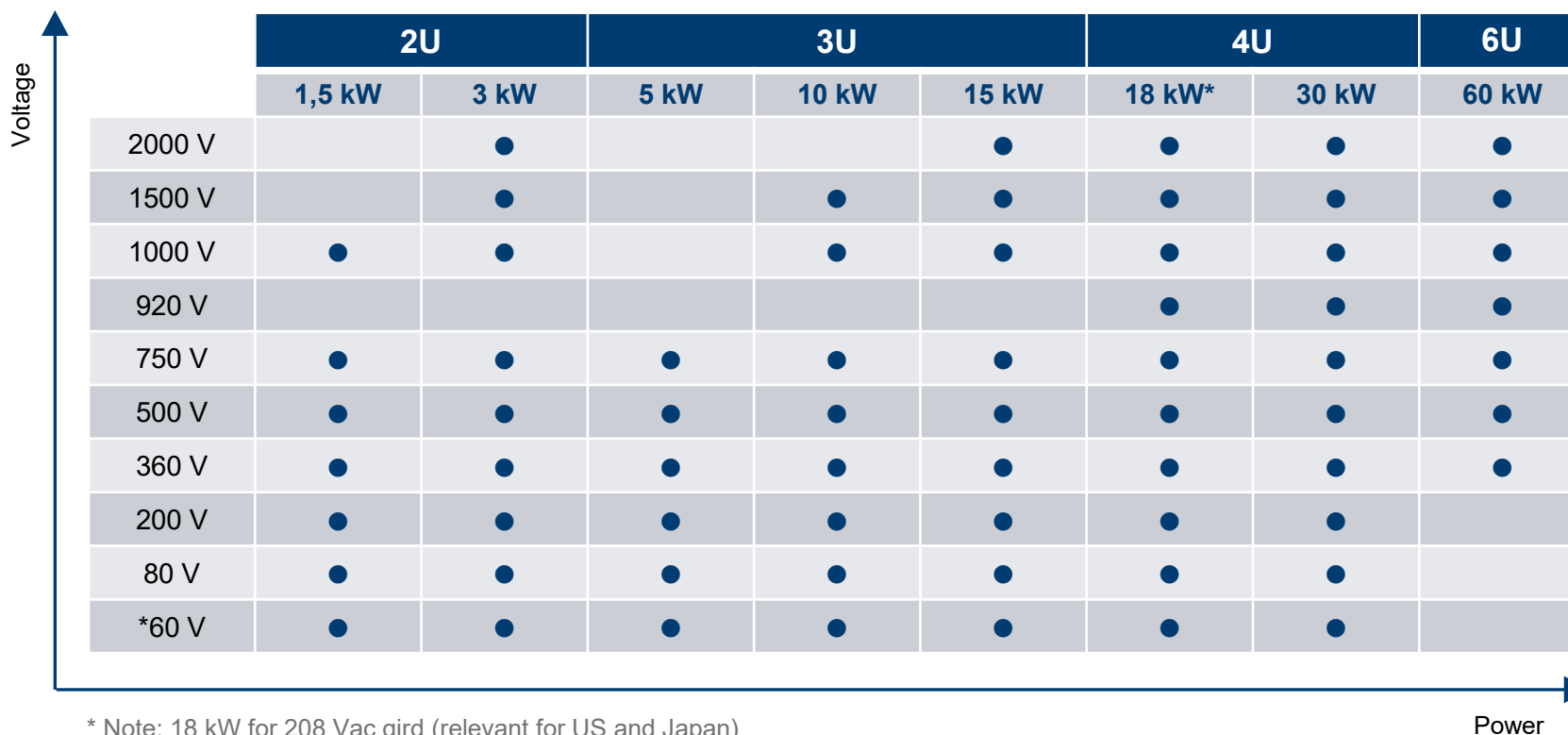
\* Note: 18 kW for 208 Vac grid (relevant for US and Japan)

Power



# PRODUCT LANDSCAPE

## EA-10000 Series by voltage



ELR and PUL  
models starting at 80 V

\* Note: 18 kW for 208 Vac grid (relevant for US and Japan)

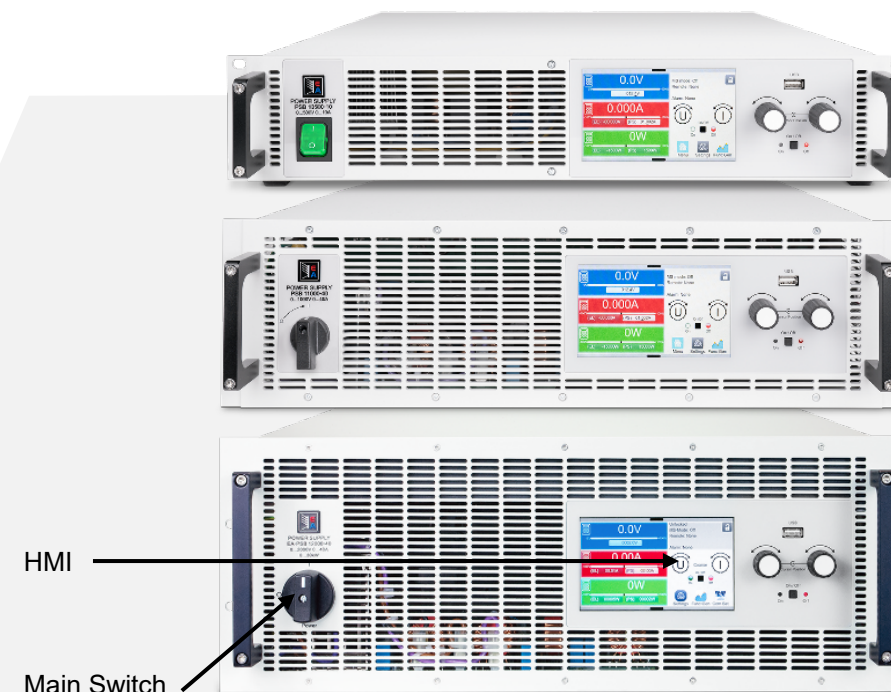
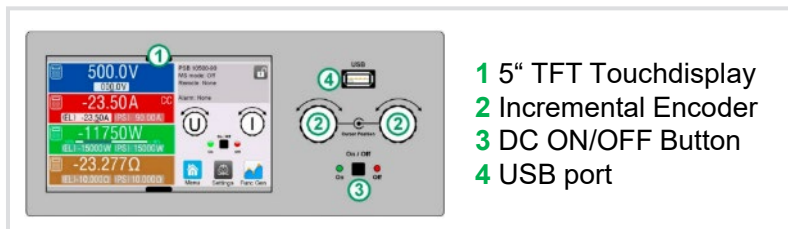
Power



# PRODUCT PORTFOLIO

## EA-10000 series - Front side

- All devices of the 10000 Series are developed identically and can be operated identically.
- Main Switch to switch the device on/off.
- 5" Touch Display to operate the device.
- Incremental encoder to set values of voltage, current, power and resistance.
- DC ON/OFF Button to switch only the DC output on/off.
- USB port for logging/sequencing or device diagnostics.



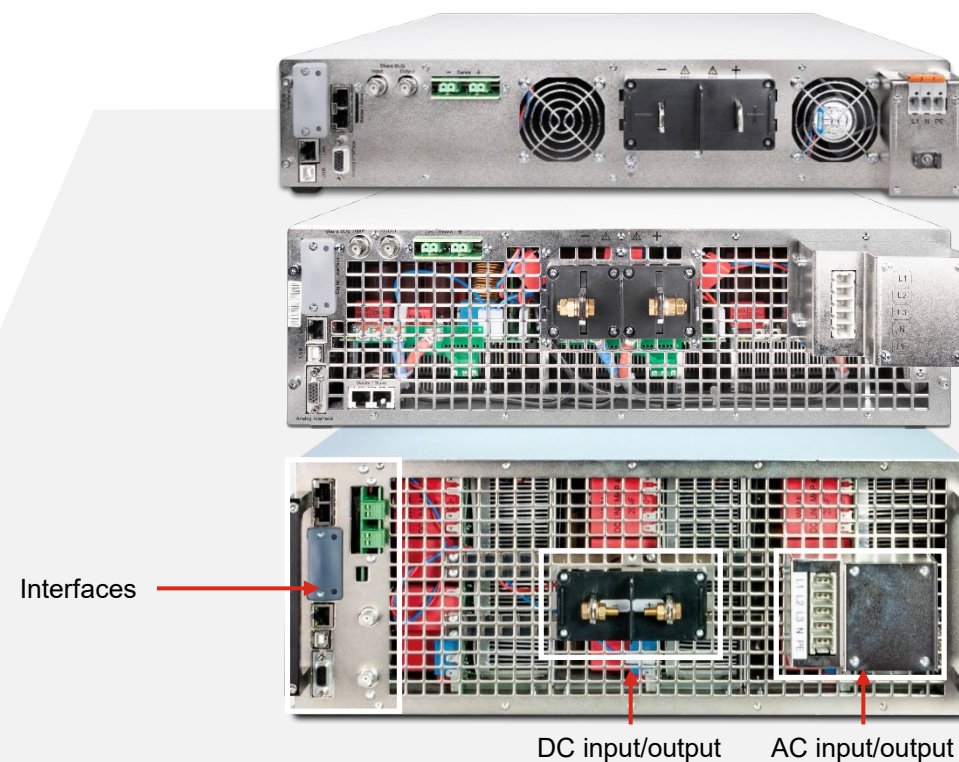


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# PRODUCT PORTFOLIO

## EA-10000 series - Rear side

- All devices of the 10000 Series are developed identically and can be operated identically.
- AC input/output and DC input/output.
- Interfaces for remote control.
- Sense connection.
- Interfaces for Master-Aux operation.







# PRODUCT PORTFOLIO

## EA-10000 Series

### EA-PSB 10000

- Top of the product line in bidirectional power supply
- Full 2-quadrants in source and sink
- All interface
- All operation modes:
  - CV, CC, CP, CR with fast crossover
  - Integrated function generator with predefined curves
  - Automotive test procedures for LV123, LV124 and LV148
  - Battery test mode, battery and fuel cell simulation
  - Photovoltaics test mode (EN 50530), MPPT
- Master Aux Bus for parallel operation of up to 64 devices of all power classes within the 10000 series
- Command languages and drivers: SCPI and ModBus, LabVIEW, IVI

### EA-PSB 10000

- Top of the product line in bidirectional power supply
- Fully featured



# PRODUCT PORTFOLIO

## EA-10000 Series

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### EA-ELR 10000

- Top product in power supply
- (load only)
- All interface
- All operation modes:
  - CV, CC, CP, CR with fast crossover
  - Integrated function generator with predefined curves
- Master Aux Bus for parallel operation of up to 64 devices of all power classes within the 10000 series
- Command languages and drivers: SCPI and ModBus, LabVIEW, IVI

### EA-ELR 10000

- Top of the product line in bidirectional power supply
- Fully featured load



# PRODUCT PORTFOLIO

## EA-10000 Series

### EA-PSI 10000

- Top product in power supply
- (source only)
- All interface
- All operation modes:
  - CV, CC, CP, CR with fast crossover
  - Integrated function generator with predefined curves
  - Automotive test procedures for LV123, LV124 and LV148
  - Fuel cell simulation
  - Photovoltaics test mode (EN 50530), MPPT
- Master Aux Bus for parallel operation of up to 64 devices of all power classes within the 10000 series
- Command languages and drivers: SCPI and ModBus, LabVIEW, IVI

### EA-PSI 10000

- Top product power supply
- Fully featured supply



# PRODUCT PORTFOLIO

## EA-10000 Series

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### EA-PS 10000

- Value power supply
- (source only)
- All interface
- Operation modes:
  - CV, CC, CP, CR with fast crossover
  - (no function generator)
- Master Aux Bus for parallel operation of up to 64 devices of all power classes within the 10000 series
- Command languages and drivers: SCPI and ModBus, LabVIEW, IVI

### EA-PS 10000

- Value product power supply
- Straight forward programmable supply



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# EA-10000 INDUSTRIAL SERIES

19" Rack mount series for industrial and high power application regenerative, air or water cooled

- 60V – 2000V
- 30K – 60kW
- 4U - 6U
- Air or water cooled

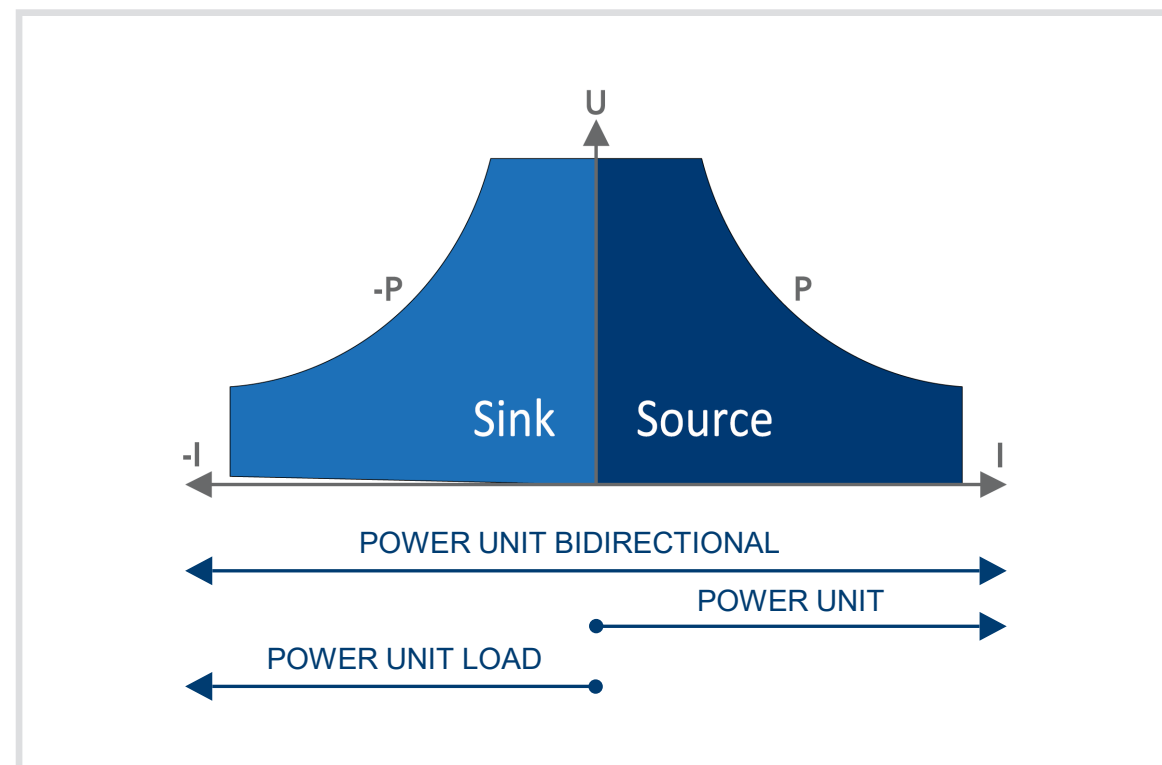




# PRODUCT LANDSCAPE

## EA-10000 Industrial Series

- **PUB** Power Unit Bidirectional
- **PU** Power Unit
- **PUL** Power Unit Load





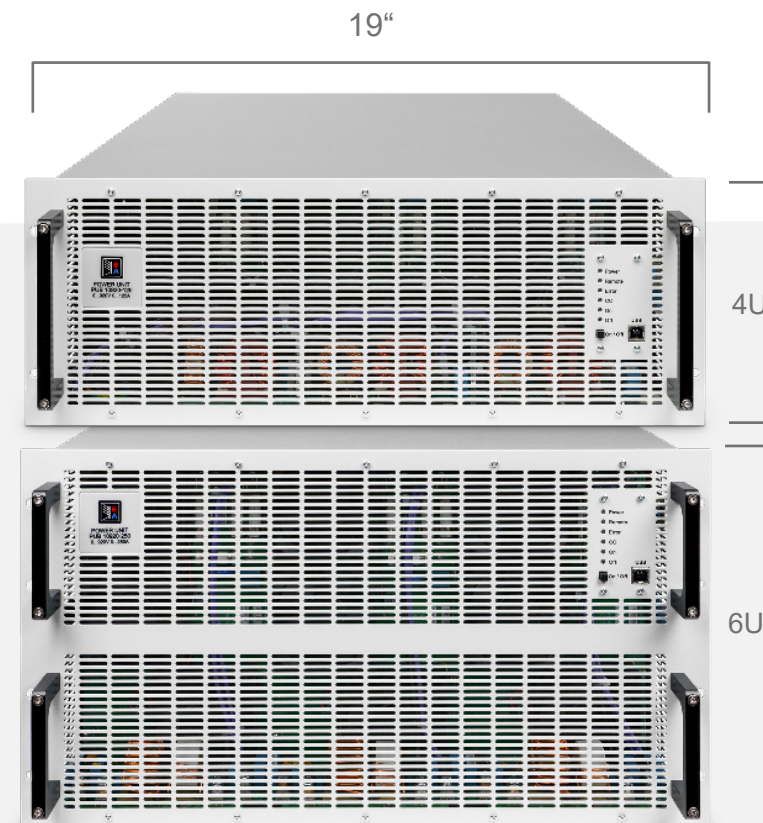
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# PRODUCT LANDSCAPE

## Product Dimensions

### EA-10000 Industrial Series Dimensions

- 19" = 482,6 mm (width)
- 4U = 177mm 7" (height)
- 6U = 266mm 10,5"



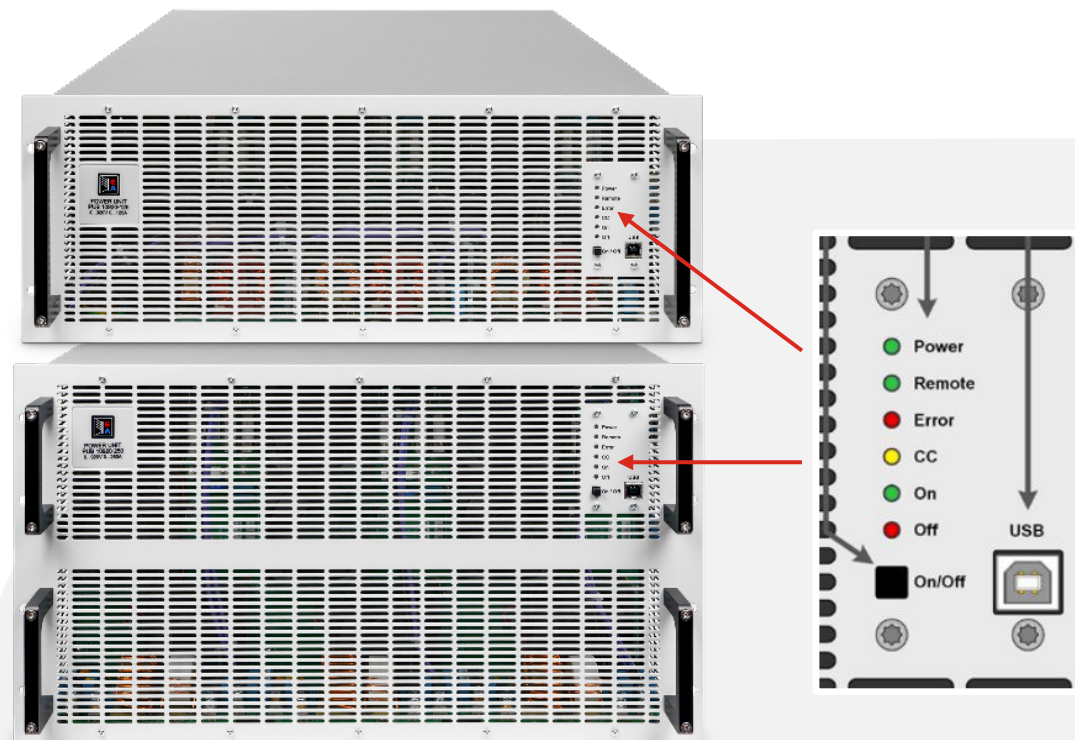


# PRODUCT PORTFOLIO

## EA-10000 Industrial Series - Front side

### Front side

- Status LED's on the frontpanel to be able to quickly recognize the condition of the device.
- The devices are optimized to be used in rack-systems, the on/off switch is integrated into the rack system.







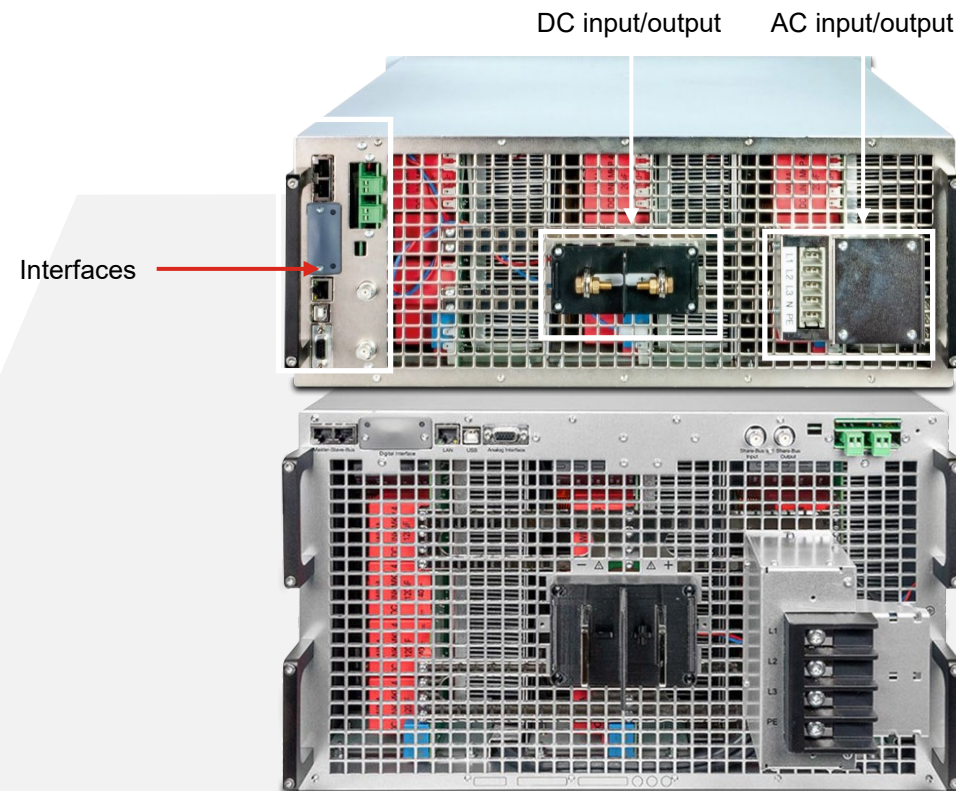
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# PRODUCT PORTFOLIO

## EA-10000 Industrial Series - Rear side

### Rear side

- All devices of the 10000 Industrial Series are developed identically and can be operated identically.
- AC input/output and DC output/input.
- Interfaces for remote control.
- Sense connection.
- Interfaces for Master-Aux operation.





# PRODUCT PORTFOLIO

## EA-10000 Industrial Series

### EA-PUB 10000

- Top industrial bidirectional power supply
- Full 2-quadrants in source and sink
- All interface
- All operation modes:
  - CV, CC, CP, CR with fast crossover
  - Function generator optional
- Available in:
  - 4U 30kW
  - 6U 60kW
- Master Aux Bus for parallel operation of up to 64 devices of all power classes within the 10000 series
- Command languages and drivers: SCPI and ModBus, LabVIEW, IVI

### EA-PUB 10000

- Industrial version bidirectional power supply
- Industrial fully featured



# PRODUCT PORTFOLIO

## EA-10000 Industrial Series

### EA-PUL 10000

- Industrial regenerative load
- (source only)
- All interface
- All operation modes:
  - CV, CC, CP, CR with fast crossover
  - Function generator optional
- Available in:
  - 4U 30kW
  - 6U 60kW
- Master Aux Bus for parallel operation of up to 64 devices of all power classes within the 10000 series
- Command languages and drivers: SCPI and ModBus, LabVIEW, IVI

### EA-PUL 10000

- Industrial version regenerative load
- Industrial fully featured



# PRODUCT PORTFOLIO

## EA-10000 Industrial Series

### EA-PU 10000

- Industrial power supply
- (sink only)
- All interface
- All operation modes:
  - CV, CC, CP, CR with fast crossover
  - Function generator optional
- Available in:
  - 4U 30kW
  - 6U 60kW
- Master Aux Bus for parallel operation of up to 64 devices of all power classes within the 10000 series
- Command languages and drivers: SCPI and ModBus, LabVIEW, IVI

### EA-PU 10000

- Industrial version power supply
- Industrial fully featured



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# PRODUCT PORTFOLIO

## EA-BT 20000 Series

### EA-BT 20000 4U - Battery Testers

Highest Voltage, Highest Current and Highest Regenerative Efficiency

- 3-Channel and single channel models
- Highest current output – 600 A and 1000 A
- Highest voltage output – 920 V and 2000 V
- Up to 10 kW/channel and 30 kW in one instrument
- 3 Channels paralleled deliver – 1800 A
- Higher current through paralleling of devices (up to 64)
- Highest efficiency for returning absorbed power to the grid – up to greater than 96%





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# EA POWER RACK

19" Rack mount series for industrial and high power application regenerative, air or water cooled

- 60V – 2000V
- Up to MW
- 15U - 426U
- Air or water cooled





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# PRODUCT PORTFOLIO

## EA Power Rack

### Integratable device series:

- EA 10000 Series
- EA 10000 Industrial Series
- EA 20000 BT Series

### Integratable device heights:

- 2U to 6U

### Rack heights:

- 15U to 42U





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# PRODUCT PORTFOLIO

## EA Power Rack

### Options:

- Fast stop
- Water cooling
- DC copper bars
- Gird monitoring
- Isolation monitoring
- DC contactors







# PRODUCT PORTFOLIO

## EA Power Rack

### EA Power Rack

- Up to 300 kW per single 42U rack
- Systems with up to 3.84 MW are possible by connecting 64 x 6U devices
- Multiple options to adopt to customer demand
- The system can be retrofitted at a later stage with the extension racks
- The DC outputs of the racks can be connected together to generate one DC connection point.
- 2-channel emergency stop in accordance with to EN 60204-1
- Control Switch to switch the whole rack on and off
- Lockable Front and rear door with mosquito grid.
- Rack width: 600 mm
- Rack depth: 1000 mm

### EA Power Rack:

- State of art cabinets to host EA equipment
- Fully featured including safety functions
- Fully flexible to configure with multiple options



# EA POWER CONTROL

Versatile Software with many functions

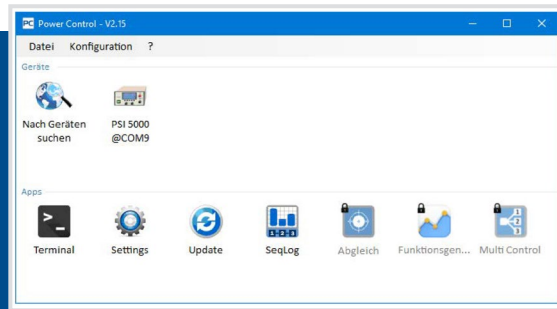
- Remote Control of up to 20 devices
- Additional functions such as sequencing and logging
- Function generator, software update
- PV Array and Fuel Cell Simulation
- Labiew VI's, Microsoft IVI drivers and dbc files for easy system integration





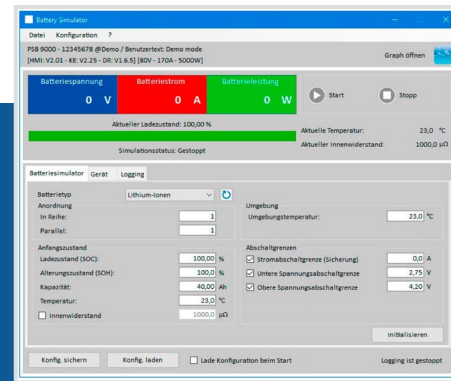
# EA POWER CONTROL

EA Software with many functions



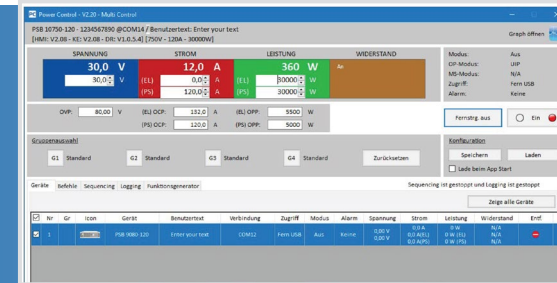
## EA Power Control

- Windows Application
- Tile style launcher page
- Full product range support
- Supports function generator, PV and automotive standards



## EA Battery Simulator

- Supports Li-Ion and Lead-Acid cell chemistries
- Array simulation up to 400 in serial or parallel connection



## EA Multi Control

- Up to 20 devices under common control
- Grouping of device in 4 control groups
- Individual sequence logging



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# YES TO EA-10000 SERIES

Largest product variety. Extended performance range. Simple and efficient.



**Yes to more choice** with more than 180 DC power supplies and electronic loads: programmable, bidirectional, regenerative



**Yes to extended power ranges:** From 600 W up to 30 kW programmable output power, from 6 A up to 1000 A output current, and from 10 V up to 2000 V output voltage



**Yes to energy recovery** greater than 96 % efficiency



**Yes to safe parallel connection** of up to 64 devices in the EA-Power Racks



**Yes to efficient applications** with autoranging and built-in function generator



**Yes to easy handling** with uniform devices and many interfaces to PCs and PLCs



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# EA HITS THE MARK

Programmable Bidirectional Power Supplies for Testing HV and LV Automotive Equipment





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**THANK YOU.**