



## 可编程能量回馈式直流电子负载

Programmable electronic DC loads with energy recovery



EA-ELR 9200-210 HP



- 宽范围的交流输入电压：360...528 V，适合400 V与480 V电网
- 可将直流电量返回到本地电网
- 直流输入端为电隔离结构
- 每台产品的输入功率高达15 kW，还可扩展至240 kW
- 输入电压高达1500 V
- 每台产品的输入电流能高达510 A
- 基于FPGA数字式控制
- 多语言TFT触摸屏
- 用户配置文档，真实函数发生器
- 电隔离
- 并联用主-从总线
- 前板有额外的USB端口，适合插外置U盘
- 可选数字式即插即用型接口，或选择安装IEEE/GPIB端口
- 支持SCPI指令语言

- AC wide range input 360-528 V, for 400 V and 480 V grids
- Energy recovery of the supplied DC energy into the local grid
- Galvanically isolated DC input
- Input power ratings up to 15 kW per unit, expandable to 240 kW
- Input voltages up to 1500 V
- Input currents up to 510 A per unit
- FPGA based digital control
- Multilingual TFT touch panel
- User profiles, true function generator
- Galvanically isolated
- Master-slave bus for parallel connection
- Extra USB port on the front for USB stick
- Optional, digital, plug & play interfaces or alternatively installed IEEE/GPIB port
- SCPI command language supported

## 概要

这一款新的能量返回式直流电子负载，称为EA-ELR 9000 HP，是EA-ELR 9000系列的延伸版。其宽范围的交流输入电压可以连接400 V或480 V三相电的工业电网。

而且所有型号都可供应更大功率级别，并增加了360 V新的电压等级。一些高电压型号的绝缘性能也有很大改善。

## General

The new series of electronic DC loads with energy recovery to mains, called EA-ELR 9000 HP, is an enhancement of the favored series EA-ELR 9000. It offers wider AC input range for the operation on industrial grids with 400 V or 480 V three-phase supply.

Furthermore, all models offer a higher power rating and there is a new voltage class with 360 V. The insulation of some high voltage models has also been improved.

**EA-ELR 9000 HP 5 kW - 15 kW**

上海雨芯仪器 021-6451135

能量返回功能可使产生的直流电同步转化成正弦波电流，然后返回给当地电网。这不仅摆脱了以前的热耗散问题，同时还节省了用电成本。其彩色TFT触摸屏为用户提供一个不同于其他产品的直观手操媒介。

经模拟或数字接口控制的反应时间已由FPGA控制硬件得到很好的改善。

多台产品并联时，可经主-从总线组成一个更大的系统，此时实际值会被累加，设定值则会均衡分布。

**功率、电压和电流等级**

本系列有0...80 V DC至0...1500 V DC输出电压的产品型号，还有一款输入电流高达510 A的型号。本系列有三个功率级别，分别为5 kW，10 kW或15 kW，单机外壳仅3U高。还可扩展至高达240 kW（组合到机柜形成更大的总电流）。

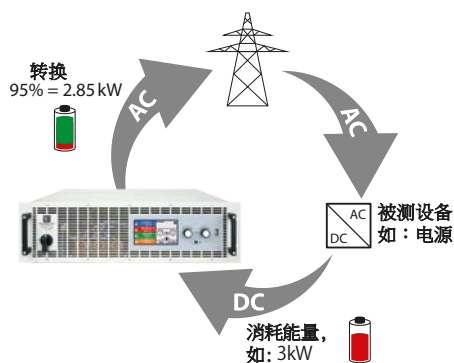
**供电**

所有型号都需接上不带N导线的400 V (L-L)或480 V两相或三相电，这在工业电网都很典型。本系列产品可接360-528 V的宽范围交流输入电压，完全覆盖400 V至480 V之间的供电电压。

**能量返回**

本负载最主要的特点是其AC输入端，即电网连接端，也可用作直流电返回的输出端，转换效率高达95%。这种能量转换方式有助于降低用电成本，且避免使用昂贵的制冷系统，因为普通电子负载使用过程中会将直流输入电量转化成热量，从而需要制冷系统进行冷却。

下面为其原理示意图：



此类回馈式负载不可用作发电。还提供能监控能量返回公共电网的电网保护装置，它同时还可达到保护人生安全与设备本身的目的，特别是在运行所谓的隔离操作时。但是该装置需要N导线。

不管用户是否装此类监控设备，我们产品上都配有一简易无冗余关闭功能，遇到电网连线突然断开时会关闭产品。本产品可监控AC电压和频率，当超过功率上限或下限时，会自动关闭功率模块。

The energy recovery function converts the supplied DC energy into a synchronous sine current and feeds it back into the local grid. This eliminates the usual heat dissipation to a minimum and saves energy costs at the same time. The large colour TFT touch panel offers a different and intuitive kind of manual operation, compared to other devices.

Response times for the control via analog or digital interfaces have been improved by the FPGA controlled hardware.

In parallel operation of multiple devices, a master-slave bus is used to connect the units to a bigger system where the actual values are totalled and the set values distributed.

**Power ratings, voltages, currents**

The available voltage range portfolio goes from models with 0...80 V DC up to models with 0...1500 V DC. Input currents up to 510 A with only one unit are available. The series offers three power classes with 5 kW, 10 kW or 15 kW in only 3U for single devices, which can be extended up to 240 kW (in cabinets for a significantly high total current).

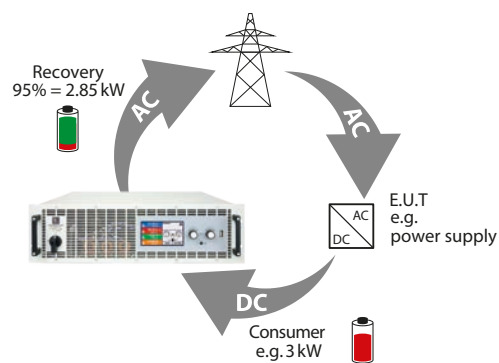
**Supply**

All models require a 2-phase or 3-phase mains supplies with 400 V (L-L) or 480 V supply voltage and without N conductor, as typical in the industrial grids. The device offer a wide range AC input with 360 - 528 V, which can even cover supply voltages between 400 V and 480 V.

**Energy recovery**

The most important feature of these electronic loads is that the AC input, i.e. grid connection, is also used as output for the recovery of the supplied DC energy, which will be converted with an efficiency of up to 95%. This way of energy recovery helps to lower energy costs and avoids expensive cooling systems, such as they are required for conventional electronic loads which convert the DC input energy into heat.

Principle view:



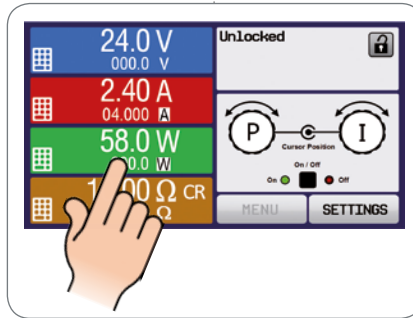
Operation of these recovering loads in terms of power generation is not intended. Grid protection devices, which could supervise the feedback of energy into the public grid, are available for optional installation and are intended to achieve additional safety of persons and equipment, especially when running the so-called isolated operation. But such a device would also require the N conductor.

Regardless of whether the user has installed that supervision unit or not, the devices feature a simple and non-redundant switch-off function for the case of an interruption in the grid connection cable. The device supervises AC voltage and frequency and will automatically switch off the power stages in case upper or lower limits are exceeded.

**EA-ELR 9000 HP 5 kW - 15 kW** 上海雨芯仪器 021-6451135**操作面板 (HMI)**

手动操作通过阻性触摸屏、两个旋钮与一个按钮来完成。这个彩色显示器能一次性显示所有设定与实际值。在人机界面也可完成整个设置，包括函数发生器（方波，三角波，正弦波等）的配置。

显示器有多种语言可选（德文，英文，俄文，中文）。

**Operation (HMI)**

Manual operation is done with a Gorilla glass touch panel, two rotary knobs and a pushbutton. The large colour display shows all relevant set values and actual values at a glance. The whole setup is also done with the human-machine interface, as well the configuration of functions (square, triangle, sine) etc.

The display is multilingual (German, English, Russian, Chinese).

**函数发生器与表格控制**

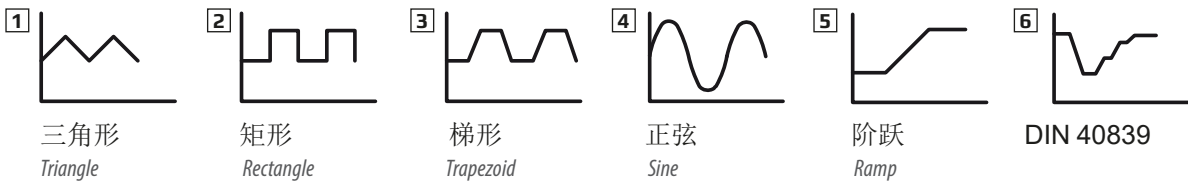
本产品还具有一基于FPGA的数字函数与任意发生器。它可控制和运行用户定制的负载配置文档，并产生任意顺序的正弦、方形、锯齿形以及跳跃型函数。

通过3276个有效点数自由编程的数值表，能实时嵌入到控制电路中，然后可重现非线性内阻，如：电池或LED灯条中的内阻。

**Function generator and table control**

A special feature is the comfortable, FPGA based, digital function and arbitrary generator. It enables to control and run user-customisable load profiles and can generate sine, square, saw tooth and ramp functions in arbitrary order.

With a freely programmable, digital value table of 3276 points, which is embedded in the control circuit, the devices can reproduce non-linear internal resistances, such as those of batteries or LED chains.

**Share-Bus-共享总线**

产品后板有一个模拟连接端子叫“Share Bus”，用来均衡本系列多台同型号产品并联时的电流。还可通过此端子连接EA-PSI 9000，EA-PS 9000与EA-PSE 9000系列电源，以便组建两象限系统。该系统专门利用源-沉原理进行测试用途。

**Share Bus**

The so-called „Share Bus“ is an analog connection at the rear of the devices and is used to balance current across multiple identical units of this series in parallel connection.

It can also be used to build a two-quadrants system in connection with power supplies of series EA-PSI 9000, EA-PS 9000 and EA-PSE 9000. This system is dedicated for testing purposes using the source-sink principle.

**电池测试**

本产品还有一电池测试模式，可以通过恒流或恒阻放电来测试各类电池。它会显示累计的测试时间与消耗的容量 (Ah)。

**Battery test**

For purposes of testing all kinds of batteries, such as for example constant current or constant resistance discharging, the devices offer a battery test mode. This show extra values for elapsed testing time and consumed capacity (Ah).

Data recorded by the PC during tests with, for example, EA Power Control can be exported as Excel table in CSV format and analysed later in MS Excel or similar tools and even visualised as a discharge diagram.

For more detailed setup, there is also an adjustable threshold to stop the battery test on low battery voltage, as well an adjustable maximum test period.

例如使用EAPC软件测试期间由电脑记录的数据，可以CSV格式导出到Excel表，并在微软Excel或类似工具下进行分析，还可形成可视化的放电图。关于更详细的设置，还可设定一可调极限值，当电池电压低时停止测试，或者停止可调最大测试期。

**远程控制 & 连接**

进行远程控制时，可使用产品后板默认配置的两个接口端口（1x模拟，1xUSB）。也可选择可插拔式数字接口模块（指定插槽）进行扩展。

**Remote control & connectivity**

For remote control, there are by default two interface ports (1x analog, 1x USB) available on the rear of the devices, which can also be extended by optional, pluggable and retrofittable, digital interface modules (dedicated slot).

Alternatively to the interface modules slot, all models can be equipped with a three-way interface (Option 3W, see below), which then offers 1x GPIB/IEEE, 1x USB and 1x Analog on the rear side of the device.

For the implementation into the LabView IDE we offer ready-to-use components (VIs) to be used with interface types USB, RS232, GPIB and Ethernet. Other IDEs and interfaces are supported by documentation about the communication protocol.

产品上还有一个接口模块插槽，所有型号都可安装一个三路接口（3W选项，见下文），为产品后板提供1xGPIB/IEEE，1xUSB，1x模拟端口。应用到LabView IDE时，用户可以结合USB，RS232，GPIB，Ethernet使用即用版(VIs)。通过通讯协议文档还可支持其它IDE与接口。



## EA-ELR 9000 HP 5 kW - 15 kW

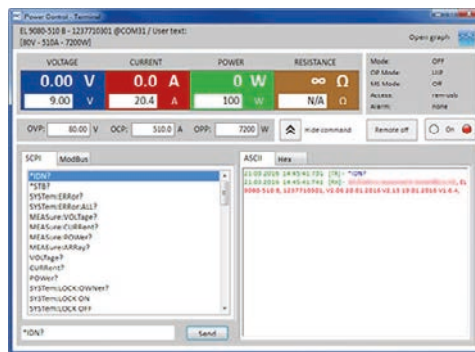
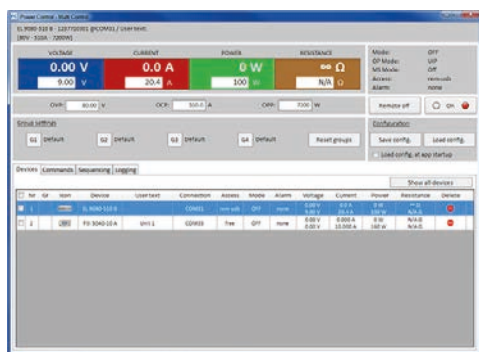
上海雨芯仪器 021-6451135

Windows用户还可使用“EA Power Control”免费软件。它具有“排序”功能，通过CSV格式的半自动化表格控制产品。此表能代表简易的测试程序，可在MS Excel或其它CSV编辑器下创建与编写，然后导入软件工具内。

该软件利用“多功能控制”特性（需注册码，非免费），可一次性监控多达20台产品。更多信息见134页。

Windows users can profit from the free software “EA Power Control”. It offers a feature called “Sequencing”, where the device is controlled through a semi-automatic table in CSV format. This table represents a simple test procedure and can be created and edited in MS Excel or other CSV editors and then imported into the software tool.

This software also allows for the control of up to 20 units at once with an optional feature called “Multi Control” (licensed, not free of charge). See page 134 for more information.



## 可选项

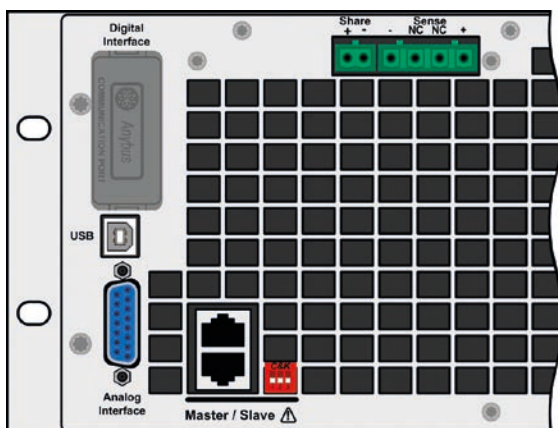
- 可插拔、可替换的数字接口模块，适合CAN, CANopen, Ethernet（1个或2个端口），Profibus, ProfiNet（1个或2个端口）RS232, EtherCAT 或ModBus TCP。见第132页。
- 可选择带固定 GPIB 端口的三路接口（3W），代替可拆装接口模块的默认插槽。

## Options

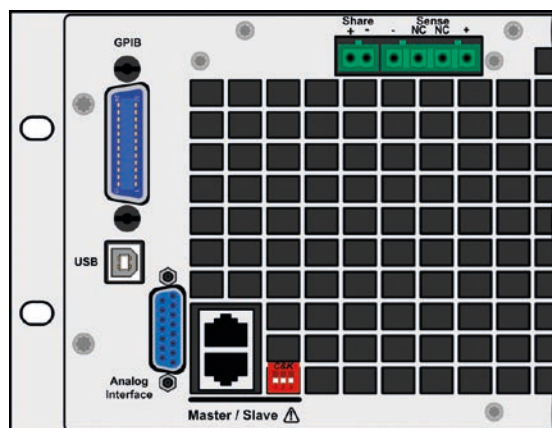
- Pluggable and retrofittable, digital interface modules for CAN, CANopen, Ethernet (1 or 2 ports), Profibus, ProfiNet (1 or 2 ports), RS232, EtherCAT or ModBus TCP. See page 132.
- Three-way interface (3W) with a rigid GPIB port installed instead of the default slot for retrofittable interface modules

## 数字接口模块

## Digital interface modules



标准型号的后板连接器 /  
Rear connectors of the standard models



带3W选项型号的后板连接器 /  
Rear connectors of models with option 3W

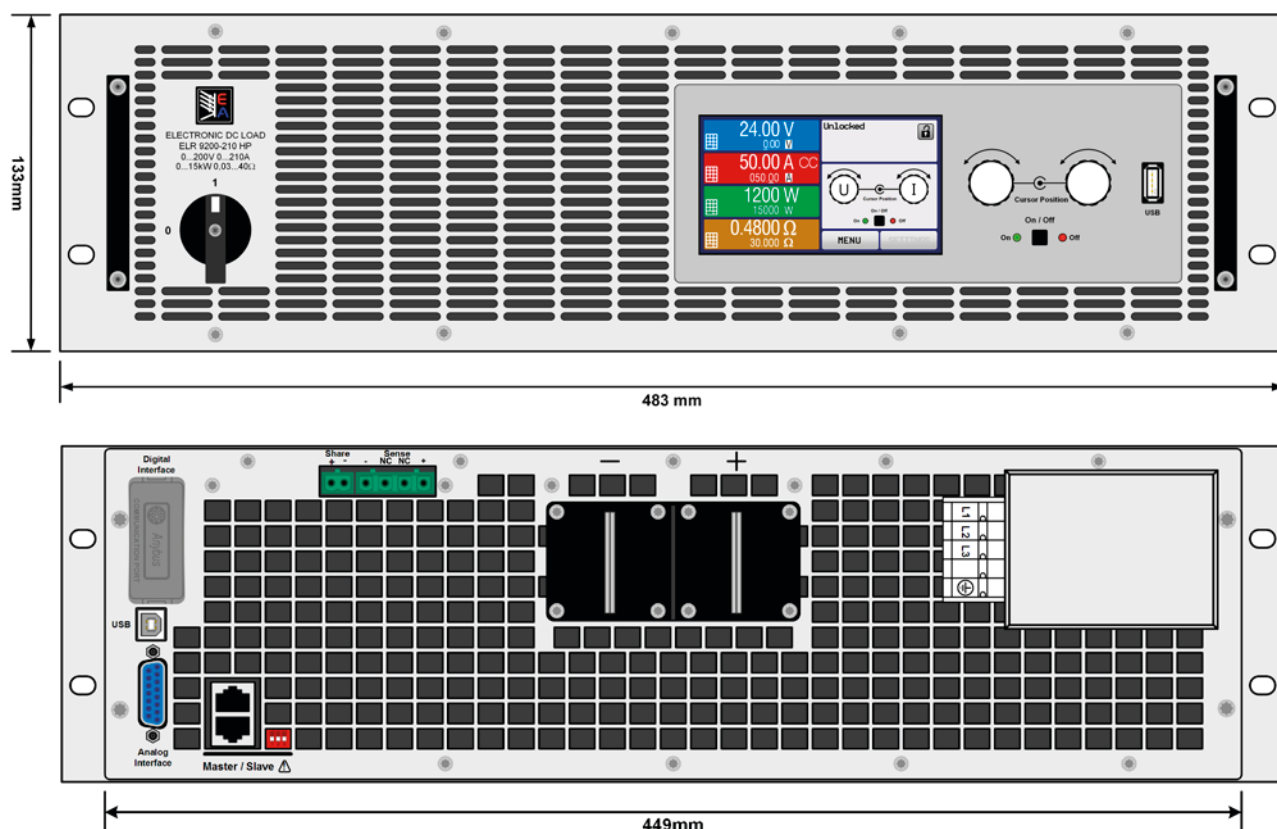
**EA-ELR 9000 HP 5 kW - 15 kW** 上海雨芯仪器 021-6451135

| 技术参数                            | Technical Data                           | Series EA-ELR 9000 HP / 系列  |
|---------------------------------|--|---|
| 交流：供电                           | AC: Supply                               |   |
| - 电压                            | - voltage                                | 400 V / 480 V (L-L), $\pm 10\%$ , 2ph-3ph   |
| - 频率                            | - Frequency                              | 45...66 Hz  |
| 直流：电压                           | DC: Voltage                              |   |
| - 精确度                           | - Accuracy                               | <额定值的0.1% / <0.1% of rated value  |
| 直流：电流                           | DC: Current                              |   |
| - 精确度                           | - Accuracy                               | <额定值的0.2% / <0.2% of rated value  |
| - 1-100% $\Delta U_{DC}$ 的负载调整率 | - Load regulation 1-100% $\Delta U_{DC}$ | <额定值的0.15% / <0.15% of rated value  |
| - 10-90% 上升时间                   | - Rise time 10-90%                       | <50 $\mu s$   |
| 直流：功率                           | DC: Power                                |   |
| - 精确度                           | - Accuracy                               | <额定值的1% / <1% of rated value  |
| 直流：内阻                           | DC: Resistance                           |   |
| - 精确度                           | - Accuracy                               | $\leq$ 最大阻值的1% + 额定电流的0.3% /<br>$\leq 1\%$ of max. resistance + 0.3% of nominal current                   |
| 显示器与控制面板                        | Display and control panel                | 带触摸屏的彩色显示器 / Graphics display with touch panel  |
| 数字接口                            | Digital interfaces                       |   |
| - 内置                            | - Built-in                               | 1x 通讯用B类USB端口 / 1x USB type B for communication<br>1x GPIB (3W选项功能用) / 1x GPIB (optional with option 3W)  |
| - 插槽                            | - Slot                                   | 1x 内置可拆装模块（仅针对标准型号） /<br>1x for retrofittable plug-in modules (standard models only)                      |
| 模拟接口                            | Analog interface                         | 内置，电隔离 /<br>Built-in, galvanically isolated   |
| - 信号范围                          | - Signal range                           | 0...5 V 或 0...10 V (可切换) / 0...5 V or 0...10 V (switchable)   |
| - 输入脚                           | - Inputs                                 | U, I, P, R, 远程开-关，直流输出开-关，内阻模式开-关 /<br>U, I, P, R, Remote on-off, DC input on-off, resistance mode on-off |
| - 输出脚                           | - Output                                 | U, I, 过压，报警，参考电压 /<br>U, I, overvoltage, alarms, reference voltage  |
| - U / I / P / R 精确度             | - Accuracy U / I / P / R                 | 0...10 V: <0.1%      0...5 V: <0.2%   |
| 制冷方式                            | Cooling                                  | 温控风扇（可选：水冷） / Temperature controlled fans (optional: water)   |
| 环境温度                            | Ambient temperature                      | 0...50 $^{\circ}C$  |
| 储存温度                            | Storage temperature                      | -20...70 $^{\circ}C$  |
| 后板端子                            | Terminals on rear                        |   |
| - 直流输入                          | - DC input                               | 螺丝端 / Screw terminal  |
| - 共享总线&感测                       | - Share Bus & Sense                      | 2&4位插头连接器 / Plug connector 2 pole & 4 pole  |
| - 模拟接口                          | - Analog interface                       | 15极Sub-D连接器 / Sub-D connector 15 pole   |
| - 数字接口                          | - Digital interfaces                     | 50位模块插座或24位的GPIB，USB /<br>Module socket 50 pole or GPIB 24pole, USB                                       |
| 尺寸(宽 x 高 x 深)                   | Dimensions (W x H x D)                   | 19" x 3 HE/U x 670 mm   |

**EA-ELR 9000 HP 5 kW - 15 kW** 上海雨芯仪器 021-6451135

| 型号                 | 功率        | 电压         | 电流        | 内阻                   | 效率         | 重量     | 订购编号 <sup>(1)</sup>            |
|--------------------|-----------|------------|-----------|----------------------|------------|--------|--------------------------------|
| Model              | Power     | Voltage    | Current   | Resistance           | Efficiency | Weight | Ordering number <sup>(1)</sup> |
| EA-ELR 9080-170 HP | 0...5 kW  | 0...80 V   | 0...170 A | 0.02...25 $\Omega$   | 92.5%      | ~18 kg | 33200435                       |
| EA-ELR 9200-70 HP  | 0...5 kW  | 0...200 V  | 0...70 A  | 0.1...150 $\Omega$   | 93.5%      | ~18 kg | 33200436                       |
| EA-ELR 9360-40 HP  | 0...5 kW  | 0...360 V  | 0...40 A  | 0.3...520 $\Omega$   | 93.5%      | ~18 kg | 33200437                       |
| EA-ELR 9500-30 HP  | 0...5 kW  | 0...500 V  | 0...30 A  | 0.5...1000 $\Omega$  | 94.5%      | ~18 kg | 33200438                       |
| EA-ELR 9750-20 HP  | 0...5 kW  | 0...750 V  | 0...20 A  | 1.28...2200 $\Omega$ | 94.5%      | ~18 kg | 33200439                       |
| EA-ELR 9080-340 HP | 0...10 kW | 0...80 V   | 0...340 A | 0.01...13 $\Omega$   | 92.5%      | ~25 kg | 33200440                       |
| EA-ELR 9200-140 HP | 0...10 kW | 0...200 V  | 0...140 A | 0.05...75 $\Omega$   | 93.5%      | ~25 kg | 33200441                       |
| EA-ELR 9360-40 HP  | 0...10 kW | 0...360 V  | 0...80 A  | 0.15...260 $\Omega$  | 93.5%      | ~25 kg | 33200442                       |
| EA-ELR 9500-60 HP  | 0...10 kW | 0...500 V  | 0...60 A  | 0.25...500 $\Omega$  | 94.5%      | ~25 kg | 33200443                       |
| EA-ELR 9750-40 HP  | 0...10 kW | 0...750 V  | 0...40 A  | 0.6...1100 $\Omega$  | 94.5%      | ~25 kg | 33200444                       |
| EA-ELR 9080-510 HP | 0...15 kW | 0...80 V   | 0...510 A | 0.006...10 $\Omega$  | 92.5%      | ~32 kg | 33200446                       |
| EA-ELR 9200-210 HP | 0...15 kW | 0...200 V  | 0...210 A | 0.033...50 $\Omega$  | 93.5%      | ~32 kg | 33200447                       |
| EA-ELR 9360-40 HP  | 0...15 kW | 0...360 V  | 0...120 A | 0.1...180 $\Omega$   | 93.5%      | ~32 kg | 33200448                       |
| EA-ELR 9500-90 HP  | 0...15 kW | 0...500 V  | 0...90 A  | 0.16...340 $\Omega$  | 94.5%      | ~32 kg | 33200449                       |
| EA-ELR 9750-60 HP  | 0...15 kW | 0...750 V  | 0...60 A  | 0.4...740 $\Omega$   | 94.5%      | ~32 kg | 33200450                       |
| EA-ELR 91000-40 HP | 0...15 kW | 0...1000 V | 0...40 A  | 0.8...1300 $\Omega$  | 94.5%      | ~32 kg | 33200451                       |
| EA-ELR 91500-30 HP | 0...15 kW | 0...1500 V | 0...30 A  | 2.5...3000 $\Omega$  | 94.5%      | ~32 kg | 33200452                       |

(1) 为标准版型号的订购编号，带3W选项的则不同 / Ordering number of the base version, models with option 3W installed have different ordering numbers





## EA-ELR 9000 HP系列从机负载模块

### Slave loads modules for series EA-ELR 9000 HP



EA-ELR 9200-210 HP Slave

#### 一般信息

EA-ELR 9000 HP Slave系列可以快速匹配EA-ELR 9000 HP系列选定型号，来扩大功率。其目的就是，通过并联与主-从操作，最多组合16台，从而获得一个高达240 kW的直流电子负载系统。所有技术规格都与EA-ELR 9000 HP系列一模一样，除了几个连接端子外。

#### 操作与配置

扩展后的控制面板精简到剩下几个必要部件。为配合手动操作、状态指示与配置，配有少数几个LED灯，一个按钮，以及一个USB端口。本系列经前板USB端口可通过软件配置，比如EA Power Control (见 134页)。

#### 主-从系统

主-从系统的配置简易又快捷。将从机模块与主机装在一起，比如在一19"机柜内。将产品连至交流供电端，并联他们的直流输出（连线或铜条），再经主-从总线与共享总线连接起来。主机上的操作仅为启动主从操作，然后整个系统将按照通电的机器数量自己配置，并准备好供用户使用或者软件操作。

#### General

The so-called "slave module" of series EA-ELR 9000 HP Slave are available for quick and cost saving power extension of 15 kW models of series EA-ELR 9000 HP. Their purpose is to run in parallel connection and master-slave operation of up to 16 units in total, in order to achieve DC power supply systems with power ratings of up to 240 kW. All technical specifications are identical to EA-ELR 9000 HP series, except for the available connectors.

#### Handling and configuration

The usual control panel has been reduced to the absolute necessary. For manual handling, status indication and configuration it offers a few LEDs, a pushbutton and an USB port. The devices are configured with software through the front USB port, for example with EA Power Control (see page 134).

#### Master-slave system

Configuring a master-slave system is very quick and easy. The slave modules and the master unit are installed together, for example in a 19" cabinet. Then they are connected to the AC supply and paralleled on their DC inputs (cables or copper bars), plus also linked via master-slave bus and Share bus. The only thing to do on the master is to enable master-slave and the system will self-configure to the number of powered units and represent itself to the user or a control software accordingly.

| 型号                       | 功率          | 电压         | 电流        | 重量      | 适用于                | 尺寸 (宽 x 高 x 深)               | 订购编号            |
|--------------------------|-------------|------------|-----------|---------|--------------------|------------------------------|-----------------|
| Model                    | Power       | Voltage    | Current   | Weight  | Suitable for       | Dimensions (W x H x D)       | Ordering number |
| EA-ELR 9080-510 HP Slave | 0...15000 W | 0...80 V   | 0...510 A | ~ 32 kg | EA-ELR 9080-510 HP | 483 mm x 3 HE / 3 U x 670 mm | 33290446        |
| EA-ELR 9200-210 HP Slave | 0...15000 W | 0...200 V  | 0...210 A | ~ 32 kg | EA-ELR 9200-210 HP | 483 mm x 3 HE / 3 U x 670 mm | 33290447        |
| EA-ELR 9360-120 HP Slave | 0...15000 W | 0...360 V  | 0...120 A | ~ 32 kg | EA-ELR 9360-120 HP | 483 mm x 3 HE / 3 U x 670 mm | 33290448        |
| EA-ELR 9500-90 HP Slave  | 0...15000 W | 0...500 V  | 0...90 A  | ~ 32 kg | EA-ELR 9500-90 HP  | 483 mm x 3 HE / 3 U x 670 mm | 33290449        |
| EA-ELR 9750-60 HP Slave  | 0...15000 W | 0...750 V  | 0...60 A  | ~ 32 kg | EA-ELR 9750-60 HP  | 483 mm x 3 HE / 3 U x 670 mm | 33290450        |
| EA-ELR 91000-40 HP Slave | 0...15000 W | 0...1000 V | 0...40 A  | ~ 32 kg | EA-ELR 91000-40 HP | 483 mm x 3 HE / 3 U x 670 mm | 33290451        |
| EA-ELR 91500-30 HP Slave | 0...15000 W | 0...1500 V | 0...30 A  | ~ 32 kg | EA-ELR 91500-30 HP | 483 mm x 3 HE / 3 U x 670 mm | 33290452        |