

# Custom RP7900 Rack

## Up to 1500 V / 720 A / 240 kW

Highest flexibility to keep up with changing demands

# Scalable DC Power System

## Why is a flexible DC power supply important?

### Automotive OEM and Tier 1 Supplier Challenges

- Customization to individual needs
- Fast transient curves to match real-world demand
- Easy integration into existing automation
- Reliable measurements
- Multipurpose devices

### Solutions

- Scalable DC power supplies
- High output dynamic combined with arbitrary waveform generation
- Uninterrupted source-sink transitioning
- Open interface to support different applications and software integration
- Separate control circuits for voltage and current

### Results

- Scalable power rack
- Build in function generation and flexible triggering
- Seamless test with charge-discharge transitions or emulation of drive profiles
- Broad integration into software and automation solutions with industry-standard interface
- Real current and voltage priority mode

# Introduction

Introducing our state-of-the-art custom power supply rack, a versatile solution designed to meet a wide range of testing and emulation requirements. With its robust design and advanced features, the rack is specifically engineered to deliver exceptional performance in applications such as battery emulation, battery drain for storage and recycling, simple battery cycling, and comprehensive testing of DC-DC converters.

## Safety

We understand that safety is key in any testing environment. That is why our power supply rack has been designed to adhere to the highest safety standards.

With built-in safety features, such as overvoltage protection, overcurrent protection, over-temperature protection, and comprehensive fault detection mechanisms such as the output inhibit mode (In this mode, if a pilot line is interrupted, the system prevents the activation of the output. If the output is already active, it will be automatically deactivated). Our power supply rack prioritizes the well-being of your personnel and devices. In addition to the safety features of the power supply, the rack is equipped with more features to ensure safe operation and integration into every laboratory or production environment.

## Battery test

To be prepared in the best way possible for rapidly changing demands, our power supply rack can be used in different scenarios in modern automotive batteries.

When emulating a battery, it is essential to not only have a very stable and precise source but also be able to control the output resistance of the power supply while operating to replicate the change in the internal resistance over the state of charge (SoC).

When the focus is on battery testing, fast transients and the highest control stability are key. Stability is needed to guarantee that the battery is charged or discharged with the exact same C-rate over time and meets the test specifications. Fast transients are used to characterize or test the batteries with real-world drive cycles.

## DC-DC converter test

In addition to its battery emulation and test capabilities, our power supply rack excels in testing DC-DC converters. Its high-speed response and low output impedance make it an ideal choice for assessing the performance and efficiency of these crucial components. By subjecting your converters to a wide range of operating conditions and transient events, our power supply rack enables you to identify potential issues, optimize designs, and ensure seamless integration into your systems. The unique features of the arbitrary curve and list mode allow you to test multiple operating points, verify pulse behavior, and handle unstable inputs and rapid load scenarios.

## Dynamometer test

Another typical area of application is in a dynamometer test setup. A power rack can serve different purposes depending on the use case, whether it's a combustion engine, PHEV, or BEV. It can power components like controllers and actuators, provide immunity testing to components, or emulate a high-voltage battery pack by supplying energy to the AC-DC converter.

# Rack Features and Configuration

## RP7900 Series Regenerative Power System

The core of the solution is built on the power supplies out of the RP7900 Series. The accuracy of the voltage and current controllers, programmable resistance, and the ability to generate arbitrary waveforms enable the power supply rack to emulate accurate batteries, allowing you to thoroughly test the performance and behavior of devices under various load conditions. Whether the scope is to develop portable electronics, electric vehicles, or renewable energy systems, Keysight power supply racks ensure that our customer's designs are thoroughly tested for reliable performance and efficiency.

The following key functionalities allow testing in an unmatched way:

1. Fastest transient in current priority and voltage priority mode
  - Voltage up and down programming: down to 0.2 ms
  - Current up and down programming: down to 100  $\mu$ s
2. Arbitrary Waveform (ARB) generation with up to 65,535 points and a minimum dwell time of 10.24  $\mu$ s
3. Programmable output resistance for better battery emulation of the effects of internal resistance and load transient behavior.
4. Flexible test automation with operating modes:
  - Step – Easy way to emulate load and supply drops
  - List – Fast way to generate multiple complex operating point test cases
  - Arb – Powerful way to generate replicas of real-world test and drive cycles
5. Advanced triggering and synchronization with build in inputs and outputs (IOs)
6. Flexible parallel operation in Leader-Follower configuration or Leader-Leader configuration
7. Built-in over-voltage, over-current, and overtemperature protection to reduce the likelihood of the (Device Under Test) DUT sustaining major damage
8. Seamless, uninterrupted transitions between sourcing and sinking current without changing the power supply's output characteristics or introducing any disruptive behavior
9. The regenerative capability enables the energy consumed to be put back onto the grid cleanly, saving costs from energy consumption and cooling.

## Recommended rack features

Every rack could be customized to individual needs. The base configuration includes extended functionality and safety.

### Standard features

- Unmanaged Ethernet switch to allow connection to all power supplies in the rack
- Air-cooled
- One-year warranty for the rack integration
- Documentation:
  - Wiring diagram
  - Rack diagram
  - Bill of materials (BOM)
  - User guides of the components

### Recommended inclusion of safety features

- Emergency Power Off (EPO)
- Fused disconnect from AC power input
- Power Distribution Unit (PDU) with individual circuit breaker for power distribution to the power supplies
- E-Stop button (fixed and magnetic mount for racks >42 U)
- Relay with DPDT (Double Pole, Double Throw contacts)
  - Normal operation = closed
  - Emergency event = open
  - Integrated rear door interlock
- Polycarbonate guard protection against accidental contact of the high voltage lines
- 16-pin connector for safe parallel operation of multiple racks (DC output inhibit and single EPO)
- Integration of external EPO

### Standard conformity

The rack is to be built with conformity to UL 508A on all systems to a maximum of 1000 VDC output.

## Optional features

- Single DC output paralleling RPs and grouped DC outputs
- DC output with high-voltage connectors
- Remote sense fuse and wiring rated up to 1500 VDC
- Network and system protection (NS protection), for example, Bender VMD460
- Integration of Keysight **SL1040A (CDS)** in the rack
- Integration of third-party equipment
- Customized Keysight **PathWave Test Automation** software plugin

## Example rack setup



**Figure 1.** Rack setup, from left to right: 90 kW, 120 kW, 210 kW and 240 kW

Note: Only a maximum of 8 units has been illustrated in a single rack in this document. In fact, RP7900 Series can be paralleled up to 20 units for more power.

## For more information

For more information on custom RP7900 racks and to get in contact with technical sales support please [contact Keysight](#).

# System setup

## 1000 V system

Rack option	60 kW rack	90 kW rack	120 kW rack	150 kW rack	180 kW rack	210 kW rack	240 kW rack
Voltage range	0 to 1000V						
Current range <sup>1</sup>	0 to ± 180 A	0 to ± 270 A	0 to ± 360 A	0 to ± 450 A	0 to ± 540 A	0 to ± 630 A	0 to ± 720 A
Power range	60 kW	90 kW	120 kW	150 kW	180 kW	210 kW	240 kW
AC input voltage	480 VAC, 3ph						
AC input current	100 A	150 A	200 A	250 A	300 A	350 A	400 A
System dimensions (W x D x H) [inch]	24 x 45 x 61 30 U	24 x 45 x 61 30 U	24 x 45 x 61 30 U	24 x 45 x 61 30 U	24 x 45 x 81 42 U	24 x 45 x 81 42 U	24 x 45 x 92 48 U
Weight [kg]	350	600	750	900	1250	1400	1750

RP7900 Series		RP7982A
Voltage up/down programming Comp 0 <sup>2</sup>	Rise/fall time 10% to 90% of step	0.2 ms
	Settling time to 0.1% of step	1 ms
Current up/down programming Comp 0 <sup>3</sup>	Rise/fall time 10% to 90% of step	100 µs
	Settling time to 0.1% of step	200 µs
Resistance programming <sup>4</sup>	Range	0 to 43.8 Ω
	Resolution	0.4 mΩ
	Accuracy	0.05% + 0.4 mΩ
Standard interface		10 Mb, 100 Mb, 1 Gb LAN
Other interfaces		USB 2.0 (USB-TMC488 protocol) GPIB SCPI - 1993, IEEE 488.2 compliant interface 1.5 LXI Device Specification 2016

<sup>1</sup> Single output of 0 to ± 90 A, rated current in parallel mode.

<sup>2</sup> With no load and a step change from 0.1% to 100% of voltage rating; bandwidth frequency = 100 kHz.

<sup>3</sup> With AC short and a step > 10% of output voltage rating; bandwidth frequency = 100 kHz.

<sup>4</sup> Resistance range per unit, parallel operation will change the range.

## 1500 V system

Rack option	60 kW rack	90 kW rack	120 kW rack	150 kW rack	180 kW rack	210 kW rack	240 kW rack
Voltage range	0 to 1500 V						
Current range <sup>1</sup>	0 to ± 120 A	0 to ± 180 A	0 to ± 240 A	0 to ± 300 A	0 to ± 360 A	0 to ± 420 A	0 to ± 480 A
Power range	60 kW	90 kW	120 kW	150 kW	180 kW	210 kW	240 kW
AC input voltage	480 VAC, 3ph						
AC input current	100 A	150 A	200 A	250 A	300 A	350 A	400 A
System dimensions (W x D x H) [inch]	24 x 45 x 61 30 U	24 x 45 x 61 30 U	24 x 45 x 61 30 U	24 x 45 x 61 30 U	24 x 45 x 81 42 U	24 x 45 x 81 42 U	24 x 45 x 92 48 U
Weight [kg]	350	600	750	900	1250	1400	1750

RP7900 Series		RP7984A
Voltage up/down programming Comp 0 <sup>2</sup>	Rise/fall time 10% to 90% of step	0.2 ms
	Settling time to 0.1% of step	1 ms
Current up/down programming Comp 0 <sup>3</sup>	Rise/fall time 10% to 90% of step	100 µs
	Settling time to 0.1% of step	200 µs
Resistance programming <sup>4</sup>	Range	0 to 98.6 Ω
	Resolution	0.8 mΩ
	Accuracy	0.05% + 0.8 mΩ
Standard interface		10 Mb, 100 Mb, 1 Gb LAN
Other interfaces		USB 2.0 (USB-TMC488 protocol)
		GPIO SCPI - 1993, IEEE 488.2 compliant interface
		1.5 LXI Device Specification 2016

<sup>1</sup> Single output of 0 to ± 60 A, rated current in parallel mode.

<sup>2</sup> With no load and a step change from 0.1% to 100% of voltage rating; bandwidth frequency = 100 kHz.

<sup>3</sup> With AC short and a step > 10% of output voltage rating; bandwidth frequency = 100 kHz.

<sup>4</sup> Resistance range per unit, parallel operation will change the range.



# Highest Flexibility to Keep up With Changing Demands

Our custom power supply rack offers a reliable and feature-rich solution for various applications. Whether you are conducting performance testing, durability assessments, or system validation, our power supply rack is an indispensable tool that ensures precise power delivery, compliance with safety standards, and reliable results.

## Extend the Capabilities of Your RPS Rack

### Meet the RP7900 Series Regenerative Power System

The Keysight RP7900 Series regenerative power system is a family of bi-directional, regenerative DC power supplies with highly integrated safety features that protect both your people and your device under test. The regenerative capability enables the energy normally consumed to be returned to the grid cleanly, saving costs associated with energy consumption and cooling.

Learn more about Keysight's [RP7900 Series Regenerative Power Supplies](#).



Figure 2. RP7900 Series Regenerative Power System.

### Meet the SL1040A Scienlab Charging Discovery System Series

The Scienlab Charging Discovery System Series from Keysight enables you to test the charging interfaces of electric vehicles (EVs) and EV supply equipment (EVSE). Thanks to its modular and innovative design, you can configure the CDS to customers' specific needs and replace multiple real EV/EVSE with one test solution to ensure an optimal price-performance ratio.

- Automated functional, conformance, interoperability, and quality testing for R&D, end-of-line (EOL), and Electromagnetic Compatibility (EMC) applications.
- Time synchronous measurement and decoding of communication and power signals.
- Scalable and futureproof hardware design according to CharIN e.V. CCS Test System.
- CE, UL, and KC-Mark conformance certified by CSA Group.
- Extensive Test Case Library for automated conformance testing of CCS, CHAdeMO, and GB/T standard.

Find out more about the [SL1040A Scienlab CDS Series](#).

## Meet the SL1047A Scienlab Charging Discovery System – High-Power Series

The Scienlab Charging Discovery System – High-Power Series (CDS HP Series) from Keysight enables you to test charging interfaces of electric vehicles (EVs) and EV supply equipment (EVSE) during high-power charging up to 1,500 V DC and  $\pm 600$  A DC. The CDS can perform all necessary conformance and interoperability tests according to worldwide charging standards. Our new solution, which features a separate Scienlab Cooling Unit with interchangeable liquid-cooled charging adapters, also enables a high-power upgrade of the SL1040A Scienlab Charging Discovery System – Portable Series.

- Automated functional, conformance, interoperability, and quality testing for R&D and EOL applications.
- Time synchronous measurement and decoding of communication and power signals.
- Scalable and futureproof hardware design according to CharIN e. V. CCS Test System.
- CE, UL, and KC-mark conformance.
- Extensive Test Case Library for automated conformance testing of CCS, CHAdeMO, and GB/T standards.

Find out more about the [SL1047A Scienlab CDS HP Series](#).



**Figure 3.** From left to right: SL1040A CDS – EMC Series, SL1040A CDS – Portable Series, and SL1047A CDS – High-Power Series.

# Meet the Keysight software portfolio

Keysight provides you with the right software solution for your application, regardless of your application.

- Learn more about battery test and emulation with [BV9210B PathWave BenchVue Advanced Battery Test and Emulation](#)
- Characterize and test your DUT with [BV9200B PathWave BenchVue Advanced Power Control and Analysis](#)
- Automate and streamline your test procedures with [PathWave Test Automation](#)
- Save up by bundling [BV9301A Value Bundles for EVs/HEVs battery testing](#)

Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at [www.keysight.com](http://www.keysight.com).



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