



## G5.RLD Regenerative DC Electronic Load Series

The G5.RLD series are unidirectional regenerative sinks that can operate in CV, CC, CP, CR, and Ri-Sim control modes. It is universally applicable and therefore suitable as a sink for all industrial and scientific applications in laboratories as well as on test benches and production lines. The modular and finely graded G5.RLD series is characterized by highly dynamic response times, adjustable filter time constants, and a wide current-voltage range with an auto-ranging factor 3. Optional software, programming and communication interfaces as well as safety functions enable the G5.RLD loads to be optimally adapted to special customer application requirements.

### Device Types

Voltage V	Power kW	Current A	Height U	Order Code
*0...80	9	-338...0	4	G5.RLD.9.80.338
*0...80	18	-676...0	4	G5.RLD.18.80.676
*0...80	27	-1014...0	7	G5.RLD.27.80.1014
*0...80	36	-1352...0	7	G5.RLD.36.80.1352
*0...80	45	-1690...0	10	G5.RLD.45.80.1690
*0...80	54	-2028...0	10	G5.RLD.54.80.2028
0...160	18	-338...0	4	G5.RLD.18.160.338
0...160	36	-676...0	7	G5.RLD.36.160.676
0...160	54	-1014...0	10	G5.RLD.54.160.1014
0...240	27	-338...0	7	G5.RLD.27.240.338
0...240	54	-676...0	10	G5.RLD.54.240.676
0...320	36	-338...0	7	G5.RLD.36.320.338
0...500	9	-54...0	4	G5.RLD.9.500.54
0...500	18	-108...0	4	G5.RLD.18.500.108
0...500	27	-162...0	7	G5.RLD.27.500.162
0...500	36	-216...0	7	G5.RLD.36.500.216
0...500	45	-270...0	10	G5.RLD.45.500.270
0...500	54	-324...0	10	G5.RLD.54.500.324
0...1000	18	-54...0	4	G5.RLD.18.1000.54
0...1000	36	-108...0	7	G5.RLD.36.1000.108
0...1000	54	-162...0	10	G5.RLD.54.1000.162
0...1500	27	-54...0	7	G5.RLD.27.1500.54
0...1500	54	-108...0	10	G5.RLD.54.1500.108

\*also as 60 V SELV version for single or parallel operation available, order code example: G5.RLD.9.60.338

### Modular and Easy Scalable Systems

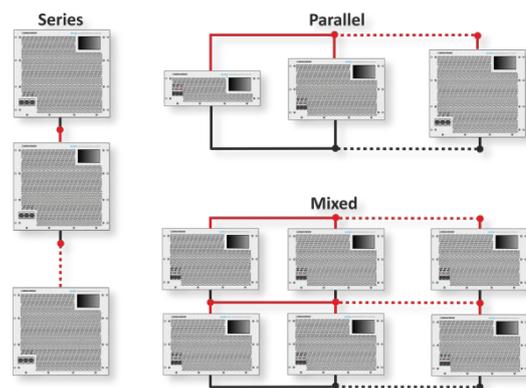


Figure 1: Modular concept for easy power and voltage increase by parallel, series, and mixed operation. The parallel configuration allows even an operation of different power levels, e.g., 18, 36, and 54 kW modules, in one system.

The output of an individual DC electronic load is in the range from 0...9 kW to 0...2000+ kW, up to 3000 VDC. The advantageous modularity of REGATRON DC electronic load solutions allows the system to be easily adapted to ever-changing test requirements. It is possible to reconfigure between parallel, series, and mixed operation.

Moreover, the system can be expanded with additional power supply units or may be split into smaller units.

Whether for single devices or powerful multi-device multi-unit systems, REGATRON also offers turnkey cabinet solutions or project-specific system integration according to customer specifications.

Therefore, the purchase of a REGATRON DC electronic load is a solid investment for the future.

### Applications and Features

The high accuracy and dynamics of the G5.RLD series, as well as the ability to easily change between different multi-unit configurations, make this series the ideal DC electronic load solution for unidirectional sink R+D tasks and test bench applications such as testing of DC sources like e.g., fuel cell stacks or simulation of any kind of DC sink.

Various excellent features such as switchable filter time constants and adjustable controller settings as well as the integrated powerful 8-channel digital scope assist the user to quickly and easily achieve optimal system behavior for a special customer application.

Simplified and safe operation can be provided by pre-programmed overvoltage protection and digital fuses with immediate and I2t triggering. Different protection levels for different DUTs can be either programmed by the user's automation test system via various interfaces or activated manually by digital input signals or even more conveniently wired to different switch positions.

The G5.RLD series also offers the possibility to store, edit, and recall any device configuration on board the DC electronic load.

### Fuel Cell Testing

One prominent application of the G5.RLD series is fuel cell testing. The fuel cell stack typically behaves like a voltage source, whereas the fuel cell tester (G5.RLD) is operated in CC and CP mode.

Fuel cell stacks have to be protected against reverse currents feeding back into the fuel cell stack due to resulting performance degradation or even damage to the fuel cell. The possibility for application-specific settings avoids overshoot and reverse currents into the fuel cell stack.

### Dynamics

Maximum speed or minimum overshoot? Figure 2 shows that the dynamic parameters of the G5.RLD series can be easily adapted to a specific task.

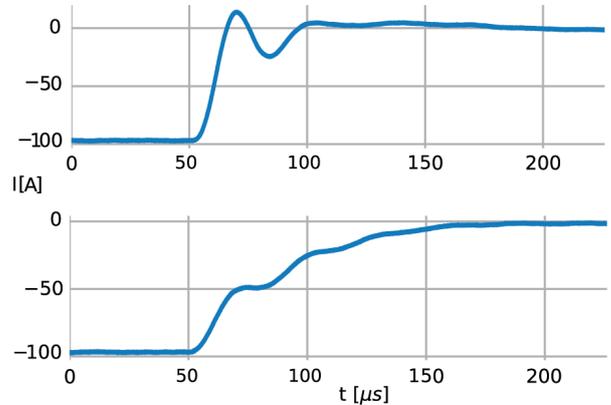


Figure 2: Parameterization example of a 36 kW, 1000 V, 108 A device: Set-value step current -97...0 A@333VDC in <50 μs with overshoot (top) or in <200 μs w/o overshoot (bottom) to avoid overshoot into the fuel cell stack.

### General Dynamic Data

rise time	sink current 0...90%	35...70 μs
set-value step		
response time	CV, recovery within	50...290 μs
load step	0.5% set value	

### G5.RLD Series as P-HIL Power Amplifier

Power-hardware-in-the-loop (P-HIL) simulation integrates physical hardware and software models in a closed-loop simulation, offering versatile opportunities to investigate the behavior of complex systems at different parameter settings.

A typical P-HIL setup includes a fast real-time computer driving a power amplifier. The G5.RLD series is best suited for this purpose due to its high dynamics and a fast analog port. Time analog-in to power output is typically 90 μs.

### Accuracy

The G5.RLD series has an exceptional voltage accuracy of 0.01...0.02% FS. The current accuracy is in the range of 0.03...0.09% FS depending on the model. There is even an additional high-resolution current measurement range from 0 to 10% FS with an accuracy of better than 0.005% FS.

## Control Modes

CV	constant voltage
CC	constant current
CP	constant power
CR	constant resistance
Ri	internal resistance simulation in CV
Gi	internal conductance simulation in CC

## Interfaces

### Ethernet and USB

To connect with:

- G5.Control the operating and maintenance software
- API .NET programming, e.g., by LabView, Python, Matlab
- WebAPI (REST) interface via the optional HMI or RCU

### I/O port

The I/O interface features analog and digital signals used for set and actual values or operating states. Integrated into the user's control system it is possible to set dynamically changing limits, to use enable signals, or trigger in- or outputs. The possibility to activate up to 4 user-defined parameter sets using digital inputs means that the system can be adapted to different EUTs. For example, predefined digital fuses and voltage limits can be set.

### Grid Connection

The wide-band AC input accepts all common AC grid systems and has an active power factor correction.

AC Grid	380...480 VAC ±10% at 50/60 Hz
PF	0.99
Efficiency	94...95%, depending on model

# Options

## Software and Control

### Time-Based Function Generator

The TFE time-based function generator allows programming either through G5.Control operating software, HMI touch display, or various interfaces.

- Time-dependent functions  $U = f(t)$ ,  $I = f(t)$ ,  $P = f(t)$ : sine, triangle, or square as well as user-defined data points. Import and export through CSV files supported
- Ramp function for amplitude and offset changes

### Sweep functionality for TFE

As an add-on to the TFE time-based function generator, the sweep mode allows for continuous or stepwise sweeping of the amplitude and the frequency of a programmed function. Both the amplitude and the frequency may be swept linearly or exponentially.

### Application Area Programming

The AAP application area programming feature allows to set the DC output voltage or current or power as a function of any of the input values  $I_{DC}$ ,  $U_{DC}$ , or  $P_{DC}$ . The functional relationship is given by a user-defined curve whose values are managed by CSV import/export. In this way, a wide variety of nonlinear electrical two-pole networks can be defined, e.g., diodes. Embedded calculation on board the G5.RLD assures real-time simulation.

### HMI / RCU

The HMI built into the front panel allows comprehensive and convenient operation of the DC electronic load via touch display or the WebAPI (REST) interface. With the remote control unit (RCU) it is possible to control the device or system from a distant location in the same manner as with the HMI.

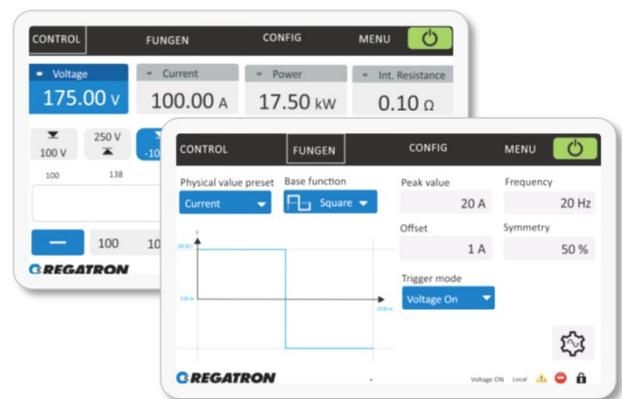


Figure 3: Intuitive control by HMI touch display. Everything you need at a glance.

### CAN Interface

The CAN multi-protocol (CANmp) interface has a 1 kHz data rate, a 16-bit resolution, and is adaptable to any proprietary CAN bus. In addition, it supports dbc file handling.

### EtherCAT Interface

The EtherCAT slave interface (ECAT) supports configuration by ESI file and communicates in a 1 kHz cycle. It transmits the entire process data in the same cycle, i.e. commands, actual states, and actual values. Acyclic communication via mailbox for device configuration is also possible.

### SCPI Interface

SCPI, Standard Commands for Programmable Instruments, are ASCII strings, which are sent to the device over TCP/IP using the LAN socket. They can perform set operations or query operations.

### User Safety

- Integrated safety relay (ISR) for increased emergency stop reliability supporting performance level PL c / PL e according to EN ISO 13849
- Discharging of the AC filter (XCD), is mandatory when using the device with a plug connection. XCD ensures a discharge time of the AC filter <1 s as required by EN 62477-1
- Based on the 80 V models, also a 60 V SELV version is available
- Various terminal protection covers

The different protective covers are designed for integration into 19" rack systems or for use as a tabletop device. The cover for cabinet integration provides protection against accidental contact, whereas the cover for the tabletop version requires touch-proof protection in accordance with standard EN 62477-1.

Voltage V	Power kW	DC-cover acc. contact	DC-cover touch-proof	AC-cover touch-proof	Tabletop use allowed	Order Code opt. cover
60...160	≤18	●	○	—	✓	G5.PAC.DCAC.1*
60...320	≥27	●	—	—	—	—
500...1000	≤18	—	●	○	✓	G5.PAC.AC.1
500...1500	≥27	—	●	○	✓	G5.PAC.AC.2

- included
- optional, mandatory for tabletop use
- \* not suitable for rack integration

### Environmental Conditions

- Front-panel-mounted air filter (AirFilter), recommended for use in dusty environments and with IP20 cabinets
- Higher degree of protection up to IP54 available on cabinet level
- Liquid cooling of the G5 devices at system level as shown in Figure 5. The Regatron solution allows to take the entire dissipated heat of the power supply out of the test bench and reuse it as process heat in the facility if possible

### Rack-Integrated System Solutions

- Mobile rack solutions on castors up to 162 kW
- IP54 protection for air or liquid-cooled systems
- Third-party product integration and numerous safety options
- Insulation monitoring: remote activation of the insulation measurement, actual insulation value and warning/error status are provided by the CANmp interface or by optional display
- Easy reconfiguration between parallel, series, and mixed operation



Figure 4: REGATRON's rack-integrated turn-key system solutions, e.g., 72 kW (left) and 162 kW (right) power levels. Various types of AC/DC connectors and cables allow for comfortable handling. Third-party product integration and numerous safety options are additional features.



Figure 5: REGATRON's liquid-cooled system solutions up to IP54 with various power levels e.g. 54...162 kW (left) and 216...324 kW (right). The remote control unit RCU, indicator lights, emergency stop button, and main switch allow the user to operate the system on the enclosure's front door.

## Important Features of the G5.RLD Series

### Technology

- Technologically advanced, fast switching, compact 19-inch DC electronic loads
- High control dynamics in the 100...200  $\mu$ s range – even at higher power levels up to 2000+ kW
- Exceptional accuracy and an additional high-resolution measurement range
- Wide current-voltage range with an auto-ranging factor 3
- CV, CC, CP, CR, and Ri/Gi-Sim control modes
- Regenerative and highly efficient, resulting in a significant reduction of energy consumption and heat dissipation

### System Control and Options

- Operating software, extended analysis, parameterization options, and calibration
- Powerful application programming interfaces (APIs)

### System Capability

- Modular and easily scalable systems
- Parallel, series, and mixed operation with a digital high-speed bus
- Simple multi-unit configuration with the operating software
- Easy rack mounting
- Liquid cooled systems in IP54 available
- Optional safety features such as 2-channel safety interface and insulation monitoring
- Turn-key cabinet solutions or project-specific system integration according to customer specification

This product is developed, produced, and tested according to ISO 9001 by REGATRON.

For detailed technical information, contact REGATRON or your local sales partner.

Regatron AG	Regatron Inc.
Feldmühlestrasse 50	100 Overlook Center, 2 <sup>nd</sup> Floor
9400 Rorschach	Princeton, NJ 08540
SWITZERLAND	USA
sales@regatron.com	inquiries@us.regatron.com
www.regatron.com	www.us.regatron.com

All product specifications and information herein are provisional and subject to change without notice.

Filename: PD\_G5.RLD\_EN\_2024-04-22

Class: Public

## REGATRON DC & AC Power Supplies: Modular · Precisely Engineered · Technologically Advanced

