CAENels
Gear for Science

Product Overview
PRELIMINARY

Bidirectional REGENERATIVE

Embedded WEB-SERVER

Waveform Generation

Embedded Oscilloscope

Bidirectional Regenerative High-Precision Digital Battery Cyclers/Testers

BatReg²

Your **DIGITAL POWER ELECTRONICS** Partner.

- **Bidirectional & Regenerative Battery Cyclers / Testers with high-stability, low noise and fast response based on digital control**
- **Control and sampling of output current and voltage at 24-bit, 100 ksps**
- **High-efficiency in both AC-DC and DC-AC modes for consistent energy savings in large installations**
- **Embedded Web-Server with Integrated Waveform Generation and Oscilloscope**

FEATURES

- **Bidirectional and Regenerative**
- **Battery Polarity detection circuit**
- **Models up to 100 V and up to 150 A**
- **High efficiency for energy and cost savings**
- **Configurable digital control loop**
- **Maximum sampling at 100 ksps 24-bit**
- **Analog Control Input, Trigger Input and Auxiliary ADC Input** - *optional*
- **K-type thermocouple Temperature readout** - *optional*
- **Embedded Waveform Generation and 4-channel Oscilloscope at 100 ksps 24-bit**
- **Embedded Web-Server**
- **Configurable acoustic alarm**
- **External Interlocks and Status Signals**
- **10/100/1000 Mbit Ethernet TCP-IP or UDP connectivity**

APPLICATIONS

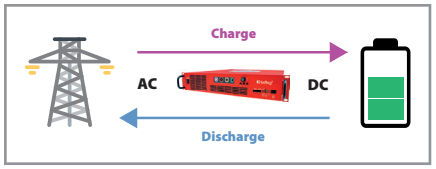
- **Battery Testing and Cycling**
- **Battery Charging**
- **Battery Simulation**

BatReg². The BatReg² (**Bat**tery **Reg**enerative **Reg**ulator) series is the new generation of **bidirectional** and **regenerative** power supplies specifically designed for the demanding needs of precision battery testing and cycling. These units are designed to **safely return the excess energy to the grid** while having state-of-the-art performances in all output control modes. Single models **up to 100 V** and **up to 150 A** are available.

These modules embed a **polarity detection circuit** that safely checks the connection to the battery in order to prevent damages or risks and enables the output only on a positive check.

A 4-channel **oscilloscope** running at 100 ksps/channel and an Arbitrary Waveform Generator (**AWG**) can be easily accessed via the Web Interface GUI in the **embedded Web Server** and they can be used for control and monitoring. The **10/100/1000 Mbit Ethernet** connection over TCP-IP or UDP and the two SFP+ slots allow controlling the power converter in different modes. The control loop is digital in order to obtain the maximum flexibility and easiness of configuration to any connected battery type (cells, modules and also packs).

The BatReg² power units feature **high-efficiency** both in charging and discharging modes. The regenerative architecture allows sending the energy back into the grid in the discharge phase. Cost savings for a 100-unit installation may reach 150.000-200.000 $/year[1].



Energy Regeneration Scheme

External configurable interlocks, over-voltage and over-current protections among others are also available via the power platform given by the on board **SoC** (FPGA+CPU) and **DSP**.

BatReg²

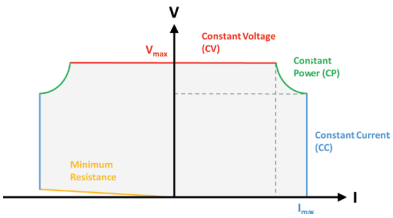
About Us

CAEN ELS is a leading company in the design of power supplies and state-of-the-art complete electronic systems for the most demanding research and high-end industrial applications.

CAEN ELS s.r.l.
via Karl Ludwig Von Bruck 32
34144 - Trieste (TS)
Italy

Registered Office:
via Vetraia 11
55049 - Viareggio (LU)
Italy

info@caenels.com
www.caenels.com



Bidirectional Operation for BatReg²

Embedded Web-Server with AWG and OSCILLOSCOPE

Technical Specifications — BatReg²

		10-150	20-100	40-50	50-30	100-20
Output Voltage Range		0 - 10 V	0 - 20 V	0 - 40 V	0 - 50 V	0 - 100 V
Output Current Range		±150 A	±100 A	±50 A	±30 A	±20 A
Output Topology		Bidirectional				
Regulation Type		Constant Current (CC), Constant Voltage (CV), Constant Power (CP)				
Current Setting/Readback		24 bit				
Voltage Setting/Readback		24 bit				
Equiv. Switching Frequency		400 kHz	400 kHz	200 kHz	200 kHz	200 kHz
Efficiency	**AC/DC**	> 86 %				
	DC/AC	> 80 %				
Power Factor	**AC/DC**	> 0.98				
	DC/AC	> 0.99				
Rise Time 10-90%		< 50 µs				
Closed Loop Bandwidth (-3 dB)		> 8 kHz				
Output Accuracy (RMS)		< 0.01 %/FS				
Temperature Stability		< 5 ppm/K/FS in CC				
Long-Term Stability (8 h)		< 0.001 %/FS in CC				
Cooling		Forced air convection				
Input Ratings		180 - 264 V_{AC} / 47 - 63 Hz				
Communication Interfaces		10/100/1000 Mbit Ethernet TCP-IP and UDP 2 x Fast SFP+ ports				
External Signals		Acoustic alarm (enabled/disabled) 4 x External Interlock Inputs (configurable dry contacts) 1 x Status Output relay (magnetic) 1 x Output Relay (solid state) 1 x Trigger Input (LVTTL, TTL) - *FB1K5OPT0001 option* 1 x Analog Control Input (±10 V) - *FB1K5OPT0001 option* 1 x 16-bit 100-kHz ADC Input for readout of external sensors - *FB1K5OPT0001 option* 1 x K-type thermocouple Input - *FB1K5OPT0001 option*				
Internal Interlocks		DC-Link Undervoltage Over-Temperature Over-Current and Over-Voltage Regulation Fault				
Hardware Protections		Battery Polarity Detection Circuit with embedded output enable switch Input Fuses				
Operating Ambient Temperature		0 ... 50 °C				
Mechanical Dimensions		19" x 2U x 587 mm (including connectors)				
Weight		15 kg				

[1] *estimation based on Electricity Price in New York State (August 2024 - 0.276 $/kWh) from the U.S. Bureau of Labor Statistics. All power supplies are considered to be working continuously as sources for 12 hrs/day and as sinks for the other 12 hrs/day at full-output power.*

Ordering Code	Acronym	Description
BREG2010150A	**BatReg² 10-150**	**BatReg² 10-150 - High-Precision Digital Battery Regenerative Regulator (10 V, ±150 A)**
BREG2020100A	**BatReg² 20-100**	**BatReg² 20-100 - High-Precision Digital Battery Regenerative Regulator (20 V, ±100 A)**
BREG2040050A	**BatReg² 40-50**	**BatReg² 40-50 - High-Precision Digital Battery Regenerative Regulator (40 V, ±50 A)**
BREG2050030A	**BatReg² 50-30**	**BatReg² 50-30 - High-Precision Digital Battery Regenerative Regulator (50 V, ±30 A)**
BREG2100020A	**BatReg² 100-20**	**BatReg² 100-20 - High-Precision Digital Battery Regenerative Regulator (100 V, ±20 A)**
Options		
FB1K5OPT0001	**ANALOG, AUX, TRIGGER, K-TYPE**	**Analog Control, Auxiliary ADC, Trigger and K-type thermocouple Inputs add-ons** - *optional for BatReg²*

Rev. 0.2 - Printed in October 2025.