

## G5.BT Battery Tester Series

The G5.BT series is bidirectional regenerative and it was developed specifically for testing energy storage devices and is suitable for use in laboratories and on test benches. The modular and finely graded G5.BT series is characterized by highly dynamic response times and a wide current-voltage range with an auto-ranging factor 3. The G5.BT series has outstanding accuracy, an additional high-resolution current measurement range, and a fast current rise time in the 100  $\mu$ s range. Ripple modulation, an integrated safety relay for PLC according to EN ISO 13849 and a powerful CAN multi-protocol interface (1 kHz, 16 bit) as well as functions to avoid reverse-polarity problems, current surges, and unwanted deep discharges make the G5.BT series the ideal, versatile battery module and battery pack tester.

### Device Types

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

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

### Modular and Easy Scalable Systems

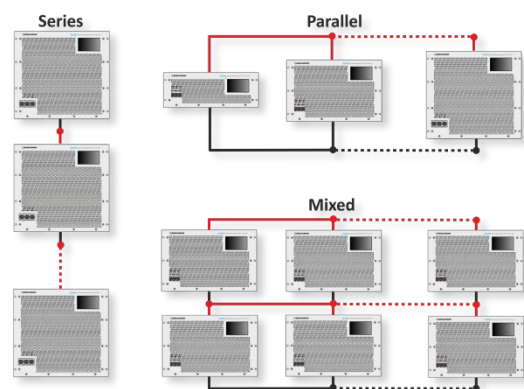


Figure 1: Modular concept for easy power and voltage increase by parallel, series, and mixed operation. The parallel configuration allows even an operation of different power levels, e.g., 18, 36, and 54 kW modules, in one system.

The output of an individual power supply is in the range from 0...9 kW to 0...2000+ kW, up to 3000 VDC. The advantageous modularity of REGATRON power supply 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 turn-key cabinet solutions or project-specific system integration according to customer specifications.

Therefore, the purchase of a REGATRON power supply is a solid investment for the future.

### Battery Module / Pack-Testing Features

The G5.BT series has an exceptional electrical performance that offers several advantages for battery testing applications:

- Voltage accuracy of <math><0.01...0.02\% \text{ FS}</math>
- Current accuracy in the range - Additional high-resolution current measurement range from -10 to 10% FS with an accuracy  $<0.005\% \text{ FS}</math>$
- Current rise time in the - Parameterizable to avoid overshoot
- Current ripple modulation up to 10 kHz

In addition, the G5.BT provides important features for user safety, power supply, and battery protection. It avoids:

- Reverse-polarity problems
- Arcing and high inrush current when connecting the battery to the DC terminals even at unmatched voltage levels
- Deep battery discharge at voltage off state (DC port impedance  $>10 \text{ M}\Omega$ )

Features such as adjustable controller settings and the integrated powerful 8-channel digital scope assist the user to quickly and easily achieve optimal system behavior for a special application requirement.

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.BT series also offers the possibility to store, edit, and recall any device configuration on board the power supply.

### Control Modes

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

### Dynamics

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

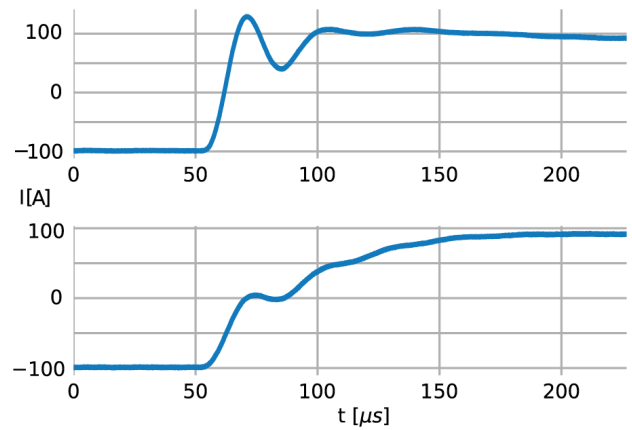


Figure 2: Parameterization example: of a 36 kW, 1000 V, 108 A device: Set-value step current -97...97 A@333VDC in  $<50 \mu\text{s}</math> with overshoot (top), in  $<200 \mu\text{s}</math> w/o overshoot (bottom). The dynamic behavior is comparable across the series of G5 devices from low voltage to high voltage$$

### General Dynamic Data

rise time	voltage 0...90%	150...220 $\mu\text{s}$
set-value step	current -90...90%	35...70 $\mu\text{s}$
response time	CV, recovery within	50...290 $\mu\text{s}$
load step	0.5% set value	

### Interfaces

#### Ethernet and USB

To connect with:

- G5.Control, the operating and maintenance software
- BatControl, the optional application software for battery testing
- 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 own 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.

### 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.

### Integrated Safety Relay

Integrated safety relay (ISR) for increased emergency stop reliability supporting performance level PL c / PL e according to EN ISO 13849.

### 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 Controls

#### BatControl

The battery tester is controlled by interfaces such as CANmp for the integration into automated test benches or by the optional application software BatControl for R+D applications in the laboratory.

BatControl allows selecting and running so-called BatScripts. These scripts automate the manually given commands to the G5 Battery Tester and allow the running of these commands according to defined schedules.

- Define charge and discharge algorithms
- Run drive cycles (according to own or already defined standards)
- Repeat previously recorded discharge/charge data

### 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
- Small signal modulation up to 10 kHz

### 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. This sweep function together with the high modulation bandwidth of 10 kHz makes devices well-suited to electrochemical impedance spectroscopy (EIS).

### HMI / RCU

The HMI built into the front panel allows comprehensive and convenient operation of the power supply 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.

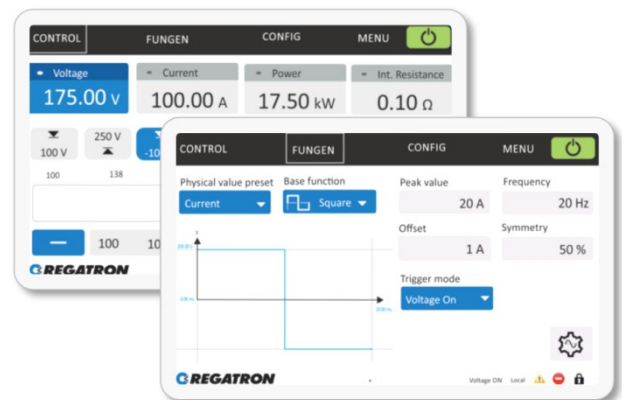


Figure 3: Intuitive control by HMI touch display. Everything you need at a glance.

### 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

- 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 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 CANmp interface or by optional display
- Easy reconfiguration between parallel, series, and mixed operation



Figure 4: REGATRON's rack-integrated turn-key system solutions with various power levels e.g. 72 kW (left) and 162 kW (right). 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.BT Series

### Technology

- Technologically advanced, fast-switching, compact 19-inch power supplies
- 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

- Application software with visualization, programming, and data logger
- 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.

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

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

Class: Public

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

