G5 System Solutions

Standardized multi-device systems for the G5 family

The G5 standard systems offer high-quality integration of the versatile G5 power supply units in the 54 kW power range. This document describes plug-and-play systems in the power and voltage range from 54…324 kW and 500…3000 V, which can be expanded as required in the multi-system configuration up to the 5000+ kW range. The systems include a lockable main circuit breaker, the entire mains distribution, auxiliary supply, and emergency stop integration with performance level e (PL e) following EN ISO 13849 and optional insulation monitoring. The possibility of configuring the G5 power supply units not only in simple parallel connection but also in series or even mixed series and parallel configuration opens up unforeseen flexibility in terms of the voltage/current range of the systems with an overall auto-ranging factor of six to nine.

Modular and Easily Scalable Systems

High-power supplies for your test and laboratory applications are expensive investments that should meet your needs for years. But who can predict which direction technical developments will take? Will there be an unexpected demand for more voltage with less amperage? Or the other way around?

Modularity is the keyword here: Thanks to the undisputed leading position of REGATRON G5 DC power supply units, the user has countless interconnection options at his disposal.

In addition to pure parallel or series connection, the latest generation of REGATRON G5 power supply units has almost any combination options in a matrix arrangement, such as series connection of device groups with group-internal parallel connection and vice versa. Another special benefit is the possibility of connecting devices of the same voltage category in parallel, regardless of their rated power.

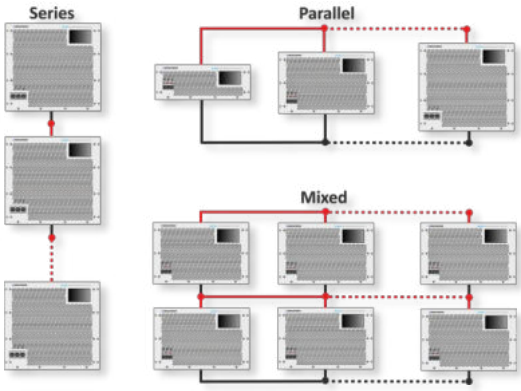

Figure 1: Modular concept for easy power and voltage increase by parallel, series, and mixed operation. The parallel configuration even allows the operation of devices with different power ratings, e.g., 18, 36, and 54 kW modules, in one system.

Overview of G5 Standard Systems

The standard systems from 54...324 kW listed below are designed on the following base units:

- G5.xxx.54.500.324 with 54 kW / 500 V / 324 A
- G5.xxx.54.1000.162 with 54 kW / 1000 V / 162 A
- G5.xxx.54.1500.108 with 54 kW / 1500 V / 108 A

Depending on the variant, the individual base units are permanently connected in parallel with DC rails or switch panels for parallel, series, or mixed parallel/series (matrix) connection.

54 kW Systems

Order Code	Voltage V	Current A	Base Unit kW / V	DC Config
SYS.54.500.324	500	324	54 / 500	single
SYS.54.1000.162	1000	162	54 / 1000	single
SYS.54.1500.108	1500	108	54 / 1500	single

108 kW Systems

Order Code	Voltage V	Current A	Base Unit kW / V	DC Config
SYS.108.500.648	500	648	54 / 500	fix par(*)
SYS.108.1000.324	1000	324	54 / 1000	fix par(*)
SYS.108.1000.648	500 1000	648 324	54 / 500	parallel series
SYS.108.1500.216	1500	216	54 / 1500	fix par(*)
SYS.108.2000.324	1000 2000	324 162	54 / 1000	parallel series
SYS.108.3000.216	1500 3000	216 108	54 / 1500	parallel series

162 kW Systems

Order Code	Voltage V	Current A	Base Unit kW / V	DC Config
SYS.162.500.972	500	972	54 / 500	fix par(*)
SYS.162.1000.486	1000	486	54 / 1000	fix par(*)
SYS.162.1500.324	1500	324	54 / 1500	fix par(*)
SYS.162.1500.972	500 1500	972 324	54 / 500	parallel series

216 kW Systems

Order Code	Voltage V	Current A	Base Unit kW / V	DC Config
SYS.216.500.1296	500	1296	54 / 500	fix par(*)
SYS.216.1000.648	1000	648	54 / 1000	fix par(*)
SYS.216.1000.1296	500 1000	1296 648	54 / 500	parallel matrix
SYS.216.1500.432	1500	432	54 / 1500	fix par(*)
SYS.216.2000.648	1000 2000	648 324	54 / 1000	parallel matrix
SYS.216.3000.432	1500 3000	432 216	54 / 1500	parallel series

270 kW Systems

Order Code	Voltage V	Current A	Base Unit kW / V	DC Config
SYS.270.500.1620	500	1620	54 / 500	fix par(*)
SYS.270.1000.810	1000	810	54 / 1000	fix par(*)
SYS.270.1500.540	1500	540	54 / 1500	fix par(*)

324 kW Systems

Order Code	Voltage V	Current A	Base Unit kW / V	DC Config
SYS.324.500.1944	500	1944	54 / 500	fix par(*)
SYS.324.1000.972	1000	972	54 / 1000	fix par(*)
SYS.324.1500.648	1500	648	54 / 1500	fix par(*)
SYS.324.1500.1944	500 1500	1944 648	54 / 500	parallel matrix
SYS.324.2000.972	1000 2000	972 486	54 / 1000	parallel matrix
SYS.324.3000.648	1500 3000	648 324	54 / 1500	parallel matrix

(*)fix par = fixed parallel configuration with DC rails

Figure 2: The 54 kW, 108 kW, and 162 kW power classes are designed as mobile units on castors.

Figure 3: The power classes 216 kW, 270 kW, and 324 kW are available for fixed installation. The bases are designed to be easily repositioned within the laboratory or the test stands using a forklift trolley.

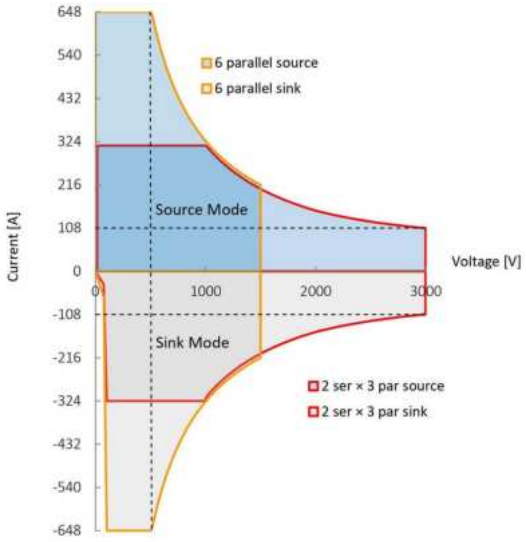

Figure 4: Illustrative voltage/current diagram using the G5 system "SYS.324.3000.648" as an example. The different pre-configurations "red" and "yellow" show the extension of the operating range at the same power rating, resulting in an auto-ranging factor of 6 for the present example.

Technical Data

Case

All systems are designed with IP20 protection and a lockable rear door. Depending on the voltage class, additional protective covers inside the system with protection class IP20 or against accidental contact are provided. Cables are routed into the enclosure via a cable brush on the rear or the open bottom of the enclosure.

- 54/108/162 kW systems are provided with castors, 360 rotatable and two of them with brakes
- 216/270/324 kW systems are mounted on a base suitable for forklift use
- Coating in RAL 7035
- Locking set EK 333 for the rear door
- Pre-wired ISR safety cable and multi-device communication cable (ComCable) for single-system operation

Order Code	Dimensions H × W × D in mm / "	Weight kg/lbs	Nominal Current A (AC)
SYS.54.*	1335 × 650 × 1000 52.6 × 25.6 × 39.4	250 550	125
SYS.108.*	1735 × 650 × 1000 68.3 × 25.6 × 39.4	420 930	200
SYS.162.*	1935 × 650 × 1000 76.2 × 25.6 × 39.4	580 1280	315
SYS.216.*	2310 × 650 × 1000 90.9 × 25.6 × 39.4	730 1610	400
SYS.270.*	1820 × 1270 × 1020 71.7 × 50.0 × 40.2	950 2090	500
SYS.324.*	2220 × 1270 × 1020 87.4 × 50.0 × 40.2	1100 2430	630

DC Connection

With the single unit system of 54 kW, the DC connection is carried out directly on the power supply unit. With the 108...324 kW systems, various DC configurations can be created due to the flexible connection capabilities. The systems are available with a fixed parallel connection. For more flexibility in terms of an increased current/voltage range, some systems are also supplied with a DC switch panel. With the various predefined jumper bars, the systems can be connected very quickly and easily in parallel, series, or mixed parallel/series (matrix) configurations.

- Ratings: 500...3000 V_{DC} / 108...1944 A
- For voltage level >1500 V_{DC}, mid-point earthing is mandatory, an earth connection is prepared on the switch panel
- Maximum current per DC connection is limited to 648 A
- Current ratings >648 A are separated by two or three connection points
  Parallel connection with additional cable pairs to be carried out by the user on the load side
- DC+ / DC- connection on rails for cable lugs
- M8 lug terminals for single-unit systems and fixed parallel configurations
- M10 lug terminals for connections on switch panels

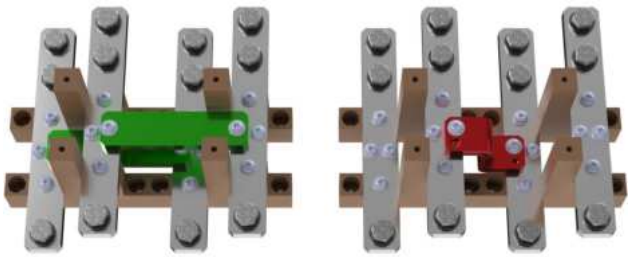

Figure 5: The DC switch panel offers high-quality jumper bars for parallel and series/matrix connection. Together with the comfortable reconfiguration tab in the G5.Control operating and service software, the current or voltage range of the G5 power system can be doubled or tripled within a very short time.

Grid Connection

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

- 380…480 VAC ±10% at 50/60 Hz
- Backup fuse on the facility side must not exceed nominal current ratings
- 3L + PE connection on rails for cable lugs M8
- 3-fold lockable mains circuit breaker
- Additional circuit breaker 2L / 10 A for control circuit and 24 V_{DC} auxiliary supply
- Designed for operation in Lightning Protection Zone 1 (LPZ1)

Safety

The integrated emergency stop circuit ensures a safe cut-off of the energy flow from the mains side to the load side and vice versa. It can be triggered by the integrated emergency stop button or via interfaces to the superordinate laboratory emergency stop circuit. The available interfaces and optional safety bus cables (SAFBUS) allow for easy interconnection of up to three systems in the same safety circuit.

- Emergency stop button red/yellow, 2-channel
- Category 3, performance level e (PL e) following DIN EN ISO 13849-2:2012
- The safety circuit requires the G5's integrated safety relay feature (ISR)
- 1x Safety I/O (D-SUB 25) and 2x P-Stop (D-SUB 9) interfaces are available for external integration or multi-system configuration
- Dummy plugs for stand-alone operation included in the scope of delivery

The safety I/O interface provides potential-free contacts to trip the higher-level safety circuit as soon as the internal emergency stop of the G5 system is triggered. The interface also features cross-circuit monitored contacts to stop the G5 system by external emergency stop equipment. Furthermore, control and diagnostics of the read-back circuit, AUTO/MANUAL reset function, and status indications are provided.

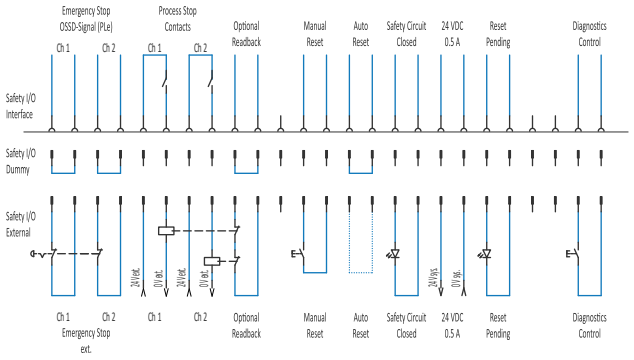

Figure 6: Overview of the safety I/O interface

The two process stop interfaces can be integrated into the higher-level safety circuit similarly to the safety I/O interface. The advantage of this interface is that the external switch-off only affects the output stages and not the G5 safety circuit. This means the higher-level system can still be activated via potential-free contacts regardless of the external switch-off, which helps to avoid possible deadlocks. These interfaces are used for the interconnection of up to three systems.

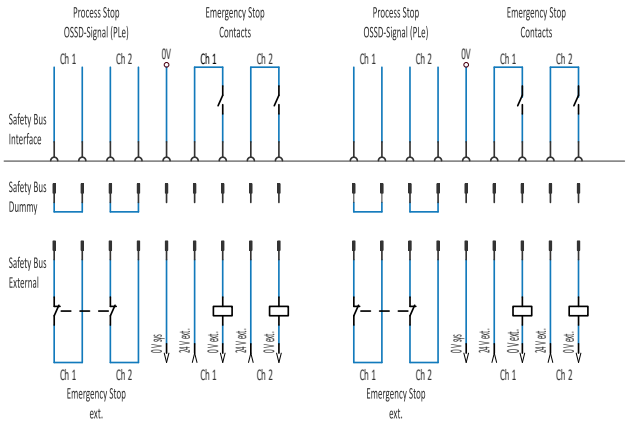

Figure 7: Overview of the two process stop interfaces

Environmental Conditions, Regulations, and Documentation

- Operating temperature: 5…40 °C
- Relative humidity: ≤85%, non-condensing
- Cooling: direct forced air, front to back
- CE conformity and design according to EN 61439-2
- User manual in German and English as default
- Wiring diagram in English as default

Options

Insulation Monitoring (ISO)

The insulation monitoring device checks the insulation resistance of the DC network to PE. Two independent threshold values can be configured, each of which activates the corresponding fault relay.

- Operating voltage 0…1000 V_{DC} (ISO.1000) or 0…1500 V_{DC} (ISO.1500)
- Adjustable warning level 64 kΩ (default on ISO.1000) and 96 kΩ (default on ISO.1500) is available on dry changeover contacts
- Adjustable error level 40 kΩ (default setting ISO.1000) and 60 kΩ (default setting ISO.1500) is integrated into the safety circuit
- Auto reset or manual reset is selectable via the safety I/O interface
- Errors must be cleared at the power supply unit level as well
- Activation/deactivation of the insulation monitoring via display mounted on the front panel
- For leakage capacitance up to 1000 µF
- Operation with earthed systems not possible

Voltage Level Indicator (VLI)

Batteries, capacitors, or fuel cells in particular, pose risks to the operator of DC power supply units, as these energy sources continue to supply dangerous voltages even when the power supply unit is switched off. The passive voltage level indicator VLI lights up an orange LED to warn when voltage is present at the DC terminals. The VLI unit does not require an auxiliary supply and therefore works even if the system is switched off or not connected to the mains.

- Operating voltage 0…1500 V_{DC}
- Adjustable threshold from 15...100 V_{DC} (15 V_{DC} default setting)

Figure 8: The VLI unit is positioned next to the DC connection point. The unit provides both an LED on the module and an interface for the external LED, which is placed on the front of the system.

Safety Bus Cable (SAFBUS)

When increasing the power ratings with multiple systems, up to three of them can be integrated into the same safety circuit. In a configuration with two systems, the systems are connected with one safety bus cable (SAFBUS) on a P-Stop interface. For a triple combination, three safety bus cables are required and connected to both P-Stop interfaces of each system in a triangle connection.

AC Cable (INACC.CEE125.400.5)

- AC cable, 5 m with 3L + PE, 25 mm^2 / AWG3
- CEE125 connector 5-pole for 125 A / 400 VAC ±10% for SYS.54.*
- Cable inlet on the left
- Including cable roll-up support, cabinet width increased to 765 mm / 30.1 “, illustration see Figure 9
- Discharging of the G5’s AC filter (XCD) is mandatory when using the system with a plug connection. The XCD option ensures a discharge time of the AC filter of <1 s as required by EN 62477-1

Prepared Module Slot (CASE.PREP.54)

A major advantage of the fully modular concept of the G5 product family is the ability to cover future requirements for higher power, voltage, or current levels with an additional 54 kW base unit. Systems can therefore initially be equipped with one G5 device less. The reserve slot is pre-wired and fully tested. The integration of the additional 54 kW unit can easily be carried out by the user on-site at a later stage.
This option contains:

- Additional blind plate 10 U
- Dummy plug for ISR circuit
- Complete cabling pre-assembled and tested

Handles (CASE.HANDLE)

The handles offer more convenience for frequent repositioning of the mobile systems SYS.54/108/162.*. The handles are mounted at a suitable working height on the left and right sides of the system front. The illustration is shown in Figure 9.

Base Plate (CASE.PLATE)

The additional base plate completely covers the bottom of the enclosure. Cable routing will therefore only be possible via the cable brushes in the rear door.

Overview of Options

Order Code	Short Description
ISO.1000	insulation monitoring unit 0…1000 V_{DC}
ISO.1500	insulation monitoring unit 0…1500 V_{DC}
VLI.1500.LED	voltage level indicator 0…1500 V_{DC} incl. external LED indication on the front panel
SAFBUS.5	safety bus cable, 5 m length
INAC.CEE125.400.5	AC cable with CEE125 plug up to 125 A available for SYS.54.*, requires XCD option on G5 device
CASE.PREP.54	prepared 19" module slot for 54 kW
CASE.HANDLE	handles for improved mobility
CASE.PLATE	closed bottom of the enclosure

Summary

G5 Standard Systems

- Single systems with 54…324 kW scalable with multi-system operation up to 5000+ kW range
- Easy reconfiguration between parallel, series, and mixed operation leading to wide voltage/current operating ranges
- 500…3000 V_{DC} and 108…1944 A
- Safety circuit with performance level e (PL e) following category as per DIN EN ISO 13849-2:2012
- Further safety options like insulation monitoring and passive voltage level indication
- IP20 with optional air filters
- Mobile and pluggable rack solutions on castors
- CE/UKCA marking with test protocols according to EN 61439-2 and comprehensive operating instructions and system description
- Highest quality standards by industrial manufacturing, automated testing of safety/control circuit, and reported long-term testing at full power ratings

Customization

Engineering on Demand

Do you have additional requirements for the standard system capabilities described before? Are test bench-specific interfaces or increased environmental requirements necessary? REGATRON's experts will be at your assistance. REGATRON's customized and turnkey test systems are always developed in close contact between our field application engineers and the customer, from the initial concept discussion to demanding factory acceptance tests and product training.

DC Configuration

- Multi-channel systems for the use of single 9...54 kW base modules or even split up multi-device configurations such as 54/108 kW, 108/108 kW, 108/162 kW, 162/162 kW, or 108/216 kW
- High-current system design with 60...320 V_{DC} up to 8000+ A with various configurations and connection possibilities

Safety

- Discharge of residual energy from rotating loads by the additional DC discharge unit (DDU) after shutdown of the test bench
- Insulation monitoring: remote activation of the insulation measurement, actual insulation value, and warning/error status are provided by the CANmp interface
- Residual Current Monitor (RCD) for grounded systems up to 3000 V_{DC}
- LED indicators for mains monitoring of voltage level, phase rotation, and position of the main switch
- Simplified and safe operation thanks to pre-programmed overvoltage protection and digital fuses with immediate and I^2t triggering. Different protection levels for different DUTs are activated by I/O signals, which can be conveniently activated via an additional selector switch
- Customer-specific safety interfaces and safety wiring for multi-system operation with more than three systems

Convenient Handling

- Pluggable AC and DC cables
- Automated reconfiguration from parallel to series/matrix connection and vice versa
- The DC connection point for the DUT can be installed separately from the power supply using the power distribution unit (PDU). If space is limited in the test bench, the power supply system can be installed in the equipment room. At the test bench, the DC power is operated and connected via the PDU. The PDU is designed for wall mounting to save space and offers a wide range of features such as DC connectors, sense connection, RCU.FD display with IP54 protection, emergency stop button including safety door limit switch, selector switch, and status indicators.
- Mains adaptation to 220, 600, and 690 V_{AC} with auto-transformer
- Third-party product integration with optional AC supply
- Laptop drawer

Environmental Conditions

- Increased protection up to IP54 for air or liquid-cooled systems
- Increased protection against shocks and vibrations during frequent transportation due to sophisticated flight case design

Figure 9: REGATRON's rack-integrated turn-key system solutions for various power levels, e.g. 72 kW (left) and 162 kW (right). Various types of AC and DC connectors, cables, and handles allow for comfortable use.

Figure 10: 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.

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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