ELECTRONIC TEST & POWER SYSTEMS

RENTAL
G5-RSS-HC

HIGH CURRENT HIGH POWER BIDIRECTIONAL DC

POSITIVE PROBLEM SOLVING

With the ability to source or sink currents up to 2704A, the G5-RSS-HC is ideal for cycling and emulating low voltage/high current energy storage devices. Short circuit testing is another common application.

These power dense modules have an extensive feature set including programmable PI parameters and an inbuilt 8 channel recording scope. Adjustable power and resistance limits are provided. Analogue, ethernet, USB and high-speed CAN interfaces are provided with each module. The G5-RSS features an autoranging output, which allows for many more V/I combinations at nominal power. Modules are delivered fitted into flight cases.

- + Programmable Ripple up to 10kHz
- + Two Current Ranges for Higher Accuracy
- + Battery Cycling and Emulation Software
- + Function Generator with V/I Capability
- + Ultra-Fast Dynamic Behaviour
- + Sink Voltages up to 160V

CONTENTS

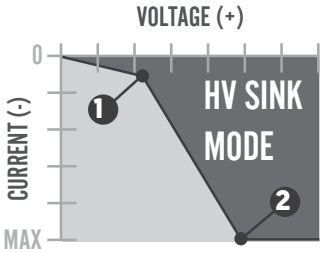
STANDARD MODELS

SELECTION TABLE

Part Number	Maximum Power	Q1 Source Voltage	Q4 Sink Voltage	Current Range	Internal Resistance Range
G5-RSS 36-80-1352-r	36kW	0 to 80Vdc	1 to 80Vdc*	0 to ±1352A	0 to 118mΩ
G5-RSS 72-80-2704-r	72kW	0 to 80Vdc	1 to 80Vdc*	0 to ±2704A	0 to 59mΩ
G5-RSS 72-160-1352-r	72kW	0 to 160Vdc	2 to 160Vdc*	0 to ±1352A	0 to 236mΩ

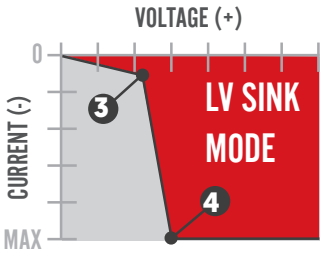
* The maximum current that can be taken derates as the voltage reduces beneath the lower level. Please see below for more details.

The maximum current that can be taken derates at low voltages. As standard the G5-RSS-HC operates in HV Sink Mode when operating as a DC load. In this mode the user can sink full current from 7.5% V_{NOM} to 100% V_{NOM}, according to the maximum power. The HV Sink Mode operating range is indicated in dark grey.



Part Number	Point 1: 10% I_{MAX} (HV Mode)	Point 2: 100% I_{MAX} (HV Mode)
G5-RSS 36-80-1352-r	5.5V / -135.2A	6V / -1352A
G5-RSS 72-80-2704-r	5.5V / -270.4A	6V / -2704A
G5-RSS 72-160-1352-r	11V / -135.2A	12V / -1352A

If you require to sink higher currents at lower voltages, then setting a maximum voltage between 2V to 26V switches the G5-RSS-HC to Low Voltage mode. The values possible at 100% I_{MAX} and 10% I_{MAX} are provided below. Lower voltages are possible with further current derating. The LV Sink Mode operating range is indicated in red.

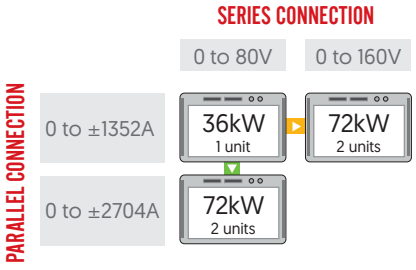


Part Number	Point 3: 10% I_{MAX} (LV Mode)	Point 4: 100% I_{MAX} (LV Mode)
G5-RSS 36-80-1352-r	0.5V / -135.2A	1V / -1352A
G5-RSS 72-80-2704-r	0.5V / -270.4A	1V / -2704A
G5-RSS 72-160-1352-r	1V / -135.2A	2V / -1352A

MODULARITY (MASTER/SLAVE)

Two G5-RSS-HC 80V modules are available in our rental range. These can be arranged in series or parallel configurations. Each module is able to operate independently, with inbuilt system comms allowing users to switch between various set-ups.

Our rental systems can be combined in series, parallel or matrix configurations with any G5-RSS-HC modules you have previously purchased, providing they have the same nominal outputs. Up to 64 modules can be connected in this way. This allows any short term requirements outside of usual operating ranges to be met.

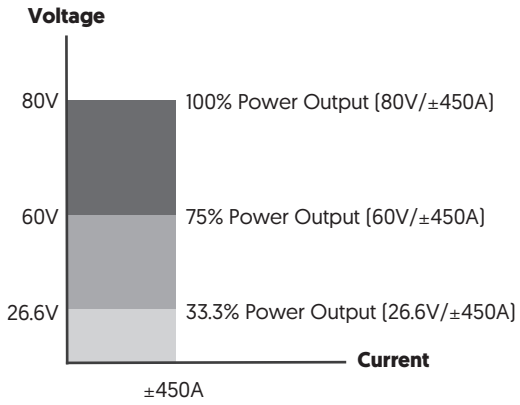


AUTORANGING CAPABILITY

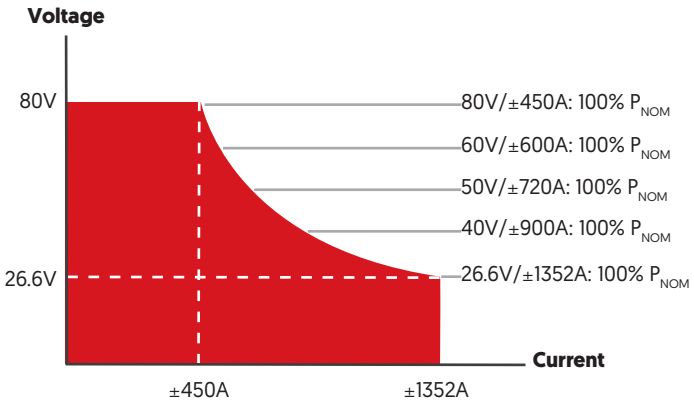
Every G5-RSS-HC features an autoranging output. This allows many more voltage/current combinations at nominal power than a traditional bidirectional DC power system. An example of the difference is shown below using a single G5-RSS 36-80-1352-r module.

Using one autoranging bidirectional PSU instead of several traditional power systems saves both cost and bench space. Despite the units offering such a large output range, they are still incredibly power dense. 36kW of output power is provided from 7U of rackmounting height.

TRADITIONAL 36W/80V SYSTEM



G5-RSS 36kW/80V SYSTEM



FORM FACTOR AND ENCLOSURES

STANDARD FEATURES

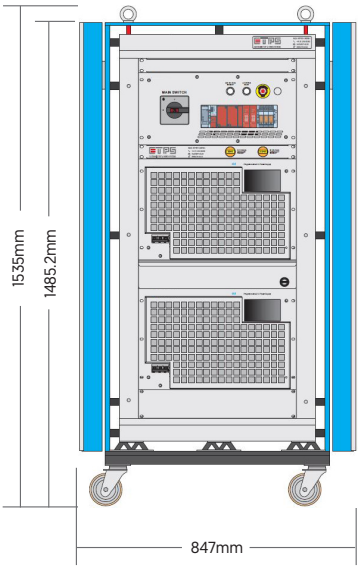
TECHNICAL DATA	
Cabinet Dimensions	847mm × 1535mm × 1150mm (W × H × D) including castors
Cabinet Weight	Approx. 430kg (with 2x modules installed)
Basic Construction	IP 20

When renting 2x G5-RSS-HC modules a cabinet integration is used to make deployment simpler, quicker and safer in master/slave. Among the cabinet safety features is a status indicator that alerts users of any residual energy on the DC link that is greater than 30V. This operates even if the mains power is turned off. Another indicator assesses the quality and correct rotation of the AC input voltage and illuminates if correct.

Key features include:

- All 4 Heavy Duty Castors with Locking Function
- Indication of Connected AC Line Voltage
- Passive Indication of DC Output Voltage
- Panel Mounted Emergency Stop
- CEE125 Plug with 5m AC Input Cable (3L + PE +N)

A separate flight case is available when renting a single module. Contact ETPS for more details.



OPERATING RANGES AND FEATURES

STANDARD FEATURES

TECHNICAL DATA (PER 36kW MODULE)	
Remote Voltage Sense	Programmable (stability/drift: ≤0.01%FS[4] | temperature coefficient: 0.007%FS/°C[5])
Stability/Drift	Voltage: ≤0.01%FS[4] | Current: ≤0.01%FS[4]
Temperature Coefficient	Voltage: 0.005%FS/°C[5] | Current: 0.005%FS/°C[5]
Efficiency	94% at P_{MAX}/V_{MAX}, 92% at P_{MAX}/I_{MAX}
Rise/Fall Time[6]: 10% to 90% of Step (0 to 90% V_{MAX}/ 90% P_{MAX})	≤220µs
Rise/Fall Time[6]: 10% to 90% of Step (0 to 33% V_{MAX}/ 30% P_{MAX})	≤160µs
Rise/Fall Time[7]: 10% to 90% of Step (-90% to 90% I_{MAX} at 33% V_{MAX}) 10% to 90% of step at low inductance	50µs
Rise/Fall Time[7]: 10% to 90% of Step (-90% to -10% I_{MAX} at 33% V_{MAX}) 10% to 90% of step at low inductance	50µs
Rise/Fall Time[7]: 10% to 90% of Step (10% to 90% I_{MAX} at 33% V_{MAX}) 10% to 90% of step at low inductance	50µs
Transient Response Time[8] (CV, Recovery Within 2% of Set Voltage)	50µs
Transient Response Time[9] (CV, Recovery Within 0.5% of Set Voltage)	≤50µs
Transient Response Time[10] (CC, Recovery Within 2% of Set Current)	≤270µs
Voltage Drop While Load Switching On (-90% to 90% P_{MAX} at 90% V_{MAX} at rate 675A/100µs in HighCap mode)	4V
Voltage Drop While Load Switching On (45% to 90% P_{MAX} at 90% V_{MAX} at rate 675A/100µs in HighCap mode)	8.5V
Voltage Overshoot While Load Switching Off (90% to -90% P_{MAX} at 90% V_{MAX} at rate 675A/100µs in HighCap mode)	4V
Voltage Overshoot While Load Switching Off (90% to 45% P_{MAX} at 90% V_{MAX} at rate 675A/100µs in HighCap mode)	8.5V
Output Capacitance: X-capacitor LowCap	2120µF
Output Capacitance: X-capacitor HighCap	49640µF
Output Capacitance: Y-capacitor at DC	263nF
Ripple: Output Voltage Ripple (4.1kHz to 3.8MHz): Vrms, LowCap, Ohmic Load, 90% P_{MAX} 90% V_{MAX}, CV Mode	≤0.15% FS
Ripple: Output Voltage Ripple (4.1kHz to 3.8MHz): Vrms, HighCap, Ohmic Load, 90% P_{MAX}, 90% V_{MAX}, CV Mode	≤0.15% FS
Ripple: Output Current Ripple (4.1kHz to 3.8MHz): Arms, LowCap, Ohmic Load, 90% P_{MAX}, CC Mode	≤0.02% FS at 46% I_{MAX}
Noise: (10Hz to 3.8MHz) : Vpp, LowCap, Ohmic Load, 90% P_{MAX}, 90% V_{MAX}, CV Mode	≤0.6% FS
Noise: (10Hz to 3.8MHz) : Vpp, HighCap, Ohmic Load, 90% P_{MAX}, 90% V_{MAX}, CV Mode	≤0.7% FS
HMI Touchpanel Meter Resolution	0.01V/0.1A
Output Discharge to <60V	Active discharge enabled: ≤1s, active discharge disabled: <60s
Static Accuracy[11]: Power at I_{MAX} 1kHz Filter	0.07% FS
Static Accuracy[11]: Voltage	0.02% FS
Static Accuracy[11]: Voltage Sense	0.02% FS
Static Accuracy[11]: Current Full Range 1kHz Filter	0.065% FS
Static Accuracy[11]: Resistance at I_{MAX} 1kHz Filter	0.065% FS

[1] At 25°C ambient temperature, constant line conditions. [2] With a constant resistive load in LowCap mode.
[3] Constant voltage mode, recovery within 0.5% SetValue at 30% V_{MAX}/100% V_{MAX}, with a resistive load in HighCap mode.
[4] 8h after 1h warm up time at constant line input, load and temperature. [5] At constant line and load conditions.
[6] Voltage set-value step, constant ohmic load, LowCap mode. [7] Current set-value step, constant voltage, LowCap mode.
[8] 0 to 90% P_{MAX} load step at 90% V_{MAX}. Assuming an ohmic load in HighCap mode.
[9] 45 to 90% P_{MAX} load step at 90% V_{MAX}. Assuming an ohmic load in HighCap mode.
[10] 45 to 90% P_{MAX} load step at 90% I_{MAX}. Assuming an ohmic load in LowCap mode.
[11] At 25° ambient temperature, constant line/load conditions normal distribution (k=2).

OPERATING RANGES AND FEATURES

STANDARD FEATURES

TECHNICAL DATA (PER 36kW MODULE)	
Small Signal Modulation (Voltage Controller LowCap Mode)	Frequency (CV, CC): 0 to 10kHz Modulation range V_{RMS} sine at 10kHz: 0 to 5% FS Attenuation at 5kHz/10kHz, operating point: 90% V_{NOM} +5% V_{NOM} amplitude: 0.4dB/5.6dB Phase lag analogue input to voltage out: 130µs
Small Signal Modulation (Current Controller LowCap Mode)	Modulation range A_{RMS} sine at 10kHz: 0 to 5% FS Phase lag analogue input to current out: 145µs
Sense Input Impedance While Operational	196kΩ
Sense Input Impedance - Voltage OFF	196kΩ
Sense Input Impedance - Voltage OFF (Output Measurement Disconnected)	Open
Ballast Resistor DC Power Port at Voltage OFF (RPP Closed)	632Ω

HIGHLIGHTED FEATURES

SENSE COMPENSATION

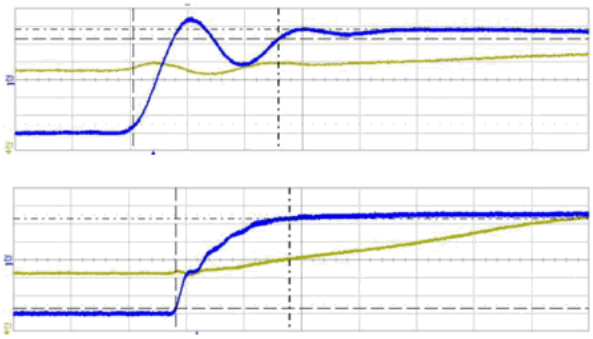
Sense plus terminals are built into the G5-RSS-HC for the connection of sense wire which compensates for voltage drops in the load lines. This has a number of advantages over traditional sense. It is permitted to interrupt the load line during operation (voltage on). The maximum voltage drop compensation is adjustable. The voltage difference between G5-RSS-HC output and sensing point is monitored. If a set limit is exceeded, the G5-RSS-HC unit shuts off. This is particularly useful for applications with long cables often prone to unwanted voltage drops.

SWITCHABLE OUTPUT CAPACITANCE

Switchable capacitance is provided within each G5-RSS-HC module as standard and is used to optimise the DC filter depending on the application in which the systems are used. A low capacitance level provides fast dynamics in constant current when charging/ discharging/ cycling energy storage devices. Switching to the higher cap value provides for smoother operation during hard load steps when operating in constant voltage. Typical applications include energy storage simulation for electric drive developments.

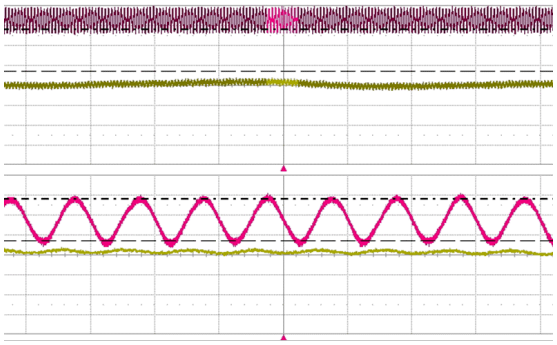
FAST DYNAMICS AND HIGH STABILITY

A current step between 90% sourcing to 90% sinking current can be as quick as 50µs, enabling high speed drives to be supplied. Advanced users have access to the controller settings enabling the response to be optimised for particular loads. This example shows a current step through quadrants. The upper trace shows the current transition is achieved in 50µs with a small overshoot before settling. The lower plot shows a more regulated response within 200µs. Voltage typically takes 100µs to recover within 0.5% of the set value. In multi-module systems the communication time between modules need to be considered.



PROGRAMMABLE RIPPLE

By utilising the embedded function generator the user can set a current ripple at up to 10kHz. The magnitude can be up to 5% of the nominal system current. Depending on the impedance of the DUT the resulting voltage ripple can be calculated. The below example shows a 10kHz ripple generated using the function generator of the G5-RSS. A peak to peak current of 8A has been superimposed on a current of 100A. Alternatively, a ripple can be implemented from an external waveform generator via the analogue interface using a proportional 0-10V signal.



OPERATING MODES

STANDARD FEATURES

TECHNICAL DATA (PER 36kW MODULE)	
Operating Modes	Constant Voltage (0 to 100% of V_{MAX}) Constant Current (0 to ±100% of I_{MAX}) Constant Power (±5% to ±100% of P_{MAX})
Internal Resistance Range	0 to 118mΩ
Programmable Load (CR Mode: R_{MAX} at V_{MAX}, R_{MIN} at V_{MIN})	0.001 to 21.3Ω
Standard Interfaces	Analogue, Ethernet (up to 800 × 16 bit/s) & USB (up to 450 × 16 bit/s)

HIGHLIGHTED FEATURE

INTERNAL RESISTANCE RANGE

Each module is built with a user programmable internal resistance range as standard. This makes the power supplies ideal for simulating the output of energy storage devices such as battery packs, fuel cell stacks and super capacitors. The exact range varies by module.

INPUT

STANDARD FEATURES

TECHNICAL DATA (PER 36kW MODULE)	
AC Line Voltage	3 × 380VAC to 480VAC ±10%
Line Frequency	50Hz/60Hz
Mains Connection Type	3L + PE (no neutral)
Rated I_{NOM}	60ARMS at 3 × 380VAC | 57ARMS at 3 × 400VAC | 55ARMS at 3 × 415VAC 52ARMS at 3 × 440VAC | 50ARMS at 3 × 460VAC | 48ARMS at 3 × 480VAC
Inrush Current	<66ARMS
Power Factor	0.99 at P_{MAX}
THDi	≤0.03 at 90%P_{MAX}
Standby Power	52W
Protective Earth Conductor Current at 150Hz	According to IEC 60990: ≤7.5mA
Input Filter Discharge to 60V	L-PE / L-L: <1s

HIGHLIGHTED FEATURE

ACTIVE POWER FACTOR CORRECTION

G5-RSS-HC modules have Active Power Factor Correction (PFC) circuit integrated into the input stage as standard. This enhances the overall efficiency of the modules across the output power range when compared to a unit that does not have active PFC. In practice, this means a significant lower peak current value, a decrease of RMS value of the phase current and less perturbations of other equipment running on the same grid.

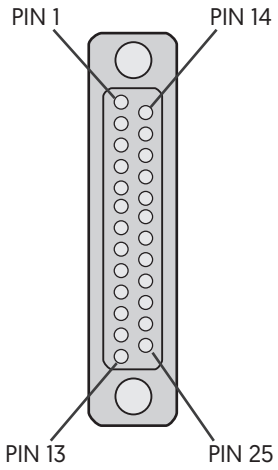
The inbuilt active PFC is also ideal for operating the power supply from a generator. Generators tend to be sensitive against high current peaks, and their voltage controllers may have some stability problems with non-sinusoidal load currents. The active PFC feature forms a lowpass filter and therefore, both the repetitive current peaks and also the harmonic content is enhanced. This will help the generator system maintain a stable and reliable output.

INTERFACES AND CONTROL

STANDARD ANALOGUE INTERFACE

An analogue interface is provided as standard which operates at 48kHz. The control port is configured as a Sub-D 25 female connector and is located on the rear panel. It allows output values to be set and read proportionally using a 0-10VDC analogue signal. Digital inputs and outputs enable various functions such as the interlock and output ON/OFF. A 10VDC reference is provided for analogue control. Digital functions are switched via a high/low signal. A 24VDC supply voltage is provided for these functions.

INPUT/OUTPUT DATA	
Number of Inputs/Outputs	4
Internal Resolution	16 bit
Input Accuracy	Bipolar range:±0.1%, Unipolar range: ±0.2%
Output Accuracy	±0.2%
Input Filter	2nd order low pass filter, cut off frequency: 15kHz
Temperature Coefficient	0.02% FS/°C
Sampling/Update Rate	48kS/s
Output Settling Time	10µs (typical)
Input Voltage Range	-10V to +10V, -5V to +5V, 0V to 5V, 0V to 10V (selectable)
Absolute Max Input Voltage	±30VDC
Input Impedance	1MΩ (typical)
Output Voltage Range	-10V to +10V, -5V to +5V, 0V to 5V, 0V to 10V (selectable)
Max Output Current	20mA (short circuit proof)
Output Impedance	0.5Ω (typical)
Delay (Typical)	89µs (input to power out), 42µs (power out to analogue out)



PIN	SIGNAL	I/O	DESCRIPTION
1	AGND	Supp	Analogue ground for pins 2–4, 14–16
2	AIN1	AI	Voltage setpoint input 0–10VDC
3	AIN2	AI	Current setpoint input 0–10VDC
4	AOUT1	AO	Current feedback output 0–10VDC
5	AOUT2	AO	Power feedback output 0–10VDC
6	AOUT3	AO	Analogue reference voltage (+10VDC)
7	DGND	Supp	(Connected to pin 17) 0VDC DigIn; common ground for pins 8–9, 18–20, 24, 25
8	APP_DIGIO_4	DI/O	Digital input/ouput[3] 0-2VDC /10-28VDC Default function: Clear error
9	APP_DIGIN_6	DI	Digital input[3] 0-2VDC /10-28VDC Default function: Voltage ON
10	REL1_14	RO	Relay output 1 normally open
11	REL1_13	RO	Relay output 1 common
12	REL2_14	RO	Relay output 2 normally open
13	REL2_13	RO	Relay output 2 common

PIN	SIGNAL	I/O	DESCRIPTION
14	AIN3	AI	Power limit analogue input 0–10VDC
15	AIN4	AI	Load resistance reference value input 0–10 VDC
16	AOUT4	AO	Voltage feedback output 0–10VDC
17	DGND	Supp	(connected to pin 7) Common ground to pins 8–9, 18–20, 24, 25
18	APP_DIGIO_1	DI/O	Digital input/ouput[3] 0-2VDC/10–28VDC
19	APP_DIGIO_2	DI/O	Digital input/ouput[3] 0-2VDC/10–28VDC
20	APP_DIGIO_3	DI/O	Digital input/ouput[3] 0-2VDC/10–28VDC No default function
21	REL3_14	RO	Relay output 3 normally open (warning)
22	REL3_12	RO	Relay output 3 normally closed (warning)
23	REL3_11	RO	Relay output 3 common (warning)
24	APP_DIGIO_5	DI/O	Digital input/ouput[3] 0-2VDC/10–28VDC No default function
25	+24 VDC	Supp	+24VDC I/O Aux power output 24VDC, max. 650mA

[1] Pin 5 (0 VDC) is used as the reference earth for pin 25 (24 VDC) and is connected internally to the equipotential bonding via a 1 kΩ resistor to earth.
[2] Maximum switching current: 1 A; maximum switching voltage: 24 V. [3] On request digital pins can be programmed for a specific application.

DIGITAL I/O	
Number of Digital Inputs/Outputs	6 (each can be used as input or output)
Output Voltage Supplied for Digital I/O	24VDC (-15%/+20%)
Digital Input Characteristic	IEC61131-2 Type 1
Digital Input Filter	3.2ms (10µs, 1ms and 10ms factory configurable)
Digital Output Switching Time	T_{ON}: 64-120µs, T_{OFF}: 90-170µs
Update Rate Digital Outputs	1kS/s

DIGITAL I/O	
Max Voltage Digital Inputs	30VDC
Sampling Rate Digital Inputs	1kS/s
Digital Output Type	High-side switch
Load Type	Ohmic, inductive, lamp load
Max Total Output Current (All Channels)	0.65A
Max Output Current Per Channel	0.625A (short circuit proof)

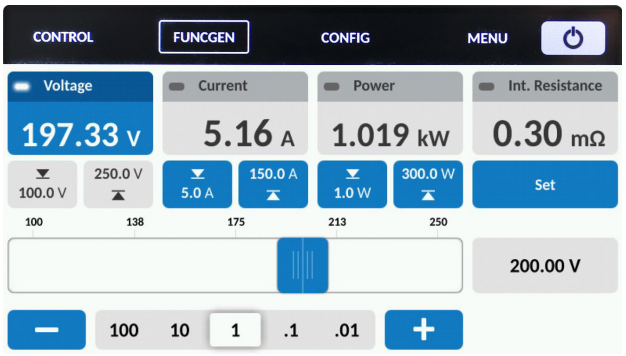
INTERFACES AND CONTROL

RELAY OUTPUTS	
Number of Relay Outputs	2 × SPST (NO), 1 × SPDT
Load Type	Ohmic, inductive, lamp load
Max Switching Voltage	30VDC
Max Switching Current	SPST: 3A, SPDT: 1A
Update Rate	48kHz

HIGHLIGHTED FEATURES

TOUCHSCREEN HMI (/HMI)

Each module's HMI provides a simple and intuitive way of control and measurement via a touchscreen panel. Users can directly access features such as the system's protections, warnings/errors and function generator without the use of a computer. A user defined passcode can be set to lock the touch screen, which prevents unauthorised access.



CAN MULTI-PURPOSE INTERFACE (/CANMP)

CANmp is a high speed digital interface operating at 1kHz. The interface gives users the capability to customise the CAN protocol. Up to 50 messages are user configurable. Along with the CAN ID the data length code, byte order, start bit, data type and signal factor can be adjusted by the user. A DBC file is provided and messages can be easily configured within the standard windows software. Messages can be sent cyclically or upon receipt of a sync or syncID signal.

SOFTWARE/SOFT TOOLS

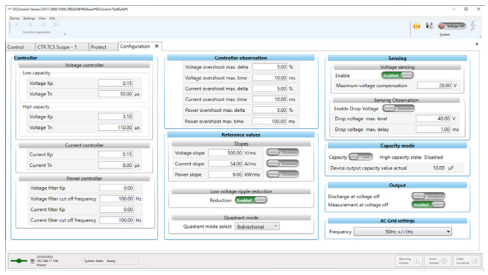
STANDARD G5.CONTROL GUI

All G5-RSS-HC units come with a simple and intuitive G5.Control operating GUI as standard. Live values of the power system are displayed graphically along with any warning and error messages. The software provides a variety of second level parameters, ideal for users who like to optimise their test processes. In standard user mode the operator can remotely program set values, enable voltage output as well as the ability to analyse different variables including set and actual values via the integrated scope.

The scope function can simultaneously record up to 8 system variables. Recording can be started manually or by a defined trigger event from any variable of the system. All actual and set values (currents/voltages/power/internal resistance) can be recorded. Other recordable items include system temperatures, intermediate DC circuit, low voltage auxiliary power supplies, error related values and variables from the controller section.

A password protected section is available to the advanced user and service technician. In addition to the standard functions the authorised user is able to:

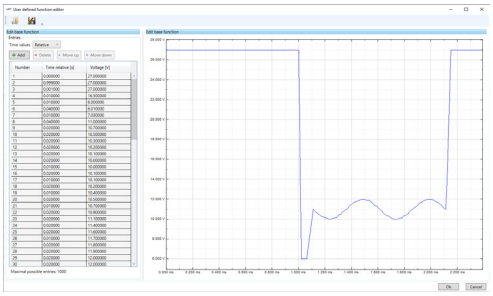
- Program linear ramp functions at start up and set value steps during operation
- Configure multi-unit operation
- Program the PI controller parameters
- Program the unit's limit values
- Calibrate and adjust values as necessary
- Update the firmware



APPLICATION GUIs

FUNCTION GENERATOR (/TFE & /AAP)

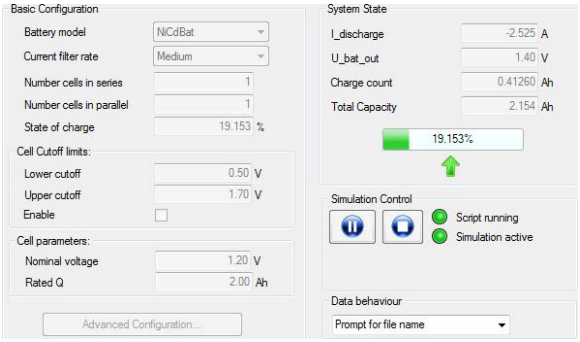
Complex DC waveforms can be implemented through an embedded function generator. The highly programmable nature of the function generator allows users to plot out exact waveforms. This is often advantageous when emulating a power device with a very specific behaviour profile. For example, when quality testing fuel cell powered equipment, the specific behaviour of a discharging fuel cell can be programmed and replicated.



As well as custom shapes, standard square, sawtooth and sine waveforms can be plotted against time. Voltage/current and voltage/power relationships can also be programmed where necessary. Parametric programming is possible, where instead of the time axis, an input variable (V_{IN}, I_{IN} or P_{IN}) can be selected.

BATTERY SIMULATION (/BATSIM)

BatSim is a battery emulation GUI for use with G5-RSS-HC power systems. The GUI allows the power supplies to simulate real world behaviour of a battery pack.



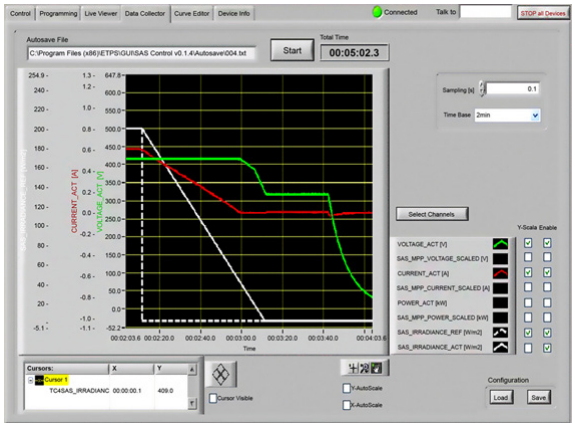
Emulating a battery pack allows specific sections of a circuit to be isolated and researched. Nearly all relevant electrical characteristics are programmable including number of cells, energy capacity, cut off limits, chemistry type and nominal voltage. The modularity of the power systems provides a convenient method to emulate different size battery stacks. Hard to replicate conditions, such as a cranking curve from a cold start can be programmed and repeated when used in conjunction with the function generator.

The multi-channel data logger provides live reporting and output to file (CSV) with timestamps. Previously recorded data can be imported, reviewed and compared in the analyser mode. Other features include:

- Adjustable internal resistance and discharge current
- Variation of exponential capacity and voltage levels
- Emulation of common battery chemistries
- Novel chemistries available on request
- Series/parallel configuration of cells

SOLAR ARRAY SIMULATION (/SASCONTROL)

SASControl software has all EN 50530 tests pre-installed, with minor adaptations possible for particular inverter models. The GUI allows users to edit irradiance, temperature, amplitude values or input scaling with special commands.



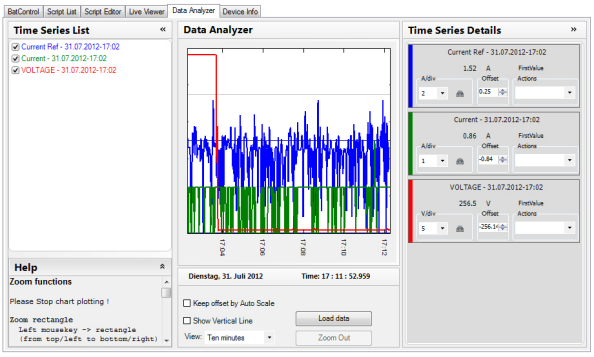
APPLICATION SPECIFIC GUIs

ELECTRIC DRIVE AND BATTERY CYCLING (/BATCONTROL)

Drive cycle tests can be implemented using BatControl. The GUI's main screen provides an overview of the main test values for all BatControl operations. Live data from the connected power system is displayed, and setting/adjustment of primary values is possible.

Previous data obtained from a test track can be imported and recreated, allowing the G5-RSS-HC to simulate a real world driving test inside a lab environment. Battery and capacitor charge/discharge profiles can also be implemented through the GUI. An internal charge counter allows users to view live data for Wh and Ah. Energy storage orientated tests which users can program include:

- Battery charge/discharge cycles
- Automated drive cycle loading and simulation
- Fuel cell loading
- Comparative studies
- Shot and burst overload tests
- System degradation tests
- Battery lifetime tests



ISOLATION

STANDARD FEATURES

TECHNICAL DATA	
DC+/DC- Output to PE	640VDC
Input Isolation Test Voltage (Line to Case/Logic)	3100VDC (2s)
Output Isolation Test Voltage (Output to Case/Logic)	1090VDC (2s)
AC Terminals to PE	900VDC
AC to DC Terminals	640VDC
Resistance (DC+/DC- output to PE)	X713 jumper inserted: 9.5MΩ, X713 jumper removed: open

MECHANICAL

STANDARD FEATURES

TECHNICAL DATA	
AC Terminals	Screw terminals 6 to 35 mm^2 wires, diameter ≤8.5mm
DC Terminals	Output bars for M12 bolts
Cooling	Direct forced air, front to back
Operating Altitude	≤2000m above sea level (slight temperature derating possible above 1000m)
Operation Temperature	-5°C to +30°C (-5°C to +40°C is possible without air filters installed)
Storage Temperature	-25°C to +70°C
Relative Humidity	0 to 95% (non condensing)
Vibration	IEC 60068-2-6 (Test Fc)
Acoustic Noise Level (1m From Front of Unit)	≤54dB (90% P_{MAX}/90% I_{MAX} at +25°C ambient)

SAFETY AND PROTECTION

STANDARD FEATURES

TECHNICAL DATA	
Over Voltage Protection	Programmable
Over Current Protection	Programmable
Over Power Protection	Programmable
Over Temperature Protection	Standard
Protection Class	1 (EN 62477-1)
Degree of Pollution	2 (EN 60664-1)
Overvoltage Category	Mains input, EN 60664-1/EN 62477-1: 3, other interfaces: 2
Safety of Machinery	EN ISO 13849-1:2015: PL c (at module level with 2 channel /ISR), PL e (when installed in 2x module cabinet with 2 channel /ISR and external safety relay)
Low Voltage Directive 2014/35/EU	EN 62477-1:2012 + A11:2014 + A1:2017 + A12:2021 EN 61010-1:2010
Electrical Equipment (Safety) Regulations 2016	BS EN 62477-1:2012+ A11:2014 + A1:2017 + A12:2021 BS EN 61010-1:2010
Directive 2014/30/EU EMC emission (industrial)	EN 61000-6-4:2007 A1:2011 / EN61000-6-4:2019 EN 61000-6-2:2005 / EN 61000-6-2:2019
Electromagnetic Compatibility Regulations 2016 EMC emission (industrial)	BS EN 61000-6-4:2007 A1:2011 /BS EN61000-6-4:2019 BS EN 61000-6-2:2005 / BS EN 61000-6-2:2019
Directive 2014/30/EU EMC industrial level A	EN 61326-1:2013
Electromagnetic Compatibility Regulations 2016 EMC industrial level A	BS EN 61326-1:2013
RoHS Directive	EN IEC 63000:2018
The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012	BS EN IEC 63000:2018
EMV-ILA 01-03b	Emission 9 to 150 kHz test stand area

HIGHLIGHTED FEATURES

AUTOMATIC VOLTAGE MATCHING WITH RPP (/RPP)

When researching energy storage devices, Reverse Polarity Protection (RPP) is provided for devices without an automatic voltage matching circuit. With the G5-RSS-HC energised but output off, the RPP senses the voltage of the connected energy storage device. A contactor is closed after matching the voltage, to prevent large inrush currents and arcing on start up. The sense lines of the G5-RSS-HC are used to measure the battery voltage. A switched sense is also provided ensuring there is quiescent current draw at voltage off state.

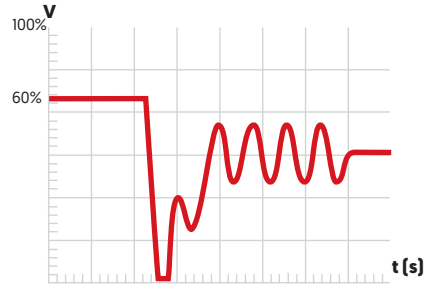
INTEGRATED SAFETY RELAY (/ISR)

For additional safety, a mechanical interlock is provided for the mains input of the G5-RSS-HC modules. The integrated safety relay provides shutdown safety according to EN 13849-1 category 2/3. The ISR is connected to the external safety switch loop. If the external loop is opened, the DC-output of the power system is powered down immediately.

COMMON G5-RSS-HC APPLICATIONS

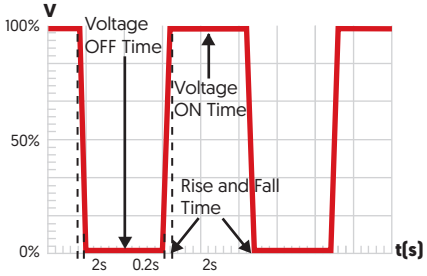
CRANKING CURVE TESTING

Electrical components within a vehicle's subsystem must be able to withstand a wide range of input voltage surges and drops during a start-up. The G5-RSS-HC can accurately recreate these conditions within a lab environment. This increases reproducibility and accuracy of results when compared to using real batteries. Hard to replicate conditions such as voltage cranking during a cold start can be achieved. Voltage/current and voltage/power relationships can be programmed against time where necessary.



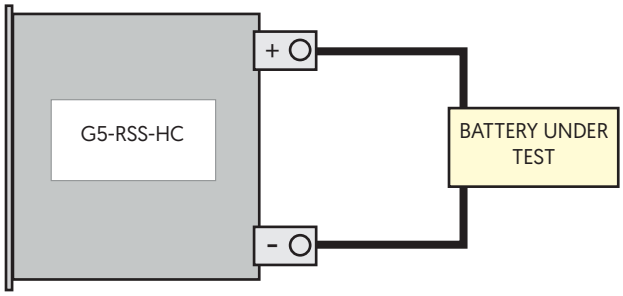
PULSED BATTERY CHARGING

Pulse charging interrupts the traditional DC charging curve with short relaxation periods. The technique is thought to improve battery discharge capacity and help facilitate longer cycle life. Some studies have shown that pulse charging is also helpful in eliminating concentration polarisation. The G5-RSS-HC's embedded function generator allows the PSU to deliver short burst of highly concentrated energy at user defined time intervals. The technique can also be used for powering lasers, electromagnets and plasma generation.



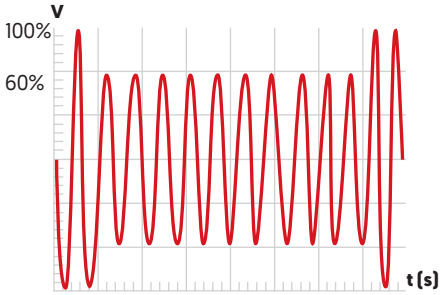
AC RIPPLE ON BATTERY LINK

A potential side effect of charger circuits that contain both AC and DC components is electrical noise. The ripple causes unwanted fluctuations in battery temperature, which results in deterioration of the battery's performance. By utilising the G5-RSS-HC's embedded function generator the user can set a current ripple at up to 10kHz to simulate this phenomenon.



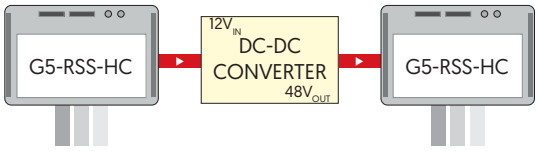
VOLTAGE DROPS & INTERRUPTS

In electronic systems sudden voltage interruptions may cause unexpected behaviour. Supply line disturbances may have several causes, including an additional switch on of large capacitive loads parallel to the supply line or a short circuit caused by loads sharing the supply. The G5-RSS-HC can generate many complex DC waveforms to test devices under realistic conditions to identify any potential issues.



INVERTER/CONVERTER TESTING

The DC input of virtually any power conversion device can be replicated. The influence that variables, such as line voltage variation, have on performance can be isolated and tested. This allows optimum operating conditions to be characterised to improve efficiency and performance.



FUEL CELL EMULATION

The discharge behaviour of an FCEV's fuel cell is often irregular. By using the function generator, both conservative and aggressive driver profiles can be replicated. This allows the G5-RSS-HC to perform effective quality testing of fuel cell powered components under all likely operating conditions.

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ELECTRONIC TEST & POWER SYSTEMS

Tel: +44 (0) 1246 452909
Sales: 0800 612 95 75
sales@etps.co.uk
www.etps.co.uk

ETPS Ltd
Unit 14, The Bridge
Beresford Way, Chesterfield
S41 9FG

POSITIVE PROBLEM SOLVING