ELECTRONIC TEST & POWER SYSTEMS

RUG-GSX

DC SOURCES WITH LOW REFLECTED HARMONICS

POSITIVE PROBLEM SOLVING

The RUG-GSX is ideal for mobile applications where space is at a premium. Each module features low reflected current harmonics and has an inbuilt active power correction of ≥0.99.

The excellent PFC allows for smaller components and cabling to be used throughout the vehicle or vessel. It also allows the RUG-GSX to be powered from a weakly regulated generator. Previous applications have varied from powering towed array and hull mounted sonar systems, to battery charging and powering vehicle transmitters. Low level protocols (LLP) gives access to the most commonly used hexadecimal memory addresses for given functions. A variety of interfaces are available for remote control of the unit.

- + Protections for Shock, Vibration & Humidity
- + Stackable up to 1500V/Very High Powers
- + Function Generator with V/I Capability
- + Inbuilt Active Power Correction ≥0.99
- + Low Reflected Current Harmonics
- + Access to Low Level Protocols

CONTENTS

STANDARD MODELS

SELECTION TABLE

Part Number	Maximum Power	Voltage Range[1]	Current Range[1]
65VDC MODULES			
RUG-GSX 20-65	20kW	0 - 65Vdc	0 to 385A
RUG-GSX 32-65	32kW	0 - 65Vdc	0 to 600A
RUG-GSX 20-65-2	40kW[2]	0 - 130Vdc	0 to 770A
RUG-GSX 32-65-2	64kW[3]	0 - 130Vdc	0 to 1200A
RUG-GSX 32-65-3	96kW[3]	0 - 195Vdc	0 to 1800A
RUG-GSX 32-65-4	128kW[3]	0 - 260Vdc	0 to 2400A
RUG-GSX 32-65-8	256kW[3]	0 - 520Vdc	0 to 4800A
130VDC MODULES			
RUG-GSX 20-130	20kW	0 - 130Vdc	0 to 192A
RUG-GSX 32-130	32kW	0 - 130Vdc	0 to 308A
RUG-GSX 20-130-2	40kW[2]	0 - 260Vdc	0 to 384A
RUG-GSX 32-130-2	64kW[3]	0 - 260Vdc	0 to 616A
RUG-GSX 32-130-3	96kW[3]	0 - 390Vdc	0 to 924A
RUG-GSX 32-130-4	128kW[3]	0 - 520Vdc	0 to 1232A
RUG-GSX 32-130-8	256kW[3]	0 - 1040Vdc	0 to 2464A
400VDC MODULES			
RUG-GSX 20-400	20kW	0 - 400Vdc	0 to 63A
RUG-GSX 32-400	32kW	0 - 400Vdc	0 to 100A
RUG-GSX 20-400-2	40kW[2]	0 - 800Vdc	0 to 126A
RUG-GSX 32-400-2	64kW[3]	0 - 800Vdc	0 to 200A
RUG-GSX 32-400-3	96kW[3]	0 - 1200Vdc	0 to 300A
RUG-GSX 32-400-4	128kW[3]	0 - 1500Vdc	0 to 400A
RUG-GSX 32-400-8	256kW[3]	0 - 1500Vdc	0 to 800A
500VDC MODULES			
RUG-GSX 20-500	20kW	0 - 500Vdc	0 to 50A
RUG-GSX 32-500	32kW	0 - 500Vdc	0 to 80A
RUG-GSX 20-500-2	40kW[2]	0 - 1000Vdc	0 to 100A
RUG-GSX 32-500-2	64kW[3]	0 - 1000Vdc	0 to 160A
RUG-GSX 32-500-3	96kW[3]	0 - 1500Vdc	0 to 240A
RUG-GSX 32-500-4	128kW[3]	0 - 1500Vdc	0 to 320A
RUG-GSX 32-500-8	256kW[3]	0 - 1500Vdc	0 to 640A
600VDC MODULES			
RUG-GSX 20-600	20kW	0 - 600Vdc	0 to 40A
RUG-GSX 32-600	32kW	0 - 600Vdc	0 to 66A
RUG-GSX 20-600-2	40kW[2]	0 - 1200Vdc	0 to 80A
RUG-GSX 32-600-2	64kW[3]	0 - 1200Vdc	0 to 132A
RUG-GSX 32-600-3	96kW[3]	0 - 1500Vdc	0 to 198A
RUG-GSX 32-600-4	128kW[3]	0 - 1500Vdc	0 to 264A
RUG-GSX 32-600-8	256kW[3]	0 - 1500Vdc	0 to 528A

[1] Values for multi-module systems represent the widest operating points. The full current range is not possible with the full voltage range simultaneously. Please see operating range diagrams on page 4 for the V/I range of a specific configuration.
[2] Composed of 20kW RUG-GSX modules. [3] Composed of 32kW RUG-GSX modules. Please contact ETPS for a full breakdown of possible module combinations.

OPTIONS TABLE

OPTIONS

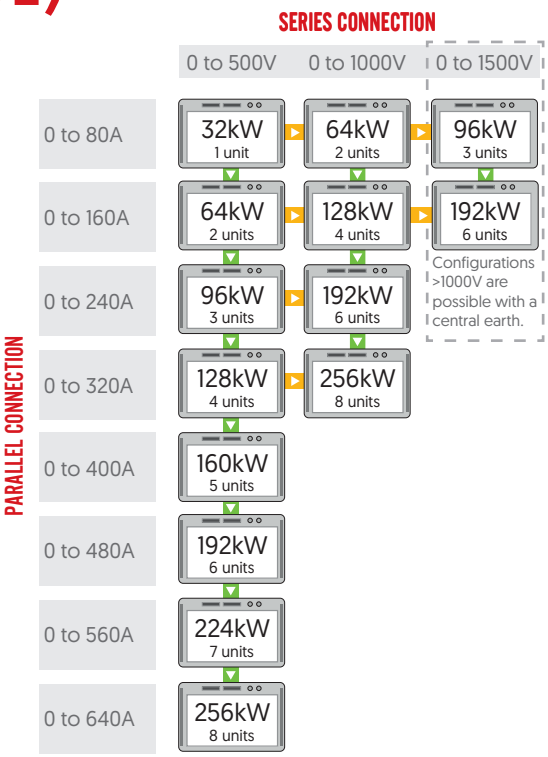
CODE	DESCRIPTION
	FORM FACTOR AND ENCLOSURES
/LR	Integration into a static enclosure.
/FC	Integration into a flightcase.
	OPERATING RANGES AND FEATURES
/IRXTS	Maximum adjustable internal resistance range extended to 32,000mΩ.
/CANCABLE	Connecting cable for multi-unit operation.
/RMB	Remote Measure Box for higher dynamics in multi-unit operation.
/EMIFILTER	EMI filter for DC output.
	INTERFACES AND CONTROL
/HMI	This provides front panel control and measurement via a menu driven LCD screen. Most users prefer their units to be fitted with HMI. For systems comprised of multiple units or where only remote control is required, cost can be saved by not including front panel controls and display.
/RS232REAR	RS-232 on front and rear panel (time shared mode with RS-232 on front).
/RS422	Differential serial interface (time shared mode with RS-232).
/IEEE	When specified, an integrated IEEE 488.2 interface is built into the rear panel (RS-232 only possible on rear panel). The programming terms employed are compliant with Standard Commands for Programmable Instrumentation (SCPI), making the RUG-GSX ideal for system integration.
/CANOPEN	On request an additional serial interface built to the CAN/CANopen standards can be integrated into the rear panel (RS-232 only possible on rear panel).
/CANMP	Integrated CANmp interface (RS-232 only possible on rear panel).
/OPTOLINK	Rear panel integrated fibre optic interface (RS-232 only possible on rear panel).
/USB	Integrated USB interface (RS-232 only possible on rear panel). The graphical user interface (TopControl) can be operated over the USB port. RS-232 and USB cannot be used at the same time.
/ETH	Ethernet interface with listener and talker functions over a LAN (RS232REAR required).
/CAN+USB	Combined CAN and USB interface.
	MECHANICAL
/FILTER	Input air filter.
/LCAL	Integrated liquid cooling of the power stage.
/RCU	The RCU provides the HMI functions via cable at a distance of up to 40m. The RCU is available in a compact desktop case or as a 19" rackmount unit.
	SAFETY AND PROTECTION
/ISR	Integrated safety relay for shutdown to EN 13849-1 Cat 2/3
/PACOB	Protection against accidental contact of output current bars.
/RPP	Protection against reverse polarity of the load.
	SOFTWARE/SOFT TOOLS
/TFE	Integrated function generating engine with application area (parametric) programming.
/SASCONTROL	Solar array simulation GUI (includes TFE option).
/BATSIM	GUI simulating battery characteristics with adjustable parameters.
/CAPSIM	GUI simulating the electrical characteristics of capacitors with adjustable parameters.
/BATCONTROL	Dedicated battery charge GUI with adaptive sampling & temperature measurement.

MODULARITY (MASTER/SLAVE)

Larger systems can be composed of smaller 20kW or 32kW RUG-GSX modules. Up to 64 of these modules can be arranged in series, parallel or matrix array configurations to create larger systems.

Each module is able to operate independently, so that systems can be reconfigured, expanded or broken up as needs dictate. Inbuilt system comms allow users to switch between various set-ups.

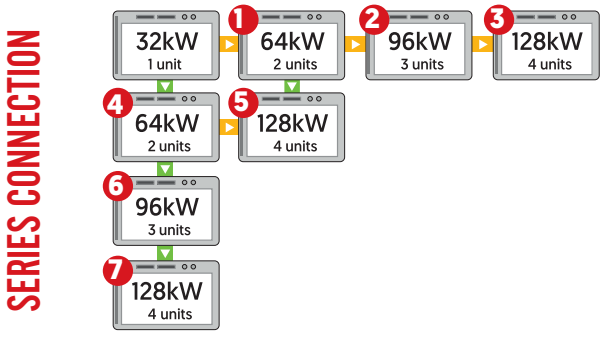
The modular approach is companies who regularly need to power different sized devices. Individual modules can be used for energising multiple small devices, then grouped together for larger projects. The diagram shows all the possible combinations with eight 32kW/500V modules.



OPERATING RANGE (SYSTEMS)

	RUG-GSX 32-65	RUG-GSX 32-130	RUG-GSX 32-400	RUG-GSX 32-500	RUG-GSX 32-600
Single Module	0 to 65V, 0 to 600A	0 to 130V, 0 to 308A	0 to 400V, 0 to 100A	0 to 500V, 0 to 80A	0 to 600V, 0 to 66A
Configuration 1	0 to 65V, 0 to 1200A	0 to 130V, 0 to 616A	0 to 400V, 0 to 200A	0 to 500V, 0 to 160A	0 to 600V, 0 to 132A
Configuration 2	0 to 65V, 0 to 1800A	0 to 130V, 0 to 924A	0 to 400V, 0 to 300A	0 to 500V, 0 to 240A	0 to 600V, 0 to 198A
Configuration 3	0 to 65V, 0 to 2400A	0 to 130V, 0 to 1232A	0 to 400V, 0 to 400A	0 to 500V, 0 to 520A	0 to 600V, 0 to 264A
Configuration 4	0 to 130V, 0 to 600A	0 to 260V, 0 to 308A	0 to 800V, 0 to 100A	0 to 1kV, 0 to 80A	0 to 1.2kV, 0 to 66A
Configuration 5	0 to 130V, 0 to 1200A	0 to 260V, 0 to 616A	0 to 800V, 0 to 200A	0 to 1kV, 0 to 160A	0 to 1.2kV, 0 to 132A
Configuration 6	0 to 195V, 0 to 600A	0 to 390V, 0 to 308A	0 to 1.2kV, 0 to 100A	0 to 1.5kV, 0 to 80A	0 to 1.5kV, 0 to 66A
Configuration 7	0 to 260V, 0 to 600A	0 to 520V, 0 to 308A	0 to 1.5kV, 0 to 100A	N/A	N/A

PARALLEL CONNECTION



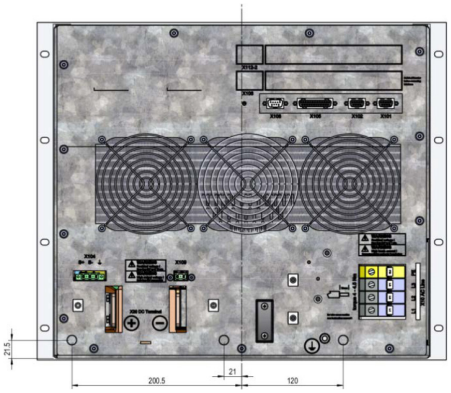
FORM FACTOR AND ENCOLSURES

STANDARD FEATURES (PER MODULE)

TECHNICAL DATA	
Dimensions	19" x 9U x 634mm (W x H x D)
Weight	112kg
Basic Construction	IP 20 (current bars on rear side excluded)
Mounted In Cabinet	Up to IP 54

Each RUG-GSX is built into a 19" rackmounting case as standard. The rear of the module contains three M8 fixation threads. The mechanical values provided within this datasheet are valid for when the module is fixed via these threads. The usable thread depth is 25mm.

Modules can be treated to an integration into a static enclosure or flight case. Common options include mains cables, passive indication of any residual DC voltage, isolation monitoring of DC cables and a panel mounted emergency stop. Switch panels with removable DC links can be fitted for modular systems. This simplifies the reconfiguration between series, parallel or independent use. Simple wheeled cabinets are also available.



MODULE REAR DIMENSIONS

Having a programmable power system mounted into a flight case on castors is often advantageous, especially when the system is regularly being moved around various sites. Multiple power systems can be fitted into the same flight case. Door hangers are fitted for convenience. Existing ETPS systems can also be retrospectively integrated into new flight cases where requested.

128kW CABINET INTEGRATION

OPTIONS

CODE	DESCRIPTION
/LR	Integration into a static enclosure.
/FC	Integration into a flightcase.

OPERATING RANGES AND FEATURES

STANDARD FEATURES (PER MODULE)

TECHNICAL DATA	
Switchable Output Capacitance	6mF / 17.2mF (65V and 130V modules) | 0.09mF / 0.9mF (400V, 500V and 600V modules)
Remote Sense	0 - V_{MAX}
Efficiency	Up to 92%
CV Load Regulation and Set Tracking	1.1ms (Typical recovery time to within <5 % band of set value for a load (or set value) step 10-90 %, ohmic load, at constant line input and temperature.)
Set Value Tracking CC*	<2ms (65V and 130V modules) | <3ms (400V, 500V and 600V modules)
Set Value Tracking CC*	<2ms
Over Voltage Protection (Programmable)	0 - 110% of V_{MAX}
Over Voltage Protection (Response Time)	50µs - 1600ms
Over Current Protection (Programmable)	0 - 110% of I_{MAX}
Over Current Protection (Response Time)	50µs - 1600ms
Output Ripple (300Hz Vpp): 65V/130V Modules	<0.2% (Typical value at nominal ohmic load, line asymmetry <1Vrms)
Output Ripple (300Hz Vpp): 400V-600V Modules	<0.5% (Typical value at nominal ohmic load, line asymmetry <1Vrms)
Output Ripple (300Hz Vrms): 65V/130V Modules	<0.05% (Typical value at nominal ohmic load, line asymmetry <1Vrms)
Output Ripple (300Hz Vrms): 400V-600V Modules	<0.1% (Typical value at nominal ohmic load, line asymmetry <1Vrms)
Output Noise (40kHz-1MHz): 65V/130V Modules	<0.2Vpp / <0.05Vrms (Typical value at nominal ohmic load, line asymmetry <1Vrms)
Output Noise (40kHz-1MHz): 400V-600V Modules	<1Vpp / <0.2Vrms (Typical value at nominal ohmic load, line asymmetry <1Vrms)
Stability (CV, CC)	<± 0.05% (Maximum drift over 8 hours after 30 minute warm-up time, at constant line input, load and temperature conditions)
Temperature Coefficient (CV)	<0.02% of full scale value per°C (Typical change of output values versus ambient temperature, at constant line input and load conditions)
Temperature Coefficient (CC)	<0.03% of full scale value per°C (Typical change of output values versus ambient temperature, at constant line input and load conditions)

* Rise/ fall time for 10%-90% of a set step.

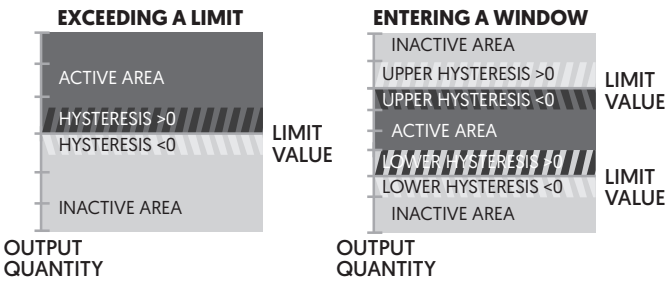
HIGHLIGHTED FEATURES

SENSE COMPENSATION

Sense plus terminals are built into the RUG-GSX 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 RUG-GSX output and sensing point is monitored. If a set limit is exceeded, the RUG-GSX unit shuts off. This is particularly useful for applications with long cables often prone to unwanted voltage drops.

VERSATILE LIMIT SETTING (VLS)

The VLS allows the output relays to be activated automatically when specific output values are met, protecting the DUT from any damaging conditions. Output voltage, current and power values which exceed or fall below a given limit or operating window can be programmed to trigger the relays. Active and inactive areas of operation are defined by a limit value, hysteresis value or a directional designator for the hysteresis.



OPTIONS

CODE	DESCRIPTION
/IRXTS	Maximum adjustable internal resistance range extended to 32,000mΩ
/CANCABLE	Connecting cable for multi-unit operation
/RMB	Remote Measure Box for higher dynamics in multi-unit operation
/EMIFILTER	EMI filter for DC output

OPERATING MODES

STANDARD FEATURES (PER MODULE)

TECHNICAL DATA	
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	AdjustableΩ_{MAX} = (V_{NOM} / I_{NOM})
Standard Interfaces	Analogue & RS-232

INPUT

STANDARD FEATURES (PER MODULE)

TECHNICAL DATA	
AC Line Voltage / Current Relationship[1]	3 × 380VAC ± 10% / 34Arms (20kW units), 54Arms (32kW units) 3 × 400VAC ± 10% / 32Arms (20kW units), 51Arms (32kW units) 3 × 415VAC ± 10% / 31Arms (20kW units), 49Arms (32kW units) 3 × 440VAC ± 10% / 29Arms (20kW units), 47Arms (32kW units) 3 × 460VAC ± 10% / 28Arms (20kW units), 45Arms (32kW units) 3 × 480VAC ± 10% / 27Arms (20kW units), 43Arms (32kW units)
Line Frequency	48 - 62Hz
Mains Connection Type	3L + PE (no neutral)
Powerfactor at P_{MAX}	≥0.99
Protective Conductor Current at 50Hz[2]	<20mA
Touch Current Unweighted[2]	<20mA
Touch Current Weighted[2]	<2mA
Load Regulation (CV, CC)	<± 0.1% of full scale value (Typical value for 0 – 100 % load variation, at constant line input and temperature conditions.)
Line Regulation (CV, CC)	<± 0.1% of full scale value (Typical value for input voltage variation within 380 VAC ± 10 % – 480 VAC ± 10 %, at constant load and temperature conditions.)

[1] At nominal output power and nominal line voltage. Soft-start to limit turn-on surge currents.
[2] According to IEC60990: Protective conductor current: 50 Hz component at 400 VAC/50Hz/P_{NOM}. For weighted touch current: Measured for perception/reaction. Protection with earth leakage circuit breaker possible. An additional PE connection is necessary.

HIGHLIGHTED FEATURE

ACTIVE POWER FACTOR CORRECTION

The RUG-GSX has 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

STANDARD RS-232 INTERFACE

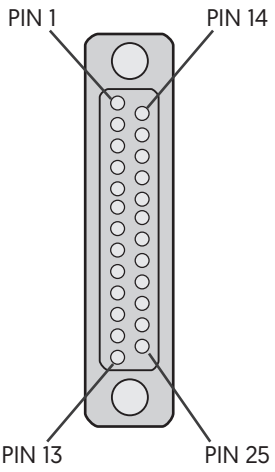
The RS-232 interface is configured as a Sub-D 9 pin connector (female) and is located on the front panel. This interface can be optionally moved to the rear panel. The graphical user interface, TopControl is operated via RS-232. The software runs on Windows and allows the user to control, measure and configure the power system.

TECHNICAL DATA	
Isolation to Electronics and Earth Configuration	125Vrms
Baud Rate	38,400 baud
Resolution (programming & readback)	0.025% FS (for V & I), 0.1% FS (for P & Ri)

STANDARD ANALOGUE INTERFACE

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. The control port is labelled X105.

TECHNICAL DATA	
Isolation to Electronics and Earth	125Vrms
Unit Ready/Error	Relay Contact
Output Voltage ON / Warnings	Relay Contact
Actual Voltage Readback 0 - 100%	0 to 10V
Actual Current Readback 0% to 100%	0 to 10V
Resolution (programming & readback) for V, I, P, Ri	0.2% FS
Output Voltage Off/On	0/24VAC/DC
2 Digital Application Inputs	0/24VAC/DC
Interlock Circuit	0/24VDC
Voltage Setting 0 to 100%	0 to 10V
Current Setting 0% to 100%	0 to 10V
Power Setting 0% to 100%	+10V to 0V
Internal Resistance Setting 0% to 100%	0 to 10V



PIN	SIGNAL	I/O	DESCRIPTION
1	AGND	I	Analogue ground for pins 2–4, 14–16
2	VREF	I	Voltage setpoint input 0–10V
3	IREF	I	Current setpoint input 0–10V
4	IACT	O	Current feedback output 0–10V
5	0 VDC	O	0 VDC I/O ground for pin 25[1]
6	+10 VDC	O	Analogue reference voltage
7	COM	I	(connected to pin 17) 0VDC DigIn; common ground for pins 8–9, 18–20, 24
8	APP_DIGITALIN_4; CLEAR_ERROR	I	Digital input 0-2V /10-24VDC
9	VOLTAGE_ON	I	Digital input 0-2/10-24VDC
10	OK/ALARM_b[2]	O	Relay output 1 normally open
11	OK/ALARM_a[2]	O	Relay output 1 common
12	RUN_b[2]	O	Relay output 2 normally open
13	RUN_a[2]	O	Relay output 2 common
14	PREF	I	Power limit analogue input 0–10V
15	RREF	I	Ri-simulation analogue input 0–10V

PIN	SIGNAL	I/O	DESCRIPTION
16	VACT	O	Voltage feedback output 0–10 V
17	COM	I	(connected to pin 7) Common ground to pins 8–9, 18–20, 24
18	APP_DIGITALIN_1	I	Digital input (low) 0-2VDC/(high) 10–28VDC
19	APP_DIGITALIN_2	I	Digital input (low) 0-2VDC/(high) 10–28VDC
20	APP_DIGITALIN_3; ANAOG_ REFERENCE_ SELECT	I	Digital input ((low) 0-2VDC/(high) 10–28VDC Analogue reference select
21	WARN_a[2]	O	Relay output 3 normally open
22	WARN_b[2]	O	Relay output 3 normally closed
23	WARN_c[2]	O	Relay output 3 common
24	INTERLOCK_IN_+	I	Input Interlock +
25	+24 VDC	O	24VDC I/O Aux power output 24VDC, max. 0.2 A

[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.

STANDARD LOW LEVEL PROTOCOLS

The Low Level Protocols (LLPs) are often ideal for mission critical applications. The LLPs give access to the hexadecimal memory addresses for a given functions such as setting and reading of voltage, current and power limit along with switching output on/off. Second level functionality can also be programmed. This includes adjusting voltage and current slopes and optimising the PID controllers. The user can also program the internal relays for V, I and W. These relays can be used to enable/disable the output depending on user set thresholds or to provide a warning signal. Function sequences, previously stored in the memory, can also be triggered via LLP enabling complex DC waveforms to be implemented.

The LLPs ensures that these power supplies can be used in situation where a Windows or Linux based PC cannot be relied upon. With 5 to 9 Bytes the LLPs provide a protocol with the lowest overheads for high reliability applications where only a PLC may be deemed appropriate.

OPTIONAL INTERFACES

CODE	DESCRIPTION
/HMI	This provides front panel control and measurement via a menu driven LCD screen. Most users prefer their units to be fitted with HMI. For systems comprised of multiple units or where only remote control is required, cost can be saved by not including front panel controls and display.
/RS232REAR	RS-232 on front and rear panel (time shared mode with RS-232 on front).
/RS422	Differential serial interface (time shared mode with RS-232).
/IEEE	When specified, an integrated IEEE 488.2 interface is built into the rear panel (RS-232 only possible on rear panel). The programming terms employed are compliant with Standard Commands for Programmable Instrumentation (SCPI), making the RUG-GSX ideal for system integration.
/CANOPEN	On request an additional serial interface built to the CAN/CANopen standards can be integrated into the rear panel (RS-232 only possible on rear panel).
/CANMP	Integrated CANmp interface (RS-232 only possible on rear panel).
/OPTOLINK	Rear panel integrated fibre optic interface (RS-232 only possible on rear panel).
/USB	Integrated USB interface. (RS-232 only possible on rear panel). The graphical user interface, TopControl can be operated over the USB port. RS-232 and USB cannot be used at the same time.
/ETH	Ethernet interface with listener and talker functions over a LAN (RS-232REAR required).
/CAN+USB	Combined CAN and USB interface.

HIGHLIGHTED OPTION

CAN MP 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.

MECHANICAL

STANDARD FEATURES (PER MODULE)

SINE VIBRATION (ACCORDING TO IEC 60068-2-6)	
Frequency Range	10Hz - 150Hz
Test Time	150 min./axis
Vibration Direction	X-, Y- and Z-axis
Range 10Hz - 57Hz (Amplitude)	±0.15mm
Range >57Hz - 150Hz (Max. Acceleration)	Test Time

RANDOM VIBRATION (ACCORDING TO IEC 60068-2-64)	
Frequency Range	10Hz - 500Hz
Random Vibration Resistance (RMS)	± 3 Shocks/axis
Test Time	30 min./axis
Vibration Direction	X-, Y- and Z-axis
Acceleration Spectral Density	$0.01g^2$/Hz (10Hz - 200Hz) | $0.005g^2$/Hz (500Hz [lin. Slope from 200Hz to 500Hz])

SHOCK TESTING INOPERATIVE UNIT (ACCORDING TO IEC 60068-2-27)	
Shock Acceleration (Vertical)	25g/11ms
Shock Acceleration (Horizontal)	15g/18ms
Shock Number and Vector	±3 Shocks/axis
Shock Direction	X-, Y- and Z-axis

SHOCK TESTING OPERATIVE UNIT (ACCORDING TO IEC 60068-2-27)	
Shock Acceleration (Vertical)	10g/11ms
Shock Acceleration (Horizontal)	10g/18ms
Shock Number and Vector	±3 Shocks/axis
Shock Direction	X-, Y- and Z-axis

AMBIENT CONDITIONS (ACCORDING TO IEC 60068-2-78)	
Operating Temperature	5 to 40°C
Relative Air Humidity (Non-Condensing)	0 to 95%

GENERAL	
Line Input Connections	Terminal block 4 x $25mm^2$
Output Terminals	Nickel-plated copper bars - Length: 40mm, 1 hole 9mm in each bar

OPTIONS

CODE	DESCRIPTION
/FILTER	Input air filter
/LCAL	Integrated liquid cooling of the power stage
/RCU	The RCU provides the HMI functions via cable at a distance of up to 40m. The RCU is available in a compact desktop case or as a 19" rackmount unit.

HIGHLIGHTED OPTIONS

INPUT AIR FILTER (/FILTER)

In environments where swarf contamination may occur, air filters with filter material rated in class G3 is available. This class is effective at trapping a high proportion (90%) of particles ≥10um according to EN 779.

LIQUID COOLING (/LCAL)

Liquid cooling of the RUG-GSX's power stage is available for units which may be subject to naturally hot or uncontrolled environments. This enables operation up to 45°C with no performance derating.

REMOTE CONTROL UNIT (/RCU)

The RCU is an external control unit for controlling multi-module systems, which reduces response times when implementing complex changes. The RCU is available as either a desktop unit or a 19" rackmounting module, with or without an emergency stop.

SAFETY & PROTECTION

STANDARD FEATURES (PER MODULE)

TECHNICAL DATA	
Max. Reactive Load Voltage	≤110% Vmax
EMC Emission / Immunity	EN 61000-6-4 / EN 61000-6-2
Low Voltage Directive 2014/35/EU	EN 50178

OPTIONS

CODE	DESCRIPTION
/ISR	Integrated safety relay for shutdown to EN 13849-1 Cat 2/3
/PACOB	Protection against accidental contact of output current bars
/RPP	Protection against reverse polarity of the load

HIGHLIGHTED OPTIONS

REVERSE POLARITY PROTECTION (/RPP)

When charging an energy storage device, Reverse Polarity Protection (RPP) is recommended for devices without a pre-charge circuit. With the RUG-GSX 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.

INTEGRATED SAFETY RELAY (/ISR)

For additional safety, a mechanical interlock is available for the mains input of the RUG-GSX. 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.

PROTECTION AGAINST OUTPUT BARS (/PACOB)

A specially produced cover is available which provides protection against accidental contact of AC and DC current bars.

ISOLATION

STANDARD FEATURES (PER MODULE)

TECHNICAL DATA	
Line to Case	1670Vdc for 1s
Output to Case	2540Vdc for 1s (65V and 130V modules) | 2540Vdc for 1s (400V, 500V and 600V modules)
Transformer	4800Vac
Output to Case	10.8MΩ / high impedance (X109 open)
Per DC Bar	35nF (65V and 130V modules) | 13.6nF (400V, 500V and 600V modules)
- Bar / + Bar[1]	+680Vdc / -680Vdc (65V and 130V modules) | +1000Vdc / -1000Vdc (400V, 500V and 600V modules)

[1] Maximum working voltage including DC output voltage.

SOFTWARE/SOFT TOOLS

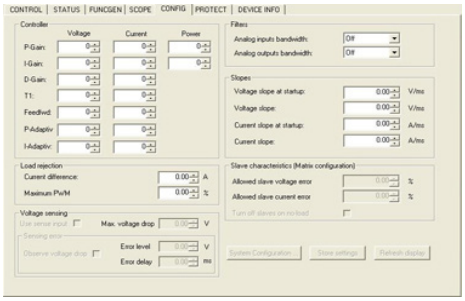
STANDARD TOP CONTROL GUI

All RUG-GSX units come with a simple and intuitive TopControl 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 PID controller parameters
- Program the unit's limit values
- Calibrate and adjust values as necessary
- Update the firmware



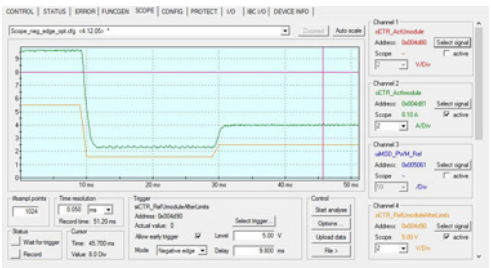
OPTIONAL SOFTWARE

CODE	DESCRIPTION
/TFE	Integrated function generating engine with application area (parametric) programming
/SAS	Solar array simulation GUI (includes TFE option)
/BATSIM	GUI simulating battery characteristics with adjustable parameters
/CAPSIM	GUI simulating the electrical characteristics of capacitors with adjustable parameters
/BATCONTROL	Dedicated battery charge GUI with adaptive sampling & temperature measurement

HIGHLIGHTED OPTION

FUNCTION GENERATOR (/TFE)

Complex DC waveforms can be implemented through an optional 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 powering sonar equipment, a specific pulse waveform 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.

HIGHLIGHTED OPTIONS

APPLICATION GUIS

An application GUI can be used to program hardware to replicate real world behaviour of a power component. This allows specific sections of a circuit to be isolated and tested. Hard to replicate conditions, such as as cranking curve from a cold start, can also be programmed and repeated.

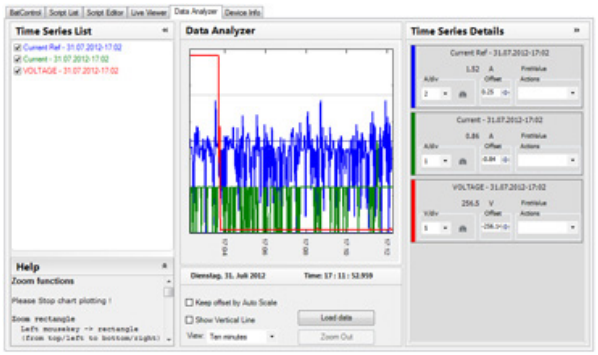
Using a GUI allows a great deal of control, monitoring and reporting to be done remotely. Other advantages include reduced operator errors and preparation time, as well as increased reproducibility and elimination of result variations.

BATTERY EMULATION (/BATSIM)

When testing devices which are typically powered by a battery, BatSim provides a convenient method for the RUG-GSX to emulate the output of different sized battery stacks. Nearly all relevant electrical characteristics are programmable, including the number of cells, energy capacity, cut off limits, chemistry type and nominal voltage.

ELECTRIC DRIVE CYCLING (/BATCONTROL)

Drive cycle tests can be implemented using BatControl. Previous data obtained from a test track can be imported and recreated, allowing the RUG-GSX to simulate a real world driving test inside a lab environment. Battery charging profiles can also be implemented through the GUI.

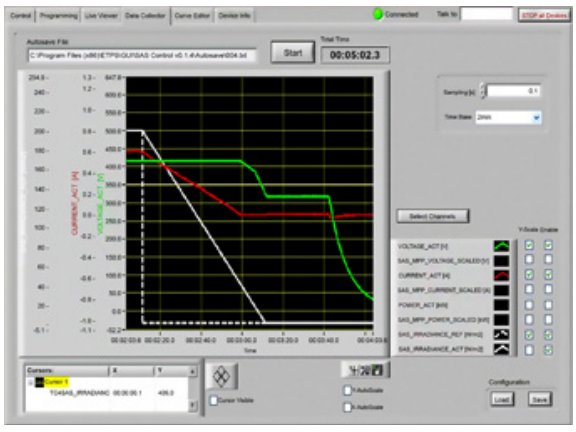


CAPACITOR SIMULATION (/CAPSIM)

The output characteristics of a real capacitor stack can be emulated when CapSim is installed with RUG-GSX modules. Number of cells in series/parallel, state of charge, cell cut off limits, dynamic capacitance and resistance are programmable.

SOLAR ARRAY SIMULATION (/SAS)

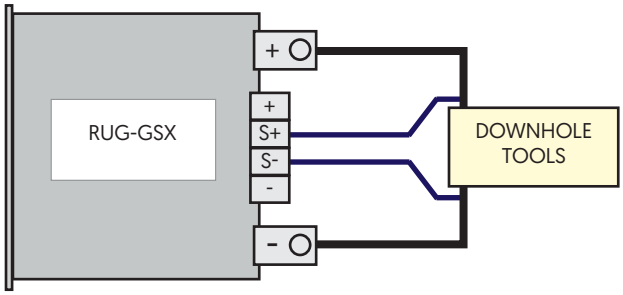
When testing PV inverters, SASControl software has all EN 50530 tests pre-installed. The GUI allows users to edit irradiance, temperature and amplitude values. Previous tests have been conducted using over 400,000 individual data points, with more possible.



COMMON RUG-GSX APPLICATIONS

POWERING DOWNHOLE TOOLS

Applications with long load lines often suffer from unintended voltage drops, such as downhole tools used in hydrocarbon exploration. The RUG-GSX's sense plus allows voltage drops to be compensated for throughout the entire length of a load line. This feature is also ideal for powering subsea devices.



POWERING ONBOARD TRANSMITTERS

The RUG-GSX can provide the short and precise DC pulses needed to power on-board transmitters in defence vehicles. Military land vehicles require ultra-reliable power supplies for mission critical electrical equipment. Each RUG-GSX unit has protections for shock, vibration and humidity allowing the power system to operate across rugged terrains.

POWERING SONAR SYSTEMS

The precise nature of sonar systems requires a highly controlled power supply. A poorly regulated PSU may provide too much energy to the sonar system's transducers, which can cause quenching. This is where the water pressure drops so low that it boils, potentially destroying the transducer. The quenching power limit rises with depth due to increased ambient pressure, so the maximum power output needs to be adjusted accordingly.

A PSU a with poor power factor can have a knock on effect on components and cabling sizing. This is particularly an issue for smaller vessels where space is at a premium. Overall system efficiency is reduced, which means more diesel is needed for the generator to power the sonar system.

The RUG-GSX provides the controlled DC energy to coils powering a sonar system. The unit's active power correction provides a PFC ≥0.99.

MOBILE BATTERY CHARGING

The RUG-GSX's wide AC input ensures charging is always possible from generators or local grid conditions. An Active Factor Correction (PFC) circuit integrated into the input helps a generator maintain a stable and reliable output.

Should you need to cycle packs or discharge them to a safe level for transit, then a heat dissipative discharge section (DDU) is optionally available. The DDU features a front panel which allows users to adjust the minimum threshold voltage. This automatically stops the discharge once a preset level is reached, preventing a damaging deep discharge of the battery pack, which may happen when using unmonitored resistor banks.

A disconnection of the DDU can also be initiated by error monitoring of the fans or DC disconnectors, temperature monitoring and via the fan controller. Users can connect remotely to the front panel of the discharge unit via an Ethernet interface. Current measurement via the front panel and a discharge counter are optionally available. Models can also be built with mains power recycling where access to a stable AC grid is possible.

Every effort is made to ensure that the information provided within this technical summary is accurate. However, ETPS Ltd must reserve the right to make changes to the published specifications without prior notice. Where certain operating parameters are critical for your application we advise that they be confirmed at the time of order. ETPS Ltd specialises in modifying its proven platforms to suit your needs. Please contact our office if your requirement is non-standard. Please note that your actual unit may differ from those shown.

ETPS engineer electronic power supply and testing systems. Our problem solving skills provide the spark of innovation to some of the world's leading technology brands.

ETPS
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