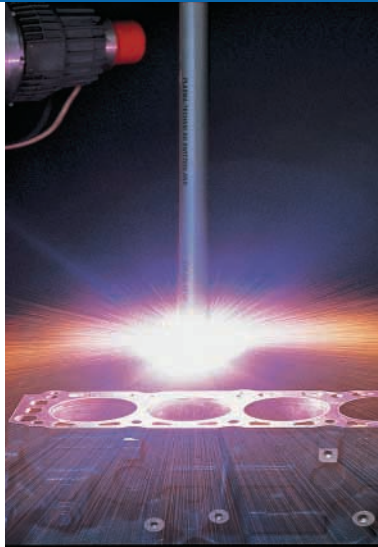


Know-how

TopCon Power Supplies



Programmable DC Power Supplies TopCon Quadro Series

Innovative High-Performance Power Supplies for your DC application

The programmable Regatron power supplies offer full output control of voltage, current and power. They are successfully used for a wide range of applications:

- Automated testing
- General lab applications
- Simulation technology
- Production technology
- Surface technology

Finely graduated product line for your voltage and power requirements

Regatron power supplies cover the voltage range from 50 VDC to 1000 VDC with finely graduated nominal output voltages. Power categories of 10, 16, 20 and 32 kW are available for each nominal output voltage.

Modular concept for easy power increase

The output power of Regatron power supplies can be increased very easily. Up to eight power supply units with identical nominal output voltage and power can be operated in multi-unit master slave operation. Parallel, series and multi-load operation are available.

Optional extras and accessories for your specific requirements

Optional extras and accessories complete the product line of power supply units and allow the adaptation of the power supply to your specific requirements.

High efficiency at a low cost

A very high level of up to 95% efficiency as well as an excellent cost-power ratio result from the application of innovative IGBT and transformer technology.

“Swiss made”

Regatron power supplies are further developed, manufactured and tested in Switzerland by Regatron AG in conformity with the ISO-9001 standards.

All Regatron power supplies bear the CE mark.



Regatron Power Supplies – your made-to-measure turnkey solution

Regatron power supplies are also available in cabinets or enclosure systems. Internal and peripheric wiring and cabling according to your requirements!



Benefits by technological innovations

Compact 19" rackmount unit: high power density, high efficiency

A compact medium-frequency transformer with highly specialised magnetic core material feeds the process energy to the galvanically isolated output side. The transformer is controlled on a semi-resonant basis by IGBT's (Insulated Gate Bipolar Transistor), reaches a high level of efficiency, and works noiselessly in the ultrasonic range.

Modern primary switchmode power supply technology enables the compact design of the Regatron power supplies:

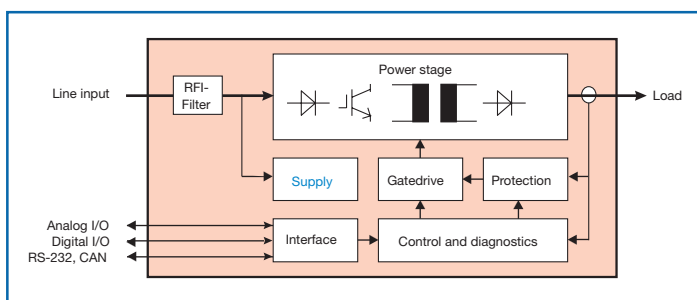
- 6 height units (262 mm) for power categories 10 and 16 kW
- 9 height units (394 mm) for power categories 20 and 32 kW

Full digital regulation: high accuracy and long-term stability

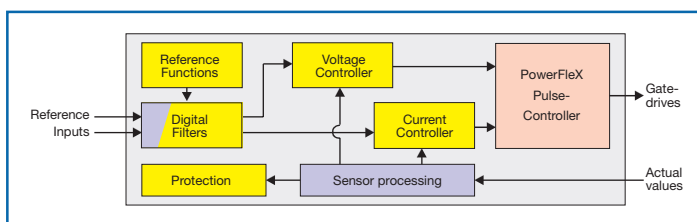
All the regulation, monitoring and communications tasks are carried out by three high-performance digital signal processors. The full digital regulation system delivers high accuracy, reproducibility and long-term stability, allows a load specific controller parameterization and enables programming of linear ramp functions related to "voltage-on" and set value steps.

Communications: Digitally controlled Master Slave operation

The power supply unit's internal communications and the communications between the individual units in multi-unit operation are designed as a fully digital system based on the high-speed, highly reliable CAN bus.



Power stage



Digital regulation

Operating modes

The programmable Regatron power supplies offer full output control of voltage, current and power as well as an adjustable internal resistance simulation.

In order to program the power supply, the following set values are available:

- ➔ Output voltage
- ➔ Output current
- ➔ Output power
- ➔ Internal resistance

The power supply shows its operating status, whether constant voltage mode, constant current mode or constant power mode, by means of LED's on the front panel.

Constant voltage or constant current

Depending on the specification of the set values for output voltage and output current, the power supply works as a constant voltage source or constant current source.

After "voltage-on", the power supply feeds just the current to reach the set output voltage. If the maximum or set output current is reached before the set voltage has been reached, the power supply works in constant current mode.

The maximum output current (I_{max}) is 125 % of the nominal current (I_{nom}). In the range between I_{nom} and I_{max} , the power controller will reduce the output voltage, if necessary, so that the nominal unit power is not exceeded ($P = U * I \leq 100 \%$).

example allows a plasma arc to be ignited with a precisely controlled voltage and then immediately be operated with constant current.

As well as the set values for voltage, current, power and internal resistance, the overvoltage limit and the overcurrent limit are freely adjustable within the range of 0 to 110 % I_{nom} resp. 0 to 110 % I_{max} . When the overvoltage or overcurrent limit is reached, the power supply instantly disables the power stage and switches over to a corresponding error status.

Constant power

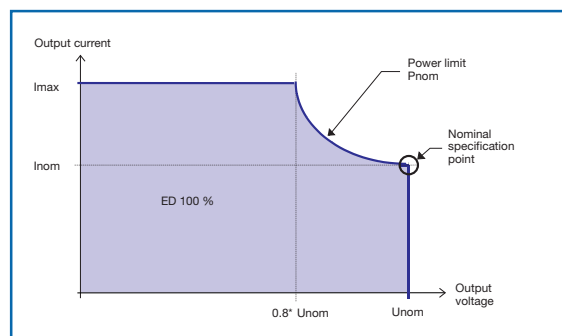
The power regulation is activated automatically, as soon as either the nominal power of the unit or the maximum output power specified by the user as the set value is reached.

Adjustable internal resistance

Regatron power supplies are equipped with an internal resistance simulation facility. The adjustable range is 0–1000 mOhm and can be optionally extended to several Ohm. The power supplies are therefore capable of a real simulation of the behaviour of lead-acid batteries or other voltage sources with actual internal resistance.

Remote sense terminal (Sense)

In order to compensate the voltage drop on the line from the power supply to the load, a sense line can be connected. Regatron power supplies are equipped with a remote sense terminal as standard.

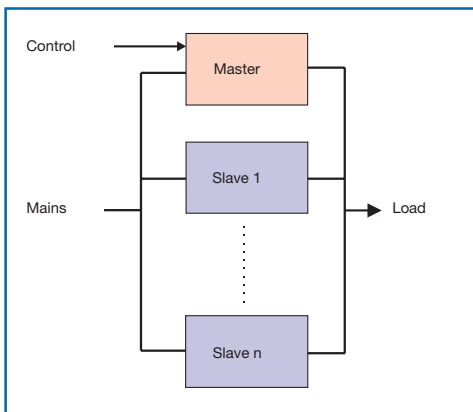


Output characteristics for voltage, current and power

The unique Power-Flex-Pulse-Controller enables the particularly fast and automatic switchover between constant voltage mode and constant current mode (automatic crossover). This for

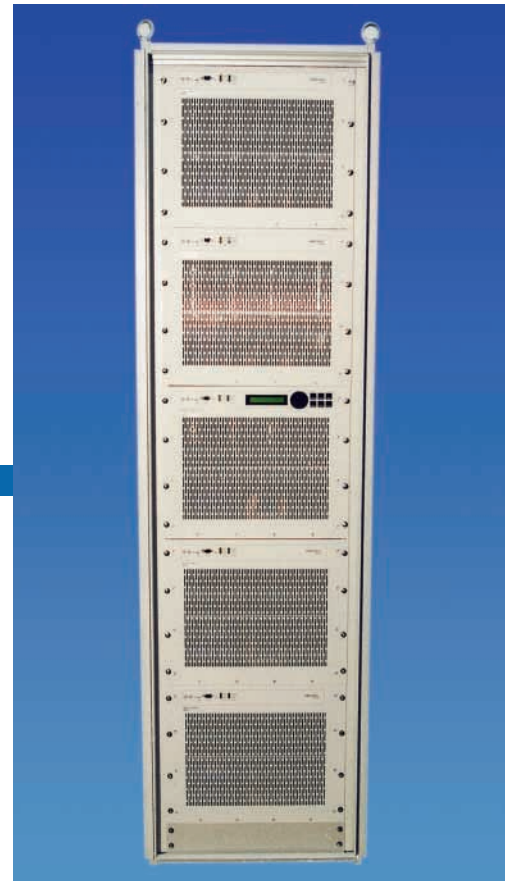
Multi-unit operation

The different operating modes (constant voltage, constant current and constant power), with or without internal resistance simulation, are also available for multi-unit master slave operation.



Parallel mode

Up to eight power supply units with identical nominal output voltage and power can be operated in multi-unit operation. The digitally controlled multi-unit operation works according to the master slave principle. The master unit controls and monitors the slave units and ensures an even power distribution between all units. A further advantage of this power supply product line: each unit in its basic design can be used as master or slave as required! In multi-unit operation, only the master unit is activated by the superposed control structure.



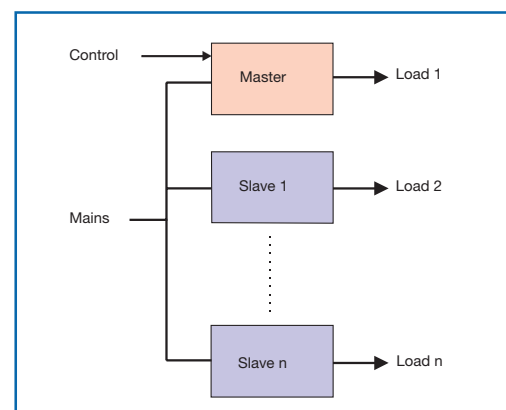
5 Regatron 32 kW power supply units in multi-unit operation

Parallel or series operation

The output power can be simply increased with the parallel or series operation of up to eight identical power supply units. The total output voltage must not exceed 1000 VDC.

Multi-load operation

For applications with a number of loads, up to 64 identical power supply units can work in multi-load operation. As opposed to parallel or series operation, in multi-load operation the individual unit outputs are available separately. The superposed control is only connected to the master unit. The individual units each follow the control commands of the master unit.



Multi-load operation

Programming of the power supply unit

Front panel control unit HMI (optional)

Individual units or complete multi-unit systems can be controlled with the front panel control unit HMI (Human Machine Interface).

Select wheel, push buttons and text menus provide easy operation. The functional scope of the HMI includes:

- Output voltage on/off
- Programming of set values and limit values
- Display of actual values as well as warning and error messages

Remote control unit RCU (optional)

Individual units or complete multi-unit systems can also be controlled with the external remote control unit RCU (Remote Control Unit). As opposed to the HMI, the RCU is connected to the power supply unit via a cable (max. 40 m) and is available in the following designs:

- Desk top case
- 19" rackmount unit with front panel

Operation and functional scope are the same as the front panel control unit HMI.

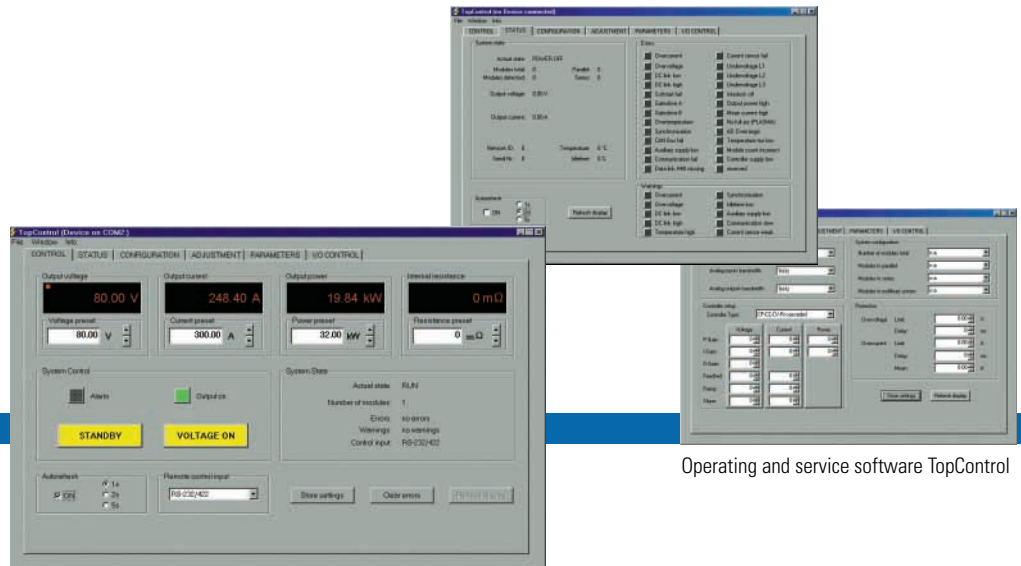
Control port / Interlock circuit

For the interfacing to superposed controls such as e.g. PLC (Programmable Logic Control), an isolated control port is available. All digital and analog control port signals as well as the interlock circuit are connected to a 25-pin D-sub connector on the rear panel of the unit:

- Output voltage on / off
- Programming of set values
- Readback of actual measured voltage and current
- Status feedback
- Digital programmable application inputs
- Interlock circuit

Breaking the interlock circuit, e.g. by means of an external emergency shutdown contact, immediately disables the power stage.





Operating and service software TopControl

Serial interface RS-232

The serial interface RS-232 is available for the communications between PC and power supply. A user-friendly PC program, **TopControl**, is included in the scope of delivery of the power supply package and enables the user to communicate with the power supply unit:

- Output voltage on / off
- Programming of the set values
- Display of actual values as well as warning and error messages

The service technician has access to an extended functional scope in the password-protected level of TopControl:

- Programming of limit values
- Load specific controller parameterization (online access to PID controller parameters)
- Configuration of multi-unit operation
- Recalibration and firmware updates

TopControl V3.01 and higher works under:

- Windows 95 with Internet Explorer 4 or higher
- Windows 98 and 98 SE
- Windows 2000 without Service Pack, Service Pack 2 is recommended
- Windows NT 4 from Service Pack 5, Service Pack 6a is recommended

For **LabVIEW®** and **Visual C++** an Application Programming Interface as a DLL file is available. For further development environments please contact factory. Like the operating and service software TopControl, the Application Programming Interface is also included in the scope of delivery of the power supply package.

The functional scope of the Application Programming Interface includes:

- Output voltage on/off
- Programming of the set values
- Readback of the actual measured values as well as warning and error messages
- Configuration of multi-unit operation

Differential serial interface RS-422 (optional)

The RS-422 interface allows longer cable lengths of up to 40 m. RS-422 is used, for example, when a power supply is programmed from a control station PC over a long distance.

Field bus interface (optional)

The field bus interface unit controls the basic functions of the power supply unit via the serial interface RS-232. Field bus interfaces are available for CanOpen, Interbus, Profibus, Devicenet. Further field bus types on request. The functional scope includes:

- Output voltage on / off
- Programming of the set values
- Readback of actual measured voltage and current
- Status feedback
- Interlock circuit

Parallel interface IEEE488.2 (optional)

The following functional scope is available via the optional interface IEEE488.2:

- Output voltage on/off
- Programming of the set values
- Readback of the actual measured values as well as warning and error messages

Technical data

Mains requirements and output specifications

AC line input	Line voltage	3 x 360 – 440 VAC
	Line frequency	48 – 62 Hz
	Mains connection type	3L + PE (without neutral)
	Leakage current L to PE	< 10 mA
Output ratings	Output power range	Refer to technical datasheet
	Output voltage range	Refer to technical datasheet
	Output current range	Refer to technical datasheet
	Internal resistance range	0 – 1000 mΩ ¹⁾ (programmable)
Operating modes	Voltage regulation (CV)	0 – 100 % U _{max} (programmable)
	Current regulation (CC)	0 – 100 % I _{max} (programmable)
	Power regulation (CP)	5 – 100 % P _{max} (programmable)
Static accuracy	Basic accuracy CV	0.1 % FS
	Basic accuracy CC	0.3 % FS
	Load regulation CV, CC	< ±0.1 % FS ²⁾
	Line regulation CV, CC	< ±0.1 % FS ³⁾
Transient response time	Load regulation CV, CC	< 2 ms ⁴⁾
	Set value tracking CV, CC	< 2 ms ⁵⁾
Stability	CV, CC	< ±0.05 % FS ⁶⁾
Temperature coefficient	CV	< 0.02 % FS / °C ⁷⁾
	CC	< 0.03 % FS / °C ⁷⁾
Output ripple and noise	50 Hz – 1MHz V _{rms}	< 0.5 % FS ⁸⁾
Remote sensing	Terminals on rear side	Line voltage drop compensation

¹⁾ Optionally extendable to a maximum of 12'000 mΩ

²⁾ Typical value for 0 – 100 % load variation, at constant line input and temperature conditions

³⁾ Typical value for input voltage variation within 360 – 440 VAC, at constant load and temperature conditions

⁴⁾ Typical recovery time to within < ±5 % band of set value for a load step 10 – 90 %, ohmic load, at constant line input and temperature conditions. Transient response time can be slightly affected by multi-unit operation.

⁵⁾ Typical recovery time to within < ±5 % band of set value for a set value step 10 – 90 %, ohmic load, at constant line input and temperature conditions. Transient response time can be slightly affected by multi-unit operation.

⁶⁾ Maximum drift over 8 hours after 30 minute warm-up time, at constant line input, load and temperature conditions

⁷⁾ Typical change of output values versus ambient temperature, at constant line input and load conditions

⁸⁾ Typical value at nominal ohmic load, line asymmetry < 1 V_{rms}

Non-ohmic loads can lead to deviations in the technical data. All product specifications are subject to change without notification.

Ambient conditions

Ambient conditions	Operating temperature	5 – 40°C ⁹⁾
	Storage temperature	–25 – 70°C
	Relative air humidity	0 – 95 % (non-condensing)
Cooling	Standard: internal temperature-controlled fans	
	Optional: integrated liquid cooling of the power stage, heat exchanger material: AC100 (Al-Ti-alloy), inlet / outlet on rear side, size R 1/4"	

⁹⁾ Certain types have ambient temperature or CDF restrictions. Refer to the type-specific technical datasheet.

Power category specific data

Power category	10 kW	16 kW	20 kW	32 kW
Input current ¹⁰⁾	20 Arms	32 Arms	40 Arms	60 Arms
Line input connections (3L + PE)	4 x 10 mm ² (terminal block)		4 x 25 mm ² (terminal block)	
Efficiency at nominal power	90 %	92 %	93 %	95 %
Weight	42 kg	44 kg	64 kg	68 kg
Width front panel	483 mm		483 mm	
Width housing	444 mm (19")		444 mm (19")	
Height front panel	265 mm		399 mm	
Height housing	262 mm (6 U)		394 mm (9 U)	
Depth with output terminals	495 mm		590 mm	
Depth housing	450 mm		525 mm	
Output terminals: nickel-plated copper bars	→ units ≤ 400 A: length 45 mm, 1 hole 9 mm ø in each bar → units > 400 A: length 65 mm, 2 holes 11 mm ø in each bar			

¹⁰⁾ At nominal output power and line input voltage 3 x 390 VAC / 50 Hz. All power supply units have a soft-start capability to limit turn-on surge currents.

Safety

Built-in protection	Overvoltage protection (OVP) Overcurrent protection (OCP) Max. reactive load voltage Short circuit protection Internal diagnostics	0 – 110 % U _{max} (programmable) 0 – 110 % I _{max} (programmable) ≤ 110 % U _{max} Continuous short circuit allowed Line input conditions Transformer primary current Temperature conditions Processor idle time System configuration System communication Sensor signals Power semiconductors
Type of protection (IEC 529)	Basic construction Mounted in cabinet	IP 20 (current bars on rear side excluded) IP 43
Standards	EMC emission EMC immunity Safety Interlock circuit	EN 50081-2, EN 55011 EN 50082-2 EN 60204, IEC 204-1 mod. EN 60204-1995
Isolation	Line to output Line to case Output to case	4000 Vrms 2500 Vrms ± 1000 VDC, > 10 mΩ / 2 x 6.8 nF



Technical data

Standard programming interfaces

Control port	Isolation to electronics and earth 25 pin D-sub connector	125 Vrms female, on rear panel
Input functions	Output voltage on / off 2 digital application inputs ¹¹⁾ Interlock circuit Voltage setting 0 – 100 % Current setting 0 – 100 % Power setting 0 – 100 % Int. resistance setting 0 – 1000 mΩ ¹¹⁾	0 / 24 VAC / DC 0 / 24 VAC / DC 0 / 24 VDC 0 – 10 V 0 – 10 V 10 – 0 V 0 – 10 V
Output functions	Unit ready / error Output voltage on Temperature warning Actual voltage readback 0 – 100 % Actual current readback 0 – 100 %	Relay contact Relay contact Relay contact 0 – 10 V 0 – 10 V
Resolution (programming and readback)	U, I, P, Ri	0.2 % FS
RS-232	Isolation to electronics and earth 9 pin D-sub connector Baud rate	125 Vrms female, on front panel 9600 baud
Resolution (programming and readback)	U, I P, Ri	0.025 % FS 0.1 % FS

¹¹⁾ Customer-specificly programmable

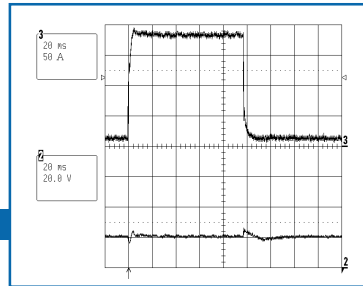
Optional programming interfaces

Front panel control unit HMI	Integrated control, programming and display unit Graphic LC-display, select wheel, push buttons, interactive text menus Languages (switchable)	English, German
Display resolution	U I P Ri	4 digits 3 digits Kilowatt + 1 decimal digit 1 mΩ
Remote control unit RCU	Specifications same as HMI max. cable length	40 m
Version desk top	Dimensions W x H x D	355 x 100 x 290 mm
Version 19" rackmount	Dimensions W x H x D	483 x 133 (3 U) x 290 mm
IEEE 488.2 ¹²⁾	GPIO (IEEE 488.2) to RS-232 converter unit Connected to power supply unit via RS-232 interface Dimensions W x H x D Converter AC line input	120 x 30 x 80 mm 1 x 230 VAC
RS-422 ¹²⁾	Isolation to electronics and earth 9 pin D-sub connector Baud rate	125 Vrms male, on rear panel 9600 baud
Resolution (programming and readback)	U, I P, Ri	0.025 % FS 0.1 % FS

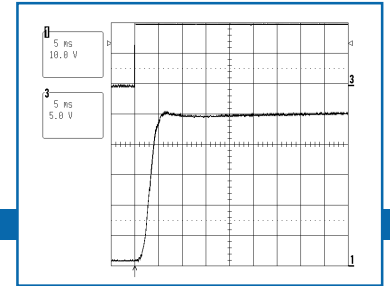
¹²⁾ This option and RS232: time-shared mode required, if used together

Typical transient response time

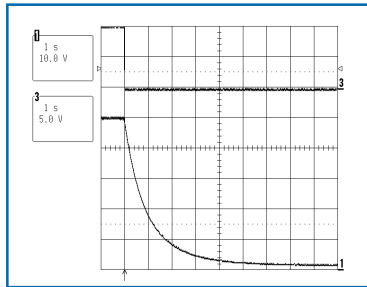
Values measured on ohmic load,
TopCon power supply unit 10 kW / 50 VDC



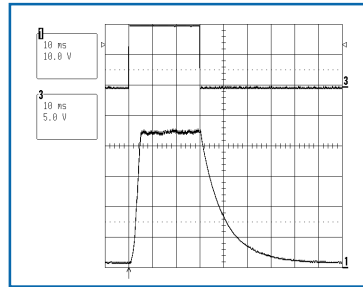
Transient response time for load steps (CV mode)
Upper: load steps 10 – 90 – 10 %
Lower: output voltage
Time base: 20 ns / div



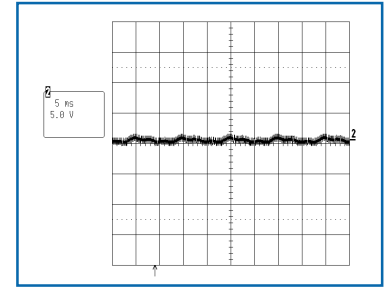
Transient response time for a set value step
Upper: set value step voltage 0 – 100 %
Lower: output voltage
Time base: 5 ns / div



Down programming with unloaded output terminals
Upper: set value step voltage 100 – 0 %
Lower: output voltage
Time base: 1 s / div



Down programming with loaded output terminals
Upper: set value steps voltage 0 – 100 – 0 %
Lower: output voltage at 90 % load current
Time base: 10 ns / div



Output voltage 20 V (CV mode)
Time base: 5 ns / div

Options

HMI	Front panel control unit HMI
RS-422	Differential serial interface RS-422
IRXTS	Internal resistance range extension (0 – max. 12'000 mΩ)
LCAL	Integrated liquid cooling of the power stage, heat exchanger material: AC100 (Al-Ti-alloy), inlet / outlet on rear side, size R 1/4"

Accessories

TC.RCU	Remote control unit RCU
TC.IEEE	Parallel interface IEEE 488.2 (GPIB)
TC.CANCABLE	Connecting cable for multi-unit operation
TC.CANOPEN	Field bus interface
TC.INTERBUS	Field bus interface
TC.PROFIBUS	Field bus interface
TC.DEVICENET	Field bus interface

Contact factory for optional accelerated down programming and voltage overshoot clipping.

TopCon

TopCon Quadro Series Programmable DC Power Supplies Overview Standard Types

Output voltage range (VDC)	Output power range (kW)	Output current range (A)	Type
0 – 50	0 – 10	0 – 250	TC.P.10.50.400.S
0 – 50	0 – 16	0 – 400*	TC.P.16.50.400.S
0 – 50	0 – 20	0 – 500*	TC.P.20.50.400.S
0 – 50	0 – 30	0 – 600*	TC.P.32.50.400.S
0 – 52	0 – 10	0 – 250	TC.P.10.52.400.S
0 – 52	0 – 16	0 – 400*	TC.P.16.52.400.S
0 – 52	0 – 20	0 – 500*	TC.P.20.52.400.S
0 – 52	0 – 30	0 – 600*	TC.P.32.52.400.S
0 – 60	0 – 10	0 – 208	TC.P.10.60.400.S
0 – 60	0 – 16	0 – 333*	TC.P.16.60.400.S
0 – 60	0 – 20	0 – 417*	TC.P.20.60.400.S
0 – 60	0 – 30	0 – 500*	TC.P.32.60.400.S
0 – 100	0 – 10	0 – 125	TC.P.10.100.400.S
0 – 100	0 – 16	0 – 200*	TC.P.16.100.400.S
0 – 100	0 – 20	0 – 250	TC.P.20.100.400.S
0 – 100	0 – 30	0 – 300*	TC.P.32.100.400.S
0 – 200	0 – 10	0 – 63	TC.P.10.200.400.S
0 – 200	0 – 16	0 – 100*	TC.P.16.200.400.S
0 – 200	0 – 20	0 – 125	TC.P.20.200.400.S
0 – 200	0 – 32	0 – 200*	TC.P.32.200.400.S
0 – 400	0 – 10	0 – 31	TC.P.10.400.400.S
0 – 400	0 – 16	0 – 50*	TC.P.16.400.400.S
0 – 400	0 – 20	0 – 63	TC.P.20.400.400.S
0 – 400	0 – 32	0 – 100*	TC.P.32.400.400.S
0 – 500	0 – 10	0 – 25	TC.P.10.500.400.S
0 – 500	0 – 16	0 – 40	TC.P.16.500.400.S
0 – 500	0 – 20	0 – 50	TC.P.20.500.400.S
0 – 500	0 – 32	0 – 80*	TC.P.32.500.400.S
0 – 600	0 – 10	0 – 20	TC.P.10.600.400.S
0 – 600	0 – 16	0 – 32	TC.P.16.600.400.S
0 – 600	0 – 20	0 – 40	TC.P.20.600.400.S
0 – 600	0 – 32	0 – 64*	TC.P.32.600.400.S
0 – 1000	0 – 10	0 – 13	TC.P.10.1000.400.S
0 – 1000	0 – 16	0 – 20	TC.P.16.1000.400.S
0 – 1000	0 – 20	0 – 25	TC.P.20.1000.400.S
0 – 1000	0 – 32	0 – 40*	TC.P.32.1000.400.S

*These types have CDF or ambient temperature restrictions. Refer to type-specific technical datasheet (available at www.regatron.ch => products => power supplies). No current derating if power supply unit equipped with optional liquid cooling.



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ISO certified
Hardmeier Gruppe