

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.

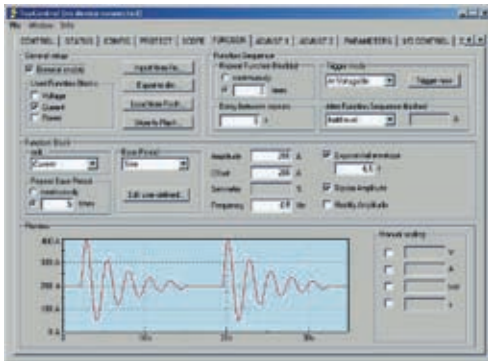


Regatron Power Supplies – your made-to-measure turnkey solution

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



Application specific TopCon system with 4 TopCon Quadro Units



Grafical user interface in TopControl to the integrated TopCon Function Engine (TFE)



Exponentially decreasing amplitude, created by the TFE

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

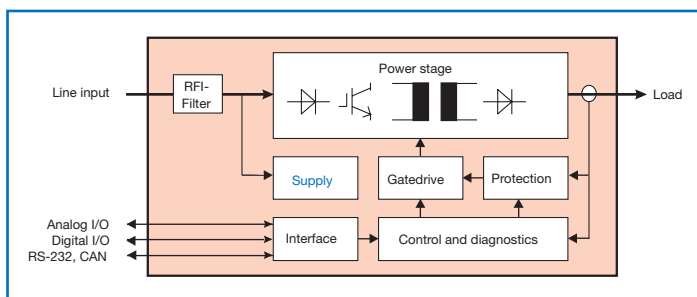
All the regulation, monitoring and communications tasks are carried out by three high-performance digital signal processors. The full digital regulation system delivers high accuracy, reproducibility and long-term stability, allows a load specific controller parameterization and enables programming of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

Communications: Digitally controlled Master Slave operation

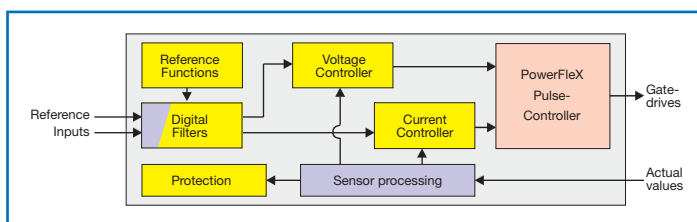
The power supply unit's internal communications and the communications between the individual units in multi-unit operation are designed as a fully digital system based on the high-speed, highly reliable CAN bus.

Open Programming Interfaces (Optional)

- Various digital and analog interfaces (I/O)
- Standard interface RS232 (optional RS422)
- External or integrated Human Machine Interface (Keyboard, LCD Panel)
- User-friendly PC software TopControl
- DLL for C/C++ programming and Labview integration
- IEEE, CAN/CANopen and various fieldbus interfaces
- Integrated function generator for time-based or user-defined arbitrary functions



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.

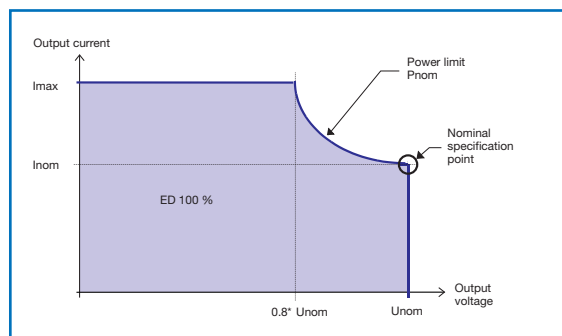
Adjustable internal resistance

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.

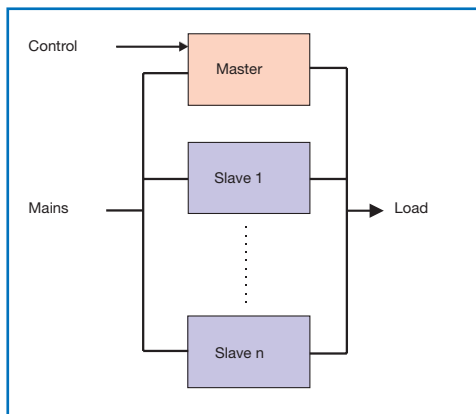
Output characteristics for voltage, current and power



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.



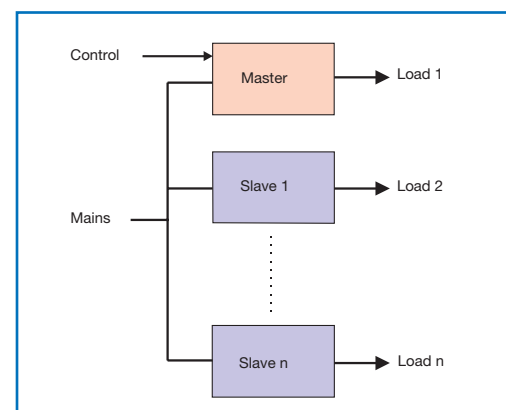
5 Regatron 32 kW power supply units in multi-unit operation

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

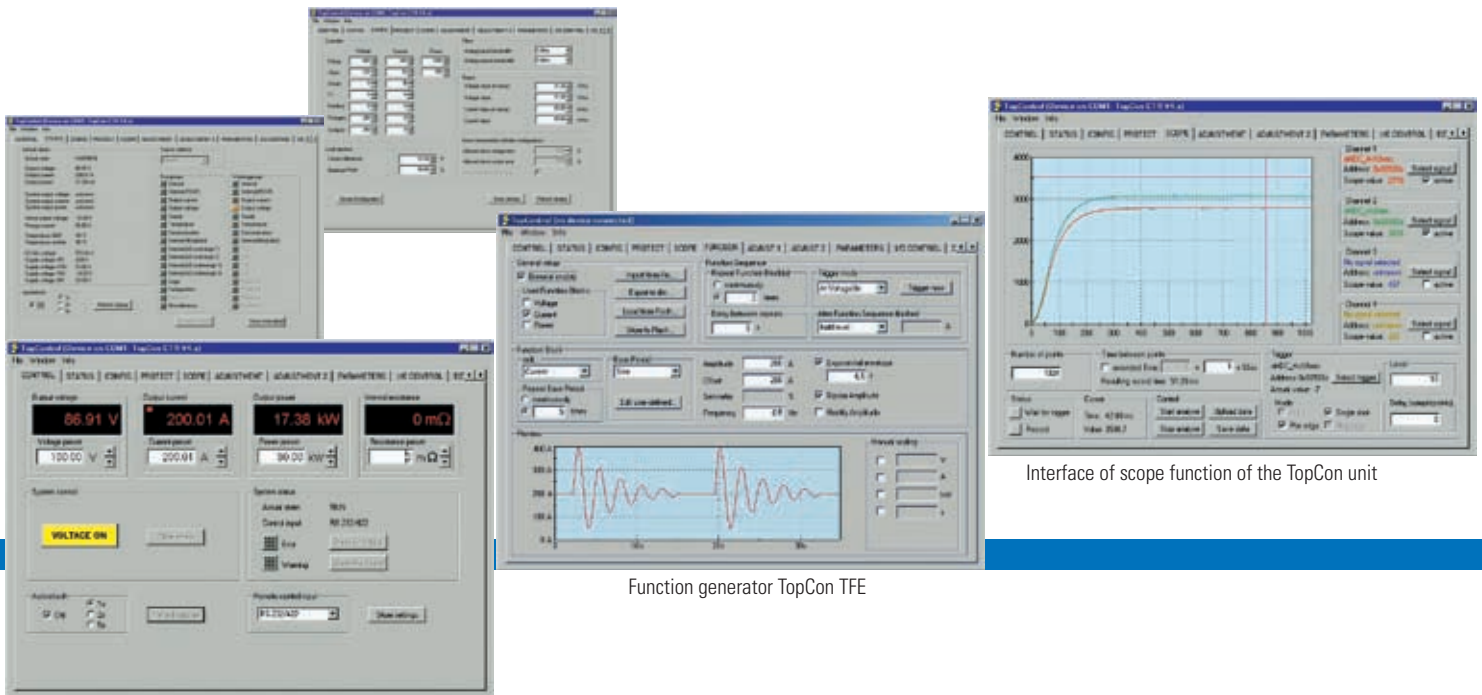
Breaking the interlock circuit, e.g. by means of an external emergency shutdown contact, immediately disables the power stage.



TopCon Front Panel control unit (HMI)



Rear side of TopCon unit with 6 HE height



Interface of scope function of the TopCon unit

Function generator TopCon TFE

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

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

Integrated Function Generator (optional)

The TopCon Function Engine (TFE) is a function generator that work as set point device for voltage, current and power control. Standard time-based functions (sine wave, rectangle, triangle) allow to simulate a powerful function generator. Likewise user-defined functions can be specified by up to 1000 points with linear interpolation. Arbitrary dying out, repetitions with definable latency allow to adapt the function to the requirements. The function generator is fully configurable by the PC software TopControl, a set of base functionality is also available in the user interfaces HMI and RCU.

TopControl Scope Functionality

By using the Scope function included in the TopCon firmware, nearly all internal signals can be recorded. After an upload to the Software TopControl they are presented in the well-known format of an oscilloscope. Thus the Scope functionality allows to analyse all process-relevant time-based signals. The users have access to all, digital and analog signals and this allows a thorough insight into the operational state of the power supply.

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

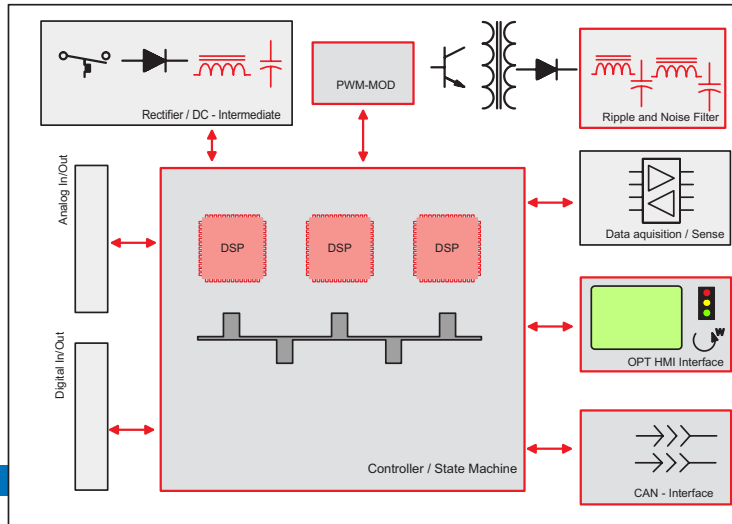
⁸⁾ Typical value at nominal ohmic load, line asymmetry < 1 V_{rms}

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» | |

TopCon Functional Block Diagram



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 | k units ≤ 400 A: length 45 mm, 1 hole 9 mm ø in each bar k 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 V _{rms} 2500 V _{rms} ± 1000 VDC, > 10 MΩ / 2 x 6.8 nF |

Technical data

Subject to change

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 ¹⁾ Interlock circuit Voltage setting 0 – 100 % Current setting 0 – 100 % Power setting 0 – 100 % Int. resistance setting 0 – 1000 mΩ ¹⁾ | 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 38400 baud |
| Resolution (programming and readback) | U, I P, Ri | 0.025 % FS 0.1 % FS |

¹⁾ 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 (adjustable) | 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 |
| RS-422 | 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 |



Customer-specific version for enhanced mechanical and thermal requirements



Multiple 32 kW TopCon power supply units in parallel mode, liquid cooled, current range from 0...2000 A



32 kW TopCon power supply with bipolar output (AC switch) for degaussing applications



Options

| | |
|--------|--|
| HMI | Front panel control unit HMI |
| RS-422 | Differential serial interface RS-422 |
| IEEE | Parallel interfaces IEEE488.2 |
| 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 Type, Customspecific Adaption on request*

| Output voltage range (VDC) | Output power range (kW) | Output current range (A) | Type** |
|----------------------------|-------------------------|--------------------------|--------------------|
| 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 – 32 | 0 – 700 | TC.P.32.52.400.S |
| 0 – 65 | 0 – 10 | 0 – 193 | TC.P.10.65.400.S |
| 0 – 65 | 0 – 16 | 0 – 308 | TC.P.16.65.400.S |
| 0 – 65 | 0 – 20 | 0 – 385 | TC.P.20.65.400.S |
| 0 – 65 | 0 – 32 | 0 – 600 | TC.P.32.65.400.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 – 32 | 0 – 400 | 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 – 66 | TC.P.32.600.400.S |
| 0 – 800 | 0 – 10 | 0 – 16 | TC.P.10.800.400.S |
| 0 – 800 | 0 – 16 | 0 – 25 | TC.P.16.800.400.S |
| 0 – 800 | 0 – 20 | 0 – 32 | TC.P.20.800.400.S |
| 0 – 800 | 0 – 32 | 0 – 50 | TC.P.32.800.400.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 |

* Model specific technical data sheets with detailed specifications are available on the Regatron website and at authorised distributors.

**All models with 20 kW or 32kW output power are also available for 480 V (instead of 400V)



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ISO zertifiziert

