GRIDCON® PCS
POWER CONVERSION SYSTEM WITH HIGHEST POWER QUALITY.
WWW.REINHAUSEN.COM
GRIDCON® PCS FOR RURAL ELECTRIFICATION WORLDWIDE.

GRIDCON® PCS BRINGS POWER QUALITY TO ENERGY STORAGE AND RENEWABLE APPLICATIONS.
GRIDCON® POWER CONVERSION SYSTEM FOR OFF-GRID AND ON-GRID.

Energy storage is making a vital contribution to the energy transformation. It provides ancillary services for grid stabilization and optimizes energy management in industrial operations. Maschinenfabrik Reinhausen (MR) combines its expertise in power quality with energy storage technologies to create real added value for energy storage integrators.

The GRIDCON® Power Conversion System (PCS) is designed to address the needs for flexibility and configurability in a quickly growing market for energy storage. Renewable energies and electromobility are pushing the development of energy storage. Stationary energy storage systems are primarily used to balance energy volatility resulting from renewable energy sources and fluctuating loads.

To design individual and sophisticated solutions for these applications, MR developed GRIDCON® PCS 400 (3-wire) and GRIDCON® PCS 120 (4-wire) on the solid basis of its decade-long experience in power conversion technologies for active filters.

Power conversion systems from MR combine the mutual benefits and dynamics of an active power filter with solid reliability. This allows GRIDCON® PCS to operate in the most challenging applications and integrate renewable technologies. From the edge of the electrical network to full off-grid operation, GRIDCON® PCS makes its contribution to the energy transformation.

The holistic approach of MR includes optional grid analysis and grid studies and aims to ensure compliance with connection codes and required power quality. GRIDCON® PCS filters grid voltage and sustains it dynamically through reactive-power injection.

Areas of application
- Peak shaving of active power
- Stabilization of grid frequency
- Active power P(f) for renewable energy sources (required by grid codes)
- Industrial DC distribution
- Micro grids
- PV-diesel-hybrid power solutions
- Power inverters for charging stations
- Grid integration of charging stations

Your solution for smart storage
GRIDCON® POWER CONVERSION SYSTEM
FLEXIBILITY MEETS CONFIGURABILITY

The networked architecture of GRIDCON® PCS provides great flexibility: The Modbus TCP interface on the controller facilitates easy integration into industrial or building networks. Furthermore, all internal connections offer simple, error-free assembly and particularly reliable communication – even under the influence of electromagnetic disturbances. The “DSC-Distributed Synchronous Control®” technology provides synchronized communication between all components.

Interface to PCS

- **Standardized PLC interface**
  Plug & play, real-time field BUS communication, complying with international regulations and standards.

- **GRIDCON® Modbus Test Environment**
  Fast and simple setup via Modbus TCP. Including software tools for starting communication setups and testing routines.

- **Full control, more possibilities**
  While the overall control is always placed at the top-level PLC, the GRIDCON® PCS offers extended control functions based on smart algorithms.

Control applications

- **Microgrid operation at its best**
  GRIDCON® PCS operates in a grid-forming capacity and provides a sustainable energy supply even in the most remote areas of the world. The combination with renewable energy sources and diesel-fueled generators is a frequent application.
  In parallel operation to generators, GRIDCON® PCS can behave as a stabilizing voltage source and provide short-circuit current.

- **Power quality for energy storage**
  GRIDCON® PCS utilizes active-filter features to achieve power quality by filtering harmonics up to the 51st order, phasing selective reactive power compensation, and balancing power.

![CCU: Control Computer Unit](image)
System design

**Configured for the application**
The modular system design gives you the opportunity to configure the system you need by defining the number of power modules (IPU) necessary for the application.

**Adjustable on the job**
Requirements can change and so on GRIDCON® PCS. By adjusting the conversion system through additional modules in the field, the energy storage system maximizes its retrofitting capability.

**Explicit, distinct design**
To minimize operation and maintenance efforts and service periods, our clear, explicit and distinct design optimizes the handling of simple maintenance procedures.

Monitoring

**Decentralized integration**
The detached measurement unit (MIO) enables installation next to current transformers. By using fiber-optic cables, integration is possible over hundreds of meters.

**Multiple measurement points**
To fully utilize the potential of GRIDCON® PCS integrated control, multiple measurement points can be connected. Operating control functions on different voltage levels as well as in different strings is possible.

**Integrated, embedded measurements**
Integrated measurements give GRIDCON® PCS the capability not only to react to changes of reference values within 100 µs, but also to perform multiple measurements at the same time.
GRIDCON® PCS 400
MODULAR INVERTER, 3-WIRE.

Optional: 7" touchpanel with uniform GRIDCON® PCS operating software

CCU (Control Computer Unit) for up to four power modules

1…4 x AC/DC IPU (IGBT Power Unit) each 125 A AC with autonomous control and self-monitoring

DC connections for batteries

Power supply: 24 V DC

MIO (Measurement/Input/Output) current and voltage measurement

In the GRIDCON® product family, the GRIDCON® PCS 400 provides the following functions and voltage levels in operation.
GRIDCON® PCS 400 PROVIDES DC CONNECTIONS AND BATTERY STORAGE TO INDUSTRIAL 3-WIRE AC POWER DISTRIBUTION.

GRIDCON® PCS 400 combines the benefits of a modular design with its high power density and low footprint. To utilize limited space while providing maximum power, GRIDCON® PCS 400 is the solution of choice.

The parallel operation of multiple GRIDCON® PCS 400s allows scalability up to 2,400 kVA. The system uses modular 3-level IGBT AC/DC converters of 125 A per module and thereby gives the integrator simple scalability for each project. In addition to this simple scalability, GRIDCON® PCS 400 is clear and straightforward in regard to its service and maintenance schedule.

Functions

- Grid forming (on-grid and off-grid)
- Active power conversion (AC/DC)
- Harmonics filtering (D) 3rd .. 51st (up to 2.55 kHz)
- Reactive power (Q, cos φ) compensation
- Load balancing (reactive as well as active power)
- Flicker compensation
- Dynamic/integrated peak shaving

Benefits

- Can be configured individually
- Extensive software library of tested and certified functions
- Hardware and software can be individually extended
- Scalable at system level from 90 kVA – 2,400 kVA
- Maximum power density

GRIDCON® PCS 400 sample configuration:

3-wire AC system with DC distribution and battery rack

With up to 400 kW per cabinet, GRIDCON® PCS 400 provides direct connection for battery storage and other storage types including super caps which reduce the power losses to a possible minimum. The DC connection therefore includes EMC filters. The DC voltage is regulated between 680–1,200 V (depending on AC voltage). The system supports an AC voltage range of 300 to 690 V, with typical applications using AC voltages between 400 V and 480 V.
GRIDCON® PCS 120
MODULAR INVERTER, 4-WIRE

Optional: 7” touchpanel with uniform GRIDCON® PCS operating software

1...3 x AC/DC IPU (IGBT Power Unit); each 40 kVA with autonomous control and self-monitoring

1 x DC/DC IPU (IGBT Power Unit)
3 x 80 A DC

3 x DC disconnector

CCU (Control Computer Unit) for up to four power modules

MIO (Measurement/Input/Output) current and voltage measurement

Power supply: 24 V DC

In the GRIDCON® product family, the GRIDCON® PCS 120 provides the following functions and voltage levels in operation.

Reactive power control
Harmonics/active filter
Voltage stabilization
Neutral modulation/artificial neutral
Peak shaving
Micro grid
Frequency control

AC
0 V
400 V
1,200 V

DC
0 V
180 V
400 V
800 V
1,200 V
GRIDCON® PCS 120 PROVIDES DC CONNECTIONS AND BATTERY STORAGE TO COMMERCIAL 4-WIRE AC POWER DISTRIBUTION.

GRIDCON® PCS 120 is equipped with a modular system configuration of up to 120 kW per cabinet. It combines a maximum of configurability with an easily accessible DC bus for the integration of additional power sources.

The system uses modular 3-level IGBT AC/DC inverters of 40 kW as well as DC/DC IGBT modules to simultaneously provide different DC voltage levels. These parallel DC strings of GRIDCON® PCS 120 provide three regulated DC voltage levels between 180–800 V, including DC connections with EMC filters and disconnectors. In addition to regular high-voltage batteries, the DC converters are designed to also integrate automotive batteries. Furthermore, GRIDCON® PCS 120 can be used for DC distribution, charging stations and other storage technologies such as super capacitors.

The AC voltage range is 300 V to 415 V (with +10% margin) while the system internally provides a constant DC voltage level. The central DC busbar grants the flexibility to connect and integrate further power sources and loads. With maximized accessibility, this allows the integration of PV string optimizers, redox-flow or flywheels.

**Functions**
- Grid forming (on- and off-grid) incl. neutral phase
- Active power conversion (AC/DC)
- Harmonics filtering (D) 3rd .. 51st (up to 2.55 kHz) incl. neutral
- Reactive power (Q, cos φ) compensation
- Load balancing (reactive as well as active power)
- Flicker compensation (with fast reaction time << 1 ms)
- Integration of automotive batteries
- Power flow control and dynamic peak shaving

**Benefits**
- Individual configuration with a simple retrofit and extension concept
- Extensive software library of tested and qualified/certified functions
- Hardware and software can be extended individually
- Scalable from 40 kVA to 120 kVA per cabinet

### GRIDCON® PCS 120 sample configuration: 4–wire AC system with DC distribution and battery rack

- **Battery**
  - 400–450 V
  - 180–800 V
  - 650 V

- **Ultra-capacitor**

- **Flywheel**

- **DC applications**

- **DC strings**
  - 180–800 V DC variable per port

- **DC link**
  - 800 V

- **AC grid**
  - 400 V AC

- 40 kW
- 40 kW
- 40 kW
- 40 kW

- 60 A (D)
- 60 A (D)
- 60 A (D)
- 60 A (D)

- 42 kvar (Q)
- 42 kvar (Q)
- 42 kvar (Q)
- 42 kvar (Q)
REFERENCE PROJECTS.

PV power plant in Northern Queensland, Australia

**Situation**
- Construction of a 13 MW PV plant in the remote area of Northern Queensland to supply 3,000 homes through renewable energy sources
- Demand for 5300 kWh of battery storage capacity

**Challenge**
- Harmonic behavior of the solar inverter units violates grid connection codes
- Voltage fluctuations cause non-reliable power supply
- Power outages and blackouts

**Solution**
- Four GRIDCON® PCS 400 with 4 x 87 kVA each
- Four cabinets for combined power of 1400 kVA with grid support mode on the 66 kV point of common coupling

**Customer benefits**
- High reliability of power generation through stable power supply
- Conformity to grid standards through harmonic filtering
- Emergency power/backup supply thanks to GRIDCON® PCS grid-forming operation

R & D facility in Bavaria, Germany

**Situation**
- Battery storage and PV integration for peak shaving in an R & D facility in Bavaria
- Sensitive electronics and machines for prototype engineering

**Challenge**
- Rarely occurring blackouts jeopardize mandatory cooling processes
- Voltage distortion affects the manufacturing of prototype samples

**Solution**
- GRIDCON® PCS 120 with 4-wire connection and 3 x 42 kVA
- Three redundant and parallel operating AC inverter modules
- Battery capacity of 3 x 50 kWh, each on a separate DC string and with individual control

**Customer benefits**
- Full off-grid and black-start capability
- Automatic emergency power and 200 ms ramp up after tripping of circuit breaker
- Integration of the installed solar generation into the emergency grid
- No installation of further transformers required
MORE POWER – MORE VALUE.

GRIDCON® PCS for energy storage – shaping the energy transformation

Expertise in power quality

- MR Power Quality provides support – from analysis including economic feasibility calculations to commissioning and subsequent service
- MR has been an expert in power quality and grid integration for over 25 years, offering original system solutions at all voltage levels
- MR’s comprehensive expertise in model design and simulation guarantees compliance with even the most sophisticated grid-connection requirements

High reliability – made in Germany

- Redundant operation even in cases of power-unit failures for maximum reliability
- Comprehensive mechanical and electrical tests, going far beyond the requirements of type testing, demonstrate the highly robust construction

True quality

- Tried-and-tested electrical engineering: Developed by MR as a special inverter for power-quality applications
- MR guarantees the provision of spare parts during the service lifetime of 10 years after delivery

Easy maintenance

- Reduced cost and time investments due to remote maintenance option
- Simplified fault analysis thanks to collection of operating data and malfunction recording
- Service technicians from MR are available to train local operating personnel to carry out simple service and maintenance tasks
DIMENSIONS.

GRIDCON® PCS 400 (3-wire)

IPU – IGBT Power Unit

MIO (measurement unit with digital inputs and outputs)
DIMENSIONS.

GRIDCON® PCS 120 (4-wire)

IPU – IGBT Power Unit
### Technical Data

<table>
<thead>
<tr>
<th>Technical data</th>
<th>GRIDCON® PCS 400 (3-wire)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rated AC voltage</strong></td>
<td>400 V/480 V (maximum 690 V, on request) +/- 10%</td>
</tr>
<tr>
<td><strong>Rated frequency</strong></td>
<td>50/60 Hz</td>
</tr>
<tr>
<td><strong>AC peak current</strong></td>
<td>2 x rated AC current</td>
</tr>
<tr>
<td><strong>AC connection</strong></td>
<td>3-phase + PE, a neutral conductor is not necessary (grids: TN, TT, IT)</td>
</tr>
<tr>
<td><strong>Function</strong></td>
<td>Bidirectional AC/DC active power conversion, integration of energy storage devices into power grids</td>
</tr>
<tr>
<td><strong>Filter function</strong></td>
<td>1\clus{1,...,15} harmonic (50 Hz) // 1\clus{1,...,41} harmonic (60 Hz)</td>
</tr>
<tr>
<td>All harmonics can be filtered simultaneously</td>
<td></td>
</tr>
<tr>
<td><strong>Additional functions</strong></td>
<td>Dynamic reactive power compensation; active and reactive power balancing (negative sequence up to 60%, zero sequence up to 100% of rated current); voltage stabilization via Q(U)-control; flicker compensation; grid-forming with neutral conductor</td>
</tr>
</tbody>
</table>

#### AC voltage

<table>
<thead>
<tr>
<th>Number of IPUs</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rated AC current</strong></td>
<td>125 A</td>
<td>250 A</td>
<td>375 A</td>
<td>500 A</td>
<td>125 A</td>
<td>250 A</td>
<td>375 A</td>
<td>500 A</td>
</tr>
<tr>
<td><strong>Rated apparent power</strong></td>
<td>87 kVA</td>
<td>173 kVA</td>
<td>260 kVA</td>
<td>346 kVA</td>
<td>104 kVA</td>
<td>208 kVA</td>
<td>312 kVA</td>
<td>416 kVA</td>
</tr>
<tr>
<td><strong>Rated reactive power</strong></td>
<td>87 kvar</td>
<td>173 kvar</td>
<td>260 kvar</td>
<td>346 kvar</td>
<td>104 kvar</td>
<td>208 kvar</td>
<td>312 kvar</td>
<td>416 kvar</td>
</tr>
<tr>
<td><strong>Rated active power</strong></td>
<td>85 kW</td>
<td>170 kW</td>
<td>255 kW</td>
<td>340 kW</td>
<td>100 kW</td>
<td>200 kW</td>
<td>300 kW</td>
<td>400 kW</td>
</tr>
</tbody>
</table>

#### DC connection

<table>
<thead>
<tr>
<th>DC voltage range (@ AC voltage)</th>
<th>680 V ... 1,200 V</th>
<th>840 V ... 1,200 V</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rated DC current (continuous)</strong></td>
<td>140 A</td>
<td>280 A</td>
</tr>
<tr>
<td><strong>Max. DC current (&lt; 1s)</strong></td>
<td>238 A</td>
<td>476 A</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>ca. 390 kg</td>
<td>ca. 530 kg</td>
</tr>
<tr>
<td><strong>Power losses</strong></td>
<td>&lt; 2.4 % in typical operation, &lt; 0.5 % when idle &lt; 100 W in standby</td>
<td>&lt; 2.1 % in typical operation, &lt; 0.5 % when idle &lt; 100 W in standby</td>
</tr>
</tbody>
</table>

#### Switching frequency

10 kHz (low loss)

#### Communication interfaces

Ethernet (TCP/IP)
Several field-bus systems with optional Anybus plug-in modules (e.g. Profinet, Modbus TCP)
4 digital outputs (potential free, programmable) for status messages
4 digital inputs (24 VDC, programmable) for external control and parameter set selection

#### Current transformer

Either 2-phase or 3-phase current measurement, xx/5 A or xx/1 A (parameterized)
Current transformers are not included, 15 VA, class 1 or better recommended

#### Converter

3-level IGBT with voltage link (DC film capacitors)

#### Color

Standard: RAL 7035 light grey (other colors and designs on request)

#### Cabinet dimensions (ca. WxDxH)

800 x 800 x 2000 mm
800 x 800 x 2200 mm with optional base (needed for main air supply from front or back)
Without DC coupling cabinet

#### Cooling

Air cooling with speed-controlled fans

#### IP protection degree

Standard: IP20, optional: IP21 .. IP54

#### Ambient conditions

Maximum ambient temperature without derating: 40° C; recommended ambient temperature for continuous operation: < 25° C; minimum operating temperature: 0° C; relative humidity: maximum 95% non-condensing; transport/storage: -20° C .. 70° C

#### Overvoltage category

CAT III, 1000 V

#### EMC class

EN 55011, class A1 (industrial environment)

#### Standards

EN 50178, EN 61439-1, EN 61439-2, EN 61000-6-2, EN 61000-6-4, EN 55011

Optional DC disconnector panel on request
# TECHNICAL DATA.

<table>
<thead>
<tr>
<th>Technical data</th>
<th>GRIDCON® PCS 120 (4-wire)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated AC voltage</td>
<td>400 V +/-10%</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>AC peak current</td>
<td>2 x rated AC current</td>
</tr>
<tr>
<td>AC cable connection</td>
<td>3-phase + PE + N/PEN, (network topology TN)</td>
</tr>
<tr>
<td>Function</td>
<td>Bidirectional AC/DC active power conversion, integration of energy storage devices into power grids</td>
</tr>
<tr>
<td>Filter function</td>
<td>1\textsuperscript{st} .. 51\textsuperscript{st} harmonic (50 Hz) // 1\textsuperscript{st} .. 41\textsuperscript{st} harmonic (60 Hz)</td>
</tr>
<tr>
<td>All harmonics can be filtered simultaneously</td>
<td></td>
</tr>
<tr>
<td>Additional functions</td>
<td>Dynamic reactive power compensation; active and reactive power balancing [negative sequence up tp 60%, zero sequence up to 100% of rated current]; voltage stabilization via Q(U) control; flicker compensation; grid-forming with neutral conductor</td>
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</tbody>
</table>

### AC voltage

<table>
<thead>
<tr>
<th>Number of IPUs</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated AC current</td>
<td>60 A</td>
<td>120 A</td>
<td>180 A</td>
</tr>
<tr>
<td>Rated apparent power</td>
<td>42 kVA</td>
<td>83 kVA</td>
<td>125 kVA</td>
</tr>
<tr>
<td>Rated reactive power</td>
<td>42 kvar</td>
<td>83 kvar</td>
<td>125 kvar</td>
</tr>
<tr>
<td>Rated active power</td>
<td>40 kW</td>
<td>80 kW</td>
<td>120 kW</td>
</tr>
</tbody>
</table>

### DC connection

- Integrated DC/DC converter with 3 x individually controlled 2-phase DC strings

<table>
<thead>
<tr>
<th>DC voltage range (@ AC voltage)</th>
<th>(0 V) 180 V ... 800 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated DC string current</td>
<td>3 x 80 A</td>
</tr>
<tr>
<td>Rated DC current (continuous)</td>
<td>195 A</td>
</tr>
<tr>
<td>Weight</td>
<td>ca. 305 kg</td>
</tr>
<tr>
<td>Power losses</td>
<td>&lt; 3.5% at typ. operation, &lt; 0.4% at no load, &lt; 100 W at standby</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>20 kHz (low loss)</td>
</tr>
<tr>
<td>Control</td>
<td>Internal control computer with two digital signal processors</td>
</tr>
<tr>
<td>System setup and display</td>
<td>Via internal webservice (TCP/IP) , SD-card parameterization or Anybus interface (field bus)</td>
</tr>
<tr>
<td>Optional: via touch panel with graphic display</td>
<td></td>
</tr>
<tr>
<td>Response time</td>
<td>&lt;= 1 ms</td>
</tr>
<tr>
<td>Communication interfaces</td>
<td>Ethernet (TCP/IP)</td>
</tr>
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<td>Several field-bus systems with optional Anybus plug-in modules (e.g. Profinet, Modbus TCP)</td>
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<td>4 digital outputs (potential free, programmable) for status messages</td>
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</tr>
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<td>Current transformer</td>
<td>3-phase current measurement, xx/5 A or xx/1 A (parameterized)</td>
</tr>
<tr>
<td>Current transformers are not included, 15 VA, class 1 or better recommended</td>
<td></td>
</tr>
<tr>
<td>Converter</td>
<td>AC/DC converter: 3-level IGBT with DC voltage link</td>
</tr>
<tr>
<td>DC/DC converter: 2-level IGBT with DC voltage link</td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>Standard: RAL 7035 light grey (other colors and designs on request)</td>
</tr>
<tr>
<td>Cabinet dimensions (ca. Wx Dx H)</td>
<td>600 x 600 x 1800 mm</td>
</tr>
<tr>
<td>600 x 600 x 2000 mm with optional base</td>
<td></td>
</tr>
<tr>
<td>Cooling</td>
<td>Air cooling with speed-controlled fans</td>
</tr>
<tr>
<td>IP protection degree</td>
<td>Standard: IP20, optional: IP21 .. IP43</td>
</tr>
<tr>
<td>Ambient conditions</td>
<td>Maximum ambient temperature without derating: 40° C; recommended ambient temperature for continuous operation: &lt; 25° C; minimum operating temperature: 0° C; relative humidity: maximum 95% non-condensing; Transport / storage: -20° C .. 70° C</td>
</tr>
<tr>
<td>Overvoltage category</td>
<td>CAT III, 300 V</td>
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<td>EMC class</td>
<td>EN 55011, class A1 (industrial environment)</td>
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<td>Standards</td>
<td>EN 50178, EN 61439-1, EN 61439-2, EN 61000-6-2, EN 61000-6-4, EN 55011</td>
</tr>
<tr>
<td>Optional DC disconnector module integrated</td>
<td></td>
</tr>
<tr>
<td>3 DC disconnectors 100 A DC, internally wired (refer to product photo on page 8)</td>
<td></td>
</tr>
</tbody>
</table>