

Source-Sinks

# SOURCE-SINK QL SERIES



- 2- or 4-quadrant models
- DC source-sink
- Additionally AC source with 4-quadrant models
- Basic operating modes CC, CV, CP, CR
- Combined operating modes CC+CV, CV+CC
- Adjustable upper and lower protections for V and I
- Adjustable internal resistance in CC and CV mode
- Functions for test of energy storage devices
- Internal resistance measurement
- List function with synchronized DAQ
- Rectangular, PWM and modulation function
- Master-slave operation for power enhancement

## SERIE QL – Brief Profile

QL series devices are sources and sinks or, respectively, power supply and electronic load in one device. They are used in testing a wide variety of energy storage devices, as well as other DUTs such as motors, chargers or coils.

The standard portfolio offers 2- or 4-quadrant devices up to 3,600 W. In addition to DC operation, 4-quadrant devices also provide the function of an AC source.

## Interfaces

- RS-232
- USB
- LAN
- GPIB
- CAN
- Analog
- Analog isolated

● Standard    ○ Option    — not available

## Operating Modes

in DC and AC mode

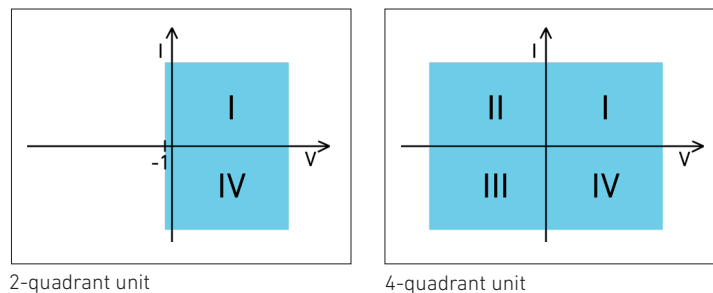
In addition to constant voltage (CV) and constant current (CC) operation, the QL source-sinks also operate in constant resistance (CR) and constant power (CP) mode. In CV operation, two current limits (source and sink current) are independently adjustable. In CC operation, an upper and a lower limit voltage can be set. This enables the combined operating modes CC+CV and CV+CC. 4-quadrant devices can also be used as AC sources.

## Source-Sink Mode

Depending on the setting of the output variable and the properties of the connected DUT, the device automatically decides whether it operates as a source or as a sink.

## 2-/4-Quadrant Models

Devices for 2-quadrant operation can supply current or consume reverse current when the output voltage is positive. To ensure that the desired function is provided at settings close to 0 V and longer connection lines, the 2-quadrant devices already operate at negative voltages from -1 V. In principle, 2-quadrant devices are also 4-quadrant devices, but with a reduced negative voltage. 4-quadrant devices can set negative values of the same magnitude as positive values.



## I/O Port

Standard or isolated (option QL06)

Analog signals  
in realtime!

The standard I/O port provides analog and digital signals for external control.

### Outputs:

- Analog voltage monitor signal  
-10 ... 0 ... 10 V
- Analog current monitor signal  
-10 ... 0 ... 10 V
- Output activation state
- Status output for high protection level
- Status output for low protection level
- Trigger output

### Inputs:

- Analog setting of I and V  
with -5 ... 0 ... 5 V or with -10 ... 0 ... 10 V
- Analog setting for upper and lower voltage or  
current protection with -10 ... 0 ... 10 V
- Output activation
- Operating mode selection CC - CV
- Control speed selection
- Remote shut-down
- Readable digital input (by SCPI command)
- Trigger input

As an option, there is a galvanically isolated version for the I/O port (option QL06).

## Factory Calibration Certificate

(FCC-QLxx)

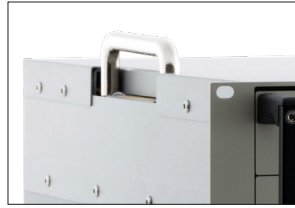
2 x for free

We supply a free Factory Calibration Certificate (FCC) with the devices. The calibration process is subject to supervision in accordance with DIN EN ISO 9001. This calibration certificate documents the traceability to national standards to illustrate the physical device in accordance with the International System of Units (SI). Within the 2-year warranty period, we will calibrate a second time free of charge if the respective device will have been registered:

<https://www.hoecherl-hackl.com/service/device-registration>

For use under laboratory conditions, H&H recommends a calibration interval of 2 years. This is an empirical value that can be used as a guide for the first period of use. Depending on the intended use, service life, relevance of the application and ambient conditions, the operator should adjust this interval accordingly.

## Mechanics



Retractable handle

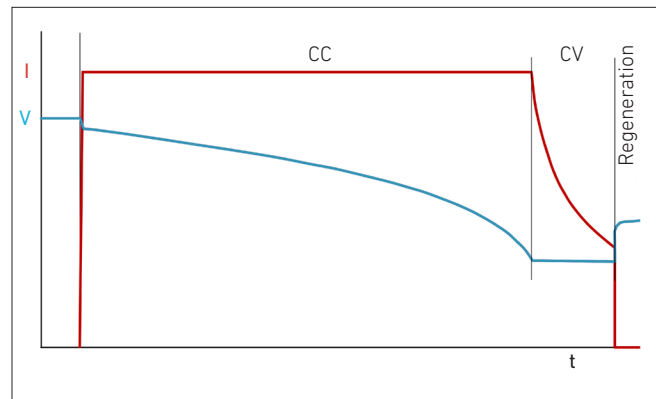
The QL series is designed in robust 19" technology and can be used as a desktop device or installed in a rack. No additional installation kits are required for 19" installation. From 5 height units, there are retractable heavy-weight handles on the top of the device.

## Safety Covers

For devices with touchable output connections, covers are supplied as touch protection.

## Functions

### Discharge Function



IUa discharge with follow-up time

The discharge function discharges and tests energy storage devices such as batteries, accumulators, ultracaps, electrolytic capacitors, etc. by discharging them in CC, CP or CR mode. The discharge function can be combined with the list function so that defined discharge profiles are possible. IUa discharge (CC+CV discharge) is also possible: in this case, the DUT is discharged with constant current until a defined voltage is detected. This voltage is then kept constant until a defined minimum current is reached.

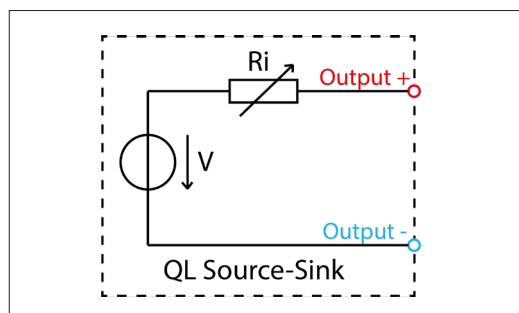
Stop criteria are charge, energy, time, current, voltage.

During data logging, a follow-up time can be defined to observe the recovery phase.

### Charge Function

Similarly to the discharge function, there is the charge function, where the same operating modes and switch-off criteria apply.

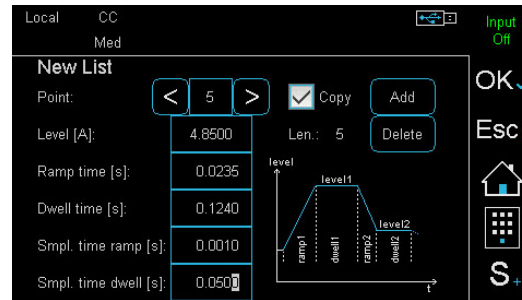
### Adjustable Internal Resistance



Equivalent circuit voltage source with internal resistance

In order to simulate different sources as flexibly as possible, a variable internal resistance can be set in constant voltage mode CV. Analogously, a conductance can be set in constant current mode CC.

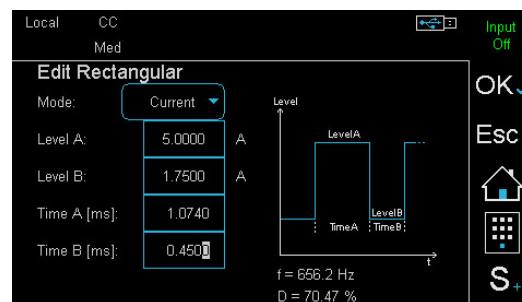
## List Function



Voltage and current are measured synchronously and stored with a time stamp. Associated sampling times can be defined for each curve section.

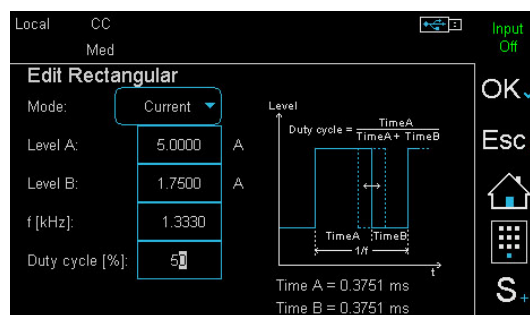
In all operating modes CC, CV, CR, or CP profiles can be simulated with the List function. Up to 300 settings of variable duration with associated ramp time are possible. The setting lists may contain positive and negative values cross-quadrant, so that there are e.g. charging and discharging currents in one list.

## Rectangular Function



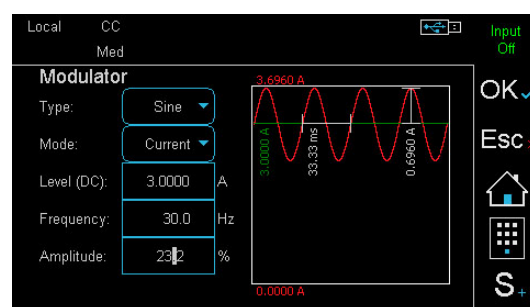
The rectangle function provides a convenient way to generate a rectangular waveform by entering absolute time and current/voltage values.

## PWM Function



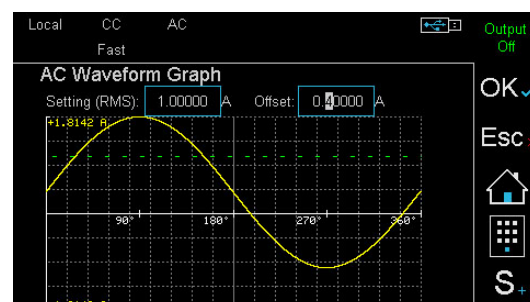
In manual operation of the PWM function, the frequency and the duty cycle can be set for the two current/voltage values.

## Modulator



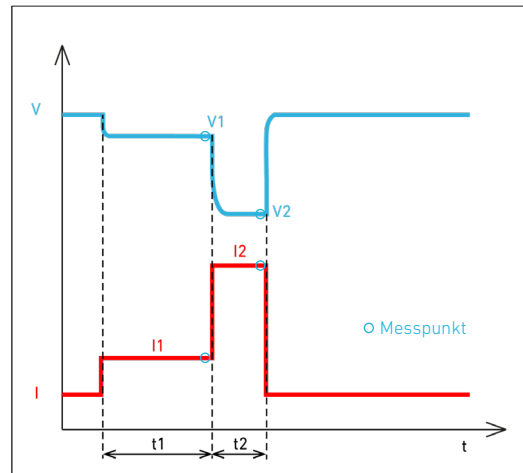
In CC or CV mode, the modulator adds a sinusoidal, square-wave, triangular or arbitrary signal to a constant setpoint. Frequency and modulation depth are adjustable.

## AC Source



4-quadrant devices can be used as DC source-sinks in the basic operating modes CC, CV, CP and CR and additionally as AC sources in the operating modes CC and CV. Selectable waveforms are sine, triangle, square, sawtooth or an arbitrary waveform with adjustable offset. The waveform is mains synchronizable.

## Internal Resistance Measurement



Ri calculation timing

The source-sink can measure the internal DC resistance of the connected DUT. The determination of the internal resistance  $R_i$  is based on the principle specified in various standards for batteries and accumulators, e.g. DIN EN 61951, DIN EN 61960. Within a defined period of time, the device measures the DUT's terminal voltage ( $V_1$ ,  $V_2$ ) at two adjustable currents ( $I_1$ ,  $I_2$ ) and calculates  $R_i$  from this. In manual mode, the device can store the parameters and the result of the measurement on a connected USB mass storage device at the touch of a button, so that a high throughput with many DUTs may be achieved.

## Data Acquisition (DAQ)

The source-sink is able to synchronously store data records from voltage and current with time stamp internally in a defined interval. Up to 40,000 data records are stored in a ring buffer and can be read via one of the data interfaces. After the recording is finished, the user may transfer data to a USB flash drive.

For processes with storage intervals in the seconds range, the device can also save data directly on the USB flash drive.

## Trigger Model

Several functions and settings may be triggered by a configurable trigger event:

- Toggle source output
- Set triggered operating mode
- Start/stop list mode
- Start/stop data acquisition
- Set triggered settings of all operating modes

Available trigger sources:

- Extern
- Bus
- Manual
- Voltage
- Current

## Changing Regulation Speed

For certain DUTs or very long connecting lines, it may be necessary to adjust the regulation time constant of the source-sink to avoid oscillation behavior and to achieve stable operation.

The control speed can be selected from slow - fast (see rise/fall times in model overview).

## Watchdog Function

To protect the DUT from communication problems, the source-sink in digital remote control mode has a watchdog function that switches off the output if the previously programmed watchdog delay time expires without the watchdog being reset.

The watchdog delay time is set by SCPI command, another command activates the watchdog. When the watchdog is active, a control program must ensure that the command to reset the watchdog is periodically sent to the source-sink.



| Model (Order Number)                        | QL1V10C20                       | QL1V20C10                       | QL1V30C8                        | QL1V42C6                        | QL1V80C3                        | QL1V100C2                       |
|---------------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Voltage range                               | -1 ... 10 V                     | -1 ... 20 V                     | -1 ... 30 V                     | -1 ... 42 V                     | -1 ... 80 V                     | -1 ... 100 V                    |
| Current range                               | ±20 A                           | ±10 A                           | ±8 A                            | ±6 A                            | ±3 A                            | ±2 A                            |
| Resistance range                            | 0.0250 ... 10.0 Ω               | 0.100 ... 40.0 Ω                | 0.200 ... 75.0 Ω                | 0.350 ... 140 Ω                 | 1.33 ... 533 Ω                  | 2.50 ... 1000.0 Ω               |
| Power                                       | 200 W                           | 200 W                           | 240 W                           | 252 W                           | 240 W                           | 200 W                           |
| Rise/fall time CC, CV <sup>1)</sup>         | 120 μs                          | 120 μs                          | 120 μs                          | 120 μs                          | 120 μs                          | 120 μs                          |
| Bandwidth                                   | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         |
| Adjustable int. resistance CC <sup>2)</sup> | 1.00 Ω ... ∞                    | 4.00 Ω ... ∞                    | 7.50 Ω ... ∞                    | 14.0 Ω ... ∞                    | 53.3 Ω ... ∞                    | 100 Ω ... ∞                     |
| Adjustable int. resistance CV               | 0 ... 0.25 Ω                    | 0 ... 1.00 Ω                    | 0 ... 1.88 Ω                    | 0 ... 3.50 Ω                    | 0 ... 13.3 Ω                    | 0 ... 25.0 Ω                    |
| Output terminals <sup>3)</sup> rear         | BPK4-30L                        | BPK4-30L                        | BPK4-30L                        | BPK4-30L                        | BPK4-30L                        | BPK4-30L                        |
| Power consumption                           | 430 VA                          | 380 VA                          | 400 VA                          | 400 VA                          | 350 VA                          | 310 VA                          |
| Mains voltage <sup>4)</sup>                 | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz |
| Mains voltage toggleable <sup>4)</sup>      | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz |
| Weight ca.                                  | 13 kg                           | 13 kg                           | 13 kg                           | 13 kg                           | 13 kg                           | 13 kg                           |
| Housing <sup>5)</sup>                       | 19", 2 U                        | 19", 2 U                        | 19", 2 U                        | 19", 2 U                        | 19", 2 U                        | 19", 2 U                        |

| Model (Order Number)                        | QL1V8C80                        | QL1V10C60                       | QL1V20C40                       | QL1V26C32                       | QL1V44C22                       | QL1V60C16                       |
|---------------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Voltage range                               | -1 ... 8 V                      | -1 ... 10 V                     | -1 ... 20 V                     | -1 ... 26 V                     | -1 ... 44 V                     | -1 ... 60 V                     |
| Current range                               | ±80 A                           | ±60 A                           | ±40 A                           | ±32 A                           | ±22 A                           | ±16 A                           |
| Resistance range                            | 0.00500 ... 200 Ω               | 0.00800 ... 3.30 Ω              | 0.0250 ... 10.0 Ω               | 0.0406 ... 16.3 Ω               | 0.100 ... 40.0 Ω                | 0.188 ... 75.0 Ω                |
| Power                                       | 640 W                           | 600 W                           | 800 W                           | 832 W                           | 968 W                           | 960 W                           |
| Rise/fall time CC, CV <sup>1)</sup>         | 150 μs                          | 120 μs                          | 120 μs                          | 120 μs                          | 120 μs                          | 120 μs                          |
| Bandwidth                                   | 2.5 kHz                         | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         |
| Adjustable int. resistance CC <sup>2)</sup> | 0.200 Ω ... ∞                   | 0.333 Ω ... ∞                   | 1.00 Ω ... ∞                    | 1.63 Ω ... ∞                    | 4.00 Ω ... ∞                    | 7.50 Ω ... ∞                    |
| Adjustable int. resistance CV               | 0 ... 0.050 Ω                   | 0 ... 0.083 Ω                   | 0 ... 0.250 Ω                   | 0 ... 0.406 Ω                   | 0 ... 1.00 Ω                    | 0 ... 1.88 Ω                    |
| Output terminals <sup>3)</sup> rear         | FKS25/10-SM10                   | BPK4-60L                        | BPK4-60L                        | BPK4-60L                        | BPK4-30L                        | BPK4-30L                        |
| Power consumption                           | 1,400 VA                        | 1,200 VA                        | 1,300 VA                        | 1,200 VA                        | 1,400 VA                        | 1,300 VA                        |
| Mains voltage <sup>4)</sup>                 | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz |
| Mains voltage toggleable <sup>4)</sup>      | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz |
| Weight ca.                                  | 39 kg                           | 33 kg                           | 33 kg                           | 23 kg                           | 23 kg                           | 23 kg                           |
| Housing <sup>5)</sup>                       | 19", 5 U                        | 19", 5 U                        | 19", 5 U                        | 19", 3 U                        | 19", 3 U                        | 19", 3 U                        |

| Model (Order Number)                        | QL1V80C11                       | QL1V8C160                       | QL1V10C120                      | QL1V20C80                       | QL1V26C60                       | QL1V44C40                       |
|---------------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Voltage range                               | -1 ... 80 V                     | -1 ... 8 V                      | -1 ... 10 V                     | -1 ... 20 V                     | -1 ... 26 V                     | -1 ... 44 V                     |
| Current range                               | ±11 A                           | ±160 A                          | ±120 A                          | ±80 A                           | ±60 A                           | ±40 A                           |
| Resistance range                            | 0.364 ... 145 Ω                 | 0.0025 ... 1.00 Ω               | 0.00417 ... 1.67 Ω              | 0.0125 ... 5.00 Ω               | 0.0217 ... 8.70 Ω               | 0.055 ... 22.0 Ω                |
| Power                                       | 880 W                           | 1,280 W                         | 1,200 W                         | 1,600 W                         | 1,560 W                         | 1,760 W                         |
| Rise/fall time CC, CV <sup>1)</sup>         | 120 μs                          | 120 μs                          | 120 μs                          | 120 μs                          | 120 μs                          | 120 μs                          |
| Bandwidth                                   | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         |
| Adjustable int. resistance CC <sup>2)</sup> | 14.5 Ω ... ∞                    | 0.100 Ω ... ∞                   | 0.167 Ω ... ∞                   | 0.500 Ω ... ∞                   | 0.867 Ω ... ∞                   | 2.20 Ω ... ∞                    |
| Adjustable int. resistance CV               | 0 ... 3.64 Ω                    | 0 ... 0.0250 Ω                  | 0 ... 0.0417 Ω                  | 0 ... 0.125 Ω                   | 0 ... 0.217 Ω                   | 0 ... 0.550 Ω                   |
| Output terminals <sup>3)</sup> rear         | BPK4-30L                        | FKS25/10-SM10                   | FKS25/10-SM10                   | FKS25/10-SM10                   | BPK4-60L                        | BPK4-60L                        |
| Power consumption                           | 1,330 VA                        | 2,700 VA                        | 2,400 VA                        | 2,725 VA                        | 2,550 VA                        | 2,500 VA                        |
| Mains voltage <sup>4)</sup>                 | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz |
| Mains voltage toggleable <sup>4)</sup>      | 1/N/PE AC 115 V<br>50 ... 60 Hz | -                               | -                               | -                               | -                               | -                               |
| Weight ca.                                  | 23 kg                           | 57 kg                           | 59 kg                           | 56 kg                           | 51 kg                           | 52 kg                           |
| Housing <sup>5)</sup>                       | 19", 3 U                        | 19", 8 U                        | 19", 8 U                        | 19", 8 U                        | 19", 8 U                        | 19", 8 U                        |

1. Rise and fall times are from 10 ... 90 % and 90 ... 10 % of the current or voltage setting range in "fast" regulation speed. Tolerance ±20 %. Measured with short-circuited output terminals (current) or with open output terminals (voltage). Other loads may increase rise times. Rise/fall time in "slow" regulation speed: approx. 300 ms.
2. Value is entered as conductance in S.
3. Description of available terminals beginning at page 131. Units with touchable terminals are supplied with safety covers.
4. Mains voltage tolerance: ±10 %.
5. 1 U = 44.45 mm. Detailed dimensions by means of 3D models at [www.hoecherl-hackl.com/downloads](http://www.hoecherl-hackl.com/downloads).

| Model (Order Number)                        | QL1V60C30                       | QL1V80C20                       | QL1V8C240                               | QL1V10C180                              | QL1V20C120                              | QL1V26C90                               |
|---------------------------------------------|---------------------------------|---------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|
| Voltage range                               | -1 ... 60 V                     | -1 ... 80 V                     | -1 ... 8 V                              | -1 ... 10 V                             | -1 ... 20 V                             | -1 ... 26 V                             |
| Current range                               | ±30 A                           | ±20 A                           | ±240 A                                  | ±180 A                                  | ±120 A                                  | ±90 A                                   |
| Resistance range                            | 0.100 ... 40.0 Ω                | 0.200 ... 80.0 Ω                | 0.00167 ... 0.667 Ω                     | 0.00278 ... 1.11 Ω                      | 0.00833 ... 3.33 Ω                      | 0.0144 ... 5.78 Ω                       |
| Power                                       | 1,800 W                         | 1,600 W                         | 1,920 W                                 | 1,800 W                                 | 2,400 W                                 | 2,340 W                                 |
| Rise/fall time CC, CV <sup>1)</sup>         | 150 μs                          | 120 μs                          | 120 μs                                  | 120 μs                                  | 120 μs                                  | 120 μs                                  |
| Bandwidth                                   | 2.5 kHz                         | 3.0 kHz                         | 3.0 kHz                                 | 3.0 kHz                                 | 3.0 kHz                                 | 3.0 kHz                                 |
| Adjustable int. resistance CC <sup>2)</sup> | 4.00 Ω ... ∞                    | 8.00 Ω ... ∞                    | 0.0667 Ω ... ∞                          | 0.111 Ω ... ∞                           | 0.333 Ω ... ∞                           | 0.578 Ω ... ∞                           |
| Adjustable int. resistance CV               | 0 ... 1.00 Ω                    | 0 ... 2.00 Ω                    | 0 ... 0.0167 Ω                          | 0 ... 0.0278 Ω                          | 0 ... 0.0833 Ω                          | 0 ... 0.144 Ω                           |
| Output terminals <sup>3)</sup> rear         | BPK4-30L                        | BPK4-30L                        | FKS25/10-SM10                           | FKS25/10-SM10                           | FKS25/10-SM10                           | FKS25/10-SM10                           |
| Power consumption                           | 2,750 VA                        | 2,200 VA                        | 4,340 VA                                | 3,800 VA                                | 3,800 VA                                | 3,775 VA                                |
| Mains voltage <sup>4)</sup>                 | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz |
| Mains voltage toggleable <sup>4)</sup>      | -                               | -                               | -                                       | -                                       | -                                       | -                                       |
| Weight ca.                                  | 52 kg                           | 50 kg                           | 81 kg                                   | 76 kg                                   | 76 kg                                   | 73 kg                                   |
| Housing <sup>5)</sup>                       | 19", 8 U                        | 19", 8 U                        | 19", 11 U                               | 19", 11 U                               | 19", 11 U                               | 19", 11 U                               |

| Model (Order Number)                        | QL1V44C60                               | QL1V60C45                               | QL1V80C30                               | QL1V8C320                               | QL1V10C240                              | QL1V20C160                              |
|---------------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|
| Voltage range                               | -1 ... 44 V                             | -1 ... 60 V                             | -1 ... 80 V                             | -1 ... 8 V                              | -1 ... 10 V                             | -1 ... 20 V                             |
| Current range                               | ±60 A                                   | ±45 A                                   | ±30 A                                   | ±320 A                                  | ±240 A                                  | ±160 A                                  |
| Resistance range                            | 0.0367 ... 14.7 Ω                       | 0.0667 ... 26.7 Ω                       | 0.133 ... 53.3 Ω                        | 0.00125 ... 0.500 Ω                     | 0.00208 ... 0.833 Ω                     | 0.00625 ... 2.50 Ω                      |
| Power                                       | 2,640 W                                 | 2,700 W                                 | 2,400 W                                 | 2,560 W                                 | 2,400 W                                 | 3,200 W                                 |
| Rise/fall time CC, CV <sup>1)</sup>         | 120 μs                                  | 120 μs                                  | 120 μs                                  | 120 μs                                  | 150 μs                                  | 150 μs                                  |
| Bandwidth                                   | 3.0 kHz                                 | 3.0 kHz                                 | 3.0 kHz                                 | 3.0 kHz                                 | 2.5 kHz                                 | 2.5 kHz                                 |
| Adjustable int. resistance CC <sup>2)</sup> | 1.47 Ω ... ∞                            | 2.67 Ω ... ∞                            | 5.33 Ω ... ∞                            | 0.0500 Ω ... ∞                          | 0.0833 Ω ... ∞                          | 0.250 Ω ... ∞                           |
| Adjustable int. resistance CV               | 0 ... 0.367 Ω                           | 0 ... 0.667 Ω                           | 0 ... 1.33 Ω                            | 0 ... 0.0125 Ω                          | 0 ... 0.0208 Ω                          | 0 ... 0.0625 Ω                          |
| Output terminals <sup>3)</sup> rear         | BPK4-60L                                | BPK4-60L                                | BPK4-30L                                | FKS25/10-SM10                           | FKS25/10-SM10                           | FKS25/10-SM10                           |
| Power consumption                           | 4,000 VA                                | 4,060 VA                                | 3,200 VA                                | 5,300 VA                                | 4,500 VA                                | 5,100 VA                                |
| Mains voltage <sup>4)</sup>                 | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz |
| Mains voltage toggleable <sup>4)</sup>      | -                                       | -                                       | -                                       | -                                       | -                                       | -                                       |
| Weight ca.                                  | 73 kg                                   | 75 kg                                   | 73 kg                                   | 99 kg                                   | 100 kg                                  | 96 kg                                   |
| Housing <sup>5)</sup>                       | 19", 11 U                               | 19", 11 U                               | 19", 11 U                               | 19", 14 U                               | 19", 14 U                               | 19", 14 U                               |

| Model (Order Number)                        | QL1V26C120                              | QL1V44C80                               | QL1V60C60                               | QL1V80C40                               |
|---------------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|
| Voltage range                               | -1 ... 26 V                             | -1 ... 44 V                             | -1 ... 60 V                             | -1 ... 80 V                             |
| Current range                               | ±120 A                                  | ±80 A                                   | ±60 A                                   | ±40 A                                   |
| Resistance range                            | 0.0108 ... 4.33 Ω                       | 0.0275 ... 11.0 Ω                       | 0.0500 ... 20.0 Ω                       | 0.100 ... 40.0 Ω                        |
| Power                                       | 3,120 W                                 | 3,520 W                                 | 3,600 W                                 | 3,200 W                                 |
| Rise/fall time CC, CV <sup>1)</sup>         | 150 μs                                  | 120 μs                                  | 150 μs                                  | 150 μs                                  |
| Bandwidth                                   | 2.5 kHz                                 | 3.0 kHz                                 | 2.5 kHz                                 | 2.5 kHz                                 |
| Adjustable int. resistance CC <sup>2)</sup> | 0.433 Ω ... ∞                           | 1.10 Ω ... ∞                            | 2.00 Ω ... ∞                            | 4.00 Ω ... ∞                            |
| Adjustable int. resistance CV               | 0 ... 0.108 Ω                           | 0 ... 0.275 Ω                           | 0 ... 0.500 Ω                           | 0 ... 1.00 Ω                            |
| Output terminals <sup>3)</sup> rear         | FKS25/10-SM10                           | FKS25/10-SM10                           | BPK4-60L                                | BPK4-60L                                |
| Power consumption                           | 4,800 VA                                | 4,900 VA                                | 4,800 VA                                | 4,400 VA                                |
| Mains voltage <sup>4)</sup>                 | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz | 3/N/PE AC 400/230V<br>16 A 50 ... 60 Hz |
| Mains voltage toggleable <sup>4)</sup>      | -                                       | -                                       | -                                       | -                                       |
| Weight ca.                                  | 96 kg                                   | 91 kg                                   | 93 kg                                   | 96 kg                                   |
| Housing <sup>5)</sup>                       | 19", 14 U                               | 19", 14 U                               | 19", 14 U                               | 19", 14 U                               |

1. Rise and fall times are from 10 ... 90 % and 90 ... 10 % of the current or voltage setting range in "fast" regulation speed. Tolerance ±20 %. Measured with short-circuited output terminals (current) or with open output terminals (voltage). Other loads may increase rise times. Rise/fall time in "slow" regulation speed: approx. 300 ms.
2. Value is entered as conductance in S.
3. Description of available terminals beginning at page 131. Units with touchable terminals are supplied with safety covers.
4. Mains voltage tolerance: ±10 %.
5. 1 U = 44.45 mm. Detailed dimensions by means of 3D models at [www.hoecherl-hackl.com/downloads](http://www.hoecherl-hackl.com/downloads).



| Model (Order Number)                        | QL10V10C10                      | QL20V20C5                       | QL30V30C3.5                     | QL50V50C2                       | QL8V8C46                        | QL10V10C38                      |
|---------------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Voltage range                               | ±10 V                           | ±20 V                           | ±30 V                           | ±50 V                           | ±8 V                            | ±10 V                           |
| Current range                               | ±10 A                           | ±5 A                            | ±3,5 A                          | ±2 A                            | ±46 A                           | ±38 A                           |
| Resistance range                            | 0.0500 ... 20.0 Ω               | 0.200 ... 80.0 Ω                | 0.429 ... 171.4 Ω               | 1.250 ... 500 Ω                 | 0.00870 ... 3.48 Ω              | 0.0132 ... 5.26 Ω               |
| Power                                       | 100 W                           | 100 W                           | 105 W                           | 100 W                           | 368 W                           | 380 W                           |
| Rise/fall time CC, CV <sup>1)</sup>         | 120 μs                          | 120 μs                          | 120 μs                          | 120 μs                          | 120 μs                          | 120 μs                          |
| Bandwidth                                   | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         |
| Adjustable int. resistance CC <sup>2)</sup> | 2.00 Ω ... ∞                    | 8.00 Ω ... ∞                    | 17.1 Ω ... ∞                    | 50.0 Ω ... ∞                    | 0.348 Ω ... ∞                   | 0.526 Ω ... ∞                   |
| Adjustable int. resistance CV               | 0 ... 0.50 Ω                    | 0 ... 2.00 Ω                    | 0 ... 4.29 Ω                    | 0 ... 12.5 Ω                    | 0 ... 0.087 Ω                   | 0 ... 0.132 Ω                   |
| Output terminals <sup>3)</sup> rear         | BPK4-30L                        | BPK4-30L                        | BPK4-30L                        | BPK4-30L                        | BPK4-60L                        | BPK4-30L                        |
| Power consumption                           | 250 VA                          | 205 VA                          | 205 VA                          | 215 VA                          | 800 VA                          | 750 VA                          |
| Mains voltage <sup>4)</sup>                 | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz |
| Mains voltage toggleable <sup>4)</sup>      | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz |
| Weight ca.                                  | 13 kg                           | 13 kg                           | 13 kg                           | 13 kg                           | 23 kg                           | 23 kg                           |
| Housing <sup>5)</sup>                       | 19", 2 U                        | 19", 2 U                        | 19", 2 U                        | 19", 2 U                        | 19", 3 U                        | 19", 3 U                        |

| Model (Order Number)                        | QL20V20C24                      | QL30V30C16                      | QL44V44C11                      | QL8V8C80                        | QL10V10C60                      | QL20V20C40                      |
|---------------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Voltage range                               | ±20 V                           | ±30 V                           | ±44 V                           | ±8 V                            | ±10 V                           | ±20 V                           |
| Current range                               | ±24 A                           | ±16 A                           | ±11 A                           | ±80 A                           | ±60 A                           | ±40 A                           |
| Resistance range                            | 0.0417 ... 16.7 Ω               | 0.0938 ... 37.5 Ω               | 0.200 ... 80.0 Ω                | 0.00500 ... 2.00 Ω              | 0.00833 ... 3.33 Ω              | 0.0250 ... 10.0 Ω               |
| Power                                       | 480 W                           | 432 W                           | 484 W                           | 640 W                           | 600 W                           | 800 W                           |
| Rise/fall time CC, CV <sup>1)</sup>         | 120 μs                          | 120 μs                          | 120 μs                          | 150 μs                          | 120 μs                          | 150 μs                          |
| Bandwidth                                   | 3.0 kHz                         | 3.0 kHz                         | 3.0 kHz                         | 2.5 kHz                         | 3.0 kHz                         | 2.5 kHz                         |
| Adjustable int. resistance CC <sup>2)</sup> | 1.67 Ω ... ∞                    | 3.75 Ω ... ∞                    | 8.00 Ω ... ∞                    | 0.200 Ω ... ∞                   | 0.333 Ω ... ∞                   | 1.00 Ω ... ∞                    |
| Adjustable int. resistance CV               | 0 ... 0.417 Ω                   | 0 ... 0.938 Ω                   | 0 ... 2.00 Ω                    | 0 ... 0.0500 Ω                  | 0 ... 0.0833 Ω                  | 0 ... 0.250 Ω                   |
| Output terminals <sup>3)</sup> rear         | BPK4-30L                        | BPK4-30L                        | BPK4-30L                        | FKS25/10-SM10                   | BPK4-60L                        | BPK4-60L                        |
| Power consumption                           | 770 VA                          | 770 VA                          | 740 VA                          | 1,360 VA                        | 1,325 VA                        | 1,390 VA                        |
| Mains voltage <sup>4)</sup>                 | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz |
| Mains voltage toggleable <sup>4)</sup>      | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz |
| Weight ca.                                  | 23 kg                           | 23 kg                           | 23 kg                           | 54 kg                           | 55 kg                           | 49 kg                           |
| Housing <sup>5)</sup>                       | 19", 3 U                        | 19", 3 U                        | 19", 3 U                        | 19", 8 U                        | 19", 8 U                        | 19", 8 U                        |

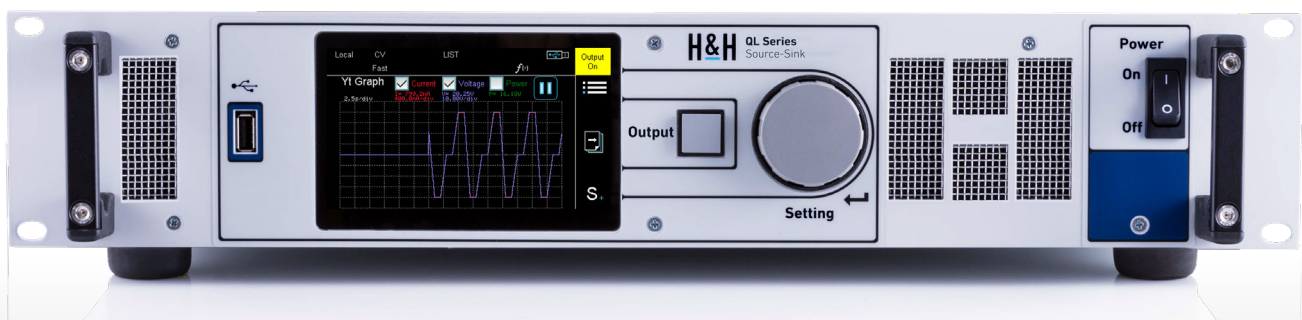
| Model (Order Number)                        | QL30V30C32                      | QL44V44C20                      | QL8V8C120                       | QL10V10C90                      | QL20V20C60                      | QL30V30C48                      |
|---------------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Voltage range                               | ±30 V                           | ±44 V                           | ±8 V                            | ±10 V                           | ±20 V                           | ±30 V                           |
| Current range                               | ±32 A                           | ±20 A                           | ±120 A                          | ±90 A                           | ±60 A                           | ±48 A                           |
| Resistance range                            | 0.0469 ... 18.8 Ω               | 0.110 ... 44.0 Ω                | 0.00333 ... 1.33 Ω              | 0.00556 ... 2.22 Ω              | 0.0167 ... 6.67 Ω               | 0.0313 ... 12.5 Ω               |
| Power                                       | 960 W                           | 880 W                           | 960 W                           | 900 W                           | 1,200 W                         | 1,440 W                         |
| Rise/fall time CC, CV <sup>1)</sup>         | 120 μs                          | 120 μs                          | 150 μs                          | 150 μs                          | 120 μs                          | 120 μs                          |
| Bandwidth                                   | 3.0 kHz                         | 3.0 kHz                         | 2.5 kHz                         | 2.5 kHz                         | 3.0 kHz                         | 3.0 kHz                         |
| Adjustable int. resistance CC <sup>2)</sup> | 1.188 Ω ... ∞                   | 4.40 Ω ... ∞                    | 0.133 Ω ... ∞                   | 0.222 Ω ... ∞                   | 0.667 Ω ... ∞                   | 1.25 Ω ... ∞                    |
| Adjustable int. resistance CV               | 0 ... 0.469 Ω                   | 0 ... 1.10 Ω                    | 0 ... 0.0333 Ω                  | 0 ... 0.0556 Ω                  | 0 ... 0.167 Ω                   | 0 ... 0.313 Ω                   |
| Output terminals <sup>3)</sup> rear         | BPK4-60L                        | BPK4-30L                        | FKS25/10-SM10                   | FKS25/10-SM10                   | FKS25/10-SM10                   | BPK4-60L                        |
| Power consumption                           | 1,560 VA                        | 1,400 VA                        | 2,200 VA                        | 2,088 VA                        | 2,200 VA                        | 2,340 VA                        |
| Mains voltage <sup>4)</sup>                 | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz |
| Mains voltage toggleable <sup>4)</sup>      | 1/N/PE AC 115 V<br>50 ... 60 Hz | 1/N/PE AC 115 V<br>50 ... 60 Hz | -                               | -                               | -                               | -                               |
| Weight ca.                                  | 49 kg                           | 55 kg                           | 80 kg                           | 80 kg                           | 80 kg                           | 80 kg                           |
| Housing <sup>5)</sup>                       | 19", 8 U                        | 19", 8 U                        | 19", 11 U                       | 19", 11 U                       | 19", 11 U                       | 19", 11 U                       |

1. Rise and fall times are from 10 ... 90 % and 90 ... 10 % of the current or voltage setting range in "fast" regulation speed. Tolerance ±20 %. Measured with short-circuited output terminals (current) or with open output terminals (voltage). Other loads may increase rise times. Rise/fall time in "slow" regulation speed: approx. 300 ms.
2. Value is entered as conductance in S.
3. Description of available terminals beginning at page 131. Units with touchable terminals are supplied with safety covers.
4. Mains voltage tolerance: ±10 %.
5. 1 U = 44.45 mm. Detailed dimensions by means of 3D models at [www.hoecherl-hackl.com/downloads](http://www.hoecherl-hackl.com/downloads).

| Model (Order Number)                        | QL44V44C30                      | QL8V8C160                       | QL10V10C120                     | QL20V20C80                      | QL30V30C64                      | QL44V44C40                      |
|---------------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Voltage range                               | ±44 V                           | ±8 V                            | ±10 V                           | ±20 V                           | ±30 V                           | ±44 V                           |
| Current range                               | ±30 A                           | ±160 A                          | ±120 A                          | ±80 A                           | ±64 A                           | ±40 A                           |
| Resistance range                            | 0.0733 ... 29.3 Ω               | 0.00250 ... 1.00 Ω              | 0.00417 ... 1.67 Ω              | 0.0125 ... 5.00 Ω               | 0.0234 ... 9.38 Ω               | 0.0550 ... 22.0 Ω               |
| Power                                       | 1,320 W                         | 1,280 W                         | 1,200 W                         | 1,600 W                         | 1,920 W                         | 1,760 W                         |
| Rise/fall time CC, CV <sup>1)</sup>         | 120 μs                          | 120 μs                          | 150 μs                          | 150 μs                          | 120 μs                          | 120 μs                          |
| Bandwidth                                   | 3.0 kHz                         | 3.0 kHz                         | 2.5 kHz                         | 2.5 kHz                         | 3.0 kHz                         | 3.0 kHz                         |
| Adjustable int. resistance CC <sup>2)</sup> | 2.93 Ω ... ∞                    | 0.100 Ω ... ∞                   | 0.167 Ω ... ∞                   | 0.500 Ω ... ∞                   | 0.938 Ω ... ∞                   | 2.20 Ω ... ∞                    |
| Adjustable int. resistance CV               | 0 ... 0.733 Ω                   | 0 ... 0.0250 Ω                  | 0 ... 0.0417 Ω                  | 0 ... 0.125 Ω                   | 0 ... 0.234 Ω                   | 0 ... 0.550 Ω                   |
| Output terminals <sup>3)</sup> rear         | BPK4-30L                        | FKS25/10-SM10                   | FKS25/10-SM10                   | FKS25/10-SM10                   | FKS25/10-SM10                   | BPK4-60L                        |
| Power consumption                           | 2,200 VA                        | 2,700 VA                        | 2,550 VA                        | 2,700 VA                        | 3,020 VA                        | 2,700 VA                        |
| Mains voltage <sup>4)</sup>                 | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz | 1/N/PE AC 230 V<br>50 ... 60 Hz |
| Mains voltage toggleable <sup>4)</sup>      | -                               | -                               | -                               | -                               | -                               | -                               |
| Weight ca.                                  | 80 kg                           | 92 kg                           | 92 kg                           | 92 kg                           | 92 kg                           | 92 kg                           |
| Housing <sup>5)</sup>                       | 19", 11 U                       | 19", 14 U                       | 19", 14 U                       | 19", 14 U                       | 19", 14 U                       | 19", 14 U                       |

## Options and Accessories

| Order Number  | Article                  | Description                                                                   |
|---------------|--------------------------|-------------------------------------------------------------------------------|
| 67-004-030-27 | K-RS-SNM 9-9             | RS-232 cable (null-modem cable)                                               |
| 52-200-001-27 | QL02                     | GPIO interface                                                                |
| 53-100-002-27 | QL06-N                   | Galvanically isolated I/O port instead of standard I/O port with new device   |
| 53-100-001-27 | QL06                     | Galvanically isolated I/O port for retrofitting at existing device            |
| 64-400-000-27 | QL14                     | Heavy-weight castors for devices from 5 U                                     |
| 67-008-020-27 | K-MS-QL+K-MS-CAN         | Cable set master-slave, consisting of K-MS-QL and K-MS-CAN (2 m each)         |
| 67-036-020-27 | K-MS-QL                  | Master-slave cable I/O port (2 m)                                             |
| 67-037-020-27 | K-MS-CAN                 | Master-slave cable CAN (2 m)                                                  |
| 63-000-008-27 | SubD25-Doppler           | Adapter 1x Sub-D25 male connector to 2x Sub-D25 female connector for I/O port |
| 65-002-000-27 | FCC-QLxx                 | Factory Calibration Certificate                                               |
| 64-403-000-27 | SAB-QL-5                 | Additional safety cover for output terminals for devices from 5 U             |
| 63-000-001-00 | SENSADAPT/4BAN/PH2/60V   | Sense adapter from 4 mm banana plug to Phoenix PH2, max. 60 V                 |
| 63-000-002-00 | SENSADAPT/4BAN/PH2/1200V | Sense adapter from 4 mm banana plug to Phoenix PH2, max. 1200 V               |
|               |                          | Load cables see starting at page 135.                                         |



| Operating modes, functions                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |
|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Basic operating modes                                                           | CC, CP, CR, CV                                                                                                                                                                                                                                                                                                                                                                                                                                   |                         |
| Extended operating modes                                                        | CC+CV, CV+CC                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |
| Functions                                                                       | DC source-sink<br>energy storage device test<br>internal resistance measurement<br>list function<br>adjustable internal resistance<br>rectangular function (also in PWM mode)<br>modulation (sine, triangle, square, arbitrary)<br>data acquisition (internally or to USB flash drive)<br>save and recall of device settings<br>watchdog in remote operation<br>master-slave mode for power extension<br>AC source (only with 4-quadrant models) |                         |
| AC source (only 4Q models)                                                      | in CC, CV mode (sine, triangular, square, sawtooth, arbitrary)<br>range values are peak values for V and I<br>adjustable offset                                                                                                                                                                                                                                                                                                                  |                         |
| Frequency range <sup>1)</sup>                                                   | 0.1 Hz ... 10 kHz, also mains synchronizable                                                                                                                                                                                                                                                                                                                                                                                                     |                         |
| User interface                                                                  | 4,3" TFT touch display                                                                                                                                                                                                                                                                                                                                                                                                                           |                         |
| Accuracy of setting DC                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |
|                                                                                 | of setting                                                                                                                                                                                                                                                                                                                                                                                                                                       | of corresponding range  |
| Voltage                                                                         | ±0.1 %                                                                                                                                                                                                                                                                                                                                                                                                                                           | ±0.05 %                 |
| Current                                                                         | ±0.2 %                                                                                                                                                                                                                                                                                                                                                                                                                                           | ±0.05 %                 |
| Resistance<br>(at 5 % to 100 % of voltage range)                                | ±1.4 %                                                                                                                                                                                                                                                                                                                                                                                                                                           | ±0.3 % of current range |
| Power<br>(at V and I > 30 % of range)<br>(at V and I > 5 % and < 30 % of range) | ±0.35 %<br>±0.7 %                                                                                                                                                                                                                                                                                                                                                                                                                                | ±0.1 %<br>±0.25 %       |
| Resolution                                                                      | 15 bits                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |
| Ripple voltage                                                                  | max. 0.1 % p-p of range                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |
| Ripple current                                                                  | max. 0.1 % p-p of range                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |
| Accuracy of setting AC (only 4-quadrant models)                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |
|                                                                                 | of setting                                                                                                                                                                                                                                                                                                                                                                                                                                       | of corresponding range  |
| Voltage (RMS) <sup>1) 2)</sup>                                                  | ±0.5 %                                                                                                                                                                                                                                                                                                                                                                                                                                           | ±0.1 %                  |
| Current (RMS) <sup>1) 2)</sup>                                                  | ±0.5 %                                                                                                                                                                                                                                                                                                                                                                                                                                           | ±0.1 %                  |
| Accuracy of adjustable protections                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |
|                                                                                 | of setting                                                                                                                                                                                                                                                                                                                                                                                                                                       | of corresponding range  |
| Current protection                                                              | ±0.2 %                                                                                                                                                                                                                                                                                                                                                                                                                                           | ±0.05 %                 |
| Voltage protection                                                              | ±0.1 %                                                                                                                                                                                                                                                                                                                                                                                                                                           | ±0.05 %                 |
| Resolution                                                                      | 13 bits                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |
| Accuracy of measurement DC                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |
|                                                                                 | of measured value (real value)                                                                                                                                                                                                                                                                                                                                                                                                                   | of corresponding range  |
| Voltage                                                                         | ±0.1 %                                                                                                                                                                                                                                                                                                                                                                                                                                           | ±0.05 %                 |
| Current                                                                         | ±0.2 %                                                                                                                                                                                                                                                                                                                                                                                                                                           | ±0.05 %                 |
| Resistance                                                                      | is calculated from current and voltage                                                                                                                                                                                                                                                                                                                                                                                                           |                         |
| Power                                                                           | is calculated from current and voltage                                                                                                                                                                                                                                                                                                                                                                                                           |                         |
| Resolution                                                                      | 15 bits                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |
| Sampling time                                                                   | 200 µs, triggerable                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |
| Accuracy of measurement AC                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |
|                                                                                 | of measured value (real value)                                                                                                                                                                                                                                                                                                                                                                                                                   | of corresponding range  |
| Voltage (RMS)                                                                   | ±0.5 %                                                                                                                                                                                                                                                                                                                                                                                                                                           | ±0.1 %                  |
| Current (RMS)                                                                   | ±0.5 %                                                                                                                                                                                                                                                                                                                                                                                                                                           | ±0.1 %                  |
| Time constant of RMS measurement                                                | ca. 500 ms                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |
| Accuracy of display                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |
| Number of decimal places                                                        | 4 + prefix conversion                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |
| Accuracy                                                                        | accuracy of measurement DC/AC ±1 digit of display value                                                                                                                                                                                                                                                                                                                                                                                          |                         |

| Accuracy of trigger voltage and current                                     |                                                                                                   |                        |
|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------------|
| Trigger voltage                                                             | ±1 % of voltage range                                                                             |                        |
| Trigger current                                                             | ±1 % of current range                                                                             |                        |
| Sampling time                                                               | 200 µs                                                                                            |                        |
| Dynamic function LIST                                                       |                                                                                                   |                        |
| Operating modes                                                             | CC, CV, CR, CP                                                                                    |                        |
| No. of load levels                                                          | max. 300, with corresponding ramp and dwell times                                                 |                        |
| Dwell time <sup>1)</sup>                                                    | 200 µs ... 1,000 s                                                                                |                        |
| Ramp time <sup>1)</sup>                                                     | 0 ... 1,000 s                                                                                     |                        |
| Resolution                                                                  | 200 µs                                                                                            |                        |
| Accuracy of setting times                                                   | ±0.02 %                                                                                           |                        |
| Delay at triggered start                                                    | max. 300 µs                                                                                       |                        |
| Dynamic function rectangular                                                |                                                                                                   |                        |
| Operating modes                                                             | CC, CV                                                                                            |                        |
| No. of levels                                                               | 2                                                                                                 |                        |
| Pulse times <sup>1)</sup> , resolution                                      | 1 µs ... 9,999.999 ms, resolution 1 µs                                                            |                        |
| Accuracy of setting times                                                   | ±0.02 %                                                                                           |                        |
| Dynamic function PWM                                                        |                                                                                                   |                        |
| Operating modes                                                             | CC, CV                                                                                            |                        |
| No. of levels                                                               | 2                                                                                                 |                        |
| Frequency <sup>1)</sup> , resolution                                        | 0.1 Hz ... 10 kHz, resolution 0.1 Hz                                                              |                        |
| Accuracy of frequency                                                       | ±0.02 %                                                                                           |                        |
| Duty cycle, resolution                                                      | 1 ... 99 %, resolution 1 %                                                                        |                        |
| Dynamic function modulation                                                 |                                                                                                   |                        |
| Operating modes                                                             | CC, CV                                                                                            |                        |
| Waveforms                                                                   | Sine, square, triangular, arbitrary (1,024 points)                                                |                        |
| Frequency <sup>1)</sup> , resol.                                            | 0.1 Hz ... 10 kHz, resolution 0.1 Hz                                                              |                        |
| Accuracy of frequency                                                       | ±0.01 %                                                                                           |                        |
| Modulation depth                                                            | 0 ... 100 %                                                                                       |                        |
| Data acquisition                                                            |                                                                                                   |                        |
| to external USB flash drive                                                 |                                                                                                   |                        |
| Sampling time                                                               | 0.5 ... 30.0 s, resolution 0.1 s                                                                  |                        |
| Measurement data                                                            | timestamp, voltage, current                                                                       |                        |
| No. of measurement points                                                   | limited by flash drive memory capacity                                                            |                        |
| File format                                                                 | .csv                                                                                              |                        |
| to internal memory                                                          |                                                                                                   |                        |
| Sampling time                                                               | 200 µs ... 1,000 s, resolution 200 µs, synchronized with dynamic function                         |                        |
| Measurement data                                                            | timestamp, voltage, current                                                                       |                        |
| No. of measurement points                                                   | max. 40,000                                                                                       |                        |
| Settings memory                                                             |                                                                                                   |                        |
| No. of memory positions                                                     | 9, selectable (incl. programmed list)<br>1 for last device settings at power-off or power failure |                        |
| I/O port: accuracy of analog control -5 ... 0 ... 5 V or -10 ... 0 ... 10 V |                                                                                                   |                        |
|                                                                             | of setting                                                                                        | of corresponding range |
| Voltage                                                                     | ±0.2 %                                                                                            | ±0.1 %                 |
| Current                                                                     | ±0.2 %                                                                                            | ±0.1 %                 |
| Overcurrent <sup>3)</sup> protection                                        | ±1 %                                                                                              | ±0.4 %                 |
| Undervoltage <sup>3)</sup> protection                                       | ±1 %                                                                                              | ±0.4 %                 |
|                                                                             | input resistance of analog inputs >10 kΩ                                                          |                        |

The specified accuracies refer to an ambient temperature of 23 ±5 °C. The specified accuracies are valid when the sense lines are connected. At voltages with higher disturbance values the accuracy can change for the worse.

1. The applicable time or frequency range is limited by the bandwidth of the respective device.

2. at 50 ... 60 Hz

3. only -10 V ... 0 ... +10 V

4. positive/negative DC voltage or RMS value of a sinusoidal AC voltage

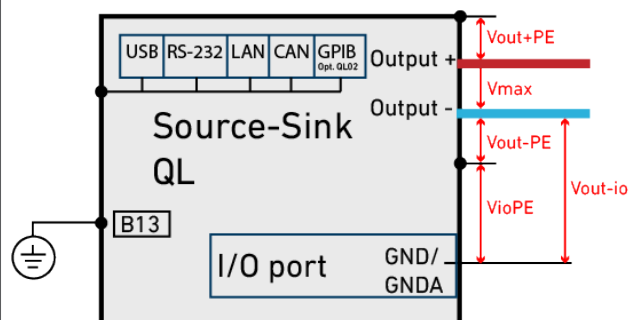
## Technical Data

### I/O port: accuracy of analog monitor outputs -10 ... 0 ... 10 V

|         | of analog signal of actual value | offset voltage |
|---------|----------------------------------|----------------|
| Voltage | ±0.2 %                           | ±15 mV         |
| Current | ±0.2 %                           | ±15 mV         |
|         | permissible load > 2 kΩ          |                |

### I/O port: permissible voltages

|                             | standard I/O port        | isolated I/O port (option QL06) |
|-----------------------------|--------------------------|---------------------------------|
| Vout-io (GND - neg. output) | max. 2 V <sup>4)</sup>   | max. 125 V <sup>4)</sup>        |
| VioPE (GND - PE)            | max. 125 V <sup>4)</sup> | max. 125 V <sup>4)</sup>        |



### I/O port: outputs and inputs

|              |                                                                                                                                                                                                                                                                                                                                               |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Outputs      | analog voltage monitor output -10 ... 0 ... 10 V<br>analog current monitor output -10 ... 0 ... 10 V<br>output activation state<br>status output for upper protection value V or I<br>status output for lower protection value V or I<br>trigger output                                                                                       |
| Output level | 5 V/24 V selectable, max. 10 mA                                                                                                                                                                                                                                                                                                               |
| Inputs       | analog setting I and V with -5 ... 0 ... 5 V or -10 ... 0 ... 10 V<br>analog protection setting I or V with -10 ... 0 ... 10 V<br>output activation state<br>operating mode CC/CV<br>control speed selection slow/fast<br>remote shut-down<br>readable digital input (by SCPI command)<br>trigger input<br>control input (activates I/O port) |
| Input level  | 2.5 ... 24 V logically high                                                                                                                                                                                                                                                                                                                   |

### Output

|                          |                                                 |
|--------------------------|-------------------------------------------------|
| Output resistance        | >50 kΩ when output is off                       |
| Parallel operation       | up to 5 equal devices in master-slave operation |
| Max. output voltage Vmax | see model overview                              |
| Min. output voltage Vmin | see model overview                              |

### Output: permissible voltages

|                            | standard I/O port               | isolated I/O port (option QL06) |
|----------------------------|---------------------------------|---------------------------------|
| Vout-PE (neg. output - PE) | max. 125 V <sup>4)</sup>        | max. 125 V <sup>4)</sup>        |
| Vout+PE (pos. output - PE) | Vmax + max. 125 V <sup>4)</sup> | Vmax + max. 125 V <sup>4)</sup> |

### Power

|                  |                                    |
|------------------|------------------------------------|
| Continuous power | see model overview (at Ta = 21 °C) |
| Derating         | -1.2 %/°C for Ta > 21 °C           |

### Protection and monitoring

|                    |                                |
|--------------------|--------------------------------|
| Protective devices | overcurrent<br>overtemperature |
| Monitoring         | overvoltage indication         |

### Terminals

|        |                                         |
|--------|-----------------------------------------|
| Output | see model overview                      |
| Sense  | PH2/7.62-BU16, see starting at page 131 |

### Operating conditions

|                                                   |                                                   |
|---------------------------------------------------|---------------------------------------------------|
| Operating temperature                             | 5 ... 40 °C                                       |
| Stock temperature                                 | -25 ... 65 °C                                     |
| Max. operating height                             | 2,000 m above sea level                           |
| Pollution degree                                  | 2                                                 |
| Overvoltage category of mains                     | II                                                |
| Max. humidity                                     | 80 % at 31 °C, linear decreasing to 50 % at 40 °C |
| Min. distance rear panel to wall or other objects | 70 cm                                             |
| Cooling                                           | temperature-controlled air cooling                |
| Noise, weight                                     | see model overview                                |
| Mains voltage                                     | see model overview                                |
| Power consumption                                 | see model overview                                |

### Housing

|                        |                      |
|------------------------|----------------------|
| Size                   | see model overview   |
| Color front            | RAL7035 (light grey) |
| Color rear             | stainless steel      |
| Color top, side panels | RAL7037 (dusty grey) |

### Safety and EMC

|                    |                                                                        |
|--------------------|------------------------------------------------------------------------|
| Protection class   | 1                                                                      |
| Protection         | IP20                                                                   |
| Measuring category | 0 (CAT I according to EN 61010:2004)                                   |
| Electrical safety  | DIN EN 61010-1<br>DIN EN 61010-2-030                                   |
| EMC                | DIN EN 61326-1<br>DIN EN 55011<br>DIN EN 61000-3-2<br>DIN EN 61000-3-3 |

### Standard interfaces

|                 |                         |
|-----------------|-------------------------|
| Data interfaces | RS-232, USB, LAN, CAN   |
| I/O port        | standard (not isolated) |

### Available options

|                               |                                                                            |
|-------------------------------|----------------------------------------------------------------------------|
| Data interface QL02           | GPIB                                                                       |
| Hardware extensions QL06 QL14 | galvanically isolated I/O port<br>heavy-weight castors for models from 5 U |

### Calibration, warranty

|                                  |                                                                    |
|----------------------------------|--------------------------------------------------------------------|
| FCC-QLxx                         | Factory Calibration Certificate, twice for free after registration |
| Recommended calibration interval | 2 years                                                            |
| Warranty                         | 2 years                                                            |

Subject to change without notice.

The specified accuracies refer to an ambient temperature of 23 ±5 °C. The specified accuracies are valid when the sense lines are connected. At voltages with higher disturbance values the accuracy can change for the worse.

1. The applicable time or frequency range is limited by the bandwidth of the respective device.
2. at 50 ... 60 Hz
3. only -10 V ... 0 ... +10 V
4. positive/negative DC voltage or RMS value of a sinusoidal AC voltage