

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

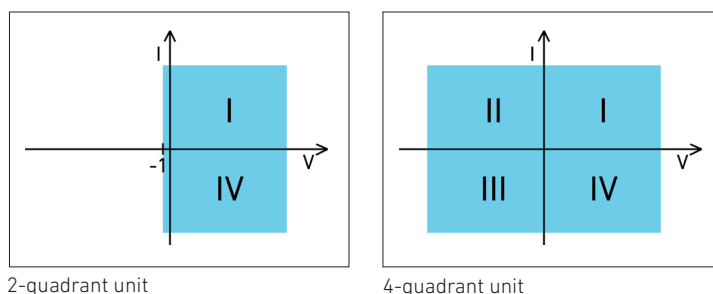
In addition to constant voltage (CV) and constant current (CC) operation, the QL source-sinks also operate in constant resistance (CR) and constant power (CP) mode. In CV operation, two current limits (source and sink current) are independently adjustable. In CC operation, an upper and a lower limit 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)

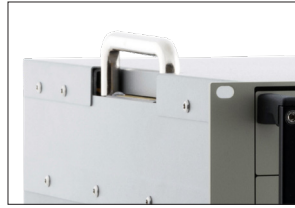
2 x for free

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

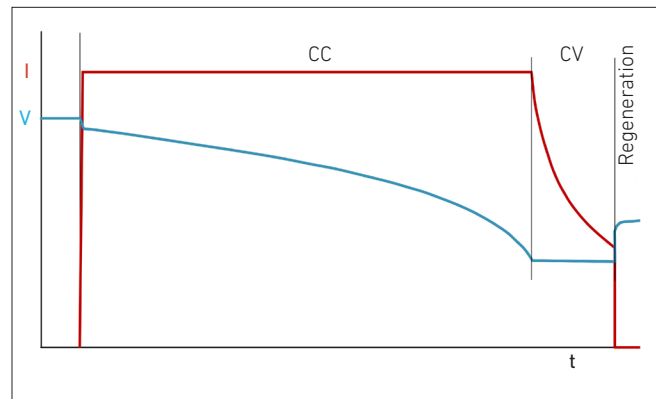
The QL series is designed in robust 19" technology and can be used as a desktop device or installed in a rack. No additional installation kits are required for 19" installation. From 5 height units, there are retractable heavy-weight handles on the top of the device.

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.

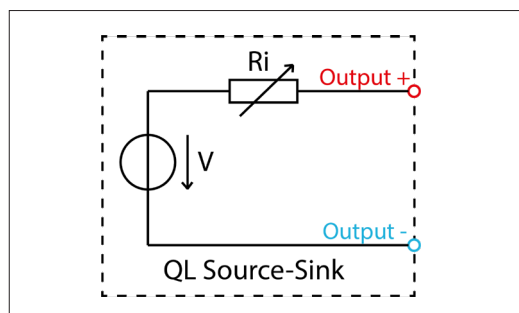
Stop criteria are charge, energy, time, current, voltage.

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.

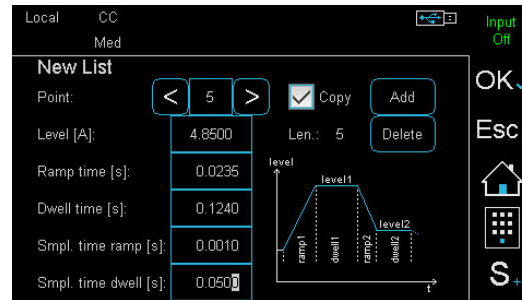
Adjustable Internal Resistance



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.

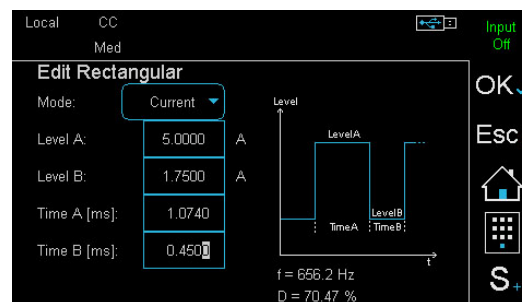
List Function



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

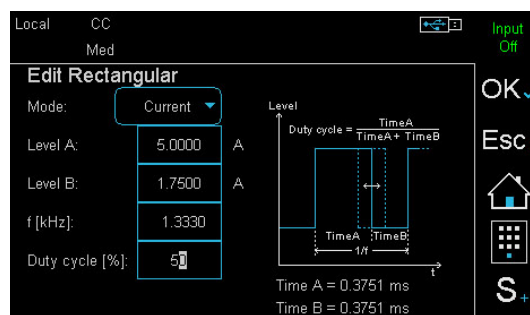
In all operating modes CC, CV, CR, or CP profiles can be simulated with the List function. Up to 300 settings of variable duration with associated ramp time are possible. The setting lists may contain positive and negative values cross-quadrant, so that there are e.g. charging and discharging currents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

Rectangular Function



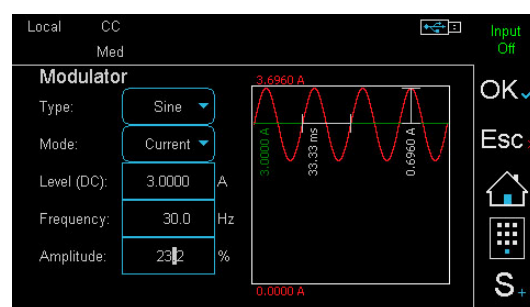
The rectangle function provides a convenient way to generate a rectangular waveform by entering absolute time and current/voltage values.

PWM Function



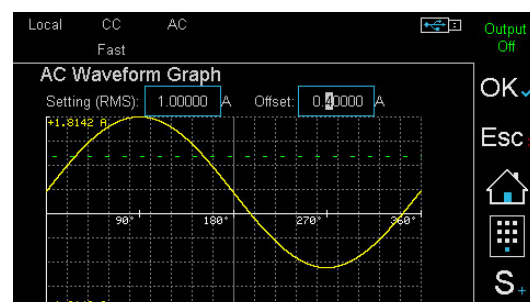
In manual operation of the PWM function, the frequency and the duty cycle can be set for the two current/voltage values.

Modulator



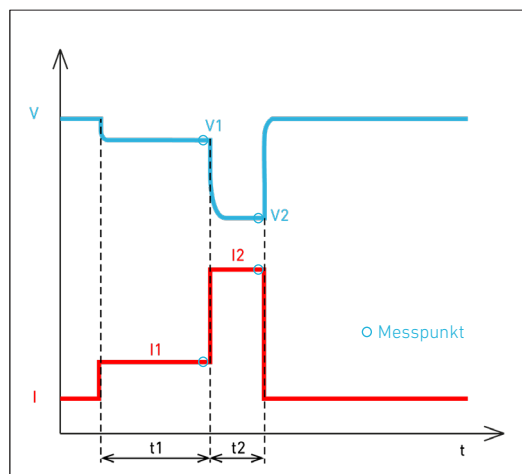
In CC or CV mode, the modulator adds a sinusoidal, square-wave, triangular or arbitrary signal to a constant setpoint. Frequency and modulation depth are adjustable.

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.

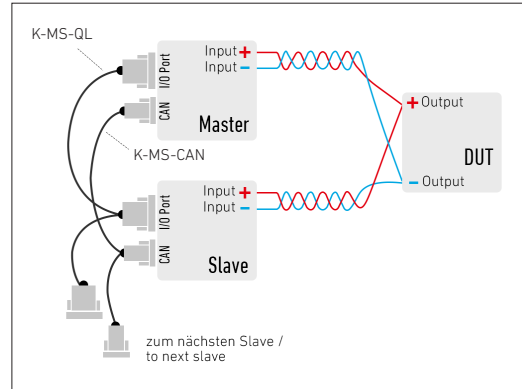
The control speed can be selected from slow - fast (see rise/fall times in model overview).

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.

Master-Slave Operation



Master-slave operation in system connection

To increase the power or current, up to 5 equal devices¹⁾ may be connected in parallel in master-slave operation²⁾.

The system operates externally as if it were one single device. The master unit controls the total current of the system, displays the total measured values and supplies these when queried via one of the data interfaces.

Wiring:

One set each of K-MS-QL and K-MS-CAN master-slave cables on all slave units (available from H&H or can be assembled by the user).

To be able to access monitor signals etc. when using the master-slave cable K-MS-QL, we offer a SubD25 doubler as an accessory.

Save Settings

In order to quickly reconstruct frequently recurring test tasks, the settings active in the source-sink can be stored non-volatile (internal or to USB flash drive) so that they can be reloaded later on. 9 internal memory positions are available.

When powered on, the source-sink can optionally set the reset state, the last active settings at power-off or memory positions 1 to 9.

Hardware Extensions

Option QL14³⁾ Heavy-weight castors



Castors

Steerable castors (option QL14) can be screwed onto big devices for easier transport. This can often save a 19" rack. This option is available for devices from 5 U and is only suitable for hard floors.

Option QL06³⁾ Galvanically isolated I/O interface



In case of potential differences between the negative output and the signals at the I/O port, the standard I/O port can be exchanged for an isolated version. All control and measurement signals are routed via isolation amplifiers and optocouplers. The board is pin compatible to the standard I/O board.

1. Equal models and equal firmware versions
2. In master-slave mode reduced function scope, controlling via CAN interface not possible
3. Retrofittable at any time

QL Series

Model Overview 2-Quadrant Models

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 ¹⁾	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 ²⁾	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 ³⁾ 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 ⁴⁾	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz
Mains voltage toggleable ⁴⁾	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz
Noise max. ca. ⁵⁾	65 dB(A)	65 dB(A)	65 dB(A)	62 dB(A)	62 dB(A)	65 dB(A)
Weight ca.	13 kg	13 kg	13 kg	13 kg	13 kg	13 kg
Housing ⁶⁾	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 ¹⁾	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 ²⁾	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 ³⁾ 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 ⁴⁾	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz
Mains voltage toggleable ⁴⁾	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz
Noise max. ca. ⁵⁾	71 dB(A)	68 dB(A)	68 dB(A)	67 dB(A)	67 dB(A)	67 dB(A)
Weight ca.	39 kg	33 kg	33 kg	23 kg	23 kg	23 kg
Housing ⁶⁾	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 ¹⁾	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 ²⁾	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 ³⁾ 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 ⁴⁾	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz
Mains voltage toggleable ⁴⁾	1/N/PE AC 115 V 50 ... 60 Hz	-	-	-	-	-
Noise max. ca. ⁵⁾	67 dB(A)	77 dB(A)	76 dB(A)	75 dB(A)	75 dB(A)	75 dB(A)
Weight ca.	23 kg	57 kg	59 kg	56 kg	51 kg	52 kg
Housing ⁶⁾	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. Measured at the front in distance of 1 m.
6. 1 U = 44,45 mm. Detailed dimensions by means of 3D models at 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 ¹⁾	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 ²⁾	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 ³⁾ 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 ⁴⁾	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A
Mains voltage toggleable ⁴⁾	-	-	-	-	-	-
Noise max. ca. ⁵⁾	75 dB(A)	75 dB(A)	76 dB(A)	76 dB(A)	76 dB(A)	76 dB(A)
Weight ca.	52 kg	50 kg	81 kg	76 kg	76 kg	73 kg
Housing ⁶⁾	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 ¹⁾	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 ²⁾	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 ³⁾ 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 ⁴⁾	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A
Mains voltage toggleable ⁴⁾	-	-	-	-	-	-
Noise max. ca. ⁵⁾	76 dB(A)	76 dB(A)	76 dB(A)	76 dB(A)	76 dB(A)	76 dB(A)
Weight ca.	73 kg	75 kg	73 kg	99 kg	100 kg	96 kg
Housing ⁶⁾	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 ¹⁾	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 ²⁾	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 ³⁾ 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 ⁴⁾	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A	3/N/PE AC 400/230V 50 ... 60 Hz, 16 A
Mains voltage toggleable ⁴⁾	-	-	-	-
Noise max. ca. ⁵⁾	76 dB(A)	76 dB(A)	76 dB(A)	76 dB(A)
Weight ca.	96 kg	91 kg	93 kg	96 kg
Housing ⁵⁾	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. Measured at the front in distance of 1 m.
6. 1 U = 44.45 mm. Detailed dimensions by means of 3D models at www.hoecherl-hackl.com/downloads.

QL Series

Model Overview 4-Quadrant Models

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 ¹⁾	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 ²⁾	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 ³⁾ 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 ⁴⁾	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz
Mains voltage toggleable ⁴⁾	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz
Noise max. ca. ⁵⁾	65 dB(A)	62 dB(A)	65 dB(A)	65 dB(A)	67 dB(A)	67 dB(A)
Weight ca.	13 kg	13 kg	13 kg	13 kg	23 kg	23 kg
Housing ⁶⁾	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 ¹⁾	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 ²⁾	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 ³⁾ 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 ⁴⁾	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz
Mains voltage toggleable ⁴⁾	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz
Noise max. ca. ⁵⁾	67 dB(A)	67 dB(A)	73 dB(A)	77 dB(A)	77 dB(A)	76 dB(A)
Weight ca.	23 kg	23 kg	23 kg	54 kg	55 kg	49 kg
Housing ⁵⁾	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 ¹⁾	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 ²⁾	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 ³⁾ 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 ⁴⁾	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz
Mains voltage toggleable ⁴⁾	1/N/PE AC 115 V 50 ... 60 Hz	1/N/PE AC 115 V 50 ... 60 Hz	-	-	-	-
Noise max. ca. ⁵⁾	67 dB(A)	67 dB(A)	73 dB(A)	77 dB(A)	77 dB(A)	76 dB(A)
Weight ca.	49 kg	55 kg	80 kg	80 kg	80 kg	80 kg
Housing ⁶⁾	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. Measured at the front in distance of 1 m.
6. 1 U = 44,45 mm. Detailed dimensions by means of 3D models at www.hoecherl-hackl.com/downloads.

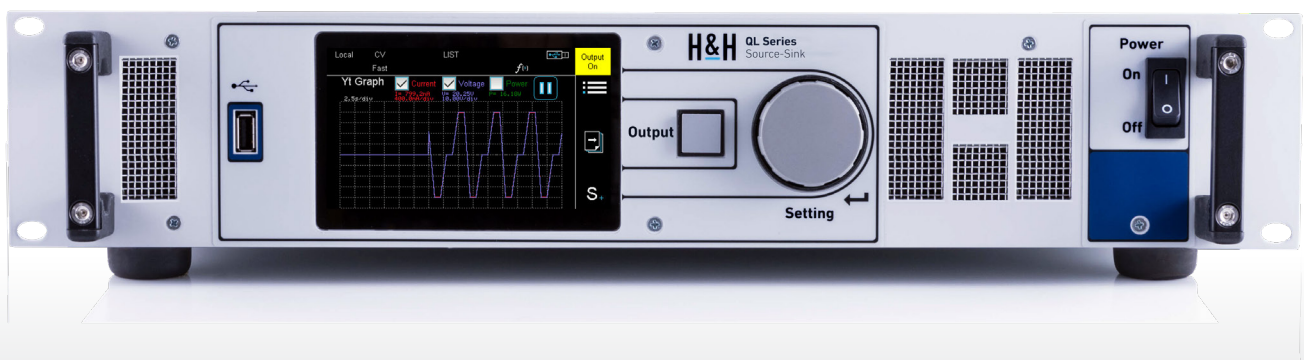
QL Series

Model Overview 4-Quadrant Models

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 ¹⁾	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 ²⁾	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 ³⁾ 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 ⁴⁾	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz	1/N/PE AC 230 V 50 ... 60 Hz
Mains voltage toggleable ⁴⁾	-	-	-	-	-	-
Noise max. ca. ⁵⁾	76 dB(A)	76 dB(A)	76 dB(A)	76 dB(A)	76 dB(A)	76 dB(A)
Weight ca.	80 kg	92 kg	92 kg	92 kg	92 kg	92 kg
Housing ⁶⁾	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
63-000-003-00	SENSADAPT/PH2/POK/60V	Sense-Adapter from Phoenix PH2 to 4 mm binding post, max. 60 V
63-000-004-00	SENSADAPT/PH2/POK/1200V	Sense-Adapter from Phoenix PH2 to 4 mm touch-protected binding post, 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 energy storage device test internal resistance measurement list function adjustable internal resistance rectangular function (also in PWM mode) modulation (sine, triangle, square, arbitrary) data acquisition (internally or to USB flash drive) save and recall of device settings watchdog in remote operation master-slave mode for power extension AC source (only with 4-quadrant models)	
AC source (only 4Q models)	in CC, CV mode (sine, triangular, square, sawtooth, arbitrary) range values are peak values for V and I adjustable offset	
Frequency range ¹⁾	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 (at 5 % to 100 % of voltage range)	±1.4 %	±0.3 % of current range
Power (at V and I > 30 % of range) (at V and I > 5 % and < 30 % of range)	±0.35 % ±0.7 %	±0.1 % ±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) ^{1) 2)}	±0.5 %	±0.1 %
Current (RMS) ^{1) 2)}	±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 ¹⁾	200 µs ... 1,000 s
Ramp time ¹⁾	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 ¹⁾ , 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 ¹⁾ , 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 ¹⁾ , 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) 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 ³⁾ protection	±1 %	±0.4 %
Undervoltage ³⁾ 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

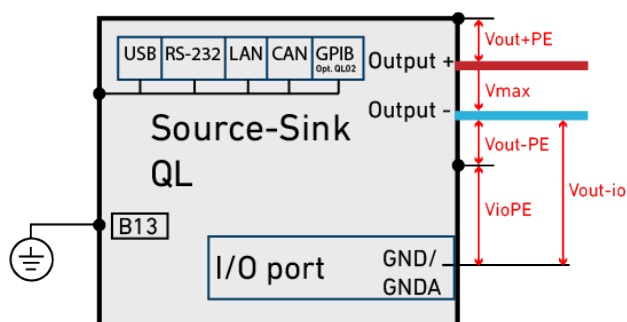
4. positive/negative DC voltage or RMS value of a sinusoidal AC voltage

Technical Data

I/O port: accuracy of analog monitor outputs -10 ... 0 ... 10 V		
	of analog signal of actual value	offset voltage
Voltage	$\pm 0.2 \%$	$\pm 15 \text{ mV}$
Current	$\pm 0.2 \%$	$\pm 15 \text{ mV}$
	permissible load > 2 k Ω	

I/O port: permissible voltages

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



I/O port: outputs and inputs

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

Output

Output resistance	>50 k Ω 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 ⁴⁾	max. 125 V ⁴⁾
Vout+PE (pos. output - PE)	Vmax + max. 125 V ⁴⁾	Vmax + max. 125 V ⁴⁾

Power

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

Protection and monitoring

Protective devices	overcurrent 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)
rear	stainless steel
top, side panels	RAL7037 (dusty grey)

Safety and EMC

Protection class	1
Measuring category	O (CAT I according to EN 61010:2004)
Electrical safety	DIN EN 61010-1 DIN EN 61010-2-030
EMC	DIN EN 61326-1 DIN EN 55011 DIN EN 61000-3-2 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 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

Technical data of production series A, rev. 1. Subject to technical changes without notice.

The specified accuracies refer to an ambient temperature of 23 $\pm$ 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

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