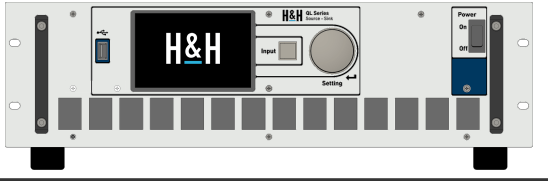


# Datasheet Series QL

|  |                              |  |
|--|------------------------------|--|
| <b>Model</b>                                       | <b>QL1V44C22</b>             |  |
| <b>Order no.</b>                                   | <b>27-011-000-01</b>         |  |
| <b>Basic operating modes</b>                       | CC, CP, CR, CV               |  |
| <b>Standard interfaces</b>                         | RS-232, USB, LAN, CAN        |  |
| <b>Voltage range</b>                               | -1 V ... 44 V                |  |
| <b>Current range</b>                               | -22 A ... 22 A               |  |
| <b>Resistance range</b>                            | 0.1 ... 40 Ω                 |  |
| <b>Power</b>                                       | 968 W                        |  |
| <b>Rise/fall time CC, CV <sup>1)</sup></b>         | 120 μs                       |  |
| <b>Bandwidth</b>                                   | 3 kHz                        |  |
| <b>Adjustable int. resistance CC <sup>2)</sup></b> | 4 Ω ... ∞                    |  |
| <b>Adjustable int. resistance CV</b>               | 0 ... 1 Ω                    |  |
| <b>Output terminals rear <sup>3)</sup></b>         | BPK4-30L                     |  |
| <b>Power consumption</b>                           | 1450 VA                      |  |
| <b>Mains voltage <sup>4)</sup></b>                 | 1/N/PE AC 230 V 50 ... 60 Hz |  |
| <b>Mains voltage toggleable</b>                    | 1/N/PE AC 115 V 50 ... 60 Hz |  |
| <b>Noise max. ca. <sup>5)</sup></b>                | 67 dB(A)                     |  |
| <b>Weight ca.</b>                                  | 23 kg                        |  |
| <b>Housing <sup>6)</sup></b>                       | 19" - 3 U                    |  |

- Rise and fall times are from 10 ... 90 % and 90 ... 10 % of the positive 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. 2 ms.
- Value is entered as conductance in S.
- BPK4-30L: Touch-protected binding posts for 4 mm laboratory jacks and stripped wires with diameter up to 4 mm, max. 30 A  
BPK4-60L: Touch-protected binding posts for 4 mm laboratory jacks and stripped wires with diameter up to 6 mm, max. 60 A  
FKS25/10-SM10: Flat copper bars 25 x 10 mm vertical with hole for screw M10
- Mains voltage tolerance: ±10 %.
- Measured on the front from distance of 1 m.
- 1 U = 44.45 mm.

| Operating modes, functions  |  |                                 |
|---|--|---------------------------------|
| Basic operating modes   | CC, CP, CR, CV   |                                 |
| Combined operating modes  | CC+CV, CV+CC, CP+CV, CR+CV   |                                 |
| Functions   | DC source-sink<br>energy storage device test<br>internal resistance measurement<br>list function<br>adjustable internal resistance<br>capacitance simulation function<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>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 positive range |
| Voltage   | ±0.1 %   | ±0.05 %                         |
| Current   | ±0.2 %   | ±0.05 %                         |
| Resistance<br>(at  V  > 5 % of positive voltage range)  | ±1.4 %   | ±0.3 % of current range         |
| Power<br>(at  V  and  I  > 30 % of corresp. pos. range)<br>(at  V  and  I  > 5 % and < 30 % of corresp. pos. range) | ±0.35 %<br>±0.7 %  | ±0.1 %<br>±0.25 %               |
| Resolution  | 15 bits in each quadrant   |                                 |
| Ripple voltage  | ca. 0.4 % p-p of positive voltage range  |                                 |
| Ripple current  | ca. 0.4 % p-p of positive voltage range  |                                 |
| Accuracy of setting AC (only 4-quadrant models)   |  |                                 |
|   | of setting   | of corresponding positive range |
| Voltage (RMS) <sup>1) 2)</sup>  | ±3 %   | ±0.25 %                         |
| Current (RMS) <sup>1) 2)</sup>  | ±3 %   | ±0.25 %                         |
| Accuracy of adjustable protections  |  |                                 |
|   | of setting   | of corresponding positive range |
| Current protection  | ±0.2 %   | ±0.05 %                         |
| Voltage protection  | ±0.1 %   | ±0.05 %                         |
| Resolution  | 13 bits in each quadrant   |                                 |
| Accuracy of measurement DC  |  |                                 |
|   | of measured value (real value)   | of corresponding positive range |
| Voltage   | ±0.1 %   | ±0.05 %                         |
| Current   | ±0.2 %   | ±0.05 %                         |
| Ext. control signal   | ±0.2 %   | ±0.1 %                          |
| Resistance  | is calculated from current and voltage   |                                 |
| Power   | is calculated from current and voltage   |                                 |
| Resolution  | 15 bits in each quadrant   |                                 |
| Sampling time   | 200 µs, triggerable  |                                 |
| Accuracy of measurement AC  |  |                                 |
|   | of measured value (real value)   | of corresponding positive range |
| Voltage (RMS)   | ±0.5 %   | ±0.1 %                          |
| Current (RMS)   | ±0.5 %   | ±0.1 %                          |
| Time constant of RMS measurement  | ca. 500 ms   |                                 |
| Accuracy of display   |  |                                 |
| No. of dec. places  | 4  |                                 |
| Accuracy  | accuracy of measurement DC/AC ±1 digit of display value  |                                 |

| Accuracy of trigger voltage and current |   |
|---|---|
| Trigger voltage                         | ±1 % of positive voltage range  |
| Trigger current                         | ±1 % of positive current range  |
| Sampling time                           | 200 µs  |
| Dynamic function LIST                   |   |
| Operating modes                         | CC, CV, CR, CP  |
| No. of settings                         | max. 300, with corresponding ramp, dwell and sample 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, resol.                      | 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 %   |
| Capacitance simulation function         |   |
| Capacitance                             | 10 mF ... 9999.99 F   |
| Data acquisition                        |   |
| to external USB flash drive             |   |
| Sampling time                           | 0.1 ... 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 meas. 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: inputs and outputs            |   |
| 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<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) |

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

|                      |   |
|----------------------|---|
| Digital input level  | logical low: 0 ... 0.8 V, logical high: 3 ... 30 V  |
| 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 |
| Digital output level | logical low: 0 ... 0.8 V<br>logical high: 5 V/24 V selectable, max. 10 mA (push-pull)   |

### I/O port: accuracy of analog control -5 ... 0 ... 5 V or -10 ... 0 ... 10 V

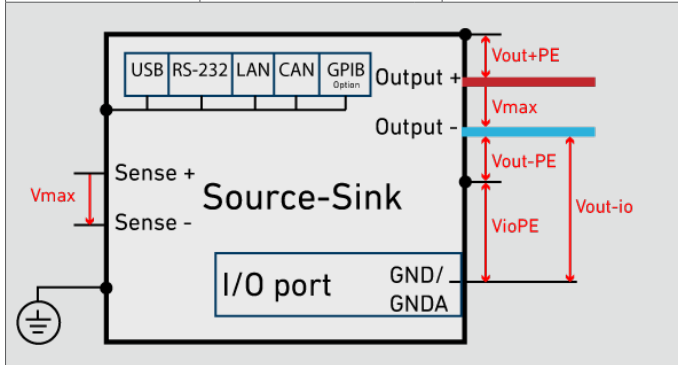
|   | of setting                               | of corresponding positive range |
|---|--|---------------------------------|
| Voltage   | ±0.2 %                                   | ±0.1 %                          |
| Current   | ±0.2 %                                   | ±0.1 %                          |
| Resistance<br>(at  V  > 5 % of positive voltage range)  | ±1.6 %                                   | ±0.4 % of current range         |
| Power<br>(at  V  and  I  > 30 % of corresp. pos. range)<br>(at  V  and  I  > 5 % and < 30 % of corresp. pos. range) | ±0.55 %<br>±0.9 %                        | ±0.2 %<br>±0.35 %               |
| Current protection <sup>3)</sup>  | ±1 %                                     | ±0.4 %                          |
| Voltage protection <sup>3)</sup>  | ±1 %                                     | ±0.4 %                          |
|   | input resistance of analog inputs >10 kΩ |                                 |

### 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>        |



### Output

|                          |                           |
|--------------------------|---------------------------|
| Output resistance        | >50 kΩ when output is off |
| 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

|               |                                    |
|---------------|------------------------------------|
| Nominal 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   | PH4/3.5-ST8, see starting at page 123                                  |
| 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   |
| Mains cable                                       | length max. 3 m<br>cross-section of mains leads min. 1 mm <sup>2</sup> |
| Power consumption                                 | see model overview   |

| Housing                                    |   |
|--|---|
| Size                                       | see model overview  |
| Color<br>front<br>rear<br>top, side panels | RAL7035 (light grey)<br>stainless steel<br>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<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<br>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  |

Technical data of production series B, rev. 6. Subject to technical changes without notice.

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- at 50 ... 60 Hz
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- positive/negative DC voltage or RMS value of a sinusoidal AC voltage