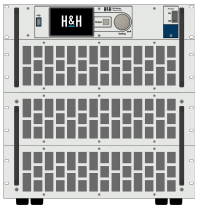
Datenblatt Series QL

H&H Höcherl & Hackl
The electronic load

Model	QL1V60C45	
Order no.	27-061-000-01	

Basic operating modes	CC, CP, CR, CV
Standard interfaces	RS-232, USB, LAN, CAN
Voltage range	-1 V ... 60 V
Current range	-45 A ... 45 A
Resistance range	0.0667 ... 26.7 Ω
Power	2700 W
Rise/fall time CC, CV [1)]	120 µs
Bandwidth	3 kHz
Adjustable int. resistance CC [2)]	2.67 Ω ... ∞
Adjustable int. resistance CV	0 ... 0.667 Ω
Output terminals rear [3)]	BPK4-60L
Power consumption	4120 VA
Mains voltage [4)]	3/N/PE AC 400/230 V 50 ... 60 Hz, 16 A
Mains voltage toggleable	-
Noise max. ca. [5)]	76 dB(A)
Weight ca.	73 kg
Housing [6)]	19" - 11 U

1. 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.
2. Value is entered as conductance in S.
3. 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
4. Mains voltage tolerance: ±10 %.
5. Measured on the front from distance of 1 m.
6. 1 U = 44.45 mm.

Änderungen ohne vorherige Ankündigung vorbehalten, Fehler und Irrtümer vorbehalten

Technical Data

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 energy storage device test internal resistance measurement list function adjustable internal resistance capacitance simulation function rectangular function (also in PWM mode) modulation (sine, triangle, square, arbitrary) data acquisition (internally or to USB flash drive) master-slave operation for power extension save and recall of device settings watchdog in remote operation AC source (only with 4-quadrant models)
AC source (only 4Q models) Frequency range [1]	in CC, CV mode (sine, triangular, square, sawtooth, arbitrary) range values are peak values for V and I adjustable offset 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 (at |V| > 5 % of positive voltage range)	±1.4 %	±0.3 % of current range
Power (at |V| and |I| > 30 % of corresp. pos. range) (at |V| and |I| > 5 % and < 30 % of corresp. pos. range)	±0.35 % ±0.7 %	±0.1 % ±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) [1] [2]	±3 %	±0.25 %
Current (RMS) [1] [2]	±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 [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, resol.	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 %

Capacitance simulation function	
Capacitance	10 mF ... 99999,99 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) 1 for last device settings at power-off or power failure

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

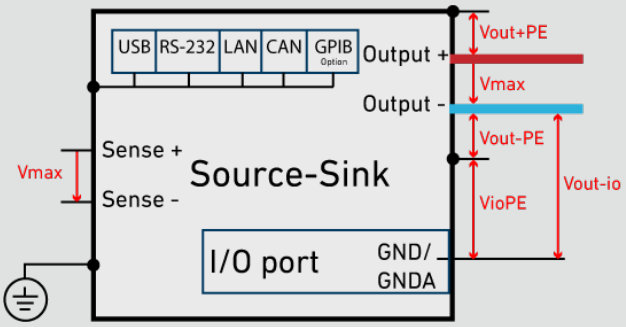
Technical Data

I/O port: inputs and outputs	
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 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)
Digital input level	logical low: 0 ... 0.8 V, logical high: 3 ... 30 V
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
Digital output level	logical low: 0 ... 0.8 V 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 (at |V| > 5 % of positive voltage range)	±1.6 %	±0.4 % of current range
Power (at |V| and |I| > 30 % of corresp. pos. range) (at |V| and |I| > 5 % and < 30 % of corresp. pos. range)	±0.55 % ±0.9 %	±0.2 % ±0.35 %
Current protection[3]	±1 %	±0.4 %
Voltage protection[3]	±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		
	unisolated I/O port	isolated I/O port (option QL06/07)
Vout-io (GND - neg. output)	max. 2 V [4]	max. 125 V [4]
VioPE (GND - PE)	max. 125 V [4]	max. 125 V [4]



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		
	unisolated I/O port	isolated I/O port (option QL06/07)
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		
Nominal 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	PH4/3.5-ST8	
Operating conditions		
Operating temp.	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, cross-section of mains leads min. 1 mm²	
Power consumption	see model overview	

Housing	
Size	see model overview
Color front rear top, side panels	 RAL7035 (light grey) stainless steel RAL7037 (dusty grey)
Safety and EMC	
Protection class	1
Measuring category	O (CAT I according to EN 61010:2004)
Electrical safety	EN 61010-1:2010/A1:2019/AC:2019-04 EN 61010-2-030:2010
EMC	EN 61326-1:2013 EN 55011:2016/A1:2017 EN 61000-3-2:2014 EN 61000-3-3:2013
Standard interfaces	
Data interfaces	RS-232, USB, LAN, CAN
I/O port	unisolated
Available options	
Data interface QL02	GPIB
Hardware extensions QL06/QL07 QL14	galvanically isolated I/O port, QL07 for master-slave op. heavy-weight castors for models from 5 U
Calibration, warranty	
FCC-QLxx	Factory Calibration Certificate, free of charge upon delivery
Recommended calibration interval	2 years
Warranty	2 years

Technical data of production series B, rev. 7. Subject to technical changes without notice.

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