

The Electronic Load



Source-Sink, NL Series

H&H
PL
ZS
ZSLC Water-cooled
ZSLV Low Voltage
PMLI Multi-channel
ZSAC AC
NL Source-Sink
Accessories
Application Notes
Software
GTC

SCPI
96 Commands



Interface overview	
RS-232	X
USB	X
GPIB	O
LAN	O
System bus	O
Analog	X
Analog isolated	O

X Standard O Option / not available



NL1V20C40

- 2-quadrant or 4-quadrant versions
- Source-sink function
- Rapid control time
- Current and voltage mode
- Adjustable limitations
- Analog measurement outputs for voltage and current
- Analog control inputs

- USB + RS-232 interface
- Programmable waveform
- SCPI programming with measurement function
- Software tools for battery testing

Operating Modes

The NL source-sinks can operate in constant voltage or constant current mode.

In voltage mode there are two current limiters (source current and sink current) which can be adjusted independently of one another. In current mode, an upper and a lower limit voltage can be set.

Source-sink Mode

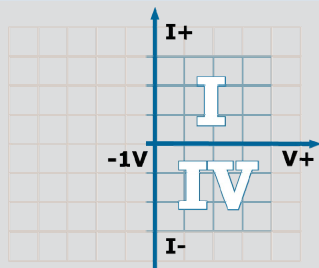
Depending on the preset output value and the characteristics of the connected test unit, the device automatically decides whether to operate as a source or a sink. Switching from source to sink mode is very rapid.

2-Quadrant / 4-Quadrant Mode

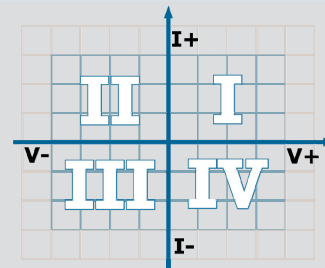
Devices for two-quadrant mode can supply or receive current with a positive output voltage. To guarantee the required function in the case of settings close to 0 V and long connection leads, the 2-quadrant devices start to operate from an output voltage of -1 V.

The 2-quadrant devices therefore also act as 4-quadrant devices but with limited negative voltage.

4-quadrant devices can be set by high negative values as well as positive values.



2-quadrant mode



4-quadrant mode



NL1V44C22

Remote Control

All source-sink functions can be controlled remotely via the standard Analog I/O Interface. Operating mode selection, output on - off and adjustment of control speed can be set with logic levels. A version (NL06) which is electrically isolated from the output is optionally available.

3 Analog Control Inputs

Depending on the selected operating mode the output voltage or output current can be preset to a control voltage 0 ... ±5 V or 0 ... ±10 V DC. There are two further analog inputs available to limit the voltage or current.

2 Analog Measurement Outputs

For voltage and current there are 0...10 V analog measurement signals available. The signals follow the curve trajectory.

Cooling

The units are air-cooled. To keep the operating noise low, the fans are temperature and current-dependently controlled.

Mechanics

The NL series is a sturdy 19" rack design and can also be installed in a cabinet or act as a table-top device.

From 5 height units there are retractable handles on the top of the device.

Optional castors can be mounted on heavy devices.

Separate installation kits are not needed for 19" rack installation.



Connections

All connections are at the back. The current connections are pole terminals or solid copper rails with screw terminals.

4mm plugs, forked cable lugs and stripped cables can be used.

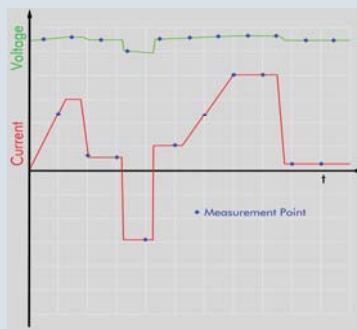


Safety

Covers are available for outputs as contact protection for units for dangerous contact voltages .

Function Range for Programming

- Programming in SCPI Syntax
- Programmable voltage and current profiles
- Dynamic mode with adjustable rise and fall time
- Measured data memory
- Trigger functions
- Use of supplied software and LabVIEW driver



Data logging with constant scanning rate

LabVIEW®

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Hardware Expansions

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GPIO Interface Expansion ¹⁾ (Option ZS03)

With the ZS03 option the device can be expanded by a GPIO interface.

Simply insert the card.

(Supplied without GPIO cable.)



Ethernet-RS-232 ^{1) 3)} Converter (Option ZS15)

Data is sent via the LAN card to the serial interface of the unit.



Electrically Isolated Analog I/O Interface ¹⁾ (Option NL06)

In the case of potential differences between the negative load input and the signals on the Analog I/O Interface the standard Analog I/O card can be replaced with an isolated version. All measurement and control signals are transmitted via isolation amplifiers and opto-couplers. The card is pin-compatible with the standard Analog I/O card. The isolation voltage is 500 V DC with respect to the negative load input.



Power I/O Card ^{1) 3)} (Option ZS07)

The Power I/O card can be expanded to control external devices. 8 relay contacts (N/O 125 V/1 A) can be actuated via the data interface and 8 logical inputs (5V ... 24V, shared GND) can be queried.

The inputs and outputs are isolated from the load input. The isolation voltage is 500 V DC with respect to the negative load input.



Temperature Interface ^{1) 3) 4)} (Option ZS16)

With the temperature interface card temperatures from 0...100 °C are captured by a NiCr-Ni (Type K) sensor and transformed into a 0 ... 10 VDC analog voltage. This analog voltage can be fed to the analog control input of the Analog I/O interface and read out via the data interface.



Castors ¹⁾ (Option ZS09)

Steerable castors can be screwed onto large devices for easier transport. A 19" rack can then often be dispensed with.

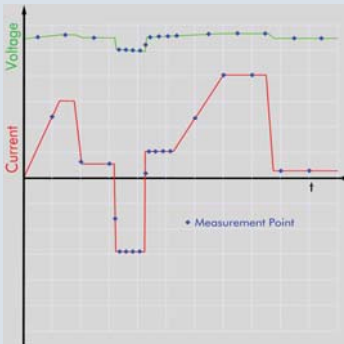
This option is available for devices from 5HU and is suitable only for hard floors.



Data Acquisition Tool (Option NL13) ^{2,3)}

The Data Acquisition Tool adds the following functions to the range of the device:

- Fast synchronized data logging for waveform generation with data memory
- Exponential inrush processes
- Battery capacity test
- MPP Tracking for solar panel test



Synchronized data logging with variable scanning rate for waveform. Simultaneous measurement of voltage and current.

Converter (in addition to 18 Bit standard A/D converter)	Fast A/D converter 13 Bit, measures voltage and current simultaneously
Sampling rate, Synchronization	min 200 µs, can be programmed separately for each wave section and synchronised with waveform generator
Measured data memory	2,000 V/I value pairs with timestamp

- 1) Can be retrofitted at any time.
- 2) Can only be retrofitted or produced by H&H.
- 3) Requires ZS01 oder ZS02
- 4) Requires Option NL13

Calibration

Factory Calibration Certificate (Option FCC-NLxx)¹⁾

A Factory Calibration Certificate (FCC) can be supplied with the devices.

The FCC meets the requirements according to DIN EN ISO 9000ff. This calibration certificate documents the traceability to national standards to illustrate the physical unit in accordance with the international device system (SI).

The recommended calibration interval is 1 year. We would be happy to calibrate your devices at regular intervals.



Software Tools

Control Tool (Universal Control Program)

Tool supplied as standard can be used to control single device.

Scope of functions:

- Device settings
- Data logging with numerical display
- Trigger source selection
- Activation of cut-off criteria
- Data logging



Dynamic List and Data Acquisition Tool

The Tool Dynamic List permits the intelligent generation of profiles in the form of straight sections.

The wave trajectory can be graphically displayed before testing.

The profiles set can be stored and re-activated when

needed.

If the NL13 option is installed, fast synchronous data logging can be carried out for the programmed wave trajectory. The measurement points can be imported directly after the end of the measurement.



¹⁾ Can only be produced by H&H.
(the FCC is more economical if ordered together with a new device)

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Battery Test Tool

- Charging
- Discharging
- Cycling
- Capacity determination
- Logging
- Cut-off criteria
- Dynamic test

The Battery Test Tool enables the testing of the most diverse energy storage units to be tested with the NL series.

Different storage types and their technical data can be

saved in a library.¹⁾

At the end of charging or discharging phases there are different monitoring criteria.

- Current
- Time
- Capacity
- -dV/Cell
- External event (Option ZS07 required)²⁾

To test the DUT for specific requirement it is possible to apply a predefined waveform.

The most important current test information is available at a glance.

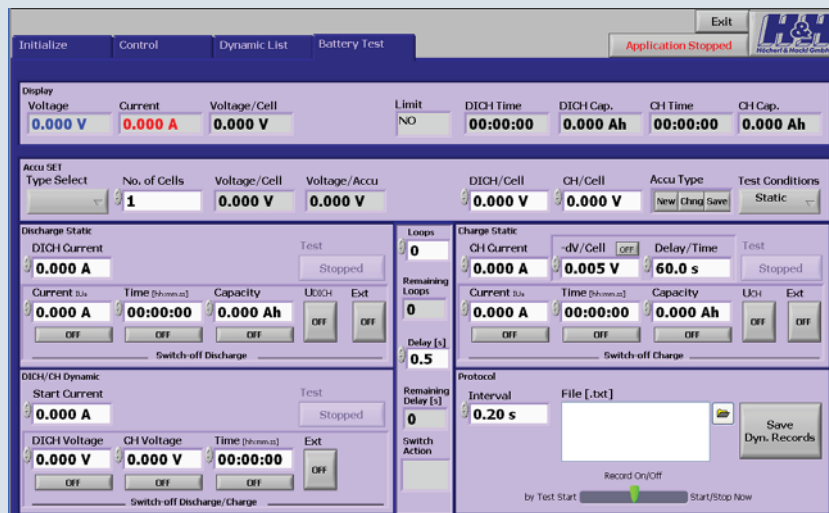
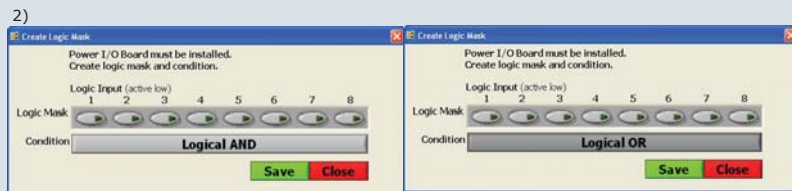
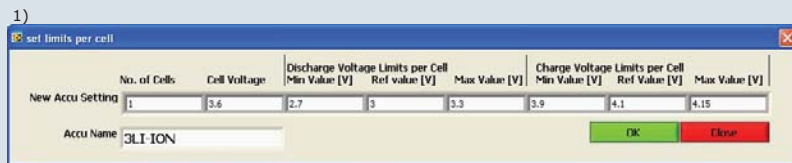
A report can be produced for documentation of the test.

The time resolution can be adjusted from 300 ms onwards.

The data can be backed up to a text file for further processing, e.g. with MS Excel.

The following are logged:

- Voltage
- Current
- Time
- Capacity
- Status
- Test conditions
- Switch-off criteria



Type Overview of Unipolar Devices

Models up to 10 kW
on request

Model (order number)	NL1V10C20	NL1V20C10	NL1V30C8	NL1V42C6	NL1V80C3	NL1V100C2
Voltage	-1 V ... +10 V	-1 V ... +20 V	-1 V ... +30 V	-1 V ... +42 V	-1 V ... +80 V	-1 V ... +100 V
Current	±20 A	±10 A	±8 A	±6 A	±3 A	±2 A
Power	200 W	200 W	240 W	252 W	240 W	200 W
Rise/fall time ¹⁾	200 µs	200 µs	200 µs	200 µs	200 µs	200 µs
Connection ²⁾	PK4	PK4	PK4	PK4	PK4	PK4
Power consumption	426 VA	380 VA	380 VA	414 VA	380 VA	310 VA
Mains supply	115/230 VAC	115/230 VAC	115/230 VAC	115/230 VAC	115/230 VAC	115/230 VAC
W x H x D (mm) ³⁾	483 x 88 x 520	483 x 88 x 520	483 x 88 x 520	483 x 88 x 520	483 x 88 x 520	483 x 88 x 520
Weight	13 kg	13 kg	13 kg	13 kg	13 kg	13 kg
Housing ⁴⁾	19" - 2 HU	19" - 2 HU	19" - 2 HU	19" - 2 HU	19" - 2 HU	19" - 2 HU

Model (order number)	NL1V8C80	NL1V10C60	NL1V20C40	NL1V26C32	NL1V44C22	NL1V80C11	NL1V200C4	NL1V400C2
Voltage	-1 V ... +8 V	-1 V ... +10 V	-1 V ... +20 V	-1 V ... +26 V	-1 V ... +44 V	-1 V ... +80 V	-1 V ... +200 V	-1 V ... +400 V
Current	±80 A	±60 A	±40 A	±32 A	±22 A	±11 A	±4 A	±2 A
Power	640 W	600 W	800 W	832 W	968 W	880 W	800 W	800 W
Rise/fall time ¹⁾	200 µs	200 µs	200 µs	200 µs	200 µs	200 µs	400 µs	400 µs
Connection ²⁾	FK25	PK60	PK60	BM8	BM8	BM8	SB4	SB4
Power consumption	1,400 VA	1,325 VA	1,400 VA	1,300 VA	1,400 VA	1,255 VA	1,000 VA	1,000 VA
Mains supply	115/230 VAC	115/230 VAC	115/230 VAC	115/230 VAC	115/230 VAC	115/230 VAC	115/230 VAC	115/230 VAC
W x H x D (mm) ³⁾	483 x 222 x 561	483 x 222 x 520	483 x 222 x 520	483 x 132 x 520	483 x 132 x 520	483 x 132 x 520	483 x 132 x 520	483 x 132 x 520
Weight	32 kg	32 kg	32 kg	23 kg	23 kg	23 kg	35 kg	35 kg
Housing ⁴⁾	19" - 5 HU	19" - 5 HU	19" - 5 HU	19" - 3 HU	19" - 3 HU	19" - 3 HU	19" - 3 HU	19" - 3 HU

Model (order number)	NL1V8C160	NL1V10C120	NL1V20C80	NL1V26C60	NL1V44C40	NL1V80C20
Voltage	-1 V ... +8 V	-1 V ... +10 V	-1 V ... +20 V	-1 V ... +26 V	-1 V ... +44 V	-1 V ... +80 V
Current	±160 A	±120 A	±80 A	±60 A	±40 A	±20 A
Power	1,280 W	1,200 W	1,600 W	1,560 W	1,760 W	1,600 W
Rise/fall time ¹⁾	200 µs	200 µs	200 µs	200 µs	200 µs	200 µs
Connection ²⁾	FK25	FK25	FK25	PK60	PK60	PK60
Power consumption	2,700 VA	2,550 VA	2,700 VA	2,550 VA	2,700 VA	2,500 VA
Mains supply	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC
W x H x D (mm) ³⁾	483 x 355 x 561	483 x 355 x 561	483 x 355 x 561	483 x 355 x 520	483 x 355 x 520	483 x 355 x 520
Weight	55 kg	55 kg	55 kg	55 kg	55 kg	55 kg
Housing ⁴⁾	19" - 8 HU	19" - 8 HU	19" - 8 HU	19" - 8 HU	19" - 8 HU	19" - 8 HU

Model (order number)	NL1V8C240	NL1V10C180	NL1V20C120	NL1V26C90	NL1V44C60	NL1V80C30
Voltage	-1 V ... +8 V	-1 V ... +10 V	-1 V ... +20 V	-1 V ... +26 V	-1 V ... +44 V	-1 V ... +80 V
Current	±240 A	±180 A	±120 A	±90 A	±60 A	±30 A
Power	1,920 W	1,800 W	2,400 W	2,340 W	2,640 W	2,400 W
Rise/fall time ¹⁾	200 µs	200 µs	200 µs	200 µs	200 µs	200 µs
Connection ²⁾	FK25	FK25	FK25	FK25	FK25	FK25
Power consumption	4,000 VA	3,775 VA	4,000 VA	3,775 VA	4,000 VA	3,350 VA
Mains supply	230/400 VAC - 16 A	230/400 VAC - 16 A	230/400 VAC - 16 A	230/400 VAC - 16 A	230/400 VAC - 16 A	230/400 VAC - 16 A
W x H x D (mm) ³⁾	483 x 488 x 561	483 x 488 x 561	483 x 488 x 561	483 x 488 x 561	483 x 488 x 561	483 x 488 x 561
Weight	80 kg	80 kg	80 kg	80 kg	80 kg	80 kg
Housing ⁴⁾	19" - 11 HU	19" - 11 HU	19" - 11 HU	19" - 11 HU	19" - 11 HU	19" - 11 HU

Model (order number)	NL1V8C320	NL1V10C240	NL1V20C160	NL1V26C120	NL1V44C80	NL1V80C40
Voltage	-1 V ... +8 V	-1 V ... +10 V	-1 V ... +20 V	-1 V ... +26 V	-1 V ... +44 V	-1 V ... +80 V
Current	±320 A	±240 A	±160 A	±120 A	±80 A	±40 A
Power	2,560 W	2,400 W	3,200 W	3,120 W	3,520 W	3,200 W
Rise/fall time ¹⁾	200 µs	200 µs	200 µs	200 µs	200 µs	200 µs
Connection ²⁾	FK25	FK25	FK25	FK25	FK25	FK25
Power consumption	5,300 VA	5,000 VA	5,300 VA	5,000 VA	5,100 VA	4,800 VA
Mains supply	230/400 VAC - 16 A	230/400 VAC - 16 A	230/400 VAC - 16 A	230/400 VAC - 16 A	230/400 VAC - 16 A	230/400 VAC - 16 A
W x H x D (mm) ³⁾	483 x 622 x 561	483 x 622 x 561	483 x 622 x 561	483 x 622 x 561	483 x 622 x 561	483 x 622 x 561
Weight	105 kg	105 kg	105 kg	105 kg	105 kg	105 kg
Housing ⁴⁾	19" - 14 HU	19" - 14 HU	19" - 14 HU	19" - 14 HU	19" - 14 HU	19" - 14 HU

1) Measured at short-circuited output terminals (current) and open output terminals (voltage). Tolerance ±20 %

2) FK25: Flat copper rail 25x10 mm with 4 mm hole and M10 and M12 screw fastenings

PK4: 4mm pole terminals
BM8: M8 screw fitting
PK60: Pole terminals for forked cable lug and 4mm jack

3) 19" rack installation, approx. 100 mm should be added to installation depth for rear cable connections. The weight of the devices means that sliding rails must be used for 19" rack installation.

4) 1 HU = 44.45 mm

H&H

PL

ZS

ZSLC

Water-cooled

ZSLV

Low Voltage

PMLI

Multi-channel

ZSAC

AC

NL

Source-Sink

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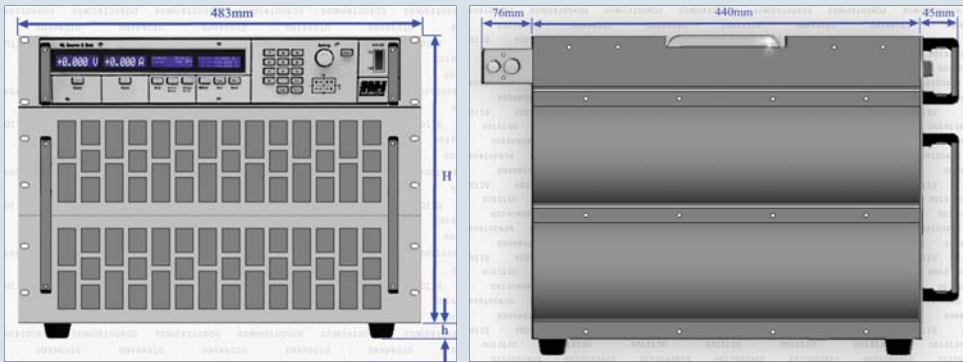
GTC

Models up to 10 kW
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Type Overview of Bipolar Devices

	H&H	PL	ZS	ZSLC Water-cooled	ZSLV Low Voltage	PMLI Multi-channel	ZSAC AC	NL Source-Sink	Accessories	Application Notes	Software	GTC
Model (order number)	NL10V10C10		NL20V20C5		NL30V30C3.5		NL50V50C2					
Voltage	±10 V		±20 V		±30 V		±50 V					
Current	±10 A		±5 A		±3,5 A		±2 A					
Power	100 W		100 W		105 W		100 W					
Rise/fall time ¹⁾	200 µs		200 µs		200 µs		200 µs					
Current Voltage	200 µs		200 µs		200 µs		200 µs					
Connection ²⁾	PK4		PK4		PK4		PK4					
Power consumption	270 VA		250 VA		235 VA		220 VA					
Mains supply	115/230 VAC		115/230 VAC		115/230 VAC		115/230 VAC					
W x H x D (mm) ³⁾	483 x 88 x 520		483 x 88 x 520		483 x 88 x 520		483 x 88 x 520					
Weight	13 kg		13 kg		13 kg		13 kg					
Housing ⁴⁾	19" - 2 HU		19" - 2 HU		19" - 2 HU		19" - 2 HU					
Model (order number)	NL8V8C46	NL10V10C38	NL20V20C24	NL30V30C16	NL44V44C11	NL100V100C4	NL200V200C2					
Voltage	±8 V	±10 V	±20 V	±30 V	±44 V	±100 V	±200 V					
Current	±46 A	±38 A	±24 A	±16 A	±11 A	±4 A	±2 A					
Power	368 W	380 W	480 W	432 W	484 W	400 W	400 W					
Rise/fall time ¹⁾	200 µs	200 µs	200 µs	200 µs	200 µs	400 µs	400 µs					
Current Voltage	200 µs	200 µs	200 µs	200 µs	200 µs	400 µs	400 µs					
Connection ²⁾	BM8	BM8	BM8	BM8	BM8	SB4	SB4					
Power consumption	740 VA	763 VA	770 VA	770 VA	710 VA	600 VA	600 VA					
Mains supply	115/230 VAC	115/230 VAC	115/230 VAC	115/230 VAC	115/230 VAC	115/230 VAC	115/230 VAC					
W x H x D (mm) ³⁾	483 x 132 x 520	483 x 132 x 520	483 x 132 x 520	483 x 132 x 520	483 x 132 x 520	483 x 132 x 520	483 x 132 x 520					
Weight	23 kg	23 kg	23 kg	23 kg	23 kg	35 kg	35 kg					
Housing ⁴⁾	19" - 3 HU	19" - 3 HU	19" - 3 HU	19" - 3 HU	19" - 3 HU	19" - 3 HU	19" - 3 HU					
Model (order number)	NL8V8C80		NL10V10C60		NL20V20C40		NL30V30C32		NL44V44C20			
Voltage	±8 V		±10 V		±20 V		±30 V		±44 V			
Current	±80 A		±60 A		±40 A		±32 A		±20 A			
Power	640 W		600 W		800 W		960 W		880 W			
Rise/fall time ¹⁾	200 µs		200 µs		200 µs		200 µs		200 µs			
Current Voltage	200 µs		200 µs		200 µs		200 µs		200 µs			
Connection ²⁾	FK25		PK60		PK60		PK60		PK60			
Power consumption	1,500 VA		1,425 VA		1,500 VA		1,660 VA		1,380 VA			
Mains supply	115/230 VAC		115/230 VAC		115/230 VAC		115/230 VAC		115/230 VAC			
W x H x D (mm) ³⁾	483 x 355 x 561		483 x 355 x 520		483 x 355 x 520		483 x 355 x 520		483 x 355 x 520			
Weight	55 kg		55 kg		55 kg		55 kg		55 kg			
Housing ⁴⁾	19" - 8 HU		19" - 8 HU		19" - 8 HU		19" - 8 HU		19" - 8 HU			
Model (order number)	NL8V8C120		NL10V10C90		NL20V20C60		NL30V30C48		NL44V44C30			
Voltage	±8 V		±10 V		±20 V		±30 V		±44 V			
Current	±120 A		±90 A		±60 A		±48 A		±30 A			
Power	960 W		900 W		1,200 W		1,440 W		1,320 W			
Rise/fall time ¹⁾	200 µs		200 µs		200 µs		200 µs		200 µs			
Current Voltage	200 µs		200 µs		200 µs		200 µs		200 µs			
Connection ²⁾	FK25		FK25		FK25		FK25		FK25			
Power consumption	2,200 VA		2,088 VA		2,200 VA		2,340 VA		2,200 VA			
Mains supply	230 VAC		230 VAC		230 VAC		230 VAC		230 VAC			
W x H x D (mm) ³⁾	483 x 488 x 561		483 x 488 x 561		483 x 488 x 561		483 x 488 x 561		483 x 488 x 561			
Weight	80 kg		80 kg		80 kg		80 kg		80 kg			
Housing ⁴⁾	19" - 11 HU		19" - 11 HU		19" - 11 HU		19" - 11 HU		19" - 11 HU			
Model (order number)	NL8V8C160		NL10V10C120		NL20V20C80		NL30V30C64		NL44V44C40			
Voltage	±8 V		±10 V		±20 V		±30 V		±44 V			
Current	±160 A		±120 A		±80 A		±64 A		±40 A			
Power	1,280 W		1,200 W		1,600 W		1,920 W		1,760 W			
Rise/fall time ¹⁾	200 µs		200 µs		200 µs		200 µs		200 µs			
Current Voltage	200 µs		200 µs		200 µs		200 µs		200 µs			
Connection ²⁾	FK25		FK25		FK25		FK25		FK25			
Power consumption	2,900 VA		2,750 VA		2,900 VA		3,120 VA		2,900 VA			
Mains supply	230 VAC		230 VAC		230 VAC		230 VAC		230 VAC			
W x H x D (mm) ³⁾	483 x 622 x 561		483 x 622 x 561		483 x 622 x 561		483 x 622 x 561		483 x 622 x 561			
Weight	105 kg		105 kg		105 kg		105 kg		105 kg			
Housing ⁴⁾	19" - 14 HU		19" - 14 HU		19" - 14 HU		19" - 14 HU		19" - 14 HU			
Model (order number)	NL8V8C160		NL10V10C120		NL20V20C80		NL30V30C64		NL44V44C40			
Voltage	±8 V		±10 V		±20 V		±30 V		±44 V			
Current	±160 A		±120 A		±80 A		±64 A		±40 A			
Power	1,280 W		1,200 W		1,600 W		1,920 W		1,760 W			
Rise/fall time ¹⁾	200 µs		200 µs		200 µs		200 µs		200 µs			
Current Voltage	200 µs		200 µs		200 µs		200 µs		200 µs			
Connection ²⁾	FK25		FK25		FK25		FK25		FK25			
Power consumption	2,900 VA		2,750 VA		2,900 VA		3,120 VA		2,900 VA			
Mains supply	230 VAC		230 VAC		230 VAC		230 VAC		230 VAC			
W x H x D (mm) ³⁾	483 x 622 x 561		483 x 622 x 561		483 x 622 x 561		483 x 622 x 561		483 x 622 x 561			
Weight	105 kg		105 kg		105 kg		105 kg		105 kg			
Housing ⁴⁾	19" - 14 HU		19" - 14 HU		19" - 14 HU		19" - 14 HU		19" - 14 HU			
1)	Measured at short-circuited output terminals (current) and open output terminals (voltage). Tolerance ±20 %											
2)	FK25: Flat copper rail 25x10 mm with 4 mm hole and M10 and M12 screw fastenings			PK4: 4mm pole terminals BM8: M8 screw fitting PK60: Pole terminals for forked lug and 4mm jack								
3)				19" rack installation, approx. 100 mm should be added to installation depth for rear cable connections. The weight of the devices means that sliding rails must be used for 19" rack installation.								
4)				1 HU = 44.1 HE = 44,45 mm								

Dimensions



h: Standard:	15 mm
Mit ZS09 option (castors):	45 mm

Size	2 HU	3 HU	5 HU	8 HU	11 HU	14 HU
H (mm)	88	133	222	355	488	622



Dimension of terminals when using protective cover

In the case of 19" rack systems, sliding rails are needed due to weight.

H&H
PL
ZS
ZSLC Water-cooled
ZSLV Low Voltage
PMLI Multi-channel
ZSAC AC
NL Source-Sink
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Technical Data NL series

H&H	Accuracy of setting	
	of the setting value	of the corresponding range
	Voltage	±0.1 % ±0.05 %
	Current	±0.2 % ±0.05 %
PL	Voltage protection ±0.1 % ±0.05 %	
	Current protection ±0.2 % ±0.05 %	
ZS	Resolution of setting 16 Bits	
	Ripple 0.05 % RMS from range	
	Load Effect 0-100 % 0.1 %	
	Line Effect ±10 % 0.02 %	
ZSLC Water-cooled	Accuracy of display	
	of the measured value (real value)	of the corresponding range
	Voltage	±0.1 % ±0.05 % ±1 digit
	Current	±0.2 % ±0.05 % ±1 digit
	Resistance Quotient of voltage and current	
	Power Product of voltage and current	
ZSLV Low Voltage	Accuracy analog control	
	-5 V ... 0 ... +5 V / -10 V ... 0 ... +10 V for current, voltage	
	of the setting value	of the corresponding range
	Voltage	±0.2 % ±0.15 %
	Current	±0.4 % ±0.15 %
	Voltage protection * (upper and lower)	±0.2 % ±0.15 %
	Current protection * (upper and lower)	±0.4 % ±0.15 %
PMLI Multi-channel	* -10 V ... 0 ... +10 V only Input resistance of analog inputs >10 kΩ GND max. ±2 V with respect to negative load input ¹⁾	
ZSAC AC	Accuracy of analog measurement outputs	
	of analog signal of real value	Offset voltage
	Voltage	±0.1 % ±15 mV
	Current	±0.2 % ±15 mV
	GND max. ±2 V with respect to negative output ¹⁾ Minimum load capacity 2kΩ	
NL Source-Sink	Output	
	Input resistance >50 kΩ in standby	
	Input capacity approx. 1.5 μF / 1,400 W	
	Parallel operation up to 3 devices in Master-Slave mode (hardware-controlled only in current mode)	
	Permissible operating voltage negative input - case: ±125 V DC GND Analog I/O interface - neg. output: ±2 V DC with option NL06 GND Analog I/O interface - neg. output: ±125 V DC	
	Protective devices Over-current and over-power protection Over-temperature cut-off	
	Rated power up to T _a = 21 °C	
	Derating -1.2 %/°C for T _a > 21 °C	
	External control functions Standby Operating mode change Trigger input and output Remote shut down	
Accessories		
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	<div style="border: 1px dashed black; padding: 5px; margin-top: 10px;"> <p>1) ±125 V with NL06 option 2) Class C protective equipment recommended due to high switch-on currents</p> </div>	
	Accuracy of measurement	
	of the measured value (real value)	of the corresponding range
	Voltage	±0.1 % ±0.05 %
	Current	±0.2 % ±0.05 %
	Resolution 18 bits	
	Sampling rate (not synchronized) 330 ms, not triggerable	
	Accuracy of measurement with Data Acquisition Tool (Option NL13), read out via data interface	
	of the measured value (real value)	of the corresponding range
	Voltage	±0.15 % ±0.07 %
	Current	±0.3 % ±0.07 %
	Resolution 13 bits	
	Sampling rate (programmable) minimal 200 μs (in memory) triggerable	
	Operating conditions	
	Operating temperature 5 °C ... 40 °C	
	Cooling Current and temperature-controlled fans (airflow from front panel to back panel)	
	Noise see type overview	
	Supply voltage 115/230 V~ ±10 %, 50 ... 60 Hz 230/400 V AC - 16 A CEE ²⁾	
	Dimensions, weight see type overview and table, page 51/52	
	Color: Front panel RAL7032 (pebble grey) side panels, top RAL7037 (stone grey)	
	Electrical safety DIN EN 61010-1	
	EMC, CE mark DIN EN 61326-1 DIN EN 61000-3-2 DIN EN 61000-3-3	
	Measuring instrument category CAT I	
	Warranty 2 years	

Subject to technical modifications

Accessories

High Current Cables

High Current Cables (Standard)

Highly flexible cables in different lengths, cross-sections and voltage strengths with cable lug.

Color coding via cable lug.
Two leads are always required for device connection.
Several cables can be connected in parallel for higher currents.



Standard HKS cable in different cross sections

High current cables (low induction)

For dynamic load with high rise times and for long load lines.

These double cables enable the voltage of the test unit to be supplied to the load input with

very low inductive losses.
Only in this way it is possible to realize fast current rise times.
The maximum voltage is 300V.



Low induction high current HKI cables

1) The specified values for L and R relate to two parallel cables leading to the test unit.

Type	Cross-section (mm ²)	Current (A)	Voltage (V)	L ¹⁾ (μH/m)	R ¹⁾ (mΩ/m)	Connection mm
HKS16-l-rt/sw	16	120	100	0.64	3.02	Ø 10
HKS25-l-rt/sw	25	160	100	0.64	2.15	Ø 12
HKS35-l-rt/sw	35	200	100	0.62	1.54	Ø 12
HKS50-l-rt/sw	50	250	100	0.61	1.00	Ø 12
HKS70-l-rt/sw	70	300	100	0.52	0.68	Ø 12
HKS95-l-rt/sw	95	365	100	0.55	0.50	Ø 12
HKS120-l-rt/sw	120	450	100	0.44	0.37	Ø 12
HKM70-l-rt/sw	70	260	450	0.52	0.68	Ø 12
HKM240-l-rt/sw	240	750	450	0.50	0.22	Ø 16
HKV16-l-rt/sw	16	100	1,500	0.64	3.02	Ø 10
HKV70-l-rt/sw	70	250	1,500	0.52	0.68	Ø 12

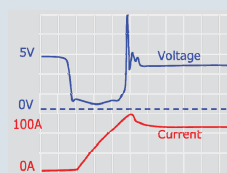
Dielectric strength: HKS cable: 100V
HKM cable: 450V
HKV cable: 1,500V

Order examples: HKS16-2-rt: 16 mm², l=2 meters, red
HKS50-1-sw: 50 mm², l=1 meter, black

Type	Cross-section (mm ²)	Current (A)	Voltage (V)	L (μH/m)	R (mΩ/m)	Connection mm
HKI12-l	2x12	80	300	0.065	3.79	Ø 10
HKI30-l	2x30	130	300	0.065	1.82	Ø 12
HKI70-l	3x70	250	300	0.081	0.68	Ø 12

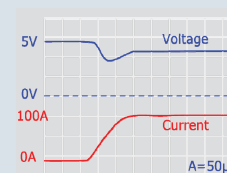
Order example: HKI30-3: 30 mm², l=3 meters

Comparison: Standard cable - low inductance cable
Voltage source 5 V, load variation 0 to 100 A



Voltage and current diagram with 2 m standard cable HKS35, slack. Voltage drops as current on cable increases.

The cable determines the maximum rise speed of the current.



Voltage and current diagram with 2 m low-inductance cable HKI30. The voltage remains stable while the current increases at the load input.

The actual control behaviour of the test unit can be analyzed.

H&H

PL

ZS

ZSLC

Water-cooled

ZSLV

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HKV16/CON High Current Cable (for ZSAC Series)

The HKV16/CON high-current cables are manufactured with an SB6 jack at one end which fits the electronic ZSAC loads with SB6 connections.

The other end is unassembled.

1 set HKV16 cable (red and black), 2 m long, included as standard with all loads with SB6 connection.



HKV16/CON high current cable for ZSAC series with SB6 socket

Order examples:
 HKV16/CON-2-rt: 16mm², l=2 meters, red
 HKV16/CON-6-sw: 16mm², l=6 meters, black

Type	Cross section (mm ²)	Current (A)	Voltage (V)	Inductance ¹⁾ (μH/m)	Resistance ¹⁾ (mΩ/m)	Connection
HKV16/CON-l-(rt/sw)	16	100	600	0.64	3.02	SB6

Other Cables

Master-Slave Cable

Order no.: K-MS-ZS

For Master-Slave operation of two devices. Length: 2m

RS-232 Cable

Order no.: K-RS-SNM9-9
 Null modem cable (RTS-CTS-handshake)
 Length: 2m

Manuals

Extra Manual:

German + English:

Order no.: HB-XXXX ²⁾

Coolant Distribution for ZSLC Loads

We supply the coolant distributors to match the configuration of your loads.



¹⁾ The specified values for resistance and inductivity relate to two parallel cables leading to the test unit

²⁾ XXXX = model name

Accessories

19" Racks

19" Racks for the Installation of Electronic Loads

The installation of electronic loads requires special racks which are designed for adequate air outlet of the heated exhaust air.

H&H racks are fitted at the back

with large scale air vents to allow exhaust air to escape practically unhindered.

The rear door is shorter to accommodate the connection cable.

The installation depth is 680 mm.

Model	Installation height front (HU)	Air outlet rear (HU)	Height (mm)
Rack 34	34	27	1,710
Rack 38	38	32	1,910
Rack 43	43	36	2,110
Rack 47	47	41	2,310

The connection cable is guided through flexible foam rubber lips.

A socket strip near the floor is provided for mains connection of devices.



19" rack for electronic loads

Mains Switches for Rack Installation

Model	Voltage	Current	Switches	RCCB	Connection	Miscellaneous	Height
SE-1PH	1~230 V	16 A	Central emergency-off switch	-	Terminal	-	2 HU
SE-3PH-16	3~230/400 V	16 A	Central emergency-off switch	-	Terminal	-	2 HU
SE-3PH-32	3~230/400 V	32 A	Central emergency-off switch	-	Terminal	-	2 HU
SE-3PH-DC	3~230/400 V	32 A	Central emergency-off switch	30 mA	2x16 A CEE 3x safety sockets	DC power supply 12 V/8 A	3 HU
SE-3PH-FI	3~230/400 V	16 A	Central emergency-off switch	30 mA	1x16 A CEE 3x safety sockets	-	3 HU



SE-3PH-FI



SE-3PH-16



SE-3PH-DC

H&H

PL

ZS

ZSLC

Water-cooled

ZSLV

Low Voltage

PMLT

Multi-channel

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AC

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The Electronic Load