Electronic DC Loads

MULTI-RANGE LOAD ZS SERIES

- Voltage up to 800 V
- Current up to 60 A
- Several current ranges
- Power 500 W
- Depending on model, temporary overload capacity
- Basic operating modes CC, CV, CR, CP
- Electronic protection
- Analog measurement outputs for voltage and current
- Analog control input
- MPP tracking
- Dynamic function with synchronized data logging
- Exponential switch-on process
- Test of energy storage devices
- System interface for multi-channel systems

ZS Series – Brief Profile

The electronic loads of the ZS series are the classics from H&H.
A special feature of the ZS series are 3 to 4 "real" current ranges for adjustment and measurement, each graduated with a factor of 10. This means that even lowest currents can be set and measured with high resolution.

Interfaces

- ○ RS-232
- ○ USB
- ○ LAN
- ○ GPIB
- — CAN
- ○ System bus
- ◉ Analog
- ○ Analog isolated

◉ Standard ○ Option — not available

Your contact:

Schulz Electronic
Professional Power Supplies

Schulz-Electronic GmbH
Dr.-Rudolf-Eberle-Straße 2
D-76534 Baden-Baden
Fon + 49.7223.9636.0
Fax + 49.7223.9636.90
vertrieb@schulz-electronic.de
www.schulz-electronic.de

Operating Modes

The devices have the basic operating modes constant current, constant voltage, constant resistance and constant power (CC, CV, CR, CP mode). A protection value for undervoltage and overcurrent can be set in each operating mode. This enables the combined operating modes CC+CV, CR+CC+CV, CP+CC+CV, CV+CC to be realized.

Setting and Measuring Ranges

The ZS series loads are characterized by several "real" current setting and measuring ranges. In the low current ranges, resolutions of a few µA are realized.

Protection, Monitoring

- Overcurrent protection
- Overpower protection
- Overtemperature protection
- Overvoltage indication
- Undervoltage protection
- Protection of the GND lines at the I/O port

Overload Capability

Depending on the model, the devices can be temporarily overloaded. The level and duration of the possible overload depends on the operating temperature of the power stage.
This means that the device can temporarely also be used for much more powerful tasks.

Cooling

The units are air-cooled. In order to keep the operating noise low, the fans are controlled according to temperature and current. The fans can be set to full power for better utilization of the maximum possible overload capacity.

I/O Port

Analog signals in realtime!

Standard I/O port for:

- Analog load setting from 0 ... 5 V or 0 ... 10 V in CC, CV, CP mode
- Operating mode selection
- Range selection
- Load input switching
- Analog voltage monitor signal 0 ... 10 V
- Analog current monitor signal 0 ... 10 V
- Analog power monitor signal
- Trigger input
- Control line to select setting A or B

As an option, the I/O port is available as galvanically isolated version (option ZS06).

Factory Calibration Certificate (FCC-ZSxx)

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 2 years after delivery, we calibrate your device a second time free of charge! 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

The ZS loads are designed in a sturdy 19" rack design and can also be used as a desktop device.

Dynamic and Control Time

The inbuilt modulator enables two independently adjustable currents and times from 100 µs ... 1 s. The control speed of the devices can be adjusted to the test unit in three stages (fast - medium - slow).
In remote control operation via one of the optional data interfaces, the possibilities for dynamic processes are much more extensive, see below, e.g. list function.

Input Voltage Switching

An undervoltage protection can be set for peak-free switching of voltages. The current is only released when the input voltage exceeds the undervoltage protection.

Safety Covers

Safety cover for ZS series

For devices for dangerous input voltages, safety covers for the load inputs are supplied.

Options: Data Interfaces

Programming via a data interface extends the functional range of the ZS load by many dynamic functions in connection with synchronous measured value storage. See below for details.
The interface cards are pluggable and can be exchanged or extended as required

Option ZS01 [2]

RS-232 + USB interface

Option ZS01 extends the device with an RS-232 and a USB interface (as Virtual COM Port). Programming is done in SCPI.
Includes 2 m RS-232 cable.

Option ZS02 [2]

GPIB + RS-232 + USB interface

The GPIB interface also includes the RS-232 + USB interface (option ZS01).
Includes 2 m RS-232 cable, without GPIB cable.

Option ZS03 [1] [3]

GPIB interface

If the RS-232 interface (option ZS01) already exists, the option ZS03 can be used to upgrade to the GPIB interface. The card is simply plugged in.
Delivery without GPIB cable.

1) can be retrofitted at any time 2) can only be retrofitted or produced by H&H 3) requires ZS01 or ZS02

Option ZS15 [1) 3)]

LAN Ethernet/RS-232 Converter

Data is sent via the LAN card to the Serial Interface of the unit. Option ZS01 is needed for this. If option ZS01 is already available the device can be easily upgraded with the ZS15 option.
Delivery without patch cable.

Option ZS04-M, ZS04-S

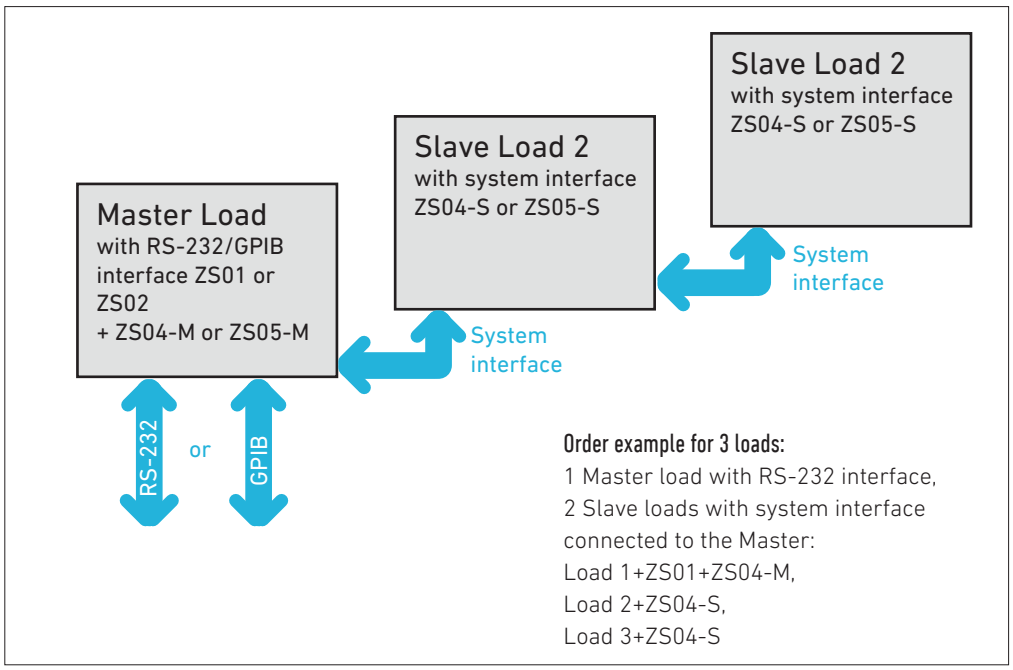
System interface cable
(-M for Master device [1) 3)],
-S for Slave device [2)])

To build multi-channel systems, additional loads can be connected to the Master device via the system interface. For this, the Master unit is fitted with the system interface ZS04-M [1) 3)] and the Slave units with ZS04-S [2)].
All units can then be programmed via the Master interface. Connection is via a standard LAN cable. The load inputs remain galvanically isolated.
Includes 1 m cable.

Option ZS05-M, ZS05-S

System interface Fiber Optic
(-M for Master device [1) 3)],
-S for Slave device [2)])

For longer distances (from 3 m) and a number of more than three devices, the system interface should be built with fiber optic. The cable version option ZS04 can easily be exchanged for the fiber optic version ZS05.
The fiber optic connection is also recommended for high EMC exposure.
Includes 5 m optical cable.



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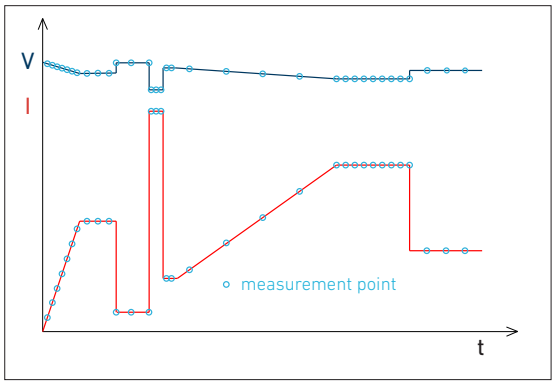
Option ZS13-15 [2)]

Data Acquisition Tool



Data acquisition with variable sampling rates synchronized to waveform (List). Voltage and current are measured simultaneously.

The Data Acquisition Tool extends the function scope of the devices by following functions:

- fast sampling synchronized to List function with data memory
- exponential inrush currents
- battery capacity test
- MPP Tracking for solar panel test

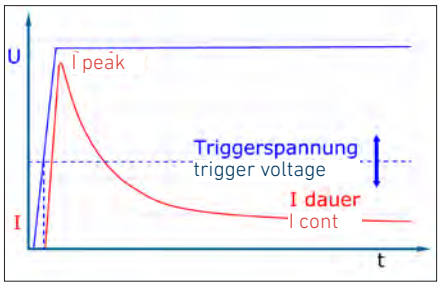
Load Profile (List Function)

In all operating modes CC, CV, CR, CP, the electronic load can simulate load profiles with the List function. Up to 50 settings of variable dwell time with associated ramp time are possible. Sampling times must be defined separately for each curve section. With option ZS13-15, voltage and current are measured synchronously and stored with a time stamp.

Capacity Test of Batteries (with Option ZS13-15)

The device discharges a battery in any operating mode up to the set cut-off voltage. When the final discharge voltage is reached, the current is switched off. Ah and Wh are measured.
To record the discharge curve, the measurement function can be started at the same time.

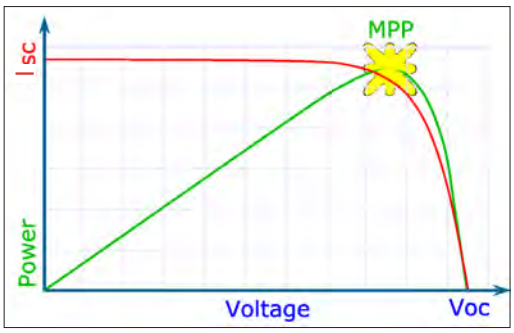
Exponential Inrush Currents (with Option ZS13-15)



Inrush process with trigger voltage

When the input voltage is applied, the device generates an exponentially decreasing curve with adjustable time constant.
Peak current, time constant (min. 2 ms) and continuous current are programmable.

MPP Tracking (with Option ZS13-15)



V/I and V/P characteristic of a PV panel

The device automatically searches for the maximum power point of solar panels and adjusts even when the sunlight changes.
Ah and Wh are measured.
At the same time the measuring function can record V and I.

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Watchdog Function

In digital remote control mode, the electronic load has a watchdog function that switches off the load input when the previously programmed watchdog delay time expires without a valid command arriving via the data interface.

Drivers

Current NI-certified LabVIEW drivers can be downloaded here:
www.hoecherl-hackl.com/ or
www.ni.com/downloads/instrument-drivers/

Software Tools

Load Control

Individual devices and multi-channel systems can be controlled via the tool.
The range of functions includes PC device set-up with the option to save, data logging with graphical display and saving data for other programs.

Data Acquisition

As well as device control, the following data can be logged and saved:
voltage - current - time

Waveform Editor

The Waveform Editor permits the intelligent generation of load profiles in the form of straight sections. The load waveform is displayed when entered. The profiles can be saved.

MPP Tracking

Solar panels can be tested in combination with Option ZS13. Voltage, current and power are displayed numerically.

Battery Test

All standard battery types can be discharged with the battery tool. The discharge curves are recorded and displayed. Ah and Wh are also logged.

Options: Hardware Expansions

Option ZS06 [1]
Galvanically isolated I/O port

In the case of potential differences between the negative load input and the signals on the Analog I/O Port 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.

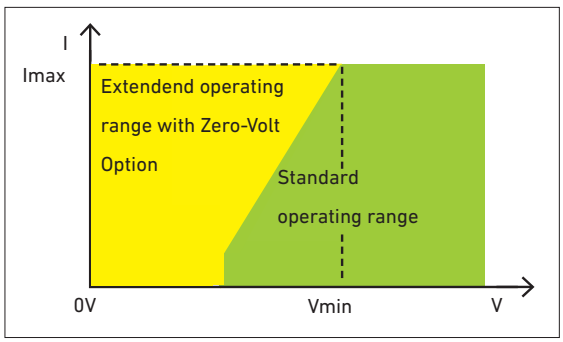
Option ZS07 [1] [3]
Power I/O Card

The Power I/O card can be expanded to control external devices. 8 relay contacts (N/O 125 V/1 A) can be actuated by SCPI commands and 8 logical inputs (5 ... 24 V, 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.

Option ZS08 [1]
Analog I/O Extension

The Analog I/O Extension card provides additional control inputs for analog presetting of trigger voltage and the current limiter. The card also has three relay outputs which are activated in the event of "Input on", reaching "voltage protection" or "overload". The signals are electrically isolated from the load input via the isolation amplifier. The isolation voltage is 500 V DC with respect to the negative load input.

NV60/NV80 [2]
Zero-Volt Option



Operating range with/without zero-volt option

The zero volt option expands the operating range of the electronic load up to the short circuit (approx. 10 mV). It can compensate voltage drops on power leads up to 0.5 V.
The zero volt option is ideal for testing fuel cells in conjunction with adjusted measuring ranges. The available zero volt options are listed in the technical overview.
The load capacity drops by approx. 3 V × the set current.
Reverse polarity protection and mains voltage switching is not available if you install a zero volt option. The fans of the zero volt option generate a continuous operating sound.

1) can be retrofitted at any time 2) can only be retrofitted or produced by H&H 3) requires ZS01 or ZS02

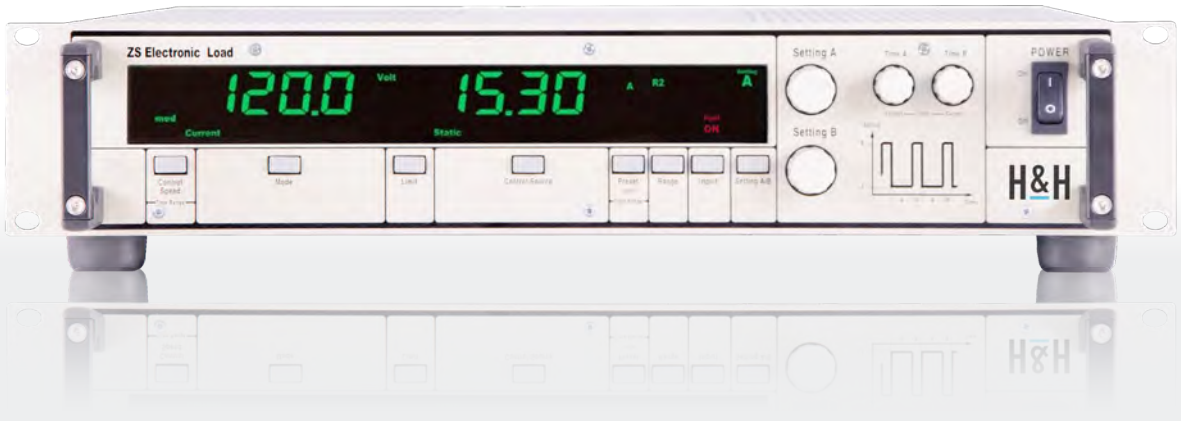
Model Overview 500 W

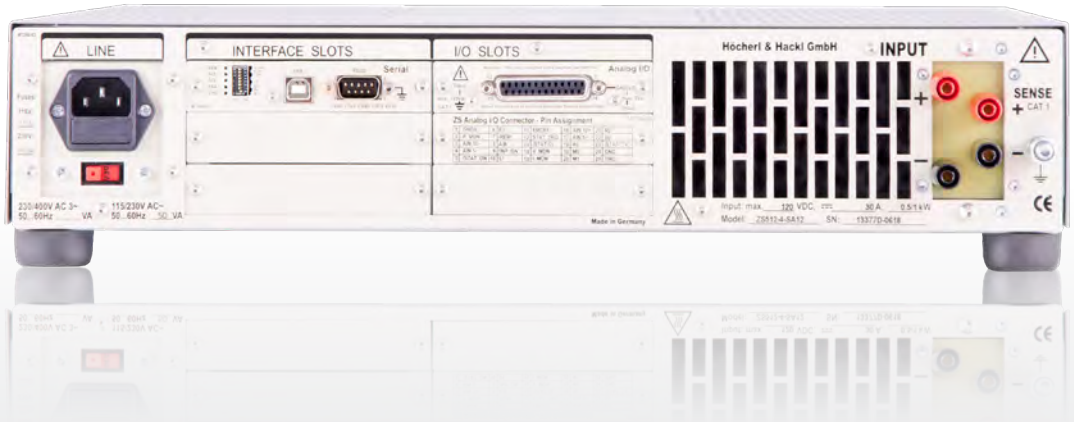
Model (order number)	ZS506-4 4 ranges	ZS512-4 4 ranges	ZS530-3 3 ranges	ZS560-3 3 ranges	ZS580-3 3 ranges
Maximum input voltage Vmax	60 V	120 V	300 V	600 V	800 V
Minimum input voltage Vmin [1]	1 V	1 V	2 V	2 V	2 V
Maximum current Imax [2]	60 mA 0.6 A 6 A 60 A	30 mA 0.3 A 3 A 30 A	120 mA 1.2 A 12 A	60 mA 0.6 A 6 A	45 mA 0.45 A 4.5 A
Continuous power	500 W	500 W	500 W	500 W	500 W
Short-time power [3]	1,000 W	1,000 W	500 W	500 W	500 W
Voltage setting	0 ... 60 V	0 ... 120 V	0 ... 300 V	0 ... 600 V	0 ... 800 V
Current setting	0 ... 60 mA 0 ... 0.6 A 0 ... 6 A 0 ... 60 A	0 ... 30 mA 0 ... 0.3 A 0 ... 3 A 0 ... 30 A	0 ... 120 mA 0 ... 1.2 A 0 ... 12 A	0 ... 60 mA 0 ... 0.6 A 0 ... 6 A	0 ... 45 mA 0 ... 0.45 A 0 ... 4,5 A
Resistance setting	33.4 Ω ... 11.1 kΩ (max. 60 mA) 3.34 Ω ... 1.11 kΩ (max. 0.6 A) 0.34 Ω ... 111 Ω (max. 6 A) 0.034 Ω ... 11.1 Ω (max. 60 A)	67 Ω ... 44.4 kΩ (max. 30 mA) 6.67 Ω ... 4.44 kΩ (max. 0.3 A) 0.67 Ω ... 444 Ω (max. 3 A) 0.067 Ω ... 44.4 Ω (max. 30 A)	16.7 Ω ... 27.7 kΩ (max. 120 mA) 1.67 Ω ... 2.77 kΩ (max. 1.2 A) 0.167 Ω ... 277 Ω (max. 12 A)	33.4 Ω ... 111 kΩ (max. 60 mA) 3.34 Ω ... 11.1 kΩ (max. 0.6 A) 0.34 Ω ... 1.11 kΩ (max. 6 A)	44.5 Ω ... 197 kΩ (max. 45 mA) 4.45 Ω ... 19.7 kΩ (max. 0.45 A) 0.45 Ω ... 1.97 kΩ (max. 4.5 A)
Power setting [4]	0 ... 1 W 0 ... 10 W 0 ... 100W 0 ... 1.000W	0 ... 1 W 0 ... 10 W 0 ... 100 W 0 ... 1.000W	0 ... 5 W 0 ... 50 W 0 ... 500 W	0 ... 5 W 0 ... 50 W 0 ... 500 W	0 ... 5 W 0 ... 50 W 0 ... 500 W
Rise/fall time [5]	60 µs	60 µs	60 µs	50 µs	60 µs
Load terminals [6] rear	FKS15/5-BO-M8x16	FKS15/5-BO-M8x16 with safety cover	SBU4-32	SBU4-32	SBU4-32
Zero-volt option	NV60	NV60	-	-	-
Power consumption	50 VA	50 VA	50 VA	50 VA	50 VA
Noise max. [7]	57 dB(A)	57 dB(A)	57 dB(A)	57 dB(A)	57 dB(A)
Weight ca.	13 kg	13 kg	12 kg	13 kg	13 kg
Housing [8]	19", 2 U	19", 2 U	19", 2 U	19", 2 U	19", 2 U

1. Minimum voltage for maximum static load current, linear derating to 0 V.
2. Each current range of a higher voltage class in the same power class can be chosen as special current range.
3. Level and duration of short-time power see diagram in technical data at page 47.
4. The setting range reaches up to the short-time power.
5. Rise and fall times are defined from 10 ... 90 % and 90 ... 10 % of maximum current at "fast" regulation speed (constant current mode, Tolerance ±20 %).
6. Description of available terminals see starting at page 109.
7. Measured at the front in distance of 1 m.
8. 1 U = 44.45 mm. Detailed dimensions by means of 3D models at www.hoecherl-hackl.com.

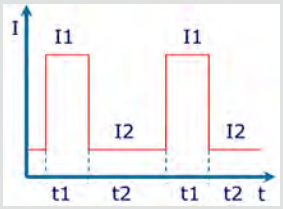
Options (Summary) and Accessories

Order number	Article	Description
52-130-001-10	ZS01	RS-232 + USB interface incl. K-RS-SNM 9-9 (RS-232 cable)
52-123-001-10	ZS02	GPIB + RS-232 + USB interface incl. K-RS-SNM 9-9 (RS-232 cable)
67-004-030-10	K-RS-SNM 9-9	RS-232 cable (nullmodem cable) ZS series
52-200-001-10	ZS03	GPIB interface extension (only if ZS01 is already installed)
52-400-001-10	ZS04-M	System interface with cable connection for ZS series ZS01 or ZS02 required incl. patch cable 1:1 blue, 1 m (system bus cable) incl. 2x Sysbus Term (termination resistor)
52-400-002-10	ZS04-S	System interface with cable connection for ZS series ZS01 and ZS02 are not installed incl. patch cable 1:1 blue, 1 m (system bus cable) incl. 2x Sysbus Term (termination resistor)
52-400-005-10	Sysbus Term	Termination resistor for ZS system bus with cable connection
67-001-010-10	Patch-Kabel 1m	Patch cable 1:1 blue, 1 m
52-400-003-10	ZS05-M	System interface fiber optic for ZS series ZS01 or ZS02 required incl. K-LWL-5 (fiber optic cable 5 m)
52-400-004-10	ZS05-S	System interface fiber optic for ZS series ZS01 and ZS02 are not installed incl. K-LWL-5 (fiber optic cable 5 m)
67-002-050-10	K-LWL-5	Fiber optic cable 5 m
54-500-001-10	ZS13-15	Data Acquisition Tool - Fast data logging, 15 bits resolution - MPP tracking - Battery capacity test - Exponential inrush processes
52-500-001-10	ZS15	Ethernet-RS-232 converter minimum ZS01 required
53-100-002-10	ZS06-N	Galvanically isolated Analog I/O Port intstead of standard Analog I/O Port
53-100-001-10	ZS06	Galvanically isolated Analog I/O Port extension for existing device
54-001-000-10	ZS07	Power I/O card 8 relay contacts 1x ON, 8 logic inputs
53-200-000-10	ZS08	Analog-I/O extension card (isolated) Analog setting of undervoltage and overcurrent protection
63-000-001-10	ZS17	Switch box external load activation via I/O port
65-002-000-10	FCC-ZSxx	Factory Calibration Certificate
64-401-000-10	SAB-ZS-2	Additional safety cover for load terminals for devices with 2 U
67-003-020-10	K-MS-ZS-2	Master-Slave cable for 2 devices (2 m)
67-003-040-10	K-MS-ZS-3	Master-Slave cable für 3 devices (2 x 2 m)
49-001-000-10	SX	Modified setting range for ZS series only after consulting H&H
49-002-000-10	SSX	Custom-specific setting range only after consulting H&H
51-060-001-10	NV60	Null-Volt option for max. 60 A
51-080-001-10	NV80	Null-Volt option for max. 80 A
		Load cables see starting at page 113


ZS Electronic Load
120.0
Volt
15.30
Current
Static
Setting A
Setting B
POWER
H&H


LINE
INTERFACE SLOTS
I/O SLOTS
Höcherl & Hackl GmbH
INPUT
SENSE
Made in Germany

Accuracy of local setting, without preset function		
	of setting	of corresponding range
Voltage	±0.2 %	±0.05 %
Current	±0.2 %	±0.05 %
Accuracy of local setting via preset function		
	of setting	of corresponding range
Voltage	±0.6 %	±0.05 %
Current	±0.6 %	±0.05 %
Resistance	±1.4 %	±0.3 % of current range
Power	±1.4 %	±0.5 %
Accuracy of adjustable protections		
	of setting	of corresponding range
Overcurrent protection	±1.4 %	±0.3 %
Undervoltage protection	±1.4 %	±0.3 %
Accuracy of display		
	of measured value (real value)	of corresponding range
Voltage	±0.2 %	±0.05 % ±1 digit
Current	±0.2 %	±0.05 % ±1 digit
Accuracy of setting, programming via data interface		
	of setting	of corresponding range
Voltage	±0.2 %	±0.05 %
Current	±0.2 %	±0.05 %
Resistance	±1 %	±0.3 % of current range
Power	±1 %	±0.5 %
Overcurrent protection	±1 %	±0.3 %
Undervoltage protection	±1 %	±0.3 %
Resolution	16 bits	
Accuracy of times at List function	5 %	
Accuracy of measurement, read out by data interface		
	of measured value (real value)	of corresponding range
Voltage	±0.1 %	±0.05 %
Current	±0.2 %	±0.05 %
Power	calculated of voltage and current	
Resolution	18 bits	
Sample rate	330 ms, not triggerable	
Accuracy of measurement, read out by data interface with option ZS13		
	of measured value (real value)	of corresponding range
Voltage	±0.15 %	±0.07 %
Current	±0.3 %	±0.07 %
Power	calculated of voltage and current	
Resolution	15 bits	
Sample rate	minimal 200 µs (in emory) triggerable	

Modulator at local operation		
2 currents and 2 times can be set independently		
Time ranges	100 ms	1000 ms
Accuracy of time setting	of setting ±1.4 %	of corresponding range ±0.5 %
Dynamic function in remote operation via data interface (List) with option ZS13		
No. of load levels	50	
	min.	max.
Dwell time	200 µs	2,000 s
Ramp time	0 s	2,000 s
Resolution	200 µs	
I/O port: accuracy analog control 0 ... 5 V / 0 ... 10 V		
	of setting	of corresponding range
Voltage	±0.2 %	±0.1 %
Current	±0.2 %	±0.1 %
Power	±2 %	±0.5 %
Overcurrent protection [1]	±1 %	±0.4 %
Undervoltage protection [1]	±1 %	±0.4 %
	Input resistance of analog inputs >10 kΩ	
I/O port: accuracy analog monitor signals 0 ... 10 V [3]		
	of analog signal of real value	offset voltage
Voltage	±0.2 %	±15 mV
Current	±0.2 %	±15 mV
Power	±2 %	±30 mV
	minimal load 2 kΩ	
I/O port: permissible potentials		
	standard I/O port	isolated I/O port (option ZS06)
GND - neg. load input	max. 2 V [2]	max. 500 V [2] not with Zero-Volt option
GND - PE	max. 125 V [2]	max. 125 V [2]
I/O port: control outputs and inputs		
Outputs	status load input (low active) status setting A - B status overload (OV, OPP, OTP, low active) status UV (low active)	
Output level	selectable 5 V, 24 V	
Control inputs	selection of setting resolution selection of operating mode selection of control source control input setting A - B control input load input (low active) remote shut-down (emergency off, high active) trigger input (low active)	
Input level	3 ... 24 V	

The specified accuracies refer to an ambient temperature of 23 ±5 °C. The specified accuracies are valid when the unit is connected to undisturbed voltages (ripple and noise < 0.1 %). At voltages with higher disturbance values the accuracy can change for the worse.

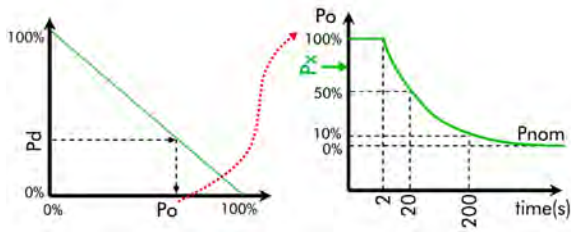
1. only if option ZS08 is installed.
2. positive or negative DC voltage or RMS value of a sinusoidal AC voltage.
3. current and power-proportional measurement signals are related to the selected setting range.

Technical Data (continued)

Input	
Input resistance	>50 kΩ when load input is off diode function at reverse polarity up to Imax
Input capacity	approx. 2 µF/1,000 W
Parallel operation	up to 3 devices in Master-Slave mode (hardware-controlled)
Max. input voltage	see model overview
Min. input voltage	see model overview

Input: permissible potentials		
	standard I/O port	isolated I/O port (option ZS06)
neg. load input - PE	max. 125 V [1]	max. 500 V [1] not with Zero-Volt option

Power	
Continuous power	see model overview (at Ta = 21 °C)
Derating	-1.2 %/°C for Ta > 21 °C
Overload capacity (short-time power)	see model overview The max. possible overload Po depends on the temperature of the device and therefore on the previously consumed continuous power Pd. The possible overload duration depends on the value of the overload Px.



Protection and monitoring	
Protective devices	overcurrent protection overpower protection overtemperature protection
Monitoring	overvoltage indication undervoltage indication (if input voltage is too low for the set current)

Terminals	
Load input	see model overview
Sense	ZS530-3, ZS560-3: SBU4-32 all others: PK4-35L-2, see starting at page 109

Operating conditions	
Operating temperature	5 ... 40 °C
Stock temperature	-25 ... 65 °C
Max. operating height	2,000 m above sea level
Pollution degree	2
Max. humidity	80 % at 31 °C, linear decreasing to 50 % at 40 °C
Min. distance rear panel - wall or other objects	70 cm
Cooling	temperature-controlled air cooling
Noise, weight	see model overview
Mains voltage	115/230 V AC (±10 %), selectable, 50 ... 60 Hz
Power consumption	see model overview

Mechanics	
Color Front Rear Side panels, top	 RAL7032 (pebble grey) RAL7032 (pebble grey) RAL7037 (dusty grey)

Safety and EMC	
Protection class	1
Protection	IP20
Measuring category	O (CAT I according to EN61010:2004)
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

Calibration, warranty	
FCC-ZSxx	Factory Calibration Certificate, twice free of charge
Warranty	2 years

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