

Electronic AC and DC Loads

# AC LOAD ZSAC SERIES



- Frequency range up to 800 Hz
- As single phase version and for 3-phase
- Star and delta connection possible
- Input voltages up to 440 V
- Power 400 W ... 21,000 W
- Operating modes CC, CR
- Programmable waveform
- Dynamic loads
- Phase angle adjustment combined with crest factor
- Harmonics, phase control
- SCPI programming with measurement function
- Electronic protection
- Isolated measurement outputs for voltage and current
- Isolated analog control input

## ZSAC Series – Brief Profile

The AC load of the ZSAC series is derived from the classic ZS series and is designed for both AC and DC applications.

In remote control mode, the ZSAC load can be programmed with various waveforms such as harmonic, phase cut or crest factor currents. Phase angle adjustment is combined with crest factor adjustment.

## Interfaces

- RS-232
- USB
- LAN
- GPIB
- CAN
- System bus
- Analog
- Analog isolated

Standard     Option     not available

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## Operating Modes

The AC loads of the ZSAC series have constant current and constant resistance modes (CC, CR mode).  
In AC operation, a sinusoidal current is set. In resistance mode, the current level and waveform depend on the input voltage.

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## Voltage Types

Depending on the type of voltage the devices can be switched between mains-synchronous voltage, AC voltage with variable frequency and DC voltage.

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## Protective Devices, Monitoring

- Overcurrent protection
- Overpower protection
- Overtemperature protection
- Overvoltage indication
- Undervoltage indication

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## Cooling

The units are air-cooled. In order to keep the operating noise low, the fans are controlled according to temperature and current.

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## I/O Port

Analog signals  
in realtime!

All inputs and outputs on the standard I/O port are galvanically isolated from the load input. The control inputs can be operated with TTL level and 24 V from PLC controls.

Signals for:

- Analog load setting from 0 ... 3.5 V or 0 ... 7 V in CC mode
- Operating mode
- Input activation state
- Function selection (AC, Line, DC)
- Waveform selection
- Control source selection (dynamic, static, extern)
- Trigger input
- Control signal for selection of setting A or B
- Analog voltage monitor signal 0 ... 7 V
- Analog current monitor signal 0 ... 7 V
- Analog power monitor signal 0 ... 5 V
- Status output input activation state
- Status output A/B (high = setting A, low = setting B)
- Status output overload

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## Waveforms

In current mode, a low-distortion sinusoidal waveform is permanently stored. In resistance mode, both the height and the waveform of the current depend on the waveform of the applied input voltage.

During programming, any waveform can be specified and stored in the recallable waveform memory. Functions for harmonic oscillations, phase cut currents and currents with adjustable crest factor are predefined. Phase angle adjustment is combined with crest factor adjustment.

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## Factory Calibration Certificate (FCC-ZSACxx)

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.

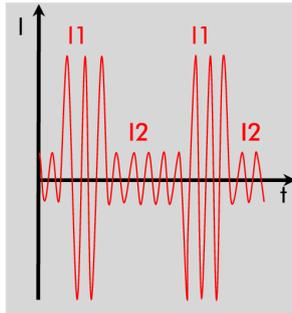
## Mechanics



Retractable handle

The ZSAC series is designed in stable 19" technology and can also be used as a desktop unit. From 5 U there are retractable heavy-duty carrying handles on the top of the unit. Castors can optionally be mounted on heavy equipment. No separate mounting kits are required for 19" installation.

## Dynamics



Dynamic Function with 2 load currents and 2 duration times in local mode

The built-in modulator allows two independently adjustable currents and times of 100  $\mu$ s ... 1 s in local operation. 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. In AC mode, the modulator is used to set the envelope of the rms alternating current (amplitude modulation).

## Options: Data Interfaces



Programming via a data interface extends the functional range of the ZSAC Load by many dynamic functions in connection with synchronous measurement storage. The interface cards are pluggable and can be exchanged or extended as required.

### Option ZS01 <sup>2)</sup> 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 <sup>2)</sup> 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 <sup>1) 3)</sup> 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** <sup>1) 3)</sup>  
 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.

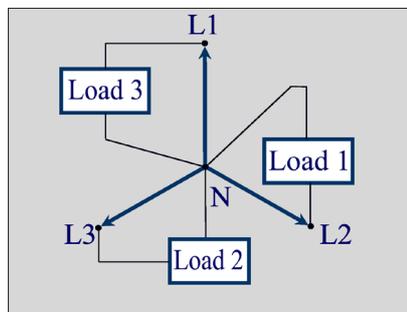
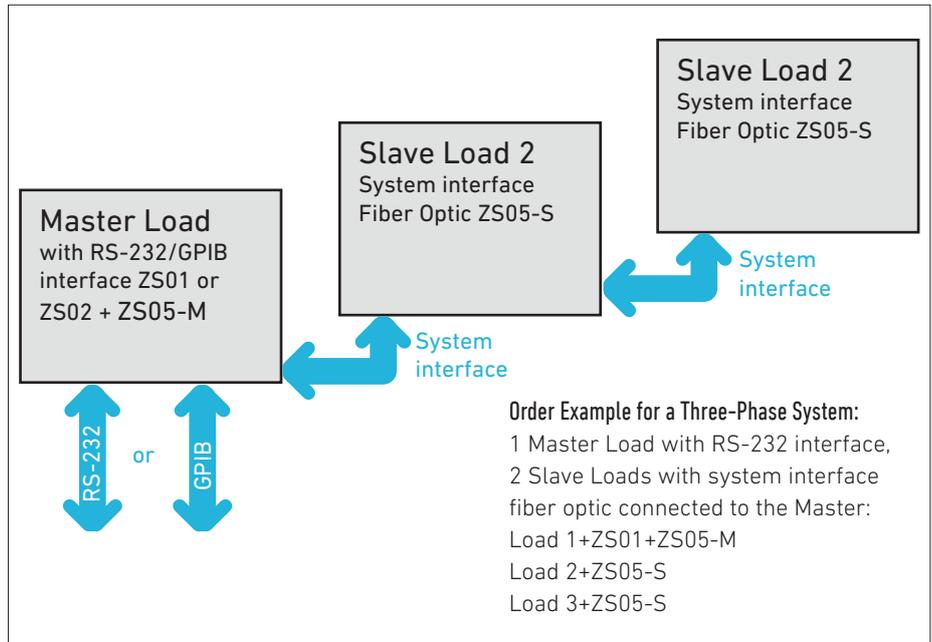
**Option ZS05-M, ZS05-S**  
 System Interface Fiber Optic  
 (-M for Master Device <sup>3)</sup>,  
 -S for Slave Device)



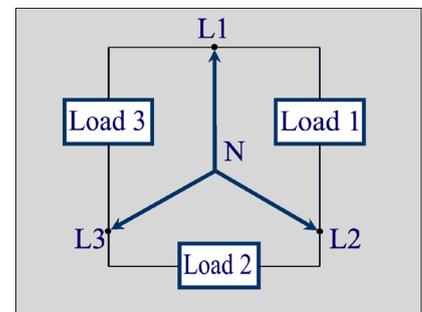
The fiber optic connection is used to control three-phase systems. Option ZS01 or ZS02 is required. Includes 5 m optical cable.

**Wiring of Three-Phase Systems**

Depending on the rated voltage, Phase-Phase, Phase-Neutral or mixed devices can be wired. The control can be either individual, in Master-Slave mode or via interface. For ease of programming we recommend connecting both Slave devices to the Master device by fiber optic interface. The devices can then be programmed in common or individually.



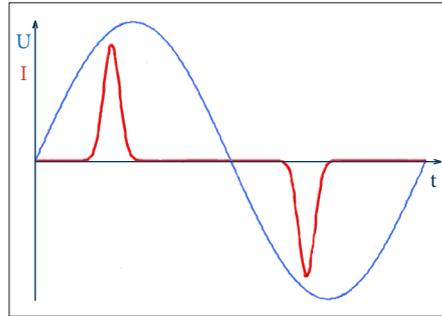
Phase-neutral connection  
 (260 V models)



Phase-phase connection  
 (440 V models)

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

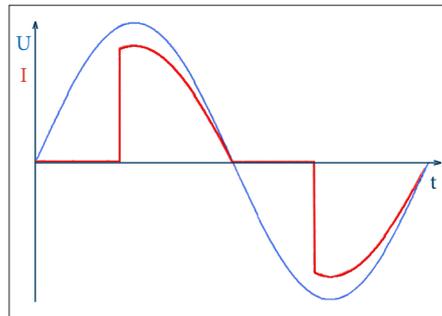
### Crest Factor and Phase Shift



Phasen shift by  $-40^\circ$  with crest factor 3

By programming a crest factor (0 ... 10), the ratio of peak value to rms value of the load current is changed in such a way that the sine half-waves are compressed in terms of time. The phase shift setting is combined with the crest factor setting. A phase shift in the sense of a fully capacitive or inductive load is not possible.

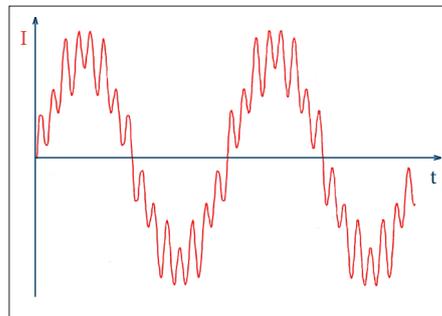
### Phase-Controlled Currents



Phase control

A phase cut angle can be programmed for each half-wave, which is set to 0 during execution. The two angles can be defined independently of each other from 0 to  $180^\circ$ . For example, an entire half-wave can be deleted.

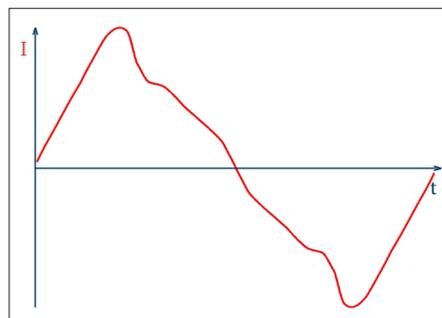
### Harmonics



Harmonics with Fourier synthesis

Fourier synthesis describes the generation of arbitrary signals from sinusoidal functions. The scaled amplitudes of the odd-numbered harmonics, i.e. 1st to 15th harmonics, are defined with 8 parameters.

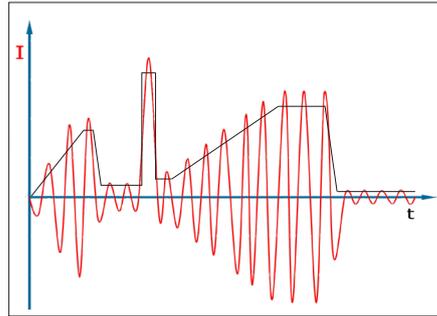
### Programmable Waveform



Programmable waveform

An AC period is internally mapped with 512 discrete points. In order to generate individual waveforms, each single point in the range from 0 to 511 can be described with a value between 0.0 and 1.0. This makes it very easy, for example, to program break-ins.

## Load Profiles (List Function)



List function as rms envelope curve

In both operating modes CC and CR, the ZSAC load can simulate load profiles with the LIST function. Up to 50 setpoints of variable duration with associated ramp time are possible. In AC mode, the LIST function serves as an envelope of the effective value.

Sampling times must be defined separately for each segment of the waveform. Voltage and current are measured synchronously and stored with a timestamp.

## Capacity Test of Energy Storage Devices

The device discharges a battery in any operating mode up to the set cut-off voltage. When the cut-off voltage is reached, the current is switched off. Ah and Wh are measured.

To record the discharge curve, the measurement function can be started simultaneously.

## 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/](http://www.hoecherl-hackl.com/) or

[www.ni.com/downloads/instrument-drivers/](http://www.ni.com/downloads/instrument-drivers/)

## Software Tools

### Data Acquisition

Together with the device control, the following measurement data can be recorded and stored: voltage - current - time.

### Waveform Editor

The Waveform Editor allows easy generation of load profiles in the form of straight sections. The load profile is displayed graphically as soon as it is entered. The profiles can be saved.

The tool also provides convenient support for generating and visualizing the waveforms (harmonics, etc.) previously shown.

## Options: Hardware Extensions

### Option ZS07 <sup>1) 3)</sup> Power I/O Card



The power I/O card can be added to control external equipment. 8 relay contacts (N/O contact 125 V/1 A) can be operated via the data interface of the load, as well as 8 logic inputs (5 ... 24 V, common GND) can be queried. The outputs and inputs are isolated from the load input. The insulation voltage is 500 V DC with respect to the negative load input.

### Option ZS09 <sup>1)</sup> Castors



Heavy-load castors

Steerable castors can be mounted on big devices for easier transport. This often saves the need for a 19" cabinet. This option is available for units from 5 U and upwards and is only suitable for hard floors.

## Options (Summary) and Accessories

Best.-Nr.	Artikel	Beschreibung
52-130-001-11	ZS01	RS-232 + USB interface incl. K-RS-SNM 9-9 (RS-232 cable)
52-123-001-11	ZS02	GPIO + RS-232 + USB interface incl. K-RS-SNM 9-9 (RS-232 cable)
67-004-030-11	K-RS-SNM 9-9	RS-232 cable (Nullmodem cable) ZSAC series
52-200-001-11	ZS03	GPIO Interface extension (only if ZS01 is already installed)
52-400-003-11	ZS05-M	System interface fiber optic for ZSAC ZS01 or ZS02 required incl. K-LWL-5 (fiber optic cable 5 m)
52-400-004-11	ZS05-S	System interface fiber optic for ZSAC ZS01 and ZS02 are not installed incl. K-LWL-5 (fiber optic cable 5 m)
67-002-050-11	K-LWL-5	Fiber optic cable 5 m
52-500-001-11	ZS15	Ethernet-RS-232 Converter minimum ZS01 required
54-001-000-11	ZS07	Power I/O Board 8 relay contacts 1x ON, 8 logic inputs
64-400-000-11	ZS09	Heavy-load castors for devices from 5 U (1 set = 4 pieces)
65-002-000-11	FCC-ZSACxx	Factory Calibration Certificate
67-003-020-11	K-MS-ZSAC-2	Master-Slave-Cable for 2 devices (2m)
67-003-040-11	K-MS-ZSAC-3	Master-Slave-Cable for 3 devices (2x 2 m)
49-002-000-11	SSX	Custom-specific setting range only after consulting H&H
73-021-020-01	HKV-F16Con/0-2-bk	High current cable black for ZSAC Series with socket SBUS6-125 (included in standard delivery for devices with SBUS6-125 load terminals)
73-022-020-01	HKV-F16Con/0-2-rd	High current cable red for ZSAC Series with socket SBUS6-125 (included in standard delivery for devices with SBUS6-125 load terminals)

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

Model (Order number)	ZSAC426	ZSAC444	ZSAC1426	ZSAC1444	ZSAC2826	ZSAC2844
Minimum ... maximum input voltage	6 ... 260 V AC 6 ... 370 V DC	10 ... 440 V AC 10 ... 620 V DC	6 ... 260 V AC 6 ... 370 V DC	10 ... 440 V AC 10 ... 620 V DC	6 ... 260 V AC 6 ... 370 V DC	10 ... 440 V AC 10 ... 620 V DC
Current	6 A	3 A	10 A	5 A	20 A	10 A
Power	400 W	400 W	1,400 W	1,400 W	2,800 W	2,800 W
Resistance	2 ... 2,000 Ω	3 ... 6,666 Ω	1 ... 1,200 Ω	2 ... 4,000 Ω	0.5 ... 600 Ω	1 ... 2,000 Ω
Load terminals <sup>1)</sup>	SBUS4-32	SBUS4-32	SBUS4-32	SBUS4-32	SBUS6-125	SBUS4-32
Power consumption	85 VA	85 VA	190 VA	140 VA	270 VA	250 VA
Noise max. <sup>2)</sup>	53 dB(A)	53 dB(A)	71 dB(A)	71 dB(A)	72 dB(A)	71 dB(A)
Weight ca.	13 kg	13 kg	29 kg	29 kg	35 kg	33 kg
Housing <sup>3)</sup>	19", 2 U	19", 2 U	19", 5 U	19", 5 U	19", 5 U	19", 5 U

Model (Order number)	ZSAC4226	ZSAC4244	ZSAC5626	ZSAC5644	ZSAC7026	ZSAC7044
Minimum ... maximum input voltage	6 ... 260 V AC 6 ... 370 V DC	10 ... 440 V AC 10 ... 620 V DC	6 ... 260 V AC 6 ... 370 V DC	10 ... 440 V AC 10 ... 620 V DC	6 ... 260 V AC 6 ... 370 V DC	10 ... 440 V AC 10 ... 620 V DC
Current	30 A	15 A	40 A	20 A	50 A	25 A
Power	4,200 W	4,200 W	5,600 W	5,600 W	7,000 W	7,000 W
Resistance	0.34 ... 400 Ω	0.7 ... 1,333 Ω	0.25 ... 300 Ω	0.5 ... 1,000 Ω	0.2 ... 240 Ω	0.4 ... 800 Ω
Load terminals <sup>1)</sup>	SBUS6-125	SBUS4-32	SBUS6-125	SBUS6-125	SBUS6-125	SBUS6-125
Power consumption	450 VA	300 VA	600 VA	420 VA	730 VA	490 VA
Noise max. <sup>2)</sup>	73 dB(A)	73 dB(A)	73 dB(A)	73 dB(A)	74 dB(A)	74 dB(A)
Weight ca.	43 kg	41 kg	53 kg	53 kg	59 kg	59 kg
Housing <sup>3)</sup>	19", 5 U	19", 5 U	19", 8 U	19", 8 U	19", 8 U	19", 8 U

Model (Order number)	ZSACR8426	ZSAC8444	ZSACR9826	ZSAC9844	ZSACRV11226	ZSAC11244
Minimum ... maximum input voltage	50 ... 260 V AC 50 ... 370 V DC	10 ... 440 V AC 10 ... 620 V DC	50 ... 260 V AC 50 ... 370 V DC	10 ... 440 V AC 10 ... 620 V DC	50 ... 260 V AC 50 ... 370 V DC	10 ... 440 V AC 10 ... 620 V DC
Current	60 A	30 A	70 A	35 A	80 A	40 A
Power	8,400 W	8,400 W	9,800 W	9,800 W	11,200 W	11,200 W
Resistance	0.84 ... 200 Ω	0.34 ... 666 Ω	0.72 ... 171 Ω	0.3 ... 570 Ω	0.63 ... 150 Ω	0.25 ... 500 Ω
Load terminals <sup>1)</sup>	SBUS6-125	SBUS6-125	SBUS6-125	SBUS6-125	SBUS6-125	SBUS6-125
Power consumption	380 VA	670 VA	430 VA	700 VA	515 VA	775 VA
Noise max. <sup>2)</sup>	74 dB(A)	74 dB(A)	74 dB(A)	74 dB(A)	76 dB(A)	76 dB(A)
Weight ca.	63 kg	64 kg	78 kg	79 kg	82 kg	84 kg
Housing <sup>3)</sup>	19", 8 U	19", 8 U	19", 11 U	19", 11 U	19", 11 U	19", 11 U

Model (Order number)	ZSACRV12626	ZSAC12644	ZSACRV14026	ZSAC14044	ZSACRV15444	ZSACRV16844
Minimum ... maximum input voltage	50 ... 260 V AC 50 ... 370 V DC	10 ... 440 V AC 10 ... 620 V DC	50 ... 260 V AC 50 ... 370 V DC	10 ... 440 V AC 10 ... 620 V DC	50 ... 440 V AC 50 ... 620 V DC	50 ... 440 V AC 50 ... 620 V DC
Current	90 A	45 A	100 A	50 A	55 A	60 A
Power	12,600 W	12,600 W	14,000 W	14,000 W	15,400 W	16,800 W
Resistance	0.56 ... 133 Ω	0.23 ... 444 Ω	0.5 ... 120 Ω	0.2 ... 400 Ω	0.91 ... 363 Ω	0.84 ... 333 Ω
Load terminals <sup>1)</sup>	SBUS6-125	SBUS6-125	SBUS6-125	SBUS6-125	SBUS6-125	SBUS6-125
Power consumption	580 VA	1,150 VA	640 VA	695 VA	735 VA	805 VA
Noise max. <sup>2)</sup>	75 dB(A)	75 dB(A)	80 dB(A)	80 dB(A)	80 dB(A)	81 dB(A)
Weight ca.	90 kg	91 kg	100 kg	103 kg	105 kg	110 kg
Housing <sup>3)</sup>	19", 11 U	19", 11 U	19", 14 U	19", 14 U	19", 14 U	19", 14 U

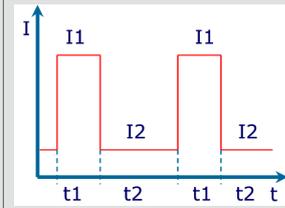
Model (Order number)	ZSACRV18244	ZSACRV19644	ZSACRV21044
Minimum ... maximum input voltage	50 ... 440 V AC 50 ... 620 V DC	50 ... 440 V AC 50 ... 620 V DC	50 ... 440 V AC 50 ... 620 V DC
Current	65 A	70 A	75 A
Power	18,200 W	19,600 W	21,000 W
Resistance	0.77 ... 307 Ω	0.72 ... 285 Ω	0.67 ... 266 Ω
Load terminals <sup>1)</sup>	SBUS6-125	SBUS6-125	SBUS6-125
Power consumption	875 VA	900 VA	900 VA
Noise max. <sup>2)</sup>	82 dB(A)	82 dB(A)	83 dB(A)
Weight ca.	114 kg	122 kg	130 kg
Housing <sup>3)</sup>	19", 17 U	19", 17 U	19", 17 U

1. Description of available terminals starting at page 103.
2. Measured at the front in distance of 1 m.
3. 1 U = 44.45 mm. Detailed dimensions by means of 3D models at [www.hoecherl-hackl.com/downloads](http://www.hoecherl-hackl.com/downloads).

Accuracy of local setting, without presetting <sup>1)</sup>		
	of setting	of corresponding range
Current DC, 50 Hz 400 Hz	±0.5 % ±1 %	±0.3 % ±0.6 %
Accuracy of local presetting <sup>1)</sup>		
	of presetting	of corresponding range
Current DC, 50 Hz 400 Hz	±0.9 % ±1.4 %	±0.3 % ±0.6 %
Resistance DC, 50 Hz 400 Hz	±1.9 % ±3.4 %	±0.5 % of current range ±1 % of current range
Total harmonic distortion <sup>2)</sup>		
DC, 50 Hz 400 Hz	1 % at maximum current 5 % at maximum current	
Accuracy of display		
	of measured value (real value)	of corresponding range
Voltage DC, 50 Hz 400 Hz	±0.3 % ±0.6 %	±0.1 % ±1 digit ±0.2 % ±1 digit
Current DC, 50 Hz 400 Hz	±0.5 % ±1 %	±0.3 % ±1 digit ±0.6 % ±1 digit
Accuracy of setting, programming via data interface <sup>1)</sup>		
	of setting	of corresponding range
Current DC, 50 Hz 400 Hz	±0.5 % ±1 %	±0.3 % ±0.6 %
Resistance DC, 50 Hz 400 Hz	±1.5 % ±3 %	±0.5 % of current range ±1 % of current range
Setting resolution	16 bits	
Accuracy of measurement, read out via data interface		
	of measured value (real value)	of corresponding range
Voltage DC, 50 Hz 400 Hz	±0.5 % ±1 %	±0.05 % ±0.1 %
Current DC, 50 Hz 400 Hz	±0.5 % ±1 %	±0.05 % ±0.1 %
Measurement resolution	18 bits	
Sampling rate	330 ms, not triggerable	

## Modulator in 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 %
I/O port: accuracy of analog control 0 ... 3.5 V / 0 ... 7 V for current		
	of setting	of corresponding range
Current DC, 50 Hz 400 Hz	±0.5 % ±1 %	±0.3 % ±0.6 %
Input resistance of analog inputs >10 kΩ		
I/O port: accuracy of analog monitor signals 0 ... 7 V for voltage and current, 0 ... 5 V for power		
	of analog signal of real value	offset voltage
Voltage DC, 50 Hz 400 Hz	±0.5 % ±1 %	±15 mV ±30 mV
Current DC, 50 Hz 400 Hz	±0.5 % ±1 %	±15 mV ±30 mV
Power DC, 50 Hz 400 Hz	±2 % ±4 %	±30 mV ±60 mV
GND galvanically isolated from load input		
I/O port: permissible potentials		
GND - Input LO	max. 500 V <sup>3)</sup>	
GND - PE	max. 125 V <sup>3)</sup>	
I/O port: control 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 operating mode selection of control source selection of waveform control input setting A - B control input load input (low active) remote shut-down (emergency off, high active) trigger input (low active)	
Input level	up to 24 V	
Input		
Frequency range	DC, 40 ... 800 Hz	
Input resistance	DC: > 50 kΩ at deactivated input	
Input capacity	ca. 1.5 μF/1,400 W	
Parallel operation	up to 3 devices in Master-Slave operation (hardware-controlled)	
Max. input voltage V <sub>max</sub>	see model overview	
Min. input voltage V <sub>min</sub> for max. current	see model overview	

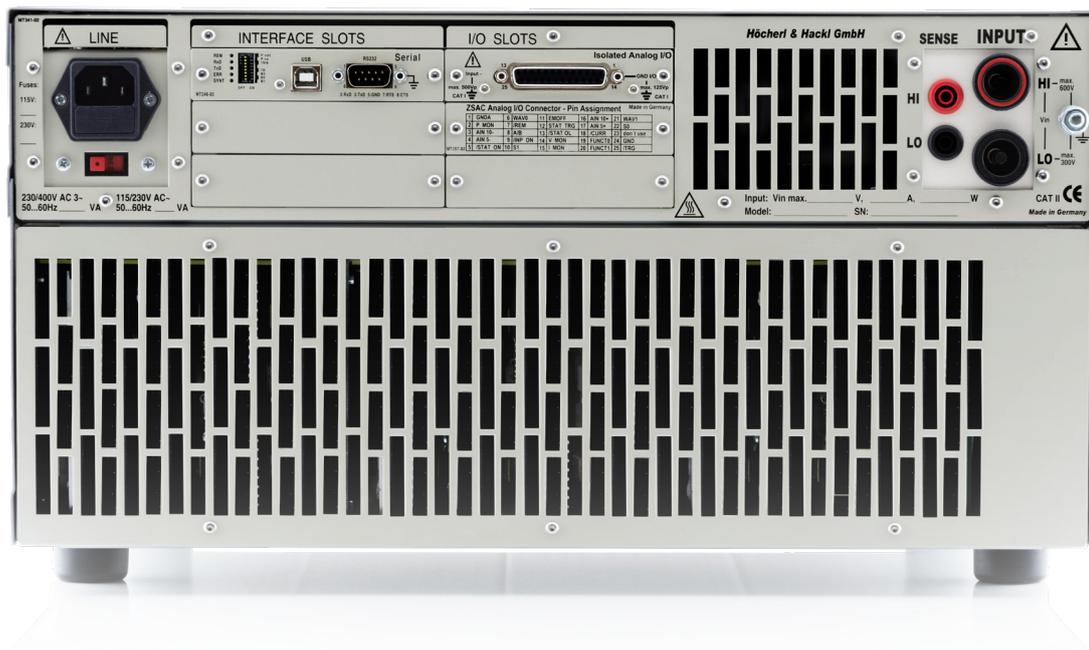
The specified accuracies refer to an ambient temperature of 23 ±5 °C. The specified accuracies are valid when the unit is connected to undisturbed voltages (ripple and noise < 0.1 %). At voltages with higher disturbance values the accuracy can change for the worse.

1. The accuracy applies for the specified frequencies.  
At higher frequencies the accuracy decreases.
2. The total harmonic distortion increases at lower currents.
3. Positive or negative DC voltage or RMS value of a sinusoidal AC voltage.

## Technical Data (continued)

Input: permissible Potentials	
Input LO - PE	max. 300 V <sup>3)</sup>
Power	
Continuous power	see model overview (at Ta = 21 °C)
Derating	-1.2 %/°C for Ta > 21 °C
Protection and monitoring	
Protective devices	overcurrent overpower overtemperature
Monitoring	overvoltage undervoltage (if the input voltage is too low for the set current)
Terminals	
Load input	see model overview
Sense	SBUS4-32, see starting at page 103
Operating conditions	
Operating temperature	5 ... 40 °C
Stock temperature	-25 ... 65 °C
Max. operating height	2,000 m above sea level
Pollution degree	1
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	see model overview
Supply voltage	115/230 V AC (±10 %), selectable, 50 ... 60 Hz
Power consumption	see model overview

Mechanics	
Housing, weight	see model overview
Color	
Front	RAL7032 (pebble grey)
Rear	RAL7032 (pebble grey)
Side panels, top	RAL7037 (dusty grey)
Safety and EMC	
Safety class	1
Safety	IP20
Measuring category	0 (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
Calibration, warranty	
FCC-ZSACxx	Factory Calibration Certificate, 2 x for free
Warranty	2 years



1. The accuracy applies for the specified frequencies. At higher frequencies the accuracy decreases.
2. The total harmonic distortion increases at lower currents.
3. Positive or negative DC voltage or RMS value of a sinusoidal AC voltage.