

ACS series of 4-quadrant amplifiers

4-QUADRANT CURRENT AMPLIFIER



4-quadrant amplifier ACS 1500

The relating applications:

*Automated tests of
circuit breakers,
fuses and relays,
coils and measuring
transformers,
capacitors and
terminal blocks*

*Test and calibration of
power analysers and meters*

- ✓ Operates from DC up to 1 kHz large signal bandwidth (-3 dB)
- ✓ Integrated 4-channel signal synthesiser for arbitrary waveform generation and integrated waveform storage capability
- ✓ High output current accuracy and stability, high short-time current capability
- ✓ Extended synchronisation possibilities (e.g. 3 x current + 3 x voltage sources)
- ✓ Modular system concept – basic amplifier unit can be combined with various transformer units for high current applications
- ✓ Remote control interface (Ethernet, Digital I/O) and optical link for easy PHIL interface
- ✓ Voltage limitation adjustable
- ✓ Internal oscilloscope
- ✓ Amplifier control via webinterface and interface commands

CURRENT SOURCE FOR ALL APPLICATIONS



Typical current amplifier

Amplifier with optional redundant shutdown, switch for common output, current transformer for high current ranges and common output panel.

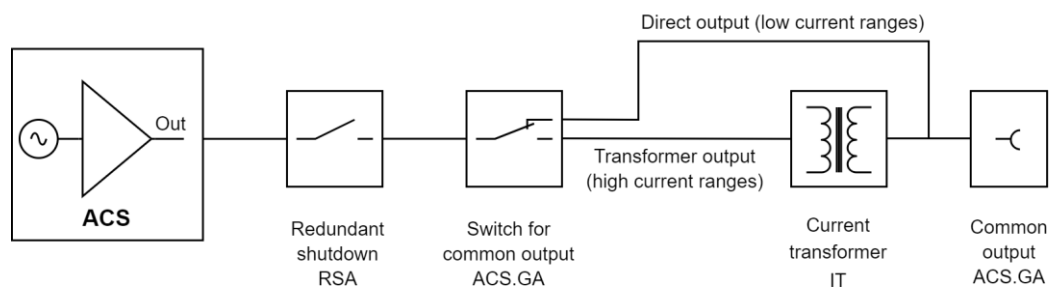


Fig. 1: Schematic overview of current amplifier

Current transformer – IT series

A current transformer allows to add additional current ranges to an ACS series amplifier. These current ranges can be individually specified, e.g. ACS 9000:

Standard current ranges (RMS / DC)	60 A / 42 A (max. 60 V / ± 85 V) 60 A / 42 A (max. 135 V / ± 191 V) 33 A / 23 A (max. 270 V / ± 382 V)
Additional current ranges with IT 9000 (RMS)	400 A (max. 22.5 V) 1200 A (max. 7.5 V)

ACS current characteristic

Short time AC current capability of the ACS series amplifier in dependency of the time duration of the pulse current.

- e.g. for 10 s 2.5 times the continuous current
- for 50 ms 4.8 times the continuous current

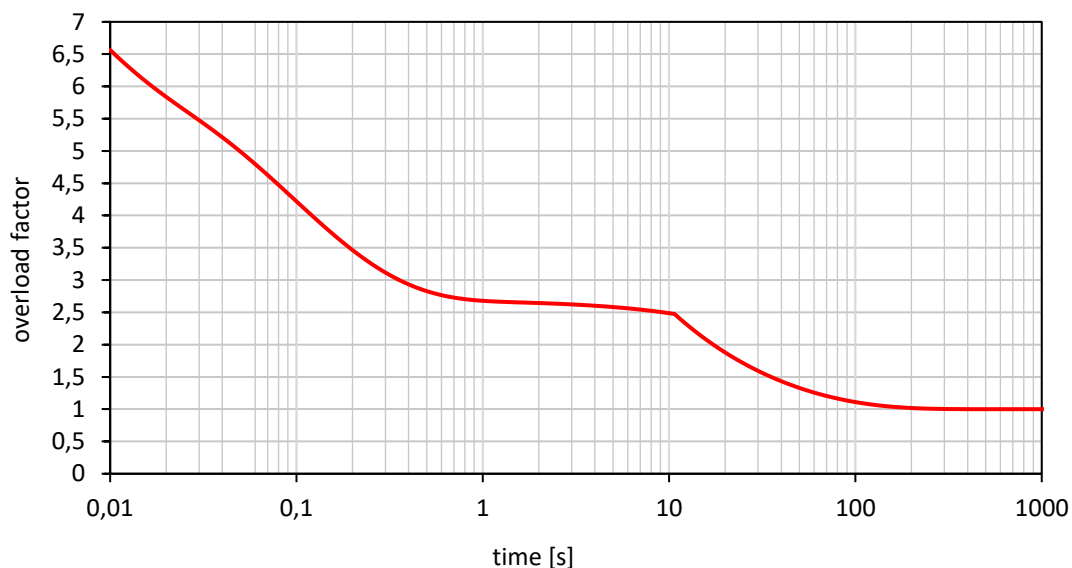


Fig. 2: AC current capability

Short time DC current capability of the ACS series amplifier in dependency of the time duration of the pulse current.

- e.g. for 10 s 1.9 times the continuous current
- for 50 ms 4.5 times the continuous current

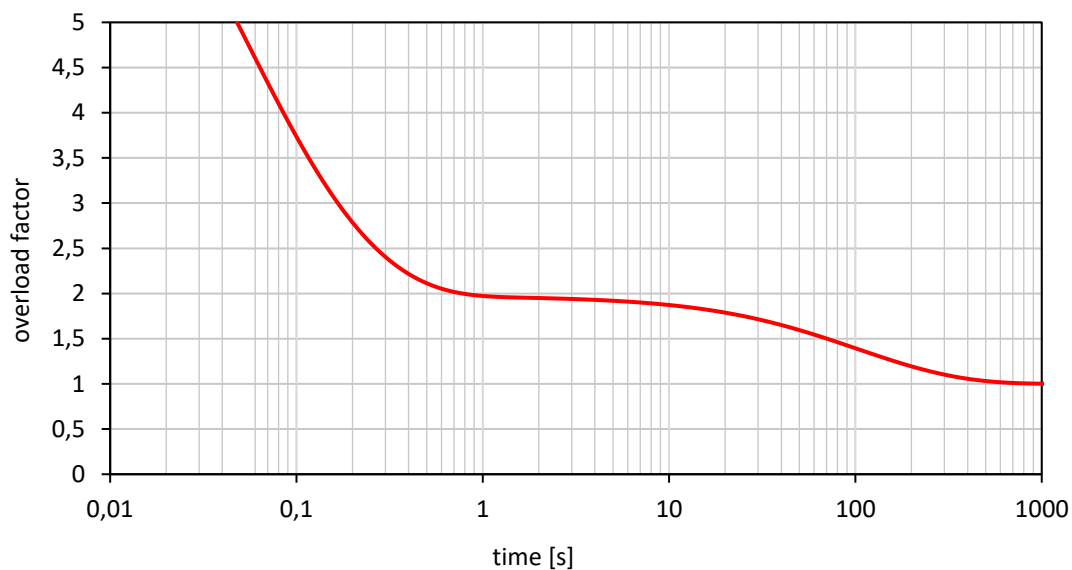


Fig. 3: DC current capability

“Overload factor” refers to the multiple of the continuous current in short-term operation for a certain period of time.

TOUCHSCREEN USER INTERFACE

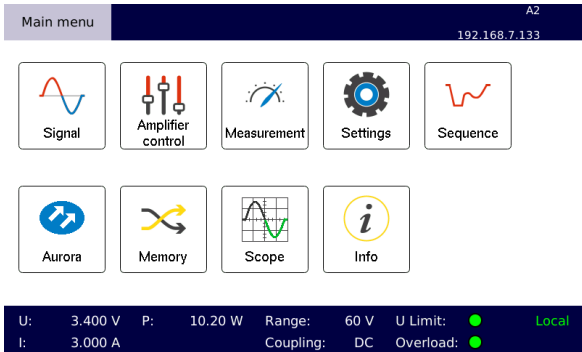


Fig. 4: Main menu

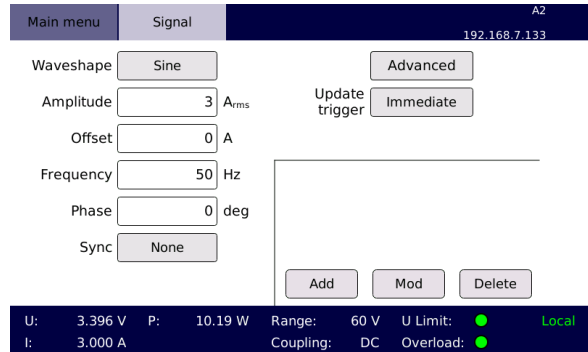


Fig.5: Signal setting

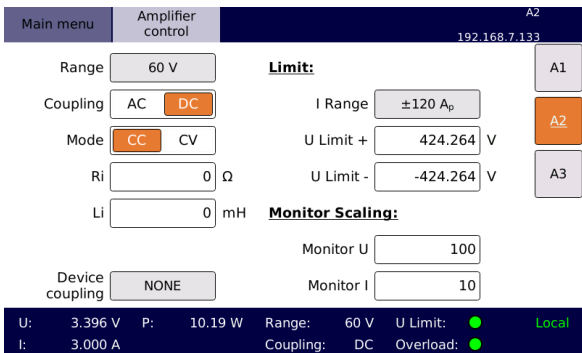


Fig. 6: Amplifier control

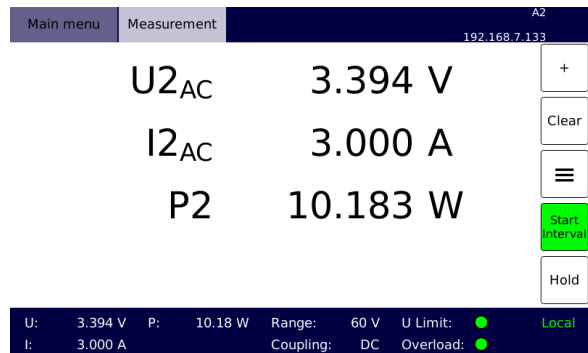


Fig.7: Measurement

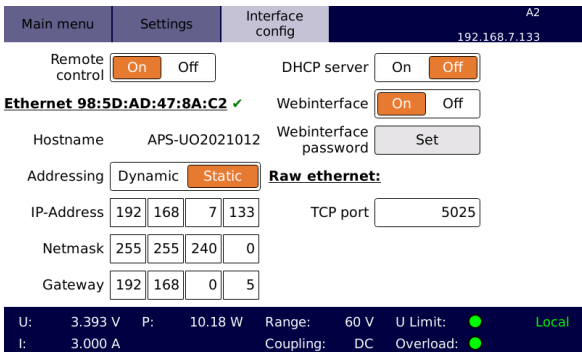


Fig. 8: Interface configuration

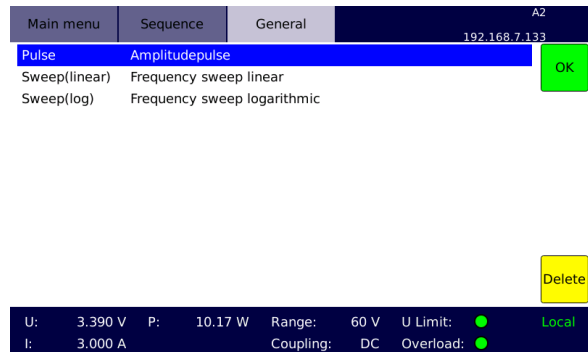


Fig.9: Sequence menu

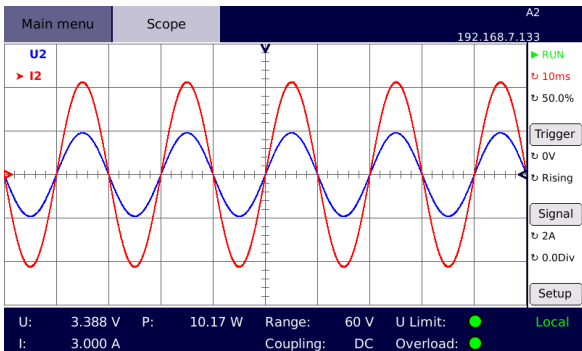


Fig. 10: Internal oscilloscope

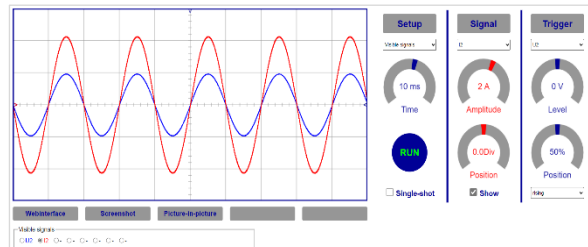


Fig. 11: Web oscilloscope

SOFTWARE CONTROL

SPS SystemControl

- ✓ Simulation and control software for arbitrary waveforms, current and frequency variations
- ✓ Generation of user defined sequences
- ✓ Sequence preview graph

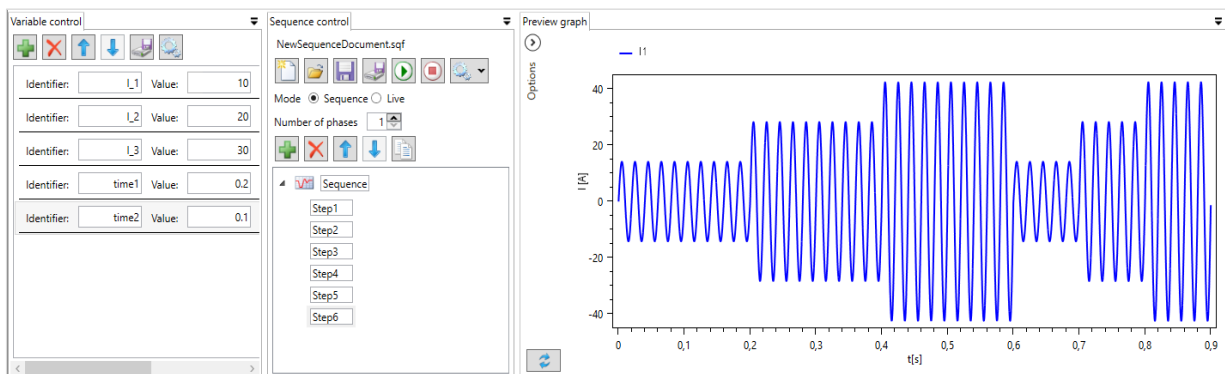


Fig. 12: SPS SystemControl software

SPS CircuitBreakerManager

- ✓ Control software for circuit breaker tests
- ✓ Automated tests available

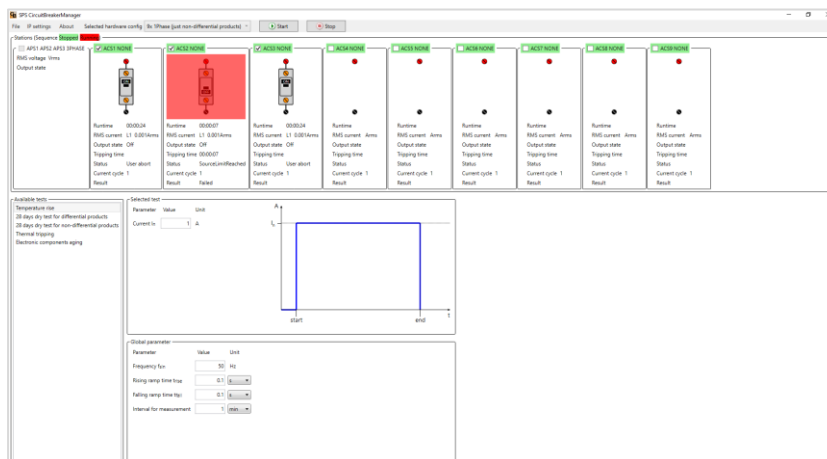


Fig. 13: SPS CircuitBreakerManager software

Command interface

- ✓ Easily integrate the device into your own software applications
- ✓ Remote control commands are based on the SCPI standard

Webinterface

- ✓ Monitor and control the connected device via a web browser
- ✓ Oscilloscope function



TECHNICAL DATA – GENERAL

		ACS series
Nominal voltage ranges <i>RMS (peak)</i>		60 V (± 85 V) 135 V (± 191 V) 270 V (± 382 V)
Load regulation <i>(short circuit to nominal load $\cos \varphi = 1$)</i>		45 Hz ... 65 Hz 0.2 %
		65 Hz ... 450 Hz 0.5 %
Stability (1 h)		gain: < 0.1 % / offset: < 0.02 % of range at constant load and temperature
Line regulation		< 1.5×10^{-4} per 10 V line-voltage change
Frequency bandwidth		large signal: DC ... 1 kHz (-3 dB)
Harmonic distortion (max.)		45 Hz ... 65 Hz 0.3 % (10 % ... 100 % of range)
		65 Hz ... 450 Hz 1.5 % (10 % ... 100 % of range)
Protection circuits		overload / overtemperature
Floating output		max. voltage between earth and the amplifier's ground output: < 300 V (RMS)
External input <i>(optional)</i>	<i>Max. peak voltage</i>	0 ... U_{ExtMax} (U_{ExtMax} is adjustable between ± 2 V ... ± 25 V)
	<i>Impedance</i>	approx. 10 k Ω
	<i>Delay time</i>	signal delay between amplifier's external input and amplifier's output < 5 μ s
Internal oscillator unit		
	<i>Type</i>	4-channel synthesiser
	<i>Wave forms</i>	DC, sine, square, triangle, ramp, arbitrary
	<i>Amplitude resolution</i>	17 Bit
	<i>Frequency range</i>	DC ... 1 MHz
	<i>Frequency resolution</i>	1 μ Hz
	<i>Frequency accuracy</i>	25 ppm
	<i>Phase range</i>	0° ... 360°
	<i>Phase resolution</i>	0.001°
	<i>Memory depth</i>	1 MSample
	<i>Synthesiser functions</i>	ADD, AM, FM, PM, PWM
	<i>Sequence memory</i>	1024 steps
Internal control unit		
	<i>Display</i>	7.0" touchscreen (17.8 cm, resolution 800 x 480)
	<i>Sequencer</i>	user defined sequences memory
	<i>User interface</i>	touchscreen / front panel button / incremental encoder webinterface
	<i>Digital I/O (optional)</i>	8 digital DC inputs: +5 V ... +24 V 8 digital DC outputs: +5 V (internal U_{CC}), $I_L = 40$ mA (external DC input U_{CC} : +5 V ... +24 V, $I_L = 250$ mA)

Measurement				
Peak voltage measurement ranges	112.5 V / 225 V / 450 V / 900 V (auto ranging)			
Current measurement ranges	depending on peak current of the amplifier range 1: $\frac{I_{peak}}{8.8}$ range 2: $\frac{I_{peak}}{4.4}$ range 3: $\frac{I_{peak}}{2.2}$ range 4: I_{peak}			
Measurement accuracy	± (% of reading + % of range)			
Frequency	DC 45 Hz ... 450 Hz	10 Hz ... 45 Hz 450 Hz ... 5 kHz		
Voltage accuracy	0.1 + 0.02		0.2 + 0.2	
Current accuracy	0.2 + 0.04		0.4 + 0.4	
Monitoring unit (optional)				
	voltage		current	
Max. peak output	±10 V			
Scaling factor 'sf' (adjustable)	sf: 0.2 ... 1000		sf: 0.1 ... 1000	
Bandwidth	300 kHz		200 kHz	
Monitoring accuracy	± (% of reading + % of range + error(sf))			
Frequency	DC 45 Hz ... 450 Hz	10 Hz ... 45 Hz 450 Hz ... 5 kHz	5 kHz ... 15 kHz	15 kHz ... 30 kHz
Voltage monitor accuracy	0.12 + 0.02 + 2 mV * sf	0.3 + 0.2 + 2 mV * sf	0.7 + 0.4 + 2.2 mV * sf	1.4 + 0.8 + 2.3 mV * sf
Current monitor accuracy	0.22 + 0.04 + 2 mA * sf	0.5 + 0.4 + 2 mA * sf	1.1 + 0.8 + 2.2 mA * sf	2.2 + 1.6 + 2.3 mA * sf
Noise of ADC measurement (RMS)	< 20 mV (DC ... 300 kHz)		< 1.5 mA (DC ... 300 kHz)	
Noise DAC output (RMS)	< 0.2 mV (DC ... 300 kHz)			
Delay time	< 1 µs			
Output impedance	47 Ω			
Isolation	earth / remaining electronics / each other			
Protection	short circuit			
Interface				
	Ethernet 100 Mbit/s (HiSLIP SCPI) USB 2.0 Host			
Synchronisation bus (multiple devices)				
	device synchronisation and internal communication optical fibre, LC duplex: - synchronised sequence start - parallel operation - only one ethernet connection required			
Insulation resistance				
	> 1 MΩ			
Peak withstand voltage (max. 10 s, output to earth)				
	> 2000 V			
Cooling				
	temperature-controlled forced air cooling			
Ambient temperature				
	+10 °C up to +40 °C			
Storage temperature				
	-25 °C up to +60 °C			
Relative humidity				
	non condensing, max. 80 % for temperature < 31 °C, decreasing linearly to 50 % at 40 °C			
Ingress protection				
	IP20			

TECHNICAL DATA – ACS series

		ACS 500	ACS 700
Peak current		26.4 A	44 A
Continuous current RMS (DC)	<i>range RMS (DC):</i>		
	60 V (± 85 V)	3.3 A (2.3 A)	4.7 A (3.3 A)
	135 V (± 191 V)	3.3 A (2.3 A)	4.7 A (3.3 A)
	270 V (± 382 V)	1.9 A (1.3 A)	2.6 A (1.8 A)
Power supply (± 10 %, 50/60 Hz)		230 V	
Line protection, connection		16 A, Schuko	16 A, Schuko
Housing		plug-in unit or rack, light grey (RAL7035)	
	<i>Amplifier approx. dimensions (H x W x D)</i>	19", 4 U 178 x 483 x 650 mm	19", 8 U 356 x 483 x 700 mm
	<i>Power supply NT approx. dimensions (H x W x D)</i>	included	included
Weight	<i>Amplifier (approx.) Power supply NT (approx.)</i>	58 kg	85 kg

		ACS 1500	ACS 3000
Peak current		88 A	176 A
Continuous current RMS (DC)	<i>range RMS (DC):</i>		
	60 V (± 85 V)	10 A (7.1 A)	20 A (14 A)
	135 V (± 191 V)	10 A (7.1 A)	20 A (14 A)
	270 V (± 382 V)	5.6 A (4 A)	11 A (7.8 A)
Power supply (± 10 %, 50/60 Hz)		230 V / 400 V	
Line protection, connection		3 x 6 A, CEE	3 x 16 A, CEE
Housing		plug-in unit or rack, light grey (RAL7035)	
	<i>Amplifier approx. dimensions (H x W x D)</i>	19", 8 U 356 x 483 x 650 mm	19", 7 U 311 x 483 x 650 mm
	<i>Power supply NT approx. dimensions (H x W x D)</i>	included	19", 5 U 222 x 483 x 650 mm
Weight	<i>Amplifier (approx.) Power supply NT (approx.)</i>	100 kg	55 kg 90 kg

		ACS 4000	ACS 6000
Peak current		264 A	440 A
Continuous current RMS (DC)	<i>range RMS (DC):</i>		
	60 V (± 85 V)	27 A (19 A)	40 A (28 A)
	135 V (± 191 V)	27 A (19 A)	40 A (28 A)
	270 V (± 382 V)	15 A (10.6 A)	22 A (15 A)
Power supply (± 10 %, 50/60 Hz)		230 V / 400 V	
Line protection, connection		3 x 20 A, CEE	3 x 32 A, CEE
Housing		plug-in unit or rack, light grey (RAL7035)	
	<i>Amplifier approx. dimensions (H x W x D)</i>	19", 10 U 444 x 483 x 650 mm	19", 17 U 755 x 483 x 650 mm
	<i>Power supply NT approx. dimensions (H x W x D)</i>	19", 5 U 222 x 483 x 650 mm	19", 10 U 444 x 483 x 650 mm
Weight	<i>Amplifier (approx.) Power supply NT (approx.)</i>	66 kg 120 kg	110 kg 180 kg

TECHNICAL DATA – ACS series

		ACS 7500	ACS 9000
Peak current		528 A	616 A
Continuous current RMS (DC)	<i>range RMS (DC):</i>		
	60 V (± 85 V)	50 A (35 A)	60 A (42 A)
	135 V (± 191 V)	50 A (35 A)	60 A (42 A)
	270 V (± 382 V)	28 A (20 A)	33 A (23 A)
Power supply (± 10 %, 50/60 Hz)		230 V / 400 V	
Line protection, connection		3 x 32 A, CEE	3 x 40 A, CEE
Housing		plug-in unit or rack, light grey (RAL7035)	
	<i>Amplifier approx. dimensions (H x W x D)</i>	19", 20 U 888 x 483 x 650 mm	19", 23 U 1022 x 483 x 650 mm
	<i>Power supply NT approx. dimensions (H x W x D)</i>	19", 10 U 444 x 483 x 650 mm	19", 12 U 533 x 483 x 650 mm
Weight	<i>Amplifier (approx.)</i>	122 kg	135 kg
	<i>Power supply NT (approx.)</i>	180 kg	240 kg

		ACS 12000	ACS 15000
Peak current		880 A	1056 A
Continuous current RMS (DC)	<i>range RMS (DC):</i>		
	60 V (± 85 V)	80 A (56 A)	100 A (71 A)
	135 V (± 191 V)	80 A (56 A)	100 A (71 A)
	270 V (± 382 V)	44 A (31 A)	56 A (40 A)
Power supply (± 10 %, 50/60 Hz)		230 V / 400 V	
Line protection, connection		3 x 63 A, CEE	3 x 63 A, CEE
Housing		plug-in unit or rack, light grey (RAL7035)	
	<i>Amplifier approx. dimensions (H x W x D)</i>	19", 33 U 1467 x 600 x 1050 mm	19", 39 U 1733 x 600 x 1050 mm
	<i>Power supply NT approx. dimensions (H x W x D)</i>	19", 12 U 533 x 600 x 1050 mm	19", 12 U 533 x 600 x 1050 mm
Weight	<i>Amplifier (approx.)</i>	220 kg	250 kg
	<i>Power supply NT (approx.)</i>	285 kg	285 kg

		ACS 18000	ACS 24000
Peak current		1150 A	1760 A
Continuous current RMS (DC)	<i>range RMS (DC):</i>		
	60 V (± 85 V)	120 A (85 A)	160 A (113 A)
	135 V (± 191 V)	120 A (85 A)	160 A (113 A)
	270 V (± 382 V)	67 A (47 A)	89 A (63 A)
Power supply (± 10 %, 50/60 Hz)		230 V / 400 V	
Line protection, connection		3 x 80 A, CEE	3 x 100 A, CEE
Housing		plug-in unit or rack, light grey (RAL7035)	
	<i>Amplifier approx. dimensions (H x W x D)</i>	19", 46 U 2044 x 600 x 1050 mm	19", 2 x 33 U 1467 x 1200 x 1050 mm
	<i>Power supply NT approx. dimensions (H x W x D)</i>	19", 22 U 978 x 600 x 1050 mm	on request
Weight	<i>Amplifier (approx.)</i>	460 kg	on request
	<i>Power supply NT (approx.)</i>	360 kg	

TECHNICAL DATA – ACS series

		ACS 30000	ACS 36000
Peak current		2112 A	2300 A
Continuous current RMS (DC)	<i>range RMS (DC):</i>		
	60 V (± 85 V)	200 A (141 A)	240 A (170 A)
	135 V (± 191 V)	200 A (141 A)	240 A (170 A)
	270 V (± 382 V)	110 A (78 A)	130 A (92 A)
Power supply (± 10 %, 50/60 Hz)		230 V / 400 V	
Line protection, connection		3 x 125 A, CEE	3 x 150 A, terminal box
Housing		plug-in unit or rack, light grey (RAL7035)	
	<i>Amplifier approx. dimensions (H x W x D)</i>	19", 2 x 39 U 1700 x 1200 x 1050 mm	19", 2 x 46 U 2044 x 1200 x 1050 mm
	<i>Power supply NT approx. dimensions (H x W x D)</i>	on request	on request
Weight	<i>Amplifier (approx.) Power supply NT (approx.)</i>	on request	on request

OPTIONS AND ACCESSORIES

OPT.01	IEEE488	Not in combination with OPT.02
OPT.02	RS232	Not in combination with OPT.01
OPT.05	U/I monitor	Galvanically isolated voltage and current measurement outputs accessible via BNC sockets (includes OPT.14)
OPT.14	External input	0 ... $U_{Ext\ max}$ $U_{Ext\ max}$ peak is adjustable between ± 2 V ... ± 25 V OPT.14 includes a digital low pass input filter Type Bessel or Butterworth, order 1 ... 6 (adjustable) Filter frequency selectable 100 Hz ... 10 MHz
OPT.30	Optical link	Optical interface to real time simulator LC duplex interface / Aurora 8B/10B protocol / 2 Gb/s data rate
IT	Current transformer	Current transformer for additional high current ranges Minimum frequency depends on IT type (e.g. $f_{min} = 15$ Hz or 25 Hz or 45 Hz) Current measurement accuracy: $f_{min} \dots 65$ Hz: 0.4 % of measured value + 0.06 % of nominal continuous current
RSA	Redundant switch off	Two channel redundant shutdown system
ACS.GA	Common output	Common output for amplifier and current transformer
STMB	Additional current measurement ranges	range: $\frac{I_{peak}}{140.8}$ range: $\frac{I_{peak}}{70.4}$ range: $\frac{I_{peak}}{35.2}$ range: $\frac{I_{peak}}{17.6}$