ACS series of 4-quadrant amplifiers

4-QUADRANT CURRENT AMPLIFIER

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

4-quadrant amplifier ACS 1500

- ✓ 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.

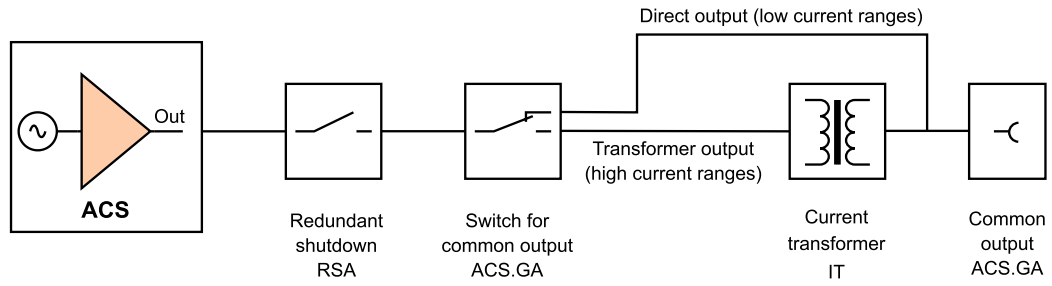

Fig. 1: Schematic overview of current amplifier

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

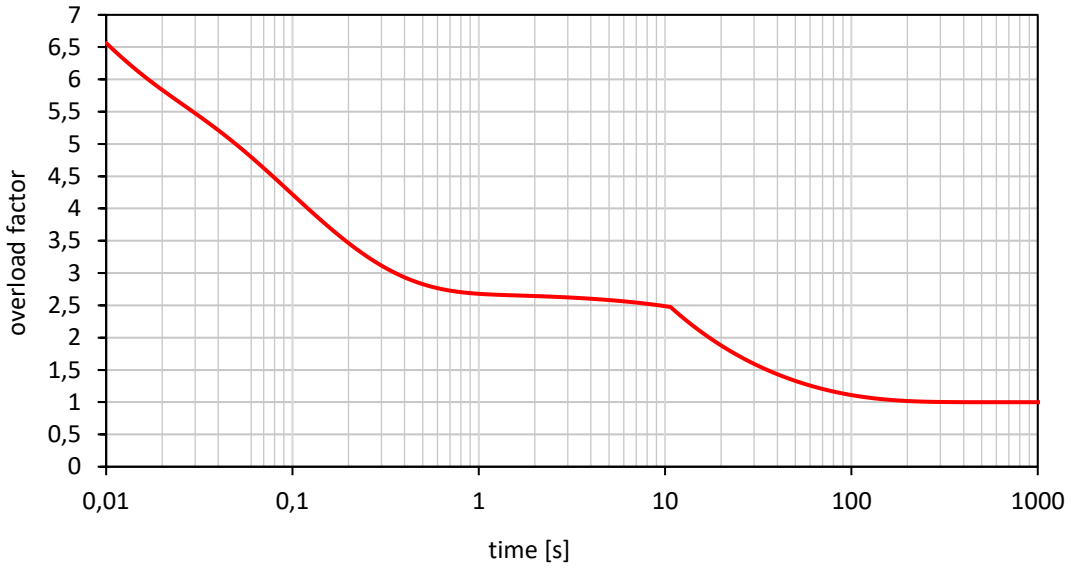

Fig. 2: AC current capability

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

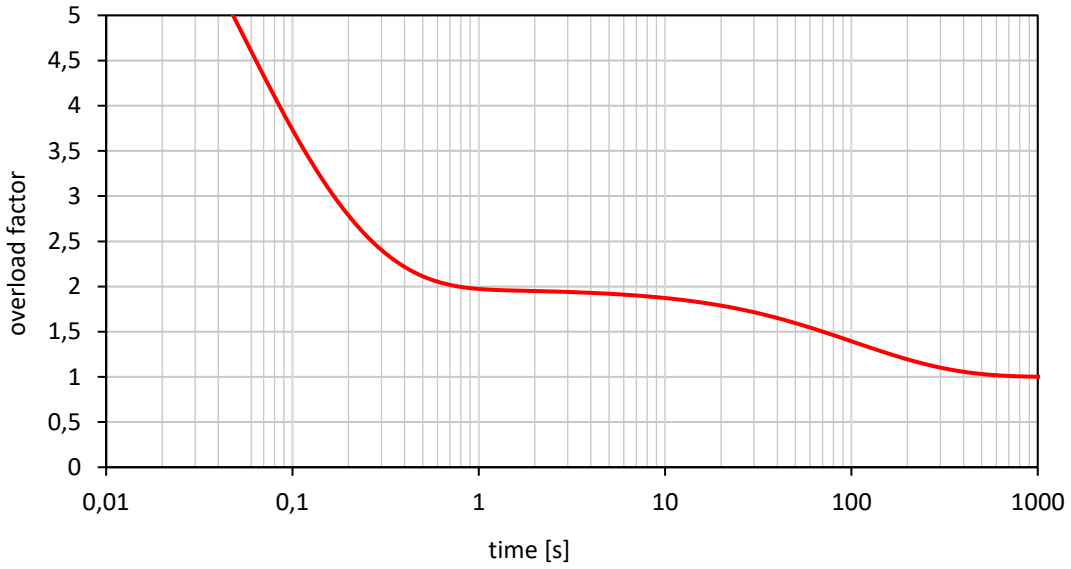

Fig. 3: DC current capability

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

TOUCHSCREEN USER INTERFACE

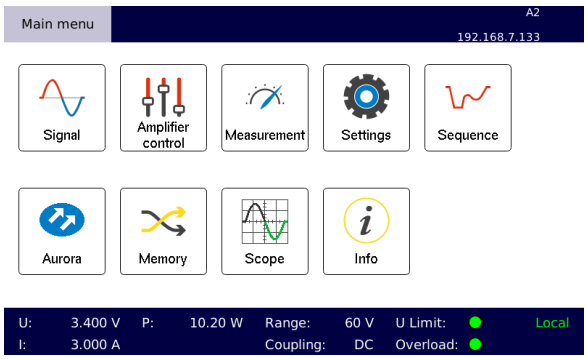

Fig. 4: Main menu

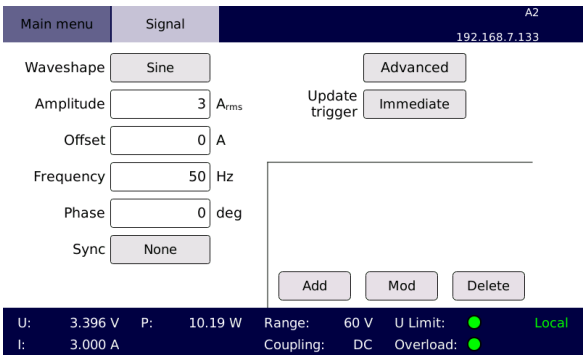

Fig.5: Signal setting

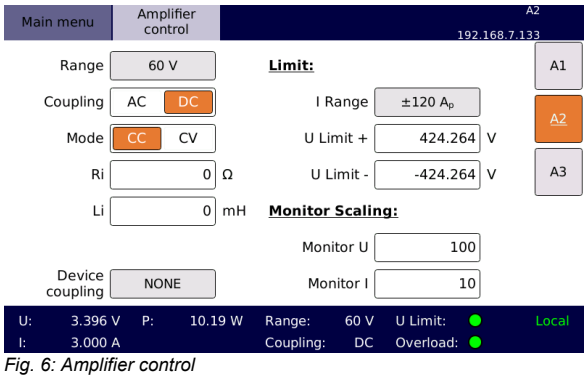

Fig. 6: Amplifier control

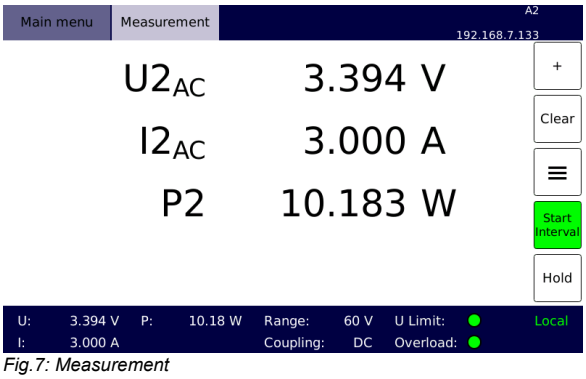

Fig.7: Measurement

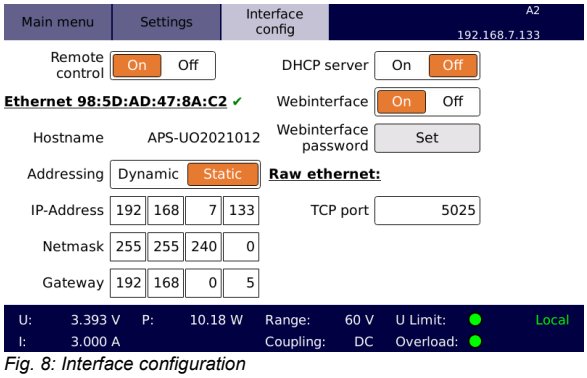

Fig. 8: Interface configuration

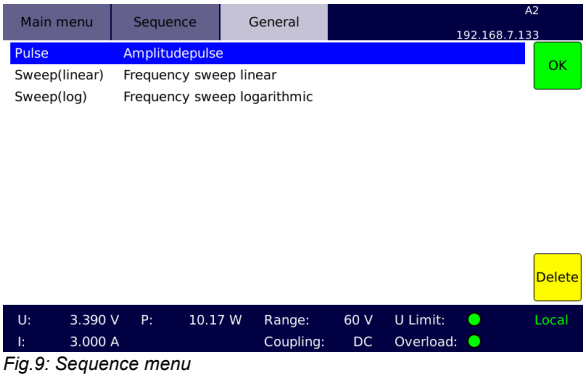

Fig.9: Sequence menu

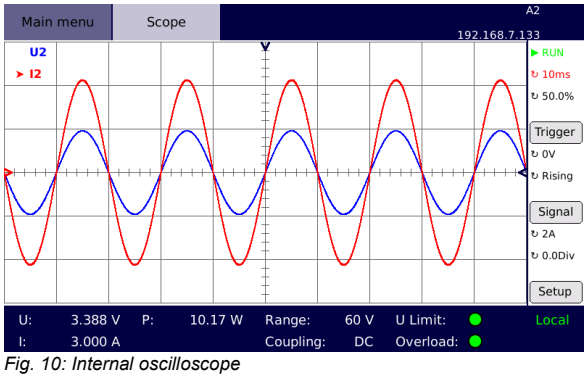

Fig. 10: Internal oscilloscope

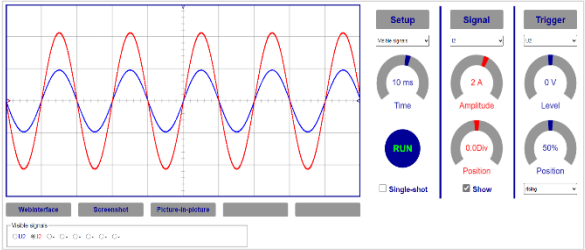

Fig. 11: Web oscilloscope

SOFTWARE CONTROL

SPS SystemControl

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

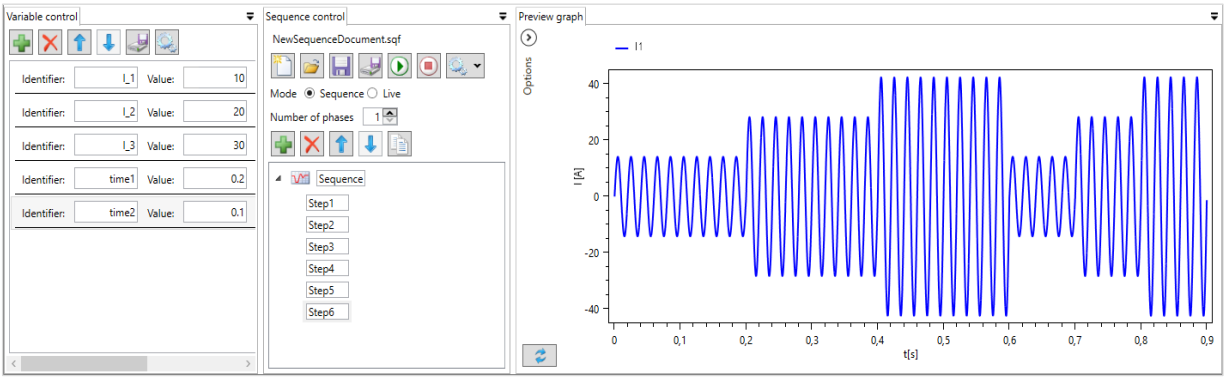

Fig. 12: SPS SystemControl software

SPS CircuitBreakerManager

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

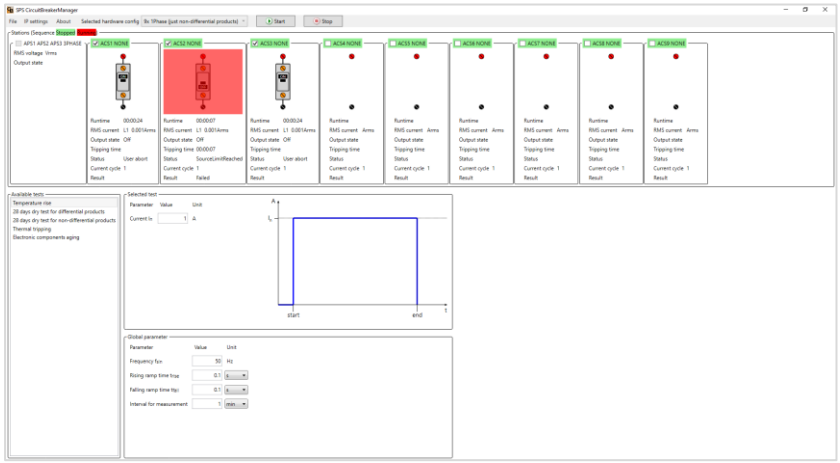

Fig. 13: SPS CircuitBreakerManager software

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 *RMS (peak)*		60 V (±85 V) 135 V (±191 V) 270 V (±382 V)	
Load regulation *(short circuit to nominal load cos φ = 1)*		45 Hz … 65 Hz 0.2 %	65 Hz … 450 Hz 0.5 %
Stability *(1 h)*		gain: < 0.1 % / offset: < 0.02 % of range end value at constant load and temperature	
Line regulation		< 1.5 x 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 end value)	65 Hz … 450 Hz 1.5 % (10 % … 100 % of range end value)
Protection circuits		overload / overtemperature	
Floating output		max. voltage between earth and the amplifier's ground output: < 300 V (RMS)	
External input *(optional)*	*Max. peak voltage*	0 … U_{ExtMax} (U_{ExtMax} is adjustable between ±2 V … ±25 V)	
	Impedance	approx. 10 kΩ	
	Delay time	signal delay between amplifier's external input and amplifier's output < 5 µs	
Internal oscillator unit			
	Type	4-channel synthesiser	
	Wave forms	DC, sine, square, triangle, ramp, arbitrary	
	Amplitude resolution	17 Bit	
	Frequency range	DC … 1 MHz	
	Frequency resolution	1 µHz	
	Frequency accuracy	25 ppm	
	Phase range	0° … 360°	
	Phase resolution	0.001°	
	Memory depth	1 MSample	
	Synthesiser functions	ADD, AM, FM, PM, PWM	
	Sequence memory	1024 steps	
Internal control unit			
	Display	7.0" touchscreen (17.8 cm, resolution 800 x 480)	
	Sequencer	user defined sequences memory	
	User interface	touchscreen / front panel button / incremental encoder webinterface	
	Digital I/O (optional)	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 measured value + % of measurement range value)			
	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 measured value + % of measurement range value + 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 air forced 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			
System of protection		IP20			

TECHNICAL DATA – ACS series

		ACS 500	ACS 700
Peak current		26.4 A	44 A
Continuous current *RMS (DC)*	*range RMS (DC):*		
	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)	
	Amplifier approx. dimensions (H x W x D)	19", 4 U 178 x 483 x 650 mm	19", 8 U 356 x 483 x 700 mm
	Power supply NT approx. dimensions (H x W x D)	included	included
Weight	*Amplifier (approx.)* *Power supply NT (approx.)*	58 kg	85 kg

		ACS 1500	ACS 3000
Peak current		88 A	176 A
Continuous current *RMS (DC)*	*range RMS (DC):*		
	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)	
	Amplifier approx. dimensions (H x W x D)	19", 8 U 356 x 483 x 650 mm	19", 7 U 311 x 483 x 650 mm
	Power supply NT approx. dimensions (H x W x D)	included	19", 5 U 222 x 483 x 650 mm
Weight	*Amplifier (approx.)* *Power supply NT (approx.)*	100 kg	55 kg 90 kg

		ACS 4000	ACS 6000
Peak current		264 A	440 A
Continuous current *RMS (DC)*	*range RMS (DC):*		
	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)	
	Amplifier approx. dimensions (H x W x D)	19", 10 U 444 x 483 x 650 mm	19", 17 U 755 x 483 x 650 mm
	Power supply NT approx. dimensions (H x W x D)	19", 5 U 222 x 483 x 650 mm	19", 10 U 444 x 483 x 650 mm
Weight	*Amplifier (approx.)* *Power supply NT (approx.)*	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)*	*range RMS (DC):*		
	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)	
	Amplifier approx. dimensions (H x W x D)	19", 20 U 888 x 483 x 650 mm	19", 23 U 1022 x 483 x 650 mm
	Power supply NT approx. dimensions (H x W x D)	19", 10 U 444 x 483 x 650 mm	19", 12 U 533 x 483 x 650 mm
Weight	*Amplifier (approx.)* *Power supply NT (approx.)*	122 kg 180 kg	135 kg 240 kg

		ACS 12000	ACS 15000
Peak current		880 A	1056 A
Continuous current *RMS (DC)*	*range RMS (DC):*		
	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)	
	Amplifier approx. dimensions (H x W x D)	19", 33 U 1467 x 600 x 1050 mm	19", 39 U 1733 x 600 x 1050 mm
	Power supply NT approx. dimensions (H x W x D)	19", 12 U 533 x 600 x 1050 mm	19", 12 U 533 x 600 x 1050 mm
Weight	*Amplifier (approx.)* *Power supply NT (approx.)*	220 kg 285 kg	250 kg 285 kg

		ACS 18000	ACS 24000
Peak current		1150 A	1760 A
Continuous current *RMS (DC)*	*range RMS (DC):*		
	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)	
	Amplifier approx. dimensions (H x W x D)	19", 46 U 2044 x 600 x 1050 mm	19", 2 x 33 U 1467 x 1200 x 1050 mm
	Power supply NT approx. dimensions (H x W x D)	19", 22 U 978 x 600 x 1050 mm	on request
Weight	*Amplifier (approx.)* *Power supply NT (approx.)*	460 kg 360 kg	on request

TECHNICAL DATA – ACS series

		ACS 30000	ACS 36000
Peak current		2112 A	2300 A
Continuous current *RMS (DC)*	*range RMS (DC):*		
	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)	
	Amplifier approx. dimensions (H x W x D)	19", 2 x 39 U 1700 x 1200 x 1050 mm	19", 2 x 46 U 2044 x 1200 x 1050 mm
	Power supply NT approx. dimensions (H x W x D)	on request	on request
Weight	*Amplifier (approx.)* *Power supply NT (approx.)*	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} ... 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: $\frac{I_{peak}}{17.6}$