

## ACS/HF series of 4-quadrant amplifiers

### 4-QUADRANT CURRENT AMPLIFIER



*The relating applications:*

*High frequency, high  
current generation*

*High frequency test and  
calibration of current  
sensors and power meters*

*4-quadrant amplifier ACS 4000/HF*

- ✓ Operates from DC up to 150 kHz large signal bandwidth
- ✓ Currents up to 140 A
- ✓ Low inductive internal output wiring to enable high current / high frequency operation
- ✓ 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)
- ✓ 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 HIGH FREQUENCY APPLICATIONS



Continuous current capability of the ACS/HF series amplifier in dependency of the frequency.

e.g.           at 50 kHz 93 % continuous current capability  
              at 150 kHz 63 % continuous current capability

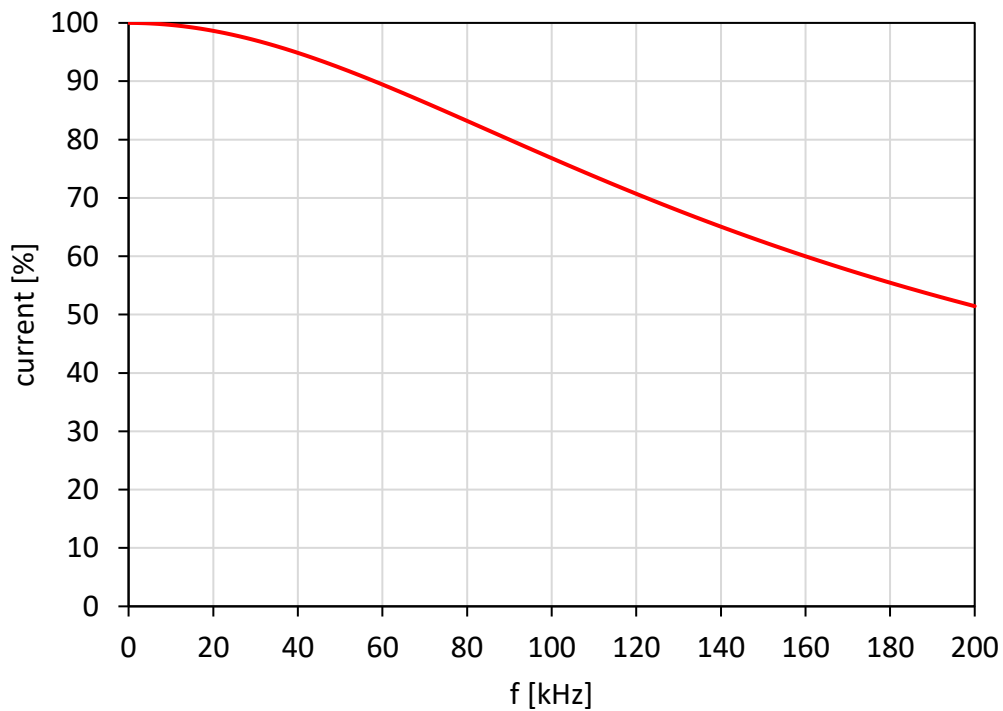


Fig. 1: Continuous current capability

## TOUCHSCREEN USER INTERFACE

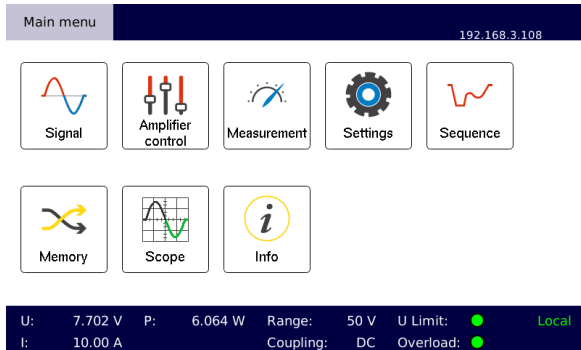


Fig. 2: Main menu

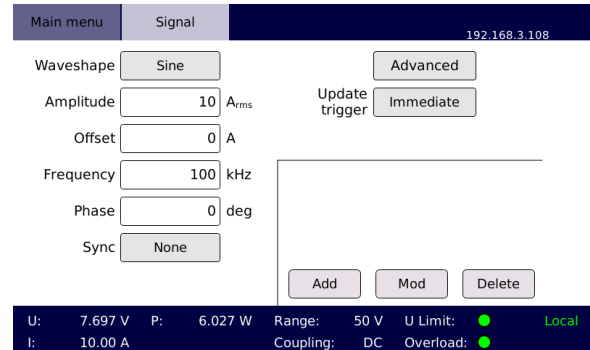


Fig. 3: Signal setting

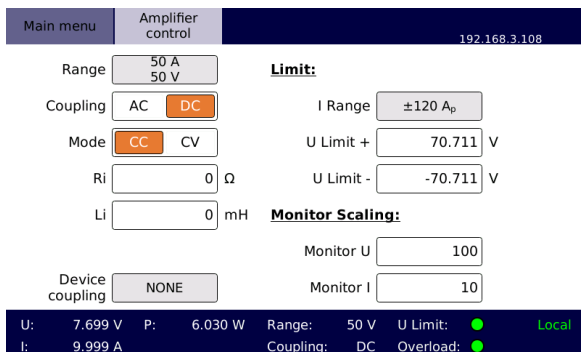


Fig. 4: Amplifier control

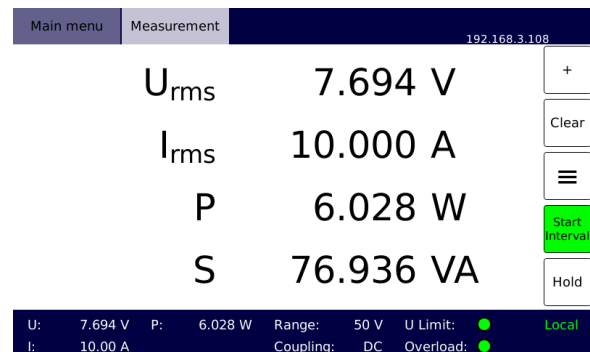


Fig. 5: Measurement

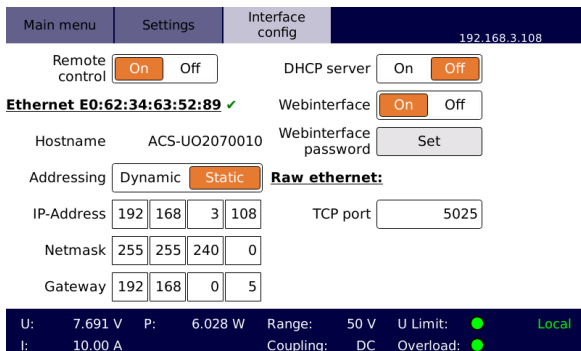


Fig. 6: Interface configuration

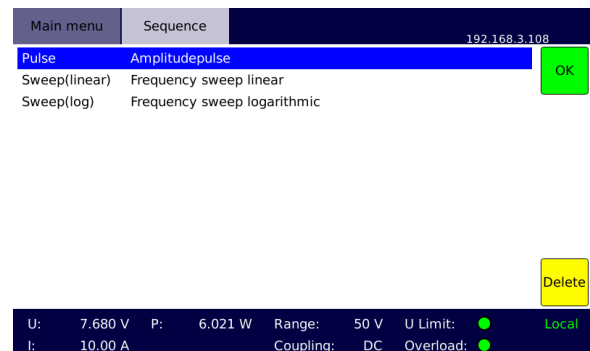


Fig. 7: Sequence menu

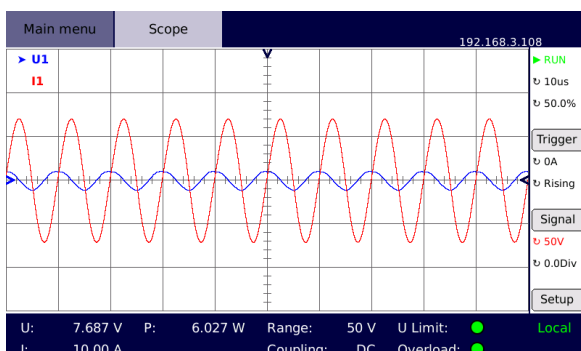


Fig. 9: Internal oscilloscope

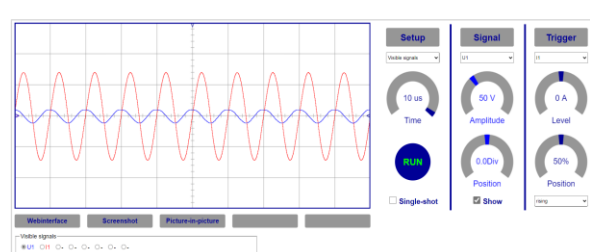


Fig. 8: Web oscilloscope

## SOFTWARE CONTROL

### SPS SystemControl

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

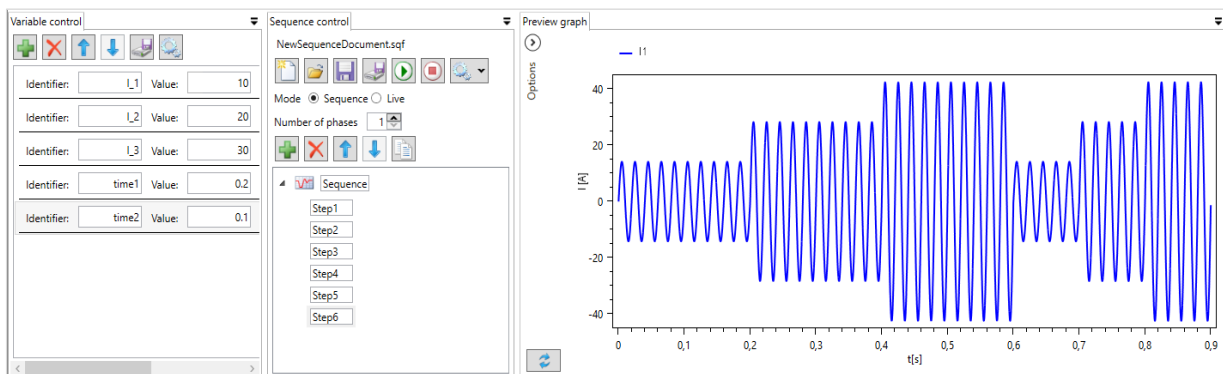


Fig. 10: SPS SystemControl software

### 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/HF series		
<b>Load regulation</b> (short circuit to nominal load $\cos \phi 1$ )	45 Hz ... 65 Hz 0.2 %	65 Hz ... 450 Hz 0.5 %
<b>Stability (1h)</b>	gain: < 0.1 % / offset: < 0.02 % of range at constant load and temperature	
<b>Line regulation</b>	< $1.5 \times 10^{-4}$ per 10 V line-voltage change	
<b>Frequency bandwidth</b>	large signal: DC ... 150 kHz (derating from 30 kHz, see diagram)	
<b>Harmonic distortion (max.)</b>	45 Hz ... 65 Hz 0.3 % (10 % ... 100 % of range)	65 Hz ... 450 Hz 1.5 % (10 % ... 100 % of range)
<b>Protection circuits</b>	overload / overtemperature	
<b>Floating output</b>	max. voltage between earth and the amplifier's ground output: < 300 V (RMS)	
<b>External input</b> (optional)	<i>Max. peak voltage</i>	0 ... $U_{ExtMax}$ ( $U_{ExtMax}$ is adjustable between $\pm 2$ V ... $\pm 25$ V)
	<i>Impedance</i>	approx. 10 k $\Omega$
	<i>Delay time</i>	signal delay between amplifier's external input and amplifier's output < 5 $\mu$ s
<b>Internal oscillator unit</b>		
	<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 $\mu$ 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
<b>Internal control unit</b>		
	<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)

<b>Measurement</b>				
	Peak voltage measurement range	112.5 V		
	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	$\pm$ (% of reading + % of range)		
	Frequency	DC 45 Hz ... 450 Hz	10 Hz ... 45 Hz 450 Hz ... 5 kHz	5 kHz ... 15 kHz 15 kHz ... 30 kHz
	Voltage accuracy	0.1 + 0.02	0.2 + 0.2	0.4 + 0.4 0.8 + 0.8
	Current accuracy	0.2 + 0.04	0.4 + 0.4	0.8 + 0.8 1.6 + 1.6
<b>Monitoring unit (optional)</b>		voltage		current
	Max. peak output	$\pm 10$ V		
	Scaling factor 'sf' (adjustable)	sf: 0.2 ... 1000		sf: 0.1 ... 1000
	Bandwidth	300 kHz		200 kHz
	Monitoring accuracy	$\pm$ (% 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 $\mu$ s		
	Output impedance	47 $\Omega$		
	Isolation	earth / remaining electronics / each other		
	Protection	short circuit		
<b>Interface</b>		Ethernet 100 Mbit/s (HiSLIP SCPI) USB 2.0 Host		
<b>Synchronisation bus (multiple devices)</b>		device synchronisation and internal communication optical fibre, LC duplex: - synchronised sequence start - parallel operation - only one ethernet connection required		
<b>Insulation resistance</b>		> 1 M $\Omega$		
<b>Peak withstand voltage (max. 10 s, output to earth)</b>		> 2000 V		
<b>Cooling</b>		temperature-controlled forced air cooling		
<b>Ambient temperature</b>		+10 °C up to +40 °C		
<b>Storage temperature</b>		-25 °C up to +60 °C		
<b>Relative humidity</b>		non condensing, max. 80 % for temperature < 31 °C, decreasing linearly to 50 % at 40 °C		
<b>Ingress protection</b>		IP20		

## TECHNICAL DATA – ACS/HF series

		ACS 700/HF
<b>Peak current</b>		44 A
<b>Continuous current</b>	<i>range RMS (DC):</i>	
<i>RMS (DC)</i>	60 V (±85 V)	8.0 A (6.0 A)
<b>Power Supply</b> (±10 %, 50/60 Hz)		230 V
<b>Line protection, connection</b>		16 A, Schuko
<b>Housing</b>		plug-in unit or rack, light grey (RAL 7035)
	<i>Amplifier</i>	19", 4 U
	<i>approx. dimensions (H x W x D)</i>	178 x 483 x 650 mm
	<i>Power Supply NT</i>	included
	<i>approx. dimensions (H x W x D)</i>	
<b>Weight</b>	<i>Amplifier (approx.)</i>	58 kg
	<i>Power Supply NT (approx.)</i>	

## TECHNICAL DATA – ACS/HF series

		ACS 1500/HF	ACS 3000/HF
<b>Peak current</b>		88 A	176 A
<b>Continuous current</b>	<i>range RMS (DC):</i>		
<i>RMS (DC)</i>	15 V (±21 V)	39 A (28 A)	78 A (55 A)
	40 V (±56 V)	20 A (14 A)	40 A (28 A)
<b>Power Supply</b> (±10 %, 50/60 Hz)		230 V / 400 V	
<b>Line protection, connection</b>		3 x 16 A, CEE	3 x 16 A, CEE
<b>Housing</b>		plug-in unit or rack, light grey (RAL 7035)	
	<i>Amplifier</i>	19", 8 U	19", 7 U
	<i>approx. dimensions (H x W x D)</i>	356 x 483 x 650 mm	311 x 483 x 650 mm
	<i>Power Supply NT</i>	included	19", 5 U
	<i>approx. dimensions (H x W x D)</i>		222 x 483 x 650 mm
<b>Weight</b>	<i>Amplifier (approx.)</i>	120 kg	55 kg
	<i>Power Supply NT (approx.)</i>		120 kg

## TECHNICAL DATA – ACS/HF series

		ACS 4000/HF
<b>Peak current</b>		264 A
<b>Continuous current</b>	<i>range RMS (DC):</i>	
<i>RMS (DC)</i>	20 V (±28 V)	100 A (70 A)
	50 V (±70 V)	50 A (35 A)
<b>Power Supply</b> (±10 %, 50/60 Hz)		230 V / 400 V
<b>Line protection, connection</b>		3 x 16 A, CEE
<b>Housing</b>		plug-in unit or rack, light grey (RAL 7035)
	<i>Amplifier</i>	19", 10 U
	<i>approx. dimensions (H x W x D)</i>	444 x 483 x 650 mm
	<i>Power Supply NT</i>	19", 5 U
	<i>approx. dimensions (H x W x D)</i>	222 x 483 x 650 mm
<b>Weight</b>	<i>Amplifier (approx.)</i>	66 kg
	<i>Power Supply NT (approx.)</i>	120 kg

## TECHNICAL DATA – ACS/HF series

		ACS 6000/HF
<b>Peak current</b>		440 A
<b>Continuous current</b> <i>RMS (DC)</i>	<i>range RMS (DC):</i>	
	30 V ( $\pm 42$ V) 70 V ( $\pm 99$ V)	140 A (100 A) 70 A (50 A)
<b>Power Supply</b> ( $\pm 10$ %, 50/60 Hz)		230 V / 400 V
<b>Line protection, connection</b>		3 x 32 A, CEE
<b>Housing</b>		plug-in unit or rack, light grey (RAL 7035)
	<i>Amplifier</i> <i>approx. dimensions (H x W x D)</i>	19", 17 U 755 x 483 x 650 mm
	<i>Power Supply NT</i> <i>approx. dimensions (H x W x D)</i>	19", 9 U 400 x 483 x 650 mm
<b>Weight</b>	<i>Amplifier (approx.)</i>	110 kg
	<i>Power Supply NT (approx.)</i>	160 kg

## OPTIONS AND ACCESSORIES

Options		
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 $\pm 2$ V ... $\pm 25$ 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