

# PAS series of 4-Quadrant-Amplifiers



## The Reference Source for all applications

- ✓ Extremely low harmonic distortion - even under very non-linear load conditions
- ✓ Very fast slew rate  $> 52\text{V}/\mu\text{s}$  (rise time  $< 5\mu\text{s}$  at  $230\text{V}_{\text{rms}}$  as required by EN 61000-4-11)
- ✓ Operates from DC up to 5kHz large signal bandwidth (-3dB) - optional to 15kHz or 30kHz
- ✓ Small signal bandwidth up to 50kHz or 100kHz
- ✓ High long-term overload characteristic (up to 1-hour)
- ✓ High short-term overload characteristic (for 5 ... 10mins.)
- ✓ Very high peak-load ability (up to 5ms)
- ✓ Very low internal resistance



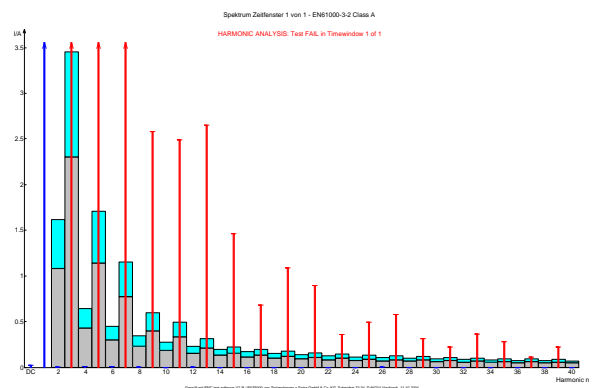
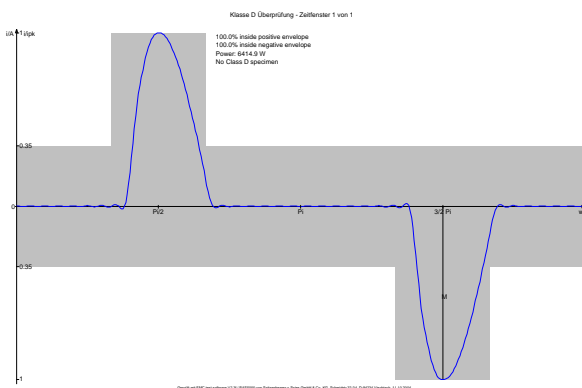
## The Real 4-Quadrant Amplifier

Compliance with the requirements of the European EMC directive requires a statement of „product conformance“ to a variety of emission and immunity specifications. These specifications define not only the type of test, but also the technical requirements for the test instrumentation. In particular, in the field of low-frequency conducted phenomena, an AC/DC-voltage source is required for almost all types of test. In order to comply with these requirements a 4-quadrant amplifier has been developed which is based upon a linear push-pull design. Some of the remarkable features of this amplifier design include it's ironless output stage, extensive use of negative feedback over all amplifier stages, an extended frequency range and a very low internal resistance.

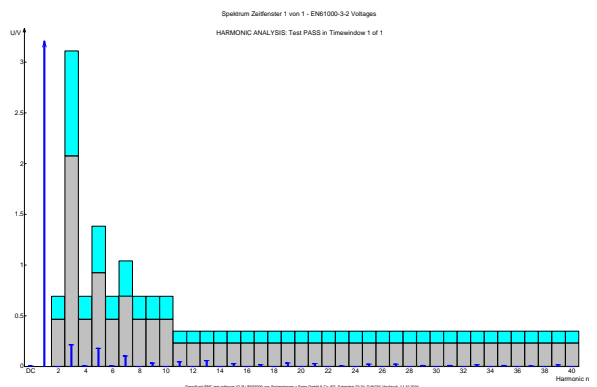
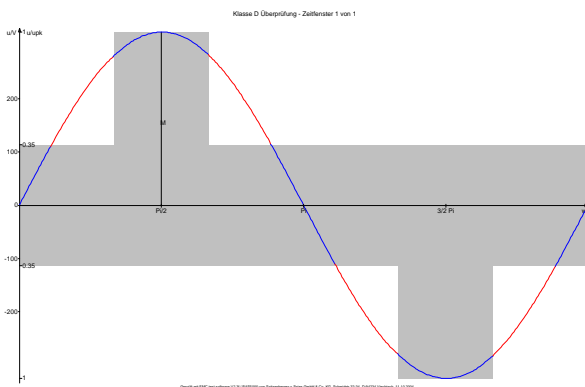
## Field of application

### Extremely low harmonic distortion

The voltage source meets the extremely rigorous requirements of the standard EN 61000-3-2, even under very non-linear conditions.



Input current ( $41A_{rms}/106A_p$ ) and frequency spectrum of the EUT

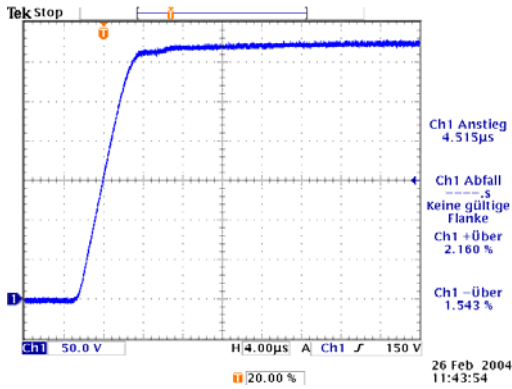


Output voltage and frequency spectrum of the voltage source (PAS 5000)

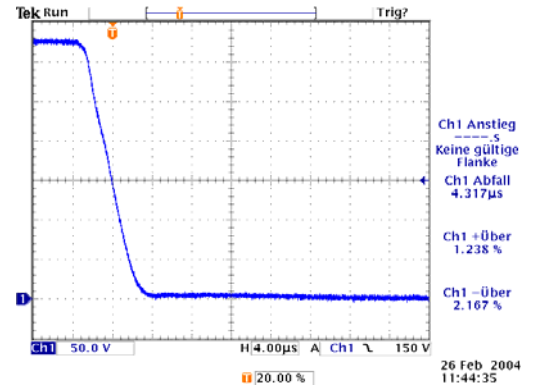


## Very fast rise time

Due to the very fast slew rate of  $>52V/\mu s$  the requirements of EN 61000-4-11 are fully met in practice.



rise time



fall time

## Control

To control the amplifier a range of different oscillators, including IEEE 488 controlled (e.g. SyCore units), are available.

## With a guaranteed future

Instead of many individual voltage sources, the use of a single universal voltage source is both efficient and economical. Apart from this, the PAS series of voltage sources are also prepared to meet the requirements of additional standards such as EN 61000-4-13, EN 61000-4-14, EN 61000-4-17, EN 61000-4-27, EN 61000-4-28, EN 61000-4-29, EN 61131-2, EN 61496-1 and German Lloyd.

## Very low internal resistance

The extremely low internal resistance of the amplifier guarantees a measurement in full conformance with the requirements of EN 61000-3-3 even under dynamic load conditions.

Testconditions: 230 V / 50 Hz / Phase: L1 / Observations: 3 x 10 min / Ztest: (0.40+j0.25) Ohm

FLICKER: Test FAIL! Max. permitted Imp.: (0.094+j0.059) Ohm

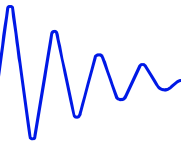
Time	Pmax	Pst	Sliding PIt	d(t)>3.30% [s]	dmax [%]	dc [%]	PASS	FAIL
12:51:28	113.300	2.6250	2.6250	-----	5.573	0.108	X	
13:01:28	24.060	2.3970	2.3970	-----	2.541	0.096	X	
13:11:28	19.660	2.3570	2.3570	-----	2.366	0.002	X	
Limits:		1.000	0.650	0.500	4.000	3.300		
PIt: 1.553090 (calculated over 12 periods)								
Evaluated: PST								

FLICKER: Source test PASS!

Time	Pmax	Pst	Sliding PIt	d(t)>3.30% [s]	dmax [%]	dc [%]	PASS	FAIL
12:51:28	0.006	0.0550	-----	-----	0.087	-----	X	
13:01:28	0.001	0.0260	-----	-----	0.108	-----	X	
13:11:28	0.001	0.0230	-----	-----	0.126	-----	X	
PIt: 0.025377 (calculated over 12 periods)								
Evaluated: PST <= 0.4 dmax < 20% dmax1								

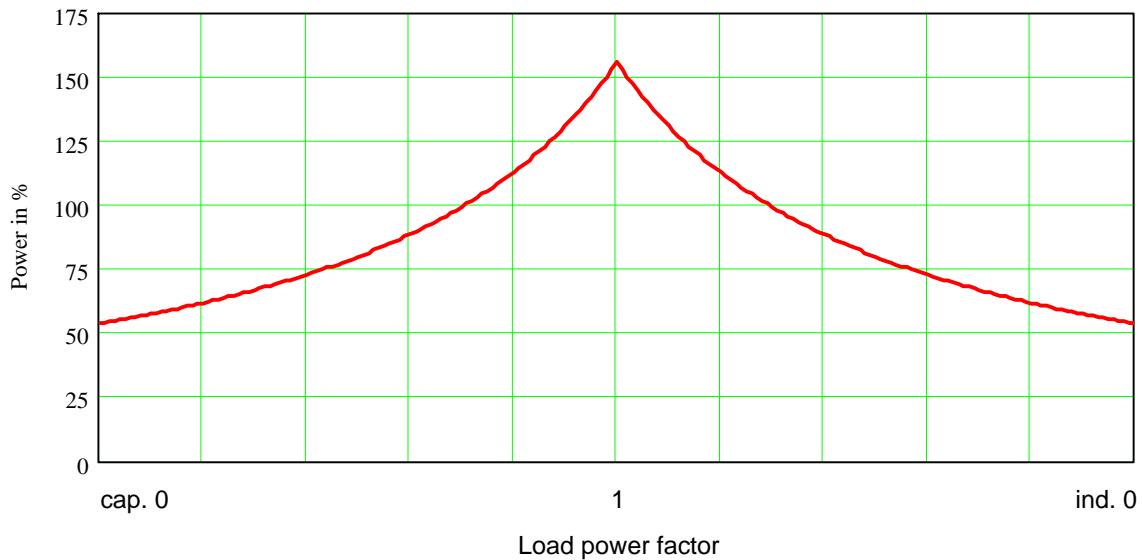
Geprüft mit EMC test software VZ.37 / PAS5000 von Spitzenberger + Spies GmbH & Co. KG, Schmidstr 32-34, D-94234 Viechtach, 11.10.2004

Flicker measurement with photocopier as the EUT



## Extremely high loadability

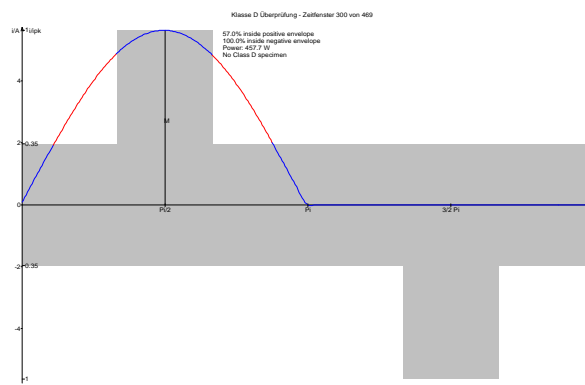
150% of rating is available in the case of a real load. Amplifier stability is absolutely assured when operating with either inductive or capacitive loads.



Performance characteristic

## DC-Simulation

The directly coupled ironless amplifier output-stage makes the generation of DC signals possible. All test devices requiring a DC content within their input current can be supplied without problem.



## Long life expectancy and high reliability

The PAS – series is the perfect programmable voltage source for all your test equipment and production line requirements.

# PAS series of 4-Quadrant-Amplifiers

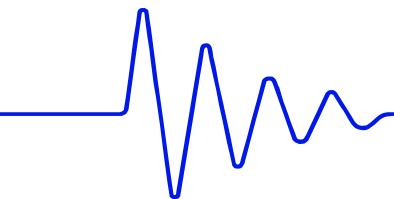
	PAS 1000	PAS 2500	PAS 5000	PAS 7500	PAS 10000	PAS 15000	PAS 20000	PAS 25000	PAS 30000	
<b>Power AC</b> (at nominal voltage and $\cos \varphi > 0.7$ ) - continuous - approx. 1h	1000VA 1500VA	2500VA 3750VA	5000VA 7500VA	7500VA 11250VA	10000VA 15000VA	15000VA 22500VA	20000VA 30000VA	25000VA 37500VA	30000VA 45000VA	
<b>Power DC</b> (at nominal voltage) - continuous - approx. 1h	1000W 1500W	2500W 3750W	5000W 7500W	7500W 11250W	10000W 15000W	15000W 22500W	20000W 30000W	25000W 37500W	30000W 45000W	
Short-time power (at 270V and $\cos \varphi > 0.7$ ) for approx. 5 ... 10mins; duty cycle 1:9	2000VA	5000VA	10000VA	15000VA	20000VA	30000VA	40000VA	50000VA	60000VA	
Peak power (at nominal voltage and $\cos \varphi > 0.7$ ) for approx 2 ... 3ms - at 135V - at 270V	3200VA <sub>p</sub> 6400VA <sub>p</sub>	10500VA <sub>p</sub> 21000VA <sub>p</sub>	21000VA <sub>p</sub> 42000VA <sub>p</sub>	31500VA <sub>p</sub> 63000VA <sub>p</sub>	43750VA <sub>p</sub> 87500VA <sub>p</sub>	70000VA <sub>p</sub> 140000VA <sub>p</sub>	100000VA <sub>p</sub> 200000VA <sub>p</sub>	105000VA <sub>p</sub> 210000VA <sub>p</sub>	126000VA <sub>p</sub> 252000VA <sub>p</sub>	
<b>Digital instrument Measuring range</b>	V: 300V I: 20A	V 300V I: 40A	V 300V I: 80A	V: 300V I: 150A	V 300V I: 200A	V: 300V I: 250A	V 300V I: 300A	V 300V I: 400A	V 300V I: 500A	
Accuracy V (of measured value $\pm 2$ digit) DC; 45Hz ... 450Hz 15Hz ... 45Hz; 450Hz ... 5kHz	max. typ. 0.5% 0.2% 1.0% 0.4%	max. typ. 0.5% 0.2% 1.0% 0.4%	max. typ. 0.5% 0.2% 1.0% 0.4%	max. typ. 0.5% 0.2% 1.0% 0.4%	max. typ. 0.5% 0.2% 1.0% 0.4%	max. typ. 0.5% 0.2% 1.0% 0.4%	max. typ. 0.5% 0.2% 1.0% 0.4%	max. typ. 0.5% 0.2% 1.0% 0.4%	max. typ. 0.5% 0.2% 1.0% 0.4%	
Accuracy I (of measured value $\pm 2$ digit) DC; 45Hz ... 450Hz 15Hz ... 45Hz; 450Hz ... 2kHz 2kHz ... 5kHz	max. typ. 0.8% 0.4% 1.6% 0.8% 1.6% 0.8%	max. typ. 0.8% 0.4% 1.6% 0.8% 5.0% 3.0%	max. typ. 0.8% 0.4% 1.6% 0.8% 5.0% 3.0%	max. typ. 0.8% 0.4% 1.6% 0.8% 5.0% 3.0%	max. typ. 0.8% 0.4% 1.6% 0.8% 5.0% 3.0%	max. typ. 0.8% 0.4% 1.6% 0.8% 5.0% 3.0%	max. typ. 0.8% 0.4% 1.6% 0.8% 5.0% 3.0%	max. typ. 0.8% 0.4% 1.6% 0.8% 5.0% 3.0%	max. typ. 0.8% 0.4% 1.6% 0.8% 5.0% 3.0%	
<b>Power Supply</b> (+6% / -10% , 50Hz ... 60Hz) Protection: Contactor type:	230V 16A Schuko	230V/400V 3 x 16A CEE	230V/400V 3 x 20A CEE	230V/400V 3 x 32A CEE	230V/400V 3 x 40A CEE	230V/400V 3 x 63A CEE	230V/400V 3 x 80A CEE	230V/400V 3 x 100A CEE	230V/400V 3 x 125A CEE	
<b>Housing</b>	Amplifier approx. dimensions in mm Power Supply approx. dimensions in mm	19", 4U 178x483x600 Power supply 19", 5U 222x483x600 included	19", 5U 222x483x600 19" 5U 222x483x600	19", 7U 311x483x600 19" 5U 222x483x600	19", 10U 444x483x600 19", 10U 444x483x600	19" 17U 755x483x600 19", 12U 533x483x600	19", 23U 1022x483x600 19", 12U 533x483x600	19", 33U 1467x483x600 19", 2x12U 1066x483x600	19", 39U 1733x483x600 19", 2x12U 1066x483x600	19", 46U 2042x483x600 19", 2x12U 1066x483x600
<b>Weight</b>	Amplifier (approx.) Power Supply (approx.)	45kg 85kg	30kg 100kg	45kg 100kg	60kg 200kg	80kg 220kg	120kg 240kg	160kg 2 x 220kg	200kg 2 x 230kg	240kg 2 x 240kg



# PAS series of 4-Quadrant-Amplifiers

<b>Nominal voltage</b>	AC: DC:	135V <sub>rms</sub> / 270V <sub>rms</sub> ±191V / ±382V
<b>Voltage adjustment</b>		depending on oscillator used
<b>Load regulation</b>		max.                      typ.
135V	DC ... 450Hz	0.5%                      0.2%
135V	450Hz ... 5kHz	2.0%                      1.0%
270V	DC ... 450Hz	0.3%                      0.1%
270V	450Hz ... 5kHz	0.6%                      0.2%
<b>Gain stability</b>	- 10min: - 8h:	<0.2% at constant load and temperature <0.5% at constant load and temperature
<b>Line regulation</b>		< 1.5x10 <sup>-4</sup> per 10V line-voltage change
<b>Frequency range</b>		DC ... 5kHz large signal bandwidth (-3dB) DC ... 50kHz small signal bandwidth
<b>Slew rate</b>		> 52V/μs (rise time < 5μs at 230V <sub>rms</sub> according to EN 61000-4-11)
<b>Harmonic distortion</b>		max.                      typ.
135V	DC ... 450Hz	0.3%                      0.1%
135V	450Hz ... 5kHz	2.5%                      1.5%
270V	DC ... 450Hz	0.1%                      0.05%
270V	450Hz ... 5kHz	0.6%                      0.3%
<b>Protection circuits</b>		- Overload - Short circuit - Over temperature
<b>Input</b>		
max. input voltage		±5V <sub>p</sub>
Input impedance		approx. 8kΩ
<b>Internal control source (optional)</b>		
Type		DDS2
Wave form		Sine wave, DC
Amplitude resolution		100mV
Frequency range		10Hz ... 5kHz
Frequency resolution		100mHz
<b>General</b>		
<b>Interfaces</b>		RS232, IEEE488 (optional)
<b>Ambient temperature</b>		0°C up to 40°C





## Option 11-56Z for 4-Quadrant-Amplifiers

	PAS 1000	PAS 2500	PAS 5000	PAS 7500	PAS 10000	PAS 15000	PAS 20000	PAS 25000	PAS 30000
<b>Option 11-56Z</b>	Additional voltage range V:0 ... 56V <sub>rms</sub> / ±79V <sub>p</sub>								
<b>Power AC</b> (at nominal voltage and cos φ > 0.7)									
- continuous	410VA	1035VA	2070VA	3100VA	4150VA	6200VA	8300VA	10375VA	12450VA
- approx. 1h	610VA	1550VA	3100VA	4650VA	6220VA	9300VA	12450VA	15560VA	18672VA
<b>Power DC</b> (at nominal voltage)									
- continuous	410W	1035W	2070W	3100W	4150W	6200W	8300W	10375W	12450W
- approx. 1h	610W	1550W	3100W	4650W	6220W	9300W	12450W	15560W	18672W
Short-time power (at 56V and cos φ > 0.7) for approx. 5 ... 10min; duty cycle 1:9	660VA	2175VA	4350VA	6500VA	8700VA	13050VA	17400VA	21750VA	26100VA
Peak power (at 56V and cos φ > 0.7) for approx 2 ... 3ms	1320VA <sub>p</sub>	4350VA <sub>p</sub>	8700VA <sub>p</sub>	13000VA <sub>p</sub>	21000VA <sub>p</sub>	28000VA <sub>p</sub>	34800VA <sub>p</sub>	43500VA <sub>p</sub>	52200VA <sub>p</sub>
Load regulation	max. typ.	max. typ.	max. typ.	max. typ.	Max. typ.	max. typ.	max. typ.	max. typ.	max. typ.
56V DC ... 450Hz	2.0% 1.0%	2.0% 1.0%	2.0% 1.0%	2.0% 2.0%	1.0% 1.0%	2.0% 1.0%	2.0% 1.0%	2.0% 1.0%	2.0% 1.0%
56V 450Hz ... 5kHz	6.0% 3.0%	6.0% 3.0%	6.0% 3.0%	6.0% 6.0%	3.0% 3.0%	6.0% 3.0%	6.0% 3.0%	6.0% 3.0%	6.0% 3.0%
Harmonic distortion	max. typ.	max. typ.	max. typ.	max. typ.	max. typ.	max. typ.	max. typ.	max. typ.	max. typ.
56V DC ... 450Hz	0.5% 0.2%	0.5% 0.2%	0.5% 0.2%	0.5% 0.5%	0.2% 0.2%	0.5% 0.2%	0.5% 0.2%	0.5% 0.2%	0.5% 0.2%
56V 450Hz ... 5kHz	3.0% 1.0%	3.0% 1.0%	3.0% 1.0%	3.0% 3.0%	1.0% 1.0%	3.0% 1.0%	3.0% 1.0%	3.0% 1.0%	3.0% 1.0%

## Options for internal control source DDS 2

<b>Option D03</b>	DC-control input 0 ... 10V control of amplitude and frequency Reaction time: 500ms
<b>Option D09</b>	Adjustable current limit with switch-off RMS control via current measurement Technical data: see current measurement