

APS series of 4-quadrant amplifiers

4-QUADRANT VOLTAGE / CURRENT AMPLIFIER



Fig. 1: 4-quadrant amplifier APS 1000

NEW: Constant current mode

The adjustable and desired output current is automatically regulated and stabilized according to the user's preferences, the only limitation is the amplifier's performance characteristic.

- ✓ Touch panel operation 7" (800x480)
- ✓ Very high peak-load ability (up to 2 ... 3ms)
- ✓ Very low internal resistance
- ✓ Very fast slew rate > 52V/μs (rise time < 5μs at 230V_{rms} acc. IEC/EN 61000-4-11)
- ✓ Extremely low harmonic distortion - even under very non-linear load conditions
- ✓ Operates from DC up to 10kHz large signal bandwidth (-3dB) - optional up to 30kHz
- ✓ Small signal bandwidth up to 50kHz
- ✓ High long-term overload characteristic (up to 1 hour)
- ✓ High short-term overload characteristic (up to 2 min)
- ✓ Sink operation mode included – real 4-quadrant operation mode
- ✓ Current and voltage limitation adjustable
- ✓ Optical link for easy PHIL interface

The relating standards:

IEC/EN 61000-3-2
 IEC/EN 61000-3-3
 IEC/EN 61000-3-11
 IEC/EN 61000-3-12
 IEC/EN 60146-1-1
 IEC/EN 61000-2-2
 IEC/EN 61000-4-8
 IEC/EN 61000-4-11
 IEC/EN 61000-4-13
 IEC/EN 61000-4-14
 IEC/EN 61000-4-17
 IEC/EN 61000-4-27
 IEC/EN 61000-4-28
 IEC/EN 61000-4-29
 IEC/EN 61000-4-34
 IEC/EN 61131-2
 IEC/EN 61496-1
 IEC/EN 61800-3
 IEC/EN 62040-2
 MIL-STD-461
 MIL-STD-704
 MIL-STD-1275
 RTCA DO-160
 SEMI F47-0706
 German. Lloyd

VOLTAGE AND CURRENT MODE OPERATION
 REFERENCE SOURCE FOR ALL APPLICATIONS

VERY FAST RISE AND FALL TIME

Due to the very fast slew rate of $>52\text{V}/\mu\text{s}$ the APS is fully compliant according to the requirements of IEC/EN 61000-4-11 in practice.

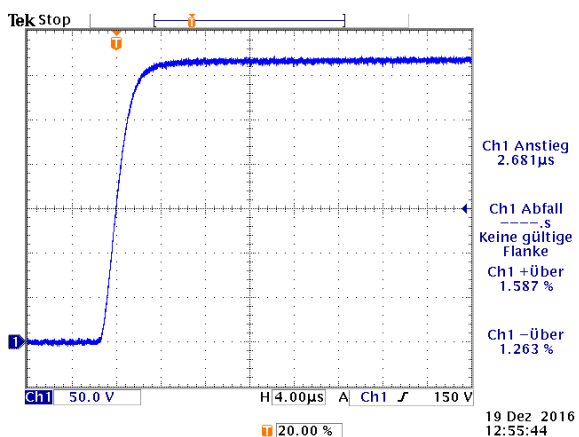


Fig. 2: rise time of the output voltage

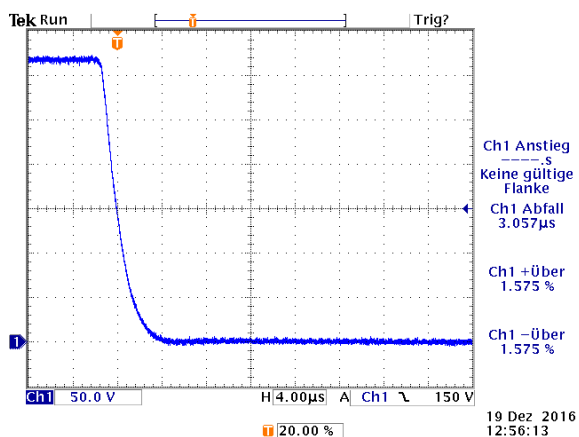


Fig. 3: fall time of the output voltage

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.

The sink mode power capability is approx. 30% of the source mode capability.

DC SIMULATION

DC signals can easily be generated using the directly coupled ironless amplifier output stage.

All test devices requiring a DC content within their input current can be supplied without problems.

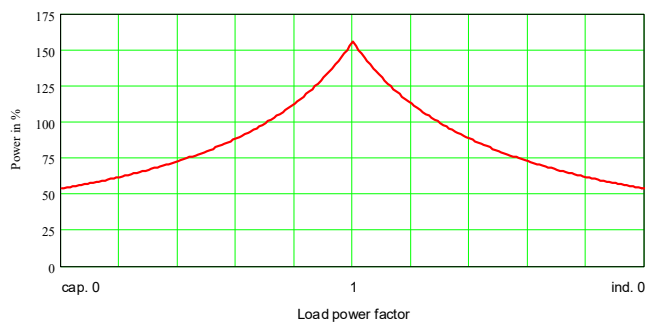


Fig. 4: APS performance characteristic

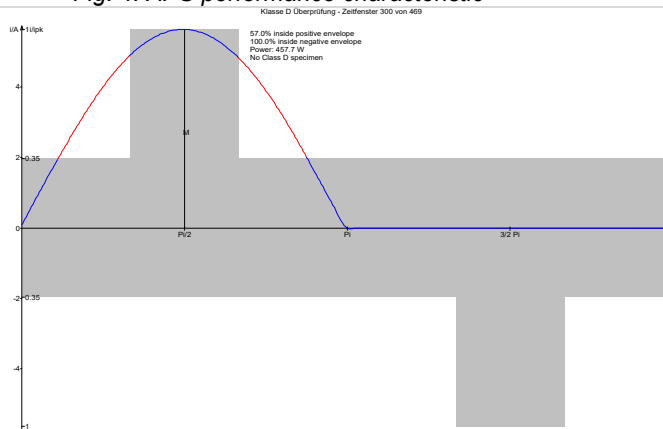


Fig. 5: APS DC characteristic

TOUCHSCREEN USER INTERFACE

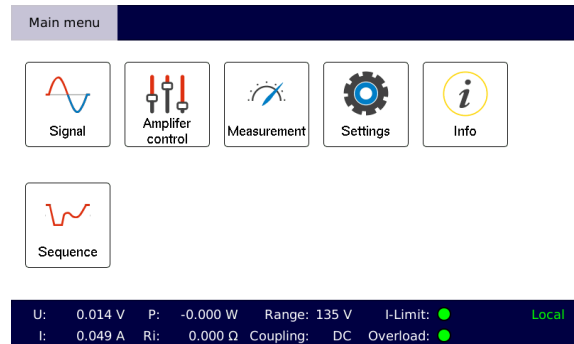


Fig. 6: Main menu

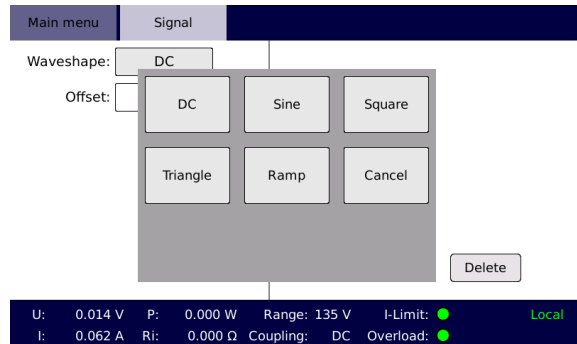


Fig. 7: Selection of the output signal waveshape

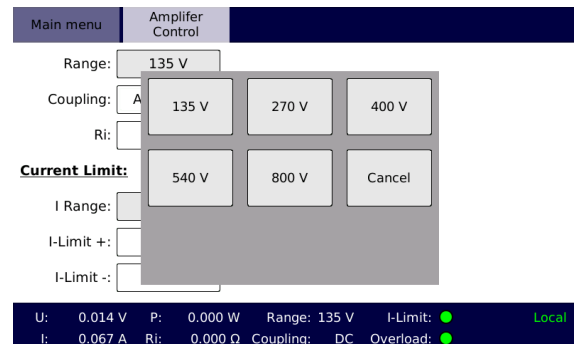


Fig. 8: Selection of the output voltage range

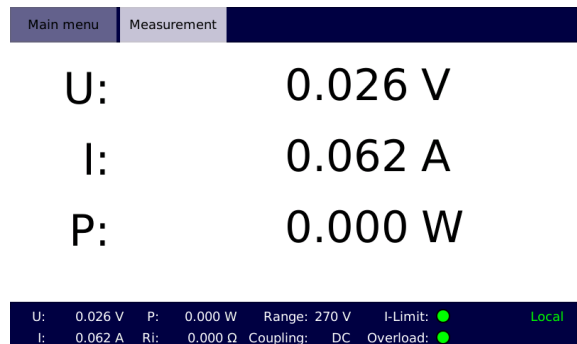


Fig. 9: Measurement unit display

TECHNICAL DATA - GENERAL

		APS series			
Nominal voltage ranges¹⁾	<i>AC (DC)</i>	135V _{rms} (±191V _{DC}) / 240V _{rms} (±339V _{DC}) / 270V _{rms} (±382V _{DC}) / 300V _{rms} (±424V _{DC})			
Load regulation		Range	DC ... 450Hz	450Hz ... 5kHz	5kHz ... 10kHz
		135V _{rms}	0.2%	5.0%	15.0%
		240V _{rms}	0.1%	2.5%	8.0%
		270V _{rms}	0.1%	1.0%	5.0%
		300V _{rms}	0.1%	1.0%	5.0%
Stability (1h)		gain: <0.1% / offset: <0.02% of range value at constant load and temperature			
Line regulation		<1.5x10 ⁻⁴ per 10V line-voltage change			
Frequency bandwidth		large signal: DC ... 10kHz (-3dB) small signal (10%): DC ... 50kHz (-3dB)			
Slew rate		>52V/μs (rise time <5μs at 230V _{rms} according to IEC/EN 61000-4-11)			
Harmonic distortion (max.)		Range	DC ... 450Hz	450Hz ... 5kHz	5kHz ... 10kHz
		135V _{rms}	0.3%	3.0%	5.0%
		240V _{rms}	0.2%	2.0%	3.0%
		270V _{rms}	0.1%	1.0%	2.5%
		300V _{rms}	0.1%	1.0%	2.5%
Floating output		max. voltage between earth and the amplifier's ground output: <300V _{rms}			
Internal resistance compensation		<8V _p (ground and each phase line)			
Protection circuits		overload / short circuit / over temperature			
External input	<i>Max. voltage</i>	±5V _p (optionally ±10V _p or ±16V _p)			
	<i>Impedance</i>	approx. 10kΩ			
	<i>Delay time</i>	Signal delay between amplifier's external input and amplifier's output <5μs			
Interface		Ethernet 100MBit			
Internal oscillator unit					
	<i>Type</i>	4-channel synthesizer			
	<i>Wave forms</i>	DC, sine, square, triangle, ramp, arbitrary			
	<i>Amplitude resolution</i>	17Bit			
	<i>Frequency range</i>	DC ... 1MHz			
	<i>Frequency resolution</i>	1μHz			
	<i>Frequency accuracy</i>	25ppm			
	<i>Phase range</i>	0° ... 360°			
	<i>Phase resolution</i>	0.001°			
	<i>Memory depth</i>	1MSample			
	<i>Synthesizer functions</i>	ADD, AM, FM, PM, PWM			
	<i>Sequence memory</i>	1024 steps			

Internal control unit				
Display	7.0" Touchscreen (17.8cm, resolution 800x480)			
Sequencer	Integrated sequences: amplitude pulse, frequency pulse (lin/log) User defined sequences memory			
User interface	Touchscreen / front-panel button / incremental encoder			
Digital I/O	8 digital inputs: +5V _{DC} ... +24V _{DC} 8 digital outputs: +5V _{DC} (internal V _{CC}), I _L =40mA (external V _{CC} input: +5V _{DC} ... +24V _{DC} , I _L =500mA)			
Digital instrument				
<i>Voltage measurement ranges</i>	112.5V _p / 225V _p / 450V _p / 900V _p (auto ranging)			
<i>Voltage accuracy</i>	± (% of measured value + % of voltage measurement range value)			
	DC 45Hz ... 450Hz	10Hz ... 45Hz 450Hz ... 5kHz	5kHz ... 15kHz	15kHz ... 30kHz
	0.1 + 0.02	0.2 + 0.2	0.4 + 0.4	0.8 + 0.8
<i>Current measurement ranges</i>	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}			
<i>Current accuracy</i>	± (% of measured value + % of current measurement range value)			
	DC 45Hz ... 450Hz	10Hz ... 45Hz 450Hz ... 5kHz	5kHz ... 15kHz	15kHz ... 30kHz
	0.2 + 0.04	0.4 + 0.4	0.8 + 0.8	1.6 + 1.6
Monitoring unit²⁾	voltage		current	
<i>Max. output</i>	±10V _p			
<i>Scaling factor 'sf' (adjustable)</i>	sf: 0.2 ... 1000		sf: 0.1 ... 1000	
<i>Bandwidth</i>	300kHz		200kHz	
<i>Monitoring accuracy frequency</i>	± (% of measured value + % of voltage measurement range value + error(sf))			
	DC 45Hz ... 450Hz	10Hz ... 45Hz 450Hz ... 5kHz	5kHz ... 15kHz	15kHz ... 30kHz
<i>voltage monitor</i>	0.12 + 0.02 + 2mV*sf	0.3 + 0.2 + 2mV*sf	0.7 + 0.4 + 2.2mV*sf	1.4 + 0.8 + 2.3mV*sf
<i>current monitor</i>	0.22 + 0.04 + 2mA*sf	0.5 + 0.4 + 2mA*sf	1.1 + 0.8 + 2.2mA*sf	2.2 + 1.6 + 2.3mA*sf
<i>Noise of ADC measurement</i>	<20mV _{rms} (DC ... 300kHz)		<1.5mA _{rms} (DC ... 300kHz)	
<i>Noise DAC output</i>	<0.2mV _{rms} (DC ... 300kHz)			
<i>Delay time</i>	<1μs			
<i>Output impedance</i>	47Ohm			
<i>Isolation</i>	earth / remaining electronics / each other			
<i>Protection</i>	short circuit			
Insulation resistance	>1MOhm			
Withstand voltage	>2000V _{DC}			
Ambient temperature	0°C up to 40°C			
Relative Humidity (non-condensing)	max. 80% for temperatures <31°C, decreasing linearly to 50% at 40°C			
System of protection	IP20			

Remarks:

- 1) 240V_{rms} range not available at APS 1000
- 2) See application note: "Technical information monitoring unit"
- 3) At cosine phi = 1

TECHNICAL DATA – APS 1000 / 2500 / 5000

		APS 1000	APS 2500	APS 5000
Power AC	- continuous	1000VA	2500VA	5000VA
	- approx. 1h ³⁾	1500VA	3750VA	7500VA
Power DC	- continuous	1000W	2500W	5000W
	- approx. 1h	1500W	3750W	7500W
Short-time power		2000VA	5000VA	10000VA
Peak current		26.4A _p	88A _p	176A _p
Power Supply (±10%, 50/60Hz)		230V Schuko	230V/400V CEE	
Protection		16A	3 x 16A	3 x 20A
Housing	<i>Amplifier</i>	19", 4U	19", 5U	19", 7U
	<i>approx. dimensions (mm)</i>	178x483x650	222x483x650	311x483x650
	<i>Power Supply</i>	included	19", 5U	19" 5U
	<i>approx. dimensions (mm)</i>	-	222x483x650	222x483x650
Weight	<i>Amplifier (approx.)</i>	50kg	30kg	45kg
	<i>Power Supply (approx.)</i>	-	85kg	100kg

TECHNICAL DATA – APS 7500 / 10000 / 15000

		APS 7500	APS 10000	APS 15000
Power AC	- continuous	7500VA	10000VA	15000VA
	- approx. 1h ³⁾	11250VA	15000VA	22500VA
Power DC	- continuous	7500W	10000W	15000W
	- approx. 1h	11250W	15000W	22500W
Short-time power		15000VA	20000VA	30000VA
Peak current		264A _p	440A _p	616A _p
Power Supply (±10%, 50/60Hz)		230V/400V CEE		
Protection		3 x 32A	3 x 40A	3 x 63A
Housing	<i>Amplifier</i>	19", 10U	19" 17U	19", 23U
	<i>approx. dimensions (mm)</i>	444x483x650	755x483x650	1022x483x650
	<i>Power Supply</i>	19", 10U	19", 12U	19", 12U
	<i>approx. dimensions (mm)</i>	444x483x650	533x483x650	533x483x650
Weight	<i>Amplifier (approx.)</i>	60kg	80kg	120kg
	<i>Power Supply (approx.)</i>	200kg	220kg	240kg

TECHNICAL DATA – APS 20000 / 25000 / 30000

		APS 20000	APS 25000	APS 30000
Power AC	- continuous	20000VA	25000VA	30000VA
	- approx. 1h ³⁾	30000VA	37500VA	45000VA
Power DC	- continuous	20000W	25000W	30000W
	- approx. 1h	30000W	37500W	45000W
Short-time power		40000VA	50000VA	60000VA
Peak current		880A _p	1056A _p	1150A _p
Power Supply (±10%, 50/60Hz)		230V/400V CEE		
Protection		3 x 63A	3 x 80A	3 x 100A
Housing	<i>Amplifier</i>	19", 33U	19", 39U	19", 46U
	<i>approx. dimensions (mm)</i>	1467x600x850	1733x600x1050	2044x600x1050
	<i>Power Supply</i>	19", 12U	19", 22U	19", 22U
	<i>approx. dimensions (mm)</i>	533x600x850	978x600x1050	978x600x1050
Weight	<i>Amplifier (approx.)</i>	160kg	200kg	240kg
	<i>Power Supply (approx.)</i>	300kg	500kg	600kg

TECHNICAL DATA – APS 40000 / 50000 / 60000

		APS 40000	APS 50000	APS 60000
Power AC	- continuous	40000VA	50000VA	60000VA
	- approx. 1h ³⁾	60000VA	75000VA	90000VA
Power DC	- continuous	40000W	50000W	60000W
	- approx. 1h	60000W	75000W	90000W
Short-time power		80000VA	100000VA	120000VA
Peak current		1760A _p	2112A _p	2300A _p
Power Supply (±10%, 50/60Hz)		230V/400V		
Protection		3 x 130A	3 x 160A	3 x 200A
Housing	<i>Amplifier</i>	19", 2 x 33U	19", 2 x 39U	19", 2 x 46U
	<i>approx. dimensions (mm)</i>	1467x1200x1050	1733x1200x1050	2044x1200x1050
	<i>Power Supply</i>	19", 42U	19", 46U	19", 46U
	<i>approx. dimensions (mm)</i>	1866x600x1050	2044x600x1050	2044x800x1050
Weight	<i>Amplifier (approx.)</i>	On request	On request	On request
	<i>Power Supply (approx.)</i>	On request	On request	On request

APS SERIES ADD-ONS AND OPTIONS

Options																																										
OPT.01	IEEE488																																									
OPT.02	RS232	RS232, RS485																																								
		USB Host, USB Device on request																																								
OPT.05	U/I monitor	Galvanically isolated BNC plugs for monitoring voltage and current (includes OPT.14.5)																																								
NT.11.33	Additional voltage range	0 ... 33V _{rms} ($\pm 47V_{DC}$)																																								
NT.11.36	Additional voltage range	0 ... 36V _{rms} ($\pm 51V_{DC}$)																																								
NT.11.56	Additional voltage range	0 ... 56V _{rms} ($\pm 79V_{DC}$)																																								
NT.11.60	Additional voltage range	0 ... 60V _{rms} ($\pm 85V_{DC}$)																																								
NT.11.150	Additional voltage range	0 ... 150V _{rms} ($\pm 212V_{DC}$)																																								
NT.11.570DC	Additional DC-voltage range	0 ... +570V _{DC}																																								
NT.11.630DC	Additional DC-voltage range	0 ... +630V _{DC}																																								
OPT.13.30	Special frequency range	DC ... 30kHz (-3dB)																																								
OPT.14	External input	0 ... V _{ExtMax}																																								
		V _{ExtMax} is adjustable between $\pm 2V_p$... $\pm 25V_p$																																								
		OPT.14 includes a digital input filter: type Bessel or Butterworth, order 1 ... 6 (adjustable) Filter frequency selectable 100Hz ... 10MHz																																								
NT.18	Special line voltage	available on request in the range of 110V _{rms} ... 300V _{rms}																																								
OPT.21	Common output	Common output plugs for parallel operation																																								
OPT.24	Programmable internal impedance	<table border="1"> <thead> <tr> <th>Model</th> <th>Ri max. (Ohm)</th> <th>Li max. (mH)</th> </tr> </thead> <tbody> <tr><td>APS 1000</td><td>30000</td><td>400</td></tr> <tr><td>APS 2500</td><td>9000</td><td>120</td></tr> <tr><td>APS 5000</td><td>4500</td><td>60</td></tr> <tr><td>APS 7500</td><td>3000</td><td>40</td></tr> <tr><td>APS 10000</td><td>1800</td><td>24</td></tr> <tr><td>APS 15000</td><td>1286</td><td>17</td></tr> <tr><td>APS 20000</td><td>900</td><td>12</td></tr> <tr><td>APS 25000</td><td>750</td><td>10</td></tr> <tr><td>APS 30000</td><td>643</td><td>9</td></tr> <tr><td>APS 40000</td><td>450</td><td>6</td></tr> <tr><td>APS 50000</td><td>375</td><td>5</td></tr> <tr><td>APS 60000</td><td>321</td><td>4</td></tr> </tbody> </table>	Model	Ri max. (Ohm)	Li max. (mH)	APS 1000	30000	400	APS 2500	9000	120	APS 5000	4500	60	APS 7500	3000	40	APS 10000	1800	24	APS 15000	1286	17	APS 20000	900	12	APS 25000	750	10	APS 30000	643	9	APS 40000	450	6	APS 50000	375	5	APS 60000	321	4	
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OPT.25	Constant current mode																																									
OPT.30	Optical link	Optical interface to real time simulator LC duplex interface / Aurora 8B/10B protocol / 2Gb/s data rate																																								
UT.540.C	Voltage transformer	Output voltages 400V _{rms} / 540V _{rms} Other voltages on request																																								