

LDS Power Amplifiers

To suit old and new LDS® and third-party shakers

The LDS purpose-designed PA, HPA-K, SPA-K and DPA-K range of power amplifiers are used to power our extensive range of shakers, along with the associated cooling systems and field power supplies.

This modular approach to power amplifier design delivers a cost-effective and future-proofed solution for your vibration test capabilities. Extra power modules can be added into the SPA-K and DPA-K amplifiers in the event that you need a larger shaker or have different test requirements in the future. It also minimises support costs as individual power modules can easily be replaced as required.

The whole test system can be controlled remotely, using an amplifier remote control unit for the SPA-K and DPA-K amplifiers, and the COMET_{USB}[™] or LASER_{USB}[™] controllers for the shaker.

The HPA-K and PA series amplifiers provide the power to drive smaller permanent magnet and air-cooled shakers up to 5 kN. Their compact size makes them ideal for laboratory or modal test applications.

All amplifiers can also be used to control third-party shakers.

SPA-K and DPA-K Power Amplifier Features

- Scalable power in 8 kVA increments, allows future upgrade of shaker without replacing the amplifier
- Complete control of shaker system possible from control room using amplifier remote control and shaker control in COMET_{USB} or LASER_{USB}
- Energy-efficient Class D amplifier design (greater than 90%) with additional Economy Running mode – reduces system operating costs
- Space-efficient design minimizes floor real estate
- Low distortion, wide bandwidth (20 Hz to 3 kHz), and signal-to-noise ratio better than –3 dB
- Configurable interlocks provide multiple safety mechanisms
- Can be used as an alternative to third-party amplifiers



HPA-K Power Amplifier Features

- Designed with both power and space efficiency in mind – the compact design maximizes cabinet space yet delivers the power required
- Class D amplifier design with up to 93% power efficiency

PA Series Power Amplifier Features

- Compact (4 U high, bench or 19" rack mounted), linear power amplifiers
- Available in 50 W, 150 W, 500 W and 1000 W units
- Total harmonic distortion typically less than 0.5%
- Signal-to-noise ratio greater than 75 dB

PA Series

The PA series of amplifiers ranges in power output from 50 W to 1000 W. These amplifiers offer a cost-effective solution for permanent magnet and small electro-dynamic shakers used in a variety of tests. PA amplifiers are also used extensively to power third-party shakers.

Fig. 1 PA1000L amplifier shown with LDS V408 and V455 shakers



HPA-K Amplifier

The HPA-K amplifier is a dedicated 5 kVA unit optimized for use with the LDS V650 and V780 air-cooled shakers to deliver greater force than if using the PA1000 amplifier. This compact unit delivers the power for both the shaker and field coils, as well as power for the cooling fan.

Fig. 2 HPA-K amplifier shown with two LDS V650 shakers



SPA-K Range

The SPA-K range of amplifiers delivers power from 8 kVA up to 56 kVA and are used with the LDS V830, V850, V875, V875LS and V8 shakers.

The amplifier provides drive power for the shaker as well as for the field power supply (FPS) and cooling units for these shakers. Power is delivered by individual 8 kVA modules connected in parallel to give scalability and resilience. Using this modular approach, power will continue to be delivered to the shaker system in the event a module fails. The system will continue to operate at a lower force output until the module can be replaced. Alternatively, additional modules can be fitted to provide redundancy and allow continuous and uninterrupted shaker system performance at maximum force.

Fig. 3 SPA-K amplifier shown with an MK4a power module



One or more MK4a (8 kVA) power modules are built inside the cabinet. This approach maximises system availability and allows for future upgrades

SPA176K Amplifier

The SPA176K amplifier delivers power from 88 kVA up to 176 kVA in 8kVA increments, and is used with the LDS V9x shaker. The amplifier incorporates the same extensive set of safety interlock circuits as the SPA-K, as well as providing power for the FPS and cooling unit for the V9x shaker.

Fig. 4 SPA176K amplifier with integral FPS shown with a V9x shaker



DPA-K Range

The DPA-K range of amplifiers delivers power from 70 kVA up to 280 kVA and is used on the LDS V900 shaker series.

DPA-K amplifiers use similar power modules to those used in the SPA-K amplifiers, along with all the benefits of using a parallel architecture. The amplifiers incorporate an extensive set of safety interlock circuits, which will safely shut the system down in the event of any them being activated.

Fig. 5 DPA280K amplifier with integral FPS



Complete Solutions

Remote Control Capability

The Remote Control option allows complete control of the SPA-K or DPA-K amplifier from a remote location over 200 m (656 ft) away.

The DPA-K amplifier is controlled by a dedicated remote control panel mounted in a 19" rack. This unit, RCP9, offers all the controls available on the amplifier itself and can be located over 200 m away connected via a fibre optic or copper cable.

The SPA-K is controlled using a software interface run on a conventional PC that is connected to the amplifier. The software allows the operator to see all the functions on the amplifier's front panel to be displayed on the PC screen, and can be run in addition to the shaker control software such as COMET_{USB} or LASER_{USB}.

In all cases, a built-in safety feature shuts down the amplifier in the event that communication between the amplifier and the remote control panel is interrupted. The emergency stop switch remains active on both the local and remote panels during shaker operation.

Replacement Amplifiers

The SPA-K range of amplifiers has been designed to replace obsolete LDS amplifiers and can also be used to replace amplifiers supplied to drive third-party shakers.

Brüel & Kjær has a wealth of experience in designing power amplifiers to suit most shakers available or in operation today. These include requirements for specific tests that may not be possible with an off-the-shelf solution. All requests will be reviewed by our in-house Special Projects team, who will recommend the optimum solution to meet your requirements.

Service and Support

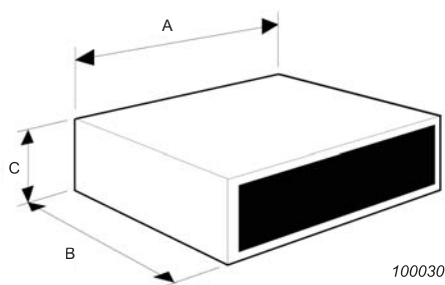
Despite being a global company, Brüel & Kjær prides itself on being able to provide support to our customers with the speed and care of a local company.

Our service to customers extends beyond the supply of vibration test and measurement equipment. We offer training and technical support on-site, delivered by dedicated industry specialists. Combined with excellent system reliability and maintenance, we ensure that you get the best possible return on your investment.

Characteristics

	PA25E	PA100E	PA500L	PA1000L
Shaker	V101, V102, V201, V203	V406, V408, V450, V451, V455, V456	V550, V551, V555, V556	V650, V651, V721, V722
Input Supply (50/60 Hz)	100, 120, 200, 240 VAC (±6%)			
Rated Sinusoidal Power Output (matched resistive load)	48 W / 5.3 Ω	147 W / 2.9 Ω	500 W	1000 W
Total Harmonic Distortion at Rated Output (20 Hz – 10 kHz)	Typically <0.5%		Typically 0.1%	Typically 0.2%
Max. Continuous Sinusoidal VA Output	48 VA	147 VA	700 VA	1400 VA
Frequency Range at Rated Power	10 Hz – 10 kHz		20 Hz – 14 kHz	
Max. Output Voltage	16 V rms	20 V rms	40 V rms	80 V rms
Max. No Load Voltage	24 Vrms	32 V rms	45 Vrms	86 V rms
Voltage Regulation	1%	3%	2%	
Output Current at Rated VA	2.7 A rms	7 A rms	18 A rms	
Max. Output Current	3 A rms	7 A rms	18 A rms	
Random Output Current	5.9 A pk	14 A pk	54 A pk	
Overcurrent Trip Level	4.2 A rms	10 A rms	19 A rms	
Input Sens. for Max. Output (400 Hz)	1.0 V rms			
Signal-to-noise Ratio	>75 dB			
Amplifier Efficiency	59%	58%	59%	
Protection	Fast-acting current limit		True rms metering with overcurrent protection	

Physical Characteristics



Amplifier	Weight kg (lb)	Dimensions in mm (in)		
		A	B	C
PA25E	9 (19.8)	488 (19.2)	337 (13.3)	92 (3.6)
PA100E	15 (33.1)	488 (19.2)	337 (13.3)	92 (3.6)
PA500L	25 (55.1)	482 (18.9)	505 (19.9)	188 (7.4)
PA1000L	35 (77.2)	482 (18.9)	505 (19.9)	188 (7.4)

Characteristics

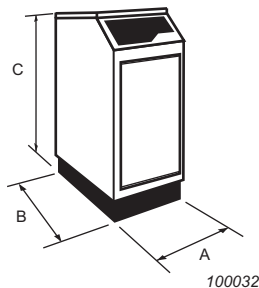
	HPA-K	SPA-K	SPA176K	DPA-K
Shakers	V650, V780	V830, V850, V875, V875LS, V8	V9x	V964, V984, V994
Input Supply	Single-phase, 50 Hz: 380, 400, 415, 440 V (line to line) Single-phase, 60 Hz: 380, 400, 415, 440, 480, 500 V (line to line)	Standard, 3-phase, 50/60 Hz: 380 to 500 V Low-voltage, 3-phase, 50/60 Hz: 200 to 220 V	3-phase, 50/60 Hz, 380 to 500 V	3-phase, 50/60 Hz: 380, 400, 415, 440V (line to line) 3-phase, 60 Hz: 380, 400, 415, 440, 480, 500, 520 V (line to line)
Power Range	5 kVA	8 – 56 kVA in 8 kVA increments	88 – 176 kVA in 8 kVA increments	40 – 280 kVA in 8 kVA increments
Total Harmonic Distortion	Typically 0.15% (measured into resistive load)	up to 0.5 – 0.8% at rated output (measured into resistive load)		
Input Impedance	10 kΩ nominal			
Input Sensitivity	1.0 Vrms input for 100 Vrms output (differential input)			1.1 Vrms (±0.1 V) input for 100 Vrms at rated sinusoidal VA output
Signal-to-noise Ratio	>68 dB*			>65 dB†
Switching Frequency	150 kHz			
Modulation Range	DC – 10 kHz			
Rated Output Voltage	100 V rms (sine)			
Continuous Output Current	50 Arms (sine and random)	80 A rms (sine and random) per 8 kVA increment		
Transient Output Current	150 A for 100 ms	240 A for 100 ms per 8 kVA increment		
Full Power Bandwidth	20 Hz – 5 kHz	20 Hz – 3 kHz		
Protection	Integral protection to prevent output devices from working outside limits			

* With respect to 100 Vrms output, 10 kΩ input termination and rated resistive load connected

† Relative to 100 Vrms output, 10 kΩ input termination and rated resistive load connected (100 kHz BW)

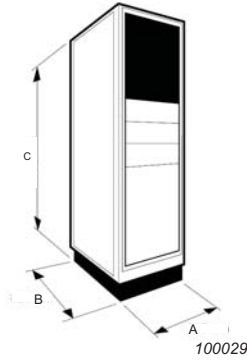
Physical Characteristics

HPA-K AMPLIFIER



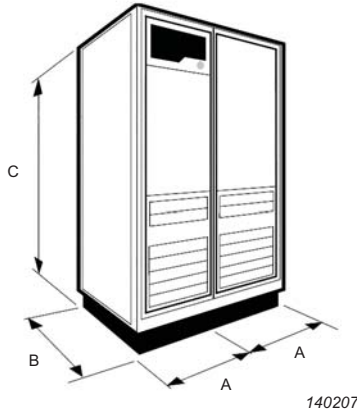
Weight kg (lb)	Dimensions in mm (in)		
	A	B	C
210 (463)	537 (21.1)	825 (32.5)	1000 (39.4)

SPA-K AMPLIFIERS



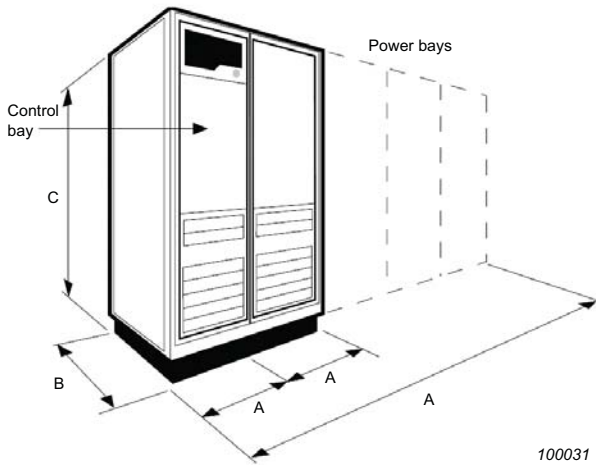
Amplifier	Weight kg (lb)	Dimensions in mm (in)		
		A	B	C
SPA16K	555 (1224)	537 (21.1)	825 (32.5)	1870 (73.6)
SPA24K	566 (1248)	537 (21.1)	825 (32.5)	1870 (73.6)
SPA32K	577 (1272)	537 (21.1)	825 (32.5)	1870 (73.6)
SPA40K	588 (1296)	537 (21.1)	825 (32.5)	1870 (73.6)
SPA48K	599 (1321)	537 (21.1)	825 (32.5)	1870 (73.6)
SPA56K	610 (1345)	537 (21.1)	825 (32.5)	1870 (73.6)

SPA176K AMPLIFIER



Weight kg (lb)	Dimensions in mm (in)		
	A	B	C
2000 (4409)	1905 (75.0)	825 (32.5)	1905 (75.0)

DPA-K AMPLIFIER



Amplifier	Weight kg (lb)	Dimensions in mm (in)		
		A	B	C
DPA40/70K	774 (1706)	1049 (41.3)	825 (32.5)	1905 (75.0)
DPA50/70K	793 (1748)	1049 (41.3)	825 (32.5)	1905 (75.0)
DPA70K	831 (1832)	1049 (41.3)	825 (32.5)	1905 (75.0)
DPA80/140K	1386 (3056)	1560 (61.4)	825 (32.5)	1905 (75.0)
DPA90/140K	1405 (3097)	1559 (61.4)	825 (32.5)	1905 (75.0)
DPA100/140K	1424 (3139)	1560 (61.4)	825 (32.5)	1905 (75.0)
DPA110/140K	1443 (3181)	1560 (61.4)	825 (32.5)	1905 (75.0)
DPA130/140K	1481 (3265)	1560 (61.4)	825 (32.5)	1905 (75.0)
DPA140K	1500 (3307)	1560 (61.4)	825 (32.5)	1905 (75.0)
DPA165/210K	2084 (4594)	2072 (81.6)	825 (32.5)	1905 (75.0)
DPA180/210K	2112 (4656)	2072 (81.6)	825 (32.5)	1905 (75.0)
DPA210K	2169 (4782)	2072 (81.6)	825 (32.5)	1905 (75.0)
DPA280K	2838 (6257)	2583 (101.7)	825 (32.5)	1905 (75.0)

Interlocks

The following lists the available functions on the amplifier to help prevent damage to the operator and/or shaker system

SPA-K AMPLIFIER INTERLOCKS

Overvoltage: The amplifier is being overdriven

Overcurrent: The output current exceeds the user-defined limit

Amplifier Cooling: Over temperature (sensed by thermostats) of the amplifier supply transformer or rectifier stacks

Vibration Overtravel: Shaker travel has exceeded the specified limits

Vibration Cooling: Fault in the shaker cooling fan

External 1 and External 2: Check that the outputs of the external interlocks are connected to potential-free contacts that open when there is a fault condition, or if not used, are disabled on the Interlock Setup page

H.T. Minimum: High tension level is below the normal minimum operating level

H.T. Level Maximum: High tension supply level has exceeded the maximum operating level

Output Offset: Output offset voltage has exceeded the specified limits during initial switch-on of the amplifier

Input Overdrive: Drive signal level to the amplifier input stages has exceeded the specified limits

Module Fault: One or more power protection circuits have activated

Power Fail: The 115 VAC supply to the switch mode power supply is below the specified limits

Vibrator Field: Shaker field current has fallen below a preset limit

Phase Failure: The incoming mains supply has lost one or more phases, or one or more phases are low

Slip Table: Oil supply to the slip table bearings and the slip table granite has fallen below operating pressure

SPA176K INTERLOCKS

Output Overvoltage: Amplifier's output voltage has exceeded the user-defined preset limit

Armature Overcurrent: Current to the armature has exceeded the user-defined preset limit

Amplifier Overtemperature: Amplifier's temperature has exceeded the user-defined preset limit

Armature Overtravel: Indicates excessive travel of the shaker's armature

Field Power Supply: Shaker's field current has fallen below the preset limit

Cooling Unit: Failure of the shaker's cooling system

H.T. Level Maximum: High tension supply has exceeded the maximum operating level

H.T. Level Minimum: High tension level is below the nominal minimum operating level

Output Offset: Output offset voltage has exceeded the specified limits during amplifier switch-on

Input Overdrive: Level of drive signal to the amplifier has exceeded the specified limit

Module Fault: One or more power protection circuits has activated

Power Fail: The supply voltage to the switch mode power supply (SMPS) is below the specified limits

Shaker Field: Will be disabled unless simulated by the field power and cooling interface unit (FPCI)

Shaker Cooling: A cooling interlock has been tripped at the FPCI

Phase Failure: The incoming mains supply has lost a phase, or a phase is low

Emergency Stop: Ensures all interlocks are in the Open state during system initialization

DPA-K AMPLIFIER INTERLOCKS

Bay 1 to Bay 4 Fault: Eight possible fault conditions:

1. Output offset

2. Auxiliary supplies

3. Module fault

4. H.T. level low

5. H.T. level high

6. H.T. ripple

7. Overcurrent

8. Transformer/Rectifier overtemp

Output Offset: Output offset voltage has exceeded the specified limits (± 1 V) during amplifier switch-on

Input Overdrive: Level of drive signal to the amplifier has exceeded the specified limits

Output Overvoltage: Amplifier's output voltage has exceeded the built-in preset limit

Output Overcurrent: Amplifier's output current has exceeded the user-defined preset level

Auxiliary Supplies: Fault in control unit (± 15 V or +5 V power supply)

Vibrator Cooling: Failure of the shaker's cooling system

Vibrator Field: Shaker's field current has fallen below a preset limit

Vibrator Overtravel: Indicates excessive travel of the shaker's armature

Emergency Stop: Ensures all interlocks are in the Open state during system initialization feedback

Replacement Amplifiers

SPA-K amplifiers are available to replace discontinued LDS amplifiers used with the following shakers, and are also available to replace most third-party amplifiers running third-party shakers. These amplifiers can be used with the Software Remote Control Option.

SPA56K AMPLIFIER REPLACEMENTS

Shaker	Force Sine kN (lbf)	Force Random kN (lbf)	Power Output kW	Blower Size kW (HP)
V824 MK1	26.69 (6000)	24.02 (5400)	32	4 (5.5)
V824 MK2	26.69 (6000)	24.02 (5400)	32	4 (5.5)
V824LS MK2	26.69 (6000)	25.16 (5656)	32	4 (5.5)
V825L	26.69 (6000)	16.39 (3685)	32	4 (5.5)
V826LS	24.02 (5400)	16.19 (3640)	16	4 (5.5)
V826	26.69 (6000)	14.82 (3331)	16	4 (5.5)
V860 Low Z series	14.68 (3300)	12.34 (2774)	8	4 (5.5)
V860 High Z Parallel	20.02 (4500)	16.06 (3610)	8	4 (5.5)
V860 Low Z Parallel	28.02 (6300)	23.97 (5389)	16	4 (5.5)
V860 HD Low Z Parallel	33.36 (7500)	25.76 (5790)	24	4 (5.5)
V890	53.38 (12,000)	55.60 (12,500)	48	5.5 (7.5)
V894	53.38 (12,000)	55.60 (12,500)	48	5.5 (7.5)

SPA24K AMPLIFIER REPLACEMENTS

Shaker	Force Sine kN (lbf)	Force Random kN (lbf)	Power Output kW	Blower Size kW (HP)
V706L	4.45 (1000)	4.33 (974)	16	0.37 (0.5)
V710L	3.20 (720)	2.52 (567)	8	0.75 (1.0)
V712	3.11 (700)	2.30 (517)	8	0.55 (0.75)
V714	3.11 (700)	2.30 (517)	8	0.55 (0.75)
V716	2.89 (650)	1.82 (410)	8	0.55 (0.75)
V721	4.10 (922)	2.20 (495)	8	0.37 (0.5)
V724 MK1	6.67 (1500)	7.22 (1623)	16	0.75 (1.0)
V724 MK2	6.67 (1500)	7.22 (1623)	16	0.75 (1.0)
V725	6.67 (1500)	5.62 (1263)	16	0.75 (1.0)
V726	6.67 (1500)	3.71 (835)	8	0.75 (1.0)
V730-185	8.90 (2000)	5.78 (1300)	16	2.2 (3.0)
V730-335	8.90 (2000)	8.90 (2000)	16	2.2 (3.0)
V804	13.34 (3000)	12.01 (2700)	16	1.5 (2.0)
V804LS	13.34 (3000)	12.01 (2700)	16	1.5 (2.0)
V805 HZ Series	11.12 (2500)	5.11 (1149)	8	1.5 (2.0)
V805 LZ Parallel	13.34 (3000)	6.89 (1549)	16	1.5 (2.0)
V806	13.34 (3000)	8.45 (1900)	8	1.5 (2.0)
V810-240	17.79 (4000)	13.34 (3000)	24	3.0 (4.0)
V810-440	17.79 (4000)	17.79 (4000)	24	3.0 (4.0)

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