

HVA1500/50 User Manual

Version 2.0

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1. SAFETY INSTRUCTIONS AND SYMBOLS

READ FIRST

To ensure safe operation and to keep the operator and the product safe, **THE INFORMATION, CAUTIONS, AND WARNINGS IN THIS MANUAL MUST BE HEEDED.**



WARNING – WARNING STATEMENTS AND SYMBOLS IDENTIFY CONDITIONS OR PRACTICES THAT COULD RESULT IN INJURY OR LOSS OF LIFE.



CAUTION – CAUTION STATEMENTS AND SYMBOLS IDENTIFY CONDITIONS OR PRACTICES THAT COULD RESULT IN DAMAGE TO THIS PRODUCT OR OTHER PROPERTY.

REVIEW THE FOLLOWING SAFETY PRECAUTIONS TO AVOID INJURY AND PREVENT DAMAGE TO THIS PRODUCT OR ANY PRODUCTS CONNECTED TO IT. TO AVOID POTENTIAL HAZARD, USE THIS PRODUCT ONLY AS SPECIFIED.

- Only qualified personnel should operate and make connections to this unit.
- All connections including removal of any connections from the High Voltage Output Connector must be done with the unit OFF and disconnected from the AC line source.
- To avoid shock hazard, electrocution, or fire, observe all ratings and markings on the product. Consult the User's Manual for further safety information before making connections to the product.

The High Voltage Amplifier HVA 1500/50 generates voltages up to 1500V. These voltages are present inside the unit and at the rear panel output connectors and are a danger to life if used improperly.

Make sure that attached cables are electrically and mechanically NOT defective. Replace cables only with the high voltage amplifier switched off.

Before switching the high voltage amplifier on, make sure that all cables are connected to the corresponding socket of the load.

Before removing the cables from the load, switch off the amplifier and wait at least 10 minutes until the load capacitors are discharged.

Never operate the high voltage amplifier if any housing part of the unit is defective or removed.

Do not open the high voltage unit. Only qualified personnel may open the unit.



Warning!

**HAZARDOUS VOLTAGES UP TO 1500V ARE
PRESENT AT THE HIGH VOLTAGE AMPLIFIER'S
OUTPUT.**

**TAKE APPROPRIATE PRECAUTIONS DURING
MEASUREMENT PROCEDURES.
BEFORE TURNING ON THE AMPLIFIER, REMOVE
HANDS AND ALL TEST EQUIPMENT FROM THE
LOAD AND CONNECTED CABLES!!**

2. OVERVIEW

The HVA1500/50 is a single channel, high voltage power amplifier. The power amplifier is capable of delivering an output voltage in the range of -500 V to +1500 V with an output current of up to 50 mA DC. The amplifier provides a large signal bandwidth of DC to 10 kHz depending on the load capacitance and has a gain of 200 V/V.

Two independent signal inputs are provided, a wave generator input and an audio signal input which can be selected by a rotary switch. The wave generator input accepts signals in the range of -2.5 V to +7.5 V at a frequency of 0 Hz to 10 kHz.

The audio signal input accepts audio signals in the range of 0.2 V to 3 V AC at a frequency of 10 Hz to 10 kHz. Two potentiometers are also provided to adjust the gain and the offset of the audio signal.

The monitoring circuitry allows output voltage and output current monitoring. Both monitoring signals are near ground potential, i.e. not hazardous, low voltages.

Two LEDs indicate the states of the output voltage/current. A LED for "HV On" and a LED for "Limit". The LED "HV On" illuminates if the output voltage is enabled by a rotary switch or by an interlock signal. The LED "Limit" illuminates if the output voltage/current exceeds the limits. The interlock circuitry allows switching off and on the high voltage by an external signal.

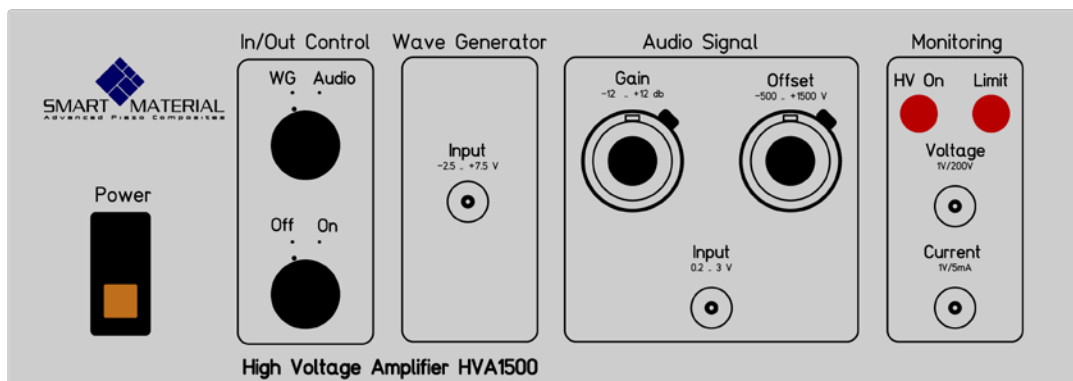


Fig 1: HVA1500/50 front panel

3. INSPECTION & INSTALLATION

This section provides information for incoming inspection, damage claims, shipping, and installation of the HVA1500/50.

3.1 WHAT COMES WITH THE HVA1500/50

The HVA1500/50 package contains the following items:

- Single channel high voltage amplifier unit HVA 1500/50,
- Line voltage cord,
- High voltage cable with an SHV plug,
- 3-pin interlock connector,
- User Manual.

3.2 INCOMING INSPECTION

The high voltage amplifier unit should be inspected for damage, scratches, dents, or other defects. Also the cushioning materials should be checked for sign of severe stress. The electrical performance of the amplifier unit should be verified upon receipt. Make sure that no cable is electrically and mechanically defective. If the unit is damaged in transit, or fails to meet the specifications upon receipt, notify the carrier and the sales office immediately. Retain the shipping carton and padding material for the carrier's inspection. The sales office will arrange for replacement or repair of your unit without waiting for claim settlement against the carrier. Before returning the high voltage amplifier for any reason, notify the sales office of the difficulty encountered. They will send shipping instructions.

3.3 INSTALLATION

The AC power supplied to the amplifier unit should be 90 to 264 VAC, 47 to 63Hz, single phase. Two 2-ampere slow blow fuses of 1.6A are used.

For safety reasons, the power supply must be grounded through the AC power cord. When operating from ungrounded power sources, a secondary grounding method is mandatory. Before operation, make sure that the output cable of the amplifier unit is connected to the load.

The cooling of the control unit is provided by convection. The location of the unit must ensure adequate air circulation.

4. SPECIFICATIONS

4.1 GENERAL SPECIFICATIONS

The HVA1500/50 is designed to be operated as a high voltage power supply for the MFC, P1 type products.

AC Power supply	90-264VAC, 47-63 Hz, 150VA
	Slow fuse 1.6A
	Standard three prong connector
Operating Conditions	Ambient Temperature 0°C to 40°C
	Relative Humidity up to 85%, noncondensing
Mechanical	255 mm W x 100 mm H x 400 mm D
	Components are mounted on both sides of the PB
	Weight approx. 8kg
Input Impedance	All input impedances are 100kOhm

4.2 OUTPUT VOLTAGE, MAXIMUM CURRENT PERFORMANCE

Output Voltage Range	-500 V to +1500 V
Variable Current Range	0 to +/- 50 mA DC
	0 to 60 mA peak AC
Output Connector	SHV Female Connector
DC Voltage Gain	200 V/V for wave generator input, noninverting
DC Voltage Gain Accuracy	Better than 0.1% of full scale
Offset Voltage	Less than 1 V
Slew rate	Greater than 50 V/ μ s
Large Signal Bandwidth	DC to 10 kHz
Drift with Time	Less than 100 ppm/hr
Drift with Temperature	Less than 50 ppm/°C
Warm up Time	5 min
Connector	+500V, 0mA to 10mA, 5W

4.3 WAVE GENERATOR INPUT

Input Voltage Range	-2.5 V to +7.5 V, corresponds to -500 V to +1500 V output
Input Resistance	100 kOhm
Signal Frequency Range	0 Hz to 10 kHz
Input Connector	BNC coaxial connector

4.4 AUDIO SIGNAL INPUT

Input Voltage Range	0.2 V to 3 V AC
Input Resistance	100 kOhm
Gain Control Range	-12 db to +12db, by using the 10-turn potentiometer Gain
Offset Control Range	-500 V to +1500 V, by using the 10-turn potentiometer OFFSET
Signal Frequency Range	10 Hz to 10 kHz
Input Connector	BNC coaxial connector

4.5 OUTPUT VOLTAGE MONITOR

Conversion Factor	1/200th of the output voltage Output
Output Impedance	1 kOhm
Output Connector	BNC coaxial connector

4.6 OUTPUT CURRENT MONITOR

Conversion Factor	0.2 V / mA
Output Impedance	1 kOhm
Output Connector	BNC coaxial connector

4.7 INDICATORS

HV On LED	The LED illuminates indicating that the high voltage is on
Limit LED	The LED illuminates if the output voltage or current exceeds the maximum limits

4.8 INTERLOCK

Function	The output voltage is turned on only if the interlock signal is closed , i.e. pin 1 and pin 2 of the interlock connector are connected together
Interlock Connector	A 3-pole socket on the rear panel
Signals	Pin 1: output signal, +5 V Pin 2: input signal, i.e. interlock signal

4.9 EU-COMPLIANCE DECLARATION

The high voltage amplifier MFC1500/50 has the CE-marking. The EU Declaration of Conformity ensures that the device meets the requirements of the European Standard given by the regulation of the Council of the European Union for assimilation of the legal regulations of the members of the European Union concerning the Electromagnetic Compatibility (89/336/EEC). Conformity is shown by the compliance with the concerning standards EN 50081-1; EN 50082 or EN50081-2; EN 50082-2 respectively.

5. OPERATION

This section outlines the general procedure for operating the high voltage amplifier and the load. For more operating information, see also the manual for any used piezo actuators.

5.1 FRONT PANEL CONTROLS

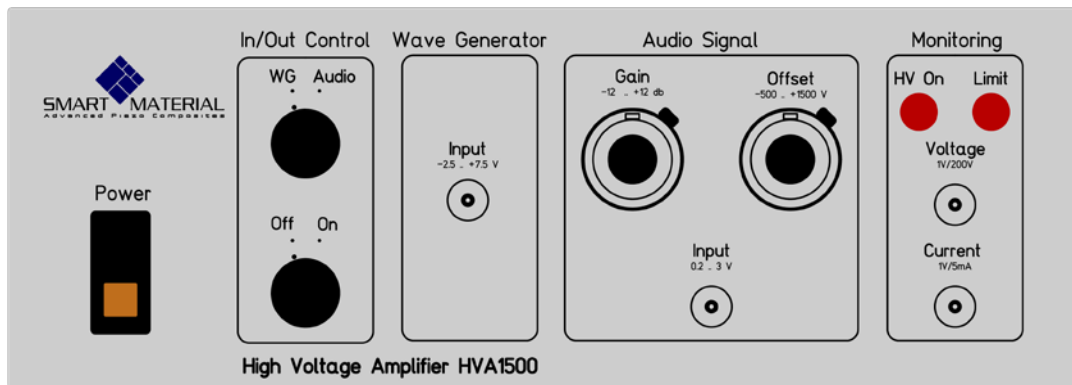


Fig 2: HVA1500/50 front panel

Power	Toggle Switch	Turns the power supply on and off.
In/Out Control	WG/Audio Switch	This rotary switch enables the wave generator input or the audio signal input.
	On/Off Switch	This rotary switch turns the output voltage on or off.
Wave Generator	Input Signal	The Wave Generator input accepts signals in the range of -2.5 V to +7.5 V at a frequency of 0 Hz to 10 kHz, which corresponds to an output voltage of -500 V to +1500 V.
Audio Signal Input	Input Signal	The audio signal input accepts signals in the range of 0.2 V AC to 3 V AC at a frequency of 10 Hz to 10 kHz.
	Gain Potentiometer	This potentiometer allows the gain adjustment in the range of -12 db to +12 db, i.e. a gain factor of 1/4 to 4.
	Offset Potentiometer	This potentiometer allows offset adjustments in the range of -500 V to +1500 V.

Monitors	LED HV On	This indicator illuminates if the output voltage is turned on by the rotary switch in the In/Out Control section <u>and</u> by the external interlock signal.
	LED Limit	This indicator illuminates if the output voltage or current exceeds the limits
	Voltage Monitor	This output signal monitors the high voltage at the output. The conversion factor is 1 V / 200V. This output signal is near ground potential.
	Current Monitor	This output signal monitors the output current. The conversion factor is 1 V / 50 mA. This output signal is near ground potential.

5.2 REAR PANEL CONTROLS

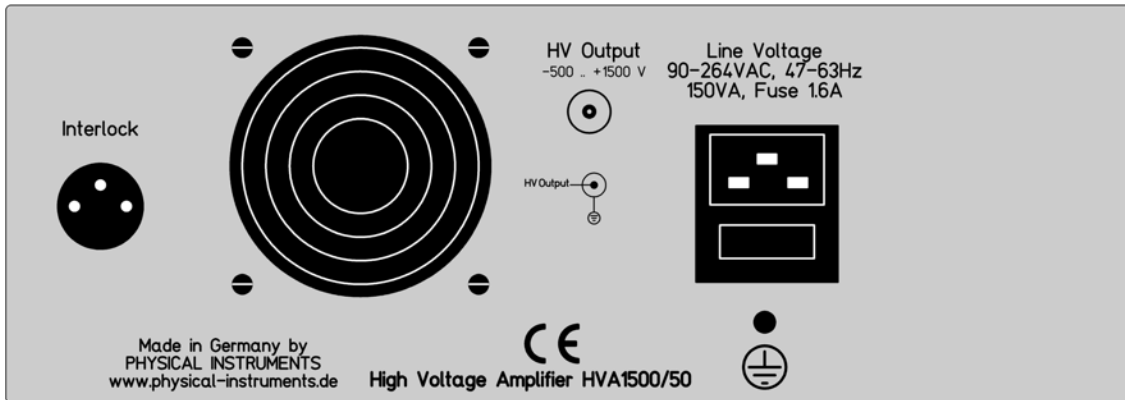


Fig 3: HVA1500/50 rear panel

Line Voltage Input	Connector	International standard three-wire connector
	Line Voltage	90-264VAC, 47-63 Hz
	Power	150VA
	Fuse	Two 1.6A slow blow fuses
Ground Screw 	Function	Allows the grounding of the unit
HV Output	Connector	SHV coaxial connector
	Voltage Range	-500 V to +1500 V
Interlock Input	Connector	3-pole socket on the rear panel
	Pin Assignment	Pin1: 5V output Pin2: interlock signal input Pin3: not used Amplifier output voltage is turned on if pin1 is connected to pin2 otherwise the output voltage is set to 0

5.3 OPERATIONAL REQUIREMENTS

Before making any connections, make sure that the amplifier unit is turned off.

- Connect the amplifier unit to the mains.
- Connect the high voltage output connector of the amplifier to the load.
- Connect the interlock cable to the interlock connector of the amplifier unit.
- Connect a ground cable from the load to the GND screw on the rear panel of the amplifier unit if necessary.
- Set the output control switch on the front panel to "Off" before switching the power on.

5.4 OPERATING MODE

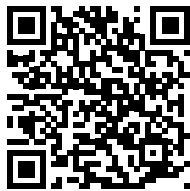
Prior to the operation, the amplifier should be warmed up 5 minutes in order to achieve the nominal stability of the amplifier.

- Set the output control switch to "Off".
- Select the required input "WG Input" or "Audio Signal Input" with the rotary switch on the front panel.
- Make sure the interlock signal is activated at the rear panel socket "Interlock".
- Apply a signal to the input selected.
- Turn on the output voltage by setting the output control switch to "On". The indicator LED "HV On" will go on. If not, check the interlock signal at the rear panel socket "Interlock".
- Check if output voltage is present at the output by monitoring the monitor signal "Voltage" or "Current" with an oscilloscope.
- Should the indicator LED "Limit" go on, lower the input signal amplitude or signal frequency. In case of an audio signal, the gain or offset potentiometer can also be used to control the limit condition.
- Turn off the unit by switching off the power.

6. FURTHER RESOURCES



We feature our popular in-depth tutorials on on our YouTube channel SmartMaterialCorp.



6.1 CONTACTS

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All rights reserved. No part of this manual may be reproduced without the prior permission of Smart Material Corporation.
This document is for the instructional use of the HVA1500/50. Please read carefully before using the equipment.

In Memory of
Dr. Hooshang Tehrani

The designer and creator of the HVA1500 and the *micro*HVA-2
High Voltage Amplifier series.
The founder of Physical Instruments.
An exceptional engineer.

6.2 LIMITED WARRANTY

(a) Seller warrants to the Buyer that, for a **period of eighteen (18) months from the date of delivery** of the Product(s) by Seller to a commercial carrier, the Product(s) will conform to Seller's stated specifications and be free from defects in workmanship and materials.

(b) Seller's limited warranty set forth in Section 1(a) shall not apply to any Product components that experience normal wear and tear.

(c) In order to maintain the limited warranty set forth in Section 1(a), Buyer must have the Product(s) calibrated on an annual basis.

(d) IN THE EVENT OF ANY BREACH OF THE LIMITED WARRANTY SET FORTH IN SECTION 1(a), SELLER'S SOLE OBLIGATION SHALL BE EXCLUSIVELY LIMITED TO, AT THE SOLE OPTION OF SELLER:

(i) REPAIR OR REPLACEMENT, FCA SELLER'S DELIVERY POINT, OF ANY PRODUCT THAT SELLER DETERMINES TO BE DEFECTIVE; OR (ii) A FULL REFUND OF THE PURCHASE PRICE UPON RETURN OF THE PRODUCT(S) TO SELLER, WITH BUYER RESPONSIBLE FOR PACKAGING AND SHIPPING THE PRODUCT(S) TO SELLER.

(e) SELLER'S MAXIMUM LIABILITY TO BUYER WITH RESPECT TO THE PRODUCT(S) SHALL IN NO EVENT EXCEED THE PURCHASE PRICE PAID BY BUYER FOR THE PRODUCT(S) THAT ARE THE SUBJECT OF THE APPLICABLE CLAIM.

(f) EXCEPT FOR THE LIMITED WARRANTY SET FORTH IN THIS SECTION, SELLER MAKES NO OTHER WARRANTIES WITH RESPECT TO ANY PRODUCT(S), WHETHER EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, QUALITY AND/OR THOSE ARISING BY STATUTE OR OTHERWISE BY LAW OR FROM ANY COURSE OF DEALING OR USE OF TRADE, ALL OF WHICH ARE HEREBY EXPRESSLY DISCLAIMED. SELLER DOES NOT WARRANT OR GUARANTEE THAT BUYER WILL REALIZE ANY RESULTS BY VIRTUE OF THE USE OF THE PRODUCT(S).

(g) ANY ORAL OR WRITTEN STATEMENT, INFORMATION OR ADVICE GIVEN OR MADE BY SELLER OR ANY OF ITS EMPLOYEES, AGENTS, REPRESENTATIVES OR DISTRIBUTORS ABOUT THE PRODUCT(S) OR THE PERFORMANCE OF THE PRODUCT(S): (i) SHALL NOT CONSTITUTE A SELLER REPRESENTATION OR WARRANTY OR IN ANY WAY INCREASE THE SCOPE OF THE LIMITED WARRANTY SET FORTH IN SECTION(a); (ii) SHALL NOT BE RELIED UPON BY BUYER OR ANY OTHER PERSON AND BUYER ACKNOWLEDGES THAT SUCH WAS NOT RELIED UPON BY BUYER IN DECIDING TO PURCHASE THE PRODUCT; AND (iii) IS NOT A PART OF THE LIMITED WARRANTY SET FORTH IN SECTION(a).

(h) Seller shall not be liable for a breach of the limited warranty set forth in Section(a) unless:

(i) Buyer delivers written notice of the defective Product(s) to Seller within eighteen (18) months from the date of delivery of the Product(s) by Seller to the commercial carrier; (ii) Seller is allowed a reasonable opportunity after receiving the written notice to examine such Products; and (iii) Seller reasonably verifies Buyer's claim that the Products are defective. Seller shall not be liable for a breach of the limited warranty set forth in Section(a) if: (i) Buyer makes any further use of such Products after delivering written notice; (ii) the defect arose because Buyer improperly used and/or inadequately maintained the Product(s); or (iii) Buyer alters or repairs such Product(s) without the prior written consent of Seller.

(j) THE REMEDIES SET FORTH IN THIS SECTION SHALL BE THE BUYER'S SOLE AND EXCLUSIVE

REMEDY AND THE SELLER'S ENTIRE LIABILITY FOR ANY BREACH OF THE LIMITED WARRANTY SET FORTH IN SECTION 1(a).

2. Indemnification.

Buyer agrees to defend, indemnify and hold harmless Seller and each of its affiliates and each of their respective directors, officers, managers, members, employees, agents, successors and assigns (collectively, "Indemnified Parties") against any damage, loss, liability, cost or expense (including reasonable attorneys' fees) incurred by any Indemnified Party arising out of or resulting from any third party claim arising out of or relating to any products sold by Buyer that incorporate the Product(s).

3. Limitation of Liability.

(a) IN NO EVENT SHALL SELLER BE LIABLE TO BUYER OR TO ANY THIRD PARTY, WHETHER IN CONTRACT, NEGLIGENCE, TORT OR UNDER ANY OTHER THEORY OF LAW, FOR LOSS OF PROFITS, LOSS OF BUSINESS OR LOSS OF BUSINESS OPPORTUNITY, OR FOR ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL, EXEMPLARY, PUNITIVE OR INDIRECT DAMAGES, HOWSOEVER CAUSED AND WHETHER FORESEEABLE OR NOT.

(b) The limitation of liability set forth in this Section 6 shall apply to the maximum extent permitted by law.

4. Miscellaneous.

Governing Law; Jurisdiction/Venue. These Terms shall be governed by, and construed in accordance with, the laws of the State of Florida, U.S.A. if the unit is sold by Smart Material Corp., the laws of Germany if the unit is sold by Smart Material GmbH without reference to conflicts of law principles. For purposes of litigating any claim or dispute arising from or related to this Agreement, the parties irrevocably submit and consent to the exclusive jurisdiction and venue of the State of Florida courts located in Sarasota County, Florida, or exclusive jurisdiction and venue of the courts located at Dresden, Germany.