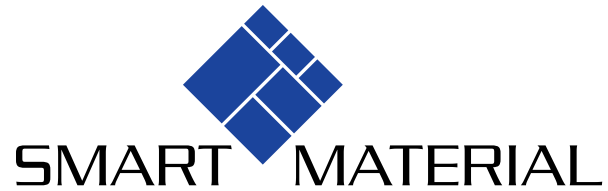


ELECTRICAL ENGINEERING LTD.



EEL1500-1 User Manual

Version 1.0

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This document is for the instructional use of the EEL1500-1. Please read carefully before using the equipment.

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.

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

Before removing the cables from the load, switch off the amplifier and wait at least 5 minutes until the load capacitors are discharged.

Warning!

HAZARDOUS VOLTAGES UP TO 2000V ARE
PRESENT AT THE OUTPUT OF THE HIGH VOLTAGE
AMPLIFIER.

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 High Voltage Amplifier (HVA) model EEL1500-1 is specifically designed for the MacroFiberComposite™ (MFC).

The EEL1500-1 is a compact, high speed, 55 Watt High Voltage Amplifier capable of generating a -500 to +1500Vpp output @ +/-50mA with a large signal bandwidth greater than 150kHz at -3db no load.

There are three LED indicators on the front panel signaling the following conditions:

1. When the unit is powered on, the LED POWER ON illuminates,
2. When the high voltage is on (enabled), the LED HIGH VOLTAGE illuminates,
3. If high voltage output goes into an Out-Of-Regulation condition (high voltage output doesn't match the input), the LED OUT OF REGULATION illuminates.

The high voltage is turned ON by providing a TTL LOW to the HIGH VOLTAGE ENABLE BNC on the rear panel, or by plugging the shorting cap to the HIGH VOLTAGE ENABLE BNC.

A DYNAMIC ADJUSTMENT1 turn potentiometer is provided on the front panel to adjust for optimum square wave shape with varying capacitive loads.

Two monitors are provided. The VOLTAGE MONITOR BNC represents a 1:200 representation of the HIGH VOLTAGE OUTPUT. The CURRENT MONITOR BNC represents a 1V to 5mA representation of the CURRENT being drawn from the amplifier.

2.1 FRONT PANEL

The Front Panel of the Model EEL1100.50.1 is shown in Figure 2-1 and 2.2. The information provides important details on features provided, which will be useful for operating the product to its fullest capability.



Fig. 2-1 EEL1500-1 Front Panel

1. **POWER SWITCH**
Rocker switch to turn ON and OFF the AC source to the unit.
2. **INPUT**
BNC used for connecting DC or AC sources to be amplified.
3. **VOLTAGE MONITOR**
BNC used for monitoring a 200:1 replica of the HV OUTPUT.
4. **CURRENT MONITOR**
BNC used for monitoring the value of current being drawn from the unit at a 1V/5mA ratio.

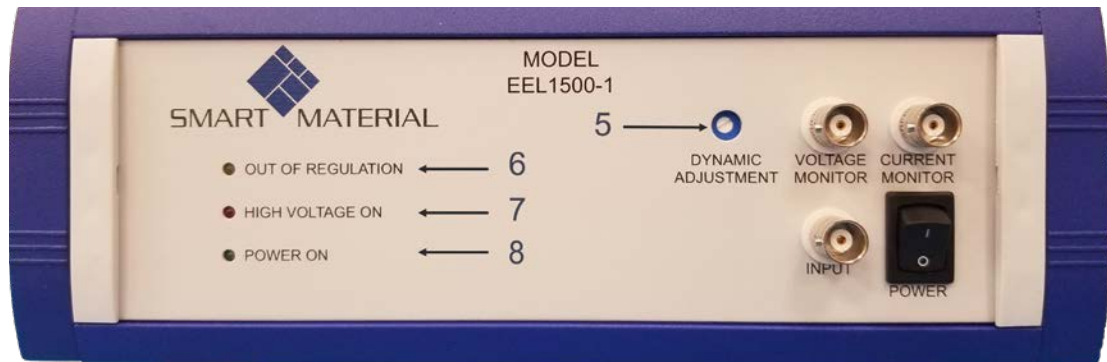


Fig. 2-2 EEL1500-1 Front Panel

5. **DYNAMIC ADJUSTMENT**
A one Turn Potentiometer used to adjust for best square wave performance with various capacitive load.
6. **OUT OF REGULATION**
Amber LED illuminated indicates when the HIGH VOLTAGE OUTPUT doesn't conform to the proper value as dictated by the INPUT signal.
7. **HIGH VOLTAGE ON**
Red LED Illuminated indicates the HIGH VOLTAGE OUTPUT is ON (Enabled)
8. **POWER ON**
Green LED illuminated indicates the unit is powered ON

2.2 REAR PANEL

The Rear Panel of the Model EEL1500-1 is shown in Figure 2-3. The information provides important details on the features provided, which will be useful for operating the product to its fullest capability.

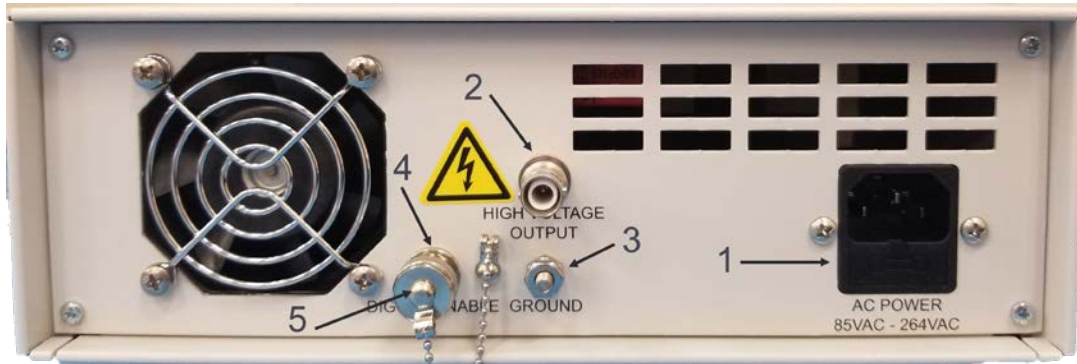


Fig. 2-3 EEL1500-1 Rear Panel

1. AC POWER PLUG
Standard AC plug with internal fuse holder.
2. HIGH VOLTAGE OUTPUT
SHV connector used to connect the unit to the high side of load.
3. GROUND LUG
8 – 32 Threaded Lug used for a ground return from the load.
4. HIGH VOLTAGE ENABLE
BNC connector to accept a TTL Low signal to Enable High Voltage or a TTL High signal (or open) will Disable High Voltage.
5. SHORTING CAP
Used to Enable High Voltage if external TTL Signals are not used.

3. INSPECTION AND PARTS

3.1 WHAT COMES WITH THE EEL1500-1

The EEL1500-1 package contains the following items:

1. The EEL1500-1
2. Power cord.
3. User's Manual.
4. High Voltage Output SHV plug and cable, unterminated.

3.2 INSPECTION AND VERIFICATION OF THE EEL1500-1

Remove the unit from the packaging and verify that no damage occurred to the product during shipping.

1. If any damage is observed, contact customer service before proceeding any further.
2. Make sure the front panel POWER switch is in the OFF position (O).
3. Remove the shorting cap from the HIGH VOLTAGE ENABLE BNC on the rear panel.
4. Connect a DMM to VOLTAGE MONITOR BNC set for DCV.
5. Connect a 1VDC source to INPUT BNC.
6. Plug the unit into a 85 - 264VAC line source.
7. Turn the POWER switch on the front panel to ON (I). The fan should be ON and the DMM should read 0V.
8. Plug the shorting cap into the HIGH VOLTAGE ENABLE BNC on the rear panel and the DMM should read 1.0VDC.
9. Change the 1.0VDC source to -1.0VDC and verify the DMM reads -1.0VDC.
10. Remove the shorting cap from the HIGH VOLTAGE ENABLE BNC and verify the DMM reads 0VDC.
11. Turn the POWER switch OFF(O). This completes the unit verification testing.

4. SPECIFICATIONS

4.1 GENERAL SPECIFICATIONS

The EEL1500-1 is designed to be operated as a high voltage power supply for the MacroFiberComposite™, MFC P1 type products.

Main Power supply	100 - 240VAC, 50 - 60Hz
Operating Conditions	Ambient Temperature 5°C to 40°C
	Relative Humidity up to 75%, noncondensing
Mechanical	85mm (3.34") H X 250mm (9.84") W X 260mm (10.23") D
	Weight approx. 2kg (4.5lbs)

4.2 OUTPUT VOLTAGE, CURRENT, POWER

High Voltage Output	-500V DC to +1500V DC or peak AC	
	Accuracy:	0.5% of F.S.
	Noise:	<600mVrms
	Offset:	<1V DC
	Output Connector:	SHV coax
Current	±50mA	
Power Rating	55W	
Large Signal Bandwidth	>150kHz No load -3db	
Small Signal Bandwidth	>165kHz No load -3db	
Input HV Control	Input Gain:	200
	Input Voltage Range:	-2.5V to +7.5V (for output -500V to +1500V)
	Input Impedance	50kOhm
	Input Connector:	BNC
High Voltage Enable	TTL, Open Collector	
High Voltage Enable Connector	BNC with shorting plug	
Dynamic Adjustment	One turn potentiometer	

4.3 MONITOR OUTPUTS

Voltage Monitor	Output Voltage:	200:1 (1V = 200V)
	Accuracy:	0.1% of Full Scale
	Bandwidth:	200kHz
	Min. Output Impedance:	> 1kOhm
	Output Connector:	BNC
Current Monitor	Output Voltage:	1V = 5mA
	Accuracy:	1% of Full Scale
	Bandwidth:	10kHz
	Min. Output Impedance:	> 1kOhm
	Output Connector:	BNC

5. OPERATIONS

The Model EEL1500-1 amplifies a signal that is applied to the INPUT BNC with a gain ratio of 200:1.



WARNING – HIGH VOLTAGE CAN BE PRESENT AT THE HIGH VOLTAGE OUTPUT WHEN THE UNIT IS TURNED ON. DO NOT MAKE ANY CONNECTIONS TO THE HIGH VOLTAGE OUTPUT WHILE THE UNIT IS ON OR PLUGGED INTO AN AC SOURCE. ALL CONNECTIONS TO THE LOAD MUST BE DONE WITH THE UNIT OFF AND UNPLUGGED.

1. Make sure the front panel POWER switch is in the OFF position (**O**) and the unit is not plugged into an AC source.
2. Remove the shorting cap from the HIGH VOLTAGE ENABLE BNC on the rear panel.
3. Connect a DMM or an Oscilloscope to VOLTAGE MONITOR BNC set for DCV.
4. Connect a -2.5V to +7.5VDC source (set to 0VDC) to the INPUT BNC.
5. Plug the unit into an 85 - 264VAC line source.
6. Turn the POWER switch on the front panel to ON (**I**). The fan should be ON and the DMM/Oscilloscope should read 0V.
7. Plug the shorting cap into the HIGH VOLTAGE ENABLE BNC on the rear panel, the DMM/Oscilloscope should still read 0VDC at the VOLTAGE MONITOR BNC.
8. Change the INPUT source to -2.5VDC and verify the DMM/Oscilloscope reads -2.5VDC.
9. Change the INPUT source to +7.5VDC and verify the DMM/Oscilloscope reads +7.5VDC.
10. Remove the shorting cap from the HIGH VOLTAGE ENABLE BNC on the rear panel and verify the DMM/Oscilloscope at the VOLTAGE MONITOR reads 0V.
11. Turn the POWER switch off (**O**). This completes the unit verification testing.

6. TROUBLESHOOTING

Symptom	Check	Action
Does not power up	Verify unit is plugged into an active AC source (85 – 264VAC)	Plug the unit into an active AC source (85 – 264VAC)
	Verify fuse is installed in the AC Plug module on the Rear Panel	Install 2.5A Slow Blow Fuse (5mm x 20mm)
	Verify fuse is not open (tripped)	Contact customer support @ Smart Material
No HIGH VOLTAGE output	Verify High Voltage cable is plugged into the HIGH VOLTAGE OUTPUT CONNECTOR on the Rear Panel	Plug High Voltage Cable into the HIGH VOLTAGE OUTPUT CONNECTOR on the Rear Panel
	Verify the EEL1500-1 is switched ON and the Power LED on the front panel illuminates	Switch the unit on
	Verify the shorting cap on the Rear Panel is plugged in and the High Voltage LED on the front panel illuminates	Plug the shorting cap into the HIGH VOLTAGE ENABLE plug on the rear panel
Unit is ON, but the fan is not running		Contact customer support @ Smart Material

7. FURTHER RESOURCES



Follow our popular in-depth tutorials on our YouTube channel SmartMaterialCorp.



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1. 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.

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