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1. Safety Instructions

This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this manual must be heeded.

The High Voltage Amplifier MFC1500/50 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.

Make sure that no cable is electrically and mechanically defective.

Replace cables only with the high voltage amplifier switched off.

Before switching on the high voltage amplifier, 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 output of high the voltage amplifier.
Take appropriate precautions during measurement procedures.
Before turning on the amplifier, remove hands and all test equipment from the load.
2. Introduction

2.1. Overview

This manual deals with the High Voltage Amplifier MFC1500/50 which is designed to supply a number of different piezoactuators.

The high voltage amplifier MFC1500/50 consists mainly of a power amplifier, two input circuitries, a monitoring and indicator circuitry, and an interlock control unit.

The power amplifier is capable of delivering an output voltage in the range of -500 V to +1500 V at an output current 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. at no hazardous voltages. Furthermore two LEDs are used to 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.

2.2. Specifications

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<td>Input Resistance</td>
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<td>0 Hz to 10 kHz</td>
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<td>BNC coaxial connector</td>
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**Audio Signal Input**
- **Input Voltage Range**: 0.2 V to 3 V AC
- **Input Resistance**: 100 kΩ
- **Gain Control Range**: -12 db to +12 db, by using a 10-turn potentiometer
- **Offset Control Range**: -500 V to +1500 V, by using a 10-turn potentiometer
- **Signal Frequency Range**: 10 Hz to 10 kHz
- **Connector**: BNC coaxial connector

**Performance**
- **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/µs
- **Large Signal bandwidth**: DC to 10 kHz
- **Drift with Time**: Less than 100 ppm/hr
- **Drift with Temperature**: Less than 50 ppm/°C
- **Warmup Time**: 5 min

**Output Voltage Monitoring**
- **Conversion Factor**: 1/200th of the output voltage
- **Output Impedance**: 1 kΩ
- **Connector**: BNC coaxial connector

**Output Current Monitoring**
- **Conversion Factor**: 0.2 V/mA
- **Output Impedance**: 1 kΩ
- **Connector**: BNC coaxial connector

**Indicators**
- **HVON**: A LED illuminates indicating that the high voltage is on
- **Limit**: A LED illuminates if the output voltage or current exceeds the limits

**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

**Power**
- **Line Voltage**: 115/230VAC, 50/60 Hz, 150VA
- **Fuse**: Two fuses 1A-2A slow blow for 230V/115V
- **Connector**: Standard three-prong power connector with fuse holder
Operating Conditions
Temperature  0°C to 40°C
Relative Humidity  to 85%, noncondensing

Mechanical
Cabinet  255 mm W x 100 mm H x 400 mm D
Weight  10 kg

Scope of Delivery
High voltage amplifier unit MFC 1500/50
Line voltage cord
High voltage cable with an SHV plug
3-pin interlock connector
User Manual

2.3. EU-Compliance Declaration

The high voltage amplifier MFC1500/50 has the CE-sign. The EU-Compliance Declaration 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.
3. Inspection and Installation

3.1 Introduction

This section provides information for incoming inspection, damage claims, shipping, and installation of the control unit.

3.2 Scope of Delivery

The high voltage amplifier package consists of the following items:

- High voltage amplifier unit MFC 1500/50
- Line voltage cord
- High voltage cable with an SHV plug
- 3-pin interlock connector
- User Manual

3.3. 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 furnish shipping instructions.

3.4. Installation

The ac power supplied to the amplifier unit should be 115VAC or 230VAC, 50 to 60Hz, single phase. Two 2-ampere slow blow fuses are used for 115VAC operation and two 1-ampere slow blow for 230VAC.

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. Operation

#### 4.1. General

This section outlines a general procedure for operating the high voltage amplifier and the load. For more operating information see also the manual of your piezoactuators.

#### 4.2. Front Panel Controls

**Power**

- **Toggle Switch**
  - Turns on and off the power supply

**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 on or off the output voltage

**WG Input**

- **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 the offset adjustment in the range of -500 V to +1500 V

**Monitoring**

- **Indicator “HV On”**
  - This indicator illuminates if the output voltage is turned on both by the rotary switch in the In/Out Control section and by the external interlock signal
- **Indicator “Limit”**
  - This indicator illuminates if the output voltage/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
4.3. Rear Panel Controls

**Line Voltage Input**
- **Connector**: International standard three-wire connector
- **Line Voltage Range**: 115 V AC / 230 V AC
- **Power**: 150 VA
- **Fuse**: Two 2A / 1A slow blow fuses for 115 V AC / 230 V AC

**Line Voltage Selector**
- **Switch**: Allows the selection of the line voltage, 115 V AC or 230 V AC

**Ground Screw**
- **Function**: Allows the grounding of the unit

**High Voltage Output**
- **Connector**: SHV 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

4.4. Operating Requirements

4.4.1. Connections
Before making any connections, make sure that the amplifier unit is turned off.
- Connect the amplifier unit to the mains. Make sure the line voltage corresponds to the voltage selected on the unit
- 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

4.5. Operating Instructions

4.5.1. Controls Presetting
Before switching on the amplifier unit, preset the controls on the front panel as given below:
- Set the output control switch to “Off”
4.5.2. Operate Mode

The procedures described below cover typical high voltage amplifier operation:

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” by the rotary switch
- Make sure the interlock signal is activated at the rear panel socket “Interlock”
- Apply signal to the input selected
- Turn on the output voltage by setting the output control switch to “on”. The indicator “HV On” goes 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” through an oscilloscope
- Should the indicator “Limit” goes on, lower the input signal amplitude or signal frequency. In case of audio signal, the gain or offset potentiometer can also be used
- To turn off the unit, just switch off the power.
5. Figures

Figure 1: Front Panel View

Figure 2: Back Panel View

Figure 3: Functional Diagram of the Interlock Circuitry
6. Warranty

This product is warranted against defects in materials and workmanship for a period of 2 years from date of shipment. During the warranty period, the manufacturer will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by the sales office. Buyer shall prepay shipping charges to the service office and service office shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to service office from another country.

6.1. Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied interfacing, unauthorized modifications or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.