OPERATOR'S MANUAL

MODEL 2220

Piezo Driver/Power Amplifier

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Thank You

Thank you for buying a Trek instrument. This instrument has been designed and built to high standards to give you years of trouble-free service.

If you have any questions, please feel free to contact your Trek Representative at:

Write:	TREK, INC. 190 Walnut Street Lockport, NY 14094-3710	
Fax:	(716) 201-1804	
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We welcome any comments or suggestions you may have relative to the operation, performance, and/or quality of this product.

Trek products are covered by United States and foreign patents, issued and pending. Information in this publication supersedes that in all previously published material. Specifications are subject to change without notice.

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Safety

Review the following safety precautions to maintain safety and prevent damage to the instrument or equipment connected to it.

The safety features of this instrument may be ineffective if the equipment is not operated in the manner stated in this manual.

Refer all maintenance procedures to qualified personnel. This instrument contains no user serviceable parts inside. Please refer all service inquires to Trek Customer Service or an authorized Trek service organization.

Safety Precautions

Use the Power Cord Provided

To avoid fire hazard, use only the power adapter provided with this instrument.

Avoid Electric Overload

To avoid electric shock or fire hazard, do not apply a voltage to a terminal that is outside the range specified for that terminal.

Avoid Electric Shock

To avoid electric shock, do not touch the high-voltage output connector or the load circuit while the instrument is on.

Ground the Product

This product is electrically grounded through the ground conductor of the power cord. To avoid electric shock, the ground conductor must be connected to earth ground. Before making connections to the input and output terminals of the product, ensure that the product is properly grounded.

Safety Precautions (cont.)

Do Not Operate Without Covers

To avoid electric shock or fire hazard, do not operate this instrument with the covers removed.

Indoor Use Only

This instrument is intended for indoor use only.

Do Not Operate in Wet or Damp Conditions

To avoid electric shock, do not operate this instrument in wet or damp conditions.

Do Not Operate in an Explosive Environment

To avoid injury or fire hazard, do not operate this instrument in an explosive environment.

Product Protection Precautions

Use the Proper Power Source

Do not operate this instrument from a power source that is different than the voltage specified on the serial number tag.

Provide Proper Ventilation

To prevent the instrument from overheating, provide proper ventilation.

Do Not Operate with Suspected Failures

Attempting to operate a damaged instrument could pose a serious safety risk to the operator. If you suspect there is damage to this instrument, have it inspected by qualified personnel.

Safety Terms and Symbols

Terms in the Manual

These terms may appear in this manual:

Warning: Warning statements identify conditions or practices that could result in injury or loss of life.

Caution: Caution statements identify conditions or practices that could result in damage to this product or other equipment.

Symbols on the Product

These symbols may appear on the instrument:

Warning, risk of electric shock

Caution, refer to Operator's Manual

CAT I Installation category I (overvoltage category): Classification for the operation of a unit using voltage systems or circuits with required standardized limits for transient voltages. Category I pertains to voltages supplied at the peripheral level, with smaller tolerances for transient voltages as specified by the Low-Voltage Safety standard (EN 61010-1).

CAT II Installation category II (overvoltage category): Classification for the operation of a unit using voltage systems or circuits with required standardized limits for transient voltages. Category II pertains to using voltage supplied on the local level (example: local wall outlets) with smaller tolerances for transient voltages as specified by the safety requirements for electrical equipment (EN 61010-1).

CE This symbol refers to the compliance of the equipment to the European Council (E.C.) standards.

Preface

This manual provides user information for the Model 2220 Power Amplifier/Piezo Driver and contains the following chapters and appendixes:

- ***General Information*** contains a brief product description and an incoming confidence test that can be used to verify the instrument was not damaged during transit.

- ***Installation*** describes how to set up the instrument for operation. Information is included on mounting the instrument, the load connection, and the various input and output connections.

- ***Operation*** contains a description of product features and a detailed explanation of proper operating procedures.

- ***Specifications*** contains a technical description of product performance levels and necessary operating requirements.

- ***Maintenance*** provides information on periodic maintenance procedures and fuse replacement.

- ***Addendum: Active Load Limitations*** describes the Model 2220 capability of driving active loads, which are capable of returning energy into the output of the amplifier.

- ***Appendix A: Accessories*** describes other products that are useful with the Model 2220.

- ***Appendix B: Warranty Statement*** describes the terms and conditions of the Trek Two-Year Warranty.

- ***Appendix C: Sales & Service*** contains Trek contact information. (*Please go to our web site: www.trekinc.com for a complete list of our sales and service representatives and distributors located in the United States and throughout the world.)*

Section I General Information

Danger: *Trek high-voltage generating equipment, including Trek amplifiers and supplies are not designed, rated, or qualified to be operated in an environment or atmosphere which contains combustible or explosive materials or gases which may be ignited by electrical discharges.*

This manual provides instructions to install and operate the Trek Model 2220 Power Amplifier/Piezo Driver. We recommend you take the time to read this manual to take full advantage of the features and benefits of the instrument.

Introduction

The Trek Model 2220 is a high-voltage DC-stable power amplifier designed to provide precise control of output voltages in the range of 0 to ±2000V DC or peak AC with an output current capability of ±10 mA DC or ±20 mA peak AC. The Model 2220 is set for a gain of 200 V/V with a noninverting input.

Applications for the Model 2220 include piezoelectric driving/control, laser modulation, semiconductor research, and ion beam control. Features include an all-solid-state design, a slew rate greater than 100 V/µs and a small signal bandwidth of greater than 100 kHz. A four-quadrant active output stage sinks or sources current into reactive or resistive loads throughout the output voltage range. This technique is essential for achieving the accurate output responses and high slew rates demanded by reactive loads.

The Model 2220 is protected against overvoltage and overcurrent conditions that may be generated by active loads or by output short circuits to ground.

Precision voltage and current monitors provide low-voltage representations of the high-voltage output and load current for monitoring purposes or for use as feedback signals in a closed-loop system.

The Digital Enable feature provides a connection for a remote device to turn ON and OFF the high voltage of the instrument. This makes the Model 2220 suitable for automated or computer controlled systems.

The Model 2220 has a Dynamics Adjustment feature which can be used to optimize the AC response of the output signal. Front panel LED indicators illuminate when the power and high-voltage are ON.

Incoming Inspection

Visually inspect the instrument for physical damage such as dents, nicks, scratches, broken fittings, etc. External damage may indicate more serious damage has occurred within the instrument. In the event of damage, notify the factory or your nearest authorized Trek Service Organization and request instructions. Do not attempt to use a damaged instrument.

Incoming Confidence Test

The Model 2220 undergoes extensive checks and adjustments at the factory, and no initial calibration should be required. However, you may wish to perform an incoming confidence test as part of the incoming inspection on the instrument. An incoming confidence test of this nature is intended to confirm that the instrument was not damaged in transit.

We recommend that you familiarize yourself with the information in Section II and Section III before performing this test.

Warning: *Do not plug in the Model 2220 or turn it on until instructed to do so. To do so before the appropriate point in time could result in an electrical shock and/or damage to the instrument.*

Caution: *Ensure that the Model 2220 has been configured for the proper nominal line voltage for your area. Damage to the system may result if it is operated at an incorrect line voltage. Refer to "Power Connection" on page II-1 for instructions to check the line voltage setting.*

1. Ensure that the power switch is in the off position.
2. Connect a digital voltmeter to the VOLTAGE MONITOR and HIGH VOLTAGE output connectors on the rear panel.
3. Install the shorting cap on the DIGITAL ENABLE output connector on the rear panel.
3. Plug the power cord into the power receptacle on the rear panel.
4. Plug the power cord into the power source.

Warning: *Make no attempt to bypass the ground feature in the AC line cord. This is a protective ground and any attempt to negate it could result in electrical shock.*

Incoming Inspection (cont.)

Incoming Confidence Test (cont.)

5. Apply a 2 volt DC signal into the INPUT SIGNAL connector on the rear panel.

NOTE: *The factory setting for the input gain is 200 V/V.*

6. Turn ON the Model 2220.

7. The voltmeter should measure 2 volts from the VOLTAGE MONITOR output and 400 V from the HIGH VOLTAGE output.

Warning: *The HIGH VOLTAGE OUTPUT connector carries high voltage. Do not touch the HIGH VOLTAGE OUTPUT connector or the load circuit while the Model 2220 is operating. Always turn off the Model 2220 before making changes to the load connections.*

This completes the incoming confidence test. Turn OFF the POWER switch.

Section II Installation

Mounting

The Model 2220 is designed for operation on a bench top and is air cooled. Allow approximately 75 mm (3 inches) of free air space around the vent holes on the front and rear panels of the instrument.

Power Connection

The Model 2220 is supplied with the proper power supply transformer with an appropriate line cord for the desired AC voltage. For instructions on how to change the line voltage range, contact TREK, INC. or an authorized Trek Service Organization. (See Appendix C.)

1. Ensure that the POWER switch is off before connecting the power cord to a power source.

2. Plug the power cord from the power supply transformer into the power connector on the rear panel.

3. Plug the free end of the AC line power cord into the AC power source.

   The power cord provided is equipped with a standard three-prong power plug to provide a grounded chassis when the cord is used in a grounded receptacle.

Warning: *Make no attempt to bypass the ground prong in the power cord. This is a protective ground and any attempt to negate it could result in an electrical shock.*

Load Connection

A high-voltage cable assembly is provided for connection of the HIGH VOLTAGE OUTPUT connector on the back panel to the load device.

1. Return the low side of the load device to ground, either through the shield of the SHV connector or to the ground jack terminal on the rear panel of the unit.

2. Connect the free, unterminated end to the load device.

   Note: *Ensure that the connection to the load device does not allow high-voltage hazards to be accessible.*

3. Connect the terminated end of the cable assembly to the HIGH VOLTAGE OUTPUT connector.

Warning: *The HIGH VOLTAGE OUTPUT connector carries high voltage. Do not touch the HIGH VOLTAGE OUTPUT connector or the load circuit while the 2220 is operating. Always turn off the 2220 before making changes to the load connections.*

Note: *The maximum voltage at the HIGH VOLTAGE OUTPUT connector is ±2000 V.*

Safety Warning - Externally Induced Flammability Hazard

Caution should be taken when an external load is connected to the amplifier. It is recommended that non-flammable material be used to protect the external load device (i.e. Protective enclosure over the load device) should a fire occur. This would also provide protection against electrical shock.

Input Connection

Connect the signal source to the INPUT SIGNAL BNC connector on the rear panel.

Note: *The voltage applied to the INPUT SIGNAL BNC connector must not exceed ±11 V.*

Voltage Monitor Connection

The VOLTAGE MONITOR BNC connector on the rear panel is a buffered output providing a low-voltage replica of the high-voltage output.

Connect a monitoring device, such as an oscilloscope, to this connector to monitor the high-voltage output. The signal at this connector can also be used as a feedback signal in a closed-loop system.

Note: *The maximum voltage at the VOLTAGE MONITOR is ±10 V.*

Current Monitor Connection

The CURRENT MONITOR BNC connector on the rear panel is a buffered output providing a low-voltage representation of the load current. 0.4 V at this connector represents 1 mA of load current.

Connect a monitoring device, such as an oscilloscope, to this connector to monitor the load current. The signal at this connector can also be used as a feedback signal in a closed-loop system.

Note: *The maximum voltage at the CURRENT MONITOR is ±15 V.*

Digital Enable Connection

The DIGITAL ENABLE BNC connector on the rear panel is used for connection of a remote device to turn on and off the high-voltage output.

A TTL high will turn off the high-voltage output. A TTL low will turn on the high-voltage output.

Note: *The voltage applied to the DIGITAL ENABLE BNC connector must not exceed 5.5 V.*

Section III Operation

Front Panel Features

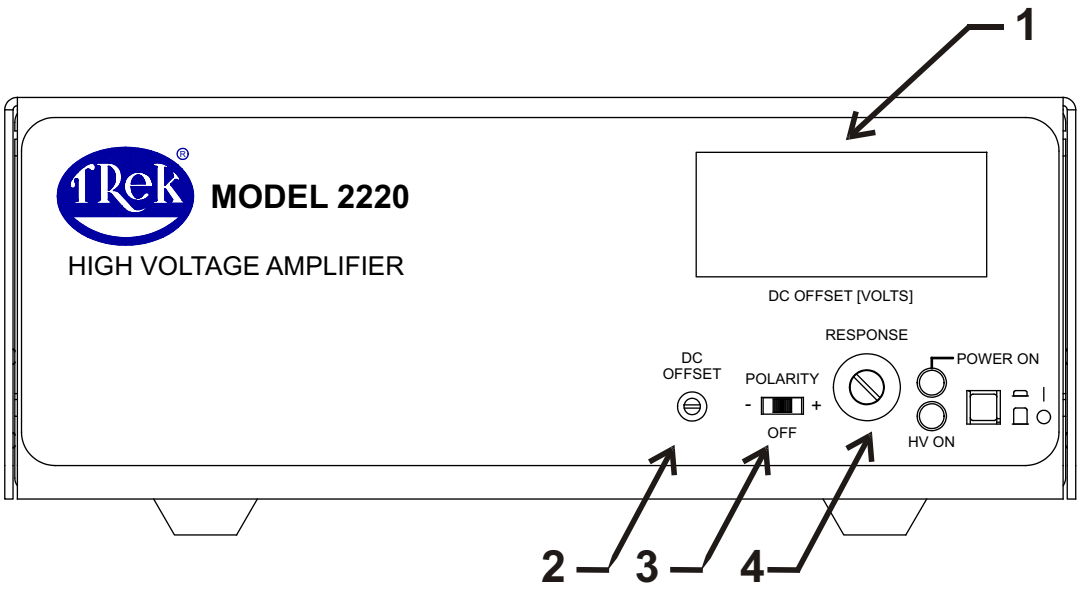

Figure 3-1: Model 2220 front panel (features 1 through 4)

1. ***DC OFFSET Display:*** This display represents the DC Offset level of the DC High Voltage output. This reading is determined by setting the DC Offset Adjustment setting. This display is active only when the offset function is enabled by the polarity switch in the "+" or "-" positions, otherwise it displays "000".

2. ***DC OFFSET Adjustment:*** This potentiometer adjusts the DC Offset voltage of the 2220 output signal from 0 to 2000 V.

3. ***POLARITY Switch:*** This switch controls the polarity of the DC Offset voltage. The Offset function is disabled when it is in the OFF position.

4. ***RESPONSE Adjustment:*** This potentiometer is used to optimize the AC response characteristics of the output voltage waveform.

Front Panel Features (cont.)

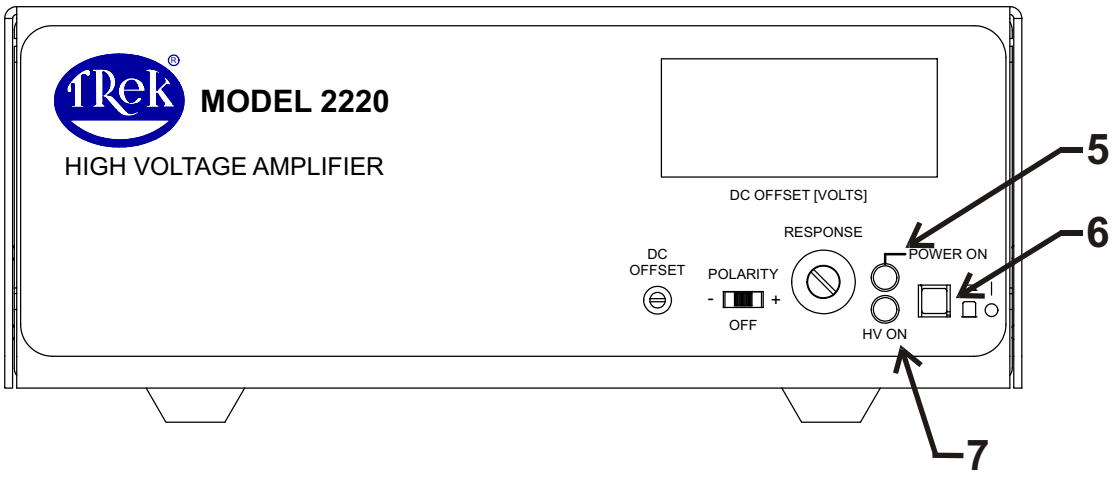

Figure 3-2: Model 2220 front panel (features 5 through 7)

5. ***POWER ON Indicator:*** This front panel green LED illuminates when front panel power switch is turned ON.

6. ***POWER Pushbutton Switch:*** This pushbutton switch turns unit ON/OFF.

7. ***HIGH-VOLTAGE ON Indicator:*** This front panel red LED illuminates when high-voltage is ON.

Rear Panel Features

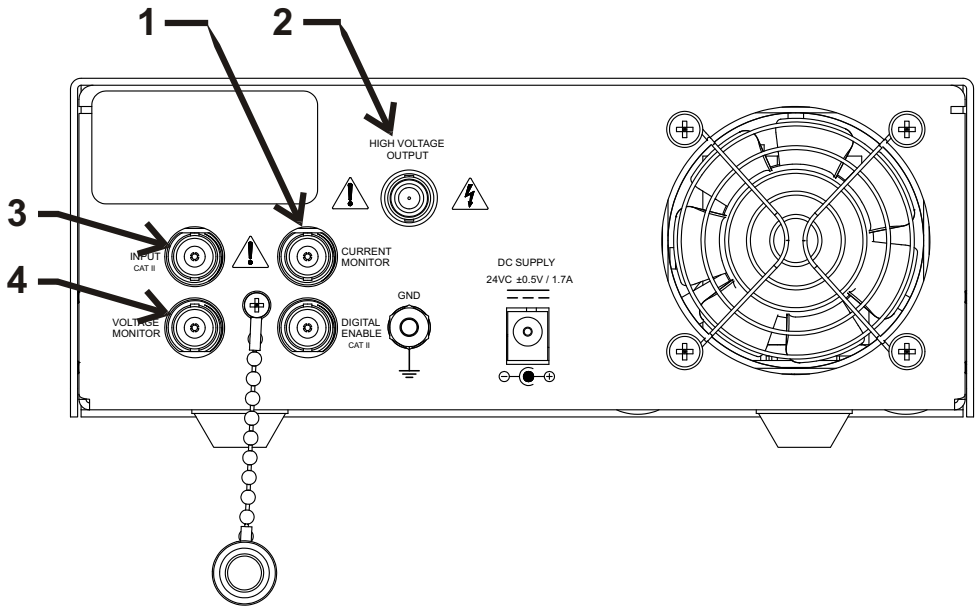

Figure 3-3: Model 2220 rear panel (features 1 through 4)

1. ***CURRENT MONITOR Connector:*** This BNC provides a buffered, low-voltage representation of the load current. The ratio to actual current is 0.4 V/mA.

2. ***HIGH VOLTAGE OUTPUT Connector:*** This SHV connector is for connection of the load device using the high-voltage output cable assembly provided.

3. ***INPUT Connector:*** This BNC is for connection of the external voltage signal to be amplified. The input voltage range of the Model 2220 is 0 to ±10 V DC or peak AC.

4. ***VOLTAGE MONITOR Connector:*** This BNC provides a buffered, low-voltage replica of the high-voltage output. The voltage at the voltage monitor connector is 1/200th the voltage at the HIGH VOLTAGE OUTPUT connector.

Rear Panel Features (cont.)

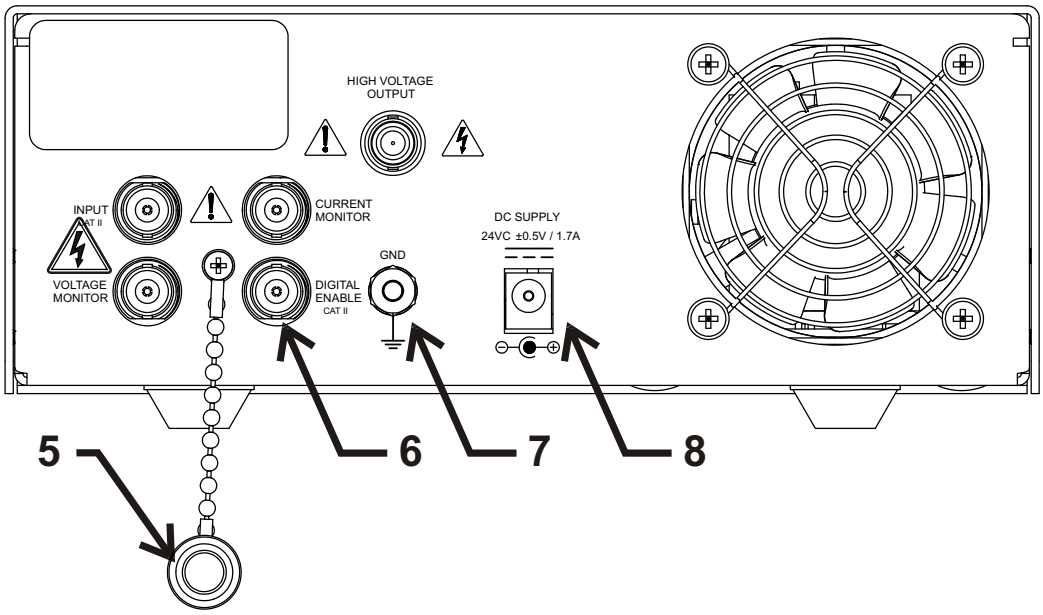

Figure 3-4: Model 2220 rear panel (features 5 through 8)

5. ***SHORTING CAP for the DIGITAL ENABLE Connector:*** This cap must be connected to the Digital Enable BNC connector when not utilizing the HV ON/OFF remote capabilities.

6. ***DIGITAL ENABLE Connector:*** This BNC is for connection of a remote device to turn ON and OFF the high-voltage output.
   Note: *When not utilizing the Digital Enable HV On/Off remote capabilities, the shorting cap must be on the Digital Enable BNC connector on the rear panel to enable the high-voltage output.*

7. ***Ground Jack:*** This binding post is a functional earth terminal and is used as a ground return point for the load circuit or a ground reference point for other equipment.

8. ***POWER ENTRY Module:*** This receptacle is a standard +24 V DC connector.

Normal Operation

The following instructions assume that the instrument has been installed according to the instructions given in Section II, INSTALLATION.

Warning: *The HIGH VOLTAGE OUTPUT connector carries high voltage. Do not touch the HIGH VOLTAGE OUTPUT connector or the load circuit while the 2220 is operating. Always turn off the Model 2220 before making changes to the load connections.*

Operating the Model 2220 as a High-Voltage Power Amplifier

When the Model 2220 is operated as a high-voltage amplifier, a low-voltage signal is applied to the INPUT signal BNC connector on the front panel. The signal is amplified by the gain ratio setting of the amplifier to generate a high-voltage output signal.

Warning: *The HIGH VOLTAGE OUTPUT connector carries high voltage. Do not touch the HIGH VOLTAGE OUTPUT connector or the load circuit while the Model 2220 is operating. Always turn off the Model 2220 before making changes to the load connections.*

The shorting cap must be on the Digital Enable BNC connector when not utilizing the digital enable function of the amplifier.

Remotely Turning On and Off the High-Voltage Output

When the DIGITAL ENABLE is utilized, the high-voltage output can be turned ON and OFF by a TTL signal.

Apply a TTL low or short to the DIGITAL ENABLE BNC connector to turn ON the high-voltage output. A TTL high (or open) turns OFF the high-voltage.

Normal Operation (cont.)

Monitoring the Output Voltage

A buffered, low-voltage replica of the output voltage is provided at the VOLTAGE MONITOR output connector on the front panel.

The voltage at this voltage monitor connector is 1/200th the voltage at the HIGH VOLTAGE OUTPUT connector.

Monitoring the Load Current

A buffered, low-voltage representation of the load current is provided at the CURRENT MONITOR connector on the front panel.

0.4 V at this connector represents 1 mA of load current.

Making Load Compensation Adjustments

The DYNAMICS ADJUSTMENT potentiometer on the front panel must be adjusted to optimize the AC response characteristics of the output voltage waveform when using a capacitive load. Monitoring the output voltage from the VOLTAGE MONITOR output, adjust the DYNAMICS ADJUSTMENT potentiometer for the optimized AC response to a square wave. See figures 3-4 and 3-5 below.

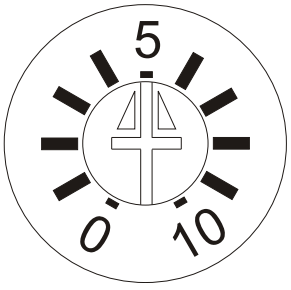

Figure 3-4: Dynamics Adjustment

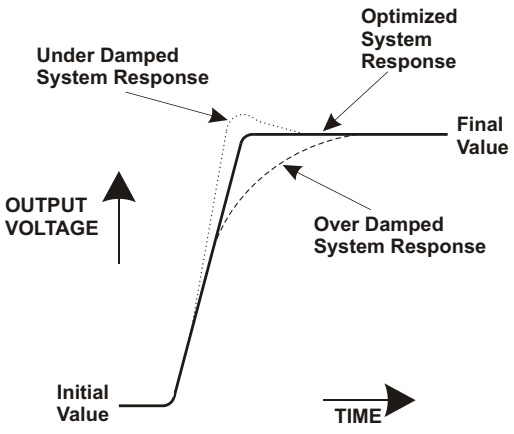

Figure 3-5: System Response

Section IV Specifications

All specifications are with no load unless otherwise noted.

OUTPUTS

Output Voltage Range	0 to ±2000 V
Output Current Range	0 to ±10 mA DC 0 to ±20 mA peak A (Better than 5 ms)

AMPLIFIER INPUT

Input Voltage Range	0 to ±10 V DC or peak AC.
Input Impedance	10 k , nominal.

FEATURES

Digital Enable	A BNC connection for a TTL compatible signal to turn on and off the high-voltage output is provided for each channel. A TTL high (or open) turns off the high-voltage output. A TTL low turns on the high-voltage output.
Response	A graduated potentiometer is used to optimize the AC response of the output signal under various load parameters.
High-Voltage LED	Front panel red LED illuminates when the high-voltage is on.

Specification (cont.)

FEATURES (cont.)

Voltage Monitor	A buffered output provides a low-voltage replica of the high-voltage output.
Scale Factor	1/200th of the high-voltage output.
DC Accuracy	Better than 0.5% of full scale.
Offset Voltage	Less than 10 mV.
Output Noise	Less than 5 mV rms (measured using the true rms feature of the Hewlett Packard Model 34401A digital multimeter).
Output Impedance	Less than 0.1 .
Current Monitor	A buffered output provides a low-voltage representation of the load current.
Scale Factor	0.4 V/mA.
DC Accuracy	Better than 2% of full scale.
Offset Voltage	Less than 10 mV.
Output Noise	Less than 20 mV rms (measured using the true rms feature of the Hewlett Packard Model 34401A digital multimeter).
Output Impedance	Less than 0.1 .
DC Offset Adjustment	
Range	0 to ±2000 V(switch selectable polarity)
Accuracy	Better than 1% of reading
Offset	2 counts maximum
Power On LED	Front panel green LED illuminates when the power is on.

Specification (cont.)

PERFORMANCE

DC Voltage Gain	200 V/V
DC Voltage Gain Accuracy (input to output)	Better than 0.5% of full scale.
Offset Voltage	Less than 1 V.
Output Noise	Less than 50 mV rms (Measured with the true rms feature of the Hewlett Packard Model 34401A digital multimeter.)
Slew Rate (10% to 90%, typical)	Greater than 100 V/ s.
Large Signal Bandwidth (-3 dB)*	DC to greater than 7.5 kHz (minimum trip off frequency)
Small Signal Bandwidth (-3 dB)	DC to greater than 50 kHz.
Settling Time to 1%	Less than 50 s for a 0 to 2000 V step
Internal Capacitance (HV output)	300 pF
Automatic Power Limit	Automatically limits the internal power dissipation to protect the Model 2220 from overheating.
Stability	
Drift with Temperature	Less than 180 ppm/°C.
Drift with Time	Less than 300 ppm/hr, noncumulative.

* Large Signal Bandwidth, Square Wave Response and output noise are optimized using the "Response" adjustment on the front of the amplifier.

Specifications (cont.)

GENERAL

Dimensions	85 mm H x 205 mm W x 325 mm D (3.3" H x 8.1" W x 12.8" D).
Weight	2 kg (4.4 lb).
High-Voltage Output Connector	SHV connector.
High-Voltage Output Impedance	11 .
Amplifier Input	BNC connector.
Voltage Monitor	BNC connector.
Current Monitor	BNC connector.
Digital Enable Connector	BNC connector.
Power Supply	
Input Power	90 to 265 V AC, at 50/60 Hz line power.
Output Power	24 V DC, regulated at 1.75 A maximum.
Output Cable/Plug	Cable length T.B.A.
AC Line Receptacle	Standard three-prong AC line connector.
Operating Conditions	
Temperature	0 °C to 40 °C.
Relative Humidity	To 85%, noncondensing.

Specifications (cont.)

Certification and Compliance

Certification	TREK, INC. certifies that each Model 2220 is tested and calibrated to specifications using measurement equipment traceable to the National Institute of Standards and Technology or traceable to consensus standards. A Certificate of Calibration accompanies each instrument when it is shipped from the factory.
Low Voltage Safety Compliance	EN 61010-1
Installation Category	CAT I: Classification for the operation of a unit using voltage systems or circuits with required standardized limits for transient voltages. CAT II: Local-level mains, appliances, portable equipment.
Pollution Category	Degree 1: Operate in environments where no pollution or only dry, nonconductive pollution occurs.

Section V Maintenance

Safety

Observe the following safety precautions when performing maintenance procedures on the Model 2220:

1. Refer all maintenance procedures to qualified personnel.

2. Always turn off the Model 2220 and disconnect it from its power source before cleaning or inspecting it. Failure to observe this precaution could result in an electrical shock.

Maintenance Assistance

Customer Service Assistance

In the event that you require assistance on a maintenance item, direct your request for assistance to the Customer Service Group at TREK, INC. or an authorized Trek Service Organization.

Telephone assistance is usually effective for obtaining additional maintenance information which is beyond the scope of this manual. Troubleshooting advice which is given over the telephone may be useful for solving the simpler malfunctions or confirming that the system should be returned to the factory or to an authorized Trek Service Organization.

Please go to our web site: www.trekinc.com for a complete list of our sales and service representatives and distributors located in the United States and throughout the world.

Maintenance Assistance (cont.)

Repairs

The terms and conditions of the warranty are stated in Appendix B.

Note: *The warranty is voided if the instrument seals are broken within the warranty period by anyone other than TREK, INC. or an authorized Trek Service Organization.*

In the event of a malfunction, and the instrument must be returned for repair:

1. Notify the Customer Service Group at TREK, INC., giving full details about the difficulty, including the model number and serial number of the instrument. The Customer Service Group will issue a return authorization number.

2. Forward the instrument (prepaid), with the return authorization number prominently displayed on the shipping container and the packing list, to TREK, INC.

The instrument may also be returned to an authorized Trek Service Organization. Contact the service organization nearest you for details. Please go to our web site: www.trekinc.com for a complete list of our sales and service representatives and distributors located in the United States and throughout the world.

Preventative Maintenance

Cleaning the Instrument

Unplug unit from power source prior to cleaning or inspecting.

Preventative maintenance consists of inspecting and cleaning the instrument. Preventative maintenance performed on a regular basis may prevent instrument failure and improve reliability.

INSPECTION: Visually inspect the instrument for loose or damaged controls and connectors or other undesirable conditions.

CLEANING: Disconnect the unit from all external connections prior to cleaning. Clean the Model 2220 as operating conditions require. Clean the exterior of the instrument with a soft cloth dampened with water. Use only water to dampen the cloth. The use of solvents may damage the finish or plastic components. A small brush is effective in removing dirt from the front and rear panel controls and connectors.

Addendum Active Load Limitations

The Model 2220 is designed to drive active loads, such as piezoelectric transducers, which can generate energy back into the 2220's output circuitry when externally excited by a mechanical force.

When this feed-back energy is within the voltage and current ranges of the amplifier's output, the amplifier will easily absorb it. If the feed-back energy is beyond the amplifiers output capability, additional energy absorption circuitry will become active to prevent damage to the amplifier. There is a limitation on the amount of energy this circuitry can absorb before damage will occur.

In an application where the absorption capability can be exceeded, additional external energy systems or components are recommended.

Appendix A Accessories

Included Accessories

Item	Part Number
Operator's Manual	23447
High-Voltage Output Connector (SHV mating connector)	43874
External 24 VDC (0.5 V) Regulated Power Supply	contact customer service

*Line cord type is determined by the geographical destination of the unit.

Appendix B Warranty Statement

New instruments sold by TREK, INC. (hereinafter called the "Company") are warranted only as stated below:

Subject to the exceptions and upon the conditions specified below, the Company agrees to correct, either by repair, or in the Company's sole discretion, by replacement, any defect of material or workmanship which develops within two years from the date of original purchase by the customer (user), provided that investigation and factory inspection by the Company discloses that such defect developed under normal and proper use. Repair or replacement are the exclusive remedies under this warranty (batteries are not included under this warranty).

The exceptions and conditions mentioned are as follows:

(a) The Company makes no warranty concerning components or accessories not manufactured by itself.

(b) The Company is released from all obligations under this warranty in the event that repairs or modifications are made by persons other than its own or authorized personnel, unless such repairs by others are made with the prior written consent of the Company. In the event of a failure, and the customer neglects to take prompt and reasonable actions to prevent further damage, the Company cannot be responsible for consequent damage.

(c) THERE ARE NO OTHER WARRANTIES WHICH EXTEND BEYOND THOSE EXPRESSLY PROVIDED FOR HEREIN AND THE AFORESAID WARRANTY AND THE COMPANY'S OBLIGATIONS AND LIABILITIES THEREUNDER ARE IN LIEU OF, AND CUSTOMER WAIVES ALL OTHER WARRANTIES AND GUARANTEES AND ALL OTHER LIABILITIES THEREFORE, EXPRESS OR IMPLIED, ARISING BY LAW OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AND ALL OBLIGATIONS AND LIABILITIES WITH RESPECT TO LOSS OF USE, REVENUE OR PROFIT, OR INDIRECT, CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND AND FROM ANY CAUSE WHATSOEVER ARISING OUT OF OR IN ANY WAY CONNECTED WITH THE MANUFACTURE, SALE, HANDLING, REPAIR, MAINTENANCE OR REPLACEMENT OF SAID PRODUCTS.

(d) Representation and warranties made by any person, including dealers and representatives of the Company, which are inconsistent or in conflict with the terms of this warranty (including, but not limited to, the limitations of the liability of the Company as set forth above), shall not be binding upon the Company unless reduced to writing and approved by an officer of the Company.

(e) This warranty shall be governed by the laws of the State of New York.

Appendix C Sales and Service

Please go to our web site: www.trekinc.com for a complete list of our sales and service representatives and distributors located in the United States and throughout the world.

Trek Contact Information:

TREK, INC.
190 Walnut Street
Lockport, NY 14094-3710 USA

Fax: (716) 201-1804
Telephone: 1 800 FOR-TREK
1 (716) 438-7555

Internet: www.trekinc.com
E-Mail: sales@trekinc.com

Trek Japan KK
Motobayashi Building
1-2-12 Nihonbashi-ningyocho, Chuo-ku
Tokyo, 103-0013, Japan

Fax: 81 3 6264 8693
Telephone: 81 3 6264 8692

Internet: www.trekj.com
E-Mail: sales@trekj.com