

# HV 200/5

– Manual & Data Sheets–

- SYMMETRIC HIGH VOLTAGE AMPLIFIER
- 3 INPUTS (-10 V TO +10 V)
- 5 OUTPUTS (-200 V TO +200 V)
- AMPLIFICATIONS SWITCH
- OFFSET CONTROL



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# TABLE OF CONTENTS

1 Technical Data.....	3
1.1 General Function.....	3
1.2 Specifications.....	4
1.3 Technical Data Acquisition Set-Up.....	5
1.3.1 Output noise.....	5
1.3.2 Bandwidth.....	5
1.3.3 Small Signal Amplifications.....	6
1.4 Test Sheets.....	6
1.4.1 Bandwidth vs. Gain .....	6
1.4.2 Overall Gain.....	6
2 Data Sheets.....	11

The manual uses the following style declarations to visualize certain meanings:

***Important notes are written in this style.***

***Technical parameters described in the text flow are written in this style.***

***Names of data channels or signals are written in this style.***

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**Attention: hazard voltages! Do not touch the output connectors!**

# 1 TECHNICAL DATA

## 1.1 GENERAL FUNCTION

The HV200/5 is a high-precision HV-amplifier designed for the control of tube scanners.

It takes three input voltages *In X*, *In Y* and *In Z* ( $-10\text{ V}$  to  $+10\text{ V}$ ), amplifies them separately (input gain switches: *x1*, *x2*, *x5*, *x10*, *x20*) and adds an offset voltage between  $-10\text{ V}$  and  $+10\text{ V}$ . In a 2<sup>nd</sup> stage, the signal is amplified by a factor of 20. This enables its use as HV amplifier in scanning image acquisition applications, such as STM or AFM, with the capability to shift the scan range in high resolution imaging.

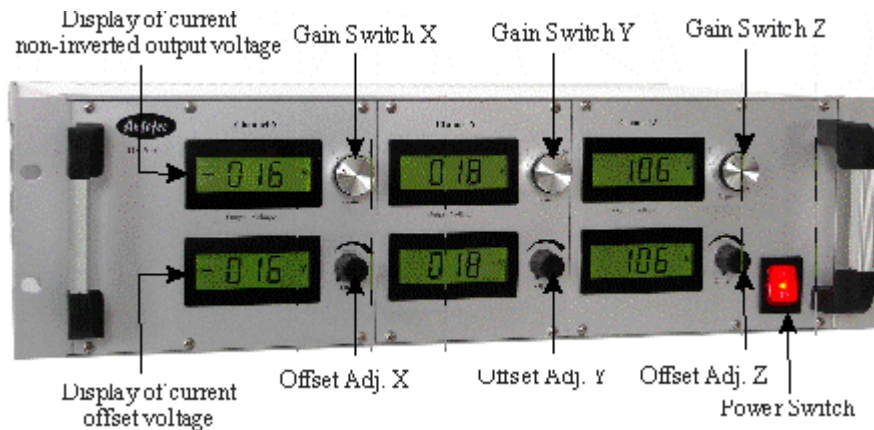


Figure 1: Front panel of the HV200/5

All switches and offset potentiometers are available on the front panel

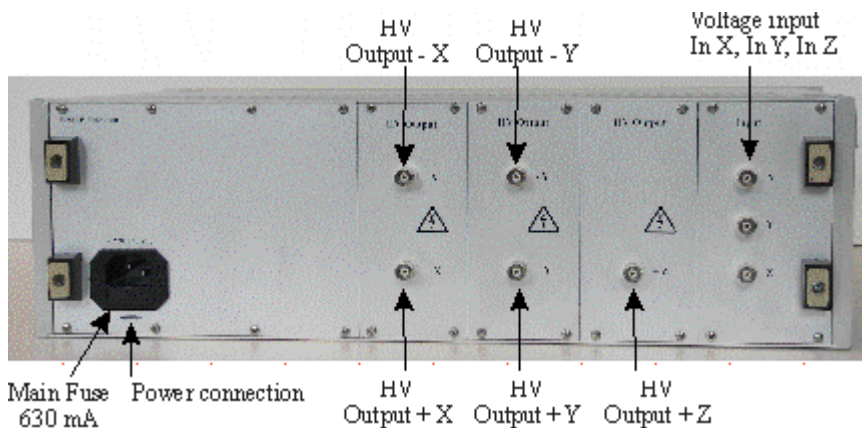


Figure 2: Back side panel of the HV200/5.

All input and output connectors (BNC) as well as the power connection are available at the backside. The main fuse is inside the power connection and can be replaced without opening the HV200/5 housing.

## 1.2 SPECIFICATIONS

### Power supply

Supply voltage	230 V ac, 50..60 Hz
Main Fuse	630 mA
Power Consumption	28 W

### General

Gain Switches	x1, x2, x5, x10, x20
Offset adjustment range	-200 V .. 200 V

### Signal Input

Voltage Input	BNC
Input Range	-10 V .. 10 V
Input Impedance	1,895 k $\Omega$ $\pm$ 1 %
Damage Threshold	+/- 15 V

### HV Output's

Maximum output voltage	- 200 V .. 200 V
Output noise	< 5 $\mu$ V/Hz <sup>0.5</sup> @ 10 kHz see Data Plots Pages 7 and 8 and < 3 mVpp @ full bandwidth Oscilloscope TDS3032B – see page 9
Band width with 10 nF load	approx. 10 kHz (see list page 6)

## 1.3 TECHNICAL DATA ACQUISITION SET-UP

For all measurements describes here, the offset is adjusted as close to zero as possible (abs (offset) < 50 mV).

### 1.3.1 OUTPUT NOISE

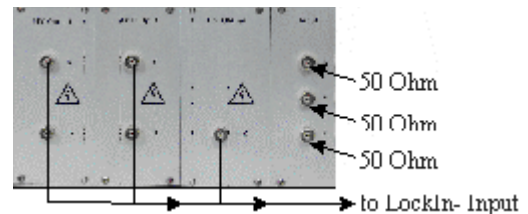
- Page 7 : Spectral output noise density of all 5 channels vs. frequency for gain 1

The related input is short-circuited with 50 Ohm vs. ground. The one output at a time is connected to the lock-in amplifier input.

eLockIn204 parameters:

time constant: 10/f, RollOff: 24 dB/oct

100 Hz to 1 MHz, 200 data points



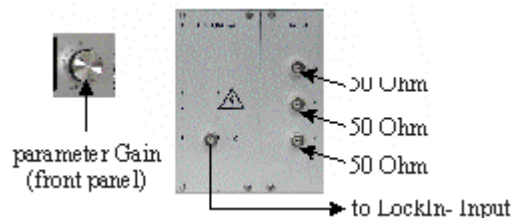
- Page 8 : Spectral output noise density of all channel +Z vs. frequency for for all five gains

The input **In Z** is short-circuited with 50 Ohm vs. ground. The output **+Z** is plugged into the lock-in amplifier input.

eLockIn204 parameters:

time constant: 10/f, RollOff: 24 dB/oct

100 Hz to 1 MHz, 200 data points



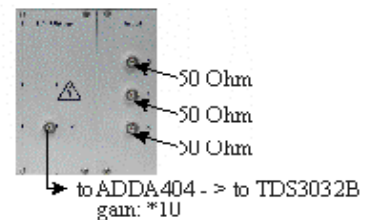
- Page 9 : peak-to-peak output noise of channel + Z for gain 1

The input **In Z** connected with 50 Ohm to ground. The output **+Z** is connected to the pre-amplifier ADA404A with gain x10. Output of ADA404A connected to TDS3032B oscilloscope.

Time scaling: 100 ms/div.

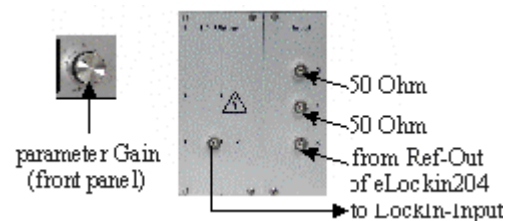
Vertical scaling: 1 mV/div

Input band width of the TDS3032B: full (300 MHz)



### 1.3.2 BANDWIDTH

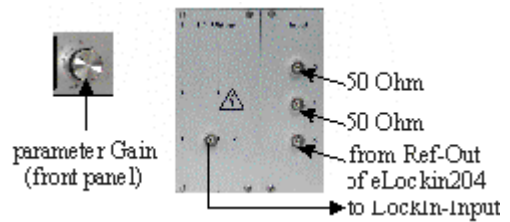
The bandwidth is measured by supplying a sine wave with 10 mV rms amplitude and 1 kHz to the related input of the HV200/5. The output is connected to the eLockIn204 and 10 nF load in parallel. The parameter is gain.



The 3dB bandwidth is determined from the spectra on page 10 by finding the frequency with an amplitude that is 0.7 \* the amplitude at low frequencies (1 kHz). These spectra were obtained by sweeping the frequency from 100 Hz to 1 MHz with adapted bandwidth (time constant: 10/f; RollOff: 24 dB/oct).

### 1.3.3 SMALL SIGNAL AMPLIFICATIONS

The gains were measured with a 10 mV<sub>rms</sub> sine wave with 1 kHz frequency applied to *InX*, *InY* or *InZ*, respectively, while the related outputs are connected one after each other to the lockin amplifier input of an eLockin204. The numbers written in the test sheet table (page 6) are the averaged outputs of the lockin amplifier displayed on the oscilloscope screen of the eLockin204 with 100 ms/div time scale.



## 1.4 TEST SHEETS

### 1.4.1 BANDWIDTH VS. GAIN

<i>Channel \ Gain</i>	<i>1</i>	<i>2</i>	<i>5</i>	<i>10</i>	<i>20</i>	<i>50</i>
+ Z	10,7 kHz	10,5 kHz	10,2 kHz	8,4 kHz	8,9 kHz	-

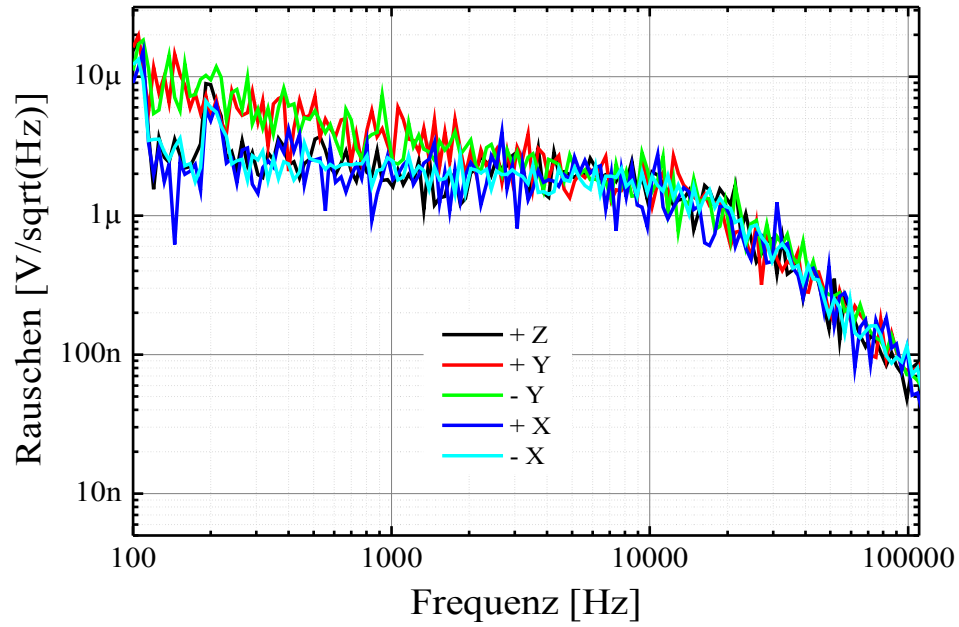
Parameters determined from measurements on Page 10 with the procedure described on Page 5.

### 1.4.2 OVERALL GAIN

<i>Channel \ Gain</i>	<i>1</i>	<i>2</i>	<i>5</i>	<i>10</i>	<i>20</i>	<i>50</i>
+ X	0,98	2,01	5,07	10,3	20,5	51,2
- X	1,00	2,04	5,09	10,0	20,3	50,2
+ Y	1,00	2,06	5,2	10,4	20,9	51,7
- Y	0,98	1,98	4,99	10,2	20,4	51,0
+ Z	0,93	1,93	5,07	10,4	20,8	51,8

Parameters are determined with the procedure described on Page 6 in the chapter “Small Signal Amplifications”.

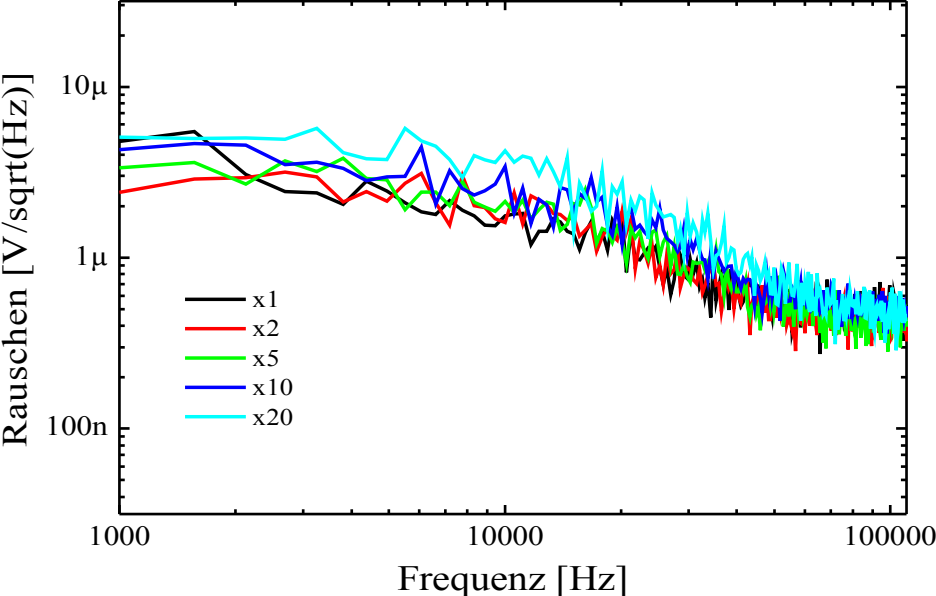
## Ausgangsrauschen des HV200/5



50 Ohm an Eingang des HV200/5  
Messung des Rauschen mit eLockIn204  
(time const:  $10/f$ , 24 dB, 100 Hz ... 1 MHz, 200 points)

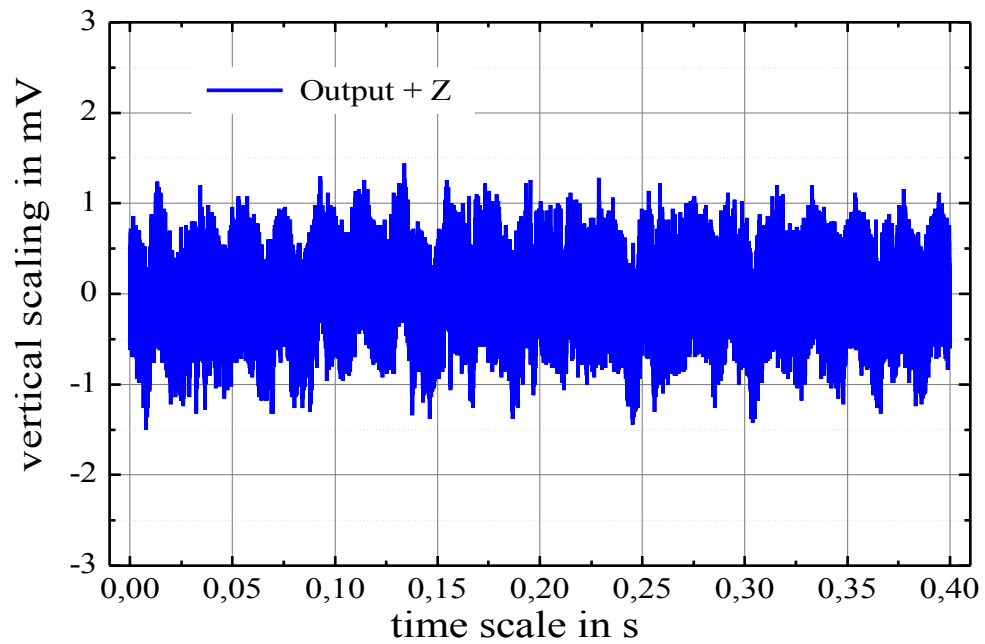
projects/HV-verstärker/Daehne/output\_noise.opj

# Ausgangsrauschen des HV200/5 in Abhängigkeit von der Ausgangsverstärkung



projects/HV-verstärker/Daehne/output\_noise.opj

## Ausgangsrauschen des HV200/5

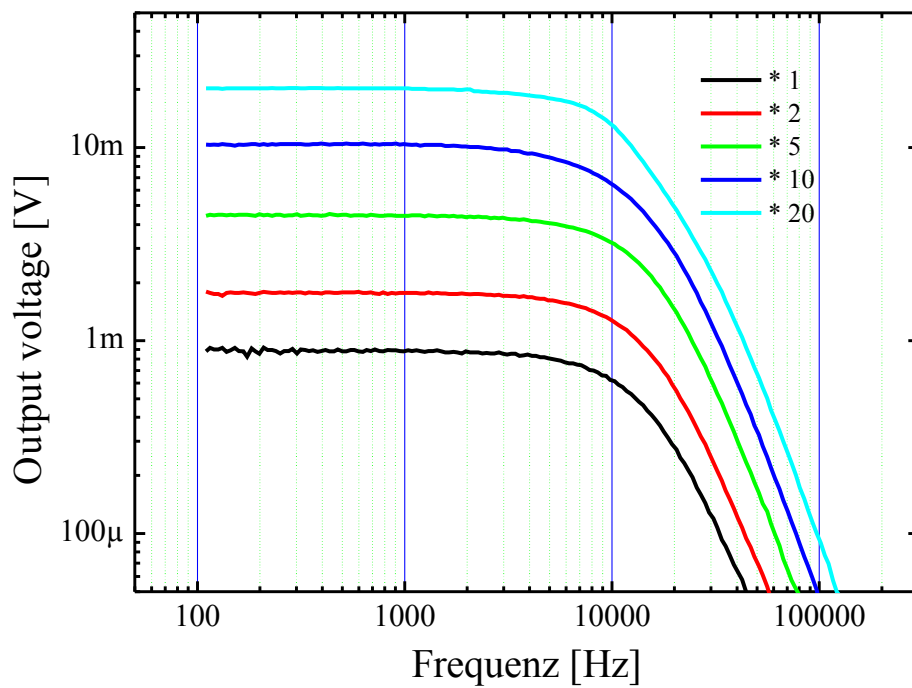


measurement conditions:

TDS3032B und ADA400A  
full bandwidth  
Input gain: x10  
Input coupling: ac  
Signal Input at HV200/5: 50 Ohm  
Output Offset corrected to < 10 mV  
Output gain: x 1

projects/HV-verstärker/Daehne/output\_noise.opj

# Ausgangsverstärkungen und Bandbreiten des HV 200/5 Kanal Z



## 2 DATA SHEETS

The data sheets are printed without page numbers. Here, a list of data sheets is given:

### 2.1