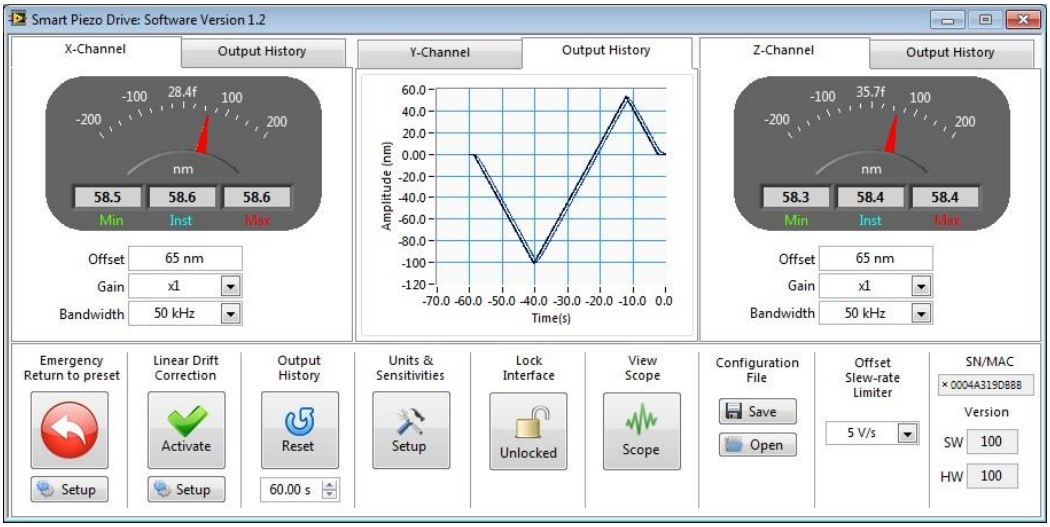
Smart Piezo Drive

Programmable & Autoinstrumented 200 Volt amplifier

User's Manual



by

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In association with

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1 Warnings

Voltages at the X, Y and Z BNC output connectors can go as high as +-200 V_{DC}. This presents a risk of electrocution.

2 Main Features

The Smart Piezo Drive is a 6-channels, very low noise and drift, high-voltage amplifier for Scanning-Probe Microscopy applications. With three main inputs, three auxiliary inputs an a wide range of adjustments for the parameters (output offsets, gains and bandwidths), the *Smart Piezo Drive* is a feature-rich, extremely versatile product. Here is the list of the amplifier features:

- Three main inputs (X, Y and Z) with adjustable bandwidth (1 kHz, 10 kHz, 50 kHz) and adjustable gain (x1, x2, x5, x10, x20) on all channels.
- Three auxiliary inputs (X-aux, Y-aux, Z-aux) with 50 kHz bandwidth and fixed x1 gain.
- Three differential outputs (X, Y and Z).
- Adjustable bandwidth (1 kHz, 10 kHz, 50 kHz) on all channels.
- Adjustable gain (x1, x2, x5, x10, x20) on all channels.
- Full-Range offset control on all channels.
- Auxiliary modulation input on all channels
- Digital control of bandwidth offset and gain through USB and Ethernet connections.
- High-Speed digital monitoring of signals. Allows peak capture as fast as 7 μs.
- USB version only: 3-channels oscilloscope function to observe the outputs signals in real time.

The next figures show the front and the rear of the Smart Piezo Driver:

Technical Data

Analog Input Channels (scanning)	
Main Inputs (X,Y and Z)	+-10V
Input Impedance	10 kΩ
Coupling	DC
Input Connectors	BNC
Bandwidth	Software adjustable: 1kHz, 10 kHz and 50 kHz
Gain	Software adjustable: x1, x2, x5, x10 and x20
Analog Input Channels (auxiliary)	
Auxiliary Inputs (X,Y and Z)	+-10V
Input Resistance	100 kΩ
Coupling	DC
Input Connectors	BNC
Bandwidth	50kHz
Gain	x1
Offset (software controlled)	
Software Adjustable Offset (X,Y and Z)	+-200V
Bandwidth	30 Hz
Slew Rate Limit	Software adjustable: 1 V/s to 10V/s or bypass
High Voltage Outputs	
Output Channels (X+,X-,Y+,Y-,Z+ and Z-)	+-200V
Maximum Current	150 mA
Maximum Capacitive Load	Tested up to 1 μF
Output Connectors	3x Hirose RM15 series circular connectors
Signal Quality	
Output Noise (gain x1 and 50kHz)	70 μVrms
Output Noise Spectral Density (gain x1 and 50kHz)	3 μVrms/sqrtHz (@ 10 Hz), 1.3 μVrms/sqrtHz (@ 100 Hz) and 500 nVrms/sqrtHz (@ 1 kHz)
Output Noise (gain x20 and 50kHz)	130 μVrms
Output Noise Spectral Density (gain x20 and 50kHz)	4.5 μVrms/sqrtHz (@ 10 Hz), 2 μVrms/sqrtHz (@ 100 Hz) and 1 μVrms/sqrtHz (@ 1 kHz)
Maximum Slew Rate (10 nF load)	10 kV/ms
Output Thermal Drift	2 ppm-FSR/degC (max)
Self-Instrumentation	
Max History Length	Unlimited
Max Scope Function Depth	60 s
Scope Function Sampling Rate	150 kHz
Dimensions	
Chassis	18"x12"x5"
Weight	5 kg
Electrical Supply	
External Power Pack	Input 120VAC, Output 24VDC 5 A (included)
Power Consumption (quiescent)	14W

3 Software Installation

To install the high voltage amplifier software, launch the installer ***SoftdB_Smart_Piezo_Drive_V130.exe*** and follow the on-screen instructions. At the end of the installation procedure, the SR3Pro USB driver is automatically installed if it was not already. The high-voltage amplifier software is located in the following folder:

C:\Program Files (x86)\SoftdB_ SoftdB_Smart_Piezo_Drive

There are two versions of the amplifier control software:

1) USB version: *Smart_Piezo_Drive.exe*

2) Ethernet version: *Smart_Piezo_Drive _Net.exe*

The following sections describe both versions.

3.1 Control Application (USB version)

The control application allows the setup and the monitoring of the high-voltage amplifier. The following control panel provides control over:

- Offsets
- Offset slew rate limiter
- Drift correction setup
- Channel sensitivity
- Channel gains
- Channel bandwidths

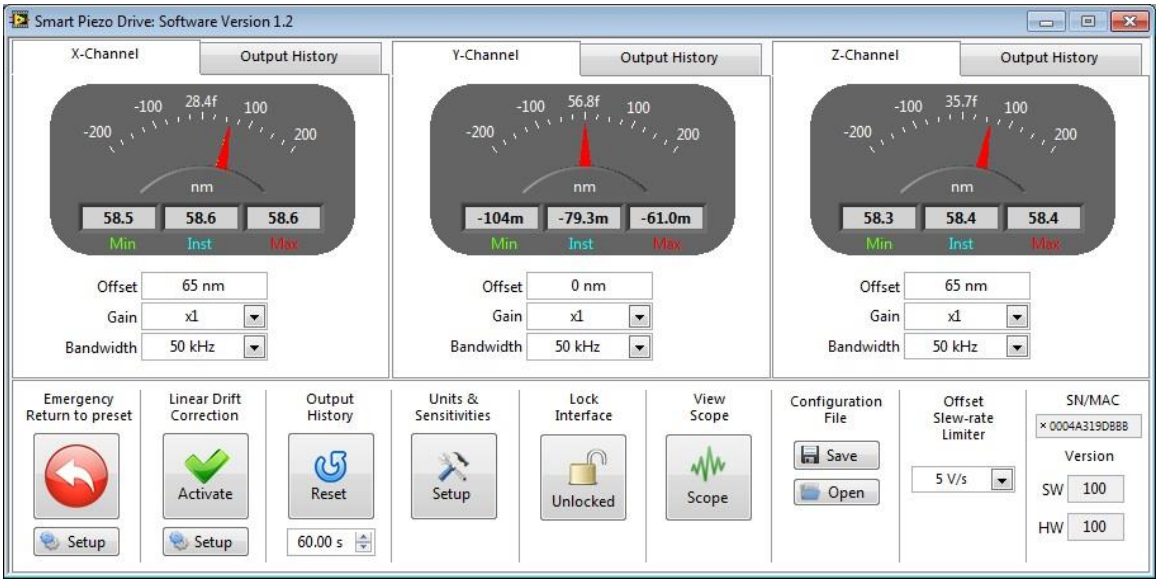


Figure 1 Control application (USB version)

Use this button to change the sensitivity and the unit name for each channel.

The output positions are presented in the user define units. All values displayed or entered can be appended with a 1-letter suffix that indicates the scaling factor:

- *m* for mili
- *u* for micro
- *n* for nano
- *p* for pico
- *f* for femto

Note: The absence of suffix implies that the scaling factor is 1. The user must be careful to use the proper suffix when it is required at the end of the entered values.
Alternately the user can append an exponent in the form exx or Exx, e-xx or E-xx at the end of the entered value.

The instantaneous, peak-minimum and peak-maximum outputs for all the output channels are monitored in real-time by the application. For each channel, the *Output History* tab presents the history for the pk-minimum, pk-maximum and the instantaneous positions:

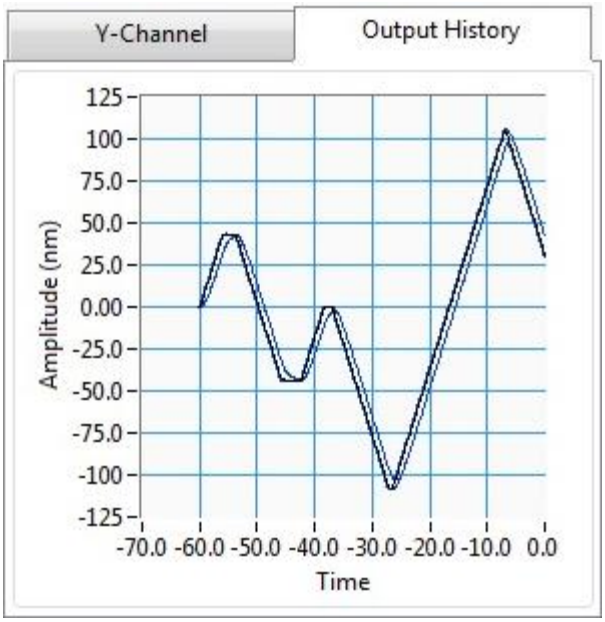


Figure 2 Output History

Use the *Output History Length* control to change the amount of recorded history. The history can be reset using the *Reset Histo* button.

The *Offset Slew-Rate Limiter* control specifies the maximum rate of change of the offset in V/s, and the value is the same for all the axes.

The red emergency button can be used to return all offsets to a preset value. Use the control *Setup* under the red button to define the preset and the offset limits for each axis:

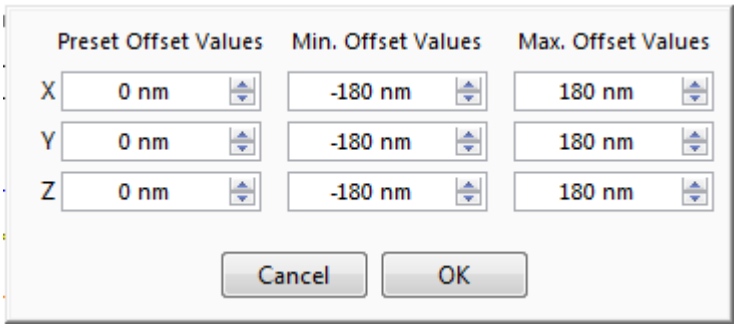


Figure 3 Offset preset and limits dialog box

A drift correction is applied when the *Activate Correction* control is set to ON. The outputs are slowly ramped up or down according to the specified drift correction values. The drift correction values are specified by the following dialog box:

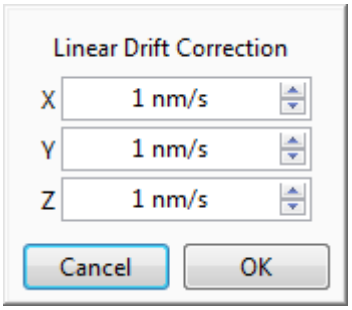
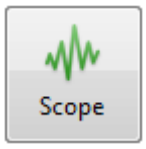


Figure 4 Drift correction dialog box

Each drift correction value is scaled by the *Sensitivity* value that is set for the corresponding channel.



With the USB version of the interface, a oscilloscope function can be used to monitor the output signals in real time. The sampling frequency is 75 kHz and the memory length is 60 s. The next figure presents the oscilloscope window (launched by the Scope button of the main interface):

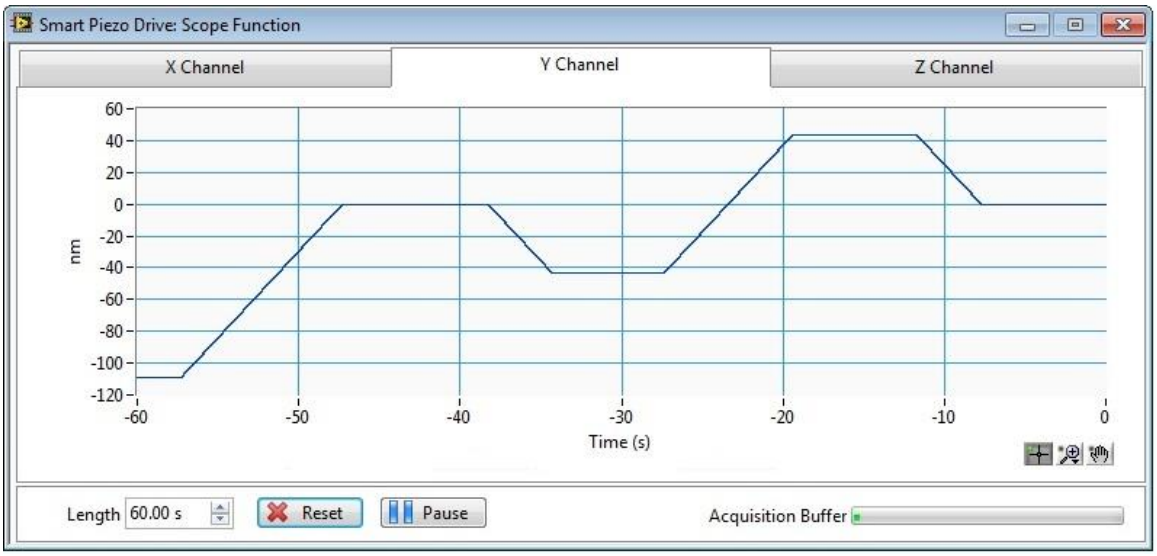


Figure 5 Oscilloscope window

The user can pause the acquisition at anytime and use the zoom functionalities on the time signals. The oscilloscope is stopped when the function window is closed.

With this button, the controls of the main interface are locked to avoid accidental changes of amplifier parameters.

The complete configuration of the amplifier is automatically saved in flash memory within the amplifier whenever a change in configuration occurs. The last configuration saved in flash will be applied the next time the amplifier is turned-on. The configuration in flash is applied even if the control application is not running. This means that it is not necessary to run the application if the amplifier setup does not require any changes.

The user can also save and recall the complete configuration of the amplifier using the *Save .cfg* and *Open .cfg* buttons.

3.2 Control Application (Ethernet version)

Except for the physical communication interface and the lack of the oscilloscope function, the Ethernet version of the control application works exactly the same way as the USB version. The Ethernet interface requires that both the PC and the amplifier be connected on the same network. When the Ethernet version is launched, the following dialog box is presented to determine the IP address of the amplifier:

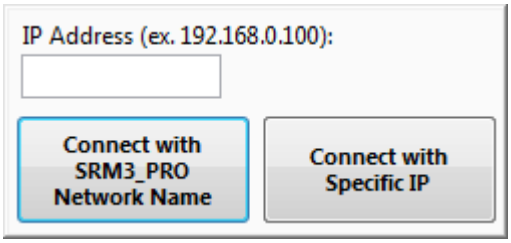


Figure 6 IP address dialog box

Note: It is possible to control the amplifier remotely through the Internet. In order to do that you need to setup your router for Port-Forwarding and connect to the amplifier using the public IP address of the router, rather than the local IP address of the amplifier.

When only one amplifier is on the network, the button *Connect with SRM3_PRO Network Name* can be used since the amplifier publishes the *SRM3_PRO* name and its IP address on the network. If the IP address of the amplifier is known, the address can be specified and the button *Connect with Specific IP* can be used. This option is required if more than one amplifier is on the network since the network name *SRM3_PRO* cannot be used to select the desired amplifier. To be sure that the right amplifier is selected, the MAC number marked on the front panel of the amplifier is presented on the control application:

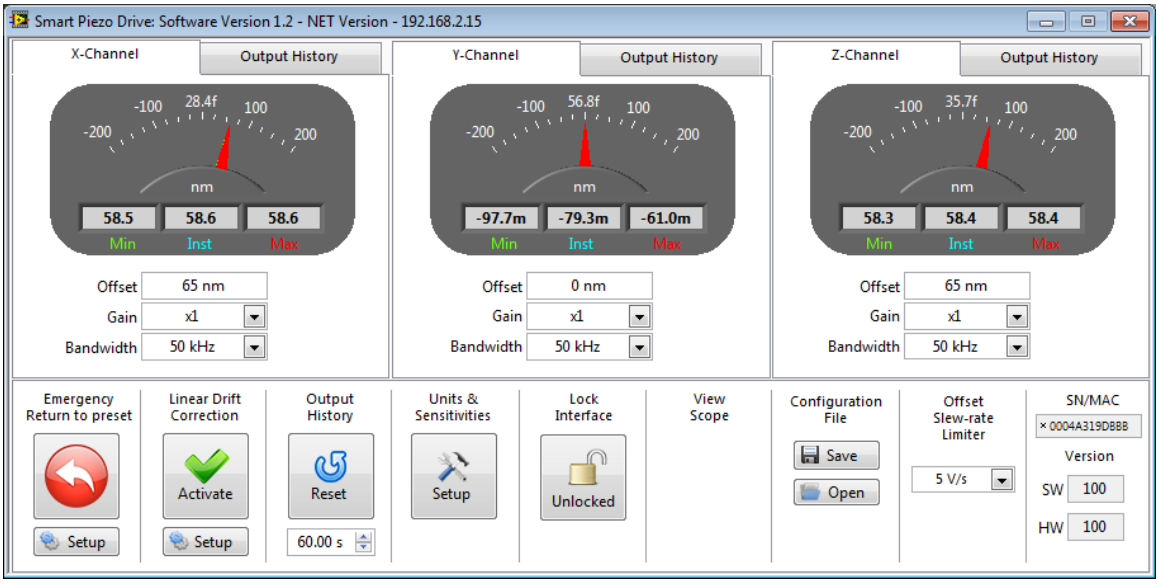


Figure 7 Control application (Ethernet version)