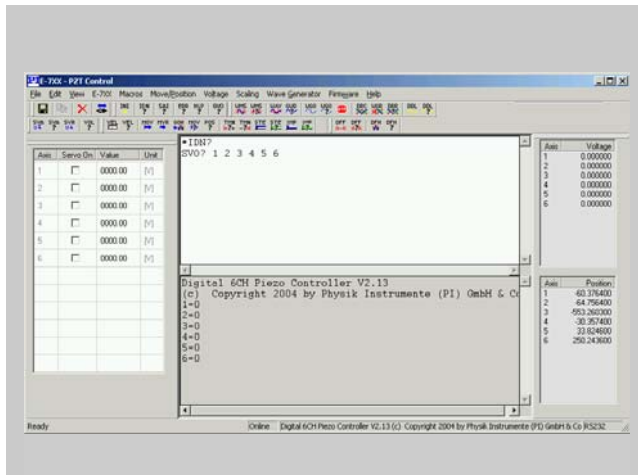


PZ 145E Software Manual

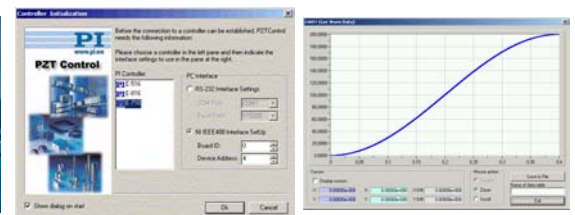
PZTControl for E-710

Release: 3.1.0 Date: 2005-07-01



This document describes software for the following product(s):

- **E-710** Digital Piezo Controller; 3- and 4-axis versions firmware rev. 5.025/6.025 or newer, 6-axis version firmware rev. 2.12 or newer



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PZTControl and this document as well as the other software tools and manuals accompanying the piezo controller system can be found on the product CD. Updated releases are available via FTP or email: contact your PI sales engineer or write info@pi.ws.

1 Introduction

1.1 Purpose of PZTControl

PZTControl is a 32-bit Windows application which was developed to control the *E-710 Digital Piezo Controller*.

The following basic functions are currently implemented:

- Input of positions and voltages (command input through a terminal and response window, toolbar buttons, panes for position or voltage input).
PZTControl provides access to all the commands in the PI General Command Set (GCS; for detailed command descriptions see the User Manual or the GCS DLL Manual). The toolbar buttons are especially useful for initial testing and simple applications.
- Convenient user interface to the E-710 wave generator functions to control the axes.

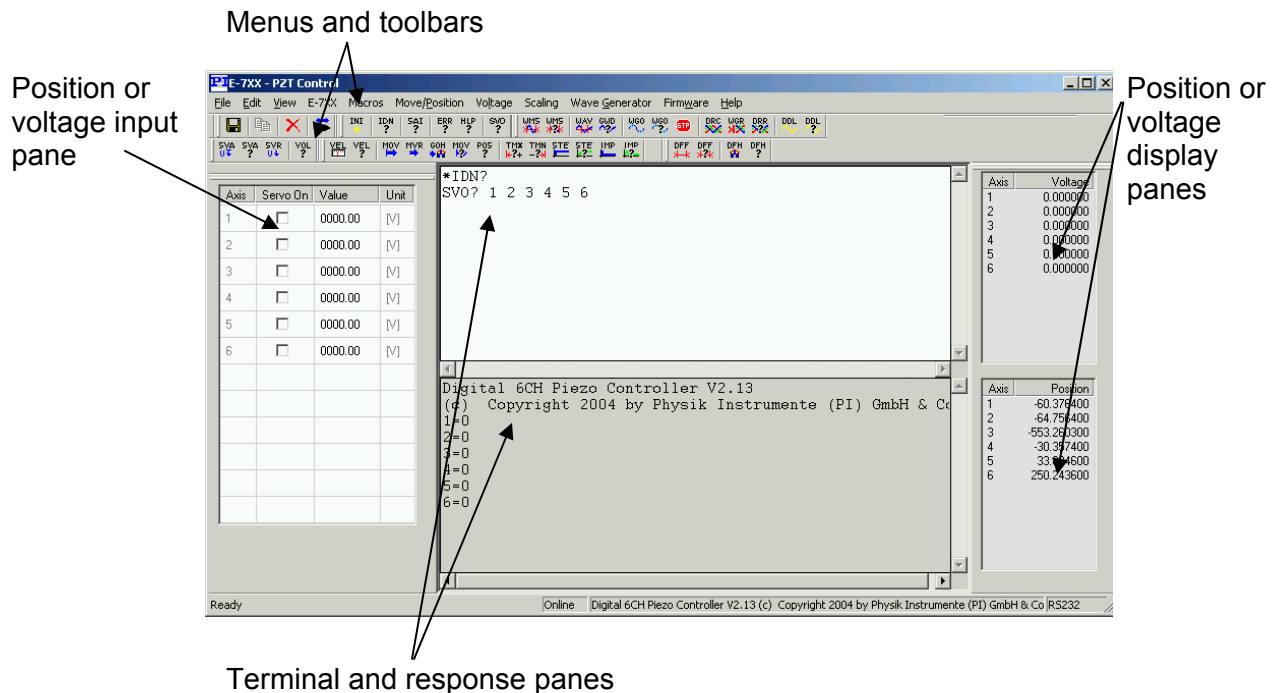
Since *PZTControl* is based on the *E-710* General Command Set (GCS) DLL, it thereby offers an easy way to observe and test the functionality of this DLL.

Other Features of *PZTControl* are:

- Control for multiple axes*
- Enable/disable servo-control (servo on = position control; servo off = voltage control)
- Communication over either RS-232 or IEEE 488 (GPIB) interface
- *Wave definition* dialog for *E-710*
- Synchronized wave generator start on more than one axis
- Real-time voltage and position display
- Firmware update for the *E-710* motion controller (DSP)
- System status display

*Note that the "axis" term used in this document stands for the motion in positioning direction(s), but not necessarily for the controller channels. "Axis" and "channel" can only be used synonymously with single-axis stages.

1.2 Overview



The toolbars provide shortcuts for certain commands. Each toolbar function can also be reached by a menu entry.

The toolbar icons or menu choices simply enter the corresponding command into the *Terminal* pane and send it to the E-710. All responses are shown in the *Response* pane.

With the entries from the *View* menu you can show or hide the various toolbars and the dockable position or voltage input and display panes. All visible items are listed with a check mark. So if you have accidentally hidden an item, you can get it back with the *View* menu.

1.3 Motion System Set-Up

This *PZTControl* manual describes the controls and the functionality of the *PZTControl* software tool. It assumes that you are already familiar with the motion system (stage, controller, host PC). All information on how to put the motion system into operation can be found in the User Manual for the appropriate controller.

2 Software Installation

2.1 Installation

The software package installs with the familiar installation procedure: a setup program guides you through all installation steps using interactive dialogs. This program is located in the installation directory. After running the program, *PZTControl* is fully installed.

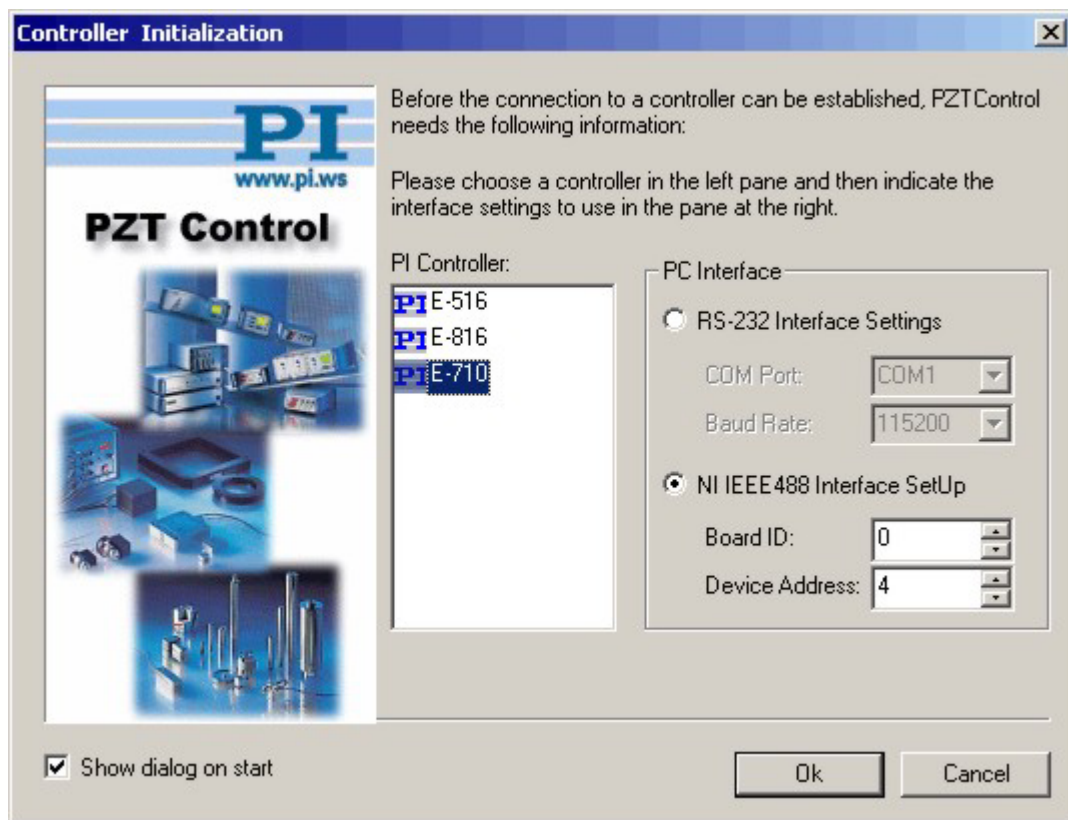
2.2 Deinstallation

During installation, *PZTControl* registers itself in the Windows system. This enables automatic de-installation using the mechanism supported by the Windows operating system. When starting the item *Add/Remove Programs* or *Software* in the *Control Panel*, the pop-up dialog shows a software list which contains the entry "PZTControl". By selecting this item, *PZTControl* can be completely removed.

3 Getting Connected

If you are using the *E-710* for the first time, you may need to select and configure the desired interface at the hardware first. Follow the instructions in the hardware device User Manual to determine (and/or set) the baud rate. The settings at the hardware must match those in the *PZTControl* host software.

When you start *PZTControl* for the first time, the *Connection Setup* dialog will be displayed:

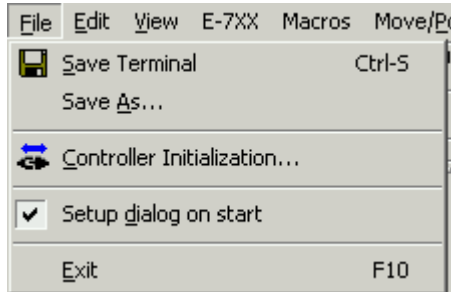


Select the installed interface type and click **OK**. The program will try to connect to the device using the current interface settings. If it fails, recall the *Connection Setup* dialog using the *File* menu and reconfigure the interface. The settings made

here and at the hardware device must match. See the hardware manuals for information on determining/changing the settings there.

Notes:

- You can inhibit display of the Connection Setup dialog on program start with the menu sequence: *File* → *Setup dialog on start*.



On the next start the *Connection Setup* dialog will not be displayed.

- To control more multiple *E-710*s from the same host PC, you must connect each to a separate interface and run separate copies of *PZTControl* in separate windows.

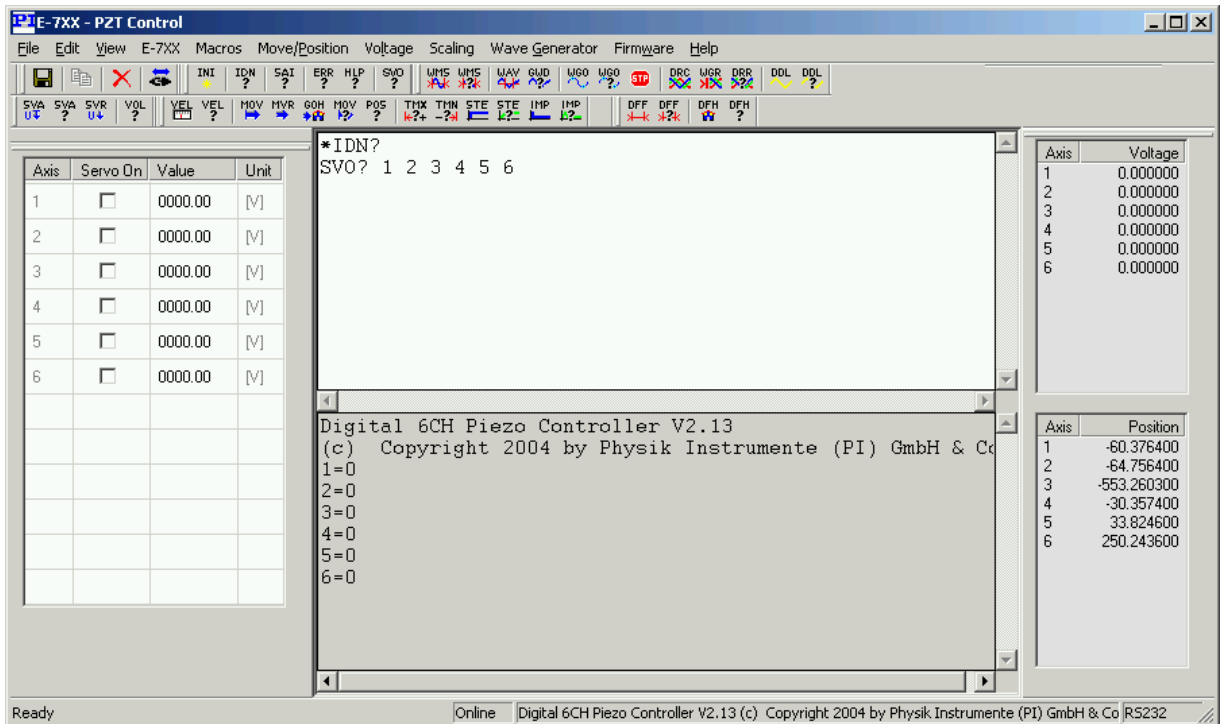
3.1 RS-232 Settings

- **COM Port:** Select the desired COM port of the PC, something like "COM1" or "COM2". Only the ports available on the system that are not in use by other applications will appear in the list.
- **Baud Rate:** The baud rate of the interface.

3.2 IEEE 488 Settings

- **Board ID:** ID of the National Instruments board installed. If, as in the usual case, only one board is installed, this will be 0. Otherwise, use the National Instruments setup and test software to determine the board ID.
- **Device Address:** The address of the connected device. Please read the documentation of the *E-710* to determine its address setting and, if necessary, how to change it. The settings here and on the *E-710* must match.

4 Terminal and Response Panes



In the center of the *PZTControl* main window you will find the two text panes of the *terminal emulator* (in the focus of the figure above). The top window is a terminal where you can enter commands for the *E-710* using the command syntax of the *PI General Command Set*. The available GCS commands are listed in the *E-710 GCS DLL manual*.

When **ENTER** ("↵") is pressed, the GCS DLL internally translates the terminal pane input into native ASCII commands and sends them to the controller. The bottom pane shows the (translated) responses sent by the device, if any:

Example:

Command: POS? 1 ↵

The response to the POS? command is the current position of axis 1. It will be displayed in the response window.

You can make the content of the terminal pane available outside of *PZTControl* with the *Save* (save as a text file) or *Copy* (copy the selected text to the clipboard) toolbar buttons or the corresponding items of the *File* menu. *Clear* will clear the active pane.

5 Edit Toolbar



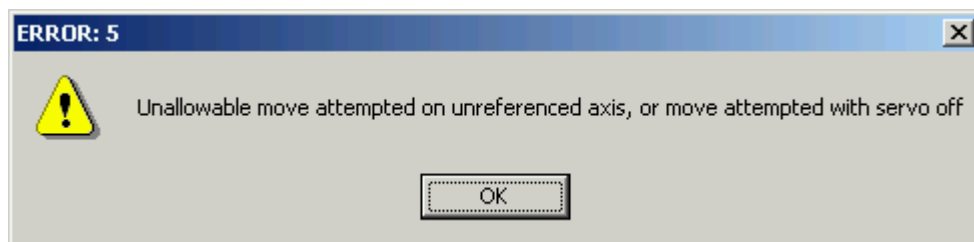
This toolbar has the standard functions familiar from many other Windows applications. With "Clear" you can clear the contents of the active terminal windows. "New device connection" (re)connects an *E-710* when communications have been interrupted.

6 General Toolbar

This toolbar has shortcuts for some simple commands. If you click on one of these buttons, the command will be entered in the terminal window and sent to the device. The response window will show the answer from the device, if any.



When "ERR?" is called from the menu or the toolbar, PZTControl also translates the response into the more meaningful text version (see Figure below) so you do not have to learn all the error codes.



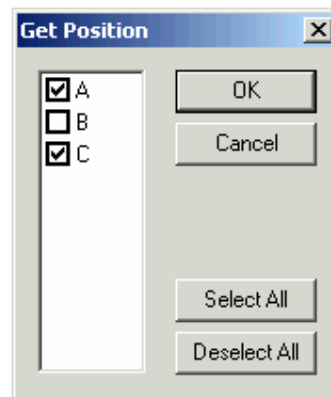
The commands on the *General* toolbar are all also available on the pull-down menu titled *E-7XX*.

7 Position and Voltage Toolbars



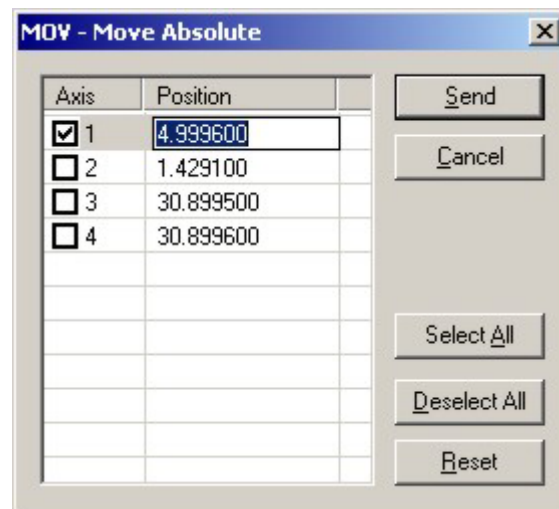
The position and voltage toolbars handle most commands for moving the connected axes or setting voltages for them. All of these commands can have one or more axes as parameters. Some of them need parameters for each axis.

When a command needing axis identifiers is selected, *PZTControl* will prompt you to select the axes you want to access.

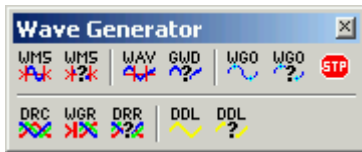


With commands that need additional parameters for each axis *PZTControl* will show the dialog displayed on the right to obtain the parameters for the axes.

You can "build" the command sent to the *E-710* by selecting the desired axes and enter the values in the edit fields (in our example "*Position*").



8 Wave Generator Toolbar



This toolbar provides convenient access to the E-710 wave generator functions with which up to two axes can be controlled.

Using the E-710 wave generator functions is as follows:

1. Define the maximum number of wave points for the axes (see Section 8.1).
2. Have the E-710 generate waveforms for the axes (see Section 8.2).
3. Check the waveforms and, if required, save them to a file on the host PC (see Section 8.3).
4. Enable wave output for up to two axes in one of a number of modes (see Section 8.4), e.g. with DDL initialization and/or usage (Dynamic Digital Linearization; provided your controller is equipped with the DDL feature; see the E-710 User Manual for details).

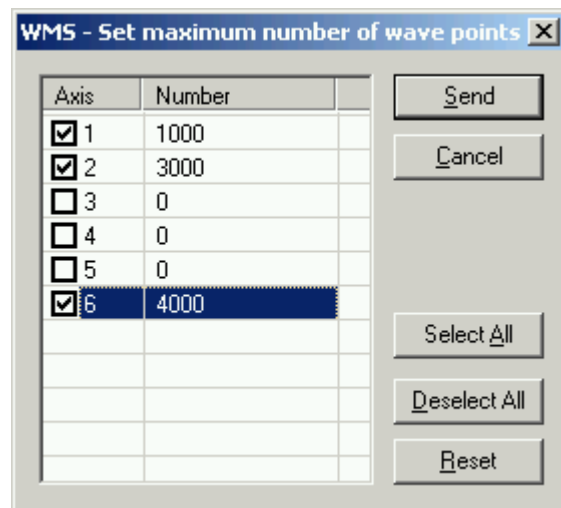
During the wave output you can record several data: e.g. target position, actual position and position error. This data can be read out in a graphical display and saved on the host PC (see Section 8.6).

It is also possible to read out the DDL tables which are generated during the wave output, to save them to the host PC and load them back to the controller if required (see Section 8.7).


8.1 Set the Maximum Number of Wave Points

With the *WMS* button you get a dialog where you have to set the maximum number of wave points for the axes and to activate the axes you want to use with the wave generator. As long as the number of points is 0 or the axis is deactivated, no waveform definition (with *WAV*, see Section 8.2) will be possible for that axis.

The total number of points available is 63488. A maximum of 4 axes can be activated at the same time. If more than 4 axes are activated, no waveform definition will be possible at all.



8.2 Wave Definition

With the  button or the *Wave Generator* → *WAV* menu item you get the *Wave definition* dialog. You can use this dialog to define a wave form for an axis either by setting several parameters for the wave or by loading a wave form from a file on the host PC.

8.2.1 Setting Wave Parameters

If you choose LIN, RAMP or SIN_P for the *Waveform*, you can define several wave parameters:

The *Segment length* value must not exceed the maximum number of wave points set by the *WMS* dialog. The *Curve length* value should not exceed the *Segment length* value, because otherwise the wave form is adapted in a way that the number of wave points is equal to the *Segment length* value and the maximum amplitude is reached at the end of the segment.

For detailed description of the wave parameters please see the E-710_GCS_DLL Manual.

If you press OK, the wave form is sent to the E-710 and stored on the controller, until a new wave form for that axis will be defined or the controller is powered down. If you want to save the wave form to a file on the host PC, use *GWD?* (see Section 8.3). The wave can then be loaded at a later date using "PNT" for the *Waveform* (see Section 8.2.2).

Wave definition

Axis: 1

Waveform: SIN_P

Segment length: 1000

Curve start point: 0

Curve length: 1000

Curve center point: 500

Speed up down: 0

Amplitude: 10

Offset: 0

Append: ☐

Cancel OK

8.2.2 Loading a Wave from a File

If you choose "PNT" for the *Waveform*, the *Load Wave* button is available in the *Wave Definition* dialog (see leftmost figure below). Pressing this button the *WAV PNT* window opens (see rightmost figure below), where you can load a wave from a file on the host PC which was saved in the *GWD?* window before (see Section 8.3). With *Send and Exit* you can send the loaded data to the controller. The *Wave definition* dialog then opens again, and you can choose the axis to which the data will be assigned, the start point in the curve and the number of values to send starting from that point.

Wave definition

Axis: 1

Waveform: PNT

Segment length: 6000

Curve start point: 0

Curve length: 6000

Curve center point: 2000

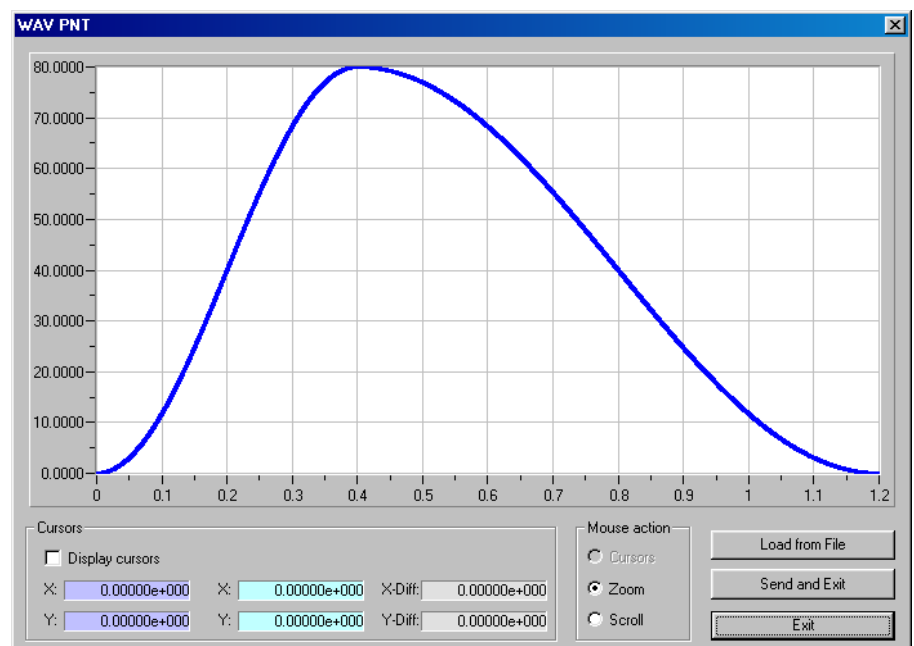
Speed up down: 0

Amplitude: 80

Offset: 0


Append: ☐ Load Wave

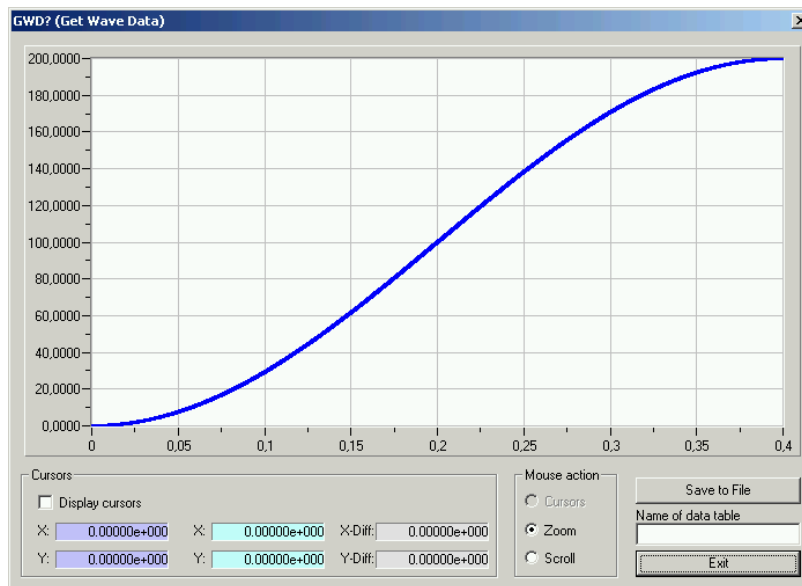
Cancel OK



8.3 Checking and Saving the Waveform

You can check the last transferred waveform for an axis with the *GWD?* command (see the E-710_GCS_DLL Manual for command description). The waveform report shows the position values for a certain number of curve points. It is recommended to use *GWD?* before you start the wave generator output to verify the waveform.


Note that if you type *GWD?* in the terminal, you obtain a list with the numerical values in the response pane. Using the  button in the toolbar or the *Wave Generator* → *GWD?* menu item, the response is shown in a separate graphical display window (see figure below). There you can also save the waveform to a file on the host PC (see Section 8.2.2 for how to load the file content to the controller).



In this example a sinusoidal waveform was sent to axis 1 (see Section 8.2). The *GWD?* command lists the position values for the number of points that were specified in the command—the first 2000 curve points in this example.

8.4 Wave Generator Start

Set servo mode ON for the axes for which you want to start the wave generator output. This can be done using the checkboxes in the *Set Positions & Voltages* pane (see p. 18). As long as servo mode is OFF, an axis will not move after the wave output was started. This is due to the fact that the wave points are interpreted as target positions but not as voltages.

To start the wave generator output, open the dialog shown below with the  button from the toolbar or using the *Wave Generator* → *WGO* menu item.

	Start Def.	Ext. Trigger	Init. DDL	Use DDL	Start at end position	DDL single run test
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Wave output can be started with the *Send* button for up to two axes at the same time.

Each row in the table belongs to one axis and makes it possible to select the start options for that axis—*Start Def.* or *Ext. Trigger* are required to start the wave output, while the other choices are optionally.

Provided your controller is equipped with the Dynamic Digital Linearization feature (DDL), you can start the wave output with DDL initialization (*Init. DDL*) and/or usage (*Use DDL*). See the E-710 User Manual for details about the DDL. See Section 8.7 for how to read back the DDL data, save them to files on the host PC and load it back to the controller.


Note that each option, i.e. each column in the dialog, represents a bit of a bit pattern which is an argument of the *WGO* command. For a detailed description of the bits and their meaning see the E710_GCS_DLL manual.

8.5 Wave Generator Stop

To stop the Wave Generator output, press the  button in the *Wave Generator* toolbar.


8.6 Data Recording

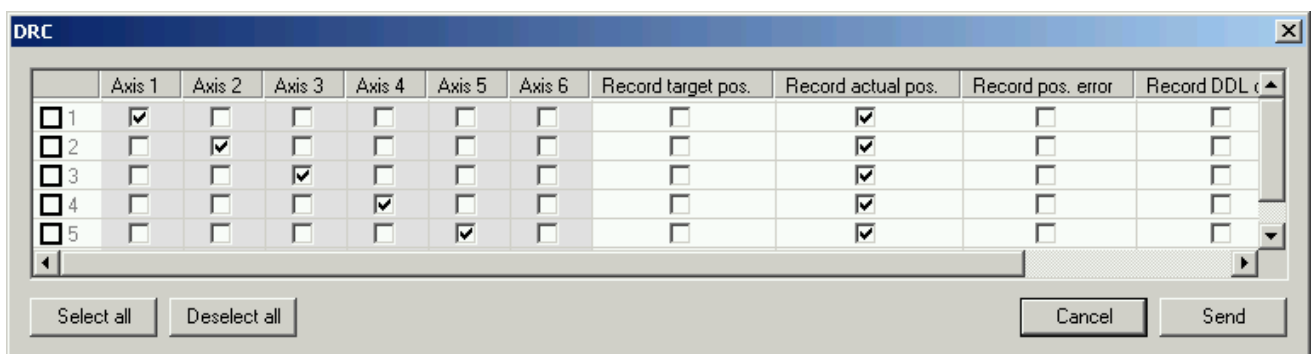
When you start the wave generator output for up to two axes with the *WGO* dialog (see Section 8.4), by default the target positions for that axes are recorded. The data for the axes is written to separate record tables. You can configure the record tables by changing the axis assignment and the data type to be recorded.

Additionally you can manually start recording for all available axes using the  button. In this case the recorded data type can be changed, but must be the same for all axes.

The recorded data can be read out and saved to a file on the host PC (see Section 8.6).

8.6.1 Configure Recording


Open the *DRC* dialog (see Figure below) for recording configuration with the  button. Each row in the dialog belongs to one record table.



	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Record target pos.	Record actual pos.	Record pos. error	Record DDL
<input type="checkbox"/> 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

For the recording which is started automatically with *WGO*, you can configure the record tables for the moving axes according to the following rules:

- Only target position or actual position or position error can be recorded.
- An axis can be assigned to only one record table. If an axis is assigned to more than one table, only the data for the last table connected to that axis will be recorded.

If you want to start recording manually with , configure the record tables according to the following rules:


- Do not change the default assignment of axes to record tables.
- The data type to be recorded must be the same for all record tables.
- To change the data type to be recorded for all tables, activate table 1 (first column), select the new data type for table 1, and press *Send*. Note: If any other record table is activated too or if the change is done for a table other than table 1, the change will be ignored.

If no configuration is done with the *DRC* dialog, the target positions will be recorded by default.

8.6.2 Start Recording


Note that every recording completely overwrites the content of all record tables. If you want to keep the recorded data, save them to files on the host PC before you start a new recording. See Section 8.6.3 for how to do this.

When you start the wave generator output with the *WGO* dialog (see Section 8.4), recording is started automatically for the moving axes according to the settings made in the *DRC* dialog.

During the wave generator output, you can restart recording manually by pressing the  button. In this case the data type set for table 1 is recorded for all axis available on the controller.

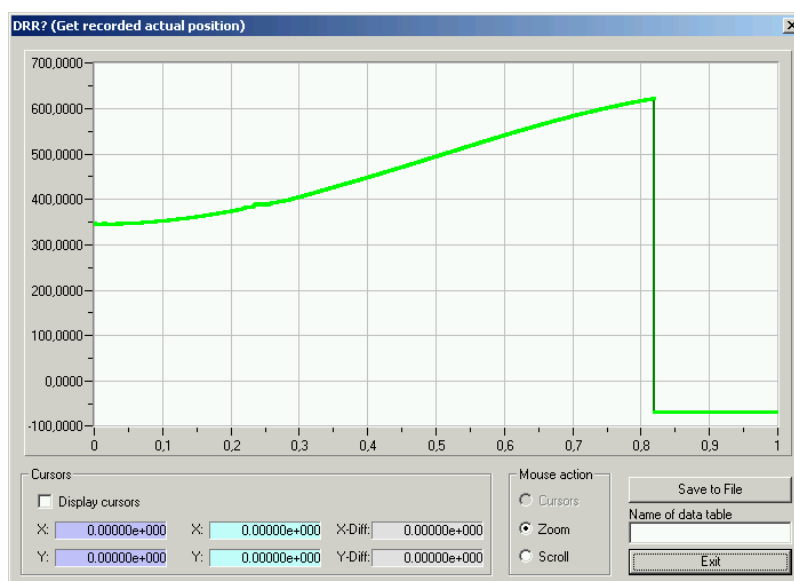
Recording is stopped, when you press the  button to stop the wave generator output.

8.6.3 Read Out the Data

Using the  button in the toolbar or the *Wave Generator* → *DRR?* menu item, the recorded data from one record table is shown in a separate graphical display window (see figure below). It is possible to read the data while recording is still in progress.

In the *DRR?* window, you can also save the data to a file on the host PC.

Note that the data is stored on the controller only until a new recording is done or the controller is powered down.



In this example a sinusoidal waveform was output for axis 2 and the actual position was recorded. The graph consists of the values for the number of points that were specified by *DRR?*—the first 5000 points in this example.


8.7 DDL Data Handling

It is possible to read out the DDL tables which are generated when the DLL initialization option is activated during the wave generator output. The data can be saved to the host PC and sent back to the controller if required.

Note that any DDL data is stored on the controller only until a new DDL initialization will be started or the controller is powered down.

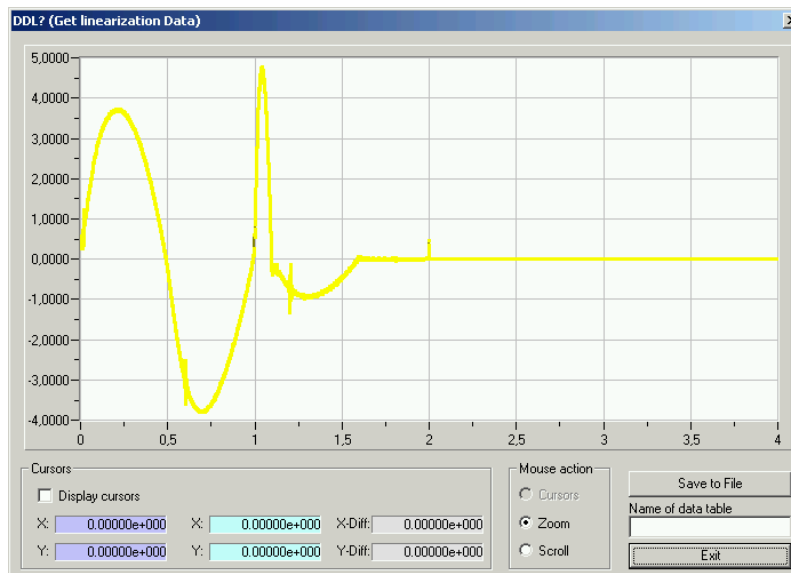
For details about the DDL feature and working principle see the E-710 User Manual.

8.7.1 Read Out the DDL Tables

Using the  button in the toolbar or the *Wave Generator* → *DDL?* menu item, the data from one DDL table is shown in a separate graphical display window (see figure below).

By default DDL table 1 belongs to axis 1, DDL table 2 to axis 2, ..., up to DDL table 6 to axis 6. The assignment of axes to DDL tables can be changed using the SPA command (see the E710_GCS_DLL manual).


In the *DDL?* window, you can save the data to a file on the host PC.



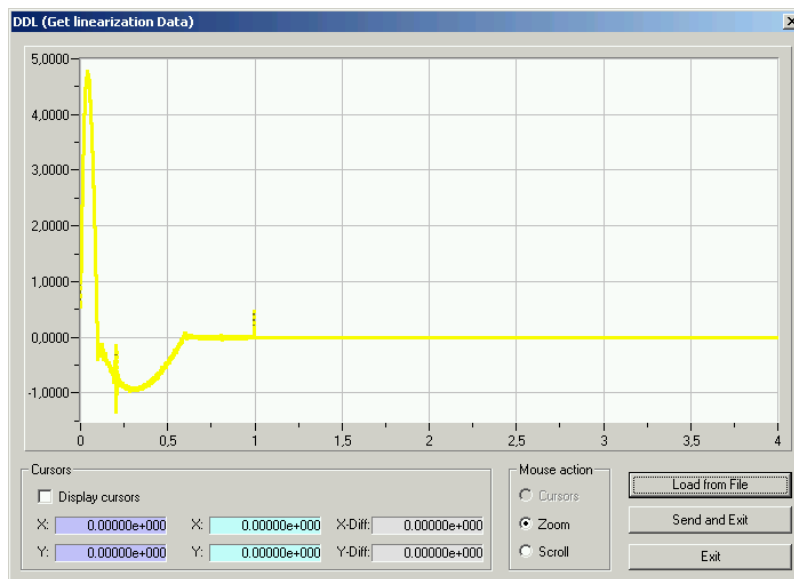
This example shows the DDL data for one axis. The graph consists of the values for the number of points that were specified by *DDL?*—the first 20000 points in this example.

Note that the DDL data which is recorded if you select the *Record DDL data* option in the *DRC* configuration dialog can not be read with *DDL?* but only with *DRR?*, and this data can not be used for further DDL applications.

8.7.2 Load DDL Tables from Files and Send them to the Controller

Using the  button or the *Wave Generator* → *DDL* menu item, you can load DDL data from the files on the host PC which were saved in the *DDL?* dialog. This way you can re-use the DDL data and do not have to repeat DDL initialization after every controller power-on—as long as the waveform and the application for an axis do not change.

In the *DDL* window, press the *Load from File* button to select the file and the table set.

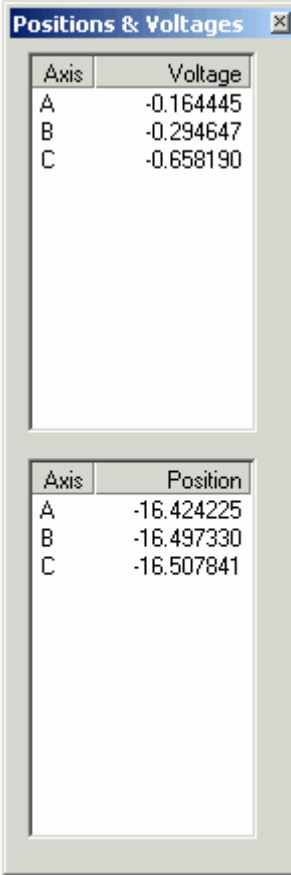


With *Send and Exit* you can send the loaded data to the controller. In the *DDL* dialog shown below, you can choose the DDL table to which the data will be written on the controller (*Linearization*), the start point in the data table and the number of values to send starting from that point. Only the defined points in the selected DDL table on the controller are overwritten.

The figure shows the 'DDL (Load linearization Data)' dialog box. It contains three input fields: 'Linearization' (set to 1), 'Start point' (set to 0), and 'Num. Values' (set to 1000). The 'OK' and 'Cancel' buttons are at the bottom.

9.2 Positions and Voltages Pane

The *Positions & Voltages* dockable pane (at right) displays the current voltage and position of the various axes connected to your *E-710*.



The screenshot shows a dockable pane titled "Positions & Voltages" with a close button (X) in the top right corner. It contains two tables. The top table, "Voltage", has columns "Axis" and "Voltage" with data for axes A, B, and C. The bottom table, "Position", has columns "Axis" and "Position" with data for axes A, B, and C.

Axis	Voltage
A	-0.164445
B	-0.294647
C	-0.658190

Axis	Position
A	-16.424225
B	-16.497330
C	-16.507841

10 Firmware Update

Note that an *E-710* firmware update is only possible if the first digit of the current firmware version number is identical to those of the update version. Example: firmware version 5.xxz can be updated with version 5.xyz, but not with version 6.xyz.

After any firmware update, you will need to re-adjust the communications parameters on the *E-710* to re-establish contact with the host computer (see Section "Getting Connected", p. 6).

To update the firmware, select the *DSP Controller Firmware...* menu item from the *Firmware* menu.



The firmware wizard appears and guides you through the update of the DSP firmware on the *E-710*.

