PI

PZ 121E Software Manual

LabView Driver Library

Release 2.0.1a

Software Interface Description

This document describes software for use with the following products:

E-816.00   **Computer Interface and Command Interpreter Submodule (firmware version 2.02) for PZT Controllers**

Release: *2.0.1a*
Release Date: *2003-05-21*

Table of Contents

0.   Disclaimer

This software is provided "as is". PI does not guarantee that this software is free of errors and will not be responsible for any damage arising from the use of this software. The user agrees to use this software on his own responsibility.

1.   Introduction

The LabVIEW software consists of a collection of virtual instrument (VI) drivers. All functionality involves invoking one or more VIs with the appropriate parameter and global variable settings.

This VI driver set supports the *PI General Command Set*, which is based on ASCII communication with well-defined commands and replies. This makes it possible to control different PI systems, such as the *E-516 Display Module* or the *C-880 Multi-Axis Controller*, with only one driver set simply by "wiring" the correct command parameters to the associated VIs.

To control PI systems that are not originally compatible with the *PI General Command Set*, such as the *C-844 Motor Controller* or the *C-843 Motion Control board*, libraries are used to translate *PI General Command Set* commands to other controller-specific languages. The universal library which adds this functionality is GCSTranslator.dll; it must be installed on the computer, no matter whether the system being controlled is *PI General Command Set* compatible or not. To control a non-GCS-compatible system, one or more system-specific DLLs and data files must also be installed. This is done by running "GCSLibrarySetup.exe", which is located in the DLL folder of this LabVIEW driver set (the DLL folder is only available if the system that this driver set came with is not GCS compatible). This setup tool makes sure that these libraries and their data files are correctly registered in the Windows environment and can be found by the GCS drivers. Once the libraries and data files for the system to control are installed, this LabVIEW driver set can be used to control a non-GCS-compatible system just like any GCS-compatible system by selecting "DLL" as communication interface (see the "1.1 General Remarks for Special System Configurations" section and the "PI Open Interface.vi" command description).

This manual covers only VIs which can be used with the product with which it came. If you would like to have one manual with all available VI descriptions, please contact your local sales office.

The LabVIEW drivers are divided into three folders: "Low Level", "High Level" and (optionally) "DLLs".

The basic "Low Level" folder contains GCSTranslator.dll and VIs for the following functions:

➢ Establishing communication with different PI systems which support the PI General Command Set via RS-232 or GPIB interfaces

➢ Defining the parameter IDs of the connected axes

➢ Sending and receiving ASCII characters to/from the specified system

➢ Sending system-specific commands (system-specific commands are separated into function-specific LLBs).

The "High Level" folder contains a terminal VI and, if available, several sample programs.

The **connector pane** of all VIs has the following pattern:

1					15
2	7	9	11	13	16
3					17
4					18
5	8	10	12	14	19
6					20

The terminals are assigned as follows (if the mentioned, control/indicator is present in one of the supplied libraries):

1   System number

2   Optical board, Interface, or other main input control

3   "Axes to query", "Affected axes", "Number of systems", or other main input control

4   "All axes?", "Invert order?", or other main input control

5   "Axis identifier?", "No. of digits", or other main input control

6   "Error in"

7   "Parameter number", "Without axis ID?", or other input control

8   "Step size", or other input control

9   "AA step size", or other input control

10   Input control

11   Input control or output indicator

12   Input control or output indicator

13   Input control or output indicator

14   Input control or output indicator

15   "Hidden error", "Connected axes", "String read", or other main output indicator

16   "Axes to query out", "Bytes read", or other main output indicator

17   "No. of rows", or other main output indicator

18   Output indicator

19   Output indicator

20   "Error out"

<mark>Important:</mark>

Two programming steps must be taken before running any VIs to control a connected system. The **first step** is to open the communications port and the **second step** is to define the connected axes.

The **communications parameter settings** can be set using "PI Ask for Communication Parameters.vi"—which opens a user interface—and "PI Open Interface.vi". The output parameters of "PI Ask for Communication Parameters.vi" must be hard-wired to "PI Open Interface.vi". If no user dialog is wanted, the correct parameters can be hard-wired to the "PI Open Interface.vi" directly.

For testing, the easiest method is to call "PI Terminal.vi", which is located in the "High Level" folder. This is a "stand-alone" routine that calls "PI Ask for Communication Parameters.vi" first and then opens the specified ports. It does not, however, define the connected axes of the (motion) systems.

The **connected axes** are defined by running "Define connected axes.vi", which is located in the "Low Level" folder in "General command.llb".

After these two steps all parameters are saved into two global variables, so that other VIs invoked during the same LabView session can access this data at runtime.

1.1.   General Remarks for Special System Configurations

C-843

To control one or more C-843 boards with this driver set "C843_GCS_DLL.dll", "MC.dll", "PiStages.dat" and the C-843 device driver must be installed on your computer. Run "GCSLibrarySetup.exe" from the DLL folder to assure proper installation of the first three items. A description of how to install the C-843 device driver is given in the C-843 system manual. See "C843_Configuration_Setup.vi" for a sample program for the driver configuration of the C-843). You must then perform the following steps:

1. Run "PI Open Interface.vi" to open a connection to the board,

2. Run "Define connected axes.vi" with "Read from controller = FALSE" and "Connected axes" = 1,2,3,4 (or 1,2 for the 2 channel version)

3. Run "CST.vi" to determine which stages are connected to the four/two channels of the C-843 board.

4. Run "Define connected axes.vi" with "Read from controller " = TRUE,

5. Run "INI.vi";

6. Then one of the reference VI's ("REF.vi", "MNL.vi", "MPL.vi", depending on which stages are connected) must be run before you can use axis-specific VIs like "POS?.vi" or "MOV.vi".

Default axis names are 1 to 4, but can be changed using "SAI.vi".

C-844

This driver set (PI General LabVIEW Driver Set) supports the C-844 system, but it does not offer the full functionality of the C-844. It can be used for normal tasks, but it is not compatible with the LabVIEW driver set that comes with the C-844 system.

To control one or more C-844 controllers with this driver set, "C844_GCS_DLL.dll" and "PiStages.dat" must be installed on your computer. Run "GCSTranslator Setup.exe" from the DLL folder to assure proper installation of these items. See "C844_Configuration_Setup.vi" for a sample program for the driver configuration of the C-844). You must then perform the following steps:

1. Run "PI Open Interface.vi" to open a connection to the C-844 controller,

2. Run "Define connected axes.vi" with "Read from controller = FALSE" and "Connected axes" = 1,2,3,4

3. Run "CST.vi" to determine which stages are connected to the four channels of the C-844.

4. Run "Define connected axes.vi" with "Read from controller " = TRUE,

5. Run "INI.vi" (After "INI.vi" a wait time of appr. 4 s must be included to prevent communication errors);

6. Then one of the reference VI's ("REF.vi", "MNL.vi", "MPL.vi", depending on which stages are connected) must be run before you can use axis-specific VIs like "POS?.vi" or "MOV.vi".

Default axis names are 1 to 4, but can be changed using "SAI.vi".

C-880

To control one or more C-880 controller with this driver set, you must first run "PI Open Interface.vi" and "Define connected axes.vi" and then one of the reference VI's ("REF.vi", "MNL.vi", "MPL.vi", depending on which stages are connected) . See "C880_Configuration_Setup.vi" for a sample program for the driver configuration of the C-880.

E-516

To use wave-generator-specific VI's, whose names start with "WGMacro_dll_*.vi", "WGMacro.dll" must be installed on your computer. See "E516_WaveGenerator_ Sample_Program.vi" for a sample program using these VIs.

E-816

When controlling the E-816, timing problems can occur if several command VIs are run in rapid sequence, resulting in lost commands. To prevent such communication errors, it is recommended that you include a certain wait time between the different programming steps, depending on the command to be executed. This is especially true for commands that need a certain execution time inside the E-816 module, like MOV, MVR, SPA, SVA, SVR, RST, WPA, SWT and WTO. Only one axis per command can be controlled. "Split num query command.vi" can be used to query POS?, MOV?, VOL?, SVA? for multiple axes at a time.

F-206

This driver set (PI General LabVIEW Driver Set) supports the F-206 system, but it does not offer the full functionality of the F-206 LabVIEW driver set that comes with the F-206 system. Both driver sets are fully compatible and can be used in parallel. For normal tasks, the F-206 can be controlled with this PI General LabVIEW Driver Set. If you want to control the F-206 with the PI General LabVIEW Driver Set, but want to use special F-206 functions which are not supported by this driver set, or if you want to use the F-206 LabVIEW sample programs for different alignment tasks, you must run "OpenInterface.vi" from the F-206 LabVIEW driver set in addition to "PI Open Interface.vi" and "Define connected axes.vi" from this driver set.
Connected axes must be defined manually ("Read from controller = FALSE"). Axes identifiers cannot be changed.

M-840 / M-850

This driver set (PI General LabVIEW Driver Set) and the M-840 / M-850 LabVIEW driver set that comes with the M-840 / M-850 system are fully compatible and can be used in parallel. The M-840 / M-850 can be fully controlled with the PI General LabVIEW Driver Set. Connected axes must be defined manually ("Read from controller = FALSE"). Axis identifiers cannot be changed.

2.   Low Level VIs

The following low-level VIs can be found in the "Low Level" folder:

2.1.   Communication VIs (Communication.llb):

2.1.1.   BDR.vi

Valid for	E-816
Input	System number (1), No. of digits (1), Baudrate (57.6), Error in (no error)
	E-816: No. of digits must be 1.
Output	Hidden error (T/F), Error out
Remarks	Set baudrate for RS-232 communication. Valid baudrates are 9.6, 19.2, 38.4, 57.6 and 115.2. "No. of digits" is the number of digits after the decimal point in the baud rate specification that will be sent. After 3000 ms ERR? is queried.
	E-816: Baudrate changes must be written to non-volatile memory with WPA.vi and do not take effect before the next power on or RST. Incorrect entries (such as 56) have unpredictable results and may not set an error status. Check RAM setting with BDR?.vi after setting the baudrate before running WPA.vi. This command cannot be issued to a slave E-816.

2.1.2.   BDR?.vi

Valid for	E-816
Input	System number (1), Error in (no error)
Output	Baudrate, Error out
Remarks	Returns current RAM baudrate setting for RS-232 communication.
	E-816: The value returned reflects the value that will be saved to non-volatile memory if parameters are saved with WPA.vi. This may differ from the value currently in effect.

2.1.3.   Close connection if open.vi

Valid for	C-843, C-844 (but must be present in Communication.llb for all other systems, too)
Input	System number (1), Error in (no error)
Output	Was connected? (T/F), Error out
Remarks	This VI checks if the connection to the selected system is already open and, if it is, it closes this connection.

2.1.4.	**Find baudrate.vi**

Valid for	C-880, E-516, E-816, F-206, M-850
Input	System number (1), RS-232 Port number (0: COM1), Timeout (2000), Valid baudrates (array of 5 values), Flow control (All FALSE, x13, x11, x0), Error in (no error)
	C-880: Input and output HW handshake must be TRUE
	E-516: Input and output HW handshake must be TRUE
	E-816: Input and output HW handshake must be TRUE
	F-206: Input and output handshake settings must be FALSE
	M-850: Input and output handshake settings must be FALSE
Output	Baudrate out, Error out
Remarks	Opens COM port of given system with valid baudrates until status of "Error out" is false.

2.1.5.	**GCSTranslator DLL Functions.vi**

Valid for	C-843, C-844 (but must be present in Communication.llb for all other systems, too)
Input	System number (1), Function (C844_IsDLLAvailable), String buffer (empty string), String input (empty string), Error in (no error)
Output	DLL I32 Return value, Numerical output, Boolean output (T/F), String output, Error out
Remarks	This VI calls a given function from GCSTranslator.dll. GCSTranslator.dll must be installed. To call a system-specific function, the system-specific GCS DLL must be installed also.
	Warning: For "XXX_GcsGetANswer" , "String buffer" must be large enough, otherwise the application may crash. Call "XXX_GcsGetANswerSize" first to determine necessary string length.

2.1.6.	**Global1.vi**

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	None
Output	None
Remarks	A global variable which contains communication setup information.

2.1.7.	**PI Ask for Communication Parameters.vi**

|	
Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	None
Output	Number of systems, Cancel (T/F), Interface configuration, DLL interface configuration, Flow control
Remarks	A user-interface VI for setting up communications parameters (RS-232 or GPIB, number of systems, baudrate, timeout etc.).

2.1.8. PI Open Interface.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	Number of systems (1), Interface configuration (RS232, 5000, COM1, 57600), DLL Interface configuration (C-843, Board, 1), Flow control (All FALSE, x13, x11, x0)
Output	Error out
<mark>Remarks</mark>	Establishes communication with the connected systems, **must be called before any other VI can use the interface.** The interface and error statuses of all connected systems are cleared by this VI, which sends XXX (no command), *IDN? and ERR?.

C-843: Interface = DLL, DLL for Device = C-843, DLL Interface = Board, Parameter = Board number (1 for first C-843 board).

C-844: Interface = DLL, DLL for Device = C-844, DLL Interface = RS232 or GPIB, Parameter = empty string, RS232 baud rate = 9600

C-880: Interface = RS232 or GPIB, RS232: Input and output HW handshake must be TRUE.

E-516: Interface = RS232 or GPIB, RS232: Input and output HW handshake must be TRUE.

E-816: Interface = RS232 (supports only RS-232 communication), Input and output HW handshake must be TRUE.

F-206: Interface = RS232 or GPIB, The error status will not be cleared by this VI. The first ERR? query will report a hidden error with error code 1, which will be cleared during system initialization (INI). RS232: Input and output handshake settings must be FALSE.

M-850: Interface = RS232 or GPIB. The error status will not be cleared by this VI. The first ERR? query will report a hidden error with error code 1, which will be cleared during system initialization (INI). Firmware versions below Hex0030 do not support *IDN?. RS232: Input and output handshake settings must be FALSE.

2.1.9. PI Receive String.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	System number (1), Error in (no error)
Output	String read, Bytes read, Error out
Remarks	Read string from selected system.

2.1.10. PI ReceiveNCharacters RS232.vi

Valid for	C-880, E-516, E-816, F-206, M-850 (but must be present in Communication.llb for all other systems, too)
Input	System number (1), Bytes to read (1), Error in (no error)
Output	String read, Bytes read, Error out
Remarks	Sub-vi for "PI Receive String" for RS 232 communication

---

2.1.11. PI ReceiveString GPIB.vi

Valid for	C-880, E-516, F-206, M-850 (but must be present in Communication.llb for all other systems, too)
Input	System number (1), Error in (no error)
Output	String read, Bytes read, Error out
Remarks	Sub-vi for "PI Receive String" for GPIB communication.

2.1.12. PI Send String.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	System number (1), String to send (empty string), Attach linefeed? (T), Error in (no error)
Output	Error out
Remarks	Sends command with or without trailing linefeed to selected system.

2.2.   General Command VIs ("General command.llb"):

2.2.1.   *IDN?.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	System number (1), Error in (no error)
Output	Identification, Error out
Remarks	Returns system identification string.

2.2.2.   Define connected axes.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	System number (1), Read from controller?(F), Invert order?(F), Connected axes (empty string array), Error in (no error)
	C-843: Read from controller = TRUE, Invert order = FALSE
	C-844: Read from controller = TRUE, Invert order = FALSE
	C-880: Read from controller = TRUE, Invert order = TRUE
	E-516: Read from controller = TRUE, Invert order = FALSE
	E-816: Read from controller = TRUE, Invert order = FALSE
	F-206: Read from controller = FALSE, Invert order = FALSE, Connected axes = X,Y,Z,U,V,W (A,B,K,L,M optional)
	M-850: Read from controller = FALSE, Invert order = FALSE, Connected axes = X,Y,Z,U,V,W
Output	Connected axes out, Error out
Remarks	Writes connected axes into Global2.vi, **must be called before any other axis-specific command VI is called.**

2.2.3.   ERR?.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	System number (1), Error in (no error)
Output	Hidden error (T/F), Error out
Remarks	Returns error information. Hidden error is TRUE if selected system reports error code $\neq$ 0.

2.2.4.   Global2.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	Connected axes (empty string array)
Output	None
Remarks	A global variable which contains identifiers for all connected axes of all connected systems.

2.2.5.   MOV.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	System number (1), Axes to move (empty string array) (empty string array), Position values (empty num. array, 0), No. of digits (4), Error in (no error)
	E-816: Only one axis per command allowed. It is necessary to wait a certain time before sending the next command to prevent it from being lost.
	F-206: No mix between F-206 axes X,Y,Z,U,V,W and separate axes A,B allowed
Output	Error out
Remarks	Moves specified axes to specified absolute positions. "No. of digits" is the number of digits after the decimal point in the position value(s) that will be sent.

2.2.6.   MOV?.vi

Valid for	C-843, C-844, C-880, E-516, E-816
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)
	C-843: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	C-844: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	C-880: If "All axes" = TRUE, then "Axis identifier" can be FALSE
	E-516: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	E-816: "All axes" = FALSE, only one axis per command allowed. C-880: If "All axes" = TRUE, then "Axis identifier" can be FALSE
	F-206: Command has different implementation, please use MOV?_old.vi
	M-850: Command has different implementation, please use MOV?_old.vi
Output	Target position, Error out
Remarks	Returns commanded target position.

2.2.7.   MVR.vi

Valid for	C-843, C-844, C-880, E-516, E-816
Input	System number (1), Axes to move (empty string array), Position values (empty num. array, 0), No. of digits (4), Error in (no error)
	E-816: Only one axis per command allowed. It is necessary to wait a certain time before sending the next command to prevent it from being lost.
Output	Error out
Remarks	Moves specified axes **relative** to current position. "No. of digits" is the number of digits after the decimal point in the position value(s) that will be sent.

2.2.8.	ONT?.vi

Valid for	C-843, C-880, E-516, E-816
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)
	C-843: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	C-880: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	E-516: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	E-816: "All axes" = FALSE, only one axis per command allowed.
Output	Axis on target? (T/F), Error out
Remarks	Indicates whether or not queried axis is at target position.

2.2.9.	POS?.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)
	C-843: If "All axes" = TRUE, then "Axis identifier" can be FALSE
	C-844: If "All axes" = TRUE, then "Axis identifier" can be FALSE
	C-880: If "All axes" = TRUE, then "Axis identifier" can be FALSE
	E-516: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	E-816: "All axes" = FALSE, only one axis per command allowed.
	F-206: Position of F-206 platform: "All axes" = TRUE AND "Axis identifier" = FALSE; position of axes A,B,K,L or M: "All axes" must be FALSE; no mixing between {A,B} and {K,L,M} allowed in same query
	M-850: "All axes" = TRUE AND "Axis identifier" = FALSE
Output	Position, Error out
Remarks	Returns position information (actual or target position, depending on system).
	C-843: Returned position value is the actual position of the axis.
	C-844: Returned position value is the actual position of the axis.
	C-880: Returned position value is the actual position of the axis.
	E-516: Returned position value is the actual position of the axis.
	E-816: Returned position value is the actual position of the axis.
	F-206: Returned position value is the commanded target position of the axis.
	M-850: Returned position value is the commanded target position of the axis.

2.2.10. SAI?.vi

Valid for	C-843, C-844, C-880, E-516, E-816
Input	System number (1), Invert order? (F), Error in (no error)
	C-843: Invert order should be FALSE
	C-844: Invert order should be FALSE
	C-880: Invert order should be TRUE
	E-516: Invert order should be FALSE
	E-816: Invert order should be FALSE
Output	Connected axes, Error out
Remarks	Returns axis identifiers of all connected axes and writes them into Global2.vi.

2.2.11. SPA.vi

Valid for	C-843, C-844, C-880, E-516, E-816
Input	System number (1), Axis to set (empty string array), Parameter value (empty num. array, 0), No. of digits (4), Parameter number (empty num. array, 0), Error in (no error)
	E-816: Only one parameter value for only one axis per command allowed.
Output	Hidden error (T/F), Error out
Remarks	Sets parameters for commanded axes, waits 100 ms and queries ERR?. See system manual for available parameter numbers and values. "No. of digits" is the number of digits after the decimal point in the parameter value(s) that will be sent. Hidden error is TRUE if selected system reports error code ≠ 0.
	E-816: This command cannot be issued to a slave.

2.2.12. SPA?.vi

Valid for	C-843, C-844, C-880, E-516, E-816
Input	System number (1), Axes to query (empty string array), Parameter numbers (empty num. array, 0), Error in (no error)
	E-816: Only one parameter value for only one axis per command allowed.
Output	Parameter value, Error out
Remarks	Returns parameter values for queried axes and parameter numbers. See system manual for available parameter numbers.
	E-816: This command cannot be issued to a slave.

2.2.13. SVO.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206
Input	System number (1), Without axis ID?(F), Axes to command (empty string array), Servo mode (empty bool. array, F), Error in (no error)
	C-843: Without axis ID = FALSE
	C-844: Without axis ID = FALSE
	C-880: Without axis ID = FALSE
	E-516: Without axis ID = FALSE
	E-816: Without axis ID = FALSE. Only one axis per command allowed.
	F-206: Without axis ID = TRUE, only first field of "Servo mode" array is valid
Output	Error out
Remarks	Sets servo-control mode for given axes. If "Without axis ID" is TRUE, then "Axes to command" is ignored and first field of "Soft limit mode" array is used.

2.2.14. SVO?.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)
	C-843: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	C-844: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	C-880: If "All axes" = TRUE, then "Axis identifier" can be FALSE
	E-516: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	E-816: "All axes" = FALSE, only one axis per command allowed.
	F-206: "All axes" = TRUE, "Axis identifier" = FALSE
Output	Servo status (T/F), Error out
	F-206: Only first field of servo status array is valid
	M-850: Only first field of servo status array is valid
Remarks	Returns servo status of queried axes.

2.3.   PZT specific VIs (PZT voltage.llb)

2.3.1.   OVF?.vi

Valid for	E-516, E-816
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)
	E-516: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	E-816: "All axes" = FALSE, only one axis per command allowed.
Output	Axis overflow? (T/F), Error out
Remarks	Returns overflow information for queried axes.

2.3.2.   SVA.vi

Valid for	E-516, E-816
Input	System number (1), Axes to move (empty string array), PZT voltage (empty num. array, 0), No. of digits (4), Error in (no error)
	E-816: Only one axis per command allowed. It is necessary to wait a certain time before sending the next command to prevent it from being lost.
Output	Error out
Remarks	Sets absolute PZT voltage for specified axes. "No. of digits" is the number of digits after the decimal point in the voltage value(s) that will be sent.

2.3.3.   SVA?.vi

Valid for	E-516, E-816
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)
	E-516: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	E-816: "All axes" = FALSE, only one axis per command allowed.
Output	Commanded PZT voltage, Error out
Remarks	Returns commanded PZT voltage for queried axes.

2.3.4.   SVR.vi

Valid for	E-516, E-816
Input	System number (1), Axes to move (empty string array), PZT voltage (empty num. array, 0), No. of digits (4), Error in (no error)
	E-816: Only one axis per command allowed. It is necessary to wait a certain time before sending the next command to prevent it from being lost.
Output	Error out
Remarks	Sets relative PZT voltage for specified axes. "No. of digits" is the number of digits after the decimal point in the voltage value(s) that will be sent.

2.3.5.   VOL?.vi

Valid for	E-516, E-816
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)
	E-516: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	E-816: "All axes" = FALSE, only one axis per command allowed.
Output	Current PZT voltage, Error out
Remarks	Returns current PZT voltage for queried axes.

2.4.   Special commands (Special commands.llb)

2.4.1. AVG.vi	
Valid for	C-880, E-516, E-816
Input	System number (1), Averaging time (1), Error in (no error)
	E-816: Averaging time can be 1, 2, 4, 8, 16, 32 or 64
Output	Error out, Hidden error
Remarks	Sets averaging time to use for measurements. "Hidden error" is TRUE if selected system reports error code ≠ 0.
	E-816: This command cannot be issued to a slave

2.4.2. AVG?.vi	
Valid for	C-880, E-516, E-816
Input	System number (1), Error in (no error)
Output	Averaging time, Error out
Remarks	Returns current measurement-averaging-time setting.
	E-816: This command cannot be issued to a slave

2.4.3. I2C?.vi	
Valid for	E-816
Input	System number (1), Error in (no error)
Output	I²C status message, Error out
Remarks	Returns the status message of the I²C bus.
	E-816: Status message consists of status bit and channel ID.

2.4.4. RST.vi	
Valid for	C-880, E-816
Input	System number (1), Axes to be restored (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)
	C-880: If "All axes" = TRUE, then "Axis identifier" must be TRUE
	E-816: "All axes" = TRUE, "Axis identifier" = FALSE; this command affects the master unit only.
Output	Error out
Remarks	Restores parameters or resets E-816 master unit.
	C-880: Restores parameters of any of the specified axes which have been modified using SPA command to values from last SAV.
	E-816: Resets the master unit.

2.4.5.   SCH.vi

Valid for	E-816
Input	System number (1), Axis name (empty string), Error in (no error)
Output	Error out
Remarks	Set axis (channel) name. See system manual for further description. Run "Define connected axes.vi" after renaming axes.
	E-816: This command cannot be issued to a slave E-816. Changes must be written to non-volatile memory with WPA.vi. and do not take effect before the next power on or RST.

2.4.6.   SCH?.vi

Valid for	E-816
Input	System number (1), Error in (no error)
Output	Axis name, Error out
Remarks	Returns the axis (channel) name of the master unit.

2.4.7.   SSN?.vi

Valid for	C-880, E-816
Input	System number (1), With channel ID (F), Channel name (empty string), Error in (no error)
	C-880: With channel ID = FALSE
	E-816: With channel ID = TRUE
Output	Serial number, Error out
Remarks	Returns controller serial number.

2.4.8.   WPA

Valid for	C-880, E-516, E-816
Input	System number (1), Password (100), Error in (no error)
Output	Error out, Hidden error
Remarks	If password is correct, this VI writes current parameter settings to non-volatile memory of the controller, waits 3000 ms and queries ERR?. "Hidden error" is TRUE if selected system reports error code ≠ 0.

2.5.   Wave-Generator-Specific Commands (WaveGenerator.llb)

2.5.1. SWT.vi	
Valid for	E-816
Input	System number (1), Axis (empty string), No. of digits (3), Max. n values (64), $A_0,...,A_{n-1}$ (0.001, 0.002,..., 0.01), Error in (no error)
	E-816: "Max. n values" = 64
Output	Successful? (T/F), Error out
Remarks	This vi defines a waveform for one axis. Data points are transferred point by point. "Max. n values" is the maximum number of points that can be transferred. "No. of digits" is the number of digits after the decimal point in the data point value(s) that will be sent. Please refer to the system manual for units and restrictions.

2.5.2. WTO.vi	
Valid for	E-816
Input	System number (1), Axis to command (empty string), No. of output points (0), Error in (no error)
Output	Error out
Remarks	Sets the wave table output. If "No. of output points" = 0, wave table output is disabled, otherwise "No. of output points" will be sent to the given axis. "No. of output points" must be less than or equal to 64.

2.6.   Support VIs

Support VIs are sub-VIs for command VIs which make certain programming tasks more convenient. They can also be used for building main programs.

Caution: Please do not change these VIs, as that might cause the command VIs that use them to fail.

2.6.1.   Analyse input string for terminal.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	String new (empty string), Last string sent (empty string)
Output	String out, Out not equal to in? (T/F)
Remarks	This VI is a sub-VI for "PI Terminal.vi". It analyses "String new" and returns it in "String out" if it is not empty and does not contain a "#" at the beginning. In case of an empty new string, "Last string sent" is returned. If "String new" contains a "#" character, the corresponding ASCII character is returned.

2.6.2.   Assign booleans from string to axes.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	System number (1), Queried axes (empty string array), All axes queried? (F), Input string (empty string), Error in (no error)
Output	Booleans(T/F), Error out
Remarks	This VI assigns numerical values from input string to boolean values for queried axes. If "All axes" is TRUE, connected axes are read from Global2.vi and displayed on the front panel for assignment.
	Example: An input string like "A=0SpaceLinefeedB=1Linefeed" or "0SpaceLinefeed1Linefeed" will be converted to an output array consisting of two values "FALSE; TRUE".

2.6.3.   Assign SPA values from string to axes.vi

Valid for	C-843, C-844, C-880, E-516, E-816
Input	Input string (empty string), Queried axes (empty string array), Parameter number (empty num. array, 0), Error in (no error)
Output	Values, Error out
Remarks	This VI assigns numerical values from input string to queried axes and parameter numbers. Sub-VI for SPA?.

2.6.4.   Assign values from string to axes.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	System number (1), Queried axes (empty string array), All axes queried? (F), Input string (empty string), Error in (no error)
Output	Values, Strings, Error out
Remarks	This VI assigns numerical values and/or single lines from input string to queried axes. If "All axes" is TRUE, connected axes are read from Global2.vi and displayed on the front panel for assignment.

2.6.5.	**Build command substring.vi**

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	Affected axes (empty string array), No. of digits (4), Parameters (empty num. array, 0)
Output	Command substring
Remarks	This VI builds a command substring by combining axis identifier and parameter. "No. of digits" is the number of digits after the decimal point in the parameter value(s) that will be sent.
	Example: For "Affected axes" = A; B, "Parameters" = 1.2342; 2.3 and "No. of digits" = 3 the resulting string is "SpaceA1.234SpaceB2.300".

2.6.6.	**Build query command substring.vi**

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	System number (1), Axes to query in (empty string array), Query all axes? (F), Axis identifer? (T),
Output	Command substring, Axes to query out, Number of rows
Remarks	This VI builds a query command substring. If "All axes" is TRUE, connected axes are read from Global2.vi and returned in "Axes to query out", otherwise "Axes to query out" is identical with "Axes to query in". Number of rows is size of the "Axes to query out" array. If "Axis identifier" is FALSE, command substring is an empty string (e.c. for systems which accept commands like POS? without axis IDs).
	Example: If axes A;B;C;D are connected to the system to command, "Axes to query in" is A;B;D, "Query all axes?" is TRUE and "Use Axis identifier" is TRUE, resulting "Command substring" is "ABCD", "Number of rows" is 4 and "Axes to query out" is A;B;C;D.

2.6.7.	**Build SPA command substring.vi**

Valid for	C-843, C-844, C-880, E-516, E-816
Input	Axes to set (empty string array), No. of digits (4), Parameter number (empty num. array, 0), Parameter values (empty num. array, 0)
Output	SPA command substring
Remarks	This VI builds a command substring for the SPA command. "No. of digits" is the number of digits after the decimal point in the parameter value(s) that will be sent. Sub-VI for SPA.

2.6.8.	**Build SPA query command substring.vi**

Valid for	C-843, C-844, C-880, E-516, E-816
Input	Axes to query (empty string array), Parameter number (empty num. array, 0)
Output	Command substring, Number of rows
Remarks	This VI builds an SPA? command substring. Axes and parameters are combined into a substring. Number of rows is size of Axes to query array. Sub-VI for SPA?.

2.6.9. Commanded axes connected?.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	System number (1), Commanded axes (empty string array), Error in (no error)
Output	Hidden error (T/F), Error out
Remarks	This VI checks if "commanded axes" are a subset of all connected axes (read from Global2.vi) and returns "Hidden error" TRUE if this is not the case. Connected axes are defined by "Define connected axes.vi".

2.6.10. Define axes to command from boolean array.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	Axes to query (empty string array), Command axis? (empty bool. array, F)
Output	Axes to command
Remarks	This VI returns only those axis IDs from the "Axes to query" array which have a boolean value TRUE in the "Command axis?" array.

2.6.11. Get lines and values from string.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	Array size (0), Input string (empty string)
Output	Numerical values, Strings
Remarks	This VI returns numerical values and single lines from input string without any axis assignment. If number of lines/values ("Array size") is known, algorithm is faster, otherwise "Array size" = 0 should be used. Sub-VI for VST?.vi and STE?.vi.

2.6.12. How often does string contain regular expression.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	Regular expression (empty string), String (empty string)
Output	Number
Remarks	This VI returns a count of the occurances of a regular expression in a string.

2.6.13. Return single characters from string.vi

Valid for	C-843, C-844, C-880, F-206, E-516, E-816, M-850
Input	Input string (empty string), Invert order (F), Error in (no error)
Output	Character array (empty string array), Error out
Remarks	Get single characters from input string.

2.6.14.   Split num query command.vi

Valid for	E-816
Input	System number (1), Query command (0: POS?), Axes to query (empty string array), Error in (no error)
Output	Values, Error out
Remarks	Splits numerical query command with more than one axis specification into the corresponding one-axis commands and returns answers for all given axes. Supported commands are POS?, MOV?, VOL?, SVA? (more commands can be added).

2.6.15.   Substract axes array subset from axes array.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	Axes to query (empty string array), Axes subset (empty string array)
Output	Axes to command
Remarks	This VI returns only these axes IDs from the "Axes to query" array which are **not** present in the "Axes subset" array.

2.6.16.   Unbundle/bundle interface clusters for PI Terminal.vi

Valid for	C-843, C-844, C-880, E-516, E-816, F-206, M-850
Input	System number (1), Interface configuration (RS232, 1000, COM1, 57600), DLL interface configuration (C-843, Board, 1), Flow control (All FALSE, x13, x11, x0)
Output	Interface, RS232 configuration system, GPIB configuration system, DLL for device, DLL interface
Remarks	This VI is a sub-VI for "PI Terminal.vi". It unbundles "Interface configuration" and "DLL interface configuration" and returns the cluster contents in a different composition which is used by "PI Terminal.vi".

3. High Level VIs

3.1. Terminal.vi

The terminal VI is a stand-alone application. It first asks the user to specify the full configuration (number of controlled systems, RS-232 or GPIB, communications parameters), then it establishes a connection with a selected system. This will work for all PI devices which support the PI General Command Set, or at least follow the same syntax rules and support the *IDN? and ERR? commands.

If the chosen timeout value is greater than 300 ms, it will automatically be set to 300 ms for a fluid program operation.
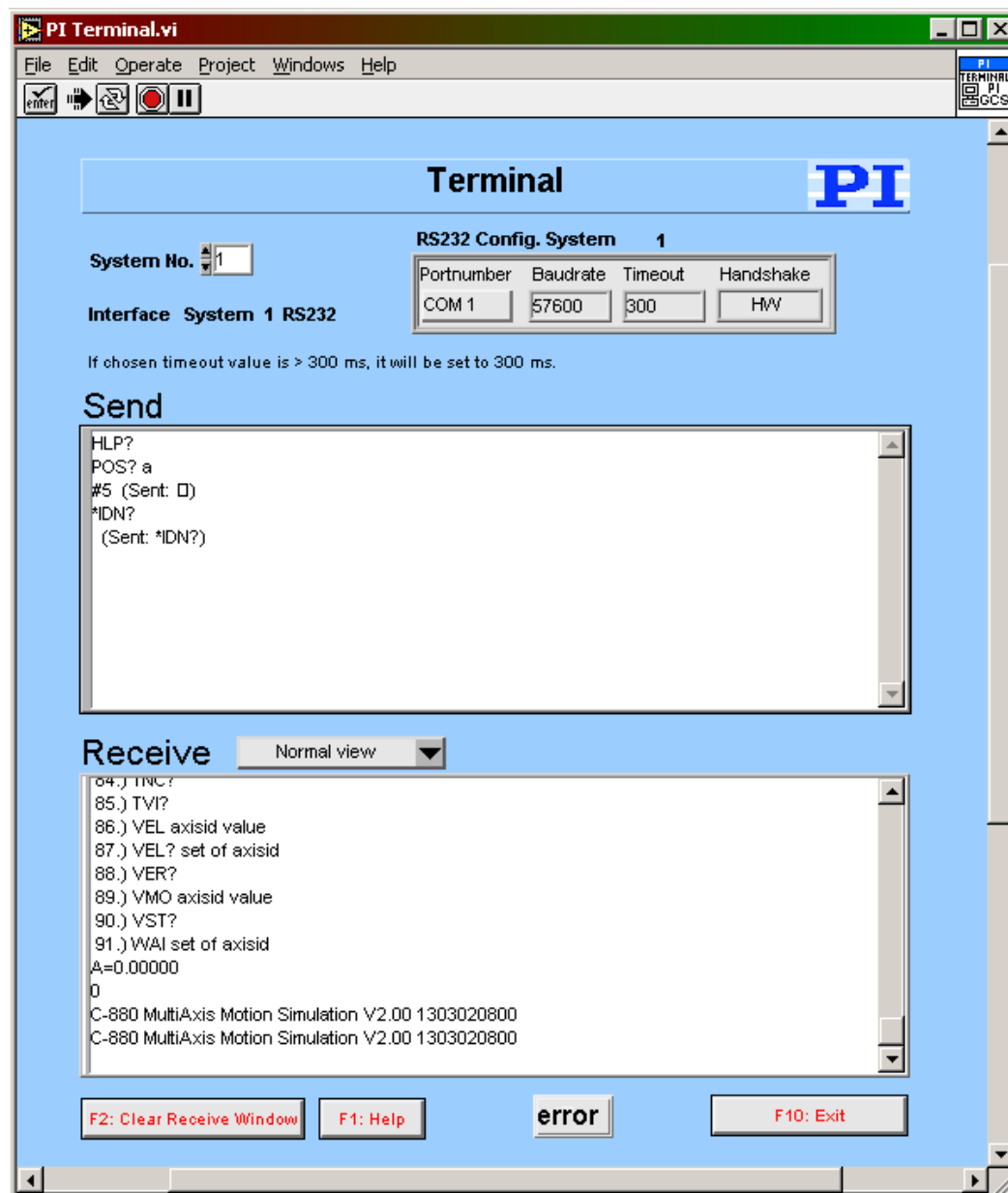
In the upper window ("Send") the user can enter commands which will be transmitted to the chosen device one line at a time when the ENTER key is pressed.

All controller responses are displayed in the "Receive" response window, which can be cleared by pressing the "Clear Receive Window" button or F2.

The view style of the "Receive" window can be changed to "Show all characters" or "Hex View" using the menu ring above the "Receive" window.

"Exit" or F10 will terminate the terminal application.

To send the last command again, just press the ENTER key again. The next line will then show the following entry: "(Send: *cmd*)" with *cmd* being the command from the line before, which was resent.

When the terminal application has just been started, pressing ENTER without entering a command will send "*IDN?" to the chosen system.

New commands can only be inserted into the last line of the "Send" window. The user can scroll through the history of the "Send" window using the scroll bar or the cursor up/down keys, but cannot change the history or resend commands by pressing ENTER unless in the last line. Pressing ENTER will always resend the last command, no matter where the cursor is positioned. Selecting text and using copy and paste (Ctrl+C, Ctrl+V) works for single lines, if only the contents of one single line (the command text) is selected and copied, not the full line (including the LineFeed) or multiple lines.

Many of PI's General Command Set compatible devices support single-byte commands. For example, the user can stop a fast scan of a C-880 or F-206 by sending an ASCII 24 (decimal). To enter this command into the "Send" window simply type a "#" followed by the decimal value of the byte to be sent, e.g. enter "#24" and presses ENTER to stop a fast scan. An entry "(Send: *)" will be added to the original command with * being the corresponding ASCII character of the single byte sent.

Pressing F1 or the "Help" button will pop up a help window. To return to the terminal application, press Esc.

3.2.   E816_Simple_Test.vi

This simple test VI is a stand-alone sample application. It first opens the chosen RS-232 port with the given baudrate, or determines the valid baudrate itself, and establishes a connection with the selected E-816 system. It queries for connected axes, position values of these axes, and the master E-816 identification string. The diagram shows how to combine the driver and support VIs for these tasks.
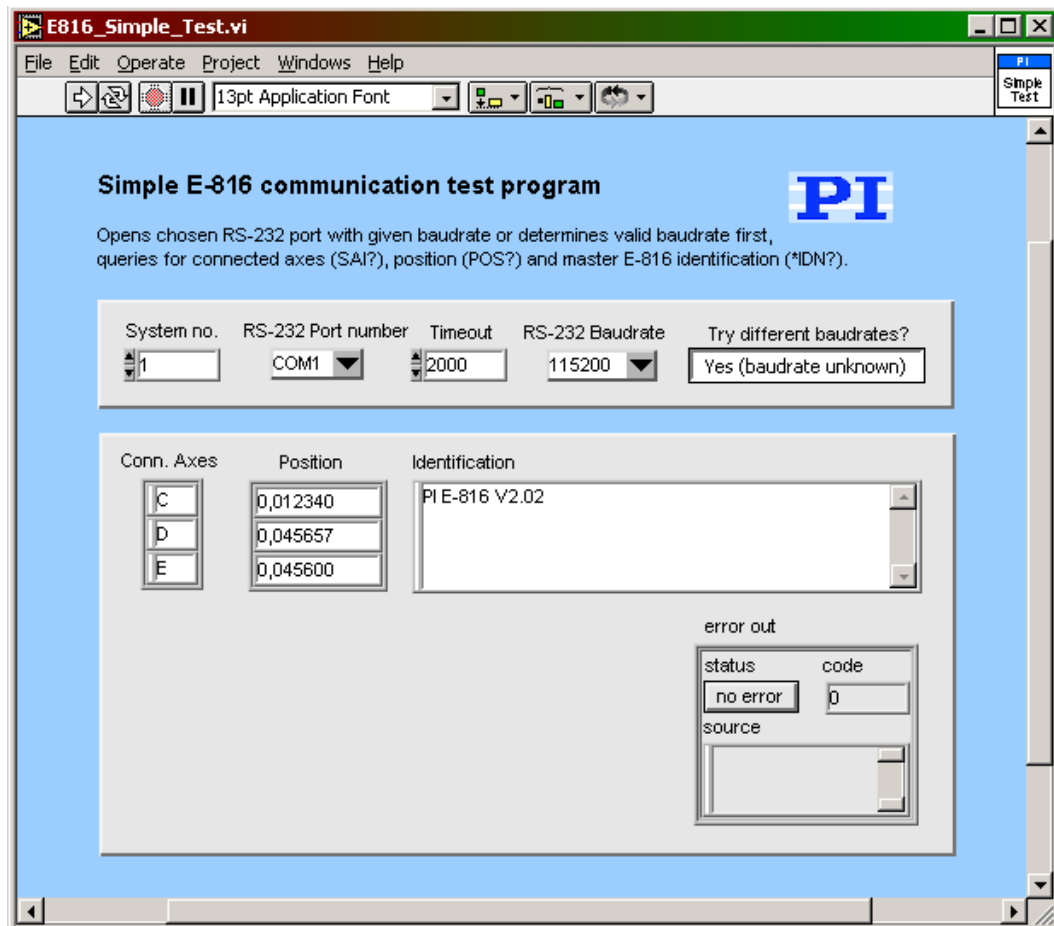
4.   PI Systems Currently Supported by This Driver Set

Product	works with LabVIEW driver version	if product firmware version is equal to or newer than
C-843	2.0 .. 2.01	MC-DLL 1.0.2.2
C-844	2.0 .. 2.01	4.4
C-880	1.1 1.2 .. 2.01	2.00 2.01
E-516	1.0 .. 2.01	DSP V3.01, MCU V5
E-816	2.01	2.02
F-206	1.1 .. 2.01	Fhx0035
M-840	1.1 .. 2.01	Hex0037
M-850	1.1 .. 2.01	Hex0030

5.   Index

V

W

End of document