Piezo · Nano · Positioning

SM151E Software Manual

Windows GCS 2.0 DLL (PI_GCS2_DLL)

Release: 2.5.0 Date: 2016-02-26

Auf der Römerstr. 1 · 76228 Karlsruhe, Germany
Tel. +49-721-4846-0 · Fax: +49-721-4846-1019
info@pi.ws · www.pi.ws

Document Number SM151E, BRo, Release 2.5.0
PIGCS_2_0_DLL_SM151E.doc

Table of Contents

1. Introduction

The PI GCS2_library allows controlling one or more PI controllers connected to a host PC. The PI General Command Set (GCS) is the PI standard command set and ensures the compatibility between different PI controllers.

The library is available for the following operating systems:

- **Windows** Vista Service Pack 1 (32 bit, 64 bit),Windows 7 (32 bit, 64 bit), Windows 8 (32 bit, 64 bit) and Windows 10 (32 bit, 64 bit): PI GCS2 DLL
  See Section 3.2 starting on p. 6 for more information about PI DLLs.
- **Linux** operating systems (kernel 2.6, GTK 2.0, glibc 2.4): libpi_pi_gcs2.so.*x.x.x* and libpi_pi_gcs2-*x.x.x*.a where *x.x.x* gives the version of the library

NOTES

This manual was originally written for the Windows version of the GCS library (DLL), and so the terminology used in this document is that common with Windows DLLs. Nevertheless this manual can also be used for the Linux versions of the GCS library because there is no difference in the functionality of the library functions between the individual operating systems.

See Section 3 starting on p. 6 for more information about PI DLLs.

There are various sample programs for different programming languages to be found in the \Sample directory of the CD of your controller.

2. Software Installation

To install the PI GCS 2 DLL on your host PC, follow the installation instructions for the PC software in the user manual of the controller or install the feature "PI_Programming_Files_PI_GCS2_DLL_Setup.exe" located in the "SingleSetups" folder of the product CD. Afterwards, the required files will be located in C:\Users\Public\PI\PI_Programming_Files_ PI_GCS2_DLL.

Copy these files to the location where the source code of your application is built (.h. and .lib) and where the application is executed (.dll).

With some controllers, you can select a parameter set appropriate for your stage from a stage database, see PI_CST() (p. 34) and "Functions for User-Defined Stages" (p. 120).

NOTE

Stage database files (PIStages2.dat and PIMicosStages2.dat) are installed in the ...\PI\GcsTranslator directory. In that directory, also the PI_UserStages2.dat database will be located which is created automatically the first time the PI_qVST() or PI_CST() functions of the PI GCS2 DLL are used.

The location of the PI directory is that specified upon installation, usually in C:\ProgramData. If this directory does not exist, the EXE file that needs the stage databases will look in its own directory. Note that in PIMikroMove, you can use the *Version Info* item in the controller menu or the *Search for controller software* item in the *Connections* menu to identify the GCSTranslator path.

PI is constantly improving the PC software. Always install the latest version of the PC software and the standard stage databases. Follow the update instructions for the PC software in the user manual of the controller. With Windows operating systems, use the PI Update Finder.

3. General Information About PI DLLs

The information below is valid for the DLL described in this manual as well as for the DLLs for many other PI products.

3.1. Threads

This DLL is not thread-safe. The function calls of the DLL are not synchronized and can be safely used only by one thread at a time.

3.2. DLL Handling

To get access to and use the DLL functions, the library must be included in your software project. There are a number of techniques supported by the Windows operating system and supplied by the different development systems. The following sections describe the methods which are most commonly used. For detailed information, consult the relevant documentation of the development environment being used. (It is possible to use the PI_GCS2_DLL.DLL in Delphi projects. Please see http://www.drbob42.com/delphi/headconv.htm for a detailed description of the steps necessary.)

3.2.1. Using a Static Import Library

The PI_GCS2_DLL.DLL module is accompanied by the PI_GCS2_DLL.LIB file. This is the static import library which can be used by the Microsoft Visual C++ system for 32-bit applications. In addition, other systems, like the National Instruments LabWindows CVI or Watcom C++ can handle, i.e. understand, the binary format of a VC++ static library. When the static library is used, the programmer must:

Use a header or source file in which the DLL functions are declared, as needed for the compiler. The declaration should take into account that these functions come from a "C-Language" Interface. When building a C++ program, the functions have to be declared with the attribute specifying that they are coming from a C environment. The VC++ compiler needs an extern "C" modifier. The declaration must also specify that these functions are to be called like standard Win-API functions. That means the VC++ compiler needs to see a WINAPI or __stdcall modifier in the declaration.
Add the static import library to the program project. This is needed by the linker and tells it that the functions are located in a DLL and that they are to be linked dynamically during program startup.

3.2.2. Using a Module Definition File

The module definition file is a standard element/resource of a 16- or 32-bit Windows application. Most IDEs (integrated development environments) support the use of module definition files. Besides specification of the module type and other parameters like stack size, function imports from DLLs can be declared. In some cases the IDE supports static import libraries. If that is the case, the IDE might not support the ability to declare DLL-imported functions in the module definition file. When a module definition file is used, the programmer must:

Use a header or source file where the DLL functions have to be declared, which is needed for the compiler. In the declaration should be taken into account that these function come from a "C-Language" Interface. When building a C++ program, the functions have to be declared with the attribute that they are coming from a C environment. The VC++ compiler needs an extern "C" modifier. The declaration also must be aware that these functions have to be called like standard Win-API functions. Therefore the VC++ compiler needs a WINAPI or __stdcall modifier in the declaration.
Modify the module definition file with an IMPORTS section. In this section, all functions used in the program must be named. Follow the syntax of the IMPORTS statement. Example:

```
IMPORTS
  PI_GCS2_DLL.PI_IsConnected
```

3.2.3. Using Windows API Functions

If the library is not to be loaded during program startup, it can sometimes be loaded during program execution using Windows API functions. The entry point for each desired function has to be obtained. The DLL linking/loading with API functions during program execution can always be done,

independent of the development system or files which have to be added to the project. When the DLL is loaded dynamically during program execution, the programmer has to:

Use a header or source file in which local or global pointers of a type appropriate for pointing to a function entry point are defined. This type could be defined in a typedef expression. In the following example, the type FP_PI_IsConnected is defined as a pointer to a function which has an int as argument and returns a BOOL value. Afterwards a variable of that type is defined.

```
typedef BOOL (WINAPI *FP_PI_IsConnected)( int );
FP_PI_IsConnected pPI_IsConnected;
```

Call the Win32-API LoadLibrary()function. The DLL must be loaded into the process address space of the application before access to the library functions is possible. This is why the LoadLibrary() function has to be called. The instance handle obtained has to be saved for use by the GetProcAddress() function. Example:

```
HINSTANCE hPI_Dll = LoadLibrary("PI_GCS2_DLL.DLL\0");
```

Call the Win32-API GetProcAddress()function for each desired DLL function. To call a library function, the entry point in the loaded module must be known. This address can be assigned to the appropriate function pointer using the GetProcAddress() function. Afterwards the pointer can be used to call the function. Example:

```
pPI_IsConnected  = (FP_PI_IsConnected)GetProcAddress(hPI_Dll,"PI_IsConnected\0");
if (pPI_IsConnected == NULL)
{
   // do something, for example
   return FALSE;
}
BOOL bResult = (*pPI_IsConnected)(1); // call PI_IsConnected(1)
```

3.3. Function Calls

The first argument to most function calls is the ID of the selected controller.

3.3.1. Error Return

Almost all functions will return a boolean value of type BOOL (see “Boolean Values” (p. 8)). The result will be zero if the DLL finds errors in the command or cannot transmit it successfully, or if the DLL internal error status is non-zero for another reason. If the command is acceptable and transmission is successful, and if the library has controller error checking enabled (see **PI_SetErrorCheck**()), the return value will further reflect the error status of the controller immediately after the command was sent. **TRUE** indicates no error. To find out what went wrong when the call returns **FALSE**, call **PI_GetError**() to obtain the error code, and, if desired, translate it to the corresponding error message with **PI_TranslateError**(). The error codes and messages are listed in “Error Codes” (p. 123).

3.3.2. Axis Identifiers

Many commands accept one ore more axis identifiers. If no axes are specified (either by giving an empty string or a **NULL** pointer) some commands will address all connected axes. Axes names are separated by a space “ “.

3.3.3. Axis Parameters

Parameters for specified axes are stored in an array passed to the function. The parameter for the first axis is stored in array[0], for the second axis in array[1], and so on. So, if you call PI_qPOS("1 2 n3", double pos[3]), the position for '1' is in pos[0], for '2' in pos[1] and for '3' in pos[2]. If you call PI_MOV("1 3", double pos[2]) the target position for '1' is in pos[0] and for '3' in pos[1].

If conflicting specifications are present, only the **last** occurrence is actually sent to the controller with its argument(s). Thus, if you call PI_MOV("1 1 2", pos[3]) with pos[3] = { 1.0, 2.0, 3.0 }, '1' will move to 2.0 and '2' to 3.0. If you then call PI_qPOS("1 1 2", pos[3]), pos[0] and pos[1] will contain 2.0 as the position of '1'.

3.4. Types Used in PI Software

3.4.1. Boolean Values

The library uses the convention used in Microsoft's C++ for boolean values. If your compiler does not support this directly, it can be easily set up: Just add the following lines to a central header file of your project:

```
typedef int BOOL;
#define TRUE 1
#define FALSE 0
```

3.4.2. NULL Pointers

In the library and the documentation "null pointers" (pointers pointing nowhere) have the value **NULL**. This is defined in the windows environment. If your compiler does not know this, simply use:

```
#define NULL 0
```

3.4.3. C-Strings

The library uses the C convention to handle strings. Strings are stored as char arrays with '\0' as terminating delimiter. Thus, the "type" of a c-string is char*. Do not forget to provide enough memory for the final '\0'. If you declare:

```
char* text = "HELLO";
```

it will occupy 6 bytes in memory. To remind you of the zero at the end, the names of the corresponding variables start with "sz".

4. Communication Functions

4.1. Usage and Overview

To use the DLL and communicate with the controller, the DLL must be initialized with one of the "connect" functions:

- PI_InterfaceSetupDlg()
- PI_ConnectNIgpib()
- PI_ConnectRS232()
- PI_ConnectDaisyChainDevice()
- PI_ConnectTCPIP()
- PI_ConnectTCPIPbyDescription()
- PI_ConnectUSB()
- PI_ConnectUSBWithBaudRate().

To allow the handling of multiple controllers, the open functions return a non-negative ID. This is a kind of index to an internal array storing the information for the (different) controllers. All other calls addressing the same controller have this ID as their first parameter. PI_CloseConnection() (p.31) will close the connection to the specified controller and free its system resources.

Daisy Chain

Note that before connecting a daisy chain device using the PI_ConnectDaisyChainDevice() function, the daisy chain port has to be opened using the PI_OpenRS232DaisyChain() or the PI_OpenUSBDaisyChain function, whichever is the appropriate one.

After the daisy chain port has been opened all controllers connected to this daisy chain port can be "opened" using PI_ConnectDaisyChainDevice(). A connection to a daisy chain device is closed using the PI_CloseConnection() function. To close the daisy chain port the PI_CloseDaisyChain() function has to be called.

For controllers whose address can be set with DIP switches: In a daisy-chain, connected via USB or via RS-232, there must be one controller with address 1. It is not required that this controller is directly connected to the host PC, i.e. this controller does not have to be the first controller of the daisy-chain. If there is no controller in a daisy-chain with address 1 an error message occurs when you try to setup a connection. All controllers in a daisy chain must be set to the same baud rate.

TCP/IP

Before connecting a device using the PI_ConnectTCPIPbyDescription() function, its description string should be queried by PI_EnumerateTCPIPDevices().

USB

Before connecting a device using the PI_ConnectUSB() function, its description string should be queried by PI_EnumerateUSB().

USB and Virtual COM Ports

The USB driver for some PI devices consists of two layers: The basic USB layer and a virtual COM port. The COM port is offered for convenience. There are legacy applications which can communicate with RS-232 to additional hardware (e.g. microscopy application where you can store command sequences that can be sent over RS-232). These applications can use the PI device with Windows's built in RS-232 support using the virtual COM port – even if the hardware connection is USB.

If you have more than one device connected to the PC, the COM port assignment is randomly chosen by the operating system. E.g. on one PC two devices may be available as COM3 and COM4, while they may be available as COM4 and COM7 on a another PC.

If you use the USB driver directly (i.e. the basic USB layer) you can connect to the device using its serial number.

The PI_GCS2_DLL supports both ways: Use either PI_ConnectRS232() with the number of the virtual COM port (baud rate doesn't matter, use 115200), or use PI_ConnectUSB() with the serial number of the device. You can also call PI_EnumerateUSB () to get a list of all connected PI devices and select the device from the list.

List of Communications Functions

Function	Short Description	Page
BOOL **PI_CancelConnect** (int threadI)	Cancel connecting thread with given ID	11
void **PI_CloseConnection** (int ID)	Close connection to the controller	11
void **PI_CloseDaisyChain** (int iPortId)	Close connection to the daisy chain port	11
int **PI_ConnectDaisyChainDevice** (int iPortId, int iDeviceNumber)	Open a daisy chain device	12
int **PI_ConnectNIgpib** (int iChannelNr, int iDeviceAddress)	Open a connection from a National Instruments IEEE 488 board to the controller	12
int **PI_ConnectRS232** (int iPortNumber, int iBaudRate)	Open an RS-232 ("COM") interface to a controller	12
int **PI_ConnectRS232ByDevName** (const char* szDevName, int BaudRate)	Open an RS-232 interface to a controller for Linux	12
int **PI_ConnectTCPIP** (const char* szHostname, int port)	Open a TCP/IP connection to the controller	12
int **PI_ConnectTCPIPbyDescription** (const char* szDescription)	Open a TCP/IP connection to the controller using one of the identification strings listed by PI_ EnumerateTCPIPDevices()	13
int **PI_ConnectUSB** (const char* szDescription)	Open an USB connection to a controller using one of the identification strings listed by PI_ EnumerateUSB()	13
int **PI_ConnectUSBWithBaudRate** (const char* szDescription,int iBaudRate)	Open an USB connection to a controller using one of the identification strings listed by PI_ EnumerateUSB()	13
int **PI_EnableTCPIPScan** (int iMask)	Selects the network hardware type (e.g. Lantronix XPort or other Ethernet device) which is to be found by PI_EnumerateTCPIPDevices()	13
int **PI_EnumerateTCPIPDevices** (char* szBuffer, int iBufferSize, const char* szFilter)	Lists the identification strings of all controllers available in the network via TCP/IP	13
int **PI_EnumerateUSB** (char* szBuffer, int iBufferSize, const char* szFilter)	Lists the identification strings of all controllers available via USB interfaces	14
int **PI_GetControllerID** (int threadID)	Get ID of connected controller for given threadID	14
int **PI_GetError** (int ID)	Get error status of the DLL and, if clear, that of the controller	14
int **PI_InterfaceSetupDlg** (const char* szRegKeyName)	Open dialog to let user select the interface and create a new PI object	14

Function	Short Description	Page
BOOL **PI_IsConnected** (int ID)	Check if there is a controller with an ID of *ID*	14
BOOL **PI_IsConnecting** (int threadID, BOOL* bCOnnecting)	Check if thread with given ID is running trying to establish communication	15
int **PI_OpenRS232DaisyChain**(int iPortNumber, int iBaudRate, int* piNumberOfConnectedDaisyChainDevices, char* szDeviceIDNs, int iBufferSize)	Open a RS-232 ("COM") interface to a daisy chain and set the baud rate of the daisy chain master	15
int **PI_OpenUSBDaisyChain** (const char* szDescription, int* pNumberOfConnectedDaisyChainDevices, char* szDeviceIDNs, int iBufferSize)	Open a USB interface to a daisy chain	15
BOOL **PI_SetErrorCheck** (int ID, BOOL bErrorCheck)	Set error-check mode of the library	15
BOOL **PI_TranslateError** (int iErrorNumber, char* szErrorMessage, int iBufferSize)	Translate error number to error message	16
int **PI_TryConnectRS232** (int port, int baudrate)	Starts background thread which tries to establish connection to controller with given RS-232 settings	16
int **PI_TryConnectUSB** (const char* szDescription)	Starts background thread which tries to establish connection to controller with given USB settings	16

4.2. Function Description

BOOL **PI_CancelConnect** (int *threadI*)

Cancel connecting thread with given thread ID

Arguments:

Thread ID

Returns:

TRUE if thread was cancelled, **FALSE** if no thread with given ID was running

void **PI_CloseConnection** (int *ID*)

Close connection to the controller associated with *ID*. *ID* will not be valid after this call.

Arguments:

ID ID of controller, if *ID* is not valid nothing will happen.

void **PI_CloseDaisyChain** (int *iPortId*)

Close connection to the daisy chain port associated with *iPortId*. *iPortId* will not be valid after this call.

Note that if there are still some open connections to one or more daisy chain devices, these connections will be closed automatically.

Arguments:

iPortId ID of the daisy chain port, if *iPortId* is not valid nothing will happen.

int **PI_ConnectDaisyChainDevice** (int *iPortId*, int *iDeviceNumber*)

Open a daisy chain device. All future calls to control this device need the ID returned by this call. Note that before connecting a daisy chain device using the PI_ConnectDaisyChainDevice() function, the daisy chain port has to be opened using the PI_OpenRS232DaisyChain() or the PI_OpenUSBDaisyChain() function, whichever is the appropriate one.
After the daisy chain port has been opened all controllers connected to this daisy chain port can be "opened" using PI_ConnectDaisyChainDevice(). A connection to a daisy chain device is closed using the PI_CloseConnection() function. To close the daisy chain port the PI_CloseDaisyChain() function has to be called. Closing the daisy chain port automatically closes all still opened daisy chain devices.

Arguments:

iPortId the ID of the daisy chain port. This ID is returned by PI_OpenRS232DaisyChain().

iDeviceNumber the number of the daisy chain device to use, is a value between 1 and the *piNumberOfConnectedDaisyChainDevices* value of the PI_OpenRS232DaisyChain() function.

Returns:

ID of new object, **-1** if interface could not be opened or no controller is responding.

int **PI_ConnectNIgpib** (int *iBoard*, const int *iDeviceAddress*)

Open a connection from a National Instruments IEEE 488 board to the controller. All future calls to control this controller need the ID returned by this call.

Arguments:

iBoard number of board (check with NI installation software)

iDeviceAddress address of connected device

Returns:

ID of new object, **-1** if interface could not be opened or no controller is responding.

int **PI_ConnectRS232** (int *iPortNumber*, int *iBaudRate*)

Open an RS-232 ("COM") interface to a controller. The call also sets the baud rate on the controller side. All future calls to control this controller need the ID returned by this call.

Arguments:

iPortNumber COM port to use (e.g. 1 for "COM1")

iBaudRate to use

Returns:

ID of new object, **-1** if interface could not be opened or no controller is responding.

int **PI_ConnectRS232ByDevName** (const char* *szDevName*, int *BaudRate*)

Open an RS-232 interface to a controller with Linux. The call also sets the baud rate on the controller side. All future calls to control this controller need the ID returned by this call.

Arguments:

szDevName device interface name for RS232 connection (Linux)

iBaudRate to use

Returns:

ID of new object, **-1** if interface could not be opened or no controller is responding.

int **PI_ConnectTCPIP** (const char* *szHostname*, int *port*)

Open a TCP/IP connection to the controller. All future calls to control this controller need the ID returned by this call. Will fail if there is already a connection.

Communication cannot be maintained after the controller is power-cycled or rebooted. The connection must then be closed and reopened.

Arguments:

szHostname host name of the controller, can be the IP address, e.g. “192.168.1.1” (Leading zeros may cause problems)

port port to connect to. For controllers from PI, the port is always 50000.

Returns:

ID of new object, **-1** if interface could not be opened or no controller is responding, or controller responds that it is already connected via TCP/IP.

int **PI_ConnectTCPIPbyDescription** (const char* *szDescription*)

Open a TCP/IP connection to the controller using one of the identification strings listed by PI_ EnumerateTCPIPDevices(). All future calls to control this controller need the ID returned by this call. Will fail if there is already a connection.

Communication cannot be maintained after the controller is power-cycled or rebooted. The connection must then be closed and reopened.

Arguments:

szDescription the description of the controller returned by PI_EnumerateTCPIPDevice

Returns:

ID of new object, **-1** if interface could not be opened or no controller is responding, or controller responds that it is already connected via TCP/IP.

int **PI_ConnectUSB** (const char* *szDescription*)

Open an USB connection to a controller using one of the identification strings listed by PI_ EnumerateUSB(). All future calls to control this controller need the ID returned by this call. Will fail if there is already a connection.

Communication cannot be maintained after the controller is power-cycled or rebooted. The connection must then be closed and reopened.

Arguments:

szDescription the description of the controller returned by PI_EnumerateUSB

Returns:

ID of new object, **-1** if interface could not be opened or no controller is responding, or the controller responds that it is already connected via USB.

int **PI_ConnectUSBWithBaudRate** (const char* *szDescription*,int *iBaudRate*)

Open an USB connection to a controller using one of the identification strings listed by PI_ EnumerateUSB(). By specifying the baud rate, a connection using a different baudrate than the standard will be established more quickly. All future calls to control this controller need the ID returned by this call. Will fail if there is already a connection.

Communication cannot be maintained after the controller is power-cycled or rebooted. The connection must then be closed and reopened.

Arguments:

szDescription the description of the controller returned by PI_EnumerateUSB
iBaudRate: to use

Returns:

ID of new object, **-1** if interface could not be opened or no controller is responding, or the controller responds that it is already connected via USB.

int **PI_EnableTCPIPScan** (int *iMask*)

Selects the network hardware type (e.g. Lantronix XPort or other Ethernet device) which is to be found by PI_EnumerateTCPIPDevices(). By default, all devices will be found—change the settings only in special cases and if you know which Ethernet hardware is implemented in your controller.

Arguments:

iMask Bit mask 1 = UDP; 2 = XPORT

Returns:

The previous bit mask

int **PI_EnumerateTCPIPDevices** (char* *szBuffer*, int *iBufferSize*, const char* *szFilter*)

Lists the identification strings of all controllers available in the network via TCP/IP. Using the mask, you can filter the results for certain text.

Arguments:

szBuffer buffer for the TCP/IP devices description.

iBufferSize size of the buffer
szFilter only controllers whose descriptions match the filter are returned in the buffer (e.g. a filter of "E-517" will only return the E-517 controllers, and not all PI controllers).

Returns:
>= 0: the number of controllers in the list
<0: Error code

int **PI_EnumerateUSB** (char* *szBuffer*, int *iBufferSize*, const char* *szFilter*)

Lists the identification strings of all controllers available via USB interfaces. Using the mask, you can filter the results for certain text.

Arguments:
szBuffer buffer for the USB devices description.
iBufferSize size of the buffer
szFilter only controllers whose descriptions match the filter are returned in the buffer (e.g. a filter of "E-861" will only return the E-861 controllers, and not all PI controllers).

Returns:
>= 0: the number of controllers in the list
<0: Error code

int **PI_GetControllerID**(int *threadID*)

Get ID of connected controller for given thread ID.

Arguments:
Thread ID

Returns:
ID of new controller (>=0), error code (<0) if there was an error, no thread running, or thread has not finished yet

int **PI_GetError** (int *ID*)

Get error status of the DLL and, if clear, that of the controller. If the library shows an error condition, its code is returned, if not, the controller error code is checked using **PI_qERR**() (p.123) and returned. After this call the DLL internal error state will be cleared; the controller error state will be cleared if it was queried.

Returns:
error ID, see **Error codes** (p. 123) for the meaning of the codes.

int **PI_InterfaceSetupDlg** (const char* *szRegKeyName*)

Open dialog to let user select the interface and create a new PI object. All future calls to control this controller need the ID returned by this call. See **Interface Settings** (p. 16) for a detailed description of the dialogs shown.

Arguments:
szRegKeyName key in the Windows registry in which to store the settings, the key used is "HKEY_LOCAL_MACHINE\SOFTWARE\<your keyname>" if *keyname* is **NULL** or "" the default key "HKEY_LOCAL_MACHINE\SOFTWARE\PI\PI_GCS2_DLL" is used.

Note:
If your programming language is C or C++, use '\\' if you want to create a key and a subkey at once. To create "MyCompany\PI_GCS2_DLL" you must call

```
PI_InterfaceSetupDlg( "MyCompany\\PI_GCS2_DLL" )
```

Returns:
ID of new object, **-1** if user pressed "CANCEL", the interface could not be opened, or no controller is responding.

BOOL **PI_IsConnected** (int *ID*)

Check if there is a controller with an ID of *ID*.

Returns:
TRUE if *ID* points to an existing controller, **FALSE** otherwise.

BOOL **PI_IsConnecting**(int *threadID*, BOOL* *bCOnnecting*)

Check if thread with given ID is running trying to establish communication.

Arguments:
Thread ID
bCOnnecting **TRUE** if thread is running **FALSE** if no thread is running with given ID

Returns:
TRUE if no error, **FALSE** otherwise (see p. 7)

int **PI_OpenRS232DaisyChain** (int *iPortNumber*, int *iBaudRate*, int* *piNumberOfConnectedDaisyChainDevices*, char* *szDeviceIDNs*, int *iBufferSize*)

Open a RS-232 ("COM") interface to a daisy chain and set the baud rate of the daisy chain master. Note that calling this function does not open a daisy chain device—to get access to a daisy chain device you have to call PI_ConnectDaisyChainDevice()! All future calls to PI_ConnectDaisyChain() need the ID returned by PI_OpenRS232DaisyChain(). The *iDeviceNumber* of the PI_ConnectDaisyChain() function is a value between 1 and the *piNumberOfConnectedDaisyChainDevices*.

Arguments:
iPortNumber COM port to use (e.g. 1 for "COM1")
iBaudRate to use
piNumberOfConnectedDaisyChainDevices variable to receive the number of connected daisy chain devices.
szDeviceIDNs buffer to receive the IDN strings of the controllers (see PI_qIDN()).
iBufferSize the size of the buffer *szDeviceIDNs*.

Returns:
ID of new object, **-1** if interface could not be opened or no controller is responding.

int **PI_OpenUSBDaisyChain** (const char* *szDescription*, long* *pNumberOfConnectedDaisyChainDevices*, char* *szDeviceIDNs*, int *iBufferSize*)

Open a USB interface to a daisy chain. Note that calling this function does not open a daisy chain device—to get access to a daisy chain device you have to call PI_ConnectDaisyChainDevice()! All future calls to PI_ConnectDaisyChain() need the ID returned by PI_OpenUSBDaisyChain(). The *iDeviceNumber* of the PI_ConnectDaisyChain() function is a value between 1 and the *piNumberOfConnectedDaisyChainDevices*.

Arguments:
szDescription the description of the controller returned by PI_EnumerateUSB
piNumberOfConnectedDaisyChainDevices variable to receive the number of connected daisy chain devices.
szDeviceIDNs buffer to receive the IDN strings of the controllers (see PI_qIDN()).
iBufferSize the size of the buffer *szDeviceIDNs*.

Returns:
ID of new object, **-1** if interface could not be opened or no controller is responding.

BOOL **PI_SetErrorCheck** (int *ID*, BOOL *bErrorCheck*)

Set error-check mode of the library. With this call you can specify whether the library should check the error state of the controller (with "ERR?") after sending a command. This will slow down communications, so if you need a high data rate, switch off error checking and call **PI_GetError**() yourself when there is time to do so. You might want to use permanent error checking to debug your application and switch it off for normal operation. At startup of the library error checking is switched on.

Arguments:
ID ID of controller
bErrorCheck switch error checking on (**TRUE**) or off (**FALSE**)

Returns:
the old state, before this call

BOOL **PI_TranslateError** (int i*ErrorNumberr*, char* *szErrorMesage*, int *iBufferSize*)

Translate error number to error message.

Arguments:

iErorrNumber number of error, as returned from **PI_GetError**().
szErrorMessage pointer to buffer that will store the message
iBufferSize size of the buffer

Returns:

TRUE if successful, **FALSE**, if the buffer was too small to store the message

Int **PI_TryConnectRS232** (int *port*, int *baudrate*)

Starts background thread which tries to establish connection to controller with given RS-232 settings.

Arguments:

port COM port to use (e.g. 1 for "COM1")
baudrate to use

Returns:

ID of new thread (>=0), **error code** (<0) if there was an error

Int **PI_TryConnectUSB** (const char* *szDescription*)

Starts background thread which tries to establish connection to controller with given USB settings.

Arguments:

szDescription the description of the controller returned by PI_EnumerateUSB

Returns:

ID of new thread (>=0), **error code** (<0) if there was an error

4.3. Interface Settings

With PI_InterfaceSetupDlg(), p. 14, the *Connect* dialog is called. This dialog offers interface tab cards where you can configure and establish the connection (see descriptions below). Note that not all of the interfaces shown via the tab cards may be present on your controller.

RS-232

- COM Port: Select the desired COM port of the PC, something like "COM1" or "COM2". Only the ports available on the system are displayed.
- Baud Rate: The baud rate of the interface. The baud rate chosen will be set on both the host PC and the controller side of the interface.

USB

- Use the "Rescan" button to obtain all controllers available via USB. In the resulting list, click on the controller to which you want to connect. Use the “Serial Settings” button to specify the baudrate set with the DIP switches on the controller.

IEEE 488

- Board ID: ID of the National Instruments board installed (currently only National Instruments IEEE boards are supported). If only one board is installed this will be 0, as in the most cases. 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 connected device to determine its address setting and, if necessary, how to change it. The settings here and at the device must match.

TCP/IP

- Use the "Search for controllers" button to obtain all available controllers with their IP address and port settings. In the resulting list, click on the controller to which you want to connect and check that its IP address and port number are correctly transferred to the Hostname / TCP/IP Address and Port fields above the list.
- In the list, you can also identify the controllers which have already a TCP/IP connection open. If you try to connect to such a controller, an error message will arise, and no connection is possible.

5. Functions for Sending and Reading Strings

With PI library functions for GCS query commands the controller automatically continues processing subsequent functions only after the controller has retrieved the complete response from the input buffer.
This is valid for all query functions except if a query is sent as a string using PI_Gcs_Commandset().

PI library functions for GCS commands are described in “Basic Functions for GCS Commands” (p. 19) and “Functions for GCS Commands for Wave Generator and DDL” (p. 105).

Example for a query function not using a string:

PI_qMOV (ID,“1”,pdValue)

CAUTION

If a query command is sent as string using PI_Gcs_Commandset() it is necessary to make sure that the size of the response string matches the size of the input buffer. Otherwise it may happen that a response has not yet been retrieved completely before a next function is processed.

Therefore, if a query command is sent as string, it is necessary to query the size of the response string in the input buffer by sending PI_GcsGetAnswerSize() and to retrieve the response from input buffer by sending PI_GcsGetAnswer().
The response to PI_GcsGetAnswerSize() determines the size (i.e, *iBufferSize*) that the input buffer (i.e., *szAxes*) must have to obtain the complete response to the query.

In some cases it can be necessary to query PI_GetAnswerSize() again after that, for it may take some time until the controller has delivered the complete response string. Then, it is recommended to keep querying PI_GetAnswerSize() until 0 is returned.

Example for a query command sent as a string:

PI_GcsCommandset (ID, “MOV? 1”)

PI_GcsGetAnswerSize()

PI_GcsGetAnswer()

5.1. Overview

BOOL **PI_GcsCommandset** (int *ID*, const char* *szCommand*)
BOOL **PI_GcsGetAnswer** (int *ID*, char* *szAnswer*, int *iBufferSize*)
BOOL **PI_GcsGetAnswerSize** (int *ID*, int* *piAnswerSize*)

5.2. Function Description

BOOL **PI_GcsCommandset** (int *ID*, const char* *szCommand*)

Sends a GCS command to the controller. Any GCS command can be sent, but this command is intended to allow use of commands not having a function in the current version of the library.

See the User Manual of the controller for a description of the GCS commands which are understood by the controller firmware, for a command reference and for any limitations regarding the arguments of the commands.

Arguments:

ID ID of controller
szCommand the GCS command as string

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_GcsGetAnswer** (int *ID*, char* *szAnswer*, int *iBufferSize*)

Gets the answer to a GCS command, provided its length does not exceed *bufsize*. The answers to a GCS command are stored inside the DLL, where as much space as necessary is obtained. Each call to this function returns and deletes the oldest answer in the DLL.

See the User Manual of the controller for a description of the GCS commands which are understood by the controller firmware, for a command reference and for any limitations regarding the arguments of the commands.

Arguments:

ID ID of controller
szAwnser the buffer to receive the answer.
iBufferSize the size of *szAnswer*.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_GcsGetAnswerSize** (int *ID*, int* *piAnswerSize*)

Gets the size of an answer of a GCS command.

Arguments:

ID ID of controller
piAnswerSize pointer to integer to receive the size of the oldest answer waiting in the DLL.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

6. Basic Functions for GCS Commands

The functions listed in this chapter are based on the commands of the GCS. You can use a function only if the corresponding command is supported by your controller. See the user manual of the controller for the supported commands.

For all details regarding the functionality and arguments of commands, see the command descriptions in the user manual of the controller.

NOTE

If a query command is sent as string using PI_Gcs_Commandset() it is necessary to make sure that the size of the response string matches the size of the input buffer.
Otherwise it may happen that a response has not yet been retrieved completely before a next function is processed.
See “Functions for Sending and Reading Strings” (p. 17) for details.

6.1. Overview

Function	Short Description	Page
BOOL **PI_AAP** *(*int *ID,* const char* *szAxis1,* double *dLength1,* const char* *szAxis2,* double *dLength2,* double *dAlignStep,* int *iNrRepeatedPositions,* int *iAnalogInput)*	Automated Alignment Part	**31**
BOOL **PI_ACC** (int *ID*, const char* *szAxes*, double* *pdValueArray*)	Set Closed-Loop Acceleration	**31**
BOOL **PI_ADD** (int *ID*, const char* *szVariable*, double *value1*, double *value2*)	Add two values and save the result to a variable	**31**
BOOL **PI_AOS** (int *ID*, const char* *szAxes*, const double* *pdValueArray*)	Set an offset to the analog input for the given axis	**32**
BOOL **PI_ATC** (int *ID*, const int* *piChannels*, const int* *piValueArray*, int *iArraySize*)	Automatic calibration	**32**
BOOL **PI_ATZ** (int *ID*, const char* *szAxes,* const double* *pdLowVoltageArray,* const BOOL* *pbUseDefaultArray*)	Automatic zero-point calibration	**32**
BOOL **PI_BRA** (const int *ID*, char *const *szAxes*, BOOL * *pbValarray*)	Set brake on/off	**33**
BOOL **PI_CCL** (int *ID*, int *iCommandLevel*, const char* *szPassWord*)	Set command level of the controller	**33**
BOOL **PI_CMO** (int *ID*, const char* *szAxes*, const int* *piValueArray*)	Select closed-loop control mode	**33**
BOOL **PI_CPY** (int *ID*, const char* *szVariable*, const char* *szCommand*)	Copy a command response into a variable	**33**
BOOL **PI_CST** (int *ID*, const char* *szAxes*, const char* *szNames*)	Loads stage parameter values from a stage database	**34**
BOOL **PI_CTI** (int *ID*, const int* *piTriggerInputIds*, const int* *piTriggerParameterArray*, const char* *szValueArray*, int *iArraySize*)	Configures the trigger input conditions	**34**
BOOL **PI_CTO** (int *ID*, const int* *piTriggerOutputIds*, const int* *piTriggerParameterArray*, const double* *pdValueArray*, int *iArraySize*)	Configures the trigger output conditions	**34**

Function	Short Description	Page
BOOL **PI_qDRR** (int *ID*, const int* *piRecTableIdsArray*, int *iNumberOfRecTables*, int *iOffsetOfFirstPointInRecordTable*, int *iNumberOfValues*, double** *pdValueArray*, char* *szGcsArrayHeader*, int *iGcsArrayHeaderMaxSize*)	Get Recorded Data Values	**67**
BOOL **PI_qDRR_SYNC** (int *ID*, int *iRecordTableId*, int *iOffsetOfFirstPointInRecordTable*, int *iNumberOfValues*, double* *pdValueArray)*	Get Recorded Data Values	**68**
BOOL **PI_qDRT** (int *ID*, const int* *piRecordTableIdsArray*, int* *piTriggerSourceArray*, char* *szValues,* int *iArraySize, int iValueBufferLength*)	Get Data Recorder Trigger Source	**68**
BOOL **PI_qEAX** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)	Get Enable Status Of Axes	**68**
BOOL **PI_qECO** (int *ID*, const char* *szSendString*, char* *szValues*, int *iBufferSize*)	Echo a String	**69**
BOOL **PI_qERR** (int *ID*, long* *pnError*)	Get Error Number	**69**
BOOL **PI_qFGC**(int *ID*, const char* *szProcessIds*, double* *pdScanAxisCenterValueArray*, double* *pdStepAxisCenterValueArray*)	Fast alignment: Gets the current center position of the circular motion of a gradient search routine	**69**
BOOL **PI_qFPH** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)	Get Phase Offset	**69**
BOOL **PI_qFRC** (int *ID*, const char* *szProcessIdsBase*, char* *szBuffer*, int *iBufferSize*)	Fast alignment: Gets coupled fast alignment routines	**70**
BOOL **PI_qFRF** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)	Get Referencing Result	**70**
BOOL **PI_qFRH** (int *ID*, char* *szBuffer*, int *iBufferSize*)	Fast alignment: Lists help string for routine results	**70**
BOOL **PI_qFRP** (int *ID*, const char* *szScanRoutineNames*, int* *piOptionsArray*)	Fast alignment: Gets the current state of a fast alignment routine	**70**
BOOL **PI_qFRR** (int *ID*, const char* *szScanRoutineNames*, const unsigned int* *iResultIdsArray*, char* *szResult*, int *iBufferSize*)	Fast alignment: Gets the results of a fast alignment routine	**71**
BOOL **PI_qFSS** (int *ID*, int* *piResult*)	Get Status of Fast Scan Routines	**71**
BOOL **PI_qHAR** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)	Indicate Hard Stops	**71**
BOOL **PI_qHDR** (int *ID*, char* *szBuffer*, int *iBufferSize*)	Get All Data Recorder Options	**71**
BOOL **PI_qHDT** (int *ID*, const int* *iDeviceIDsArray*, const int* *iAxisIDsArray*, int* *piValueArray*, int *iArraySize*)	Get HID Default Lookup Table	**72**
BOOL **PI_qHIA** (int *ID*, const char* *szAxes*, const int* *iFunctionArray*, int* *iDeviceIDsArray*, int* *iAxesIDsArray*)	Get Configuration Of Control Done By HID Axis	**72**
BOOL **PI_qHIB** (int *ID*, const int* *iDeviceIDsArray*, const int* *iButtonIDsArray*, int* *pbValueArray*, int *iArraySize*)	Get State Of HID Button	**72**
BOOL **PI_qHIE** (int *ID*, const int* *iDeviceIDsArray*, const int* *iAxesIDsArray*, double* *pdValueArray*, int *iArraySize*)	Get Deflection Of HID Axis	**73**
BOOL **PI_qHIL** (int *ID*, const int* *iDeviceIDsArray*, const int* *iLED_IDsArray*, int* *pnValueArray*, int *iArraySize*)	Get State Of HID LED	**73**
BOOL **PI_qHIN** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)	Get Activation State Of HID Control	**73**

Function	Short Description	Page
BOOL **PI_qMAN** (int *ID*, const char* *szCommand*, char* szBuffer, *int iBufferSize*)	Get Help String For Command	**80**
BOOL **PI_qMOD** (int *ID*, const char* *szItems*, const unsigned int* *iModeArray*, char* *szValues*, int *iMaxValuesSize*)	Get Mode	**80**
BOOL **PI_qMOV** (int *ID*, const char* *szAxes*, double* *pdValueArray*)	Get Target Position	**80**
BOOL **PI_qNAV** (int *ID*, const int* *piAnalogChannelIds*, int* *piNrReadingsValues*, int *iArraySize*)	Get Number of Readings to be Averaged	**80**
BOOL **PI_qNLM** (int *ID*, const char* *szAxes*, double* *pdValueArray*)	Get Low Position Soft Limit	**81**
BOOL **PI_qOAC** (int *ID*, const int* *piPIEZOWALKChannelsArray*, double* *pdValueArray*, int *iArraySize*);	Get open-loop acceleration	**81**
BOOL **PI_qOAD** (int *ID*, const int* *piPIEZOWALKChannelsArray*, double* *pdValueArray*, int *iArraySize*)	Get Voltage For Open-Loop Analog Motion	**81**
BOOL **PI_qODC** (int *ID*, const int* *piPIEZOWALKChannelsArray*, double* *pdValueArray*, int *iArraySize*);	Get Open-Loop Deceleration	**81**
BOOL **PI_qOMA** (int *ID*, const char* *szAxes*, double* *pdValueArray*);	Get Open-Loop Target Position	**82**
BOOL **PI_qONL** (int *ID*, const int* *iPiezoCannels*, int* *pdValarray*, int *iArraySize*)	Get Control Mode	**82**
BOOL **PI_qONT** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)	Get On Target State	**82**
BOOL **PI_qOSN** (int *ID*, const int* *piPiezoWalkChannelsArray*, double* *pdValueArray*, int *iArraySize*)	Get number of steps still to be performed	**82**
BOOL **PI_qOVF** (int *ID*, const char* *szAxes*, BOOL* *pbOverflow*)	Checks overflow status	**82**
BOOL **PI_qOVL** (int *ID,* const int* *piPIEZOWALKChannelsArray*, double* *pdValueArray*)	Get Open-Loop Velocity	**83**
BOOL **PI_qPLM** (int *ID*, const char* *szAxes*, double* *pdValueArray*)	Get High Position Soft Limit	**83**
BOOL **PI_qPOS** (int *ID*, const char* *szAxes*, double* *pdValueArray*)	Get Real Position	**83**
BOOL **PI_qPUN** (int *ID*, const char* *szAxes*, char* *szUnit,* int *iBufferSize*)	Get the Position Units	**83**
BOOL **PI_qRMC** (int *ID*, char * *szBuffer*, int *iBufferSize*)	List Running Macros	**84**
BOOL **PI_qRON** (int *ID*, const char* *szAxes*, BOOL* pbValueArray)	Get Reference Mode	**84**
BOOL **PI_qRTO** (int *ID*, const char* *szAxes*, int* *pbValueArray*)	Read the "ready-for-turn-off state"	**84**
BOOL **PI_qRTR** (int *ID*, int* *piRecordTableRate*)	Get Record Table Rate	**84**
BOOL **PI_qSAI** (int *ID*, char* sz*Axes*, int *iBufferSize*)	Get List Of Current Axis Identifiers	**85**
BOOL **PI_qSAI _ALL** (int *ID*, char* *szAxes*, int *iBufferSize*)	Get List Of Current Axis Identifiers	**85**
BOOL **PI_qSCT** (int *ID*, double* *pdCycleTime*)	Get Cycle Time	**85**
BOOL **PI_qSEP** (int *ID*, const char* *szAxes*, const int* *piParameterArray*, double* *pdValueArray*, char* *szStrings*, int *iMaximumStringSize*)	Get Nonvolatile Memory Parameters	**85**

Function	Short Description	Page
BOOL **PI_qSGA** (int *ID*, const int* *piAnalogChannelIds*, int* *piGainValues*, int *iArraySize*)	Get Gain	**86**
BOOL **PI_qSIC** (int *ID*, const int* *piFastAlignmentInputIdsArray*, int *iNumberOfInputIds*, char* *szBuffer*, int *iBufferSize*)	Fast alignment: Gets the calculation settings for the given fast alignment input channel	**86**
BOOL **PI_qSMO** (int *ID*, char *const *szAxes*, int * *pnValueArray*)	Get Control Value	**86**
BOOL **PI_qSPA** (int *ID*, const char* *szAxes*, unsigned int* *piParameterArray*, double* *pdValueArray*, char* *szStrings*, int *iMaxNameSize*)	Get Volatile Memory Parameters	**86**
BOOL **PI_qSPI** (int *ID*, const char* *szAxes*, double* *pdValueArray*)	Get Pivot Point	**87**
BOOL **PI_qSRG** (int ID, const char*szAxes, const int* iRegisterArray, int * iValArray)	Query Status Register Value	**87**
BOOL **PI_qSSA** (int *ID*, const int* *iPIEZOWALKChannels*, double* *pdValueArray*, int *iArraySize*)	Get Step Amplitude	**87**
BOOL **PI_qSSL** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)	Get Soft Limit Status	**87**
BOOL **PI_qSSN** (int *ID*, char* *szSerialNumber*, int *iBufferSize*)	Get Device Serial Number	**88**
BOOL **PI_qSST** (int *ID*, const char* *szAxes*, double* *pdValueArray*)	Get Step Size	**88**
BOOL **PI_qSTE** (int *ID*, const char* *szAxes*, double* *pdValueArray*)	Get last sent step size	**88**
BOOL **PI_qSVA** (int *ID*, const char* *szAxes*, double* *pdValueArray*)	Returns last valid open-loop control value	**88**
BOOL **PI_qSVO** int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)	Get Servo State (Open-Loop / Closed-Loop Operation)	**89**
BOOL **PI_qTAC** (int *ID*, int * *piNrChannels*	Tell Analog Channels	**89**
BOOL **PI_qTAD** (int *ID*, const int* *piSensorChannelsArray*, int* *piValueArray, int iArraySize*)	Returns ADC value	**89**
BOOL **PI_qTAV** (int *ID*, const int* pi*ChannelsArray*, double* *pdValueArray,* int *iArraySize*)	Get Analog Input Voltage	**89**
BOOL **PI_qTCI** (int *ID*, const int* *piFastAlignmentInputIDsArray*, double* *pdCalculatedInputValueArray*, int *iArraySize*))	Fast alignment: Gets calculated value of given fast alignment input channel.	**89**
BOOL **PI_qTCV** (int *ID*, const char* *szAxes*, double* *pdValueArray*)	Get Commanded Closed-Loop Velocity	**90**
BOOL **PI_qTIO** (int *ID*, int* *piInputNr,* int* *piOutputNr*)	Tell Digital I/O Lines	**90**
BOOL **PI_qTMN** (int *ID*, const char* *szAxes*, double* *pdValueArray*)	Get Minimum Commandable Position	**90**
BOOL **PI_qTMX** (int *ID*, const char* *szAxes*, double* *pdValueArray*)	Get Maximum Commandable Position	**90**
BOOL **PI_qTNR (**int *ID*, int* *piNumberOfRecordTables*)	Get Number Of Record Tables	**91**
BOOL **PI_qTNS** (int *ID*, const int* *piSensorChannelsArray*, double* *pdValueArray*, int *iArraySize*)	Returns normalized sensor value for the specified sensor number	**91**
BOOL **PI_qTPC** (int *ID*, int* *piNumberOfPiezoChannels*)	Get the number of output signal channels available on the controller.	**91**
BOOL **PI_qTRA** (int *ID*, const char* *szAxes*, const double* *pdComponents*, double* *pdValueArray*)	Get maximum absolute position which can be reached from the current position	**91**

Function	Short Description	Page
BOOL **PI_qTRI** (int *ID*, const int* *piTriggerInputIds*, BOOL* *pbTriggerState*, int *iArraySize*)	Get Trigger Input State	**92**
BOOL **PI_qTRO** (int *ID*, const int* *piTriggerOutputIds*, BOOL* *pbTriggerState*, int *iArraySize*)	Get Trigger Output State	**92**
BOOL **PI_qTRS** (nt *ID*, const char* *szAxes*, BOOL * *pbValueArray*)	Indicate Reference Switch	**92**
BOOL **PI_qTSC** (int *ID*, int* *piNumberOfSensorChannels*)	Get the number of input signal channels available on the controller.	**92**
BOOL **PI_qTSP** (int *ID*, const int* *piSensorChannelsArray*, double* *pdValueArray*, int *iArraySize*)	Requests the current position of the given input signal channel	**93**
BOOL **PI_qTVI** (int *ID*, char * *szBuffer*, int *iBufferSize*)	Tell Valid Character Set For Axis Identifiers	**93**
BOOL **PI_qVAR** (int *ID*, const char* *szVariables*, char* *szValues*,int *iBufferSize*)	Get Variable Values	**93**
BOOL **PI_qVCO** (int *ID*, char* *szAxes*, BOOL* *pbValueArray*)	Get Velocity Control Mode	**93**
BOOL **PI_qVEL** (int *ID*, const char* *szAxes*, double* *pdValueArray*)	Get Closed-Loop Velocity	**94**
BOOL **PI_qVER** (int *ID*, char* *szVersion*, int *iBufferSize*)	Get Version	**94**
BOOL **PI_qVLS** (int *ID*, double* *pdSystemVelocity*)	Get System Velocity	**94**
BOOL **PI_qVMA** (int *ID*, const int* *piPiezoChannelsArray*, double* *pdValueArray*, int *iArraySize*)	Get Voltage Output High Limit	**94**
BOOL **PI_qVMI** (int *ID*, const int* *piPiezoChannelsArray*, double* *pdValueArray*, int *iArraySize*)	Get Voltage Output Low Limit	**94**
BOOL **PI_qVMO** (int *ID*, const char* *szAxes*, const double* *pdValarray*, BOOL* *pbMovePossible*)	Virtual Move	**95**
BOOL **PI_qVOL** (int *ID*, const int* *piPiezoChannelsArray*, double* *pdValueArray*, int *iArraySize*)	Get current piezo output voltages	**95**
BOOL **PI_qVST** (int *ID*, char * *szBuffer*, int *iBufferSize*)	Get the names of the available stage types	**95**
BOOL **PI_RBT** (int *ID*)	Reboot System	**96**
BOOL **PI_RNP** (int *ID*, const int* *piPIEZOWALKChannelsArray*, const double* *pdValueArray*, int *iArraySize*)	Relax PiezoWalk Piezos	**96**
BOOL **PI_RON** (const int ID, char *const szAxes, BOOL *pbValarray)	Set Reference Mode	**96**
BOOL **PI_RPA** (int *ID*, const char* *szAxes*, const int* *piParameterArray*)	Reset Volatile Memory Parameters	**96**
BOOL **PI_RTO** (int *ID*, const char* *szAxes*)	Make Ready to Turn OFF	**97**
BOOL **PI_RTR** (int *ID* , int *iRecordTableRate*)	Set Record Table Rate	**97**
BOOL **PI_SAI** (int *ID*, char *const *szOldAxes*, char *const *szNewAxes*)	Set Current Axis Identifiers	**97**
BOOL **PI_SCT** (int *ID*, double *dCycleTime*)	Set Cycle Time	**97**
BOOL **PI_SEP** (int *ID*, const char* *szPassword*, const char* *szAxes*, const int* *piParameterArray*, const double* *pdValueArray*, const char* *szStrings*)	Set Nonvolatile Memory Parameters	**98**
BOOL **PI_SGA** (int *ID*, const int* *piAnalogChannelIds*, const int* *piGainValues*, int *iArraySize*)	Set Gain	**98**

6.2. Function Description

The functions listed in this chapter are based on the commands of the GCS. You can use a function only if the corresponding command is supported by your controller. See the user manual of the controller for the supported commands.

For all details regarding the functionality and arguments of commands, see the command descriptions in the user manual of the controller.

See **"**Function Calls**"** (p. 7) for some general notes about the argument syntax.

BOOL **PI_AAP** *(*int *ID,* const char* *szAxis1,* double *dLength1,* const char* *szAxis2,* double *dLength2,* double *dAlignStep,* int *iNrRepeatedPositions,* int *iAnalogInput)*

Corresponding command: AAP

Starts a scanning procedure for better determination of the maximum intensity of an analog input signal.

The scanning procedure started with PI_AAP() corresponds to the "fine portion" of the scanning procedure that was started with PI_FSA().

Arguments:

ID ID of controller
szAxis1 first axis that defines scanning area
dLength1 length of scanning area along *szAxis1*
szAxis2 second axis that defines scanning area
dLength2 length of scanning area along *szAxis2*
dAlignStep starting value for the step size
iNrRepeatedPositions number of successful checks of the local maximum at the current position that is required for successfully completing
iAnalogInput is the identifier of the analog input signal whose maximum intensity is sought

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_ACC** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: ACC

Set the acceleration to use during moves of *szAxes*. The PI_ACC() setting only takes effect when the given axis is in closed-loop operation (servo on).

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray maximum accelerations for the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_ADD** (int *ID*, const char* *szVariable*, double *value1*, double *value2*)

Corresponding command: ADD

Add two values and save the result to a variable.

Arguments:

ID ID of controller
szVariable name of variable to store the result
value1 first value to be added
value2 second value to be added

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_AOS** (int *ID*, const char* *szAxes*, const double* *pdValueArray*)

Corresponding command: AOS

Set an offset to the analog input for the given axis.

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray analog offset for the axes.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_ATC** (int *ID*, const int* *piChannels*, const int* *piValueArray*, int *iArraySize*)

Corresponding command: ATC

Automatic calibration.

See "Calibration Settings" and the description of the ATC command in the User Manual of the controller for more information.

Arguments:

ID ID of controller
piChannels string with channels of the piezo control electronics
piValueArray comprises the settings to be calibrated.
iArraySize size of arrays

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_ATZ** (int *ID*, const char* *szAxes,* const double* *pdLowVoltageArray,* const BOOL* *pbUseDefaultArray*)

Corresponding command: ATZ

Automatic zero-point calibration for *szAxes*. Sets the output voltage which is to be applied at the zero position of the axis and starts an appropriate calibration procedure.

CAUTION: The AutoZero procedure will move the axis, and the motion may cover the whole travel range. Make sure that it is safe for the stage to move.

See "AutoZero Procedure" and the description of the ATZ command in the User Manual of the controller for more information.

Arguments:

ID ID of controller
szAxes string with axes
pdLowVoltageArray Array with low voltages for the corresponding axes.
pbUseDefaultArray If TRUE the value in *pdLowVoltageArray* for the axis is ignored and the value stored in the controller (Autozero Low Voltage parameter, ID 0x07000A00) is used.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_BRA** (const int *ID*, char *const *szAxes*, BOOL * *pbValarray*)

Corresponding command: BRA

Set brake state for *szAxes* to on (**TRUE)** or off (**FALSE)**.

Arguments:

ID ID of controller
szAxes string with axes
pbValarray modes for the specified axes, **TRUE** for on, **FALSE** for off

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_CCL** (int *ID*, int *iCommandLevel*, const char* *szPassWord*)

Corresponding command: CCL

If *Password* is correct, this function sets the *CommandLevel* of the controller and determines thus the availability of commands and the write access to the system parameters. Use PI_qHLP() to determine which commands are available in the current command level. PI_qHPA() lists the parameters including the information about which command level allows write access to them.

Arguments:

ID ID of controller
iCommandLevel can be
0 = the default setting, all commands provided for "normal" users are available, read access to all parameters
1 = provides additional commands and write access to level-1-parameters (commands and parameters from level 0 are included).
szPassword password for CCL 1 is “ADVANCED”, for CCL 0 no password is required

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_CMO** (int *ID*, const char* *szAxes*, const int* *piValueArray*)

Corresponding command: CMO

Select closed-loop control mode. The selection determines the controlled variable (e.g. position or velocity or force).

The currently valid target value for the controlled variable can be queried with PI_qCTV(). An absolute target for the controlled variable can be set with PI_CTV(), a relative target can be set with PI_CTR(). The current value of the controlled variable can be queried with PI_qCAV().**Arguments:**

ID ID of controller
szAxes string with axes
piValueArray modes for the specified axes

Returns:

TRUE if successful, **FALSE** otherwise (see p. 7)

BOOL **PI_CPY** (int *ID*, const char* *szVariable*, const char* *szCommand*)

Corresponding command: CPY

Copy a command response into a variable.

Arguments:

ID ID of controller
szVariable name of variable
szCommand query command, the result is stored in the variable given

Returns:

TRUE if successful, **FALSE** otherwise (see p. 7)

BOOL **PI_CST** (int *ID*, const char* *szAxes*, const char* *szNames*)

Corresponding command: CST

Loads the specific values for the *szNames* stage from a stage database (see also p. 120) and sends them to the controller so that the controller parameters are properly adjusted to the connected mechanics.

E-861, C-867, C-863, C-884, E-871:

The following actions are included:

- Sets the servo off
- Loads parameter values from stage database and sends them to the controllers RAM using PI_SPA()
- Checks the error

C-887:

Error checking is included.

With the C-887, the corresponding stage type is automatically assigned to all axes when the controller is switched on or rebooted.

The assignment of a stage type with PI_CST() is only permissible for axes A and B. In order to change the standard assignment for A and B in the volatile memory, PI_CST() can be used e.g. in a start-up macro.

The permissible stage types can be listed with the PI_qVST() function.

PI_CST() also switches on servo mode for axes A and B.

Arguments:

ID ID of controller
szAxes identifiers of the axes
szNames the names of the stages separated by '\n' ("line-feed"), the names must be present in one of the stage database files

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_CTI** (int *ID*, const int* *piTriggerInputIds*, const int* *piTriggerParameterArray*, const char* *szValueArray*, int *iArraySize*)

Corresponding command: CTI

Configures the trigger input conditions for the given digital input line. Depending on the controller, the trigger input conditions will either become active immediately, or will become active when activated with PI_TRI().

Arguments:

ID ID of controller
piTriggerInputIds is an array with the trigger input lines of the controller
piTriggerParameterArray is an array with the CTI parameter IDs
szValueArray is a list of the values to which the CTI parameters are set. The single values must be separated by a linefeed character
iArraySize is the size of the array *piTriggerInputIds*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_CTO** (int *ID*, const int* *piTriggerOutputIds*, const int* *piTriggerParameterArray*, const double* *pdValueArray*, int *iArraySize*)

Corresponding command: CTO

Configures the trigger output conditions for the given digital output line. Depending on the controller, the trigger output conditions will either become active immediately, or will become active when activated with PI_TRO().

Arguments:

ID ID of controller

piTriggerOutputIds is an array with the trigger output lines of the controller
piTriggerParameterArray is an array with the CTO parameter IDs
pdValueArray is an array of the values to which the CTO parameters are set
iArraySize is the size of the array *piTriggerOutputIds*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_CTOString** (int *ID*, const int* *piTriggerOutputIds*, const int* *piTriggerParameterArray*, const char* *szValueArray*, int *iArraySize*)

Corresponding command: CTO

Configures the trigger output conditions for the given digital output line. Depending on the controller, the trigger output conditions will either become active immediately, or will become active when activated with PI_TRO().

Arguments:

ID ID of controller
piTriggerOutputIds is an array with the trigger output lines of the controller
piTriggerParameterArray is an array with the CTO parameter IDs
szValueArray is a list of the values to which the CTO parameters are set. The single values must be separated by a linefeed character
iArraySize is the size of the array *piTriggerOutputIds*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_CTR** (int *ID*, const char* *szAxes*, const double* *pdValueArray*)

Corresponding command: CTR

Set relative closed-loop target *for szAxes*. Moves the given axes. All axes start moving simultaneously. Servo must be enabled for all commanded axes prior to using this command.

The selected closed-loop control mode (see PI_CMO()) determines the variable which is controlled with PI_CTR() (e.g. position or velocity or force).

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray relative target values for the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_CTV** (int *ID*, const char* *szAxes*, const double* *pdValueArray*)

Corresponding command: CTV

Set absolute closed-loop target *for szAxes*. Moves the given axes. All axes start moving simultaneously. Servo must be enabled for all commanded axes prior to using this command.

The selected closed-loop control mode (see PI_CMO()) determines the variable which is controlled with PI_CTV() (e.g. position or velocity or force).

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray target values for the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_DCO** (int *ID*, const char* *szAxes*, const BOOL* *pbValueArray*)

Corresponding command: DCO

Sets drift compensation mode for given axes (on or off). Drift compensation is applied to avoid unwanted changes in displacement over time and is therefore recommended for static operation. For a detailed description see "Drift Compensation" in the controller User Manual.

Drift compensation is automatically deactivated as long as the wave generator is activated.

Arguments:

ID ID of controller
szAxes string with axes
pbValueArray gives the drift compensation mode, can have the following values:
0 = drift compensation off
1 = drift compensation on

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_DEC** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: DEC

Set the deceleration to use during moves of *szAxes*. The PI_DEC() setting only takes effect when the given axis is in closed-loop operation (servo on).

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray maximum decelerations for the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_DEL** (int *ID*, int *iMilliSeconds*)

Corresponding command: DEL

Delay the controller for *iMilliSeconds* milliseconds.

Arguments:

ID ID of controller
iMilliSeconds delay value in milliseconds

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_DFH** (int *ID*, const char* *szAxes*)

Corresponding command: DFH

Defines the current positions of *szAxes* as the axis home position (by setting the position value to 0.00).

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are affected.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_DIO** (int *ID*, const int* *piChannelsArray*, const BOOL* *pbValueArray*, int *iArraySize*)

Corresponding command: DIO

Set digital output channels HIGH or LOW.

Arguments:

ID ID of controller

piChannelsArray array containing digital output channel identifiers

pbValueArray array containing the states of specified digital ouput channels, **TRUE** if HIGH, **FALSE** if LOW

If piChannelsArray contains 0, the array is a bit pattern which gives the states of all lines

iArraySize the size of the array *pbValueArray*

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_DPA** (int *ID*, const char* *szPassWord*, const char* *szAxes*, const int* *piParameterArray*)

Corresponding command: DPA

Resets parameters or settings to default values. DPA does not overwrite parameters or parameter-independent settings in non-volatile memory.

Arguments:

ID ID of controller

szPassWord The password depends on the parameter or parameter-independent setting to be resetted. See the user manual of the controller for details.

szAxes string with designators. For each designator in *szAxes* one parameter value is reset.

piParameterArray Array with parameter IDs

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_DRC** (int *ID*, const int* *piRecordTableIdsArray*, const char* *szRecordSourceIds*, const int* *piRecordOptionsArray*)

Corresponding command: DRC

Set data recorder configuration: determines the data source (*szRecordSourceIdsArray*) and the kind of data (*piRecordOptionsArray*) used for the given data recorder table.

Arguments:

ID ID of controller

piRecordTableIdsArray ID of the record table

szRecordSourceIds ID of the record source, for example axis number or channel number. The value of this argument depends on the corresponding record option.

piRecordOptionsArray record option, i.e. the kind of data to be recorded

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_DRT** (int *ID*, const int* *piRecordTableIdsArray*, const int* pi*TriggerSourceArray*, const char* *szValues*, int *iArraySize*)

Corresponding command: DRT

Defines a trigger source for the given data recorder table.

For the data recorder configuration, i.e. for the assignment of data sources and record options to the recorder tables, use PI_DRC().

With PI_qDRR() you can read the last recorded data set.

For more information see “Data Recorder” in the controller User Manual.

Arguments:

ID ID of controller
piRecordTableIdsArray ID of the record table
piTriggerSourceArray ID of the trigger source
szValues depending on the trigger source, value can be a dummy, e.g. an arbitrary character, or the ID of a certain digital input line
iArraySize size of *piRecordTableIdsArray, piTriggerSourceArray* and *szValues.*

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_EAX** (int *ID*, const char* *szAxes*, const BOOL* *pbValueArray*)

Corresponding command: EAX

Enable axis. If disabled, no motion is executed. If motion is commanded for an axis that is not enabled, an error will be set.

Arguments:
ID ID of controller
szAxes string with axes
pbValueArray enable status for the specified axes, **TRUE** for "on", **FALSE** for "off"

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_FDG** (int *ID*, const char* *szScanRoutineName*, const char* *szScanAxis*, const char* *szStepAxis*, const char* *szParameters*)

Corresponding command: FDG

Fast alignment: Defines a fast alignment gradient search routine. Use PI_FRS to start the routine. With PI_qFRR(), you can read out the definition and the results of the routine.

See the E712T0016 Technical Note (“Fast Alignment Routines”) for detailed descriptions.

Arguments:
ID ID of controller
szScanRoutineName The identifier of the routine.
szScanAxis Identifier of the axis that is to be the master axis of the gradient search routine.
szStepAxis Identifier of the axis that is to be the second axis of the gradient search routine.
szParameters The parameters are optional. For parameters that are omitted, default values will be used.

[ML <stop level>] // *float*
ML: Required keyword
<stop level>: Gives one stop criterion for the gradient search routine.
[A <alignment signal input channel>] // *int*
A: Required keyword
<alignment signal input channel>: Identifier of the fast alignment input channel whose maximum intensity is sought.
[MIA <min radius>] // *float*
MIA: Required keyword
<min radius>: Minimum radius of the circular motion for scan axis and step axis (= amplitude of the sine curve).
[MAA <max radius>] // *float*
MAA: Required keyword
<max radius>: Maximum radius of the circular motion for scan axis and step axis (= amplitude of the sine curve).
[F <frequency>] // *float*
F: Required keyword
<frequency>: Frequency of the sine curves for scan axis and step axis.
[SP <speed factor>] // *float*
SP: Required keyword
<speed factor>: The speed factor can be used to speed up the offset change.

[V <max velocity>] // *float*
V: Required keyword
<max velocity>: Velocity limit for the offset change..
[MDC <max direction changes>] // *int*
MDC: Required keyword
<max direction changes>: Gives one stop criterion for the gradient search routine.
[SPO <speed offset>] // *float*
SPO: Required keyword
<speed offset>: Offset that can be applied in the velocity calculation.

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_FDR** (int *ID*, const char* *szScanRoutineName*, const char* *szScanAxis*, const double *dScanAxisRange*, const char* *szStepAxis*, const double *dStepAxisRange*, const char* *szParameters*)

Corresponding command: FDR

Fast alignment: Defines a fast alignment area scan routine. Use PI_FRS to start the routine. With PI_qFRR(), you can read out the definition and the results of the routine.
See the E712T0016 Technical Note (“Fast Alignment Routines”) for detailed descriptions.

Arguments:
ID ID of controller
szScanRoutineName The identifier of the routine.
szScanAxis Identifier of the axis that is to be the master axis of the scan routine.
dScanAxisRange Scan range for the scan axis.
szStepAxis Identifier of the step axis.
dStepAxisRange Scan range for the step axis.
szParameters The parameters are optional. For parameters that are omitted, default values will be used.
[L <threshold level>] // float
L: Required keyword
Minimum intensity threshold of the analog input signal. If during an area scan routine no value of the analog input signal is higher than the given minimum threshold level, PI_qFRR() will report “not successful” for the routine.
[A <alignment signal input channel>] // int
A: Required keyword
<alignment signal input channel>: Identifier of the fast alignment input channel whose maximum intensity is sought.
[F <frequency>] // float
F: Required keyword
Frequency of the scan axis.
[V <velocity>] // float
V: Required keyword
<velocity>: Velocity of the step axis.
[MP1 <scan axis middle position>] // float
MP1: Required keyword
<scan axis middle position>: Middle position of the scan range for the scan axis.
[MP2 <step axis middle position>] // float
MP2: Required keyword
<step axis middle position>: Middle position of the scan range for the step axis.
[TT <target type>] // int
TT: Required keyword
<target type>: ID of the area scan type. Possible values:
0 = raster scan
1 = spiral scan
[CM <estimation method>] // int
CM: Required keyword
<estimation method>: ID of the estimation method for the position of the global intensity maximum:

0 = global maximum is at the position where the maximum value was recorded
1 = position of global maximum is calculated from the recorded data using a Gaussian LS fit.
2 = position of global maximum is calculated from the recorded data using an analogy to a center-of-gravity calculation

[MIIL <minimum level of fast alignment input>] // float
MIIL: Required keyword
<minimum level of fast alignment input>: Minimum intensity to be used for estimation method 1 or 2 (see CM above), in % of the maximum intensity that has been recorded.

[MAIL <maximum level of fast alignment input>] // float
MAIL: Required keyword
<maximum level of fast alignment input>: Maximum intensity to be used for estimation method 1 or 2 (see CM above), in % of the maximum intensity that has been recorded.

[SP <stop position option>] // int
SP: Required keyword
<stop position option>: ID of the position to be approached by scan axis and step axis when the area scan routine has been completed:
0 = move to scan axis and step axis position with the maximum intensity of the analog input signal
1 = stay at the end position of the area scan routine
2 = move to the start position of the area scan routine

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_FED** (int *ID*, const char* *szAxes,* const int* *iEdgeArray*, const int* *iParamArray*)

Corresponding command: FED

Moves given axis to a given signal edge and then moves out of any limit condition.

Arguments:

ID ID of controller
szAxes axes to move.
iEdgeArray Defines the type of edge the axis has to move to.
The following edge types are available:
1 = negative limit switch
2 = positive limit switch
3 = reference switch
iParamArray at present, this argument is not needed, should contain zeros

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_FGC**(int *ID*, const char* *szProcessIds*, const double* *pdScanAxisCenterValueArray*, const double* *pdStepAxisCenterValueArray*)

Corresponding command: FGC

Fast alignment: Change center position of gradient search routine.

Arguments:

ID ID of controller
szProcessIds The identifier of the routine.
pdScanAxisCenterValueArray Center position of the circular motion for the scan axis.
pdStepAxisCenterValueArray Center position of the circular motion for the step axis.
Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_FIO** (int *ID*, const char* *szAxis1*, double *dLength1*, const char* *szAxis2*, double *dLength2*, double *dThreshold*, double *dLinearStep*, double *dAngleScan*, int *iAnalogInput*)

Corresponding command: FIO

Starts a scanning procedure for the alignment of optical elements (e.g. optical fibers), the input and output of which are on the same side.

Arguments:

ID ID of controller
szAxis1 first axis that defines scanning area
dLength1 length of scanning area along *szAxis1*
szAxis2 second axis that defines scanning area
dLength2 length of scanning area along *szAxis2*
dThreshold intensity threshold of the analog input signal, in V
dLinearStep step size in which the platform moves along the spiral path
dAngleScan angle around the pivot point at which scanning is done, in degrees
iAnalogInput is the identifier of the analog input signal whose maximum intensity is sought

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_FLM** (int *ID*, const char* *szAxis*, double *dLength*, double *dThreshold*, int *iAnalogInput*, int *iDirection)*

Corresponding command: FLM

Starts a scanning procedure to determine the global maximum intensity of an analog input signal.

Arguments:

ID ID of controller
szAxis one axis of the controller, axes X, Y, Z, U, V, W are permissible
dLength distance to be scanned along the axis
dThreshold intensity threshold of the analog input signal, in V
iAnalogInput is the identifier of the analog input signal whose maximum intensity is sought
iDirection indicates the direction of the scanning procedure as well as the starting and end position of the distance

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_FLS** (int *ID*, const char* *szAxis*, double *dLength*, double *dThreshold*, int *iAnalogInput*, int *iDirection)*

Corresponding command: FLS

Starts a scanning procedure which scans a specified distance along an axis until the analog input signal reaches a specified intensity threshold.

Arguments:

ID ID of controller
szAxis one axis of the controller, axes X, Y, Z, U, V, W are permissible
dLength distance to be scanned along the axis
dThreshold intensity threshold of the analog input signal, in V
iAnalogInput is the identifier of the analog input signal whose maximum intensity is sought
iDirection indicates the direction of the scanning procedure as well as the starting and end position of the distance

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_FNL** (int *ID*, const char* *szAxes*)

Corresponding command: FNL

Starts a reference move: Moves all axes *szAxes* synchronously to the negative physical limits of their travel ranges and sets the current positions to the negative range limit values.

Note: Call PI_IsControllerReady() to find out if referencing is complete (the controller will be "busy" while referencing, so most other commands will cause a PI_CONTROLLER_BUSY error) and PI_qFRF() to check whether the reference move was successful.

Arguments:

ID ID of controller
szAxes axes to move

Returns:

TRUE if successful, **FALSE** otherwise

Errors:

PI_UNKNOWN_AXIS_IDENTIFIER cAxis is not a valid axis identifier

BOOL **PI_FPH** (int *ID*, const char* *szAxes*)

Corresponding command: FPH

Starts phase finding process: Finds offset between motor and encoder by performing a homing process. Notice: The stage will start moving.

Arguments:

ID ID of controller
szAxes axes to perform phase finding

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_FPL** (int *ID*, const char* *szAxes*)

Corresponding command: FPL

Starts a reference move: Moves all axes *szAxes* synchronously to the positive physical limits of their travel ranges and sets the current positions to the positive range limit values.

Note: Call PI_IsControllerReady() to find out if referencing is complete (the controller will be "busy" while referencing, so most other commands will cause a PI_CONTROLLER_BUSY error) and PI_qFRF() to check whether the reference move was successful.

Arguments:

ID ID of controller
szAxes axes to move

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_FRC** (int *ID*, const char* *szProcessIdBase*, const char* *szProcessIdsCoupled*)

Corresponding command: FRC

Fast alignment: Couples fast alignment routines to each other.

Routine types that can be coupled: gradient search routines. Coupled routines are not allowed to stop until all routines coupled to them are finished.

Arguments:

ID ID of controller
szProcessIdBase The identifier of a routine.
szProcessIdsCoupled The identifier of a routine that is to be coupled to the routine given by *szProcessIdBase*

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_FRF** (int *ID*, const char* *szAxes*)

Corresponding command: FRF

Starts a reference move: Synchronous reference move of all axes *szAxes,* i.e. the given axis is moved to its physical reference point and the current position is set to the reference position.

Note: Call PI_IsControllerReady() to find out if referencing is complete (the controller will be "busy" while referencing, so most other commands will cause a PI_CONTROLLER_BUSY error) and PI_qFRF() to check whether the reference move was successful.

Arguments:

ID ID of controller

szAxes string with axes

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_FRP** (int *ID*, const char* *szScanRoutineNames*, const int* *piOptionsArray*)

Corresponding command: FRP

Fast alignment: Stops, pauses or resumes a fast alignment routine. A routine to be stopped or paused must have been started with PI_FRS before. A routine to be resumed with PI_FRP must have been paused with PI_FRP before.

Arguments:

ID ID of controller

szScanRoutineNames The identifier of the routine.

piOptionsArray The action to be performed for the routine. Possible actions:

0 = stop the routine
1 = pause the routine
2 = resume the routine

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_FRS** (int *ID,* const char* *szScanRoutineNames*

Corresponding command: FRS

Fast alignment: Starts a fast alignment routine. The routine must have been defined before with PI_FDR() or PI_FDG() or via the appropriate parameters (see E712T0016 Technical Note).

Arguments:

ID ID of controller

szScanRoutineNames The identifier of the routine. Multiple gradient search routines can run synchronously for the axes on both the sender and receiver side. They can be coupled to each other with PI_FRC().

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_FSA** (int *ID*, const char* *szAxis1*, double *dLength1*, const char* *szAxis2,* double *dLength2,* double *dThreshold*, double *dDistance*, double *dAlignStep*, int *iAnalogInput)*

Corresponding command: FSA

Starts a scanning procedure to determine the maximum intensity of an analog input signal in a plane. The search consists of two subprocedures:

- "Coarse portion"; corresponds to the procedure that is started with the PI_FSC() function
- "Fine portion"; corresponds to the procedure that is started with the PI_AAP() function

The fine portion is only executed when the coarse portion has previously been successfully completed.

Arguments:

ID ID of controller
szAxis1 first axis that defines scanning area. Axes X, Y, and Z are permissible. During the coarse portion, the platform is moved in this axis from scanning line to scanning line by the distance given by *dDistance*.
dLength1 length of scanning area along *szAxis1*
szAxis2 second axis that defines scanning area. Axes X, Y, and Z are permissible. During the coarse portion, the scanning lines are in this axis.
dLength2 length of scanning area along *szAxis2*
dThreshold intensity threshold of the analog input signal, in V
dDistance distance between the scanning lines, is only used during the coarse portion
dAlignStep starting value for the step size, is only used during the fine portion,
iAnalogInput is the identifier of the analog input signal whose maximum intensity is sought

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_FSC** (int *ID*, const char* *szAxis1*, double *dLength1*, const char* *szAxis2,* double *dLength2,* double *dThreshold*, double *dDistance*, int *iAnalogInput)*

Corresponding command: FSC

Starts a scanning procedure which scans a specified area ("scanning area") until the analog input signal reaches a specified intensity threshold.

The scanning procedure started with PI_FSC() corresponds to the "coarse portion" of the scanning procedure that is started with the PI_FSA function.

Arguments:

ID ID of controller
szAxis1 the axis in which the platform moves from scanning line to scanning line by the distance given by *dDistance*.
dLength1 length of scanning area along *szAxis1*
szAxis2 is the axis in which the scanning lines are located,
dLength2 length of scanning area along *szAxis2*
dThreshold intensity threshold of the analog input signal, in V
dDistance distance between the scanning lines
iAnalogInput is the identifier of the analog input signal whose maximum intensity is sought

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_FSM** (int *ID*, const char* *szAxis1*, double *dLength1*, const char* *szAxis2,* double *dLength2,* double *dThreshold*, double *dDistance*, int *iAnalogInput)*

Corresponding command: FSM

Starts a scanning procedure to determine the global maximum intensity of an analog input signal in a plane.

Arguments:

ID ID of controller
szAxis1 the axis in which the platform moves from scanning line to scanning line by the distance given by *dDistance*.
dLength1 length of scanning area along *szAxis1*
szAxis2 is the axis in which the scanning lines are located,
dLength2 length of scanning area along *szAxis2*
dThreshold intensity threshold of the analog input signal, in V
dDistance distance between the scanning lines
iAnalogInput is the identifier of the analog input signal whose maximum intensity is sought

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_GetAsyncBuffer** (int *ID*, double **pnValArray*)

Get address of internal buffer used for storing data read in by a call to PI_qDRR(), PI_qDDL(), PI_qGWD(), PI_qTWS(), PI_qJLT() or PI_qHIT().

Arguments:

ID ID of controller

pnValarray pointer to receive address of internal array used to store the data, the DLL will have allocated enough memory to store all data; call **PI_GetAsyncBufferIndex()** to find out how many data points have been transferred up to that time.

Returns:

TRUE if successful, **FALSE** otherwise

int **PI_GetAsyncBufferIndex** (int *ID*)

Get index used for the internal buffer filled with data read in by a call to PI_qDRR(), PI_qDDL(), PI_qGWD(), PI_qTWS(), PI_qJLT() or PI_qHIT().

Arguments:

ID ID of controller

Returns:

Index of the data element which was last read in, **-1** otherwise

BOOL **PI_GetDynamicMoveBufferSize** (int *ID*, long* *pnSize*)

Corresponding command: #11

#11 gets the free memory space of a buffer that contains the motion profile points. For more information, see "Motions of the Hexapod" in the controller User Manual.

Arguments:

ID ID of controller

pnSize current number of free motion profile points

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_GOH** (int *ID*, const char* *szAxes*)

Corresponding command: GOH

Move all axes in *szAxes* to their home positions (is equivalent to moving the axes to positions 0 using PI_MOV()).

Depending on the controller, the definition of the home position can be changed with PI_DFH().

Arguments:

ID ID of controller

szAxes string with axes, if "" or **NULL** all axes are affected.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_HasPosChanged** (int *ID*, const char* *szAxes,* BOOL* *pbValueArray)*

Corresponding command: #6

Queries whether the axis positions have changed since the last position query was sent.

Arguments:

ID ID of controller

szAxes axis of controller

pbValueArray indicates whether axis positions have changed, the response is bit-mapped

Returns:
TRUE if successful, FALSE otherwise (see p. 7)

BOOL **PI_HDT** (int *ID*, const int* *iDeviceIDsArray*, const int* *iAxisIDsArray*, const int* *piValueArray*, int *iArraySize*)

Corresponding command: HDT
Assigns a lookup table to the given axis of the given HID device.

Arguments:
ID ID of controller
iDeviceIDsArray HID devices connected to the controller
iAxisIDsArray axes of the HID device(s)
piValueArray lookup tables to be assigned. Supported tables depend on the controller.
Possible tables (ID: type):
1: linear
2: parabolic
3: cubic
4: exponential
5: inverted linear
6: inverted parabolic
101 or higher: user-defined tables
iArraySize size of *iDeviceIDsArray*, *iAxisIDsArray* and *piValueArray*

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_HIA** (int *ID*, const char* *szAxes*, const int* *iFunctionArray*, const int* *iDeviceIDsArray*, const int* *iAxesIDsArray)*

Corresponding command: HIA
Configures the control of axes of the controller by axes of HID devices ("HID control"): Assigns an axis of an HID device to the given motion parameter of the given axis of the controller.

Arguments:
ID ID of controller
szAxes axes of controller
iFunctionArray motion parameters to be controlled by the axes of HID devices
iDeviceIDsArray HID devices connected to the controller
iAxesIDsArray axes of the HID device(s)

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_HIL** (int *ID*, const int* *iDeviceIDsArray*, const int* *iLED_IDsArray*, const int* *pnValueArray*, int *iArraySize*)

Corresponding command: HIL
Sets the current state of the given output unit or characteristic ("LED") of the given HID device.

Arguments:
ID ID of controller
iDeviceIDsArray HID devices connected to the controller
iLED_IdsArray output units or characteristics ("LEDs") of the HID device(s)
pnValueArray states to be set for the output units or characteristics of the HID device(s)
iArraySize size of *iDeviceIDsArray*, *iLED_IDsArray* and *pnValueArray*

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_HIN** (int *ID*, const char* *szAxes*, const BOOL* *pbValueArray*)

Corresponding command: HIN

Enables or disables the control by HID devices ("HID control") for the given axis of the controller.

Arguments:

ID ID of controller
szAxes string with axes of the controller
pbValueArray activation state of the HID control for the specified controller axes, **TRUE** for "enabled", **FALSE** for "disabled"

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_HIS** (int *ID*, const int* *iDeviceIDsArray*, const int* *iItemIDsArray*, const int* *iPropertyIDArray*, const char* *szValues*, int *iArraySize*)

Corresponding command: HIS

Configures the given HID device.

Arguments:

ID ID of controller
iDeviceIDsArray HID devices connected to the controller
iItemIDsArray operating elements of the HID device(s)
iPropertyIDArray properties of the operating elements of the HID device(s)
szValues string with the values to which the properties of the operating elements are to be set
iArraySize size of *iDeviceIDsArray*, *iItemIDsArray* and *iPropertyIDArray*

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_HIT** (int *ID*, const int* *piTableIdsArray*, const int* *piPointNumberArray*, const double* *pdValueArray*, int *iArraySize*)

Corresponding command: HIT

Fills the given lookup table with values.

Arguments:

ID ID of controller
piTableIdsArray lookup tables of the controller
piPointNumberArray points in the lookup table (index begins with 1)
pdValueArray values of the points (range is -1.0 to 1.0)
iArraySize size of *piTableIdsArray*, *piPointNumberArray* and *pdValueArray*

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_HLT** (int *ID*, const char* *szAxes*)

Corresponding **command:** HLT

Halt the motion of given axes smoothly.

Error code 10 is set. PI_HLT() does not stop macros.

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are affected.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_IFC** (int *ID*, const char* *szParameters*, const char* *szValues*)

Corresponding command: IFC
Interface configuration.

After PI_IFC() is sent, the new setting becomes active and the host PC interface configuration may need to be changed to maintain communication.

Arguments:

ID ID of controller
szParameters determines which interface <parameter> should be changed. See szValues.
szValues Array with the values of the parameters:
- for ***szParameters*** = RSBAUD, the ***szValues*** parameter value gives the baud rate to be used for RS-232 communication
- for ***szParameters*** = GPADR, the ***szValues*** parameter value gives the device address to be used for GPIB (IEEE 488) communication
- for ***szParameters*** = IPADR, the first four portions of the ***szValues*** parameter value specify the default IP address for TCP/IP communication, the last portion specifies the default port to be used
- for ***szParameters*** = IPSTART, the ***szValues*** parameter value defines the startup behavior for configuration of the IP address for TCP/IP communication:
  0 = use IP address defined with IPADR
  1 = use DHCP to obtain IP address, if this fails, use IPADR
- for ***szParameters*** = IPMASK, the ***szValues*** parameter value gives the IP mask to be used for TCP/IP communication, in the form uint.uint.uint.uint

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_IFS** (int *ID*, const char* *szPassword*, const char* *szParameters*, const char* *szValues*)

Corresponding command: IFS
Interface parameter store.

The power-on default parameters for the interface are changed in non-volatile memory, but the current active parameters are not. Settings made with PI_IFS() become active with the next power-on or reboot.

Arguments:

ID ID of controller
szPassword > the default password to write to EPROM is 100.
szParameters determines which interface <parameter> should be changed. See szValues.
szValues Array with the values of the parameters:
- for ***szParameters*** = RSBAUD, the ***szValues*** parameter value gives the baud rate to be used for RS-232 communication
- for ***szParameters*** = GPADR, the ***szValues*** parameter value gives the device address to be used for GPIB (IEEE 488) communication
- for ***szParameters*** = IPADR, the first four portions of the ***szValues*** parameter value specify the default IP address for TCP/IP communication, the last portion specifies the default port to be used
- for ***szParameters*** = IPSTART, the ***szValues*** parameter value defines the startup behavior for configuration of the IP address for TCP/IP communication:
  0 = use IP address defined with IPADR
  1 = use DHCP to obtain IP address, if this fails, use IPADR
- for ***szParameters*** = IPMASK, the ***szValues*** parameter value gives the IP mask to be used for TCP/IP communication, in the form uint.uint.uint.uint

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_IMP** (int *ID*, const char* *szAxes*, const double* *pdImpulseSize*)

Corresponding command: IMP

Starts performing an impulse and recording the impulse response for the given axis. An "impulse" consists of a relative move of the specified amplitude followed by an equal relative move in the opposite direction.

Arguments:

ID ID of controller
szAxes axes for which the impulse response will be recorded
pdImpulseSize array with the pulse height (amplitude values).

Returns:

TRUE if no error **FALSE** otherwise

BOOL **PI_IsControllerReady** (int *ID*, int * *piControllerReady*)

Corresponding command: #7 (ASCII 7)

Asks controller for ready status (tests if controller is ready to perform a new command).

Arguments:

ID ID of controller
piControllerReady array to receive the status of the controller:1 if controller is ready 0 if controller is not ready (e.g. performing a referencing command)

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_IsMoving** (int *ID*, const char * *szAxes*, BOOL* *pbValueArray*)

Corresponding command: #5 (ASCII 5)

Check if *szAxes* are moving. If an axis is moving the corresponding element of the array will be TRUE, otherwise FALSE. If no axes were specified, only one boolean value is returned and *pbValarray[0]* will contain a generalized state: TRUE if at least one axis is moving, FALSE if no axis is moving.

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are affected.
pbValueArray array to receive the status of the axes

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_IsRunningMacro** (int *ID*, BOOL* *pbRunningMacro*)

Corresponding command: #8 (ASCII 8)

Check if controller is currently running a macro

Arguments:

ID ID of controller
pbRunningMacro pointer to boolean to receive answer: **TRUE** if a macro is running, **FALSE** otherwise

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_JAX** (int *ID*, const *int iJoystickID*, const int *iAxesID*, const char* *szAxesBuffer*)

Corresponding command: JAX

Set axis controlled by a joystick which is directly connected to the controller.

Each axis of the controller can only be controlled by one joystick axis.

See "Joystick Control" in the controller User Manual for details.

Arguments:

ID ID of controller
iJoystickID joystick device connected to the controller
iAxesID IDs of the joystick axes
szAxesBuffer name(s) of the axis or axes to be controlled by this joystick axis

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_JDT** (int *ID*, const int* *iJoystickIDs*, const int* *iAxesIDs*, const int* *piValarray*, int *iArraySize*)

Corresponding command: JDT

Set default lookup table for the given joystick axis of the given joystick which is directly connected to the controller.

The current valid lookup table for the specified joystick axis is overwritten by the selection made with PI_JDT().

See "Joystick Control" in the controller User Manual for details.

Arguments:
ID ID of controller
iJoystickIDs array with joystick devices connected to the controller
iAxesIDs array with joystick axis to be set
piValarray pointer to array with table types for the corresponding joystick axes, valid table types are:
1 = linear
2 = parabolic
iArraySize size of arrays

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_JLT** (int *ID*, int *iJoystickID*, int *iAxisID*, int *iStartAdress*, const double* *pdValueArray*,int *iArraySize*)

Corresponding command: JLT

Fills the lookup table for the given axis of the given joystick device which is connected to the controller.

Arguments:
ID ID of controller
iJoystickID joystick device connected to the controller
iAxisID joystick axis to be set
iStartAdress index of a point in the lookup table, starts with 1
pdValueArray values of the points in the lookup table
iArraySize size of arrays

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_JON** (int *ID*, const int* iJoystickIDs, const BOOL* pbValarray, int iArraySize)

Corresponding command: JON

Enable or disable a joystick which is directly connected to the controller.

The joystick must be enabled for joystick control of the controller axis which was assigned to the joystick axis with PI_JAX().

See "Joystick Control" in the controller User Manual for details.

Arguments:
ID ID of controller
iJoystickIDs array with joystick devices connected to the controller
pbValarray pointer to array with joystick enable states (0 for deactivate, 1 for activate)
iArraySize size of arrays

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_KCP** (int *ID*, const char* *szSource*, const char* *szDestination*)

Corresponding command: KCP

Copies a coordinate system.

Arguments:

ID ID of controller
szSource name of already defined coordinate system
szDestination name of coordinate system copy

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_KEN** (int *ID*, const char* *szNameOfCoordSystem*)

Corresponding command: KEN

Enables an already defined coordinate system.

Arguments:

ID ID of controller
szNameOfCoordSystem name of the coordinate system to be enabled

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_KLD** (int *ID*, const char* *szNameOfCoordSystem,* const char* *szAxes,* const double* *pdValueArray*)

Corresponding command: KLD

Defines a levelling coordinate system (KLD type). A coordinate system defined with KLD is intended to eliminate Hexapod misalignment. Use KLD in case misalignment is known via an external measurable deviation.

Arguments:

ID ID of controller
szNameOfCoordSystem name of the coordinate system to be defined
szAxes string with axes
pdValueArray positions (for axes X, Y, Z) and angles (for axes U, V, W)

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_KLF** (int *ID*, const char* *szNameOfCoordSystem*)

Corresponding command: KLF

Defines a levelling coordinate system (KLF type). A coordinate system defined with KLF is intended to eliminate Hexapod misalignment. Use KLF in case the Hexapod is already in the aligned position.

Arguments:

ID ID of controller
szNameOfCoordSystem name of the coordinate system to be defined

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_KLN** (int *ID*, const char* *szNameOfChild*, const char* *szNameOfParent*)

Corresponding command: KLN

Links two coordinate systems together by defining a parent-child relation; thus forming a chain.

Arguments:

ID ID of controller
szNameOfChild name of the child coordinate system
szNameOfParent name of the parent coordinate system

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_KRM** (int *ID*, const char* *szNameOfCoordSystem*)

Corresponding command: KRM

This command deletes a coordinate system

Arguments:
ID ID of controller
szNameOfCoordSystem name of the coordinate system to be deleted

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_KSB** (int *ID*, const char* *szNameOfCoordSystem,* const char* *szAxes,* const double* *pdValueArray*)

Corresponding command: KSB

Defines a new coordinate system of KSB type by changing the orientation of the base coordinate system (possible in steps of 90°).

Arguments:
ID ID of controller
szNameOfCoordSystem name of the coordinate system to be defined
szAxes string with axes, possible values are U, V, W
pdValueArray angles in degrees, possible values are 0, 90, 180, 270, -90, -180, -270

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_KSD** (int *ID*, const char* *szNameOfCoordSystem,* const char* *szAxes,* const double* *pdValueArray*)

Corresponding command: KSD

This command defines a new KSD type coordinate system. The center of rotation can be changed with the coordinates X, Y, Z. The orientation of the coordinate system can be changed with the coordinates U, V, W.

Arguments:
ID ID of controller
szNameOfCoordSystem name of the coordinate system to be defined
szAxes string with axes
pdValueArray positions (for axes X, Y, Z) and angles (for axes U, V, W)

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_KSF** (int *ID*, const char* *szNameOfCoordSystem*)

Corresponding command: KSF

This command defines a new KSF type coordinate system based on the current position and orientation of the Hexapod platform.

Arguments:
ID ID of controller
szNameOfCoordSystem name of the coordinate system to be defined

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_KST** (int *ID*, const char* *szNameOfCoordSystem,* const char* *szAxes,* const double* *pdValueArray*)

Corresponding command: KST

This command defines a new Tool coordinate system (KST type).

Arguments:

ID ID of controller
szNameOfCoordSystem name of the coordinate system to be defined
szAxes string with axes
pdValueArray positions (for axes X, Y, Z) and angles (for axes U, V, W)

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_KSW** (int *ID*, const char* *szNameOfCoordSystem,* const char* *szAxes,* const double* *pdValueArray*)

Corresponding command: KSW

This command defines a new Work coordinate system (KSW type).

Arguments:

ID ID of controller
szNameOfCoordSystem name of the coordinate system to be defined
szAxes string with axes
pdValueArray positions (for axes X, Y, Z) and angles (for axes U, V, W)

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_MAC_BEG** (int *ID*, const char * *szMacroName*)

Corresponding command: MAC BEG

Put the DLL in macro recording mode. This function sets a flag in the library and effects the operation of other functions. Function will fail if already in recording mode. If successful, the commands that follow become part of the macro, so do not check error state unless FALSE is returned. End the recording with PI_MAC_END().

See "Controller Macros" and the MAC command description in the controller User Manual for details.

Arguments:

ID ID of controller
szMacroName name under which macro will be stored in the controller

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_MAC_DEF** (int *ID*, const char * *szMacroName*)

Corresponding command: MAC DEF

Set macro with name *szMacroName* as start-up macro. This macro will be automatically executed with the next power-on or reboot of the controller. If *szMacroName* is omitted, the current start-up macro selection is canceled. To find out what macros are available call PI_qMAC().

See "Controller Macros" and the MAC command description in the controller User Manual for details.

Arguments:

ID ID of controller
szMacroName name of the macro to be the start-up macro

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_MAC_DEL** (int *ID*, const char * *szMacroName*)

Corresponding command: MAC DEL

Delete macro with name *szMacroName*. To find out what macros are available call PI_qMAC().

See "Controller Macros" and the MAC command description in the controller User Manual for details.

Arguments:

ID ID of controller

szMacroName name of the macro to delete

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_MAC_END** (int *ID*)

Corresponding command: MAC END

Take the DLL out of macro recording mode. This function resets a flag in the library and effects the operation of certain other functions. Function will fail if the DLL is not in recording mode.

See "Controller Macros" and the MAC command description in the controller User Manual for details.

Arguments:

ID ID of controller

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_MAC_NSTART** (int *ID*, const char * *szMacroName*, int *nrRuns*)

Corresponding command: MAC NSTART

Start macro with name *szMacroName*. The macro is repeated *nrRuns* times. To find out what macros are available call PI_qMAC().

See "Controller Macros" and the MAC command description in the controller User Manual for details.

Arguments:

ID ID of controller

szMacroName string with name of the macro to start

nrRuns number of runs

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_MAC_NSTART_Args** (int *ID*, const char * *szMacroName*, int *nrRuns,* const char* *szArgs*)

Corresponding command: MAC NSTART

Start macro with name *szMacroName*. The macro is repeated *nrRuns* times. Another execution is started when the last one is finished.

szArgs stands for the value of a local variable contained in the macro. The sequence of the values in the input must correspond to the numbering of the appropriate local variables, starting with the value of the local variable 1. The individual values must be separated from each other with spaces. A maximum of 256 characters are permitted per function line. *szArgs* can be given directly or via the value of another variable.

To find out what macros are available call PI_qMAC().

See "Controller Macros" and the MAC command description in the controller User Manual for details.

Arguments:

ID ID of controller

szMacroName string with name of the macro to start

nrRuns number of runs

szArgs value of a local variable contained in the macro

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_MAC_qDEF** (int *ID*, char * *szBuffer*, int *iBufferSize*)

Corresponding command: MAC DEF?

Ask for the start-up macro.

See "Controller Macros" and the MAC command description in the controller User Manual for details.

Arguments:

ID ID of controller

szBuffer buffer to receive the string read in from controller, contains the name of the start-up macro. If no start-up macro is defined, the response is an empty string with the terminating character.

iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_MAC_qERR** (int *ID*, char * *szBuffer*, int *iBufferSize*)

Corresponding command: MAC ERR?

Reports the last error which occurred during macro execution.

See "Controller Macros" and the MAC command description in the controller User Manual for details.

Arguments:

ID ID of controller

szBuffer buffer to receive the string read in from controller, contains the error code number.

iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise.

BOOL **PI_MAC_qFREE** (int *ID*, int * *pnFreeSpace*)

Corresponding command: MAC ERR?

Gets the free memory space for macro recording.

See "Controller Macros" and the MAC command description in the controller User Manual for details.

Arguments:

ID ID of controller

pnFreeSpace number of characters in bytes for which free memory is still available.

Returns:

TRUE if successful, **FALSE** otherwise.

BOOL **PI_MAC_START** (int *ID*, const char * *szMacroName*)

Corresponding command: MAC START

Start macro with name *szMacroName*. To find out what macros are available call PI_qMAC().

See "Controller Macros" and the MAC command description in the controller User Manual for details.

Arguments:

ID ID of controller

szMacroName string with name of the macro to start

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_MAC_START_Args** (int *ID*, const char * *szMacroName*, const char* *szArgs*)

Corresponding command: MAC START

Start macro with name *szName*. *szArgs* has the same function as with PI_MAC_NSTART_Args.

To find out what macros are available call PI_qMAC().

See "Controller Macros" and the MAC command description in the controller User Manual for details.

Arguments:

ID ID of controller
szMacroName string with name of the macro to start
szArgs value of a local variable contained in the macro

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_MEX** (int *ID*, const char * *szCondition*)

Corresponding command: MEX

Stop macro execution due to a given condition of the following type: a specified value is compared with a queried value according to a specified rule.

Can only be used in macros.

When the macro interpreter accesses this command the condition is checked. If it is true the current macro is stopped, otherwise macro execution is continued with the next line. Should the condition be fulfilled later, the interpreter will ignore it.

See also PI_WAC().

See "Controller Macros" and the MEX command description in the controller User Manual for details.

Arguments:

ID ID of controller
szCondition string with condition to evaluate **Returns:**
TRUE if successful, **FALSE** otherwise

BOOL **PI_MOD** (int *ID*, const char* *szItems*, const unsigned int * *iModeArray,* const char* *szValues*)

Corresponding command: MOD

Set modes for axes / channels / system.

Arguments:

ID ID of controller
szItems string with item identifiers
iModeArray array with IDs of modes to be set
zsValues string with values for each mode to be set

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_MOV** (int *ID*, const char* *szAxes*, const double* *pdValueArray*)

Corresponding command: MOV

Move *szAxes* to specified absolute positions. Axes will start moving to the new positions if ALL given targets are within the allowed ranges and ALL axes can move. All axes start moving simultaneously. Servo must be enabled for all commanded axes prior to using this command.

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray target positions for the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_MRT** (int *ID*, const char* *szAxes*, const double* *pdValueArray*)

Corresponding command: MRT

Move *szAxes* relative to current position and orientation in Tool coordinate system. Position and orientation of the Tool coordinate system change with each motion of the platform.

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray amounts to be added (algebraically) to current target positions of the axes

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_MRW** (int *ID*, const char* *szAxes*, const double* *pdValueArray*)

Corresponding command: MRW

Move *szAxes* relative to current position and orientation in Work coordinate system. Position and orientation of the Work coordinate system do NOT change with motions of the platform.

Arguments:
ID ID of controller
szAxes string with axes
pdValueArray amounts to be added (algebraically) to current target positions of the axes

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_MVE** (int *ID*, const char* *szAxes*, const double* *pdValueArray*)

Corresponding command: MVE

Set new absolute target positions for given axes. Axes will start moving to the new positions if ALL given targets are within the allowed range and ALL axes can move.

If the affected axes are mounted in a way that they move perpendicular to each other, the combined motion of them will describe a linear path. This is achieved by appropriate calculation of accelerations, velocities and decelerations. The current settings for velocity, acceleration and deceleration define the maximum possible values, and the slowest axis determines the resulting velocities.

All axes start moving simultaneously.

This command can be interrupted by PI_STP() and PI_HLT(). No other motion commands (e.g. PI_MOV(), PI_MVR()) are allowed during vector move.

Servo must be enabled for all commanded axes prior to using this command. If servo is switched off or motion error occurs during motion, all axes are stopped.

Arguments:
ID ID of controller
szAxes string with axes
pdValueArray target positions for the axes

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_MVR** (int *ID*, const char* *szAxes*, const double* *pdValueArray*)

Corresponding command: MVR

Move *szAxes* relative to current target position. The new target position is calculated by adding the given position value to the last commanded target value. Axes will start moving to the new position if ALL given targets are within the allowed range and ALL axes can move. All axes start moving simultaneously. Servo must be enabled for all commanded axes prior to using this command.

Arguments:
ID ID of controller
szAxes string with axes
pdValueArray amounts to be added (algebraically) to current target positions of the axes

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_NAV** (int *ID*, const int* *piAnalogChannelIds*, const int* *piNrReadingsValues,* int *iArraySize)*

Corresponding command: NAV

Determines the number of readout values of the analog input that are averaged.

Arguments:

ID ID of controller
piAnalogChannelIds identifier of the analog input channel
piNrReadingsValues number of readout values of the analog signal
iArraySize size of arrays *piAnalogChannelIds* and *piNrReadingsValues*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_NLM** (int *ID*, const char* *szAxes*, const double* *pdValueArray*)

Corresponding command: NLM

Set lower limits ("soft limit") for the positions of *szAxes*.

Depending on the controller, the soft limits are activated and deactivated with PI_SSL().

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray lower limits for position

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_OAC** (int *ID*, const int* *piPIEZOWALKChannelsArray*, const double* *pdValueArray*, int *iArraySize*);

Corresponding command: OAC

Set open-loop acceleration of szAxes. The PI_OAC setting only takes effect when the given axis is in open-loop operation (servo off).

Arguments:

ID ID of controller
piPIEZOWALKChannelsArray array with PiezoWalk channels
pdValueArray acceleration value
iArraySize the size of the arrays with the PiezoWalk channels and accerlation values

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_OAD** (int *ID*, const int* *piPIEZOWALKChannelsArray*, const double* *pdValueArray*, int *iArraySize*)

Corresponding command: OAD

Open-loop analog driving of the given PiezoWalk channel.

Servo must be disabled for the commanded axis prior to using this command (open-loop operation).

Arguments:

ID ID of controller
piPIEZOWALKChannelsArray array with PiezoWalk channels
pdValueArray is the feed voltage amplitude in V, see above for details
iArraySize the size of the arrays with the PiezoWalk channels and feed voltages

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_ODC** (int *ID*, const int* *piPIEZOWALKChannelsArray*, const double* *pdValueArray*, int *iArraySize*);

Corresponding command: ODC

Set open-loop deceleration of *szAxes*. The PI_ODC setting only takes effect when the given axis is in open-loop operation (servo off).

Arguments:

ID ID of controller
piPIEZOWALKChannelsArray array with PiezoWalk channels
pdValueArray deceleration value
iArraySize the size of the arrays with the PiezoWalk channels and deceleration values

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_OMA** (int *ID*, const char* *szAxes*, const double* *pdValueArray*);

Corresponding command: OMA

Commands *szAxes* to the given absolute position. Motion is realized in open-loop nanostepping mode. Servo must be disabled for the commanded axis prior to using this function (open-loop operation).

With PI_OMA() there is no position control (i.e. the target position is not maintained by any control loop).

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray target positions for the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_OMR** (int *ID*, const char* *szAxes*, const double* *pdValueArray*);

Corresponding command: OMR

Commands *szAxes* to a position relative to the last commanded open-loop target position. The new open-loop target position is calculated by adding the given value *pdValueArray* to the last commanded target value. Motion is realized in nanostepping mode. Servo must be disabled for the commanded axis prior to using this function (open-loop operation). With PI_OMR there is no position control (i.e. the target position is not maintained by a control loop).

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray target positions for the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_ONL** (int *ID*, const int* *iPiezoChannels*, const int* *pdValarray*, int *iArraySize*)

Corresponding command: ONL

Sets control mode for given piezo channel (ONLINE or OFFLINE mode).

Arguments:

ID ID of controller
iPiezoChannels string with piezo channels
pbValueArray gives the control mode, can have the following values:

0 = OFFLINE mode, the output voltage depends on analog control input and DC offset applied to the channel
1 = ONLINE mode, the controller controls the generation of the output voltage
In ONLINE mode the SERVO switches of all channels must be set to OFF on the piezo control electronics.

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_OSM** (int *ID*, const int* *piPIEZOWALKChannelsArray*, const int* piValueArray, int *iArraySize*)

Corresponding command: OSM
Open-loop step moving of the given PiezoWalk channel.
Prior to using PI_OSM(), servo must be disabled for the axis to which the PiezoWalk channel is assigned (open-loop operation).
Arguments:
ID ID of controller
piPIEZOWALKChannelsArray array with PiezoWalk channels
piValueArray number of steps for the PiezoWalk channels (integer steps only)
iArraySize the size of the arrays with the PiezoWalk channels and number of steps
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_OSMf** (int *ID*, const int* *piPIEZOWALKChannelsArray*, const double* *pdValueArray*, int *iArraySize*)

Corresponding command: OSM
Open-loop step moving of the given PiezoWalk channel.
Prior to using PI_OSMf(), servo must be disabled for the axis to which the PiezoWalk channel is assigned (open-loop operation).
PI_OSMf() is identical with PI_OSM() but allows to command parts of a step cycle (floating-point numbers are accepted).
Arguments:
ID ID of controller
piPIEZOWALKChannelsArray array with PiezoWalk channels
pdValueArray number of steps for the PiezoWalk channels (floating-point numbers)
iArraySize the size of the arrays with the PiezoWalk channels and number of steps
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_OVL** (int *ID*, const int* *piPIEZOWALKChannelsArray*, double* *pdValueArray, int ArraySize*)

Corresponding command: OVL
Set velocity for open-loop nanostepping motion of given PiezoWalk channel.
The PI_OVL() setting only takes effect when the given axis is in open-loop operation (servo off).
Arguments:
ID ID of controller
piPIEZOWALKChannelsArray Array with PIEZOWALK channels
pdValueArray maximum velocities for the axes
iArraySize number of items in arrays
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_PLM** (int *ID*, const char* *szAxes*, const double* *pdValueArray*)

Corresponding command: PLM

Set upper limits ("soft limit") for the positions of *szAxes*.

Depending on the controller, the soft limits are activated and deactivated with PI_SSL().

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray upper limits for position

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_POS** (int *ID*, const char* *szAxes*, const double* *pdValueArray*)

Corresponding command: POS

Set current position for given axis (does not cause motion). An axis is considered as "referenced" when the position was set with PI_POS(), so that PI_qFRF() replies "1". Setting the current position with PI_POS() is only possible when the referencing mode is set to "0", see PI_RON().

CAUTION:

The "software-based" travel range limits (PI_qTMN() and PI_qTMX()) and the "software-based" home position (PI_qDHF()) are not adapted when a position value is set with PI_POS(). This may result in

- target positions which are inside the range limits but can not be reached by the hardware—the mechanics is at the hardstop but tries to move further and must be stopped with PI_STP()
- target positions which can be reached by the hardware but are outside of the range limits—e.g. the mechanics is at the negative hardstop and physically could move to the positive hardstop, but due to the software based-travel range limits the target position is not accepted and no motion is possible
- a home position which is outside of the travel range.

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray new axis positions in physical units

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qACC** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: ACC?

Gets the acceleration value set with PI_ACC() for closed-loop operation.

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to be filled with the acceleration settings of the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qAOS** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: AOS?

Get **A**nalog Input **O**ffset, which was set by PI_AOS() or by a parameter command.

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to be filled with analog offset of the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qATC** (int *ID*, const int* *piChannels*, int* *piValueArray*, int *iArraySize*)

Corresponding command: ATC?

Get the options used for the latest auto calibration procedure started with PI_ATC().

See "Calibration Settings" in the User Manual of the controller for more information.

Arguments:

ID ID of controller

piChannels string with channels of the piezo control electronics

piValueArray comprises the settings of the latest auto calibration procedure.

iArraySize size of arrays

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qATZ** (int *ID*, const char* *szAxes,* int* *piAtzResult*)

Corresponding command: ATZ?

Reports if the AutoZero procedure called by PI_ATZ() was successful

Arguments:

ID ID of controller

szAxes string with axes, if "" or **NULL** all axes are queried.

piAtzResult 1 if PI_ATZ was successful performed, 0 if not successful

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qATS** (int *ID*, const int* *piChannels*, const int* *piOptions*, int* *piValueArray*, int *iArraySize*)

Corresponding command: ATS?

Query the results of the latest auto calibration procedure started with PI_ATC().

See "Calibration Settings" in the User Manual of the controller for more information.

Arguments:

ID ID of controller

piChannels string with channels of the piezo control electronics

piOptions gives the option to be queried. See PI_ATC() for details.

piValueArray gives the results of the latest auto calibration procedure. If 0, the PI_ATC() procedure was successful. Values >0 indicate option specific error codes; multiple non-zero error codes for the same channel and option will be listed one after another.

iArraySize size of arrays

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qBRA** (const int *ID*, char * *szBuffer*, const int *maxlen*)

Corresponding command: BRA?

Gets brake activation state of given axes.

Arguments:

ID ID of controller

szBuffer buffer to store the read in string

maxlen size of *buffer*, must be given to avoid a buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qCAV** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: CAV?

Get the current value of the variable controlled by the selected closed-loop control mode (see PI_CMO() for selection).

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to be filled with current values of the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qCCL** (int *ID*, int* *piCommandLevel*)

Corresponding command: CCL?

Returns the current *CommandLevel*.

Arguments:

ID ID of controller
piCommandLevel variable to receive the current command level. See PI_CCL() for possible values.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qCCV** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: CCV?

Get currently valid control value.

PI_qCCV() queries the control value in open-loop and closed-loop operation.

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to be filled with current control values of the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qCMN** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: CMN?

Get the minimum commandable closed-loop target *of szAxes.* The physical unit and hence the interpretation of the value depend on the closed-loop control mode which is selected for the axis (see PI_CMO() for selection).

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to receive the minimum commandable closed-loop target of the axes in physical units.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qCMO** (int *ID*, const char* *szAxes*, int* *piValueArray*)

Corresponding command: CMO?

Get the closed-loop control mode which is currently selected for *szAxes*..**Arguments:**

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried
piValueArray array to receive modes for the specified axes

Returns:
TRUE if successful, **FALSE** otherwise (see p. 7)

BOOL **PI_qCMX** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: CMX?
Get the maximum commandable closed-loop target of *szAxes.* The physical unit and hence the interpretation of the value depend on the closed-loop control mode which is selected for the axis (see PI_CMO() for selection).
Arguments:
ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried
pdValueArray array to receive the maximum commandable closed-loop target of the axes in physical units.
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qCOV** (int *ID*, const int* *piChannelsArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: COV?
Get current open-loop velocity
Arguments:
ID ID of controller
piChannelsArray is an array with the channels to be queried
pdValueArray array to receive the values
iArraySize is the size of the array **pdValueArray**
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qCST** (int *ID*, const char* *szAxes*, char* *szNames*, int *iBufferSize*)

Corresponding command: CST?
Get the type names of the stages associated with *szAxes*. The individual names are preceded by the one-character axis identifier followed by "=" the stage name and a "\n" (line-feed). The line-feed is preceded by a space on every line except the last.
Arguments:
ID ID of controller
szAxes identifiers of the axes, if "" or **NULL** all axes are queried
szNames buffer to receive the string read in from controller, lines are separated by '\n' ("line-feed")
iBufferSize size of *szNames*, must be given to avoid a buffer overflow.
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qCSV** (int *ID*, double* *pdCommandSyntaxVersion*)

Corresponding command: CSV?
Returns the current *CommandSyntaxVersion*.
Arguments:
ID ID of controller
pdCommandSyntaxVersion variable to receive the current command syntax version (2.0 for GCS 2.0).
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qCTI** (int *ID*, const int* *piTriggerInputIds*, const int* *piTriggerParameterArray*, char* *szValueArray*, int *iArraySize,* int *iBufferSize*)

Corresponding command: CTI?
Get the trigger input configuration for the given trigger input line.

Arguments:
ID ID of controller
piTriggerInputIds is an array with the trigger input lines of the controller
piTriggerParameterArray is an array with the CTI parameter IDs
szValueArray buffer to receive the values to which the CTI parameters are set, each line has a value of a single CTI parameter, lines are separated by '\n' ("line-feed")
iArraySize is the size of the array *piTriggerInputIds*
iBufferSize size of *szValueArray*, must be given to avoid a buffer overflow.
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qCTO** (int *ID*, const int* *piTriggerOutputIds*, const int* *piTriggerParameterArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: CTO?
Get the trigger output configuration for the given trigger output line.

Arguments:
ID ID of controller
piTriggerOutputIds is an array with the trigger output lines of the controller
piTriggerParameterArray is an array with the CTO parameter IDs
pdValueArray buffer to receive the values to which the CTO parameters are set
iArraySize is the size of the array *piTriggerOutputIds*
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qCTOString** (int *ID*, const int* *piTriggerOutputIds*, const int* *piTriggerParameterArray*, char* *szValueArray*, int *iArraySize,* int *iBufferSize)*

Corresponding command: CTO?
Get the trigger output configuration for the given trigger output line.

Arguments:
ID ID of controller
piTriggerOutputIds is an array with the trigger output lines of the controller
piTriggerParameterArray is an array with the CTO parameter IDs
szValueArray buffer to receive the values to which the CTO parameters are set, each line has a value of a single CTO parameter, lines are separated by '\n' ("line-feed")
iArraySize is the size of the array *piTriggerOutputIds*
iBufferSize size of *szValueArray*, must be given to avoid a buffer overflow.
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qCTV** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: CTV?
Get the currently valid closed-loop target for *szAxes*. The physical unit and hence the interpretation of the value depend on the closed-loop control mode which is selected for the axis (see PI_CMO() for selection).
Use PI_qCAV() to get the current value of the controlled variable.
Arguments:
ID ID of controller

szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to be filled with target values of the axes

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qDCO** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)

Corresponding command: DCO?
Gets drift compensation mode of *szAxes*

Arguments:
ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried
pbValueArray array to receive the drift compensation modes of the specified axes, **TRUE** for "on", **FALSE** for "off"

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qDEC** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: DEC?
Gets the deceleration value for closed-loop operation set with PI_DEC().

Arguments:
ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to be filled with the deceleration settings of the axes

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qDFH** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: DFH?
Returns the sensor positions the current home position definitions of *szAxes* are based on.

Arguments:
ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to receive the sensor positions that were valid when PI_DFH() was called the last time (are used as offsets for the calculation of the current axis positions)

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qDIO** (int *ID*, const long* *piChannelsArray*, BOOL* *pbValueArray*, int *iArraySize*)

Corresponding command: DIO?
Returns the states of the specified digital input channels.
Use PI_qTIO() (p. 90) to get the number of installed digital I/O channels.

Arguments:
ID ID of controller
piChannelsArray array containing digital output channel identifiers
pbValueArray array containing the states of specified digital ouput channels, **TRUE** if HIGH, **FALSE** if LOW
Depending on the controller, piChannelsArray can contain 0. In this case, the array is a bit pattern which gives the states of all lines.
iArraySize the size of piChannelsArrayand pbValueArray

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qDRC** (int *ID*, const int* *piRecordTableIdsArray*, char* *szRecordSourceIds*, int* *piRecordOptionArray*, int *iRecordSourceIdsBufferSize*, int *iRecordOptionArraySize*

Corresponding command: DRC?
Returns the data recorder configuration for the queried record table. The configuration can be changed with PI_DRC(). The recorded data can be read with PI_qDRR().
Trigger options for recording can be set with PI_DRT() and read with PI_qDRT().
Arguments:
ID ID of controller
piRecordTableIdsArray array of the record table IDs.
szRecordSourceIds array to receive the record source (for example axis number or channel number. The meaning of this value depends on the corresponding record option).
piRecordOptionsArray array to receive the record option, i.e. the kind of data to be recorded
iRecordSourceIdsBufferSize size of *szRecordSourceIds*, must be given to avoid a buffer overflow
iRecordOptionArraySize size of *piRecordTableIdsArray and piRecordOptionsArray*
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qDRL** (int *ID*, const int* *piRecordTableIdsArray,* int* *piNumberOfRecordedValuesArray,* int *iArraySize*)

Corresponding command: DRL?
Reads the number of points comprised by the last recording, i.e. the number of values that have been recorded since data recording was last triggered. This way it is possible to find out if recording has been finished (all desired points are in the record table) or to find out how many points can be currently read from the record table. Depending on the controller, reading more points than the number returned by PI_qDRL can also read old record table content.
Arguments:
ID ID of controller
piRecordTableIdsArray array of the record channel IDs
piNumberOfRecordedValuesArray array to receive the number of values that have been recorded since recording was last triggered or PI_DRC() was called for the record channel
iArraySize the size of the arrays *piRecordTableIdsArray*, *piNumberOfRecordedValuesArray*
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qDRR** (int *ID*, const int* *piRecTableIdsArray*, int *iNumberOfRecTables*, int *iOffsetOfFirstPointInRecordTable*, int *iNumberOfValues*, double** *pdValueArray*, char* *szGcsArrayHeader*, int *iGcsArrayHeaderMaxSize*)

Corresponding command: DRR?
Read data record tables. This function reads the data asynchronously, it will return as soon as the data header has been read and start a background process which reads in the data itself. See PI_GetAsyncBuffer() and PI_GetAsyncBufferIndex(). Detailed information about the data read in can be found in the header sent by the controller. See the GCS Array manual for details.
It is possible to read the data while recording is still in progress.
The data is stored on the controller only until a new recording is done or the controller is powered down.
For more information see “Data Recorder” in the controller User Manual.
Arguments:
ID ID of controller
piRecTableIdArray IDs of data record tables

iNumberOfRecTables number of record tables to read
iOffsetOfFirstPointInRecordTable index of first value to be read (starts with index 1)
iNumberOfValues number of values to read
pdValarray pointer to internal array to store the data; data from all tables read will be placed in the same array with the values interspersed; the DLL will allocate enough memory to store all data, call **PI_GetAsyncBufferIndex()** to find out how many data points have already been transferred
szGcsArrayHeader buffer to store the GCS array header
iGcsArrayHeaderMaxSize size of the buffer to store the GCS Array header, must be given to prevent buffer overflow

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_qDRR_SYNC** (int *ID*, int *iRecordTableId*, int *iOffsetOfFirstPointInRecordTable*, int *iNumberOfValues*, double* *pdValueArray*)

Corresponding command: DRR?

Returns the data points of the last recorded data set.

It is possible to read the data while recording is still in progress.

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

For detailed information see “Data Recorder” in the controller User Manual.

Arguments:
ID ID of controller
iRecordTableId Id of the record table.
iOffsetOfFirstPointInRecordTable The start point in the specified record table (starts with index 1)
iNumberOfValues The number of values to read.
pdValueArray array to receive the values

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qDRT** (int *ID*, const int* *piRecordTableIdsArray*, int* *piTriggerSourceArray*, char* *szValues*, int *iArraySize*, int *iValueBufferLength*)

Corresponding command: DRT?

Returns the current trigger source setting for the given data recorder table.

Arguments:
ID ID of controller
piRecordTableIdsArray array of the record table IDs
piTriggerSourceArray array to receive the trigger source
szValues buffer to receive the trigger-source-dependent value
iArraySize size of *piRecordTableIdsArray* and *piTriggerSourceArray*
iValueBufferLength size of *szValues,* must be given to prevent buffer overflow

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qEAX** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)

Corresponding command: EAX?

Get enable status of axes: enabled/not enabled.

Arguments:
ID ID of controller
szAxes string with axes
pbValueArray enable status for the specified axes, **TRUE** for “enabled”, **FALSE** for "not enabled"

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qECO** (int *ID*, const char* *szSendString, char* szValues*, int *iBufferSize*)

Corresponding command: ECO?

Returns a string. PI_qECO() can be used to test the communication.

Arguments:

ID ID of controller
szSendString array of any given combination of characters consisting of letters and numbers
szValues buffer to receive the string read in from controller
iBufferSize size of *szValues*

Returns:

TRUE if query successful, **FALSE** otherwise

BOOL **PI_qERR** (int *ID*, long* *pnError*)

Corresponding command: ERR?

Get the error state of the controller. Because the DLL may have queried (and cleared) controller error conditions on its own, it is safer to call PI_GetError() which will first check the internal error state of the library. For a list of possible error codes see p. 123.

Arguments:

ID ID of controller
pnError integer to receive error code of the controller

Returns:

TRUE if query successful, **FALSE** otherwise

BOOL **PI_qFGC**(int *ID*, const char* *szProcessIds*, double* *pdScanAxisCenterValueArray*, double* *pdStepAxisCenterValueArray*)

Corresponding command: FGC?

Fast alignment: Gets the current center position of the circular motion of a gradient search routine.

Arguments:

ID ID of controller
szProcessIds The identifier of the routine.
pdScanAxisCenterValueArray Current center position of the circular motion for the scan axis
pdStepAxisCenterValueArray Current center position of the circular motion for the step axis

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qFPH** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)

Corresponding command: FPH?

Gets found phase (offset between motor and encoder) for *szAxes.*

Arguments:

ID ID of controller
szAxes string with axes
pbValueArray array to receive the phase offsets found for the specified axes, **TRUE** for "on", **FALSE** for "off"

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qFRC** (int *ID*, const char* *szProcessIdsBase*, char* *szBuffer*, int *iBufferSize*)

Corresponding command: FRC?
Fast alignment: Gets coupled fast alignment routines.
Arguments:
ID ID of controller
szProcessIdBase The identifier of the routine to be queried.
szBuffer buffer to receive the string read in from controller, lines are separated by '\n' ("line-feed"). Contains the identifiers of routines that are coupled to the routine given by *szProcessIdBase*.
iBufferSize size of szBuffer, must be given to avoid buffer overflow.
Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_qFRF** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)

Corresponding command: FRF?
Indicates whether the given axis is referenced or not.
An axis is considered as "referenced" when the current position value is set to a known position. Depending on the controller, this is the case if a reference move was successfully executed with PI_FRF(), PI_FNL() or PI_FPL(), or if the position was set manually with PI_POS().
Arguments:
ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are affected.
pbValueArray array to receive, 1 if successful, 0 if axis is not referenced (e.g. referencing move failed or has not finished yet)
Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_qFRH** (int *ID*, char* *szBuffer*, int *iBufferSize*)

Corresponding command: FRH?
Fast alignment: Lists descriptions and physical units for the routine results that can be queried with PI_qFRR().
Arguments:
ID ID of controller
szBuffer buffer to receive the string read in from controller, lines are separated by '\n' ("line-feed")
iBufferSize size of szBuffer, must be given to avoid buffer overflow
Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_qFRP** (int *ID*, const char* *szScanRoutineNames*, int* *piOptionsArray*)

Corresponding command: FRP?

Fast alignment: Gets the current state of a fast alignment routine.
Arguments:
ID ID of controller
szScanRoutineNames The identifier of the routine.
piOptionsArray is the current state of the routine. Possible states:
0 = routine has been stopped / is not running
1 = routine has been paused
2 = routine is running
If no routine ID is given, the state of all routines is returned.
Returns:
TRUE if successful, FALSE otherwise (see p. 7)

BOOL **PI_qFRR** (int *ID*, const char* *szScanRoutineNames*, const unsigned int* *iResultIdsArray*, char* *szResult*, int *iBufferSize*)

Corresponding command: FRR?

Fast alignment: Gets the results of a fast alignment routine. See the E712T0016 Technical Note for valid result identifiers and possible results. Use the response to PI_qFRH() to get information on the supported result identifiers.

Arguments:

ID ID of controller

szScanRoutineNames The identifier of the routine. If no routine identifier is given, all available results are queried.

iResultIdsArray The identifier of the result. If no result identifier is given, all available results for the given routine are queried.

szResult buffer to receive the string read in from controller, lines are separated by '\n' ("line-feed")

iBufferSize size of szBuffer, must be given to avoid buffer overflow.")

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qFSS** (int *ID*, int* *piResult)*

Corresponding command: FSS?

Gets the status of the last scanning procedure that was started.

In order to check whether a scanning procedure is still going on, the motion status of the axes can be queried with PI_IsMoving().

PI_qFSS() gets the status of scanning procedures that are started with the following commands: PI_AAP(), PI_FIO(), PI_FLM(), PI_FLS(), PI_FSA(), PI_FSC(), PI_FSM()

Arguments:

ID ID of controller

piResult indicates the status of the last scanning procedure that was started.

1: Scanning procedure has been successfully completed

0: Scanning procedure is still going on or has been unsuccessfully completed.

Returns:

TRUE if successful, FALSE otherwise (see p. 7)

BOOL **PI_qHAR** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)

Corresponding command: HAR?

Gets whether the hard stops of the axis can be used for reference moves.

Arguments:

ID ID of controller

szAxes string with axes

pbValueArray indicates whether the axis can be referenced using the hard stop (= 1) or not (= 0).

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qHDR** (int *ID*, char* *szBuffer*, int *iBufferSize*)

Corresponding command: HDR?

Lists a help string which contains all information available for data recording (record options and trigger options, information about additional parameters and commands regarding data recording).

For more information see “Data Recorder” in the controller User Manual.

Arguments:

ID ID of controller
szBuffer buffer to receive the string read in from controller, lines are separated by '\n' ("line-feed")
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qHDT** (int *ID*, const int* *iDeviceIDsArray*, const int* *iAxisIDsArray*, int* *piValueArray*, int *iArraySize*)

Corresponding command: HDT?

Gets the currently assigned lookup table for the given axis of the given HID device.

Arguments:

ID ID of controller
iDeviceIDsArray HID devices connected to the controller.
iAxisIDsArray axes of the HID device(s)
piValueArray lookup tables assigned to the axes of the HID device(s), see PI_HDT() for available tables
iArraySize size of *iDeviceIDsArray*, *iAxisIDsArray* and *piValueArray*

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qHIA** (int *ID*, const char* *szAxes*, const int* *iFunctionArray*, int* *iDeviceIDsArray*, int* *iAxesIDsArray*)

Corresponding command: HIA?

Gets the current control configuration for the given motion parameter of the given axis of the controller, i. e. the currently assigned axis of an HID device.

Arguments:

ID ID of controller
szAxes string with axes of the controller
iFunctionArray motion parameters to be queried
iDeviceIDsArray IDs of the HID devices used for HID control
iAxesIDsArray IDs of the axes of the HID device(s) used for HID control

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qHIB** (int *ID*, const int* *iDeviceIDsArray*, const int* *iButtonIDsArray*, int* *pbValueArray*, int *iArraySize*)

Corresponding command: HIB?

Gets the current state of the given button of the given HID device.

Arguments:

ID ID of controller
iDeviceIDsArray HID devices connected to the controller
iButtonIDsArray buttons of the HID device(s)
pbValueArray array to receive the states of the buttons
iArraySize size of *iDeviceIDsArray*, *iButtonIDsArray* and *pbValueArray*

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qHIE** (int *ID*, const int* *iDeviceIDsArray*, const int* *iAxesIDsArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: HIE?

Gets the current displacement of the given axis of the given HID device.

Arguments:

ID ID of controller
iDeviceIDsArray HID devices connected to the controller
iAxesIDsArray axes of the HID device(s)
pdValueArray array to receive the displacement of the axes of the HID device(s)
iArraySize size of *iDeviceIDsArray*, *iAxesIDsArray* and *pdValueArray*

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qHIL** (int *ID*, const int* *iDeviceIDsArray*, const int* *iLED_IDsArray*, int* *pnValueArray*, int *iArraySize*)

Corresponding command: HIL?

Gets the current state of the given output unit or characteristic ("LED") of the given HID device.

Arguments:

ID ID of controller
iDeviceIDsArray HID devices connected to the controller
iLED_IdsArray output units or characteristics ("LEDs") of the HID device(s)
pnValueArray array to receive the states of the LEDs
iArraySize size of *iDeviceIDsArray*, *iLED_IDsArray* and *pnValueArray*

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qHIN** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)

Corresponding command: HIN?

Gets the activation state of the control by HID devices ("HID control") for the given axis of the controller.

Arguments:

ID ID of controller
szAxes string with axes
pbValueArray array to receive the activation state of the HID control

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qHIS** (int *ID*, char* *szBuffer*, int *iBufferSize*)

Corresponding command: HIS?

Gets the properties of the operating elements of HID devices connected to the controller.

Arguments:

ID ID of controller
szBuffer buffer to receive the string read in from controller, lines are separated by '\n' ("line-feed")
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:

TRUE if no error, FALSE otherwise

BOOL **PI_qHIT** (int *ID*, const int* *piTableIdsArray*, int *iNumberOfTables*, int *iOffsetOfFirstPointInTable*, int *iNumberOfValues*, double** *pdValueArray*, char* *szGcsArrayHeader*, int *iGcsArrayHeaderMaxSize*)

Corresponding command: HIT?

Gets the values of the given points in the given lookup table.

Arguments:

ID ID of controller
piTableIdsArray IDs of the lookup tables of the controller
iNumberOfTables number of tables to read
iOffsetOfFirstPointInTable index of first point to be read (starts with index 1)
iNumberOfValues number of points to read
pdValueArray pointer to internal array to store the data; data from all tables read will be placed in the same array with the values interspersed; the DLL will allocate enough memory to store all data, call PI_GetAsyncBufferIndex() to find out how many data points have already been transferred
szGcsArrayHeader buffer to store the GCS array header
iGcsArrayHeaderMaxSize size of the buffer to store the GCS array header, must be given to prevent buffer overflow

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qHLP** (int *ID*, char* *szBuffer*, int *iBufferSize*)

Corresponding command: HLP?

Read in the help string from the controller. The answer is quite long (up to 3000 characters) so be sure to provide enough space! (And you may have to wait a bit...)

Arguments:

ID ID of controller
szBuffer buffer to receive the string read in from controller, lines are separated by '\n' ("line-feed")
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qHPA** (int *ID*, char* *szBuffer*, int *iBufferSize*)

Corresponding command: HPA?

Lists a help string which contains all available parameters with short descriptions. See the user manual of the controller for an appropriate list of all parameters available for your controller.

Arguments:

ID ID of controller
szBuffer buffer to receive the string read in from controller, lines are separated by '\n' ("line-feed")
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qHPV** (int *ID*, char* *szBuffer*, int *iBufferSize*)

Corresponding command: HPV?

Responds with a help string which contains possible parameters values. Use PI_qHPA instead to get a help string which contains all available parameters with short descriptions.

Arguments:

ID ID of controller
szBuffer buffer to receive the string read in from controller, lines are separated by '\n' ("line-feed").
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qIDN** (int *ID*, char* *szBuffer*, int *iBufferSize*)

Corresponding command: *IDN?

Get identification string of the controller.

Arguments:

ID ID of controller

szBuffer buffer to receive the string read in from controller

iBufferSize size of *szBuffer*, must be given to avoid a buffer overflow.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qIFC** (int *ID*, const char* *szParameters*, char* *szBuffer*, int *iBufferSize*)

Corresponding command: IFC?

Get the interface configuration from volatile memory.

Arguments:

ID ID of controller

szParameters the interface parameter to be queried, can be RSBAUD, GPADR, IPADR, IPSTART, IPMASK and MACADR (depends on the controller)

szBuffer Buffer to receive the values of the parameters from volatile memory

iBufferSize the size of the buffer *szBuffer*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qIFS** (int *ID*, const char* *szParameters*, char* *szBuffer*, int *iBufferSize*)

Corresponding command: IFS?

Get the interface configuration stored in non-volatile memory (this is the current power-on default).

Arguments:

ID ID of controller

szParameters the interface parameters to be queried, can be RSBAUD, GPADR, IPADR, IPSTART, IPMASK and MACADR (depends on the controller)

szBuffer buffer to receive the values of the parameters from non-volatile memory

iBufferSize size of *szBuffer,* must be given to avoid a buffer overflow.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qIMP** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: IMP?

Get last sent impulse parameters for given axis (sent with PI_IMP()).

Arguments:

ID ID of controller

szAxes axis for which the impulse parameters are to be read

pdValueArray Array to be filled with impulse parameters of the axes; currently only the pulse height.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qJAS** (int *ID*, const int* *iJoystickIDsArray*, const int* *iAxesIDsArray*, double* *pdValarray*, int *iArraySize*)

Corresponding command: JAS?

Get the current status of the given axis of the given joystick device which is directly connected to the controller. The reported factor is applied to the velocity set with PI_VEL() (closed-loop operation) or PI_OVL() (open-loop operation), the range is -1.0 to 1.0.

See "Joystick Control" in the controller User Manual for details.

Arguments:

ID ID of controller
iJoystickIDsArray array with joystick devices connected to the controller
iAxesDsArray array with joystick axes
pdValarray pointer to array to receive the joystick axis amplitude, i.e. the factor which is currently applied to the current valid velocity setting of the controlled motion axis; corresponds to the current displacement of the joystick axis.
iArraySize size of arrays

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qJAX** (int *ID*, const int* *iJoystickIDsArray*, const int* *iAxesIDsArray*, int *iArraySize*, char* *szAxesBuffer*, int *iBufferSize*)

Corresponding command: JAX?

Get axis controlled by a joystick axis of a joystick device which is directly connected to the controller.

See "Joystick Control" in the controller User Manual for details.

Arguments:

ID ID of controller
iJoystickIDsArray array with joystick devices connected to the controller
iAxesIDsArray array with IDs of the joystick axes
iArraySize size of arrays
buffer buffer to receive the string read in from controller; will contain axis IDs of axes associated with corresponding joystick axis
maxlen size of *buffer*, must be given to avoid buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qJBS** (int *ID*, const int* *iJoystickIDsArray*, const int* *iButtonIDsArray*, BOOL* *pbValarray*, int *iArraySize*)

Corresponding command: JBS?

Get the current status of the given button of the given joystick device which is directly connected to the controller.

See "Joystick Control" in the controller User Manual for details.

Arguments:

ID ID of controller
iJoystickIDsArray array with joystick devices connected to the controller
iButtonIDsArray array with joystick buttons
pbValarray pointer to array to receive the joystick button state, indicates if the joystick button is pressed; 0 = not pressed, 1 = pressed
iArraySize size of arrays

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qJLT** (int *ID*, const int* *iJoystickIDsArray*, const int* *iAxisIDsArray*, int *iNumberOfTables*, int *iOffsetOfFirstPointInTable*, int *iNumberOfValues*, double** *pdValueArray*, char* *szGcsArrayHeader*, int *iGcsArrayHeaderMaxSize*)

Corresponding command: JLT?

Get joystick lookup table values.

Arguments:

ID ID of controller
szAxes string with axes
iJoystickIDsArray array with joystick devices connected to the controller
iAxisIDsArray array with joystick axes
iNumberOfTables number of tables to read
iOffsetOfFirstPointInTable index of first point to be read (starts with index 1)
iNumberOfValues number of points to read
pdValueArray pointer to internal array to store the data; data from all tables read will be placed in the same array with the values interspersed; the DLL will allocate enough memory to store all data, call PI_GetAsyncBufferIndex() to find out how many data points have already been transferred
szGcsArrayHeader buffer to store the GCS array header
iGcsArrayHeaderMaxSize size of the buffer to store the GCS array header, must be given to prevent buffer overflow

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qJON** (int *ID*, const int* *iJoystickIDsArray*, BOOL* *pbValarray*, int *iArraySize*)

Corresponding command: JON?

Get activation state of the given joystick device which is directly connected to the controller.
See "Joystick Control" in the controller User Manual for details.

Arguments:

ID ID of controller
iJoystickIDsArray array with joystick devices connected to the controller
pbValarray pointer to array to receive the joystick enable states (0 for deactivated, 1 for activated)
iArraySize size of arrays

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qKEN** (int *ID*, const char* *szNamesOfCoordSystems*, char* *buffer*, int *bufsize*)

Corresponding command: KEN?

Lists enabled coordinate systems by name.

Arguments:

ID ID of controller
szNamesOfCoordSystems string with name of the coordinate system. Can be NULL or “” to return all
szBuffer buffer to receive the string read in from controller, lines are separated by line-feed characters
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qKET** (int *ID*, const char* *szNamesOfCoordSystems*, char* *buffer*, int *bufsize*)

Corresponding command: KET?

Lists enabled coordinate systems by type.

Arguments:

ID ID of controller
szNamesOfCoordSystems string with name of the coordinate system. Can be NULL or "" to return all
szBuffer buffer to receive the string read in from controller, lines are separated by line-feed characters
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qKLC** (int *ID*, const char* *szNamesOfCoordSystem1*, const char* *szNamesOfCoordSystem2*, const char* *szItem1*, const char* *szItem2*, char* *buffer*, int *bufsize*)

Corresponding command: KLC?

Lists properties of combinations of Work and Tool coordinate systems.

Arguments:

ID ID of controller
szNamesOfCoordSystem1 string with name of the coordinate system. Can be NULL or ""
szNamesOfCoordSystem2 string with name of the coordinate system. Can be NULL or ""
szItem1 string with first item to query. Can be NULL or ""
szItem2 string with second item to query. Can be NULL or ""
Buffer buffer to receive the string read in from controller, lines are separated by line-feed characters
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qKLN** (int *ID*, const char* *szNamesOfCoordSystems*, char* *buffer*, int *bufsize*)

Corresponding command: KLN?

Lists coordinate system chains.

Arguments:

ID ID of controller
szNamesOfCoordSystems string with name of the coordinate system. Can be NULL or "" to return all
szBuffer buffer to receive the string read in from controller, lines are separated by line-feed characters
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qKLS** (int *ID*, const char* *szNamesOfCoordSystem*, const char* *szItem1*, const char* *szItem2*, char* *buffer*, int *bufsize*)

Corresponding command: KLS?

Lists properties of all coordinate systems..

Arguments:

ID ID of controller
szNamesOfCoordSystem string with name of the coordinate system. Can be NULL or ""
szItem1 string with first item to query. Can be NULL or ""
szItem2 string with second item to query. Can be NULL or ""

szBuffer buffer to receive the string read in from controller, lines are separated by line-feed characters
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_qKLT** (int *ID*, const char* *szStartCoordSystem*, const char* *szEndCoordSystem*, char* *buffer*, int *bufsize*)

Corresponding command: KLT?

Returns the position and orientation of the coordinate system which results from a chain of linked coordinate systems, or from a part of a chain. The part to be queried can be limited by specifying the start and end points in the chain.

Arguments:
ID ID of controller
szStartCoordSystem name of the coordinate system which is the start point in the chain. Can be NULL or “”
szEndCoordSystem name of the coordinate system which is the end point in the chain. Can be NULL or “”
szBuffer buffer to receive the string read in from controller, lines are separated by line-feed characters
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_qLIM** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)

Corresponding command: LIM?

Check if the given axes have limit switches.

Arguments:
ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pbValueArray array for limit switch info: **TRUE** if axis has limit switches, **FALSE** if not

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_qMAC** (int *ID*, const char* *szMacroName*, char* *szBuffer*, int *iBufferSize*)

Corresponding command: MAC?

Get available macros, or list contents of a specific macro. If *szMacroName* is empty or **NULL**, all available macros are listed in *szBuffer*, separated with line-feed characters. Otherwise the content of the macro with name *szMacroName* is listed, the single lines separated by line-feed characters. If there are no macros stored or the requested macro is empty the answer will be "".

See “Controller Macros” and the MAC command description in the controller User Manual for details.

Arguments:
ID ID of controller
szMacroName string with name of the macro to list
szBuffer buffer to receive the string read in from controller, lines are separated by line-feed characters
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_qMAN** (int *ID*, const char* *szCommand*, char* szBuffer, *int iBufferSize*)

Corresponding command: MAN?

Shows a detailed help text for individual commands.

Arguments:

ID ID of controller
szCommand is the command mnemonic of the command for which the help text is to be displayed.
szBuffer buffer to receive the string that describes the command.
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qMOD** (int *ID*, const char* *szItems*, const unsigned int * *iModeArray,* char* *szValues,* int *iMaxValueSize*)

Corresponding command: MOD?

Get modes for axes / channels / system.

Arguments:

ID ID of controller
szItems string with item identifiers
iModeArray array with IDs of modes to be queried
szValues string to be filled with values for each mode
iMaxValueSize size of *szValues*, must be given to avoid buffer overflow

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qMOV** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: MOV?

Read the commanded target positions for *szAxes*. Use PI_qPOS() to get the current positions.

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to be filled with target positions of the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qNAV** (int *ID*, const int* *piAnalogChannelIds*, int* *piNrReadingsValues,* int iArraySize*)*

Corresponding command: NAV?

Gets the number of readout values of the analog input used for averaging.

The response consists of a line feed when the controller does not contain an analog input channel.

Arguments:

ID ID of controller
piAnalogChannelIds array of analog input channel identifiers
piNrReadingsValues array to be filled with number of readout values used for averaging
iArraySize size of *piAnalogChannelIds* and *piNrReadingsValues*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qNLM** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: NLM?

Get lower limits ("soft limits") for the positions of *szAxes*.

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray array to be filled with lower limits for position of the axes.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qOAC** (int *ID*, const int* *piPIEZOWALKChannelsArray*, double* *pdValueArray*, int *iArraySize*);

Corresponding command: OAC?

Get current open-loop acceleration of the PiezoWalk channels.

Arguments:

ID ID of controller
piPIEZOWALKChannelsArray array with PiezoWalk channels, if **NULL** all PiezoWalk channels are queried
pdValueArray array to receive the acceleration value
iArraySize size of the arrays *piPIEZOWALKChannelsArray* (if not **NULL**) and *pdValueArray*

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qOAD** (int *ID*, const int* *piPIEZOWALKChannelsArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: OAD?

Reads last commanded open-loop analog driving voltage of given PiezoWalk channel.

Arguments:

ID ID of controller
piPIEZOWALKChannelsArray array with PiezoWalk channels, if **NULL** all PiezoWalk channels are queried.
pdValueArray array to receive the last-commanded feed voltage amplitude in V
iArraySize size of the arrays *piPIEZOWALKChannelsArray* (if not **NULL**) and *pdValueArray*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qODC** (int *ID*, const int* *piPIEZOWALKChannelsArray*, double* *pdValueArray*, int *iArraySize*);

Corresponding command: ODC?

Get current open-loop deceleration of the PiezoWalk channels.

Arguments:

ID ID of controller
piPIEZOWALKChannelsArray array with PiezoWalk channels, if **NULL** all PiezoWalk channels are queried
pdValueArray array to receive the acceleration value
iArraySize size of the arrays *piPIEZOWALKChannelsArray* (if not **NULL**) and *pdValueArray*

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qOMA** (int *ID*, const char* *szAxes*, double* *pdValueArray*);

Corresponding command: OMA?

Reads last commanded open-loop target *pdValueArray* of given *szAxes*.

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to be filled with target positions of the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qONL** (int *ID*, const int* *iPiezoChannels*, int* *pdValarray*, int *iArraySize*)

Corresponding command: ONL?

Gets current control mode for *iPiezoChannels*.

Arguments:

ID ID of controller
iPiezoChannels string with piezo channels, if "" or **NULL** all piezo channels are queried
pbValueArray array to receive the control modes of the specified piezo channels, **TRUE** for "ONLINE", **FALSE** for "OFFLINE"

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qONT** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)

Corresponding command: ONT?

Check if *szAxes* have reached the target.

Arguments:

ID ID of controller
szAxes string with axes
pbValueArray array to be filled with current on-target state of the axes

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qOSN** (int *ID*, const int* *piPiezoWalkChannelsArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: OSN?

Reads the number of steps still to be performed for the given PiezoWalk channel after the last call of PI_OSM().

Arguments:

ID ID of controller
piPiezoWalkChannelsArray array with PiezoWalk channels, if **NULL** all PiezoWalk channels are queried.
pdValueArray array to receive the number of steps which are still to be performed for open-loop step moving of the given PiezoWalk channels
iArraySize size of the arrays *piPiezoWalkChannelsArray* (if not **NULL**) and *pdValueArray*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qOVF** (int *ID*, const char* *szAxes*, BOOL* *pbOverflow*)

Corresponding command: OVF?

Checks overflow status of *szAxes*. Overflow means that the control variables are out of range (can only happen if controller is in closed-loop mode).

Arguments:

ID ID of controller
szAxes string with axes
pbOverflow array to be filled with current overflow status of the axes ("0" = axis is not in overflow or "1" = axis is in overflow)

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qOVL** (int *ID*, const int* *piPIEZOWALKChannelsArray*, double* *pdValueArray, int iArraySize*)

Corresponding command: OVL?

Get the current value of the velocity for open-loop nanostepping motion.

Arguments:

ID ID of controller
piPIEZOWALKChannelsArray array with PiezoWalk channel identifiers
pdValueArray array to be filled with the current active velocity values for open-loop nanostepping motion, in steps/s
iArraySize size of arrays

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qPLM** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: PLM?

Get upper limits ("soft limit") for the positions of *szAxes*.

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray array to be filled with upper limits for position of the axes.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qPOS** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: POS?

Get the current positions of *szAxes*. If no position sensor is present in your system, the response to PI_qPOS() is not meaningful.

To request the current position of input signal channels (sensors) in physical units, use PI_qTSP() instead.

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to receive the current positions of the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qPUN** (int *ID*, const char* *szAxes*, char* *szUnit*, int *iBufferSize*)

Corresponding command: PUN?

Get the position units of *szAxes*.

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to receive the position units of the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qRMC** (int *ID*, char * *szBuffer*, int *iBufferSize*)

Corresponding command: RMC?

List macros which are currently running.

See “Controller Macros” and the MAC command description in the controller User Manual for details.

Arguments:

ID ID of controller

szBuffer buffer to receive the string read in from controller, lines are separated by line-feed characters. Contains the names of the macros which are saved on the controller and currently running. The response is an empty line when no macro is running.

iBufferSize size of *buffer*, must be given to avoid buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qRON** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)

Corresponding command: RON?

Gets reference mode for given axes.

Arguments:

ID ID of controller

szAxes string with axes

pbValarray array to receive reference modes for the specified axes

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qRTO** (int *ID*, const char* *szAxes*, int* *pbValueArray*)

Corresponding command: RTO?

Read the "ready-for-turn-off state" of the given axis (check whether PI_RTO() was successful).

Arguments:

ID ID of controller

szAxes string with axes, if "" or **NULL** all axes are affected.

pbValueArray array to receive, 1 if ready (i.e. PI_RTO() was successful), 0 if not ready (i.e. PI_RTO() was not successful)

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qRTR** (int *ID*, int* *piRecordTableRate*)

Corresponding command: RTR?

Gets the current record table rate, i.e. the number of servo-loop cycles used in data recording operations.

Arguments:

ID ID of controller

piRecordTableRate variable to be filled with the record table rate

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qSAI** (int *ID*, char* sz*Axes*, int *iBufferSize*)

Corresponding command: SAI?

Get the identifiers for all configured axes. Each character in the returned string is an axis identifier for one logical axis.

Deactivated axes are not shown.

Arguments:

ID ID of controller
szAxes buffer to receive the string read in
iBufferSize size of *szAxes*, must be given to avoid a buffer overflow.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qSAI _ALL** (int *ID*, char* sz*Axes*, int *iBufferSize*)

Corresponding command: SAI?

Get the identifiers for all axes (configured and unconfigured axes). Each character in the returned string is an axis identifier for one logical axis. This function is provided for compatibility with controllers which allow for axis deactivation. PI_qSAI_ALL() then ensures that the answer also includes the axes which are "deactivated".

Arguments:

ID ID of controller
szAxes buffer to receive the string read in
iBufferSize size of *szAxes*, must be given to avoid a buffer overflow.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qSCT** (int *ID*, double* *pdCycleTime)*

Corresponding command: SCT?

Gets the current cycle time for running a defined motion profile.

Arguments:

ID ID of controller
pdCycleTime cycle time in ms

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qSEP** (int *ID*, const char* *szAxes*, const int* *piParameterArray*, double* *pdValueArray*, char* *szStrings*, int *iMaximumStringSize*)

Corresponding command: SEP?

Query specified parameters for *szAxes* from non-volatile memory. For each desired parameter you must specify a designator in *szAxes* and the parameter ID in the corresponding element of *iParameterArray*.

See the user manual of the controller for a list of the available parameters.

Arguments:

ID ID of controller
szAxes string with designator, one parameter is read for each designatorID in *szAxes*
piParameterArray parameter IDs
pdValueArray array to receive the values of the requested parameters
szStrings string to receive the with linefeed-separated parameter values; when not needed set to **NULL** (i.e. if numeric parameter values are queried)
iMaximumStringSize size of *szStrings*, must be given to avoid a buffer overflow.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qSGA** (int *ID*, const int* *piAnalogChannelIds*, int* *piGainValues,* int *iArraySize)*

Corresponding command: SGA?

Gets the gain value *piGainValues* for the given analog input channel *piAnalogChannelIds*.

The response consists of a line feed when the controller does not contain an optical analog input channel.

Arguments:

ID ID of controller
piAnalogChannelIds identifier of the analog input channel
piGainValues array to be filled with gain factor values
iArraySize size of *piAnalogChannelIds* and *piGainValues*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qSIC** (int *ID*, const int* *piFastAlignmentInputIdsArray*, int *iNumberOfInputIds*, char* *szBuffer*, int *iBufferSize*)

Corresponding command: SIC?

Fast alignment: Gets the calculation settings for the given fast alignment input channel.

The calculation results can be queried with PI_qTCI().

See the E712T0016 Technical Note (“Fast Alignment Routines”) for detailed descriptions of the fast alignment input channels.

Arguments:

ID ID of controller
piFastAlignmentInputIdsArray The identifier of a fast alignment input channel of the controller.
iNumberOfInputIds size of *piFastAlignmentInputIdsArray*
szBuffer buffer to receive the string read in from controller, lines are separated by '\n' ("line-feed").
iBufferSize size of *szBuffer*, must be given to avoid buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qSMO** (int *ID*, char *const *szAxes*, int * *pnValueArray*)

Corresponding command: SMO?

Gets last valid control value of *szAxes*.

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are affected.
pnValueArray control values for the specified axes. In servo-on mode the current value, set by the controller, is reported. In servo-off mode the value set by PI_SMO() is reported.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qSPA** (int *ID*, const char* *szAxes*, unsigned int* *piParameterArray*, double* *pdValueArray*, char* *szStrings*, int *iMaxNameSize*)

Corresponding command: SPA?

Query specified parameters for *szAxes* from RAM. For each desired parameter you must specify a designator in *szAxes* and the parameter ID in the corresponding element of *iParameterArray*. See the user manual of the controller for a list of the available parameters.

Arguments:

ID ID of controller
szAxes string with designator, one parameter is read for each designator in *szAxes*
piParameterArray parameter IDs
pdValueArray array to be filled with the values of the requested parameters

szStrings string to receive the linefeed-separated parameter values; when not needed set to **NULL** (i.e. if numeric parameter values are queried)
iMaxNameSize size of *szStrings*, must be given to avoid a buffer overflow.

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qSPI** (int *ID*, const char* *szAxes*, double* *pdValueArray)*

Corresponding command: SPI?

Gets the pivot point coordinates in the volatile memory.

Arguments:
ID ID of controller
szAxes can be R, S and T. X, Y and Z can also be used as alias identifiers for R, S and T
pdValueArray value array of the pivot point coordinates in physical units

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qSRG** (int *ID*, char *const *szAxes*, int * *iRegisterarray*, int * *iValarray*)

Corresponding command: SRG?
Returns register values for queried axes and register numbers.

Arguments:
ID ID of controller
szAxes axis for which the register values should be read
iRegisterarray IDs of registers
iValarray array to be filled with the values for the registers. The answer is bit-mapped and returned as the sum of the individual codes, in hexadecimal format.

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_qSSA** (int *ID*, const int* *iPIEZOWALKChannels*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: SSA?
Get the current value of the voltage amplitude used for nanostepping motion.

Arguments:
ID ID of controller
piPIEZOWALKChannelsArray array with PiezoWalk channels
pdValueArray array to be filled with the current active voltage amplitude values in V
iArraySize size of the arrays *piPIEZOWALKChannelsArray* and *pdValueArray*

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qSSL** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray)*

Corresponding command: SSL?

Gets the state of the soft limits that are set with PI_NLM() and PI_PLM(). If all arguments are omitted, the state is queried for all axes.

Arguments:
ID ID of controller
szAxes axes of the controller
pbValueArray array to receive the state of the soft limits:
0 = soft limits deactivated

1 = soft limits activated

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qSSN** (int *ID*, char* *szSerialNumber*, int *iBufferSize*)

Corresponding command: SSN?

Get serial number of the controller.

Arguments:

ID ID of controller

szSerialNumber buffer for storing the string read in

iBufferSize size of buffer, must be given to avoid buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qSST** (int *ID*, const char* *szAxes*, double* *pdValueArray)*

Corresponding command: SST?

Gets the distance ("step size") for motions of the given axis that are triggered by a manual control unit.

Arguments:

ID ID of controller

szAxes axes of the controller, if "" or **NULL** all axes are queried.

pdValueArray array to receive the distance values used for the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qSTE** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: STE?

Get last sent amplitude for the step response measurement for given axis (sent with PI_STE()).

Arguments:

ID ID of controller

szAxes axes to be read

pdValueArray array to be filled with the step amplitude values of the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qSVA** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: SVA?

Returns last valid open-loop control value for *szAxes*.

Arguments:

ID ID of controller

szAxes string with axes, if "" or **NULL** all axes are queried

pdValueArray array to be filled with the last commanded open-loop control values (dimensionless). The interpretation of the open-loop control values depends on the controller.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qSVO** (int *ID*, const char* *szAxes*, BOOL* *pbValueArray*)

Corresponding command: SVO?

Get the servo-control mode for *szAxes*

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried
pbValueArray array to receive the servo modes of the specified axes, **TRUE** for "on", **FALSE** for "off"

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTAC** (int *ID*, int* *piNrChannels*)

Corresponding command: TAC?

Get the number of installed analog channels.

Arguments:

ID ID of controller
piNrChannels pointer to int to receive the number of installed analog channels

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qTAD** (int *ID*, const int* *piSensorChannelsArray*, int* *piValueArray,* int *iArraySize*)

Corresponding command: TAD?

Returns ADC value for the given input signal channel, without filtering, linearization and transformation.

The response consists of a line feed when the controller does not contain an analog input channel.

Arguments:

ID ID of controller
piSensorChannelsArray array with input signal channels, if **NULL** all channels are queried.
pdValueArray array to receive ADC value (dimensionless)
iArraySize size of the arrays *pdValueArray* and *piSensorChannelsArray* (if not **NULL**)

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTAV** (int *ID*, const int* pi*ChannelsArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: TAV?

Returns voltage value for the specified analog input channel.

The response consists of a line feed when the controller does not contain an analog input channel.

Arguments:

ID ID of controller
piChannelsArray string with channels. If "" or **NULL** all analog input channels are queried.
pdValueArray array to receive voltage value (in volts)
iArraySize size of *pdValueArray*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTCI** (int *ID*, const int* *piFastAlignmentInputIDsArray*, double* *pdCalculatedInputValueArray*, int *iArraySize*))

Corresponding command: TCI?

Fast alignment: Gets calculated value of given fast alignment input channel.

The calculation settings of a fast alignment input channel can be defined with PI_SIC() and queried with PI_qSIC().
See the E712T0016 Technical Note ("Fast Alignment Routines") for detailed descriptions of the fast alignment input channels.

Arguments:

ID ID of controller
piFastAlignmentInputIDsArray The identifier of a fast alignment input channel of the controller.
pdCalculatedInputValueArray The current value of the calculated input.
iArraySize size of *pdCalculatedInputValueArray*

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qTCV** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: TCV?

Gets the current value of the velocity for closed-loop operation (value calculated by the profile generator).

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray array to be filled with the current velocity values calculated by the profile generator

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qTIO** (int *ID*, int* *piInputNr*, int* *piOutputNr*)

Corresponding command: TIO?

Returns the number of available digital I/O channels.

Arguments:

ID ID of controller
piInputNr variable to receive number of available digital input channels
piOutputNr variable to receive number of available digital output channels

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTMN** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: TMN?

Get the low end of the travel range of *szAxes*

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to receive low end of the travel range of the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTMX** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: TMX?

Get the high end of the travel range of *szAxes.*

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried
pdValueArray array to receive high end of travel range of the axes

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTNR** (int *ID*, int* *piNumberOfRecordTables*

Corresponding command: TNR?
Returns the number of data recorder tables.
For more information see "Data Recorder" in the controller User Manual.
Arguments:
ID ID of controller
piNumberOfRecordTables variable to receive number of data recorder tables
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTNS** (int *ID*, const int* *piSensorChannelsArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: TNS?
Returns normalized value for the specified input signal channel.
Arguments:
ID ID of controller
piSensorChannelsArray array with input signal channels, if **NULL** all channels are queried.
pdValueArray array to receive normalized value (dimensionless)
iArraySize the size of the arrays *pdValueArray* and *piSensorChannelsArray* (if not **NULL**)
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTPC** (int *ID*, int* *piNumberOfPiezoChannels*)

Corresponding command: TPC?
Get the number of output signal channels available on the controller.
Arguments:
ID ID of controller
piNumberOfPiezoChannels variable to receive number of available output signal channels
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTRA** (int *ID*, const char* *szAxes*, const double* *pdComponents*, double* *pdValueArray*)

Corresponding command: TRA?
This command returns the maximum absolute position which can be reached from the current position in the given direction for the queried axis vector.
Arguments:
ID ID of controller
szAxes string with axes
pdComponents components of the vector
pdValueArray array to receive maximum positions of the axes
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTRI** (int *ID*, const int* *piTriggerInputIds*, BOOL* *pbTriggerState*, int *iArraySize*)

Corresponding command: TRI?

Returns if the trigger input configuration made with PI_CTI() is enabled or disabled for the given digital input line.

Arguments:

ID ID of controller
piTriggerInputIds digital input lines of the controller
pbTriggerState the current states of the digital input lines:
FALSE = Trigger input disabled
TRUE = Trigger input enabled
iArraySize size of the arrays

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qTRO** (int *ID*, const int* *piTriggerOutputIds*, BOOL* *pbTriggerState*, int *iArraySize*)

Corresponding command: TRO?

Returns if the trigger output configuration made with PI_CTO() is enabled or disabled for the given digital output line.

Arguments:

ID ID of controller
piTriggerOutputIds digital output lines of the controller
pbTriggerState the current states of the digital output lines:
FALSE = Trigger output disabled
TRUE = Trigger output enabled
iArraySize size of the arrays

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qTRS** (int *ID*, const char* *szAxes*, BOOL * *pbValueArray*)

Corresponding command: TRS?

Ask if *szAxes* have reference sensors with direction sensing.

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pbValueArray array for reference sensor info: **TRUE** if axis has a reference sensor with direction sensing, **FALSE** if not

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qTSC** (int *ID*, int* *piNumberOfSensorChannels*)

Corresponding command: TSC?

Get the number of input signal channels available on the controller.

Arguments:

ID ID of controller
piNumberOfSensorChannels variable to receive number of input signal channels

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTSP** (int *ID*, const int* *piSensorChannelsArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: TSP?

Requests the current position of the given input signal channel in physical units (µm).

Arguments:

ID ID of controller
piSensorChannelsArray array with input signal channels, if **NULL** all channels are queried.
pdValueArray array to receive channel position (in µm)
iArraySize the size of the arrays *pdValueArray* and *piSensorChannelsArray* (if not **NULL**)

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTVI** (int *ID*, char * *szBuffer*, int *iBuffersize*)

Corresponding GCS command: TVI?

Get valid characters for axes. Each character in the returned string is a valid axis identifier that can be used to "name" an axis with PI_SAI().

Arguments:

ID ID of controller
szBuffer buffer to store the read in string
iBuffer size of *szBufferr*, must be given to avoid a buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qVAR** (int *ID*, const char * *szVariables*, char* *szValues,* int *iBufferSize*)

Corresponding command: VAR?

Gets variable value.

If PI_qVAR is combined with PI_CPY(), PI_JRC(), PI_MEX() or PI_WAC(), the response to PI_qVAR() has to be a single value and not more.

More information regarding local and global variables can be found in “Variables” in the controller User Manual.

Arguments:

ID ID of controller
szVariables name of the variable to be queried
szValues is the value to which the variable is set
iBufferSize size of *szVariables* and *szValues*, must be given to avoid buffer overflow

Returns:

TRUE if successful, **FALSE** otherwise.

BOOL **PI_qVCO** (int *ID*, char* *szAxes*, BOOL* *pbValueArray*)

Corresponding command: VCO?

Get the velocity-control mode for *szAxes*

Arguments:

ID ID of controller
szAxes string with axes
pbValueArray array to be filled with the velocity-control modes of the specified axes, **TRUE** for "on", **FALSE** for "off"

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qVEL** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: VEL?

Gets the velocity value commanded with PI_VEL() for *szAxes*.

Arguments:

ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are queried.
pdValueArray array to be filled with the velocity settings of the axes

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qVER** (int *ID*, char* *szVersion*, int *iBufferSize*)

Corresponding command: VER?

Reports the versions of the controller firmware and the underlying drivers and libraries.

Arguments:

ID ID of controller
szVersion buffer for storing the string read in
iBufferSize size of *szVersion*, must be given to avoid buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qVLS** (int *ID*, double* *pdSystemVelocity)*

Corresponding command: VLS?

Gets the velocity of the moving platform of the Hexapod that is set with PI_VLS().

Arguments:

ID ID of controller
pdSystemVelocity velocity value in physical units

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qVMA** (int *ID*, const int* *piPiezoChannelsArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: VMA?

Get upper piezo voltage soft limit for *piPiezoChannelsArray*.

Arguments:

ID ID of controller
piPiezoChannelsArray array with piezo channels, if **NULL** all piezo channels are queried.
pdValueArray array to be filled with the upper limits for the piezo voltage
iArraySize size of the arrays *pdValueArray* and *piPiezoChannelsArray* (if not **NULL**)

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qVMI** (int *ID*, const int* *piPiezoChannelsArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: VMI?

Get lower piezo voltage soft limit for *piPiezoChannelsArray*.

Arguments:

ID ID of controller
piPiezoChannelsArray array with piezo channels, if **NULL** all piezo channels are queried
pdValueArray array to be filled with the lower limits for the piezo voltage

iArraySize size of the arrays *pdValueArray* and *piPiezoChannelsArray* (if not **NULL**)

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qVMO** (int *ID*, const char* *szAxes*, const double* *pdValarray,* BOOL* *pbMovePossible*)

Corresponding command: VMO?

Checks whether the moving platform of the Hexapod can approach a specified position from the current position.

PI_qVMO() does not trigger any motion.

Arguments:

ID ID of controller
szAxes string with axes
pdValarray array of target positions
pbMovePossible value to receive, indicates whether the moving platform can approach the position resulting from the given target position values:
0 = specified position cannot be approached

1 = specified position can be approached

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qVOL** (int *ID*, const int* *piPiezoChannelsArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: VOL?

Get current piezo voltages for *piPiezoChannelsArray*.

Arguments:

ID ID of controller
piPiezoChannelsArray array with channels, if **NULL** all channels are queried
pdValueArray array to be filled with the current voltages for the channels
iArraySize size of the arrays *pdValueArray* and *piPiezoChannelsArray* (if not **NULL**)

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qVST** (int *ID*, char * *szBuffer*, int *iBufferSize*)

Corresponding command: VST?

Get the names of the available stage types. The available stages are read from stage database(s). Depending on the controller, the stage databases are stored on the PC or on the controller.

The stage types listed with PI_qVST() can be assigned to the axes of the controller with PI_CST().

Arguments:

ID ID of controller
szBuffer buffer for storing the string read in, lines are separated by \n (line feed)
iBufferSize size of *szBuffer*, must be given to avoid a buffer overflow.

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_RBT** (int *ID*)

Corresponding command: RBT

Reboot Controller. Controller behaves like after a cold start.

Arguments:

ID ID of controller

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_RNP** (int *ID*, const int* *piPIEZOWALKChannelsArray*, const double* *pdValueArray*, int *iArraySize*)

Corresponding command: RNP

"Relax" the piezos of a given PiezoWalk channel without motion.

Arguments:

ID ID of controller

piPIEZOWALKChannelsArray string with PiezoWalk channels

pdValueArray voltages which must be applied for the PiezoWalk channels, must be 0 to set the voltages to 0 V

iArraySize size of the arrays *pdValueArray* and *piPIEZOWALKChannelsArray*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_RON** (const int *ID*, char *const *szAxes*, BOOL * *pbValarray*)

Corresponding command: RON

Sets referencing mode for given axes. Determines how to reference axes measured by incremental sensors.

Arguments:

ID ID of controller

szAxes string with axes

pbValarray reference modes for the specified axes:

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_RPA** (int *ID*, const char* *szAxes*, const int* *piParameterArray*)

Corresponding command: RPA

Copy specified parameters for *szAxes* from the non-volatile memory and write them to RAM. For each desired parameter you must specify a designator in *szAxes,* and the parameter ID in the corresponding element of *iParameterArray*. See the user manual of the controller for a list of available parameters.

Arguments:

ID ID of controller

szAxes string with designators, one parameter is copied for each designator in *szAxes*

piParameterArray parameter IDs

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_RTO** (int *ID*, const char* *szAxes*)

Corresponding command: RTO

Make ready to turn off: The current position of the given axis is written to the non-volatile memory of the controller. Especially for systems which use incremental sensors. Check with PI_qRTO if PI_RTO() was successful.

Arguments:

ID ID of controller

szAxes string with axes, if "" or **NULL** all axes are affected.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_RTR** (int *ID*, int *iRecordTableRate*)

Corresponding command: RTR

Sets the record table rate, i.e. the number of servo-loop cycles to be used in data recording operations. Settings larger than 1 make it possible to cover longer time periods with a limited number of points.

For more information see "Data Recorder" in the controller User Manual

Arguments:

ID ID of controller

iRecordTableRate is the record table rate to be used (unit: number of servo-loop cycles), must be larger than zero

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_SAI** (int *ID*, char *const *szOldAxes*, char *const *szNewAxes*)

Corresponding command: SAI

Rename axes: *szOldAxes* will be set to *szNewAxes*. The characters in *szNewAxes* must not be in use for any other existing axes and must each be one of the valid identifiers. All characters in *szNewAxes* will be converted to uppercase letters. Only the **last** occurence of an axis identifier in *szNewAxes* will be used to change the name.

Arguments:

ID ID of controller

szOldAxes old axis identifiers

szNewAxes new identifiers for the axes

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_SCT** (int *ID*, double *dCycleTime)*

Corresponding command: SCT

Determines the cycle time for running a motion profile.

Arguments:

ID ID of controller

dCycleTime cycle time in ms

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_SEP** (int *ID*, const char* *szPassword*, const char* *szAxes*, const int* *piParameterArray*, const double* *pdValueArray*, const char* *szStrings*)

Corresponding command: SEP

Set specified parameters for *szAxes* in non-volatile memory. For each parameter you must specify a designator in *szAxes,* and the parameter ID in the corresponding element of *iParameterArray*. See the user manual of the controller for a list of available parameters.

Notes:

If the same designator has the same parameter number more than once, only the **last** value will be set. For example PI_SEP(id, “100”, "111", {0x1, 0x1, 0x2}, {3e-2, 2e-2, 2e-4}) will set the P-term of '1' to 2e-2 and the I-term to 2e-4.

After parameters were set with PI_SEP(), use PI_RPA() to activate them (write them to volatile memory), or they become active after next power-on or reboot.

Warnings:

This command is for setting hardware-specific parameters. Wrong values may lead to improper operation or damage of your hardware!

The number of write times of non-volatile memory is limited. Do not write parameter values except when necessary.

Arguments:

ID ID of controller
szPassword There is a password required to set parameters in the non-volatile memory. This password is “100”
szAxes string with designators, one parameter is set for each designator in *szAxes*
piParameterArray Parameter IDs
pdValueArray array with the values for the respective parameters
szStrings string with linefeed-separated parameter values; when not needed set to **NULL** (i.e. if numeric parameter values are used)

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_SGA** (int *ID*, const int* *piAnalogChannelIds*, const int* *piGainValues,* int iArraySize*)*

Corresponding command: SGA

Determines the gain value for the given analog input channel.

Arguments:

ID ID of controller
piAnalogChannelIds array of analog input channel identifiers
piGainValues array *of* gain factors
iArraySize size of *piAnalogChannelIds* and *piGainValues*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_SIC** (int *ID*, int *iFastAlignmentInputId*, int *iCalcType*, const double* *pdParameters*, int *iNumberOfParameters*)

Corresponding command: SIC

Fast alignment: Defines calculation settings for the given fast alignment input channel.

The current valid calculation settings can be queried with PI_qSIC(). The calculation results can be queried with PI_qTCI().

See the E712T0016 Technical Note (“Fast Alignment Routines”) for detailed descriptions.

Arguments:

ID ID of controller
iFastAlignmentInputId The identifier of a fast alignment input channel of the controller.
iCalcType The type of calculation to be applied, can be:

0 = No calculation
1 = Exponential calculation
2 = Polynomial calculation

pdParameters The settings for the selected calculation type.
iNumberOfParameters size of *pdParameters*.

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_SMO** (int *ID*, char *const *szAxes*, int * *pnValueArray*)

Corresponding command: SMO

Sets control value directly to move the axis. Profile generator (if present), sensor feedback and servo algorithm are not taken into account. This is only possible if servo-control is OFF (see PI_SVO()).

CAUTION: In the case of large control values, the stage can strike the hard stop despite the limit switch function. This can cause damage to equipment.

Arguments:
ID ID of controller
szAxes string with axes
pnValueArray array with control values.

Returns:
TRUE if successful, **FALSE** otherwise

BOOL **PI_SPA** (int *ID*, const char* *szAxes*, const unsigned int* *piParameterArray*, const double* *pdValueArray*, const char* *szStrings*)

Corresponding command: SPA

Set specified parameters for *szAxes* in RAM. For each parameter you must specify a designator in *szAxes,* and the parameter ID in the corresponding element of *iParameterArray*. See the user manual of the controller for a list of available parameters.

Notes:
If the same designator has the same parameter number more than once, only the **last** value will be set. For example PI_SPA(id, "111", {0x1, 0x1, 0x2}, {3e-2, 2e-2, 2e-4}) will set the P-term of '1' to 2e-2 and the I-term to 2e-4.

Warning:
This command is for setting hardware-specific parameters. Wrong values may lead to improper operation or damage of your hardware!

Arguments:
ID ID of controller
szAxes string with designators, one parameter is set for each designator in *szAxes*
piParameterArray Parameter IDs
pdValueArray array to receive with the values for the respective parameters
szStrings string, with linefeed-separated parameter values; when not needed set to **NULL** (i.e. if numeric parameter values are used)

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_SPI** (int *ID*, const char* *szAxes*, const double* *pdValueArray)*

Corresponding command: SPI

Sets the pivot point coordinates in the volatile memory.

Arguments:
ID ID of controller
szAxes can be R, S and T. X, Y and Z can also be used as alias identifiers for R, S and T
pdValueArray value array of the pivot point coordinates

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_SSA** (int *ID*, const int* *piPIEZOWALKChannelsArray*, const double* *pdValueArray*, int *iArraySize*)

Corresponding command: SSA

Set the voltage amplitude for nanostepping motion of given PiezoWalk channel.

Arguments:

ID ID of controller
piPIEZOWALKChannelsArray string with PiezoWalk channels
pdValueArray the voltage amplitude for nanostepping motion, in V
iArraySize the size of the arrays *piPIEZOWALKChannelsArray* and *pdValueArray*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_SSL** (int *ID*, const char* *szAxes*, const BOOL* *pbValueArray)*

Corresponding command: SSL

Activates or deactivates the soft limits that are set with PI_NLM() and PI_PLM(). Soft limits can only be activated/deactivated when the axis is not moving (query with PI_IsMoving()).

Arguments:

ID ID of controller
szAxes axes of the controller
pbValueArray array with the states of the soft limits:

0 = soft limits deactivated

1 = soft limits activated

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_SST** (int *ID*, const char* *szAxes*, const double* *pdValueArray)*

Corresponding command: SST

Sets the distance ("step size") for motions of the given axis that are triggered by a manual control unit.

Arguments:

ID ID of controller
szAxes axes of the controller
pdValueArray value array of the distance values

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_STE** (int *ID*, const char* *szAxes*, const double* *pdStepSize*)

Corresponding command: STE

Starts performing a step and recording the step response for the given axis.

Arguments:

ID ID of controller
szAxes axes for which the step response will be recorded
pdStepSize amplitude of the step

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_StopAll** (int *ID*)

Corresponding command: #24

Stops the motion of all axes instantaneously. Sets error code to 10. This function is identical in function to PI_STP(), but only one character is sent via the interface.

Arguments:

ID ID of controller

Returns:

TRUE if successful, **FALSE** otherwise (see p. 7)

BOOL **PI_STP** (int *ID*)

Corresponding command: STP

Stops the motion of all axes instantaneously. Sets error code to 10.

PI_STP() also stops macros.

After the axes are stopped, their target positions are set to their current positions.

Arguments:

ID ID of controller

Returns:

TRUE if successful, **FALSE** otherwise (see p. 7)

BOOL **PI_SVA** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: SVA

Set absolute open-loop control value to move *szAxes*.

Servo must be switched off (open-loop operation) when using this command.

Arguments:

ID ID of controller
szAxes string with axes
pdValueArray absolute open-loop control value

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_SVO** (int *ID*, const char* *szAxes*, const BOOL* *pbValueArray*)

Corresponding command: SVO

Set servo-control "on" or "off" (closed-loop/open-loop mode).

Arguments:

ID ID of controller
szAxes string with axes
pbValueArray servo modes for the specified axes, **TRUE** for "on", **FALSE** for "off"

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_SVR** (int *ID*, const char* *szAxes*, double* *pdValueArray*)

Corresponding command: SVR

Set open-loop control value relative to the current open-loop control value to move *szAxes*.

The new open-loop control value is calculated by adding the given value to the last commanded open-loop control value.

Servo must be switched off when using this command (open-loop operation).

Arguments:

ID ID of controller
szAxes string with axes

pdValueArray the open-loop control values which are added to the current values

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_TRI** (int *ID*, const int* *piTriggerInputIds*, const BOOL* *pbTriggerState*, int *iArraySize*)

Corresponding command: TRI

Enables or disables the trigger input mode which was set with PI_CTI() for the given digital input line.

Arguments:

ID ID of controller

piTriggerInputIds is an array with the digital input lines of the controller.

pbTriggerState pointer to boolean array with modes for the specified trigger lines, **TRUE** for "on", **FALSE** for "off"

iArraySize number of trigger lines

Returns:

TRUE if successful, **FALSE** otherwise (see p. 7)

BOOL **PI_TRO** (int *ID*, const int* *piTriggerOutputIds*, const BOOL* *pbTriggerState*, int *iArraySize*)

Corresponding command: TRO

Enables or disables the trigger output mode which was set with PI_CTO() for the given digital output line.

Arguments:

ID ID of controller

piTriggerOutputIds is an array with the digital output lines of the controller.

pbTriggerState pointer to boolean array with modes for the specified trigger lines, **TRUE** for "on", **FALSE** for "off"

iArraySize number of trigger lines

Returns:

TRUE if successful, **FALSE** otherwise (see p. 7)

BOOL **PI_VAR** (int *ID*, const char * *szVariable*, const char* *szValue*)

Corresponding command: VAR

Sets a variable to a certain value.

Local variables can be set using PI_VAR() in macros only.

The variable is present in RAM only.

See “Variables” and "Controller Macros" in the controller User Manual for details.

Arguments:

ID ID of controller

szVariable name of the variable whose value is to be set

szValue is the value to which the variable is to be set. If omitted, the variable is deleted.

Returns:

TRUE if successful, **FALSE** otherwise.

BOOL **PI_VCO** (int *ID*, char* *szAxes*, BOOL* *pbValueArray*)

Corresponding command: VCO

Set velocity-control "on" or "off". When velocity-control is "on", the corresponding axes will move with the currently valid velocity. That velocity can be set with PI_VEL() (p. 103).

Arguments:

ID ID of controller

szAxes string with axes
pbValueArray modes for the specified axes, **TRUE** for "on", **FALSE** for "off"

Returns:
TRUE if successful, **FALSE** otherwise (see p. 7)

BOOL **PI_VEL** (int *ID*, const char* *szAxes*, const double* *pdValueArray*)

Corresponding command: VEL
Set the velocities to use during moves of *szAxes*. The PI_VEL() setting only takes effect when the given axis is in closed-loop operation (servo on).

Arguments:
ID ID of controller
szAxes string with axes
pdValueArray velocities for the axes

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_VLS** (int *ID*, double *dSystemVelocity)*

Corresponding command: VLS

Sets the velocity for the moving platform of the Hexapod.

Arguments:
ID ID of controller
dSystemVelocity velocity value in physical units

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_VMA** (int *ID*, const int* *piPiezoChannelsArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: VMA
Set upper PZT voltage soft limit of given piezo channel.

Arguments:
ID ID of controller
piPiezoChannelsArray array with piezo channels
pdValueArray upper limits for piezo voltage
iArraySize the size of the arrays *piPiezoChannelsArray* and *pdValueArray*

Returns:
TRUE if successful, **FALSE** otherwise (see p. 7)

BOOL **PI_VMI** (int *ID*, const int* *piPiezoChannelsArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: VMI
Set lower PZT voltage soft limit of given piezo channel.

Arguments:
ID ID of controller
piPiezoChannelsArray array with piezo channels
pdValueArray lower limits for piezo voltage
iArraySize the size of the arrays *piPiezoChannelsArray* and *pdValueArray*

Returns:
TRUE if successful, **FALSE** otherwise (see p. 7)

BOOL **PI_WAC** (int *ID*, const char * *szCondition*)

Corresponding command: WAC

Wait until a given condition of the following type occurs: a specified value is compared with a queried value according a specified rule.

Can only be used in macros.

See also PI_MEX()

See "Controller Macros" in the controller User Manual for details.

Valid for:

E-861, C-867, C-887, C-863, C-884, E-871

Arguments:

ID ID of controller

szCondition string with condition to evaluate

Returns:

TRUE if successful, **FALSE** otherwise (see p. 7)

BOOL **PI_WPA** (int *ID*, const char* *szPassWord*, const char* *szAxes*, const int* *piParameterArray*)

Corresponding command: WPA

Gets values of the specified parameters from RAM and copies them to non-volatile memory. For each parameter you must specify a designator in *szAxes* and the parameter ID in the corresponding element of *iParameterArray*. See the user manual of the controller for a list of available parameters.

CAUTION: If current parameter values are incorrect, the system may malfunction. Be sure that you have the correct parameter settings before using PI_WPA().

Settings not saved with PI_WPA() will be lost when the controller is powered off or rebooted.

Arguments:

ID ID of controller

szPassWord The password for writing to non-volatile memory depends on the parameter. See the parameter overview and the description of the WPA command in the user manual of the controller.

szAxes string with designators. For each designator in *szAxes* one parameter value is copied.

piParameterArray Array with parameter IDs

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

7. Functions for GCS Commands for Wave Generator and DDL

The functions listed in this chapter are relevant for controllers which support the wave generator functionality and the Dynamic Digital Linearization (DDL).

The listed functions are based on the commands of the GCS. You can use a function only if the corresponding command is supported by your controller. See the user manual of the controller for the supported commands.

For all details regarding the functionality and arguments of commands, see the command descriptions in the user manual of the controller.

NOTE

If a query command is sent as string using PI_Gcs_Commandset() it is necessary to make sure that the size of the response string matches the size of the input buffer.
Otherwise it may happen that a response has not yet been retrieved completely before a next function is processed.
See “Functions for Sending and Reading Strings” (p. 17) for details.

Wave Generator

Each axis can be controlled by a "wave generator" which outputs user-specified patterns, so-called "waveforms". This feature is especially important in dynamic applications which require periodic, synchronous motion of the axes. The waveforms to be output are stored in "wave tables" in the controllers volatile memory—one waveform per wave table. Waveforms can be created based on predefined "curve" shapes. Programmable trigger inputs and outputs facilitate synchronization of external events. See "Wave Generator" in the user manual of the controller for more information and for examples.

During the wave generator output, data is recorded in "record tables" on the controller. See "Data Recording" in the controllers User Manual for more information.

The different software interfaces provided for the controller also support use of the wave generator. Waveforms can be defined, stored and displayed in and by the software in a more user-friendly way. If using the wave generator with PIMikroMove, NanoCapture or LabView, read the descriptions in the associated software manual first.

Dynamic Digital Linearization (DDL)

The DDL option can be used in conjunction with the wave generator output in addition to the "normal" servo algorithm in closed-loop operation. The DDL makes it possible to achieve significantly better position accuracy for dynamic applications with periodic motion. DDL "observes" axis motion over one or more wave generator output cycles (DDL initialization). The information gathered is written to "DDL tables" and can then be used to refine the control output signals. The DDL feature must be expressly ordered. You can activate it after purchase and without opening the device. See "Dynamic Digital Linearization (DDL)" in the controllers User Manual for more information and for how to activate the DDL licence.

7.1. Functions Overview

Function	Short Description	Page
BOOL **PI_DDL** (int *ID*, int *iDdlTableId*, int *iOffsetOfFirstPointInDdlTable*, int *iNumberOfValues*, double* *pdValueArray*)	Transfer DDL data to a DDL data table on controller	**107**
BOOL **PI_DPO** (int *ID*, const char* *szAxes*)	Recalculate internal DDL processing parameters	**108**
BOOL **PI_DTC** (int *ID*, const int *piDdlTableIdsArray*, int *iArraySize*)	Clear given DDL table	**108**
BOOL **PI_IsGeneratorRunning** (int *ID*, const int* *piWaveGeneratorIdsArray*, BOOL* *pbValueArray*, int *iArraySize*)	Check if wave generators are running	**108**
BOOL **PI_qDDL** (int *ID*, const int* *piDdlTableIdsArrays*, int *iNumberOfDdlTables*, int *iOffset*, int *nrValues*, double** *pdValArray*, char* *szGcsArrayHeader*, int *iGcsArrayHeaderMaxSize*)	Read DDL tables asynchronously	**108**
BOOL **PI_qDDL_SYNC** (int *ID*, int *iDdlTableId*, int *iOffsetOfFirstPointInDdlTable*, int *iNumberOfValues*, double* *pdValueArray*)	Read DDL tables synchronously	**109**
BOOL **PI_ qDTL** (int *ID*, const int* *piDdlTableIdsArray*, int* *piValueArray*, int *iArraySize*)	Get DDL table length	**109**
BOOL **PI_qGWD** (int *ID*, const int* *piWaveTableIdsArray*, int *iNumberOfWaveTables*, int *iOffset*, int *nrValues*, double** *pdValArray*, char* *szGcsArrayHeader*, int *iGcsArrayHeaderMaxSize*)	Read wave tables asynchronously	**110**
BOOL **PI_qGWD_SYNC**(int *ID*, int *iWaveTableId*, int *iOffsetOfFirstPointInWaveTable*, int *iNumberOfValues*, double* *pdValueArray*)	Read wave tables	**110**
BOOL **PI_qTLT** (int *ID*, int* *iNumberOfLinearizationTables*)	Get the number of DDL data tables	**110**
BOOL **PI_qTWG** (int *ID*, int* *iNumberOfWaveGenerators*)	Get the number of wave generators	**111**
BOOL **PI_qTWS** (int *ID*, const int* *piTriggerChannelIdsArrays*, int *iNumberOfTriggerChannels*, int *iOffset*, int *nrValues*, double** *pdValArray*, char* *szGcsArrayHeader*, int *iGcsArrayHeaderMaxSize*)	Read trigger line settings	**111**
BOOL **PI_qWAV** (int *ID*, const int* *piWaveTableIdsArray*, const int* *piParameterIdsArray*, double* *pdValueArray, int iArraySize*)	Get the parameters for a defined waveform	**111**
BOOL **PI_qWGC** (int *ID*, const int* *piWaveGeneratorIdsArray*, int* *piValueArray*, int *iArraySize*)	Get the number of wave generator output cycles	**112**
BOOL **PI_qWGO** (int *ID*, const int *piWaveGeneratorIdsArray*, int* *piValueArray*, int *iArraySize*)	Get the start/stop mode of the given wave generator	**112**
BOOL **PI_qWMS** (int *ID*, const int* *piWaveTableIdsArray*, int* *iMaximumWaveSizeArray*, int *iArraySize*)	Gets the maximum size of the wave storage	**112**
BOOL **PI_qWOS** (int *ID*, const int* *piWaveGeneratorIdsArray*, double* *pdValueArray*, int *iArraySize*)	Reads the current value of the offset which is added to the wave generator output	**112**
BOOL **PI_qWSL** (int *ID*, const int* *piWaveGeneratorIdsArray*, int* *piWaveTableIdsArray*, int *iArraySize*)	Get current setting of wave table selection	**113**
BOOL **PI_qWTR** (int *ID*, const int* *piWaveGeneratorIdsArray*, long* *piTableRateArray*, long* *piInterpolationTypeArray*, int *iArraySize*)	Gets the current wave generator table rate	**113**
BOOL **PI_TWC** (int *ID*)	Clears all output trigger settings for the wave generators	**113**

Function	Short Description	Page
BOOL **PI_TWS** (int *ID*, const int* *piTriggerChannelIdsArray*, const int* *piPointNumberArray*, const int* *piSwitchArray*, int *iArraySize*)	Sets trigger line actions to waveform points for the given trigger output line	**113**
BOOL **PI_WAV_SINP** (int *ID*, int *iWaveTableId*, int *iOffsetOfFirstPointInWaveTable*, int *iNumberOfPoints*, int *iAppendWave*, int *iCenterPointOfWave*, double *dAmplitudeOfWave*, double *dOffsetOfWave*, int *iSegmentLength*)	Define sine curve for given wave table	**114**
BOOL **PI_WAV_LIN** (int *ID*, int *iWaveTableId*, int *iOffsetOfFirstPointInWaveTabel*, int *iNumberOfWavePoints*, int *iAppendWave*, int *iNumberOfSpeedUpDownPointsOfWave*, double *dAmplitudeOfWave*, double *dOffsetOfWave*, int *iSegmentLength*)	Define a single scan line curve for given wave table	**115**
BOOL **PI_WAV_PNT** (int *ID*, int *iWaveTableId*, int *iOffsetOfFirstPointInWaveTable*, int *iNumberOfWavePoints*, int *iAppendWave*, const double* *pdWavePoints*)	Create a user-defined curve for given wave table	**116**
BOOL **PI_WAV_RAMP** (int *ID*, int *iWaveTableId*, int *iOffsetOfFirstPointInWaveTable*, int *iNumberOfWavePoints*, int *iAppendWave*, int *iCenterPointOfWave*, int *iNumberOfSpeedUpDownPointsOfWave*, double *dAmplitudeOfWave*, double *dOffsetOfWave*, int *iSegmentLength*)	Define a ramp curve for given wave table	**116**
BOOL **PI_WCL** (int *ID*, int *iWaveTableIdsArray*, int *iArraySize*)	Clears the content of the given wave table	**117**
BOOL **PI_WGC** (int *ID*, const int* *piWaveGeneratorIdsArray*, const int* *piNumberOfCyclesArray*, int *iArraySize*)	Set the number of cycles for the wave generator output	**118**
BOOL **PI_WGO** (int *ID*, const int* *piWaveGeneratorIdsArray*, condt int* *piStartModArray*, int *iArraySize*)	Start and stop the specified wave generator with the given mode	**118**
BOOL **PI_WGR** (int *ID*)	Restarts recording when the wave generator is running	**118**
BOOL **PI_WOS** (int *ID*, const int* *piWaveGeneratorIdsArray*, const double* *pdValueArray*, int *iArraySize*)	Sets an offset to the output of a wave generator	**118**
BOOL **PI_WSL** (int *ID*, const int* *piWaveGeneratorIdsArray*, const int* *piWaveTableIdsArray*, int *iArraySize*)	Wave table selection: connects a wave table to a wave generator	**119**
BOOL **PI_WTR** (int *ID*, const int* *piWaveGeneratorIdsArray*, const long* *piTableRateArray*, const long* *piInterpolationTypeArray*, int *iArraySize*)	Set wave generator table rate and interpolation type	**119**

7.2. Function Documentation

BOOL **PI_DDL** (int *ID*, int *iDdlTableId*, int *iOffsetOfFirstPointInDdlTable*, int *iNumberOfValues*, double* *pdValueArray*)

Corresponding command: DDL

Transfer dynamic digital linearization feature data to a DDL data table on the controller.

Arguments:

ID ID of controller

iDdlTableId number of the DDL data table to use.

iOffsetOfFirstPointInDdlTable index of first value to be transferred, (the first value in the DDL table has index 1)

iNumberOfValues number of values to be transferred

pdValueArray Array with the values for the DDL table (can have been filled with PI_qDDL()).

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_DPO** (int *ID*, const char* *szAxes*)

Corresponding command: DPO

Dynamic Digital Linearization (DDL) Parameter Optimization. Recalculates the internal DDL processing parameters (Time Delay Max, ID 0x14000006, Time Delay Min, ID 0x14000007) for specified axis.

Arguments:
ID ID of controller
szAxes string with axes, if "" or **NULL** all axes are affected.

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_DTC** (int *ID*, const int *piDdlTableIdsArray*, int *iArraySize*)

Corresponding command: DTC

Dynamic Digital Linearization (DDL) table clear: clears the given DDL table.

PI_DTC() also stops a running DDL initialization process.

Arguments:
ID ID of controller
iDdlTableIdIdsArray array with the IDs of the data tables which are to be cleared.
iArraySize the size of the array *iDdlTableIdsArray*.

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_IsGeneratorRunning** (int *ID*, const int* *piWaveGeneratorIdsArray*, BOOL* *pbValueArray*, int *iArraySize*)

Corresponding command: #9 (ASCII 9)

Check if wave generators are running. If TRUE for a wave generator, the corresponding element of the array will be set to **TRUE**, otherwise to **FALSE.** If no wave generators were specified, only one boolean value is set and it is placed in *pbValueArray[0]*: It is **TRUE** if at least one wave generator is TRUE, **FALSE** otherwise.

Arguments:
ID ID of controller
piWaveGeneratorIdsArray string with wave generator IDs, if "" or **NULL** all wave generators are queried and a global result placed in *pbValueArray[0]*
pbValueArray array to receive status of the wave generators, TRUE for wave generator in progress, FALSE otherwise
iArraySize the size of the array *pbValueArray* and *piWaveGeneratorIdsArray* (if not **NULL**)

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qDDL** (int *ID*, const int* *piDdlTableIdsArrays*, int *iNumberOfDdlTables*, int *iOffset*, int *nrValues*, double** *pdValArray*, char* *szGcsArrayHeader*, int *iGcsArrayHeaderMaxSize*)

Corresponding command: DDL?

Read DDL tables. This function reads the data asynchronously, it will return as soon as the data header has been read and start a background process which reads in the data itself. See PI_GetAsyncBuffer() and PI_GetAsyncBufferIndex(). Detailed information about the data read in can be found in the header sent by the controller. See the GCS Array manual for details.

Only tables with the same length can be read at the same time. Because DDL tables do not have a common length, use PI_qDTL to read the table length before reading the table data.

Arguments:

ID ID of controller
piDdlTableIdsArray IDs of DDL tables
iNumberOfDdlTables number of DDL tables to read
iOffset index of first value to be read (starts with index 1)
nrValues number of values to read
pdValarray pointer to internal array to store the data; data from all tables read will be placed in the same array with the values interspersed; the DLL will allocate enough memory to store all data, call **PI_GetAsyncBufferIndex()** to find out how many data points have already been transferred
szGcsArrayHeader buffer to store the GCS array header
iGcsArrayHeaderMaxSize size of the buffer to store the GCS array header, must be given to prevent buffer overflow

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qDDL_SYNC** (int *ID*, int *iDdlTableId*, int *iOffsetOfFirstPointInDdlTable*, int *iNumberOfValues*, double* *pdValueArray*)

Corresponding command: DDL?

Get the dynamic digital linearization feature data from a DDL data table from the controller. For large N values, communication timeout must be set long enough, otherwise a communication error may occur.

Arguments:

ID ID of controller
iDdlTableId ID of the DDL data table.
iOffsetOfFirstPointInDdlTable index in the DDL table of first value to be read, the first value in the DDL table has index 1
iNumberOfValues number of values to be read
pdValueArray Array to receive the values. Caller is responsible for providing enough space for *iNumberOfValues* doubles

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_ qDTL** (int *ID*, const int* *piDdlTableIdsArray*, int* *piValueArray*, int *iArraySize*)

Corresponding command: DTL?

Get Dynamic Digital Linearizations Table Length.
The table length should be read before reading the table data by PI_qDDL.

Arguments:

ID ID of controller
piDdlTableIdsArray array of the DDL table IDs
piValueArray array to receive the DDL table size
iArraySize the size of the arrays *piDdlTableIdsArray* and *piValueArray*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qGWD** (int *ID*, const int* *piWaveTableIdsArrays*, int *iNumberOfWaveTables*, int *iOffset*, int *nrValues*, double** *pdValArray*, char* *szGcsArrayHeader*, int *iGcsArrayHeaderMaxSize*)

Corresponding command: GWD?

Read wave tables. This function reads the data asynchronously, it will return as soon as the data header has been read and start a background process which reads in the data itself. See PI_GetAsyncBuffer() and PI_GetAsyncBufferIndex(). Detailed information about the data read in can be found in the header sent by the controller. See the GCS Array manual for details.

Depending on the waveform definition with PI_WAV(), the wave tables may have different lengths. But due to the definition of the GCS array as the response format, it is not possible to read tables with different lengths at the same time. You can ask with PI_qWAV() for the current length of the wave tables.

Arguments:

ID ID of controller
piWaveTableIdsArray IDs of wave tables
iNumberOfWaveTables number of wave tables to read
iOffset index of first value to be read (starts with index 1)
nrValues number of values to read
pdValarray pointer to internal array to store the data; data from all tables read will be placed in the same array with the values interspersed; the DLL will allocate enough memory to store all data, call PI_GetAsyncBufferIndex() to find out how many data points have already been transferred
szGcsArrayHeader buffer to store the GCS array header
iGcsArrayHeaderMaxSize size of the buffer to store the GCS array header, must be given to prevent buffer overflow

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qGWD_SYNC** (int *ID*, int *iWaveTableId*, int *iOffsetOfFirstPointInWaveTable*, int *iNumberOfValues*, double* *pdValueArray*)

Corresponding command: GWD?

Read the waveform associated with *iWaveTableId*.

Arguments:

ID ID of controller
iWaveTableId identifier for wave table
iOffsetOfFirstPointInWaveTable index of first point to be read, starts with index 1
iNumberOfPoints number of points to read
pdValuesArray array to receive the waveform. (Caller must provide enough space to store *iNumberOfPoints* double values!)

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTLT** (int *ID*, int* *iNumberOfLinearizationTables*)

Corresponding command: TLT?

Get the number of DDL data tables.

Arguments:

ID ID of controller
piNumberOfLinearizationTables pointer to receive the number of DDL data tables.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTWG** (int *ID*, int* *iNumberOfWaveGenerators*)

Corresponding command: TWG?

Get the number of wave generators.

Arguments:

ID ID of controller

iNumberOfWaveGenerators pointer to store the number of wave generators.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qTWS** (int *ID*, const int* *piTriggerChannelIdsArrays*, int *iNumberOfTriggerChannels*, int *iOffset*, int *nrValues*, double** *pdValArray*, char* *szGcsArrayHeader*, int *iGcsArrayHeaderMaxSize*)

Corresponding command: TWS?

Reading of the trigger line settings made with PI_TWS for the waveform points. This function reads the data asynchronously, it will return as soon as the data header has been read and start a background process which reads in the data itself. See PI_GetAsyncBuffer() and PI_GetAsyncBufferIndex(). Detailed information about the data read in can be found in the header sent by the controller. See the GCS Array manual for details.

To query the waveform shape, use PI_qGWD.

Arguments:

ID ID of controller

piTriggerChannelIdsArray IDs of the trigger line (digital output line)

iNumberOfTriggerChannels number of trigger lines to read

iOffset index of first value to be read (starts with index 1)

nrValues number of values to read

pdValarray pointer to internal array to store the data; data from all trigger lines read will be placed in the same array with the values interspersed; the DLL will allocate enough memory to store all data, call PI_GetAsyncBufferIndex() to find out how many data points have already been transferred

szGcsArrayHeader buffer to store the GCS array header

iGcsArrayHeaderMaxSize size of the buffer to store the GCS array header, must be given to prevent buffer overflow

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_qWAV** (int *ID*, const int* *piWaveTableIdsArray*, const int* *piParameterIdsArray*, double* *pdValueArray, int iArraySize*)

Corresponding command: WAV?

Get the parameters for a defined waveform. For each desired parameter you must specify a wave table in *piWaveTableIdsArray* and a parameter ID in the corresponding element of *piParameterIdsArray*. The following parameter ID is valid:

1: Number of waveform points for currently defined wave.

Arguments:

ID ID of controller

piWaveTableIdsArray array with wave table IDs for which the parameter(s) should be read

piParameterIdsArray array with IDs of requested parameters

pdValueArray array to be filled with the values for the parameters

iArraySize the size of the arrays *piWaveTablesArray*, *piParameterIdsArray*, and *pdValueArray*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qWGC** (int *ID*, const int* *piWaveGeneratorIdsArray*, int* *piValueArray*, int *iArraySize*)

Corresponding command: WGC?

Get the number of wave generator output cycles set by PI_WGC (p. 118).

Arguments:

ID ID of controller
piWaveGeneratorIdsArray array with wave generators, if **NULL** all wave generators are queried
piValueArray array with number of cycles for each wave generator in *piWaveGeneratorIdsArray*
iArraySize the size of the arrays *piWaveGeneratorIdsArray* (if not **NULL**) and *piValueArray*.

Returns:

TRUE if no error, FALSE otherwise

BOOL **PI_qWGO** (int *ID*, const int *piWaveGeneratorIdsArray*, int* *piValueArray*, int *iArraySize*)

Corresponding command: WGO?

Get the start/stop mode of the given wave generator.

Note: Ask with PI_IsGeneratorRunning() for the current activation state of the wave generator. The reply shows if a wave generator is running or not, but does not contain any information about the wave generator start mode (e.g. with trigger output). With PI_qWGO you can ask for the last commanded wave generator start option (set by PI_WGO (p. 118)).

Arguments:

ID ID of controller
piWaveGeneratorIdsArray array with wave generators for which the start mode values will be read out, if **NULL** all wave generators are queried
piValueArray array with modes for each wave generator in *piWaveGeneratorIdsArray*
iArraySize the size of the arrays *piWaveGeneratorIdsArray* (if not **NULL**) and *piValueArray*.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qWMS** (int *ID*, const int* *piWaveTableIdsArray*, int* *iMaximumWaveSizeArray*, int *iArraySize*)

Corresponding command: WMS?

Gets the maximum size of the wave storage for *piWaveTableIds*Array

Arguments:

ID ID of controller
piWaveTableIdsArray array with wave tables, if **NULL** all wave tables are queried.
piMaximumWaveSizeArray array to be filled with the maximum size of the wave storage for the corresponding wave table (number of points).
iArraySize the size of the arrays *piWaveTableIdsArray* (if not **NULL**) and *piMaximumWaveSizeArray*.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qWOS** (int *ID*, const int* *piWaveGeneratorIdsArray*, double* *pdValueArray*, int *iArraySize*)

Corresponding command: WOS?

Reads the current value of the offset which is added to the wave generator output.

Arguments:

ID ID of controller
piWaveGeneratorIdsArray array with wave generators, if **NULL** all wave generators are queried.
pdValueArray array to receive the offsets of the wave generators.
iArraySize the size of the arrays *piWaveGeneratorIdsArray* (if not **NULL**) and *pdValueArray*.

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_qWSL** (int *ID*, const int* *piWaveGeneratorIdsArray*, int* *piWaveTableIdsArray*, int *iArraySize*)

Corresponding command: WSL?
Get current setting of wave table selection
Arguments:
ID ID of controller
piWaveGeneratorIdsArray array with wave generators, if **NULL** all wave generators are queried.
piWaveTableIdsArray array to receive the wave table IDs
iArraySize the size of the arrays *piWaveGeneratorIdsArray* (if not **NULL**) and *piWaveTableIdsArray*.
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_ qWTR** (int *ID*, const int* *piWaveGeneratorIdsArray*, long* *piTableRateArray*, long* *piInterpolationTypeArray*, int *iArraySize*)

Corresponding command: WTR?
Gets the current wave generator table rate, i.e. the number of servo-loop cycles used for wave generator output. Gets also the interpolation type used with table rate values > 1.
Arguments:
ID ID of controller
piWaveGeneratorIdsArray array with wave generators, if **NULL** all wave generators are queried.
piTableRateArray array to receive the wave table rate.
piInterpolationTypeArray array to receive the interpolation type.
iArraySize the size of the arrays *piWaveGeneratorIdsArray* (if not **NULL**) and *piTableRateArray* and *piInterpolationTypeArray*.
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_TWC** (int *ID*)

Corresponding command: TWC
Clears all output trigger settings for the wave generators (the settings made with PI_TWS).
Arguments:
ID ID of controller
Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_TWS** (int *ID*, const int* *piTriggerChannelIdsArray*, const int* *piPointNumberArray*, const int* *piSwitchArray*, int *iArraySize*)

Corresponding command: TWS
Sets trigger line actions to waveform points for the given trigger output line.
The power-on default state of all points is low. Afterwards, the signal state of the trigger output line can be switched to "low" for all points using PI_TWC(). It is recommended to use PI_TWC() before trigger actions are set with PI_TWS().
For the selected trigger output line the generator trigger mode must be activated by PI_CTO().
Arguments:
ID ID of controller
piTriggerChannelIdsArray array with the trigger output lines.
piPointNumberArray array with the wave points.

piSwitchArray with the signal states of the trigger output lines at the wave points, if zero the trigger is set low, otherwise the trigger is set high.
iArraySize the number of points in the arrays *piTriggerChannelIdsArray, piPointNumberArray* and *piSwitchArray*.

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

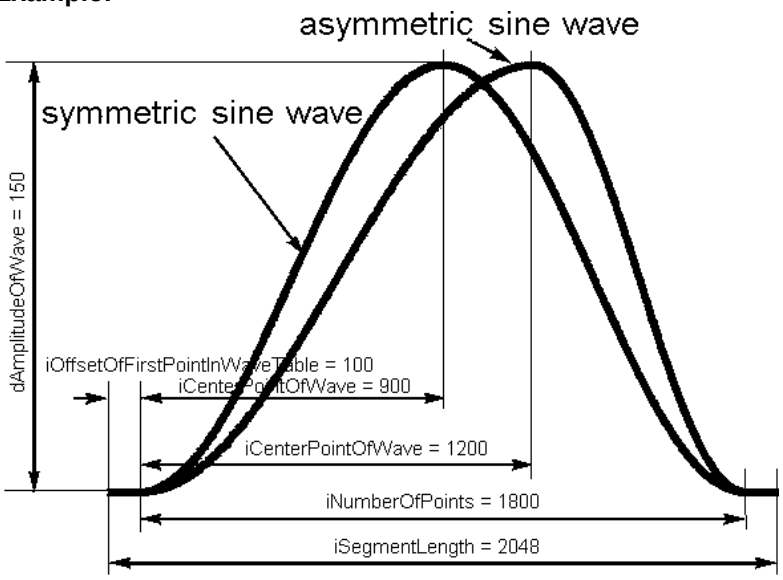
BOOL **PI_WAV_SIN_P** (int *ID*, int *iWaveTableId*, int *iOffsetOfFirstPointInWaveTable*, int *iNumberOfPoints*, int *iAppendWave*, int *iCenterPointOfWave*, double *dAmplitudeOfWave*, double *dOffsetOfWave*, int *iSegmentLength*)

Corresponding command: WAV

Define sine curve for given wave table.

To allow for flexible waveform shapes, a wave table can be divided into "segments". Each segment must be defined with a separate call of PI_WAV_SIN_P() or one of the other PI_WAV functions. In doing so, the *iAppendWave* argument (see below) is used to concatenate the segments so that they will form the final waveform. To change individual segments or to modify their order, the complete waveform must be recreated segment-by-segment. See the user manual of the controller for more information and for more examples.

Example:



Arguments:
ID ID of controller
iWaveTableId The wave table ID
iOffsetOfFirstPointInWaveTable The index of the starting point of the curve in the segment. Gives the phase shift. Lowest possible value is 0.
iNumberOPoints The length of the curve as number of points.
iAppendWave Possible values (supported values depend on controller):
0 = clears the wave table and starts writing with the first point in the table
1 = adds the content of the defined segment to the already existing wave table contents (i.e. the values of the defined points are added to the existing values of that points)
2 = appends the defined segment to the already existing wave table content (i.e. concatenates segments to form one final waveform)
iCenterPointOfWave The index of the center point of the sine curve. Determines if the curve is symmetrically or not. Lowest possible value is 0.
dAmplitudeOfWave The amplitude of the sine curve.
dOffsetOfWave The offset of the sine curve.
iSegmentLength The length of the wave table segment as number of points. Only the number of points given by *iSegmentLength* will be written to the wave table. If the *iSegmentLength* value is

larger than the *iNumberOPoints* value, the missing points in the segment are filled up with the endpoint value of the curve.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

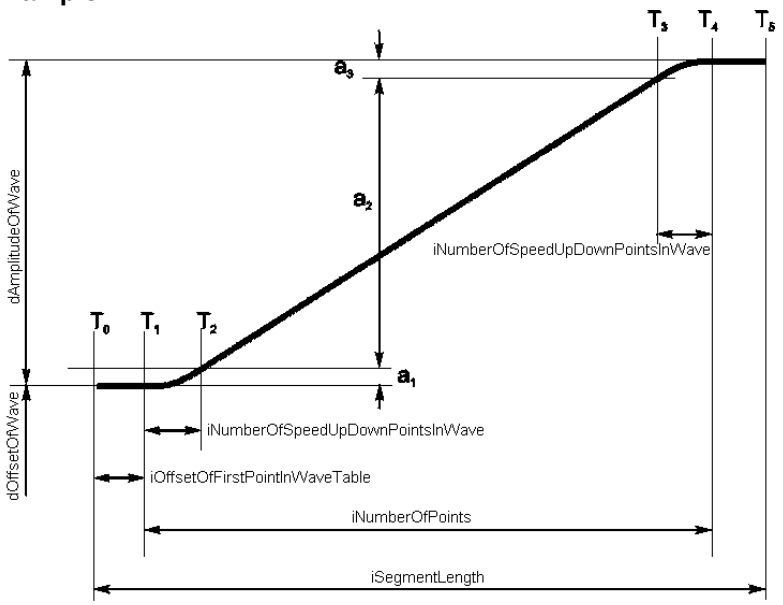
BOOL **PI_WAV_LIN** (int *ID*, int *iWaveTableId*, int *iOffsetOfFirstPointInWaveTable*, int *iNumberOfWavePoints*, int *iAppendWave*, int *iNumberOfSpeedUpDownPointsOfWave*, double *dAmplitudeOfWave*, double *dOffsetOfWave*, int *iSegmentLength*)

Corresponding command: WAV

Define a single scan line curve for given wave table.

To allow for flexible waveform shapes, a wave table can be divided into "segments". Each segment must be defined with a separate call of PI_WAV_LIN() or one of the other PI_WAV functions. In doing so, the *iAppendWave* argument (see below) is used to concatenate the segments so that they will form the final waveform. To change individual segments or to modify their order, the complete waveform must be recreated segment-by-segment. See the user manual of the controller for more information and for more examples.

Example:



Arguments:

ID ID of controller

iWaveTableId The ID of the wave table

iOffsetOfFirstPointInWaveTable The index of the starting point of the scan line in the segment. Lowest possible value is 0.

iNumberOfWavePoints The length of the single scan line curve as number of points.

iAppendWave Possible values (supported values depend on controller):

0 = clears the wave table and starts writing with the first point in the table

1 = adds the content of the defined segment to the already existing wave table contents (i.e. the values of the defined points are added to the existing values of that points)

2 = appends the defined segment to the already existing wave table content (i.e. concatenates segments to form one final waveform)

dAmplitudeOfWave The amplitude of the scan line.

iNumberOfSpeedUpDownPointsOfWave The number of points for speed up and down.

dOffsetOfWave The offset of the scan line

iSegmentLength The length of the wave table segment as number of points. Only the number of points given by *iSegmentLength* will be written to the wave table. If the *iSegmentLength* value is larger than the *iNumberOPoints* value, the missing points in the segment are filled up with the endpoint value of the curve.

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_WAV_PNT** (int *ID*, int *iWaveTableId*, int *iOffsetOfFirstPointInWaveTable*, int *iNumberOfWavePoints*, int *iAppendWave*, const double* *pdWavePoints*)

Corresponding command: WAV

Create a user-defined curve for given wave table.

To allow for flexible waveform shapes, a wave table can be divided into "segments". Each segment must be defined with a separate call of PI_WAV_PNT() or one of the other PI_WAV functions. In doing so, the *iAppendWave* argument (see below) is used to concatenate the segments so that they will form the final waveform. To change individual segments or to modify their order, the complete waveform must be recreated segment-by-segment. See the user manual of the controller for more information and for more examples.

Arguments:

ID ID of controller

iWaveTableIds The ID of the wave table

iOffsetOfFirstPointInWaveTable The index of the starting point. Must be 1.

iNumberOfWavePoints The length of the user-defined curve as number of points.

iAppendWave Possible values (supported values depend on controller):

0 = clears the wave table and starts writing with the first point in the table

1 = adds the content of the defined segment to the already existing wave table contents (i.e. the values of the defined points are added to the existing values of that points)

2 = appends the defined segment to the already existing wave table content (i.e. concatenates segments to form one final waveform)

iSegmentLength The segment length, i.e. the number of points written to the wave table. Is identical to the *iNumberOfWavePoints* value.

pdWavePoints array with the wave points.

Returns:
TRUE if no error, FALSE otherwise (see p. 7)

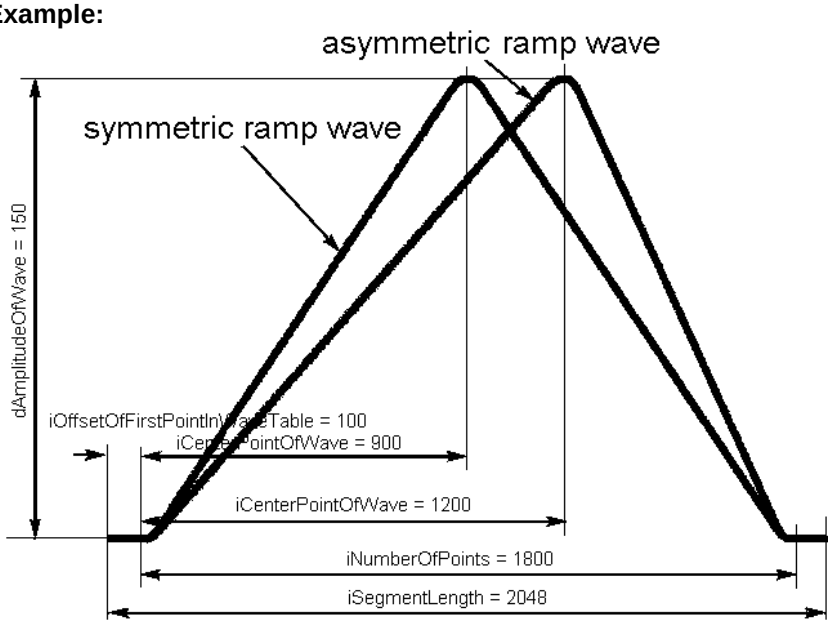
BOOL **PI_WAV_RAMP** (int *ID*, int *iWaveTableId*, int *iOffsetOfFirstPointInWaveTable*, int *iNumberOfWavePoints*, int *iAppendWave*, int *iCenterPointOfWave*, int *iNumberOfSpeedUpDownPointsOfWave*, double *dAmplitudeOfWave*, double *dOffsetOfWave*, int *iSegmentLength*)

Corresponding command: WAV

Define a ramp curve for given wave table.

To allow for flexible waveform shapes, a wave table can be divided into "segments". Each segment must be defined with a separate call of PI_WAV_RAMP() or one of the other PI_WAV functions. In doing so, the *iAppendWave* argument (see below) is used to concatenate the segments so that they will form the final waveform. To change individual segments or to modify their order, the complete waveform must be recreated segment-by-segment. See the user manual of the controller for more information and for more examples.

Example:



Arguments:

ID ID of controller

iWaveTableIds The ID of the wave table

iOffsetOfFirstPointInWaveTable The index of the starting point of the ramp curve in the segment. Gives the phase shift. Lowest possible value is 0.

INumberOfWavePoints The length of the ramp curve as number of points.

iAppendWave Possible values (supported values depend on controller):

0 = clears the wave table and starts writing with the first point in the table

1 = adds the content of the defined segment to the already existing wave table contents (i.e. the values of the defined points are added to the existing values of that points)

2 = appends the defined segment to the already existing wave table content (i.e. concatenates segments to form one final waveform)

iCenterPointOfWave The index of the center point of the ramp curve. Determines if the curve is symmetrically or not. Lowest possible value is 0.

dAmplitudeOfWave The amplitude of the ramp curve.

iNumberOfSpeedUpDownPointsOfWave The number of points for speed up and down.

dOffsetOfWave The offset of the ramp curve.

iSegmentLength The length of the wave table segment as number of points. Only the number of points given by *iSegmentLength* will be written to the wave table. If the *iSegmentLength* value is larger than the *iNumberOPoints* value, the missing points in the segment are filled up with the endpoint value of the curve.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_WCL** (int *ID*, int *iWaveTableIdsArray*, int *iArraySize*)

Corresponding command: WCL

Clears the content of the given wave table.

As long as a wave generator is running, it is not possible to delete the connected wave table.

Arguments:

ID ID of controller

iWaveTableIdsArray array with the IDs of the wave tables to be cleared.

iArraySize the size of the array *iWaveTableIdsArray.*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_WGC** (int *ID*, const int* *piWaveGeneratorIdsArray*, const int* *piNumberOfCyclesArray*, int *iArraySize*)

Corresponding command: WGC

Set the number of cycles for the wave generator output (which is started with PI_WGO()).

Arguments:

ID ID of controller
piWaveGeneratorIdsArray array with wave generators
piNumberOfCyclesArray array with number of cycles for each wave generator in *piWaveGeneratorIdsArray*
iArraySize the size of the arrays *piWaveGeneratorIdsArray* and *piNumberOfCyclesArray*

Returns:

TRUE if successful, **FALSE** otherwise

BOOL **PI_WGO** (int *ID*, const int* *piWaveGeneratorIdsArray*, condt int* *piStartModArray*, int *iArraySize*)

Corresponding command: WGO

Start and stop the specified wave generator with the given mode. Depending on the controller, starts also data recording.

Arguments:

ID ID of controller
piWaveGeneratorIdsArray array with wave generators.
piStartModArray array with start modes for each wave generator in *piWaveGeneratorIdsArray* (hex format, optional decimal format)
iArraySize the size of the arrays *piWaveGeneratorIdsArray* and *piStartModArray*

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_WGR** (int *ID*)

Corresponding command: WGR

Restarts recording when the wave generator is running (a first data recording cycle is started with PI_WGO() which starts the wave generator output).

The data recorder configuration can be made with PI_DRC() and PI_DRT. Data can be read with PI_qDRR() (p. 68).

Arguments:

ID ID of controller

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_WOS** (int *ID*, const int* *piWaveGeneratorIdsArray*, consst double* *pdValueArray*, int *iArraySize*)

Corresponding command: WOS

Sets an offset to the output of a wave generator. The current wave generator output is then created by adding the offset value to the current wave value:

Generator Output = Offset + Current Wave Value

Do not confuse the output-offset value set with PI_WOS() with the offset settings done during the waveform creation with the PI_WAV() functions. While the PI_WAV() offset belongs to only one waveform, the PI_WOS() offset is added to all waveforms which are output by the given wave generator.

Deleting wave table content with PI_WCL() has no effect on the offset settings for the wave generator output.

Arguments:

ID ID of controller
piWaveGeneratorIdsArray array with wave generators.
pdValueArray array with the offsets of the wave generators.
iArraySize the size of the arrays *piWaveGeneratorIdsArray* and *pdValueArray*.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_WSL** (int *ID*, const int* *piWaveGeneratorIdsArray*, const int* *piWaveTableIdsArray*, int *iArraySize*)

Corresponding command: WSL

Wave table selection: connects a wave table to a wave generator or disconnects the selected generator from any wave table.

Two or more generators can be connected to the same wave table, but a generator cannot be connected to more than one wave table.

Deleting wave table content with PI_WCL has no effect on the PI_WSL settings.

As long as a wave generator is running, it is not possible to change the connected wave table.

Arguments:

ID ID of controller
piWaveGeneratorIdsArray array with wave generators.
piWaveTableIdsArray array with the wave table ID. "0" disconnects the selected generator from any wave table.
iArraySize the size of the arrays *piWaveGeneratorIdsArray* and *piWaveTableIdsArray*.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

BOOL **PI_WTR** (int *ID*, const int* *piWaveGeneratorIdsArray*, const long* *piTableRateArray*, const long* *piInterpolationTypeArray*, int *iArraySize*)

Corresponding command: WTR

Set wave generator table rate and interpolation type:

Using PI_WTR(), you can "extend" the individual output cycles of the waveform. Depending on the controller, PI_WTR() furthermore determines the type of interpolation to use for the wave generator output. If the Wave Generator Table Rate is larger than 1, an interpolation helps to avoid sudden position jumps of the axis controlled by the wave generator.

Arguments:

ID ID of controller
piWaveGeneratorIdsArray array with wave generator IDs.
piTableRateArray array with the wave table rates.
piInterpolationTypeArray array with the interpolation types.
iArraySize the size of the arrays *piWaveGeneratorIdsArray* and *piTableRateArray* and *piInterpolationTypeArray*.

Returns:

TRUE if no error, FALSE otherwise (see p. 7)

8. Functions for User-Defined Stages

8.1. Overview

The information in this chapter is relevant for controllers which support the use of stage databases that are located on the host PC. See the user manual of your controller to find out if the use of such stage databases is supported.

The PI GCS 2 DLL has functions allowing you to both define and save new stages (parameter sets) to the PI_UserStages2.dat stage database on the host PC (see “Stage Databases” below for more information). Being able to specify the parameters of a stage and then save those parameters as a set under the stage name makes it easier to connect to previously defined stages.

You can create a new stage parameter set by changing the stage parameters with PI_SPA(). It is important to set the stage parameters correctly. Note that the parameter which determines whether a stage is “new” or not is the Stage Name parameter (ID 0x3C). If it is not specified, the PI_AddStage command will fail. See the user manual of the controller for a complete parameter list and parameter handling details.

You can ease the creation by loading an existing parameter set with PI_CST() and afterwards change the name and any other parameters, which differ, with PI_SPA(). PI_CST() “connects” a valid stage, i.e. makes its parameter set active. It uses the corresponding parameters in the DAT files, so that you do not have to set them all by yourself.

To save the new stage and thus make it available for a future connection with PI_CST(), use PI_AddStage() to add its parameter set to PI_UserStages2.dat. After adding it to PI_UserStages2.dat, the stage will also appear in the list returned by PI_qVST().

If you want to remove a stage from PI_UserStages2.dat call PI_RemoveStage().

It may be more comfortable to set the stage parameters using the PIStageEditor (a GUI dialog). See the separate PI Stage Editor manual (SM144E) for a description of how to operate that graphic interface.

The PIStageEditor can also be started from PIMikroMove. This program provides several functions which ease creating and editing stage parameter sets. For further information, refer to “Stage Editor” and “Tutorials - Frequently Asked Questions” in the PIMikroMove manual.

NOTES

The PI_OpenUserStagesEditDialog() or PI_OpenPiStagesEditDialog() functions are provided for compatibility reasons only and should not be used to open the PIStageEditor. Since the PIStageEditor is not modal, problems can occur when the calling application exits before the PIStageEditor window is closed. Please start the PIStageEditor either from PIMikroMove or via its executable.

BOOL PI_FUNC_DECL **PI_AddStage** (const int ID, char *const szAxes)
BOOL PI_FUNC_DECL **PI_RemoveStage** (const int ID, char *szStageName)

8.2. Function Description

BOOL **PI_AddStage** (const int *ID*, const char* *szAxes*)

Adds the stage specified for szAxes to the PI_UserStages2.dat file which contains user-defined stages.

Arguments:

ID ID of controller

szAxes string with axis identifier.

Returns:

TRUE if successful, **FALSE**, if the buffer was too small to store the message

BOOL **PI_RemoveStage** (const int *ID*, char * *szStageName*)

Removes the stage with the given name from the PI_UserStages2.dat file which contains user-defined stages.

Arguments:

ID ID of controller

szStageName the stage name as string.

Returns:

TRUE if successful, **FALSE**, if the buffer was too small to store the message

8.3. Stage Databases

The PI GCS 2 DLL and the GCS-based host software from PI use multiple databases for stage parameters:

- **PIStages2.dat** and **PIMicosStages2.dat** contain parameter sets for all standard stages from PI and PI miCos and are automatically installed on the host PC with the setup. They cannot be edited; should changes in a file become necessary, you must obtain a new version from PI or PI miCos and install it on your host PC.
- **PI_UserStages2.dat** allows you to create and save your own stages (see “Overview” on p. 120). This database is created on the host PC the first time you connect stages in the host software (i.e. the first time the PI_qVST() or PI_CST() functions of the PI GCS 2 library are used which is the case, for example, when VST? or CST are sent in PITerminal or the *Select connected stages* startup step is performed in PIMikroMove).
- **X-xxx.dat** files contain parameter sets for custom stages delivered by PI or PI miCos. Those files are provided with the stages and have to be copied to the host PC according to the accompanying instructions.
  X-xxx.dat files cannot be edited; should changes become necessary, you must obtain a new version from PI or PI miCos.

The PIStages2.dat, PIMicosStages2.dat, PI_UserStages2.dat and X-xxx.dat databases are located in the ...\PI\GcsTranslator directory on the host PC. The location of the PI directory is that specified upon installation, usually in C:\Documents and Settings\All Users\Application Data (Windows XP) or C:\ProgramData (Windows Vista, 7). If this directory does not exist, the program that needs the stage databases will look in its own directory. In PIMikroMove, you can use the *Version Info* item in the controller menu or the *Search for controller software* item in the *Connections* menu to identify the GcsTranslator path.

See the user manual of your controller for how to install or update stage databases on the host PC.

Notes for users which have already installed older versions of PI GCS 2 DLL, PIMikroMove and PIStageEditor:

- The format of the stage database files has changed (more parameters provided), realized by a file version change from 1 to 2. Note that stage database files with version 2 contain a "2" in their file name, e.g. PIStages2.dat (instead of PIStages.dat for version 1).
- Existing PI_Userstages DAT files of version 1 are automatically converted to version 2 files the first time you connect stages in the host software, i.e. the first time the PI_qVST() or PI_CST() functions of the PI GCS 2 library are used which is the case, for example, when VST? or CST are sent in PITerminal or the *Select connected stages* startup step is performed in PIMikroMove. Parameters which were not present in version 1 are set to default values during conversion.
- Version 4 and newer of the PIStageEditor supports stage database files of version 2 (in PIMikroMove, you can check the version of the PIStageEditor with *Help → Show version information…*).

8.4. Troubleshooting

Problem:

Stage database file cannot be opened, or stage selection in host software is not possible. Error message arises saying that the stage database does not have the correct revision.

Solution:

To support new hardware (controller or stages), it is necessary to release new revisions of the stage database files. Although PI aims for highest compatibility, the latest host software may not be able to work with older stage database files. You can check the revision of your stage database files using the *PIStageEditor* (see the PIStageEditor manual for details).

If your *PIStages2.dat* file does not have the correct revision, download the latest revision from www.pi.ws. For detailed update instructions see the user manual of the controller.

The *PI_UserStages2.dat* file is created the first time you connect stages in the host software (i.e. the first time the PI_qVST() or PI_CST() functions of the PI GCS 2 DLL are used). If you have already a *PI_UserStages2.dat* file for your controller but this file cannot be opened with the latest software, proceed as follows:

1 Rename the existing *PI_UserStages2.dat* file on your host PC.

2 Create a new *PI_UserStages2.dat*. This can be done by calling the PI_qVST() or PI_qCST() functions of the PI GCS 2 DLL.

3 Open the new *PI_UserStages2.dat* in the *PIStageEditor.*

4 Import the content of the old (renamed) *PI_UserStages2.dat* file to the new file. See the *PIStageEditor* manual for details. Note that during the import procedure, the imported stage parameter sets are converted to fit the new revision. Parameters which were not present in the old revision are set to default values which may need to be optimized.

9. Error Codes

The error codes listed here are those of the *PI General Command Set.* As such, some are not relevant to your controller and will simply never occur with the systems this manual describes.

Controller errors		
0	PI_CNTR_NO_ERROR	No error
1	PI_CNTR_PARAM_SYNTAX	Parameter syntax error
2	PI_CNTR_UNKNOWN_COMMAND	Unknown command
3	PI_CNTR_COMMAND_TOO_LONG	Command length out of limits or command buffer overrun
4	PI_CNTR_SCAN_ERROR	Error while scanning
5	PI_CNTR_MOVE_WITHOUT_REF_OR_NO_SERVO	Unallowable move attempted on unreferenced axis, or move attempted with servo off
6	PI_CNTR_INVALID_SGA_PARAM	Parameter for SGA not valid
7	PI_CNTR_POS_OUT_OF_LIMITS	Position out of limits
8	PI_CNTR_VEL_OUT_OF_LIMITS	Velocity out of limits
9	PI_CNTR_SET_PIVOT_NOT_POSSIBLE	Attempt to set pivot point while U,V and W not all 0
10	PI_CNTR_STOP	Controller was stopped by command
11	PI_CNTR_SST_OR_SCAN_RANGE	Parameter for SST or for one of the embedded scan algorithms out of range
12	PI_CNTR_INVALID_SCAN_AXES	Invalid axis combination for fast scan
13	PI_CNTR_INVALID_NAV_PARAM	Parameter for NAV out of range
14	PI_CNTR_INVALID_ANALOG_INPUT	Invalid analog channel
15	PI_CNTR_INVALID_AXIS_IDENTIFIER	Invalid axis identifier
16	PI_CNTR_INVALID_STAGE_NAME	Unknown stage name
17	PI_CNTR_PARAM_OUT_OF_RANGE	Parameter out of range
18	PI_CNTR_INVALID_MACRO_NAME	Invalid macro name
19	PI_CNTR_MACRO_RECORD	Error while recording macro
20	PI_CNTR_MACRO_NOT_FOUND	Macro not found
21	PI_CNTR_AXIS_HAS_NO_BRAKE	Axis has no brake
22	PI_CNTR_DOUBLE_AXIS	Axis identifier specified more than once
23	PI_CNTR_ILLEGAL_AXIS	Illegal axis
24	PI_CNTR_PARAM_NR	Incorrect number of parameters
25	PI_CNTR_INVALID_REAL_NR	Invalid floating point number
26	PI_CNTR_MISSING_PARAM	Parameter missing
27	PI_CNTR_SOFT_LIMIT_OUT_OF_RANGE	Soft limit out of range
28	PI_CNTR_NO_MANUAL_PAD	No manual pad found
29	PI_CNTR_NO_JUMP	No more step-response values
30	PI_CNTR_INVALID_JUMP	No step-response values recorded
31	PI_CNTR_AXIS_HAS_NO_REFERENCE	Axis has no reference sensor
32	PI_CNTR_STAGE_HAS_NO_LIM_SWITCH	Axis has no limit switch
33	PI_CNTR_NO_RELAY_CARD	No relay card installed
34	PI_CNTR_CMD_NOT_ALLOWED_FOR_STAGE	Command not allowed for selected stage(s)
35	PI_CNTR_NO_DIGITAL_INPUT	No digital input installed

36	PI_CNTR_NO_DIGITAL_OUTPUT	No digital output configured
37	PI_CNTR_NO_MCM	No more MCM responses
38	PI_CNTR_INVALID_MCM	No MCM values recorded
39	PI_CNTR_INVALID_CNTR_NUMBER	Controller number invalid
40	PI_CNTR_NO_JOYSTICK_CONNECTED	No joystick configured
41	PI_CNTR_INVALID_EGE_AXIS	Invalid axis for electronic gearing, axis cannot be slave
42	PI_CNTR_SLAVE_POSITION_OUT_OF_RANGE	Position of slave axis is out of range
43	PI_CNTR_COMMAND_EGE_SLAVE	Slave axis cannot be commanded directly when electronic gearing is enabled
44	PI_CNTR_JOYSTICK_CALIBRATION_FAILED	Calibration of joystick failed
45	PI_CNTR_REFERENCING_FAILED	Referencing failed
46	PI_CNTR_OPM_MISSING	OPM (Optical Power Meter) missing
47	PI_CNTR_OPM_NOT_INITIALIZED	OPM (Optical Power Meter) not initialized or cannot be initialized
48	PI_CNTR_OPM_COM_ERROR	OPM (Optical Power Meter) communication error
49	PI_CNTR_MOVE_TO_LIMIT_SWITCH_FAILED	Move to limit switch failed
50	PI_CNTR_REF_WITH_REF_DISABLED	Attempt to reference axis with referencing disabled
51	PI_CNTR_AXIS_UNDER_JOYSTICK_CONTROL	Selected axis is controlled by joystick
52	PI_CNTR_COMMUNICATION_ERROR	Controller detected communication error
53	PI_CNTR_DYNAMIC_MOVE_IN_PROCESS	MOV! motion still in progress
54	PI_CNTR_UNKNOWN_PARAMETER	Unknown parameter
55	PI_CNTR_NO_REP_RECORDED	No commands were recorded with REP
56	PI_CNTR_INVALID_PASSWORD	Password invalid
57	PI_CNTR_INVALID_RECORDER_CHAN	Data record table does not exist
58	PI_CNTR_INVALID_RECORDER_SRC_OPT	Source does not exist; number too low or too high
59	PI_CNTR_INVALID_RECORDER_SRC_CHAN	Source record table number too low or too high
60	PI_CNTR_PARAM_PROTECTION	Protected Param: Current Command Level (CCL) too low
61	PI_CNTR_AUTOZERO_RUNNING	Command execution not possible while autozero is running
62	PI_CNTR_NO_LINEAR_AXIS	Autozero requires at least one linear axis
63	PI_CNTR_INIT_RUNNING	Initialization still in progress
64	PI_CNTR_READ_ONLY_PARAMETER	Parameter is read-only
65	PI_CNTR_PAM_NOT_FOUND	Parameter not found in nonvolatile memory
66	PI_CNTR_VOL_OUT_OF_LIMITS	Voltage out of limits
67	PI_CNTR_WAVE_TOO_LARGE	Not enough memory available for requested wave curve
68	PI_CNTR_NOT_ENOUGH_DDL_MEMORY	Not enough memory available for DDL table; DDL cannot be started
69	PI_CNTR_DDL_TIME_DELAY_TOO_LARGE	Time delay larger than DDL table; DDL cannot be started
70	PI_CNTR_DIFFERENT_ARRAY_LENGTH	The requested arrays have different lengths; query them separately
71	PI_CNTR_GEN_SINGLE_MODE_RESTART	Attempt to restart the generator while it is running in single step mode
72	PI_CNTR_ANALOG_TARGET_ACTIVE	Motion commands and wave generator activation are not allowed when analog target is active

73	PI_CNTR_WAVE_GENERATOR_ACTIVE	Motion commands are not allowed when wave generator is active
74	PI_CNTR_AUTOZERO_DISABLED	No sensor channel or no piezo channel connected to selected axis (sensor and piezo matrix)
75	PI_CNTR_NO_WAVE_SELECTED	Generator started (WGO) without having selected a wave table (WSL).
76	PI_CNTR_IF_BUFFER_OVERRUN	Interface buffer overran and command couldn't be received correctly
77	PI_CNTR_NOT_ENOUGH_RECORDED_DATA	Data record table does not hold enough recorded data
78	PI_CNTR_TABLE_DEACTIVATED	Data record table is not configured for recording
79	PI_CNTR_OPENLOOP_VALUE_SET_WHEN_SERVO_ON	Open-loop commands (SVA, SVR) are not allowed when servo is on
80	PI_CNTR_RAM_ERROR	Hardware error affecting RAM
81	PI_CNTR_MACRO_UNKNOWN_COMMAND	Not macro command
82	PI_CNTR_MACRO_PC_ERROR	Macro counter out of range
83	PI_CNTR_JOYSTICK_ACTIVE	Joystick is active
84	PI_CNTR_MOTOR_IS_OFF	Motor is off
85	PI_CNTR_ONLY_IN_MACRO	Macro-only command
86	PI_CNTR_JOYSTICK_UNKNOWN_AXIS	Invalid joystick axis
87	PI_CNTR_JOYSTICK_UNKNOWN_ID	Joystick unknown
88	PI_CNTR_REF_MODE_IS_ON	Move without referenced stage
89	PI_CNTR_NOT_ALLOWED_IN_CURRENT_MOTION_MODE	Command not allowed in current motion mode
90	PI_CNTR_DIO_AND_TRACING_NOT_POSSIBLE	No tracing possible while digital IOs are used on this HW revision. Reconnect to switch operation mode.
91	PI_CNTR_COLLISION	Move not possible, would cause collision
92	PI_CNTR_SLAVE_NOT_FAST_ENOUGH	Stage is not capable of following the master. Check the gear ratio.
93	PI_CNTR_CMD_NOT_ALLOWED_WHILE_AXIS_IN_MOTION	This command is not allowed while the affected axis or its master is in motion.
94	PI_CNTR_OPEN_LOOP_JOYSTICK_ENABLED	Servo cannot be switched on when open-loop joystick control is enabled.
95	PI_CNTR_INVALID_SERVO_STATE_FOR_PARAMETER	This parameter cannot be changed in current servo mode.
96	PI_CNTR_UNKNOWN_STAGE_NAME	Unknown stage name
97	PI_CNTR_INVALID_VALUE_LENGTH	Invalid length of value (too much characters)
98	PI_CNTR_AUTOZERO_FAILED	AutoZero procedure was not successful
100	PI_LABVIEW_ERROR	PI LabVIEW driver reports error. See source control for details.
200	PI_CNTR_NO_AXIS	No stage connected to axis
201	PI_CNTR_NO_AXIS_PARAM_FILE	File with axis parameters not found
202	PI_CNTR_INVALID_AXIS_PARAM_FILE	Invalid axis parameter file
203	PI_CNTR_NO_AXIS_PARAM_BACKUP	Backup file with axis parameters not found
204	PI_CNTR_RESERVED_204	PI internal error code 204
205	PI_CNTR_SMO_WITH_SERVO_ON	SMO with servo on
206	PI_CNTR_UUDECODE_INCOMPLETE_HEADER	uudecode: incomplete header
207	PI_CNTR_UUDECODE_NOTHING_TO_DECODE	uudecode: nothing to decode
208	PI_CNTR_UUDECODE_ILLEGAL_FORMAT	uudecode: illegal UUE format
209	PI_CNTR_CRC32_ERROR	CRC32 error

210	PI_CNTR_ILLEGAL_FILENAME	Illegal file name (must be 8-0 format)
211	PI_CNTR_FILE_NOT_FOUND	File not found on controller
212	PI_CNTR_FILE_WRITE_ERROR	Error writing file on controller
213	PI_CNTR_DTR_HINDERS_VELOCITY_CHANGE	VEL command not allowed in DTR command mode
214	PI_CNTR_POSITION_UNKNOWN	Position calculations failed
215	PI_CNTR_CONN_POSSIBLY_BROKEN	The connection between controller and stage may be broken
216	PI_CNTR_ON_LIMIT_SWITCH	The connected stage has driven into a limit switch, some controllers need CLR to resume operation
217	PI_CNTR_UNEXPECTED_STRUT_STOP	Strut test command failed because of an unexpected strut stop
218	PI_CNTR_POSITION_BASED_ON_ESTIMATION	While MOV! is running position can only be estimated!
219	PI_CNTR_POSITION_BASED_ON_INTERPOLATION	Position was calculated during MOV motion
230	PI_CNTR_INVALID_HANDLE	Invalid handle
231	PI_CNTR_NO_BIOS_FOUND	No bios found
232	PI_CNTR_SAVE_SYS_CFG_FAILED	Save system configuration failed
233	PI_CNTR_LOAD_SYS_CFG_FAILED	Load system configuration failed
301	PI_CNTR_SEND_BUFFER_OVERFLOW	Send buffer overflow
302	PI_CNTR_VOLTAGE_OUT_OF_LIMITS	Voltage out of limits
303	PI_CNTR_OPEN_LOOP_MOTION_SET_WHEN_SERVO_ON	Open-loop motion attempted when servo ON
304	PI_CNTR_RECEIVING_BUFFER_OVERFLOW	Received command is too long
305	PI_CNTR_EEPROM_ERROR	Error while reading/writing EEPROM
306	PI_CNTR_I2C_ERROR	Error on I2C bus
307	PI_CNTR_RECEIVING_TIMEOUT	Timeout while receiving command
308	PI_CNTR_TIMEOUT	A lengthy operation has not finished in the expected time
309	PI_CNTR_MACRO_OUT_OF_SPACE	Insufficient space to store macro
310	PI_CNTR_EUI_OLDVERSION_CFGDATA	Configuration data has old version number
311	PI_CNTR_EUI_INVALID_CFGDATA	Invalid configuration data
333	PI_CNTR_HARDWARE_ERROR	Internal hardware error
400	PI_CNTR_WAV_INDEX_ERROR	Wave generator index error
401	PI_CNTR_WAV_NOT_DEFINED	Wave table not defined
402	PI_CNTR_WAV_TYPE_NOT_SUPPORTED	Wave type not supported
403	PI_CNTR_WAV_LENGTH_EXCEEDS_LIMIT	Wave length exceeds limit
404	PI_CNTR_WAV_PARAMETER_NR	Wave parameter number error
405	PI_CNTR_WAV_PARAMETER_OUT_OF_LIMIT	Wave parameter out of range
406	PI_CNTR_WGO_BIT_NOT_SUPPORTED	WGO command bit not supported
500	PI_CNTR_EMERGENCY_STOP_BUTTON_ACTIVATED	The \"red knob\" is still set and disables system
501	PI_CNTR_EMERGENCY_STOP_BUTTON_WAS_ACTIVATED	The \"red knob\" was activated and still disables system - reanimation required
502	PI_CNTR_REDUNDANCY_LIMIT_EXCEEDED	Position consistency check failed
503	PI_CNTR_COLLISION_SWITCH_ACTIVATED	Hardware collision sensor(s) are activated
504	PI_CNTR_FOLLOWING_ERROR	Strut following error occurred, e.g. caused by overload or encoder failure
505	PI_CNTR_SENSOR_SIGNAL_INVALID	One sensor signal is not valid

506	PI_CNTR_SERVO_LOOP_UNSTABLE	Servo loop was unstable due to wrong parameter setting and switched off to avoid damage.
507	PI_CNTR_LOST_SPI_SLAVE_CONNECTION	Digital connection to external spi slave device is lost
530	PI_CNTR_NODE_DOES_NOT_EXIST	A command refers to a node that does not exist
531	PI_CNTR_PARENT_NODE_DOES_NOT_EXIST	A command refers to a node that has no parent node
532	PI_CNTR_NODE_IN_USE	Attempt to delete a node that is in use
533	PI_CNTR_NODE_DEFINITION_IS_CYCLIC	Definition of a node is cyclic
536	PI_CNTR_HEXAPOD_IN_MOTION	Transformation cannot be defined as long as Hexapod is in motion
537	PI_CNTR_TRANSFORMATION_TYPE_NOT_SUPPORTED	Transformation node cannot be activated
539	PI_CNTR_NODE_PARENT_IDENTICAL_TO_CHILD	A node cannot be linked to itself
540	PI_CNTR_NODE_DEFINITION_INCONSISTENT	Node definition is erroneous or not complete (replace or delete it)
542	PI_CNTR_NODES_NOT_IN_SAME_CHAIN	The nodes are not part of the same chain
543	PI_CNTR_NODE_MEMORY_FULL	Unused nodes must be deleted before new nodes can be stored
544	PI_CNTR_PIVOT_POINT_FEATURE_NOT_SUPPORTED	With some transformations pivot point usage is not supported
545	PI_CNTR_SOFTLIMITS_INVALID	Soft limits invalid due to changes in coordinate system
546	PI_CNTR_CS_WRITE_PROTECTED	Coordinate system is write protected
547	PI_CNTR_CS_CONTENT_FROM_CONFIG_FILE	Coordinate system cannot be changed because its content is loaded from a configuration file
548	PI_CNTR_CS_CANNOT_BE_LINKED	Coordinate system may not be linked
549	PI_CNTR_KSB_CS_ROTATION_ONLY	A KSB-type coordinate system can only be rotated by multiples of 90 degrees
551	PI_CNTR_CS_DATA_CANNOT_BE_QUERIED	This query is not supported for this coordinate system type
552	PI_CNTR_CS_COMBINATION_DOES_NOT_EXIST	This combination of work and tool coordinate systems does not exist
553	PI_CNTR_CS_COMBINATION_INVALID	The combination must consist of one work and one tool coordinate system
554	PI_CNTR_CS_TYPE_DOES_NOT_EXIST	This coordinate system type does not exist
555	PI_CNTR_UNKNOWN_ERROR	BasMac: unknown controller error
556	PI_CNTR_CS_TYPE_NOT_ACTIVATED	No coordinate system of this type is activated
557	PI_CNTR_CS_NAME_INVALID	Name of coordinate system is invalid
558	PI_CNTR_CS_GENERAL_FILE_MISSING	File with stored CS systems is missing or erroneous
559	PI_CNTR_CS_LEVELING_FILE_MISSING	File with leveling CS is missing or erroneous
601	PI_CNTR_NOT_ENOUGH_MEMORY	Not enough memory
602	PI_CNTR_HW_VOLTAGE_ERROR	Hardware voltage error
603	PI_CNTR_HW_TEMPERATURE_ERROR	Hardware temperature out of range
604	PI_CNTR_POSITION_ERROR_TOO_HIGH	Position error of any axis in the system is too high
606	PI_CNTR_INPUT_OUT_OF_RANGE	Maximum value of input signal has been exceeded
607	PI_CNTR_NO_INTEGER	Value is not integer
608	PI_CNTR_FAST_ALIGNMENT_PROCESS_IS_NOT_RUNNING	Fast alignment process cannot be paused because it is not running

609	PI_CNTR_FAST_ALIGNMENT_PROCESS_IS_NOT_PAUSED	Fast alignment process cannot be restarted/resumed because it is not paused
650	PI_CNTR_UNABLE_TO_SET_PARAM_WITH_SPA	Parameter could not be set with SPA - SEP needed?
651	PI_CNTR_PHASE_FINDING_ERROR	Phase finding error
652	PI_CNTR_SENSOR_SETUP_ERROR	Sensor setup error
653	PI_CNTR_SENSOR_COMM_ERROR	Sensor communication error
654	PI_CNTR_MOTOR_AMPLIFIER_ERROR	Motor amplifier error
655	PI_CNTR_OVER_CURR_PROTEC_TRIGGERED_BY_I2T	Overcurrent protection triggered by I2T-module
656	PI_CNTR_OVER_CURR_PROTEC_TRIGGERED_BY_AMP_MODULE	Overcurrent protection triggered by amplifier module
657	PI_CNTR_SAFETY_STOP_TRIGGERED	Safety stop triggered
658	PI_SENSOR_OFF	Sensor off?
700	PI_CNTR_COMMAND_NOT_ALLOWED_IN_EXTERNAL_MODE	Command not allowed in external mode
710	PI_CNTR_EXTERNAL_MODE_ERROR	External mode communication error
715	PI_CNTR_INVALID_MODE_OF_OPERATION	Invalid mode of operation
716	PI_CNTR_FIRMWARE_STOPPED_BY_CMD	Firmware stopped by command (#27)
717	PI_CNTR_EXTERNAL_MODE_DRIVER_MISSING	External mode driver missing
718	PI_CNTR_CONFIGURATION_FAILURE_EXTERNAL_MODE	Missing or incorrect configuration of external mode
719	PI_CNTR_EXTERNAL_MODE_CYCLETIME_INVALID	External mode cycletime invalid
720	PI_CNTR_BRAKE_ACTIVATED	Brake is activated
1000	PI_CNTR_TOO_MANY_NESTED_MACROS	Too many nested macros
1001	PI_CNTR_MACRO_ALREADY_DEFINED	Macro already defined
1002	PI_CNTR_NO_MACRO_RECORDING	Macro recording not activated
1003	PI_CNTR_INVALID_MAC_PARAM	Invalid parameter for MAC
1004	PI_CNTR_RESERVED_1004	PI internal error code 1004
1005	PI_CNTR_CONTROLLER_BUSY	Controller is busy with some lengthy operation (e.g. reference move, fast scan algorithm)
1006	PI_CNTR_INVALID_IDENTIFIER	Invalid identifier (invalid special characters, ...)
1007	PI_CNTR_UNKNOWN_VARIABLE_OR_ARGUMENT	Variable or argument not defined
1008	PI_CNTR_RUNNING_MACRO	Controller is (already) running a macro
1009	PI_CNTR_MACRO_INVALID_OPERATOR	Invalid or missing operator for condition. Check necessary spaces around operator.
1010	PI_CNTR_MACRO_NO_ANSWER	No answer was received while executing WAC/MEX/JRC/...
1011	PI_CMD_NOT_VALID_IN_MACRO_MODE	Command not valid during macro execution
1024	PI_CNTR_MOTION_ERROR	Motion error: position error too large, servo is switched off automatically
1063	PI_CNTR_EXT_PROFILE_UNALLOWED_CMD	User profile mode: command is not allowed, check for required preparatory commands
1064	PI_CNTR_EXT_PROFILE_EXPECTING_MOTION_ERROR	User profile mode: first target position in user profile is too far from current position
1065	PI_CNTR_PROFILE_ACTIVE	Controller is (already) in user profile mode
1066	PI_CNTR_PROFILE_INDEX_OUT_OF_RANGE	User profile mode: block or data set index out of allowed range
1071	PI_CNTR_PROFILE_OUT_OF_MEMORY	User profile mode: out of memory
1072	PI_CNTR_PROFILE_WRONG_CLUSTER	User profile mode: cluster is not assigned to this axis
1073	PI_CNTR_PROFILE_UNKNOWN_CLUSTER_IDENTIFIER	Unknown cluster identifier

1090	PI_CNTR_TOO_MANY_TCP_CONNECTIONS_OPEN	There are too many open tcpip connections
2000	PI_CNTR_ALREADY_HAS_SERIAL_NUMBER	Controller already has a serial number
4000	PI_CNTR_SECTOR_ERASE_FAILED	Sector erase failed
4001	PI_CNTR_FLASH_PROGRAM_FAILED	Flash program failed
4002	PI_CNTR_FLASH_READ_FAILED	Flash read failed
4003	PI_CNTR_HW_MATCHCODE_ERROR	HW match code missing/invalid
4004	PI_CNTR_FW_MATCHCODE_ERROR	FW match code missing/invalid
4005	PI_CNTR_HW_VERSION_ERROR	HW version missing/invalid
4006	PI_CNTR_FW_VERSION_ERROR	FW version missing/invalid
4007	PI_CNTR_FW_UPDATE_ERROR	FW update failed
4008	PI_CNTR_FW_CRC_PAR_ERROR	FW Parameter CRC wrong
4009	PI_CNTR_FW_CRC_FW_ERROR	FW CRC wrong
5000	PI_CNTR_INVALID_PCC_SCAN_DATA	PicoCompensation scan data is not valid
5001	PI_CNTR_PCC_SCAN_RUNNING	PicoCompensation is running, some actions cannot be executed during scanning/recording
5002	PI_CNTR_INVALID_PCC_AXIS	Given axis cannot be defined as PPC axis
5003	PI_CNTR_PCC_SCAN_OUT_OF_RANGE	Defined scan area is larger than the travel range
5004	PI_CNTR_PCC_TYPE_NOT_EXISTING	Given PicoCompensation type is not defined
5005	PI_CNTR_PCC_PAM_ERROR	PicoCompensation parameter error
5006	PI_CNTR_PCC_TABLE_ARRAY_TOO_LARGE	PicoCompensation table is larger than maximum table length
5100	PI_CNTR_NEXLINE_ERROR	Common error in NEXLINE® firmware module
5101	PI_CNTR_CHANNEL_ALREADY_USED	Output channel for NEXLINE® cannot be redefined for other usage
5102	PI_CNTR_NEXLINE_TABLE_TOO_SMALL	Memory for NEXLINE® signals is too small
5103	PI_CNTR_RNP_WITH_SERVO_ON	RNP cannot be executed if axis is in closed loop
5104	PI_CNTR_RNP_NEEDED	Relax procedure (RNP) needed
5200	PI_CNTR_AXIS_NOT_CONFIGURED	Axis must be configured for this action
5300	PI_CNTR_FREQU_ANALYSIS_FAILED	Frequency analysis failed
5301	PI_CNTR_FREQU_ANALYSIS_RUNNING	Another frequency analysis is running
6000	PI_CNTR_SENSOR_ABS_INVALID_VALUE	Invalid preset value of absolute sensor
6001	PI_CNTR_SENSOR_ABS_WRITE_ERROR	Error while writing to sensor
6002	PI_CNTR_SENSOR_ABS_READ_ERROR	Error while reading from sensor
6003	PI_CNTR_SENSOR_ABS_CRC_ERROR	Checksum error of absolute sensor
6004	PI_CNTR_SENSOR_ABS_ERROR	General error of absolute sensor
6005	PI_CNTR_SENSOR_ABS_OVERFLOW	Overflow of absolute sensor position

Interface errors

0	COM_NO_ERROR	No error occurred during function call
-1	COM_ERROR	Error during com operation (could not be specified)
-2	SEND_ERROR	Error while sending data
-3	REC_ERROR	Error while receiving data
-4	NOT_CONNECTED_ERROR	Not connected (no port with given ID open)
-5	COM_BUFFER_OVERFLOW	Buffer overflow

-6	CONNECTION_FAILED	Error while opening port
-7	COM_TIMEOUT	Timeout error
-8	COM_MULTILINE_RESPONSE	There are more lines waiting in buffer
-9	COM_INVALID_ID	There is no interface or DLL handle with the given ID
-10	COM_NOTIFY_EVENT_ERROR	Event/message for notification could not be opened
-11	COM_NOT_IMPLEMENTED	Function not supported by this interface type
-12	COM_ECHO_ERROR	Error while sending "echoed" data
-13	COM_GPIB_EDVR	IEEE488: System error
-14	COM_GPIB_ECIC	IEEE488: Function requires GPIB board to be CIC
-15	COM_GPIB_ENOL	IEEE488: Write function detected no listeners
-16	COM_GPIB_EADR	IEEE488: Interface board not addressed correctly
-17	COM_GPIB_EARG	IEEE488: Invalid argument to function call
-18	COM_GPIB_ESAC	IEEE488: Function requires GPIB board to be SAC
-19	COM_GPIB_EABO	IEEE488: I/O operation aborted
-20	COM_GPIB_ENEB	IEEE488: Interface board not found
-21	COM_GPIB_EDMA	IEEE488: Error performing DMA
-22	COM_GPIB_EOIP	IEEE488: I/O operation started before previous operation completed
-23	COM_GPIB_ECAP	IEEE488: No capability for intended operation
-24	COM_GPIB_EFSO	IEEE488: File system operation error
-25	COM_GPIB_EBUS	IEEE488: Command error during device call
-26	COM_GPIB_ESTB	IEEE488: Serial poll-status byte lost
-27	COM_GPIB_ESRQ	IEEE488: SRQ remains asserted
-28	COM_GPIB_ETAB	IEEE488: Return buffer full
-29	COM_GPIB_ELCK	IEEE488: Address or board locked
-30	COM_RS_INVALID_DATA_BITS	RS-232: 5 data bits with 2 stop bits is an invalid combination, as is 6, 7, or 8 data bits with 1.5 stop bits
-31	COM_ERROR_RS_SETTINGS	RS-232: Error configuring the COM port
-32	COM_INTERNAL_RESOURCES_ERROR	Error dealing with internal system resources (events, threads, ...)
-33	COM_DLL_FUNC_ERROR	A DLL or one of the required functions could not be loaded
-34	COM_FTDIUSB_INVALID_HANDLE	FTDIUSB: invalid handle
-35	COM_FTDIUSB_DEVICE_NOT_FOUND	FTDIUSB: device not found
-36	COM_FTDIUSB_DEVICE_NOT_OPENED	FTDIUSB: device not opened
-37	COM_FTDIUSB_IO_ERROR	FTDIUSB: IO error
-38	COM_FTDIUSB_INSUFFICIENT_RESOURCES	FTDIUSB: insufficient resources
-39	COM_FTDIUSB_INVALID_PARAMETER	FTDIUSB: invalid parameter
-40	COM_FTDIUSB_INVALID_BAUD_RATE	FTDIUSB: invalid baud rate
-41	COM_FTDIUSB_DEVICE_NOT_OPENED_FOR_ERASE	FTDIUSB: device not opened for erase
-42	COM_FTDIUSB_DEVICE_NOT_OPENED_FOR_WRITE	FTDIUSB: device not opened for write
-43	COM_FTDIUSB_FAILED_TO_WRITE_DEVICE	FTDIUSB: failed to write device
-44	COM_FTDIUSB_EEPROM_READ_FAILED	FTDIUSB: EEPROM read failed
-45	COM_FTDIUSB_EEPROM_WRITE_FAILED	FTDIUSB: EEPROM write failed
-46	COM_FTDIUSB_EEPROM_ERASE_FAILED	FTDIUSB: EEPROM erase failed
-47	COM_FTDIUSB_EEPROM_NOT_PRESENT	FTDIUSB: EEPROM not present
-48	COM_FTDIUSB_EEPROM_NOT_PROGRAMMED	FTDIUSB: EEPROM not programmed
-49	COM_FTDIUSB_INVALID_ARGS	FTDIUSB: invalid arguments

-50	COM_FTDIUSB_NOT_SUPPORTED	FTDIUSB: not supported
-51	COM_FTDIUSB_OTHER_ERROR	FTDIUSB: other error
-52	COM_PORT_ALREADY_OPEN	Error while opening the COM port: was already open
-53	COM_PORT_CHECKSUM_ERROR	Checksum error in received data from COM port
-54	COM_SOCKET_NOT_READY	Socket not ready, you should call the function again
-55	COM_SOCKET_PORT_IN_USE	Port is used by another socket
-56	COM_SOCKET_NOT_CONNECTED	Socket not connected (or not valid)
-57	COM_SOCKET_TERMINATED	Connection terminated (by peer)
-58	COM_SOCKET_NO_RESPONSE	Can't connect to peer
-59	COM_SOCKET_INTERRUPTED	Operation was interrupted by a nonblocked signal
-60	COM_PCI_INVALID_ID	No device with this ID is present
-61	COM_PCI_ACCESS_DENIED	Driver could not be opened (on Vista: run as administrator!)
-62	COM_SOCKET_HOST_NOT_FOUND	Host not found
-63	COM_DEVICE_CONNECTED	Device already connected

DLL errors

-1001	PI_UNKNOWN_AXIS_IDENTIFIER	Unknown axis identifier
-1002	PI_NR_NAV_OUT_OF_RANGE	Number for NAV out of range--must be in [1,10000]
-1003	PI_INVALID_SGA	Invalid value for SGA--must be one of 1, 10, 100, 1000
-1004	PI_UNEXPECTED_RESPONSE	Controller sent unexpected response
-1005	PI_NO_MANUAL_PAD	No manual control pad installed, calls to SMA and related commands are not allowed
-1006	PI_INVALID_MANUAL_PAD_KNOB	Invalid number for manual control pad knob
-1007	PI_INVALID_MANUAL_PAD_AXIS	Axis not currently controlled by a manual control pad
-1008	PI_CONTROLLER_BUSY	Controller is busy with some lengthy operation (e.g. reference move, fast scan algorithm)
-1009	PI_THREAD_ERROR	Internal error--could not start thread
-1010	PI_IN_MACRO_MODE	Controller is (already) in macro mode--command not valid in macro mode
-1011	PI_NOT_IN_MACRO_MODE	Controller not in macro mode--command not valid unless macro mode active
-1012	PI_MACRO_FILE_ERROR	Could not open file to write or read macro
-1013	PI_NO_MACRO_OR_EMPTY	No macro with given name on controller, or macro is empty
-1014	PI_MACRO_EDITOR_ERROR	Internal error in macro editor
-1015	PI_INVALID_ARGUMENT	One or more arguments given to function is invalid (empty string, index out of range, ...)
-1016	PI_AXIS_ALREADY_EXISTS	Axis identifier is already in use by a connected stage
-1017	PI_INVALID_AXIS_IDENTIFIER	Invalid axis identifier
-1018	PI_COM_ARRAY_ERROR	Could not access array data in COM server
-1019	PI_COM_ARRAY_RANGE_ERROR	Range of array does not fit the number of parameters
-1020	PI_INVALID_SPA_CMD_ID	Invalid parameter ID given to SPA or SPA?
-1021	PI_NR_AVG_OUT_OF_RANGE	Number for AVG out of range--must be >0
-1022	PI_WAV_SAMPLES_OUT_OF_RANGE	Incorrect number of samples given to WAV
-1023	PI_WAV_FAILED	Generation of wave failed
-1024	PI_MOTION_ERROR	Motion error: position error too large, servo is switched off automatically
-1025	PI_RUNNING_MACRO	Controller is (already) running a macro

-1026	PI_PZT_CONFIG_FAILED	Configuration of PZT stage or amplifier failed
-1027	PI_PZT_CONFIG_INVALID_PARAMS	Current settings are not valid for desired configuration
-1028	PI_UNKNOWN_CHANNEL_IDENTIFIER	Unknown channel identifier
-1029	PI_WAVE_PARAM_FILE_ERROR	Error while reading/writing wave generator parameter file
-1030	PI_UNKNOWN_WAVE_SET	Could not find description of wave form. Maybe WG.INI is missing?
-1031	PI_WAVE_EDITOR_FUNC_NOT_LOADED	The WGWaveEditor DLL function was not found at startup
-1032	PI_USER_CANCELLED	The user cancelled a dialog
-1033	PI_C844_ERROR	Error from C-844 Controller
-1034	PI_DLL_NOT_LOADED	DLL necessary to call function not loaded, or function not found in DLL
-1035	PI_PARAMETER_FILE_PROTECTED	The open parameter file is protected and cannot be edited
-1036	PI_NO_PARAMETER_FILE_OPENED	There is no parameter file open
-1037	PI_STAGE_DOES_NOT_EXIST	Selected stage does not exist
-1038	PI_PARAMETER_FILE_ALREADY_OPENED	There is already a parameter file open. Close it before opening a new file
-1039	PI_PARAMETER_FILE_OPEN_ERROR	Could not open parameter file
-1040	PI_INVALID_CONTROLLER_VERSION	The version of the connected controller is invalid
-1041	PI_PARAM_SET_ERROR	Parameter could not be set with SPA--parameter not defined for this controller!
-1042	PI_NUMBER_OF_POSSIBLE_WAVES_EXCEEDED	The maximum number of wave definitions has been exceeded
-1043	PI_NUMBER_OF_POSSIBLE_GENERATORS_EXCEEDED	The maximum number of wave generators has been exceeded
-1044	PI_NO_WAVE_FOR_AXIS_DEFINED	No wave defined for specified axis
-1045	PI_CANT_STOP_OR_START_WAV	Wave output to axis already stopped/started
-1046	PI_REFERENCE_ERROR	Not all axes could be referenced
-1047	PI_REQUIRED_WAVE_NOT_FOUND	Could not find parameter set required by frequency relation
-1048	PI_INVALID_SPP_CMD_ID	Command ID given to SPP or SPP? is not valid
-1049	PI_STAGE_NAME_ISNT_UNIQUE	A stage name given to CST is not unique
-1050	PI_FILE_TRANSFER_BEGIN_MISSING	A uuencoded file transferred did not start with "begin" followed by the proper filename
-1051	PI_FILE_TRANSFER_ERROR_TEMP_FILE	Could not create/read file on host PC
-1052	PI_FILE_TRANSFER_CRC_ERROR	Checksum error when transferring a file to/from the controller
-1053	PI_COULDNT_FIND_PISTAGES_DAT	The PiStages.dat database could not be found. This file is required to connect a stage with the CST command
-1054	PI_NO_WAVE_RUNNING	No wave being output to specified axis
-1055	PI_INVALID_PASSWORD	Invalid password
-1056	PI_OPM_COM_ERROR	Error during communication with OPM (Optical Power Meter), maybe no OPM connected
-1057	PI_WAVE_EDITOR_WRONG_PARAMNUM	WaveEditor: Error during wave creation, incorrect number of parameters
-1058	PI_WAVE_EDITOR_FREQUENCY_OUT_OF_RANGE	WaveEditor: Frequency out of range
-1059	PI_WAVE_EDITOR_WRONG_IP_VALUE	WaveEditor: Error during wave creation, incorrect index for integer parameter
-1060	PI_WAVE_EDITOR_WRONG_DP_VALUE	WaveEditor: Error during wave creation, incorrect index for floating point parameter
-1061	PI_WAVE_EDITOR_WRONG_ITEM_VALUE	WaveEditor: Error during wave creation, could not calculate value

-1062	PI_WAVE_EDITOR_MISSING_GRAPH_COMPONENT	WaveEditor: Graph display component not installed
-1063	PI_EXT_PROFILE_UNALLOWED_CMD	User Profile Mode: Command is not allowed, check for required preparatory commands
-1064	PI_EXT_PROFILE_EXPECTING_MOTION_ERROR	User Profile Mode: First target position in User Profile is too far from current position
-1065	PI_EXT_PROFILE_ACTIVE	Controller is (already) in User Profile Mode
-1066	PI_EXT_PROFILE_INDEX_OUT_OF_RANGE	User Profile Mode: Block or Data Set index out of allowed range
-1067	PI_PROFILE_GENERATOR_NO_PROFILE	ProfileGenerator: No profile has been created yet
-1068	PI_PROFILE_GENERATOR_OUT_OF_LIMITS	ProfileGenerator: Generated profile exceeds limits of one or both axes
-1069	PI_PROFILE_GENERATOR_UNKNOWN_PARAMETER	ProfileGenerator: Unknown parameter ID in Set/Get Parameter command
-1070	PI_PROFILE_GENERATOR_PAR_OUT_OF_RANGE	ProfileGenerator: Parameter out of allowed range
-1071	PI_EXT_PROFILE_OUT_OF_MEMORY	User Profile Mode: Out of memory
-1072	PI_EXT_PROFILE_WRONG_CLUSTER	User Profile Mode: Cluster is not assigned to this axis
-1073	PI_UNKNOWN_CLUSTER_IDENTIFIER	Unknown cluster identifier
-1074	PI_INVALID_DEVICE_DRIVER_VERSION	The installed device driver doesn't match the required version. Please see the documentation to determine the required device driver version.
-1075	PI_INVALID_LIBRARY_VERSION	The library used doesn't match the required version. Please see the documentation to determine the required library version.
-1076	PI_INTERFACE_LOCKED	The interface is currently locked by another function. Please try again later.
-1077	PI_PARAM_DAT_FILE_INVALID_VERSION	Version of parameter DAT file does not match the required version. Current files are available at www.pi.ws.
-1078	PI_CANNOT_WRITE_TO_PARAM_DAT_FILE	Cannot write to parameter DAT file to store user defined stage type.
-1079	PI_CANNOT_CREATE_PARAM_DAT_FILE	Cannot create parameter DAT file to store user defined stage type.
-1080	PI_PARAM_DAT_FILE_INVALID_REVISION	Parameter DAT file does not have correct revision.
-1081	PI_USERSTAGES_DAT_FILE_INVALID_REVISION	User stages DAT file does not have correct revision.
-1082	PI_SOFTWARE_TIMEOUT	Timeout Error. Some lengthy operation did not finish within expected time.
-1083	PI_WRONG_DATA_TYPE	A function argument has an unexpected data type.
-1084	PI_DIFFERENT_ARRAY_SIZES	Length of data arrays is different.
-1085	PI_PARAM_NOT_FOUND_IN_PARAM_DAT_FILE	Parameter value not found in parameter DAT file.
-1086	PI_MACRO_RECORDING_NOT_ALLOWED_IN_THIS_MODE	Macro recording is not allowed in this mode of operation.
-1087	PI_USER_CANCELLED_COMMAND	Command cancelled by user input.
-1088	PI_TOO_FEW_GCS_DATA	Controller sent too few GCS data sets
-1089	PI_TOO_MANY_GCS_DATA	Controller sent too many GCS data sets
-1090	PI_GCS_DATA_READ_ERROR	Communication error while reading GCS data
-1091	PI_WRONG_NUMBER_OF_INPUT_ARGUMENTS	Wrong number of input arguments
-1092	PI_FAILED_TO_CHANGE_CCL_LEVEL	Change of command level has failed
-1093	PI_FAILED_TO_SWITCH_OFF_SERVO	Switching off the servo mode has failed
-1094	PI_FAILED_TO_SET_SINGLE_PARAMETER_WHILE_PERFORMING_CST	A parameter could not be set while performing CST: CST was not performed (parameters remain unchanged).
-1095	PI_ERROR_CONTROLLER_REBOOT	Connection could not be reestablished after reboot.
-1096	PI_ERROR_AT_QHPA	Sending HPA? or receiving the response has failed.
-1097	PI_QHPA_NONCOMPLIANT_WITH_GCS	HPA? response does not comply with GCS2 syntax.

-1098	PI_FAILED_TO_READ_QSPA	Response to SPA? could not be received.
-1099	PI_PAM_FILE_WRONG_VERSION	Version of PAM file cannot be handled (too old or too new)
-1100	PI_PAM_FILE_INVALID_FORMAT	PAM file does not contain required data in PAM-file format
-1101	PI_INCOMPLETE_INFORMATION	Information does not contain all required data
-1102	PI_NO_VALUE_AVAILABLE	No value for parameter available
-1103	PI_NO_PAM_FILE_OPEN	No PAM file is open
-1104	PI_INVALID_VALUE	Invalid value
-1105	PI_UNKNOWN_PARAMETER	Unknown parameter