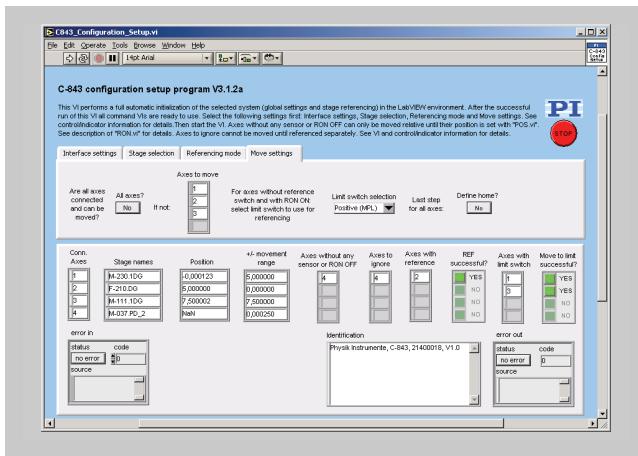


# MS 89E Software Manual

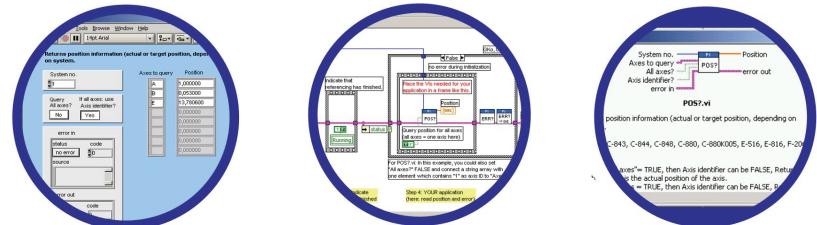
## C-843 LabView Driver Library

Release: : 5.7.5 Date: 2009-05-08



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

■ **C-843.x1**  
DC-Motor Controller Card (PCI)



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Release: 5.7.5

File:C843\_GCS\_LabVIEW\_MS89E\_574.doc, 3373568 Bytes

## 0. Disclaimer

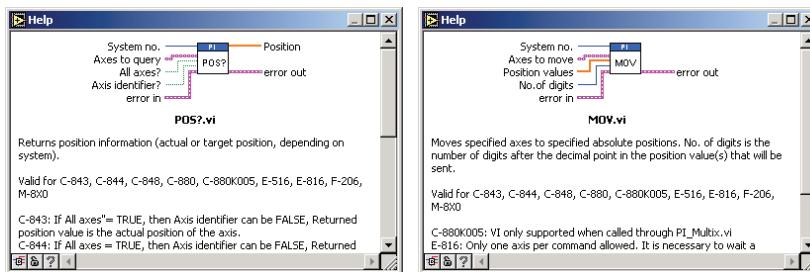
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## 1. Introduction

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

These VIs are provided to ease the task of programming your application. They, and the accompanying documentation, assume a prior knowledge of proper LabView programming techniques. The provided "Simple Test" and "Configuration Setup" VIs help to solve the essential initialization steps, but are not intended to provide an out-of-the-box, universal solution to a particular application.

To minimize the need for consulting the manual during programming, each VI comes with a detailed VI description that appears in the *Context Help* window when you move the cursor over the VI icon. Use the *Help→Show Context Help* menu sequence in the LabVIEW environment to display the *Context Help* window.



LabVIEW 7.1 or higher and NI-VISA 3.6 or higher must be installed prior to using this driver set.

To control an analog system, DAQmx 8.3 or higher and a DAQmx-compatible National Instruments DAC card must also be installed.

With Linux operating systems, the installation is done via the INSTALL script which is to be found in the /linux directory on the software CD (if available, see the controller User manual for more information).

With Windows Vista and PCI cards (C-843, C-843.PM, E-761), the VIs must always be started with the "Run as administrator" option. To do this, click on the VI with the right mouse button and select the "Run as administrator" entry from the context menu.

### 1.1. PI General Command Set (GCS)

This VI driver set supports the *PI General Command Set*, which is based on ASCII communication with well-defined commands and replies. This makes it possible to control different PI systems, such as the *E-516 Display Module* or the *C-880 Multi-Axis Controller*, with only one driver set simply by "wiring" the correct command parameters to the associated VIs. To achieve this, a unique "System no." must be selected in each "XXXX\_Configuration\_Setup.vi" (with XXX being the PI product

no. of your system). This System no. is then used in all sub-VIs to tell LabVIEW which connected system to talk to.

### Translation Libraries

To control PI systems with a native command set that is not compatible with the *PI General Command Set*, e.g. the *E-710 Digital Piezo Controller* or the *C-843 Motion Control Board*, controller-specific libraries are used. Each such library translates *PI General Command Set* commands to the controller's native language. **There is also a universal library which adds this functionality: GCSTranslator; it must be installed on the computer in the GCS\_LabVIEW\Low Level folder, no matter whether the system being controlled is *PI General Command Set* compatible or not.**

For these and certain other systems (such as PC add-on cards), the required system-specific libraries and data files (e.g. PIStages.dat) must be properly installed. If you install this driver set from within the setup program of the PI software CD ROM, this installation is done automatically. If you want to install this driver set manually, please run "GCSLibrarySetup.exe" from the CD-ROM that came with your system. This setup tool makes sure that all necessary libraries and their data files are correctly registered in the Windows™ environment and can be found by the GCS drivers (if LabVIEW still cannot find PIStages.dat, it may be because it is marked read-only. To see, open Microsoft Explorer, right-click the file PIStages.dat and select *Properties*. Make sure that the *read-only* attribute is not checked.)

Once the libraries and data files for the system to control are installed, this LabVIEW driver set can be used to control a non-GCS-compatible system just like any GCS-compatible system, and PCI/ISA-based controller boards by selecting "DLL" as communication interface (see Section "First Steps for GCS-Compatible PI Controllers" on p. 7 and the "XXXX\_Configuration\_Setup.vi" (with XXXX being the PI product number of your system) in section 3).

### Units and GCS

The GCS system uses physical units of measure. Most controllers and GCS software have default conversion factors chosen to convert hardware-dependent units (e.g. encoder counts) into mm or degrees, as appropriate. These defaults are generally taken from a database of stages that can be connected. The direction of motion associated with positive and negative relative moves can also be controlled by parameter settings. In some cases an additional scale factor can be applied, making a second physical unit available without overwriting the conversion factor for the first. It is also sometimes possible to enter a conversion factor as numerator and denominator of a fraction, reducing the number of digits and outside calculations needed for high-precision entry of gearhead system values. See the DFF.vi and SPA.vi command descriptions (if supported by your PI controller), taking special note of the sections referring specifically to your controller.

## 1.2. Scope of This Manual

This manual covers only VIs which can be used with the product with which it came, and VIs which must be present for all products supported by this driver set. A VI can be used with a certain product if the product name is mentioned in the "Valid for" line of the VI description..

For VIs which are based on GCS commands, see the User manual of the controller or, if present, the special GCS commands manual for further details.

### 1.3. VI Structure

The folder structure of the LabVIEW drivers consists of the main folder "GCS\_LabVIEW" with the sub-folder "Low Level".

The main folder "GCS\_LabVIEW" contains a terminal VI (for command based systems), a configuration VI (XXXX\_Configuration\_Setup.vi with XXXX being the PI product number of your system), a simple test VI, and, if available, several sample programs.

The sub-folder "Low Level" contains VIs for the following functions:

- Establishing communication with different PI systems which support the PI General Command Set via RS-232, GPIB or TCP/IP interfaces, or with analog systems, defining the parameter IDs of the connected axes, sending and receiving ASCII characters to/from the specified system or setting and reading voltages for an analog system. These VIs are mainly sub-VIs for the XXXX\_Configuration\_Setup.vi which overtake the communication parameter setup and initialization of all necessary settings automatically.
- Support functions which are helpful for several common tasks in LabVIEW and are used by the command VIs
- Sending system-specific commands (system-specific commands are separated into function-specific LLBs) which are the "construction set" to build your application.

Additionally, the sub-folder "Low Level" contains GCSTranslator.dll.

Following the data flow concept of LabVIEW, all VIs have their wiring inputs on the left side and their wiring outputs on the right side of each connector pane. For quick integration, this **connector pane** in most cases has the following pattern:

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

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

- 1 System number
- 2 Optical board, Interface, or other main input control
- 3 Axes to query, Affected axes, Number of systems, or other main input control
- 4 All axes?, Invert order?, or other main input control
- 5 Axis identifier?, No. of digits, or other main input control
- 6 Error in
- 7 Parameter number, Without axis ID?, or other input control
- 8 Step size, or other input control
- 9 AA step size, or other input control
- 10 Input control
- 11 Input control or output indicator

- 12 Input control or output indicator
- 13 Input control or output indicator
- 14 Input control or output indicator
- 15 Hidden error, Connected axes, String read, or other main output indicator
- 16 Axes to query out, Bytes read, or other main output indicator
- 17 No. of rows, or other main output indicator
- 18 Output indicator
- 19 Output indicator
- 20 Error out

Also note that this driver set does not use the standard LabVIEW error numbers recommended by National Instruments, but rather those used by PI controllers. As a result, the error texts displayed by LabVIEW will not describe the error accurately. Use "GCSTranslateError.vi" to get the description of a PI GCS error number. Some VIs use an additional indicator Controller error to indicate that the selected system has been queried for a controller error with „ERR?“ and reported an error number ≠ zero.

See also chapter 5 on p. 103 for a summary of error numbers produced by this driver set.

In LabVIEW, uncheck *Enable automatic error handling dialogs* in *Tools→Options→New and Changed in 7.x* to prevent that LabVIEW suspends execution and displays an error dialog box for any error that occurs during the execution of the VIs.

### Important:

Before running any VIs to control a connected system, "**XXXX\_Configuration\_Setup.vi**" (located in the main folder, with XXXX being the PI product number of your system) must be run. This initialization VI performs all necessary steps automatically:

1. It opens the communications port,
2. It defines the IDs for the connected axes,
3. It references the connected stages (if appropriate), depending on if the controller requires a referencing before axes can be moved and on your custom settings,
4. It defines the controller name.

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

As the initialization is a complex procedure which uses a large number of sub-VIs, **XXXX\_Configuration\_Setup.vi** is password-protected, meaning that you cannot see or modify the diagram. In this way, the full initialization is packed into one single and fully tested procedure which you simply insert into your own application program. For security reasons as well as your convenience, we recommend that you not modify this VI.

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

A more system-specific sample VI is "XXXX\_Simple\_Test.vi" (with XXXX being the PI product number of your system), also located in the "GCS\_LabVIEW" main folder. It is available both for command-based and analog systems.

#### **1.4. Working with two PI products which understand PI's General Command Set (GCS) in LabVIEW**

When installing the LabVIEW programming support for two different PI products, there are two "Low Level" folders installed, one in each product-specific LabVIEW driver set. This is because every product comes with only the VIs which are used with the product. Another product may have different libraries or different library contents due to the product supporting more or fewer functions. When working with two product-specific LabVIEW driver set installations on one computer, it is important to make sure that LabVIEW always uses the right libraries.

- a) When working separately with two products, the "Low Level" folder of each product must be located in the same folder as the product-specific main VI which calls sub-VIs from the product-specific driver set. Otherwise LabVIEW will start searching for sub VIs wherever it finds them, which may result in version conflicts and "broken Run" arrows. Please make sure that no VIs are saved under LabVIEWs own "user.lib" sub-folder. If they are LabVIEW will always find them there first, which will cause errors in many cases.
- b) When working with two products in parallel, the libraries should be combined. Please use "MergePIDriver.vi", located in "MergeDrivers.llb", to combine two or more PI driver sets. Make sure to work thereafter with the combined libraries instead of the product-specific libraries. If you encounter any broken arrows or error messages after merging please contact your local sales representative with the following information:
  - i. Product names of PI LabVIEW drivers to merge
  - ii. Version file "version.txt" of all driver sets to merge (located in the Low Level folder of each source driver set after merging)
  - iii. Name(s) of VI(s) with broken arrows
  - iv. Error code (if any) and name of VI in which the error occurred

Before combining driver sets, please do always check if there is an update available for one of the driver sets to merge, or for the Merge Tool itself.

Select a unique "System no." in each XXXX\_Configuration\_Setup.vi (with XXXX being the PI product number of your system) and use this System no. in all command VIs to tell LabVIEW which system to send commands to.

## 1.5. First Steps for GCS-Compatible PI Controllers

### 1.5.1. C-843

To control one or more C-843 boards with this driver set, "C843\_GCS\_DLL.dll", "MC.dll", "PiStages.dat" and the C-843 device driver must be installed on your computer. See chapter 1.1 for information about methods for proper installation of the first three items. A description of how to install the C-843 device driver is given in the C-843 User Manual. The following steps must then be performed:

*Step 1 (advanced users can skip this step):* To check communication with the C-843 board in the host PC, run "C843\_Simple\_Test.vi". This VI will return the ID string of the C-843 board and the axis IDs of the connected axes. See chapter 3 for a description of this VI and use the *Help→Show Context Help* menu sequence in the LabVIEW environment to display the *Context Help* window with the VI and control/indicator descriptions.

*Step 2:*

#### **WARNING: C843\_Configuration\_Setup.vi May Cause Move**

When you start "C843\_Configuration\_Setup.vi" with *All axes?* = TRUE, the VI will automatically determine which axes have a reference switch and which have limit switches and, if the referencing mode of these axes is ON, will move these stages to these sensor switches. It is therefore important to make sure that items connected to or mounted on connected stages cannot be damaged by such a move. If referencing is not possible (because the connected stage has no reference or limit switch) or not desired, referencing mode (the mode which tells the controller to reference the stages or not) can be switched off. See description of RON for details and warnings.

Open "C843\_Configuration\_Setup.vi". Select your C-843 board (2- or 4-axis version, board number) and leave "Use dialog to define connected stages" = TRUE. Run the VI. In the following screen, specify which stages you have connected to which axes and press OK. This VI performs all steps necessary for a full configuration of the driver VIs in the LabVIEW environment: the definition of axis IDs, the initialization of the connected stages including referencing (if appropriate) and the definition of the controller name. During your testing phase (when you simply run the VIs without wiring them together into a program), do not close "C843\_Configuration\_Setup.vi"; otherwise all global settings will be lost and the driver VIs will not work. When programming your application, you can implement "C843\_Configuration\_Setup.vi" as an initialization VI in your software. See chapter 3 for a detailed description of "C843\_Configuration\_Setup.vi" and use the *Help→Show Context Help* menu sequence in the LabVIEW environment to display the *Context Help* window with the VI and control/indicator descriptions.

If you do not find your stage in the drop-down list, press CANCEL. You can then either define a User Stage with the Stage Editor, or you can contact PI to see about getting a new stage list: the "PiStages.dat" file contains all relevant stage parameters.

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

GCS syntax version: 1.0

## 2. Low Level VIs

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

### 2.1. Analog controller VIs (“Analog control.llb”)

#### 2.1.1. Analog FGlobal.vi (Analog control.llb)

Valid for	Analog systems (but must be present for all other systems also)
Input	System no. (1), Read(F)/Write (TRUE), VI ref in
Output	VI ref out
Remarks	This VI works as a functional global variable for VI references

#### 2.1.2. Analog functions.vi (Analog control.llb)

Valid for	Analog systems (but must be present as a Dummy VI for all other systems also)
Input	System number (1), String to send (empty string), type specifier VI Refnum, AI Task, AO Task, Waveform to write, Continuously? (TRUE), Error in (no error)
Output	Command, String output, Boolean output, Error out
Remarks	Calls Analog Functions (dyn).vi functions dynamically during runtime, depending on <u>String to send</u> .

#### 2.1.3. Analog functions.vi (Analog control.llb)

Valid for	Analog systems (but must be present for all other systems also) --- Dummy VI
Input	System number (1), String to send (empty string), type specifier VI Refnum, AI Task, AO Task, Waveform to write, Continuously? (TRUE), Error in (no error)
Output	Command, String output, Boolean output, Error out
Remarks	Dummy VI

#### 2.1.4. Analog Receive String.vi (Analog control.llb)

Valid for	Analog systems (but must be present for all other systems also)
Input	System number (1), Read/Write (T) (FALSE), Ini (False), Error in (no error)
Output	String out, Strings out, Error out
Remarks	Works as an old style global variable for String out.

#### 2.1.5. Available Analog Commands.ctl (Analog control.llb)

Valid for	Analog systems (but must be present for all other systems also)
Input	None
Output	None
Remarks	Type definition for available analog commands.

**2.1.6. Global Analog.vi (Analog control.llb)**

Valid for	Analog systems (but must be present for all other systems also)
Input	None
Output	None
Remarks	A global variable which contains setup information for analog systems.

**2.2. Communication VIs (“Communication.llb”):****2.2.1. Available DLL interfaces.ctl (Communication.llb)**

Valid for	C-843, C-843.PM, C-865, C-866, C-867, E-517, E-710, E-712, E-725, E-755, E-761, E-816, E-861, Mercury™ (but must be present for all other systems also)
Input	None
Output	None
Remarks	Type definition for hardware interfaces available when communicating with a system through a PI GCS DLL.

**2.2.2. Available DLLs.ctl (Communication.llb)**

Valid for	C-843, C-843.PM, C-865, C-866, C-867, E-517, E-710, E-712, E-725, E-755, E-761, E-816, E-861, Mercury™ (but must be present for all other systems also)
Input	None
Output	None
Remarks	Type definition for available GCS DLLs for communicating with a system.

**2.2.3. Available interfaces.ctl (Communication.llb)**

Valid for	All systems
Input	None
Output	None
Remarks	Type definition for available interfaces for communicating with a system.

**2.2.4. Close connection if open.vi (Communication.llb)**

Valid for	All systems
Input	System number (1), Error in (no error)
Output	Was connected? (T/F), Error out
Remarks	This VI checks if the connection to the selected system is already open and, if it is, it closes this connection.

### 2.2.5. GCSTranslator DLL Functions.vi (Communication.llb)

Valid for	C-843, C-843.PM, C-844, C-865, C-866, C-867, E-517, E-710, E-712, E-725, E-755, E-761, E-816, E-861, Mercury™ (but must be present in Communication.llb for all other systems also)
Input	System number (1), Function (C844_IsDLLAvailable), String buffer (empty string), String input (empty string), Error in (no error)
Output	DLL I32 Return value, Numerical output, Boolean output (T/F), String output, Error out
Remarks	This VI calls a given function from GCSTranslator.dll. GCSTranslator.dll must be installed. To call a system-specific function, the system-specific GCS DLL must be installed also.  <b>Warning:</b> For <u>XXX_GcsGetAnswer</u> , <u>String buffer</u> must be large enough, otherwise the application may crash. Call <u>XXX_GcsGetAnswerSize</u> first to determine necessary string length.

### 2.2.6. GetQMC\_GetQMCA.vi (Communication.llb)

Valid for	C-843, C-843.PM, C-865, C-866
Input	System number (1), Function (GetQMC), Command (0), Axis (0), Parameter (0), Error in (no error)
Output	DLL I32 Return value, Result, Error out
Remarks	This vi calls the GetQMC or GetQMCA function in the GCSTranslator.dll. GCSTranslator.dll and the corresponding system specific GCS DLL must be installed. The VI reads the system name from Global 2 (Array).vi and calls the corresponding DLL function. <u>Parameter</u> is only valid for GetQMCA. When using as a sub-VI, take special care to use the correct data representation when connecting values to the input terminals. If coercion dots appear at the terminals, the VI may not function correctly.

### 2.2.7. Get subnet.vi (Communication.llb)

Valid for	C-702, E-517, E-712, E-725, E-753, F-206, M-8X0 (but must be present for all other systems except Analog systems, too)
Input	None
Output	Subnet
Remarks	Calls IPCONFIG and returns subnet broadcast addresses of all installed network cards.

### 2.2.8. Global DaisyChain.vi (Communication.llb)

Valid for	All systems
Input	None
Output	None
Remarks	A global variable which contains setup information for DaisyChain systems.

**2.2.9. Global1.vi (Communication.llb)**

Valid for All systems  
Input None  
Output None  
Remarks A global variable which contains communication setup information.

**2.2.10. Initialize Global1.vi (Communication.llb)**

Valid for All systems  
Input System number (1), Error in (no error)  
Output Error out  
Remarks This VI initializes Global1 according to the given system no.

**2.2.11. Initialize Global DaisyChain.vi (Communication.llb)**

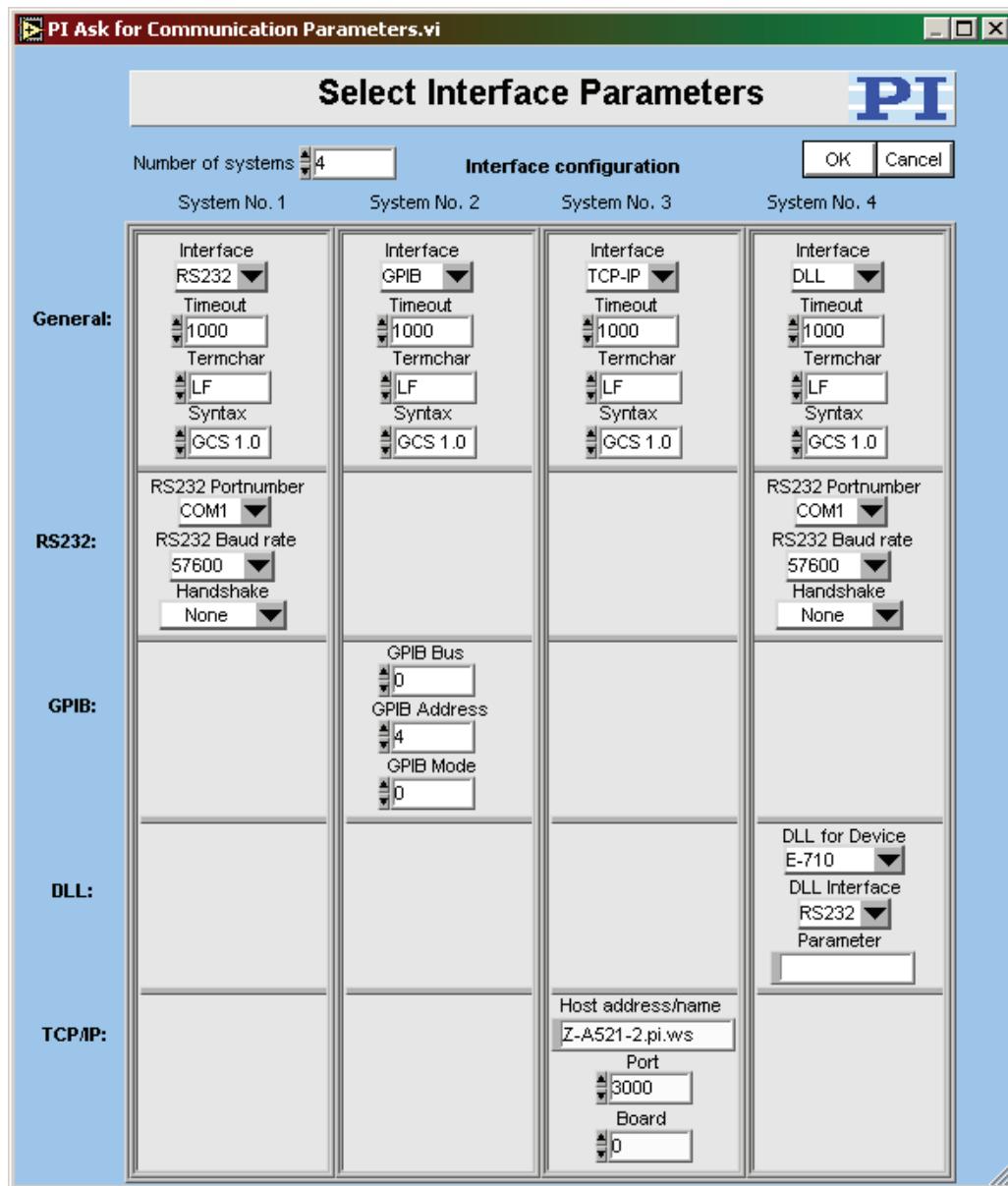
Valid for C-867, E-755, E-861 (but must be present for all other systems except Analog systems, too)  
Input System number (1), Error in (no error)  
Output Error out  
Remarks This VI initializes Global DaisyChain according to the given system no.

**2.2.12. Is DaisyChain open.vi (Communication.llb)**

Valid for C-867, E-755, E-861 (but must be present for all other systems except Analog systems, too)  
Input System number (1), Error in (no error)  
Output Port ID, DC open?, Error out  
Remarks This VI checks if a DaisyChain connection is already open for the communication port defined for the given system no. It does also return the Port ID of the DaisyChain connection if any exists.

**2.2.13. PI Ask for Communication Parameters.vi (Communication.llb)**

Valid for All except analog systems  
Input None  
Output Number of systems, Cancel (T/F), Interface configuration, DLL interface configuration, Flow control  
Remarks A user-interface VI for setting up communications parameters (RS-232 or GPIB, number of systems, baudrate, timeout etc.) for up to 4 systems. Press F1 for displaying a help window with the appropriate interface configuration of each PI controller.



#### 2.2.14. PI Open Interface of one system.vi (Communication.llb)

Valid for	All except analog systems
Input	System Number (1), Interface configuration (RS232, 5000, COM1, 57600), DLL Interface configuration (C-843, Board, 1), TCP/IP configuration (localhost, 3000, 0), Flow control (All FALSE, x13, x11, x0), Bitt settings and parity (8, 1bit, no parity), Termination character (LF), Syntax (GCS 1.0), String to send (*idn?), Interface clear (XXX\n), Register DC (FALSE: If not open)
Output	String read, Error out
Remarks	Establishes communication with one connected system. <b>This VI is called automatically by "XXXX_Configuration_Setup.vi"</b> (with XXXX being the PI product number of your system) and must be completed successfully before any other VI can use the interface. The interface and error status of the chosen system are cleared by this VI, which sends XXX (no command), *IDN? and ERR?.

C-702: Interface = RS232 or TCP/IP, RS232: Input and output HW handshake

must be TRUE, Syntax: GCS 1.0; Term char = LF.

C-843: Interface = DLL, DLL for Device = C-843, DLL Interface = Board, Parameter = Board number (1 for first C-843 board), Syntax: GCS 1.0; Term char = LF.

C-843.PM: Interface = DLL, DLL for Device = C-843.PM, DLL Interface = Board, Parameter = Board number (1 for first C-843 board) , Syntax: GCS 1.0; Term char = LF.

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

C-865: Interface = DLL, DLL for Device = C-865, DLL Interface = RS232, Parameter = empty string, RS232 baud rate = set as appropriate, Syntax: GCS 1.0; Term char = LF.

C-866: Interface = DLL, DLL for Device = C-866, DLL Interface = RS232 or USB, RS232: Parameter = empty string, RS232 baud rate = set as appropriate, USB: Parameter = Serial no. of system to connect to, Syntax: GCS 1.0; Term char = LF.

C-867: Single Device: Interface = RS232 or DLL, RS232: Input and output HW handshake must be FALSE. DLL (USB): DLL for Device = C-867, DLL Interface = USB, Parameter = Serial no. of system to connect to.  
DaisyChain: Interface = DLL, DLL for Device = C-867, DLL Interface = RS232\_DC, Parameter = Number of device in chain, Register DC: FALSE. Syntax: GCS 2.0; Term char = LF.

C-880: Interface = RS232 or GPIB, RS232: Input and output HW handshake must be TRUE, Syntax: GCS 1.0; Term char = LF.

C-848: Interface = RS232 or GPIB, RS232: Input and output HW handshake must be TRUE, Syntax: GCS 1.0; Term char = LF.

C-880K005: Interface = RS232, Input and output HW handshake must be FALSE, Syntax: GCS 1.0; Term char = LF.

E-516: Interface = RS232 or GPIB, RS232: Input and output HW handshake must be TRUE, Syntax: GCS 1.0; Term char = LF.

E-517: Interface = RS232, GPIB, TCP/IP or DLL, RS232: Input and output HW handshake must be TRUE, DLL (USB): DLL for Device = E-517, DLL Interface = USB, Parameter = Serial no. of system to connect to.  
Syntax: GCS 2.0; Term char = LF.

E-710: Interface = DLL, DLL for Device = E-710, DLL Interface = RS232 or GPIB, Parameter = empty string, Syntax: GCS 1.0; Term char = LF.

E-712: Interface = RS232, TCP/IP or DLL, RS232: Input and output HW handshake must be TRUE. DLL: DLL for Device = E-712, DLL Interface = USB, Parameter = Serial no. of system to connect to.  
Syntax: GCS 2.0; Term char = LF.

E-725: Interface = RS232, TCP/IP or DLL, RS232: Input and output HW handshake must be TRUE. DLL: DLL for Device = E-725, DLL Interface = USB, Parameter = Serial no. of system to connect to.  
Syntax: GCS 2.0; Term char = LF.

E-753: Interface = RS232 or TCP/IP, RS232: Input and output HW handshake must be TRUE, Syntax: GCS 2.0; Term char = LF.

E-755: Single Device: Interface = RS232, Input and output HW handshake must be TRUE.  
DaisyChain: Interface = DLL, DLL for Device = E-755, DLL Interface = RS232\_DC, Parameter = Number of device in chain (first device: 1), Register DC: FALSE.

Syntax: GCS 2.0; Term char = LF.

E-761: Interface = DLL, DLL for Device = E-761, DLL Interface = Board, Parameter = Board number (1 for first E-761 board), Syntax: GCS 1.0; Term char = LF.

E-816: Interface = RS232 or DLL, RS232: Input and output HW handshake must be TRUE. DLL (USB): DLL for Device = E-816, DLL Interface = USB, Parameter = Serial no. of system to connect to. Syntax: GCS 1.0; Term char = LF.

E-861: Single Device: Interface = RS232 or DLL, RS232: Input and output HW handshake must be FALSE. DLL (USB): DLL for Device = E-861, DLL Interface = USB, Parameter = Serial no. of system to connect to. DaisyChain: Interface = DLL, DLL for Device = E-861, DLL Interface = RS232\_DC, Parameter = Number of device in chain, Register DC: FALSE. Syntax: GCS 2.0; Term char = LF.

F-206: Interface = RS232, GPIB or TCP/IP, The error status will not be cleared by this VI. The first ERR? query will report a hidden error with error code 1, which will be cleared during system initialization (INI). RS232: Input and output handshake settings must be FALSE, Syntax: GCS 1.0; Term char = LF.

M-8X0: Interface = RS232, GPIB or TCP/IP. RS232: Input and output handshake settings must be FALSE, Syntax: GCS 1.0; Term char = LF.

Mercury™: Interface = DLL, DLL for Device = Mercury, DLL Interface = RS232 (even if using USB), Parameter = empty string, RS232 baud rate = same as controller hardware setting (even if using USB), Syntax: GCS 1.0; Term char = LF.

### 2.2.15. PI Open Interface.vi (Communication.llb)

Valid for	All except analog systems
Input	Number of systems (1), Interface configuration (RS232, 5000, COM1, 57600), DLL Interface configuration (C-843, Board, 1), TCP/IP configuration (localhost, 3000, 0), Flow control (All FALSE, x13, x11, x0), Bitt settings and parity (8, 1bit, no parity), Termination character (LF), Syntax (GCS 1.0), String to send (*idn?)
Output	Error out
Remarks	Establishes communication with up to four connected systems. The interface and error statuses of all connected systems are cleared by this VI, which sends XXX (no command), *IDN? and ERR?.  See "PI Open Interface of one system.vi" for control settings.

### 2.2.16. PI Receive String.vi (Communication.llb)

Valid for	All systems
Input	System number (1), Strip spaces? (F), Error in (no error)
Output	String read, Bytes read, Error out
Remarks	Read string from selected system.

### 2.2.17. PI Send String.vi (Communication.llb)

Valid for	All systems
Input	System number (1), String to send (empty string), Attach termination char.? (T), Error in (no error)

Output	Error out
Remarks	Sends command with or without trailing termination character to selected system.

#### 2.2.18. PI VISA Receive Characters.vi (Communication.llb)

Valid for	C-702, C-848, C-867, C-880, C-880K005, E-516, E-517, E-712, E-725, E-753, E-816, E-861, F-206, M-8X0 (but must be present in Communication.llb for all other systems also)
Input	System number (1), Bytes to read (1), Error in (no error)
Output	String read, Bytes read, Error out
Remarks	This vi reads n bytes (characters) via the chosen VISA interface. Sub-vi for "PI Receive String.vi".

#### 2.2.19. Set logging mode.vi (Communication.llb)

Valid for	All systems
Input	System number (1), Logging mode (OFF), Path in (empty path), File dialog (T)
Output	Error out
Remarks	Sets logging mode for all communication interfaces. When <u>Logging mode</u> is ON, each string sent to or received from the controller is written to a .txt file for debugging. When File dialog is TRUE, a dialog box will pop up where the file to write can be selected, otherwise Path in must contain a valid path to a .txt file. Depending on the call chain of "Set logging mode.vi", the VI will either stop (correct behavior when called from another VI) or it will remain idle (correct behavior when command VIs from this driver set are to be run manually, i.e. non-programmatically). In the latter case do not forget to press the STOP button when you have finished working with the command VIs.

#### 2.2.20. SetQMC\_SetQMCA.vi (Communication.llb)

Valid for	C-843, C-843.PM, C-865, C-866
Input	System number (1), Function (SetQMC), Command (0), Axis (0), Parameter (0), Parameter 1 (0), Parameter 2 (0), Error in (no error)
Output	DLL I32 Return value, Error out
Remarks	This vi calls the SetQMC or SetQMCA function in the GCSTranslator.dll. GCSTranslator.dll and the corresponding system specific GCS DLL must be installed. The VI reads the system name from Global 2 and calls the corresponding DLL function. Parameter is only valid for SetQMC, Parameter 1 and Parameter 2 are only valid for SetQMCA. When using as a sub-VI, take special care to use the correct data representation when connecting values to the input terminals. If coercion dots appear at the terminals, the VI may not function correctly. After changing values, the update function must be called to activate the new values. See User Manual for details.

#### 2.2.21. Syntax.ctl (Communication.llb)

Valid for	All systems
Input	None

Output	None
Remarks	Type definition for GCS version.

### 2.2.22. Termination character.ctl (Communication.llb)

Valid for	All systems
Input	None
Output	None
Remarks	Type definition for termination character.

## 2.3. File handling VIs (“File handling.llb”)

### 2.3.1. File handler.vi (File handling.llb)

Valid for	All systems
Input	Path in (empty path), Read (F) or write (T)? (F), With dialog? (F), Write new file? (F), Default file name (empty string), Extension (txt)
Output	Path out, Cancelled? (T/F), Data added? (T/F)
Remarks	This vi handles file name selections with or without a user interface. Files can be read or written. <u>Path in</u> is the path to the file to read or write. <u>Extension</u> is the file extension for the file to write (e.g. txt, jpg). If <u>Read (F)</u> or <u>write (T)</u> is TRUE, <u>Extension</u> must be given and entry must not have a dot. If <u>With dialog?</u> is TRUE, in every case a dialog box will pop up where the file to read or write can be selected. <u>Default file name</u> is used for naming suggestions if a dialog pops up. If <u>Read (F) or write (T)?</u> is TRUE and <u>Write new file?</u> is TRUE, a dialog box will pop up if the selected file name already exists. If <u>Write new file?</u> is FALSE and the selected file name already exists, a dialog box will pop up to ask if data should be added. <u>Data added?</u> indicates if data was added to an existing file. <u>Cancelled?</u> indicates if the user has cancelled the operation. <u>Path out</u> is NotAPath if operation was cancelled or not successful and contains the selected path for the file which was read or written if the operation was successful.

### 2.3.2. GetDataFormat.vi (File handling.llb)

Valid for	Analog systems, C-702, C843, C-866, C-867, C-880, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861, F-206, M-8X0. To support analog interfacing, VI must be present for E-816 also.
Input	IOSource (Read (F)/Write (F), Path (empty path), ArrayName (empty string), Datastream (empty string)), Error in (no error)
Output	Header out (Separator, NDim, Remarks), DataOK, Found Header, Data Type, NData, Names out, Sample time, Error out
Remarks	This vi checks the format of a data file. See separate manual “GCSData_User_SM146E.pdf” and control descriptions in the diagram for more information.

**2.3.3. MatrixIO.vi (File handling.llb)**

Valid for	Analog systems, C-843, C-866, C-867, C-880, E-517, E-712, E-725, E-753, E-755, E-761, E-861, F-206, M-8X0. To support analog interfacing, VI must be present for E-816 also.
Input	IOSource (Read (F)/Write (F), Path (empty path), ArrayName (empty string), Datastream (empty string)), Header in (Separator (\t), NDim (0), Remarks (empty string)), Data names (XName (empty string), YName (empty string), ZName (empty string)), XArray in (empty num. array), YArray in (empty num. array), ZMatrix in (empty 2D num. array), Sample time in (0), (Error in (no error))
Output	Datastream out, Header out (Separator, NDim, Remarks), Data names out (XName, YName, ZName), XArray out, YArray out, ZMatrix out, Sample time out, Error out
Remarks	This vi reads or writes data files in matrix format. See separate manual "GCSData_User_SM146E.pdf" and control descriptions in the diagram for more information.

**2.3.4. TableIO.vi (File handling.llb)**

Valid for	Analog systems, C-702, C-843, C-866, C-867, C-880, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861, F-206, M-8X0, Mercury. To support analog interfacing, VI must be present for E-816 also.
Input	IOSource (Read (F)/Write (F), Path (empty path), ArrayName (empty string), Datastream (empty string)), Header in (Separator (\t), NDim (0), Remarks (empty string)), Names in (empty string array), Table in (empty 2D num. array), Sample time in (0), (Error in (no error))
Output	Datastream out, Header out (Separator, NDim, Remarks), Names out, Table out, Sample time out, Error out
Remarks	This vi reads or writes data files in table format. See separate manual "GCSData_User_SM146E.pdf" and control descriptions in the diagram for more information. Sub-VI for "DRR?.vi".

**2.4. General Command VIs ("General command.llb"):****2.4.1. \*IDN?.vi (General command.llb)**

Valid for	All systems
Input	System number (1), Error in (no error)
Output	Identification, Error out
Remarks	Returns system identification string. E-816: This command cannot be issued to a slave.

#### 2.4.2. Controller names.ctl (General command.llb)

Valid for	All systems
Input	None
Output	None
Remarks	Type definition for control <u>Controller names</u> .

#### 2.4.3. Define connected axes.vi (General command.llb)

Valid for	All systems
Input	System number (1), Read from controller?(F), Invert order?(F), Conn. axes (empty string array), Error in (no error) Analog: Only supported when called by Analog_Configuration_Setup.vi C-702: <u>Read from controller</u> = TRUE, <u>Invert order</u> = TRUE C-848: <u>Read from controller</u> = TRUE, <u>Invert order</u> = TRUE C-880: <u>Read from controller</u> = TRUE, <u>Invert order</u> = TRUE F-206: <u>Read from controller</u> = FALSE, <u>Invert order</u> = FALSE, <u>Connected axes</u> = X,Y,Z,U,V,W, (A,B,K,L,M optional) M-8X0: <u>Read from controller</u> = FALSE, <u>Invert order</u> = FALSE, <u>Connected axes</u> = X,Y,Z,U,V,W, (A,B optional) All other systems: <u>Read from controller</u> = TRUE, <u>Invert order</u> = FALSE
Output	Connected axes out, Error out
Remarks	Writes connected axes into Global2 (Array).vi. <b>This VI is called automatically by “XXXX_Configuration_Setup.vi” (with XXXX being the PI product number of your system) and must be completed successfully before any other axis-specific command VI is called.</b> Requires “SAI?.vi” to be present.

#### 2.4.4. Define connected systems (Array).vi (General command.llb)

Valid for	All systems
Input	Controller names (array of Enum controls, none), Change only one system? (F), System number (1), Error in (no error) Analog system: Only supported when called by Analog_Configuration_Setup.vi
Output	Controller names out, Error out
Remarks	Defines connected systems and writes controller names into Global2 (Array).vi. <b>This VI is called automatically by “XXXX_Configuration_Setup.vi” (with XXXX being the PI product number of your system) and must be completed successfully before “General wait for movement to stop.vi” is called. If <u>Change only one system?</u> is FALSE, all entries from <u>Controller names</u> are written into “Global2 (Array).vi”. If <u>Change only one system?</u> is TRUE, only the entry for the given system number is overwritten in “Global2 (Array).vi”.</b>

#### 2.4.5. ERR?.vi (General command.llb)

Valid for	All systems.
Input	System number (1), Error in (no error)
Output	Controller error (T/F), Error out

	Analog: VI does not report any errors.
Remarks	Returns error information. <u>Controller error</u> is TRUE if selected system reports error code ≠ 0. See appendix A of this manual for a list of PI error codes and use "GCSTranslateError.vi" to translate error codes into error descriptions programmatically.
	E-816: This command cannot be issued to a slave.

#### 2.4.6. Global2 (Array).vi (General command.llb)

Valid for	All systems
Input	System (array of Conn. axes (empty string array), Controller name (Enum control, none))
Output	None
Remarks	A global variable which contains identifiers for all connected axes of all connected systems and the names of all connected systems.

#### 2.4.7. HLP?.vi (General command.llb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, E-516, E-517, E-712, E-725, E-710, E-753, E-755, E-761, E-861, F-206, Mercury™, M-8X0 (but must be present for all other systems also).
Input	System number (1), Error in (no error)
Output	Help string, Error out
Remarks	Returns help string. F-206, M-8X0: Check HELP answer to determine if HLP? is supported. HLP? and HELP are equivalent.

#### 2.4.8. HLT.vi (General command.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-517, E-710, E-755, E-761, E-861, Mercury™
Input	System number (1), Affected axes (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  C-702: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-843: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-843.PM: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-844: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-848: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-865: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-866: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-867: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-880: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-517: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE E-710: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-761: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE E-861: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE

	Mercury™: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	Error out
Remarks	Stops motion of specified axes. HLT sets error code 10, call "ERR?.vi" to reset error after HLT has been called.

#### 2.4.9. HPA?.vi (General command.llb)

Valid for	C-843, C-867, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861, Mercury
Input	System number (1), Error in (no error)
Output	Parameter help string, Error out
Remarks	Returns a help string containing information about valid parameter IDs.

#### 2.4.10. Initialize Global2.vi (General command.llb)

Valid for	All systems
Input	System number (1), Error in (no error)
Output	Error out
Remarks	This VI initializes Global2 (Array) according to the given system no.

#### 2.4.11. MOV.vi (General command.llb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, F-206, M-8X0, Mercury™
Input	System number (1), Axes to move (empty string array), Position values (empty num. array, 0), No. of digits (4), Error in (no error)  C-867: This command works only in closed-loop operation. Motion commands like MOV are not allowed when a joystick is active on the axis.  C-880K005: VI only supported when called through PI_Multix.vi  E-517: Motion commands like MOV are not allowed when the E-517 is in OFFLINE mode or when the wave generator output is active. When a macro is running on the E-517, MOV will be executed not until the macro is finished or stopped. See "Control Value Generation" and "Control Modes" in the E-517 User manual for details.  E-712: Motion commands are not allowed when a wave generator is active or the analog input is used for target generation.  E-725: Motion commands are not allowed when a wave generator is active or the analog input is used for target generation.  E-753: Motion commands are not allowed when the wave generator is active or the analog input is used for target generation.  E-755: Command not available for E-755.101.  E-816: Only one axis per command allowed. It is necessary to wait a certain time before sending the next command to prevent it from being lost.  E-861: This command works only in closed-loop operation. With open-loop systems, use OAD or OSM instead to command motion. Motion commands like MOV are not allowed when a joystick is active on the axis.  F-206: No mix between F-206 axes X,Y,Z,U,V,W and separate axes A,B allowed

Output	Error out
Remarks	Moves specified axes to specified absolute positions. <u>No. of digits</u> is the number of digits after the decimal point in the position value(s) that will be sent.  E-710: See also "NMOV.vi" in "Old commands.llb".
<b>2.4.12. MOV?.vi (General command.llb)</b>	

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, Mercury™
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  C-702: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-843: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-843.PM: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-844: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-848: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-865: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-866: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-867: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-880: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE E-516: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-517: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE E-710: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-712: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. E-725: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. E-753: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Command not available for E-755.101. E-761: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE E-816: <u>All axes?</u> = FALSE, only one axis per command allowed. E-861: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE F-206: Command has different implementation, please use MOV?_old.vi M-8X0: Command has different implementation, please use MOV?_old.vi Mercury™: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	Target position, Error out
Remarks	Returns commanded target position.

#### **2.4.13. MVR.vi (General command.llb)**

Valid for	Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, Mercury™
Input	System number (1), Axes to move (empty string array), Position values (empty num. array, 0), No. of digits (4), Error in (no error)

	C-867: This command works only in closed-loop operation. Motion commands like MVR are not allowed when a joystick is active on the axis.
	C-880K005: VI only supported when called through PI_Multix.vi
	E-755: Command not available for E-755.101.
	E-816: Only one axis per command allowed. It is necessary to wait a certain time before sending the next command to prevent it from being lost.
	E-861: This command works only in closed-loop operation. With open-loop systems, use OAD or OSM instead to command motion.
Output	Error out
Remarks	Moves specified axes <b>relative</b> to current position. <u>No. of digits</u> is the number of digits after the decimal point in the position value(s) that will be sent.  E-517: Motion commands like MVR are not allowed when the E-517 is in OFFLINE mode or when the wave generator output is active. When a macro is running on the E-517, MVR will be executed not until the macro is finished or stopped. See "Control Value Generation" and "Control Modes" in the E-517 User manual for details.  E-710: See also "NMVR.vi" in "Old commands.llb".  E-712: Motion commands are not allowed when a wave generator is active or the analog input is used for target generation.  E-725: Motion commands are not allowed when a wave generator is active or the analog input is used for target generation.  E-753: Motion commands are not allowed when the wave generator is active or the analog input is used for target generation.

#### 2.4.14. ONT?.vi (General command.llb)

Valid for	C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, Mercury™ (but must be present for all other systems also)
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  C-702: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-843: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-843.PM: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-848: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-865: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-866: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-867: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. C-880: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-516: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. E-517: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE E-710: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. E-712: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. E-725: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. E-753: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE.

	E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Command not available for E-755.101
	E-761: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE.
	E-816: <u>All axes?</u> = FALSE, only one axis per command allowed.
	E-861: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
	Mercury™: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE.
Output	Axis on target? (T/F), Error out
Remarks	Indicates whether or not queried axis is at target position.

#### 2.4.15. POS?.vi (General command.llb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, F-206, M-8X0, Mercury™
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  C-880K005: VI only supported when called through PI_Multix.vi E-516: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-710: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Command not available for E-755.101. E-816: <u>All axes?</u> = FALSE, only one axis per command allowed. F-206: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE M-8X0: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE All other systems: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE.
Output	Position, Error out
Remarks	Returns position information (actual or target position, depending on system).  F-206: Returned position value is the commanded target position for the axis. M-8X0: Returned position value is the commanded target position for the axis.

#### 2.4.16. SAI?.vi (General command.llb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, Mercury™ (but must be present in "General command.llb" for all other systems also)
Input	System number (1), Invert order? (F), SAI? ALL (F), Write to Global2? (F), Error in (no error)  Analog: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> must be FALSE C-702: <u>Invert order</u> should be TRUE, <u>SAI? ALL</u> must be FALSE C-843: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> is supported C-843.PM: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> must be FALSE C-844: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> must be FALSE C-848: <u>Invert order</u> should be TRUE, <u>SAI? ALL</u> must be FALSE C-865: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> is supported

	C-866: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> is supported
	C-867: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> is supported
	C-880: <u>Invert order</u> should be TRUE, <u>SAI? ALL</u> must be FALSE to read all configured axis IDs and must be TRUE to get all physically defined axis IDs
	C-880K005: VI only supported when called through PI_Multix.vi, <u>SAI? ALL</u> must be FALSE
	E-516: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> must be FALSE
	E-517: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> is supported
	E-710: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> is supported
	E-712: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> is supported
	E-725: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> is supported
	E-753: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> is supported
	E-755: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> is supported
	E-761: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> is supported
	E-816: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> must be FALSE
	E-861: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> is supported
	Mercury™: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> is supported
Output	Connected axes, Error out
Remarks	Returns axis identifiers of all configured axes and writes them into Global2 (Array).vi. If <u>SAI? ALL</u> is TRUE, all physically available axes are returned, no matter if configured or not. Required by "Define connected axes.vi". If <u>SAI? ALL</u> is TRUE, returned identifiers normally may not be written to "Global2 (Array).vi". To write them to "Global2 (Array).vi" nevertheless, set <u>Write to Global2?</u> to TRUE.
	E-816: This command cannot be issued to a slave.

#### 2.4.17. SPA.vi (General command.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, Mercury™
Input	System number (1), Axis to set (empty string array), Parameter number (empty num. array, 0), Parameter number (hex) (empty hex. array, 0), Parameter value (empty num. array, 0), No. of digits (4), Parameter string (empty string array), Parameter no. format (Decimal: FALSE) (F), Parameter format (Num.: FALSE) (F), Error in (no error)

C-702: Parameter no. format is FALSE (decimal).

**WARNING**

This command is for setting hardware-specific parameters. Wrong values may lead to improper operation or damage of your hardware! Change settings only after consultation with PI.

C-843: Parameter no. format is FALSE (decimal).

**WARNING**

This command is primarily for setting hardware-specific parameters of non-PI stages connected to the controller. Please refer to the stage manual for valid parameter settings. If you have a PI stage connected, please do not change any

parameters except P (1), I (2), D (3), I-limit (4) and VFF (5).

C-843.PM: Parameter no. format is FALSE (decimal). See C-843 for warnings.

C-848: Parameter no. format is FALSE (decimal). See C-880 for warnings.

C-865: Parameter no. format is FALSE (decimal). See C-843 for warnings.

C-866: Parameter no. format is FALSE (decimal). See C-843 for warnings.

C-867: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers or see the C-867 User Manual. Only one parameter value for only one axis per command allowed. See E-710 for warnings.

C-880: Parameter no. format is FALSE (decimal).

#### **WARNING**

This command is for setting hardware-specific parameters of non-PI stages connected to the controller. Please refer to the stage manual for valid parameter settings. If you have a PI stage connected, please do not change any parameters except P (1), I (2), D (3), I-limit (4) and VFF (5). The most important parameter numbers are:

- 1: P-term (0 to 32767)
- 2: I-term (0 to 32767)
- 3: D-term (0 to 32767)
- 4: I-Limit (integration limit) (0 to 32767)
- 5: VFF (velocity feed forward) (0 to 32767)
- 7: motor bias (-32767 to 32767)
- 8: maximum position error (0 to 32767)
- 9: maximum value for the motor output (0 to 32767)
- 10: maximum velocity (allowed range depends on stage)
- 11: maximum allowed acceleration (allowed range depends on stage)
- 13: maximum allowed Jerk (allowed range depends on stage)
- 14, 15: reserved

C-880K005: VI only supported when called through PI\_Multix.vi. See C-880 for warnings and description of parameter numbers.

E-516: Parameter no. format is FALSE (decimal).

#### **WARNING**

This command is for setting hardware-specific calibration parameters, except parameter number 268500993. Incorrect values may lead to improper operation.

The following parameter numbers are valid:

- 7: Ksen (Coefficient of Sensor K\_s). When sensor output change is 1V, the position change of stage is K\_s ( $\mu$ m). (- 3.402823466e+38F to 3.402823466e+38F)
- 8: Osen (Offset of Sensor Os). When sensor output is 0V, the actual position of stage is Os ( $\mu$ m). (- 3.402823466e+38F to 3.402823466e+38F)
- 9: Kpzt (Coefficient of PZT voltage amplifier Kpzt). When DAC output change is 1V, the PZT Voltage change is Kpzt (V) (- 3.402823466e+38F to 3.402823466e+38F)
- 10: Opzt (Offset of PZT voltage amplifier Opzt) When DAC output is 0V, the PZT Voltage is Opzt (V) (- 3.402823466e+38F to 3.402823466e+38F)

- 117442816: Tolerance for ONT software emulation ( $\mu\text{m}$ ) ( $0 < \text{value} < 1000$ )

E-517: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers or see the E-517 User Manual. See E-710 for warnings.

E-710: Parameter no. format is TRUE (hex.) Use “HPA?.vi” to get valid parameter numbers or see the E7XX\_GCS\_DLL Manual.

#### WARNING

This command is for setting hardware-specific parameters. Wrong values may lead to improper operation or damage of your hardware!

E-712: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers or see the E-712 User Manual. See E-710 for warnings. Do not set more than 10 parameters at once.

E-725: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers or see the E-725 User Manual. See E-710 for warnings. Do not set more than 10 parameters at once.

E-753: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers or see the E-753 User Manual. See E-710 for warnings.

E-755: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers or see the E-755 User Manual. See E-710 for warnings.

E-761: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers or see the User Manual. See E-710 for warnings. Do not set more than 10 parameters at once.

E-816: Parameter no. format is FALSE (decimal). See E-516 for warnings and a description of parameter numbers. Each command limited to setting one parameter for only one axis.

E-861: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers or see the E-861 User Manual. Only one parameter value for only one axis per command allowed. See E-710 for warnings.

Mercury™: Parameter no. format is FALSE (decimal). See C-843 for warning.

Output Controller error (T/F), Error out

Remarks Sets parameters, waits 100 ms and queries ERR?. For axis-related parameters, Axis to set is the axis name; for piezo- or sensor-related parameters, the channel number; otherwise a parameter-related code. If parameter number is in decimal format, use Parameter number input, for hexadecimal parameter numbers use Parameter number (hex.) input and switch Parameter no. format to TRUE. For numeric parameter values use Parameter value input, for parameter strings use Parameter string input and switch Parameter format to TRUE. Do not mix decimal and hex. parameter numbers or numeric and string parameter values in one call. Parameter numbers which can be set depend on current CCL level. See GCS DLL manual for available parameter numbers and values. No. of digits is the number of digits after the decimal point in the numeric parameter value(s) that will be sent. Controller error is TRUE if selected system reports error code ≠ 0.

C-867, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-861: The SPA command saves the parameters in RAM only. To save the currently valid parameters to flash ROM, where they become the power-on defaults, you must run WPA.vi. Parameter changes not

saved with WPA will be lost when the controller is powered off.

C-843: For precision and convenience with gearbox systems, the counts per physical unit factor can be entered as numerator and denominator of a fraction (parameters 14 and 15).

E-816: This command cannot be issued to a slave.

E-761: The SPA command saves the parameters in RAM only. To save the currently valid parameters to flash ROM, where they become the power-on defaults, you must run WPA.vi. Parameter changes not saved with WPA will be lost when the PC is powered off or the E-761 is rebooted.

Mercury™: The SPA command saves the parameters in RAM only. Use PIStageEditor.exe to change parameters or add new stages to the data base permanently.

#### 2.4.18. SPA?.vi (General command.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, Mercury™, M-8X0
Input	<p>System number (1), Axes to query (empty string array), Parameter no. format (Decimal: FALSE) (F), Without axes? (F), Parameter no. (empty num. array, 0), Parameter no. (hex) (empty hex. array, 0), Error in (no error)</p> <p>C-702: <u>Parameter no. format</u> is FALSE (decimal).</p> <p>C-843: <u>Parameter no. format</u> is FALSE (decimal).</p> <p>C-843.PM: <u>Parameter no. format</u> is FALSE (decimal).</p> <p>C-848: <u>Parameter no. format</u> is FALSE (decimal).</p> <p>C-865: <u>Parameter no. format</u> is FALSE (decimal). Parameter number 25 is read-only.</p> <p>C-866: <u>Parameter no. format</u> is FALSE (decimal). Parameter number 25 is read-only.</p> <p>C-867: <u>Parameter no. format</u> is TRUE (hex.). Use "HPA?.vi" to get valid parameter numbers. Only one parameter value for only one axis per command allowed. <u>Use Without axes?</u> = TRUE for a query of all parameters.</p> <p>C-880: <u>Parameter no. format</u> is FALSE (decimal). Additional read-only parameter numbers are:</p> <ul style="list-style-type: none"><li>• 14: Numerator of the counts per physical unit factor (1 to 2147483647) (factor = num./denom.)</li><li>• 15: Denominator of the counts per physical unit factor (1 to 2147483647) (factor = num./denom.)</li><li>• 16: Drive mode: 0=Analog 1=PWM</li><li>• 19: Axis type: 0=Linear 1=Rotary</li><li>• 20: Reference switch: 0=no present, 1=present</li><li>• 28: Reference status: 0=axis not referenced; 1=axis is referenced</li></ul> <p>C-880K005: VI only supported when called through PI_Multix.vi</p> <p>E-516: <u>Parameter no. format</u> is FALSE (decimal).</p> <p>E-517: <u>Parameter no. format</u> is TRUE (hex.). Use "HPA?.vi" to get valid parameter numbers.</p> <p>E-710: <u>Parameter no. format</u> is TRUE (hex.). Use "HPA?.vi" to get valid parameter numbers.</p>

E-712: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers. Do not query more than 10 parameter no. at once (except with Without axes? = TRUE).

E-725: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers. Do not query more than 10 parameter no. at once (except with Without axes? = TRUE).

E-753: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers.

E-755: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers.

E-761: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers. Do not query more than 10 parameter no. at once (except with Without axes? = TRUE).

E-816: Parameter no. format is FALSE (decimal).

E-861: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers. Only one parameter value for only one axis per command allowed. Use Without axes? = TRUE for a query of all parameters.

Mercury™: Parameter no. format is FALSE (decimal).

M-8X0: Parameter no. format is FALSE (decimal). Axes to query can be 1 to 6 (corresponds to strut no.). Parameter no. can be 512 (reports if strut is extended or retracted) or 513 (reports commanded strut length). Only one parameter value for only one axis per command allowed.

#### Output

Parameter value, Parameter string, Error out

#### Remarks

Returns parameter values for queried items and parameter numbers. For axis-related parameters, Axis to query is the axis name; for piezo- or sensor-related parameters, the channel number; otherwise a parameter-related code. If parameter number is in decimal format, use “Parameter no.” input, for hexadecimal parameter numbers use “Parameter no. (hex)” input and switch “Parameter no. format” to TRUE. If Without axes? is TRUE, all available parameter for all axes/designators are returned. For parameter numbers which output a string use Parameter string output. See GCS DLL Manual for available parameter numbers.

E-816: This command cannot be issued to a slave

C-843: The following parameter number outputs a string:

60: stage name (maximum 14 characters)

C-843.PM: The following parameter number outputs a string:

60: stage name (maximum 14 characters)

C-866: The following parameter number outputs a string:

60: stage name (maximum 14 characters)

C-865: The following parameter number outputs a string:

60: stage name (maximum 14 characters)

E-861: The following parameter number outputs a string:

60 (0x3C): stage name (maximum 16 characters)

Mercury™: The following parameter number outputs a string:

60: stage name (maximum 14 characters)

#### 2.4.19. STP.vi (General command.llb)

##### Valid for

Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-516, E-517, E-712, E-725, E-753, E755, E-761, E-861, Mercury™ (but must be present for E-710 also). To support analog

	interfacing, VI must be present for E-816 also.
Input	<p>System number (1), Affected axes? (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)</p> <p>Analog: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE. STP does not set any error code.</p> <p>C-702: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE</p> <p>C-843: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE</p> <p>C-843.PM: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE</p> <p>C-844: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE</p> <p>C-848: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE</p> <p>C-865: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE</p> <p>C-866: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE</p> <p>C-867: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE</p> <p>C-880: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE</p> <p>E-516: If <u>All axes?</u> = TRUE, then <u>Axis identifier</u>? must be TRUE</p> <p>E-517: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE</p> <p>E-712: If <u>All axes?</u> = TRUE, then <u>Axis identifier</u>? can be FALSE</p> <p>E-725: If <u>All axes?</u> = TRUE, then <u>Axis identifier</u>? can be FALSE</p> <p>E-753: If <u>All axes?</u> = TRUE, then <u>Axis identifier</u>? can be FALSE</p> <p>E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier</u>? can be FALSE</p> <p>E-761: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE</p> <p>E-861: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE</p> <p>Mercury™: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE</p>
Output	Error out
Remarks	<p>Stops motion of specified axes. To stop a referencing routine (REF, MNL, MPL) or fast scan routine (FSC, FSA etc.), or AutoZero procedure (ATZ), or wave generator run (WGO), use "#24.vi". STP sets error code 10, call "ERR?.vi" to reset error after STP has been called.</p> <p>E-517: STP.vi stops motion of all axes caused by move commands (MOV, MVR, GOH, SVA, SVR). Furthermore, it stops macros (MAC) and wave generator output (WGO).</p> <p>E-712, E-725, E-753: STP.vi stops motion of all axes caused by move commands (MOV, MVR, SVA, SVR), by the wave generator (WGO), by analog control input and autozero motion (ATZ).</p>

#### 2.4.20. SVO.vi (General command.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, F-206, M-8X0, Mercury™
Input	<p>System number (1), Without axis ID?(F), Axes to command (empty string array), Servo mode (empty bool. array, F), Error in (no error)</p> <p>E-755: <u>Without axis ID</u> = FALSE. When the servo mode is switched off, RNP is automatically performed for the corresponding Nexline channel, which could take a few seconds. Command not available for E-755.101.</p> <p>E-816: <u>Without axis ID</u> = FALSE. Only one axis per command allowed.</p>

	F-206: <u>Without axis ID</u> = TRUE, only first field of <u>Servo mode</u> array is valid M-8X0: <u>Without axis ID</u> = TRUE, only first field of <u>Servo mode</u> array is valid All other systems: <u>Without axis ID</u> = FALSE
Output	Error out
Remarks	Sets servo-control mode for given axes. If <u>Without axis ID</u> is TRUE, then <u>Axes to command</u> is ignored and first field of <u>Servo mode</u> array is used. M-8X0: Check HELP answer to find out if SVO is supported. E-516, E-517: Make sure that all servo switches on the piezo control electronics are set to "Off" to give the interface/display module complete control over the servo state.

#### 2.4.21. SVO?.vi (General command.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, F-206, M-8X0, Mercury™
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  C-843, C-843.PM, C-844: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-865, C-866: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-516, E-710: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-816: <u>All axes?</u> = FALSE, only one axis per command allowed.  F-206: <u>All axes?</u> = TRUE, <u>Axis identifier?</u> = FALSE M-8X0: <u>All axes?</u> = TRUE, <u>Axis identifier?</u> = FALSE  All other systems: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	Servo status (T/F), Error out  F-206: Only first field of <u>servo status</u> array is valid M-8X0: Only first field of <u>servo status</u> array is valid
Remarks	Returns servo status of queried axes. M-8X0: Check HELP answer to find out if SVO? is supported.

#### 2.4.22. VEL.vi (General command.llb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861, F-206, M-8X0, Mercury™. To support analog interfacing, VI must be present for E-816 also.
Input	System number (1), Without axis ID? (F), No. of digits (4), Axes to set (empty string array), Velocity values (empty num. array, 0), Error in (no error)  Analog: <u>Without axis ID?</u> = FALSE; Velocity unit is µm/sec C-867: <u>Without axis ID?</u> = FALSE. Velocity unit is mm/s. C-880: <u>Without axis ID?</u> = FALSE, for NanoCube axes command is not valid C-880K005: VI only supported when called through PI_Multix.vi E-516, E-712, E-725, E-753, E-861: <u>Without axis ID?</u> = FALSE. Velocity unit is µm/s. E-517: <u>Without axis ID?</u> = FALSE. Velocity unit is µm/s in closed-loop operation

	and V/s in open-loop operation.
	E-710, E-761: <u>Without axis ID?</u> = FALSE. Velocity unit is $\mu\text{m}/\text{ms}$ .
	E-755: <u>Without axis ID?</u> = FALSE. Velocity unit is $\mu\text{m}/\text{s}$ . Command not available for E-755.101.
	F-206: F-206 platform velocity: <u>Without axis ID?</u> = TRUE; velocity of axes A and/or B: <u>Without axis ID?</u> = False; axes K,L,M: command not valid
	M-8X0: M-8X0 platform velocity: <u>Without axis ID?</u> = TRUE; velocity of axes A and/or B: <u>Without axis ID?</u> = False
	All other systems: <u>Without axis ID?</u> = FALSE
Output	Error out, Controller error
Remarks	Sets velocity and checks for error. If <u>Without axis ID?</u> is TRUE, then <u>Axes to set</u> is ignored and first field of <u>Velocity values</u> array is used for velocity command. The velocity should not be set to 0. <u>Number of digits</u> is the number of digits after the decimal point in the velocity value(s) that will be sent. <u>Controller error</u> is TRUE if selected system reports error code $\neq 0$ .  C-867: The VEL command saves the parameters in RAM only. To save the currently valid parameters to flash ROM, where they become the power-on defaults, you must run WPA.vi. Parameter changes not saved with WPA will be lost when the C-867 is powered off.  E-516: The VEL command saves the parameters in RAM only. To save the currently valid parameters to flash ROM, where they become the power-on defaults, you must run WPA.vi. Parameter changes not saved with WPA will be lost when the E-516 is powered off.  E-517, E-712, E-725, E-753, E-755: Velocity settings made with VEL are present in RAM only and will be reset to default ("Servo Loop Slew Rate" value) when the controller is powered down or rebooted.  E-761: The VEL command saves the "Servo Loop Slew Rate" parameter in RAM only. To save the currently valid parameter to flash ROM, where it becomes the power-on default, you must run WPA.vi. Parameter changes not saved with WPA will be lost when the PC is powered off or the E-761 is rebooted.  E-861: The VEL setting only takes effect when the given axis is in closed-loop operation (servo on). For open-loop operation, use OVL instead. The maximum value which can be set with the VEL command is given by the Closed-loop velocity parameter, ID 0xA (can be changed with SPA and SEP). On power-on, the current closed-loop velocity is half the maximum.

#### 2.4.23. VEL?.vi (General command.llb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861, F-206, M-8X0, Mercury™. To support analog interfacing, VI must be present for E-816 also.
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  Analog: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE; Velocity unit is $\mu\text{m}/\text{s}$  C-702, C-848, C-880, Mercury™: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE  C-865, C-866, C-867: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Velocity unit is mm/s.  C-843, C-843.PM, C-844, E-516: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be

	TRUE
	C-880K005: VI only supported when called through PI_Multix.vi
	E-710: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE. Velocity unit is µm/ms.
	E-517: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Velocity unit is µm/s in closed-loop operation and V/s in open-loop operation.
	E-712, E-725, E-753, E-861: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Velocity unit is µm/s.
	E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Velocity unit is µm/s. Command not available for E-755.101.
	E-761: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Velocity unit is µm/ms.
	F-206: Velocity of F-206: <u>All axes?</u> = TRUE AND <u>Axis identifier?</u> = FALSE; velocity of axes A,B: <u>All axes?</u> must be FALSE; axes K,L,M: command not valid
	M-8X0: Velocity of M-8X0: <u>All axes?</u> = TRUE AND <u>Axis identifier?</u> = FALSE; velocity of axes A,B: <u>All axes?</u> must be FALSE
Output	Velocity, Error out
	C-880: NanoCube axes will report velocity = 0
	F-206: F-206 velocity: only first field of <u>velocity</u> array is valid
	M-8X0: M-8X0 velocity: only first field of <u>velocity</u> array is valid
Remarks	Returns velocity setting for specified axes.

## 2.5. Joystick-specific VIs (“Joystick.llb”)

### 2.5.1. Calculate joystick scaling.vi (Joystick.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861
Input	XPos min (0), YPos min (0), XPos max (65535), YPos max (65535), Resolution factor X (150), Resolution factor Y (150)
Output	XPos min scaled, YPos min scaled, XPos max scaled, YPos max scaled, XPos Center scaled, YPos Center scaled, Scaling factor X, Scaling factor Y
Remarks	Sub-VI for operation with a joystick connected to the game port of the host computer. Calculates joystick position scaling. If <u>Resolution factor *</u> = <u>*Pos max</u> , maximum resolution is achieved. <u>*Pos min</u> and <u>*Pos max</u> depend on the Windows joystick calibration.

### 2.5.2. JAX.vi (Joystick.llb)

Valid for	C-843, C-867, E-861
Input	System number (1), JoystickID (0), Joystick axis (0), Axes to set (empty string array), Error in (no error)
Output	Error out
Remarks	Enables control of specified axes with an axis of a joystick connected to the controller. If <u>Axes to set</u> is an empty array, the current settings are cleared and no axes are controlled. Settings will not influence

“Joystick\_Operation\_Sample\_Program.vi” which works with a joystick connected to the host computer.

#### 2.5.3. JAX?.vi (Joystick.llb)

Valid for	C-843, C-867, E-861, Mercury
Input	System number (1), Joystick ID to query (empty string array), Without JoystickIDs? (F), Joystick axis (empty num. array, 0), Error in (no error)
Output	Controlled axes, Error out
Remarks	Returns axes which are controlled by joystick axes of joysticks connected to the controller.

#### 2.5.4. JON.vi (Joystick.llb)

Valid for	C-843, C-867, E-861, Mercury
Input	System number (1), JoystickID to command (empty num. array, 0), Joystick mode (empty num. array, 0), Error in (no error) C-843, C-867, E-861, Mercury: <u>Joystick mode</u> can be 0 (OFF) or 1 (ON).
Output	Controller error, Error out
Remarks	Enables or disables joysticks connected to the controller. <u>Controller error</u> is TRUE if selected system reports error code ≠ 0. Settings will not influence “Joystick_Operation_Sample_Program.vi” which works with a joystick connected to the host computer. E-861: Motion commands like MOV or OSM are not allowed when a joystick is active on the axis. C-843, C-867, Mercury: Motion commands like MOV are not allowed when a joystick is active on the axis.

#### 2.5.5. JON?.vi (Joystick.llb)

Valid for	C-843, C-867, E-861, Mercury
Input	System number (1), JoystickID to query (empty string array), All joysticks? (F), Error in (no error)
Output	Joystick status, Error out
Remarks	Returns activation status of queried joysticks connected to the controller.

#### 2.5.6. Read joystick.vi (Joystick.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861
Input	Joystick ID (0), Error in (no error)
Output	XPos, YPos, Button 1 pressed (T/F), Button 2 pressed (T/F), Error out
Remarks	Sub-VI for operation with a joystick connected to the game port of the host computer. Reads joystick position and button status for a standard 2-button 2-axis joystick. Install joystick driver and calibrate joystick in the Windows control panel before running this VI.

### 2.5.7. Scale joystick data.vi (Joystick.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861
Input	XPos (0), YPos (0), XPos Center (0), YPos Center (0), Dead band X (0), Dead band Y (0), Factor X (0), Factor Y (0)
Output	XPos scaled, YPos scaled
Remarks	Sub-VI for operation with a joystick connected to the game port of the host computer. Scales joystick position. Use output value from "Calculate joystick scaling.vi" for <u>Factor</u> *. <u>Dead band</u> * is the maximum scaled position value that does not result in any motion.

## 2.6. Limit- and reference-specific commands (“Limits.llb”)

### 2.6.1. DFH.vi (Limits.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, C-880K005, E-517, E-710, E-755, E-761, Mercury™
Input	System number (1), DFH axes (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  C-880K005: VI only supported when called through PI_Multix.vi  E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE. Command not available for E-755.101.  All other systems: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE
Output	Error out
Remarks	Defines the current position of the <u>DFH axes</u> as home position. Their position value is set to 0. Due to the change of the home position the values for the travel range limits (TMN?, TMX?) are also changed accordingly. The home position is reset to default by ATZ, REF, MNL, MPL or similar commands.  E-517: The values are saved with WPA 100. The position shown in the E-517 display is not affected by DFH because it is that of the sensor channel (can also be queried with TSP?). DFH affects only the axis position which can be queried with POS?.  E-761: The values are saved with WPA 100.

### 2.6.2. DFH?.vi (Limits.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, C-880K005, E-517, E-710, E-755, E-761, Mercury™
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  C-702, C-848, C-880, E-517, Mercury™: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE  C-843, C-843.PM, C-844, C-865, C-866, E-710, E-761: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE  C-880K005: VI only supported when called through PI_Multix.vi  E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Command not

available for E-755.101.

Output	Home position, Error out
Remarks	Returns the difference between the current home position and the absolute or initial zero point (default home position) for each of the queried axes.

### 2.6.3. FED.vi (Limits.llb)

Valid for	C-843, C-867, E-861
Input	System number (1), Axis to set (empty string array), EdgeID (empty num. array, 0), Parameter (empty num. array, 0), Error in (no error) C-843: <u>EdgeID</u> can be 1 to 3. <u>Parameter value</u> can be -1, 0 or 1, depending on <u>EdgeID</u> . C-867, E-861: <u>EdgeID</u> can be 1 to 3. <u>Parameter value</u> must be 0.
Output	Error out
Remarks	Moves given axis to a given signal edge. If multiple axes are to command, they are moved synchronously. This command does not change the reference state of the axis and does not set a certain position value. Valid <u>Parameter values</u> depend on <u>EdgeID</u> : <ul style="list-style-type: none"> <li>▪ EdgeID 1: negative limit switch, <u>Parameter value</u> is 0 when the default setting should be used (e.g. from pistages.dat), 1 when active high, -1 when active low</li> <li>▪ EdgeID 2: positive limit switch, <u>Parameter value</u> is 0 when the default setting should be used (e.g. from pistages.dat), 1 when active high, -1 when active low</li> <li>▪ EdgeID 3: reference switch, <u>Parameter value</u> is 0 when the default setting should be used (e.g. from pistages.dat), 1 when active high, -1 when active low</li> <li>▪ EdgeID 4: autofind AxisIn (is one input line of the motion chip carrying an external sensor signal which changes its state at a certain position), <u>Parameter value</u> gives the signal state to the left of the edge (high or low)</li> <li>▪ EdgeID 5: find arbitrary edge (i.e. change of the state of the AxisIn signal), <u>Parameter value</u> gives the direction of motion: 1=positive, -1=negative</li> </ul> C-843, C-867, E-861: The firmware detects the presence or absence of reference switch and limit switches using controller parameters (ID 0x14 for reference switch; ID 0x32 for limit switches). According to the values of those parameters, the controller enables or disables FED motions to the appropriate signal edges. Adapt the parameter values to your hardware using SPA (or SEP, if supported).

### 2.6.4. FED?.vi (Limits.llb)

Valid for	C-843
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (F), Error in (no error) C-843: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	EdgeID, Parameter, Error out
Remarks	Get the parameters of the last Find Edge motion performed with FED.

**2.6.5. FES?.vi (Limits.llb)**

Valid for	C-843
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) C-843: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	FED status (T/F), Error out
Remarks	Returns "finde edge" status. Indicates whether the last FED command was successful or not.

**2.6.6. FNL.vi (Limits.llb)**

Valid for	C-843, C-843.PM, C-867, E-755, E-861
Input	System number (1), Affected axes (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) C-843, C-843.PM, C-867, E-861: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Command not available for E-755.101
Output	Error out
Remarks	This VI starts a fast move to negative limit of the specified axes. Use #7 polling to determine end of this referencing procedure. E-861, C-867: Servo must be enabled with SVO for the commanded axis prior to using this command (closed-loop operation). The reference mode must be set to "1" (factory default) with the RON command if referencing is to be done by performing a reference move. The negative limit switch of the mechanics is used to determine the negative physical limit of the travel range. The difference of VALUE_AT_REF_POS (parameter ID 0x16) and DISTANCE_REF_TO_N_LIM (parameter ID 0x17) is set as the current position when the axis is at the negative limit switch (value can be negative). If the soft limits (MAX_TRAVEL_RANGE_POS, parameter ID 0x15, and MAX_TRAVEL_RANGE_NEG, parameter ID 0x30) are used to reduce the travel range, the limit switches can not be used for reference moves. FNL and FPL commands will provoke an error message, and only the reference switch can be used for a reference move (FRF command).

**2.6.7. FPL.vi (Limits.llb)**

Valid for	C-843, C-843.PM, C-867, E-755, E-861
Input	System number (1), Affected axes (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) C-843, C-843.PM, C-867, E-861: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Command not available for E-755.101
Output	Error out
Remarks	This VI starts a fast move to positive limit of the specified axes. Use #7 polling to determine end of this referencing procedure. E-861, C-867: Servo must be enabled with SVO for the commanded axis prior to using this command (closed-loop operation).

The reference mode must be set to "1" (factory default) with the RON command if referencing is to be done by performing a reference move. The positive limit switch of the mechanics is used to determine the positive physical limit of the travel range. The sum of VALUE\_AT\_REF\_POS (parameter ID 0x16) and DISTANCE\_REF\_TO\_P\_LIM (parameter ID 0x2F) is set as the current position when the axis is at the positive limit switch. If the soft limits (MAX\_TRAVEL\_RANGE\_POS, parameter ID 0x15, and MAX\_TRAVEL\_RANGE\_NEG, parameter ID 0x30) are used to reduce the travel range, the limit switches can not be used for reference moves. FNL and FPL commands will provoke an error message, and only the reference switch can be used for a reference move (FRF command).

#### 2.6.8. FRF.vi (Limits.llb)

Valid for	C-843, C-843.PM, C-867, C-880 (only K006/K007 version), C-880K005, E-861
Input	System number (1), Affected axes (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) C-843, C-843.PM, C-867, C-880, E-861: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-880K005: VI only supported when called through PI_Multix.vi
Output	Error out
Remarks	This VI starts a fast referencing of the specified axes. Use #7 polling to determine end of this referencing procedure. E-861, C-867: Servo must be enabled with SVO for the commanded axis prior to using this command (closed-loop operation). The reference mode must be set to "1" (factory default) with the RON command if referencing is to be done by performing a reference move. The value of the VALUE_AT_REF_POS parameter (ID 0x16) is set as the current position when the axis is at the reference switch. Use FNL or FPL instead of FRF to perform a reference move for an axis which has no reference sensor but limit switches.

#### 2.6.9. FRF?.vi (Limits.llb)

Valid for	C-843, C-843.PM, C-866, C-867, C-880 (only C-880K006/C-880K007 version), C-880K005, E-755, E-861
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) C-843, C-843.PM, C-866, C-867, C-880, E-861: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-880K005: VI only supported when called through PI_Multix.vi E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Command not available for E-755.101
Output	Referenced? (T/F), Error out
Remarks	Indicates whether queried axes have been referenced (using REF, FNL, FPL, FRF, MPL, MNL, or - if reference mode is OFF - using POS) successfully or not.

#### 2.6.10. GOH.vi (Limits.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-
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	880K005, E-517, E-710, E-755, E-761, E-861, Mercury™
Input	System number (1), GOH axes (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)
	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-710, E-861: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE
	C-880K005: VI only supported when called through PI_Multix.vi
	E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Command not available for E-755.101.
	E-517, E-761, Mercury™: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	Error out
Remarks	Moves specified axes to their home positions.

#### 2.6.11. LIM?.vi (Limits.llb)

Valid for	C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, E-755, E-861, Mercury™
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)
	All systems: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	Axis with limit switch? (T/F), Error out

Remarks      Indicates whether queried axes have limit switches or not.

#### 2.6.12. LSS?.vi (Limits.llb)

Valid for	C-880K005
Input	System number (1), Axes to query (empty string array), All axes? (F), Axes identifier? (T), Error in (no error)
	C-880K005: VI only supported when called through PI_Multix.vi
Output	Limit sensor status, Error out

Remarks      Returns limit sensor status for queried axes.

#### 2.6.13. MNL.vi (Limits.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-865, C-866, C-848, C-880, Mercury™
Input	System number (1), All axes? (F), Affected axes (empty string array), Stop refnum (F), Local stop (F), Error in (no error)
Output	MNL successful? (T/F), Error out
Remarks	Moves specified axes to the negative limit switch, waits until this position is reached using #7 polling and indicates whether this was successful or not. VI will also stop if <u>Stop refnum</u> or <u>Local stop</u> is TRUE.

#### 2.6.14. MPL.vi (Limits.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, Mercury™
Input	System number (1), All axes? (F), Affected axes (empty string array), Stop refnum (F), Local stop (F), Error in (no error)
Output	MPL successful? (T/F), Error out
Remarks	Moves specified axes to the positive limit switch, waits until this position is reached using #7 polling and indicates whether this was successful or not.

VI will also stop if Stop refnum or Local stop is TRUE.

#### 2.6.15. REF.vi (Limits.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, C-880K005, Mercury™
Input	System number (1), All axes? (F), Affected axes (empty string array), Stop refnum (F), Local stop (F), Error in (no error) C-880K005: VI only supported when called through PI_Multix.vi
Output	REF successful? (T/F), Error out
Remarks	Moves the specified axes to the reference position, waits until this position is reached (polling with #7), and indicates whether referencing was successful or not. VI will also stop if <u>Stop refnum</u> or <u>Local stop</u> is TRUE. The home position is reset to default by REF.

#### 2.6.16. REF?.vi (Limits.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, C-880K005, Mercury™
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) C-702: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-843: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-843.PM: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-844: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-848: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-865: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-866: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-880: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-880K005: VI only supported when called through PI_Multix.vi Mercury™: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	Axis with reference? (T/F), Error out
Remarks	Indicates whether queried axes have a reference switch or not.

#### 2.6.17. RON.vi (Limits.llb)

Valid for	C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, C-880K005, E-861, Mercury™
Input	System number (1), Without axis ID?(F), Axes to command (empty string array), Reference mode (empty bool. array, F), Error in (no error) C-880K005: VI only supported when called through PI_Multix.vi All other systems: <u>Without axis ID</u> = FALSE
Output	Error out

Remarks	Sets reference mode for given axes. If <u>Without axis ID</u> is TRUE, then <u>Axes to command</u> is ignored and first field of the <u>Reference mode</u> array is used for the reference mode.  If the reference mode of an axis is ON, the axis must be driven to the reference switch (using "REF.vi" or "FRF.vi") or, if no reference switch is available, to a limit switch (positive limit switch: using "MPL.vi" or "FPL.vi"; negative limit switch: using "MNL.vi" or "FNL.vi") before any other motion can be commanded in closed-loop operation.  If reference mode is OFF, no referencing is required for the axis. In closed-loop operation, only relative moves can be commanded (using "MVR.vi"), unless the actual position is set with POS.vi. Afterwards, relative and absolute moves can be commanded.  For stages with neither reference nor limit switch, reference mode is automatically OFF.
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**WARNINGS:**

If reference mode is switched off, and relative moves are commanded, stages can be driven into the mechanical hard stop if moving to a position which is outside the travel range!

If reference mode is switched off, and the actual position is incorrectly set with "POS.vi", stages can be driven into the mechanical hard stop when moving to a position which is thought to be within the travel range of the stage, but actually is not.

**2.6.18. RON?.vi (Limits.llb)**

Valid for	C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, C-880K005, E-861, Mercury™
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  C-880K005: VI only supported when called through PI_Multix.vi  All other systems: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	Reference on? (T/F), Error out
Remarks	Indicates whether queried axes have reference mode ON or OFF. See "RON.vi" above for description of reference mode.

**2.6.19. TMN?.vi (Limits.llb)**

Valid for	Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861, Mercury™. To support analog interfacing, VI must be present for E-816 also.
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  Analog, C-702, C-848, C-865, C-866, C-867, C-880, E-517, E-712, E-725, E-753, E-761, E-861, Mercury™: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE  C-843, C-843.PM, C-844, E-710: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE  E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Command not available for E-755.101.
Output	Minimum travel limit, Error out

Remarks	Returns minimum (low-end) travel limit (if present, position of negative limit switch, or value of negative soft limit, if set, whichever is higher).  C-867: The minimum commandable position is defined by the MAX_TRAVEL_RANGE_NEG parameter ID 0x30 (SPA).  E-517, E-761: Get the minimum accessible position value, i.e. the value of the "Range min limit" parameter (ID 0x07000000). Note: The minimum position which can be commanded depends either on the "Range min limit" parameter or - if it is greater than the "Range min limit" parameter value - on the value of the negative soft limit set with NLM.  E-861: The minimum commandable position is defined by the MAX_TRAVEL_RANGE_NEG parameter, ID 0x30 (SPA).
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#### 2.6.20. TMX?.vi (Limits.llb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861, Mercury™. To support analog interfacing, VI must be present for E-816 also.
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  Analog, C-702, C-848, C-865, C-866, C-867, C-880, E-517, E-712, E-725, E-753, E-761, E-861, Mercury™: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE  C-843, C-843.PM, C-844, E-710: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE  E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Command not available for E-755.101.
Output	Maximum travel limit, Error out
Remarks	Returns maximum (high-end) travel limit (if present, position of positive limit switch or value of positive soft limit, if set, whichever is lower).  C-867: The maximum commandable position is defined by the MAX_TRAVEL_RANGE_POS parameter ID 0x15 (SPA).  E-517, E-761: Get the maximum accessible position value, i.e. the value of the "Range max limit" parameter (ID 0x07000001). Note: The maximum position which can be commanded depends either on the "Range max limit" parameter or—if it is smaller than the "Range max limit" parameter value—on the value of the positive soft limit set with PLM.  E-861: The maximum commandable position is defined by the MAX_TRAVEL_RANGE_POS parameter, ID 0x15 (SPA).

## 2.7. Old commands and commands with alternate implementations (“Old commands.llb”)

### 2.7.1. #5\_old.vi (Old commands.llb)

Valid for	F-206, M-8X0 (but must be present for all other systems also)
Input	System number (1), Error in (no error)
Output	Overall system moving? (T/F), Sep. Axis 1 moving? (T/F), Sep. Axis 2 moving? (T/F), Error out
Remarks	Polls the motion status of the F-206/M-8X0 and/or up to 2 additional connected axes by sending the single ASCII character 5. Required by “General wait for movement to stop.vi”.

### 2.7.2. Define connected systems.vi (Old commands.llb)

Valid for	C-843, C-843.PM, C-844, C-848, C-865, C-880, C-880K005, E-516, E-710, E-761, E-816, F-206, M-8X0, Mercury™
Input	Controller names (cluster of 4 Enum controls, none), Change only one system? (F), System number (1), Error in (no error)
Output	Controller names out, Error out
Remarks	Defines connected systems and writes controller names into Global2.vi. <b>This VI is called automatically by “XXXX_Configuration_Setup.vi” (with XXXX being the PI product number of your system) and must be completed successfully before “General wait for movement to stop.vi” is called.</b> If <u>Change only one system?</u> is FALSE, all four entries from <u>Controller names</u> are written into “Global2.vi”. If <u>Change only one system?</u> is TRUE, only the entry for the given system number is overwritten in “Global2.vi”. Old VI – only for compatibility reasons available. Limited to 4 systems. Use Define connected systems (Array).vi instead.

### 2.7.3. Wait for hexapod system axes to stop.vi (Old commands.llb)

Valid for	F-206, M-8X0 (but must be present for all other systems also)
Input	System number (1), All axes? (T), Axes to wait for (empty string array), Stop refnum (F), Local stop (F), Error in (no error)
	To wait for the hexapod to stop, only one hexapod axis (X, Y, Z, U, V or W) needs to be commanded, because the VI cannot distinguish between the different hexapod axes. F-206: <u>Axes to wait for</u> can be any of X, Y, Z, U, V, W, A, B, K, L, M M-8X0: <u>Axes to wait for</u> can be any of X, Y, Z, U, V, W, A, B
Output	Error out
Remarks	This vi waits for the specified axes of a PI hexapod system (hexapod axes X, Y, Z, U, V, W and separate axes A, B) to stop using #5 polling. If a NanoCube axis (K, L or M) is commanded, the VI will return immediately. If one of the hexapod axes (X, Y, Z, U, V or W) is commanded, it will wait for all six hexapod axes to stop. It returns immediately if a communications error occurred, or if <u>Local stop</u> or <u>Stop refnum</u> is TRUE. When using as a sub-VI, use <u>Refnum stop</u> to stop VI from caller. Required by “General wait for movement to stop.vi”.

## 2.8. Special commands (“Special command.llb”)

### 2.8.1. #24.vi (Special command.llb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, E-516, E-517, E-712, E-725, E-753, E-755, E-761, E-816, E-861, F-206, M-8X0, Mercury™ (but must be present for E-710 also). To support analog interfacing, VI must be present for E-816 also.
Input	System number (1), Error in (no error)  Analog systems: #24 does not set any error code. When used with any digital controller, does not influence connection between selected analog input channel and axis.  C-880K005: VI only supported when called through PI_Multix.vi
Output	Error out
Remarks	Stops all motion (by sending the single ASCII character 24). #24 sets error code 10, call “ERR?.vi” to reset error after #24 has been called.  E-761: #24 does not take effect to analog input which is used for “direct” axis control (see the E-761 User manual). To disable “direct” control for an axis, the value of the corresponding “Aux-Input to target factor” parameter (ID 0x06000902) must be set to 0 with SPA.  E-816: This command cannot be issued to a slave. Check controller manual to find out if #24 is supported.  F-206, M-8X0: Depending on the firmware version on the controller, this command may not take immediate effect for motion initiated by INI or fast scanning commands.

### 2.8.2. #5.vi (Special command.llb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-517, E-712, E-725, E-753, E-755, E-761, E-861, Mercury™ (but must be present for all other systems also)
Input	System number (1), Error in (no error)
Output	Axis moving? (T/F), Error out
Remarks	Polls the motion status of the connected axes by sending the single ASCII character 5. Connected axes are read from Global2.vi and displayed on the front panel for assignment. Required by “General wait for movement to stop.vi” and “Wait for axes to stop.vi”.  Analog: Motion status can only be determined for all connected axes, not for single axes.  F-206: Different coding in answer, please use #5_old.vi  M-8X0: Different coding in answer, please use #5_old.vi

### 2.8.3. #7.vi (Special command.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, E-517, E-710, E-725, E-755, E-761, E-861, Mercury™ (but must be present for E-516, E-712, E-753, E-816, F-206, M-8X0 also)
Input	System number (1), Error in (no error)  C-880K005: VI only supported when called through PI_Multix.vi
Output	Ready? (T/F), String read, Error out

**Remarks** Sends the single ASCII character 7 and returns the ready status of the controller. Sub-VI for “Wait for answer of longlasting command.vi”.

#### 2.8.4. ACC.vi (Special command.llb)

**Valid for** C-843, C-867

**Input** System number (1), Without axis ID? (F), No. of digits (4), Axes to set (empty string array), Acceleration values (empty num. array, 0), Error in (no error)  
C-843, C-867: Without axis ID? = FALSE. Acceleration unit is mm/s<sup>2</sup>.

**Output** Error out, Controller error

**Remarks** Sets closed-loop acceleration and checks for error. If Without axis ID? is TRUE, then Axes to set is ignored and first field of Acceleration values array is used for acceleration command. Number of digits is the number of digits after the decimal point in the acceleration value(s) that will be sent. Controller error is TRUE if selected system reports error code ≠ 0.

#### 2.8.5. ACC?.vi (Special command.llb)

**Valid for** C-843, C-867

**Input** System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  
C-843, C-867: If All axes? = TRUE, then Axis identifier? can be FALSE.  
Acceleration unit is mm/s<sup>2</sup>.

**Output** Acceleration, Error out

**Remarks** Returns closed-loop acceleration setting for specified axes.

#### 2.8.6. BRA.vi (Special command.llb)

**Valid for** C-843, C-843.PM, C-844, C-848, C-880, Mercury™

**Input** System number (1), Axes to command (empty string array), Brake on (empty bool. array, F), Error in (no error)

**Output** Error out

**Remarks** Switches brake for given axes on or off.

#### 2.8.7. BRA?.vi (Special command.llb)

**Valid for** C-843, C-843.PM, C-844, C-848, C-880, Mercury™

**Input** System number (1), Invert order? (F), Axes to query (empty string array), Query status of all brakes? (F), Error in (no error)  
C-843, C-843.PM, C-844, C-867, Mercury™: Invert order should be FALSE  
C-848, C-880: Invert order should be TRUE

**Output** Axes with brake, Brake status?, Error out  
C-843, C-843.PM, C-844, C-848, C-880, Mercury™: Brake status? is not valid.

**Remarks** Returns list of axes with a brake and status of the brakes for queried axes. Requires SPA?.vi to be present.

### 2.8.8. CLR.vi (Special command.llb)

Valid for	C-702, C-843, C-843.PM, C-848, C-865, C-866, C-880, E-755 (but must be present for Mercury™ also)
Input	System number (1), CLR axes (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)
	C-702: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE
	C-843: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE
	C-843.PM: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE
	C-865: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE
	C-865: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE
	C-848: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE
	C-880: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE
	E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE
Output	Error out
Remarks	Clears axis status for specified axes.

### 2.8.9. CST.vi (Special command.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, E-710, E-761, Mercury™
Input	System number (1), Axis ID's (empty string array), Stage names (empty string array), Error in (no error)
Output	Error out
Remarks	Assigns axes to stages and queries "ERR?". With this command the stage assignment of the connected axes can be changed. Valid stage names can be listed with VST?.vi.  E-761: The settings are automatically written to non-volatile memory. Valid stage names are "ID-STAGE for configured axes (a stage should be connected) and "NOSTAGE" for non-configured axes (no stage should be connected). The axis configuration as "ID-Stage" is required before you can address any move command to this axis (i.e. to the connected stage).

### 2.8.10. CST?.vi (Special command.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-710, E-712, E-725, E-753, E-755, E-761, E-861, F-206, M-8X0, Mercury™
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  C-702, C-843, C-843.PM, C-844, C-848, C-880, F-206, M-8X0: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE  C-865, C-866, C-867, E-710, E-712, E-725, E-753, E-755, E-761, E-861, Mercury™: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	Stage names, Error out
Remarks	Returns the name of the connected stage for queried axes.  F-206, M-8X0: Check HELP answer to find out if CST? is supported.

**2.8.11. CTO.vi (Special command.llb)**

Valid for	C-702, C-843, C-866, E-517, E-712, E-725, E-753, Mercury
Input	System number (1), TriggerOut to set (empty string array), CTO Parameter ID (empty num. array, 0), Parameter value (empty num. array, 0), No. of digits (4), Error in (no error)  C-702: <u>TriggerOut to set</u> can be 1 to 8. C-843: <u>TriggerOut to set</u> can be 1 to 4 (4-axis card) or 2 (2-axis card). C-866: <u>TriggerOut to set</u> can be 1. E-517: <u>TriggerOut to set</u> can be 1 to 3. E-712: <u>TriggerOut to set</u> can be 1 to 7. E-725: <u>TriggerOut to set</u> can be 1 to 7. E-753: <u>TriggerOut to set</u> can be 1.  Mercury: <u>TriggerOut to set</u> can be 1 to N (N: number of connected axes, if supported by corresponding Mercury firmware).
Output	Controller error (T/F), Error out
Remarks	This vi Configures the Trigger Output conditions for the given trigger output line, waits 100 ms and queries ERR?. The trigger output will always be periodically. The trigger output only becomes active when enabled with TRO. Note: Do not use DIO when an axis was configured with CTO. See User manual or GCS DLL manual for available parameter numbers and values. <u>No. of digits</u> is the number of digits after the decimal point in the numeric parameter value(s) that will be sent. <u>Controller error</u> is TRUE if selected system reports error code ≠ 0.  C-702: DIO uses A-H to designate the same lines CTO calls 1-8.  E-517: The trigger output is immediately active when the condition given by the CTO configuration is fulfilled (there is no TRO command). If the CTO Parameter ID is "Trigger Mode" and the Parameter value is "Generator Trigger", then the trigger points in the waveform must be set with TWS and/or with WGO. The current trigger output configuration is saved with the WPA command, in addition to the current parameter values and other settings. The width of a trigger pulse is 30 µs by default, except with the MinMaxThreshold trigger mode where the pulse width depends on the threshold settings. You can change the default pulse width using the Pulse Width parameter, ID 0x0E000900. Possible values are in the range of 10 to 150 µs. The assignment of the trigger lines to the axes of the E-517 is fixed (DIO_O1 belongs to the first axis (A by default), DIO_O2 to the second axis (B by default) and DIO_O3 to the third axis (C by default)).  E-712: The trigger output is immediately active when the condition given by the CTO configuration is fulfilled (there is no TRO command). If the CTO Parameter ID is "Trigger Mode" and the Parameter value is "Generator Trigger", then the trigger points in the waveform must be set with TWS. By default, axis 1 is connected to TriggerOut line 1, axis 2 to line 2, axis 3 to line 3, ..., axis n to line n. If the number of TriggerOut lines exceeds the number of axes, the "surplus" lines are all connected to the last axis.  E-725: The trigger output is immediately active when the condition given by the CTO configuration is fulfilled (there is no TRO command). If the CTO Parameter ID is "Trigger Mode" and the Parameter value is "Generator Trigger", then the trigger points in the waveform must be set with TWS. By default, axis 1 is connected to TriggerOut line 1, axis 2 to line

2, axis 3 to line 3, ..., axis n to line n. If the number of TriggerOut lines exceeds the number of axes, the "surplus" lines are all connected to the last axis.

E-753: The trigger output is immediately active when the condition given by the CTO configuration is fulfilled (there is no TRO command). If the CTO Parameter ID is "Trigger Mode" and the Parameter value is "Generator Trigger", then the trigger points in the waveform must be set with TWS.

#### 2.8.12. CTO?.vi (Special command.llb)

Valid for	C-702, C-843, C-866, E-517, E-712, E-725, E-753, Mercury
Input	System number (1), TriggerOut to query (empty string array), All triggers? (F), CTO parameter ID (empty num. array, 0), Error in (no error)  C-702: <u>TriggerOut to query</u> can be 1 to 8.  C-843: <u>TriggerOut to query</u> can be 1 to 4 (4-axis card) or 2 (2-axis card).  C-866: <u>TriggerOut to query</u> can be 1.  E-517: <u>TriggerOut to query</u> can be 1 to 3.  E-712: <u>TriggerOut to query</u> can be 1 to 7.  E-725: <u>TriggerOut to query</u> can be 1 to 7.  E-753: <u>TriggerOut to query</u> can be 1.  Mercury: <u>TriggerOut to query</u> can be 1 to N (N: number of connected axes, if supported by corresponding Mercury firmware).
Output	Parameter value, Error out
Remarks	Returns the Trigger Output configuration for the given trigger output line.

#### 2.8.13. DEC.vi (Special command.llb)

Valid for	C-843, C-867
Input	System number (1), Without axis ID? (F), No. of digits (4), Axes to set (empty string array), Deceleration values (empty num. array, 0), Error in (no error)  C-843, C-867: <u>Without axis ID?</u> = FALSE. Deceleration unit is mm/s <sup>2</sup> .
Output	Error out, Controller error
Remarks	Sets closed-loop deceleration and checks for error. If <u>Without axis ID?</u> is TRUE, then <u>Axes to set</u> is ignored and first field of <u>Deceleration values</u> array is used for deceleration command. <u>Number of digits</u> is the number of digits after the decimal point in the deceleration value(s) that will be sent. <u>Controller error</u> is TRUE if selected system reports error code ≠ 0.

#### 2.8.14. DEC?.vi (Special command.llb)

Valid for	C-843, C-867
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  C-843, C-867: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Deceleration unit is mm/s <sup>2</sup> .
Output	Deceleration, Error out
Remarks	Returns closed-loop deceleration setting for specified axes.

**2.8.15. DFF.vi (Special command.llb)**

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, E-710, Mercury™
Input	System number (1), Axis (empty string array), Factor (empty num. array, 0), No. of digits (4), Error in (no error)
Output	Error out
Remarks	Defines scale factor which is applied to the basic unit (default is 1). E.g. 25.4 changes the physical unit from mm to inches. <u>No. of digits</u> is the number of digits after the decimal point in the factor value(s) that will be sent.  <i>Example: The physical unit is mm and the scale factor is 1. The current position of a stage is 12. Now the scale factor is set to 3 with DFF. Reading the position gives 4 as result. A relative move of 1.5 causes the stage to move 4.5 mm.</i>
	All systems: <u>Factor</u> can only be positive

**2.8.16. DFF?.vi (Special command.llb)**

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, E-710, Mercury™
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  C-702: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-843: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-843.PM: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-844: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-848: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE C-865: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-866: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-880: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE E-710: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE Mercury™: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	Factor, Error out
Remarks	Returns constant unit value for specified axes (e.g. 25.4 for inches).

**2.8.17. DIO.vi (Special command.llb)**

Valid for	C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, E-861, Mercury™
Input	System number (1), DO's to command (empty string array), DO mode (empty bool. array, F), DO mode format (boolean), DO pattern (0), Error in (no error)  C-702, C-843, C-843.PM, C-848: <u>DO's to command</u> can be A-H. <u>DO mode format</u> is Boolean, <u>DO pattern</u> is not valid. C-865, C-866: <u>DO's to command</u> can be A-B. . <u>DO mode format</u> is Boolean, <u>DO pattern</u> is not valid. C-867, E-861: For <u>DO mode format</u> = Boolean, <u>DO's to command</u> can be 1-4 and

only one DO per command allowed. For DO mode format = hexadecimal, DO's to command and DO mode are not valid and DO pattern must be set correctly (all DO's are set with one single command).

C-880: DO's to command can be A-H (one C-842 inside), A-P (two C-842 inside) etc. DO mode format is Boolean, DO pattern is not valid.

Mercury™: DO's to command can be A-D, E-H, I-L etc., see GCS DLL Manual for details. DO mode format is Boolean, DO pattern is not valid.

Output	Error out
Remarks	Switches digital outputs on or off. For DO mode format = Boolean, <u>DO mode</u> must be selected for each <u>DO to command</u> . For DO mode format = hexadecimal (decimal), <u>DO mode</u> and <u>DO's to command</u> are not valid and DO pattern must be selected correctly in hexadecimal (decimal) format.

#### 2.8.18. DIO?.vi (Special command.llb)

Valid for	C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, E-517, E-761, E-861, Mercury™
Input	<p>System number (1), DI's to query (empty string array), All DI's? (F), DI identifier? (T), Invert order for TVI? (T), Query pattern? (F), Error in (no error)</p> <p>C-702, C-848, C-880: If <u>All DI's</u> = TRUE, then <u>DI identifier</u> can be FALSE and <u>Invert order for TVI?</u> must be TRUE. <u>Query pattern?</u> is not valid.</p> <p>C-843, C-843.PM, C-865, C-866: If <u>All DI's</u> = TRUE, then <u>DI identifier</u> must be TRUE and <u>Invert order for TVI?</u> must be FALSE. <u>Query pattern?</u> is not valid.</p> <p>C-867, E-861: If <u>All DI's</u> = TRUE, then <u>DI identifier</u> must be FALSE. <u>Invert order for TVI?</u> is not valid. <u>DI's to query</u> are 1-4. <u>Query pattern?</u> can be TRUE.</p> <p>E-517: If <u>All DI's</u> = TRUE, then <u>DI identifier</u> can be FALSE. <u>Invert order for TVI?</u> is not valid. <u>DI's to query</u> are 1-3. <u>Query pattern?</u> is not valid.</p> <p>E-761: <u>All DI's</u> = FALSE. <u>DI's to query</u> are "1". <u>Query pattern?</u> is not valid.</p> <p>Mercury™: <u>All DI's</u> must be FALSE. <u>DI's to query</u> can be A-D, E-H, I-L etc., see GCS DLL Manual for details. <u>Query pattern?</u> is not valid.</p>
Output	DI value (T/F), Error out
Remarks	Returns digital input values for queried digital inputs. Uses "TIO?.vi" (GCS I and II) and "TVI?.vi" (GCS I) to determine available DI identifiers if <u>All DI's</u> = TRUE and <u>DI identifier</u> = TRUE. If <u>Query pattern?</u> = TRUE, returns binary pattern for the digital input status of all channels.
	E-761: Note that the E-761 has no genuine digital input lines, but the analog input is internally interpreted as digital input for triggering tasks (see E-761 User Manual), and its signal state can be queried by this command. If the voltage on the analog input is < 0.8 V, the signal is interpreted as LOW, if the voltage is ≥ 2.4 V, the signal is interpreted as HIGH.

#### 2.8.19. DRC.vi (Special command.llb)

Valid for	C-702, C-843, C-866, C-867, E-517, E-710, E-712, E-725, E-753, E-755, E-861
Input	<p>System number (1), Rec. table (0), Source ID (empty string), Rec. option (0), Trigger option (0), Error in (no error)</p> <p>C-843, C-866, E-517, E-712, E-725, E-753, E-861: <u>Trigger option</u> must be 0.</p>

	E-710: <u>Rec. table</u> and <u>Source ID</u> must be identical.
Output	Controller error (T/F), Error out
Remarks	This VI configures the data recording, waits 100 ms and queries ERR?. See GCS DLL manual or User manual for available recording and trigger options. GCS 2.0: <u>Trigger option</u> must be 0. <u>Controller error</u> is TRUE if selected system reports error code ≠ 0.
	C-843: See User Manual for available record options. The C-843 has four data recorder tables. The available points per table depend on the host computer's memory only. Some hardware revisions do not allow the parallel use of DIO and the data recorder. To switch between both modes the C-843 needs to be reconnected.
	C-866: See C-866_GCS_Commands_SM150E.pdf for available record options.
	C-867: See User Manual for available record options. The C-867 has four data recorder tables with 8192 points per table.
	E-517: See User Manual for available record options. The number of data recorder tables is 3 with 8192 points per table. The current data recorder configuration is saved with WPA, in addition to the current parameter values and other settings.
	E-712, E-725, E-753: See User Manual for available record options. By default, the number of data recorder tables is 8. It can be reduced by setting the appropriate parameter value, see User Manual for details.
	E-861: See User Manual for available record options. The E-861 has two data recorder tables with 1024 points per table.

#### 2.8.20. DRC?.vi (Special command.llb)

Valid for	C-702, C-843, C-866, C-867, E-517, E-710, E-712, E-725, E-753, E-755, E-861
Input	System number (1), Rec. table to query (empty num. array, 0), Error in (no error)
Output	Source ID (empty string array), Rec. option (empty num. array, 0), Trigger option (empty num. array, 0), Error out C-843, C-866, C-867, E-517, E-712, E-725, E-753, E-861: <u>Trigger option</u> is not valid.
Remarks	This VI returns the data recording configuration ( <u>Source ID</u> , <u>Rec. option</u> and <u>Trigger option</u> ) for the queried record table. GCS 2.0: <u>Trigger option</u> is not valid.

#### 2.8.21. DRR?.vi (Special command.llb)

Valid for	Analog systems, C-702, C-843, C-866, C-867, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861, M-8X0. To support analog interfacing, VI must be present for E-816 also.
Input	System number (1), Rec. table IDs (Empty num. array, 0), xo (0), N (100), Nmax (1024), Without parameter? (FALSE), Error in (no error) Analog: <u>Rec. table IDs</u> , <u>xo</u> , <u>N</u> and <u>Nmax</u> are not valid. <u>Without parameter?</u> must be TRUE. C-702: <u>Xo</u> >= 0. <u>Nmax</u> = 262144.
	C-843: <u>Xo</u> >= 1. Check C-843 User Manual for valid <u>Nmax</u> values. Some hardware revisions don't allow the parallel use of DIO and the data recorder. To switch between both modes the C-843 needs to be

	reconnected. If <u>N</u> = -1 all points of the last record are returned.
	C-866: <u>Xo</u> >= 1. <u>Nmax</u> = 32,256. If <u>N</u> = -1 all points of the last record are returned.
	C-867: <u>Xo</u> >= 1. <u>Nmax</u> = 8192.
	E-517: <u>Xo</u> >= 1. <u>Nmax</u> = 8192.
	E-710: <u>Xo</u> >= 1. <u>Nmax</u> = 32256.
	E-712: <u>Xo</u> >= 1. <u>Nmax</u> = 262,144.
	E-725: <u>Xo</u> >= 1. <u>Nmax</u> = 262,144.
	E-753: <u>Xo</u> >= 1. <u>Nmax</u> = 65,536.
	E-755: <u>Xo</u> >= 1. <u>Nmax</u> = 4096.
	E-761: <u>Xo</u> >= 0. <u>Nmax</u> = 8192.
	E-861: <u>Xo</u> >= 1. <u>Nmax</u> = 1024.
	M-8X0: Rec. table IDs, <u>xo</u> , <u>N</u> and <u>Nmax</u> are not valid. Without parameter? must be TRUE.
Output	Data, Names, Sample time, Error out
Remarks	Returns <u>N</u> recorded data points. <u>N</u> must be less than or equal to <u>Nmax</u> . For large <u>N</u> values, communication timeout must be set long enough, otherwise a communication error may occur.  C-843: The number of tables is 4. The available points are in equal shares assigned to the available data recorder tables. By default, the number of tables is 4. It can be reduced with DRC, see C-843 User Manual for details.  C-867: The number of tables is 4.  E-517: The number of tables is 3.  E-761: Recording takes place for all recorder tables as long as the wave generator is running for an arbitrary axis, when an impulse is started with IMP or when a step is started with STE. The assignment of axis and data sources to the recorder tables is as follows:  table 1: axis 1 actual position table 2: axis 2 actual position table 3: axis 3 actual position  table 4: analog input voltage (same value as read with TAV?, i.e. contains gain and offset for the analog input, see E-761 User Manual). The maximum number of data points is 8192 per recorder table.  E-712: The 262,144 points are in equal shares assigned to the available data recorder tables. By default, the number of tables is 8. It can be reduced by setting the appropriate parameter value, see E-712 User Manual for details.  E-725: The 262,144 points are in equal shares assigned to the available data recorder tables. By default, the number of tables is 8. It can be reduced by setting the appropriate parameter value, see E-725 User Manual for details.  E-753: The 65,536 points are in equal shares assigned to the available data recorder tables. By default, the number of tables is 8. It can be reduced by setting the appropriate parameter value, see E-753 User Manual for details.  E-861: Two data recorder tables with 1024 points per table are provided.  M-8X0: Only supported if controller is based on C-842.80 board. Check HELP answer to find out if DRR? is supported. Returns 360 motor current values recorded during execution of DRV.

### 2.8.22. DRR? and display data.vi (Special command.llb)

Valid for	Analog systems, C-702, C-843, C-866, C-867, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861, M-8X0. To support analog interfacing, VI must be present for E-816 also.
Input	<p>System number (1), Rec. table IDs (Empty num. array, 0), xo (0), N (100), Nmax (1024), Without parameter? (FALSE), Error in (no error)</p> <p>Analog: <u>Rec. table IDs</u>, <u>xo</u>, <u>N</u> and <u>Nmax</u> are not valid. <u>Without parameter?</u> must be TRUE.</p> <p>C-702: <u>Xo</u> &gt;= 0. <u>Nmax</u> = 262144.</p> <p>C-843: <u>Xo</u> &gt;= 1. <u>Nmax</u> depends on the host computer's memory only. Some hardware revisions don't allow the parallel use of DIO and the data recorder. To switch between both modes the C-843 needs to be reconnected.</p> <p>C-866: <u>Xo</u> &gt;= 1. <u>Nmax</u> = 32,256. If N = -1 all points of the last record are returned.</p> <p>C-867: <u>Xo</u> &gt;= 1. <u>Nmax</u> = 8192.</p> <p>E-517: <u>Xo</u> &gt;= 1. <u>Nmax</u> = 8192.</p> <p>E-710: <u>Xo</u> &gt;= 1. <u>Nmax</u> = 32256.</p> <p>E-712: <u>Xo</u> &gt;= 1. <u>Nmax</u> = 262,144.</p> <p>E-725: <u>Xo</u> &gt;= 1. <u>Nmax</u> = 262,144.</p> <p>E-753: <u>Xo</u> &gt;= 1. <u>Nmax</u> = 65,536.</p> <p>E-755: <u>Xo</u> &gt;= 1. <u>Nmax</u> = 4096.</p> <p>E-761: <u>Xo</u> &gt;= 0. <u>Nmax</u> = 8192.</p> <p>E-861: <u>Xo</u> &gt;= 1. <u>Nmax</u> = 1024.</p> <p>M-8X0: <u>Rec. table IDs</u>, <u>xo</u>, <u>N</u> and <u>Nmax</u> are not valid. <u>Without parameter?</u> must be TRUE.</p>
Output	Data, Names, Sample time, Error out
Remarks	<p>Returns <u>N</u> recorded data points and displays them in a 2D graph by calling "Show_Save_Load_XY_Data.vi. N must be less than or equal to <u>Nmax</u>. For large <u>N</u> values, communication timeout must be set long enough, otherwise a communication error may occur.</p> <p>C-843: The number of tables is 4. The available points are in equal shares assigned to the available data recorder tables. By default, the number of tables is 4. It can be reduced with DRC, see C-843 User Manual for details.</p> <p>C-867: The number of tables is 4.</p> <p>E-517: The number of tables is 3.</p> <p>E-761: Recording takes place for all recorder tables as long as the wave generator is running for an arbitrary axis, when an impulse is started with IMP or when a step is started with STE. The assignment of axis and data sources to the recorder tables is as follows:</p> <ul style="list-style-type: none"> <li>table 1: axis 1 actual position</li> <li>table 2: axis 2 actual position</li> <li>table 3: axis 3 actual position</li> <li>table 4: analog input voltage (same value as read with TAV?, i.e. contains gain and offset for the analog input, see E-761 User Manual).</li> </ul> <p>The maximum number of data points is 8192 per recorder table.</p> <p>E-712: The 262,144 points are in equal shares assigned to the available data</p>

recorder tables. By default, the number of tables is 8. It can be reduced by setting the appropriate parameter value, see E-712 User Manual for details.

E-725: The 262,144 points are in equal shares assigned to the available data recorder tables. By default, the number of tables is 8. It can be reduced by setting the appropriate parameter value, see E-725 User Manual for details.

E-753: The 65,536 points are in equal shares assigned to the available data recorder tables. By default, the number of tables is 8. It can be reduced by setting the appropriate parameter value, see E-753 User Manual for details.

E-861: Two data recorder tables with 1024 points per table are provided.

M-8X0: Only supported if controller is based on C-842.80 board. Check HELP answer to find out if DRR? is supported. Returns 360 motor current values recorded during execution of DRV.

#### 2.8.23. DRT.vi (Special command.llb)

Valid for	C-702, C-843, C-866, C-867, E-755, E-861
Input	System number (1), DataRecorderTable (empty num. array, 0), Trigger source (empty num. array, 0), Value (empty string array), Error in (no error)
Output	Controller error (T/F), Error out
Remarks	This vi defines a trigger source for data recorder tables, waits 100 ms and queries ERR?. See GCS DLL manual or User manual for available trigger sources and values. <u>Controller error</u> is TRUE if selected system reports error code ≠ 0.  C-866: See C-866_GCS_Commands_SM150E.pdf for available trigger sources and values. <u>DataRecorderTable</u> = 0 (the specified trigger source is set for all data recorder tables).  C-843, C-867, E-861: See User Manual for available trigger sources and values. <u>DataRecorderTable</u> = 0 (the specified trigger source is set for all data recorder tables).

#### 2.8.24. DRT?.vi (Special command.llb)

Valid for	C-702, C-843, C-866, C-867, E-755, E-861
Input	System number (1), Rec. table to query (empty num. array, 0), Error in (no error)
Output	Trigger source (empty num array, 0), Value (empty string array), Trigger option (empty num. array, 0), Error out
Remarks	This VI returns the Data Recorder Trigger source and value for the queried data recorder tables.

#### 2.8.25. EGE.vi (Special command.llb)

Valid for	C-843, C-848, C-880
Input	System number (1), Without axis ID?(F), Axes to command (empty string array), Electronic gearing mode (empty bool. array, F), Error in (no error)  C-843: <u>Without axis ID</u> = FALSE. This command can only be issued to a slave axis. The master-slave assignments are set with "MAS.vi". Use "MAS?.vi" to get the current master axis, i.e. the one to be commanded with "MOV.vi".
	C-848: <u>Without axis ID</u> = FALSE. This command can only be issued to a slave axis. The master-slave assignments are hardware-dependent. Use "MAS?.vi" to

	get the related master axis, i.e. the one to be commanded with "MOV.vi".
	C-880: <u>Without axis ID</u> = FALSE. This command can only be issued to a slave axis. The master-slave assignments are hardware-dependent. Use "MAS?.vi" to get the related master axis, i.e. the one to be commanded with "MOV.vi".
Output	Error out
Remarks	Sets electronic gearing mode for given axes. If <u>Without axis ID</u> is TRUE, then <u>Axes to command</u> is ignored and first field of <u>Electronic gearing mode</u> array is used.

#### 2.8.26. EGE?.vi (Special command.llb)

Valid for	C-843, C-848, C-880
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) C-843, C-848, C-880: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	Electronic gearing mode (T/F), Error out
Remarks	Returns electronic gearing mode of queried axes.

#### 2.8.27. INI.vi (Special command.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, E-710, F-206, M-8X0, Mercury™
Input	System number (1), INI axes (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) C-702: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-843: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-843.PM: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-844: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-848: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-865: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-866: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE C-880: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-710: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE F-206: Initialize F-206: <u>All axes?</u> = TRUE, <u>Axis identifier?</u> = FALSE (separate axes A,B (if present) will not be initialized); initialize axes A,B: <u>All axes?</u> = FALSE, axes K,L,M: command not valid (NanoCube is initialized with F-206); VI will not wait for INI procedure to finish. Use "INI hexaxes and wait until finished.vi" to initialize hexapod and/or separate axes and wait for the procedure to finish. Depending on the firmware version on the controller, motion initiated by INI may not be able to be stopped by STOP, #24 or #27. M-8X0: Initialize M-8X0: <u>All axes?</u> = TRUE, <u>Axis identifier?</u> = FALSE, (separate axes A,B (if present) will not be initialized); initialize axes A,B: <u>All axes?</u> = FALSE; VI will not wait for INI procedure to finish. Use "INI hexaxes and wait until finished.vi" to initialize hexapod and/or separate axes and wait for the procedure to finish. Depending on the firmware version on the controller, motion initiated by INI may not be able to be stopped by STOP, #24 or #27. Mercury™: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	Error out

Remarks	Initializes axes. System-specific: see individual GCS-DLL Manual for details.  C-844: It is necessary to wait a certain time – appr. 4 s – before sending the next command to prevent it from being lost.
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#### 2.8.28. MAS.vi (Special command.llb)

Valid for	C-843
Input	System number (1), Slave axis (empty string array), Master axis (empty string array), Error in (no error)
Output	Error out
Remarks	Set master axis.

#### 2.8.29. MAS?.vi (Special command.llb)

Valid for	C-843, C-848, C-880
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  C-843, C-848, C-880: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE.
Output	Master axis, Error out
Remarks	Returns the master axis for the specified axis.

#### 2.8.30. MVE.vi (Special command.llb)

Valid for	C-843, C-867
Input	System number (1), Axes to move (empty string array), Position values (empty num. array, 0), No. of digits (4), Error in (no error)
Output	Error out
Remarks	Vector path move to specified absolute position. Specified axes to move start moving simultaneously. The current settings for velocity, acceleration and deceleration define the maximum possible values. The actual velocity is defined by the slowest axis. No other motion commands are allowed during vector move. No. of digits is the number of digits after the decimal point in the position value(s) that will be sent.  C-867: Check HLP? answer to find out if MVE is supported.

#### 2.8.31. OpenStageEditorDialog.vi (Special command.llb)

Valid for	C-843, C-843.PM, C-865, C-866
Input	System number (1), Database (PIStages), Error in (no error)
Output	DLL I32 Return value, Error out
Remarks	This vi calls the PIStageEditor which can be used to view/change stage parameters and/or add new stages. To view parameters of PI stages, select PIStages in <u>Database</u> . To add stages and/or change parameters, select UserStages in <u>Database</u> . GCSTranslator.dll and the corresponding system specific GCS DLL must be installed. The VI reads the system name from Global 2 and calls the corresponding DLL function.

### 2.8.32. POS.vi (Special command.llb)

Valid for	C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, C-880K005, E-755, E-861, Mercury™
Input	System number (1), Axes to set (empty string array), Position values (empty num. array, 0), No. of digits (4), Error in (no error) C-880K005: VI only supported when called through PI_Multix.vi E-755: Command not available for E-755.101 E-861: With open-loop systems, this command is not useful because there is no position sensor.
Output	Error out
Remarks	Assigns new position value to current position without moving the stage. Command can only be used when the reference mode is switched off (see "RON.vi"). <u>No. of digits</u> is the number of digits after the decimal point in the position value(s) that will be sent. <b>Warning:</b> If the current position is incorrectly set on an axis with reference mode OFF, the stage can be driven into the mechanical hard stop when moving to a position which is thought to be within the travel range of the stage, but actually is not.

### 2.8.33. RTR.vi (Special command.llb)

Valid for	C-843, C-867, E-517, E-712, E-725, E-753, E-761, E-861
Input	System number (1), Table rate (1), Error in (no error)
Output	Error out, Hidden error
Remarks	This vi sets the table rate and queries ERR?. The table rate is 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. <u>Hidden error</u> is TRUE if selected system reports error code ≠ 0.

### 2.8.34. RTR?.vi (Special command.llb)

Valid for	C-843, C-867, E-517, E-712, E-725, E-753, E-761, E-861
Input	System number (1), Error in (no error)
Output	Record table rate, Error out
Remarks	Returns the current table rate.

### 2.8.35. SAI.vi (Special command.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-517, E-710, E-761, Mercury™
Input	System number (1), Old axis ID (empty string array), New axis ID (empty string array), Error in (no error) E-517: Maximum length for axis name is 8 characters.
Output	Error out
Remarks	Set axis identifier. With this command the axis identifiers of the configured axes can be changed. GCS 1.0: Only one character is allowed as axis ID. Valid axis IDs can be listed with TVI?.vi. GCS 2.0: Characters that Axis IDs can contain can be listed with TVI?.vi.

Please run “Define connected axes.vi” with new axis IDs after renaming axes.

E-517: SAI affects the Axis Name parameter, ID 0x07000600, in volatile memory (RAM). To save the currently valid value to non-volatile memory, where it becomes the power-on default, you must use WPA. Changes not saved with WPA will be lost when the E-517 is powered down or rebooted.

E-761: The settings are automatically written to non-volatile memory.

### 2.8.36. SMO.vi (Special command.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880
Input	System number (1), No. of digits (4), Axes to set (empty string array), Motor output (empty num. array, 0), Error in (no error)  All systems: <u>No. of digits</u> is 0.
Output	Error out, Hidden error
Remarks	Sets the motor output directly and checks for error. Command will only be executed if channel is in servo-off mode (SVO.vi).

**Caution: In servo-off mode limit switches are not enabled!**

No. of digits is the number of digits after the decimal point in the motor output value(s) that will be sent. Hidden error is TRUE if selected system reports error code ≠ 0.

### 2.8.37. SMO?.vi (Special command.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)  C-702, C-848, C-865, C-866, C-867, C-880: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE  C-843, C-843.PM, C-844: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE
Output	Current motor output, Error out
Remarks	Returns the current motor output. In servo-on mode, the actual value as set by the regulator is reported. In servo-off mode, the value set by the last SMO command is reported.

### 2.8.38. SRA.vi (Special command.llb)

Valid for	C-843, C-848, C-880
Input	System number (1), Axes to set (empty string array), Gear ratio values (empty num. array, 0), No. of digits (4), Error in (no error)  C-843 This command can only be issued to a slave axis. Use MAS to define the master axis.  C-848: This command can only be issued to a slave axis. The master-slave assignments are hardware-dependent.  C-880: This command can only be issued to a slave axis. The master-slave assignments are hardware-dependent.
Output	Error out
Remarks	Sets gear ratio for electronic gearing mode. <u>No. of digits</u> is the number of digits after the decimal point in the gear ratio value(s) that will be sent.

**2.8.39. SRA?.vi (Special command.llb)**

Valid for	C-843, C-848, C-880
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)
	C-843, C-848, C-880: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. This command can only be issued to a slave axis.
Output	Gear ratio, Error out
Remarks	Returns gear ratio values for specified axes.

**2.8.40. SRG?.vi (Special command.llb)**

Valid for	C-843, C-843.PM, C-866, C-867, E-861, Mercury™
Input	System number (1), Axes to query (empty string array), Register no. (empty num. array, 0), Error in (no error)
	C-843, C-843.PM: Register numbers are: ➤ 1: Event status register ➤ 2: Activity status register ➤ 3: Signal status register
	C-866: Register numbers are: ➤ 1: Event status register ➤ 2: Activity status register ➤ 3: Signal status register ➤ 4: Signal sense register
	C-867: Register number is: ➤ 1: Status register
	E-861: Register number is: ➤ 1: Status register
	Mercury™: Register number is: ➤ 3: Signal status register
Output	Parameter value, Error out
Remarks	Returns register values for queried axes and register numbers. See Motion Processor or Controller User Manual for a description of bit-coded answer.

**2.8.41. STA?.vi (Special command.llb)**

Valid for	C-702, C-848, C-880, C-880K005, M-8X0 (but must be present in Special command.llb for all other systems also)
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)
	C-702: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
	C-848: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
	C-880: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
	C-880K005: VI only supported when called through PI_Multix.vi
	M-8X0: <u>All axes?</u> = TRUE, <u>Axis identifier?</u> = FALSE

Output	Axis status, Error out																				
	C-702: See GCS DLL manual or User manual for supported status bits.																				
	C-848, C-880:																				
	The status word for each axis is a 16-bit register containing the following information (bit encoding is 0 = LSB, 15 = MSB):																				
Bit #	Description																				
0	Motion complete flag. This bit is set (1) when the axis trajectory has completed. This flag is only valid for the S-curve, trapezoidal, and velocity contouring profile modes.																				
1	Wrap-around condition flag. This bit is set (1) when the axis has reached one end of its travel range and has wrapped to the other end of the travel range. Specifically, when traveling in a positive direction past the position +1,073,741,823, the axis will wrap to position -1,073,741,824, and vice-versa. The bit can be reset with the CLR command.																				
2	Breakpoint reached flag. This bit is set (1) when one of the breakpoint conditions has occurred.																				
3	Index pulse received flag. This bit is set (1) when an index pulse has been received.																				
4	Motion error flag. This bit is set (1) when the maximum position error is exceeded. This bit can only be reset when the axis is no longer in a motion error condition																				
5	Positive limit switch flag. This bit is set (1) when the positive limit switch goes active.																				
6	Negative limit switch flag. This bit is set (1) when the negative limit switch goes active.																				
7	Command error flag. This bit is set (1) when an erroneous command has been received by the motion control chip.																				
8*	Servo-control on/off status (1 indicates on, 0 indicates off).																				
9*	Axis on/off status (1 indicates on, 0 indicates off). The C-848 always has the axis ON.																				
10*	In-motion flag. This bit is continuously updated and indicates whether or not the axis is in motion: 1 indicates axis is in motion, 0 not in motion.																				
11*	Reserved (may contain 0 or 1)																				
12*,13*	Current axis # (13 bit = high bit, 12 bit = low bit). Axis encoding is as follows:																				
	<table><thead><tr><th>Bit 13</th><th>Bit12</th><th>MC Axis</th><th>C-848 Axis</th></tr></thead><tbody><tr><td>0</td><td>0</td><td>1</td><td>A</td></tr><tr><td>0</td><td>1</td><td>2</td><td>B</td></tr><tr><td>1</td><td>0</td><td>3</td><td>C</td></tr><tr><td>1</td><td>1</td><td>4</td><td>D</td></tr></tbody></table>	Bit 13	Bit12	MC Axis	C-848 Axis	0	0	1	A	0	1	2	B	1	0	3	C	1	1	4	D
Bit 13	Bit12	MC Axis	C-848 Axis																		
0	0	1	A																		
0	1	2	B																		
1	0	3	C																		
1	1	4	D																		
14,15	Reserved (may contain 0 or 1)																				

C-880K005:

The status word for each axis is a 16-bit register containing the following information (bit encoding is 0 = LSB, 15 = MSB):

Bit # Description

- 0 Motion complete flag. Set to 1 when motion is completed.  
SetMotionCompleteMode determines if this bit is based on the trajectory generator position or the encoder position.
- 1 Wrap-around condition flag. This bit is set (1) when the actual (encoder) position wraps from maximum allowed position to minimum or vice versa.
- 2 Breakpoint 1 reached flag. This bit is set (1) when breakpoint 1 is triggered.
- 3 Capture received flag. This bit is set (1) when a position capture occurs.
- 4 Motion error flag. This bit is set (1) when a motion error occurs
- 5 Positive limit switch flag. This bit is set (1) when the positive limit switch goes active.
- 6 Negative limit switch flag. This bit is set (1) when the negative limit switch goes active.
- 7 Instruction error flag. This bit is set (1) when an instruction error occurs.
- 8-10 Reserved, may be 0 or 1.
- 11 Commutation error flag. This bit is set (1) when a commutation error occurs.
- 12-13 Reserved, may be 0 or 1.
- 14 Breakpoint 2 reached flag. This bit is set (1) when breakpoint 2 is triggered.
- 15 Reserved, may be 0 or 1.

**Remarks** Returns axis status (integer). Required by “General wait for movement to stop.vi” and “Wait for axes to stop.vi”.  
M-8X0: Check HELP answer to find out if STA? is supported. Command is equivalent to #4.

#### 2.8.42. STE.vi (Special command.llb)

Valid for	Analog systems, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861. To support analog interfacing, VI must be present for E-816 also.
Input	System number (1), Axis to command (empty string), Step size (0), Delay (0), No. of digits (4), Error in (no error)  All systems: <u>Delay</u> = 0.
Output	Error out
Remarks	Performs a step-move from, and back to, the current position with specified <u>step size</u> (amplitude). If supported, <u>Delay</u> sets the number of servo loops between position recording (GCS 2.0: <u>Delay</u> must be 0).. <u>No. of digits</u> is the number of digits after the decimal point in the <u>step size</u> (amplitude) values that will be sent. Controller saves a definite number of position values which can be read out with STE?.vi (GCS 1.0) or DRR?.vi (GCS 2.0). Use “General wait for movement to stop.vi” before calling “STE?.vi” or “DRR?.vi” to make sure that motion has finished before reading back the saved values. For an impulse-move, see “IMP.vi”.  Analog: Use DRR?.vi or DRR? and display data.vi to read position values back. C-843: Controller saves up to 32,640 position values for all 4 channels in sum. Use STE?.vi to read position values back. C-843.PM: Controller saves up to 32,640 position values for all 4 channels in sum. Use STE?.vi to read position values back. C-848: Controller saves 1024 position values. Use STE?.vi to read position values

back.

C-865: Controller saves up to 32,640 position values. Use STE?.vi to read position values back.

C-866: Controller saves up to 32,256 position values. STE will overwrite DRC settings of Rec. table 1 to record actual position values. Use DRC to define additional record options for Rec. table no. 2 to 4. Record table rate is reset to 1 by STE. Use STE?.vi to read position values back or DRR? to read all Rec. tables back. You can also use MVR in combination with DRC to record values of a step motion. Use DRR? to read values back then.

C-867: Controller saves up to 8192 position values.

Motion commands like STE are not allowed when the joystick is active for the axis. Use DRC to define record options. Use DRR?.vi or DRR? and display data.vi to read recorded values back. You can also use MVR in combination with DRC to record values of a step motion.

C-880: Controller saves 1024 position values. Use STE?.vi to read position values back.

E-517: Controller saves up to 8,192 position values. Use DRR?.vi or DRR? and display data.vi to read recorded values back. The number of servo cycles used for data recording depends on the setting made with RTR.

Motion commands like STE are not allowed when the E-517 is in OFFLINE mode or when the wave generator output is active. When a macro is running on the E-517, STE will be executed not until the macro is finished or stopped. See "Control Value Generation" and "Control Modes" in the E-517 User manual for details.

E-710: Controller saves 8192 position values. "Table Rate" parameter, set with SPA, is used as sampling interval instead of Delay. Caution: Table Rate parameter influences Wave Generator, not only STE. Use STE?.vi to read position values back.

E-712: Controller saves up to 262,144 position values. Use DRR?.vi or DRR? and display data.vi to read recorded values back. The number of servo cycles used for data recording depends on the setting made with RTR.

Motion commands are not allowed when a wave generator is active or the analog input is used for target generation.

E-725: Controller saves up to 262,144 position values. Use DRR?.vi or DRR? and display data.vi to read recorded values back. The number of servo cycles used for data recording depends on the setting made with RTR.

Motion commands are not allowed when a wave generator is active or the analog input is used for target generation.

E-753: Controller saves up to 65,536 position values. Use DRR?.vi or DRR? and display data.vi to read recorded values back. The number of servo cycles used for data recording depends on the setting made with RTR.

Motion commands are not allowed when the wave generator is active or the analog input is used for target generation.

E-755: Controller saves 4,096 position values. Use DRR?.vi or DRR? and display data.vi to read recorded values back.

E-761: Controller saves 8192 position values. The number of servo cycles used for data recording depends on the setting made with RTR. Use DRR?.vi or STE?.vi to read position values back.

E-861: Step response measurements provide meaningful results only in closed-loop operation. Controller saves up to 1,024 position values.

Motion commands like STE are not allowed when the joystick is active for the axis. Use DRC to define record options. Use DRR?.vi or DRR? and display data.vi to read recorded values back. You can also use MVR in

combination with DRC to record values of a step motion.

#### 2.8.43. STE?.vi (Special command.llb)

Valid for	C-843, C-843.PM, C-848, C-865, C-866, C-880, E-517, E-710, E-755, E-761
Input	System number (1), Query axis (empty string), xo (0), N (100), Nmax (1024), Error in (no error)  C-843: <u>Nmax</u> = 32640.  C-843.PM: <u>Nmax</u> = 32640.  C-848: <u>Nmax</u> = 1024.  C-865: <u>Nmax</u> = 32640  C-866: <u>Nmax</u> = 32256.  C-880: <u>Nmax</u> = 1024.  E-517: <u>xo</u> , <u>N</u> and <u>Nmax</u> are not valid.  E-710: <u>Nmax</u> = 8192.  E-755: <u>xo</u> , <u>N</u> and <u>Nmax</u> are not valid.  E-761: <u>Nmax</u> = 8192.
Output	Step response, Step size, Error out  C-843 C-843.PM, C-848, C-865, C-866, C-880, E-710, E-761: VI reads step response points. <u>Step size</u> is not valid.  E-517, E-755: VI reads STE settings. <u>Step response</u> is not valid.
Remarks	GCS 1.0 controller: Returns N saved step response points. N must be less than or equal to Nmax. For large N values, communication timeout must be set long enough, otherwise a comm.error may occur.  GCS 2.0 or higher: Returns STE settings. Use DRR? to read impulse response points back.

#### 2.8.44. TIO?.vi (Special command.llb)

Valid for	C-702, C-843, C-843.PM, C-848, C-866, C-867, C-880, E-517, E-761, E-861, Mercury™ (but must be present for E-816 also)
Input	System number (1), Error in (no error)
Output	No. of dig. inputs, No. of dig. outputs, Error out
Remarks	Returns the number of digital inputs and outputs available in the controller.  E-761: The E-761 has no genuine digital input and output lines, but the analog input is internally interpreted as digital input for triggering tasks (see E-761 User Manual), and its signal state can be queried by the DIO? command.

#### 2.8.45. TRO.vi (Special command.llb)

Valid for	C-702, C-843, C-866, Mercury
Input	System number (1), TriggerOut to command (empty string array), Trigger status (empty bool. array, F), Error in (no error)
Output	Error out
Remarks	Enables or disables the TRigger Output mode which was set with CTO. Do not use DIO on output lines for which the trigger output is activated with TRO.

C-702: TriggerOut to command can be 1 to 8.  
 C-843: TriggerOut to command can be 1 to 4 (4-axis card) or 2 (2-axis card).  
 C-866: TriggerOut to command can be 1.  
 Mercury: TriggerOut to command can be 1 to N (N: number of connected axes, if supported by corresponding Mercury firmware).

#### 2.8.46. TRO?.vi (Special command.llb)

Valid for C-702, C-843, C-866, Mercury  
 Input System number (1), TriggerOut to query (empty string array), All triggers? (F), Error in (no error)  
 Output Trigger status? (T/F), Error out  
 Remarks Returns the trigger output mode enable status for the given trigger output lines.  
 C-702: TriggerOut to query can be 1 to 8.  
 C-843: TriggerOut to query can be 1 to 4 (4-axis card) or 2 (2-axis card).  
 C-866: TriggerOut to query can be 1.  
 Mercury: TriggerOut to query can be 1 to N (N: number of connected axes, if supported by corresponding Mercury firmware).

#### 2.8.47. TVI?.vi (Special command.llb)

Valid for C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-517, E-710, E-761, Mercury™ (but must be present for E-816 and E-861 also)  
 Input System number (1), Invert order, Error in (no error)  
 C-702, C-848, C-880: Invert order should be TRUE. Returns valid axis identifiers.  
 C-843, C-843.PM, C-844, C-865, C-866, E-710, E-761, Mercury™: Invert order must be FALSE. Returns valid axis identifiers.  
 C-867, E-517: Invert order must be FALSE. Returns valid characters for axis IDs.  
 Output Valid axis IDs, Error out  
 Remarks GCS 1.0: Get valid axis identifiers. Should be called before axes are renamed with SAI.vi.  
 GCS 2.0: Get valid characters for axis IDs.

#### 2.8.48. VST?.vi (Special command.llb)

Valid for C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, E-710, E-761, Mercury™  
 Input System number (1), Error in (no error)  
 Output Available stages, Error out  
 Remarks Returns the names of all stages which can be connected to the controller.

## 2.9. Support VIs (“Support.llb”)

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

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

### 2.9.1. Analyse input string for terminal.vi (Support.llb)

Valid for	All except analog systems
Input	String new (empty string), Last string sent (empty string)
Output	String out, Out not equal to in? (T/F), Attach term. char.? (T/F)
Remarks	This VI is a sub-VI for “PI Terminal.vi”. It analyses <u>String new</u> and returns it in <u>String out</u> if it is not empty and does not contain a “#” at the beginning. In case of an empty new string, <u>Last string sent</u> is returned. If <u>String new</u> contains a “#” character, the corresponding ASCII character is returned.

### 2.9.2. Assign booleans from string to axes.vi (Support.llb)

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

### 2.9.3. Assign DRC values.vi (Support.llb)

Valid for	C-702, C-843, C-866, C-867, E-517, E-710, E-712, E-725, E-753, E-755, E-861
Input	Input string (empty string), Queried Rec. table (empty num. array, 0), Error in (no error)
Output	Source ID (empty string array), Rec. option (empty num. array, 0), Trigger option (empty num. array), Queried Rec. table out (empty num. array), Rec. option string (empty string array), Error out
Remarks	This VI assigns values ( <u>Source ID</u> , <u>Rec. option etc.</u> ) from <u>Input string</u> to <u>Queried Rec. tables</u> . Sub-VI for DRC?.vi. GCS 2.0: <u>Trigger option</u> is not valid.

### 2.9.4. Assign NaN for chosen axes.vi (Support.llb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, E-517, E-712, E-725, E-753, E-755, E-861, F-206, M-8X0, Mercury™. To support analog interfacing, VI must be present for E-816 also.
Input	Queried axes (empty string array), Values (empty num. array), Axes subset (empty string array), Value to set (NaN)

Output	New values
Remarks	This VI returns “NaN” or any given <u>Value to set</u> for the given axes subset.

#### 2.9.5. Assign SPA values from string to axes.vi (Support.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, Mercury™
Input	Input string (empty string), Parameter no. format (Decimal: FALSE, F), Syntax (GCS 1.0), Queried axes (empty string array), Parameter no. (empty num. array, 0), Parameter no. (hex) (empty hex. array, 0), Error in (no error)
Output	Parameter values, Parameter strings, Queried axes out, Parameter no. out, Parameter no. (hex) out, Error out
Remarks	This VI assigns numerical values / strings from input string to queried axes and parameter numbers. Sub-VI for “SPA?.vi” and “SEP?.vi”.

#### 2.9.6. Assign three values from string to axes.vi (Support.llb)

Valid for	C-702, C-843
Input	Queried axes (empty string array) Input string (empty string), Error in (no error)
Output	Values1, Strings1, Values2, Strings2, Values3, Strings3, Queried axes out, Error out
Remarks	This vi assigns three values and/or strings from input string to queried axes. Sub-VI for MVS.vi.

#### 2.9.7. Assign values from string to axes.vi (Support.llb)

Valid for	All systems
Input	System number (1), Queried axes (empty string array), All axes queried? (F), Axes related? (T), Input string (empty string), Error in (no error)
Output	Values, Strings, Error out
Remarks	This VI assigns numerical values and/or single lines from input string to queried axes. If <u>All axes?</u> is TRUE, connected axes are read from Global2.vi and displayed on the front panel for assignment. If <u>All axes?</u> is TRUE and <u>Axes related?</u> is FALSE, item names from <u>Input string</u> are displayed instead of connected axes.

#### 2.9.8. Boolean array calculations.vi (Support.llb)

Valid for	All systems
Input	Array1 (empty bool. array), Array2 (empty bool. array), Array3 (empty bool. array), Operator (AND)
Output	Array out
Remarks	This vi performs a boolean operation of up to three boolean input arrays. The difference to LabVIEWs own boolean operators is that the input arrays can have different sizes. The missing elements are considered to be FALSE elements and the resulting array contains the maximum number of elements.

**2.9.9. Build command substring.vi (Support.llb)**

Valid for	All systems
Input	Affected axes (empty string array), No. of digits (4), Parameters (empty num. array, 0), Parameters (hex.) (empty hex. array), Parameter no. format (Decimal: FALSE) (F), With space? (F)
Output	Command substring
Remarks	This VI builds a command substring by combining axis identifier and parameter. If parameter number is in decimal format, use <u>Parameters</u> input, for hexadecimal parameter numbers use <u>Parameters (hex.)</u> input and switch <u>Parameter no. format</u> to TRUE. Do not mix decimal and hex. parameter numbers in one call. <u>No. of digits</u> is the number of digits after the decimal point in the parameter value(s) that will be sent.  Example: For <u>Affected axes</u> = A; B, <u>Parameters</u> = 1.2342; 2.3 and <u>No. of digits</u> = 3 the resulting string is "SpaceA1.234SpaceB2.300".

**2.9.10. Build DIO? query command substring.vi (Support.llb)**

Valid for	C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, E-517, E-761, E-816, E-861, Mercury™
Input	System number (1), DI's to query in (empty string array), Query all DI's? (F), DI identifier? (T), Invert order for TVI? (T), Error in (no error)
Output	Command substring, DI's to query out, Number of rows, Error out
Remarks	This VI builds a DIO? query command substring. If <u>Query all DI's</u> is TRUE, available analog inputs are read using TIO? and DI identifiers are assigned using TVI? (valid identifiers are assigned to available DI's in ascending order) (GCS 1.0) or 1 to x with x being the number of available analog inputs (GCS 2.0). <u>Number of rows</u> is the size of the "DI's to query out" array. If <u>DI identifier</u> is FALSE, command substring is an empty string.

**2.9.11. Build num command substring.vi (Support.llb)**

Valid for	All systems
Input	No. of digits (4), Num 1 (empty num. array, 0), Num 2 (empty num. array, 0)
Output	Command substring
Remarks	This VI builds a command substring by combining <u>Num1</u> , Space and <u>Num2</u> . <u>No. of digits</u> is the number of digits after the decimal point in the <u>Num 1/2</u> value(s) that will be sent.  Example: For Num 1 = 1.24; 3.25456, Num 2 = 5.0; 7.4321 and No. of digits = 3 the resulting string is "Space1.240Space5.000Space3.255Space7.432"

**2.9.12. Build query command substring.vi (Support.llb)**

Valid for	All systems
Input	System number (1), Axes to query in (empty string array), Query all axes? (F), With space? (F), Axis identifier? (T),
Output	Command substring, Axes to query out, Number of rows
Remarks	This VI builds a query command substring. If <u>All axes?</u> is TRUE, connected axes are read from "Global2.vi" and returned in <u>Axes to query out</u> , otherwise <u>Axes to query out</u> is identical with <u>Axes to query in</u> . <u>Number of</u>

rows is size of the Axes to query out array. If Axis identifier? is FALSE, command substring is an empty string (e.c. for systems which accept commands like POS? without axis IDs). If With space? is TRUE or system supports GCS 2.0, a space character is added between the axes identifiers.

Example: If axes A;B;C;D are connected to the system to command, Axes to query in is A;B;D, Query all axes? is TRUE and Use Axis identifier? is TRUE, resulting Command substring is “ABCD”, Number of rows is 4 and Axes to query out is A;B;C;D. If With space? is TRUE, the resulting Command substring is “A B C D”.

#### 2.9.13. Build REL? query command substring.vi (Support.llb)

Valid for	C-880
Input	System number (1), Relays to query in (empty string array), Query all relays? (F), Relay identifier? (T), Error in (no error)
Output	Command substring, Relays to query out, Number of rows, Error out
Remarks	This VI builds a REL? query command substring. If <u>Query all relays</u> is TRUE, available relays are read using “TRC?.vi” and relay identifiers are assigned using “TVI?.vi” (valid identifiers are assigned to available relays in ascending order). <u>Number of rows</u> is size of the <u>Relays to query out</u> array. If <u>Relay identifier</u> is FALSE, <u>Command substring</u> is an empty string.  Example: If one relay board is installed in the system to command, <u>Relays to query in</u> is A;B;D, <u>Query all relays?</u> is TRUE and <u>Use Relay identifier</u> is TRUE, resulting <u>Command substring</u> is “ABCDEFGH”, <u>Number of rows</u> is 8 and <u>Relays to query out</u> is A;B;C;D;E;F;G;H.

#### 2.9.14. Build SPA command substring.vi (Support.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, E-516, E-517, E-712, E-725, E-753, E-816, E-861, Mercury™ (but must be present for E-710, E-755 and E-761 also)
Input	Axes to set (empty string array), No. of digits (4), Parameter no. format (Decimal: FALSE, F), Parameter format (Num.: FALSE, F), Parameter number (empty num. array, 0), Parameter number (hex) (empty hex. array, 0), Parameter values (empty num. array, 0), Parameter strings (empty string array), With space? (F)
Output	SPA command substring
Remarks	This VI builds a command substring for the SPA command. <u>No. of digits</u> is the number of digits after the decimal point in the parameter value(s) that will be sent. Sub-VI for “SPA.vi”, “CTO.vi”, “WTR.vi”.

#### 2.9.15. Build SPA query command substring.vi (Support.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, Mercury™
Input	Axes to query (empty string array), Parameter no. format (Decimal: FALSE, F), Syntax (GCS 1.0), Parameter number (empty num. array, 0), Parameter number (hex) (empty hex. array, 0)
Output	Command substring, Number of rows
Remarks	This VI builds an SPA? Command substring. Axes and parameters are combined into a substring, depending on <u>Parameter no. format.. Number of</u>

rows is size of Axes to query array. Sub-VI for “SPA?.vi” and “SEP?.vi” .

#### 2.9.16. Build stringplusnum substring.vi (Support.llb)

Valid for	All systems
Input	Sequence (String1String2String3Value1Value2), String1 (empty string array), String2 (empty string array), String3 (empty string array), Value1 (empty num. array, 0), Value2 (empty num. array, 0), No. of digits Value1 (6), No. of digits Value2 (6), Input selection (T,T,T,T,F), Error in (no error)
Output	Substring, Error out
Remarks	This vi builds a command substring by combining up to three strings and two values in the given order.

#### 2.9.17. Commanded axes connected?.vi (Support.llb)

Valid for	All systems
Input	System number (1), Commanded axes (empty string array), Error in (no error)
Output	Controller error (T/F), Error out
Remarks	This VI checks if <u>Commanded axes</u> are a subset of all connected axes (read from “Global2 (Array).vi”) and returns <u>Controller error</u> TRUE if this is not the case. Connected axes are defined by “Define connected axes.vi”, which is called by “XXX_Configuration_Setup.vi” automatically. White space strings in <u>Commanded axes</u> are ignored.

#### 2.9.18. Commanded stage name available?.vi (Support.llb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, E-710, E-761, Mercury™
Input	System number (1), Commanded stages (empty string array), Error in (no error)
Output	Hidden error (T/F), Error out
Remarks	This VI checks if <u>Commanded stages</u> is a subset of all available stages and returns <u>Hidden error</u> TRUE if this is not the case. Available stages are defined by “VST?.vi”.

#### 2.9.19. Convert num array to string.vi (Support.llb)

Valid for	All systems
Input	Number of digits (4), Num. values (empty num. array)
Output	Output string
Remarks	This vi converts an array of numerical values to a space separated output string. The difference to LabVIEW’s native Array to Spreadsheet String function is that no carriage return or newline is added.

#### 2.9.20. Convert num value to syntax selection.vi (Support.llb)

Valid for	All systems
Input	GCS syntax version (1,00)
Output	Syntax

**Remarks** This VI converts a numerical value to the corresponding GCS syntax version.

#### 2.9.21. Count occurrences in string.vi (Support.llb)

**Valid for** All systems

**Input** Input string (empty string), Expression (empty string)

**Output** Occurrences

**Remarks** This VI counts, how often an expression occurs in a string.

#### 2.9.22. Cut out additional spaces.vi (Support.llb)

**Valid for** All systems

**Input** Mode (All Spaces), String (empty string)

**Output** String out

**Remarks** Searches for spaces in String and cuts them out, depending on Mode.

#### 2.9.23. Define axes to command from boolean array.vi (Support.llb)

**Valid for** All systems

**Input** Axes to query (empty string array), Command axis? (empty bool. array, F)

**Output** Axes to command, Remaining axes

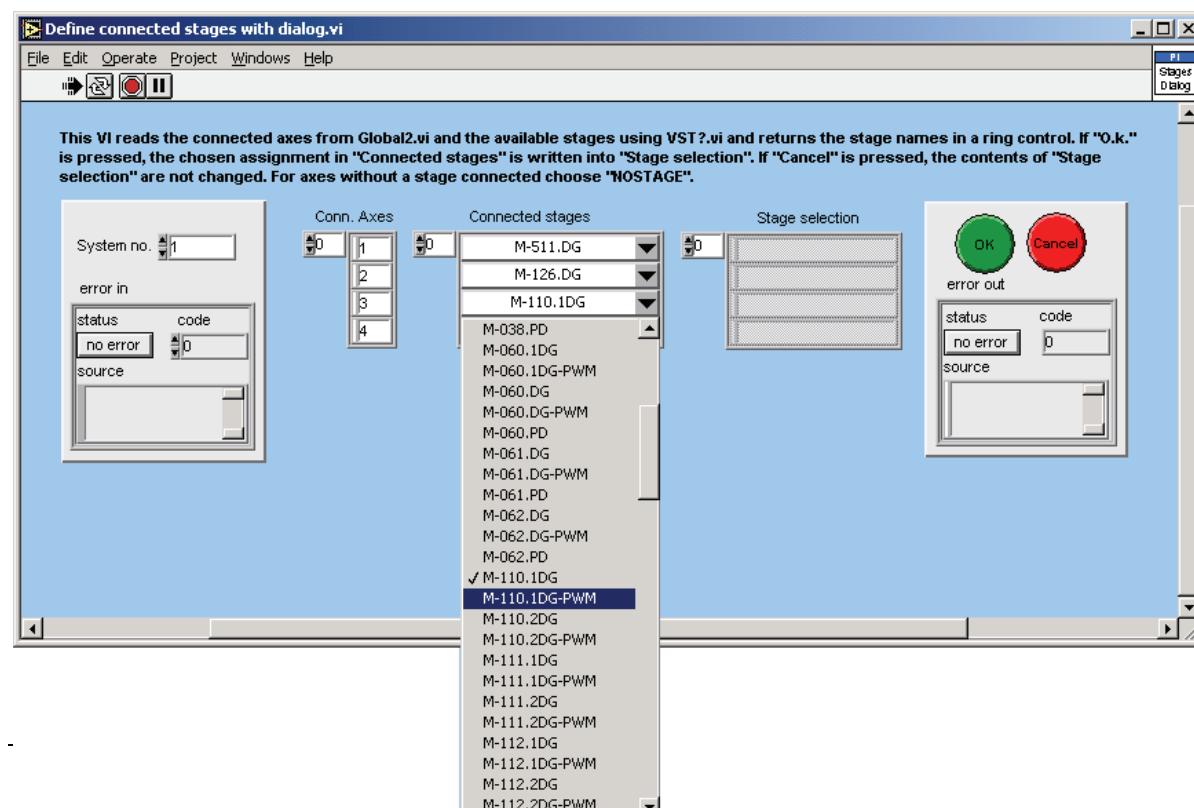
**Remarks** This VI returns only those axis IDs from the Axes to query array in the Axes to command array which have a boolean value TRUE in the Command axis? array, and all remaining axes in the Remaining axes array.

#### 2.9.24. Define connected stages with dialog.vi (Support.llb)

**Valid for** C-843, C-843.PM, C-844, C-865, C-866, Mercury™

**Input** System number (1), Error in (no error)

**Output** Stage selection, Error out



Remarks	This VI reads the connected axes from "Global2.vi" and the available stages using "VST?.vi" and returns the stage names in a ring control. <b>If there are no entries in that ring control, PIStages.dat was not found, or is marked read-only.</b> See chapter 1.1 for information about methods for proper registration of PIStages.dat. In Microsoft Explorer, right-click the file PIStages.dat and select "Properties". Make sure that the "read-only" attribute is not checked.  If <u>OK</u> is pressed, the chosen assignment in <u>Connected stages</u> is written into <u>Stage selection</u> . If <u>Cancel</u> is pressed, the contents of <u>Stage selection</u> are not changed. For axes without a stage connected, choose "NOSTAGE".
---------	--

#### 2.9.25. GCSTranslateError.vi (Support.llb)

Valid for	All systems
Input	Error in (no error)
Output	Error out, GCS Error?, Error description
Remarks	Returns if <u>error in</u> contains a GCS error code and if this is the case, it displays the corresponding error message and appends it to <u>source</u> in <u>error out</u> .

#### 2.9.26. General wait for movement to stop.vi (Support.llb)

Valid for	All systems
Input	System no. (1), Axes to wait for (empty string array), All axes? (T), Polling cycle time, ms (1), Additional wait time, ms (0), Error in (no error)  E-816: <u>All axes?</u> = FALSE, only one axis per command allowed  F-206: VI will not wait for INI procedure to complete.  M-8X0: VI will not wait for INI procedure to complete.
Output	Error out
Remarks	This VI waits for the specified axes to stop. An additional wait time can be specified. The wait method depends on the system to command. "XXX_Configuration_Setup.vi" (with XXX being the product name of your system) must be run before running this vi. Requires "Wait for axes to stop.vi", "#5.vi", "STA?.vi", "#5_old.vi", "ONT?.vi" and "Wait for hexapod system axes to stop.vi" to be present.

#### 2.9.27. Get all axes.vi (Support.llb)

Valid for	All systems
Input	System no. (1)
Output	Conn. Axes
Remarks	This VI reads all connected axes for given system from "Global2 (Array).vi". Connected axes are defined by "Define connected axes.vi", which is called by "XXX_Configuration_Setup.vi" automatically.

#### 2.9.28. Get arrays without blanks.vi (Support.llb)

Valid for	All systems
Input	String array in (empty string array), Values in (empty num. array), Booleans in (empty bool. array, F), Array size in (0)

Output	String array out, Values out, Booleans out, Array size out
Remarks	Returns the string array and related values and boolean arrays without white space string fields.

#### 2.9.29. Get lines and values from string.vi (Support.llb)

Valid for	All systems
Input	Array size (0), Input string (empty string)
Output	Numerical values, Strings
Remarks	This VI returns numerical values and single lines from input string without any axis assignment. If number of lines/values ( <u>Array size</u> ) is known, algorithm is faster, otherwise <u>Array size</u> = 0 should be used. Sub-VI for "VST?.vi" and "STE?.vi".

#### 2.9.30. Get lines from string.vi (Support.llb)

Valid for	All systems
Input	Array size (0), Input string (empty string)
Output	Strings
Remarks	This VI returns single lines from input string. If number of lines ( <u>Array size</u> ) is known, algorithm is faster, otherwise <u>Array size</u> = 0 should be used. Sub-VI for "VST?.vi".

#### 2.9.31. Get string array size without blanks.vi (Support.llb)

Valid for	All systems
Input	String array (empty string array)
Output	Corrected array size
Remarks	This VI returns the size of a string array without counting white space strings.

#### 2.9.32. How often does string contain regular expression.vi (Support.llb)

Valid for	All systems
Input	Regular expression (empty string), String (empty string)
Output	Number
Remarks	This VI returns a count of the occurrences of a regular expression in a string.

#### 2.9.33. Increase array size.vi (Support.llb)

Valid for	All systems
Input	Size (0), Array in (empty num. array, NaN), Only if Array is not empty?
Output	Array out
Remarks	If size of <u>Array in</u> is smaller than <u>Size</u> , this VI increases the size of <u>Array in</u> to <u>Size</u> . If <u>Array in</u> is an empty array and <u>Only if Array is not empty?</u> is FALSE, VI builds an array of zeros with the size of <u>Size</u> .

**2.9.34. Longlasting one-axis command.vi (Support.llb)**

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, C-880K005, E-710, E-761, F-206, Mercury™ (but must be present for E-712, E-725, and E-753 also)
Input	System number (1), Axis to command (empty string), Command (empty string), Axis and value? (F), Value (NaN), Error in (no error)
Output	Answer (T/F), Error out
Remarks	This VI sends a command (like REF, MNL or MPL), polls with #7 for controller-ready signal and returns original (boolean) command response.

**2.9.35. Manual VMO.vi (Support.llb)**

Valid for	C-844, C-848, C-848.PM, C-865, C-880, E-516, E-710, E-761, E-816, F-206, M-8X0
Input	System number (1), Axes to command (empty string array), Minimum pos. (empty num. array), Maximum pos. (empty num. array), Position values (empty num. array, 0), Error in (no error)
Output	Move possible (T/F), Error out
Remarks	Virtual movement. Indicates whether a move to the specified position is possible or not by checking if the commanded position value is within the given position range. Axes will NOT be moved.

**2.9.36. Return single characters from string.vi (Support.llb)**

Valid for	All systems
Input	Input string (empty string), Invert order (F), Error in (no error)
Output	Character array (empty string array), Error out
Remarks	Get single characters from input string.

**2.9.37. Return space.vi (Support.llb)**

Valid for	All systems
Input	System no. (1), With space? (F)
Output	String out, Space returned?
Remarks	This VI returns a space character in <u>String out</u> if <u>With space?</u> is TRUE or GCS syntax version is higher than 1.0.

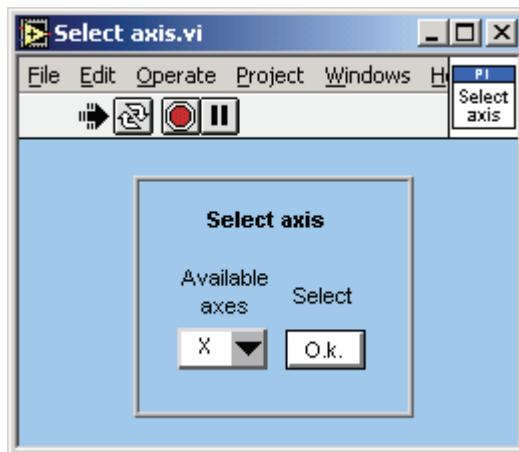
**2.9.38. Round with options.vi (Support.llb)**

Valid for	All systems
Input	No. of digits to round to (2), Round mode selection (Round to nearest), Numeric in (0), Num array in (empty num. array)
Output	Numeric out, Num array out
Remarks	Rounds <u>Numeric in</u> and <u>Num array in</u> according to <u>No. of digits to round to</u> and <u>Round mode selection</u> .

**2.9.39. Select axis.vi (Support.llb)**

Valid for	All systems
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Input	System number (1)
Output	Selected axis, Index of axis in Global2
Remarks	This VI reads all connected axes from Global2 and writes them into a menu ring control for selection. The selected axis and its index in Global2 are returned.



#### 2.9.40. Select values for chosen axes.vi (Support.llb)

Valid for	All systems
Input	Queried axes (empty string array), Values (empty num. array), Axes subset (empty string array)
Output	Values subset
Remarks	This VI returns only values for the given axes subset.

#### 2.9.41. Select with boolean array input.vi (Support.llb)

Valid for	All systems
Input	Size (0), T string (empty string), F string (empty string), T/F (empty boolean array)
Output	String array out
Remarks	This vi returns a string array of a given size with <u>T string</u> and <u>F string</u> , depending on the boolean value at the corresponding index of <u>T/F</u> .

#### 2.9.42. Selection to string array.vi (Support.llb)

Valid for	All systems
Input	Selection array (empty Menu Ring array, 0), String input (empty string array)
Output	String array
Remarks	This vi returns a string array which contains strings according to the selected value of <u>String input</u> . Example: For <u>Selection array</u> = (2,0,1) and <u>String input</u> = (A,B,C) the resulting <u>String array</u> is (C,A,B).

#### 2.9.43. Set RON and return RON status.vi (Support.llb)

Valid for	C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, E-861, Mercury™
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Input	System number (1), All axes? (F), Affected axes (empty string array), Reference mode (empty bool. Array, F), Error in (no error)
Output	Axes with RON OFF, Axes with RON ON, Error out
Remarks	Sets RON mode ON or OFF and returns which of the connected axes have RON mode ON and which have RON mode OFF.  If reference mode is OFF, no referencing is required for the axis. Only relative moves can be commanded (using "MVR.vi"), unless the actual position is set with POS.vi. Afterwards, relative and absolute moves can be commanded.  For stages with neither reference nor limit switch, reference mode is automatically OFF.
	<b>WARNING!</b> If reference mode is switched off, and relative moves are commanded, stages can be driven into the mechanical hard stop if moving to a position which is outside the travel range!
	If reference mode is switched off, and the actual position is incorrectly set with "POS.vi", stages can be driven into the mechanical hard stop when moving to a position which is thought to be within the travel range of the stage, but actually is not.

#### 2.9.44. String with ASCII code conversion.vi (Support.llb)

Valid for	All systems
Input	Input string (empty string)
Output	Output string
Remarks	Converts each ASCII control code from Input string to "\x" with x being the ASCII code of the corresponding character for better readability of log files.

#### 2.9.45. Subtract axes array subset from axes array.vi (Support.llb)

Valid for	All systems
Input	Axes to query (empty string array), Axes subset (empty string array)
Output	Axes to command, All present?
Remarks	This VI returns only these axes IDs from the <u>Axes to query</u> array which are <b>not</b> present in the <u>Axes subset</u> array. If no axes IDs are returned, <u>All present?</u> is TRUE. Needed by "Define axes to command from boolean array.vi".

#### 2.9.46. Unbundle/bundle interface clusters for PI Terminal.vi (Support.llb)

Valid for	All except analog systems
Input	System number (1), Interface configuration (RS232, 1000, COM1, 57600), DLL interface configuration (C-843, Board, 1), Flow control (All FALSE, x13, x11, x0), TCP/IP Configuration (localhost, 3000, 0), Termination character (LF)
Output	Interface, RS232 configuration system, GPIB configuration system, DLL for device, DLL interface, TCP/IP config. system, Term. char
Remarks	This VI is a sub-VI for "PI Terminal.vi". It unbundles <u>Interface configuration</u> and <u>DLL interface configuration</u> and returns the cluster contents in a different composition which is used by "PI Terminal.vi".

**2.9.47. Wait for answer 0 or 1 without polling.vi (Support.llb)**

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, C-880K005, F-206, M-8X0, Mercury™
Input	System number (1), Start time (0), Timeout (s) (60), Stop refnum (F), Local stop (F), Error in (no error)
Output	Scan successful? (T/F), Error out
Remarks	This VI waits until answer 0 or 1 comes or timeout is reached without single-character polling. VI also stops if <u>Stop refnum</u> or <u>Local stop</u> is TRUE. When using as a sub-VI, use Stop refnum to stop VI from caller.

**2.9.48. Wait for answer of longlasting command.vi (Support.llb)**

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, C-880K005, E-710, E-761, Mercury™ (but must be present for E-516, E-712, E-725, E-753, F-206 and M-8X0, too)
Input	System number (1), Stop refnum (F), Local stop (F), Error in (no error)
Output	Answer (T/F), Error out
Remarks	This VI waits for the answer of commands like REF, MPL, MNL or scanning routines using #7 polling and stops if answer has come, <u>Stop refnum</u> or <u>Local stop</u> is TRUE, or if a communications error occurred. Sub-VI for Long-lasting, one-axis commands and controller-algorithm commands. Requires "#7.vi" to be present. When using as a sub-VI, use <u>Stop refnum</u> to stop VI from caller.

**2.9.49. Wait for axes to stop.vi (Support.llb)**

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-867, C-880, E-517, E-712, E-725, E-753, E-755, E-861, Mercury™ (but must be present in Support.llb for all other systems also)
Input	System number (1), Axes to wait for (empty string array), With status bit polling? (F), Polling cycle time, ms (400), Stop refnum (F), Local stop (F), Error in (no error) C-880: <u>With status bit polling?</u> = TRUE All other systems: <u>With status bit polling?</u> = FALSE
Output	Error out
Remarks	This VI waits for the specified axes to stop using #5 polling. It also stops if a communication error occurred, <u>Stop refnum</u> or <u>Local stop</u> is TRUE. Requires "STA?.vi" to be present. Required by "General wait for movement to stop.vi". When using as a sub-VI, use <u>Stop refnum</u> to stop VI from caller.

**2.9.50. Wait for controller ready.vi (Support.llb)**

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-517, E-710, E-755, E-761, E-861, Mercury™ (but must be present for E-816 also)
Input	System number (1), Polling time, ms (50), Stop refnum (F), Local stop (F), Error in (no error)
Output	Stopped (T/F), Error out
Remarks	This VI waits for controller ready signal using #7 polling and stops also if <u>Stop refnum</u> or <u>Local stop</u> is TRUE, or if a communications error occurred. Requires "#7.vi" to be present. When using as a sub-VI, use <u>Stop refnum</u> to

stop VI from caller.

## 2.10. Wave-Generator-Specific Commands (“WaveGenerator.llb”)

### 2.10.1. #9.vi (WaveGenerator.llb)

Valid for	C-843, C-843.PM, E-516, E-517, E-710, E-712, E-725, E-753, E-761
Input	System number (1), Read WG IDs? (F), Error in (no error)
Output	WG running? (T/F), Error out
Remarks	Polls to determine whether a wave generator is running for any of the connected axes/available wave generators by sending the single ASCII character 9. Connected axes are read from Global2.vi, available wave generators are determined by calling TWG?.vi. If <u>Read WG IDs?</u> is TRUE, and axes/wave generators are displayed on the front panel for assignment. C-843: #9 polls the state of the User Profile mode.

### 2.10.2. TWG?.vi (WaveGenerator.llb)

Valid for	E-517, E-710, E-712, E-725, E-753, E-761 (but must be present for C-843 also)
Input	System number (1), Error in (no error)
Output	Number of wave generators, Error out E-517: <u>Number of wave generators</u> = 3 E-710: <u>Number of wave generators</u> = 2 E-712: <u>Number of wave generators</u> = No. of connected axes E-725: <u>Number of wave generators</u> = No. of connected axes E-753: <u>Number of wave generators</u> = 1 E-761: <u>Number of wave generators</u> = 4
Remarks	Returns the number of available wave generators.

The following VIs can be found in the "GCS\_LabVIEW\_MergeTool" folder:

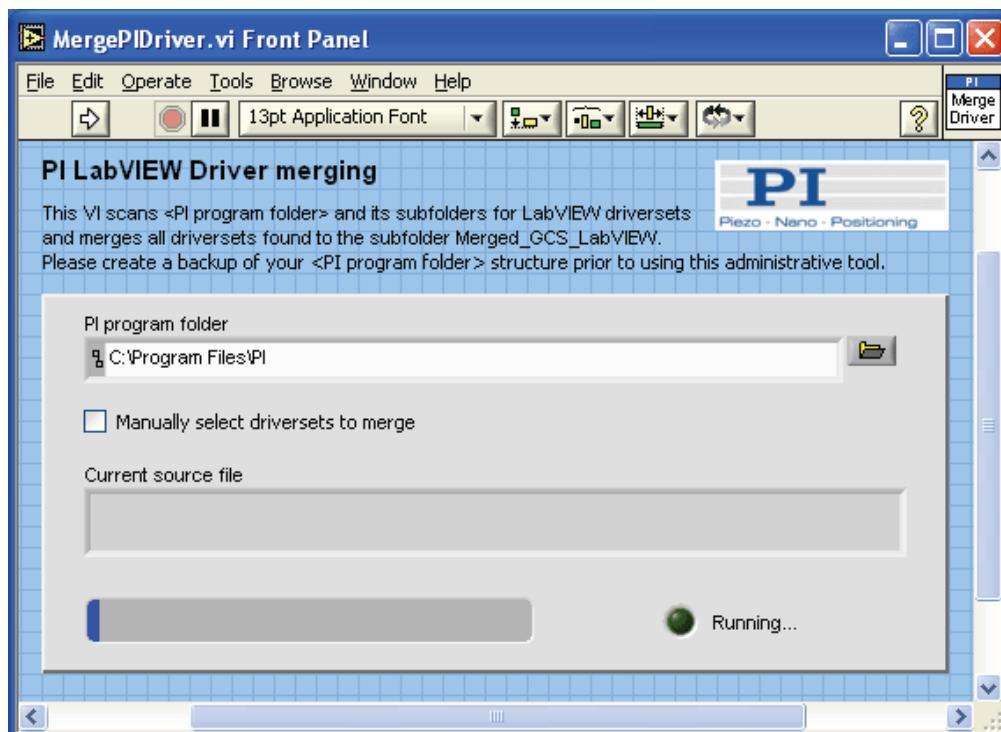
## 2.11. Merge Driverset VIs ("MergeDrivers.llb")

### 2.11.1. MergePIDriver.vi (MergeDrivers.llb)

Valid for	All systems
Input	PI program folder (C:\Program Files\PI)
Output	none
Remarks	Please create a backup of your <PI program folder> structure prior to using this administrative tool.

This VI scans the <PI program folder> and its subfolders for any LabVIEW driver sets and merges all driver sets found to the subfolder "Merged\_GCS\_LabVIEW". An optional supplemental driver set in the VI's subfolder "MergeSupport" will also be merged.

Filetypes considered are \*.vi, \*.llb and \*.dll. Files that are already present in the destination path will be overwritten only if the source version is higher than the destination version. The files in the source folders are renamed to prevent LabVIEW from accessing them. Any read-only file attribute will be reset.



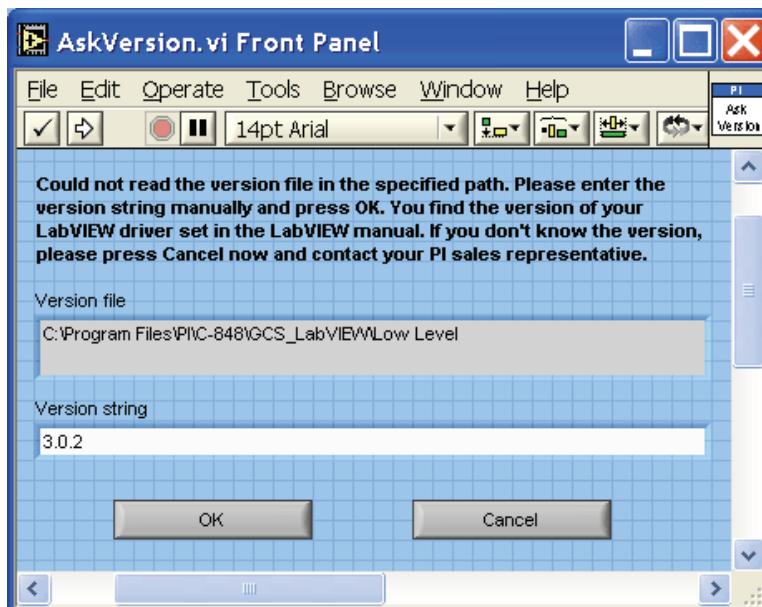
Constraints and remarks:

- The optional supplemental merge support folder must be named "MergeSupport" and be located in the "MergeDrivers.llb" folder
- "MergeDrivers.llb" does not need to be located inside the <PI program folder> structure
- The destination folder is named "Merged\_GCS\_LabVIEW" and created inside the <PI program folder>
- All Low Level folders must be named "Low Level"
- The "communication.llb" file must be present in a valid PI GCS driver

- set's Low Level folder
- File names are case insensitive
  - Customer VIs must not have the same name as any PI VI
  - The "Merged\_GCS\_LabVIEW\Low Level\merged.txt" file must not be modified outside this merge tool
  - There must not be any recursive links inside the <PI program folder> structure
  - You need write access rights for the <PI program folder> and its subfolders

#### 2.11.2. AskVersion.vi (MergeDrivers.llb)

Valid for	All systems
Input	Version.txt (empty path constant), Error in (no error)
Output	Version string, Error out
Remarks	Opens a modal dialog to ask for a version string. A "Version.txt" file is then generated in the corresponding Low Level directory.



#### 2.11.3. BuildPath.vi (MergeDrivers.llb)

Valid for	All systems
Input	Version info (Cluster of VI (empty string), Version (0), LLB (empty string) and Path (empty path)), Dest. Path (empty path)
Output	Source path, Dest. path
Remarks	Builds a VI's full path from <u>Version info</u> record.

#### 2.11.4. DeleteObsolete.vi (MergeDrivers.llb)

Valid for	All systems
Input	Dest. Version (empty array of cluster of Path (empty path), LLB (empty string), VI (empty string) and Version (0)), Error in (no error)
Output	Dest. version out, Error out (no error)

**Remarks** Deletes old VIs specified in the batch file <obsolete.txt> from merged libraries if the latest version of all merged driver sets is newer than the version specified in the file.

#### 2.11.5. FileOperation.vi (MergeDrivers.llb)

**Valid for** All systems  
**Input** Source path (empty path), Destination path (empty path), Error in (no error)  
**Output** Error out  
**Remarks** Resets read only attributes. Deletes a single file if destination path is not empty. Moves a single file if destination path and source path are not empty.

#### 2.11.6. FindVIs.vi (MergeDrivers.llb)

**Valid for** All systems  
**Input** Highlevel paths (array of path (empty path)), error in (no error)  
**Output** Source versions, Array of cluster of (Path, LLB, VI, Version)  
**Remarks** Scans the Highlevel paths folders and their "Low Level" folders for VIs, VIs in LLBs and DLLs and adds them to the Source Versions array. Duplicate entries of same VIs in the array are reduced to the latest one only.

#### 2.11.7. GetHighlevelFolders.vi (MergeDrivers.llb)

**Valid for** All systems  
**Input** PI folder (empty path), error in (no error)  
**Output** Highlevel paths, Error out  
**Remarks** Scans PI folder and all subfolders for the essential "Communication.llb" PI driver library. If found, the appropriate Highlevel path is added to the Highlevel paths array. Creates subfolder "Merged\_GCS\_LabVIEW"

#### 2.11.8. GetVersion.vi (MergeDrivers.llb)

**Valid for** All systems  
**Input** Highlevel path (empty path), Error in (no error)  
**Output** Version, Error out  
**Remarks** Opens the "Highlevel path\Low Level\Version.txt" file and searches for the line starting with (case insensitive) "VERSION". The following string is converted to a double constant Version, see "VersionString.vi". If file or "Version" is not found, a dialog window pops up. See "AskVersion.vi".

#### 2.11.9. MergeFiles.vi (MergeDrivers.llb)

**Valid for** All systems  
**Input** Dest. path (empty path), Source versions (empty array of cluster of Path (empty path), LLB (empty string), VI (empty string) and Version (0)), Dest. versions (empty array of cluster of Path (empty path), LLB (empty string), VI (empty string) and Version (0)), Source VI refnum (empty refnumber), Percent done (empty refnumber), Error in (no error)  
**Output** # of merged files, Dest. versions out, Error out

**Remarks** Copies all files in Source versions to the appropriate destination folder.  
Updates or adds an entry to the Dest versions array.

#### 2.11.10. RemoveOlderVIs.vi (MergeDrivers.llb)

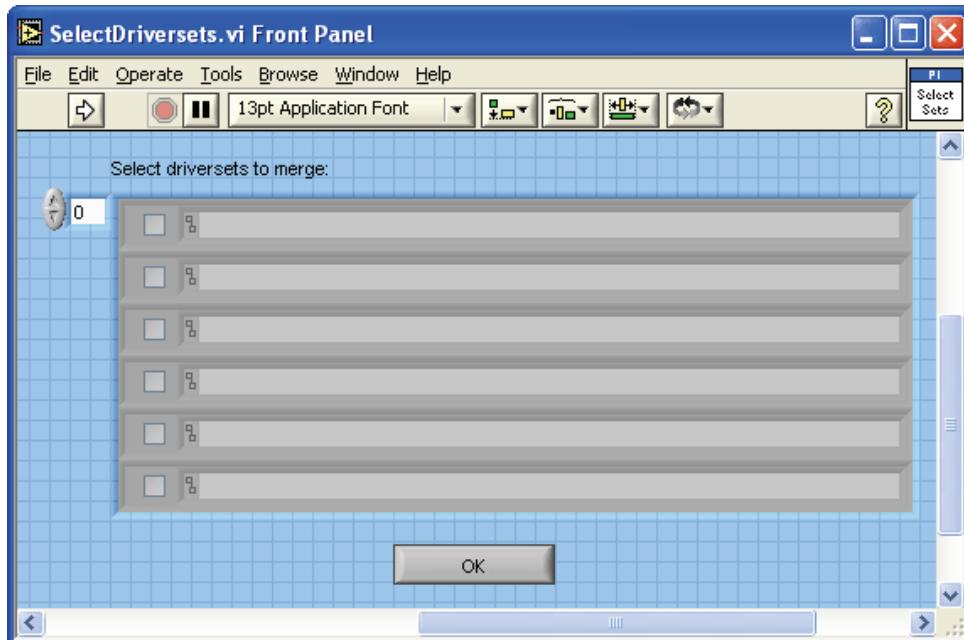
**Valid for** All systems  
**Input** Source versions (empty array or cluster of Path (empty path), LLB (empty string), VI (empty string) and Version (0)), Dest. versions (empty array of cluster of Path (empty path), LLB (empty string), VI (empty string) and Version (0)), Error in (no error)  
**Output** Source versions out, Error out (no error)  
**Remarks** Reduces the Source versions array. Entry is removed if  
 1. Source is not newer than destination, or  
 2. Analog "dummy" VI would overwrite a functional VI, or  
 3. Source is merge support supplement and destination nonexistent

#### 2.11.11. Rename.vi (MergeDrivers.llb)

**Valid for** All systems  
**Input** Highlevel paths (empty path array), Error in (no error)  
**Output** Error out (no error)  
**Remarks** Renames all files \*.vi, \*.llb, \*.dll in the Highlevel paths and their "Low Level" subfolders to \*.v\_, \*.ll\_ or \*.dl\_ to prevent LabVIEW from accessing them.

#### 2.11.12. SelectDriversets.vi (MergeDrivers.llb)

**Valid for** All systems  
**Input** Highlevel paths (empty path array), Error in (no error)  
**Output** Highlevel paths out, Error out (no error)  
**Remarks** Lets the user select driver sets to merge interactively.



**2.11.13. SetAttributes.vi (MergeDrivers.llb)**

Valid for All systems  
Input Path (empty path), Error in (no error)  
Output Error out (no error)  
Remarks Resets read only file attributes of all files in Path recursively.

**2.11.14. VersionInfo\_Load.vi (MergeDrivers.llb)**

Valid for All systems  
Input Dest. Path (empty path), Error in (no error)  
Output Dest. versions, Error out (no error)  
Remarks Loads the version information of VIs in Dest Path from the "Low Level\merged.txt" file.

**2.11.15. VersionInfo\_Save.vi (MergeDrivers.llb)**

Valid for All systems  
Input Dest. Path (empty path), Dest. versions (empty array of cluster of Path (empty path), LLB (empty string), VI (empty string) and Version (0)), Error in (no error)  
Output Error out (no error)  
Remarks Saves the version information of all merged VIs in Dest. path to the "Low Level\merged.txt" file, also if there is an incoming error.

**2.11.16. VersionString.vi (MergeDrivers.llb)**

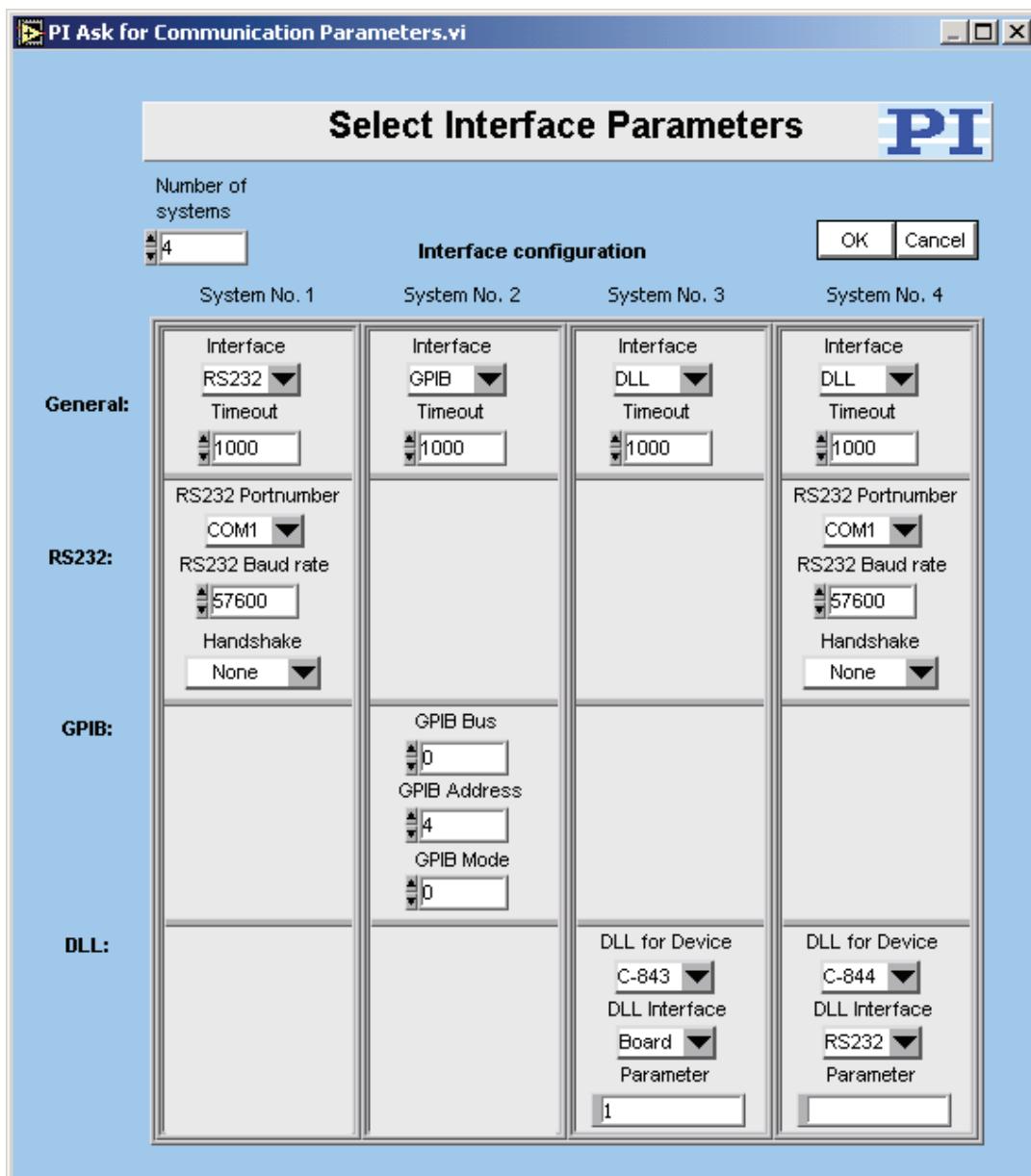
Valid for All systems  
Input Version string (empty string)  
Output Version  
Remarks Converts a PI version string to a double constant. Only the 5 most significant digits in the string are considered. Digit separator is the decimal point character. Decimal point is optional, i.e. every single character is treated as a significant digit (1.29 is the same as 1.2.9). Only alphanumeric characters '0-9' and 'A-I' are evaluated, all others are omitted. Case does not matter. "Beta" decreases double by 0.5. First digit can be 0-99.  
Sample version string: 3.1.4a, 3.1.4(a), 2.8beta, 1.29  
Illegal version string: 1.2.3.456 consists of 6 digits

### 3. High Level VIs

#### 3.1. PI Terminal.vi

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

After starting the VI, the interface parameters of the systems with which to communicate must be selected. For this reason, "PITerminal.vi" calls "PI Ask for Communication Parameters.vi". Select here the number of connected PI systems that you want to communicate with. For each system, select the appropriate interface parameters.



- C-702: Interface = RS232 or TCP/IP, RS232: Input and output HW handshake must be TRUE. Syntax: GCS 1.0; Term char = LF.
- C-843: Interface = DLL, DLL for Device = C-843, DLL Interface = Board, Parameter = Board number (1 for first C-843 board). Syntax: GCS 1.0; Term char = LF.
- C-843.PM: Interface = DLL, DLL for Device = C-843.PM, DLL Interface = Board, Parameter = Board number (1 for first C-843 board). Syntax: GCS 1.0; Term char = LF.
- C-844: Interface = DLL, DLL for Device = C-844, DLL Interface = RS232 or GPIB, Parameter = empty string, RS232 baud rate = 9600. Syntax: GCS 1.0; Term char = LF.
- C-865: Interface = DLL, DLL for Device = C-865, DLL Interface = RS232, Parameter = empty string, RS232 baud rate = set as appropriate. Syntax: GCS 1.0; Term char = LF.
- C-866: Interface = DLL, DLL for Device = C-866, DLL Interface = RS232 or USB, RS232: Parameter = empty string, RS232 baud rate = set as appropriate, USB: Parameter = Serial no. of system to connect to, Syntax: GCS 1.0; Term char = LF.
- C-867: Single Device: Interface = RS232 or DLL, RS232: Input and output HW handshake must be FALSE. DLL (USB): DLL for Device = C-867, DLL Interface = USB, Parameter = Serial no. of system to connect to.  
DaisyChain: Interface = DLL, DLL for Device = C-867, DLL Interface = RS232\_DC, Parameter = Number of device in chain, Register DC: FALSE. Syntax: GCS 2.0; Term char = LF.
- C-880, C-848: Interface = RS232 or GPIB, RS232: Input and output HW handshake must be TRUE. Syntax: GCS 1.0; Term char = LF.
- C-880K005: Interface = RS232, Input and output HW handshake must be FALSE. Syntax: GCS 1.0; Term char = LF.
- E-516: Interface = RS232 or GPIB, RS232: Input and output HW handshake must be TRUE. Syntax: GCS 1.0; Term char = LF.
- E-517: Interface = RS232, GPIB, TCP/IP or DLL, RS232: Input and output HW handshake must be TRUE, DLL (USB): DLL for Device = E-517, DLL Interface = USB, Parameter = Serial no. of system to connect to. Syntax: GCS 2.0; Term char = LF.
- E-710: Interface = DLL, DLL for Device = E-710, DLL Interface = RS232 or GPIB, Parameter = empty string. Syntax: GCS 1.0; Term char = LF.
- E-712: Interface = RS232, TCP/IP or DLL, RS232: Input and output HW handshake must be TRUE. DLL: DLL for Device = E-712, DLL Interface = USB, Parameter = Serial no. of system to connect to. Syntax: GCS 2.0; Term char = LF.
- E-725: Interface = RS232, TCP/IP or DLL, RS232: Input and output HW handshake must be TRUE. DLL: DLL for Device = E-725, DLL Interface = USB, Parameter = Serial no. of system to connect to. Syntax: GCS 2.0; Term char = LF.
- E-753: Interface = RS232 or TCP/IP, RS232: Input and output HW handshake must be TRUE. Syntax: GCS 2.0; Term char = LF.
- E-755: Single Device: Interface = RS232, Input and output HW handshake must be TRUE. DaisyChain: Interface = DLL, DLL for Device = E-755, DLL Interface = RS232\_DC, Parameter = Number of device in chain (first device: 1). Syntax: GCS 2.0; Term char = LF.

- E-761: Interface = DLL, DLL for Device = E-761, DLL Interface = Board, Parameter = Board number (1 for first E-761 board). Syntax: GCS 1.0; Term char = LF.
- E-816: Interface = RS232 or DLL, RS232: Input and output HW handshake must be TRUE. DLL (USB): DLL for Device = E-816, DLL Interface = USB, Parameter = Serial no. of system to connect to. Syntax: GCS 1.0; Term char = LF.
- E-861: Single Device: Interface = RS232 or DLL, RS232: Input and output HW handshake must be FALSE. DLL (USB): DLL for Device = E-861, DLL Interface = USB, Parameter = Serial no. of system to connect to. DaisyChain: Interface = DLL, DLL for Device = E-861, DLL Interface = RS232\_DC, Parameter = Number of device in chain (first device: 1), Register DC: FALSE. Syntax: GCS 2.0; Term char = LF.
- F-206: Interface = RS232, GPIB or TCP/IP, The error status will not be cleared by this VI. The first ERR? query will report a hidden error with error code 1, which will be cleared during system initialization (INI). RS232: Input and output handshake settings must be FALSE. Syntax: GCS 1.0; Term char = LF.
- M-8X0: Interface = RS232, GPIB or TCP/IP. RS232: Input and output handshake settings must be FALSE. Syntax: GCS 1.0; Term char = LF.
- Mercury™: Interface = DLL, DLL for Device = Mercury™, DLL Interface = RS232 (even if using USB), Parameter = empty string, RS232 baud rate = same as set on controller hardware, Syntax: GCS 1.0; Term char = LF.

If the chosen timeout value is greater than 300 ms, it will automatically be set to 300 ms for a fluid program operation.

In the upper window ("Send") the user can enter commands which will be transmitted to the chosen device one line at a time when the ENTER key is pressed.

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

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

Exit or F10 will terminate the terminal application.

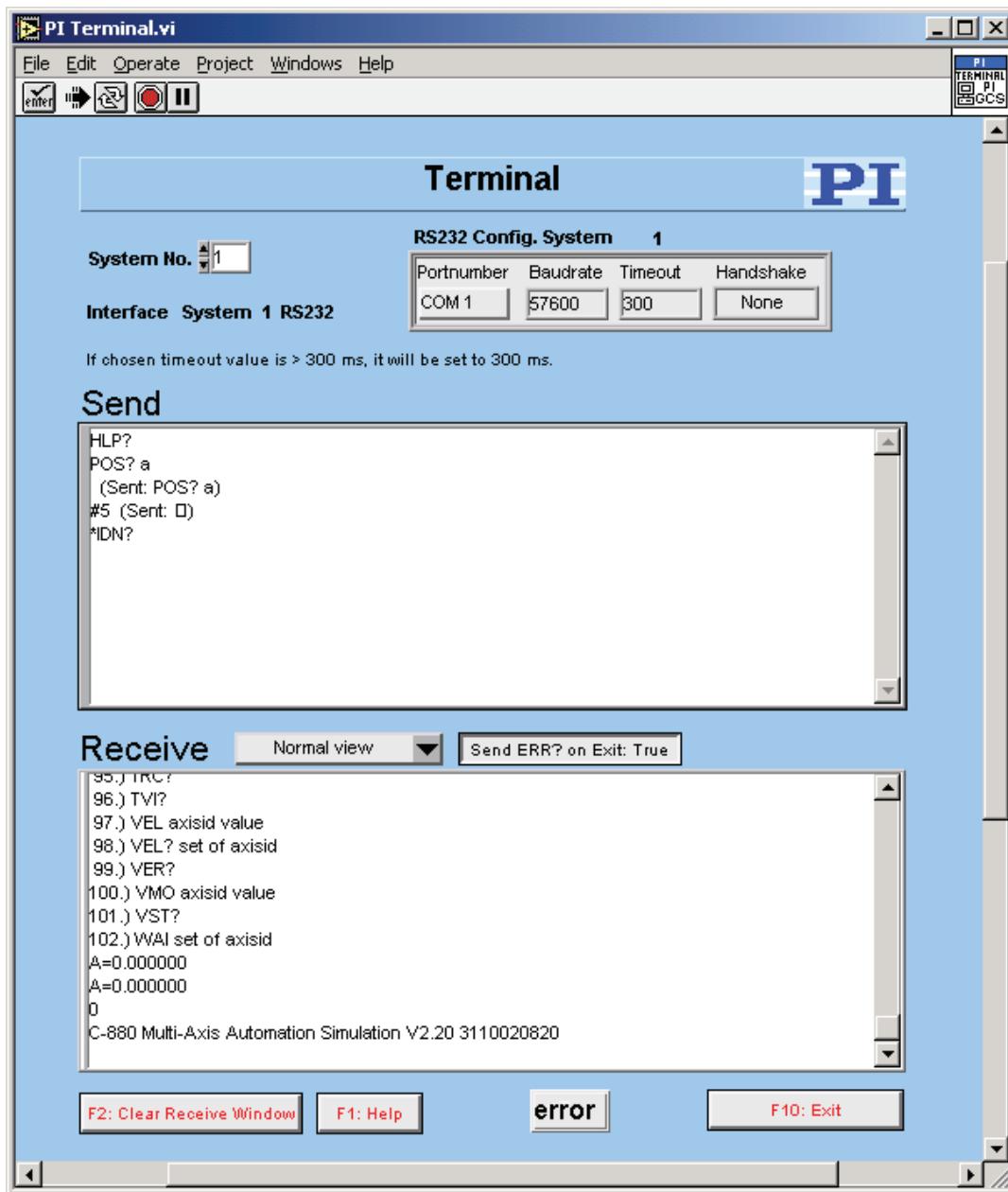
To send the last command again, just press the ENTER key again. The next line will then show the following entry: "(Send: cmd)" with cmd being the command from the line before, which was resent.

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

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

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

"#24" and presses ENTER to stop a fast scan. An entry "(Send: \*)" will be added to the original command with \* being the corresponding ASCII character of the single byte sent.



Pressing F1 or the Help button will pop up a help window. To return to the terminal application, press Esc. If Send ERR? on Exit? is TRUE, an "ERR?" query is sent to the device when Exit is pressed to prevent the controller from keeping an error condition produced during the use of the terminal application.

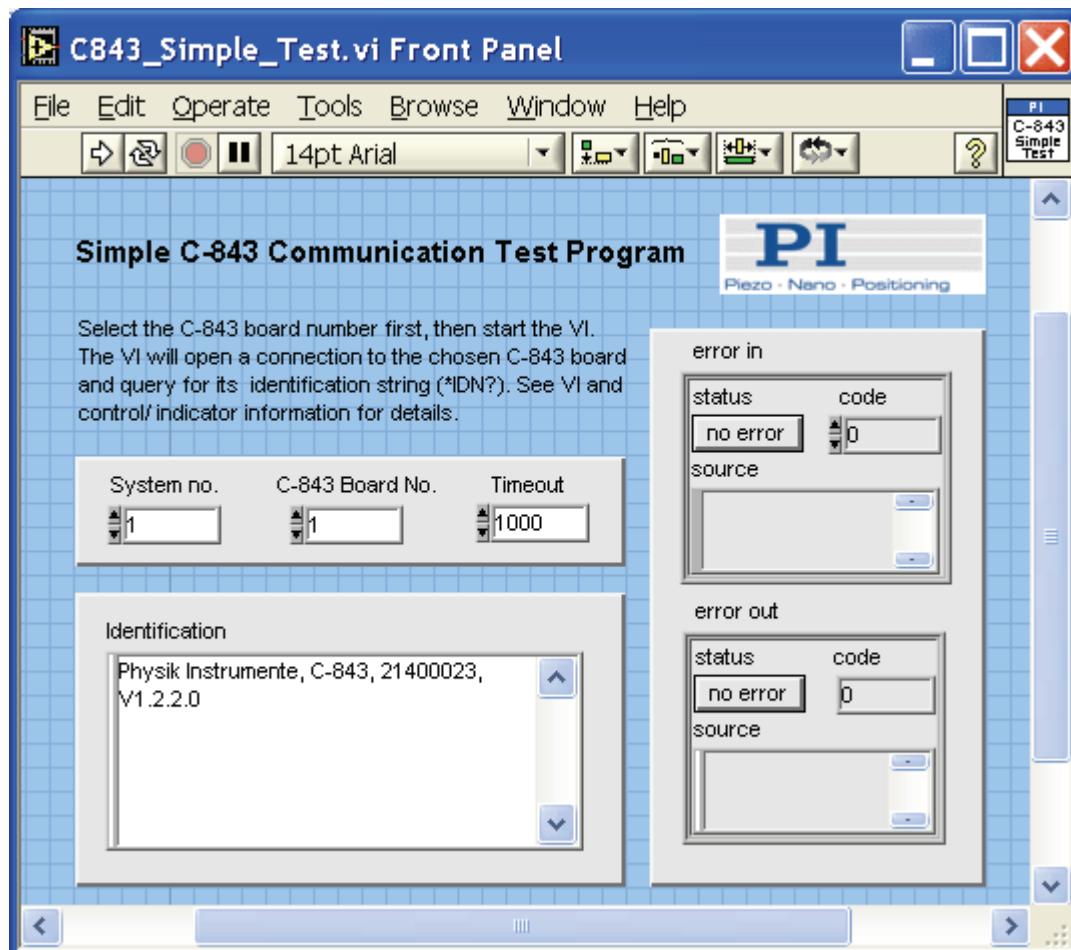
### 3.2. C843\_Simple\_Test.vi

This simple test VI is a stand-alone sample application. Use the *Help→Show Context Help* menu sequence in the LabVIEW environment to display the *Context Help* window with the VI and control/indicator descriptions.

Specify

- System number (= 1 in a one-system configuration),
- C-843 board number: must match the board ID (= 1 for only one C-843 board, the default).
- Timeout value (in milliseconds)

Then start the VI. The VI will open a connection to the chosen C-843 board, and query the board for its identification string. The diagram shows how to combine the driver and support VIs for these tasks.

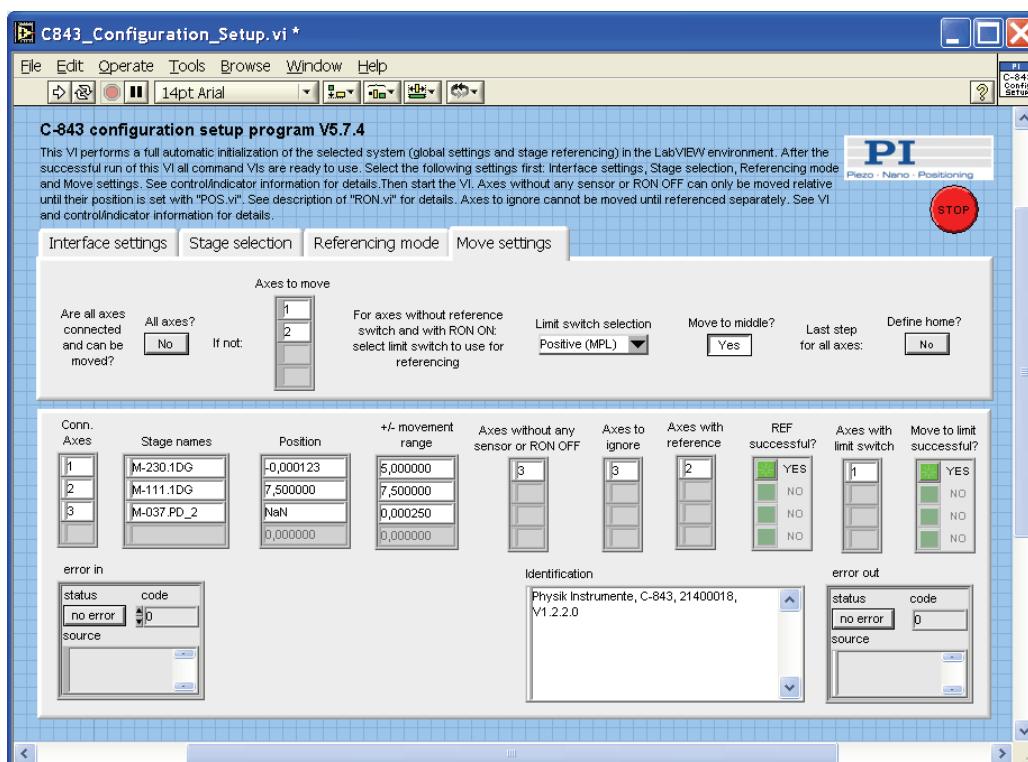


### 3.3. C843\_Configuration\_Setup.vi

This VI performs a fully automatic initialization of the selected system (global settings and stage referencing) in the LabVIEW environment. Use the *Help→Show Context Help* menu sequence in the LabVIEW environment to display the *Context Help* window with the VI and control/indicator descriptions.

After the successful run of this VI, all command VIs are ready to use. Specify the correct parameters first:

- C-843 version: TRUE, for C-843 4-axis version, FALSE, for C-843 2-axis version.
- Board No.: must match the board ID (= 1 for only one C-843 board, the default).
- System No.: 1 in a one-system-only configuration.
- Reference mode (only if needed, see description of RON.vi for details and warnings)
- "Use dialog to define connected stages": if Yes, you can select the connected stages after starting the VI. If No, the dialog allowing stage selection will not appear and you must type the correct stage names into "Stage names input". For axes without a stage connected, choose "NOSTAGE".
- Whether or not all axes are connected and can be moved (depends on mechanical setup).
- If not, which axes can be moved.
- Which limit switch to use for referencing axes that are to be referenced but have no reference switch.
- If all axes are to be moved to the middle position of their travel range.
- Whether the final position should be set as home position.



Then start the VI.

"C843\_Configuration\_Setup.vi" performs the following initialization tasks:

1. Runs "PI Open Interface of one system.vi" to open a connection to the board.
2. Runs "\*IDN?.vi" to query for the controller identification string.
3. Defines the selected system to be "C-843".
4. Runs "Define connected axes.vi" with Read from controller = FALSE and Connected axes = 1,2,3,4 (or 1,2 for the 2-channel version).
5. Runs "CST.vi" to determine which stages are connected to the four/two channels of the C-843 board, according to your selection.
6. Runs "Define connected axes.vi" with Read from controller = TRUE. Axes with "NOSTAGE" as stage name will not appear as connected axes.
7. Runs "CST?.vi" to query for the connected stages (axes with NOSTAGE will not appear as connected stages).
8. Runs "INI.vi"
9. Sets the reference mode for the axes specified in RON Affected axes according to the value in Reference mode (Reference mode tab).
10. Reads which axes have reference mode OFF.
11. Determines which of the remaining axes have a reference switch (REF?).
12. Moves those axes to the reference position (REF).
13. Reads which of the remaining axes have a limit switch.
14. Moves them to the positive or negative limit position (MPL/MNL) as specified.
15. Reads the position range (TMN?, TMX?).
16. If Move to middle? is TRUE, moves each axis which has been referenced or moved to a limit switch to the middle position of its range (MOV).
17. Waits for motion to stop
18. Defines home (if so specified).
19. Runs "POS?.vi" to query for the position of all axes.
20. Runs "ERR?.vi" to query the controller for its error status.
21. Runs "GCSTranslateError.vi" to append the error message which corresponds with a GCS error number returned by "ERR?.vi" to Source from Error out.

If "Use dialog to define connected stages" is TRUE, the VI reads the available stages from PIStages.dat (by querying with "VST?.vi") and returns the stage names in a ring control. **If there are no entries in that ring control, PIStages.dat was not found, or is marked read-only.** See chapter 1.1 for information about methods for proper registration of PIStages.dat. In Microsoft Explorer, right-click the file PIStages.dat and select "Properties". Make sure that the "read-only" attribute is not checked.

Axes with referencing mode OFF, whose referencing was not successful, or designated "to ignore", report NaN as position value. Axes without any sensor or with RON OFF can only be moved relative until their position is set with "POS.vi". See description of "RON.vi" for details. Axes "to ignore" cannot be moved until referenced separately.

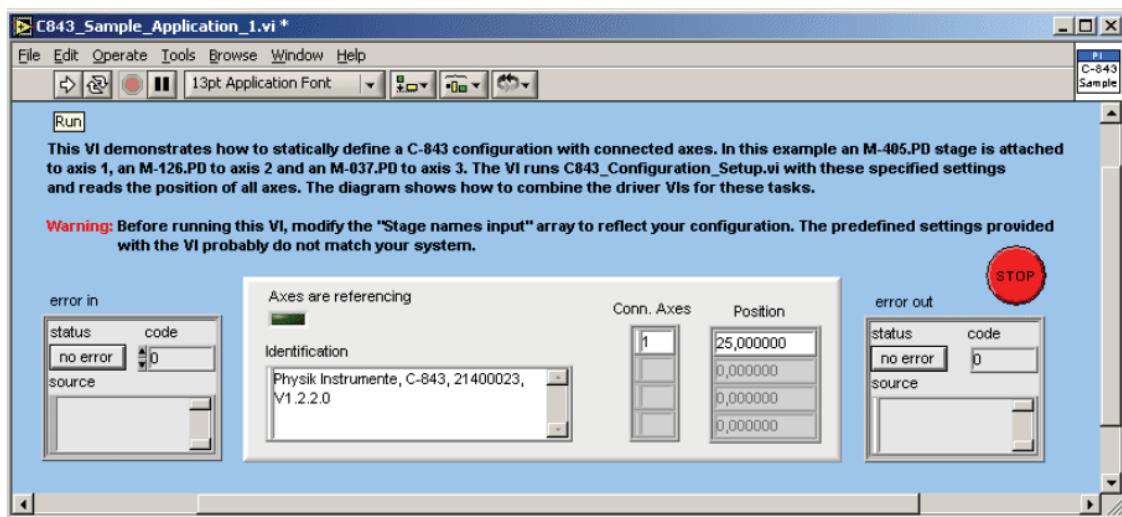
Use this VI as the initialization VI for the C-843 in your application.

As the initialization is a complex procedure which uses a large number of sub-VIs, C843\_Configuration\_Setup.vi is password-protected, meaning that you cannot see or modify the diagram. In this way, the full initialization is packed into one single and fully tested procedure which you simply insert into your own application program. For security reasons as well as your convenience, we recommend that you not modify this VI.

### 3.4. C843\_Sample\_Application\_1.vi

This VI demonstrates how to statically define a C-843 configuration with connected axes. In this example an M-405.PD stage is attached to axis 1, an M-126.PD to axis 2 and an M-037.PD to axis 3. The VI runs C843\_Configuration\_Setup.vi with these specified settings and reads the position of all axes. The diagram shows how to combine the driver VIs for these tasks.

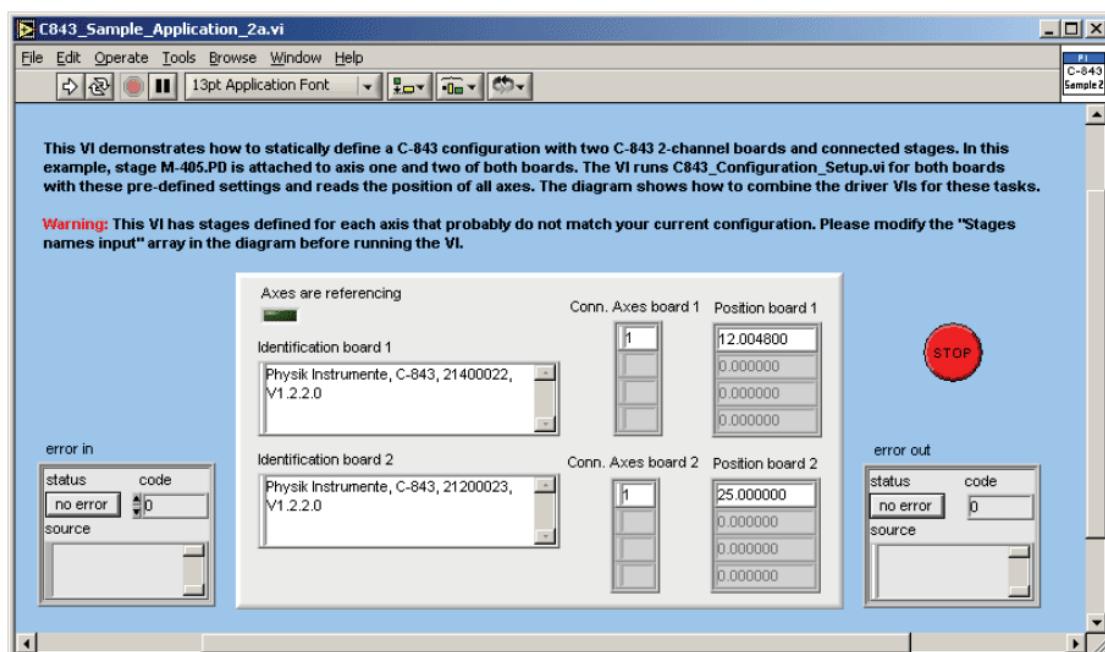
**Warning:** Before running this VI, modify the "Stage names input" array to reflect your configuration. The predefined settings provided with the VI probably do not match your system.



### 3.5. C843\_Sample\_Application\_2a.vi

This VI demonstrates how to statically define a C-843 configuration with two C-843 2-channel boards and connected stages. In this example, stage M-405.PD is attached to axis one and two of both boards. The VI runs C843\_Configuration\_Setup.vi for both boards with these pre-defined settings and reads the position of all axes. The diagram shows how to combine the driver VIs for these tasks.

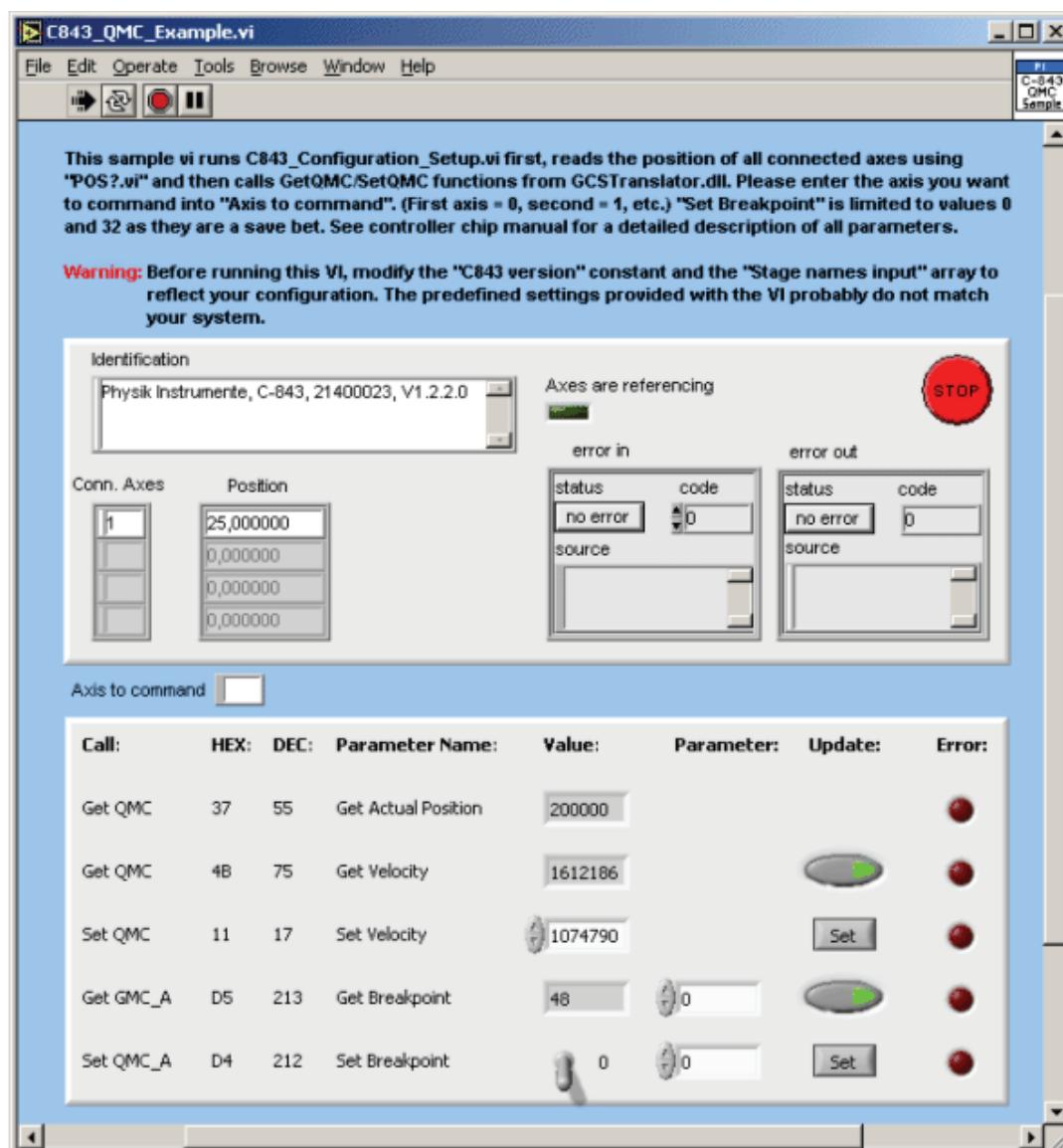
**Warning:** This VI has stages defined for each axis that probably do not match your current configuration. Please modify the "Stages names input" array in the diagram before running the VI.



### 3.6. C843\_QMC\_Example.vi

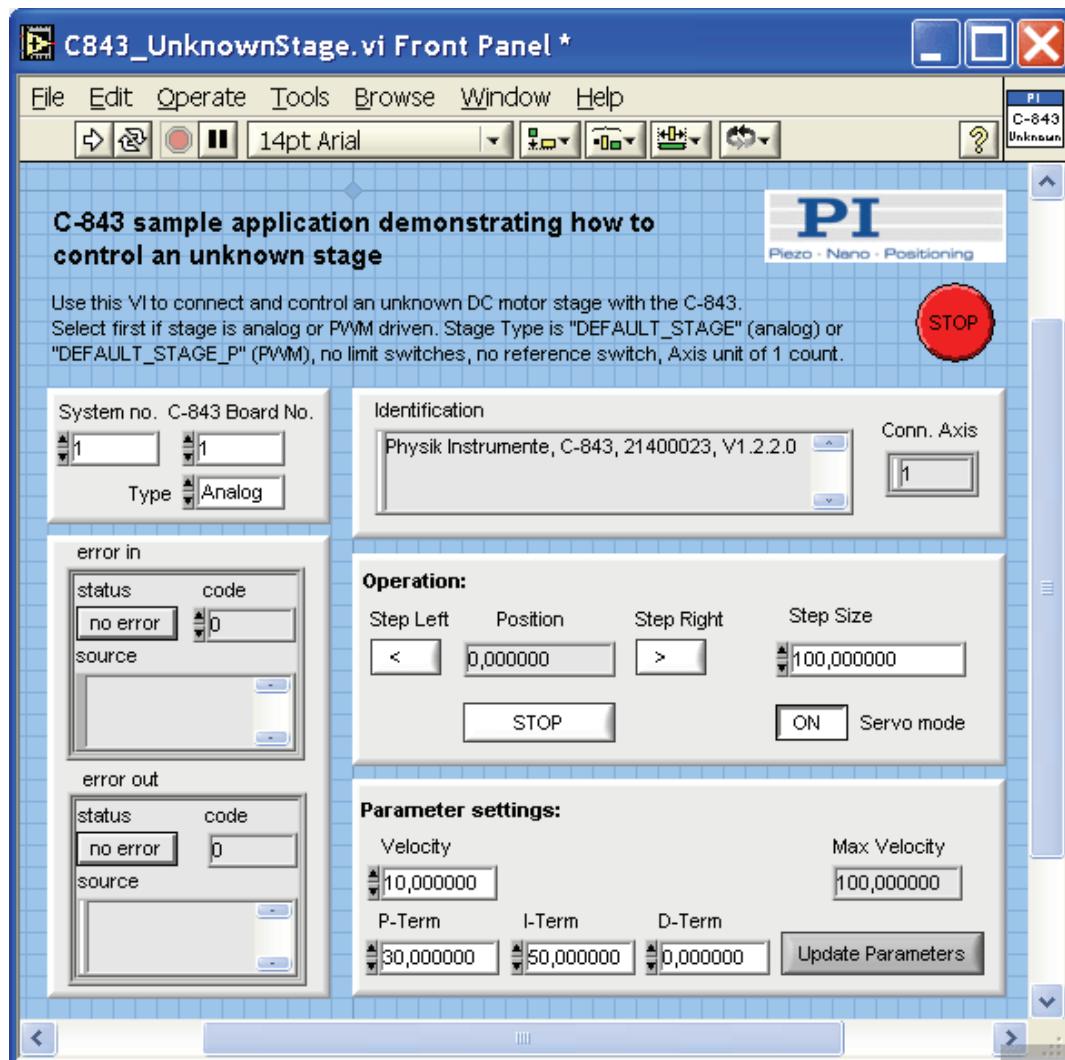
This sample vi runs C843\_Configuration\_Setup.vi first, reads the position of all connected axes using "POS?.vi" and then calls GetQMC/SetQMC functions from GCSTranslator.dll. Please enter the axis you want to command into Axis to command. (First axis = 1, second = 2, etc.) Set Breakpoint is limited to values 0 and 32 as they are a save bet. See controller chip manual for a detailed description of all parameters. The diagram shows how to combine the driver VIs for these tasks.

**Warning:** Before running this VI, modify the "C843 version" constant and the "Stage names input" array to reflect your configuration. The predefined settings provided with the VI probably do not match your system.



### 3.7. C843\_UnknownStage.vi

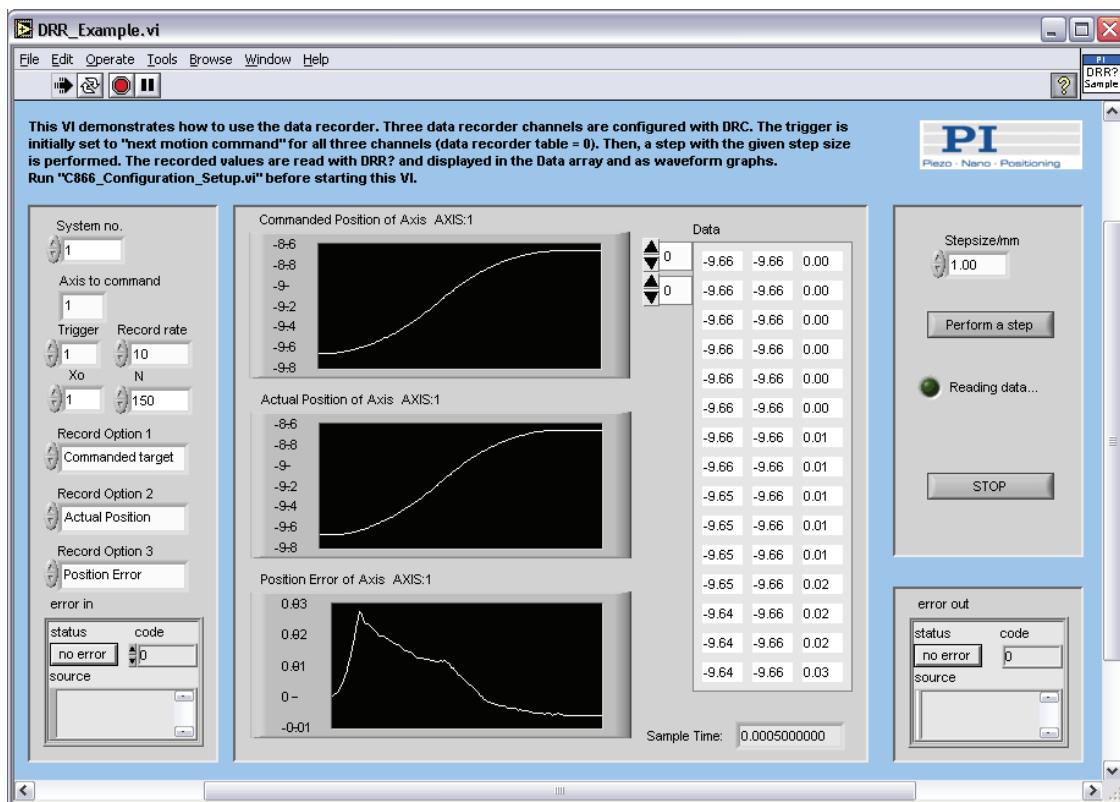
Use this VI to connect and control an unknown DC motor stage with the C-843. Select first if the connected stage is analog or PWM driven. The VI runs "C843\_Configuration\_Setup.vi" without moving any axis. It defines axis 1 to be "DEFAULT\_STAGE" (analog) or "DEFAULT\_STAGE\_P" (PWM), which corresponds to no limit switches, no reference switch, and a position unit of 1 count. It reads the current velocity, the maximum allowed velocity, and the PID values of this stage type and sets the servo state to ON. Then it runs in a loop, reading the current position value, and giving the user the possibility to make relative moves in forward or backward direction, or to set velocity and PID values. Pressing the STOP button will send a STP command to the board, set the servo state to OFF and stop the VI.



### 3.8. DRR\_Example.vi

This VI demonstrates how to use the data recorder. The VI configures three data recorder tables with DRC. The trigger is initially set to "next motion command" for all three tables (data recorder table = 0). Then, a step with the given step size is performed. The recorded values are read with DRR? and displayed in the Data array and as a graph.

Run "XXX\_Configuration\_Setup.vi" (with XXX being the PI product number of your system) before starting this VI.



Valid for	C-843, C-866
Input	System 1(1), Axis to command (1), Trigger (1), Sample interval (10), Xo (1), N (500), Record Option 1 (Commanded target), Record Option 2 (Actual Position), Record Option 3 (Position Error), Stepsize/mm (1,00), (Error in (no error))
Output	Data, Sample time, Error out
Remarks	none

### 3.9. Joystick Operation.vi

This VI can be used to control 2 closed-loop axes (which can belong to one or two connected systems) with a standard 2-button, 2-axis joystick connected to the game port of the host computer. The absolute value of the joystick position is converted into velocity values for the two stages connected to the system being commanded. Two velocity levels for each axis can be specified, e.g. one for fast, rough positioning and one for slow, fine positioning. Joystick button 2 switches between these levels. The sign of the joystick position determines whether the move command issued contains the positive or negative travel limit (read automatically if Read travel range from controller? is TRUE) of the corresponding axis. When the joystick is “in the middle position”, the velocity of the corresponding axis is set to zero.

Dead band \* is the maximum size of the scaled joystick position value that does not result in any motion.

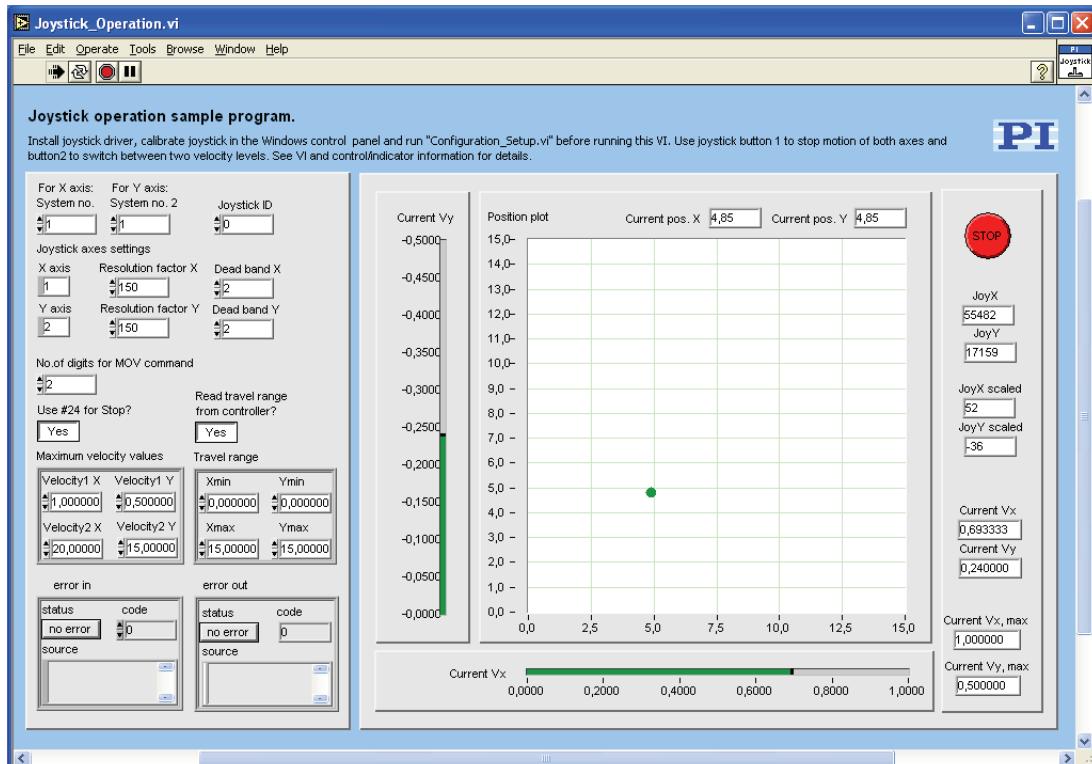
Resolution factor \* determines the joystick resolution.

No. of digits is the number of digits after the decimal point in the position values that will be sent by the MOV command.

If joystick button 1 is pressed, a stop command (STP or #24, depending on Use 24 for stop, is sent to the controller. The diagram shows how to combine the driver and support VIs for these tasks.

If only one motion axis is to be controlled, Y Axis must be identical to X Axis, System no. 2 must be identical to System no. 1, and Y axis of joystick is to be used for control of the motion axis.

**Important:** Install joystick driver and calibrate joystick in the Windows Control Panel before running this VI.



Valid for C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, E-517, E-710, E-712, E-725, E-753, E-755, E-761, E-861

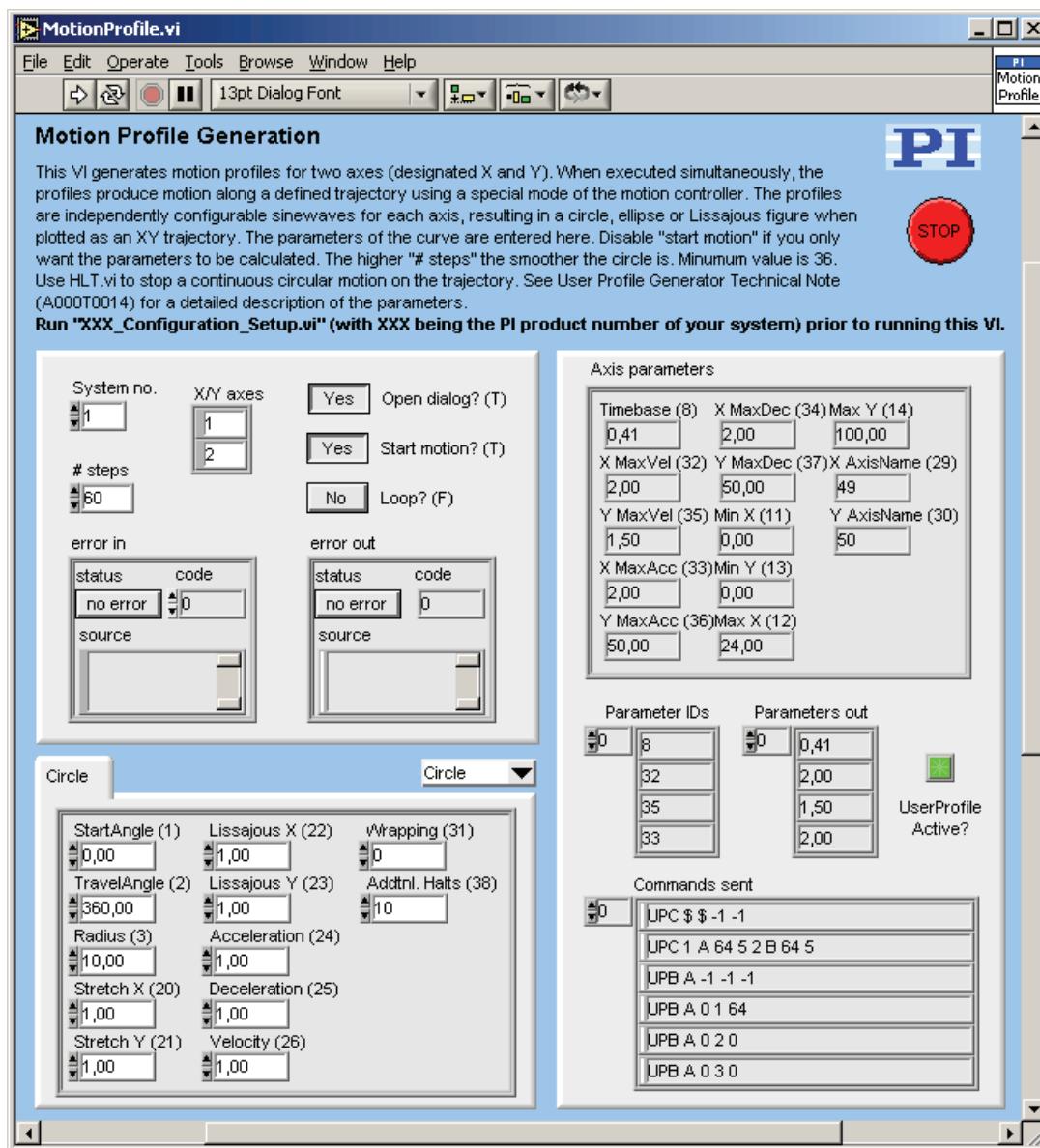
Input	System number (1), System no. 2 (1), Joystick ID (0), X axis (empty string), Y axis (empty string), Resolution factor X (150), Resolution factor Y (150), Dead band X (2), Dead band Y (2), No. of digits (2), Use #24 for stop (TRUE), Read from controller (T), Maximum velocity values (2, 20, 0.5, 15), Travel range (0, 10, 0, 5), Error in (no error)
C-702:	<u>Use #24 for stop = TRUE, Read from controller = TRUE</u> Run "C702_Configuration_Setup.vi" prior to running this VI.
C-843:	<u>Use #24 for stop = TRUE, Read from controller = TRUE;</u> Run "C843_Configuration_Setup.vi" prior to running this VI.
C-843.PM:	<u>Use #24 for stop = TRUE, Read from controller = TRUE;</u> Run "C843_PM_Configuration_Setup.vi" prior to running this VI.
C-844:	<u>Use #24 for stop = TRUE, Read from controller = TRUE</u> Run "C844_Configuration_Setup.vi" prior to running this VI.
C-848:	<u>Use #24 for stop = TRUE, Read from controller = TRUE</u> Run "C848_Configuration_Setup.vi" prior to running this VI.
C-865:	<u>Use #24 for stop = TRUE, Read from controller = TRUE;</u> Run "C865_Configuration_Setup.vi" prior to running this VI.
C-866:	<u>Use #24 for stop = TRUE, Read from controller = TRUE;</u> Run "C866_Configuration_Setup.vi" prior to running this VI.
C-867:	<u>Use #24 for stop = TRUE, Read from controller = TRUE;</u> Run "C867_Configuration_Setup.vi" prior to running this VI.
C-880:	<u>Use #24 for stop = TRUE, Read from controller = TRUE</u> Run "C880_Configuration_Setup.vi" prior to running this VI.
E-517:	<u>Use #24 for stop = TRUE, Read from controller = TRUE.</u> Default position unit is $\mu\text{m}$ , default velocity unit is $\mu\text{m}/\text{s}$ . Run "E517_Configuration_Setup.vi" prior to running this VI.
E-710:	<u>Use #24 for stop = FALSE, Read from controller = TRUE.</u> Default position unit is $\mu\text{m}$ , default velocity unit is $\mu\text{m}/\text{ms}$ . Joystick button 1 is not supported (controller does not support #24 or STP). Run "E710_Configuration_Setup.vi" prior to running this VI.
E-712:	<u>Use #24 for stop = TRUE, Read from controller = TRUE.</u> Default position unit is $\mu\text{m}$ , default velocity unit is $\mu\text{m}/\text{s}$ . Run "E712_Configuration_Setup.vi" prior to running this VI.
E-725:	<u>Use #24 for stop = TRUE, Read from controller = TRUE.</u> Default position unit is $\mu\text{m}$ , default velocity unit is $\mu\text{m}/\text{s}$ . Run "E725_Configuration_Setup.vi" prior to running this VI.
E-753:	<u>Use #24 for stop = TRUE, Read from controller = TRUE.</u> Default position unit is $\mu\text{m}$ , default velocity unit is $\mu\text{m}/\text{s}$ . Run "E753_Configuration_Setup.vi" prior to running this VI.
E-755:	<u>Use #24 for stop = TRUE, Read from controller = TRUE.</u> Default position unit is $\mu\text{m}$ , default velocity unit is $\mu\text{m}/\text{s}$ . Run "E755_Configuration_Setup.vi" prior to running this VI. VI does not work with E-755.101.
E-761:	<u>Use #24 for stop = TRUE, Read from controller = TRUE.</u> Default position unit is $\mu\text{m}$ , default velocity unit is $\mu\text{m}/\text{ms}$ . Run "E761_Configuration_Setup.vi" prior to running this VI.
E-861:	<u>Use #24 for stop = TRUE, Read from controller = TRUE;</u> Run "E861_Configuration_Setup.vi" prior to running this VI.

Use the *Help→Show Context Help* menu sequence in the LabVIEW environment to display the *Context Help* window with the VI and control/indicator descriptions.

### 3.10. MotionProfile.vi

This VI generates motion profiles for two axes (designated X and Y). When executed simultaneously, the profiles produce motion along a defined trajectory using a special mode of the motion controller. The profiles are independently configurable sinewaves for each axis, resulting in a circle, ellipse or Lissajous figure when plotted as an XY trajectory. The curve parameters are entered here.

System No. and X/Y axes are the axes that will perform the motion. # steps influences how smooth the curve will be. Minimum value is 32. You can open a dialog window to change parameters and see the results interactively. Otherwise parameters must be provided by entering them into the circle parameters cluster or wiring them to the VI. If Start motion is FALSE the motion is not started but only calculations will be done. Loop redisplays the dialog window indefinitely for testing or demonstration purposes. You can terminate the VI by pressing Cancel within the dialog window.



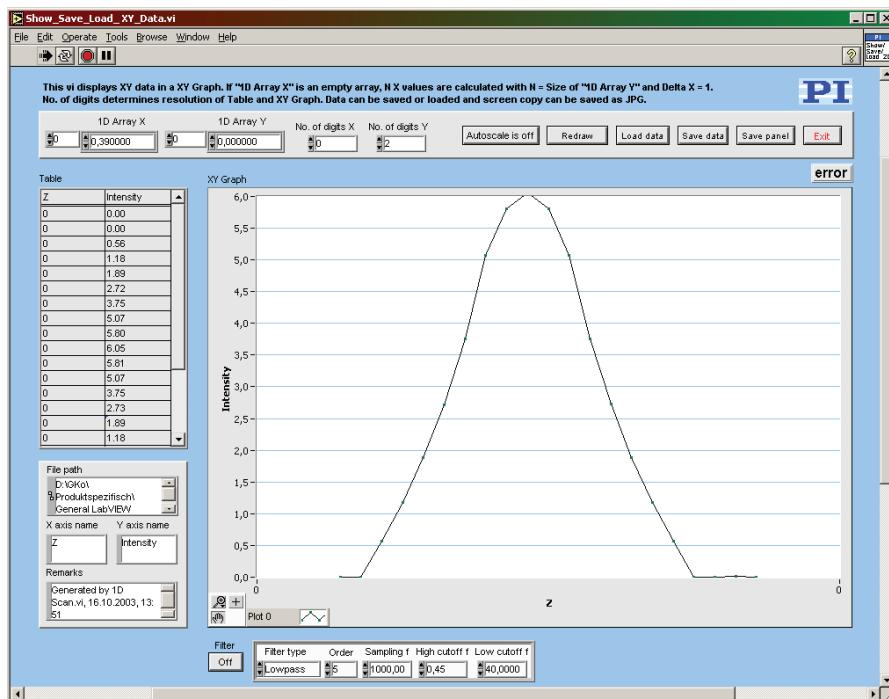
If continuous motion was started (wrap-around TRUE) use "HLT.vi" to stop it on the trajectory. See the User Profile Generator Technical Note (A000T0014) for a detailed description of the parameters.

Run "XXXX\_Configuration\_Setup.vi" (with XXXX being the PI product number of your system) prior to running this VI.

Valid for      C-843, C-843.PM

### 3.11. Show\_Save\_Load\_XY\_Data.vi

This VI displays XY data in an XY Graph. If 1D Array X is an empty array, N X values are calculated with N = Size of 1D Array Y and Delta X = 1. No. of digits determines the resolution of Table and XY Graph. Data can be saved or loaded and a screen copy can be saved as JPG.



If data (1D Array X, 1D Array Y) are sent to the VI via the corresponding connectors, the VI will display the corresponding graphics after being called. To load data at runtime, press the Load data button. A dialog will pop up where a data file to open can be selected. The VI can read data in GCSArray, GCSTable and simple ASCII column format. Autoscale can be switched on or off. If Autoscale is off, the Y axis of the graph is scaled from 0-10.

Filter can be used to apply a filter to the current graph. For Filter = TRUE, a Lowpass, Highpass, Bandpass or Bandstop filter with appropriate settings can be selected.

Press Save data to save data (file header and numerical data). Data will be saved in GCS Array format. The file header will contain information given in X axis name, Y axis name and Remarks. With Save panel a screen copy of this VI can be saved as a JPG file. XY Graph will show the Y values over the corresponding X values. Table contains the numerical values for X and Y. Press Exit to stop execution of this VI.

**Valid for** Analog systems, C-843, C-866, C-867, C-880, E-517, E-712, E-725, E-753, E-755, E-761, E-861, F-206, M-8X0. To support analog interfacing, VI must be present for E-816 also.

**Input** 1D Array X (empty num. array), 1D Array Y (empty num. array), 2D Array Z (empty 2D num. array), No. of digits X (, No. of digits Y, No. of digits Z, Autoscale, Error in (no error)

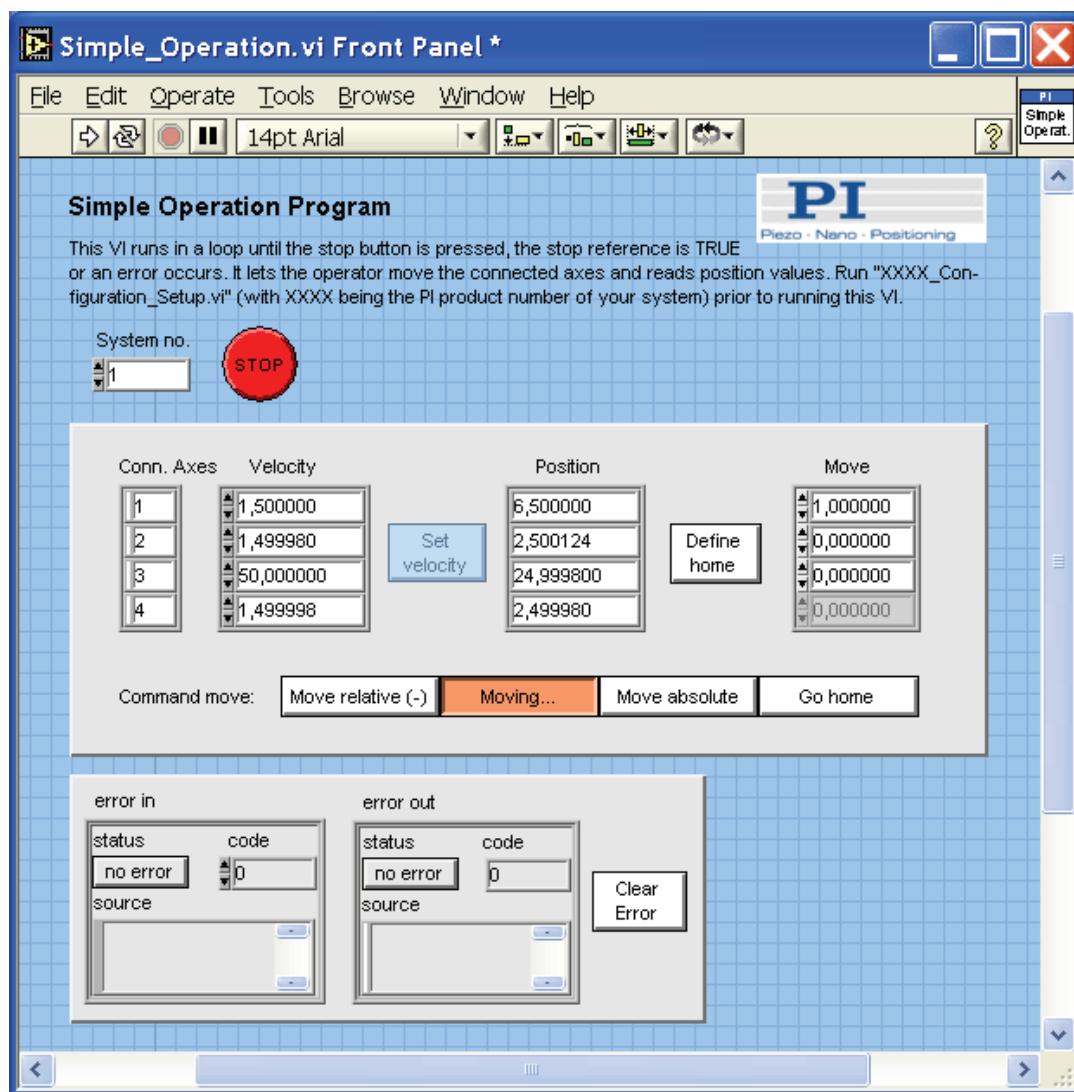
**Output** Error out

**Remarks**

### 3.12. Simple\_Operation.vi

This VI runs in a loop until the stop button is pressed, the stop reference is TRUE or an error occurs. It lets the operator set the velocity, move the connected axes to relative, absolute or to the home position, and reads the current position continuously. The diagram shows how to combine the driver and support VIs for these tasks. Use the *Help→Show Context Help* menu sequence in the LabVIEW environment to display the *Context Help* window with the VI and control/indicator descriptions.

Run “XXXX\_Configuration\_Setup.vi” (with XXXX being the PI product number of your system) prior to running this VI.



Valid for C-843, C-843.PM, C-865, C-866, Mercury™

#### 4. PI Systems Currently Supported by This Driver Set

Product	works with LabVIEW driver version (or higher)	if product firmware/ drivers version is equal to or newer than
Analog	5.2.2	-
C-702	4.0.0	1.4.0
C-843	2.01 – 2.02	MC-DLL 1.0.2.2
	2.05 – 2.06	MC-DLL 1.0.2.3
	3.1.2., 3.1.2a	MC-DLL 1.0.2.3
	3.4.3	MC-DLL 1.0.2.8
	3.6.1	MC-DLL 1.0.2.8 GCS_DLL 1.3.1
	5.7.4	GCS_DLL 2.0.0
C-843.PM	3.1.0	MC-DLL 1.0.2.5
	3.4.3a	MC-DLL 1.0.2.5
	3.6.2	MC-DLL 1.0.2.5 GCS_DLL 1.3.0
C-848	3.0.2	1.0
C-865	3.3.0	MC_C865.dll 1.0
C-866	5.2.1	MC_C866.dll 1.0
C-867	5.6.0	1.1.0.0
	5.7.2	C-867: 2.0.0.0 C-867.160: 1.0.0.0
C-880	1.1	2.00
	1.2	2.10
	2.04	2.20
	2.05 – 2.06	2.21
	3.2.0	2.40
C-880K005	2.06	1.0
C-880K006	2.06	1.0
C-880K007	2.06	1.0
E-516	1.0 – 2.02	DSP V3.01, MCU V5
	2.05 – 2.06	DSP V3.11, MCU V5
	3.4.2	DSP V3.30, MCU V5
E-517	5.7.0	1.1.0
E-710 3- & 4-channel versions	3.4.0	5.027
	3.4.4 (a, b)	5.0.33, 6.0.33
E-710 6-channel	3.4.4 (a, b)	2.13

E-712	5.3.1	1.0.1.0
E-725	5.5.0	02.00.03.00 For USB: E7XX_GCS2_DLL.dll V2.2.0
E-753	5.2.0	1.0.0
E-755	5.1.0	2.0.4.1 E7XX_GCS2_DLL.dll V1.1.0
E-761	3.5.0 5.4.1	1.0.0 2.0.1
E-861	5.4.0	6.0
E-816	2.01 – 2.06 5.3.0 5.7.1	2.02 2.1.1 3.2.0
F-206	1.1 – 2.06 5.4.2	Fhx0035 and higher Fhx0035 and higher, FHXF6 recommended
M-840	2.03 – 2.06 2.2.0 3.0.1 3.1.1 5.4.2	Hex0037 and higher Hex0037 and higher, Hex0045 recomm. Hex0037 and higher, Hex0050 recomm. Hex0037 and higher, Hex0051 recomm. Hex0037 and higher, HEXF6 recommended
M-850	2.03 – 2.06 3.0.1 3.1.1 5.4.2	Hex0040 and higher Hex0040 and higher, Hex0050 recomm. Hex0040 and higher, Hex0051 recomm. Hex0040 and higher, HEXF6 recommended
Mercury™	3.6.0 5.7.3	1.0.6 PI_MERCURY_GCS_DLL.dll V 1.0.0.17 2.4.0 PI_MERCURY_GCS_DLL.dll V 2.0.0

## 5. Appendix A

Error codes are not unambiguous, but can result from a PI error message or LabVIEW internal error code. In addition to the list below see National Instruments error codes.

100	PI LabVIEW driver reports error. See <a href="#">source control</a> for details.
0	No error
1	Parameter syntax error
2	Unknown command
3	Command length out of limits or command buffer overrun
4	Error while scanning
5	Unallowable move attempted on unreferenced axis, or move attempted with servo off
6	Parameter for SGA not valid
7	Position out of limits
8	Velocity out of limits
9	Attempt to set pivot point while U,V and W not all 0
10	Controller was stopped by command
11	Parameter for SST or for one of the embedded scan algorithms out of range
12	Invalid axis combination for fast scan
13	Parameter for NAV out of range
14	Invalid analog channel
15	Invalid axis identifier
16	Unknown stage name
17	Parameter out of range
18	Invalid macro name
19	Error while recording macro
20	Macro not found
21	Axis has no brake
22	Axis identifier specified more than once
23	Illegal axis
24	Incorrect number of parameters
25	Invalid floating point number
26	Parameter missing
27	Soft limit out of range
28	No manual pad found

29	No more step-response values
30	No step-response values recorded
31	Axis has no reference sensor
32	Axis has no limit switch
33	No relay card installed
34	Command not allowed for selected stage(s)
35	No digital input installed
36	No digital output configured
37	No more MCM responses
38	No MCM values recorded
39	Controller number invalid
40	No joystick configured
41	Invalid axis for electronic gearing, axis can not be slave
42	Position of slave axis is out of range
43	Slave axis cannot be commanded directly when electronic gearing is enabled
44	Calibration of joystick failed
45	Referencing failed
46	OPM (Optical Power Meter) missing
47	OPM (Optical Power Meter) not initialized or cannot be initialized
48	OPM (Optical Power Meter) Communication Error
49	Move to limit switch failed
50	Attempt to reference axis with referencing disabled
51	Selected axis is controlled by joystick
52	Controller detected communication error
53	MOV! motion still in progress
54	Unknown parameter
55	No commands were recorded with REP
56	Password invalid
57	Data Record Table does not exist
58	Source does not exist; number too low or too high
59	Source Record Table number too low or too high
60	Protected Param: current Command Level (CCL) too low
61	Command execution not possible while Autozero is running
62	Autozero requires at least one linear axis
63	Initialization still in progress
64	Parameter is read-only
65	Parameter not found in non-volatile memory
66	Voltage out of limits

67	Not enough memory available for requested wave curve
68	Not enough memory available for DDL table; DDL can not be started
69	Time delay larger than DDL table; DDL can not be started
70	The requested arrays have different lengths; query them separately
71	Attempt to restart the generator while it is running in single step mode
72	Motion commands and wave generator activation are not allowed when analog target is active
73	Motion commands are not allowed when wave generator output is active; use WGO to disable generator output
74	No sensor channel or no piezo channel connected to selected axis (sensor and piezo matrix)
75	Generator started (WGO) without having selected a wave table (WSL).
76	Interface buffer did overrun and command couldn't be received correctly
77	Data Record Table does not hold enough recorded data
78	Data Record Table is not configured for recording
79	Open-loop commands (SVA, SVR) are not allowed when servo is on
80	Hardware error affecting RAM
81	Not macro command
82	Macro counter out of range
83	Joystick is active
84	Motor is off
85	Macro-only command
86	Invalid joystick axis
87	Joystick unknown
88	Move without referenced stage
89	Command not allowed in current motion mode
90	No tracing possible while digital IOs are used on this HW revision. Reconnect to switch operation mode.
91	Move not possible, would cause collision
100	PI LabVIEW driver reports error. See source control for details.
200	No stage connected to axis
201	File with axis parameters not found
202	Invalid axis parameter file
203	Backup file with axis parameters not found
204	PI internal error code 204
205	SMO with servo on
206	uudecode: incomplete header
207	uudecode: nothing to decode
208	uudecode: illegal UUE format

209	CRC32 error
210	Illegal file name (must be 8-0 format)
211	File not found on controller
212	Error writing file on controller
213	VEL command not allowed in DTR Command Mode
214	Position calculations failed
215	The connection between controller and stage may be broken
216	The connected stage has driven into a limit switch, call CLR to resume operation
217	Strut test command failed because of an unexpected strut stop
218	While MOV! is running position can only be estimated!
219	Position was calculated during MOV motion
230	Invalid handle
231	No bios found
232	Save system configuration failed
233	Load system configuration failed
301	Send buffer overflow
302	Voltage out of limits
303	Open-loop motion attempted when servo ON
304	Received command is too long
305	Error while reading/writing EEPROM
306	Error on I2C bus
307	Timeout while receiving command
308	A lengthy operation has not finished in the expected time
309	Insufficient space to store macro
310	Configuration data has old version number
311	Invalid configuration data
333	Internal hardware error
400	Wave generator index error
401	Wave table not defined
402	Wave type not supported
403	Wave length exceeds limit
404	Wave parameter number error
405	Wave parameter out of range
406	WGO command bit not supported
555	BasMac: unknown controller error
601	Not enough memory
602	Hardware voltage error

603	Hardware temperature out of range
1000	Too many nested macros
1001	Macro already defined
1002	Macro recording not activated
1003	Invalid parameter for MAC
1004	Deleting macro failed
1005	Controller is busy with some lengthy operation (e.g. reference move, fast scan algorithm)
2000	Controller already has a serial number
4000	Sector erase failed
4001	Flash program failed
4002	Flash read failed
4003	HW match code missing/invalid
4004	FW match code missing/invalid
4005	HW version missing/invalid
4006	FW version missing/invalid
4007	FW update failed
0	No error occurred during function call
-1	Error during com operation (could not be specified)
-2	Error while sending data
-3	Error while receiving data
-4	Not connected (no port with given ID open)
-5	Buffer overflow
-6	Error while opening port
-7	Timeout error
-8	There are more lines waiting in buffer
-9	There is no interface or DLL handle with the given ID
-10	Event/message for notification could not be opened
-11	Function not supported by this interface type
-12	Error while sending "echoed" data
-13	IEEE488: System error
-14	IEEE488: Function requires GPIB board to be CIC
-15	IEEE488: Write function detected no listeners
-16	IEEE488: Interface board not addressed correctly
-17	IEEE488: Invalid argument to function call
-18	IEEE488: Function requires GPIB board to be SAC
-19	IEEE488: I/O operation aborted
-20	IEEE488: Interface board not found

-21	IEEE488: Error performing DMA
-22	IEEE488: I/O operation started before previous operation completed
-23	IEEE488: No capability for intended operation
-24	IEEE488: File system operation error
-25	IEEE488: Command error during device call
-26	IEEE488: Serial poll-status byte lost
-27	IEEE488: SRQ remains asserted
-28	IEEE488: Return buffer full
-29	IEEE488: Address or board locked
-30	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	RS-232: Error configuring the COM port
-32	Error dealing with internal system resources (events, threads, ...)
-33	A DLL or one of the required functions could not be loaded
-34	FTDIUSB: invalid handle
-35	FTDIUSB: device not found
-36	FTDIUSB: device not opened
-37	FTDIUSB: IO error
-38	FTDIUSB: insufficient resources
-39	FTDIUSB: invalid parameter
-40	FTDIUSB: invalid baud rate
-41	FTDIUSB: device not opened for erase
-42	FTDIUSB: device not opened for write
-43	FTDIUSB: failed to write device
-44	FTDIUSB: EEPROM read failed
-45	FTDIUSB: EEPROM write failed
-46	FTDIUSB: EEPROM erase failed
-47	FTDIUSB: EEPROM not present
-48	FTDIUSB: EEPROM not programmed
-49	FTDIUSB: invalid arguments
-50	FTDIUSB: not supported
-51	FTDIUSB: other error
-52	Error while opening the COM port: was already open
-53	Checksum error in received data from COM port
-54	Socket not ready, you should call the function again
-55	Port is used by another socket
-56	Socket not connected (or not valid)
-57	Connection terminated (by peer)

-58	Can't connect to peer
-59	Operation was interrupted by a nonblocked signal
-60	No Device with this ID is present
-61	Driver could not be opened (on Vista: run as administrator!)
-1001	Unknown axis identifier
-1002	Number for NAV out of range--must be in [1,10000]
-1003	Invalid value for SGA--must be one of 1, 10, 100, 1000
-1004	Controller sent unexpected response
-1005	No manual control pad installed, calls to SMA and related commands are not allowed
-1006	Invalid number for manual control pad knob
-1007	Axis not currently controlled by a manual control pad
-1008	Controller is busy with some lengthy operation (e.g. reference move, fast scan algorithm)
-1009	Internal error--could not start thread
-1010	Controller is (already) in macro mode--command not valid in macro mode
-1011	Controller not in macro mode--command not valid unless macro mode active
-1012	Could not open file to write or read macro
-1013	No macro with given name on controller, or macro is empty
-1014	Internal error in macro editor
-1015	One or more arguments given to function is invalid (empty string, index out of range, ...)
-1016	Axis identifier is already in use by a connected stage
-1017	Invalid axis identifier
-1018	Could not access array data in COM server
-1019	Range of array does not fit the number of parameters
-1020	Invalid parameter ID given to SPA or SPA?
-1021	Number for AVG out of range--must be >0
-1022	Incorrect number of samples given to WAV
-1023	Generation of wave failed
-1024	Motion error while axis in motion, call CLR to resume operation
-1025	Controller is (already) running a macro
-1026	Configuration of PZT stage or amplifier failed
-1027	Current settings are not valid for desired configuration
-1028	Unknown channel identifier
-1029	Error while reading/writing wave generator parameter file
-1030	Could not find description of wave form. Maybe WG.INI is missing?
-1031	The WGWaveEditor DLL function was not found at startup
-1032	The user cancelled a dialog

-1033	Error from C-844 Controller
-1034	DLL necessary to call function not loaded, or function not found in DLL
-1035	The open parameter file is protected and cannot be edited
-1036	There is no parameter file open
-1037	Selected stage does not exist
-1038	There is already a parameter file open. Close it before opening a new file
-1039	Could not open parameter file
-1040	The version of the connected controller is invalid
-1041	Parameter could not be set with SPA--parameter not defined for this controller!
-1042	The maximum number of wave definitions has been exceeded
-1043	The maximum number of wave generators has been exceeded
-1044	No wave defined for specified axis
-1045	Wave output to axis already stopped/started
-1046	Not all axes could be referenced
-1047	Could not find parameter set required by frequency relation
-1048	Command ID given to SPP or SPP? is not valid
-1049	A stage name given to CST is not unique
-1050	A uuencoded file transferred did not start with "begin" followed by the proper filename
-1051	Could not create/read file on host PC
-1052	Checksum error when transferring a file to/from the controller
-1053	The PiStages.dat database could not be found. This file is required to connect a stage with the CST command
-1054	No wave being output to specified axis
-1055	Invalid password
-1056	Error during communication with OPM (Optical Power Meter), maybe no OPM connected
-1057	WaveEditor: Error during wave creation, incorrect number of parameters
-1058	WaveEditor: Frequency out of range
-1059	WaveEditor: Error during wave creation, incorrect index for integer parameter
-1060	WaveEditor: Error during wave creation, incorrect index for floating point parameter
-1061	WaveEditor: Error during wave creation, could not calculate value
-1062	WaveEditor: Graph display component not installed
-1063	User Profile Mode: Command is not allowed, check for required preparatory commands
-1064	User Profile Mode: First target position in User Profile is too far from current position
-1065	Controller is (already) in User Profile Mode
-1066	User Profile Mode: Block or Data Set index out of allowed range

-1067	ProfileGenerator: No profile has been created yet
-1068	ProfileGenerator: Generated profile exceeds limits of one or both axes
-1069	ProfileGenerator: Unknown parameter ID in Set/Get Parameter command
-1070	ProfileGenerator: Parameter out of allowed range
-1071	User Profile Mode: Out of memory
-1072	User Profile Mode: Cluster is not assigned to this axis
-1073	Unknown cluster identifier
-1074	The installed device driver doesn't match the required version. Please see the documentation to determine the required device driver version.
-1075	The library used doesn't match the required version. Please see the documentation to determine the required library version.
-1076	The interface is currently locked by another function. Please try again later.

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