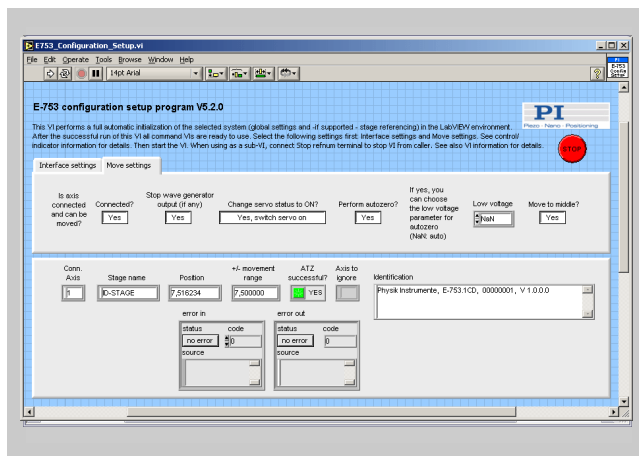


PZ 186E Software Manual

E-753 LabView Driver Library

Release: 6.3.1

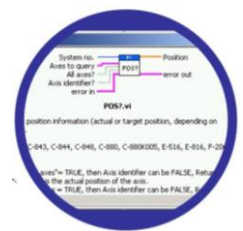
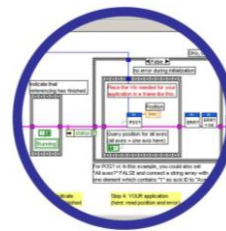
Date: 2013-12-09



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

■ E-753.1CD

Digital Controller, 1 Channel, for Capacitive Sensors



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Release: 6.3.1

File:E753_GCSLabVIEW_PZ186E_631, 2215936 Bytes

0. Disclaimer

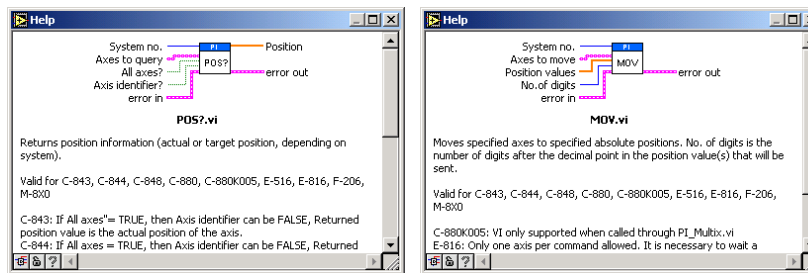
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1. Introduction

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 which supports waveform generation 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-517 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. *PIStages2.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 operating system environment and can be found by the GCS drivers (if LabVIEW still cannot find *PIStages2.dat*, it may be because it is marked read-only. To see, open an Explorer, right-click the file *PIStages2.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 (see Section "First Steps for GCS-Compatible PI Controllers" on p. 6 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 \neq zero.

See also chapter 5 on p. 115 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 LabVIEW's 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 "C:\Users\Public\PI\PI_LabVIEW_Merge_Tool\MergeDrivers.llb" (also available via the Windows start menu), 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 run PIUpdateFinder.exe to 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. Software updates

The installation disk shipped with your product may contain outdated versions of software components or drivers.

To check for the latest versions, we recommend to use the PIUpdateFinder. If this software tool has not already been installed via the CD setup, follow the instructions on <http://update.pi-portal.ws/> to download the guided installer of PIUpdateFinder.

The latest versions of software components or drivers are also available on <http://www.pi-portal.ws/> in the section of your controller or in the “General Software” section. For log-in instructions, refer to the “X-XXX Releasenews_XXX.pdf” document in the “Manuals” directory of the installation disk.

1.6. First Steps for GCS-Compatible PI Controllers

1.6.1. E-753

Step 1: The E-753 controller is delivered pre-configured. Before you start, please check that the current configuration matches your stage connections.

Step 2 (advanced users can skip this step): To check communication between the E-753 controller and the host PC, run “E753_Simple_Test.vi”. This VI will return the ID string of the E-753 controller, the axis ID and stage name of the connected axis, and its current position. 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 3:

WARNING: E753_Configuration_Setup.vi May Cause Move

When you start “E753_Configuration_Setup.vi” with Connected? = TRUE and Perform Autozero? = TRUE or Move to Middle? = TRUE, the VI will move the stage. It is therefore important to make sure that items connected to or mounted on the connected stage cannot be damaged by such a move. If a move is not desired, Connected? can be switched off (see chapter 3).

To control one or more E-753 controllers with this driver set, run “E753_Configuration_Setup.vi”. This VI performs all steps necessary for a full configuration of the driver VIs in the LabVIEW environment: the definition of the axis ID, the automated zero-point calibration (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 “E753_Configuration_Setup.vi”; otherwise all global settings will be lost and the driver VIs will not work.

When programming your application, you can implement “E753_Configuration_Setup.vi” as an initialization VI in your software. See chapter 3 for a detailed description of “E753_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. See also “E753_Sample_Application_1.vi” and “E753_Sample_Application_2a.vi” as sample VIs showing how to implement your application using “E753_Configuration_Setup.vi”.

Before using a joystick connected to the host PC, install joystick driver and calibrate joystick in the Windows control panel.

Default position unit is μm , default velocity unit is $\mu\text{m/s}$.

Default axis ID is “1”.

GCS syntax version: 2.0

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.cti (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, C-884, E-517, E-709, E-710, E-712, E-725, E-755, E-761, E-816, E-861, E-870, E-871, Hydra, Pollux, Mercury, Mercury_GCS (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, C-884, E-517, E-709, E-710, E-712, E-725, E-755, E-761, E-816, E-861, E-870, E-871, Hydra, Pollux, Mercury, Mercury_GCS (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. Find baudrate.vi (Communication.llb)

Valid for	C-702, C848, C-867, C-880, C-880K005, C-884, E-516, E-517, E-709, E-712, E-725, E-755, E-816, E-861, E-871, F-206, M-8X0, Mercury_GCS
-----------	---

Input	<p>System number (1), RS-232 Port number (0: COM1), Timeout (2000), Valid baudrates (array of 5 values), Flow control (All FALSE, x13, x11, x0), Termination character (LF), Interface clear (XXX\n), String to Send (*idn?), Error in (no error)</p> <p>C-702: Input and output HW handshake must be TRUE. All other controls=default.</p> <p>C-848: Input and output HW handshake must be TRUE. All other controls=default.</p> <p>C-867: Input and output HW handshake must be FALSE. All other controls=default.</p> <p>C-880: Input and output HW handshake must be TRUE. All other controls=default.</p> <p>C-880K005: All controls=default.</p> <p>C-884: Input and output HW handshake must be FALSE. All other controls=default.</p> <p>E-516: Input and output HW handshake must be TRUE. All other controls=default.</p> <p>E-517: Input and output HW handshake must be TRUE. Not available for Interface = GPIB, TCP/IP or DLL (USB). All other controls=default.</p> <p>E-709: Input and output HW handshake must be TRUE. Not available for Interface = USB. All other controls=default.</p> <p>E-712: Input and output HW handshake must be TRUE. Not available for Interface = TCP/IP or DLL (USB). All other controls=default.</p> <p>E-725: Input and output HW handshake must be TRUE. Not available for Interface = TCP/IP or DLL (USB). All other controls=default.</p> <p>E-753: Input and output HW handshake must be TRUE. Not available for Interface = TCP/IP. All other controls=default.</p> <p>E-755: Input and output HW handshake must be TRUE. Not available for Interface = DLL and DLL Interface = RS232DC (DaisyChain). Interface clear = \18 (Use "\"Codes Display" to enter), String to Send = err?. All other controls=default.</p> <p>E-816: Input and output HW handshake must be TRUE. All other controls=default.</p> <p>E-861: Input and output HW handshake must be FALSE. All other controls=default.</p> <p>E-871: Input and output HW handshake must be FALSE. All other controls=default.</p> <p>F-206: All controls=default.</p> <p>M-8X0: All controls=default.</p> <p>Mercury_GCS: Input and output HW handshake must be FALSE. All other controls=default.</p>
Output	Baudrate out, String read, Error out
Remarks	<p>Opens COM port of given system with valid baudrates until status of <u>Error out</u> is false.</p> <p>E-861, E-871, C-867, Mercury_GCS: The baudrate is set via the DIP switches on the controller front panel. See the controller User manual for details.</p> <p>C-884: The baudrate is set via IFC/IFS.vi. See the controller User manual for details.</p>

2.2.6. Find host address.vi (Communication.IIb)

Valid for	C-702, C-884, E-517, E-712, E-725, E-753, F-206, M-8X0
Input	<p>Port (50000), Controller names (empty string array), Mode (Find controller by UDP), Error in (no error)</p> <p>C-702: <u>Controller names</u> = C-702, <u>Mode</u> = Find controller by UDP, <u>Port</u> = 50000</p> <p>C-884: <u>Controller names</u> = C-884, <u>Mode</u> = Find controller by UDP, <u>Port</u> = 50000</p>

E-517: Controller names = E-517, Mode = Find controller by UDP, Port = 50000

E-712: Controller names = E-712, Mode = Find controller by UDP, Port = 50000

E-725: Controller names = E-725, Mode = Find XPort by UDP, Port = 30718

E-753: Controller names = E-753, Mode = Find controller by UDP, Port = 50000

F-206: Controller names = F-206, F-HEX, Mode = Find XPort by UDP, Port = 30718

M-8X0: Controller names = M-8X0, HEXAPOD, Mode = Find XPort by UDP, Port = 30718

Output All addresses, All IDs, Address, ID, Error out

Remarks Performs an UDP broadcast and returns IP addresses of all controllers matching Controller name.

2.2.7. GCSTranslator DLL Functions.vi (Communication.llb)

Valid for C-843, C-843.PM, C-844, C-865, C-866, C-867, C-884, E-517, E-709, E-710, E-712, E-725, E-755, E-761, E-816, E-861, E-870, E-871, Hydra, Pollux, Mercury, Mercury_GCS (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.

Warning: For XXX_GcsGetANswer, String buffer must be large enough, otherwise the application may crash. Call XXX_GcsGetANswerSize first to determine necessary string length.

2.2.8. Get subnet.vi (Communication.llb)

Valid for C-702, C-884, 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.

2.2.9. Global DaisyChain.vi (Communication.llb)

Valid for All systems

Input None

Output None

Remarks A global variable which contains setup information for DaisyChain systems.

2.2.10. Global1.vi (Communication.llb)

Valid for All systems

Input None

Output	None
Remarks	A global variable which contains communication setup information.

2.2.11. IFC.vi (Communication.IIb)

Valid for	C-702, C-884, E-517, E-709, E-712, E-725, E-753, Hydra, Pollux
Input	System number (1), Interface parameter (Empty string array), Parameter value (Empty string array), Error in (no error)
Output	Error out
Remarks	<p>Changes the current InterFace Configuration. After IFC is sent, the new interface configuration of the controller becomes active and the host must change the interface configuration too. Settings made with IFC are valid until the controller is powered down. To save them to EPROM and make them the default use IFS instead.</p> <p>C-884: MACADR cannot be changed with IFC. To change IPADR the use of IFS is recommended instead.</p> <p>E-517: The current active RS-232 baud rate and GPIB (IEEE 488) address can also be set on the E-517 front panel in the COMMUNICATION display screen. This screen can be accessed by the trackball. The front panel settings interdepend with the interface parameter settings set with IFC. See E-517 User Manual for details.</p> <p>E-709: Use IFC to change baud rate settings only.</p> <p>E-712: Use IFC to change baud rate settings only, for all other settings use IFS instead.</p> <p>E-725: Use IFC to change baud rate settings only, for all other settings use IFS instead.</p> <p>E-753: Use IFC to change baud rate settings only, for all other settings use IFS instead.</p>

2.2.12. IFC?.vi (Communication.IIb)

Valid for	C-702, C-884, E-517, E-709, E-712, E-725, E-753, Hydra, Pollux
Input	System number (1), Interface parameter (Empty string array), All parameters? (F), Error in (no error)
Output	Parameter value, Error out
Remarks	<p>Returns the current interface configuration.</p> <p>E-517, E-753: Note that when the controller is part of a network with DHCP, the static IP address of the controller is returned, not the currently used IP address, which was obtained from the DHCP server.</p>

2.2.13. IFS.vi (Communication.IIb)

Valid for	C-702, C-884, E-517, E-709, E-712, E-725, E-753, F-206, M-8X0
Input	System number (1), Password (100), Interface parameter (Empty string array), Parameter value (Empty string array), Error in (no error)
	E-709: <u>Interface parameter</u> can only be RSBAUD.
Output	Error out
Remarks	If <u>Password</u> is correct, the default parameter(s) for the interface are changed, but the current active parameters are not changed. Settings made with IFS are saved to EPROM and become active with the next

startup/reboot. To change settings immediately (but temporarily) use IFC instead (if supported by your controller).

F-206, M-8X0: Check HLP?/HELP answer to find out if IFS is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

2.2.14. IFS?.vi (Communication.IIb)

Valid for	C-702, C-884, E-517, E-709, E-712, E-725, E-753, F-206, M-8X0
Input	System number (1), Interface parameter (Empty string array), All parameters? (F), Error in (no error)
Output	Parameter value, Error out
Remarks	Returns the default Interface configuration which is stored in EPROM. F-206, M-8X0: Check HLP?/HELP answer to find out if IFS? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

2.2.15. Initialize Global1.vi (Communication.IIb)

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.

2.2.16. Initialize Global DaisyChain.vi (Communication.IIb)

Valid for	C-867, E-709, E-755, E-861, E-871, Mercury_GCS (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. E-709: Only supported if E-709 is used inside C-867K012/K013.

2.2.17. Is DaisyChain open.vi (Communication.IIb)

Valid for	C-867, E-709, E-755, E-861, E-871, Mercury_GCS (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. E-709: Only supported if E-709 is used inside C-867K012/K013.

2.2.18. PI Ask for Communication Parameters.vi (Communication.IIb)

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.

2.2.19. PI Open Interface of one system.vi (Communication.IIb)

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. **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 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.

C-884: Interface = RS232, TCP/IP or DLL, RS232: Input and output HW handshake must be FALSE. DLL (USB): DLL for Device = PI_GCS2_DLL, DLL Interface = USB, Parameter = Serial no. of system to connect to. Syntax: GCS 2.0; 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-709: Interface = RS232 or USB, RS232: Input and output HW handshake must be TRUE, DLL: DLL for Device = E-709, 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 or USB_DC, Parameter = Number of device in chain, Register DC: FALSE. Syntax: GCS 2.0; Term char = LF.

E-870: Interface = DLL, DLL (USB): DLL for Device = PI_GCS2_DLL, DLL Interface = USB, Parameter = Serial no. of system to connect to. Syntax: GCS 2.0; Term char = LF.

E-871: Single Device: Interface = RS232 or DLL, RS232: Input and output HW handshake must be FALSE. DLL (USB): DLL for Device = PI_GCS2_DLL, DLL Interface = USB, Parameter = Serial no. of system to connect to.

DaisyChain: Interface = DLL, DLL for Device = PI_GCS2_DLL, DLL Interface = RS232_DC or USB_DC, Parameter = Number of device in chain, Register DC: FALSE. Syntax: GCS 2.0; Term char = LF.

F-206: F-206 (GCS 1.0): 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.

C-887 + H-206 (GCS 2.0): Interface = RS232 or TCP/IP, RS232: Input and output handshake settings must be FALSE, Syntax: GCS 2.0; Term char = LF.

Hydra, Pollux: Interface = DLL, DLL (TCP/IP and RS-232): DLL for Device = PI_HydraPollux_GCS2_DLL, DLL Interface = RS232 or TCP/IP, Syntax: GCS 2.0; Term char = LF.

M-8X0: M-810/11/24/40/50 (GCS 1.0): Interface = RS232, GPIB or TCP/IP, RS232: Input and output handshake settings must be FALSE, Syntax: GCS 1.0; Term char = LF.

C-887 + H-810/11/24/40/50 (GCS 2.0): Interface = RS232 or TCP/IP, RS232: Input and output handshake settings must be FALSE, Syntax: GCS 2.0; 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.

Mercury_GCS: Single Device: Interface = RS232 or DLL, RS232: Input and output HW handshake must be FALSE. DLL (USB): DLL for Device = PI_GCS2_DLL, DLL Interface = USB, Parameter = Serial no. of system to connect to.

DaisyChain: Interface = DLL, DLL for Device = PI_GCS2_DLL, DLL Interface = RS232_DC or USB_DC, Parameter = Number of device in chain, Register DC: FALSE. Syntax: GCS 2.0; Term char = LF.

2.2.20. 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.

2.2.21. 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.

2.2.22. PI Send String.vi (Communication.llb)

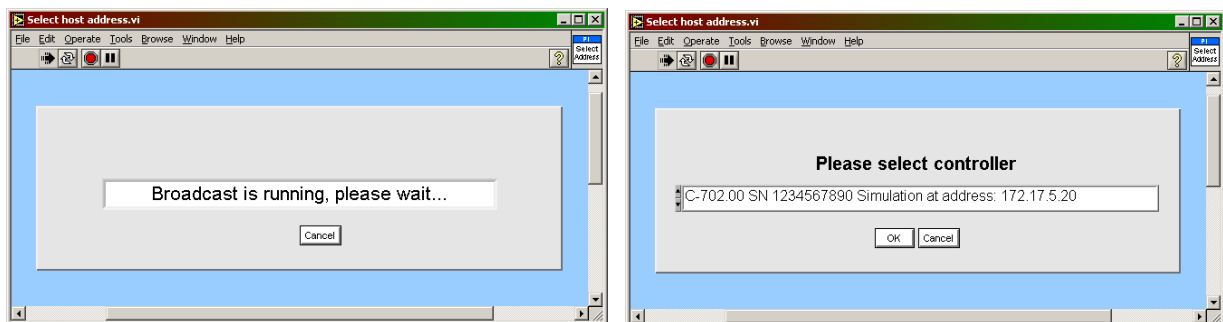
Valid for	All systems
Input	System number (1), String to send (empty string), Attach termination char.? (T), Error in (no error)
Output	Error out
Remarks	Sends command with or without trailing termination character to selected system.

2.2.23. PI VISA Receive Characters.vi (Communication.llb)

Valid for	C-702, C-848, C-867, C-880, C-880K005, C-884, E-516, E-517, E-712, E-725, E-753, E-709, E-816, E-861, E-871, F-206, M-8X0 , Mercury_GCS (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".

2.2.24. Select host address.vi (Communication.lib)

Valid for	C-702, C-884, E-517, E-712, E-725, E-753, F-206, M-8X0
Input	Port (50000), Controller names (empty string array), Mode (Find controller by UDP), Local Stop (FALSE), Error in (no error) C-702: <u>Controller names</u> = C-702, <u>Mode</u> = Find controller by UDP, <u>Port</u> = 50000 C-884: <u>Controller names</u> = C-884, <u>Mode</u> = Find controller by UDP, <u>Port</u> = 50000 E-517: <u>Controller names</u> = E-517, <u>Mode</u> = Find controller by UDP, <u>Port</u> = 50000 E-712: <u>Controller names</u> = E-712, <u>Mode</u> = Find controller by UDP, <u>Port</u> = 50000 E-725: <u>Controller names</u> = E-725, <u>Mode</u> = Find XPort by UDP, <u>Port</u> = 30718 E-753: <u>Controller names</u> = E-753, <u>Mode</u> = Find controller by UDP, <u>Port</u> = 50000 F-206: <u>Controller names</u> = F-206, F-HEX, <u>Mode</u> = Find XPort by UDP, <u>Port</u> = 30718 M-8X0: <u>Controller names</u> = M-8X0, HEXAPOD, <u>Mode</u> = Find XPort by UDP, <u>Port</u> = 30718
Output	Selected Host address/name, Error out
Remarks	Performs an UDP broadcast, returns IP addresses and names of all controllers matching "Controller name" and lets the user select the appropriate controller from a ring control. VI will also stop if Cancel is TRUE.



2.2.25. Set logging mode.vi (Communication.lib)

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.

2.2.26. Syntax.ctl (Communication.llb)

Valid for	All systems
Input	None
Output	None
Remarks	Type definition for GCS version.

2.2.27. 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) or 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. Cancelled? 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, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-871, F-206, M-8X0, Mercury_GCS. 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. Sub-VI for "Show_Save_Load_XY_Data.vi". See separate manual

“GCSDData_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-702, C-843, C-866, C-867, C-880, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-871, F-206, M-8X0, Mercury_GCS. 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. Sub-VI for “1D_Scan.vi”, “2D_Scan.vi”, “Show_Save_Load_XY_Data.vi” and “Show_Save_Load_XYZ_Data.vi”. See separate manual “GCSDData_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-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-870, E-871, F-206, M-8X0, Mercury, Mercury_GCS. 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. Sub-VI for “DDL.vi”, “DRR?.vi”, “GWD?.vi”, “JLT?.vi”, “TWS.vi” etc. See separate manual “GCSDData_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. CSV?.vi (General command.llb)

Valid for	C-702, C-867, C-884, E-517, E-709, E-712, E-725, E-753, E-755, E-761, E-861, E-870, E-871, F-206, Hydra, Pollux, M-8X0, Mercury_GCS
Input	System number (1), Error in (no error)
Output	Syntax, Error out
Remarks	Returns current GCS syntax version. F-206, M-8X0: Check HLP?/HELP answer to find out if CSV? is supported. Only for GCS syntax version = GCS 2.0 or higher (If CSV?.vi is not supported, syntax version is GCS 1.0).

2.4.4. 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, 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,K,L,M 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. 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. Requires “SAI?.vi” to be present.

2.4.5. 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. 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</u>

one system? is FALSE, all entries from Controller names are written into "Global2 (Array).vi". If Change only one system? is TRUE, only the entry for the given system number is overwritten in "Global2 (Array).vi".

2.4.6. 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 $\neq 0$. 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.

2.4.7. 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.

2.4.8. 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, C-884, E-516, E-517, E-709, E-712, E-725, E-710, E-753, E-755, E-761, E-861, E-870, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS (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: For GCS syntax version = GCS 1.0 (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), check HELP answer to determine if HLP? is supported. HLP? and HELP are equivalent.

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

Valid for	C-843, C-867, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-870, E-871, Hydra, Pollux, Mercury, Mercury_GCS
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. HPV?.vi (General command.llb)

Valid for	E-709, E-712, E-725, E-753, E-870
Input	System number (1), Error in (no error)

Output	Parameter values help string, Error out
Remarks	Returns a help string containing information about valid parameter values. E-709, E-712, E-725, E-753: Check HLP? answer to find out if HPV? is supported.

2.4.11. 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.

2.4.12. 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, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS
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 C-884: This command works only in closed-loop operation. Motion commands like MOV are not allowed when control via a Human Interface Device (HID) is active on the axis. 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-709: Motion commands are not allowed when the wave generator is active or the analog input is used for target generation. 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, OSM, OMA or OMR instead to command motion. Motion commands like MOV are not allowed when a joystick is active on the axis. E-871: This command works only in closed-loop operation. Motion commands like MOV are not allowed when a joystick is active on the axis. F-206, M-8X0: For GCS syntax version = GCS 1.0 (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), no mix between F-206 axes

X,Y,Z,U,V,W, separate axes A, B and NanoCube axes K, L, M in one call allowed. Subsequent MOV commands are handled in a buffer on controller, so please use General Wait for motion to stop.vi or #5.vi to check for motion to stop before sending the next MOV.

For GCS syntax version = GCS 2.0 or higher, subsequent MOV commands override the target position of the previous MOV command. Behavior can be changed by setting parameter 0x19001900 (SPA.vi), see controller User Manual for details.

Hydra, Pollux: This command works only in closed-loop operation.

Mercury_GCS: This command works only in closed-loop operation.

Motion commands like MOV are not allowed when a joystick is active on the axis.

Output Error out

Remarks Moves specified axes to specified absolute positions. No. of digits is the number of digits after the decimal point in the position value(s) that will be sent.

E-710: See also "NMOV.vi" in "Old commands.llb".

2.4.13. MOV?.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-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS

Input System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)

E-516: If All axes? = TRUE, then Axis identifier? must be TRUE

E-710: If All axes? = TRUE, then Axis identifier? must be TRUE

E-755: If All axes? = TRUE, then Axis identifier? can be FALSE. Command not available for E-755.101.

E-816: All axes? = FALSE, only one axis per command allowed.

F-206: For GCS syntax version = GCS 1.0 (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), command has different implementation, please use MOV?_old.vi

M-8X0: For GCS syntax version = GCS 1.0 (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), command has different implementation, please use MOV?_old.vi

All other systems: If All axes? = TRUE, then Axis identifier? can be FALSE

Output Target position, Error out

Remarks Returns commanded target position.

2.4.14. 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, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS

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

C-884: This command works only in closed-loop operation. Motion commands like MOV are not allowed when control via a Human Interface Device (HID) is active on the axis.

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, OSM, OMA or OMR instead to command motion. Motion commands like MVR are not allowed when a joystick is active on the axis.

E-871: This command works only in closed-loop operation. Motion commands like MOV are not allowed when a joystick is active on the axis.

F-206, M-8X0: Check HLP?/HELP answer to find out if MVR is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

Hydra, Pollux: This command works only in closed-loop operation.

Mercury_GCS: This command works only in closed-loop operation. Motion commands like MVR are not allowed when a joystick is active on the axis.

Output Error out

Remarks Moves specified axes **relative** to current position. No. of digits is the number of digits after the decimal point in the position value(s) that will be sent.

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-709: Motion commands are not allowed when the wave generator is active or the analog input is used for target generation.

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.

2.4.15. ONT?.vi (General command.llb)

Valid for C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS (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)

E-755: If All axes? = TRUE, then Axis identifier? can be FALSE. Command not available for E-755.101

	E-816: <u>All axes?</u> = FALSE, only one axis per command allowed.
	All other systems: 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.
	F-206, M-8X0: Check HLP?/HELP answer to find out if ONT? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

2.4.16. POS?.vi (General command.IIb)

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, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS
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. 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, M-8X0: For GCS syntax version = GCS 1.0 (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), returned position value is the commanded target position for the axis.

2.4.17. PUN?.vi (General command.IIb)

Valid for	E-712, E-725, E-753, F-206, M-8X0
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) E-712, E-725, E-753, F-206, M-8X0: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	Position unit, Error out
Remarks	Returns the name of the current position unit for queried axes. E-712, E-725, E-753: Check HLP? answer to find out if PUN? is supported. F-206, M-8X0: Check HLP?/HELP answer to find out if PUN? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

2.4.18. SAI?.vi (General command.IIb)

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, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-871, F-206, Hydra, Pollux, M-8X0,
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	Mercury, Mercury_GCS (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-848: <u>Invert order</u> should be TRUE, <u>SAI? ALL</u> must be FALSE
	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-816: <u>Invert order</u> should be FALSE, <u>SAI? ALL</u> must be FALSE
	All other systems: <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.
	F-206, M-8X0: Check HLP?/HELP answer to find out if SAI? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

2.4.19. 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, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS
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.

C-884: Parameter no. format is TRUE (hex.). Use "HPA?.vi" to get valid parameter numbers or see the C-884 User Manual. Do not set more than 4 parameters at once. See E-710 for warnings.

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 (μm). (- 3.402823466e+38F to 3.402823466e+38F)
- 8: Osen (Offset of Sensor O_s). When sensor output is 0V, the actual position of stage is O_s (μm). (- 3.402823466e+38F to 3.402823466e+38F)
- 9: Kpzt (Coefficient of PZT voltage amplifier K_{pzt}). When DAC output change is 1V, the PZT Voltage change is K_{pzt} (V) (- 3.402823466e+38F to 3.402823466e+38F)

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 (μm) ($0 < \text{value} < 1000$)

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-709: Parameter no. format is TRUE (hex.). Only one parameter value for only one axis per command allowed. Use “HPA?.vi” to get valid parameter numbers or see the E-709 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 is limited to set 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.

E-870: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers or see the E-870 User Manual. See E-710 for warnings. Each command is limited to set one parameter for only one channel.

E-871: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers or see the controller User Manual. Only one parameter value for only one axis per command allowed. See E-710 for warnings.

F-206, M-8X0: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers or see the controller User Manual.

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

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

	Mercury_GCS: Parameter no. format is TRUE (hex.). Use "HPA?.vi" to get valid parameter numbers or see the Mercury User Manual. Only one parameter value for only one axis per command allowed. See E-710 for warnings.
Output	Controller error (T/F), Error out
Remarks	<p>Sets parameters, waits 100 ms and queries ERR?. For axis-related parameters, <u>Axis to set</u> is the axis name; for piezo-, sensor, PIShift- or demux-related parameters, the channel number; otherwise a parameter-related code. If parameter number is in decimal format, use <u>Parameter number</u> input, for hexadecimal parameter numbers use <u>Parameter number (hex.)</u> input and switch <u>Parameter no. format</u> to TRUE. For numeric parameter values use <u>Parameter value</u> input, for parameter strings use <u>Parameter string</u> input and switch <u>Parameter format</u> to TRUE. Do not mix decimal and hex. parameter numbers or numeric and string parameter values in one call. <u>Parameter numbers</u> which can be set depend on current CCL level. See 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 $\neq 0$.</p> <p>C-867, C-884, E-516, E-517, E-710, E-712, E-725, E-753, E-755, E-861, E-870, E-871, Hydra, Pollux, Mercury_GCS: 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.</p> <p>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).</p> <p>E-816: This command cannot be issued to a slave.</p> <p>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.</p> <p>F-206, M-8X0: Check HLP?/HELP answer to find out if SPA is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).</p> <p>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.</p>

2.4.20. SPA?.vi (General command.IIb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-870, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS
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>

- C-848: Parameter no. format is FALSE (decimal).
- C-865: Parameter no. format is FALSE (decimal). Parameter number 25 is read-only.
- C-866: Parameter no. format is FALSE (decimal). Parameter number 25 is read-only.
- C-867: 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.
- C-880: Parameter no. format is FALSE (decimal). Additional read-only parameter numbers are:
- 14: Numerator of the counts per physical unit factor (1 to 2147483647) (factor = num./denom.)
 - 15: Denominator of the counts per physical unit factor (1 to 2147483647) (factor = num./denom.)
 - 16: Drive mode: 0=Analog 1=PWM
 - 19: Axis type: 0=Linear 1=Rotary
 - 20: Reference switch: 0=no present, 1=present
 - 28: Reference status: 0=axis not referenced; 1=axis is referenced
- C-880K005: VI only supported when called through PI_Multix.vi
- C-884: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers. Do not query more than 4 parameter no. at once (except with Without axes? = TRUE) Use Without axes? = TRUE for a query of all parameters.
- E-516: Parameter no. format is FALSE (decimal).
- E-517: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers.
- E-709: Parameter no. format is TRUE (hex.). Only one parameter value for only one axis per command allowed. Use Without axes? = TRUE for a query of all parameters. Use “HPA?.vi” to get valid parameter numbers.
- E-710: Parameter no. format is TRUE (hex.). Use “HPA?.vi” to get valid parameter numbers.
- 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.

E-870: Parameter no. format is TRUE (hex.). Use "HPA?.vi" to get valid parameter numbers. Only one parameter value for only one channel per command allowed. Use Without axes? = TRUE for a query of all parameters.

E-871: 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).

F-206: Check HLP?/HELP answer to find out if SPA? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). Parameter no. format is TRUE (hex.). Use "HPA?.vi" to get valid parameter numbers. Length of command is limited by firmware (appr. 10 parameters per call), see controller User Manual for details. Use Without axes? = TRUE for a query of all parameters.

Hydra, Pollux: 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) Use Without axes? = TRUE for a query of all parameters.

M-8X0: Check HLP?/HELP answer to find out if SPA? is supported.
For GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), Parameter no. format is TRUE (hex.). Use "HPA?.vi" to get valid parameter numbers. Length of command is limited by firmware (appr. 10 parameters per call), see controller User Manual for details. Use Without axes? = TRUE for a query of all parameters.
For GCS syntax version = GCS 1.0, Parameter no. format is FALSE (decimal), Axes to query can be 1 to 6 (corresponds to strut no.) and 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.

Mercury_GCS: 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.

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-, sensor, PIShift or demux-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)

2.4.21. STP.vi (General command.IIb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-884, E-516, E-517, E-709, E-712, E-725, E-753, E-755, E-761, E-861, E-870, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS (but must be present for E-710 also). To support analog interfacing, VI must be present for E-816 also.
Input	System number (1), Affected axes? (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) Analog: <u>All axes?</u> = TRUE, <u>Axis identifier</u> = FALSE. STP does not set any error code. All other systems: <u>All axes?</u> = TRUE, <u>Axis identifier?</u> = FALSE
Output	Error out
Remarks	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. 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). E-709, 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). F-206, M-8X0: Check HLP?/HELP answer to find out if STP is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). For GCS 1.0, use STOP.vi instead.

2.4.22. SVO.vi (General command.IIb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS
Input	System number (1), Without axis ID?(F), Axes to command (empty string array), Servo mode (empty bool. array, F), Error in (no error) 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. E-816: <u>Without axis ID</u> = FALSE. Only one axis per command allowed. F-206, M-8X0: For GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), <u>Without axis ID</u> = FALSE. For GCS 1.0, <u>Without axis ID</u> = TRUE and only first field of <u>Servo mode</u> array is valid All other systems: <u>Without axis ID</u> = FALSE
Output	Error out

Remarks	<p>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.</p> <p>M-8X0: Check HLP?/HELP answer to find out if SVO is supported.</p> <p>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.</p> <p>E-861: If you have enabled servo, controller is busy for 100 ms, only after this period a next command can be performed.</p>
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2.4.23. SVO?.vi (General command.IIb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS
Input	<p>System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)</p> <p>C-843, C-843.PM, C-844: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE</p> <p>C-865, C-866: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE</p> <p>E-516, E-710: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE</p> <p>E-816: <u>All axes?</u> = FALSE, only one axis per command allowed.</p> <p>F-206: <u>All axes?</u> = TRUE, <u>Axis identifier?</u> = FALSE</p> <p>M-8X0: <u>All axes?</u> = TRUE, <u>Axis identifier?</u> = FALSE</p> <p>All other systems: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE</p>
Output	<p>Servo status (T/F), Error out</p> <p>F-206, M-8X0: For GCS syntax version = GCS 1.0 (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), only first field of <u>servo status</u> array is valid.</p>
Remarks	<p>Returns servo status of queried axes.</p> <p>F-206, M-8X0: Check HLP?/HELP answer to find out if SVO? is supported.</p>

2.4.24. VEL.vi (General command.IIb)

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, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS. To support analog interfacing, VI must be present for E-816 also.
Input	<p>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)</p> <p>Analog: <u>Without axis ID?</u> = FALSE; Velocity unit is $\mu\text{m}/\text{sec}$</p> <p>C-867, C-884, Mercury_GCS: <u>Without axis ID?</u> = FALSE. Velocity unit is mm/s.</p> <p>C-880: <u>Without axis ID?</u> = FALSE, for NanoCube axes command is not valid</p> <p>C-880K005: VI only supported when called through PI_Multix.vi</p> <p>E-516, E-709, E-712, E-725, E-753, E-861: <u>Without axis ID?</u> = FALSE. Velocity unit is $\mu\text{m}/\text{s}$.</p> <p>E-517: <u>Without axis ID?</u> = FALSE. Velocity unit is $\mu\text{m}/\text{s}$ in closed-loop operation and V/s in open-loop operation.</p>

	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, M-8X0: For GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), VEL command is only valid for velocity of axes A and/or B, <u>Without axis ID?</u> = False. For platform velocity, VI sends command VLS instead, in this case <u>Without axis ID?</u> = TRUE. For axes K, L, M command is not valid. For GCS syntax version = GCS 1.0, to set platform velocity: <u>Without axis ID?</u> = TRUE; to set velocity of axes A and/or B: <u>Without axis ID?</u> = False; axes K, L, M: command not valid.
	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, C-884, Hydra, Pollux, Mercury_GCS: 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 controller 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-709, 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.

2.4.25. VEL?.vi (General command.IIb)

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, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS. 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, C-884, Hydra, Pollux, Mercury_GCS: If All axes? = TRUE, then Axis identifier? can be FALSE. Velocity unit is mm/s.

C-843, C-843.PM, C-844, E-516: If All axes? = TRUE, then Axis identifier? must be TRUE

C-880K005: VI only supported when called through PI_Multix.vi

E-710: If All axes? = TRUE, then Axis identifier? must be TRUE. Velocity unit is $\mu\text{m}/\text{ms}$.

E-517: If All axes? = TRUE, then Axis identifier? can be FALSE. Velocity unit is $\mu\text{m}/\text{s}$ in closed-loop operation and V/s in open-loop operation.

E-709, E-712, E-725, E-753, E-861: If All axes? = TRUE, then Axis identifier? can be FALSE. Velocity unit is $\mu\text{m}/\text{s}$.

E-755: If All axes? = TRUE, then Axis identifier? can be FALSE. Velocity unit is $\mu\text{m}/\text{s}$. Command not available for E-755.101.

E-761: If All axes? = TRUE, then Axis identifier? can be FALSE. Velocity unit is $\mu\text{m}/\text{ms}$.

F-206, M-8X0: For GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), and velocity of axes A and/or B, All axes? must be FALSE. For platform velocity, All axes? must be TRUE AND Axis identifier? = FALSE; VI sends VLS? instead. For axes K, L, M command is not valid.

For GCS syntax version = GCS 1.0, Velocity of platform: All axes? = TRUE AND Axis identifier? = FALSE; velocity of axes A, B: All axes? must be FALSE; axes K, L, M: command not valid

Output Velocity, Error out

C-880: NanoCube axes will report velocity = 0

F-206, M-8X0: For platform velocity: only first field of velocity array is valid

Remarks Returns velocity setting for specified axes.

2.5. Joystick-specific VIs (“Joystick.IIb”)

2.5.1. Calculate joystick scaling.vi (Joystick.IIb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, Hydra, Pollux, Mercury_GCS
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. 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, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, Hydra, Pollux, Mercury_GCS
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.

2.5.3. 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, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, Hydra, Pollux, Mercury_GCS
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. ATZ.vi (Limits.llb)

Valid for	E-709, E-710, E-712, E-725, E-753, E-761
Input	System number (1), Affected axes (empty string array), All axes? (F), Low voltage parameter (empty num. array), Stop refnum (F), Local stop (F), Error in (no error)
Output	Error out
Remarks	Performs an automatic zero-point calibration for the specified linear axes (see User Manual for details), waits until this procedure has finished and returns whether ATZ was successful or not. Select NaN as <u>Low voltage</u> parameter if you want the controller to use the stored values it has. VI will also stop if <u>Stop refnum</u> or <u>Local stop</u> is TRUE. The home position is reset to default by ATZ. ATZ works independent of servo mode. E-709: The result of the AutoZero procedure (new offset value) is present in RAM only. To save the result to EEPROM, where it becomes the power-on default, you must run WPA.vi. For stages with ID-chip the option "Power Up Read ID-Chip" must be disabled by default to make the AutoZero result available in the future. See E-709 User Manual for details. E-712: The result of the AutoZero procedure (new offset value) is present in RAM only. To save the result to EEPROM, where it becomes the power-on default, you must run WPA.vi. For stages with ID-chip the option "Power Up Read ID-Chip" must be disabled by default to make the AutoZero result

available in the future. See E-712 User Manual for details.

E-725: The result of the AutoZero procedure (new offset value) is present in RAM only. To save the result to EEPROM, where it becomes the power-on default, you must run WPA.vi. For stages with ID-chip the option "Power Up Read ID-Chip" must be disabled by default to make the AutoZero result available in the future. See E-725 User Manual for details.

E-753: The result of the AutoZero procedure (new offset value) is present in RAM only. To save the result to EEPROM, where it becomes the power-on default, you must run WPA.vi. For stages with ID-chip the option "Power Up Read ID-Chip" must be disabled by default to make the AutoZero result available in the future. See E-753 User Manual for details.

E-761: Be aware that the result of the AutoZero procedure (new offset value) is automatically written to non-volatile memory (EPROM). For stages with ID-chip the option "Read ID-Chip always" must be disabled by default to make the AutoZero result (new offset value) available in the future. See E-761 User Manual for details.

2.6.2. ATZ?.vi (Limits.IIb)

Valid for	E-709, E-712, E-725, E-753 (but must be present for E-710 and E-761 also)
Input	System number (1), Axes to query (empty string array), All axes? (F), Axes identifier? (F), Error in (no error)
Output	ATZ successful?, Error out
Remarks	Returns if ATZ was successful or not for queried axes. E-709: 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

2.6.3. TMN?.vi (Limits.IIb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS. 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, C-884, E-517, E-709, E-712, E-725, E-753, E-761, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS: 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, C-884, E-871, Hydra, Pollux, Mercury_GCS: 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).

F-206, M-8X0: Check HLP?/HELP answer to find out if TMN? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). TMN? returns the minimum travel range of the axis with all other axes positions being zero. If this is not the case, the available travel range may be less.

2.6.4. 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, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS. To support analog interfacing, VI must be present for E-816 also.
Input	<p>System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)</p> <p>Analog, C-702, C-848, C-865, C-866, C-867, C-880, C-884, E-517, E-709, E-712, E-725, E-753, E-761, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE</p> <p>C-843, C-843.PM, C-844, E-710: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE</p> <p>E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. Command not available for E-755.101.</p>
Output	Maximum travel limit, Error out
Remarks	<p>Returns maximum (high-end) travel limit (if present, position of positive limit switch or value of positive soft limit, if set, whichever is lower).</p> <p>C-867, C-884, E-871, Hydra, Pollux, Mercury_GCS: The maximum commandable position is defined by the MAX_TRAVEL_RANGE_POS parameter ID 0x15 (SPA).</p> <p>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.</p> <p>E-861: The maximum commandable position is defined by the MAX_TRAVEL_RANGE_POS parameter, ID 0x15 (SPA).</p> <p>F-206, M-8X0: Check HLP?/HELP answer to find out if TMX? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). TMX? returns the maximum travel range of the axis with all other axes positions being zero. If this is not the case, the available travel range may be less.</p>

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. 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. Commands for Optical or Analog Signals ("Optical or Analog Input.llb")

2.8.1. TAD?.vi (Optical or Analog Input.llb)

Valid for	E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-870, F-206, M-8X0
Input	System number (1), Sensors to query (empty string array), All sensors? (F), Sensor identifier? (T), Error in (no error) E-710: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> must be TRUE. E-517, E-709, E-712, E-725, E-753, E-870, F-206, M-8X0: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> must be FALSE. E-755: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> must be FALSE. Command not available for E-755.101. E-761: <u>Sensors to query</u> can be 1 to 3. If <u>All sensors?</u> = TRUE, then <u>Sensor</u>

	<u>identifier?</u> can be FALSE.
Output	AD value, Error out
Remarks	<p>Returns AD value for the specified sensor number.</p> <p>E-517: The input signal channels to be queried with TAD? are the sensor channels of the piezo control electronics, IDs = 1 to 3 (actually available IDs depend on the response to TSC?).</p> <p>E-709: <u>Sensors to query</u> comprises all ADC channels of the device: can be the "genuine" sensor (sensor integrated in the mechanics, identifier = 1) and the "general purpose" analog input (identifier = 2).</p> <p>E-710: Command is available for 4-channel version only and in command level 1 only (see "CCL.vi", "CCL?.vi")</p> <p>E-712: <u>Sensors to query</u> comprises all ADC channels of the device: can be a "genuine" sensor (capacitive sensor integrated in the mechanics) or a "general purpose" analog input.</p> <p>E-725: <u>Sensors to query</u> comprises all ADC channels of the device: can be a "genuine" sensor (capacitive sensor integrated in the mechanics) or a "general purpose" analog input.</p> <p>E-753: <u>Sensors to query</u> comprises all ADC channels of the device: can be the "genuine" sensor (capacitive sensor integrated in the mechanics, identifier = 1) and the "general purpose" analog input (identifier = 2).</p> <p>E-870: <u>Sensors to query</u> comprises all ADC channels of the device: can be the analog command input (identifier = 1) or other internal on board sources for diagnosis information (identifier = 2...5).</p> <p>F-206, M-8X0: Check HLP?/HELP answer to find out if TAD? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).</p>

2.8.2. TNS?.vi (Optical or Analog Input.IIb)

Valid for	E-709, E-710, E-712, E-725, E-753, E-755, E-761
Input	<p>System number (1), Sensors to query (empty string array), All sensors? (F), Sensor identifier? (T), Error in (no error)</p> <p>E-709: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> must be FALSE.</p> <p>E-710: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> must be TRUE.</p> <p>E-712: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> must be FALSE.</p> <p>E-725: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> must be FALSE.</p> <p>E-753: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> must be FALSE.</p> <p>E-755: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> must be FALSE. Command not available for E-755.101.</p> <p>E-761: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> can be FALSE.</p>
Output	Nom. sensor value, Error out
Remarks	<p>Returns normalized sensor value for the specified sensor number.</p> <p>E-709: <u>Sensors to query</u> comprises all ADC channels of the device: can be the "genuine" sensor (sensor integrated in the mechanics, identifier = 1) and the "general purpose" analog input (identifier = 2).</p> <p>E-710: Command is available in command level 1 only (see "CCL.vi", "CCL?.vi")</p> <p>E-712: <u>Sensors to query</u> comprises all ADC channels of the device: can be a "genuine" sensor (capacitive sensor integrated in the mechanics) or a</p>

"general purpose" analog input.

E-725: Sensors to query comprises all ADC channels of the device: can be a "genuine" sensor (capacitive sensor integrated in the mechanics) or a "general purpose" analog input.

E-753: Sensors to query comprises all ADC channels of the device: can be the "genuine" sensor (capacitive sensor integrated in the mechanics, identifier = 1) and the "general purpose" analog input (identifier = 2).

2.8.3. TSC?.vi (Optical or Analog Input.llb)

Valid for	E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761 (but must be present for Analog systems, C-867, E-516, E-816, E-861, E-870, E-871, F-206, M-8X0 and Mercury_GCS also)
Input	System number (1), Error in (no error)
Output	Number of sensor channels, Error out
Remarks	Returns the number of available sensor channels. E-517: Using the Sensor Enable parameter, ID 0x02000000, you can change the E-517 configuration in case of hardware changes, e.g. if you install additional sensor and/or amplifier channels in the system. If this parameter is changed, the Number Of Sensor Channels parameter is adapted automatically. E.g. if parameter 0x02000000 is set to "disabled" for a sensor channel, this sensor channel is no longer included in the TSC? response. See "Configure Axes and Channels" in the E-517 User manual for details. E-712, E-725: The response comprises all ADC channels of the device: "genuine" sensors (capacitive sensors integrated in the mechanics) and "general purpose" analog input channels. E-753: The response comprises all ADC channels of the device: the "genuine" sensor (capacitive sensor integrated in the mechanics) and the "general purpose" analog input. E-709: The response comprises all ADC channels of the device: the "genuine" sensor (sensor integrated in the mechanics) and the "general purpose" analog input.

2.8.4. TSP?.vi (Optical or Analog Input.llb)

Valid for	E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761
Input	System number (1), Sensors to query (empty string array), All sensors? (F), Sensor identifier? (T), Error in (no error) E-517, E-761: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> can be FALSE. E-710: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> must be TRUE. E-709, E-712, E-725, E-753: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> must be FALSE. E-755: If <u>All sensors?</u> = TRUE, then <u>Sensor identifier?</u> can be FALSE. Command not available for E-755.101.
Output	Sensor position, Error out
Remarks	Returns sensor position for the specified sensor number. E-709: <u>Sensors to query</u> comprises all ADC channels of the device: can be the "genuine" sensor (sensor integrated in the mechanics, identifier = 1) and the "general purpose" analog input (identifier = 2). E-517: The input signal channels to be queried with TSP? are the sensor channels of the piezo control electronics, IDs = 1 to 3 (actually available IDs depend

on the response to TSC?).

E-710: Command is available in command level 1 only (see "CCL.vi", "CCL?.vi")

E-712, E-725: Sensors to query comprises all ADC channels of the device: can be a "genuine" sensor (capacitive sensor integrated in the mechanics) or a "general purpose" analog input.

E-753: Sensors to query comprises all ADC channels of the device: can be the "genuine" sensor (capacitive sensor integrated in the mechanics, identifier = 1) and the "general purpose" analog input (identifier = 2).

2.9. PZT specific VIs ("PZT voltage.llb")

2.9.1. DPO.vi (PZT voltage.llb)

Valid for	E-710, E-712, E-725, E-753
Input	System number (1), DPO axes (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) 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
Output	Error out
Remarks	DDL processing parameter correction for specified axis. Calculates internal DDL processing parameters. DPO is required when servo parameters have changed for an axis. E-710: Command is available in command level 1 only (see "CCL.vi", "CCL?.vi")

2.9.2. DTC.vi (PZT voltage.llb)

Valid for	E-710, E-712, E-725, E-753, E-761
Input	System number (1), DTC table (empty string array), All tables? (F), Error in (no error) E-710: <u>All tables?</u> must be FALSE. E-712: <u>All tables?</u> must be FALSE. E-725: <u>All tables?</u> must be FALSE. E-753: <u>All tables?</u> must be FALSE. E-761: <u>All tables?</u> must be FALSE.
Output	Error out
Remarks	Clears DDL table.

2.9.3. OVF?.vi (PZT voltage.llb)

Valid for	E-516, E-517, E-709, E-712, E-725, E-753, E-761, E-816
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) E-516: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-517, E-709, E-712, E-725, E-753, E-761: If <u>All axes?</u> = TRUE, then <u>Axis</u>

identifier? can be FALSE

E-816: All axes? = FALSE, only one axis per command allowed.

Output Axis overflow? (T/F), Error out
Remarks Returns overflow information for queried axes.

2.9.4. SVA.vi (PZT voltage.llb)

Valid for E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816

Input System number (1), Axes to move (empty string array), PZT voltage (empty num. array, 0), No. of digits (4), Error in (no error)

E-816: Only one axis per command allowed. It is necessary to wait a certain time before sending the next command to prevent it from being lost.

Output Error out

Remarks Sets absolute PZT voltage for specified axes. Servo must be switched off (using "SVO.vi") when using this command. No. of digits is the number of digits after the decimal point in the voltage value(s) that will be sent.

E-517: Motion commands like SVA 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, SVA 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-709: Motion commands are not allowed when a wave generator is active or the analog input is used for target generation.

E-712: For axes driven by conventional piezo actuators, PZT voltage is a dimensionsless value whose range corresponds approximately to the mechanics travel range in μm .
For axes driven by NEXLINE® drives, PZT voltage is given in volts. SVA affects only the shearing segments of the NEXLINE® stack actuators. Hence SVA will cause motion in analog mode only.
Motion commands are not allowed when a wave generator is active or the analog input is used for target generation.

E-725, E-753: PZT voltage is a dimensionsless value whose range corresponds approximately to the mechanics travel range in μm .
Motion commands are not allowed when a wave generator is active or the analog input is used for target generation.

E-761: PZT voltage is a dimensionsless value whose range corresponds approximately to the mechanics travel range in μm . Motion commands are not allowed when a wave generator is active.

2.9.5. SVA?.vi (PZT voltage.llb)

Valid for E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816

Input System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)

E-516, E-710: If All axes = TRUE, then Axis identifier? must be TRUE

E-517, E-709, E-712, E-725, E-753, E-755, E-761: If All axes = TRUE, then Axis identifier? can be FALSE

E-816: All axes? = FALSE, only one axis per command allowed.

Output Commanded PZT voltage, Error out

Remarks Returns commanded PZT voltage for queried axes.

E-712, E-725, E-753, E-761: The response is a dimensionsless value whose range corresponds approximately to the mechanics travel range in μm .

2.9.6. SVR.vi (PZT voltage.llb)

Valid for	E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816
Input	System number (1), Axes to move (empty string array), PZT voltage (empty num. array, 0), No. of digits (4), Error in (no error) E-816: Only one axis per command allowed. It is necessary to wait a certain time before sending the next command to prevent it from being lost.
Output	Error out
Remarks	Sets relative PZT voltage for specified axes. Servo must be switched off (using "SVO.vi") when using this command. <u>No. of digits</u> is the number of digits after the decimal point in the voltage value(s) that will be sent. E-517: Motion commands like SVR 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, SVR 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-709: Motion commands are not allowed when a wave generator is active or the analog input is used for target generation. E-712: SVR is valid for axes driven by conventional piezo actuators only. <u>PZT voltage</u> is a dimensionsless value whose range corresponds approximately to the mechanics travel range in μm . Motion commands are not allowed when a wave generator is active or the analog input is used for target generation. E-725, E-753: <u>PZT voltage</u> is a dimensionsless value whose range corresponds approximately to the mechanics travel range in μm . Motion commands are not allowed when a wave generator is active or the analog input is used for target generation. E-761: <u>PZT voltage</u> is a dimensionsless value whose range corresponds approximately to the mechanics travel range in μm . Motion commands are not allowed when a wave generator is active.

2.9.7. VOL?.vi (PZT voltage.llb)

Valid for	Analog systems, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816
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. VI reads control voltage. 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. <u>Axes to query</u> are piezo channel numbers E-710: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE. <u>Axes to query</u> are piezo channel numbers. E-709, E-712, E-725, E-753, E-755: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. <u>Axes to query</u> are piezo channel numbers. E-761: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE. <u>Axes to query</u> are piezo channel numbers, which can be 1 to 4.

	E-816: <u>All axes?</u> = FALSE, only one axis per command allowed.
Output	Current PZT voltage, Error out
Remarks	Returns current PZT voltage for queried axes / piezo channels.

2.10. Support VIs for scanning algorithms (“Scan support.llb”)

2.10.1. Axis names.vi (Scan support.llb)

Valid for	Analog systems, C702, C-866, C-867, C-880, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-871, F-206, M-8X0, Mercury_GCS. To support analog interfacing, VI must be present for E-816 also.
Input	Names (empty string array)
Output	X axis name, Y axis name, Z axis name
Remarks	Checks if "Names" contains three strings for axis names. If this is not the case, it assigns "X Values", "Y Values" and/or "Z Values" as the missing axis name. Sub-VI for “Show_Save_Load_XY_Data.vi”

2.11. Special commands (“Special command.llb”)

2.11.1. #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, C-884, E-516, E-517, E-709, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-870, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS (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.

2.11.2. #5.vi (Special command.IIb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-884, E-517, E-709, E-712, E-725, E-753, E-755, E-761, E-861, E-870, E-871, Hydra, Pollux, Mercury, Mercury_GCS (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	<p>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".</p> <p>Analog: Motion status can only be determined for all connected axes, not for single axes.</p> <p>F-206: For GCS syntax version = GCS 1.0 (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), coding in answer is different, please use #5_old.vi.</p> <p>M-8X0: For GCS syntax version = GCS 1.0 (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), coding in answer is different, please use #5_old.vi.</p>

2.11.3. #7.vi (Special command.IIb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, C-884, E-517, E-709, E-710, E-712, E-725, E-755, E-761, E-861, E-870, E-871, Hydra, Pollux, Mercury, Mercury_GCS (but must be present for E-516, E-753, E-816, F-206, M-8X0 also)
Input	<p>System number (1), Error in (no error)</p> <p>C-880K005: VI only supported when called through PI_Multix.vi</p> <p>F-206: Check HLP?/HELP answer to find out if #7 is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).</p> <p>M-8X0: Check HLP?/HELP answer to find out if #7 is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).</p>
Output	Ready? (T/F), String read, Error out
Remarks	<p>Sends the single ASCII character 7 and returns the ready status of the controller. Sub-VI for "Wait for answer of longlasting command.vi".</p> <p>E-712: This VI is to be used during reference moves only. Check HLP? answer to find out if #7 is supported.</p>

2.11.4. AOS.vi (Special command.IIb)

Valid for	E-709, E-712, E-725, E-753
Input	System number (1), Axes to set (empty string array), Analog offset values (empty num. array, 0), No. of digits (4), Error in (no error)
Output	Error out
Remarks	Set Analog Input Offset. This command adds an offset value to an input value of an analog input, which is configured as analog target position for the selected axis. The target position of the selected axis is Target = Analog Input + Offset. <u>No. of digits</u> is the number of digits after the decimal

point in the position value(s) that will be sent.

2.11.5. AOS?.vi (Special command.IIb)

Valid for	E-709, E-712, E-725, E-753
Input	System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) E-709, E-712, E-725, E-753: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE
Output	Analog offset, Error out
Remarks	Returns analog input offset, which was set by AOS or by a parameter command.

2.11.6. CCL.vi (Special command.IIb)

Valid for	C-867, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-870, E-871, F-206, M-8X0
Input	System number (1), Password (100), Command level (0), Error in (no error) C-867, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-870, E-871, F-206, M-8X0: Command level can be 0 (only commands needed for normal operation are available) or 1 (all commands from command level 0 plus special commands for advanced users are available). Password for CCL 1 is "ADVANCED".
Output	Error out, Hidden error
Remarks	If password is correct, this vi sets the command level of the controller and queries ERR?. <u>Hidden error</u> is TRUE if selected system reports error code $\neq 0$. User "HLP?.vi" to determine which commands are available in the current command level. C-867: Check HLP? answer to find out if CCL is supported. F-206: Check HLP?/HELP answer to find out if CCL is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). M-8X0: Check HLP?/HELP answer to find out if CCL is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

2.11.7. CCL?.vi (Special command.IIb)

Valid for	C-702, C-867, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-816, E-870, E-871, F-206, M-8X0
Input	System number (1), Error in (no error)
Output	Command level, Error out
Remarks	Returns the current command level. C-867: Check HLP? answer to find out if CCL? is supported. E-816: This command cannot be issued to a slave. Check controller manual to find out if CCL? is supported. F-206: Check HLP?/HELP answer to find out if CCL? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). M-8X0: Check HLP?/HELP answer to find out if CCL? is supported. Only for GCS

syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

2.11.8. 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, C-884, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS
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, C-884, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-871, Hydra, Pollux, Mercury, Mercury_GCS: 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 HLP?/HELP answer to find out if CST? is supported.

2.11.9. CTO.vi (Special command.llb)

Valid for	C-702, C-843, C-866, C-867, C-884, E-517, E-709, E-712, E-725, E-753, E-871, Mercury, Mercury_GCS
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. C-867, C-884, E-871: Check the User Manual of the controller for available output trigger numbers. E-517: <u>TriggerOut to set</u> can be 1 to 3. E-709: <u>TriggerOut to set</u> can be 1 to 2. 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). Mercury_GCS: Check Mercury User Manual for available output trigger numbers.
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.
- C-867: Check HLP? answer to find out if CTO is supported.
- 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 μ s 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 μ s.
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-709: 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.
- 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.

2.11.10. CTO?.vi (Special command.llb)

Valid for	C-702, C-843, C-866, C-867, C-884, E-517, E-709, E-712, E-725, E-753, E-871, Mercury, Mercury_GCS
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. C-867, C-884, E-871: Check the User Manual of the controller for available output

trigger numbers.

E-517: TriggerOut to query can be 1 to 3.

E-709: TriggerOut to query can be 1 to 2.

E-712: TriggerOut to query can be 1 to 7.

E-725: TriggerOut to query can be 1 to 7.

E-753: 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).

Mercury_GCS: Check Mercury User Manual for available output trigger numbers.

Output Parameter value, Error out

Remarks Returns the Trigger Output configuration for the given trigger output line.
C-867: Check HLP? answer to find out if CTO? is supported.

2.11.11. DRC.vi (Special command.IIb)

Valid for C-702, C-843, C-866, C-867, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-861, E-871, F-206, M-8X0, Mercury_GCS

Input System number (1), Rec. table (0), Source ID (empty string), Rec. option (0), Trigger option (0), Error in (no error)
C-843, C-866, C-884, E-517, E-709, E-712, E-725, E-753, E-861, E-871, F-206, M-8X0, Mercury_GCS: Trigger option must be 0.
E-710: Rec. table and Source ID 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: Trigger option must be 0. Controller error is TRUE if selected system reports error code $\neq 0$.
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, 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.
C-884: See User Manual for available record options. The C-884 has eight 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-709: See User Manual for available record options. By default, the number of data recorder tables is 4. It can be reduced by setting the appropriate parameter value, see User Manual for details.
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.

E-871: See User Manual for available record options.

The E-871 has two data recorder tables with 1024 points per table.

F-206, M-8X0: Check HLP?/HELP answer to find out if DRC is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). See User Manual for available record options, trigger options, number of data recorder tables and points per table. The number of points can be changed by setting the appropriate parameter value, see User Manual of the controller for details.

Mercury_GCS: See User Manual for available record options.

The Mercury_GCS has two data recorder tables with 1024 points per table.

2.11.12. DRC?.vi (Special command.IIb)

Valid for	C-702, C-843, C-866, C-867, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-861, E-871, F-206, M-8X0, Mercury_GCS
Input	System number (1), Rec. table to query (empty num. array, 0), With Rec. table IDs? (F), 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, C-884, E-517, E-709, E-712, E-725, E-753, E-861, E-871, F-206, M-8X0, Mercury_GCS: <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. F-206, M-8X0: Check HLP?/HELP answer to find out if DRC? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

2.11.13. DRL?.vi (Special command.IIb)

Valid for	C-867, C-884, E-709, E-712, E-725, E-753, E-871, F-206, M-8X0
Input	System number (1), Rec. table to query (empty num. array, 0), With Rec. table IDs? (F), Error in (no error)
Output	No. of rec. values (empty num. array, 0), Error out
Remarks	This VI returns the number of recorded data values for the given record tables. C-867: Check HLP? answer to find out if DRL? is supported. E-712, E-725, E-753: Check HLP? answer to find out if DRL? is supported. F-206, M-8X0: Check HLP?/HELP answer to find out if DRL? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

2.11.14. DRR?.vi (Special command.IIb)

Valid for	Analog systems, C-702, C-843, C-866, C-867, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-871, F-206, M-8X0, Mercury_GCS. 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: Rec. table IDs, xo, N and Nmax are not valid. Without parameter? must be TRUE.

C-702: Xo >= 0. Nmax = 262144.

C-843: Xo >= 1. Check C-843 User Manual for valid Nmax 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 N = -1 all points of the last record are returned.

C-866: Xo >= 1. Nmax = 32,256. If N = -1 all points of the last record are returned.

C-867: Xo >= 1. Nmax = 8192.

C-884: Xo >= 1. Nmax = 8192.

E-517: Xo >= 1. Nmax = 8192.

E-709: Xo >= 1. Nmax = 4096.

E-710: Xo >= 1. Nmax = 32256.

E-712: Xo >= 1. Nmax = 262,144.

E-725: Xo >= 1. Nmax = 262,144.

E-753: Xo >= 1. Nmax = 65,536.

E-755: Xo >= 1. Nmax = 4096.

E-761: Xo >= 0. Nmax = 8192.

E-861: Xo >= 1. Nmax = 1024.

E-871: Xo >= 1. Nmax = 1024.

F-206: Xo >= 1. See the User Manual of the controller for Nmax default value (can be changed with SPA.vi).

M-8X0: For GCS syntax version = 1.0 (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), Rec. table IDs, xo, N and Nmax are not valid and Without parameter? must be TRUE.

For GCS syntax version = 2.0, Xo >= 1. See the User Manual of the controller for Nmax default value (can be changed with SPA.vi).

Mercury_GCS: Xo >= 1. Nmax = 1024.

Output Data, Names, Sample time, Error out

Remarks Returns N recorded data points. If N is greater than Nmax, multiple queries are sent. For large Nmax 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.

C-884: The number of tables is 8.

E-517: The number of tables is 3.

E-709: The 4096 points are in equal shares assigned to the available data recorder tables. By default, the number of tables is 4. It can be reduced by setting the appropriate parameter value, see E-709 User Manual for details.

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.

E-871: Two data recorder tables with 1024 points per table are provided.

F-206: Check HLP?/HELP answer to find out if DRR? is supported. Only for GCS syntax version = GCS 2.0 or higher (check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). See controller User Manual for available data recorder tables and points.

M-8X0: Only supported if controller is based on C-842.80 board or GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). Check HLP?/HELP answer to find out if DRR? is supported. For GCS 1.0, returns 360 motor current values recorded during execution of DRV.
For GCS 2.0 and higher, see controller User Manual for available data recorder tables and points.

Mercury_GCS: Two data recorder tables with 1024 points per table are provided.

2.11.15. DRR? and display data.vi (Special command.IIb)

Valid for Analog systems, C-702, C-843, C-866, C-867, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-871, F-206, M-8X0, Mercury_GCS. 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: Rec. table IDs, xo, N and Nmax are not valid. Without parameter? must be TRUE.

C-702: Xo >= 0. Nmax = 262144.

C-843: Xo >= 1. Nmax 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.

C-866: Xo >= 1. Nmax = 32,256. If N = -1 all points of the last record are returned.

C-867: Xo >= 1. Nmax = 8192.

C-884: Xo >= 1. Nmax = 8192.

E-517: Xo >= 1. Nmax = 8192.

E-709: Xo >= 1. Nmax = 4096.

	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.
	E-871: <u>Xo</u> >= 1. <u>Nmax</u> = 1024.
	F-206: <u>Xo</u> >= 1. See C-887 User Manual for <u>Nmax</u> default value(can be changed with SPA.vi).
	M-8X0: For GCS syntax version = 1.0 (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), <u>Rec. table IDs</u> , <u>xo</u> , <u>N</u> and <u>Nmax</u> are not valid and <u>Without parameter?</u> must be TRUE. For GCS syntax version = 2.0, <u>Xo</u> >= 1. See C-887 User Manual for <u>Nmax</u> default value (can be changed with SPA.vi).
	Mercury_GCS: <u>Xo</u> >= 1. <u>Nmax</u> = 1024.
Output	Data, Names, Sample time, Error out
Remarks	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. If Sample time is zero, it is set to 1.0 for displaying data in the 2D graph only.
	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.
	C-884: The number of tables is 8.
	E-517: The number of tables is 3.
	E-709: The 4096 points are in equal shares assigned to the available data recorder tables. By default, the number of tables is 4. It can be reduced by setting the appropriate parameter value, see E-709 User Manual for details.
	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.

E-871: Two data recorder tables with 1024 points per table are provided.

F-206: Check HLP?/HELP answer to find out if DRR? is supported. Only for GCS syntax version = GCS 2.0 or higher (check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). See controller User Manual for available data recorder tables and points.

M-8X0: Only supported if controller is based on C-842.80 board or GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). Check HLP?/HELP answer to find out if DRR? is supported. For GCS 1.0, returns 360 motor current values recorded during execution of DRV.
For GCS 2.0 and higher, see controller User Manual for available data recorder tables and points.

Mercury_GCS: Two data recorder tables with 1024 points per table are provided.

2.11.16. DRT.vi (Special command.llb)

Valid for	C-702, C-843, C-866, C-867, C-884, E-709, E-712, E-725, E-753, E-755, E-861, E-871, F-206, M-8X0, Mercury_GCS
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, C-884, E-709, E-861, E-871, Mercury_GCS: See User Manual for available trigger sources and values. <u>DataRecorderTable</u> = 0 (the specified trigger source is set for all data recorder tables). E-712, E-725, E-753: See User Manual for available trigger sources and values. The specified trigger source is set for all data recorder tables. Check HLP? answer to find out if DRT is supported. F-206, M-8X0: Check HLP?/HELP answer to find out if DRT is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). See User Manual of the controller for available trigger sources and values. <u>DataRecorderTable</u> = 0 (the specified trigger source is set for all data recorder tables).

2.11.17. DRT?.vi (Special command.llb)

Valid for	C-702, C-843, C-866, C-867, C-884, E-709, E-712, E-725, E-753, E-755, E-861, E-871, F-206, M-8X0, Mercury_GCS
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	<p>This VI returns the Data Recorder Trigger source and value for the queried data recorder tables.</p> <p>E-712, E-725, E-753: Check HLP? answer to find out if DRT? is supported.</p> <p>F-206, M-8X0: Check HLP?/HELP answer to find out if DRT? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).</p>
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2.11.18. HDR?.vi (Special command.IIb)

Valid for	C-866, C-867, C-884, E-517, E-709, E-712, E-725, E-753, E-861, E-871, F-206, M-8X0, Mercury_GCS
Input	System number (1), Section header (empty string), Error in (no error)
Output	Data recorder help string, Lines, Enum values, Error out
Remarks	<p>Returns help on data recording: possible parameter values for record sources and record trigger options (DRC, DRT), parameters to set and other information. If <u>Section header</u> contains a valid section name, <u>Lines</u> and <u>Enum values</u> return the correspondig section content.</p> <p>F-206, M-8X0: Check HLP?/HELP answer to find out if HDR? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).</p>

2.11.19. IMP.vi (Special command.IIb)

Valid for	E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, F-206, M-8X0
Input	<p>System number (1), Axis to command (empty string), Impulse size (0), Delay (0), No. of digits (4), Error in (no error)</p> <p><u>E-517, E-709, E-710, E-712, E-725, E-753, E-755, F-206, M-8X0: Delay = 0.</u></p> <p><u>E-761: Delay</u> is impuls width in servo loops. Default value is 0 (for one servo loop)</p>
Output	Error out
Remarks	<p>Performs a single impulse-move (two equal moves in opposite directions in quick succession) from the current position with specified <u>Impulse size</u> (amplitude), and records fixed number of actual positions at specified intervals thereafter. If supported, <u>Delay</u> sets the number of servo loops between each position recording. <u>No. of digits</u> is the number of digits after the decimal point in the impulse amplitude values that will be sent. Controller saves a fixed number of position values, which can be read out with IMP?.vi (GCS 1.0) or DRR?.vi (GCS 2.0).</p> <p>E-517: Controller saves up to 8,192 position values. Typically, IMP is used in open-loop mode. For a single step-move, see "STE.vi". Use DRR?.vi to read recorded values back. The number of servo cycles used for data recording depends on the setting made with RTR.</p> <p>Motion commands like IMP 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, IMP 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.</p> <p>E-709: Controller saves up to 4096 position values. Typically, IMP is used in open-loop mode. For a single step-move, see "STE.vi". Use DRR?.vi to read recorded values back. The number of servo cycles used for data recording depends on the setting made with RTR.</p> <p>Motion commands are not allowed when the wave generator is active or the analog input is used for target generation.</p>

- E-710: Controller saves 32,256 position values. Width of impulse and sampling interval taken from "Table Rate" parameter, set with "SPA_Hex.vi".
Caution: "Table Rate" parameter influences Wave Generator also, not only IMP. Typically, IMP is used in open loop mode. For a single step-move, see "STE.vi". Use IMP?.vi to read position values back.
- E-712: Controller saves up to 262,144 position values. Typically, IMP is used in open-loop mode. For a single step-move, see "STE.vi". Use DRR?.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. Typically, IMP is used in open-loop mode. For a single step-move, see "STE.vi". Use DRR?.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. Typically, IMP is used in open-loop mode. For a single step-move, see "STE.vi". Use DRR?.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. Typically, IMP is used in open-loop mode. For a single step-move, see "STE.vi". Use DRR?.vi to read recorded values back.
- E-761: Controller saves 8,192 position values. Typically, IMP is used in open loop mode. For a single step-move, see "STE.vi". The number of servo cycles used for data recording depends on the setting made with RTR. Use DRR?.vi or IMP?.vi to read position values back.
- F-206, M-8X0: Check HLP?/HELP answer to find out if IMP is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). See controller User Manual for number of points (can be changed by setting the appropriate parameter value). For a single step move, see "STE.vi". Use DRR?.vi to read recorded values back.

2.11.20. RBT.vi (Special command.llb)

Valid for	C-702, C-867, C-884, E-517, E-709, E-712, E-725, E-753, E-755, E-761, E-861, E-870, E-871, F-206, Hydra, Pollux, M-8X0, Mercury_GCS
Input	System number (1), Error in (no error)
Output	Error out
Remarks	Reboots the controller. The controller behaves like after a cold start. F-206, M-8X0: For GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

2.11.21. RPA.vi (Special command.llb)

Valid for	C-867, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-870, E-871, Mercury_GCS
Input	System number (1), Affected axes (empty string array), Parameter to restore (empty num. array), Parameter to restore (hex.) (empty hex. array),

Parameter no. format (Decimal: FALSE) (F), Error in (no error)

E-710, E-761: If Affected axes = empty array, all parameters for all axes are restored. Parameter no. format is TRUE (hex.). Use "HPA?.vi" to get valid parameter numbers or see the E7XX_GCS_DLL Manual.

E-517, E-712, E-725, E-753, E-755: If Affected axes = empty array, all parameters for all axes are restored. Parameter no. format is TRUE (hex.). Use "HPA?.vi" to get valid parameter numbers or see User Manual.

C-867, E-709, E-861, E-870, E-871, Mercury_GCS: You can reset either all parameters or one single parameter with RPA. If Affected axes = empty array, all parameters for all axes are restored. Parameter no. format is TRUE (hex.). Use "HPA?.vi" to get valid parameter numbers or see User Manual.

C-884: You can reset either all parameters or up to four single parameters per command call with RPA. If Affected axes = empty array, all parameters for all axes are restored. Parameter no. format is TRUE (hex.). Use "HPA?.vi" to get valid parameter numbers or see User Manual.

Output Error out, Hidden error

Remarks Replaces the current values of the given parameters to restore for Affected axes in the controller RAM with the values from non-volatile memory, waits 5000 ms and queries ERR?. For axis-related parameters, Affected axes 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 to restore input, for hexadecimal parameter numbers use Parameter to restore (hex.) input and switch Parameter no. format to TRUE. Do not mix decimal and hex. parameter numbers in one call. See GCS DLL manual for available parameter numbers and values. If Affected axes is an empty array, RPA is sent without axis (item) and parameter specification and controller restores all values for all axes (items). Hidden error is TRUE if selected system reports error code ≠ 0.

2.11.22. RTR.vi (Special command.IIb)

Valid for C-843, C-867, C-884, E-517, E-709, E-712, E-725, E-753, E-761, E-861, E-871, F-206, M-8X0, Mercury_GCS

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. Hidden error is TRUE if selected system reports error code ≠ 0.

F-206, M-8X0: Check HLP?/HELP answer to find out if RTR is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

2.11.23. RTR?.vi (Special command.IIb)

Valid for C-843, C-867, C-884, E-517, E-709, E-712, E-725, E-753, E-761, E-861, E-871, F-206, M-8X0, Mercury_GCS

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

Output Record table rate, Error out

Remarks Returns the current table rate.

F-206, M-8X0: Check HLP?/HELP answer to find out if RTR? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

2.11.24. SEP.vi (Special command.llb)

Valid for	C-867, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-870, E-871, Mercury_GCS
Input	<p>System number (1), Password (100), 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)</p> <p>C-867, E-871, Mercury_GCS: <u>Parameter no. format</u> is TRUE (hex.). You can write only one single parameter per SEP command. Interpolation unit parameters (if any) cannot be changed with SEP. See User manual for more information.</p> <p>C-884: <u>Parameter no. format</u> is TRUE (hex.). You can write up to four single parameters per SEP command. See User manual for more information.</p> <p>E-709: <u>Parameter no. format</u> is TRUE (hex.). You can write only one single parameter per SEP command.</p> <p>E-710: <u>Parameter no. format</u> is TRUE (hex.). Command is available in command level 1 only (see "CCL.vi", "CCL?.vi"). Command writes parameters to Eprom and RAM</p> <p>E-517, E-712, E-725, E-753, E-755, E-761: <u>Parameter no. format</u> is TRUE (hex.)</p> <p>E-712, E-725, E-753: Do not set more than 10 parameters at once.</p> <p>E-861: <u>Parameter no. format</u> is TRUE (hex.) You can write only one single parameter per SEP command. The GEMAC parameters (ID 0x7000010 to ID 0x700001F) cannot be changed with SEP. Use SPA and WPA instead to save their values to non-volatile memory. See "GEMAC Parameter Adjustment" in the E-861 User manual for more information.</p> <p>E-870: <u>Parameter no. format</u> is TRUE (hex.). You can write only one single parameter per SEP command.</p>
Output	Hidden error (T/F), Error out
Remarks	<p>If <u>Password</u> is correct, this VI sets parameters for commanded axes to EPROM, waits 100 ms and queries ERR?. For axis-related parameters, <u>Axis to set</u> 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 <u>Parameter number</u> input, for hexadecimal parameter numbers use <u>Parameter number (hex.)</u> input and switch <u>Parameter no. format</u> to TRUE. For numeric parameter values use <u>Parameter value</u> input, for parameter strings use <u>Parameter string</u> input and switch <u>Parameter format</u> to TRUE. Do not mix decimal and hex. parameter numbers or numeric and string parameter values in one call. <u>Parameter numbers</u> which can be set depend on current CCL level. Use "HPA?.vi" to get valid parameter numbers or see 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>Hidden error</u> is TRUE if selected system reports error code ≠ 0.</p> <p>Note: This command sets the same parameters as SPA, but SPA writes them only to volatile memory, while SEP only writes to non-volatile</p>

memory. After parameters were set with SEP, use RPA to activate them (write them to volatile memory), or they become active after next power up.

E-712, E-725, E-753: Requires command level 1 ("CCL.vi")

E-709: Required command level depends on parameter ("CCL.vi")

E-517: Requires command level 1 ("CCL.vi") for parameter 0X02000000 (used to enable/disable axes which is only required if the hardware configuration is changed), 0x04000E00 and 0x04000E01 (used to configure unit and format of the LCD display on the E-517 front panel).

2.11.25. SEP?.vi (Special command.llb)

Valid for	C-867, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-870, E-871, Mercury_GCS
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>All systems: Use "HPA?.vi" to get valid parameter numbers. Parameter no. format is TRUE (hex).</p> <p>C-867, E-709, E-871, Mercury_GCS: Only one parameter value for only one axis per command allowed. Use <u>Without axes?</u> = TRUE for a query of all parameters.</p> <p>C-884: Use <u>Without axes?</u> = TRUE for a query of all parameters.</p> <p>E-712, E-725, E-753: Do not query more than 10 parameter no. at once (except with <u>Without axes?</u> = TRUE).</p> <p>E-861: Only one parameter value for only one axis per command allowed. Use <u>Without axes?</u> = TRUE for a query of all parameters.</p> <p>E-870: Only one parameter value for only one axis per command allowed. Use <u>Without axes?</u> = TRUE for a query of all parameters.</p>
Output	Parameter value, Parameter string, Error out
Remarks	<p>Returns parameter values from non-volatile memory for queried axes and parameter numbers. For axis-related parameters, <u>Axes to query</u> 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. Do not mix decimal and hex. parameter numbers in one call. If <u>Without axes?</u> 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.</p>

2.11.26. STA?.vi (Special command.llb)

Valid for	C-702, C-848, C-880, C-880K005, F-206, M-8X0 (but must be present in Special command.llb for all other systems also)
Input	<p>System number (1), Axes to query (empty string array), All axes? (F), Axis identifier? (T), Error in (no error)</p> <p>C-702: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE</p> <p>C-848: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE</p> <p>C-880: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> can be FALSE</p>

Output

C-880K005: VI only supported when called through PI_Multix.vi

F-206, M-8X0: All axes? = TRUE, Axis identifier? = FALSE

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:

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".

F-206, M-8X0: Check HLP?/HELP answer to find out if STA? is supported. Command is equivalent to #4. For details see User Manual of the controller.

2.11.27. STE.vi (Special command.IIb)

Valid for Analog systems, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-871, F-206, M-8X0, Mercury_GCS. 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: Delay = 0.

Output Error out

Remarks Performs a step-move from the current position with specified step size (amplitude). If supported, Delay sets the number of servo loops between position recording (GCS 2.0: Delay must be 0).. No. of digits is the number of digits after the decimal point in the step size (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.
- C-884: Controller saves 8192 position values. Motion commands like STE are not allowed when control via a Human Interface Device (HID) is active for the axis of the controller. 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.
- 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-709: Controller saves up to 4096 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-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.

E-871: Controller saves up to 1024 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.

F-206, M-8X0: Check HLP?/HELP answer to find out if STE is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0). See controller User Manual for number of points (can be changed by setting the appropriate parameter value). For a single impulse-move, see "IMP.vi". Use DRR?.vi to read recorded values back.

Mercury_GCS: 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.

2.11.28. TNR?.vi (Special command.llb)

Valid for	C-702, C-866, C-867, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-871, F-206, M-8X0, Mercury_GCS
Input	System number (1), Error in (no error)
Output	Number of Rec. tables, Error out
Remarks	Returns the number of recording tables. F-206, M-8X0: Check HLP?/HELP answer to find out if TNR? is supported. Only for GCS syntax version = GCS 2.0 or higher (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0).

2.11.29. TPC?.vi (Special command.llb)

Valid for	E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761 (but must be present for Analog systems, C-867, C-884, E-516, E-816, E-861, E-870, E-871, F-206 and M-8X0 and Mercury_GCS also)
Input	System number (1), Error in (no error)
Output	Number of piezo channels, Error out
Remarks	Returns the number of available piezo channels. E-517: Using the Sensor Enable parameter, ID 0x02000000, you can change the

E-517 configuration in case of hardware changes, e.g. if you install additional sensor and/or amplifier channels in the system. If this parameter is changed, the Number Of Piezo Channels parameter is adapted automatically. E.g. if parameter 0x02000000 is set to "disabled" for a sensor channel, the corresponding piezo channel is disabled too and no longer included in the TPC? response. See "Configure Axes and Channels" in the E-517 User manual for details.

E-709, E-712, E-725: Returns all Output Signal Channels (piezo channels + analog output channels).

2.11.30. WPA.vi (Special command.IIb)

Valid for C-867, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-870, E-871, Hydra, Pollux, Mercury_GCS

Input System number (1), Password (100), Affected axes (empty string array), Parameter no. format (Decimal: FALSE) (F), Parameter to save (empty num. array), Parameter to save (hex.) (empty hex. array), Parameter, Error in (no error)

C-867, C-884, Hydra, Pollux, Mercury_GCS: Affected axes = empty array, the currently valid values of all parameters affected by the specified password are saved (see below). Parameter no. format is TRUE (hex).

E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-861, E-870, E-871: If Affected axes = empty array, all parameters for all axes are saved. Parameter no. format is TRUE (hex).

E-516, E-816: Affected axes and Parameter to save = empty array

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

Output Error out, Hidden error

Remarks If password is correct, this vi writes current settings of the given parameter numbers for Affected axes to non-volatile memory of the controller, waits 3000 ms (E-725: waits for controller ready by polling with #7) and queries ERR?. For axis-related parameters, Affected axes 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 to save input, for hexadecimal parameter numbers use Parameter to save (hex) input and switch Parameter no. format to TRUE. Do not mix decimal and hex. parameter numbers in one call. See GCS DLL Manual for available parameter numbers. If "Affected axes" is an empty array, WPA is sent without axis and parameter specification. Hidden error is TRUE if selected system reports error code ≠ 0.

WARNING:

If current parameter values are incorrect, the system may malfunction. Be sure that you have the correct parameter settings before using the WPA command.

C-867: The WPA command saves the currently valid parameter values to non-volatile memory, where they become the power-on defaults. Settings not saved with WPA will be lost when the controller is powered off or rebooted. Parameters can be changed in volatile memory with SPA, ACC, DEC and VEL. WPA must be used without specifying any arguments except of the password, the currently valid values of all parameters affected by the

specified password are saved.

C-884: Depending on the password, the WPA command saves the currently valid parameter values and/or the current HI device configuration to non-volatile memory, where they become the power-on defaults. Settings not saved with WPA will be lost when the controller is powered off or rebooted.

Valid passwords and affected settings:

100: all parameters, settings of HDT, HIA, HIT

101: all parameters

HID: settings of HDT, HIA, HIT

Parameters can be changed in volatile memory with SPA, ACC, DEC and VEL.

WPA must be used without specifying any arguments except of the password.

Hydra, Pollux: The WPA command saves the currently valid parameter values to non-volatile memory, where they become the power-on defaults. Settings not saved with WPA will be lost when the controller is powered off or rebooted. Parameters can be changed in volatile memory with SPA, ACC, and VEL. WPA must be used without specifying any arguments except of the password, the currently valid values of all parameters affected by the specified password are saved.

E-516: The WPA command saves the currently valid parameters listed below to flash ROM, where they become the power-on defaults. Parameter changes not saved with WPA will be lost when the E-516 is powered off.

Communication interface, enabled channels and display format, averaging (AVG), drift compensation mode (DCO), velocity control mode (VCO) and velocity (VEL), offset and gain for position and output voltage display, mode and tolerance for on-target reading (SPA), position limits (NLM, PLM), voltage limits (VMA, VMI), macros and default macro setting.

E-517: The WPA command saves the currently valid parameter values to non-volatile memory, where they become the power-on defaults. Settings not saved with WPA will be lost when the E-517 is powered off or rebooted. Parameters can be changed in volatile memory with SPA, IFC, SAI, DFH, VMI, VMA, WAV, WGC, WOS, WTR, RTR, and VEL. Furthermore, WPA saves the current settings of NLM, PLM (position soft limits), VCO (velocity control mode), DRC (data recorder configuration), CTO (trigger output configuration) and CSV (GCS syntax version, i.e. E-517 or E-516 mode; requires command level 1 ("CCL.vi").

E-709: The WPA command saves the currently valid parameter values to non-volatile memory, where they become the power-on defaults. Settings not saved with WPA will be lost when the E-709 is powered off or rebooted. Parameters can be changed in volatile memory with SPA, AOS, ATZ, IFC, RTR, VEL, WOS and WTR. Depending on the parameter to be saved, it may be necessary to switch to command level 1 ("CCL.vi").

E-710: Command is available in command level 1 only (see "CCL.vi", "CCL?.vi").

E-712: The WPA command saves the currently valid parameter values to non-volatile memory, where they become the power-on defaults. Settings not saved with WPA will be lost when the E-712 is powered off or rebooted. Parameters can be changed in volatile memory with SPA, AOS, ATZ, DPO, IFC, RTR, VEL, WOS and WTR. Requires command level 1 ("CCL.vi").

E-725: The WPA command saves the currently valid parameter values to non-volatile memory, where they become the power-on defaults. Settings not saved with WPA will be lost when the E-725 is powered off or rebooted. Parameters can be changed in volatile memory with SPA, AOS, ATZ, DPO, IFC, RTR, VEL, WOS and WTR. Requires command level 1 ("CCL.vi"). As the WPA command takes up to 90 seconds to finish execution, "WPA.vi"

polls for the controller ready signal (#7) before returning.

- E-753: The WPA command saves the currently valid parameter values to non-volatile memory, where they become the power-on defaults. Settings not saved with WPA will be lost when the E-753 is powered off or rebooted. Parameters can be changed in volatile memory with SPA, AOS, ATZ, DPO, IFC, RTR, VEL, WOS and WTR. Requires command level 1 ("CCL.vi").
- E-755: The WPA command saves the currently valid parameter values to non-volatile memory, where they become the power-on defaults. Settings not saved with WPA will be lost when the E-755 is powered off or rebooted. Parameters can be changed in volatile memory with SPA, APG, BDR and SSA.
- E-761: The WPA command saves the currently valid parameter values and the additional settings listed below to non-volatile memory, where they become the power-on defaults. Settings not saved with WPA will be lost when the PC is powered off or the E-761 is rebooted. Additional settings saved with WPA: Velocity control mode (VCO), position limits (NLM, PLM).
- E-861: The WPA command saves the currently valid parameter values to non-volatile memory, where they become the power-on defaults. Settings not saved with WPA will be lost when the E-861 is powered off or rebooted. The password for writing to non-volatile memory depends on the parameter and can be "100" or "4711". See the parameter list in "Controller Parameters" in the E-861 User manual for the password assignment. When WPA is used without specifying any arguments except of the password, the currently valid values of all parameters affected by the specified password are saved. Otherwise only one single parameter can be saved per WPA command. Parameters can be changed in volatile memory with SPA, SSA, ACC, DEC, VEL, OVL, OAC and ODC .
- E-870: The WPA command saves the currently valid parameter values to non-volatile memory, including the joystick configuration, where they become the power-on defaults. Settings not saved with WPA will be lost when the E-870 is powered off or rebooted. Parameters can be changed in volatile memory with SPA.
- E-871: Depending on the password, the WPA command saves the currently valid parameter values and/or the current HI device configuration to non-volatile memory, where they become the power-on defaults. Settings not saved with WPA will be lost when the controller is powered off or rebooted.
Valid passwords and affected settings:
100: all parameters, settings of HDT, HIA, HIT
101: all parameters
HID: settings of HDT, HIA, HIT
Parameters can be changed in volatile memory with SPA.
WPA must be used without specifying any arguments except of the password.
- Mercury_GCS: The WPA command saves the currently valid parameter values to non-volatile memory, where they become the power-on defaults. Settings not saved with WPA will be lost when the Mercury is powered off or rebooted. Parameters can be changed in volatile memory with SPA, ACC, DEC and VEL. WPA must be used without specifying any arguments except of the password, the currently valid values of all parameters affected by the specified password are saved.

2.12. Support VIs (“Support.Ilb”)

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.

2.12.1. Analyse input string for terminal.vi (Support.Ilb)

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.

2.12.2. Assign booleans from string to axes.vi (Support.Ilb)

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”.

2.12.3. Assign DRC values.vi (Support.Ilb)

Valid for	C-702, C-843, C-866, C-867, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-861, E-871, F-206, M-8X0, Mercury_GCS
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.

2.12.4. Assign NaN for chosen axes.vi (Support.Ilb)

Valid for	Analog systems, C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, C-884, E-517, E-709, E-712, E-725, E-753, E-755, E-861, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS. 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.

2.12.5. Assign SPA values from string to axes.vi (Support.IIb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-870, E-871, Hydra, Pollux, Mercury, Mercury_GCS
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”.

2.12.6. Assign values from string to axes.vi (Support.IIb)

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.

2.12.7. Boolean array calculations.vi (Support.IIb)

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 LabVIEW's 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.

2.12.8. Build channel query command substring.vi (Support.IIb)

Valid for	Analog systems, C-867, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E755, E-761, E-816, E-861, E-870, E-871, Mercury_GCS
Input	System number (1), Channels to query in (empty string array), Query all channels? (F), With space? (F), Channel identifier? (T), Channel type (piezo), Error in (no error)
Output	Command substring, Channels to query out, Number of rows, Error out
Remarks	This VI builds a query command substring for channel query commands. If <u>All channels?</u> is TRUE, channels to command are determined in a

controller specific way and returned in Channels to query out, otherwise Channels to query out is identical with Channels to query in. Number of rows is size of the Channels to query out array. If Channel identifier? is FALSE, command substring is an empty string (e.c. for systems which accept commands like VMA? without channel IDs). If With space? is TRUE, a space character is added between the channel identifiers.

2.12.9. Build command substring.vi (Support.IIb)

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	<p>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.</p> <p>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".</p>

2.12.10. Build num command substring.vi (Support.IIb)

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	<p>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.</p> <p>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"</p>

2.12.11. Build query command substring.vi (Support.IIb)

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	<p>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 rows</u> is size of the <u>Axes to query out</u> array. If <u>Axis identifier?</u> is FALSE, command substring is an empty string (e.c. for systems which accept commands like POS? without axis IDs). If <u>With space?</u> is TRUE or system supports GCS 2.0, a space character is added between the axes identifiers.</p> <p>Example: If axes A;B;C;D are connected to the system to command, <u>Axes to query in</u> is A;B;D, <u>Query all axes?</u> is TRUE and <u>Use Axis identifier?</u> is TRUE, resulting <u>Command substring</u> is "ABCD", <u>Number of rows</u> is 4 and</p>

Axes to query out is A;B;C;D. If With space? is TRUE, the resulting Command substring is "A B C D".

2.12.12. Build SPA command substring.vi (Support.IIb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, C-884, E-516, E-517, E-709, E-712, E-725, E-753, E-816, E-861, E-870, E-871, F-206, Hydra, Pollux, M-8X0, Mercury, Mercury_GCS (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".

2.12.13. Build SPA query command substring.vi (Support.IIb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-867, C-880, C-880K005, C-884, E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-761, E-816, E-861, E-870, E-871, Hydra, Pollux, Mercury, Mercury_GCS
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</u> . <u>Number of rows</u> is size of <u>Axes to query</u> array. Sub-VI for "SPA?.vi" and "SEP?.vi".

2.12.14. Build stringplusnum substring.vi (Support.IIb)

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.

2.12.15. Build WAV command substring.vi (Support.IIb)

Valid for	E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-761
Input	Axes to set (empty string array), Waveform (SIN), No. of digits (3), Xo (0), N (1000), Add? (+) (F), Append? (&) (F), SIN Parameters (5,7692,0,0,5), TAN Parameters (10,6283,0,0,0), POL Parameters (0,0,0.01,0,0,0,0), RAMP Parameters (500,0,5,0), SIN_P Parameters (500,5,0), LIN Parameters (0,5,0), PNT Parameters (0.001,0.002,...,0.01), NOISE Parameters (5,0), Nmax for PNT (5), Segment length (0), Error in (no error)

Output	WAV command substring
Remarks	This vi builds a command substring for the WAV 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 "WAV.vi".

2.12.16. Combine axes arrays.vi (Support.IIb)

Valid for	All systems
Input	Axes subset 1 (empty string array), Axes subset 2 (empty string array),
Output	Combined axes, Double axes
Remarks	This vi combines axes from Axes subset 1 and Axes subset 2 and returns the combined and sorted axes array plus axes which had double entries.

2.12.17. Commanded axes connected?.vi (Support.IIb)

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.

2.12.18. Convert error to warning.vi (Support.IIb)

Valid for	All systems
Input	Error in (no error), Codes (empty num. array)
Output	Error out
Remarks	If <u>code</u> is one of the code numbers given in <u>Codes</u> , resets error status to "no error" and adds "Warning: " to "source".

2.12.19. Convert num array to string.vi (Support.IIb)

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.

2.12.20. Convert num value to syntax selection.vi (Support.IIb)

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.

2.12.21. Count occurrences in string.vi (Support.Ilb)

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.

Cut out additional spaces.vi (Support.Ilb)

Valid for	All systems
Input	Mode (All Spaces), String (empty string)
Output	String out
Remarks	Searches for spaces in <u>String</u> and cuts them out, depending on <u>Mode</u> .

2.12.22. Define axes to command from boolean array.vi (Support.Ilb)

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 <u>Axes to query</u> array in the <u>Axes to command array</u> which have a boolean value TRUE in the <u>Command axis?</u> array, and all remaining axes in the <u>Remaining axes</u> array.

2.12.23. GCSTranslateError.vi (Support.Ilb)

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 in error out</u> .

2.12.24. General wait for movement to stop.vi (Support.Ilb)

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), Add. wait only? (F), Stop refnum (F), Error in (no error) E-816: <u>All axes?</u> = FALSE, only one axis per command allowed F-206, M-8X0: For GCS syntax version = GCS 1.0 (Check with CSV?.vi. If CSV?.vi is not supported, syntax version is GCS 1.0), 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. If <u>Add. wait only?</u> is TRUE, VI waits the given <u>Additional wait time</u> only. 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. VI does not time out, so when using

as a sub-VI, use Stop refnum to stop VI from caller.

2.12.25. Get all axes.vi (Support.IIb)

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.

2.12.26. Get arrays without blanks.vi (Support.IIb)

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.

2.12.27. Get lines and values from string.vi (Support.IIb)

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".

2.12.28. Get lines from string.vi (Support.IIb)

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".

2.12.29. Get string array size without blanks.vi (Support.IIb)

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.

2.12.30. Get total number of commanded axes.vi (Support.IIb)

Valid for	All systems
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Input	System no. (1), String (empty string)
Output	Equal?, Axes, Commanded axes, Index of axis
Remarks	This vi returns how many axes to command <u>String</u> contains and if that number is equal to the total number of connected axes. Additionally it returns all commanded axes and their index in the Connected Axes array.

2.12.31. How often does string contain regular expression.vi (Support.IIb)

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.

2.12.32. Increase array size.vi (Support.IIb)

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> .

2.12.33. Longlasting one-axis command.vi (Support.IIb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, C-880K005, C-884, E-710, E-761, E-871, F-206, Hydra, Pollux, Mercury (but must be present for E-709, 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.

2.12.34. Return single characters from string.vi (Support.IIb)

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.

2.12.35. Return space.vi (Support.IIb)

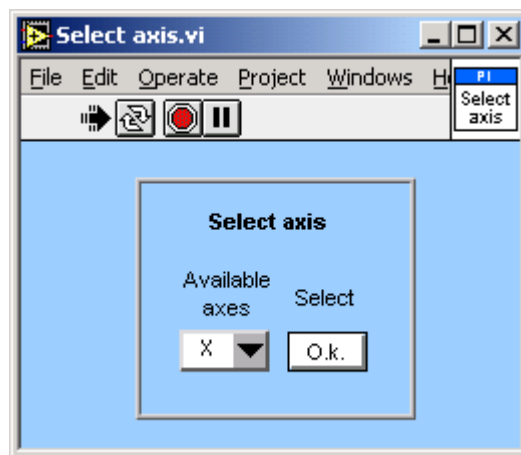
Valid for	All systems
Input	System no. (1), With space? (F)
Output	String out, Space returned?
Remarks	This VI returns a space character in <u>String out</u> if <u>With space?</u> is TRUE or GCS syntax version is higher than 1.0.

2.12.36. Round with options.vi (Support.IIb)

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> .

2.12.37. Select axis.vi (Support.IIb)

Valid for	All systems
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 it's index in Global2 are returned.



2.12.38. Select values for chosen axes.vi (Support.IIb)

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.

2.12.39. Select with boolean array input.vi (Support.IIb)

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> .

2.12.40. Selection to string array.vi (Support.IIb)

Valid for	All systems
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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).

2.12.41. String with ASCII code conversion.vi (Support.Ilb)

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.

2.12.42. Subtract axes array subset from axes array.vi (Support.Ilb)

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 not 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".

2.12.43. Unbundle/bundle interface clusters for PI Terminal.vi (Support.Ilb)

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".

2.12.44. Wait for answer of longstanding command.vi (Support.Ilb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-866, C-880, C-880K005, C-884, E-710, E-761, E-871, Hydra, Pollux, Mercury (but must be present for E-516, E-709, 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.

2.12.45. Wait for axes to stop.vi (Support.Ilb)

Valid for	C-702, C-843, C-843.PM, C-844, C-848, C-865, C-867, C-880, C-884, E-517, E-709, E-712, E-725, E-753, E-755, E-861, E-870, E-871, Hydra, Pollux, Mercury , Mercury_GCS (but must be present in Support.Ilb 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.

2.12.46. Wait for controller ready.vi (Support.Ilb)

Valid for	C-702, C-843, C-843.PM, C-848, C-865, C-866, C-867, C-880, C-884, E-517, E-709, E-710, E-712, E-755, E-761, E-861, E-870, E-871, Hydra, Pollux, Mercury , Mercury_GCS (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.

2.13. Wave-Generator-Specific Commands ("WaveGenerator.Ilb")

2.13.1. #9.vi (WaveGenerator.Ilb)

Valid for	C-843, C-843.PM, E-516, E-517, E-709, 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.

2.13.2. DDL.vi (WaveGenerator.llb)

Valid for	E-710, E-712, E-725, E-753
Input	System number (1), Table number (1), Offset (0), No. of digits (6), Values (empty num. array), Error in (no error) E-710: <u>Table number</u> can be 1 to 8. First stored value in table has index 1, index 0 is the DDL repeat number. Maximum 32768 values can be stored. E-712: <u>Table number</u> can be 1 to the maximum number of axes (query with TLT? for the number of DDL tables). First stored value in the tables has index 1, so <u>Offset</u> must be greater than zero. Maximum 262,144 values can be stored. Due to the maximum numbers of parameters per command only 30 DDL table values can be set per one command call. E-725: <u>Table number</u> can be 1 to the maximum number of axes (query with TLT? for the number of DDL tables). First stored value in table has index 1, so <u>Offset</u> must be greater than zero. Maximum 262,144 values can be stored. Due to the maximum numbers of parameters per command only 30 DDL table values can be set per one command call. E-753: <u>Table number</u> can be 1. First stored value in table has index 1, so <u>Offset</u> must be greater than zero. Maximum 65,536 values can be stored. Due to the maximum numbers of parameters per command only 30 DDL table values can be set per one command call.
Output	Error out
Remarks	Loads the specified values to the specified DDL Table. Please refer to the GCS DLL Manual for units and restrictions.

2.13.3. DDL?.vi (WaveGenerator.llb)

Valid for	E-710, E-712, E-725, E-753
Input	System number (1), Table number (1), Offset (1), N (100), Error in (no error) E-710: <u>Table number</u> can be 1 to 8. First stored value in table has index 1, index 0 is the DDL repeat number. Maximum 32768 values can be stored. E-712: <u>Table number</u> can be 1 to the maximum number of axes (query with TLT? for the number of DDL tables). <u>Offset</u> is start point and must be greater than zero, because first stored value in tables has index 1. Maximum 262,144 values can be stored. E-725: <u>Table number</u> can be 1 to the maximum number of axes (query with TLT? for the number of DDL tables). <u>Offset</u> is start point and must be greater than zero, because first stored value in table has index 1. Maximum 262,144 values can be stored. E-753: <u>Table number</u> can be 1. <u>Offset</u> is start point and must be greater than zero, because first stored value in table has index 1. Maximum 65,536 values can be stored.
Output	Values, Error out
Remarks	Returns N values from specified DDL Table (in the controller memory). For large <u>N</u> values, communication timeout must be set long enough, otherwise a comm.error may occur.

2.13.4. DTL?.vi (WaveGenerator.llb)

Valid for	E-712, E-725, E-753
Input	System number (1), DDL table to query (empty num. array), All tables? (F), Error in (no error)
Output	Table length, Error out
Remarks	Returns DDL table length.

2.13.5. GWD?.vi (WaveGenerator.llb)

Valid for	E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-761
Input	<p>System number (1), Query axis (empty string), Xo (0), N (10), Nmax (64), Error in (no error)</p> <p>E-516: Nmax = 5, N can be 8192 maximum</p> <p>E-517: <u>Query axis</u> is identical with wave table number, which can be 1 to 3. Nmax must be less than or equal to the length of the defined. Xo must be greater than zero.</p> <p>E-709: <u>Query axis</u> is identical with wave table number, which can be 1 to 4. Nmax must be less than or equal to the length of the defined wave. The recommended <u>Nmax</u> value is 1000. For larger values it might be necessary to increase the timeout value in E709_Configuration_Setup.vi. Xo must be greater than zero.</p> <p>E-710: <u>Query axis</u> is identical with wave table number. Nmax must be less than the length of the defined wave.</p> <p>E-712: <u>Query axis</u> is identical with wave table number, which can be 1 to 90. Nmax must be less than or equal to the length of the defined wave. Xo must be greater than zero.</p> <p>E-725: <u>Query axis</u> is identical with wave table number, which can be 1 to 30. Nmax must be less than or equal to the length of the defined wave. Xo must be greater than zero.</p> <p>E-753: <u>Query axis</u> is identical with wave table number, which can be 1 to 10. Nmax must be less than or equal to the length of the defined wave. Xo must be greater than zero.</p> <p>E-761: <u>Query axis</u> is identical with wave table number, which can be 1 to 4. Nmax must be less than the length of the defined wave.</p>
Output	Waveform points, Error out
Remarks	<p>Returns <u>N</u> waveform sequence points. <u>Nmax</u> is the maximum number of points that can be read at once. If <u>N</u> > <u>Nmax</u>, then the VI will query GWD? more than once to read all <u>N</u> values.</p> <p>E-517: The response to GWD? does not contain any offset to the wave generator output set with WOS.</p> <p>E-761: The content of a wave table is not completely erased when a new waveform is written to this table. Only the number of points given by the new waveform is written beginning with the first point in the table, but any subsequent data points will keep the old values from the former waveform. This affects only the response to the GDW? query and not the wave generator output which will only send the new waveform points.</p>

2.13.6. TLT?.vi (WaveGenerator.IIb)

Valid for	E-710, E-712, E-725, E-753, E-761
Input	System number (1), Error in (no error)
Output	Number of tables, Error out
Remarks	Returns the number of DDL tables available in the controller.

2.13.7. TWC.vi (WaveGenerator.IIb)

Valid for	E-517, E-709, E-710, E-712, E-725, E-753
Input	System number (1), Error in (no error)
Output	Error out
Remarks	Clears the trigger wave settings for the waveform.

2.13.8. TWG?.vi (WaveGenerator.IIb)

Valid for	E-517, E-709, 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-709: <u>Number of wave generators</u> = 1 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.

2.13.9. TWS.vi (WaveGenerator.IIb)

Valid for	E-517, E-709, E-710, E-712, E-725, E-753
Input	System number (1), Wavepoint (empty num. array, 0), Trigger value (empty num. array, 0), Switch (empty num. array, 0), Error in (no error) E-517: <u>Trigger value</u> is the trigger line to use, can be 1 to 3. <u>Wavepoint</u> can be 1 to 8,192. The power-on default state of all points is low. Afterwards, the signal state of the trigger output line can be switched to "low" for all points using the TWC command. It is recommended to use TWC before trigger actions are set with TWS. E-709: <u>Trigger value</u> is the trigger line to use, can be 1 or 2. Line 2 is identical with line 1 here as there is only one trigger table for all wave tables. See User Manual for details. <u>Wavepoint</u> can be 1 to 16,332. <u>Switch</u> can be 0 (low) or 1 (high). The power-on default state of all points is low. Afterwards, the signal state of the trigger output line can be switched to "low" for all points using the TWC command. It is recommended to use TWC before trigger actions are set with TWS. Only one trigger line per command allowed. E-710: <u>Wavepoint</u> can be 1-16000. <u>Switch</u> is not valid. <u>Trigger value</u> is bitmapped: <ul style="list-style-type: none"> • Bit 0: trigger line 1: 0 not active, 1 active

- Bit 1: trigger line 2: 0 not active, 1 active
- Bit 2: trigger line 3: 0 not active, 1 active
- Bit 3: trigger line 4: 0 not active, 1 active
- Bit 8: If = 0, then the Trigger values apply to corresponding Wavepoints only.
If = 1, then the Trigger value applies to all points between the last point set by this command and the corresponding Wavepoint point.

E-712: Trigger value is the trigger line to use, can be 1 to 7. Wavepoint can be 1 to 262,144. Switch can be 0 (low) or 1 (high).

The power-on default state of all points is low. Afterwards, the signal state of the trigger output line can be switched to "low" for all points using the TWC command. It is recommended to use TWC before trigger actions are set with TWS. Due to the maximum number of parameters per command 10 trigger lines can be set per command call.

E-725: Trigger value is the trigger line to use, can be 1 to 7. Wavepoint can be 1 to 262,144.. Switch can be 0 (low) or 1 (high). The power-on default state of all points is low. Afterwards, the signal state of the trigger output line can be switched to "low" for all points using the TWC command. It is recommended to use TWC before trigger actions are set with TWS.

E-753: Trigger value is the trigger line to use, can be 1. Wavepoint can be 1 to 65,536. Switch can be 0 (low) or 1 (high).

The power-on default state of all points is low. Afterwards, the signal state of the trigger output line can be switched to "low" for all points using the TWC command. It is recommended to use TWC before trigger actions are set with TWS.

Output Hidden error (T/F), Error out

Remarks GCS 1.0: Sets trigger values for point(s) on the waveform and checks for error. Trigger value is bit-mapped.

GCS 2.0: Defines the trigger state of a certain trigger line for a certain waveform point to high or low.

Hidden error is TRUE if selected system reports error code ≠ 0.

E-517: During the waveform output, the TWS settings will only be used if the configuration of the appropriate trigger line was set with CTO before (set Parameter value "Generator Trigger" for CTO Parameter ID "Trigger Mode"). If you start the wave generator with the WGO start options given by bit 3, 4 or 5, the corresponding pulses are output in addition to the output pulses defined with TWS. The number of wave generator output cycles during which trigger pulses are to be output can be set using the Number Of Trigger Cycles parameter, ID 0x18000100. The width of a trigger pulse is 30 µs by default. 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.

E,709, E-712, E-725, E-753: During the waveform output, the TWS settings will only be used if the configuration of the appropriate trigger line was set with CTO before (set Parameter value "Generator Trigger" for CTO Parameter ID "Trigger Mode").

2.13.10. TWS?.vi (WaveGenerator.IIb)

Valid for E-517, E-712, E-725

Input System number (1), TriggerOut to query (Empty num. array, 0), xo (0), N (100), Nmax (1024), Without parameter? (FALSE), Error in (no error)

	E-517: <u>Nmax</u> = 8192.
	E-712: <u>Nmax</u> = 262,144.
	E-725: <u>Nmax</u> = 262,144.
Output	Data, Names, Sample time, Error out
Remarks	Returns trigger points set by TWS. 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.

2.13.11. WAV.vi (WaveGenerator.llb)

Valid for	E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-761
Input	<p>System number (1), Affected axes (empty string array), Waveform (SIN), No. of digits (3), Xo (0), N (1000), Add? (+) (F), Append? (&) (F), SIN Parameters (5,7692,0,0,5), TAN Parameters (10,6283,0,0,0), POL Parameters (0,0,0.01,0,0,0,0), RAMP Parameters (500,0,5,0), SIN_P Parameters (500,5,0), LIN Parameters (0,5,0), PNT Parameters (0.001,0.002,...,0.01), NOISE Parameters (5,0), Nmax for PNT (5), Segment length (0), Error in (no error)</p> <p>E-516: <u>Waveform</u> can be: SIN, TAN, POL or PNT. The following parameters are equivalent (see GCS DLL manual): <u>Affected axes</u> = szAxes, <u>Xo</u> = nStart, <u>N</u> = nLength, <u>Add?</u> = Add, <u>PNT Parameters</u> = pPoints (<u>PNT parameters</u> is an array consisting of single data points which will be sent in groups of <u>Nmax for PNT</u> data points.)</p> <p>Valid for SIN: <u>Affected axes</u>, <u>No. of digits</u>, <u>Xo</u>, <u>N</u>, <u>Add?</u>, <u>SIN Parameters</u> (A, N, Xo, Phi and B)</p> <p>Valid for TAN: <u>Affected axes</u>, <u>No. of digits</u>, <u>Xo</u>, <u>N</u>, <u>Add?</u>, <u>TAN Parameters</u> (A, N, Xo, Phi and B)</p> <p>Valid for POL: <u>Affected axes</u>, <u>No. of digits</u>, <u>Xo</u>, <u>N</u>, <u>Add?</u>, <u>POL Parameters</u> (Xo, Ao to A5)</p> <p>Valid for PNT: <u>Affected axes</u>, <u>No. of digits</u>, <u>Xo</u>, <u>N</u>, <u>Add?</u>, <u>Nmax for PNT</u>, <u>PNT Parameters</u> (Ao to An-1)</p> <p>E-517: <u>Affected axis</u> is identical with wave table number, which can be 1 to 3. One wave table number per command call allowed only. <u>Waveform</u> can be: SIN_P, RAMP or LIN.</p> <p>The following parameters are equivalent (see GCS DLL manual): <u>Affected axes</u> = szWaveTableIds, <u>Xo</u> = iOffsetOfFirstPointInWaveTable, <u>N</u> = iNumberOfPoints, <u>Append?</u> = iAddAppendWave, <u>C</u> = iCenterPointOfWave, <u>J</u> = iNumberOfSpeedUpDownPointsInWave, <u>A</u> = dAmplitudeOfWave, <u>O</u> = dOffsetOfWave, <u>Segment length</u> = iSegmentLength, <u>PNT Parameters</u> = pdWavePoints (<u>PNT parameters</u> is an array consisting of single data points which will be sent in groups of <u>Nmax for PNT</u> data points.)</p> <p>Valid for SIN: <u>Affected axes</u>, <u>No. of digits</u>, <u>Xo</u>, <u>N</u>, <u>Add?</u>, <u>SIN Parameters</u> (A, N, Xo, Phi and B). Segment length must be zero.</p> <p>Valid for TAN: <u>Affected axes</u>, <u>No. of digits</u>, <u>Xo</u>, <u>N</u>, <u>Add?</u>, <u>TAN Parameters</u> (A, N, Xo, Phi and B). Segment length must be zero.</p> <p>Valid for POL: <u>Affected axes</u>, <u>No. of digits</u>, <u>Xo</u>, <u>N</u>, <u>Add?</u>, <u>POL Parameters</u> (Xo, Ao to A5). Segment length must be zero.</p> <p>Valid for PNT: <u>Affected axes</u>, <u>No. of digits</u>, <u>Xo</u>, <u>N</u>, <u>Add?</u>, <u>Nmax for PNT</u>, <u>PNT Parameters</u> (Ao to An-1) <u>Nmax</u> for PNT must be ≤ 20 (8,192 is maximum size for all wave tables in total but input buffer size is 256</p>

characters). Segment length must be zero for PNT.

Valid for SIN_P: Affected axes, No. of digits, Xo, N, Append?, Segment length, SIN_P Parameters (C, A and O)

Valid for RAMP: Affected axes, No. of digits, Xo, N, Append?, Segment length, RAMP Parameters (C, J, A and O)

Valid for LIN: Affected axes, No. of digits, Xo, N, Append?, Segment length, LIN Parameters (J, A and O)

E-709: Affected axis is identical with wave table number. 4 waves can be defined in total. Use WSL.vi to connect wave table to wave generator. Waveforms are automatically stored in non-volatile memory. Note that the number of write cycles is limited. See User Manual for details.
Waveform can be: SIN_P, RAMP, or LIN.

The following parameters are equivalent (see GCS DLL manual):
Affected axes = szWaveTableIds, Xo = iOffsetOfFirstPointInWaveTable,
N = iNumberOfPoints, Append? = iAddAppendWave,
C = iCenterPointOfWave, J = iNumberOfSpeedUpDownPointsInWave,
A = dAmplitudeOfWave, O = dOffsetOfWave,
Segment length = iSegmentLength

Valid for SIN_P: Affected axes, No. of digits, Xo, N, Append?, Segment length, SIN_P Parameters (C, A and O)

Valid for RAMP: Affected axes, No. of digits, Xo, N, Append?, Segment length, RAMP Parameters (C, J, A and O)

Valid for LIN: Affected axes, No. of digits, Xo, N, Append?, Segment length, LIN Parameters (J, A and O)

E-710: Affected axis is identical with wave table number.
Waveform can be: SIN_P, RAMP, LIN or PNT.

The following parameters are equivalent (see GCS DLL manual):
Affected axes = szWaveTableIds, Xo = iOffsetOfFirstPointInWaveTable,
N = iNumberOfPoints, Append? = iAddAppendWave,
C = iCenterPointOfWave, J = iNumberOfSpeedUpDownPointsInWave,
A = dAmplitudeOfWave, O = dOffsetOfWave,
Segment length = iSegmentLength, PNT Parameters = pdWavePoints (PNT parameters is an array consisting of single data points which will be sent in groups of Nmax for PNT data points.)

O (dOffsetOfWave) is only valid if a wave segment is being concatenated to an existing wave (Append? = TRUE).

Valid for SIN_P: Affected axes, No. of digits, Xo, N, Append?, Segment length, SIN_P Parameters (C, A and O)

Valid for RAMP: Affected axes, No. of digits, Xo, N, Append?, Segment length, RAMP Parameters (C, J, A and O)

Valid for LIN: Affected axes, No. of digits, Xo, N, Append?, Segment length, LIN Parameters (J, A and O)

Valid for PNT: Affected axes, No. of digits, Xo, N, Append?, Segment length, Nmax for PNT, PNT Parameters (Ao to An-1). Nmax for PNT must be ≤ Wave storage max. value set with WMS.vi. Segment length must be zero for PNT.

The length of the wave to define must be less than the value defined with "WMS.vi".

E-712: Affected axis is identical with wave table number. 90 waves can be defined in total. Use WSL.vi to connect wave table to wave generator.
Waveform can be: SIN_P, RAMP, LIN, NOISE or PNT.

The following parameters are equivalent (see GCS DLL manual):

Affected axes = szWaveTableIds, Xo = iOffsetOfFirstPointInWaveTable, N = iNumberOfPoints, Append? = iAddAppendWave, C = iCenterPointOfWave, J = iNumberOfSpeedUpDownPointsInWave, A = dAmplitudeOfWave, O = dOffsetOfWave, Segment length = iSegmentLength, PNT Parameters = pdWavePoints (PNT parameters is an array consisting of single data points which will be sent in groups of Nmax for PNT data points.)

Valid for SIN_P: Affected axes, No. of digits, Xo, N, Append?, Segment length, SIN_P Parameters (C, A and O)

Valid for RAMP: Affected axes, No. of digits, Xo, N, Append?, Segment length, RAMP Parameters (C, J, A and O)

Valid for LIN: Affected axes, No. of digits, Xo, N, Append?, Segment length, LIN Parameters (J, A and O)

Valid for PNT: Affected axes, No. of digits, Xo, N, Append?, Segment length, Nmax for PNT, PNT Parameters (Ao to An-1). Nmax for PNT must be ≤ 20 (262,144 is maximum size for all wave tables in total but input buffer size is 256 characters). Segment length must be zero for PNT.

Valid for NOISE: Affected axes, No. of digits, Append?, Segment length, NOISE Parameters (A and O)

E-725: Affected axis is identical with wave table number. 30 waves can be defined in total. Use WSL.vi to connect wave table to wave generator. Waveform can be: SIN_P, RAMP, LIN, NOISE or PNT.

The following parameters are equivalent (see GCS DLL manual):

Affected axes = szWaveTableIds, Xo = iOffsetOfFirstPointInWaveTable, N = iNumberOfPoints, Append? = iAddAppendWave, C = iCenterPointOfWave, J = iNumberOfSpeedUpDownPointsInWave, A = dAmplitudeOfWave, O = dOffsetOfWave, Segment length = iSegmentLength, PNT Parameters = pdWavePoints (PNT parameters is an array consisting of single data points which will be sent in groups of Nmax for PNT data points.)

Valid for SIN_P: Affected axes, No. of digits, Xo, N, Append?, Segment length, SIN_P Parameters (C, A and O)

Valid for RAMP: Affected axes, No. of digits, Xo, N, Append?, Segment length, RAMP Parameters (C, J, A and O)

Valid for LIN: Affected axes, No. of digits, Xo, N, Append?, Segment length, LIN Parameters (J, A and O)

Valid for PNT: Affected axes, No. of digits, Xo, N, Append?, Segment length, Nmax for PNT, PNT Parameters (Ao to An-1). Nmax for PNT must be ≤ 20 (262,144 is maximum size for all wave tables in total but input buffer size is 256 characters). Segment length must be zero for PNT.

Valid for NOISE: Affected axes, No. of digits, Append?, Segment length, NOISE Parameters (A and O)

E-753: Affected axis is identical with wave table number. 10 waves can be defined in total. Use WSL.vi to connect wave table to wave generator. Waveform can be: SIN_P, RAMP, LIN, NOISE or PNT.

The following parameters are equivalent (see GCS DLL manual):

Affected axes = szWaveTableIds, Xo = iOffsetOfFirstPointInWaveTable, N = iNumberOfPoints, Append? = iAddAppendWave, C = iCenterPointOfWave, J = iNumberOfSpeedUpDownPointsInWave, A = dAmplitudeOfWave, O = dOffsetOfWave, Segment length = iSegmentLength, PNT Parameters = pdWavePoints (PNT parameters is an array consisting of single data points which will be sent in

groups of Nmax for PNT data points.)

Valid for SIN_P: Affected axes, No. of digits, Xo, N, Append?, Segment length, SIN_P Parameters (C, A and O)

Valid for RAMP: Affected axes, No. of digits, Xo, N, Append?, Segment length, RAMP Parameters (C, J, A and O)

Valid for LIN: Affected axes, No. of digits, Xo, N, Append?, Segment length, LIN Parameters (J, A and O)

Valid for PNT: Affected axes, No. of digits, Xo, N, Append?, Segment length, Nmax for PNT, PNT Parameters (Ao to An-1). Nmax for PNT must be ≤ 20 (65,536 is maximum size for all wave tables in total but input buffer size is 256 characters). Segment length must be zero for PNT.

Valid for NOISE: Affected axes, No. of digits, Append?, Segment length, NOISE Parameters (A and O)

E-761: Affected axis is identical with wave table number.

Waveform can be: SIN_P, RAMP, LIN, PNT or POL.

The following parameters are equivalent (see GCS DLL manual):

Affected axes = szWaveTableIds, Xo = iOffsetOfFirstPointInWaveTable,

N = iNumberOfPoints, Append? = iAddAppendWave,

C = iCenterPointOfWave, J = iNumberOfSpeedUpDownPointsInWave,

A = dAmplitudeOfWave, O = dOffsetOfWave,

Segment length = iSegmentLength, PNT Parameters = pdWavePoints (PNT parameters is an array consisting of single data points which will be sent in groups of Nmax for PNT data points.)

Valid for SIN_P: Affected axes, No. of digits, Xo, N, Append?, Segment length, SIN_P Parameters (C, A and O)

Valid for RAMP: Affected axes, No. of digits, Xo, N, Append?, Segment length, RAMP Parameters (C,J,A and O)

Valid for LIN: Affected axes, No. of digits, Xo, N, Append?, Segment length, LIN Parameters (J,A and O)

Valid for PNT: Affected axes, No. of digits, Xo, N, Append?, Segment length, Nmax for PNT, PNT Parameters (Ao to An-1). Nmax for PNT must be \leq Wave storage max. value set with WMS.vi, and can be 50 maximum. Segment length must be zero for PNT.

Valid for POL: Affected axes, No. of digits, N, Add?, POL Parameters (Xo, Ao to A5)

Output Hidden error (T/F), Error out

Remarks Defines or modifies a stored waveform for one or more axes. Please refer to the GCS DLL manual or to the User manual for a description of waveform parameters, units and restrictions. No. of digits is the number of digits after the decimal point in the parameter value(s) that will be sent. Hidden error is TRUE if selected system reports error code $\neq 0$.

2.13.12. WAV?.vi (WaveGenerator.llb)

Valid for E-517, E-709. E-710, E-712, E-725, E-753, E-761

Input System number (1), Axes to query (empty string array), Parameter numbers (empty num. array, 0), Error in (no error)

All systems: Axis to query is identical with wave table number. The following parameter number is valid:

- 1: Number of waveform points for currently defined wave

Output	WAV Parameter value, Error out
Remarks	Returns waveform parameter values for queried axes and parameter numbers.

2.13.13. WCL.vi (WaveGenerator.IIb)

Valid for	E-517, E-709, E-710, E-712, E-725, E-753, E-761
Input	System number (1), WCL axes (empty string array), All axes? (F), Axis identifier? (T), Error in (no error) E-517: <u>WCL axes</u> is identical with wave table number which can be 1 to 3. <u>All axes?</u> must be FALSE. E-709: <u>WCL axes</u> is identical with wave table number which can be 1 to 4. <u>All axes?</u> must be FALSE. E-710: <u>All axes?</u> Must be FALSE, only one axis per command allowed. E-712: <u>WCL axes</u> is identical with wave table number which can be 1 to 90. <u>All axes?</u> must be FALSE. E-725: <u>WCL axes</u> is identical with wave table number which can be 1 to 30. <u>All axes?</u> must be FALSE. E-753: <u>WCL axes</u> is identical with wave table number which can be 1 to 10. <u>All axes?</u> must be FALSE. E-761: <u>All axes?</u> must be FALSE
Output	Error out
Remarks	Clears waveform associated with specified axis. E-710: Does also clear DDL table.

2.13.14. WGC.vi (WaveGenerator.IIb)

Valid for	E-516, E-517, E-709, E-712, E-725, E-753, E-761
Input	System number (1), Affected axes (empty string array), Cycles (empty num. array, 0), Error in (no error) E-517: <u>Affected axes</u> is identical with wave generator ID, which can be 1 to 3. If <u>Cycles</u> = 0 the wave is performed periodically until it is stopped otherwise. E-709: <u>Affected axes</u> is identical with wave generator ID, which can be 1. If <u>Cycles</u> = 0 the wave is performed periodically until it is stopped otherwise. E-712: <u>Affected axes</u> is identical with wave generator ID, which can be 1 to No. of connected axes. If <u>Cycles</u> = 0 the wave is performed periodically until it is stopped otherwise. <u>Cycles</u> set for any wave generator ID are valid for all wave generators (cannot be set differently). E-725: <u>Affected axes</u> is identical with wave generator ID, which can be 1 to No. of connected axes. If <u>Cycles</u> = 0 the wave is performed periodically until it is stopped otherwise. <u>Cycles</u> set for any wave generator ID are valid for all wave generators (cannot be set differently). E-753: <u>Affected axes</u> is identical with wave generator ID, which can be 1. If <u>Cycles</u> = 0 the wave is performed periodically until it is stopped otherwise. E-761: <u>Affected axes</u> is identical with wave table number which can be 1 to 4. If <u>Cycles</u> = 0 the wave is performed periodically until it is stopped otherwise.
Output	Hidden error (T/F), Error out

Remarks	Sets number of wave generator cycles. <u>Hidden error</u> is TRUE if selected system reports error code $\neq 0$. E-517, E-761: WGC saves the new value in RAM only. The WPA command saves the currently valid value to non-volatile memory, where it becomes the power-on default. Settings not saved with WPA will be lost on power down or reboot.
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2.13.15. WGC?.vi (WaveGenerator.IIb)

Valid for	E-516, E-517, E-709, E-712, E-725, E-753, E-761
Input	System number (1), Axes to query (empty string array), All axes? (F), Axes identifier? (T), Error in (no error) E-516: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE E-517: <u>Axes to query</u> is identical with wave generator ID, which can be 1 to 3. <u>All axes?</u> must be FALSE. E-709: <u>Axes to query</u> is identical with wave generator ID, which can be 1. <u>All axes?</u> must be FALSE. E-712: <u>Axes to query</u> is identical with wave generator ID, which can be 1 to No. of connected axes. <u>All axes?</u> = must be FALSE. E-725: <u>Axes to query</u> is identical with wave generator ID, which can be 1 to No. of connected axes. <u>All axes?</u> must be FALSE. E-753: <u>Axes to query</u> is identical with wave generator ID, which can be 1. <u>All axes?</u> must be FALSE. E-761: <u>Axes to query</u> is identical with wave table number, which can be 1 to 4. <u>All axes?</u> must be FALSE
Output	Cycles, Error out
Remarks	Returns number of wave generator cycles set for specified axes.

2.13.16. WGO.vi (WaveGenerator.IIb)

Valid for	E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-761
Input	System number (1), Affected axes (empty string array), WGO Parameter (empty num. array, 0), Error in (no error) E-517: <u>Affected axis</u> is identical with wave generator number, which can be 1 to 3. See E-517 User Manual for a description of valid parameters. E-709: <u>Affected axis</u> is identical with wave generator number, which can be 1. See E-709 User Manual for a description of valid parameters. E-710: <u>Affected axis</u> is identical with wave generator number. See E7XX_GCS_ DLL Manual for a description of valid parameters. E-712: <u>Affected axis</u> is identical with wave generator number, which can be 1 to No. of connected axes. See E-712 User Manual for a description of valid parameters. E-725: <u>Affected axis</u> is identical with wave generator number, which can be 1 to 3. See E-725 User Manual for a description of valid parameters. E-753: <u>Affected axis</u> is identical with wave generator number, which can be 1. See E-753 User Manual for a description of valid parameters. E-761: <u>Affected axis</u> is identical with wave generator number, which can be 1 to 4. See E7XX_GCS_ DLL Manual or the User manual for a description of valid parameters.

Output	Hidden error (T/F), Error out
Remarks	<p>Enables, disables, and sets wave generator output mode. <u>Parameter</u> is bit-mapped. <u>Hidden error</u> is TRUE if selected system reports error code $\neq 0$. See GCS DLL Manual for parameter definition.</p> <p>E-517: Use DRC to configure data recording. Recording ends when the record table content has reached the maximum number of points (8,192 in total).</p> <p>E-709: Use DRC to configure data recording. Recording ends when the record table content has reached the maximum number of points (4096 in total). Starting the wave generator is not allowed when the analog input is used for target generation.</p> <p>E-710: Only two wave generators can run simultaneously.</p> <p>E-712: Use DRC to configure data recording. Recording ends when the record table content has reached the maximum number of points (262,144 in total). Starting the wave generator is not allowed when the analog input is used for target generation.</p> <p>E-725: Use DRC to configure data recording. Recording ends when the record table content has reached the maximum number of points (262,144 in total). Starting the wave generator is not allowed when the analog input is used for target generation.</p> <p>E-753: Use DRC to configure data recording. Recording ends when the record table content has reached the maximum number of points (65,536 in total). Starting the wave generator is not allowed when the analog input is used for target generation.</p> <p>E-761: Four wave generators can run simultaneously. Each time the wave generator is started recording starts automatically as follows: recorder table 1: axis 1 actual position recorder table 2: axis 2 actual position recorder table 3: axis 3 actual position recorder 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) Recording ends when the record table content has reached the maximum number of points (8192 per table).</p>

2.13.17. WGO?.vi (WaveGenerator.IIb)

Valid for	E-516, E-517, E-709, E-710, E-712, E-725, E-753, E-761
Input	<p>System number (1), Axes to query (empty string array) , All axes? (F), Axes identifier? (T), Error in (no error)</p> <p>E-516: If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be FALSE</p> <p>E-517: <u>Axis to query</u> is identical with wave generator number, which can be 1 to 3. If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be FALSE.</p> <p>E-709: <u>Axis to query</u> is identical with wave generator number, which can be 1. If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be FALSE.</p> <p>E-710: <u>Axis to query</u> is identical with wave generator number. If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be TRUE</p> <p>E-712: <u>Axis to query</u> is identical with wave generator number, which can be 1 to No. of connected axes. If <u>All axes?</u> = TRUE, then <u>Axis identifier?</u> must be FALSE.</p> <p>E-725: <u>Axis to query</u> is identical with wave generator number, which can be 1 to</p>

No. of connected axes.

If All axes? = TRUE, then Axis identifier? must be FALSE.

E-753: Axis to query is identical with wave generator number, which can be 1.

If All axes? = TRUE, then Axis identifier? must be FALSE.

E-761: Axis to query is identical with wave generator number, which can be 1 to 4.

All axes? must be FALSE.

Output WGO parameter, Error out

Remarks Returns WGO parameter for specified axes.

2.13.18. WGR.vi (WaveGenerator.IIb)

Valid for E-517, E-709, E-710, E-712, E-725, E-753, E-761

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

Output Error out

Remarks Starts a new recording.

E-517: Use DRC to configure data recording. Recording ends when the record table content has reached the maximum number of points (8,192 in total). If more than one wave generator is running, recording starts at the waveform start point which occurs first.

E-709: Use DRC to configure data recording. Recording ends when the record table content has reached the maximum number of points (4096 in total).

E-712: Use DRC to configure data recording. Recording ends when the record table content has reached the maximum number of points (262,144 in total).

E-725: Use DRC to configure data recording. Recording ends when the record table content has reached the maximum number of points (262,144 in total).

E-753: Use DRC to configure data recording. Recording ends when the record table content has reached the maximum number of points (65,536 in total).

E-761: Recording will be started for all recorder tables when the wave generator is running for an arbitrary axis. The assignment of axis and data sources to the data 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)

Recording starts always with the next start point of the waveform, i.e. there might be a short delay between sending WGR and the start of the record. If more than one wave generator is running, recording starts at the waveform start point which occurs first. Recording ends when the record table content has reached the maximum number of points (8192 per table).

2.13.19. WOS.vi (WaveGenerator.IIb)

Valid for E-517, E-709, E-712, E-725, E-753

Input System number (1), Generator ID (empty num. array), Offset (empty num. array, 0), No. of digits (4), Error in (no error)

	E-517: <u>Generator ID</u> can be 1 to 3.
	E-709: <u>Generator ID</u> can be 1
	E-712: <u>Generator ID</u> can be 1 to No. of connected axes.
	E-725: <u>Generator ID</u> can be 1 to No. of connected axes
	E-753: <u>Generator ID</u> can be 1
Output	Error out
Remarks	<p>Sets Wave Generator Output Offset. The current wave generator output is created by adding the output offset value to the current wave value: Generator Output = Output Offset + Current Wave Value.</p> <p>The value is also modified by the generator when the WGO command was executed with iStartMod bit 8 set: At the end of each cycle the output offset value is equate with the current Generator Output.</p> <p><u>No. of digits</u> is the number of digits after the decimal point in the position value(s) that will be sent.</p> <p>E-517: You can set the offset also using the CFG wave type (see WAV command) or by directly changing the Wave Offset parameter, ID 0x1300010b, with SPA.</p>

2.13.20. WOS?.vi (WaveGenerator.IIb)

Valid for	E-517, E-709, E-712, E-725, E-753
Input	<p>System number (1), Generator ID (empty num. array), All generators? (F), Error in (no error)</p> <p>E-517: <u>Generator ID</u> can be 1 to 3.</p> <p>E-709: <u>Generator ID</u> can be 1</p> <p>E-712: <u>Generator ID</u> can be 1 to No. of connected axes.</p> <p>E-725: <u>Generator ID</u> can be 1 to No. of connected axes</p> <p>E-753: <u>Generator ID</u> can be 1</p>
Output	Offset, Error out
Remarks	Returns wave generator output offset.

2.13.21. WSL.vi (WaveGenerator.IIb)

Valid for	E-709, E-517, E-712, E-725, E-753
Input	<p>System number (1), Generator ID (empty num. array), WaveTable ID (empty num. array, 0), Error in (no error)</p> <p>E-709: <u>Generator ID</u> can be 1, <u>WaveTableID</u> can be 1 to 4.</p> <p>E-517: <u>Generator ID</u> can be 1 to 3., <u>WaveTableID</u> can be 1 to 3.</p> <p>E-712: <u>Generator ID</u> can be 1 to No. of connected axes, <u>WaveTableID</u> can be 1 to 90.</p> <p>E-725: <u>Generator ID</u> can be 1 to No. of connected axes, <u>WaveTableID</u> can be 1 to 30</p> <p>E-753: <u>Generator ID</u> can be 1, <u>WaveTableID</u> can be 1 to 10</p>
Output	Error out
Remarks	<p>Connects a wave table to a generator or disconnects the selected generator from any wave table.</p> <p>E-517: Check HLP? answer to find out if WSL is supported.</p>

2.13.22. WSL?.vi (WaveGenerator.llb)

Valid for	E-709, E-517, E-712, E-725, E-753
Input	System number (1), Generator ID (empty num. array), All generators? (F), Error in (no error) E-709: Generator ID can be 1 E-517: <u>Generator ID</u> can be 1 to 3. E-712: Generator ID can be 1 to No. of connected axes. E-725: Generator ID can be 1 to No. of connected axes E-753: Generator ID can be 1
Output	WaveTable ID, Error out
Remarks	Returns current setting of wave table selection. If <u>WaveTableID</u> is zero no wave table is connected to the generator. E-517: Check HLP? answer to find out if WSL? is supported.

2.13.23. WTR.vi (WaveGenerator.llb)

Valid for	E-517, E-709, E-712, E-725, E-753
Input	System number (1), Generator ID (empty num. array, 0), Table rate (empty num. array, 1), Interpolation type (empty num. array, 0), Error in (no error) E-517: <u>Interpolation type</u> must be 0. <u>Generator ID</u> can be 1 to 3. E-709: The following <u>interpolation types</u> can be selected: 0 = no interpolation. <u>Generator ID</u> can be 0 or 1 as there is only one generator. E-712: The following <u>Interpolation types</u> can be selected: 0 = no interpolation, 1 = straight line <u>Generator ID</u> must be 0 because values can only be set for all generators. E-725: The following <u>Interpolation types</u> can be selected: 0 = no interpolation, 1 = straight line, <u>Generator ID</u> must be 0 because values can only be set for all generators. E-753: The following <u>Interpolation types</u> can be selected: 0 = no interpolation, 1 = straight line <u>Generator ID</u> must be 0 because values can only be set for all generators.
Output	Error out
Remarks	Set Wave Generator Table Rate. This will change the sampling interval of the wave generator. When <u>Generator ID</u> is zero all generators are selected, otherwise each generator is selected individually. <u>Table Rate</u> sets the duration of the wave table points as a multiple of the servo interval time. When a <u>Table rate</u> higher than 1 is set, <u>Interpolation type</u> can be used to join each wave table point by an interpolation. E-517: WTR sets the value of the Wave Generator Table Rate parameter, ID 0x13000109, in volatile memory. You can set the wave table rate also using the CFG wave type (see WAV command) or by directly changing the parameter with SPA.

2.13.24. WTR?.vi (WaveGenerator.llb)

Valid for	E-517, E-709, E-712, E-725, E-753
Input	System number (1), Generator ID to query (empty num. array, 0), All Generator ID? (F), Error in (no error)

E-517: Generator ID can be 1 to 3.

E-709: Generator ID can be 0 or 1 because there is only one generator.

E-712: Generator ID must be 0 because values are valid for all generators.

E-725: Generator ID must be 0 because values are valid for all generators.

E-753: Generator ID must be 0 because values are valid for all generators.

Output Table rate, Interpolation type, Error out

Remarks Returns the current settings of the wave generator table rate.

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, "PI Terminal.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.

PI Ask for Communication Parameters.vi

Select Interface Parameters **PI**

Number of systems: 4

Interface configuration

OK Cancel

	System No. 1	System No. 2	System No. 3	System No. 4
General:	Interface: RS232 Timeout: 1000	Interface: GPIB Timeout: 1000	Interface: DLL Timeout: 1000	Interface: DLL Timeout: 1000
RS232:	RS232 Portnumber: COM1 RS232 Baud rate: 57600 Handshake: None			RS232 Portnumber: COM1 RS232 Baud rate: 57600 Handshake: None
GPIB:		GPIB Bus: 0 GPIB Address: 4 GPIB Mode: 0		
DLL:			DLL for Device: C-843 DLL Interface: Board Parameter: 1	DLL for Device: C-844 DLL Interface: RS232 Parameter:

- 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.
- C-884: Interface = RS232, TCP/IP or DLL, RS232: Input and output HW handshake must be FALSE. DLL (USB): DLL for Device = PI_GCS2_DLL, DLL Interface = USB, Parameter = Serial no. of system to connect to. Syntax: GCS 2.0; 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-709: Interface = RS232 or DLL, RS232: Input and output HW handshake must be TRUE. DLL (USB): DLL for Device = E-709, 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.
- E-870: Interface = DLL, DLL (USB): DLL for Device = PI_GCS2_DLL, DLL Interface = USB, Parameter = Serial no. of system to connect to. Syntax: GCS 2.0; Term char = LF.
- E-871: Single Device: Interface = RS232 or DLL, RS232: Input and output HW handshake must be FALSE. DLL (USB): DLL for Device = PI_GCS2_DLL, DLL Interface = USB, Parameter = Serial no. of system to connect to. DaisyChain: Interface = DLL, DLL for Device = PI_GCS2_DLL, DLL Interface = RS232_DC or USB_DC, Parameter = Number of device in chain, Register DC: FALSE. Syntax: GCS 2.0; Term char = LF
- F-206, M-8X0: For GCS syntax version = GCS 1.0 (older firmware or compatibility mode, can be set with CSV.vi), Interface = RS232, GPIB (not available for C-887 controller) 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. For GCS syntax version = GCS 2.0 (C-887 controller), Interface = RS232 or TCP/IP. RS232: Input and output handshake settings must be FALSE. Syntax: GCS 2.0; Term char = LF.
- Hydra: Interface = DLL, DLL (TCP/IP and RS-232): DLL for Device = PI_HydraPollux_GCS2_DLL, DLL Interface = RS232 or TCP/IP, Syntax: GCS 2.0; 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.
- GCS_Mercury: Single Device: Interface = RS232 or DLL, RS232: Input and output HW handshake must be FALSE. DLL (USB): DLL for Device = PI_GCS2_DLL, DLL Interface = USB, Parameter = Serial no. of system to connect to. DaisyChain: Interface = DLL, DLL for Device = PI_GCS2_DLL, DLL Interface = RS232_DC or USB_DaisyChain, Parameter = Number of device in chain, Register DC: FALSE. Syntax: GCS 2.0; Term char = LF.
- Pollux: Interface = DLL, DLL (RS-232): DLL for Device = PI_HydraPollux_GCS2_DLL, DLL Interface = RS232, Baudrate must be 19200, Syntax: GCS 2.0; 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.

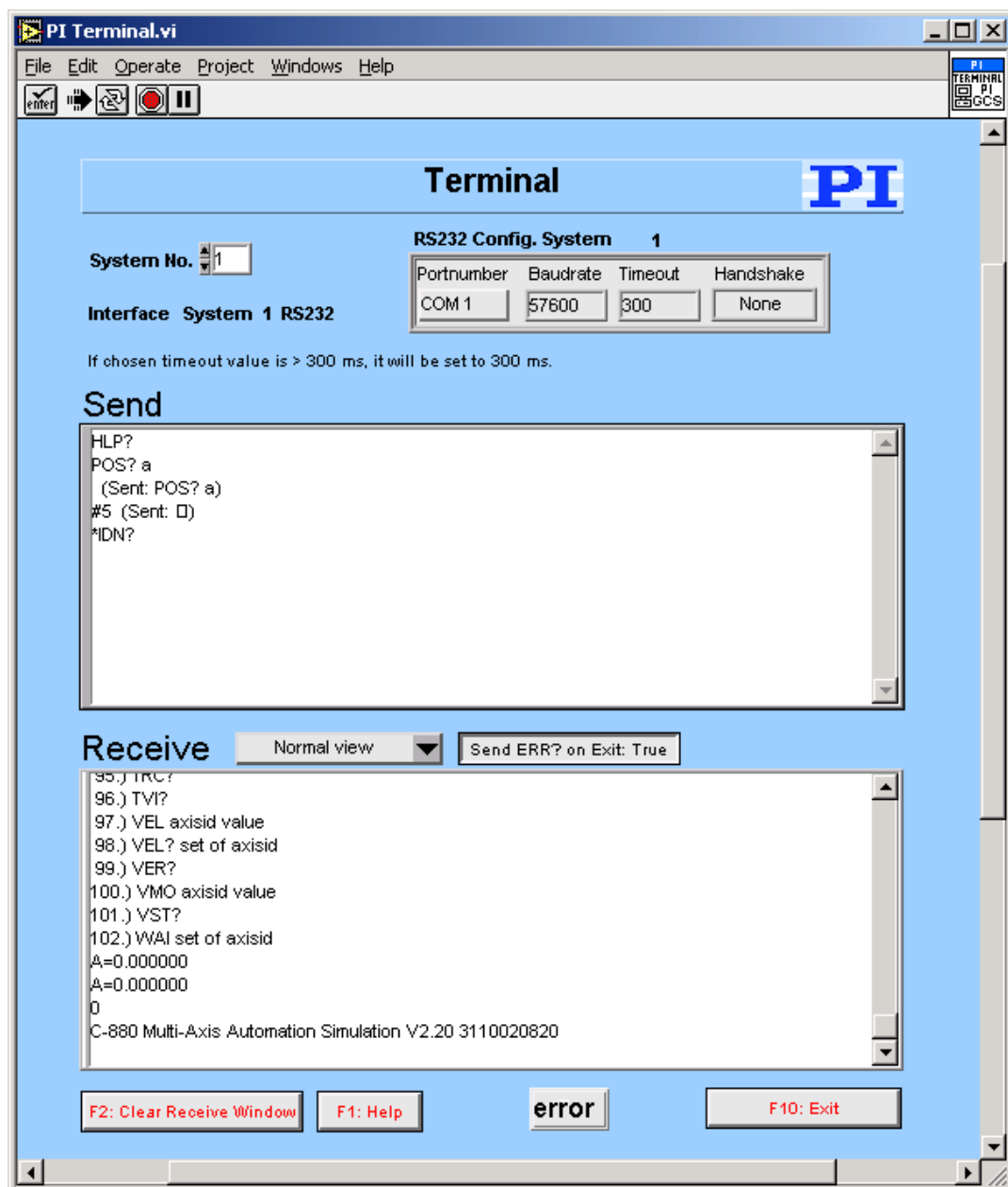
In the upper window ("Send") the user can enter commands which will be transmitted to the chosen device one line at a time when the ENTER key is pressed.

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.

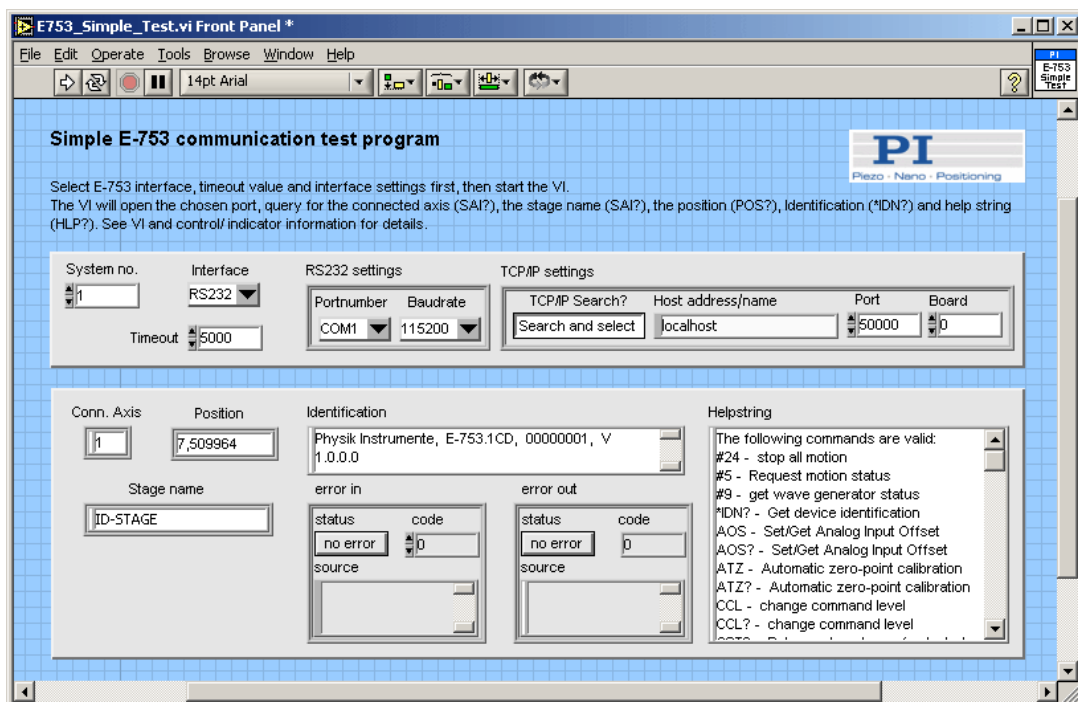
3.2. E753_Simple_Test.vi

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 no. (= 1 in a one-system configuration),
- Interface (= RS232 or TCP/IP)
- Timeout value (in milliseconds)
- and interface settings first.

Then start the VI. The VI will open a connection to the E-753 and query the controller for its identification string (*IDN?), help string (HLP?), the ID (SAI?) and stage name (CST?) of the connected axis and its current position value (POS?). The diagram shows how to combine the driver and support VIs for these tasks.



3.3. E753_Configuration_Setup.vi

This VI performs a fully automatic initialization of the selected system (global settings and automatic zero-point calibration of the stages, if appropriate) 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:

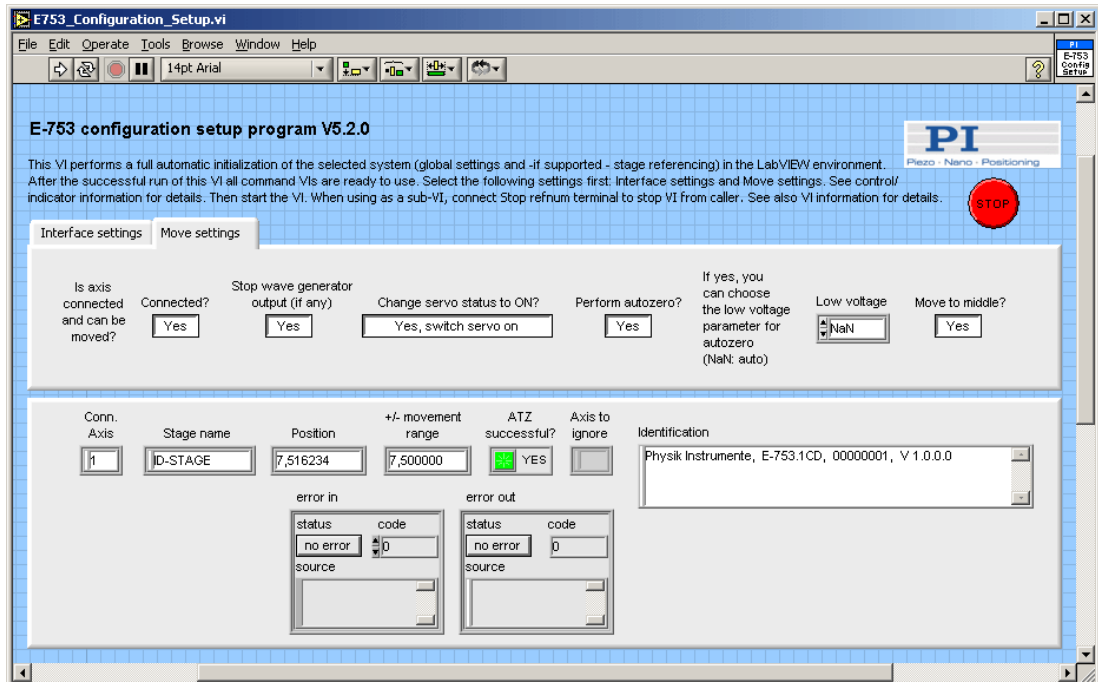
- System No.: 1 in a one-system-only configuration
- Interface (= RS232 or TCP/IP). For interface = TCP/IP, select also if you want to call a dialog to select the connected E-753 controller from a list (TRUE) or if you know the host address/name of the controller to connect (FALSE).
- Timeout value (in milliseconds)
- Interface settings
- If axis is connected and can be moved
- Whether a wave generator output is to be stopped (if you are not sure if any wave generator is running, leave this control TRUE).
- Whether the servo status of the connected axis is to change to TRUE. If FALSE is selected here, the servo status will not be changed.
- If auto zero is to be performed, whether the low voltage parameter is to define manually (Low voltage = I32 value) or automatically (Low voltage = NaN)
- If axis is to be moved to the middle position of its travel range.

Then start the VI.

"E753_Configuration_Setup.vi" performs the following initialization tasks:

1. Initializes all Global variables.
2. Runs "PI Open Interface of one system.vi" to open a connection to the controller.
3. Runs "*IDN?.vi" to query for the controller identification string.
4. Defines the selected system to be "E-753"
5. Runs "Define connected axes.vi" with Read from controller = TRUE to query for the axis ID of the connected axis.
6. Runs "CST?.vi" to query for the name of the connected stage. Depending on Connected?, VI will stop here or proceed as follows:
7. Runs "SVO.vi" to switch servo on (if Change servo status to ON? is TRUE)
8. Runs "SVO?.vi" to display servo status of axis
9. If Stop wave generator output (if any) is TRUE, runs "WGO.vi" with WGO parameter = 0.
10. If Perform autozero? is TRUE, runs "ATZ.vi"
11. Runs "POS?.vi" to query for the position of the connected axis
12. Reads the position range (TMN?, TMX?) of the axis.
13. If Move to middle? is TRUE, moves axis to the middle position of its range (MOV).

14. Runs "POS?.vi" to query for the position of the axis.
15. Runs "ERR?.vi" to query the controller for its error status.
16. Runs "GCSTranslateError.vi" to append the error message which corresponds with a GCS error number returned by "ERR?.vi" to Source from Error out.



Use this VI as the initialization VI for the E-753 in your application.

When using as a sub-VI, connect Stop refnum terminal to stop VI from caller.

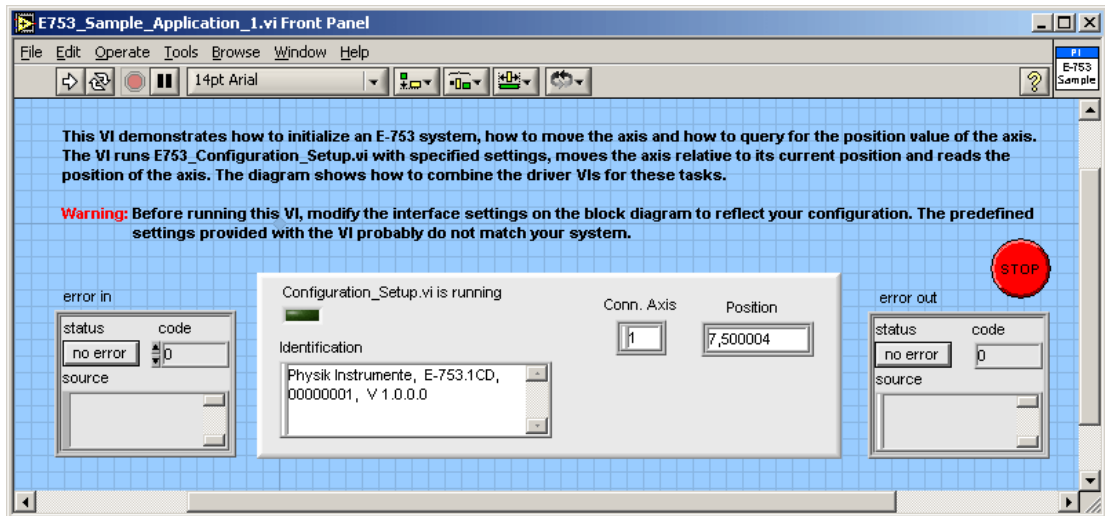
As the initialization is a complex procedure which uses a large number of sub-VIs, E753_Configuration_Setup.vi is password-protected, meaning that you cannot see or modify the diagram. In this way, the full initialization is packed into one single and fully tested procedure which you simply insert into your own application program. For security reasons as well as your convenience, we recommend that you not modify this VI.

3.4. E753_Sample_Application_1.vi

This VI demonstrates how to initialize an E-753 system, how to move the axis and how to query for the position value of the axis.

In this example the E-753 is connected through COM port 1 with baudrate 115200. The VI runs E753_Configuration_Setup.vi with these specified settings, moves the axis relative to its current position and reads the position of the axis. The diagram shows how to combine the driver VIs for these tasks.

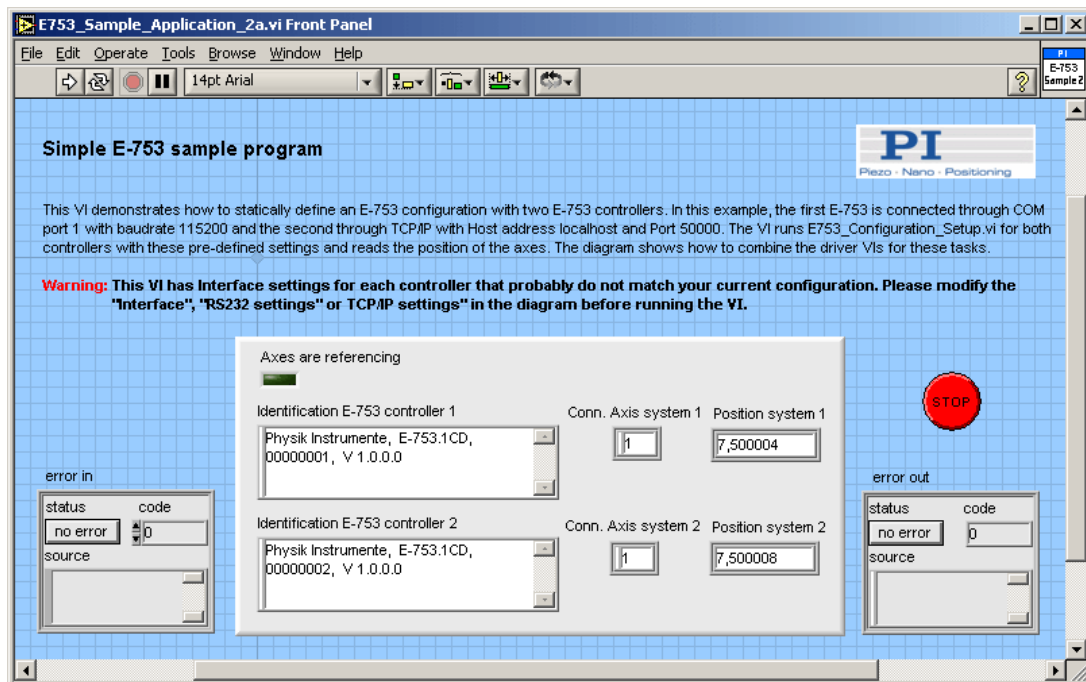
Warning: Before running this VI, modify the "Interface" and "RS232 settings" (or "TCP/IP settings") to reflect your configuration. The predefined settings provided with the VI probably do not match your system.



3.5. E753_Sample_Application_2a.vi

This VI demonstrates how to statically define an E-753 configuration with two E-753 controllers. In this example, the first E-753 is connected through COM port 1 with baudrate 115200 and the second through TCP/IP with Host address localhost and Port 50000. The VI runs "E753_Configuration_Setup.vi" for both controllers with these pre-defined settings and reads the position of the axes. The diagram shows how to combine the driver VIs for these tasks.

Warning: This VI has Interface settings for each controller that probably do not match your current configuration. Please modify the "Interface", "RS232 settings" or "TCP/IP settings" in the diagram before running the VI.



3.6. 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.

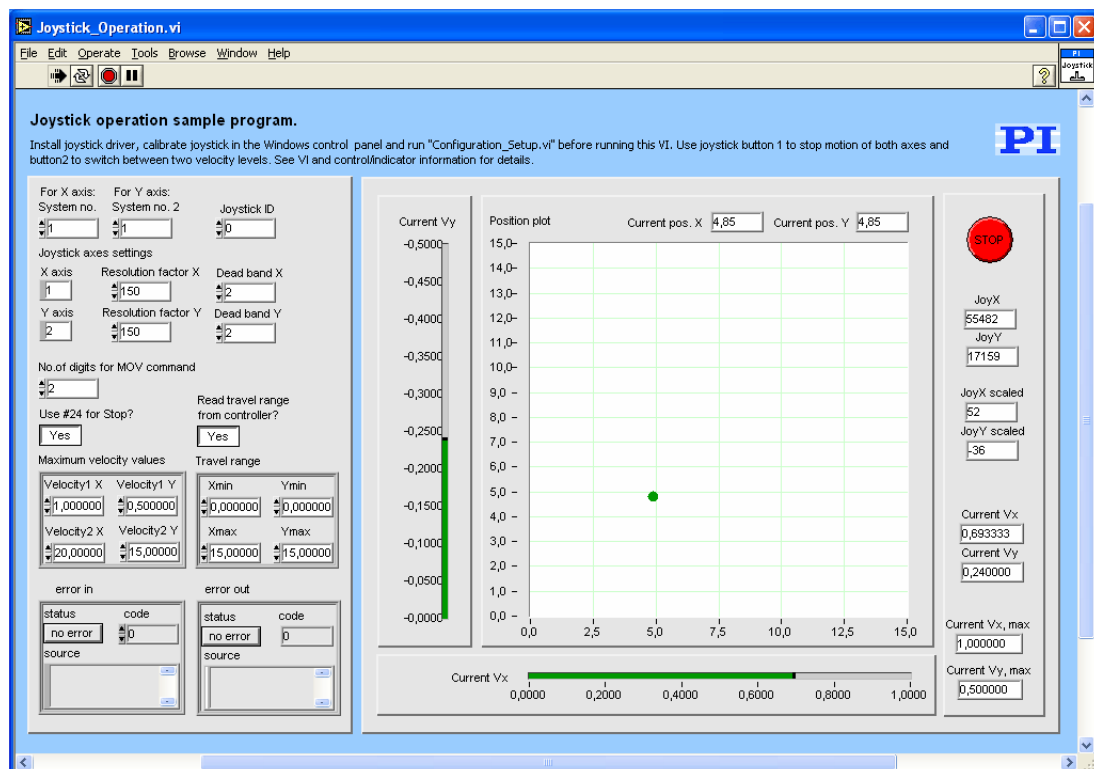
Resolution factor * determines the joystick resolution.

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, C-884, E-517, E-709, E-710, E-712, E-725, E-753, E-755, E-

761, E-861, Hydra, Pollux, Mercury_GCS

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: Use #24 for stop = TRUE, Read from controller = TRUE
Run "C702_Configuration_Setup.vi" prior to running this VI.

C-843: Use #24 for stop = TRUE, Read from controller = TRUE;
Run "C843_Configuration_Setup.vi" prior to running this VI.

C-843.PM: Use #24 for stop = TRUE, Read from controller = TRUE;
Run "C843_PM_Configuration_Setup.vi" prior to running this VI.

C-844: Use #24 for stop = TRUE, Read from controller = TRUE
Run "C844_Configuration_Setup.vi" prior to running this VI.

C-848: Use #24 for stop = TRUE, Read from controller = TRUE
Run "C848_Configuration_Setup.vi" prior to running this VI.

C-865: Use #24 for stop = TRUE, Read from controller = TRUE;
Run "C865_Configuration_Setup.vi" prior to running this VI.

C-866: Use #24 for stop = TRUE, Read from controller = TRUE;
Run "C866_Configuration_Setup.vi" prior to running this VI.

C-867: Use #24 for stop = TRUE, Read from controller = TRUE;
Run "C867_Multiaxis_Configuration_Setup.vi" prior to running this VI.

C-880: Use #24 for stop = TRUE, Read from controller = TRUE
Run "C880_Configuration_Setup.vi" prior to running this VI.

C-884: Use #24 for stop = TRUE, Read from controller = TRUE;
Run "C884_Configuration_Setup.vi" prior to running this VI.

E-517: Use #24 for stop = TRUE, Read from controller = TRUE.
Default position unit is μm , default velocity unit is $\mu\text{m/s}$.
Run "E517_Configuration_Setup.vi" prior to running this VI.

E-709: Use #24 for stop = TRUE, Read from controller = TRUE.
Default position unit is μm , default velocity unit is $\mu\text{m/s}$.
Run "E709_Configuration_Setup.vi" prior to running this VI.

E-710: Use #24 for stop = FALSE, Read from controller = TRUE.
Default position unit is μm , default velocity unit is $\mu\text{m/ms}$. 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: Use #24 for stop = TRUE, Read from controller = TRUE.
Default position unit is μm , default velocity unit is $\mu\text{m/s}$.
Run "E712_Configuration_Setup.vi" prior to running this VI.

E-725: Use #24 for stop = TRUE, Read from controller = TRUE.
Default position unit is μm , default velocity unit is $\mu\text{m/s}$.
Run "E725_Configuration_Setup.vi" prior to running this VI.

E-753: Use #24 for stop = TRUE, Read from controller = TRUE.
Default position unit is μm , default velocity unit is $\mu\text{m/s}$.
Run "E753_Configuration_Setup.vi" prior to running this VI.

E-755: Use #24 for stop = TRUE, Read from controller = TRUE.
Default position unit is μm , default velocity unit is $\mu\text{m/s}$.
Run "E755_Configuration_Setup.vi" prior to running this VI. VI

does not work with E-755.101.

E-761: Use #24 for stop = TRUE, Read from controller = TRUE.
Default position unit is μm , default velocity unit is $\mu\text{m}/\text{ms}$.
Run "E761_Configuration_Setup.vi" prior to running this VI.

E-861: Use #24 for stop = TRUE, Read from controller = TRUE;
Run "E861_Configuration_Setup.vi" prior to running this VI.

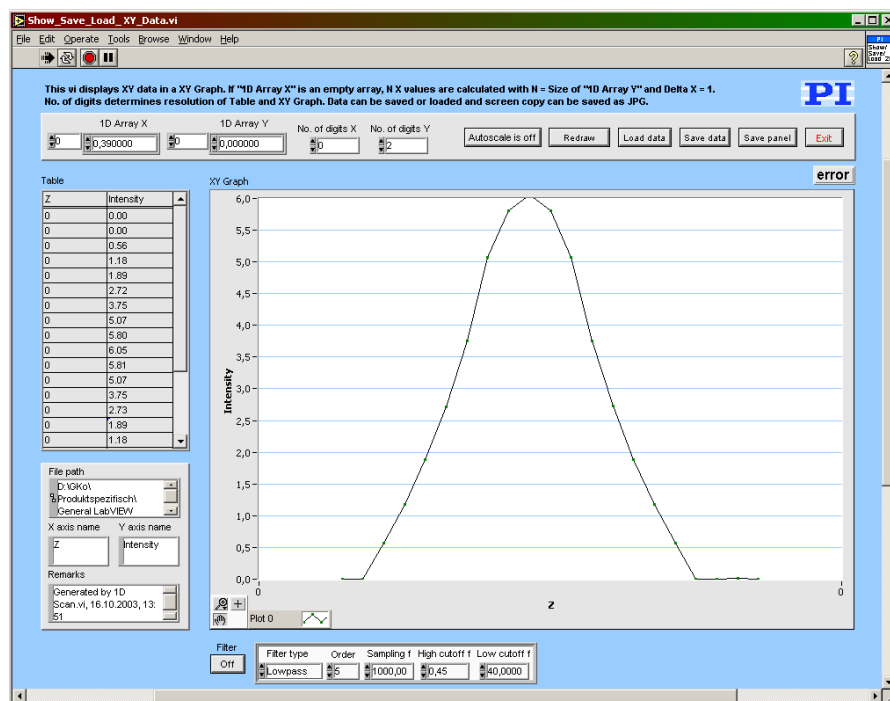
Hydra, Pollux: Use #24 for stop = TRUE, Read from controller = TRUE;
Run "HydraPollux_Configuration_Setup.vi" prior to running this VI.

Mercury_GCS: Use #24 for stop = TRUE, Read from controller = TRUE;
Run "Mercury_GCS_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.

3.7. 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 $N = \text{Size of } \underline{1D \text{ Array Y}} \text{ and } \Delta X = 1$. 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.



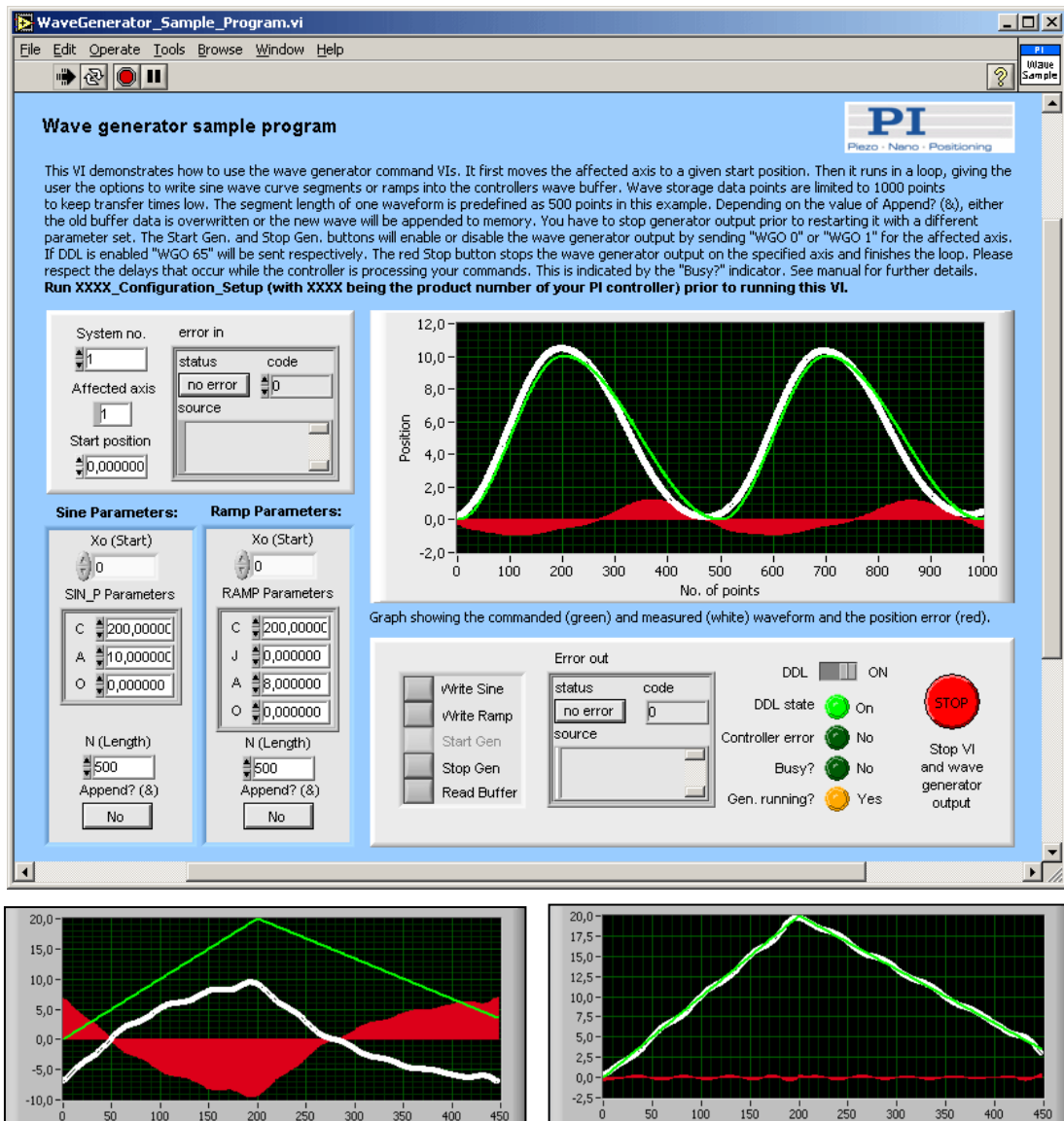
If data (1D Array X, 1D Array Y) are sent to the VI via the corresponding connectors, the VI will display the corresponding graphics after being called. To load data at runtime, press the Load data button. A dialog will pop up where a data file to open can be selected. The VI can read data in GCSArray, 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, C-884, E-517, E-709, E-712, E-725, E-753, E-755, E-761, E-861, E-871, F-206, M-8X0, Mercury_GCS. 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	

3.8. WaveGenerator_Sample_Program.vi

This VI demonstrates how to use the wave generator command VIs. It first moves the affected axis to a given start position. Then it runs in a loop, giving the user the options to write sine wave curve segments or ramps into the controllers wave buffer. Wave storage data points are limited to 1000 points to keep transfer times low. The segment length of one waveform - which normally defines the frequency - is predefined as 500 points in this example. Depending on the value of Append? (&), either the old buffer data is overwritten or the new wave will be appended to memory. Please take into account that you can append at most two waveforms since buffer size is limited to 1000 points as mentioned above.



Position graph with DDL off

Position graph with DDL on

Adjust the following controls to modify the shape of the waveforms.

N (Length): Waveform (i.e. the points to be modified) goes from 1 to Length. Datapoints from Length to 500 are filled with value of last wave point.

- Xo (Start): Position where the first point of the waveform is located.
- C: Center point of the wave. If $C = \text{Length}/2$ then the wave is symmetrical.
- A: Amplitude of the waveform. $F(x) = A \cdot \sin(x) + Q$
- Q: Offset of the waveform. $F(x) = A \cdot \sin(x) + Q$
- J: Jerk. Means curvature in the transition to or from standstill.

You have to stop generator output prior to restarting it with a different parameter set. The Start Gen. and Stop Gen. buttons will enable or disable the wave generator output by sending "WGO 0" or "WGO 1" for the affected axis. If DDL is enabled "WGO 65" will be sent respectively. The red Stop button stops the wave generator output on the specified axis and finishes the loop. Please respect the delays that occur while the controller is processing your commands. This is indicated by the "Busy?" indicator. See manual for further details.

In case of an error a button Clear Error will appear and the control buttons above will be disabled. Pressing this button will clear the error status and enable the control buttons again.

With DDL ON you can achieve significantly better position accuracy. Compare the target (green), response (white) and error (red) signals on the graph. Since this is a very sensitive mechanism we recommend starting with low amplitudes and adjusting the parameters with caution. The DDL button works only if the controller supports DDL. Contact PI for information on activation of DDL support.

See User Manual for details about the use of the wave generator.

Run XXXX_Configuration_Setup (with XXXX being the product number of your PI controller) prior to running this VI.

Valid for: E-712, E-725, E-753

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 6.3.1	-
C-702	4.0.0	1.4.0
C-843	2.01 – 2.02 2.05 – 2.06 3.1.2., 3.1.2a 3.4.3 3.6.1 5.7.4	MC-DLL 1.0.2.2 MC-DLL 1.0.2.3 MC-DLL 1.0.2.3 MC-DLL 1.0.2.8 MC-DLL 1.0.2.8 GCS_DLL 1.3.1 GCS_DLL 2.0.0
C-843.PM	3.1.0 3.4.3a 3.6.2	MC-DLL 1.0.2.5 MC-DLL 1.0.2.5 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 5.7.2 6.4.0	1.1.0.0 C-867: 2.0.0.0 C-867.160: 1.0.0.0 For USB: PI_GCS2_DLL.dll V2.16.0.0
C-880	1.1 1.2 2.04 2.05 – 2.06 3.2.0	2.00 2.10 2.20 2.21 2.40
C-880K005	2.06	1.0
C-880K006	2.06	1.0
C-880K007	2.06	1.0
C-884	6.2.0	1.0.0
C-887	6.0.0	1.1.1
E-516	1.0 – 2.02 2.05 – 2.06 3.4.2	DSP V3.01, MCU V5 DSP V3.11, MCU V5 DSP V3.30, MCU V5
E-517	5.7.0	1.1.0

E-709	5.8.0 6.3.1	GCSTranslator.dll V1.6.0.1 or higher For USB: PI_GCS2_DLL.dll V2.16.0.0
E-710 3- & 4-channel versions	3.4.0 3.4.4 (a, b)	5.027 5.0.33, 6.0.33
E-710 6-channel	3.4.4 (a, b)	2.13
E-712	5.3.1 5.8.2 6.31	1.0.1.0 10.00.06.00 For USB: PI_GCS2_DLL.dll V2.16.0.0
E-725	5.5.0 6.3.1	02.00.03.00 For USB: E7XX_GCS2_DLL.dll V2.2.0 For USB: PI_GCS2_DLL.dll V2.16.0.0
E-753	5.2.0 6.3.1	1.0.0 For USB: PI_GCS2_DLL.dll V2.16.0.0
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 5.8.1	6.0 7.0, GCSTranslator.dll V 1.6.0.2
E-816	2.01 – 2.06 5.3.0 5.7.1	2.02 2.1.1 3.2.0
E-870	6.1.0	1.0.0
E-871	6.3.0	01.000
F-206	1.1 – 2.06 5.4.2	Fhx0035 and higher Fhx0035 and higher, FHXF6 recommended
Hydra/ Pollux	6.1.0	Firmware Hydra: 3.3.1 HydraPollux_GCS_DLL: 1.0.0
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	1.0.6 PI_MERCURY_GCS_DLL.dll V 1.0.0.17

	5.7.3	2.4.0 PI_MERCURY_GCS_DLL.dll V 2.0.0
Mercury_ GCS	5.9.0	PI_GCS2_DLL 2.9.0, Firmware 1.2.0.0

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 <u>source</u> control 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	Invalid 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
92	Stage is not capable of following the master. Check the gear ratio(SRA).
93	This command is not allowed while the affected axis or its master is in motion.
94	Servo cannot be switched on when open-loop joystick control is enabled.
95	This parameter cannot be changed in current servo mode.
96	Unknown stage name
97	Invalid length of value (too much characters)
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, some controllers need 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
500	The "red knob" is still set and disables system
501	The "red knob" was activated and still disables system - reanimation required
502	Position consistency check failed
503	Hardware collision sensor(s) are activated
504	Strut following error occurred, e.g. caused by overload or encoder failure
505	One sensor signal is not valid

506	Servo loop was unstable due to wrong parameter setting and switched off to avoid damage.
507	digital connection to external spi slave device is lost
530	A command refers to a coordinate system that does not exist
531	A command refers to a coordinate system that has no parent node
532	Attempt to delete or change a coordinate system that is in use
533	Definition of a coordinate system is cyclic
536	Coordinate system cannot be defined as long as Hexapod is in motion
537	Coordinate system type is not intended for manual activation
539	A coordinate system cannot be linked to itself
540	Coordinate system definition is erroneous or not complete (replace or delete it)
542	The coordinate systems are not part of the same chain
543	Unused coordinate system must be deleted before new coordinate system can be stored
544	With this coordinate system type SPI usage is not supported
545	Soft limits invalid due to changes in coordinate system
546	Coordinate system is write protected
547	Coordinate system cannot be changed because its content is loaded from a configuration file
548	Coordinate system may not be linked
549	A KSB-type coordinate system can only be rotated by multiples of 90 degrees
551	This query is not supported for this coordinate system type
552	This combination of work and tool coordinate systems does not exist
553	The combination must consist of one work and one tool coordinate system
554	This coordinate system type does not exist
555	BasMac: unknown controller error
556	No coordinate system of this type is activated
557	Name of coordinate system is invalid
558	File with stored CS systems is missing or erroneous
559	File with leveling CS is missing or erroneous
601	Not enough memory
602	Hardware voltage error
603	Hardware temperature out of range
604	Position error of any axis in the system is too high
606	Maximum value of input signal has been exceeded
607	Value is not integer
700	Command not allowed because fieldbus target is active
710	Error in fieldbus-interface occurred
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)
1006	Invalid identifier (invalid special characters, ...)
1007	Variable or argument not defined
1008	Controller is (already) running a macro
1009	Invalid or missing operator for condition. Check necessary spaces around operator.
1010	No answer was received while executing WAC/MEX/JRC/...
1011	Command not valid during macro execution
1024	Motion error: position error too large, servo is switched off automatically
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
1071	User Profile Mode: Out of memory
1072	User Profile Mode: Cluster is not assigned to this axis
1073	Unknown cluster identifier
1090	There are too many open tcpip connections
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
4008	FW Parameter CRC wrong
4009	FW CRC wrong
5000	PicoCompensation scan data is not valid
5001	PicoCompensation is running, some actions can not be executed during scanning/recording
5002	Given axis can not be defined as PPC axis
5003	Defined scan area is larger than the travel range
5004	Given PicoCompensation type is not defined
5005	PicoCompensation parameter error

5006	PicoCompensation table is larger than maximum table length
5100	Common error in Nexline firmware module
5101	Output channel for Nexline can not be redefined for other usage
5102	Memory for Nexline signals is too small
5103	RNP can not be executed if axis is in closed loop
5104	relax procedure (RNP) needed
5200	Axis must be configured for this action
6000	Invalid preset value of absolute sensor
6001	Error while writing to sensor
6002	Error while reading from sensor
6003	Checksum error of absolute sensor
6004	General error of absolute sensor
6005	Overflow of absolute sensor position
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!)
-62	Host not found
-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: position error too large, servo is switched off automatically
-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 transfered 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
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- 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
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- 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
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