GaGe

CompuScope SDK for LabWindows/CVI

User's Guide

For CompuScope CompactPCI/PXI Digitizers

For SDK version 3.60+

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Preface

This manual is meant to serve as an aid to engineers using the CompuScope CompactPCI/PXI series of high performance digitizer cards in the LabWindows/CVI 6.0+ for Windows environment.

Throughout this manual, it is assumed that you are familiar with the LabWindows/CVI graphical programming environment. If you do not feel comfortable with LabWindows/CVI, it is highly recommended that you go through the Getting Started with LabWindows/CVI for Windows manual supplied to you by National Instruments, before starting any program development for the CompuScope cards.

It is also assumed that you have correctly installed and configured the CompuScope Windows drivers.

The CompuScope SDK for LabWindows/CVI supports Gage CompactPCI/PXI CompuScope cards. Please refer to the CompuScope Hardware manual for your CompuScope card in order to determine the capabilities of your CompuScope.
It is also assumed that you are familiar with the IBM PC and Microsoft Windows.

Chapter 1: Installing CompuScope SDK for LabWindows/CVI

Before installing the CompuScope SDK for LabWindows/CVI, you must first install the Gage CompuScope Windows drivers, supplied on the Gage Driver Disk CD Rom, and then install and configure the CompuScope hardware board. Please refer to the Driver Installation Guide, supplied with your CompuScope board, for instructions on installing the CompuScope Windows drivers. The CompuScope SDK for LabWindows/CVI may be operated under the following Windows operating Systems: Windows 98, Windows ME, Windows NT, Windows 2000 and Windows XP.

Before attempting to use the CompuScope SDK for LabWindows/CVI, you should ensure that the CompuScope hardware is operating correctly by testing it with either the GageScope or CS_Test software.

To install the CompuScope SDK for LabWindows/CVI, insert the installation disk into your PC drive and follow the installation instruction screens. The installation disk will install the CompuScope SDK for LabWindows/CVI and also the IVI Drivers.

When installing the CompuScope SDK for LabWindows/CVI, the installation program will ask you for a destination folder in which to install the CompuScope SDK for LabWindows/CVI. You can press **NEXT** to accept the default location, which is "Root:\Gage\CompuScope SDK for Windows\SDK for LabWindows-CVI" or BROWSE to choose a different location. The installation program will then copy the Gage_CVI_Scope.c, Gage_CVI_Scope.cws, Gage_CVI_Scope.exe, Gage_CVI_Scope.h, Gage_CVI_Scope.prj and Gage_CVI_Scope.uir files to the destination directory.

Chapter 2: Overview of CompuScope SDK for LabWindows/CVI

Gage now has an IVI (Interchangeable Virtual Instrument) interface or "IVI drivers" for CompactPCI/PXI CompuScope boards. This IVI interface allows Windows applications to control Gage CompuScope hardware from LabWindows/CVI, using device-non-specific commands. These commands are translated by the IVI interface and are passed along to the CompuScope Windows Drivers as CompuScope-specific Gage API function calls. The IVI interface enables users to write generic digitizer applications that can control any digitizer that has IVI support.

The CompuScope SDK for LabWindows/CVI supports dual channel capture from a single CompuScope and from a Master/Slave CompuScope system in Single Record mode.

Currently the Gage IVI interface supports only standard IVI functions. Several Gage operating modes, such as Multiple Record, are not supported by standard IVI functions. These operating modes may be implemented as IVI "extended" or "instrument specific" functionality. At present, however, the CompuScope SDK for LabWindows/CVI does not support the following CompuScope functionality:

- Single channel mode
- Multiple record mode
- External clock
- Differential input
- Advanced triggering
- Software trigger
- Forced trigger after a trigger time out
- Transferring raw data to optimize the transfer routines

A schematic illustration of the program control flow is shown below:

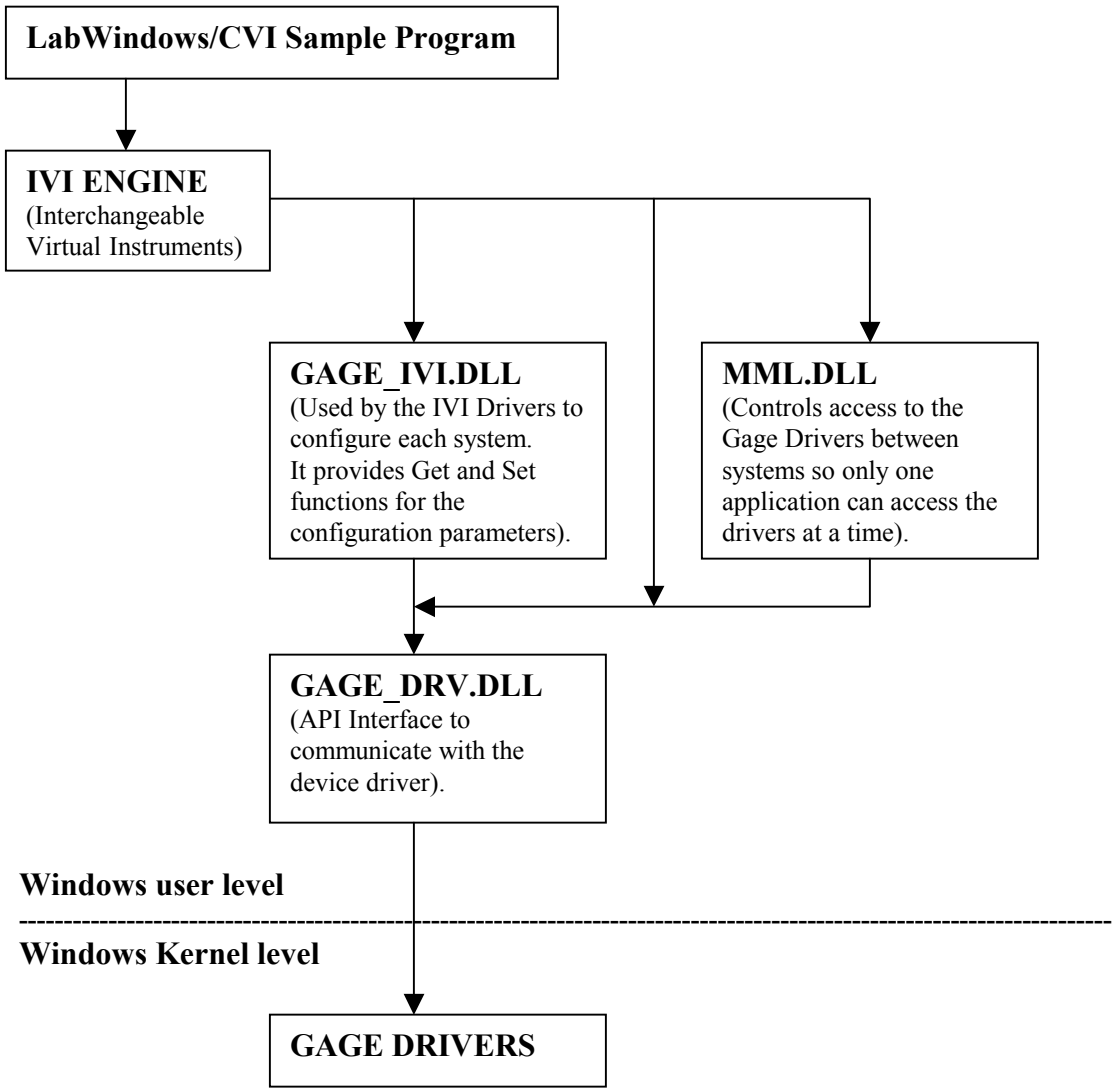


Figure 1. Graphical Representation of CompuScope Application Design in LabWindows/CVI

The basic algorithm for any data acquisition using Gage's CompuScope cards is:

1) Initialize the CompuScope driver and the CompuScope Hardware.

2) Set-up the CompuScope Hardware with the desired settings.

3) Start the CompuScope Hardware to digitize data into its on-board memory and await a trigger event.

4) Continuously check to see if a trigger event has occurred.

5) Continuously check to see if the CompuScope Hardware has finished capturing the current record.

6) After the acquisition is finished, determine where the data that was requested for downloading resides in CompuScope memory.

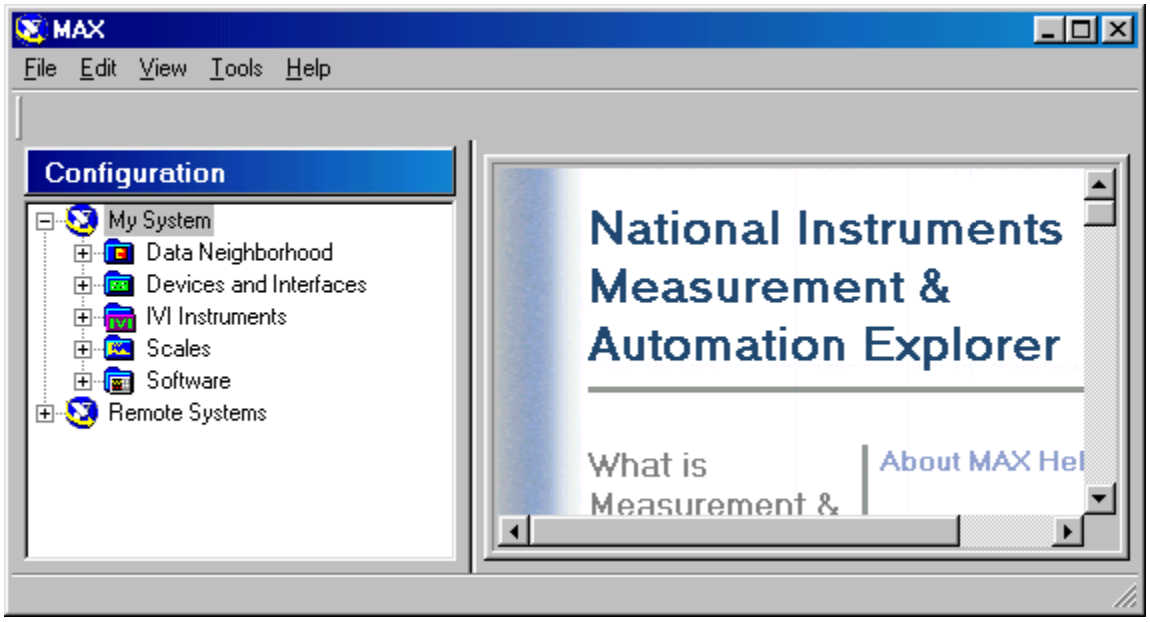
7) Download the data from the CompuScope Hardware.

8) Display, analyze or store the data.

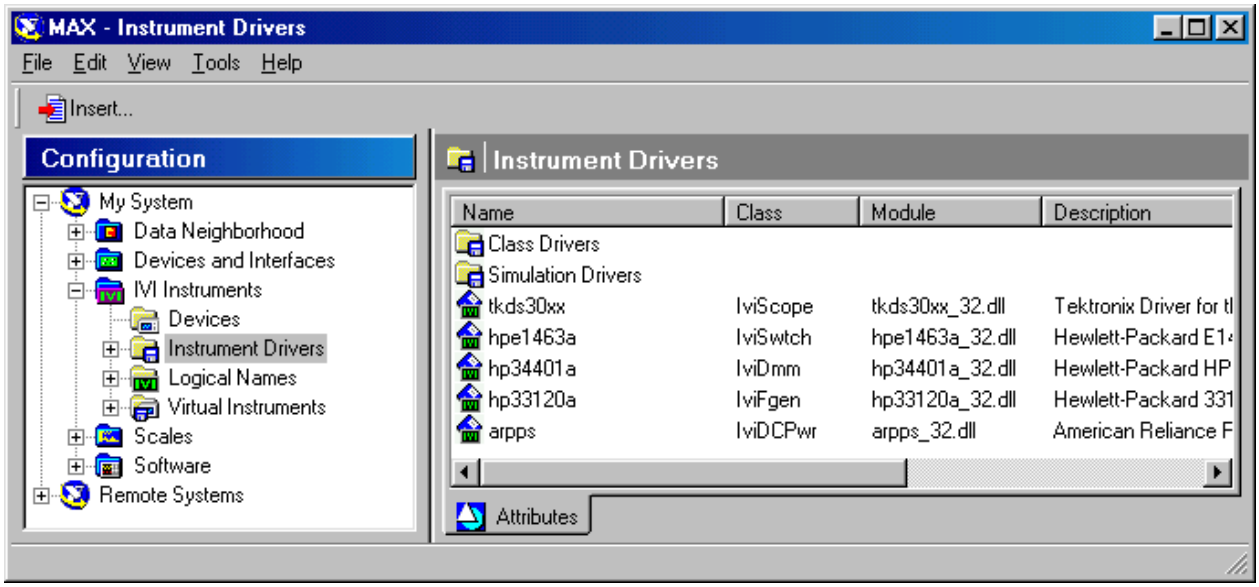
Chapter 3: Configuring a Virtual Instrument using National Instrument's MAX

Before proceeding with the steps described below it is assumed that the user has installed Gage CompuScope hardware, Gage CompuScope Drivers, Gage IVI Drivers, IVI Engine and NI-MAX. In the example session below, it is assumed that the CompuScope 1610C board is installed properly in the computer.

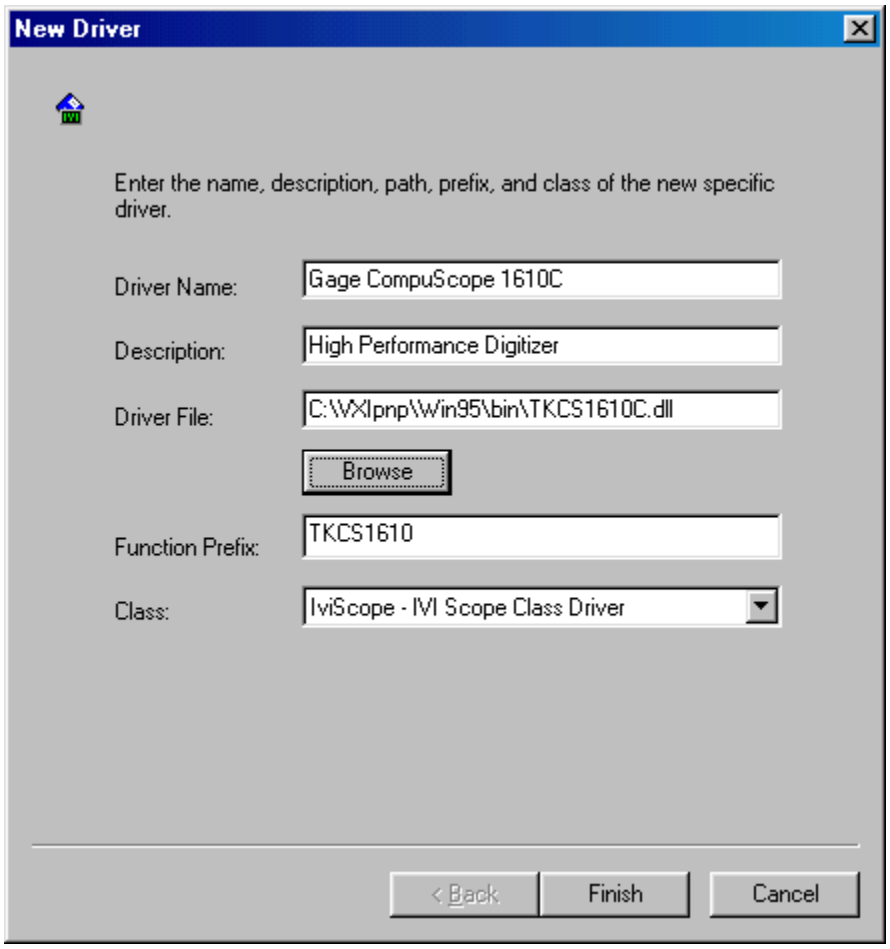
Run MAX (National Instruments Measurement & Automation Explorer).



Select My System → IVI Instruments → Instrument Drivers. Right Click on "Instruments Drivers" and select "Insert".



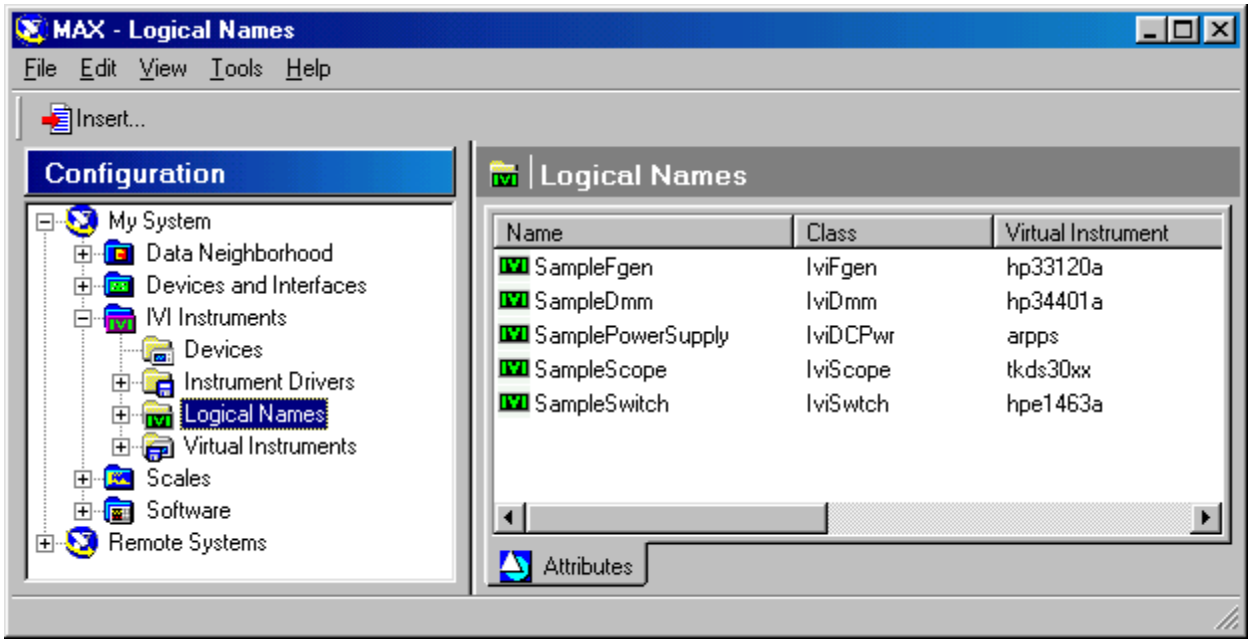
Enter the Driver Name and Description as shown below. For Driver File, select the appropriate driver DLL whose name contains the model name of your CompuScope hardware (TKCS1610C.DLL, TKCS14100C.DLL, TKCS85GC.DLL or TKCS82GC.DLL). These DLLs are located in the C:\VXIpnp\Winxx\Bin directory. The Function Prefix for CS1610C, CS14100C, CS85GC and CS82GC are TKCS1610, TKCS1410, TKCS85GC and TKCS82GC respectively. Select "IviScope – IVIScope Class Driver" for Driver Class.



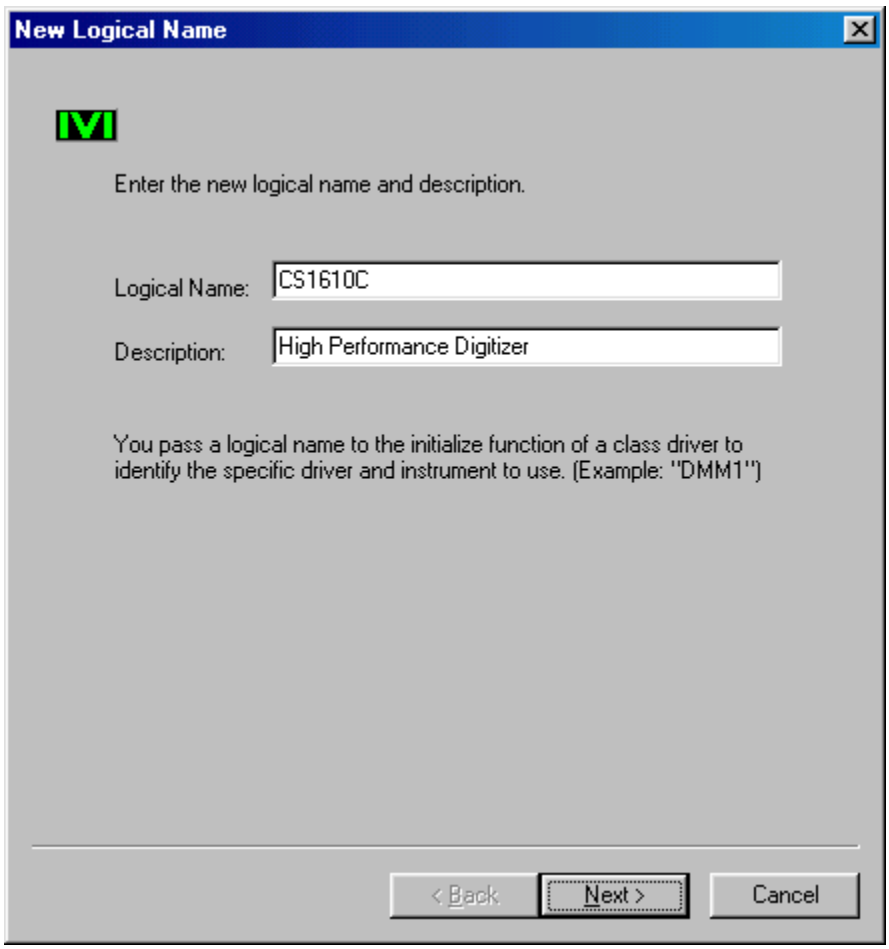
Click on 

.

Right click on “Logical Names” (under “IVI Instruments”) and select “Insert”.



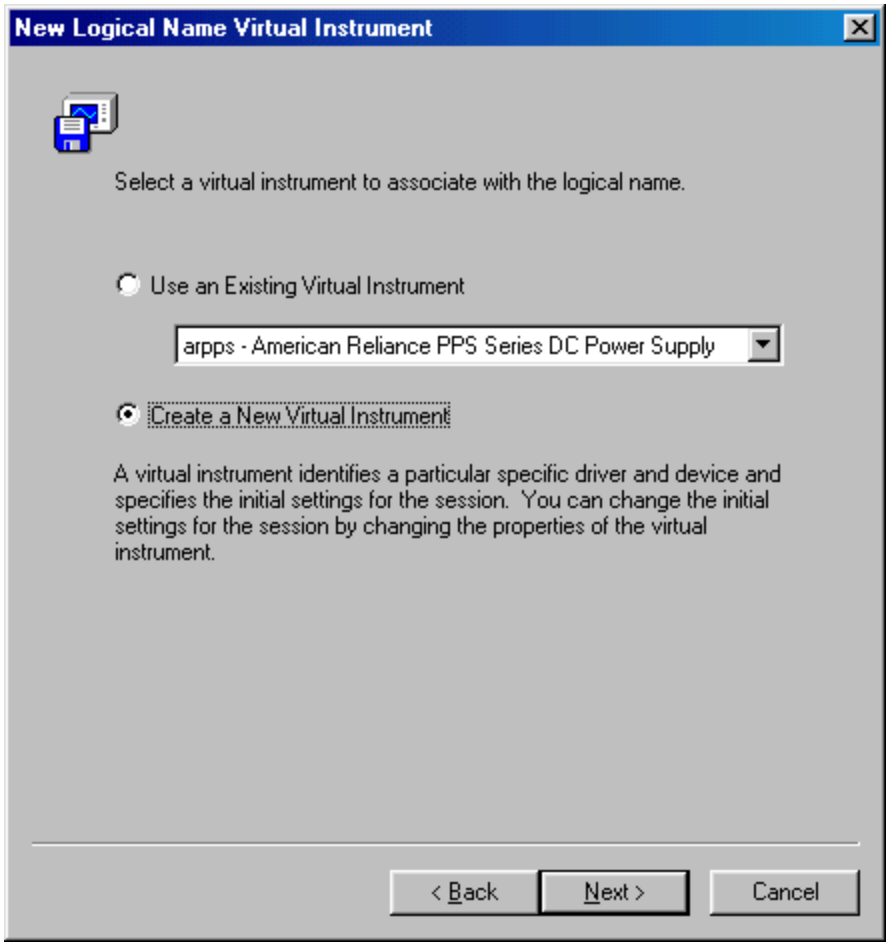
You will see a “New Logical Name” window as shown below. Enter the Logical Name and the Description of the device. The Logical name can be anything.



Click on 

.

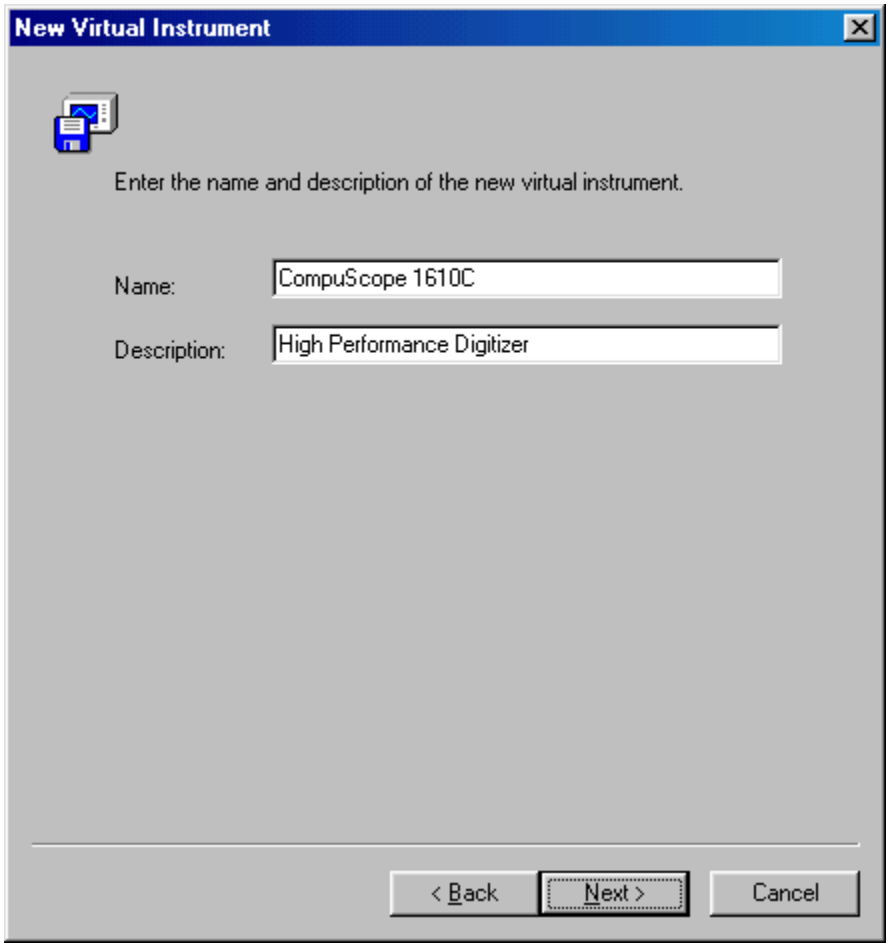
Now select the virtual instrument you want to associate with the logical name. If the virtual instrument was never created before, you must create one by selecting "Create a New Virtual Instrument" as below.



Click on 

.

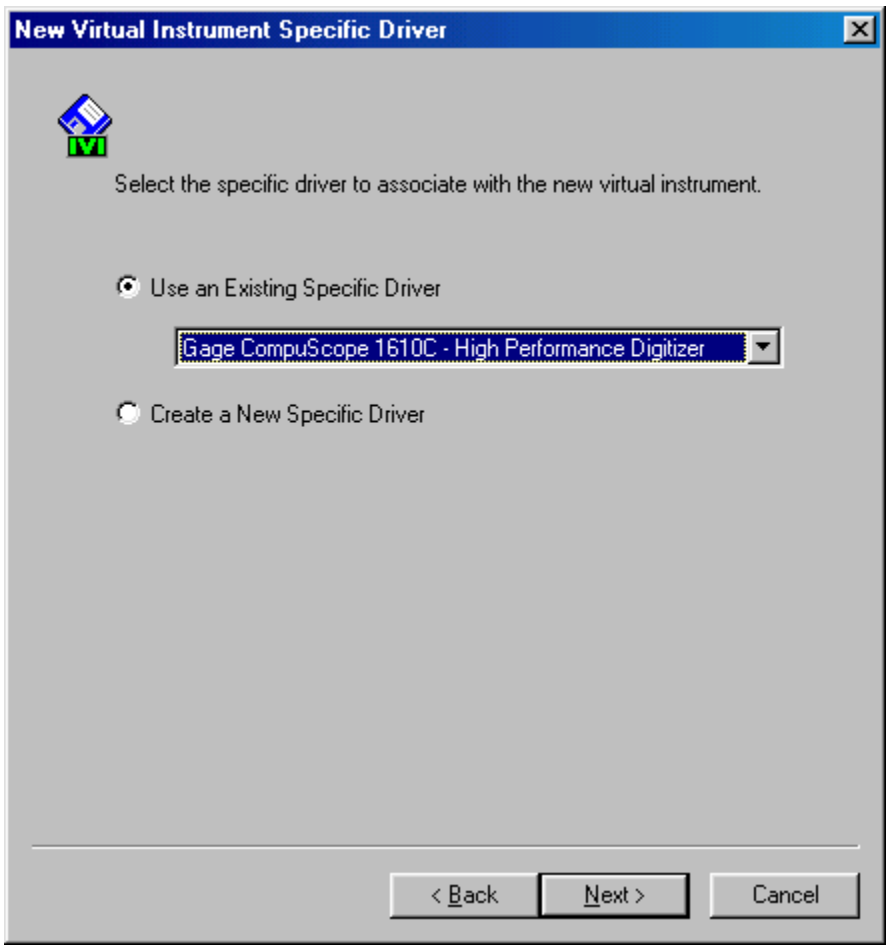
Enter the name and description of the new virtual instrument as below.



Click on 

.

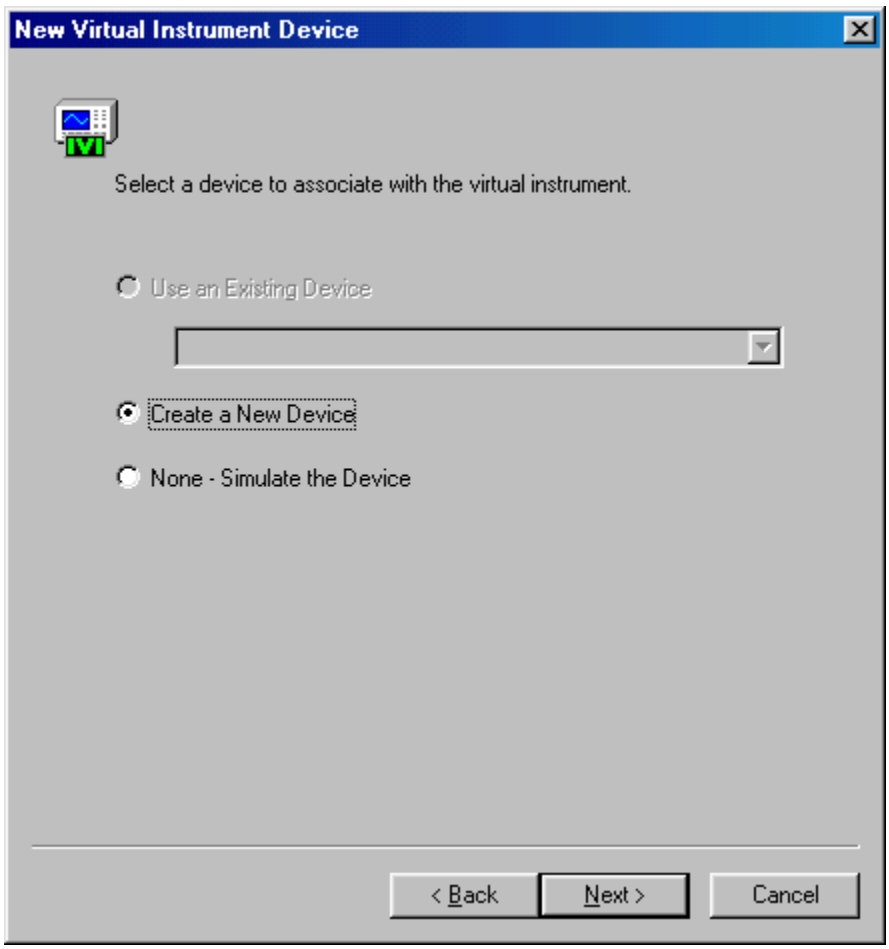
Now select the instrument driver to associate with the virtual instrument as shown below.



Click on 

.

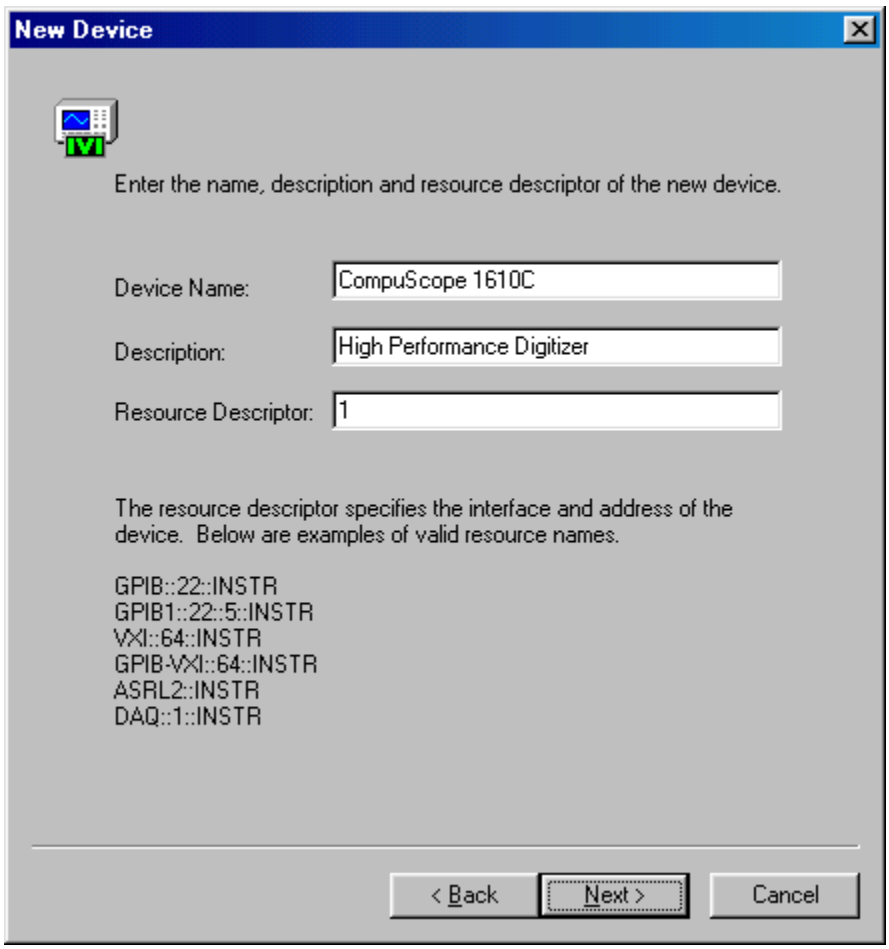
Select “Use an Existing Device” if it already exists or select “Create a New Device” as shown below.



Click on 

.

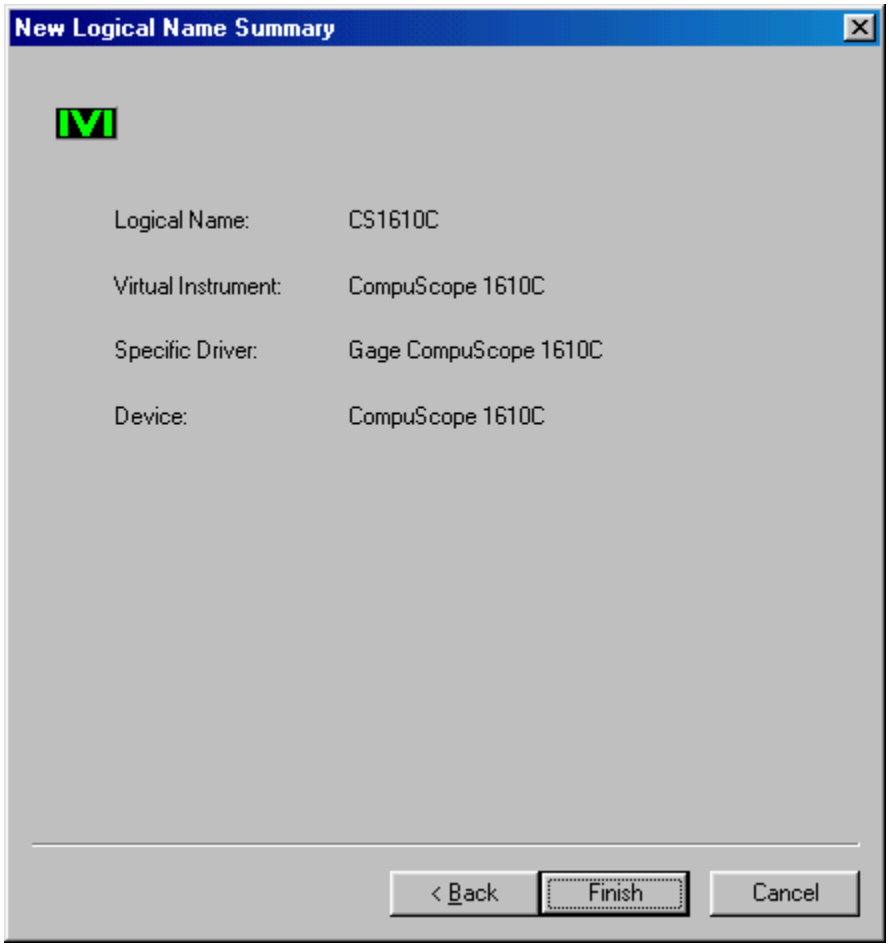
Enter the Device Name, Description and Resource Descriptor as shown below.



Click on 

.

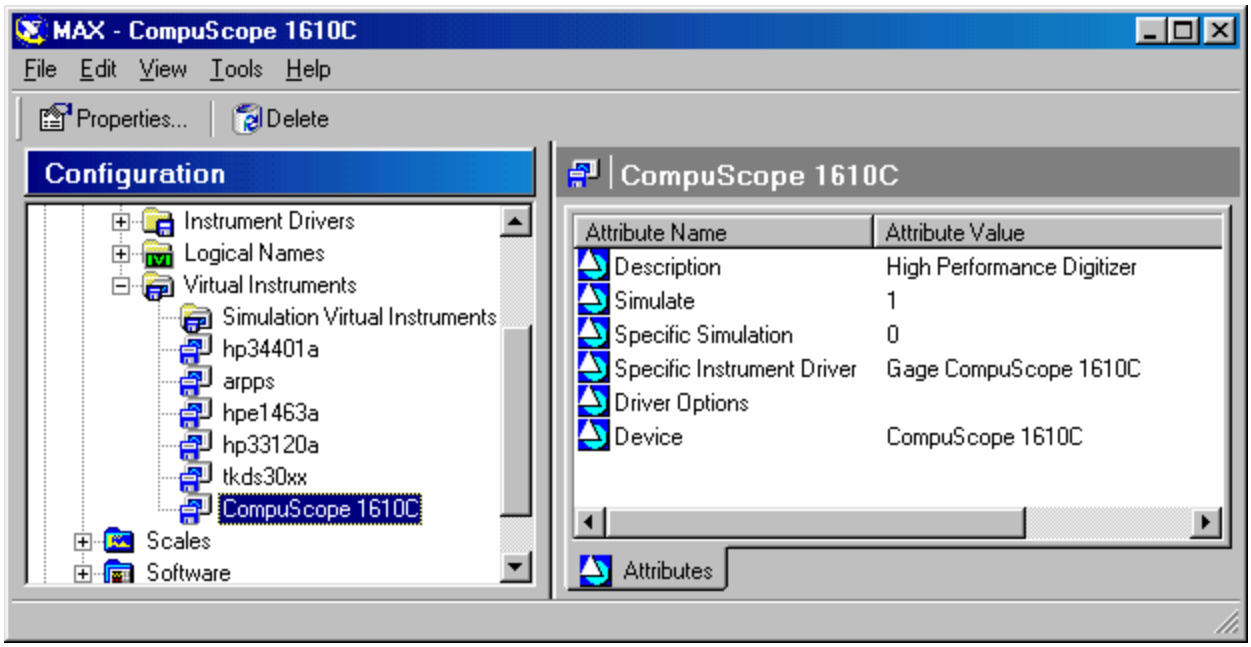
The “New Logical Name Summary” window is displayed as below.



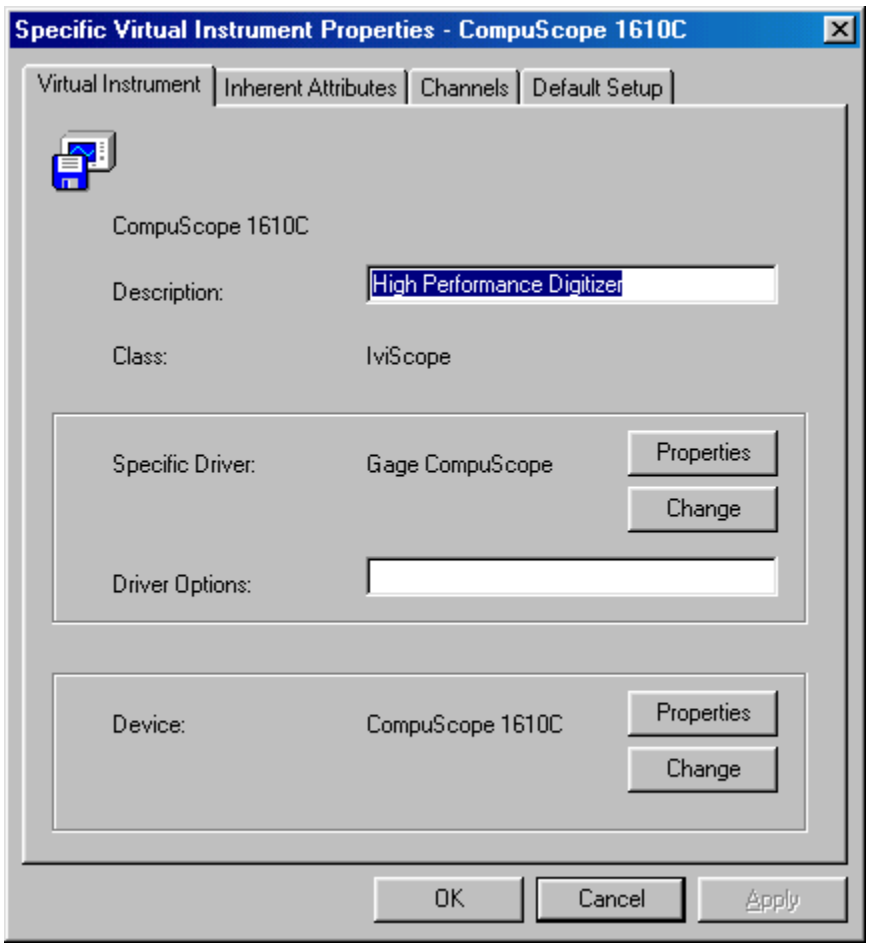
Click on 

.

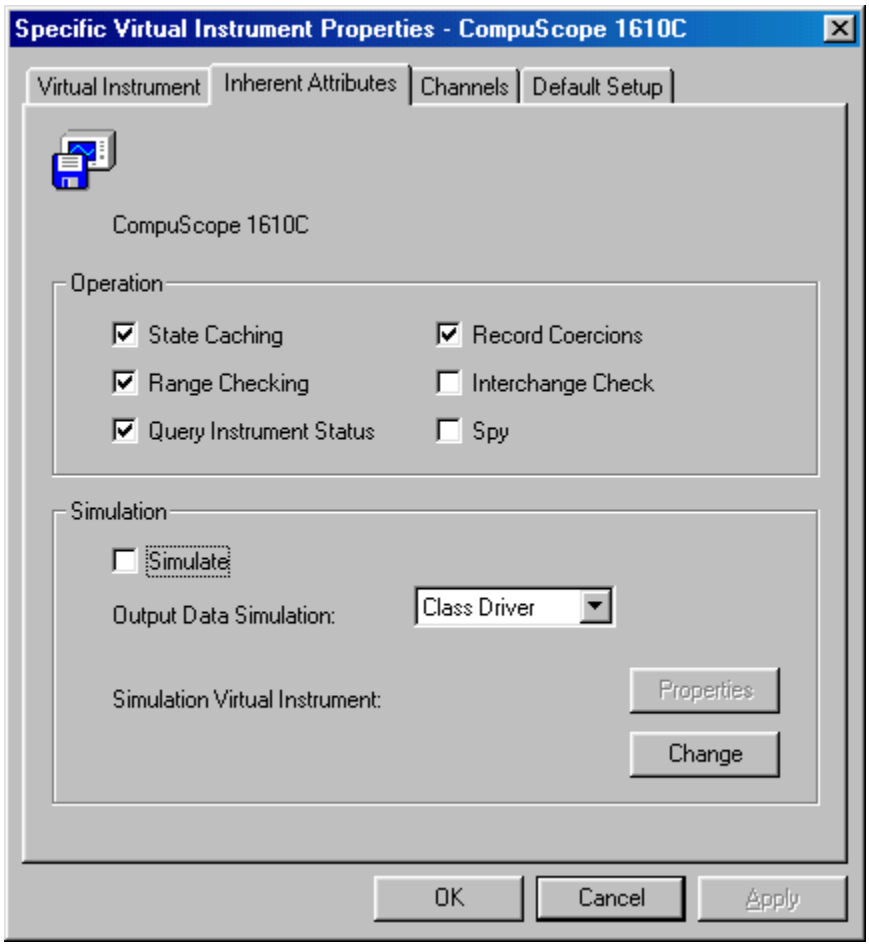
Now select My System → IVI Instruments → Virtual Instruments. Select and right click on "CompuScope 1610C". Select "Properties"



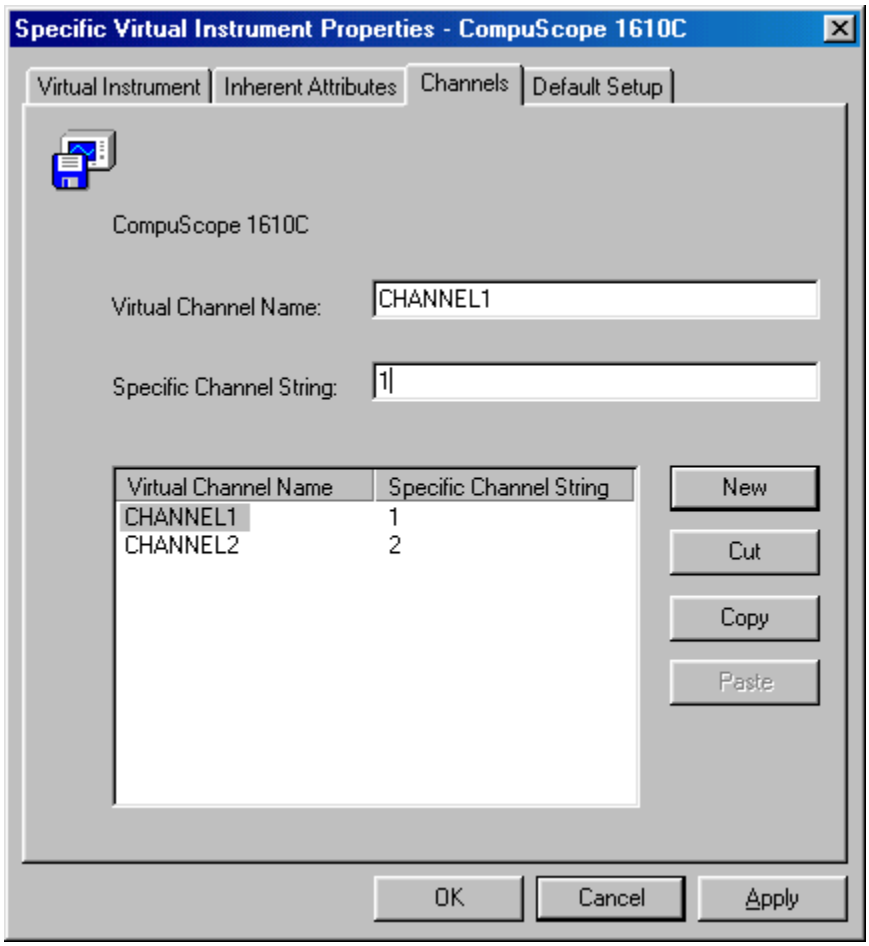
You will see the following “Specific Virtual Instrument Properties – CompuScope 1610C” window.



Click on “Inherent Attributes” and configure the attributes you want for this virtual instrument. Please note that Gage IVI drivers do not support the “Interchange Check” and the “Spy” attribute requires the IVI tool set from National Instruments. Please also note that the “Simulate” option must be unchecked, as it is checked by default.



Select My System → IVI Instruments → Virtual Instruments. Select and right click on "CompuScope 1610C". Select "Properties". Click on "Channels" and add all the channels you need for the Gage CompuScope 1610C card as shown below. You can enter any name in the "Virtual Channel Name" field. This is the string with which you will refer to the channel name in the "CompuScope SDK for LabWindows/CVI" sample program. The "Specific Channel String" must be an integer going from 1 to the number of channels. The number of channels is always 2 except when the hardware is configured as a Master/Slave Multi-CompuScope system, in which case the number of channels is twice the number of CompuScope boards in the system.

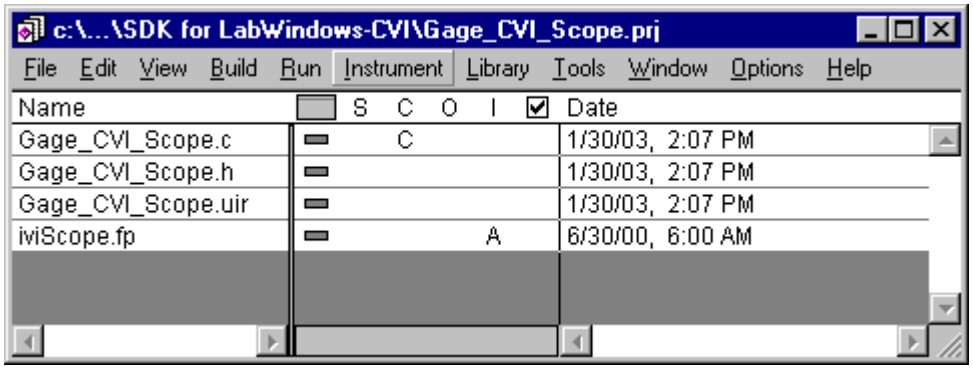


CompuScope 1610C board is configured properly.

Chapter 4: Detailed Description of CompuScope LabWindows/CVI Sample Program

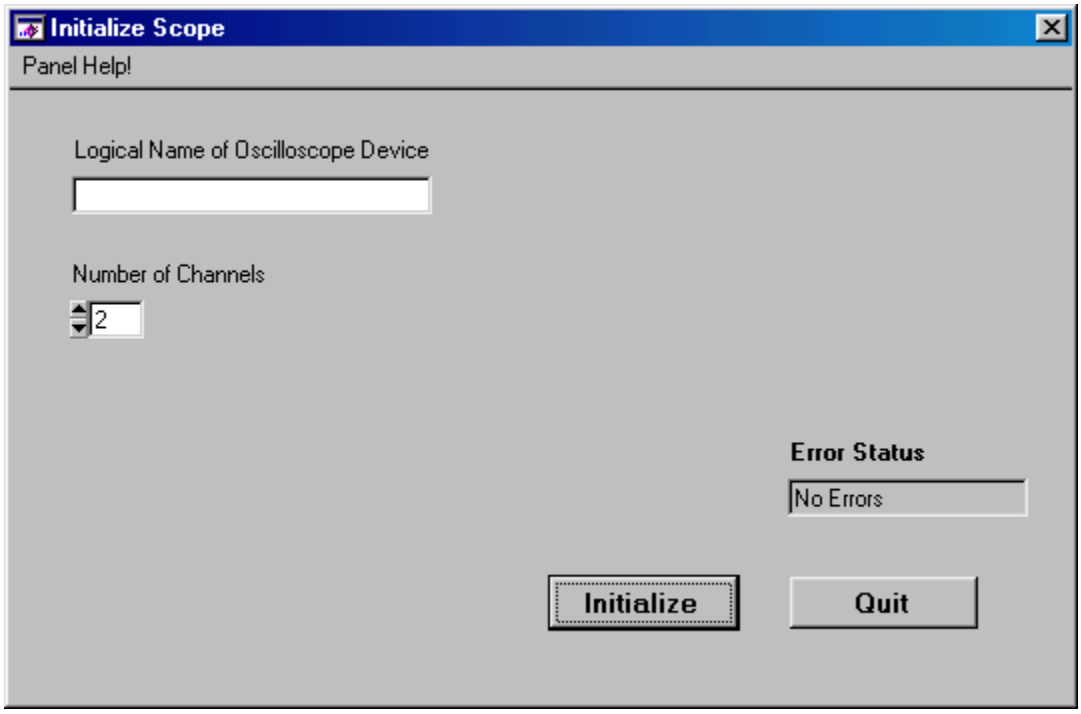
The sample program Gage_CVI_Scope included in the "CompuScope SDK for LabWindows/CVI" performs single record capture from a single card or Master/Slave set of any cPCI/PXI model CompuScope hardware. Run "National Instruments CVI" and load Gage_CVI_Scope.prj project file.

As shown below the files Gage_CVI_Scope.c, Gage_CVI_Scope.h, Gage_CVI_Scope.uir and iviScope.fp are included in the project file Gage_CVI_Scope.prj. The front panel file iviScope.fp does not get installed with the SDK installation. The default path is set to C:\Program Files\National Instruments\MeasurementStudio\CVI\instr\iviclass**.**

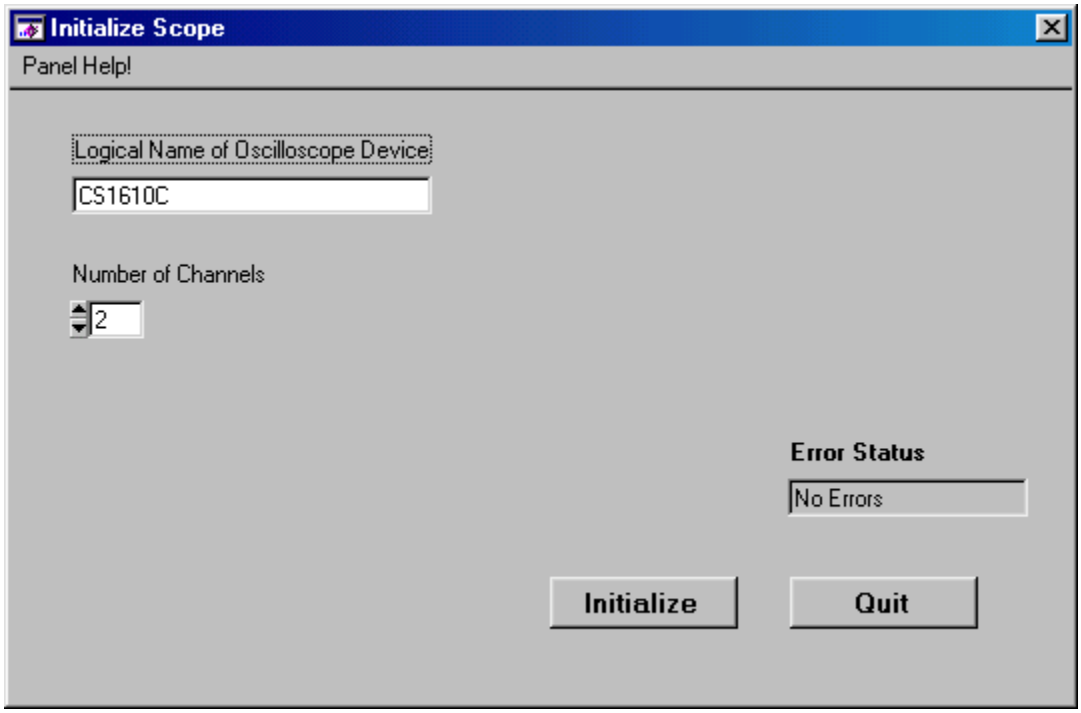


The program begins with a sequence of several panels, which are described below.

The following “Initialize Scope” panel is displayed when the sample program Gage_CVI_Scope is executed by selecting Run → Execute Gage_CVI_Scope.exe from the Main menu.

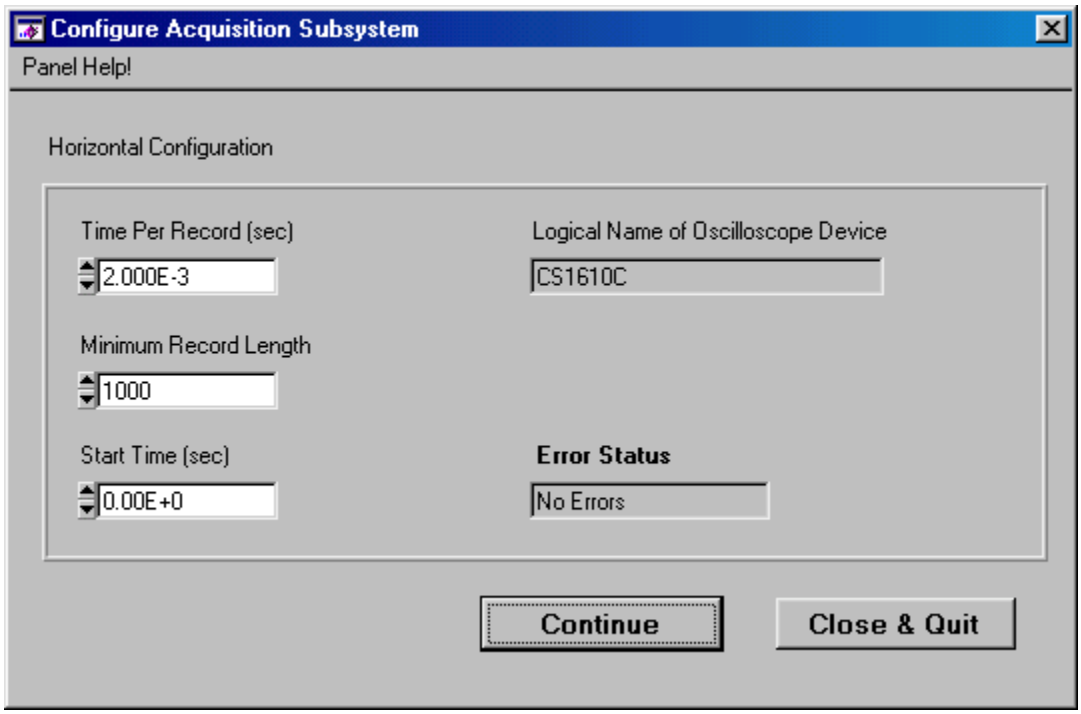


As shown below, the user must enter the “Logical name of Oscilloscope Device” as established in the NI MAX utility. In case of the invalid “Logical name of oscilloscope Device” an “Invalid value” is indicated in the “Error Status” box.



Click on 

. You will see “Configure Acquisition Subsystem” panel.



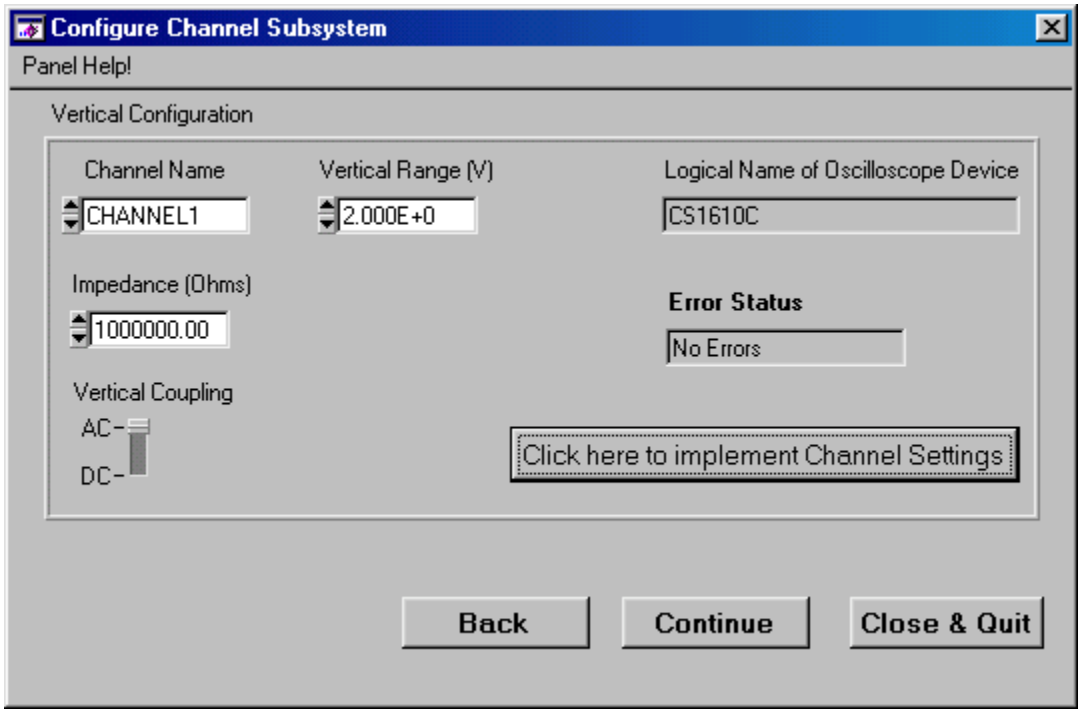
The user must enter the “Time Per Record ” (total capture time), “Minimum Record Length” (depth), “Start Time” (time with respect to trigger of first download point). Please note that the “Minimum Record Length” is limited to a maximum of 65536 samples per channel. This maximum limit can be increased by increasing the value of the defined constant “ARRAY_SIZE” within the program source code file. This limit was imposed in order to avoid memory allocation and display size limitations. If the user wants to capture extremely large amounts of data, they must implement a paging scheme in which smaller manageable pages of data are downloaded from the CompuScope hardware one at a time.

After 

is pressed, the program will increase the “Minimum Record Length” value to the next highest value allowed by the Gage CompuScope trigger resolution. The program will then calculate the sample rate (Minimum Record Length/ Time Per Record) and round it up to the next highest available Gage CompuScope sampling rate value. If necessary, the value for “Minimum Record Length” will be increased so that the (Minimum Record Length / Sample Rate) is equal to or greater than the value for “Time per Record”. If this value leads to a “Minimum Record Length” that exceeds the CompuScope channel memory, then the program will return “Invalid value” in the “Error Status” box because the value for “Minimum Record Length” is too high.

If the value for “Start Time” is negative, then the program will capture pre-trigger data. If the acquisition “Start Time” is not consistent with the other two inputs an “Invalid value” is returned in the “Error Status” box.

Next is “Configure Channel Subsystem” panel as shown below.



The channel settings (Channel Name, Vertical Range, Impedance, Vertical Coupling) must be adjusted for each channel in the system. The “Channel Name” is assigned during the NI MAX configuration procedure. “Vertical Range” represents the whole full scale range i.e., the value 2.000E+0 represents +/-1 Volt range.

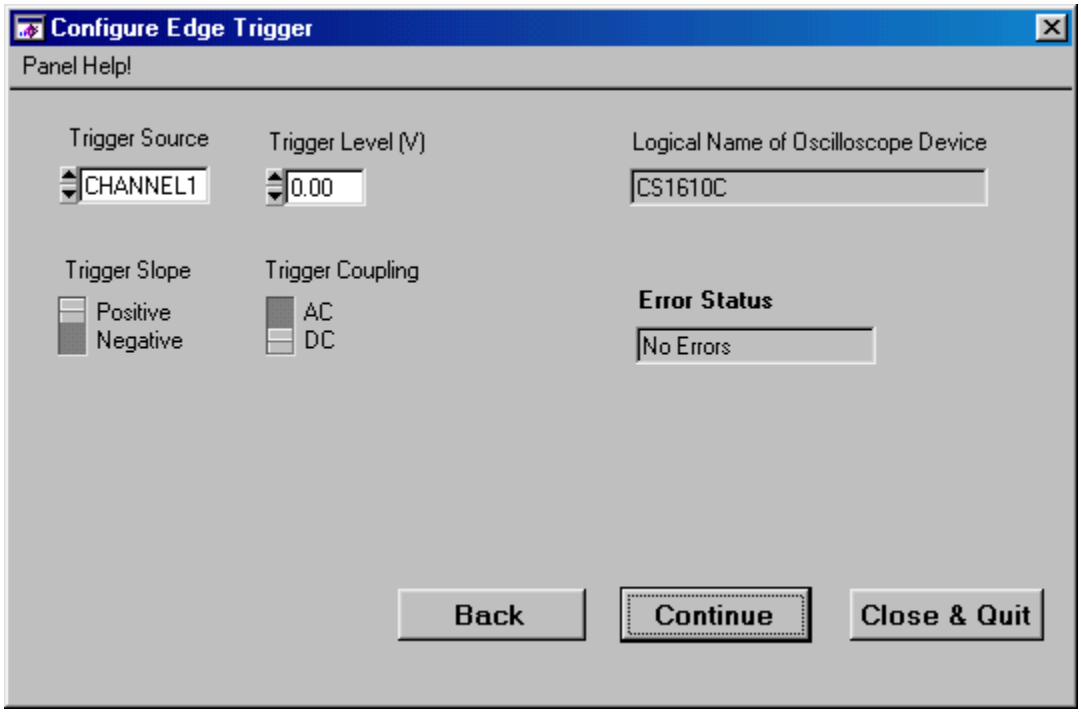
Click on 

after you have adjusted each channel's settings to the desired values.

When 

is pressed, all channel settings are actually implemented. In case of any error an “Invalid value” is displayed in the “Error Status” box.

Next is “Configure Edge Trigger” panel as shown below.

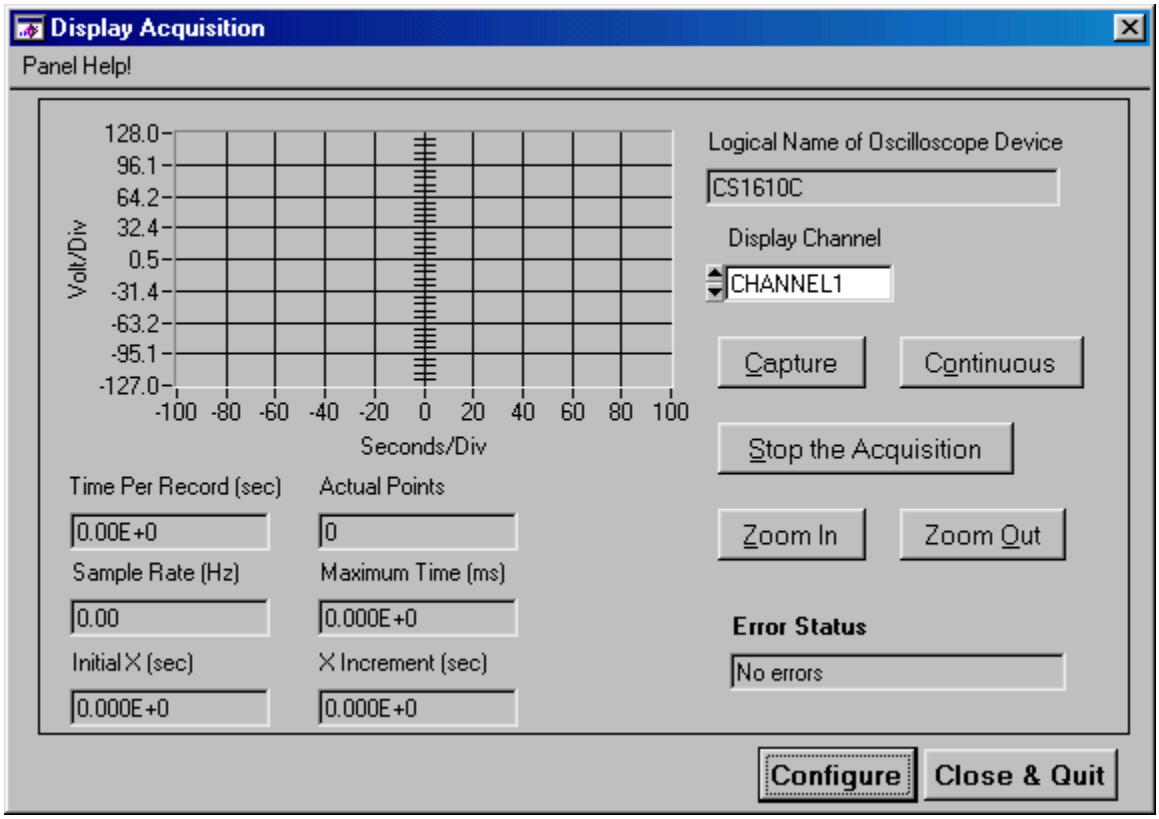


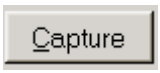
The trigger settings (Trigger Source, Trigger Level, Trigger Slope, Trigger Coupling) must be configured for the installed Gage CompuScope board in the system.

When 

is pressed, trigger settings are actually implemented. In case of any error an “Invalid value” is displayed in the “Error Status” box.

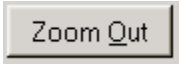
Next is “Display Acquisition” panel as shown below.

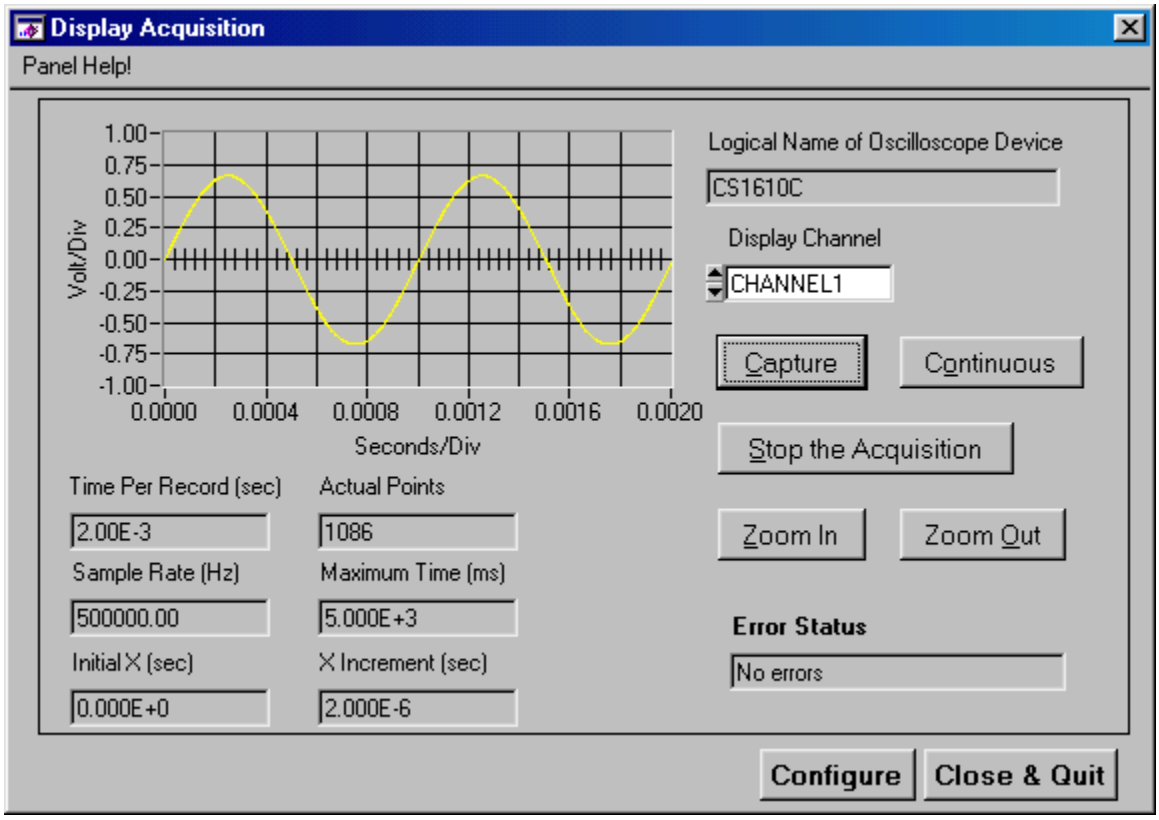


Click on  to acquire a signal with the installed Gage CompuScope hardware and display it once on the screen.

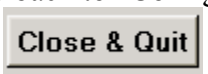
The signals can also be acquired and viewed continuously by pressing the  button. Choose the channel name for the channel on which you want to capture the data with “Display Channel”.

You can click on  to stop an acquisition.

 or  buttons are used to view the entire acquired signal or a portion of the it. Zooming changes the horizontal scale only, it does not effect the vertical scale of the channels.



You can go back to "Configure Acquisition Subsystem Panel" by clicking on 

button and 

to exit the sample program.

Chapter 5: IVI Routines

The following is a brief description of IviScope class functions used in the Gage_CVI _Scope.c program. For a detailed description, please visit the www.ivifoundation.org web site.

Name or Class	Function Name and Description
Configuration…	
Acquisition…	
Configure Acquisition Record	IviScope_ConfigureAcquisitionRecord This function configures the time per record, minimum record length, and the acquisition start time attributes.
Channel…	
Configure Channel	IviScope_ConfigureChannel This function configures the range, offset, coupling, probe attenuation, and whether the channel is enabled.
Configure Channel Characteristics	IviScope_ConfigureChanCharacteristics This function configures the input impedance and the maximum frequency of the input signal attributes.
Trigger…	
Configure Trigger	IviScope_ConfigureTrigger This function configures the trigger type and trigger holdoff attributes.
Configure Trigger Coupling	IviScope_ConfigureTriggerCoupling This function sets the trigger coupling attribute.
Configure Edge Trigger Source	IviScope_ConfigureEdgeTriggerSource This function sets the edge triggering attributes
Waveform Acquisition…	
Read Waveform	IviScope_ReadWaveform This function initiates an acquisition on the channels that the end-user configures with the Configure Channel function. It then waits for the acquisition to complete, and returns the waveform for the channel the end-user specifies.

The following is a list of IviScope class attributes used in Gage_CVI_Scope.c file. For detailed descriptions, please visit the www.ivifoundation.org web site.

Category or Generic Attribute Name	C Defined Constant and Description
Acquisition	
Acquisition Start Time	IVISCOPE_ATTR_ACQUISITION_START_TIME Specifies the length of time from the trigger event to the first point in the waveform record. If the value is positive, the first point in the waveform record occurs *after* the trigger event. If the value is negative, the first point in the waveform record occurs *before* the trigger event. The units are seconds.
Horizontal Minimum Number of Points	IVISCOPE_ATTR_HORZ_MIN_NUM_PTS Specifies the minimum number of points the end-user requires in the waveform record for each channel. The Horizontal Record Length attribute returns the actual record length.
Horizontal Sample Rate	IVISCOPE_ATTR_HORZ_SAMPLE_RATE Returns the effective sample rate of the acquired waveform using the current configuration. The units are samples per second.
Horizontal Time Per Record	IVISCOPE_ATTR_HORZ_TIME_PER_RECORD Specifies the length of time that corresponds to the record length. The units are seconds.
Channel	
Probe Attenuation	IVISCOPE_ATTR_PROBE_ATTENUATION Specifies the scaling factor by which the probe the end-user attaches to the channel attenuates the input. The source code for the sample program has this value hard-coded to 1.0, since for regulatory and safety reasons, Gage does not recommend the use of probes with its CompuScope cards. The user is free to change this value in order to compensate for some known system attenuation factor.
Vertical Range	IVISCOPE_ATTR_VERTICAL_RANGE Specifies the absolute value of the full-scale input range for a channel. The units are volts.
Vertical Coupling	IVISCOPE_ATTR_VERTICAL_COUPLING Specifies how the oscilloscope couples the input signal for the channel.
Input Impedance	IVISCOPE_ATTR_INPUT_IMPEDANCE Specifies the input impedance for the channel in Ohms.

Category or Generic Attribute Name	C Defined Constant and Description
Trigger	
Trigger Source	IVISCOPE_ATTR_TRIGGER_SOURCE Specifies the source the oscilloscope monitors for the trigger event.
Trigger Coupling	IVISCOPE_ATTR_TRIGGER_COUPLING Specifies how the oscilloscope couples the trigger source.
Trigger Level	IVISCOPE_ATTR_TRIGGER_LEVEL Specifies the voltage threshold for the trigger sub-system. The units are volts.
Trigger Slope	IVISCOPE_ATTR_TRIGGER_SLOPE Specifies whether a rising or a falling edge triggers the oscilloscope.

Technical Support

Gage Applied Technologies, Inc. offers technical support for all its Software Development Kits.

In order to serve you better, we have created a web-based technical support system that is available to you 24 hours a day.

By utilizing the internet to the fullest, we are able to provide you better than ever technical support without increasing our costs, thereby allowing us to provide you the ***best possible product at the lowest possible price.***

To obtain technical support, simply visit:

`www.gage-applied.com/support.asp`

Please complete this form and submit it. Our form processing system will intelligently route your request to the Technical Support Specialist (TSS) most familiar with the intricacies of your product. This TSS will be in contact with you within 24 hours of form submittal.

In the odd case that you have problems submitting the form on our web site, please e-mail us at

`support@gage-applied.com`

As opposed to automatic routing of technical support requests originating from the Gage web site, support requests received via e-mail or telephone calls are routed manually by our staff. Providing you with high quality support may take an average of 2 to 3 days if you do not use the web-based technical support system.

Please note that Technical Support Requests received

via e-mail or by telephone will take an average of 2 to 3 days to process.

It is faster to use the web site!

When calling for support we ask that you have the following information available:

1. Version and type of your CompuScope SDK and drivers.
   (The version numbers are indicated on the distribution diskette(s). Version numbers can also be obtained by looking in the appropriate README.TXT files)

2. Type, version and memory depth of your CompuScope card.

3. Type and version of your operating system.

4. Type and speed of your computer and bus.

5. Contents of your CONFIG.SYS and AUTOEXEC.BAT files.

6. Any extra hardware peripherals (i.e. CD-ROM, joystick, network card, etc.)

7. Were you able to reproduce the problem with standalone Gage Software (e.g. GageScope, GageBit)?

Gage Products

For ordering information, see Gage's product catalog, or visit our web site at http://www.gage-applied.com

CompactPCI Bus Products	CompuScope 85GC	8 bit, 5 GS/s Analog Input Card
	CompuScope 82GC	8 bit, 2 GS/s Analog Input Card
	CompuScope 14100C	14 bit, 100 MS/s Analog Input Card
	CompuScope 1610C	16 bit, 10 MS/s Analog Input Card
	CompuScope 3200C	32 bit, 100 MHz Digital Input for CompactPCI Bus
PCI Bus Products	CompuScope 1610	16 bit, 10 MS/s Analog Input Card
	CompuScope 1602	16 bit, 2.5 MS/s Analog Input Card
	CompuScope 14200	14 bit, 200 MS/s Analog Input Card
	CompuScope 14105	14 bit, 105 MS/s Analog Input Card
	CompuScope 14100	14 bit, 100 MS/s Analog Input Card
	CompuScope 1450	14 bit, 50 MS/s Analog Input Card
	CompuScope 12100	12 bit, 100 MS/s Analog Input Card
	CompuScope 1250	12 bit, 50 MS/s Analog Input Card
	CompuScope 1220	12 bit, 20 MS/s Analog Input Card
	CompuScope 85G	8 bit, 5 GS/s Analog Input Card
	CompuScope 82G	8 bit, 2 GS/s Analog Input Card
	CompuScope 8500	8 bit, 500 MS/s Analog Input Card
	CompuScope 3200	32 bit, 100 MHz Digital Input for PCI Bus
CompuGen	CompuGen 1100	12 bit, 80 MS/s Analog Output Card
	CompuGen 3250	32 bit, 50 MHz Digital Output Card
Application Software	GageScope	World's Most Powerful Oscilloscope Software
	GageBit	Digital Input/Output Software
	CompuGen for Windows	Arbitrary Waveform Generator Software for Windows
Software Development Kits	CompuScope SDK for C/C++ for Windows	
	CompuScope LabVIEW SDK for Windows	
	CompuScope MATLAB SDK for Windows	
	CompuScope LabWindows/CVI SDK (for CompactPCI/PXI bus CompuScope cards)	
	CompuGen Analog SDK for C/C++ for Windows	
	CompuGen Digital SDK for C/C++ for Windows	
	CompuGen Analog LabVIEW SDK for Windows	
	CompuGen Digital LabVIEW SDK for Windows	
	CompuGen Analog MATLAB SDK for Windows	
	CompuGen Digital MATLAB SDK for Windows	
Instrument Mainframes	Instrument Mainframe 7000 Instrument Mainframe 2000	Instrument Mainframes for Housing CompuScope and CompuGen Products.
	Instrument Mainframe 8000C	Instrument Mainframes for Housing CompactPCI/PXI CompuScope Products.