GaGe

GAGE APPLIED TECHNOLOGIES

Gage CompactPCI/PXI Hardware Manual and Driver Installation Guide

Please complete the following section and keep it handy when calling Gage for **technical support**:

Owned by: _____
Serial Number(s):   _____
                             _____
Purchase Date: _____
Purchased From: _____

You must also have the following information when you call:

· Software Driver & Application Version
· Software Development Kit, if applicable
· Brand name and type of computer
· Processor and bus speed
· Total memory size
· Information on all other hardware in the computer

How to reach Gage Applied Technologies, Inc. for Product Support
Toll-free phone: (800) 567-GAGE   Toll-free fax: (800) 780-8411

To reach Gage from outside North America
Tel: +1-514-633-7447   Fax: +1-514-633-0770

Email: prodinfo@gage-applied.com   **Website**: www.gage-applied.com

Table of contents

Preface

This manual provides detailed information on the hardware features of CompuScope CompactPCI/PXI Analog Input and Digital Input cards. This information includes specifications, block diagrams, and connector descriptions, as well as memory architecture.

In addition, this guide takes you through the process of installing your CompactPCI/PXI CompuScope card(s) and describes available custom features.

Please note that this manual is not intended as a reference for PCI bus CompuScope cards. If you did not receive the correct guide, please contact the factory for a replacement.

It is assumed that the reader is familiar with using PCs, Windows and CompactPCI™ cards. No description is included for these topics. If you are not comfortable with these areas, it is strongly recommended that you refer to the relevant product guides.

To maintain the accuracy of the information contained herein, we reserve the right to make changes to this manual from time to time.

Note: For brevity, in this manual,

"CompuScope 85GC" is sometimes abbreviated as "CS85GC"

"CompuScope 82GC" is sometimes abbreviated as "CS82GC"

"CompuScope 14100C" is sometimes abbreviated as "CS14100C"

"CompuScope 1610C" is sometimes abbreviated as "CS1610C"

"CompuScope 3200C" is sometimes abbreviated as "CS3200C"

Preventing ESD

Before installing or servicing this product, read the ESD information below:

⚠ **CAUTION. S***tatic discharge can damage any*
semiconductor component in this instrument.

When handling this instrument in any way that requires access to the on-board circuitry, adhere to the following precautions to avoid damaging the circuit components due to electrostatic discharge (ESD).

1. Minimize handling of static-sensitive circuit boards and components.

2. Transport and store static sensitive modules in their static protected containers or on a metal rail. Label any package that contains static sensitive boards.

3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules and circuit boards. Do installation and service of static-sensitive modules only at a static-free work station.

4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.

5. Handle circuit boards by the edges when possible.

6. Do not slide the circuit boards over any surface.

7. Avoid handling circuit boards in areas that have a floor or work-surface covering capable of generating a static charge.

General safety summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Observe all terminal ratings.
To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, which exceeds the maximum rating of that terminal.

Do not operate with suspected failures.
If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Installing single or multiple/independent CompuScope CompactPCI/PXI cards

In this section, we will go over a simple, step-by-step procedure for installing a single CompactPCI/PXI CompuScope card in your CompactPCI system.

If you have purchased 2 or more cards for a Multiple/Independent system, simply repeat steps 2 to 7 (inclusively) as many times as needed to install all of your cards. Note that current versions of GageScope software can display channels from only one multiple-independent card in the same window. GageScope will automatically open one separate display window for each enabled CompuScope.

Before installing the CompuScope card, please refer to page 1 for Electrostatic Discharge (ESD) handling procedures.

1   **Power off your CompactPCI chassis.**
     CompuScope cards are not hot-swappable and all installation and removal must be done with the power off.

2   **Select the required number of unused full-sized 6U CompactPCI expansion slots.**
     You need one slot for the following cards: CompuScope 82GC; CompuScope 85GC; CompuScope 14100C-1M; CompuScope 1610C-1M, CompuScope 3200C-2MB.

     You will need two slots for the following cards with 8M or more memory: CompuScope 1610C, CompuScope 14100C, or CompuScope 3200C.

     There is no limitation on which slot is used, as the CompuScope card will operate correctly in any slot.
     FOR HIGHEST SIGNAL FIDELITY, IT IS RECOMMENDED THAT THE COMPUSCOPE CARD BE INSTALLED AT LEAST ONE SLOT AWAY FROM A HIGH FREQUENCY NOISE SOURCE, SUCH AS A POWER SUPPLY OR CPU CARD.

3   **Unfasten the screw holding the unused slot's frontplate and remove it. For the following cards with 8M or more memory: CompuScope 1610C, CompuScope 14100C, or CompuScope 3200C, remove two adjacent frontplates.**

Figure 1: Unscrew the slot's frontplate and remove it

4   **Open the card handles.**
This is essential for the card to slide into the CompactPCI slot. If these handles are closed, gently press on the red tabs. This action will cause the handles to open.

Please note that the connectors in the illustration below may not be identical to your CompuScope card. We are using a CompuScope 14100C for this example, but the card handles work the same way on all the CompuScope CompactPCI/PXI cards.
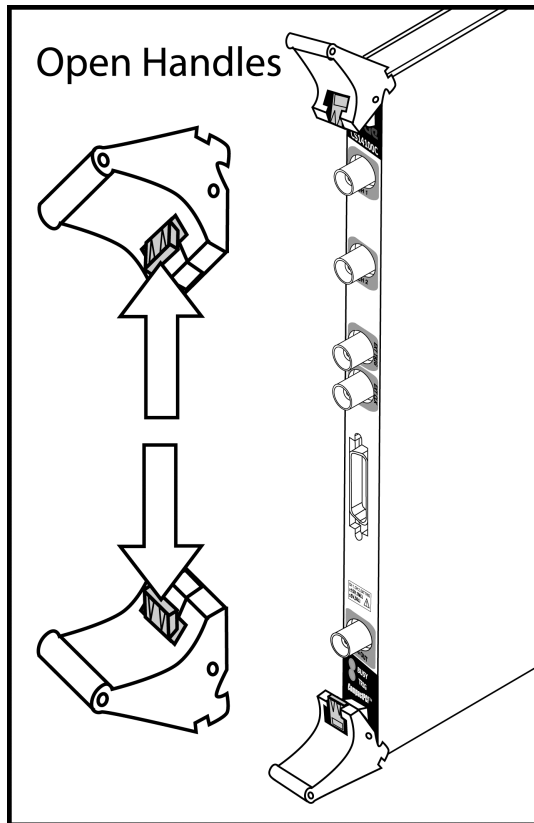
Figure 2: Open the card handles (CS14100C shown)

5 **Insert the CompuScope card into the empty slot.**
Ensure that the card slides into the card guides on the chassis.

Some CompactPCI chassis have air deflectors installed in unused slots. If the card does not insert in the chassis, check for and remove the air deflector before inserting the card.
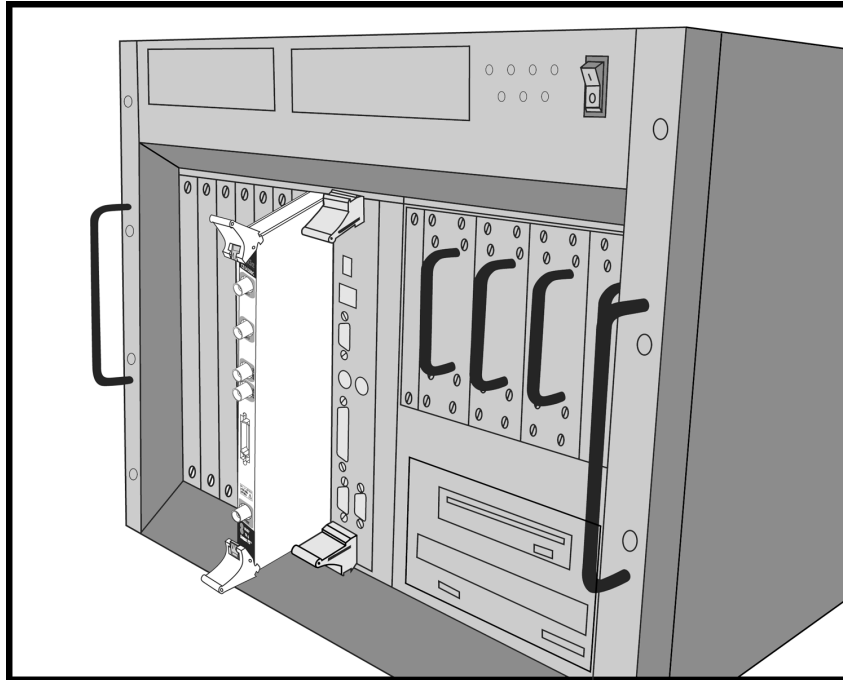
Figure 3: Inserting a single-slot CompactPCI CompuScope card
(CS85GC, CS82GC, CS14100C-1M, CS1610C-1M or CS3200C-2M)
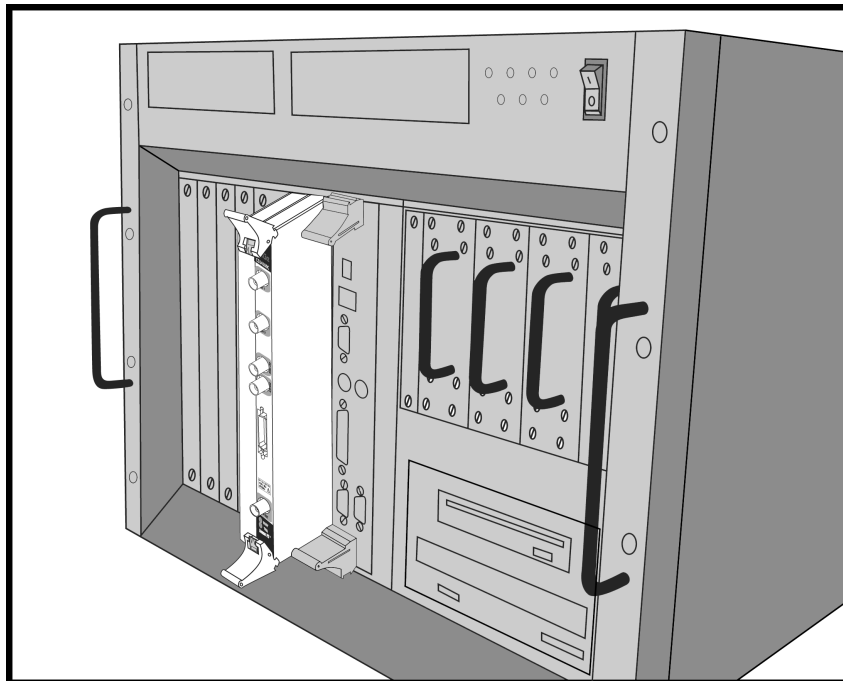
Figure 4: Inserting a 2-slot CompactPCI CompuScope card
(CS14100C-8M and up, CS1610C-8M and up or CS3200C-256M and up)

6   **Fully slide the card into the chassis.**
Gently push the card into the chassis until you hear the handles click into position. If necessary, provide manual assistance in the proper closure of the handles.

Please note that the connectors in the illustration below may not be identical to your CompuScope card. We are using a CompuScope 14100C for this example, but the card handles work the same way on all the CompuScope CompactPCI/PCI cards.

Figure 5: Slide the card until the handles click (CS14100C shown)

7   **Fasten the card to the chassis using the screws embedded in the card handles.**

Figure 6: Fasten the card to the chassis using screws (CS14100C shown)

8   **Turn on the power switch of the CompactPCI chassis.**

9   **Install software drivers.**
Refer to the section within this manual called *Driver installation guide* for instructions on installing
Windows drivers for the CompuScope cards. Windows drivers are supplied with the product on CD.

10   **Verify presence of the CompuScope card using the configuration utility provided with the drivers.**
Refer to the section within this manual called *Driver installation guide*.

11   **(Optional) Verify the operation of the card using CSTest+ or CSTest.**
CSTest+ and CSTest are sample programs provided with the CompuScope drivers to ensure proper
operation of the CompuScope cards. CSTest+ is provided with the 3.82.xx drivers and CSTest is
provided with the 3.60.xx drivers. Please refer to the section within this manual called **Section 3 –
Verifying signal acquisition with CSTest+** for details on running CSTest+.

12   **Install GageScope software for CS85GC, CS82GC, CS14100C and CS1610C.**
Refer to the section within this manual called *GageScope* in the *Driver installation guide* section for
instructions on installing this software.

If you have a CS3200C, install GageBit software.
Refer to the section within this manual called *Free Applications* in the *Driver installation guide* section
for instructions on installing this software.

13   **Run GageScope software and start acquiring data (not applicable for CS3200C).**
Follow the instructions provided in the GageScope manual for using this software.

14   **(Optional) Writing your own program using Gage Software Development Kits (SDKs).**
When writing your own program using one of Gage's Software Development Kits (SDKs), please refer to
the appropriate Gage SDK manual for information on installation and operation of the Gage SDK.

Installing CompactPCI/PXI Master/Slave multi-card systems

Below, you will find detailed instructions to guide you through the installation process of your Master/Slave Multi-Card system.

Before installing the CompuScope cards, please refer to page 1 for Electrostatic Discharge (ESD) handling procedures.

Please note that, unlike other types of CompuScope cards, multiple CS85GC cards cannot be configured as a Master/Slave Multi-Card system. Multi-Card CompuScope 85GC systems must be installed and operated as a Multiple-Independent Multi-Card system.

If you are installing a Multiple/Independent system, follow the instructions listed in the previous section, *Installing single or multiple/independent CompuScope CompactPCI/PXI* , for installing each of the cards.

1   **Power off your CompactPCI chassis.**
    CompuScope cards are not hot-swappable and all installation and removal must be done with the power off.

2   **Select adjacent full-sized 6U CompactPCI expansion slots.**
    If you are installing a Master/Slave system consisting of CompuScope 82GC, CompuScope 14100C-1M, CompuScope 1610C-1M or CompuScope 3200C-2MB cards, the number of adjacent slots should be equal to the number of CompuScope cards you want to install.

    If you are installing a Master/Slave system consisting of the following CompuScope cards with 8M or more memory: CompuScope 14100C, CompuScope 1610C, CompuScope 3200C, the number of adjacent slots should be twice the number of CompuScope cards you want to install.

    There is no limitation on which slots are used, as the CompuScope cards will operate correctly in any slot.

    FOR HIGHEST SIGNAL FIDELITY, IT IS RECOMMENDED THAT COMPUSCOPE CARDS BE INSTALLED AT LEAST ONE SLOT AWAY FROM A HIGH FREQUENCY NOISE SOURCE, SUCH AS A POWER SUPPLY OR CPU CARD

3   **Unscrew the screws holding the unused slots' frontplates and remove them.**
For the following cards with 8M or more memory: CompuScope 1610C, CompuScope 14100C, or
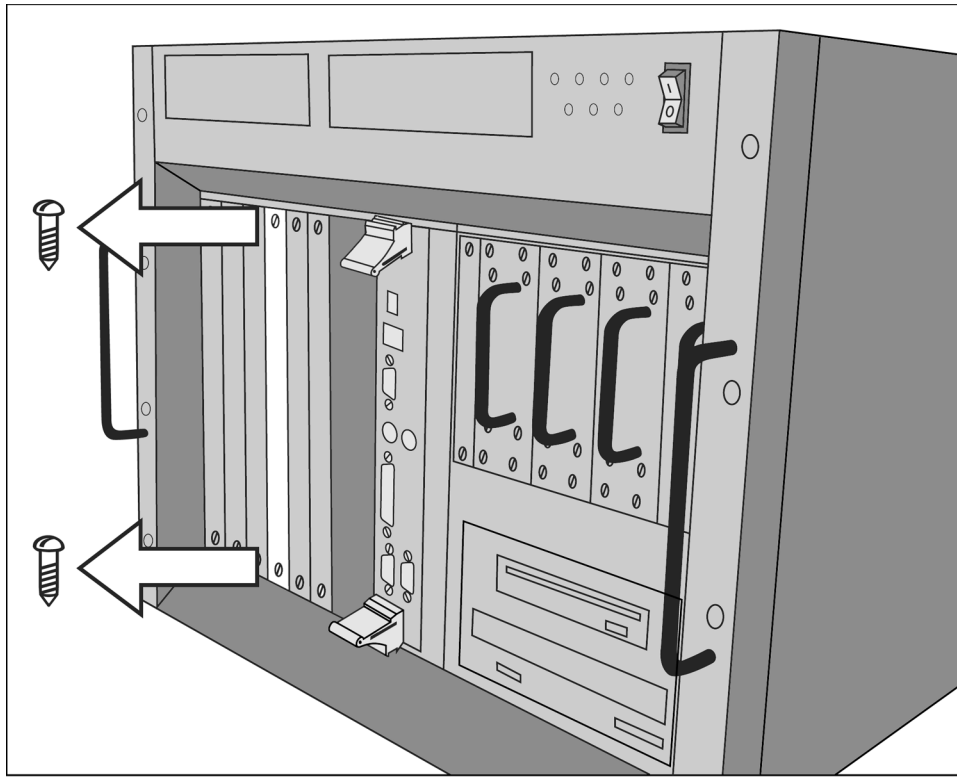**CompuScope 3200C, remove two adjacent frontplates.**
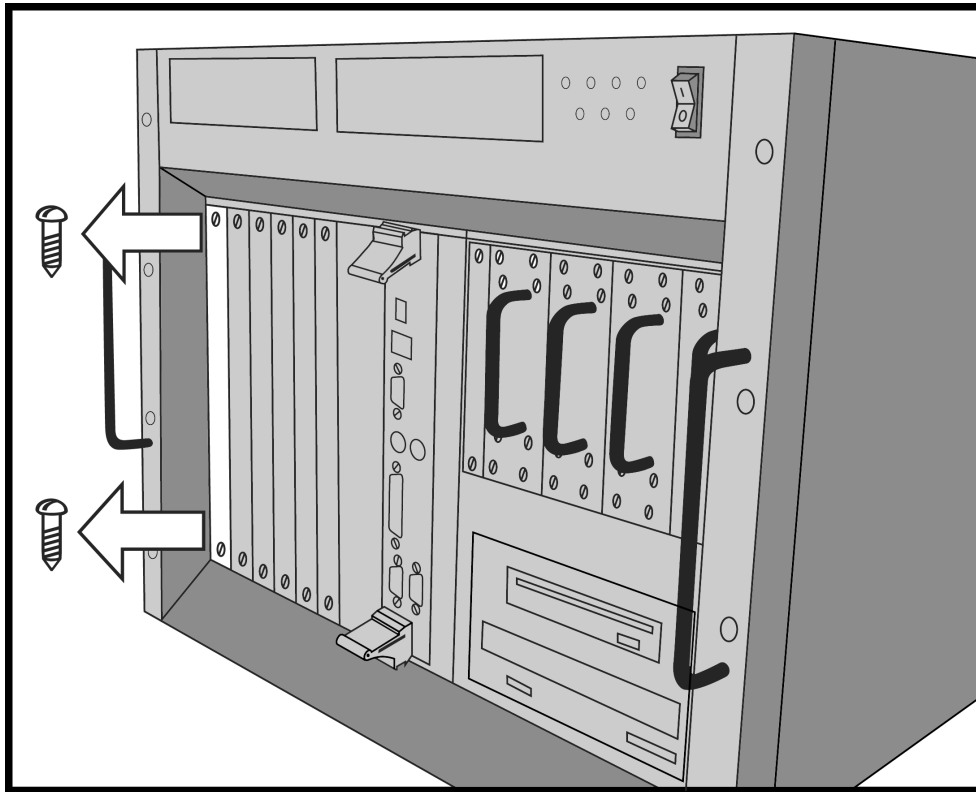
Figure 7: Unscrew the slot's frontplate and remove it

4   Open the card handles of all CompuScope cards.
This is essential for the cards to slide into the CompactPCI slot. If these handles are closed, gently press on the red tabs. This action will cause the handles to open.

Please note that the connectors in the illustration below may not be identical to your CompuScope card. We are using a CompuScope 14100C for this example, but the card handles work the same way on all the CompuScope CompactPCI/PCI cards.
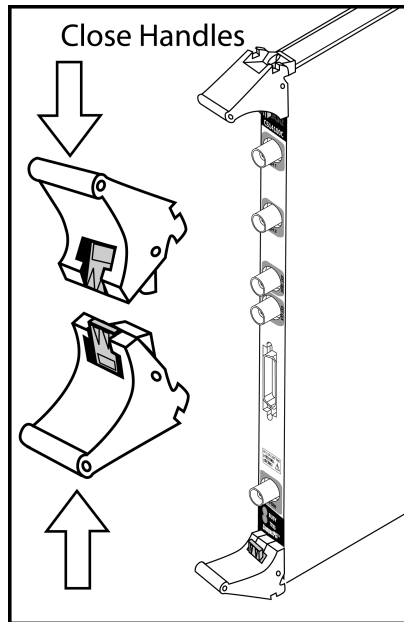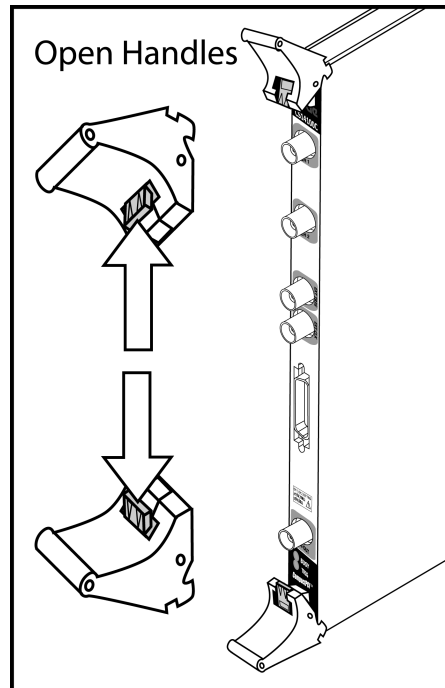

Figure 8: Open the card handles (CS14100C shown)

5   **Insert the MASTER CompuScope card into the left-most empty slot.**
Note that the MASTER card is the one labeled "CH 1" & "CH 2". Ensure that the card slides into the card guides on the chassis.

Some CompactPCI chassis have air deflectors installed in unused slots. If the card does not insert in the chassis, check for and remove the air deflector before inserting the card.
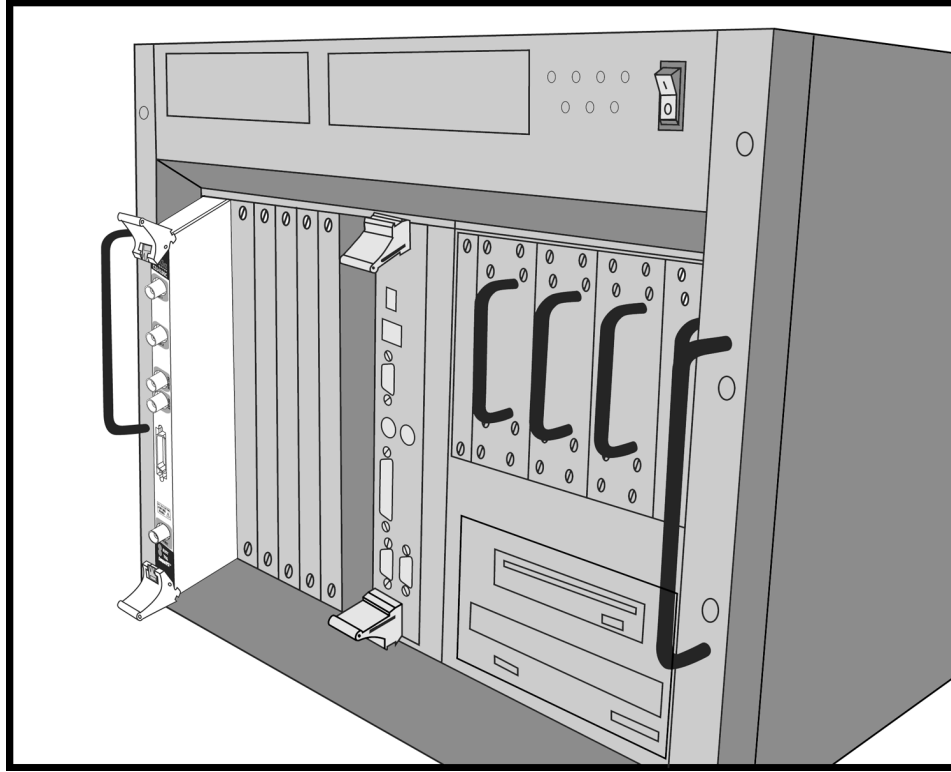
Figure 9: Inserting the MASTER card (CS14100C shown)

6   **Fully slide the card into the chassis.**
Gently push the card into the chassis until you hear the handles click into position. If necessary, provide manual assistance in the proper closure of the handles.

Please note that the connectors in the illustration below may not be identical to your CompuScope card. We are using a CompuScope 14100C for this example, but the card handles work the same way on all the CompuScope CompactPCI/PCI cards.
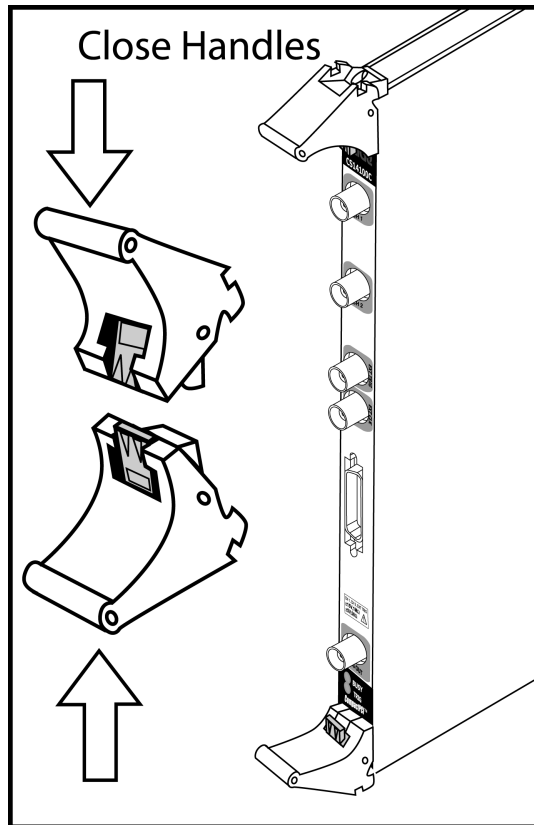
Figure 10: Slide the card until the handles click (CS14100C shown)

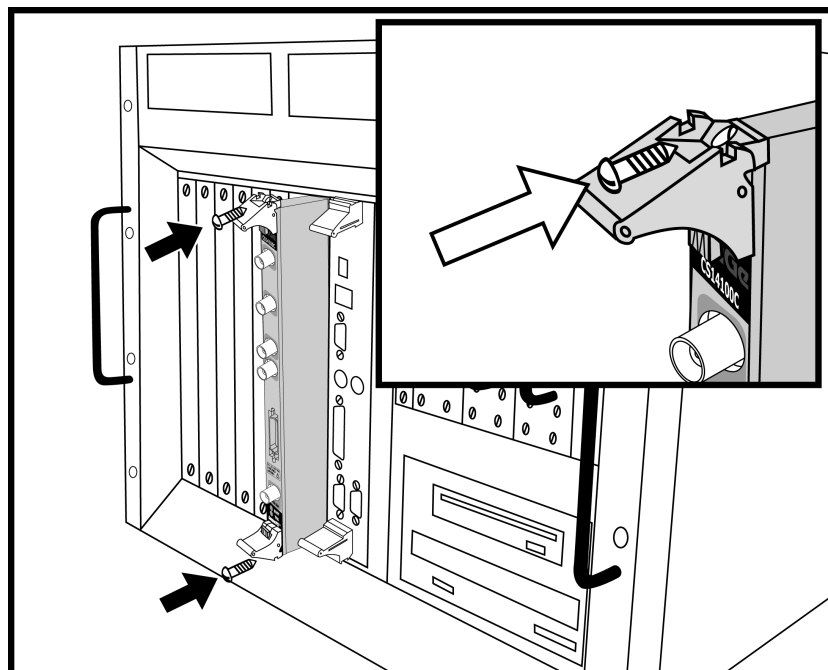**7**   **Fasten the card to the chassis using the screws embedded in the card handles.**
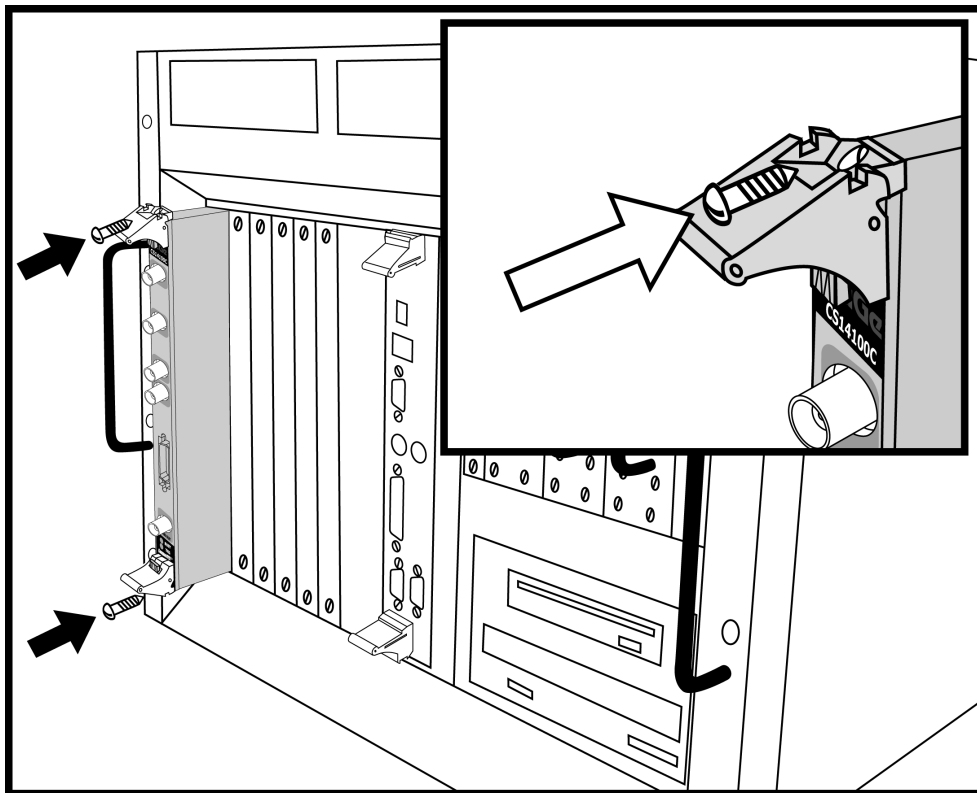
Figure 11: Fasten the card to the chassis using screws (CS14100C shown)

8   **Repeat steps 5 through 7 for the SLAVE cards.**
      Make sure you maintain consecutive channel numbering. Slave Cards must be installed into slots on the
      right side of the Master card.
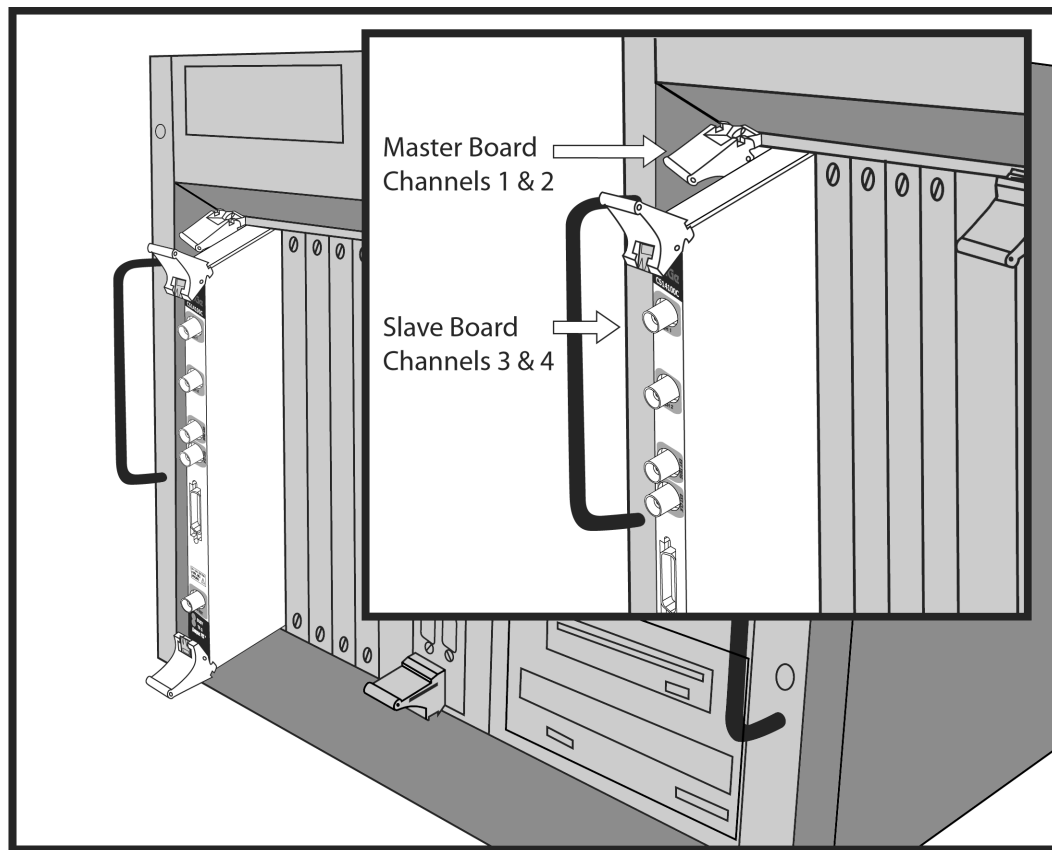
Figure 12: Insert all Slave cards (CS14100C shown)

9   **Attach the Master/Slave Timing Module (MSTM) to the cards.**
Plug the MSTM to the front panel of the CompuScope cards and then attach the MSTM to the
CompuScope cards using the screws provided with the MSTM.

The MSTM can only be inserted into the installed Master/Slave Set in one orientation. Do not force.
The text on the MSTM label should be right side up.
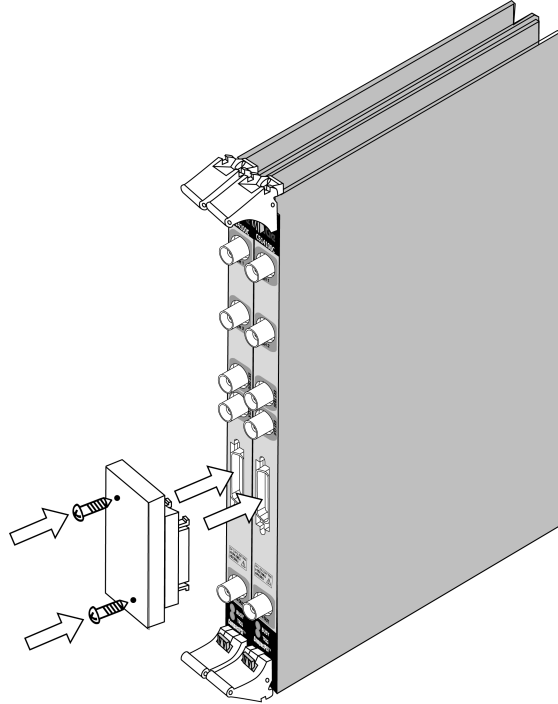
Figure 13: Attach the Master/Slave Timing Module (CS14100C shown)

10   **Turn on the power switch of the CompactPCI chassis.**

11   **Install software drivers.**
Refer to the section within this manual called *Driver installation guide* for instructions on installing
Windows drivers for the CompuScope cards. Windows drivers are supplied with the product on CD.

12   **Verify presence of the CompuScope card using the configuration utility provided with the drivers.**
Refer to the section within this manual called *Driver installation guide*.

13   **(Optional) Verify the operation of the card using CSTest+ or CSTest.**
CSTest+ and CSTest are sample programs provided with the CompuScope drivers to ensure proper
operation of the CompuScope cards. CSTest+ is provided with the 3.82.xx drivers and CSTest is
provided with the 3.60.xx drivers. Please refer to the section within this manual called **Section 3 –
Verifying signal acquisition with CSTest+** for details on running CSTest+.

14   **Install GageScope software for CS82GC, CS14100C and CS1610C.**
Refer to the section within this manual called *GageScope* in the *Driver installation guide* section for
instructions on installing this software.

If you have a CS3200C, install GageBit software.
Refer to the section within this manual called *Free Applications* in the *Driver installation guide* section
for instructions on installing this software.

15   **Run GageScope software and start acquiring data (not applicable for CS3200C).**
Follow the instructions provided in the GageScope manual for using this software.

16   **(Optional) Writing your own program using Gage Software Development Kits (SDKs).**
When writing your own program using one of Gage's Software Development Kits (SDKs), please refer
to the appropriate Gage SDK manual for information on installation and operation of the Gage SDK.

Notes

Multiple Record for CompuScope 14100C and CompuScope 1610C

Please note: the CompuScope 85GC and CompuScope 3200C do not support Multiple Record.
See next page for details on Multiple Record for the CompuScope 82G.

Even though the CompactPCI bus allows very fast data throughput to system RAM, there may still be applications in which data bursts cannot be off-loaded either because of very fast trigger repeat frequency or because of software limitations.

Multiple Recording allows the CompuScope card to capture data on successive triggers and stack it in the on-board memory.

It should be noted that only post-trigger data can be captured in Multiple Record mode.

GageScope software can display the stacked data as individual acquisitions. Software drivers also provide support for accessing Multiple Record data.

Once the CompuScope card has finished capturing a Multiple Record segment, the trigger circuitry is automatically re-armed within 16 sample clock cycles to start looking for the next trigger. No software intervention is required.
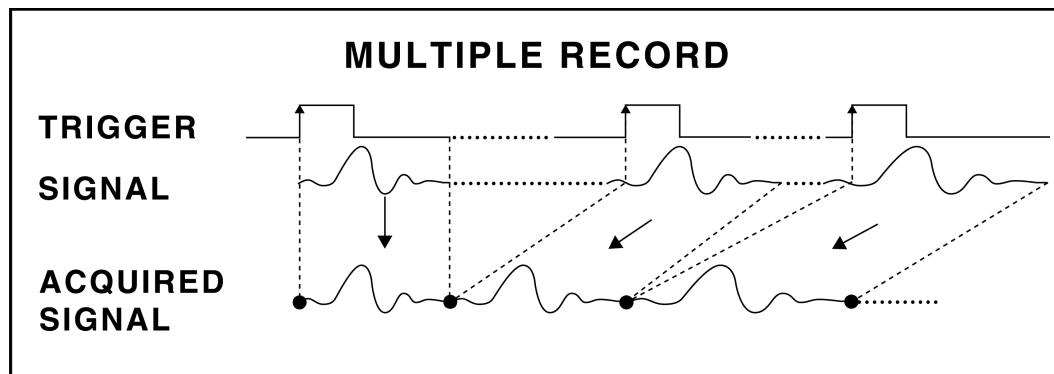
Figure 14: Multiple Record mode

Multiple Recording is useful for applications in which a series of bursts of data have to be captured in quick succession and there is not enough time to off-load the data to the system RAM.

Another situation in which Multiple Recording may be used is when data storage has to be optimized. These are cases in which only certain portions of the incoming signal are of interest and data capture during the dead time between successive portions is not useful.

Examples of these situations are radar pulses, ultrasound data, lightning pulses, imaging signals and explosion testing.

Multiple Record for the CompuScope 82GC

Even though the CompactPCI bus allows very fast data throughput to system RAM, there may still be applications in which data bursts cannot be off-loaded either because of very fast trigger repeat frequency or because of software limitations.

Multiple Recording allows CompuScope 82GC to capture data on successive triggers and stack it in the on-board memory. The minimum record size is 256 samples in dual channel mode and 512 samples in single channel mode. CompuScope 82GC models with 16M acquisition memory provide up to 21,845 records which can be captured in Multiple Record mode.

The CompuScope 82GC is capable of capturing pre-trigger data in Multiple Record mode. Software can configure the CompuScope 82GC to capture between 0 to 32K points of pre-trigger data.

GageScope software can display the stacked data as individual acquisitions. Software drivers also provide support for accessing Multiple Record data.

Once the CompuScope 82GC has finished capturing a Multiple Record segment, the trigger circuitry is automatically re-armed within 152 (*304*) sample clock cycles in dual (*single*) channel mode to start looking for the next trigger. No software intervention is required. This is required to ensure that the necessary pre-trigger data is acquired. That is, data is acquired during this time, however, the trigger is only enabled once the pre-trigger data has been recorded.
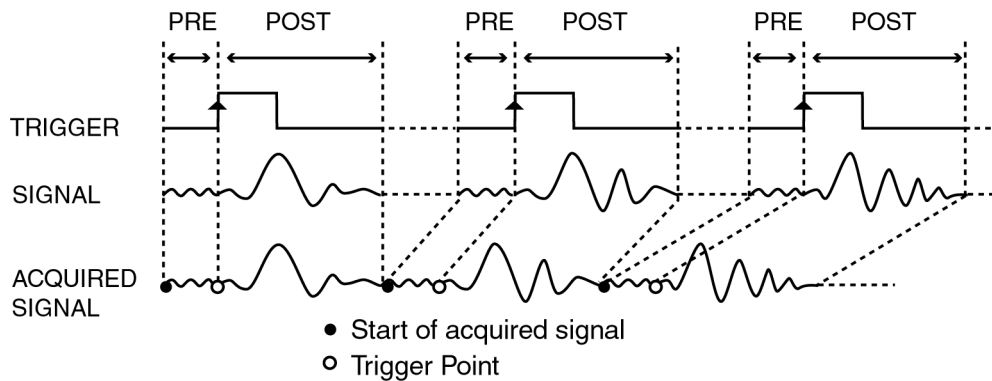
Figure 15: Multiple Record mode with Pre-Trigger data

Multiple Recording is useful for applications in which a series of bursts of data have to be captured in quick succession and there is not enough time to off-load the data to the system RAM.

Another situation in which Multiple Recording may be used is when data storage has to be optimized. These are cases in which only certain portions of the incoming signal are of interest and data capture during the dead time between successive portions is not useful.

Examples of these situations are radar pulses, ultrasound data, lightning pulses, imaging signals and explosion testing.

Memory organization on CompuScopes (except for the CS85GC)

> **Please note: for memory organization on the CompuScope 85GC, please refer to the next section.**

Memory architecture

CompuScope cards have high-speed on-board memory to store the digital data for the CompactPCI^{TM} bus to access it in post-processing mode.

Interface to the CompactPCI^{TM} bus

In order to allow optimum data transfer rates from the CompuScope card memory to the PC memory, the on-board RAM is mapped into the memory space of the CompactPCI^{TM} bus.

The exact address at which this memory is mapped is determined by the CompactPCI^{TM} Plug-n-Play BIOS. This means that the user does not have to set any jumpers or switches to configure the CompuScope card—it really is plug and play.

Bus Mastering mode

Full Bus Mastering capabilities are provided on CompuScope cards, allowing the fast data transfer to occur as a result of a Direct Memory Access (DMA).

Software loads the start address, destination pointer and number of points to be transferred into the CompactPCI^{TM} bus controller on the CompuScope card and then asks the card to do a DMA transfer. The CompactPCI^{TM} bus mastering control circuitry takes over from this point and performs the transfer without any CPU involvement.

Data storage

The data coming out of the A/D converters or digital input is stored in the on-board memory buffer, which is configured as a circular buffer. A circular buffer is used to guarantee that the system will keep on capturing data indefinitely until a trigger event is detected.

The sequence of events is as follows:

- CompactPCI^{TM} bus tells the CompuScope to **start_capture** using a register bit.

- The CompuScope sets BUSY flag. CompactPCI^{TM} bus is denied any further access to the on-board memory.

- The on-board memory counters initialize to ZERO and start counting up, thereby starting data storage at memory address ZERO.

- The system waits for a trigger event to occur while it is storing data in the on-board memory. This data is called Pre-Trigger data.

- Once the trigger event is received, a specified number of Post-Trigger points are captured. The number of Post-Trigger Points can be specified by writing to a register on the CompuScope.

- After storing the specified number of Post-Trigger Points subsequent to receiving the trigger event, acquisition is stopped, BUSY flag is reset and PC bus is allowed access to the on-board memory.

A graphical representation of the above sequence is as follows:

Figure 16: Pre-Trigger: all data points in buffer valid

In the diagram above, the circular memory buffer is shown as a ring with the physical memory address ZERO at the top. Data storage is shown as a spiraling line going clockwise.

Storage starts at address ZERO and keeps on writing into the memory until it is filled (the spiraling line completes a circle) and then starts overwriting the data stored in addresses ZERO, 1, 2...

Once a trigger event is detected, the address to which the data was being written into is tagged as the Trigger Address, a specified number of Post-Trigger points are captured and then the acquisition is stopped.

The memory address at which the acquisition is stopped is designated as the End Address and the address after that one is called Start Address.

Now, Pre-Trigger data lies between Start Address and Trigger Address, and Post-Trigger data between Trigger Address and End Address.

It is clear from the diagram shown above that memory address ZERO is not necessarily the first point, or Start Address, of the signal being captured. In fact, the physical address ZERO has very little significance in such a system, as the trigger can happen at any time.

One case in which ZERO is the Start Address is when a trigger is received before the memory had filled up, i.e. the trigger was received right after the software tells the CompuScope to **start_capture**.

This situation is illustrated below:
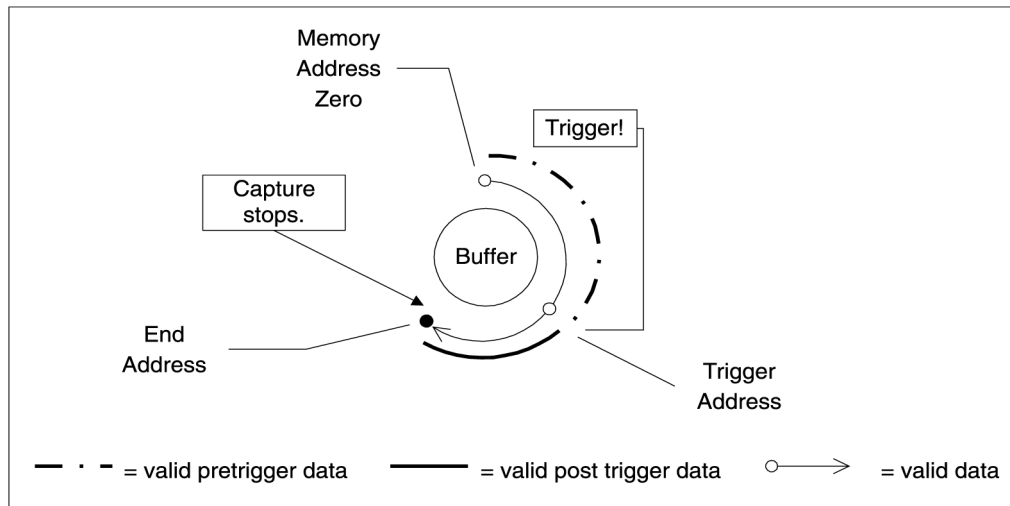
Figure 17: Pre-Trigger: not all data points in buffer valid

This condition can be detected by looking at the RAMFULL bit in the STATUS register. This bit is reset to ZERO when a **start_capture** command is issued and is set to ONE when the memory counters overflow from FFFFF to ZERO, for example.

In this case, Pre-Trigger data lies between ZERO and Trigger Address, and Post-Trigger between Trigger Address and End Address.

These issues are handled seamlessly by the driver and the Software Development Kits (SDKs).

Notes

Memory organization on CompuScope 85GC

FISO memory architecture

CompuScope 85GC uses a very unique memory system that uses on-chip analog memory cells that can store the instantaneous value of the input voltage at a particular time.

By using 10,000 such cells for each of the input channels, CompuScope 85GC can offer acquisition depth of 10,000 points per channel.

This "analog storage data" is then converted to digital codes using a very accurate, but slower speed A/D converter to yield very fast sampling speed at an unprecedented price.

Hence the name, **F**ast **I**n **S**low **O**ut.

On-board error correction and calibration

Not surprisingly, the analog memory cells on the CompuScope 85GC are not absolutely accurate from one device to another. As such, it is necessary for each CompuScope 85GC to be calibrated.

All error correction and calibration is performed by very powerful signal processors, including custom ASICs, on-board the CompuScope 85GC.

Interface to the CompactPCI^{TM} bus

In order to allow optimum data transfer rates from the CompuScope 85GC acquisition memory to the PC memory, the on-board circuitry uses DMA to move the data from the memory of the on-board calibration processors into PCI memory.

CompactPCI^{TM} Plug-n-Play BIOS is fully supported by CompuScope 85GC, making it unnecessary for the user to worry about setting any jumpers or switches to configure the CS85GC.

A/D data storage

FISO memories are configured as circular buffers. A circular buffer is used to guarantee that the system will keep on capturing data indefinitely until a trigger event is detected.

The sequence of events is as follows:
- CompactPCI^{TM} bus tells the CompuScope to **start_capture** using a register bit.
- BUSY flag is set by the CompuScope. CompactPCI^{TM} bus is denied any further access to the on-board memory.
- The on-board FISO memory counters initialize to ZERO and start counting up, thereby starting data storage at memory address ZERO.
- The system waits for a trigger event to occur while it is storing data in the on-board memory. This data is called Pre-Trigger data.
- Once the trigger event is received, a specified number of Post-Trigger points are captured. The number of Post-Trigger Points can be specified by writing to a register on the CompuScope.
- After storing the specified number of Post-Trigger Points subsequent to receiving the trigger event, acquisition is stopped, BUSY flag is reset and PC bus is allowed access to the on-board memory.

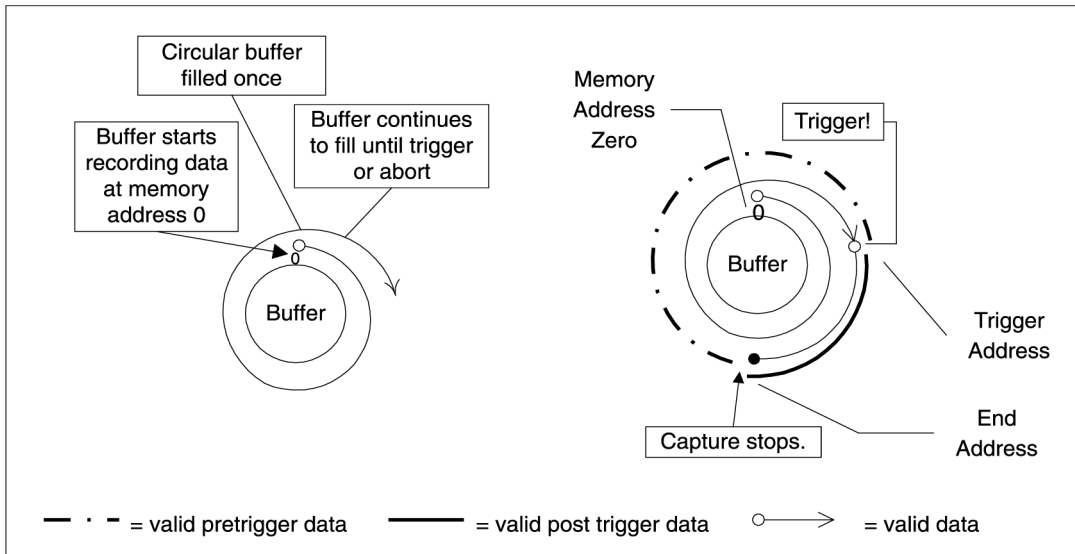A graphical representation of the above sequence is as follows:

Figure 18: Pre-Trigger: all data points in buffer valid

In the diagram above, the circular memory buffer is shown as an annulus with the physical memory address ZERO at the top. Data storage is shown as a spiraling line going clockwise.

Storage starts at address ZERO and keeps on writing into the memory until it is filled (the spiraling line completes a circle) and then starts overwriting the data stored in addresses ZERO, 1, 2...

Once a trigger event is detected, the address to which the data was being written into is tagged as the Trigger Address, a specified number of Post-Trigger points are captured and then the acquisition is stopped.

The memory address at which the acquisition is stopped is designated as the End Address and the address after that one is called Start Address.

Now, Pre-Trigger data lies between Start Address and Trigger Address, and Post-Trigger data between Trigger Address and End Address.

It is clear from the diagram shown above that memory address ZERO is not necessarily the first point, or Start Address, of the signal being captured. In fact, the physical address ZERO has very little significance in such a system, as the trigger can happen at any time.

Driver installation guide

Installing your Gage hardware in a computer is only one step in setting up your system. You also need to install drivers and application software to operate the instrument card or cards you purchased. This section will describe how to install software and verify the operation of your new hardware.

Please note that due to the various versions of operating systems supported by Gage, the screen captures serving as illustrations in this manual may differ from what you will see on your screen. The discrepancies will not be material when it comes to basic functionalities and operation; however, the look and certain names will be slightly different.

Section 1 – Installing drivers and applications

The product you bought comes with a totally re-designed and vastly improved installation package. This new installer was designed to work the same way on all supported operating systems. It was also designed to be intuitive to most users and easy to follow for anyone familiar with installing software on a computer running Windows. Therefore a certain level of familiarity with the Windows operating system is assumed in this manual.

The basic instructions presented in this section should be sufficient for most installation needs.

The main installation steps are as follows: (you may skip some of the steps if you do not wish or need to install certain drivers or applications)

A – If you have not already done so, insert your Gage Software CD into the CD-ROM drive of your computer. The AutoRun feature of Windows should kick-in and bring up the installer's main screen. If this does not take place, you can start the installer by double-clicking on the gage.exe item that you will find on the CD.

The Gage software disk main screen will appear (see Figure 19 below).

Figure 19: The Gage Software Disk's main screen

This window offers four possible options (not counting the Exit option):
- Install Software
- Browse CD
- Contact Gage
- About CD

The fourth option, About CD, is an important first step whenever troubleshooting the installation or asking for technical support from Gage. It provides valuable information about the various software drivers and application

packages available on the CD. Figure 20 gives an example from the first version of this new installation package.
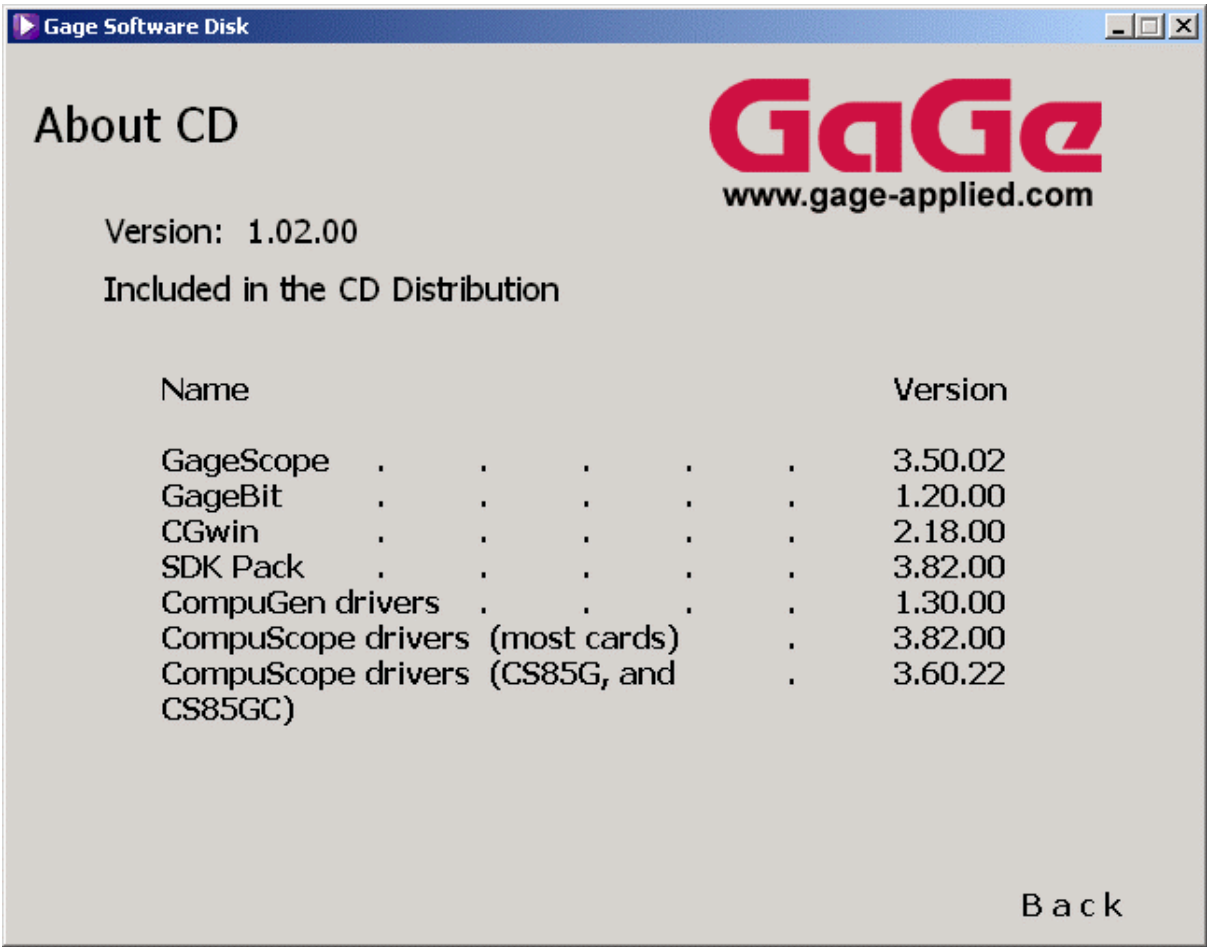
Figure 20: The About CD screen

Whenever navigating the installation software, you can use the Back button at the bottom-right of the screen to return to a previous screen in the installation hierarchy.
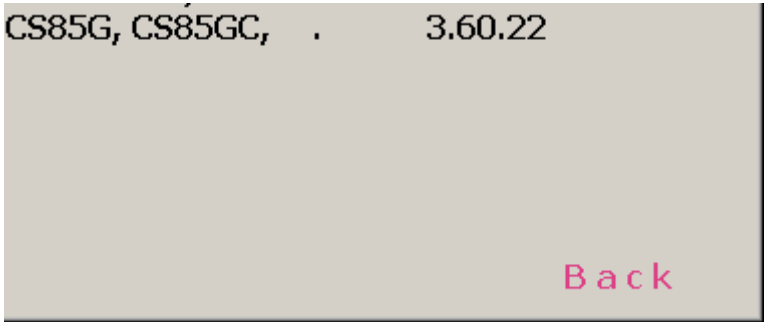
Figure 21: The Back button

Another useful feature of the installer is the Contact Gage option available from the Gage Software Disk's main screen. From this screen, you will find useful contact information for Gage for technical support.

Figure 22: The Contact screen

Also from the Gage Software Disk's main screen, you can directly access Gage's Web site by clicking on the Web address under the Gage logo.

Figure 23: The link to Gage's Web site on the Gage Software Disk's main screen

Finally, as a last exploratory step before installing, you can click on the Browse CD button to open a Windows Explorer window showing the content of the Gage Software Disk (see Figure 24 below).
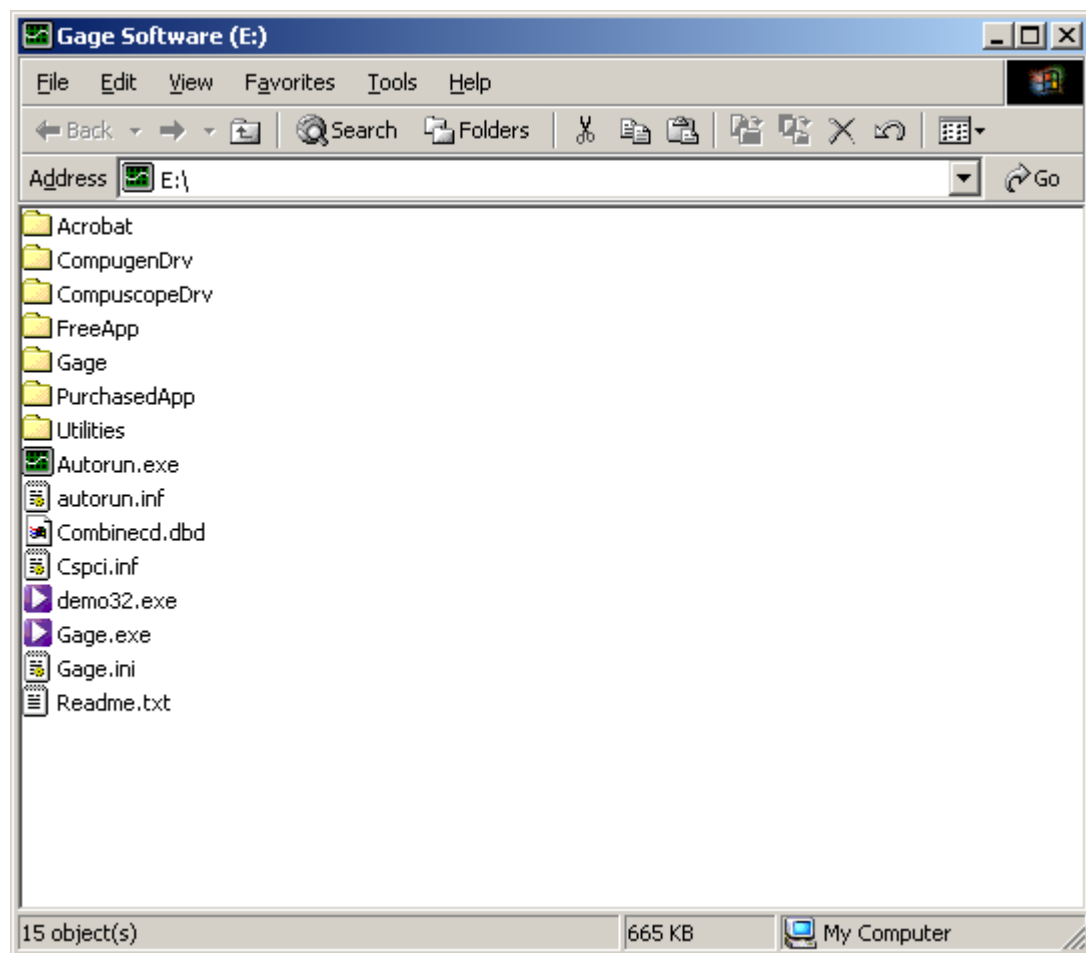
Figure 24: Browsing the CD

Now that you have become familiar with the first level of the installer, we can proceed with the installation proper.

B – Click on the Install Software button to start installing the Gage software.

The Install Software screen (Figure 25) offers four software options to install:
- CompuScope drivers
- CompuGen drivers
- Free applications
- Purchased software

Figure 25: The Install Software screen

As you position the mouse over one of the four menu options, details of each option appear in a text box to the right of the screen (see Figure 26):

Figure 26: Example of information visible when positioning the mouse on a menu item

If you wish to leave the Install Software screen without installing any software, simply click the Back button to go back to the Gage Applied Technologies screen.

Once you are back to the main Gage Software Disk screen, click on the Exit button located at the bottom right of the screen. The last screen you will see upon exiting is shown below (Figure 27).

Figure 27: Splash screen seen upon exiting the installer

CompuScope Drivers Installation

Click on the CompuScope drivers button to go to the CompuScope drivers screen (Figure 28). The installer offers two choices of drivers; you must choose according to the type of hardware you purchased.

Figure 28: CompuScope Drivers for Win2K/WinXP

Since the CompuScope Windows 98/ME and Windows 2K/XP drivers are plug-and-play, we recommend that you first install your CompuScope hardware and then use the Add New Hardware function of your operating system (if the system does not automatically prompt you for the location of the driver) to install the CompuScope drivers.

CompuScope 3.82 Drivers

For the CompuScope 3.82 drivers, it is possible to install directly from the Gage Software disk. To start the installation, click on CompuScope 3.82 Drivers from the Software Install option of the Gage Software Disk:
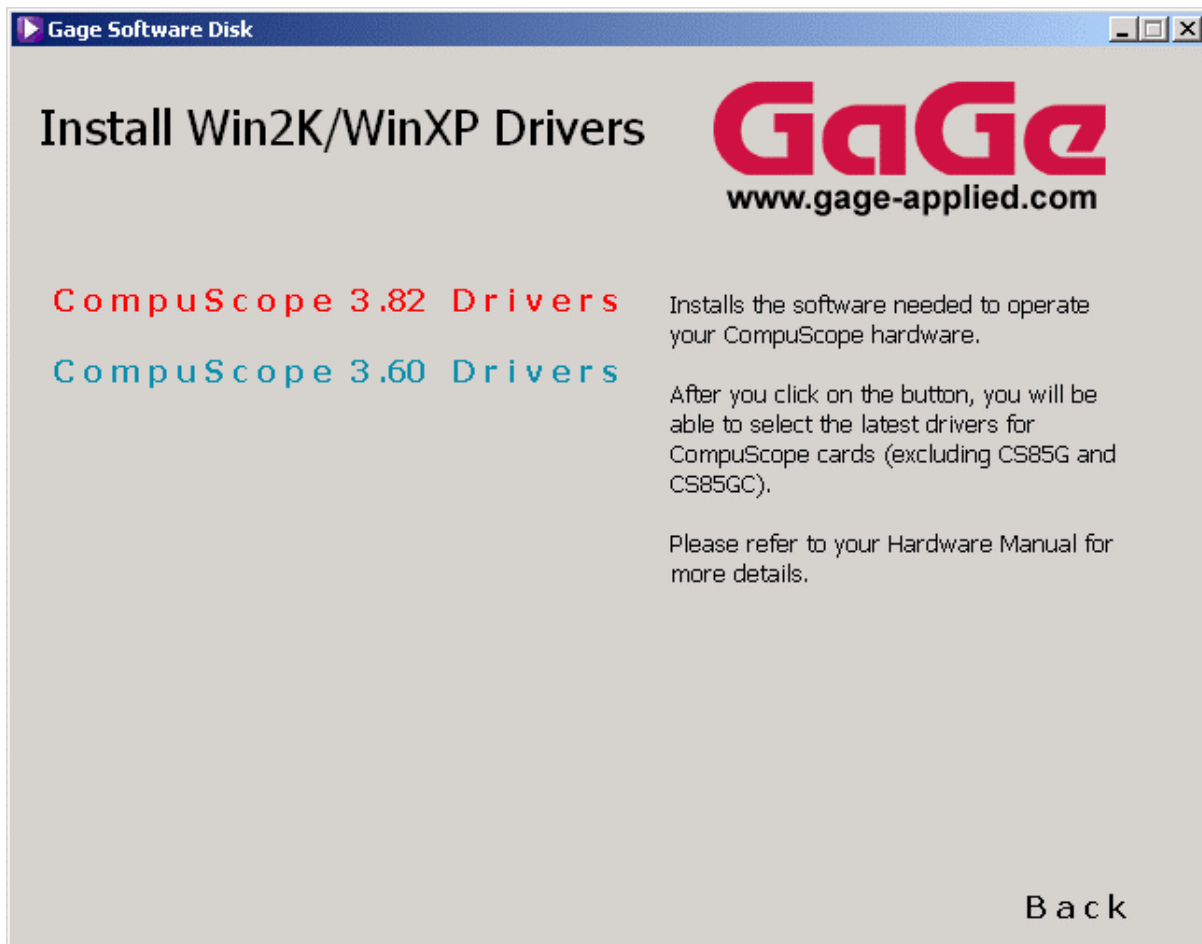
Figure 29: CompuScope Drivers for Win2K/WinXP

The following InstallShield Wizard screen appears:
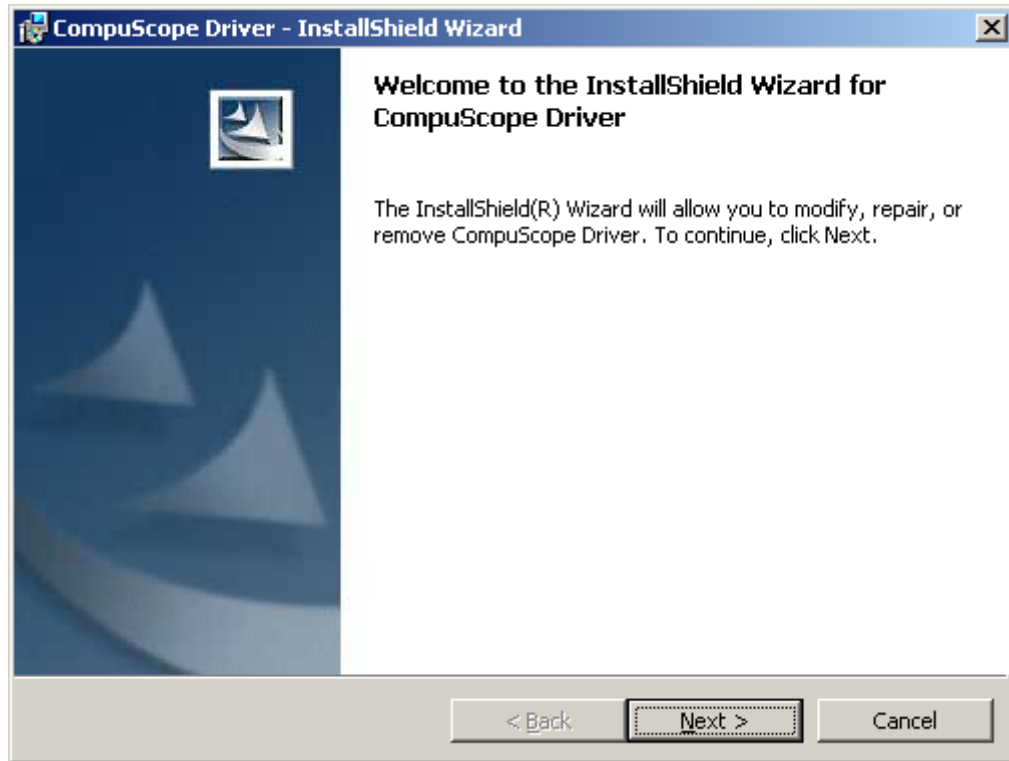
Figure 30: InstallShield wizard

Click Next to continue with the installation of the CompuScope 3.82 drivers. Carefully read the Software and Documentation License Agreement text as shown below.
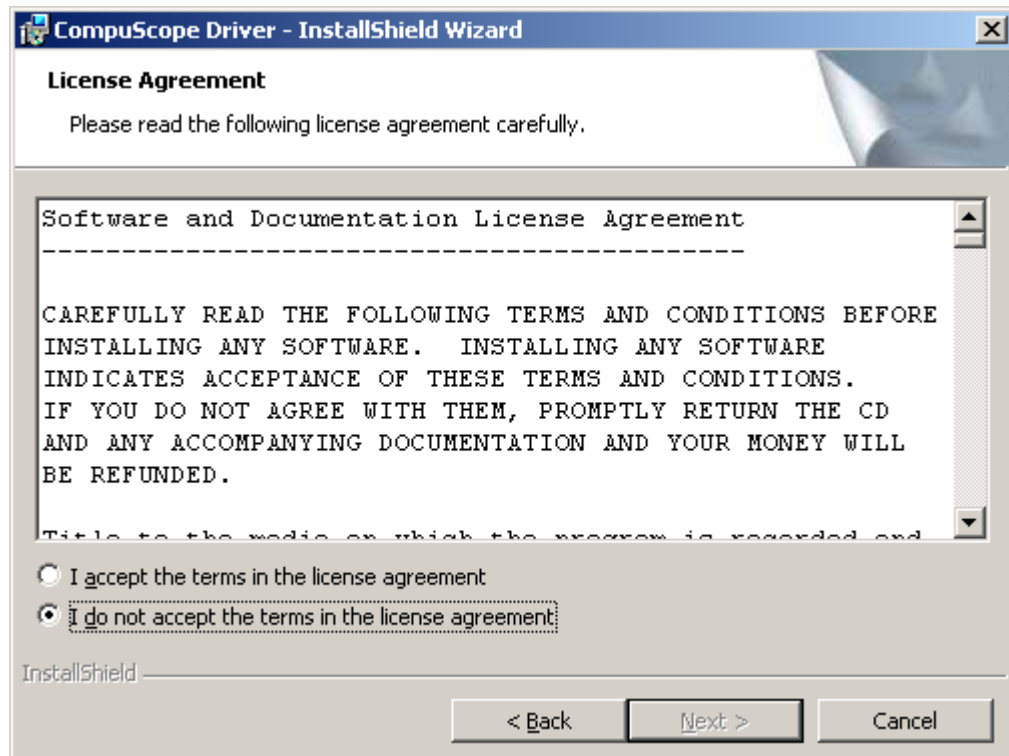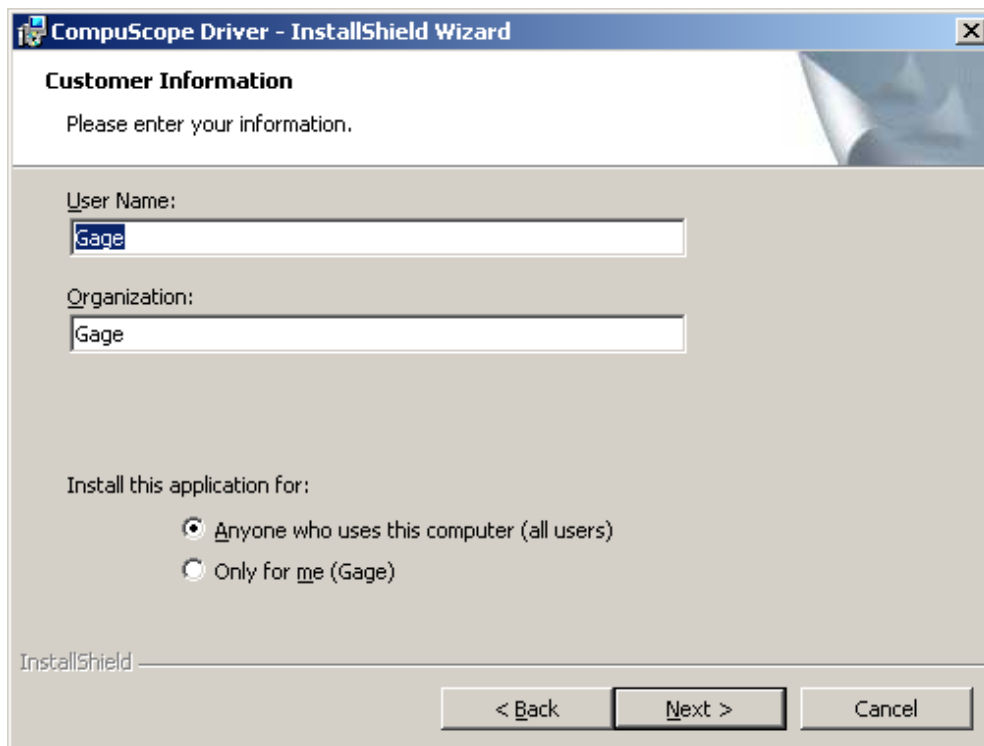
Figure 31: License agreement text
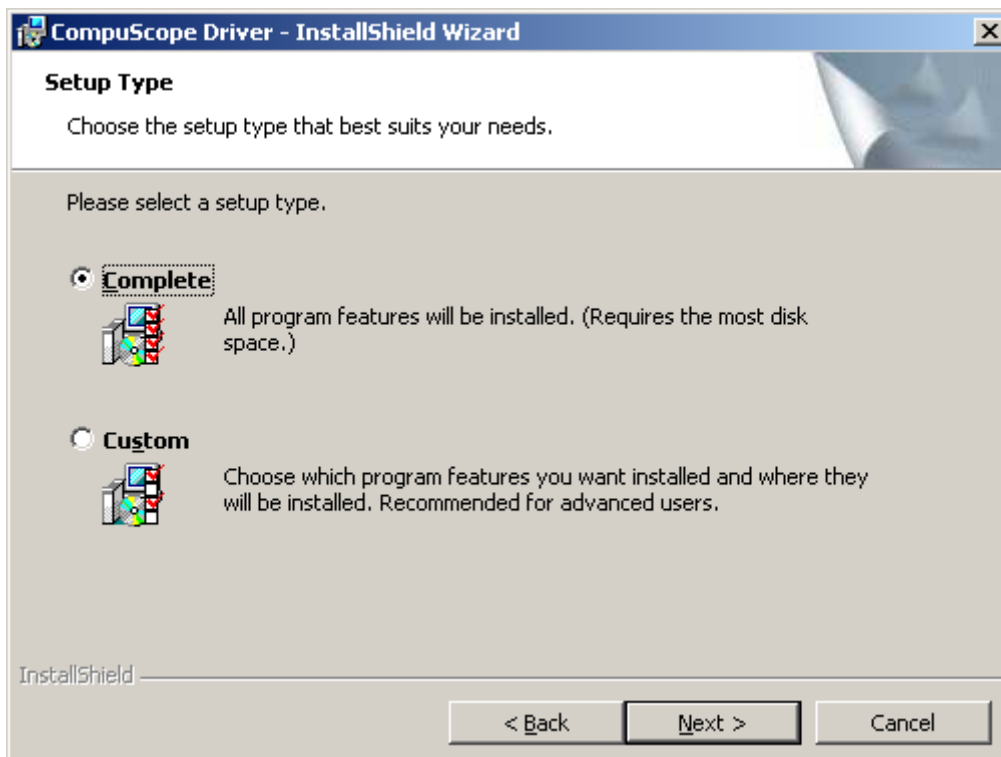
To continue with the installation, you must agree with the terms in the license agreement. Otherwise, the installation will be aborted.

Figure 32: Customer information

Enter your user information in the Customer Information screen. By default, all program features will be installed. Alternately, you can choose the Custom option to install only specific program features.

Figure 33: Installation setup

The CompuScope 3.82 drivers will be installed in the O/S system drive:\Program Files\Gage\CompuScope 3.82 directory by default. You can optionally install the software into a directory of your choice.
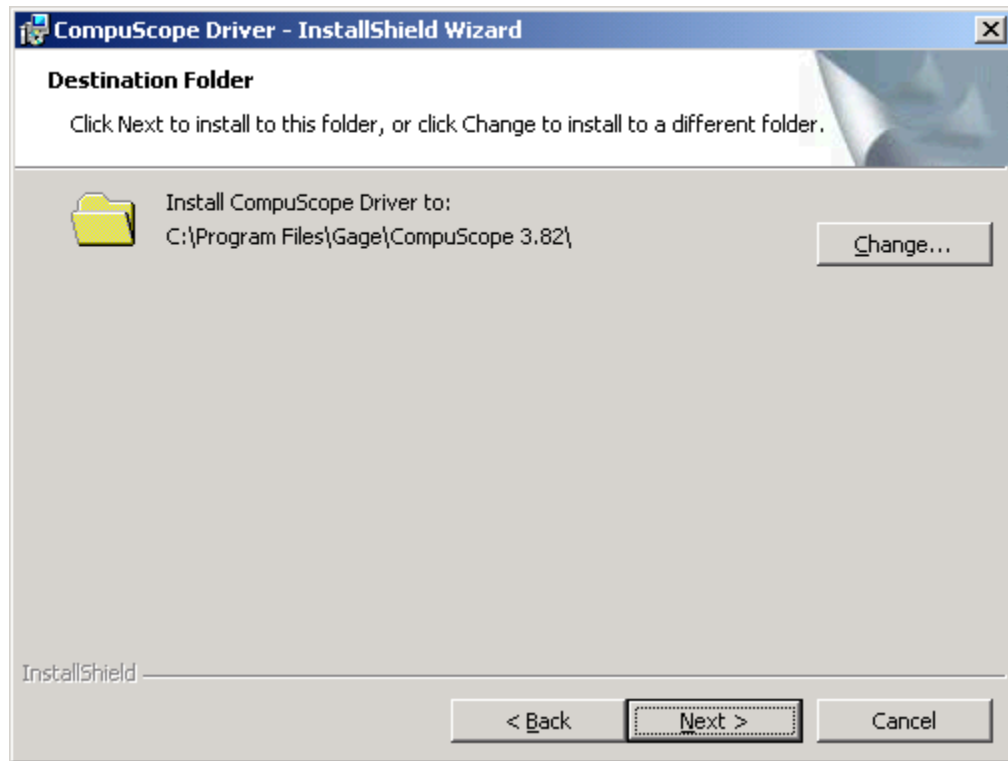
Figure 34: Destination folder for CompuScope 3.82 drivers

Click on Install to begin the installation.
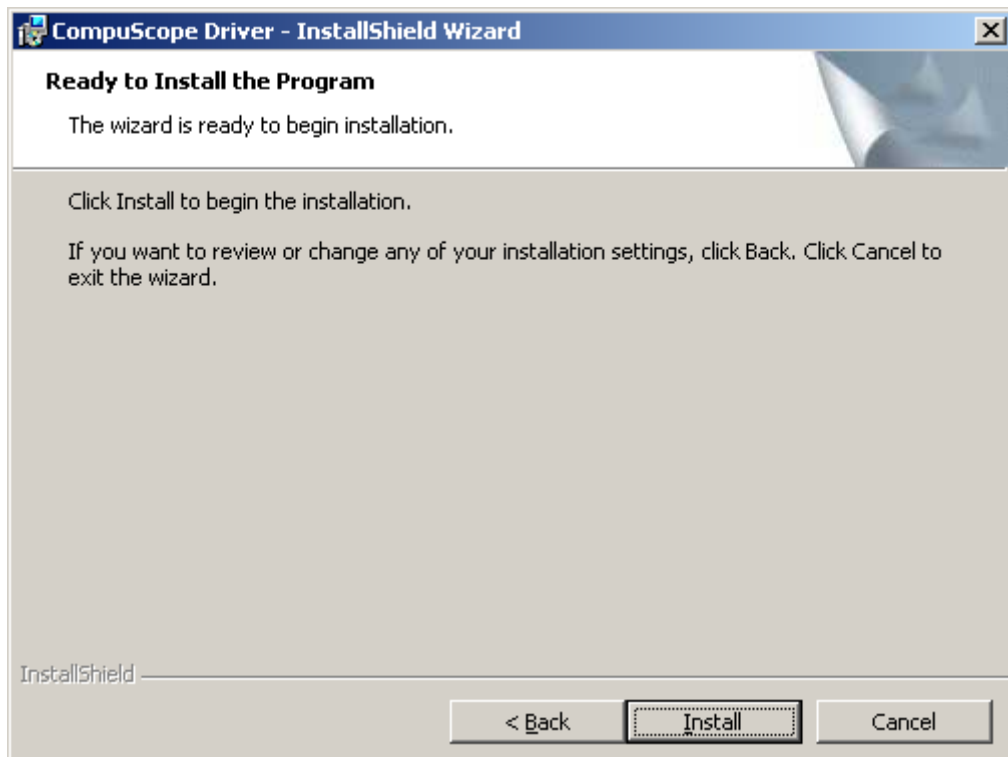
Figure 35: Begin installation

Clicking on Cancel at anytime will abort the driver installation.
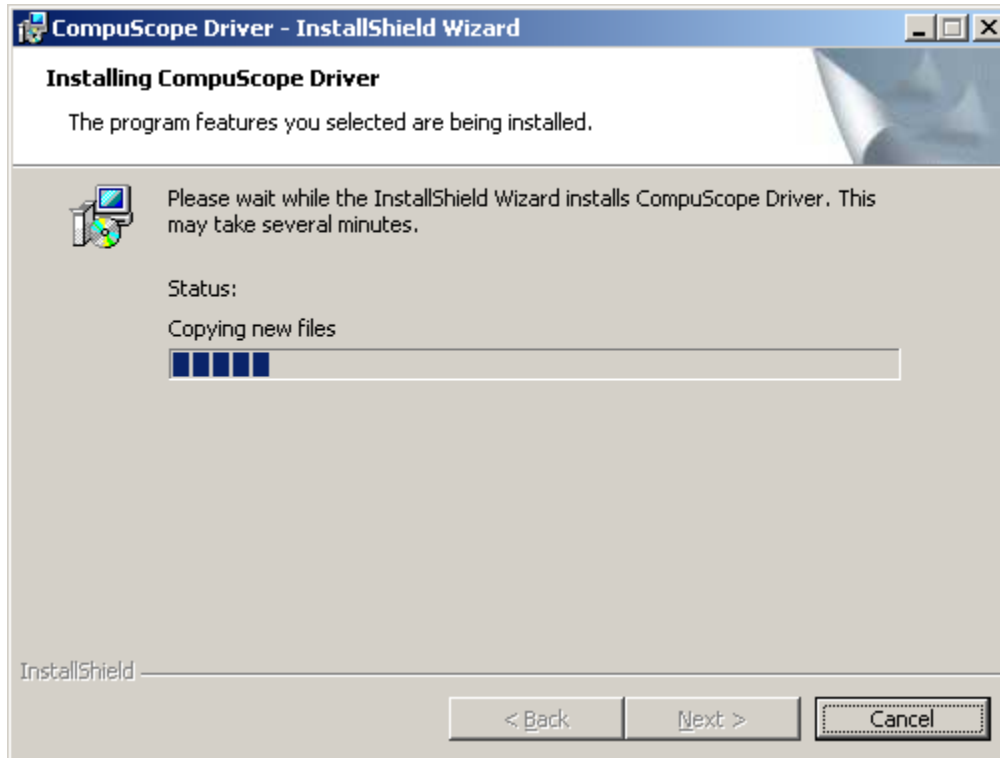
Figure 36: Installing drivers

Click on Finish to complete the installation.
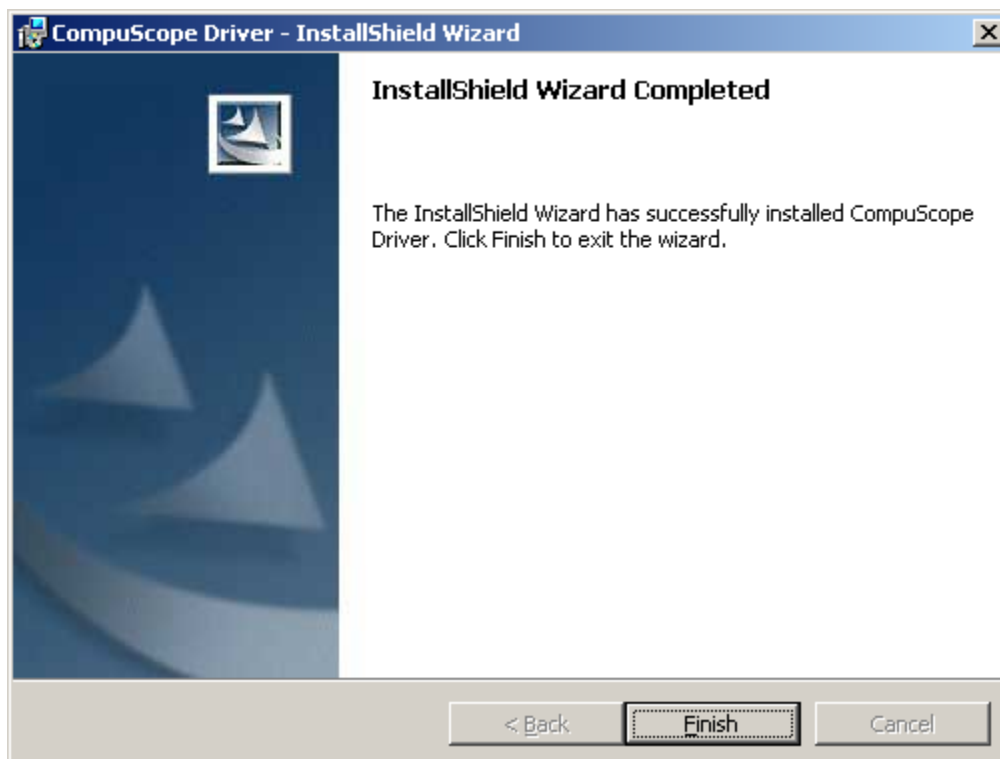
Figure 37: Installation successfully completed

In order to use the CompuScope Drivers, you must restart your computer. You will be asked whether or not you want to restart your computer immediately, or you may choose to restart your computer later.
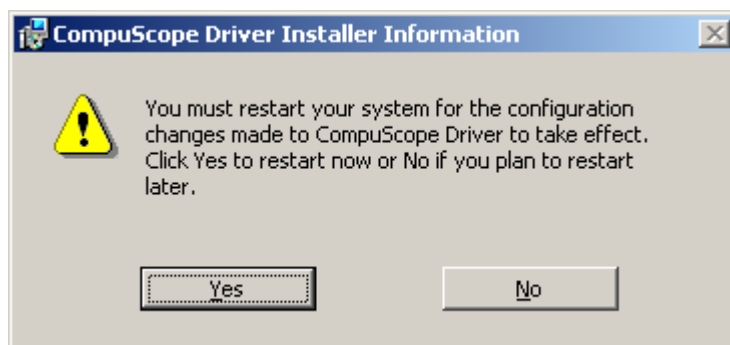
CompuScope 3.60 Windows 98/ME or Windows 2K/XP Drivers

For the CompuScope 3.60 Windows 98/ME or Windows 2K/XP drivers, you will actually see the following message (Figure 38) if you try to install from this screen:

Figure 38: Plug-n-Play CompuScope driver message

The installation of the CompuScope 3.60 Windows 98/ME or Windows 2K/XP drivers should therefore be done from the Add New Hardware function of Windows (note that the CompuScope 3.82 drivers are not available for Windows 98/ME). To complete the installation of CompuScope drivers you will only have to point Windows to the Gage Software Disk and Windows will do the rest of the work.

CompuScope 3.60 Windows NT Driver Installation

Note that if you are using Windows NT, the Add New Hardware function is not available. In order to install the CompuScope 3.60 drivers (note that the CompuScope 3.82 drivers are not available for Windows NT), you must run the Setup.exe file found in the CompuscopeDev/Legacy/WinNT/ directory on the Gage Software Disk:
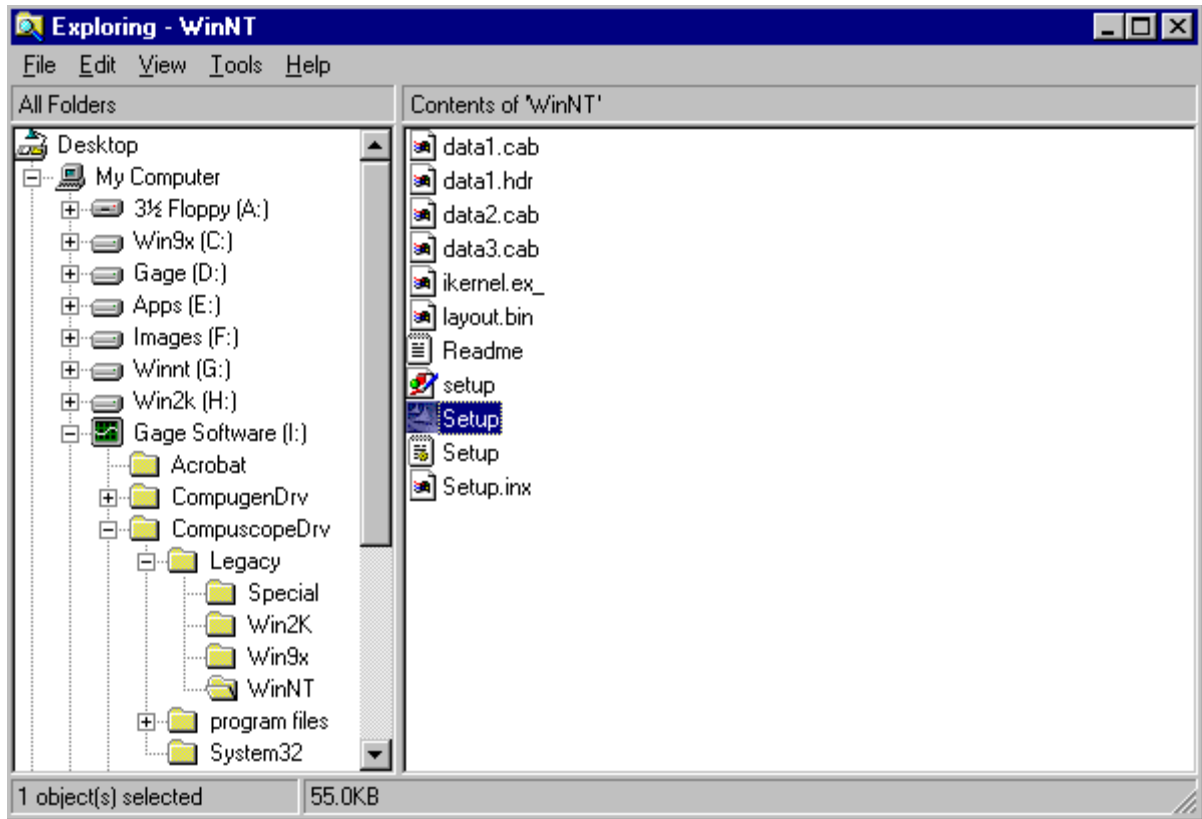
Figure 39: WinNT Explorer window

Running the Setup.exe file will start the InstallShield Wizard for the CompuScope Win NT drivers. Click on Next from the InstallShield Welcome screen to continue with the installation:
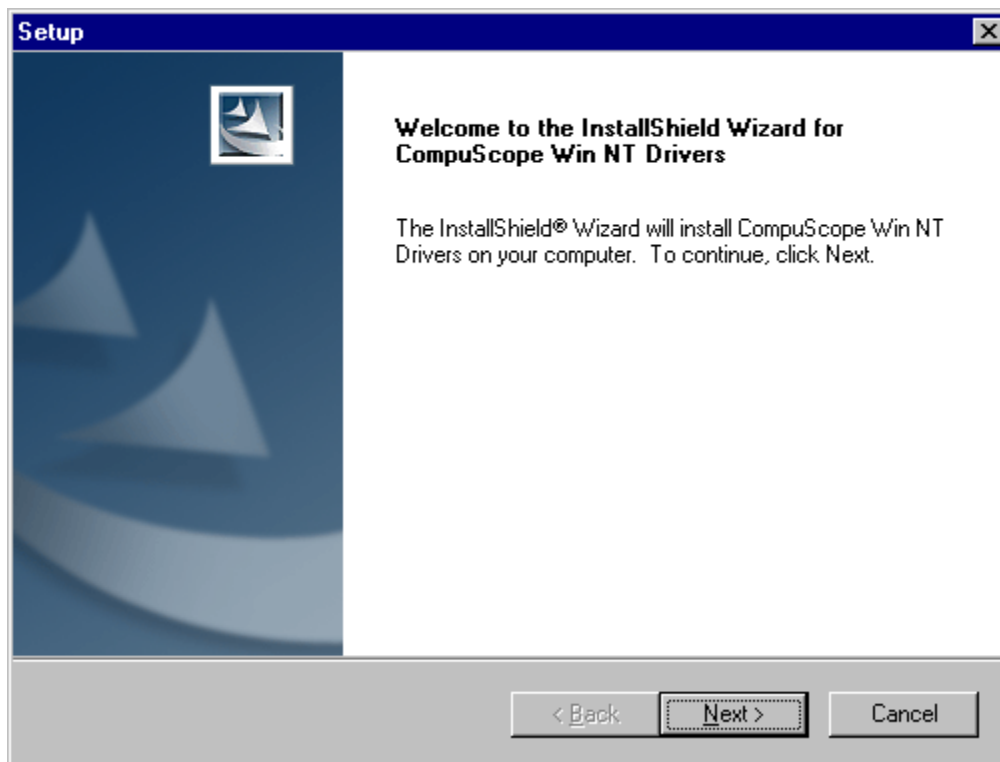
Figure 40: InstallShield Wizard for CompuScope WinNT Drivers

You will then need to choose a destination directory on your computer where you want the drivers to be installed. By default, the drivers will be installed in the O/S system drive:\Gage\CompuScope SDK for Windows directory. Alternately, you can choose a destination directory of your preference. Click on Next to continue with the installation:
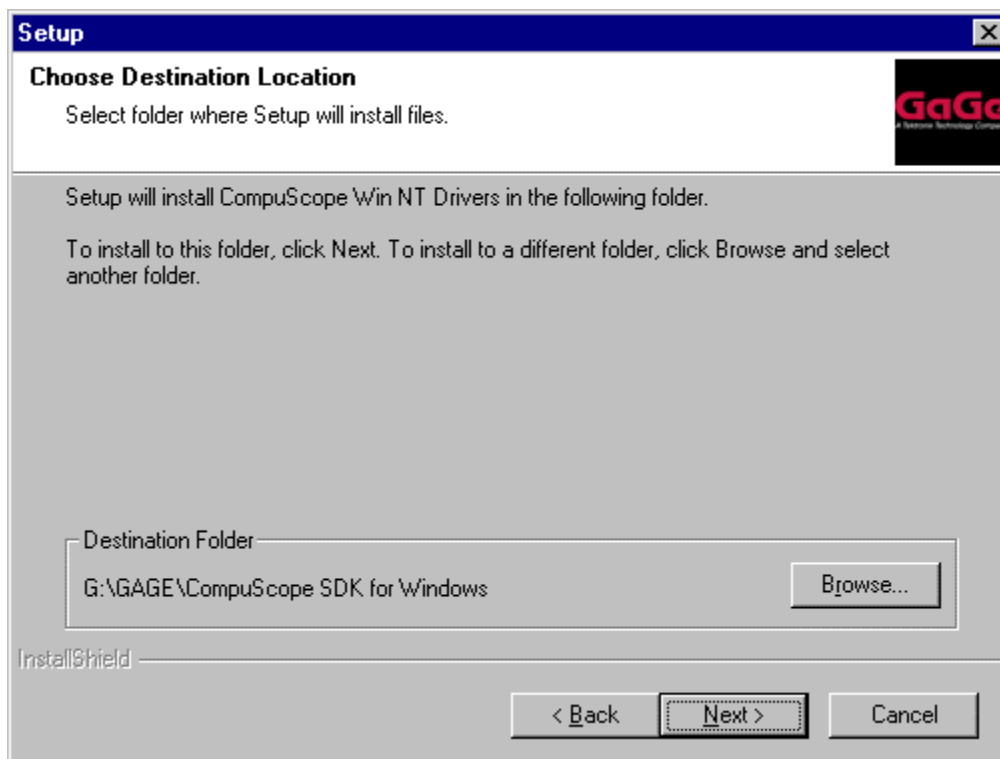
Figure 41: Installation setup

You will be prompted to view the ReadMe file during the installation.
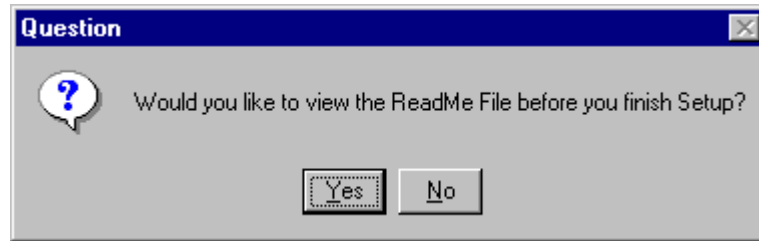
Figure 42: View ReadMe file during installation

The following screen appears if you click Yes to view the ReadMe file:
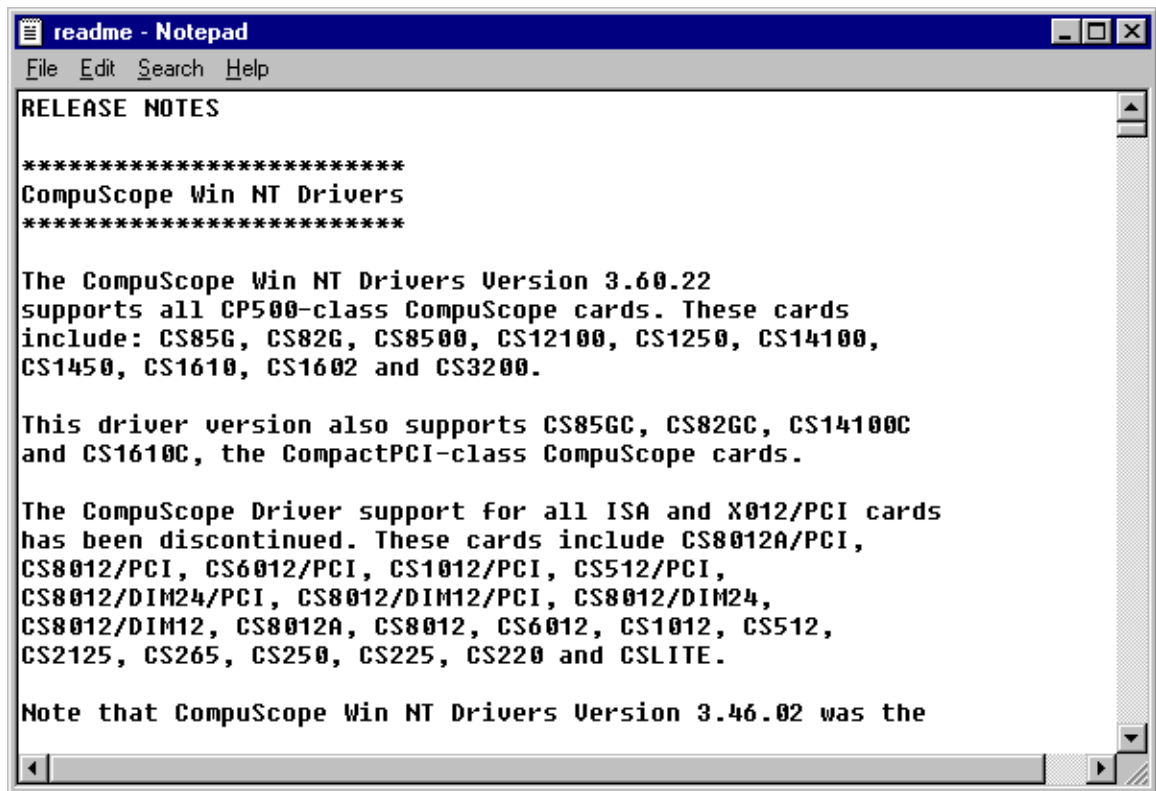
Figure 43: ReadMe file for CompuScope Win NT drivers

If you prefer not to read the ReadMe file, click No and the driver installation completes. In order to use the CompuScope Drivers, you must restart your computer. You will be asked whether or not you want to restart your computer immediately, or you may choose to restart your computer later:
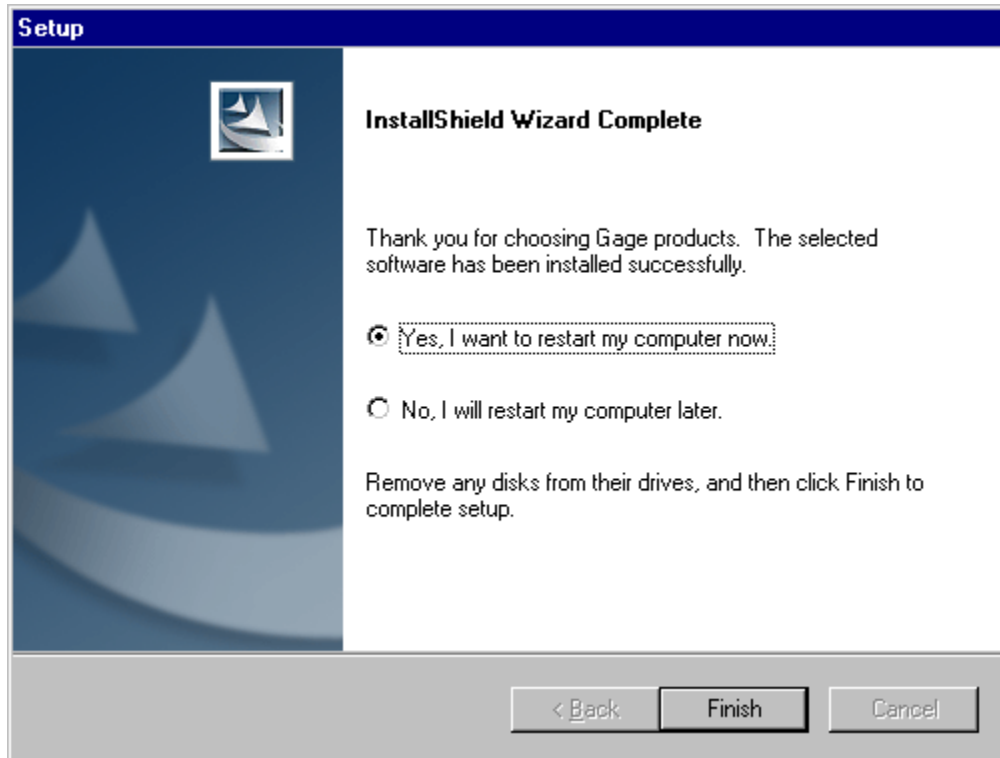
Figure 44: Installation Complete

Free Applications

You can install Free Applications by clicking on the Free Applications button from the Install Software screen. Depending on the type of hardware you purchased from Gage, you may need some of these free applications to operate your card or cards.

Figure 45: Selection of free applications from Gage

If you have bought a digital capture product from Gage, you should install the GageBit Application. To do so, simply click on the appropriate button on the screen shown in Figure 45 above and follow the instructions of the GageBit Install Wizard.

Purchased Software

Purchased Software is similarly accessed from the Install Software screen by clicking on the Purchased Software button. There are two main categories of Purchased Software available from the Gage Software Disk: GageScope and Software Development Kits (see Figure 46 below).

Figure 46: Selection of free applications from Gage

Clicking to install one of the software packages will bring up an install Wizard as usual; simply follow the instructions on screen to install your software. Make sure you have your software key or keys handy as you begin the installation process for GageScope or one of the Software Development Kits.

GageScope

Figure 47 shows the first screen of the GageScope Install Wizard.
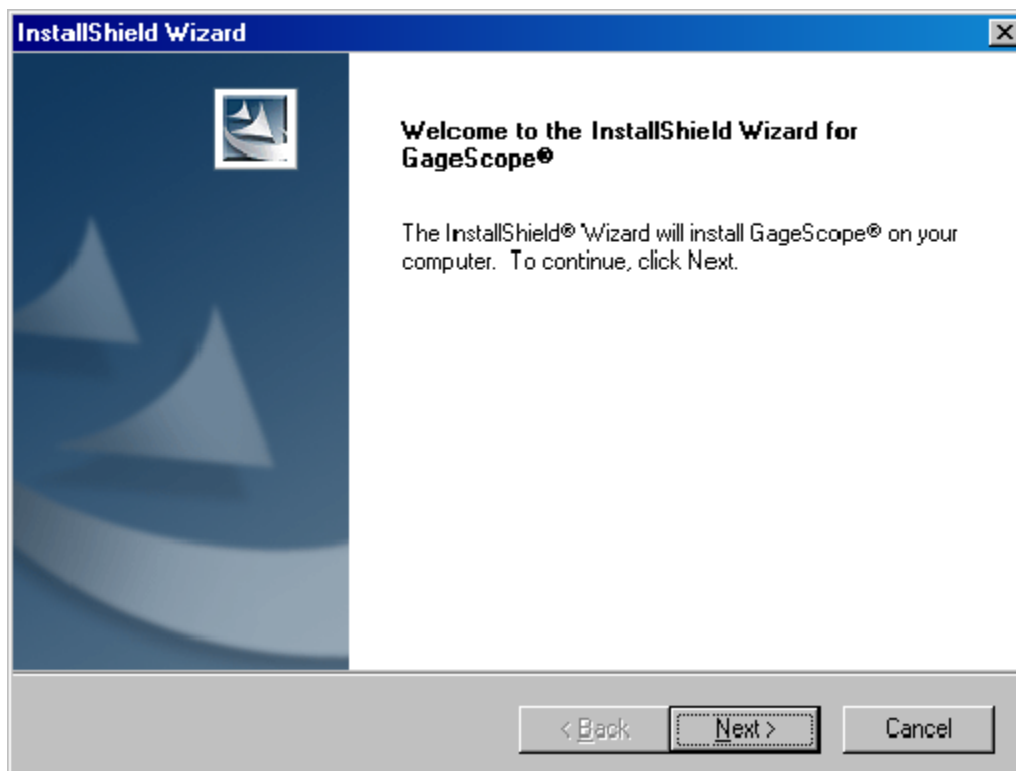
Figure 47: GageScope Install Wizard

For more details on the GageScope installation, please refer to the GageScope Manual that is included in PDF format on the Gage Software Disk (CD Drive:/Gage/SW Manuals).

Software Development Kits (SDKs)

The Software Development Kits (SDKs) also have standardized installation procedures and therefore will not be covered in detail in this manual. Note that all SDKs from Gage are available from the Gage Software CD: C/C++, MATLAB, LabVIEW and LabWindows/CVI.

The first two screens of the SDK Install Wizard are shown below.
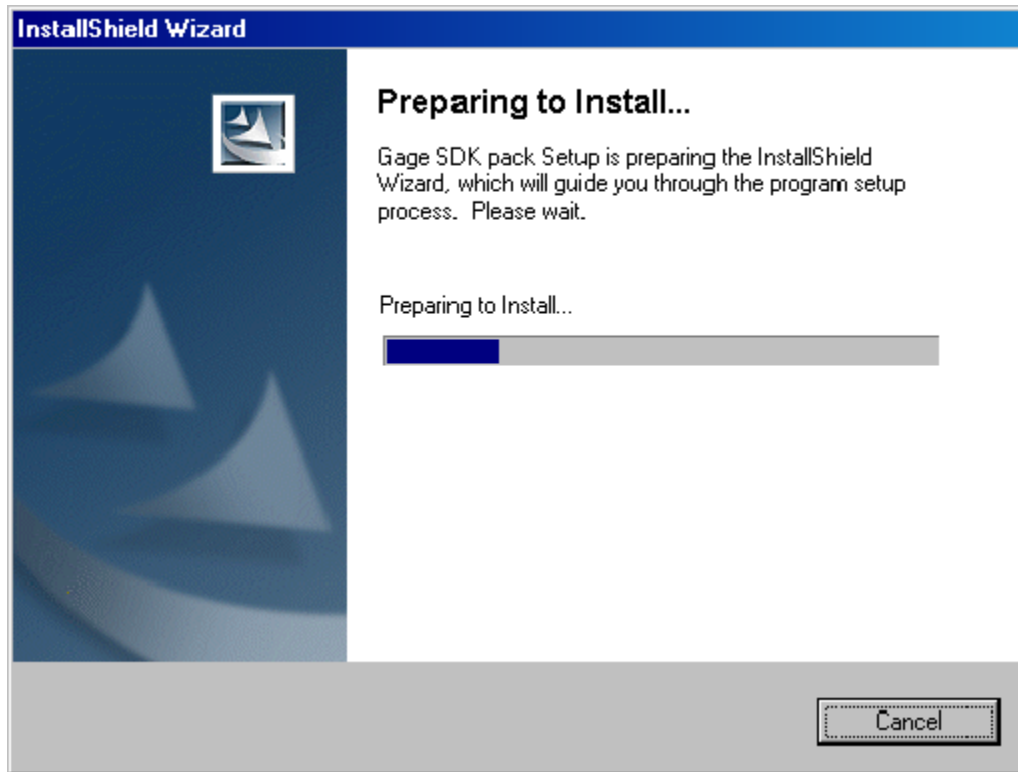
Figure 48: First screen of the SDK Install Wizard
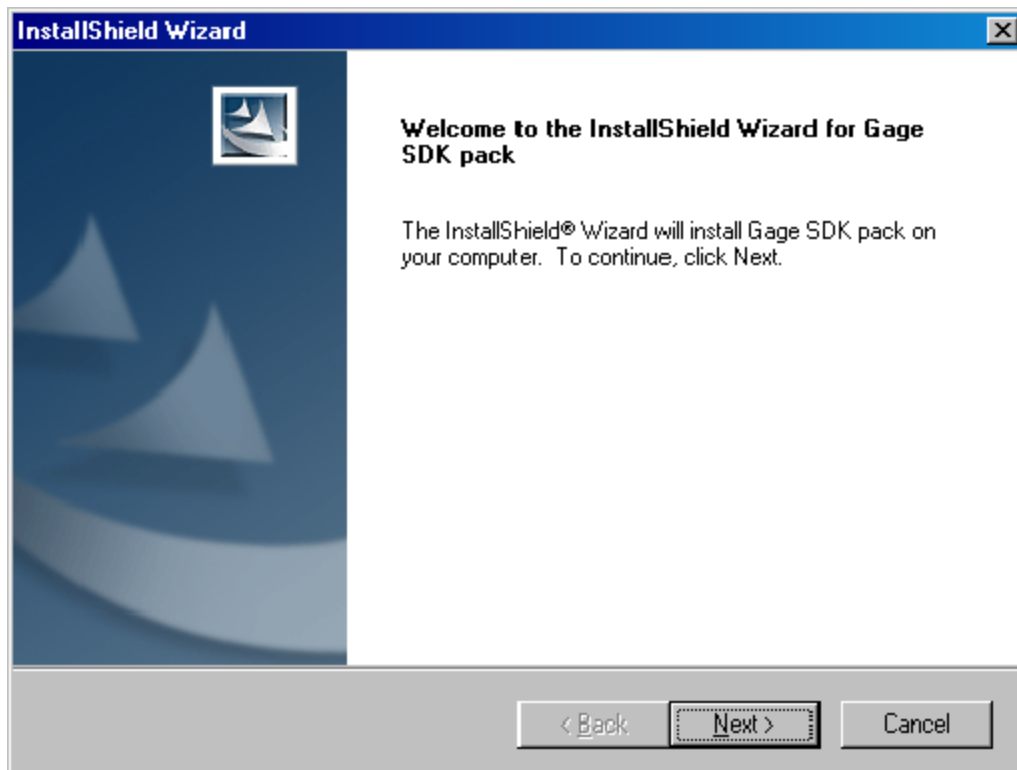
Figure 49: Second screen of the SDK Install Wizard

IMPORTANT NOTE:
If you have purchased a Software Development Kit, or if you are trying to install GageScope, you must first install the drivers for your hardware in order to use the software. If you do not install the drivers, the sample programs will not work properly and GageScope will only function in Demo Mode.

Section 2 – Verifying the operation of your hardware

Verifying installation and configuration of CompuScope hardware under Windows 2000/XP with CompuScope Manager

If you wish to verify installation and configuration of your CompuScope cards under Windows 98/ME/NT, please refer to the next section: Verifying installation and configuration of CompuScope hardware under Windows 98/ME/NT with GageConfig.

The CompuScope Manager utility is used to verify the configuration your CompuScope cards under Windows 2000/XP.

The CompuScope Manager utility is installed at the same time as the CompuScope 3.82 drivers. You can access the CompuScope Manager from the Gage folder in the Programs category of the Start Menu of Windows.

The main screen of the CompuScope Manager is the Resource Manager tab (see Figure 50 below):
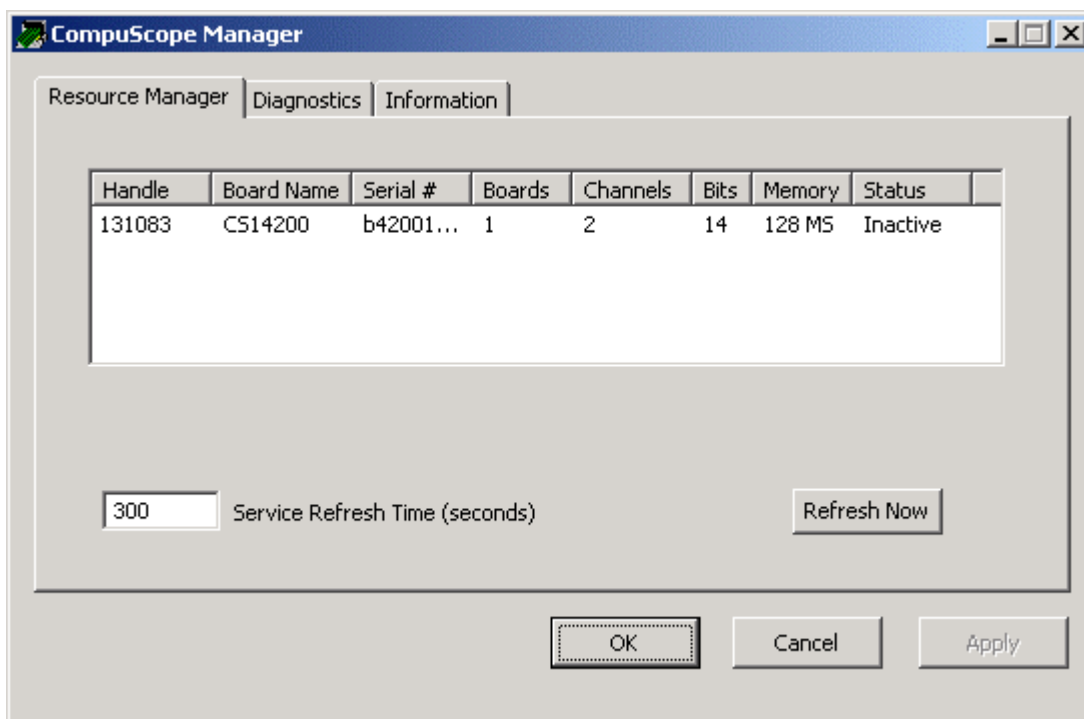
Figure 50: Card information from the Resource Manager tab of the CompuScope Manager

This screen provides you information about the Gage card or cards installed in your system. You can see the type of card, the number of cards in the system, the number of channels on the card, the nominal resolution of the card, the on-board memory, whether the card is active or inactive, and even the handle that the system has to control the card from software (through the driver).

Verifying installation and configuration of CompuScope hardware under Windows 98/ME/NT with GageConfig

GageConfig is used to verify the configuration your CompuScope cards under Windows 98/ME/NT.

The GageConfig Manager utility is installed at the same time as the drivers and you do not need to do anything special to get it. You can access GageConfig from the Gage folder in the Programs category of the Start Menu of Windows.
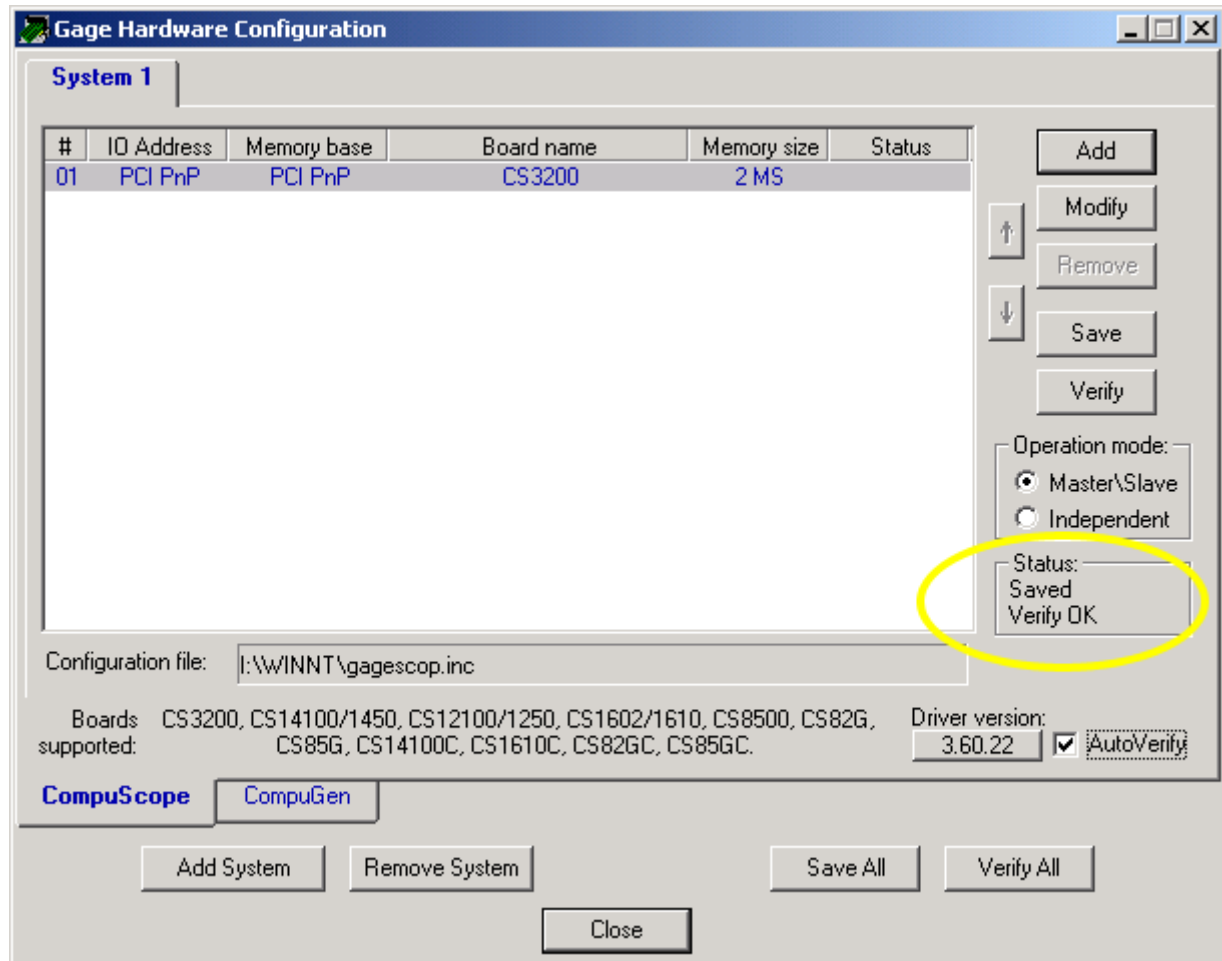
Figure 51: GageConfig screen

GageConfig creates a binary file called GAGESCOP.INC that contains the information necessary for the driver to recognize the CompuScope card(s). This file is kept in the **Windows\System** folder of your computer.

Please note that the CompuScope cards are plug-and-play devices, so you do not need to specify an I/O or a memory address, as you would have had to for ISA products.

It is, however, necessary to declare the I/O and Memory addresses as "PnP" in the appropriate section of GageConfig. This would tell GageConfig that we are trying to locate a Plug-n-Play device.

If I/O and Memory Base addresses are not specified to "PnP", GageConfig will not recognize your CompuScope card.

If you require more information on how to use GageConfig, you can download a manual from the Gage website http://www.gage-applied.com/support/softwares.php (click on Download Utilities).

Verifying signal acquisition of a CompuScope card with GageScope and CSTest

Gage strongly recommends that you become familiar with GageScope as a powerful tool for capturing and analyzing signals, even if you will eventually develop your own application to control your hardware. Since it embodies all the knowledge required to operate the wide array of CompuScope cards and all their functionalities, GageScope is the ideal tool to verify the operation of your hardware and to troubleshoot applications you may develop on your own. GageScope Lite is provided for free to all users of CompuScope cards for precisely this purpose.

You can find extremely detailed instructions on how to use GageScope in the GageScope manual that is included in PDF format on the Gage Software Disk (CD Drive:/Gage/SW Manuals).

However, if you have not already installed GageScope, or if you do not wish to install it at this point, Gage provides a simple application, CSTest+ for CompuScope 3.82 drivers (or CSTest for CompuScope 3.60 drivers) that allows you to capture signals and verify the correct operation of your new CompuScope card. Note that the following section details the CSTest+ functionality only, but CSTest has a slightly different interface.

Section 3 – Verifying signal acquisition with CSTest+

CSTest+ is a utility program that allows acquisition and display of data from a CompuScope card using CompuScope 3.82 drivers. It acts as a test to ensure that your CompuScope card(s) is fully functional.

Now that you have successfully installed the CompuScope drivers and have tested driver installation with the CompuScope Manager utility, you can run CSTest+ to verify that these drivers are properly communicating with your CompuScope card(s).

Setting-up your Hardware
Using a function (signal) generator, generate a 1 MHz sine wave signal and connect it to the CH1 input of your CompuScope card. If you have installed a CompuScope 8500 card, use the 1 MΩ input instead.

Running CSTest+
You can run CSTest+ from the Windows Start Menu:
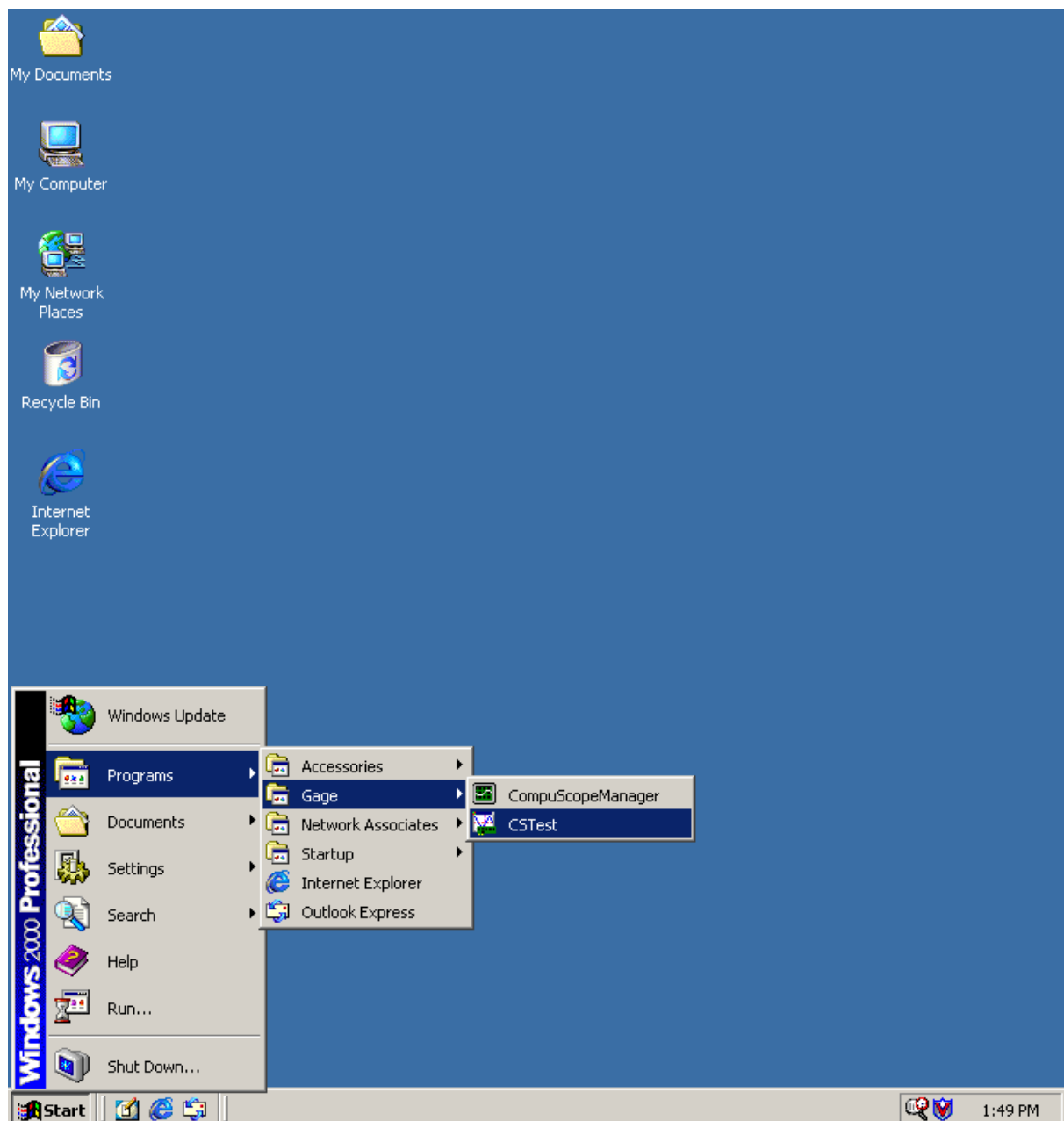
If there is more than one acquisition system installed on the same computer, you should see the **Select System** dialog pop-up. Select the acquisition system you want to test then click OK. You will not see this dialog if there is only one acquisition system installed in the computer.
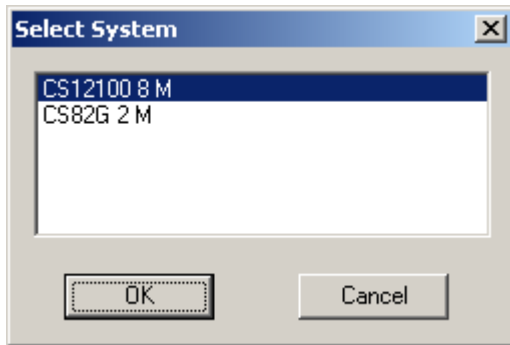
You should now see a window labeled **CsTest +**. You can view the sine wave that you have generated using the function generator that you have previously connected by selecting **Acquire** from the **Controls** menu:
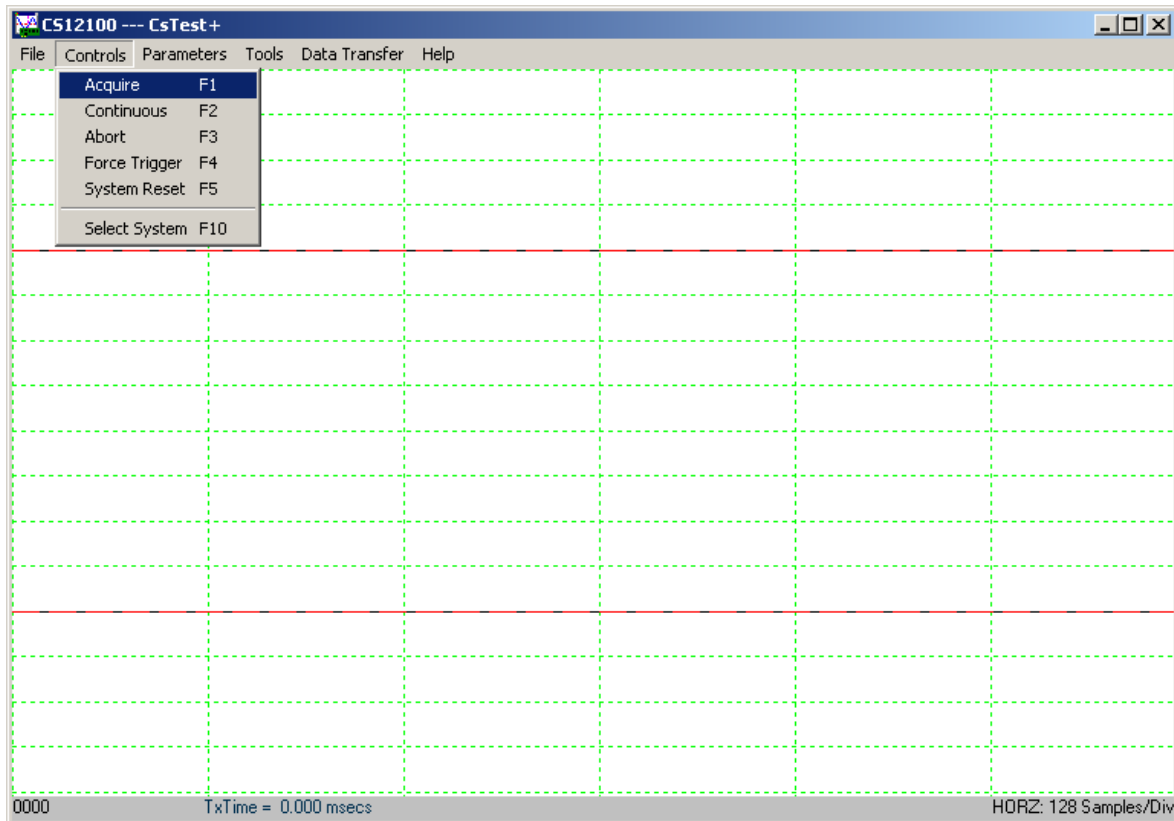
To view the sine wave continuously in time, go to the **Controls** menu and click on **Continuous**. Note that the sine wave on the screen starts from the positive slope. As you change the frequency of the sine wave on your function generator, you will see a corresponding change in the sine wave displayed in CSTest+.

Note: You may have noticed the four-digit number in the bottom left corner of the CSTest+ window. This is a counter. Every time CSTest+ acquires data, the counter is incremented by 1.

On the right of the counter is the acquisition status. The acquisition status can be one of the following:

Ready	Ready for another data acquisition.
Waiting For Trigger	Data acquisition is in progress, the trigger condition has not been met.
Triggered…	Data acquisition is in progress.
Data Transfer…	Data transfer from on-board memory to PC memory is in progress.

Driver installation guide

Now, go back to the **Controls** menu and click on **Abort**. This will stop any further acquisition.
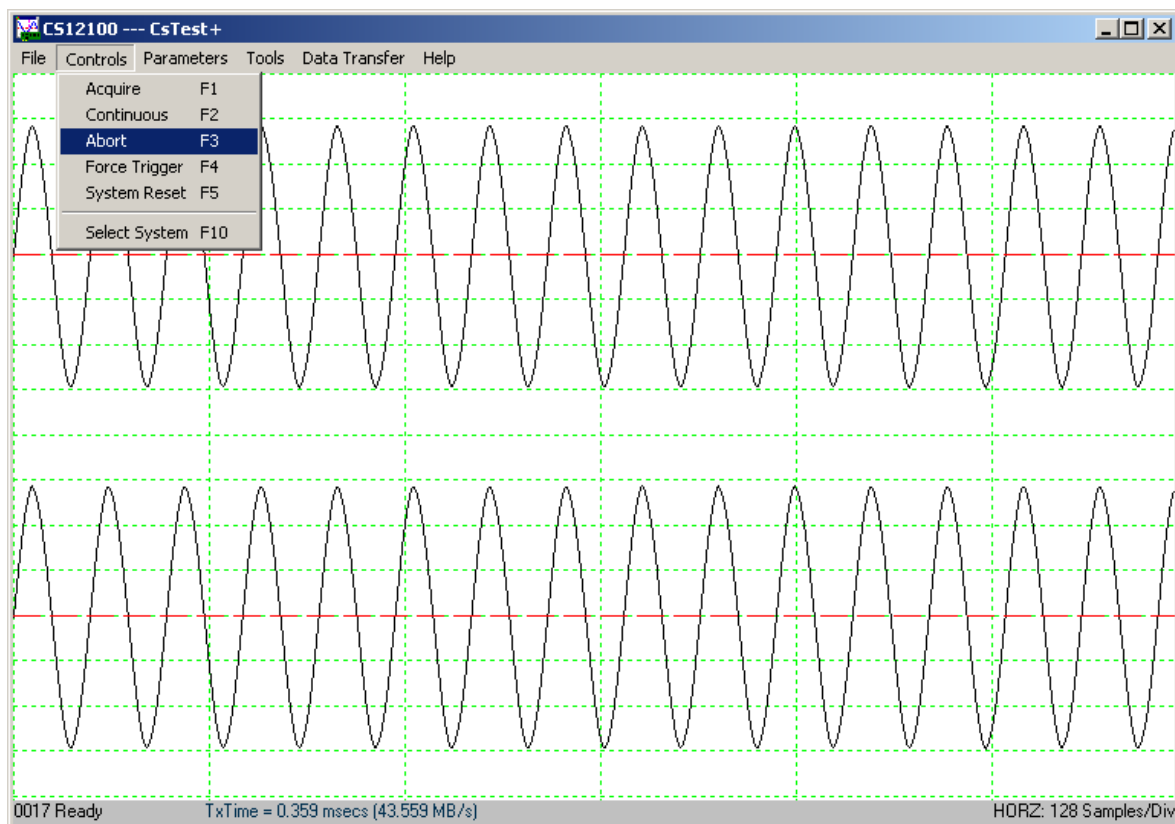
We will now change a trigger parameter such as **Trigger Slope** to verify that all controls for the card are working as they should. Go to the **Parameters** menu and select **Trigger Config**.
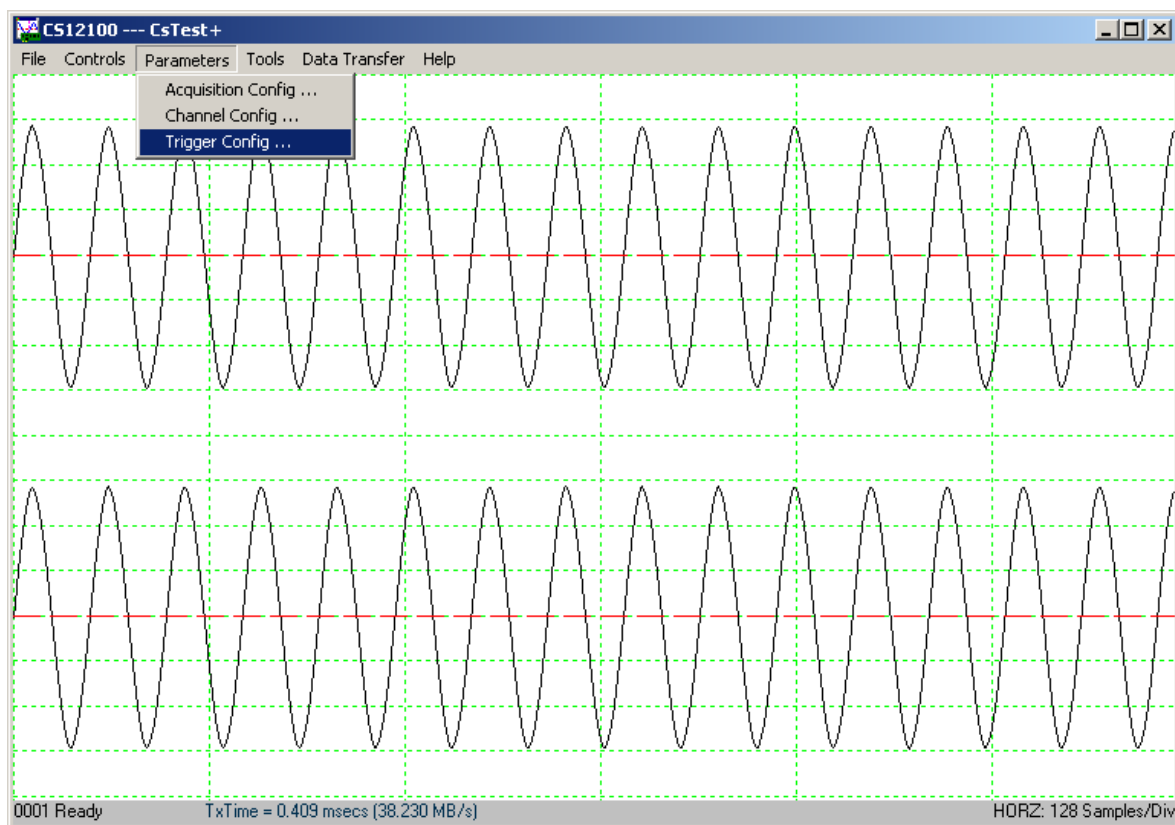
You should see a new dialog box: (Depending on the version of drivers you have installed, the dialog may look slightly different)
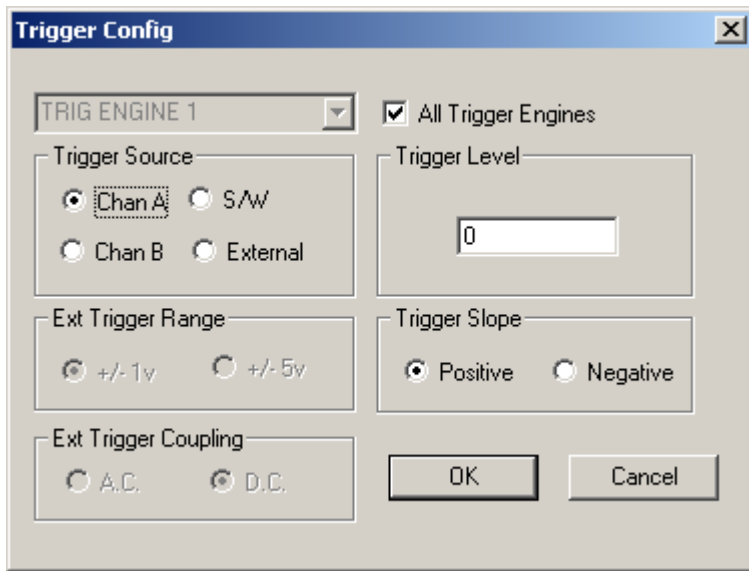
Click on the radio button next to **Negative** in the **Trigger Slope** panel to change the trigger slope from positive to negative. Click on **OK** for this change to be registered and to close the dialog box.

When you go back to the **Controls** menu and click on **Continuous**, you should see the same sine wave, but starting from a negative slope.

This short experiment proves that communication between a utility program, CSTest+, the CompuScope drivers and a CompuScope card has been successfully established. The following screens describe the other functionalities available with CSTest+:

File – Save Channels
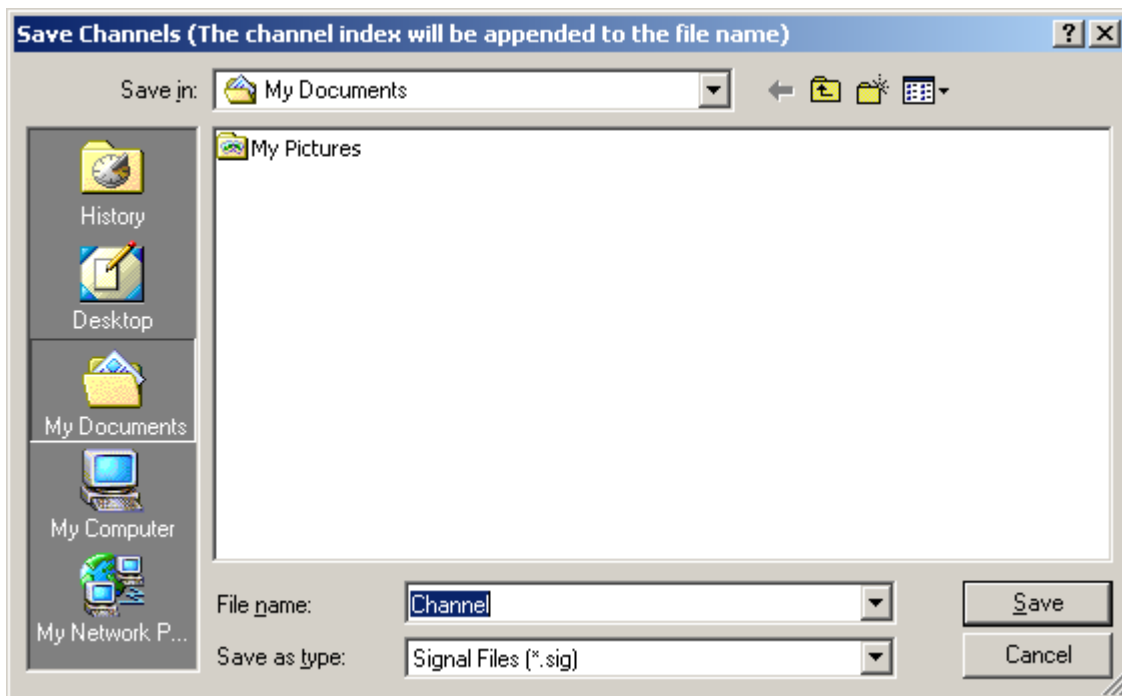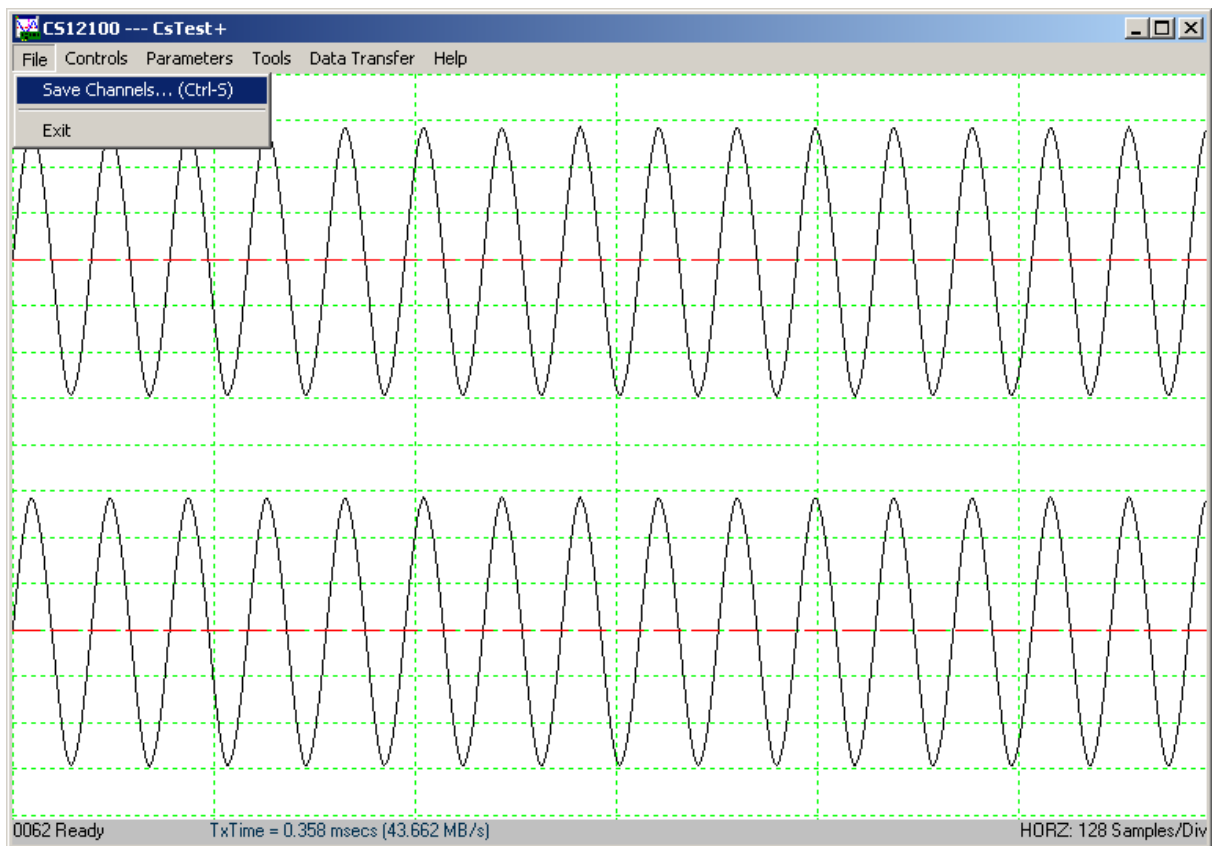
Save Channels saves data captured from different channels into different files in Gage's SIG file format. The Gage SIG file can be read from applications that support Gage's SIG file such as GageScope.

To exit CSTest+, select **Exit** from the **Controls** menu.

Controls – Force Trigger
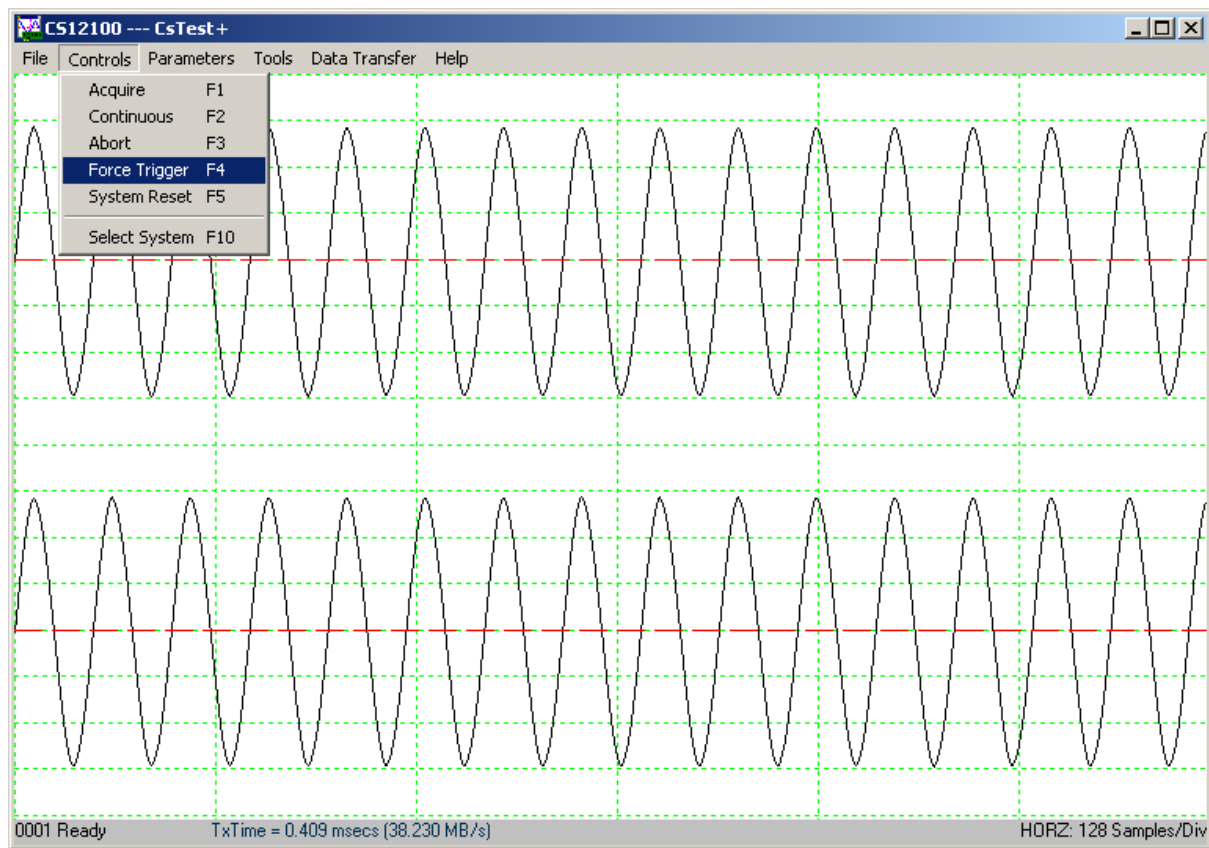
Force Trigger causes the acquisition system to be triggered immediately, no matter what the trigger configuration parameters are.

Controls – System Reset
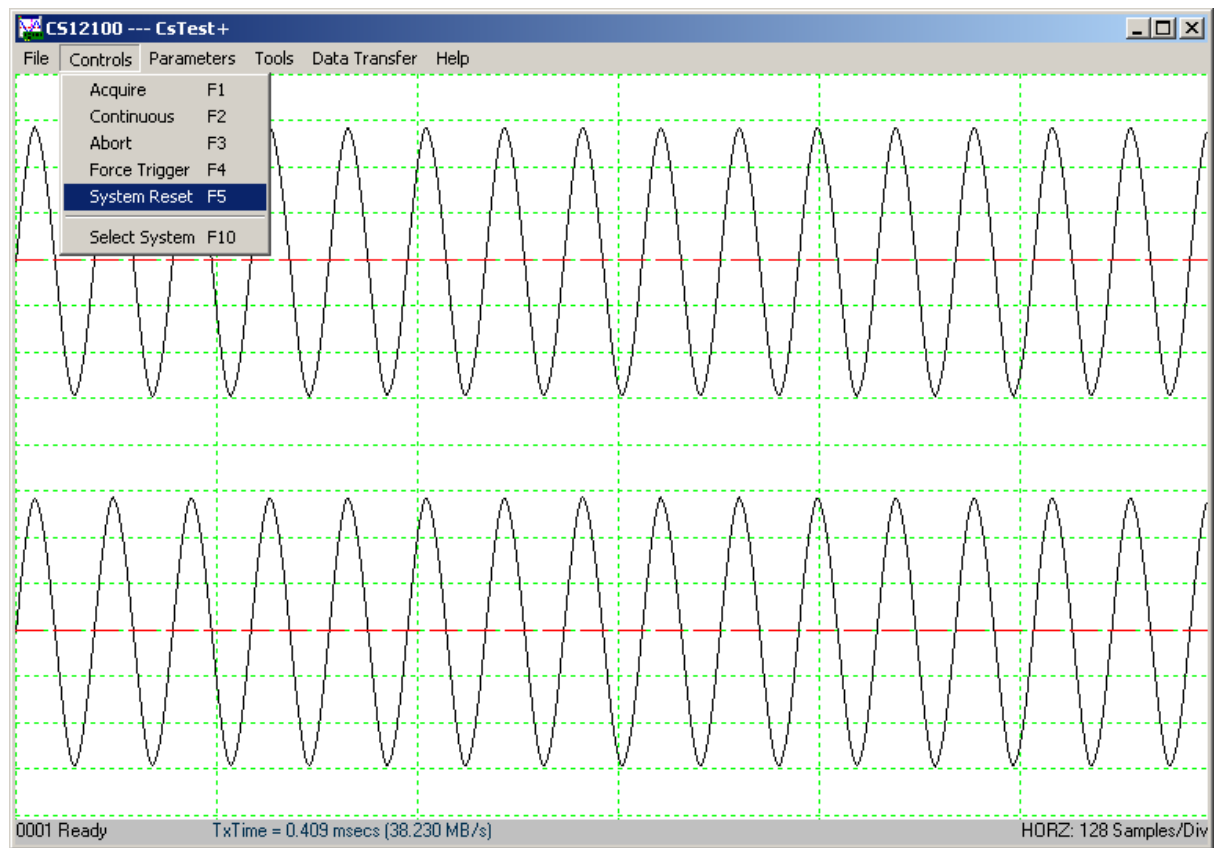
System Reset resets the acquisition system to the default state. The current data acquisition will be aborted and all configuration parameters (Acquisition, Channels and Triggers configurations) will be reset to the default settings.

Controls - Select System
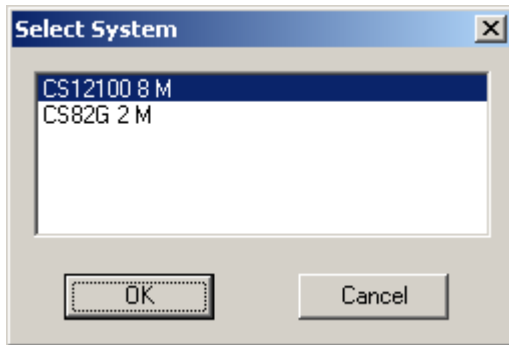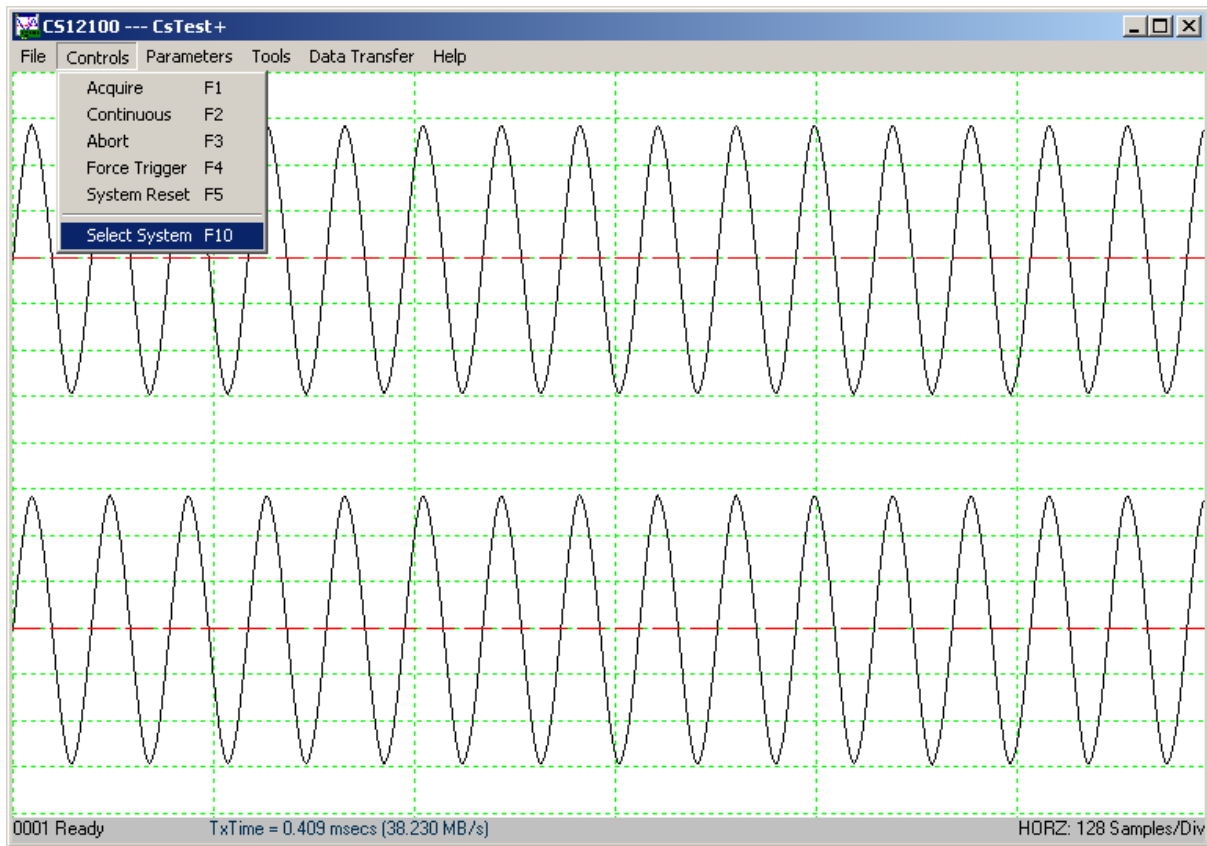
If there is more than one acquisition system installed in the same computer, **Select System** allows the user to select another acquisition system and make it the active acquisition system in CsTest+.

Parameters – Acquisition Config
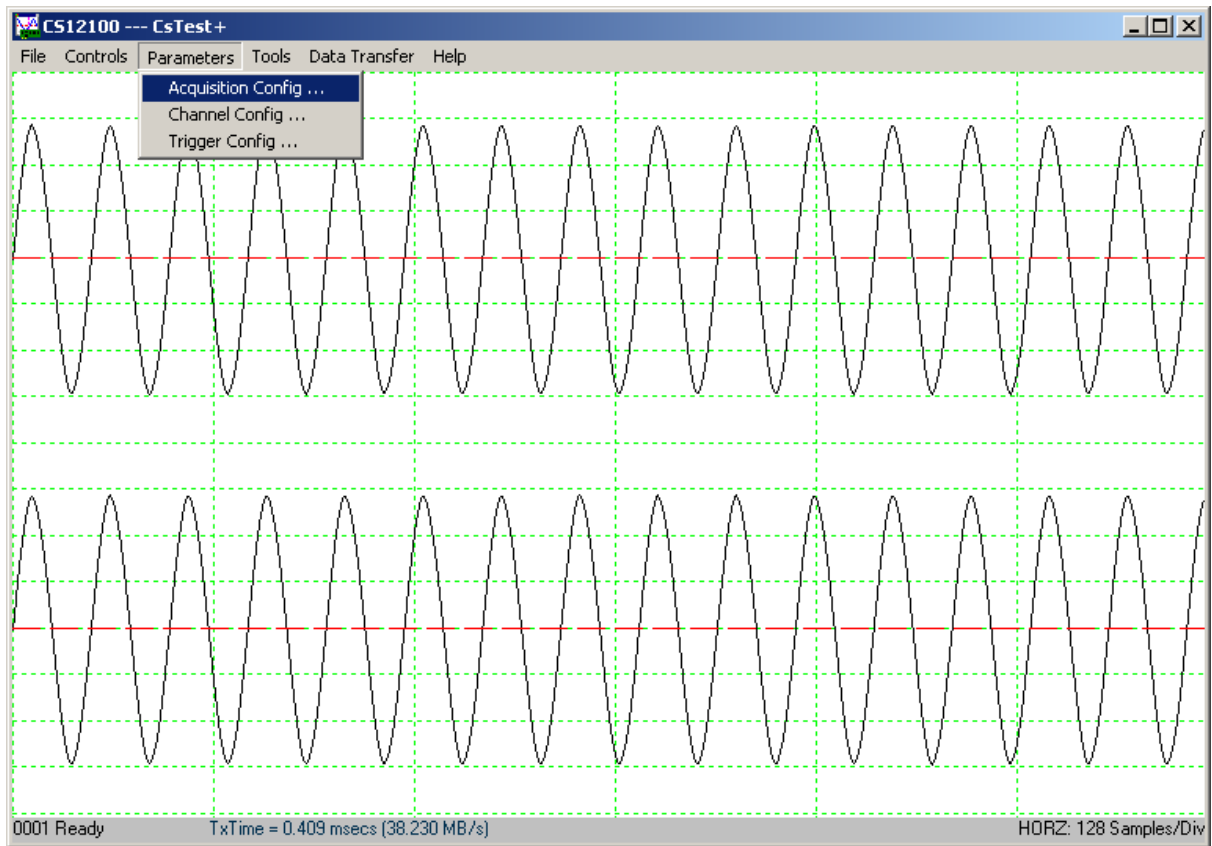
(Depending on the CompuScope card(s) and version of drivers you have installed, the dialog may look slightly different)

Acquisition Config allows users to modify different acquisition configuration parameters such as Pre-Trigger and Post-Trigger depth, Multiple Recording, Sample Rate, Trigger Timeout…

Parameters – Channel Config
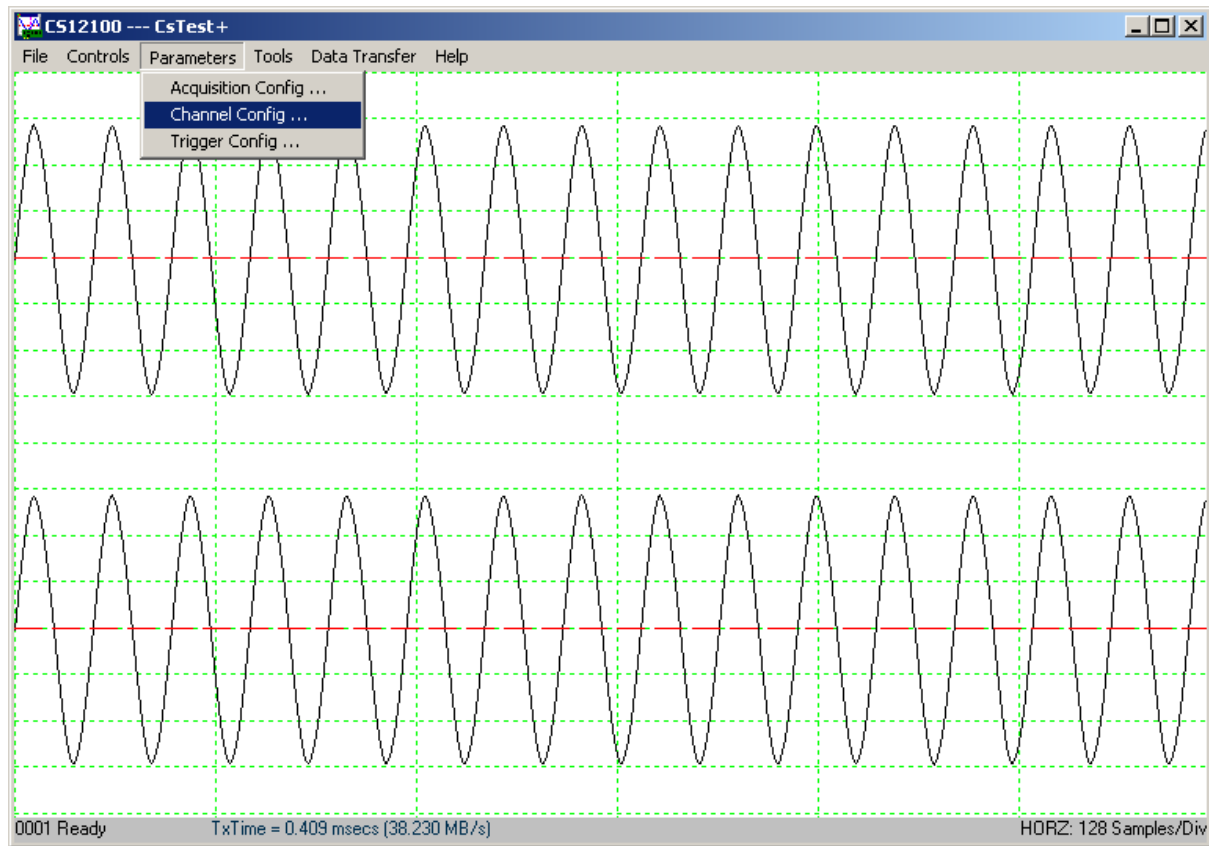
(Depending on the CompuScope card(s) and version of drivers you have installed, the dialog may look slightly different)

Channel Config allows users to modify signal conditioning parameters such as Coupling, Impedance and Gain….

Calib [==0==] is Null Channel Input, which will force the recalibration of the hardware, taking the average value of the current input as a new reference for the zero level.
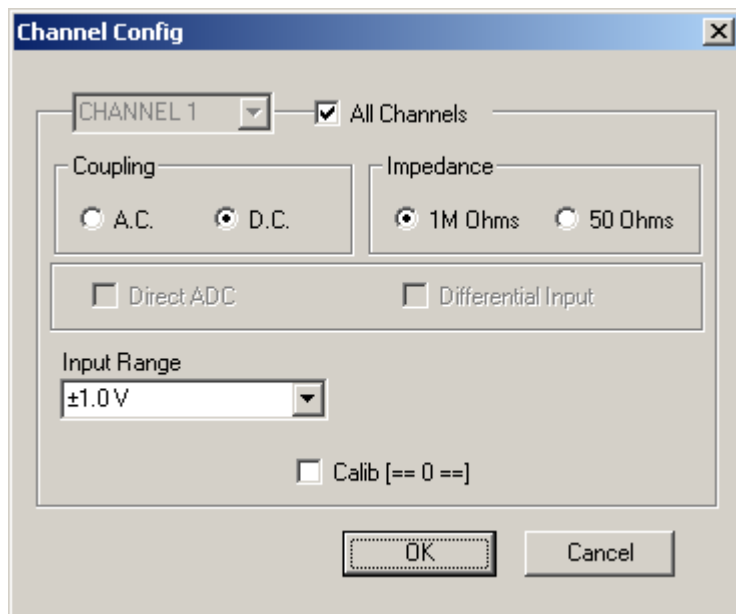
Parameters – Trigger Config
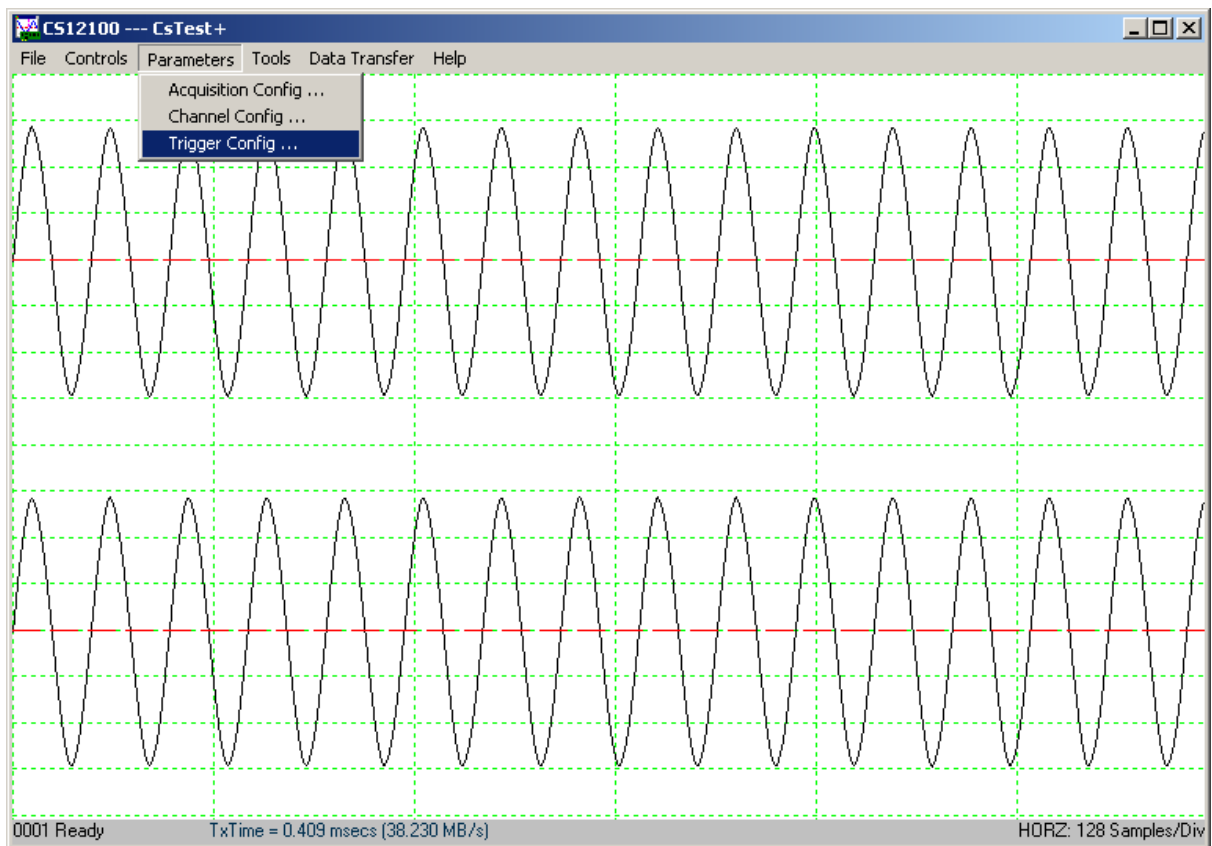
(Depending on the CompuScope card(s) and version of drivers you have installed, the dialog may look slightly different)

Trigger Config allows users to modify different trigger configuration parameters such as trigger source, level and slope…
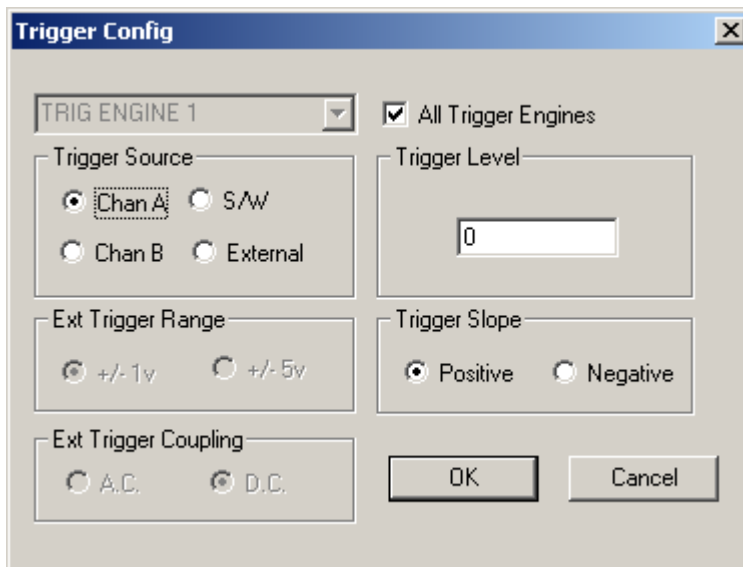
Tools – Performance
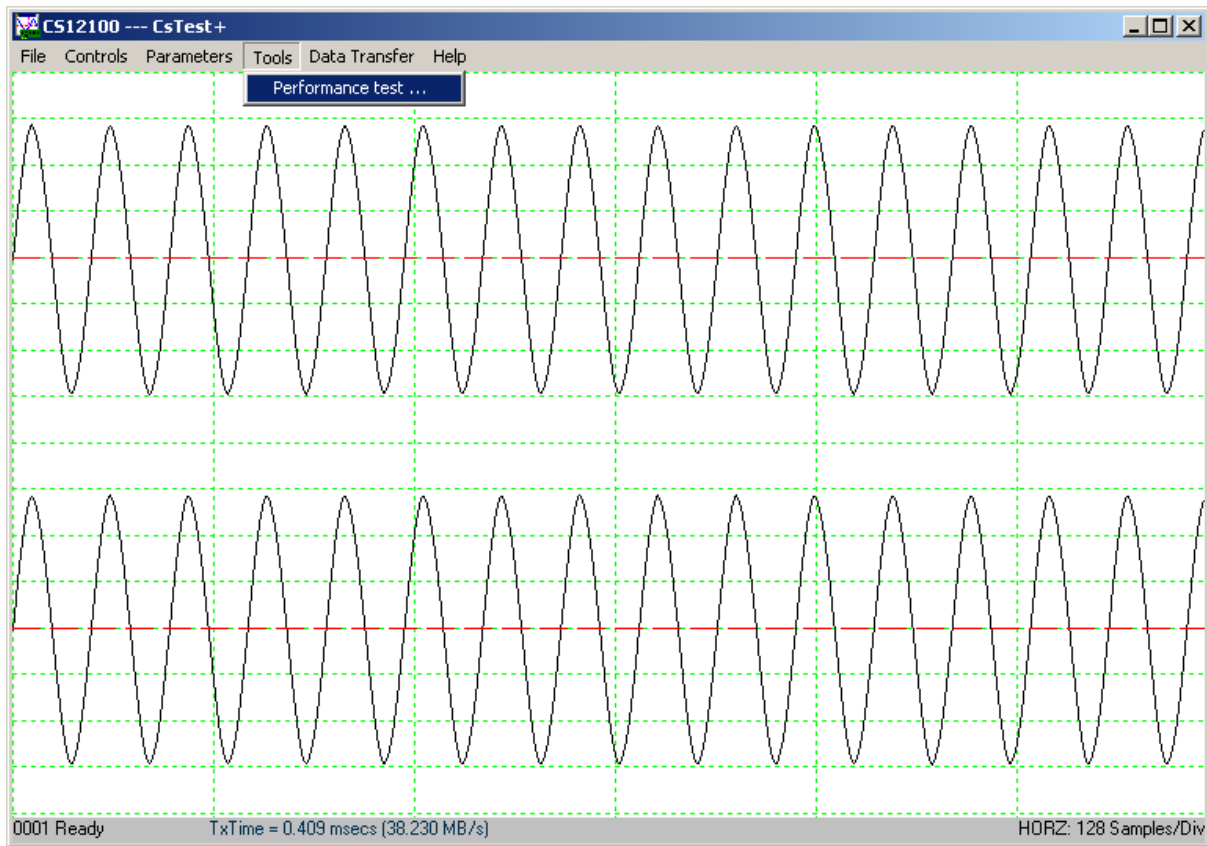
Performance tests the PRF performance of the acquisition system using the current configuration parameters.

Data Transfer – Busmaster Synchronous
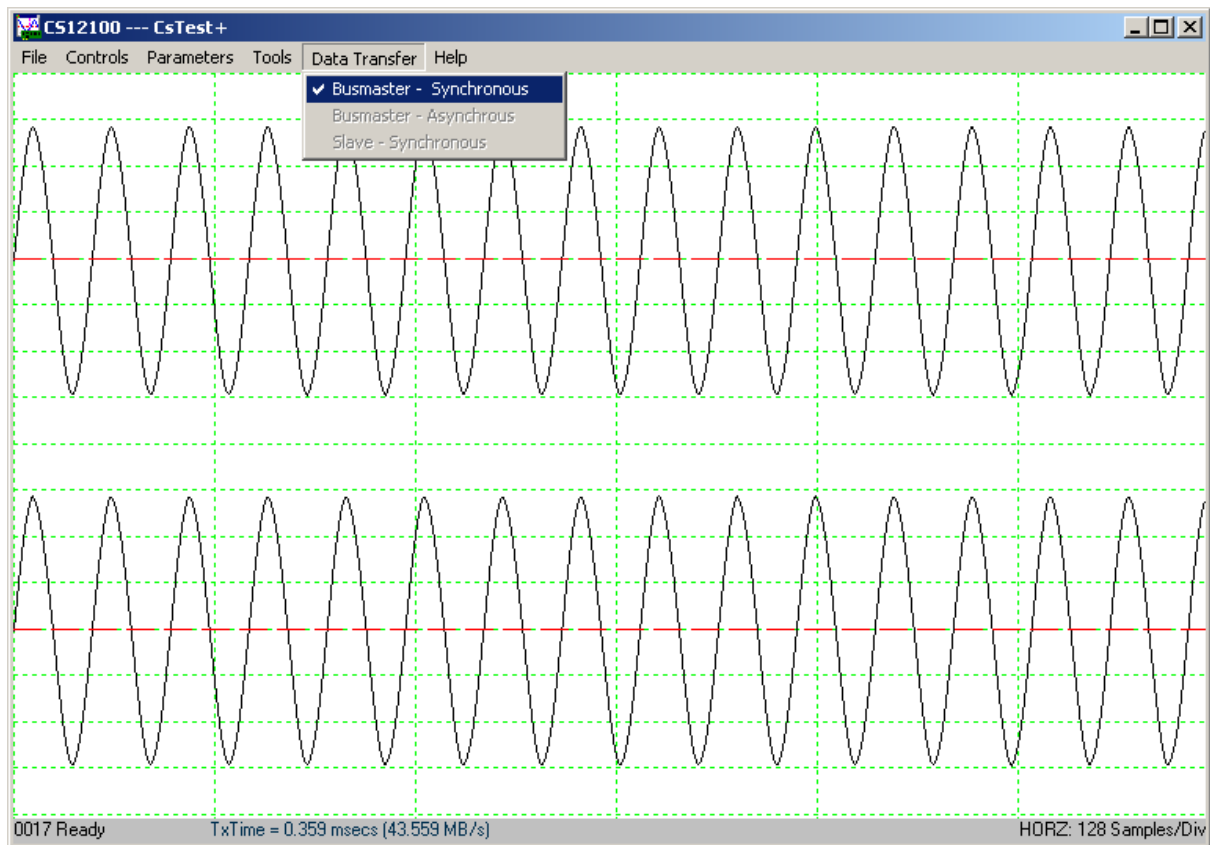
The current version of the Gage drivers only supports synchronous data transfer. Please refer to the CompuScope SDK manual for more information about synchronous and asynchronous data transfer.

Help – Display Controls
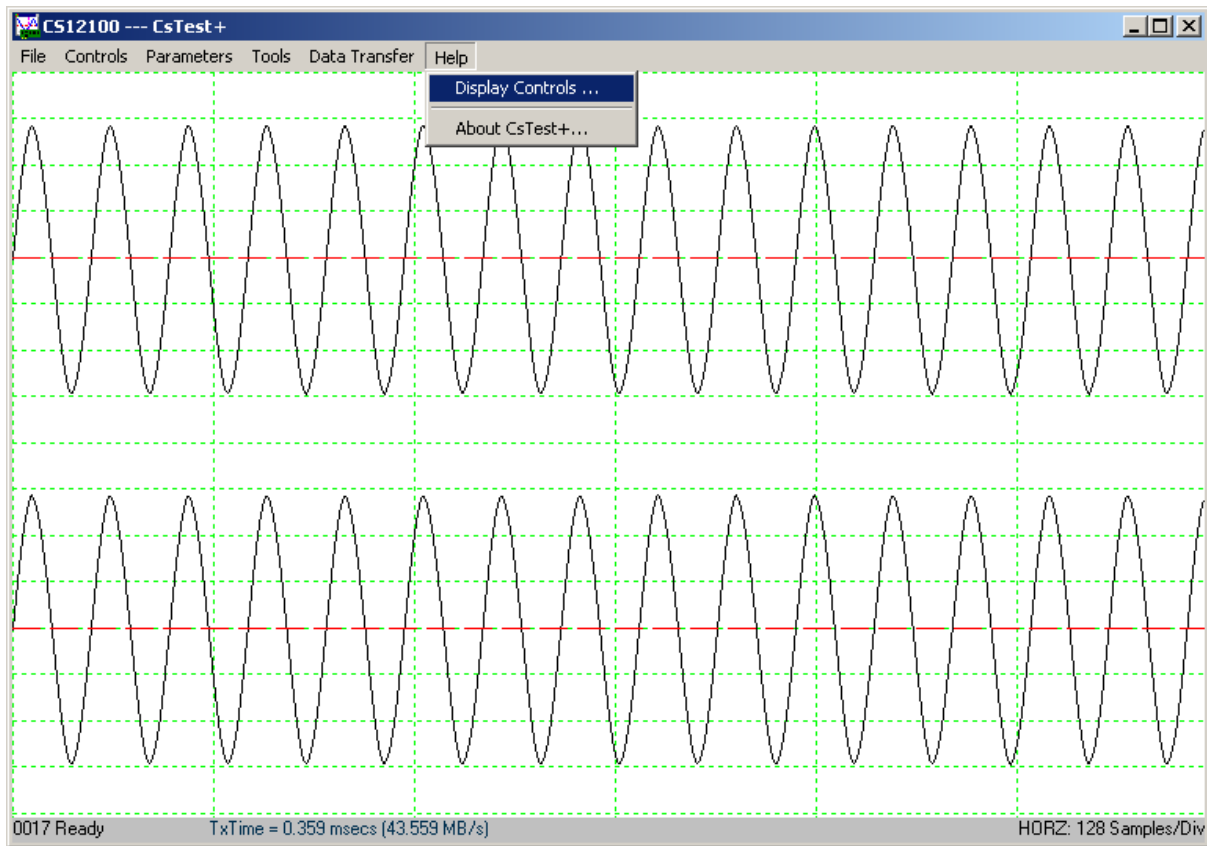
Display Controls shows different shortcuts to control the display of the captured data.
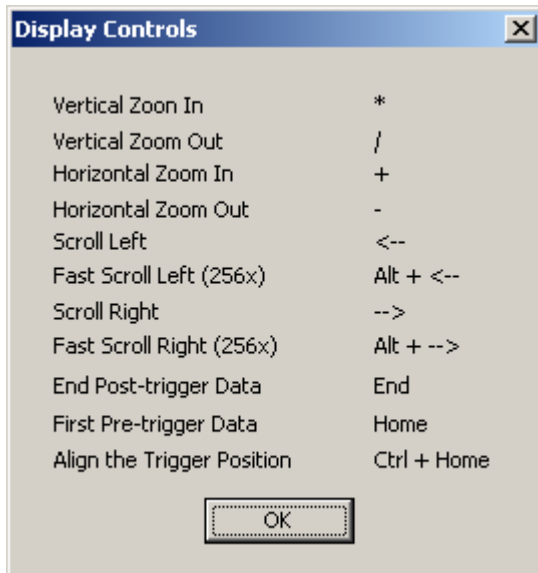
Help – About CsTest+
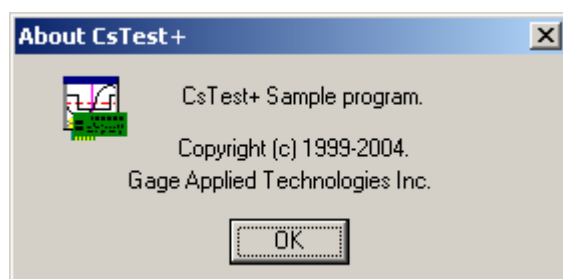
Notes

What you should receive with your CompuScope 85GC

If you order an independent CompuScope 85G card, you should receive the following articles:

- CompuScope 85GC card
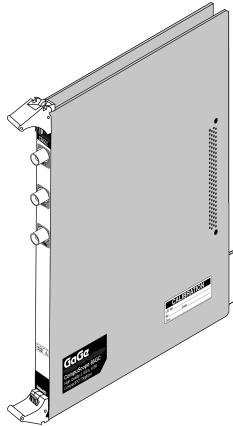
- Standard items included with each CompuScope card

  Hardware manual, including Driver Installation Guide

  Note that you will receive only one copy of the Hardware Manual per order placed with Gage. Additional copies can be requested at order time.

  The Hardware Manual is also available in PDF format on the Gage Software Disk or you can download card-specific manuals from Gage's Web site (www.gage-applied.com).

  Gage Software Disk (with GageScope Software)

  The Gage Software Disk, included on the inside-front cover of the Hardware Manual and Installation Guide, contains all of the software drivers you need to operate your Gage hardware. The CD also contains all of the installers for the application packages provided by Gage, including Lite, Standard and Professional editions of GageScope.

  Note that some packages will only be available if you have purchased the software and have a key provided by Gage.

  CompuScope Certificate of NIST Traceable Calibration

  Each CompuScope card is shipped with a Certificate of NIST Traceable Calibration. NIST is the National Institute to Standards and Technologies - the US organization that is responsible for the definitions and measurement of metrology standards.

  Prior to shipment, Gage runs each CompuScope card through a battery of over 1000 automated performance verification tests using a NIST traceable calibration source. The tested CompuScope is then considered a NIST traceable calibration instrument for a period of one year – the calibration interval that is generally accepted by the Test and Measurement industry.

Warranty card

- You may also receive a number of optional items, if purchased:

GageScope® software and
Standard or Professional edition
Software Key envelope

Software Development Kits (SDKs)
& applicable manual(s)

Carefully inspect these articles before proceeding further. If you find any damage caused by transportation, please report it to the organization from which you purchased the CompuScope card.

CompuScope 85GC compliance statement

Category	Standards or description
EC Declaration of Conformity – EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:
	EN 61326 EMC requirements for Class A electrical equipment for measurement, control and laboratory use. [1, 2, 3]
	IEC61000-4-2 Electrostatic Discharge (Performance criterion B)
	IEC61000-4-3 RF Electromagnetic Field (Performance criterion A)
	IEC61000-4-4 Electrical Fast Transient/Burst Immunity (Performance criterion B)
	IEC61000-4-5 Power Line Surge Immunity (Performance criterion B)
	IEC61000-4-6 Conducted RF Immunity (Performance criterion A)
	IEC61000-4-11 Voltage Dips and Interruptions Immunity (Performance criterion B)
	EN 61000-3-2 AC Power Line Harmonic Emissions
Australia / New Zealand Declaration of Conformity - EMC	Complies with EMC provision of Radio communications Act per the following standard(s):
	AS/NZS 2064.1/2 Industrial, Scientific and Medical Equipment: 1992 [1, 2, 3]

1. **High-quality shielded cables must be used to ensure compliance to the above listed standards**

2. **Compliance demonstrated on a single card configuration**

3. **On the host PC used by the customer, all unused back panel slots must be covered with EMI blocking plates**

CompuScope 85GC product introduction

CompuScope 85GC is the world's fastest CompactPCI^{TM} waveform digitizer, capable of sampling two simultaneous input channels at rates as fast as 5 GS/s with 8 bit vertical resolution.

Recognizing that until very recently, almost all multi-MegaHertz data acquisition was done using Digital Storage Oscilloscopes under GPIB control, Gage has ported all the features of these DSOs onto the CompuScope card. This means that you do not have to rethink the solution in terms of a completely unknown data acquisition card. You can simply develop the data acquisition system as if an oscilloscope were being used, but instead use a CompuScope card to take advantage of its attractive price and performance.

Of course, CompuScope cards are much more than just another DSO under GPIB control:

- Data transfer rates from CompuScope memory to PC memory or extended memory run at least 100 times faster than a GPIB-DSO combination
- CompuScope cards are easier to program, as Software Development Kits (SDKs) are available for C/C++, MATLAB, LabVIEW and LabWindows/CVI.
- In case you do not want to program the CompuScope 85G, you can use the powerful GageScope® oscilloscope software to acquire, analyze and archive signals.
- CompuScope cards are installed inside the CompactPCI^{TM} chassis, so there is no external box such as a DSO.

CompuScope 85GC specifications

PLEASE CHECK THE GAGE WEBSITE FOR THE MOST UP-TO-DATE SPECIFICATIONS.

SYSTEM REQUIREMENT
CompactPCI PICMG compliant system with the required number of free 6U slots; controller or PC with 128 MB RAM, 50 MB hard disk and SVGA video.

SIZE
6U CompactPCI
Occupies one (1) slot

POWER (IN WATTS)

	Worst Case	Typical
+ 5 Volts	25.0 W	22.0 W
+ 12 Volts	12.0 W	10.0 W

CHANNELS 1 & 2

Number of inputs: 2

Connector: BNC

Impedance: 1 MΩ, 15 pF or 50 Ω, software selectable

Coupling: AC or DC, software selectable

DC Coupled Bandwidth

All ranges except ±20 mV	DC to 500 MHz
±20 mV	DC to 300 MHz

Lower Frequency
AC coupled bandwidth: 10 Hz with 1 MΩ impedance
                          140 kHz with 50 Ω impedance

Input Voltage Ranges:
    1 MΩ Input: ±20 mV, ±50 mV, ±100 mV, ±200 mV, ±500 mV,
                          ±1 V, ±2 V, ±5 V, ±10 V, ±20 V

    50 Ω Input: ±20 mV, ±50 mV, ±100 mV, ±200 mV, ±500 mV,
                          ±1 V, ±2 V, ±5 V

Input Protection: Diode Clamped for 1 MΩ
                      Thermal cut-off for 50 Ω

Resolution: 8 bits

Sampling Rate
    GS/s: 5, 2.5, 1
    MS/s: 500, 250, 100, 50, 25, 10, 5, 2.5, 1
    kS/s: 500, 100, 50, 10, 5, 1

Absolute Maximum Input:
    1 MΩ Impedance: ±30 Volts (continuous)
    50 Ω Impedance: ±5 Volts (continuous),

DC Accuracy: ±2% of full scale input,
                      derated at 0.025% per degree Celsius above 30 degrees Celsius

INTERNAL CLOCK

Source: Crystal oscillator

Accuracy: ± 50 ppm

DYNAMIC PARAMETERS

Measured using 100 MHz sine wave input at 5 GS/s, dual channel mode with amplitude of 95% of full scale on the ±1V range. Typical values listed below:

SNR:	38 dB
SFDR:	47 dB
SINAD:	37 dB
THD:	-42 dB
ENOB:	6.01 bits

ACQUISITION MEMORY

Data Storage: In on-board memory

Maximum On-board
Memory Size: 10,000 samples on each of the two channels

TRIGGERING

Number of Trigger Inputs:	1 per system
Source:	CH 1, CH 2, EXT or Software
Type:	Slope-and-level and software
TV Trigger Mode Type:	NTSC and PAL
Trigger Level:	Controlled by on-board DAC
Sensitivity:	± 5% of full scale (DC to 50 MHz) ± 12.5% of full scale (50 MHz to 500 MHz) This number specifies the minimum required signal amplitude to cause a trigger to occur. Smaller signals are rejected as noise.
Level Accuracy:	± 5% of full scale
Slope:	Positive or Negative
Pre-Trigger:	From zero to almost 100% of record length. All captured data that is not part of post-trigger depth is pre-trigger data.
Post-Trigger Depth:	500 points minimum. Can be defined with 100 point resolution

EXTERNAL TRIGGER

Impedance:	1 MΩ, 20 pF
Amplitude:	Absolute Max ±15 Volts
Voltage Range:	±800 mV and ±8 V
Coupling:	AC or DC
Bandwidth:	300 MHz
Connector:	BNC

MULTI-CARD SYSTEMS

Operating Mode:	Multiple/Independent
Max. number of cards:	8

OPERATING SYSTEMS SUPPORTED

- Windows 98/ME/NT*/2000/XP   CompuScope Driver version 3.60.22
    * Version 4, SP3 or higher

APPLICATION SOFTWARE

GageScope®: Windows-based software for programming-free operation

LITE Edition: Included with purchase, provides basic functionality
Standard Edition: Provides limited functionality of advanced analysis tools, except for Extended Math
Professional Edition: Provides full functionality of all advanced analysis tools

SOFTWARE DEVELOPMENT KITS (SDK)

- CompuScope SDK for C/C++
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for MATLAB
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for LabVIEW
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for LabWindows/CVI
  For Windows 98/ME/NT/2000/XP

WARRANTY $C\epsilon$ Compliant

One year parts and labor

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

CompuScope 85GC ordering information

Hardware and Upgrades

Product	Order No.
CompuScope 85GC	785-001-002

GageScope Software

Product	Order No.
GageScope Lite Edition	Included
GageScope Standard Edition – purchased with CompuScope hardware	300-100-351
GageScope Standard Edition – purchased independently	300-100-352
GageScope Professional Edition – purchased with CompuScope hardware	300-100-354
GageScope Professional Edition – purchased independently	300-100-355

Software Development Kits (SDKs)

Product	Order No.
Gage SDK Pack on CD (No Hardcopy of Manuals included)	200-113-000
Gage SDK Pack on CD (Hardcopy of Manuals included)	200-113-002
CompuScope SDK for C/C++	200-200-101
CompuScope SDK for MATLAB	200-200-102
CompuScope SDK for LabVIEW	200-200-103
CompuScope SDK for LabWindows/CVI	200-300-100

CompuScope 85GC simplified block diagram
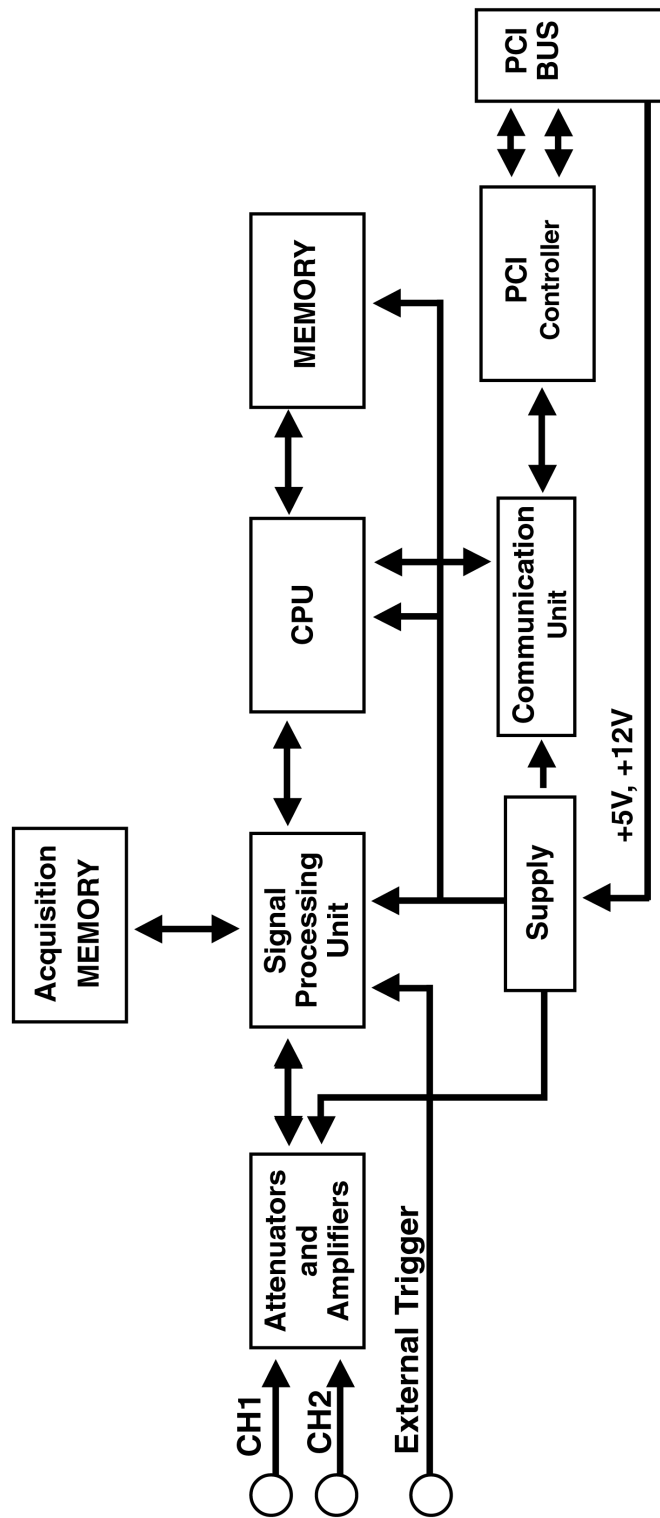
Figure 52: CS85G simplified block diagram

CompuScope 85GC: identifying your CompuScope card(s)

Your CompuScope 85GC card is composed of the CS85GC base board and the CS85GC analog board.

You will find your CompuScope 85GC card type and version as shown in *Figure 53: CS85GC labels, card type & hardware version number*. Figure 53 also shows the location of the Calibration label.

The Calibration label lists your CompuScope card's serial numbers. You should record these serial numbers for future reference on the technical support form found at the front of this guide.
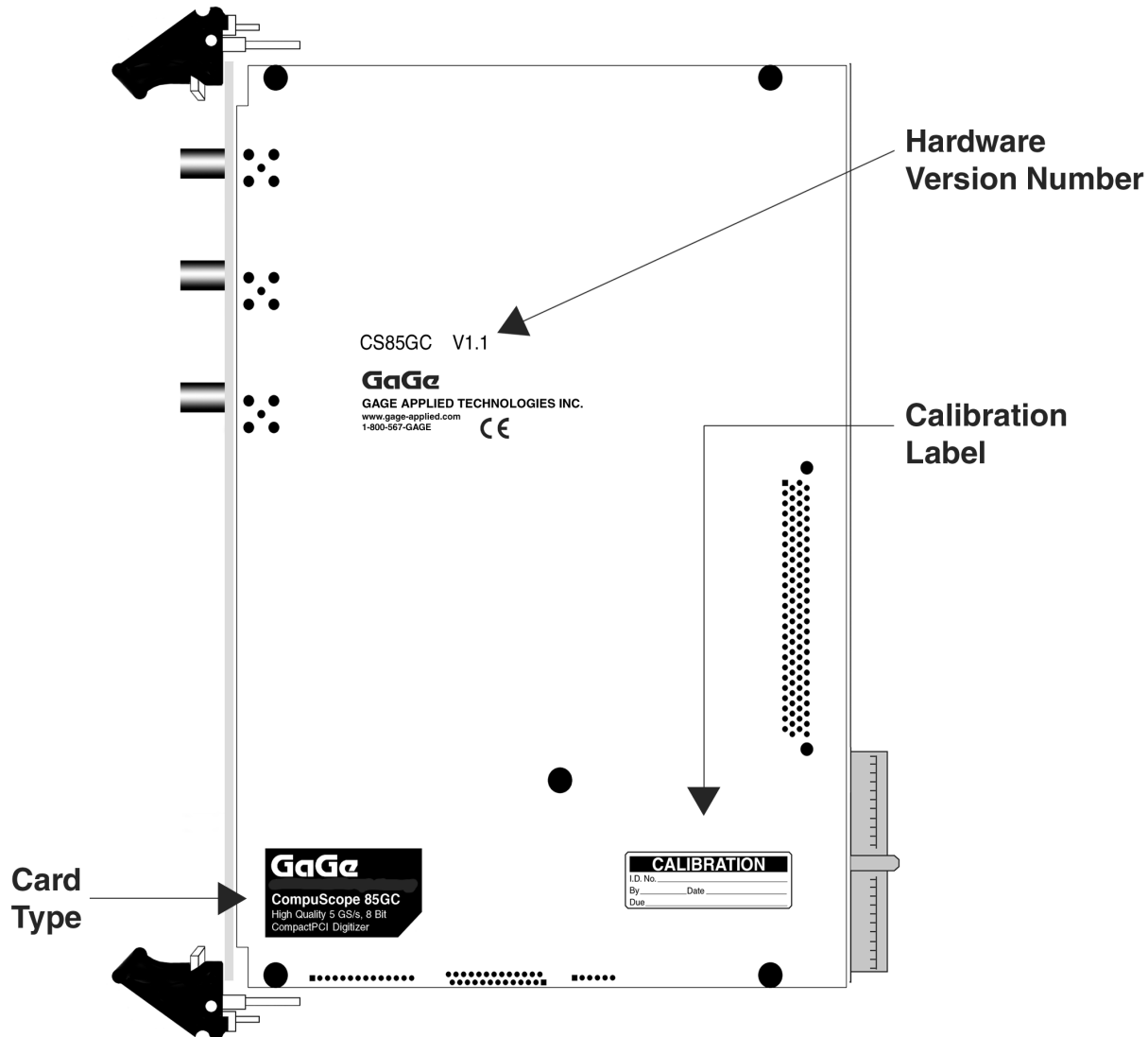
Figure 53: CS85GC labels, card type & hardware version number

CompuScope 85GC connectors and headers

CompuScope cards connect to the outside world through connectors, both analog (BNC) and digital (CompactPCI Bus). This section describes these connectors for the CS85GC card.

The connectors and headers on the CS85GC card are shown below:
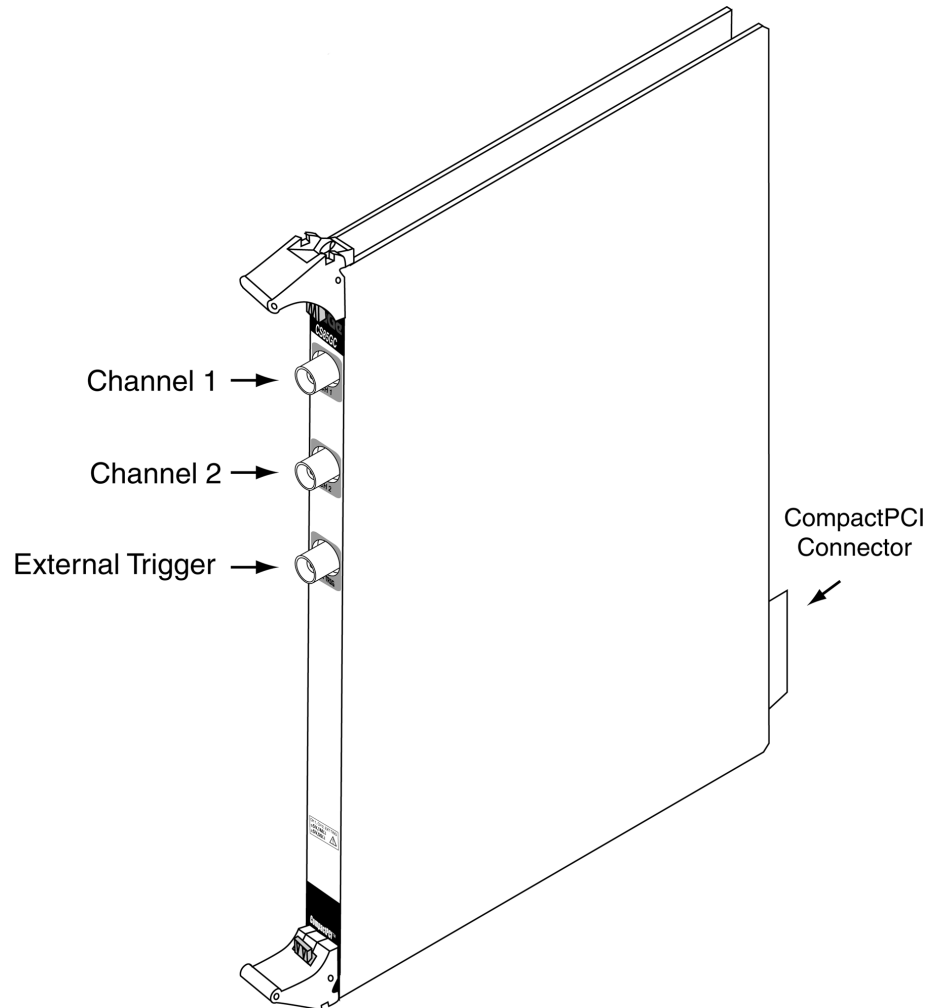
Figure 54: Connectors on CS85GC

- **CH 1 BNC** connector is the single-ended input of channel 1 that is used to input an analog signal that is sampled as Channel 1.

- **CH 2 BNC** connector is the single-ended input of channel 2 that is used to input an analog signal that is sampled as Channel 2.

- **External Trigger BNC** connector is used to input an analog or digital signal, which may be used as an External Trigger. External Trigger is defined exactly as in an oscilloscope: this signal can be used to trigger the system but cannot be viewed or digitized.

- **CompactPCI^{TM} connector** is located at the rear of the card. This is an industry standard connector that complies with all specifications of the CompactPCI^{TM} bus.

CompuScope 85GC triggering

CompuScope 85GC features state-of-the-art triggering.

The trigger circuit is identical to that of an oscilloscope. This way, a user can easily replace the Digital Oscilloscope in his or her application with a CompuScope 85GC. A user can select the trigger source, trigger level and trigger slope using software commands.

The user can software-select the trigger source from any one of the following:

- Channel 1
- Channel 2
- External Trigger
- Software Trigger

The selected trigger source is then compared to a trigger level set by an on-board DAC. An on-board, high-speed comparator is used for this function, making it possible to trigger on narrow pulses or glitches that are much shorter than the sample rate.

Each time the selected signal crosses the trigger level, the on-board triggering circuitry monitors it for the slope selected by the user. When the appropriate slope is detected, a Trigger signal is generated.
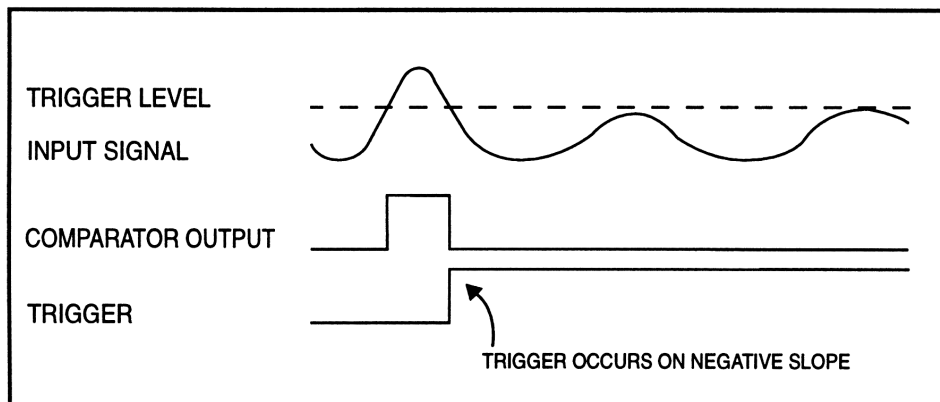
Figure 55: Generation of a trigger signal

External Trigger amplifier

The External Trigger input also has oscilloscope-like 1 MΩ / 20 pF input impedance.

Gage's proprietary input-protection circuitry allows the FET stage to withstand voltages as high as ±15 Volts without causing any damage to the inputs.

Software-selectable attenuation of X1 or X5 on the External Trigger input allows input ranges of ±800 mVolt and ±8 Volt, respectively.

TV Triggering

The CompuScope 85GC provides a TV triggering mode so that it may be triggered off of standard TV signals. TV signal protocols supported are NTSC and PAL.

CompuScope 85GC allows triggering off of even or odd signal fields or off of any horizontal line which is specified by a line number.

CompuScope 85GC throughput & maximum PRF

A number of applications require the CompuScope 85GC to acquire data based on a rapidly occurring trigger signal. These high Pulse Repeat Frequency (PRF) applications include imaging, radar, ultrasound and lightning test.

The following test results were obtained using a computer configured as follows:
- Pentium III, 850 MHz processor
- 256 MB RAM
- 20 GB disk drive
- Windows 98
- 33 MHz, 32 bit CompactPCI^{TM} bus
- All slots support bus mastering

A C application program optimized for fast repetitive capture was used for throughput measurements.

The PRF rates shown below are for dual channel data acquisition, but data is being read out of the card from only CH 1.

PRF on CS85GC using C PRF application under Win 98
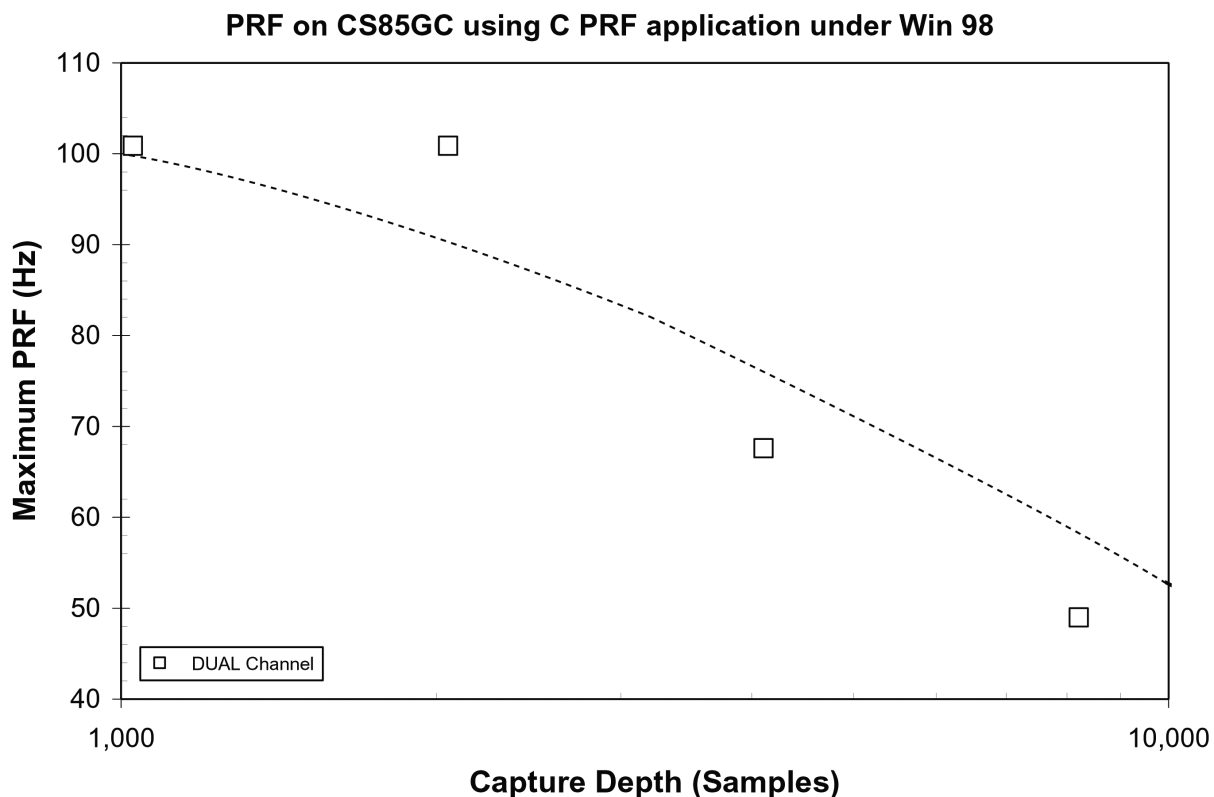
Figure 56: Maximum PRF vs. acquisition length

Notice that a PRF of about 100 Hz can be obtained for all possible capture depths.

Notes

What you should receive with your CompuScope 82GC

If you order an independent CompuScope 82G card, you should receive the following articles:

- One CompuScope 82GC card (of memory model type purchased – 2M, 8M or 16M)

- Standard items included with each independent CompuScope card

Hardware Manual, including Driver Installation Guide

Note that you will receive only one copy of the Hardware Manual per order placed with Gage. Additional copies can be requested at order time.

The Hardware Manual is also available in PDF format on the Gage Software Disk or you can download card-specific manuals from Gage's Web site (www.gage-applied.com).

Gage Software Disk (with GageScope Software)

The Gage Software Disk, included on the inside-front cover of the Hardware Manual and Installation Guide, contains all of the software drivers you need to operate your Gage hardware. The CD also contains all of the installers for the application packages provided by Gage, including Lite, Standard and Professional editions of GageScope.

Note that some packages will only be available if you have purchased the software and have a key provided by Gage.

CompuScope Certificate of NIST Traceable Calibration

Each CompuScope card is shipped with a Certificate of NIST Traceable Calibration. NIST is the National Institute to Standards and Technologies - the US organization that is responsible for the definitions and measurement of metrology standards.

Prior to shipment, Gage runs each CompuScope card through a battery of over 1000 automated performance verification tests using a NIST traceable calibration source. The tested CompuScope is then considered a NIST traceable calibration instrument for a period of one year – the calibration interval that is generally accepted by the Test and Measurement industry.

Warranty card

- You may also receive a number of optional items, if purchased:

GageScope® software and
Standard or Professional edition
Software Key envelope

Software Development Kits (SDKs)
& applicable manual(s)

- If you ordered a Master/Slave set, you will receive a Master/Slave Timing Module in addition to the number of CompuScope cards in your Master/Slave system.

Carefully inspect these articles before proceeding further. If you find any damage caused by transportation, please report it to the organization from which you purchased the CompuScope card.

CompuScope 82GC compliance statement

Category	Standards or description
EC Declaration of Conformity – EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities: EN 61326 — EMC requirements for Class A electrical equipment for measurement, control and laboratory use. [1, 2, 3] IEC61000-4-2 — Electrostatic Discharge (Performance criterion B) IEC61000-4-3 — RF Electromagnetic Field (Performance criterion A) IEC61000-4-4 — Electrical Fast Transient/Burst Immunity (Performance criterion B) IEC61000-4-5 — Power Line Surge Immunity (Performance criterion B) IEC61000-4-6 — Conducted RF Immunity (Performance criterion A) IEC61000-4-11 — Voltage Dips and Interruptions Immunity (Performance criterion B) EN 61000-3-2 — AC Power Line Harmonic Emissions
Australia / New Zealand Declaration of Conformity - EMC	Complies with EMC provision of Radio communications Act per the following standard(s): AS/NZS 2064.1/2 — Industrial, Scientific and Medical Equipment: 1992 [1, 2, 3]

1 **Emissions which exceed the levels required by this standard may occur when this equipment is connected to a test object.**

2 **High-quality shielded cables must be used to ensure compliance to the above listed standards.**

3 **Compliance demonstrated on a two card Master/Slave configuration (qty 2 cards maximum).**

CompuScope 82GC product introduction

CompuScope 82GC is an 8 Bit, waveform digitizer card for the CompactPCI^{TM} Bus, capable of 2 GS/s sampling on one channel and 1 GS/s sampling on two simultaneous channels.

Recognizing that until very recently, almost all multi-MegaHertz data acquisition was done using Digital Storage Oscilloscopes under GPIB control, Gage has ported all the features of these DSOs onto the CompuScope card. This means that you do not have to rethink the solution in terms of a completely unknown data acquisition card. You can simply develop the data acquisition system as if an oscilloscope were being used, but instead use a CompuScope card to take advantage of its attractive price and performance.

Of course, CompuScope cards are much more than just another DSO under GPIB control:

- CS82GC features deep acquisition memory of up to 16 MB.
- Multi-card Master/Slave systems provide scalability from 2 to 4 channels of simultaneous A/D conversion.
- Data transfer rates from CompuScope memory to PC memory or extended memory run as high as 80 MB/s for the CS82GC as compared to a few hundred KB/s for GPIB.
- CompuScope cards are easier to program, as Software Development Kits (SDKs) are available for C/C++, MATLAB, LabVIEW and LabWindows/CVI.
- CompuScope cards are installed inside the CompactPCI^{TM} chassis, so there is no external box such as a DSO.
- The CS82GC cards have Pre-Trigger Multiple Record as a standard feature, which helps optimize the use of the on-board memory by stacking data from successive bursts.
- You can also write software for a multi-card system in which all the cards are not in a Master/Slave configuration. Drivers supplied by Gage support all these multi-card configurations.
- In case you do not want to program the CompuScope 82GC card(s), you can use the powerful GageScope$^{®}$ oscilloscope software to acquire, analyze and archive signals.

Special features on the CompuScope 82GC include:

- Bus Mastering

  CompuScope 82GC is fully capable of becoming a bus master in order to transfer data at the maximum rate of 80 MB/s.

  A bus Master is a card that can take control of the bus and transfer data to any PCI target device such as system RAM without any involvement from the CPU.

- External Clocking

  CompuScope 82GC comes standard with external clocking capability that allows synchronization of the digitizers with an external reference clock.

- Trigger Output

  CompuScope 82GC provides a TTL output on one of the front panel connectors. The rising edge of this output signifies that a trigger event has been detected on the CompuScope 82GC.

- Pre-Trigger Multiple Record

  Pre-Trigger Multiple Recording allows CompuScope 82G to collect pre-trigger data when the card is in Multiple Record mode. Up to 32 K points can be captured as pre-trigger data.

CompuScope 82GC specifications

PLEASE CHECK THE GAGE WEBSITE FOR THE MOST UP-TO-DATE SPECIFICATIONS.

SYSTEM REQUIREMENT

CompactPCI PICMG compliant system with the required number of free 6U slots; controller or PC with 128 MB RAM, 50 MB hard disk and SVGA video.

There must be at least 10 A of 5 V and 3.3 A of 3.3 V for each CS82GC card

The CompuScope 82GC must be installed in a slot that supports bus mastering to achieve stated performance.

SIZE

6U CompactPCI
Occupies one (1) slot

POWER (IN WATTS)

	Worst Case	Typical	Power Down
+ 5 Volts	50.0 W	46.0 W	7.0 W
+ 12 Volts	5.0 W	4.0 W	4.0 W
+ 3.3 Volts	11.0 W	10.0 W	1.0 W
- 12 Volts	3.0 W	3.0 W	3.0 W

CHANNELS 1 & 2

Inputs per card:	2
†Impedance:	1 MΩ, 25 pF or 50 Ω, software selectable
†Coupling:	AC or DC
Resolution:	8 bits

†Typical DC Coupled Bandwidth:

	50 Ω Dual Channel	50 Ω Single Channel	1 MΩ Dual Channel	1 MΩ Single Channel
±100 mV	N/A	N/A	250 MHz	200 MHz
±200 mV	250 MHz	150 MHz	300 MHz	200 MHz
±500 mV	400 MHz	300 MHz	300 MHz	250 MHz
±1 V	400 MHz	300 MHz	300 MHz	250 MHz
±2 V	400 MHz	300 MHz	300 MHz	250 MHz
±4 V	400 MHz	300 MHz	N/A	N/A
±5 V	N/A	N/A	300 MHz	250 MHz
±10 V	N/A	N/A	300 MHz	250 MHz

Lower Frequency Limit

AC Coupled:	1 MΩ Input:	10 Hz
	50 Ω Input:	20 kHz

†Input Voltage Ranges:

1 MΩ:	±100 mV, ±200 mV, ±500 mV, ±1 V, ±2 V, ±5 V, ±10 V
50 Ω:	±200 mV, ±500 mV, ±1 V, ±2 V, ±4 V

Absolute Maximum Amplitude:

1 MΩ:	±15 Volts (continuous)
50 Ω:	±5 Volts (continuous)

DC Accuracy relative to full scale input:

All ranges:	±2% of full scale

Sampling Rate

  Single-Channel Mode (Channel 1 only)

GS/s:	2, 1
MS/s:	500, 250, 200, 100, 40, 20

  Dual-Channel Mode (Channels 1 and 2 simultaneously)

GS/s:	1
MS/s:	500, 250, 125, 100, 50, 20, 10, 5, 2, 1
kS/s:	500, 200, 100

[†]Input Protection

1 MΩ impedance:	Diode Clamped
50 Ω impedance:	No protection
Connector:	BNC

[†]DYNAMIC PARAMETERS

Measured using a sine wave input at 1 GS/s, dual channel mode with amplitude of 95% of full scale on the ±1 V range with a 50 Ω input. Typical values are listed below.

	10 MHz Input	100 MHz Input
SNR	45 dB	43 dB
SFDR	54 dB	50 dB
SINAD	44 dB	42 dB
THD	-52 dB	-48 dB
ENOB	7.2 bits	6.85 bits

ACQUISITION MEMORY

Data Storage:	In on-board memory
Memory sizes:	2 M, 8M, 16M (8 bit samples)

Maximum memory depth:

Single Channel Mode:	Up to full on-board memory
Dual Channel Mode:	Up to half on-board memory per channel

[†]TRIGGERING

Number of Trigger Inputs:	1 per system
Trigger Source:	CH 1, CH 2, EXT or Software
Type:	Analog triggering
Sensitivity:	± 10% of full scale
Level Accuracy:	± 5% of full scale
Slope:	Positive or Negative, software selectable
Post Trigger Data:	256 *(512)* points minimum. Can be defined with a 128 *(256)* point resolution in dual *(single)* channel mode

EXTERNAL TRIGGER

Impedance:	1 MΩ, 25 pF
Amplitude:	Absolute Max ±15 V
Voltage Range:	±1 V and ±5 V
Bandwidth:	300 MHz
Coupling:	AC or DC
Connector:	BNC

TRIGGER OUTPUT

Signal Type:	TTL
Active Edge:	Rising (low-to-high)
Synchronization:	Synchronized to on-board system clock

INTERNAL CLOCK

Source:	1 GHz SAW oscillator
Accuracy:	± 200 ppm

EXTERNAL CLOCK

Maximum Frequency:	1 GHz
Minimum Frequency:	10 MHz
Signal Type:	Sine wave
Connector:	SMA
Signal Level:	MIN 225 mV RMS MAX 500 mV RMS
Impedance:	50 Ω
Sampling Edge:	
Single:	Rising and Falling
Dual:	Rising
Coupling:	AC
Duty Cycle:	50% ±5% Single/Dual

MULTIPLE RECORD

Pre-trigger Data:	Up to 32K points
Record Length:	256 *(512)* points minimum. Can be defined with a 128 *(256)* point resolution in dual *(single)* channel mode
Max. number of Triggers:	21,845 with 16M model
Re-arm time:	152 *(304)* sample clock cycles in dual *(single)* channel mode

MULTI-CARD SYSTEMS

Operating modes:	Master/Slave or Multiple Independent
Number of Cards	
Master/Slave:	2 cards
Multiple/Ind.:	Limited by backplane
Maximum Number of Channels in Master/Slave Mode:	
	4 at 1 GS/s
	2 at 2 GS/s

MASTER/SLAVE SYSTEM TRIGGERING

Number of Trigger Inputs: 1 per system

Trigger Source: CH 1, CH 2, EXT or Software (Master card only)

Sensitivity: ± 10% of full scale

Level Accuracy: ± 5% of full scale

Slope: Positive or Negative, software selectable

OPERATING SYSTEMS SUPPORTED

- Windows 98/ME/NT*   CompuScope Driver version [†]3.60.22
  - * Version 4, SP3 or higher
- Windows 2000**/XP   CompuScope Driver version 3.82.xx
  - ** SP1 or higher

APPLICATION SOFTWARE

GageScope®: Windows-based software for programming-free operation

LITE Edition: Included with purchase, provides basic functionality
Standard Edition: Provides limited functionality of advanced analysis tools, except for Extended Math
Professional Edition: Provides full functionality of all advanced analysis tools

SOFTWARE DEVELOPMENT KITS (SDK)

- CompuScope SDK for C/C++
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for MATLAB
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for LabVIEW
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for LabWindows/CVI
  For Windows 98/ME/NT/2000/XP

ENVIRONMENTAL

Operating Temperature: 5 degree Celsius to 40 degree Celsius

Relative Humidity: Less than 80%, non-condensing

Maximum Altitude: 2,000 meters

ELECTROMAGNETIC COMPATIBILITY

CE Compliant

The following CS82GC configurations have been tested for CE Compliance:

1 Card: CE Compliant
2 Card M/S Set: CE Compliant

WARRANTY

One year parts and labor

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

[†] These specs differ on the CompuScope 82GC – 1GHz Bandwidth version.
Please refer to the section: CompuScope 82GC - 1 GHz Bandwidth version on page 104 for specs on this model.

CompuScope 82GC ordering information

Hardware and upgrades

Product	Order No.
CompuScope 82GC - 2M	782-001-001
CompuScope 82GC - 8M	782-001-002
CompuScope 82GC - 16M	782-001-003
CS82GC: Memory Upgrade Charge	782-181-004
CS82GC: Master/Slave Modification Charge	782-181-005
CS82GC: Upgrade to 1 GHz Bandwidth	782-181-006
CS82GC-2M: 2 Card Master/Slave Set	782-001-010
CS82GC-8M: 2 Card Master/Slave Set	782-001-020
CS82GC-16M: 2 Card Master/Slave Set	782-001-030
CS82GC-1GHz - 2M	782-001-202
CS82GC-1GHz - 8M	782-001-203
CS82GC-1GHz - 16M	782-001-204
CS82GC-1GHz - 2M with Internal Trigger	782-001-205
CS82GC-1GHz - 8M with Internal Trigger	782-001-206
CS82GC-1GHz - 16M with Internal Trigger	782-001-207
CS82GC-1GHz - 2M: 2 Card Master/Slave Set	782-001-110
CS82GC-1GHz - 8M: 2 Card Master/Slave Set	782-001-120
CS82GC-1GHz - 16M: 2 Card Master/Slave Set	782-001-130
CS82GC-1GHz - 2M: 2 Card Master/Slave Set with Internal Trigger	782-001-110
CS82GC-1GHz - 8M: 2 Card Master/Slave Set with Internal Trigger	782-001-120
CS82GC-1GHz - 16M: 2 Card Master/Slave Set with Internal Trigger	782-001-130

GageScope Software

Product	Order No.
GageScope Lite Edition	Included
GageScope Standard Edition – purchased with CompuScope hardware	300-100-351
GageScope Standard Edition – purchased independently	300-100-352
GageScope Professional Edition – purchased with CompuScope hardware	300-100-354
GageScope Professional Edition – purchased independently	300-100-355

Software Development Kits (SDKs)

Product	Order No.
Gage SDK Pack on CD (No Hardcopy of Manuals included)	200-113-000
Gage SDK Pack on CD (Hardcopy of Manuals included)	200-113-002
CompuScope SDK for C/C++	200-200-101
CompuScope SDK for MATLAB	200-200-102
CompuScope SDK for LabVIEW	200-200-103
CompuScope SDK for LabWindows/CVI	200-300-100

CompuScope 82GC simplified block diagram
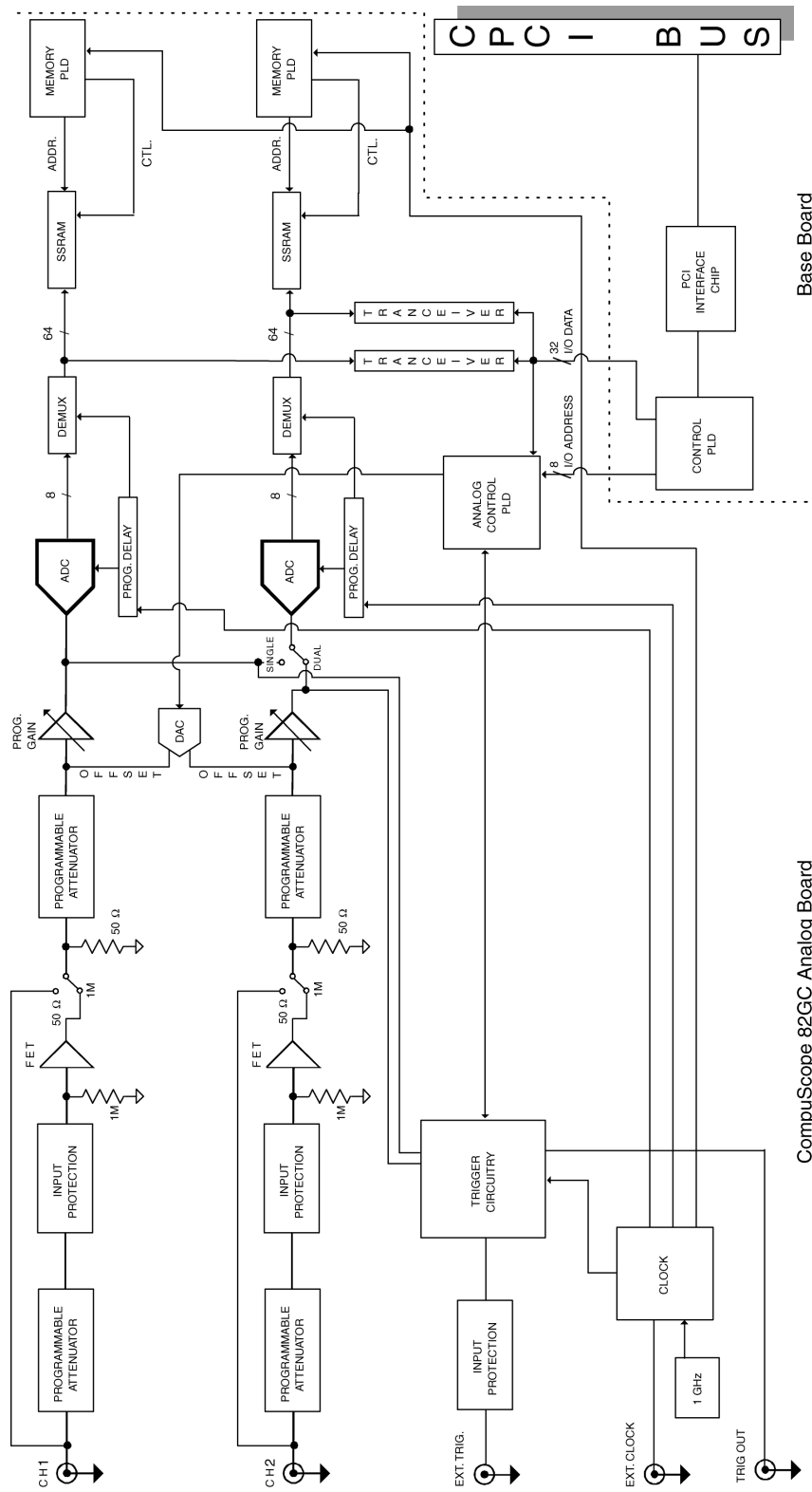
Figure 57: CS82GC simplified block diagram

CompuScope 82GC: identifying your CompuScope card(s)

Your CompuScope 82GC card is composed of the CS82GC base board and the CS82GC analog board.

You will find your CompuScope 82GC card type and version as shown in Figure 58 and Figure 59. Figure 58 also shows the location of the Calibration label. The Calibration label lists your CompuScope card's serial numbers. You should record these serial numbers for future reference on the technical support form found at the front of this guide.

You may also see an "OPTION/MOD" label listing any upgrades or modifications that have been performed on your card. For example, if you have purchased a CompuScope 82GC-8M card, the "OPTION/MOD" label will list "8M" as an option.
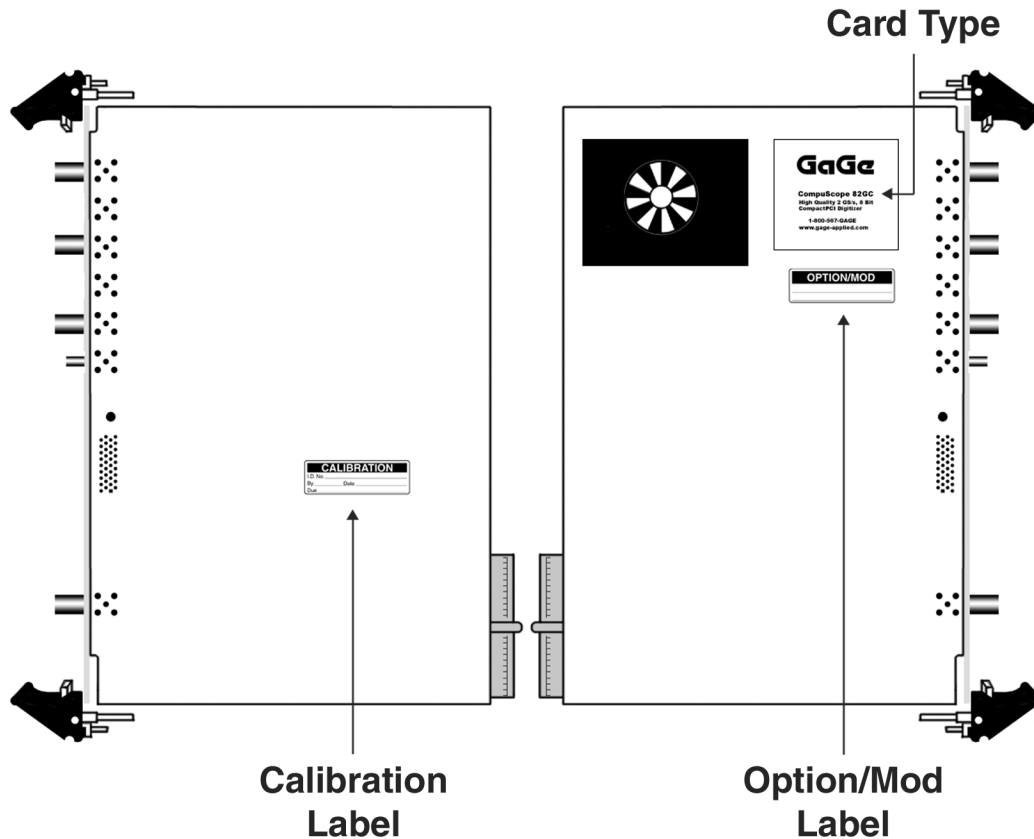
Figure 58: CS82GC labels
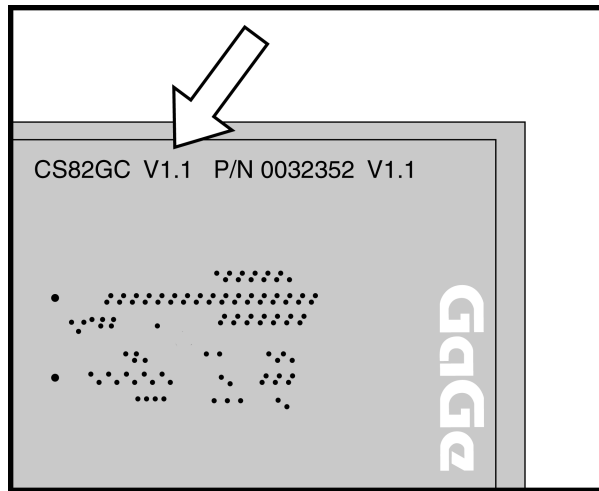
Figure 59: CS82GC hardware version number

If you have purchased a multi-card system, you will notice that input channel connectors on one card are numbered "CH 1" & "CH 2" and the other "CH 3" & "CH 4".

The MASTER card is labeled "CH 1" & "CH 2" and the SLAVE card is labeled "CH 3" & "CH 4".
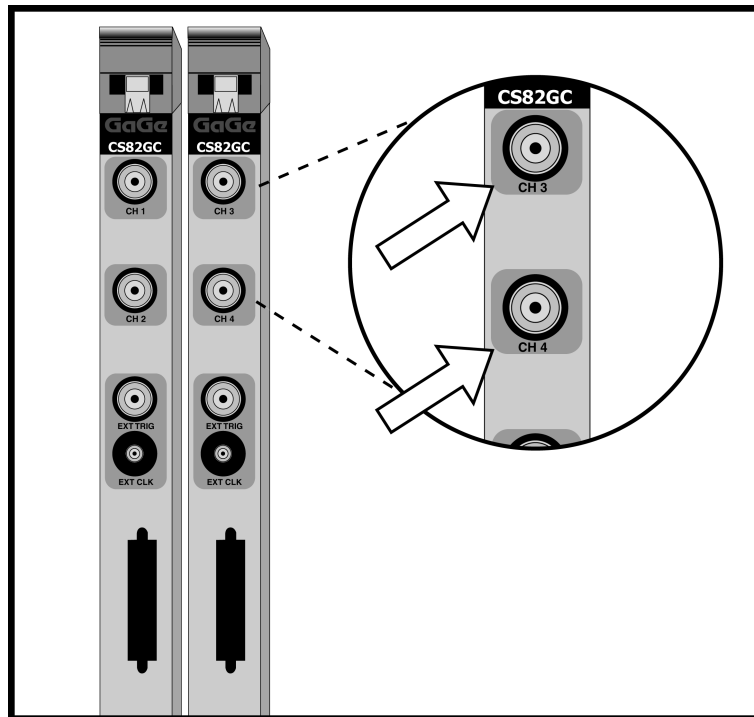
Figure 60: Master/Slave card designation

CompuScope 82GC connectors and headers

CompuScope cards connect to the outside world through connectors, both analog (BNC) and digital (CompactPCI Bus, Master/Slave, etc.). This section describes these connectors for the CS82GC card.

The connectors and headers on the CS82GC card are shown below:
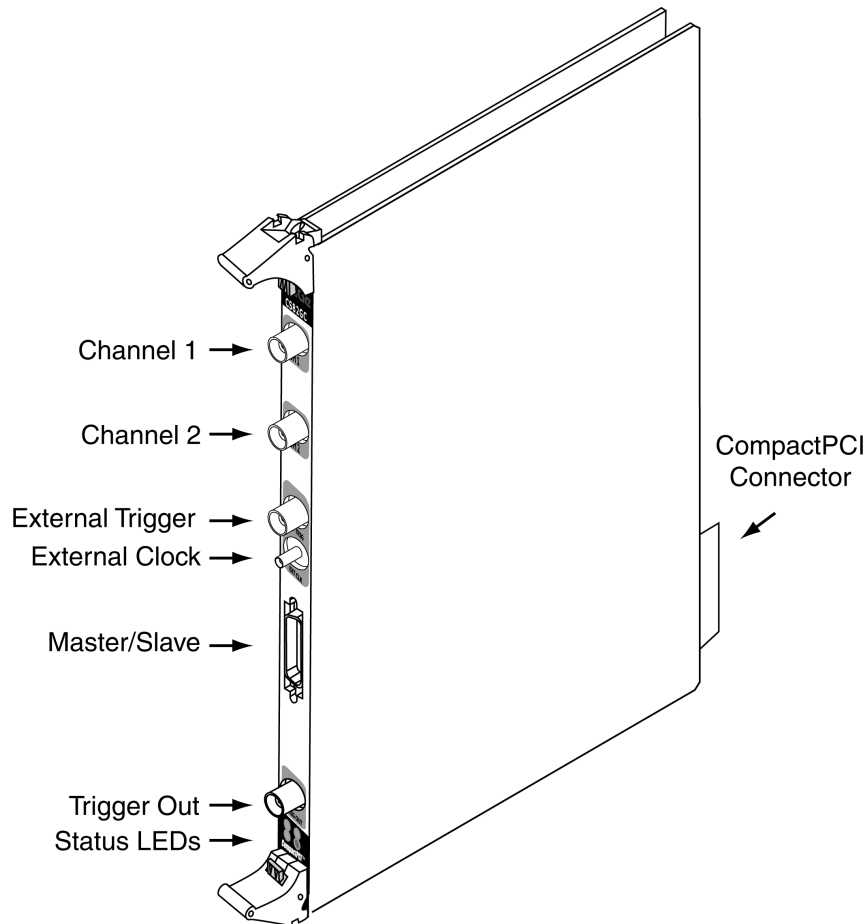
Figure 61: Connectors on CS82GC

- **CH 1 BNC** connector is the single-ended input of channel 1 that is used to input an analog signal that is sampled as Channel 1.

- **CH 2 BNC** connector is the single-ended input of channel 2 that is used to input an analog signal that is sampled as Channel 2.

- **External Trigger BNC** connector is used to input an analog or digital signal, which may be used as an External Trigger. External Trigger is defined exactly as in an oscilloscope: this signal can be used to trigger the system but cannot be viewed or digitized.

- **External Clock SMA** connector is located on the front panel. This input can be used for injecting a specific clock signal for digitizing the analog inputs. See the section *CompuScope 82GC External Clock* for more details.

- **Master/Slave connector** is located on the front panel. This connector is used to pass Clock, Trigger and Initialization signals from a Master card to Slave card using a Master/Slave Timing Module.

- **Trigger Out BNC** connector is located on the front panel near the bottom of the card. This connector outputs a TTL signal, the low to high transition of which signifies the occurrence of a trigger event on the CS82GC. See the section *CompuScope 82GC Trigger Output* for more details.

- **CompactPCI^{TM} connector** is located at the rear of the card. This is an industry standard connector that complies with all specifications of the CompactPCI^{TM} bus.

- **Status LEDs** are located at the bottom of the front panel. Note that the BUSY LED is illuminated when the CompuScope 82GC is capturing a signal. The TRIG LED is illuminated after the CompuScope 82GC receives a trigger.

CompuScope 82GC triggering

CompuScope 82GC features state-of-the-art triggering.

An analog comparator provides triggering from either one of the input channels, or from an external signal or from software.

In addition to the trigger source, trigger level and slope are also selectable by software, making the trigger system similar to traditional oscilloscopes.

The user can software-select the trigger source from any one of the following:

- Channel 1
- Channel 2
- External Trigger
- Software Trigger

The selected trigger source is then compared to a trigger level set by an on-board, 8 bit software-controlled DAC. An on-board, high-speed comparator is used for this function, making it possible to trigger on narrow pulses or glitches that are much shorter than the sample rate, subject to the 300 MHz bandwidth limitation of the front-end trigger circuitry.

Each time the selected signal crosses the trigger level, the on-board triggering circuitry monitors it for the slope selected by the user. When the appropriate slope is detected, a Trigger signal is generated.
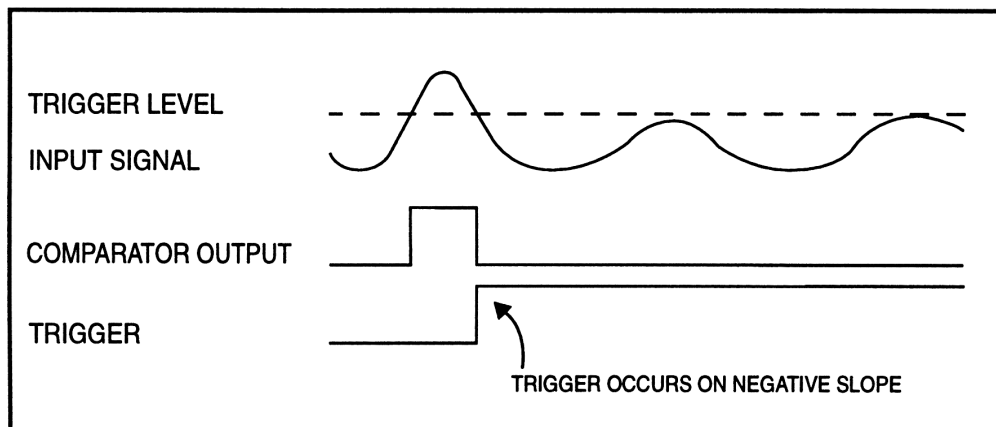
Figure 62: Generation of a trigger signal – negative slope

External Trigger amplifier

The External Trigger input also has oscilloscope-like 1 MΩ / 25 pF input impedance.

Gage's proprietary input-protection circuitry allows the FET stage to withstand voltages as high as ±15 Volts without causing any damage to the inputs.

The trigger comparator has an operating range of ±1 Volt.
Software-selectable attenuation of X1 or X5 on the External Trigger input allows input ranges of ±1 Volt and ±5 Volt, respectively.

CompuScope 82GC External Clock

External clocking is a very powerful feature in a digitizer. It allows the user to synchronize the digitizer to an external system.

On the CompuScope 82GC, external clock signal must be a continuous sine wave signal of amplitude between 225 mV RMS and 500 mV RMS. Note that the external clock input is AC coupled, so DC biases get canceled.

The allowable external clock frequency is between 1 GHz and 10 MHz. An SMA connector is employed for the External Clock input because of its superior high frequency response at 1 GHz – BNC connectors start running into bandwidth limitations at such high frequencies.

PLEASE NOTE:
> THE EXTERNAL CLOCK ILLUSTRATIONS IN THIS SECTION DEPICT THE CLOCK SIGNAL AS A SQUARE WAVE FOR CLARITY, PLEASE FOLLOW THE RECOMMENDATIONS ABOVE TO ACHIEVE PROPER OPERATION.

In single channel mode, sampling is done on both the "rising" and "falling" edge of the sine wave.
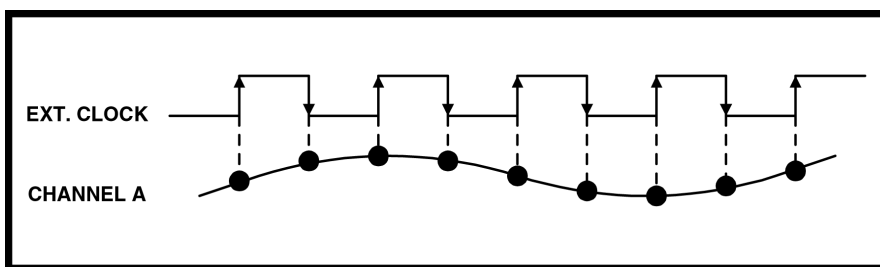
Figure 63: External Clocking in single channel mode

In dual channel mode, sampling is done on only the "rising" edge of the sine wave.
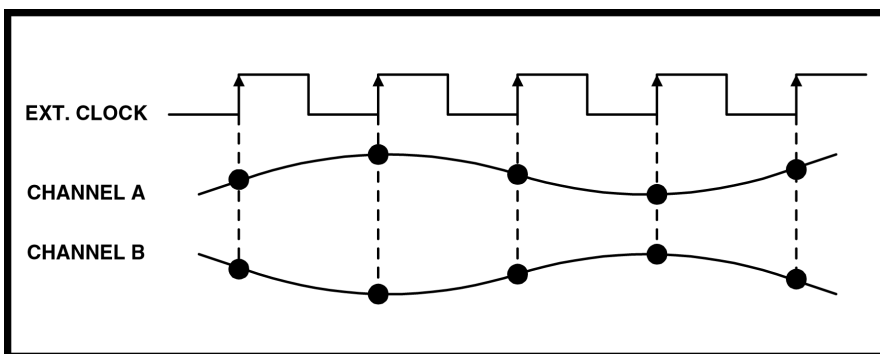
Figure 64: External Clocking in dual channel mode

Note that high-speed waveform digitizers are very sensitive to phase noise and duty cycle of the external clock input. All efforts should be made to minimize jitter and distortion on the external clock signal.

Care should be taken not to inject a TTL or CMOS signal (0 to 5 Volts) into the external clock input, as it may result in saturation of the input circuitry.

CompuScope 82GC Trigger Output

A Trigger signal is used to synchronize different parts of a measurement system to the same event.

CompuScope 82GC provides a TTL output on one of the front panel connectors. The rising edge of this output signifies that a trigger event has been detected on the CompuScope 82GC.

In a Master/Slave configuration, only the Trigger Output of the Master card should be used.

For best results, this output should be terminated with a 50 Ω load capable of absorbing 0.5 Watt power. There is no output short protection on this signal, so care should be taken in not interfacing it to any output, be it Ground or any other voltage.

This TTL output is always asserted after a well defined latency inherent in the trigger circuitry. The table shown below lists the latency for each of the sample rates that the user may select.

Sample Rate	Dual Channel Latency	Single Channel Latency
2 GS/s	N/A	84 clocks
1 GS/s	45 clocks	70 clocks
500 MS/s	34 clocks	58 clocks
250 MS/s	30 clocks	56 clocks
200 MS/s	N/A	55 clocks
125 MS/s	28 clocks	N/A
100 MS/s	27 clocks	53 clocks
50 MS/s	25 clocks	N/A
40 MS/s	N/A	50 clocks
20 Ms/s	25 clocks	50 clocks
10 MS/s	25 clocks	N/A
5 MS/s, 2 MS/s, 1 MS/s, 500 kS/s, 200 kS/s, 100 kS/s	24 clocks	N/A

It should be noted that Trigger Output is synchronized to an internal clock, called GCLK, on the CompuScope 82GC. This clock is not the same as the sampling clock.

The relationship between GCLK and sampling clock must be understood in order to take full advantage of this powerful feature.

Single channel mode

In single channel mode, GCLK is always one-sixteenth the frequency of the sampling clock.

Consequently, Trigger Out signal will be activated after any one of the sixteen rising edges of the sampling clock after the trigger latency has expired.
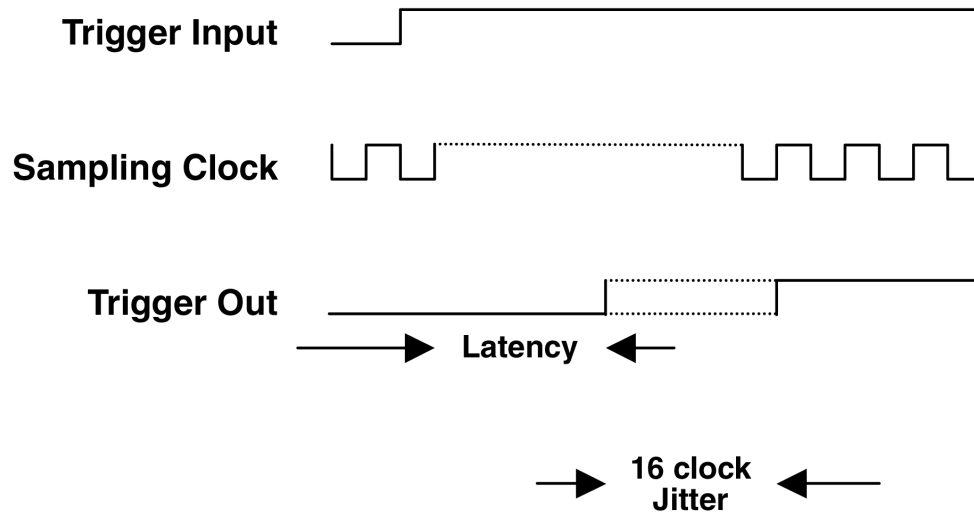
Figure 65: Trigger Out in single channel mode

Dual channel mode

In dual channel mode, GCLK is always one-eighth the frequency of the sampling clock.

Consequently, Trigger Out signal will be activated after any one of the eight subsequent rising edges of the sampling clock after the trigger latency has expired.
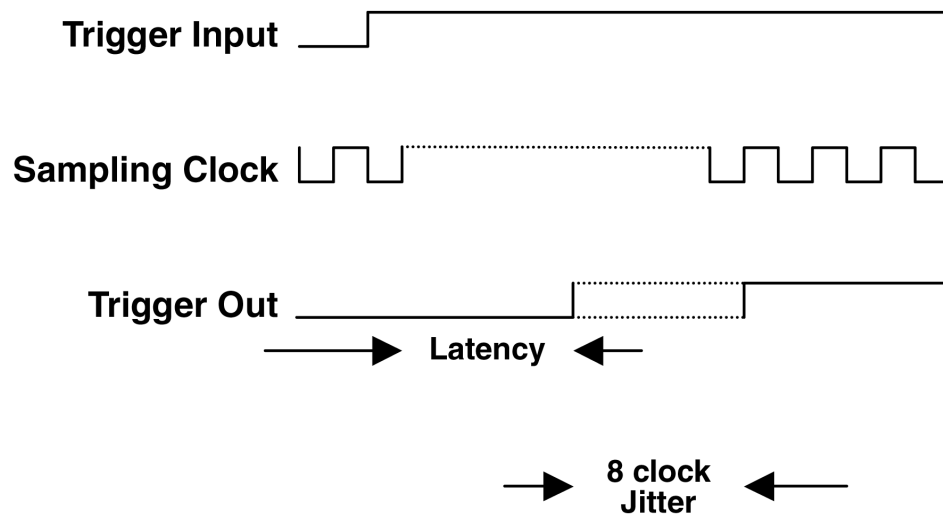
Figure 66: Trigger Out in dual channel mode

CompuScope 82GC - 1 GHz Bandwidth version

The CompuScope 82GC – 1 GHz is a special member of Gage's high-performance CS82GC product family. This section explains the key differences between the standard CS82GC and the special 1 GHz bandwidth version.

1. **Why is 1 GHz of bandwidth important?**

   A higher bandwidth increases the precision and widens the range of applications of fast digitizers. By 'precision' we mean "less distortion" of the high frequency components that can be found in the spectrum of very fast transients.

   While operating at 2 GS/s, the CompuScope 82GC – 1 GHz provides a bandwidth limit that is equal to the Nyquist frequency of 1 GHz.

2. **Specifications of the CS82GC – 1GHz Bandwidth version**

   The 1GHz bandwidth version of the CS82GC shares most of the specifications of the standard product. However, a few key differences exist. This section will highlight these differences and describe how to best operate the product so as to perform accurate measurements and prevent damage to the card.

   Note that the CS82GC – 1 GHz can be ordered with or without Internal Triggering. Only the dynamic performance of the product is affected by this choice.

   2.1 – Input Characteristics and Protection

   The modification made to the CS82GC to give it a 1GHz bandwidth requires the bypassing of most of the protection from high voltages as well as of all but 1 input range in each of the operating modes.

   The input must be single-ended with an impedance of 50 Ohms, which is protected by diode clamping. Therefore, when operating a CS82GC – 1 GHz, users must be cautious to not exceed the absolute maximum input voltage of ± 1V.

   Furthermore, the only input ranges available for this product are ± 250mV in Dual Channel Mode, and ± 500mV in Single Channel Mode.

   The following table provides the typical bandwidth of the CompuScope 82GC – 1 GHz with, and without, Internal Trigger.

	Single Channel	Dual Channel
Bandwidth with Internal Trigger	1 GHz	380 MHz
Bandwidth without Internal Trigger	1.3 GHz	1 GHz

   2.2 – Dynamic Performance

   The following tables provide the typical dynamic performance of the CompuScope 82GC – 1 GHz with (and without) Internal Trigger.

   Single Channel Mode – sampling at 2 GS/s

Signal Input:	**15 MHz**	**100 MHz**	**200 MHz**
SNR (dB)	43 (43)	42 (42)	41 (42)
SFDR (dB)	52 (55)	50 (55)	49 (54)
SINAD (dB)	43 (43)	41 (43)	40 (42)
THD (dB)	-56 (-56)	-52 (-55)	-47 (-54)
ENOB (bits)	6.8 (6.8)	6.7 (6.7)	6.5 (6.7)

Dual Channel Mode – sampling at 1 GS/s

Signal Input:	10 MHz	100 MHz	200 MHz
SNR (dB)	44 (42)	43 (43)	42 (42)
SFDR (dB)	53 (54)	51 (54)	50 (53)
SINAD (dB)	44 (44)	42 (43)	41 (42)
THD (dB)	-53 (-53)	-50 (-52)	-45 (-50)
ENOB (bits)	7.0 (7.2)	6.8 (7.0)	6.7 (6.8)

3. **Software considerations**

Users of the CS82GC – 1 GHz under Windows 98/ME/NT require a special driver version (3.60.30), which is supplied on the Gage Software Disk. Please note that the CompuScope 3.60.30 driver is a special release and is not available through the standard install procedure. Instructions on locating the CompuScope 3.60.30 driver can be found in the Gage Software Disk readme, in the section titled: "Which CompuScope drivers should be installed".

Users of the CS82GC – 1 GHz under Windows 2000/XP can use the most recent CompuScope Win 2K/XP drivers.

GageScope® and the various SDKs, however, will not perceive the 1GHz version of the CS82GC as having only 2 input ranges (one for Dual Channel Mode, one for Single Channel Mode). Users must therefore ensure that they request the correct input ranges when operating the card, or risk seeing their data scaled by the wrong factors (see Section 2 on previous page).

CompuScope 82GC throughput & maximum PRF

A number of applications require the CompuScope 82GC to acquire data based on a rapidly occurring trigger signal. These high Pulse Repeat Frequency (PRF) applications include imaging, radar, ultrasound and lightning test.

Gage has performed extensive repetitive capture benchmarks in single record mode. In this mode, the signal is captured into on-board CompuScope memory and the captured data are transferred through the PCI bus using PCI bus mastering to PC RAM.

Please note that much higher PRFs will be achieved using CompuScope Multiple Record mode.

The following test results were obtained using a computer configured as follows:
- Pentium III, 850 MHz processor
- 256 MB RAM
- 20 GB disk drive
- Windows 98
- 33 MHz, 32 bit CompactPCI^{TM} bus
- All slots support bus mastering

A C application program optimized for fast repetitive capture in single record mode was used for throughput measurements. The CS82GC was operated using this application in both single and dual channel mode for many different capture depths and the results are plotted as points in the graph below. The PCI transfer rates were calculated from the linear portion of the curves at high depths.

PCI data transfer rate (single channel):	*80 MB/s*
PCI data transfer rate (dual channel):	*50 MB/s*
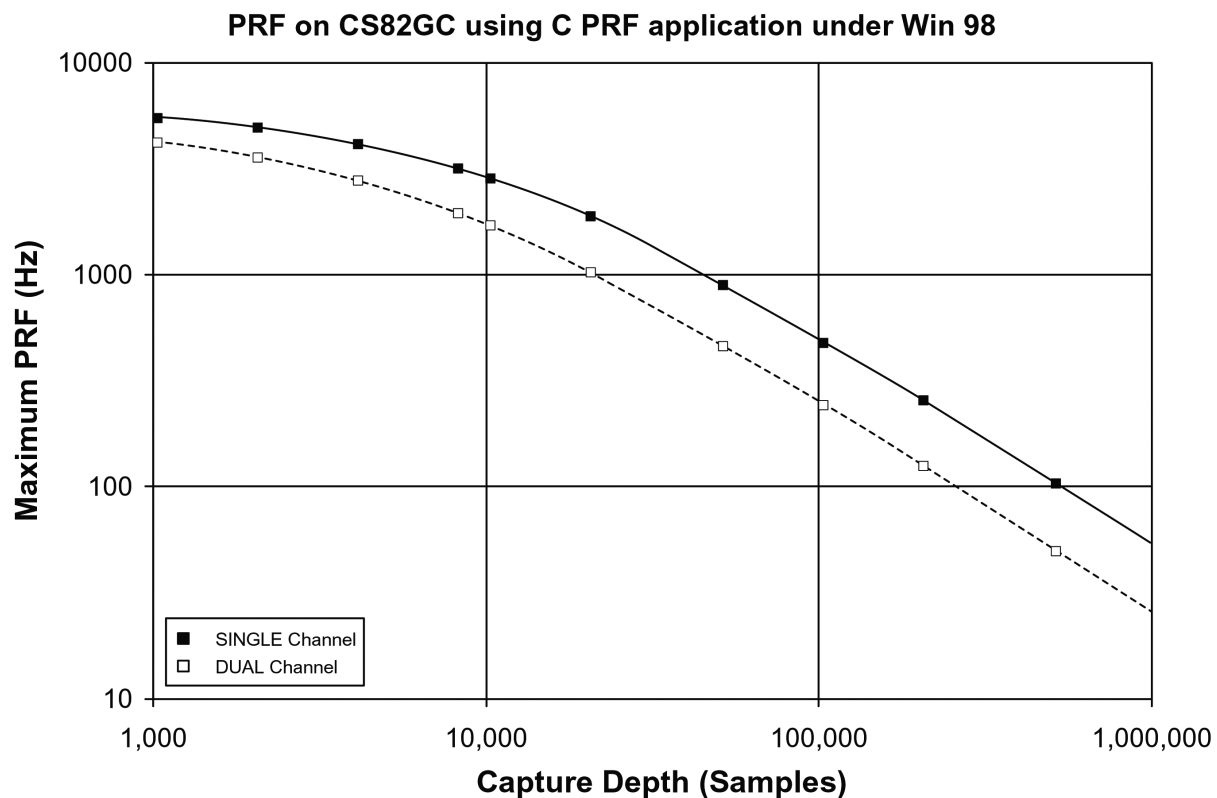
Figure 67: Maximum PRF vs. acquisition length

What you should receive with your CompuScope 14100C

If you order an independent CompuScope 14100 card, you should receive the following articles:

- One CompuScope 14100C card (of memory model type purchased)

1M model
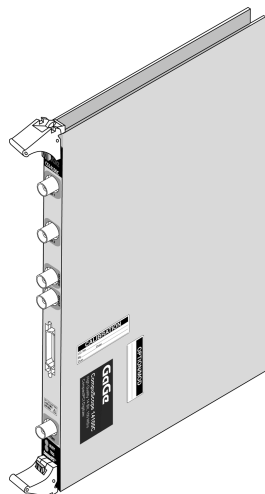
8M, 128M,
or 1G model
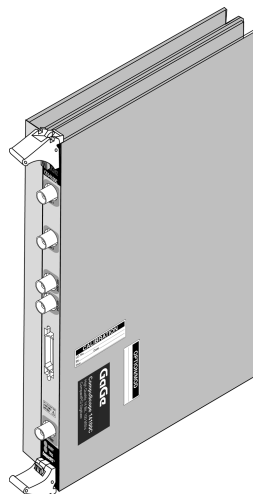
and   Two (2) EMI snap-on
              ferrite beads

- Standard items included with each independent CompuScope card

  Hardware Manual, including Driver Installation Guide

  Note that you will receive only one copy of the Hardware Manual per order placed with Gage. Additional copies can be requested at order time.

  The Hardware Manual is also available in PDF format on the Gage Software Disk or you can download card-specific manuals from Gage's Web site (www.gage-applied.com).

  Gage Software Disk (with GageScope Software)

  The Gage Software Disk, included on the inside-front cover of the Hardware Manual and Installation Guide, contains all of the software drivers you need to operate your Gage hardware. The CD also contains all of the installers for the application packages provided by Gage, including Lite, Standard and Professional editions of GageScope.

  Note that some packages will only be available if you have purchased the software and have a key provided by Gage.

  CompuScope Certificate of NIST Traceable Calibration

  Each CompuScope card is shipped with a Certificate of NIST Traceable Calibration. NIST is the National Institute to Standards and Technologies - the US organization that is responsible for the definitions and measurement of metrology standards.

  Prior to shipment, Gage runs each CompuScope card through a battery of over 1000 automated performance verification tests using a NIST traceable calibration source. The tested CompuScope is then considered a NIST traceable calibration instrument for a period of one year – the calibration interval that is generally accepted by the Test and Measurement industry.

  Warranty card

- You may also receive a number of optional items, if purchased:

  GageScope® software and Standard or Professional edition Software Key envelope

  Software Development Kits (SDKs) & applicable manual(s)

- If you ordered a Master/Slave set, you will receive one of the following Master/Slave Timing Modules in addition to the number of CompuScope cards in your Master/Slave system.

2 slot module for use with:
2 card M/S sets of 1M

4 slot module for use with:
2 card M/S sets of 8M or more
4 card M/S sets of 1M

6 slot module for use with:
3 card M/S sets of 8M or more
6 card M/S sets of 1M

8 slot module for use with
4 card M/S sets of 8M or more
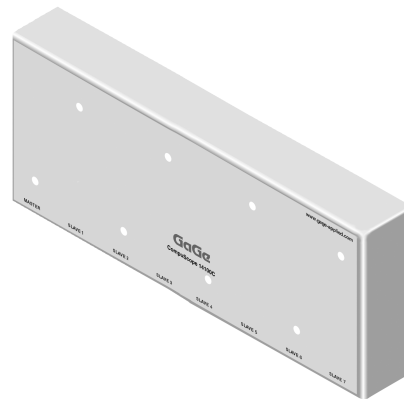
Carefully inspect these articles before proceeding further. If you find any damage caused by transportation, please report it to the organization from which you purchased the CompuScope card.

CompuScope 14100C compliance statement

Category	Standards or description
EC Declaration of Conformity – EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:
	EN 61326 EMC requirements for Class A electrical equipment for measurement, control and laboratory use. [1, 2, 3, 4, 5]
	IEC61000-4-2 Electrostatic Discharge (Performance criterion B)
	IEC61000-4-3 RF Electromagnetic Field (Performance criterion A)
	IEC61000-4-4 Electrical Fast Transient/Burst Immunity (Performance criterion B)
	IEC61000-4-5 Power Line Surge Immunity (Performance criterion B)
	IEC61000-4-6 Conducted RF Immunity (Performance criterion A)
	IEC61000-4-11 Voltage Dips and Interruptions Immunity (Performance criterion B)
	EN 61000-3-2 AC Power Line Harmonic Emissions
Australia / New Zealand Declaration of Conformity - EMC	Complies with EMC provision of Radio communications Act per the following standard(s):
	AS/NZS 2064.1/2 Industrial, Scientific and Medical Equipment: 1992 [1, 2, 3, 4, 5]

1   **Emissions which exceed the levels required by this standard may occur when this equipment is connected to a test object.**

2   **High-quality shielded cables must be used to ensure compliance to the above listed standards.**

3   **Clip-on ferrite beads must be applied to the mouse and keyboard cables equivalent to (Steward part number 25A2025-0A0) as supplied by the manufacturer.**

4   **An empty unused slot must be maintained between the PC Controller and the CS14100C card set.**

5   **Compliance demonstrated on the following configurations:**

- **A two card Master/Slave configuration with 8 MegaSamples of memory (qty 2 cards maximum)**

- **A four card Master/Slave configuration with 1 MegaSamples of memory (qty 4 cards maximum)**

CompuScope 14100C product introduction

CompuScope 14100C is a 14 Bit, 100 MS/s data acquisition card for the CompactPCI^{TM} Bus, capable of sampling one channel at 100 MS/s and two simultaneous channels at 50 MS/s.

Recognizing that until very recently, almost all multi-MegaHertz data acquisition was done using Digital Storage Oscilloscopes under GPIB control, Gage has ported all the features of these DSOs onto the CompuScope card. This means that you do not have to rethink the solution in terms of a completely unknown data acquisition card. You can simply develop the data acquisition system as if an oscilloscope were being used, but instead use a CompuScope card to take advantage of its attractive price and performance.

Of course, CompuScope cards are much more than just another DSO under GPIB control:

- CS14100C features 14 bit vertical resolution as opposed to the 8 bit resolution offered by DSOs.
- Multi-card Master/Slave systems provide from 2 to 12 channels of simultaneous A/D conversion, something normal DSOs simply cannot do.
- Data transfer rates from CompuScope memory to PC memory or extended memory run as high as 80 MB/s for the CS14100C as compared to a few hundred KB/s for GPIB.
- CompuScope cards are easier to program, as Software Development Kits (SDKs) are available for C/C++, MATLAB, LabVIEW and LabWindows/CVI.
- CompuScope cards are installed inside the CompactPCI^{TM} chassis, so there is no external box such as a DSO.
- The CS14100C cards have standard features such as Multiple Record, which help optimize the use of the on-board memory by stacking data from successive bursts.
- You can also write software for a multi-card system in which all the cards are not in a Master/Slave configuration. Drivers supplied by Gage support all these multi-card configurations.

Special features on the CompuScope 14100C include:

- Bus Mastering

  CompuScope 14100C is fully capable of becoming a bus master in order to transfer data at the maximum rate of 80 MB/s.

  A bus Master is a card that can take control of the bus and transfer data to any PCI target device such as system RAM without any involvement from the CPU.

- External Clocking

  CompuScope 14100C comes standard with external clocking capability that allows synchronization of the digitizers with an external system.

- Trigger Output

  CompuScope 14100C provides a TTL output that signifies the occurrence of a trigger event on the card. This signal can be used to synchronize other parts of the measurement signals to the CompuScope 14100C.

CompuScope 14100C specifications

PLEASE CHECK THE GAGE WEBSITE FOR THE MOST UP-TO-DATE SPECIFICATIONS.

SYSTEM REQUIREMENT

CompactPCI PICMG compliant system with the required number of free 6U slots; controller or PC with 128 MB RAM, 50 MB hard disk and SVGA video.

The CompuScope 14100C must be installed in a slot that supports bus mastering to achieve stated performance.

SIZE

6U CompactPCI
1M Memory Model:	Occupies 1 slot
8M Memory Model:	Occupies 2 slots
128M Memory Model:	Occupies 2 slots
1G Memory Model:	Occupies 2 slots

POWER (IN WATTS)

+ 5 Volts		
	Worst Case	**Typical**
All Memory Models	24.8 Watts	22.5 Watts
- 5 Volts		
	Worst Case	**Typical**
All Memory Models	0.0 Watts	0.0 Watts
+ 12 Volts		
	Worst Case	**Typical**
All Memory Models	1.7 Watts	1.5 Watts
- 12 Volts		
	Worst Case	**Typical**
All Memory Models	0.6 Watts	0.5 Watts

CHANNELS 1 & 2

Inputs per card:	2
Impedance:	1 MΩ, 40 pF or 50 Ω, software selectable
Coupling:	AC or DC
Resolution:	14 bits
Analog Bandwidth:	DC to 50 MHz (DC coupled) 10 Hz to 50 MHz (AC coupled)
Input Voltage Ranges:	±100 mV, ±200 mV, ±500 mV, ±1 V, ±2 V, ±5 V
Absolute Maximum Amplitude:	
1 MΩ Impedance:	±15 Volts (continuous)
50 Ω Impedance:	±5 Volts (continuous)

DC Accuracy relative to full scale input:

Input Range	DC Accuracy
±5 V, ±2 V, ±1 V, ±500 mV	0.5 %
±200 mV	1 %
±100 mV	2 %

Internal Sampling Rate
    Single Channel Mode (Channel 1 only):
        MS/s: 100, 50, 25, 10, 5, 2, 1
        kS/s: 500, 200, 100, 50, 20, 10, 5, 2, 1
    Dual Channel Mode (Channels 1 and 2 simultaneously):
        MS/s: 50, 25, 10, 5, 2, 1
        kS/s: 500, 200, 100, 50, 20, 10, 5, 2, 1

Protection:
    1 MΩ Impedance: Diode Clamped
    50 Ω Impedance: No protection

Connector: BNC

DYNAMIC PARAMETERS

Measured for a single card configuration using 1 MHz sine wave input at 50 MS/s dual channel mode with amplitude of 95% of full scale on the ±1 V range. Typical values listed below:

    SNR: 63 dB

    SFDR: 73 dB

    SINAD: 60 dB

    THD: -72 dB

    ENOB: 10.2 bits

ACQUISITION MEMORY

Data Storage: In on-board memory

Memory Sizes: 1M, 8M, 128M, 1G (14 bit samples)

Maximum memory depth:
    Single channel: Up to full on-board memory
    Dual channel: Up to half on-board memory per channel

TRIGGERING

Number of Trigger Inputs: 2 per system

Source: CH 1, CH 2, EXT or Software

Type: Analog triggering

Sensitivity: ± 10% of full scale

Level Accuracy: ± 5% of full scale

Slope: Positive or Negative, software selectable

Post Trigger Data: 128 *(256)* points minimum.
                           Can be defined with a 64 *(128)* point resolution in dual *(single)* channel mode.

EXTERNAL TRIGGER

Impedance: 1 MΩ, 35 pF

Amplitude: Absolute Max ±15 V

Voltage Range: ±1 V and ±5 V

Bandwidth: 30 MHz

Coupling: AC or DC

Connector: BNC

TRIGGER OUTPUT

Signal Type:	TTL
Active Edge:	Rising (low-to-high)
Synchronization:	Synchronized to on-board system clock

INTERNAL CLOCK

Source:	Clock oscillator
Accuracy:	± 50 ppm (0 to 70 degrees Celsius)

EXTERNAL CLOCK

Maximum Frequency:	100 MHz in single-channel mode 50 MHz in dual-channel mode
Minimum Frequency:	40 MHz in single-channel mode 20 MHz in dual-channel mode
Signal Type:	Sine wave
Signal Level:	MIN 1 V RMS MAX 2 V RMS
Impedance:	50Ω
Sampling Edge:	Rising
Coupling:	AC
Required Duty Cycle:	50% ± 30% in single-channel mode 50% ± 5% in dual-channel mode

MULTIPLE RECORD

Pre-trigger Data:	None
Record Length:	256 *(512)* points minimum. Can be defined with a 64 *(128)* point resolution in dual *(single)* channel mode

MULTI-CARD SYSTEMS

Operating Mode:	Master/Slave or Multiple Independent
Number of Cards	
Master/Slave:	2, 4, or 6 cards for 1M memory models 2, 3 or 4 cards for 8M memory models Available upon request: 128M and 1G memory models
Multiple/Ind.:	Limited by the backplane
Max. # Channels	
in Master/Slave Mode:	12 at 50 MS/s (for 1M model) 6 at 100 MS/s (for 1M model)

MASTER/SLAVE SYSTEM TRIGGERING

Number of Trigger Inputs:	2 per system
Trigger Source:	CH 1, CH 2, EXT or Software (Master Card only)
Sensitivity:	± 10% of full scale
Level Accuracy:	± 5% of full scale
Trigger Slope:	Positive or Negative, software selectable

OPERATING SYSTEMS SUPPORTED

- Windows 98/ME/NT*   CompuScope Driver version 3.60.22
  * Version 4, SP3 or higher

- Windows 2000**/XP   CompuScope Driver version 3.82.xx
  ** SP1 or higher

APPLICATION SOFTWARE

GageScope®: Windows-based software for programming-free operation

LITE Edition: Included with purchase, provides basic functionality
Standard Edition: Provides limited functionality of advanced analysis tools, except for Extended Math
Professional Edition: Provides full functionality of all advanced analysis tools

SOFTWARE DEVELOPMENT KITS (SDK)

- CompuScope SDK for C/C++
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for MATLAB
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for LabVIEW
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for LabWindows/CVI
  For Windows 98/ME/NT/2000/XP

ENVIRONMENTAL

Operating Temperature: 5 degrees Celsius to 40 degrees Celsius

Relative Humidity: Less than 80%, non-condensing

Maximum Altitude: 2,000 meters

ELECTROMAGNETIC COMPATIBILITY   CE Compliant

The following CS14100C configurations have been tested for CE Compliance:

For 1M memory models:
1 Card Independent: CE Compliant
2 & 4 Card M/S Sets: CE Compliant
6 Card M/S Set: Contact Gage for details

For 8M memory models:
1 Card Independent: CE Compliant
2 Card M/S Sets: CE Compliant
3 & 4 Card M/S Set: Contact Gage for details

For Extreme memory models (128M & more):
Contact Gage for details

WARRANTY

One year parts and labor

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

CompuScope 14100C ordering information

Hardware and upgrades

Product	Order No.
CompuScope 14100C-1M	741-001-002
CompuScope 14100C-8M	741-001-003
CompuScope 14100C-128M	741-001-004
CompuScope 14100C-1G	741-001-006
CS14100C-1M: 2 Card Master/Slave Set	741-001-010
CS14100C-1M: 4 Card Master/Slave Set	741-001-011
CS14100C-1M: 6 Card Master/Slave Set	741-001-012
CS14100C-8M: 2 Card Master/Slave Set	741-001-020
CS14100C-8M: 3 Card Master/Slave Set	741-001-021
CS14100C-8M: 4 Card Master/Slave Set	741-001-022
CS14100C-128M: Master/Slave Sets	Available upon request
CS14100C-1G: Master/Slave Sets	Available upon request
CS14100C: Memory Upgrade Charge	741-181-004

GageScope Software

Product	Order No.
GageScope Lite Edition	Included
GageScope Standard Edition – purchased with CompuScope hardware	300-100-351
GageScope Standard Edition – purchased independently	300-100-352
GageScope Professional Edition – purchased with CompuScope hardware	300-100-354
GageScope Professional Edition – purchased independently	300-100-355

Software Development Kits (SDKs)

Product	Order No.
Gage SDK Pack on CD (No Hardcopy of Manuals included)	200-113-000
Gage SDK Pack on CD (Hardcopy of Manuals included)	200-113-002
CompuScope SDK for C/C++	200-200-101
CompuScope SDK for MATLAB	200-200-102
CompuScope SDK for LabVIEW	200-200-103
CompuScope SDK for LabWindows/CVI	200-300-100

CompuScope 14100C simplified block diagram

Figure 68: CompuScope 14100C simplified block diagram

CompuScope 14100C: identifying your CompuScope card(s)

Your CompuScope 14100C card is composed of the CS14100C base board and the CS14100C analog board.

You will find your CompuScope 14100C card type and version as shown in Figure 69 and Figure 70. Figure 69 also shows the location of the Calibration label. The Calibration label lists your CompuScope card's serial numbers. You should record these serial numbers for future reference on the technical support form found at the front of this guide.

You may also see an "OPTION/MOD" label listing any upgrades or modifications that have been performed on your card. For example, if you have purchased a CompuScope 14100C-1M card, the "OPTION/MOD" label will list "1M" as an option.

Calibration Label

Option/Mod Label

Card Type
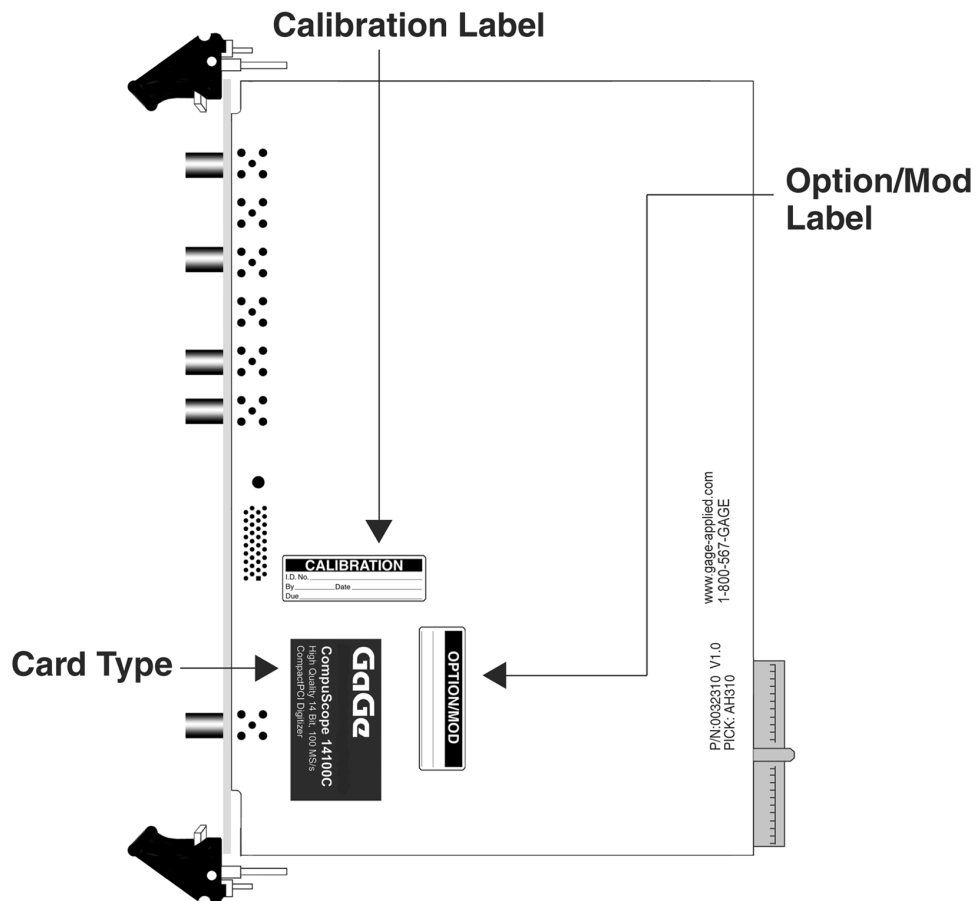
Figure 69: CS14100C labels
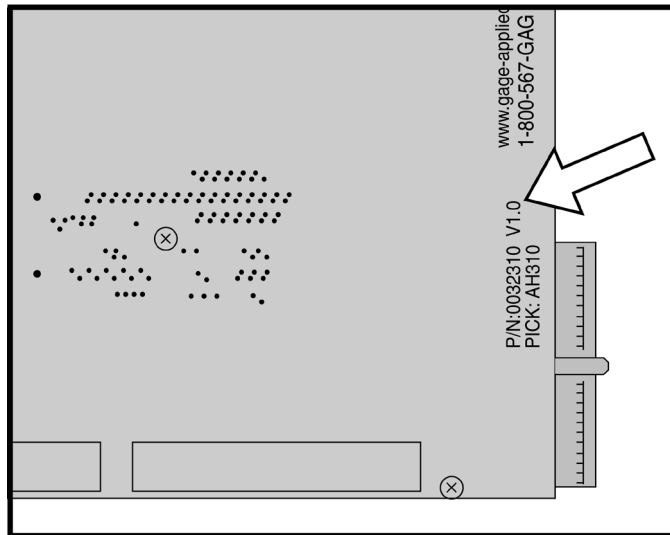
Figure 70: CS14100C hardware version number

If you have purchased a multi-card system, you will notice that input channel connectors on one card are numbered "CH 1" & "CH 2" and the other "CH 3" & "CH 4" and so on.

The MASTER card is labeled "CH 1" & "CH 2" and each SLAVE card is labeled with successive channel numbers.
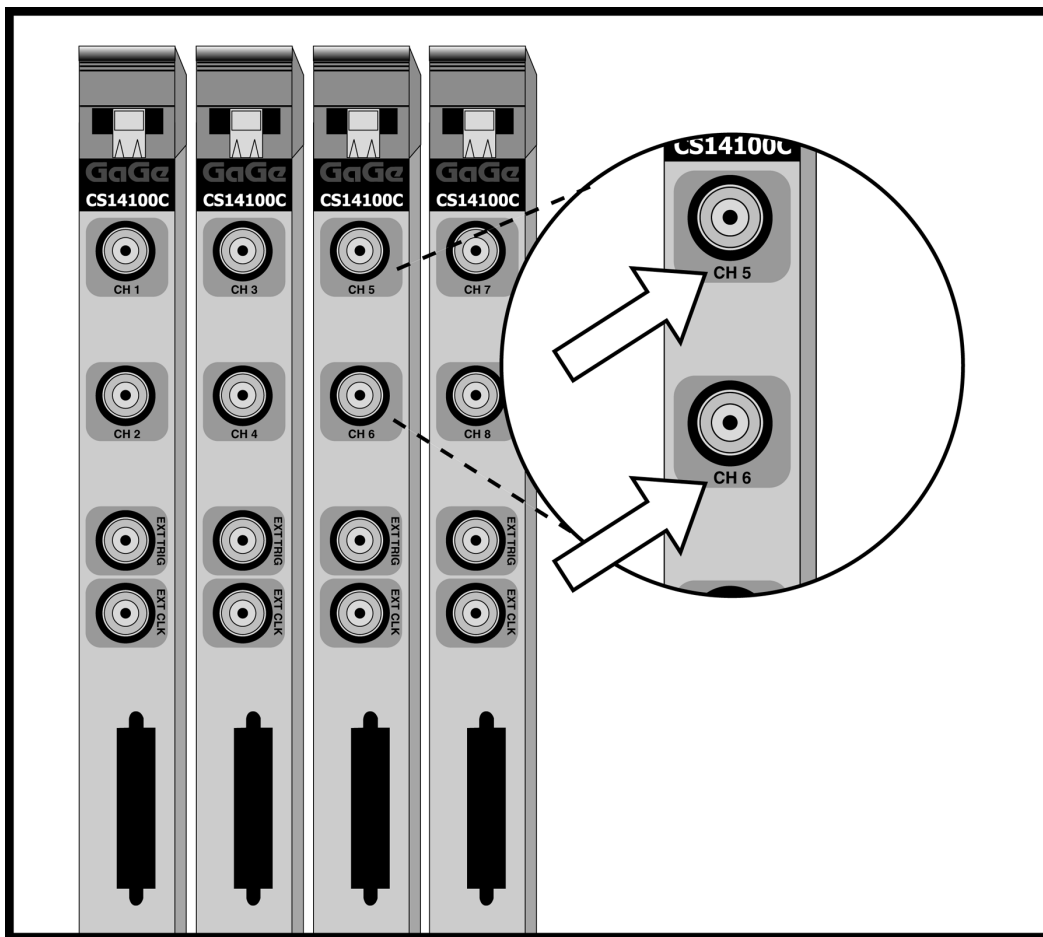
Figure 71: CompuScope 14100C Master/Slave card designation

If you purchased a CompuScope 14100C card with 8M, 128M or 1G on-board acquisition memory, you should notice that the expanded memory card occupies a second slot. Such a 2-slot product is also referred to as a "Deep Memory Card" or, in the case of the 128M and 1G versions, an "Extreme Memory Card".

The exact amount of on-board acquisition memory is listed on the OPTION/MOD sticker.
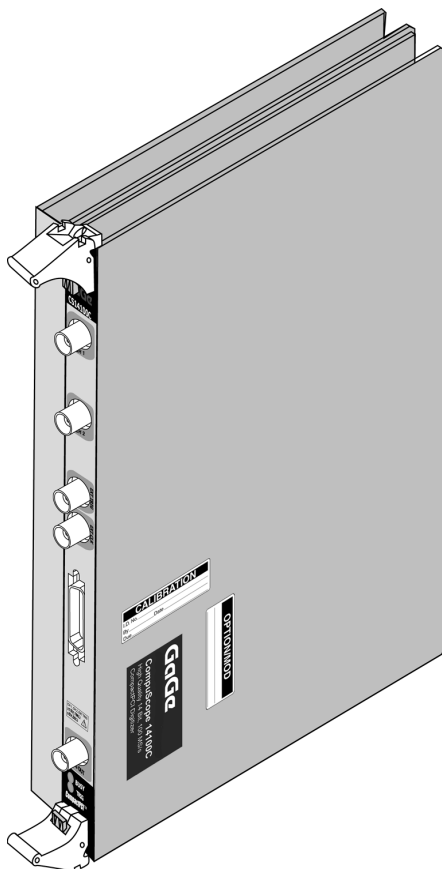
Figure 72: CompuScope 14100C occupying 2 slots to accommodate extra memory capacity

CompuScope 14100C connectors and headers

CompuScope cards connect to the outside world through connectors, both analog (BNC) and digital (CompactPCI Bus, Master/Slave, etc.). This section describes these connectors for the CS14100C card.

The connectors and headers on the CS14100C card are shown below:
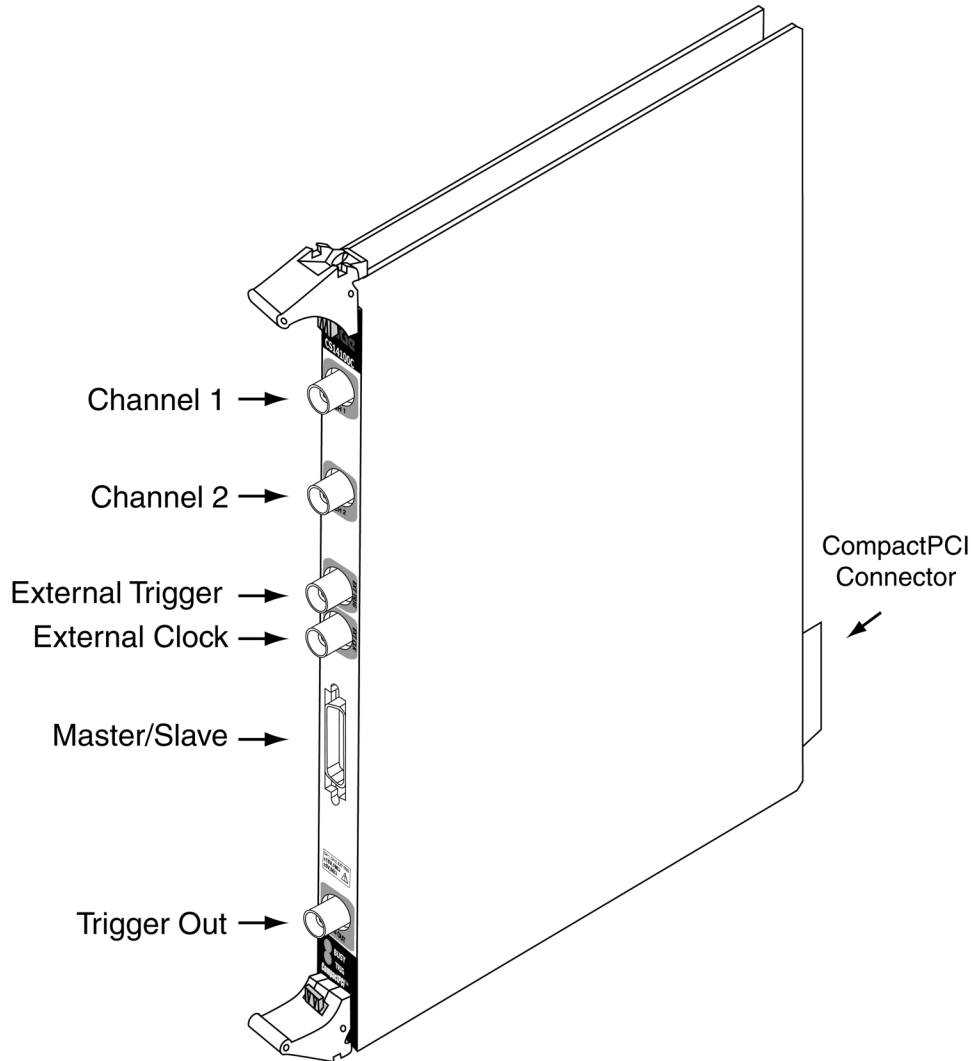
Figure 73: Connectors on CS14100C

- **CH 1 BNC** connector is the single-ended input of channel 1 that is used to input an analog signal that is sampled as Channel 1.

- **CH 2 BNC** connector is the single-ended input of channel 2 that is used to input an analog signal that is sampled as Channel 2.

- **External Trigger BNC** connector is used to input an analog or digital signal, which may be used as an External Trigger. External Trigger is defined exactly as in an oscilloscope: this signal can be used to trigger the system but cannot be viewed or digitized.

- **External Clock BNC** connector is located on the front panel. This input can be used for injecting a specific clock signal for digitizing the analog inputs. See the section *CompuScope 14100C External Clock* for more details.

- **Master/Slave connector** is located on the front panel. This connector is used to pass Clock, Trigger and Initialization signals from a Master card to Slave card(s) using a Master/Slave Timing Module.

- **Trigger Out BNC** connector is located on the front panel near the bottom of the card. This connector outputs a TTL signal, the low to high transition of which signifies the occurrence of a trigger event on the CS14100C. See the section *CompuScope 14100C Trigger Output* for more details.

- **CompactPCI**^{TM} **connector** is located at the rear of the card. This is an industry standard connector that complies with all specifications of the CompactPCI^{TM} bus.

- **Status LEDs** are located at the bottom of the front panel. Note that the BUSY LED is illuminated when the CompuScope 14100C is capturing a signal. The TRIG LED is illuminated after the CompuScope 14100C receives a trigger.

CompuScope 14100C triggering

CompuScope 14100C features state-of-the-art Windowed triggering. The user has the ability to set up two independent triggers that are ORed by the on-board circuitry.

Each of the two triggers are designed to be similar to an oscilloscope, so the user can easily replace the Digital Oscilloscope in his or her application with a CompuScope 14100C. A user can select the trigger source, trigger level and trigger slope using software commands.

The user can software-select the trigger source from any one of the following:

- Channel 1
- Channel 2
- External Trigger
- Software Trigger

The selected trigger source is then compared to a trigger level set by an on-board, 8 bit software-controlled DAC. An on-board, high-speed comparator is used for this function, making it possible to trigger on narrow pulses or glitches that are much shorter than the sample rate, subject to the 30 MHz bandwidth limitation of the front-end trigger circuitry.

Each time the selected signal crosses the trigger level, the on-board triggering circuitry monitors it for the slope selected by the user. When the appropriate slope is detected, a Trigger signal is generated.
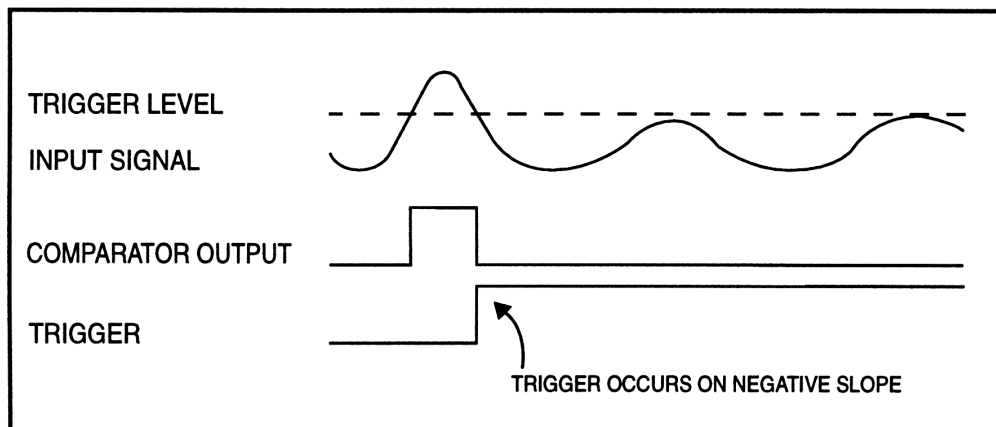
Figure 74: Generation of a trigger signal (negative slope)

Windowed triggering

Using the CompuScope 14100C's ability to have two independent trigger sources which are ORed together, the user can set up the triggering such that a trigger will occur if the input signal is outside a specified "window," i.e. it is higher than the upper limit or lower than the lower limit.
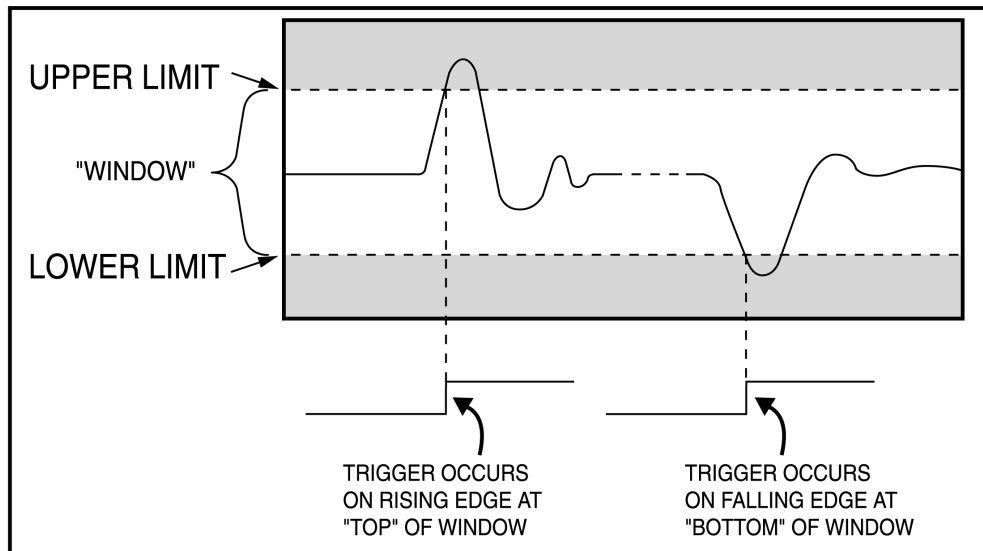
Figure 75: Windowed triggering

External Trigger amplifier

The External Trigger input also has oscilloscope-like 1 MΩ / 35 pF input impedance.

Gage's proprietary input-protection circuitry allows the FET stage to withstand voltages as high as ±15 Volts without causing any damage to the inputs.

The trigger comparators have an operating range of ±1 Volt. Software-selectable attenuation of X1 or X5 on the External Trigger input allows input ranges of ±1 Volt and ±5 Volt, respectively.

CompuScope 14100C External Clock

External clocking is a very powerful feature in a digitizer. It allows the user to synchronize the digitizer to an external system.

On the CompuScope 14100C, external clock signal must be a continuous sine wave signal of amplitude between 1 V RMS and 2 V RMS. Note that the external clock input is AC coupled, so DC biases get canceled.

In single channel mode, the allowable external clock frequency is between 40 MHz and 100 MHz. Sampling is done on each "rising edge" of the sine wave.

In dual channel mode, the allowable external clock frequency is between 20 MHz and 50 MHz. Sampling is done on each "rising edge" of the sine wave.

Note that high-resolution waveform digitizers are very sensitive to phase noise and duty cycle of the external clock input. All efforts should be made to minimize jitter and distortion on the external clock signal.

Care should be taken not to inject a TTL or CMOS signal (0 to 5 Volts) into the external clock input, as it may result in saturation of the input circuitry.

CompuScope 14100C Trigger Output

A Trigger signal is used to synchronize different parts of a measurement system to the same event.

CompuScope 14100C provides a TTL output on one of the front panel connectors. The rising edge of this output signifies that a trigger event has been detected on the CompuScope 14100C.

In a Master/Slave configuration, only the Trigger Output of the Master card should be used.

For best results, this output should be terminated with a 50 Ω load capable of absorbing 0.5 Watt power.

It should be noted that this output is synchronized to an internal clock, called GCLK, on the CompuScope 14100C. This clock is not the same as the sampling clock.

The relationship between GCLK and sampling clock must be understood in order to take full advantage of this powerful feature.

Single channel mode

In single channel mode, GCLK is always one-half the frequency of the sampling clock. Consequently, if the trigger event is asynchronous to the sampling clock, Trigger Out signal will only be activated after one of the two subsequent rising edges of the sampling clock.

Trigger Input

Sampling Clock
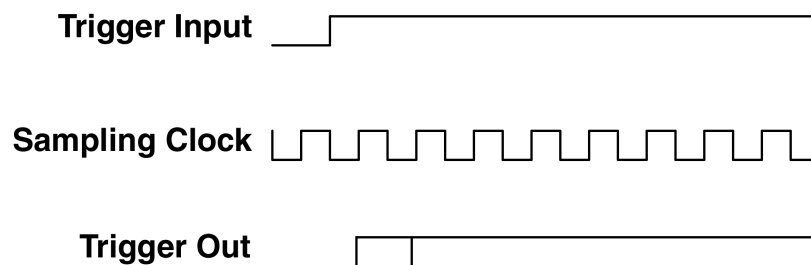
Trigger Out

Figure 76: Trigger Out in single channel mode

Dual channel mode

In dual channel mode, GCLK is exactly the same frequency as the sampling clock. Consequently, if the trigger event is asynchronous to the sampling clock, Trigger Out signal will only be activated after the subsequent rising edge of the sampling clock.

Trigger Input

Sampling Clock
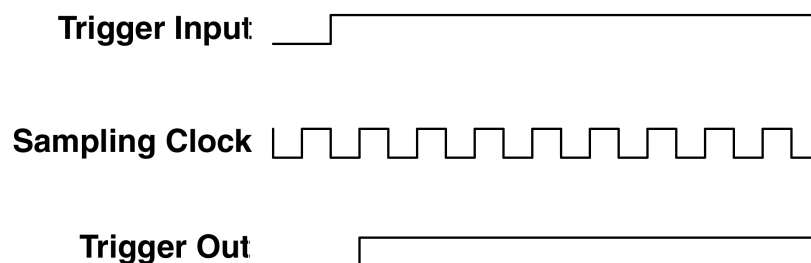
Trigger Out

Figure 77: Trigger Out in dual channel mode

Finally, note that there is no output short protection on this signal, so care should be taken in not interfacing it to any output, be it Ground or any other voltage.

CompuScope 14100C throughput & maximum PRF

A number of applications require the CompuScope 14100C to acquire data based on a rapidly occurring trigger signal. These high Pulse Repeat Frequency (PRF) applications include imaging, radar, ultrasound and lightning test.

Gage has performed extensive repetitive capture benchmarks in single record mode. In this mode, the signal is captured into on-board CompuScope memory and the captured data are transferred through the PCI bus using PCI bus mastering to PC RAM.

Please note that much higher PRFs will be achieved using CompuScope Multiple Record mode.

The following test results were obtained using a computer configured as follows:
- Pentium III, 500 MHz processor
- 128 MB RAM
- 20 GB disk drive
- Windows NT 4.0 with SP6
- NT File System
- 33 MHz, 32 bit CompactPCI^{TM} bus
- All slots support bus mastering

A C application program optimized for fast repetitive capture in single record mode was used for throughput measurements. The CS14100C was operated using this application in both single and dual channel mode for many different capture depths and the results are plotted as points in the graph below. The PCI transfer rates were calculated from the linear portion of the curves at high depths.

PCI data transfer rate (single channel):	*80 MB/s*
PCI data transfer rate (dual channel):	*50 MB/s*
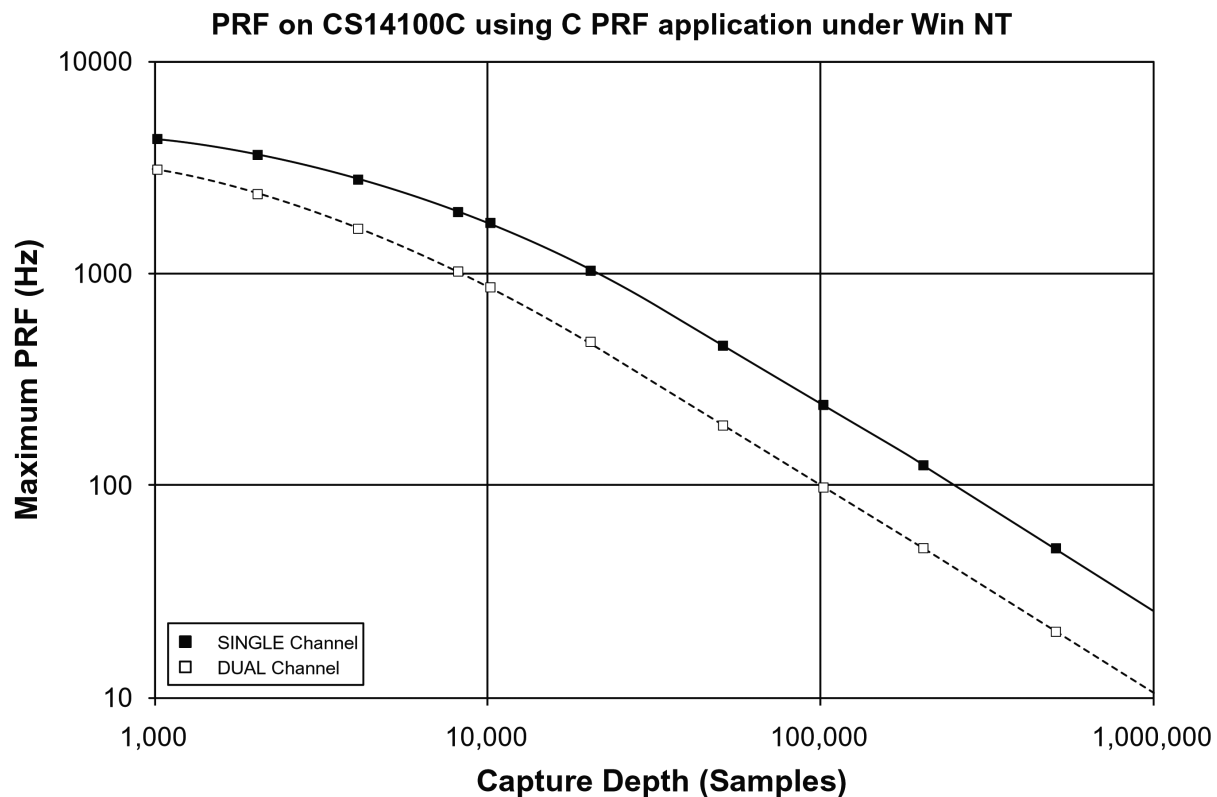
Figure 78: Maximum PRF vs. acquisition length

What you should receive with your CompuScope 1610C

If you order an independent CompuScope 1610 card, you should receive the following articles:

- One CompuScope 1610C card (of memory model type purchased)

1M model

8M, 128M or
1G model

- Standard items included with each independent CompuScope card

    Hardware Manual, including Driver Installation Guide

    Note that you will receive only one copy of the Hardware Manual per order placed with Gage. Additional copies can be requested at order time.

    The Hardware Manual is also available in PDF format on the Gage Software Disk or you can download card-specific manuals from Gage's Web site (www.gage-applied.com).

    Gage Software Disk (with GageScope Software)

    The Gage Software Disk, included on the inside-front cover of the Hardware Manual and Installation Guide, contains all of the software drivers you need to operate your Gage hardware. The CD also contains all of the installers for the application packages provided by Gage, including Lite, Standard and Professional editions of GageScope.

    Note that some packages will only be available if you have purchased the software and have a key provided by Gage.

    CompuScope Certificate of NIST Traceable Calibration

    Each CompuScope card is shipped with a Certificate of NIST Traceable Calibration. NIST is the National Institute to Standards and Technologies - the US organization that is responsible for the definitions and measurement of metrology standards.

    Prior to shipment, Gage runs each CompuScope card through a battery of over 1000 automated performance verification tests using a NIST traceable calibration source. The tested CompuScope is then considered a NIST traceable calibration instrument for a period of one year – the calibration interval that is generally accepted by the Test and Measurement industry.

Warranty card

- You may also receive a number of optional items, if purchased:

GageScope® software and
Standard or Professional edition
Software Key envelope

Software Development Kits (SDKs)
& applicable manual(s)

- If you ordered a Master/Slave set, you will receive one of the following Master/Slave Timing Modules in addition to the number of CompuScope cards in your Master/Slave system.

2 slot module for use with:
2 card M/S sets of 1M

4 slot module for use with:
2 card M/S sets of 8M or more
4 card M/S sets of 1M

6 slot module for use with: 8 slot module for use with
3 card M/S sets of 8M or more   4 card M/S sets of 8M or more
6 card M/S sets of 1M   8 card M/S sets of 1M

Carefully inspect these articles before proceeding further. If you find any damage caused by transportation, please report it to the organization from which you purchased the CompuScope card.

CompuScope 1610C compliance statement

Category	Standards or description
EC Declaration of Conformity – EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities: EN 61326 — EMC requirements for Class A electrical equipment for measurement, control and laboratory use. [1, 2, 3, 4] IEC61000-4-2 — Electrostatic Discharge (Performance criterion B) IEC61000-4-3 — RF Electromagnetic Field (Performance criterion A) IEC61000-4-4 — Electrical Fast Transient/Burst Immunity (Performance criterion B) IEC61000-4-5 — Power Line Surge Immunity (Performance criterion B) IEC61000-4-6 — Conducted RF Immunity (Performance criterion A) IEC61000-4-11 — Voltage Dips and Interruptions Immunity (Performance criterion B) EN 61000-3-2 — AC Power Line Harmonic Emissions
Australia / New Zealand Declaration of Conformity - EMC	Complies with EMC provision of Radio communications Act per the following standard(s): AS/NZS 2064.1/2 — Industrial, Scientific and Medical Equipment: 1992 [1, 2, 3, 4]

1   **Emissions which exceed the levels required by this standard may occur when this equipment is connected to a test object.**

2   **High-quality shielded cables must be used to ensure compliance to the above listed standards.**

3   **An empty unused slot must be maintained between the PC Controller and the CS1610C card set.**

4   **Compliance demonstrated on the following configurations:**

- **A two card Master/Slave configuration with 8 MegaSamples of memory (qty 2 cards maximum)**

- **A four card Master/Slave configuration with 1 MegaSamples of memory (qty 4 cards maximum)**

CompuScope 1610C product introduction

CompuScope 1610C is a 16 Bit, dual channel 10 MS/s data acquisition card for the CompactPCI^{TM} Bus, the world's fastest 16 bit waveform digitizer.

Recognizing that until very recently, almost all multi-MegaHertz data acquisition was done using Digital Storage Oscilloscopes under GPIB control, Gage has ported all the features of these DSOs onto the CompuScope card. This means that you do not have to rethink the solution in terms of a completely unknown data acquisition card. You can simply develop the data acquisition system as if an oscilloscope were being used, but instead use a CompuScope card to take advantage of its attractive price and performance.

Of course, CompuScope cards are much more than just another DSO under GPIB control:

- CS1610C features 16 bit vertical resolution as opposed to the 8 bit resolution offered by DSOs.

- Multi-card Master/Slave systems provide from 2 to 16 channels of simultaneous A/D conversion, something normal DSOs simply cannot do.

- Data transfer rates from CompuScope memory to PC memory or extended memory run as high as 50 MB/s for the CS1610C as compared to a few hundred KB/s for GPIB.

- CompuScope cards are easier to program, as Software Development Kits (SDKs) are available for C/C++, MATLAB, LabVIEW and LabWindows/CVI.

- CompuScope cards are installed inside the CompactPCI^{TM} chassis, so there is no external box such as a DSO.

- The CS1610C cards have standard features such as Multiple Record and External Clocking, which help optimize the use of the on-board memory by stacking data from successive bursts.

- You can also write software for a multi-card system in which all the cards are not in a Master/Slave configuration. Drivers supplied by Gage support all these multi-card configurations.

Special features on the CompuScope 1610C include:

- Bus Mastering

  CompuScope 1610C is fully capable of becoming a bus master in order to transfer data at the maximum rate of 50 MB/s.

  A bus Master is a card that can take control of the bus and transfer data to any PCI target device such as system RAM without any involvement from the CPU.

  When a CompactPCI^{TM} card such as the CompuScope 1610C becomes the bus master, it is said to be operating in the Master Mode.

  On the other hand, when the CPU is controlling the transfer of data from the add-on card to its system RAM, the card is said to be working in the Slave mode.

- External Clocking

  CompuScope 1610C comes standard with external clocking capability that allows synchronization of the digitizers with an external system.

  It should be noted that the frequency of the external clock must be twice the desired sampling frequency.

CompuScope 1610C specifications

PLEASE CHECK THE GAGE WEBSITE FOR THE MOST UP-TO-DATE SPECIFICATIONS.

SYSTEM REQUIREMENT

CompactPCI PICMG compliant system with the required number of free 6U slots; controller or PC with 128 MB RAM, 50 MB hard disk and SVGA video.

The CompuScope 1610C must be installed in a slot that supports bus mastering to achieve stated performance.

SIZE

6U CompactPCI

1M Memory Model:	Occupies 1 slot
8M Memory Model:	Occupies 2 slots
128M Memory Model:	Occupies 2 slots
1G Memory Model:	Occupies 2 slots

POWER (IN WATTS)

+ 5 Volts		
	Worst Case	**Typical**
All Memory Models	25 Watts	17.5 Watts

CHANNELS 1 & 2

Inputs per card:	2 differential inputs
Impedance:	1 MΩ, 35 pF or 50 Ω, software selectable
Coupling:	AC or DC
Resolution:	16 bits
A/D Type:	Monolithic, 16 bit over sampling with decimation filter
Analog Bandwidth:	DC to 4 MHz (DC coupled)
	10 Hz to 4 MHz (AC coupled)
	DSP FIR filter limits the signal bandwidth to Nyquist Frequency
Single-Ended Input Voltage Ranges:	±500 mV, ±1 V, ±2 V, ±5 V, ±10 V
DC Accuracy:	0.5% of full scale
Common Mode Input Voltage:	±7.5 Volts (DC + peak AC), maximum
Common Mode Rejection Ratio:	80 dB at 60 Hz
Absolute Maximum Amplitude:	
1 MΩ Impedance:	±15 Volts (continuous)
50 Ω Impedance:	±5 Volts (continuous),
	±15 Volts (for 1 ms duration)
Internal Sampling Rate	
MS/s:	10, 5, 2.5, 1
kS/s:	500, 200, 100, 50, 20, 10, 5, 2, 1
Protection:	Diode Clamped
Connector:	2 BNCs per channel

DYNAMIC PARAMETERS

Measured using 1 MHz sine wave input at 10 MS/s with amplitude of 95% of full scale on the ±1V range. Typical values listed below.

SNR:	70 dB
SFDR:	71 dB
SINAD:	66 dB
THD:	-68 dB
ENOB:	11.5 bits

ACQUISITION MEMORY

Data Storage:	In on-board memory
Memory Sizes:	1M, 8M, 128M, 1G (16 bit samples)
Maximum memory for each channel:	Up to half on-board memory per channel

TRIGGERING

Number of Trigger Inputs:	2 per card
Source:	CH 1, CH 2, EXT or Software
Type:	Analog triggering
Sensitivity:	± 20% of full scale
Level Accuracy:	± 10% of full scale
Slope:	Positive or Negative, software selectable
Post Trigger Data:	128 points minimum. Can be defined with a 64 point resolution

EXTERNAL TRIGGER

Impedance:	1 MΩ, 30 pF
Input Type:	Single-ended analog
Amplitude:	Absolute Max ±15 V
Voltage Range:	±1 V and ±5 V
Bandwidth:	10 MHz
Connector:	BNC

TRIGGER OUTPUT

Signal Type:	TTL
Active Edge:	Rising (low-to-high)
Synchronization:	Synchronized to sampling clock

INTERNAL CLOCK

Source:	Clock oscillator
Accuracy:	± 50 ppm (0 to 70 degrees Celsius)

EXTERNAL CLOCK

Maximum Frequency:	20 MHz, maximum Uses 2x decimation filter Clock must be present during initialization
Minimum Frequency:	2 kHz
Signal Level:	TTL
Required Duty Cycle:	50% +5%, -0% at 20 MHz

MULTIPLE RECORD

Record Length: 256 points minimum. Can be defined with a 64 point resolution

MULTI-CARD SYSTEMS

Operating Mode: Master/Slave or Multiple Independent

Max. # of Cards
    Master/Slave: 2, 4, 6 or 8 cards for 1M memory models
    2, 3 or 4 cards for 8M memory models
    Available upon request: 128M and 1G memory models

    Multiple/Ind.: Limited by the backplane

Max. # Channels
in Master/Slave Mode: 16 at 10 MS/s (for 1M model)

MASTER/SLAVE SYSTEM TRIGGERING

Number of Trigger Inputs: 2 per card

Source for each input: CH 1, CH 2, EXT or Software

Combination of all inputs: Wired OR
    (if one card detects a trigger event, the entire system triggers simultaneously)

Sensitivity for each input: $\pm$ 20% of full scale

Level Accuracy: $\pm$ 5% of full scale

Slope for each input: Positive or Negative, software selectable

OPERATING SYSTEMS SUPPORTED

- Windows 98/ME/NT*   CompuScope Driver version 3.60.22
     * Version 4, SP3 or higher

- Windows 2000**/XP   CompuScope Driver version 3.82.xx
     ** SP1 or higher

APPLICATION SOFTWARE

GageScope®: Windows-based software for programming-free operation

    LITE Edition: Included with purchase, provides basic functionality
    Standard Edition: Provides limited functionality of advanced analysis tools, except for Extended Math
    Professional Edition: Provides full functionality of all advanced analysis tools

SOFTWARE DEVELOPMENT KITS (SDK)

- CompuScope SDK for C/C++
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- CompuScope SDK for MATLAB
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for LabVIEW
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for LabWindows/CVI
  For Windows 98/ME/NT/2000/XP

ENVIRONMENTAL

Operating Temperature: 5 degree Celsius to 40 degree Celsius

Relative Humidity: Less than 80%, non-condensing

Maximum Altitude: 2,000 meters

ELECTROMAGNETIC COMPATIBILITY CE Compliant

The following CS1610C configurations have been tested for CE Compliance:

For 1M memory models:
1 Card Independent: CE Compliant
2 & 4 Card M/S Sets: CE Compliant
6 & 8 Card M/S Sets: Contact Gage for details

For 8M memory models:
1 Card Independent: CE Compliant
2 Card M/S Sets: CE Compliant
3 & 4 Card M/S Sets: Contact Gage for details

For Extreme memory models (128M & more):
Contact Gage for details

WARRANTY

One year parts and labor

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

CompuScope 1610C ordering information

Hardware and upgrades

Product	Order No.
CompuScope 1610C – 1M	761-001-002
CompuScope 1610C – 8M	761-001-003
CompuScope 1610C – 128M	761-001-004
CompuScope 1610C – 1G	761-001-006
CS1610C-1M: 2 Card Master/Slave Set	761-001-010
CS1610C-1M: 4 Card Master/Slave Set	761-001-011
CS1610C-1M: 6 Card Master/Slave Set	761-001-012
CS1610C-1M: 8 Card Master/Slave Set	761-001-013
CS1610C-8M: 2 Card Master/Slave Set	761-001-020
CS1610C-8M: 3 Card Master/Slave Set	761-001-021
CS1610C-8M: 4 Card Master/Slave Set	761-001-022
CS1610C-128M: Master/Slave Sets	Available upon request
CS1610C-1G: Master/Slave Sets	Available upon request
CS1610C: Memory Upgrade Charge	761-181-004

GageScope Software

Product	Order No.
GageScope Lite Edition	Included
GageScope Standard Edition – purchased with CompuScope hardware	300-100-351
GageScope Standard Edition – purchased independently	300-100-352
GageScope Professional Edition – purchased with CompuScope hardware	300-100-354
GageScope Professional Edition – purchased independently	300-100-355

Software Development Kits (SDKs)

Product	Order No.
Gage SDK Pack on CD (No Hardcopy of Manuals included)	200-113-000
Gage SDK Pack on CD (Hardcopy of Manuals included)	200-113-002
CompuScope SDK for C/C++	200-200-101
CompuScope SDK for MATLAB	200-200-102
CompuScope SDK for LabVIEW	200-200-103
CompuScope SDK for LabWindows/CVI	200-300-100

CompuScope 1610C simplified block diagram

Figure 79: CompuScope 1610C simplified block diagram

CompuScope 1610C: identifying your CompuScope card(s)

Your CompuScope 1610C card is composed of the CS1610C base board and the CS1610C analog board.

You will find your CompuScope 1610C card type and version as shown in Figure 80 and Figure 81. Figure 80 also shows the location of the Calibration label. The Calibration label lists your CompuScope card's serial numbers. You should record these serial numbers for future reference on the technical support form found at the front of this guide.

You may also see an "OPTION/MOD" label listing any upgrades or modifications that have been performed on your card. For example, if you have purchased a CompuScope 1610C-1M card, the "OPTION/MOD" label will list "1M" as an option.
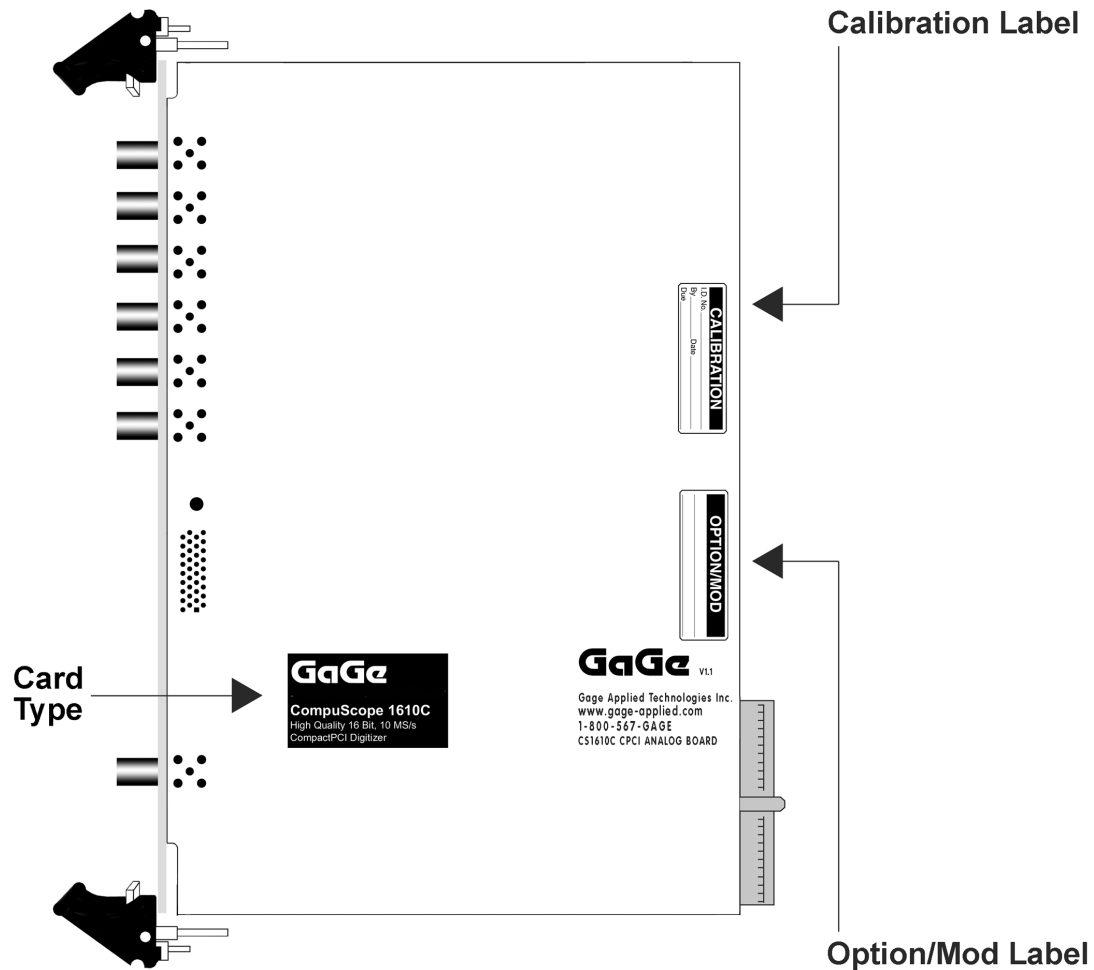
Figure 80: CS1610C labels
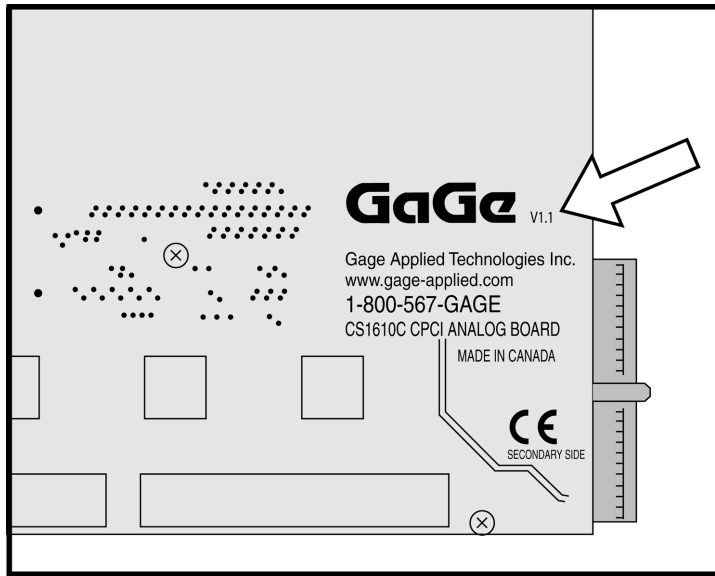
Figure 81: CS1610C hardware version number

If you have purchased a multi-card system, you will notice that input channel connectors on one card are numbered "CH 1" & "CH 2" and the other "CH 3" & "CH 4".

The MASTER card is labeled "CH 1" & "CH 2" and the SLAVE card is labeled "CH 3" & "CH 4".
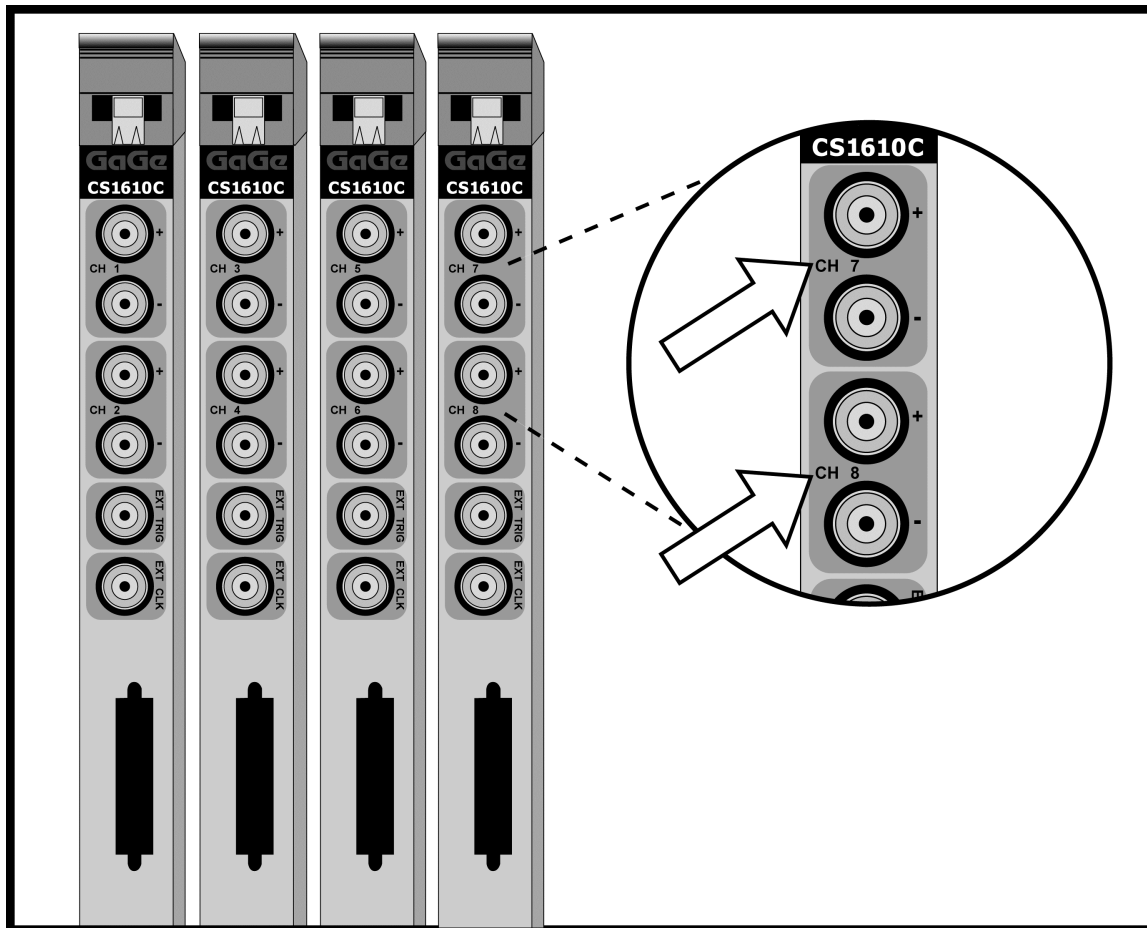
Figure 82: CS1610C Master/Slave card designation

If you purchased a CompuScope 1610C card with 8M, 128M or 1G on-board acquisition memory, you should notice that the expanded memory card occupies a second slot. Such a 2-slot product is also referred to as a "Deep Memory Card" or, in the case of the 128M and 1G versions, an "Extreme Memory Card".

The exact amount of on-board acquisition memory is listed on the OPTION/MOD sticker.
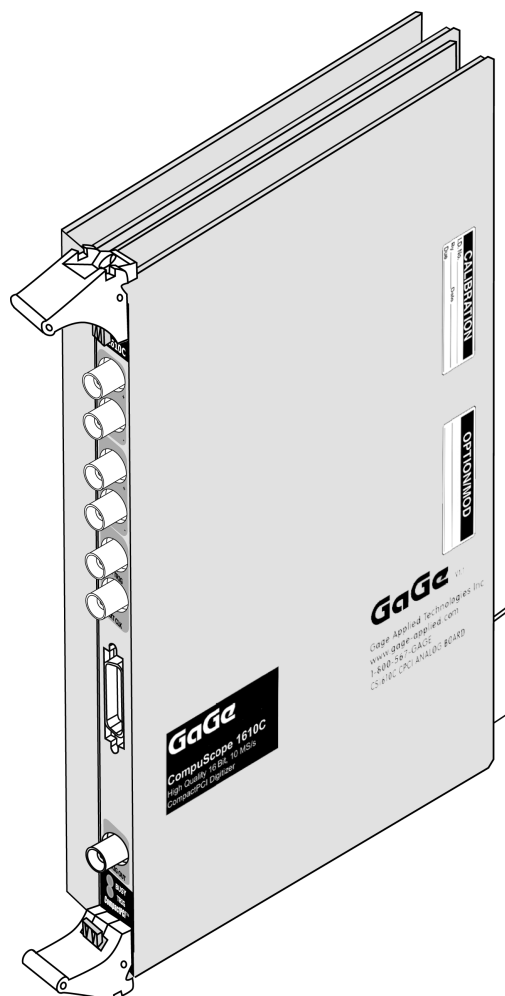
Figure 83: CompuScope 1610C occupying 2 slots to accommodate extra memory capacity

CompuScope 1610C connectors and headers

CompuScope cards connect to the outside world through connectors, both analog (BNC) and digital (CompactPCI Bus, Master/Slave, etc.). This section describes these connectors for the CS1610C card.

The connectors and headers on the CS1610C card are shown below:
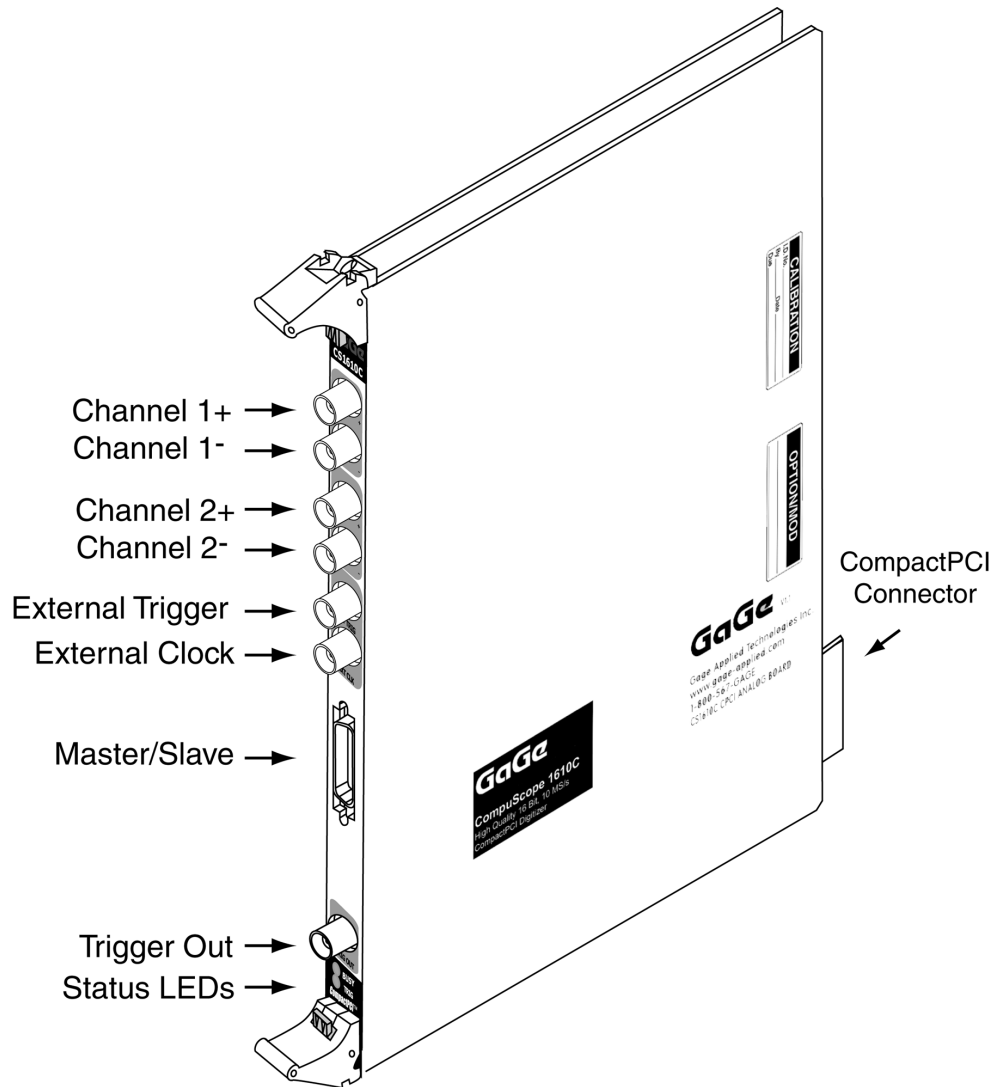
Figure 84: Connectors on CS1610C

- **CH 1**+ **BNC** connector is the positive differential input of channel 1 which is used to input an analog signal that is sampled as Channel 1.

- **CH 1**- **BNC** connector is the negative differential input of channel 1 which is used to input an analog signal that is sampled as Channel 1.

- **CH 2**+ **BNC** connector is the positive differential input of channel 2 that is used to input an analog signal that is sampled as Channel 2.

- **CH 2**- **BNC** connector is the negative differential input of channel 2, which is used to input an analog signal that is sampled as Channel 2.

- **External Trigger BNC** connector is used to input an analog or digital signal, which may be used as an External Trigger. External Trigger is defined exactly as in an oscilloscope: this signal can be used to trigger the system but cannot be viewed or digitized.

- **External Clock BNC** connector is located on the front panel. This input can be used for injecting a specific clock signal for digitizing the analog inputs. See the section *CompuScope 1610C External Clock* for more details.

- **Master/Slave connector** is located on the front panel. This connector is used to pass Clock, Trigger and Initialization signals from a Master card to Slave card(s) using a Master/Slave Timing Module.

- **Trigger Out BNC** connector is located on the front panel near the bottom of the card. This connector outputs a TTL signal, the low to high transition of which signifies the occurrence of a trigger event on the CS1610C. This signal is synchronized to the sampling clock. See the section *CompuScope 1610C Trigger Output* for more details.

- **CompactPCI^{TM} connector** is located at the rear of the card. This is an industry standard connector that complies with all specifications of the CompactPCI^{TM} bus.

- **Status LEDs** are located at the bottom of the front panel. Note that the BUSY LED is illuminated when the CompuScope 1610C is capturing a signal. The TRIG LED is illuminated after the CompuScope 1610C receives a trigger.

CompuScope 1610C triggering

CompuScope 1610C features state-of-the-art Windowed triggering. The user has the ability to set up two independent trigger sources per card that are ORed by the on-board circuitry.

Each of the two trigger sources are designed to be similar to an oscilloscope, so the user can easily replace the Digital Oscilloscope in his or her application with a CompuScope 1610C. A user can select the trigger source, trigger level and trigger slope using software commands.

The user can software-select the trigger source from any one of the following:

- Channel 1
- Channel 2
- External Trigger
- Software Trigger

The selected trigger source is then compared to a trigger level set by an on-board, 12 bit software-controlled DAC (only the 8 most significant bits are actually used). An on-board, high-speed comparator is used for this function, making it possible to trigger on narrow pulses or glitches that are much shorter than the sample rate.

Each time the selected signal crosses the trigger level, the on-board triggering circuitry monitors it for the slope selected by the user. When the appropriate slope is detected, a Trigger signal is generated.
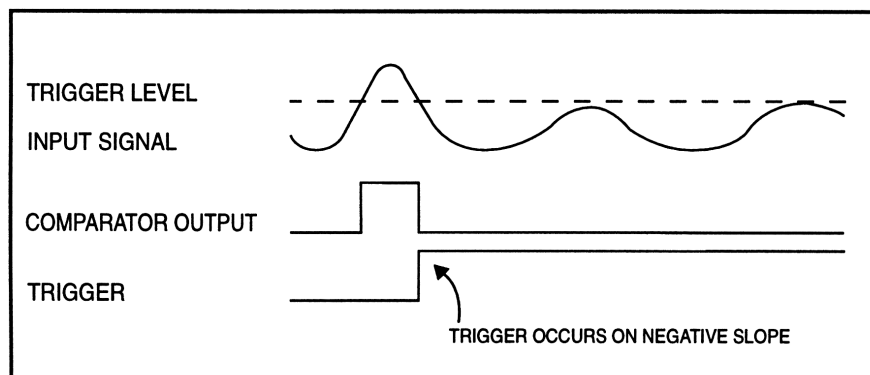
Figure 85: Generation of a trigger signal – negative slope

Windowed triggering

Using the CompuScope 1610C's ability to have two independent trigger sources which are ORed together, the user can set up the triggering such that a trigger will occur if the input signal is outside a specified "window," i.e. it is higher than the upper limit or lower than the lower limit.
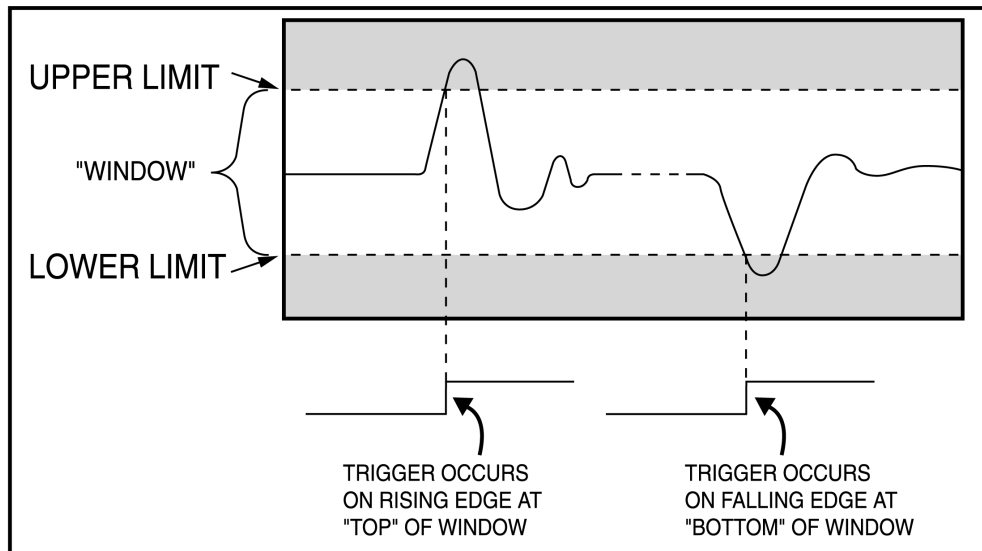
Figure 86: Windowed triggering

Channel 1 or 2 triggering

There are occasions when it is not possible to predict if the trigger is going to occur on Channel 1 or 2. For example, if the CompuScope 1610C is hooked up to two photon detectors that are picking up random or intermittent pulses, the user is not able to select the trigger source.

The CompuScope 1610C can be put in a mode in which it will trigger on, say, the rising edge of a pulse on Channel 1 or on the rising edge of a pulse on Channel 2.

In other words, by selecting two different sources with independent levels and slopes, the user can generate a trigger on the first occurrence of the pulse on either of the two channels.

Trigger bus for Master/Slave systems

In a Master/Slave system, any one of the input channels can be used as a trigger source.

This is achieved by having a trigger bus in the Master/Slave Timing Module that causes any one of the CompuScope 1610C cards in the system to cause the entire system to trigger.

This powerful feature allows the use of a multi-channel, Master/Slave CompuScope 1610C system for acquiring signals in a system in which the user cannot predict which channel would receive the trigger signal. Examples of these applications are explosion testing and acoustic emission testing.

External Trigger amplifier

The External Trigger input also has oscilloscope-like 1 MΩ / 30 pF input impedance.

Gage's proprietary input-protection circuitry allows the FET stage to withstand voltages as high as ±15 Volts without causing any damage to the inputs.

The trigger comparators have an operating range of ±1 Volt. Software-selectable attenuation of X1 or X5 on the External Trigger input allows input ranges of ±1 Volt and ±5 Volt, respectively.

CompuScope 1610C External Clock

External clocking is a very powerful feature in a digitizer. It allows the user to synchronize the digitizer to an external system.

It is important to note, however, that the external clock for CompuScope 1610C must be 2 times faster than the required sample rate, i.e. if 8 MS/s sampling is required, the external clock must be 16 MHz.

A corollary to this is that the "sampling clock" will always be a divide-by-2 of the external clock.

The External Clock must be a TTL signal (0 to +5 Volts) with a maximum frequency of 20 MHz and minimum frequency of 2 kHz.

The rise and fall times of the clock signal must be better than 8 ns for proper operation at the peak sample rates. A minimum pulse width of 22.5 ns must be respected.

In other words, the duty cycle of the clock must be between 50% and 55%.

CompuScope 1610C Trigger Output

A Trigger signal is used to synchronize different parts of a measurement system to the same event.

CompuScope 1610C provides a TTL output on one of the front panel connectors. The rising edge of this output signifies that a trigger event has been detected on the CompuScope 1610C.

For best results, this output should be terminated with a 50 Ω load capable of absorbing 0.5 Watt power.

It should be noted that this output is synchronized to the sampling clock of the CompuScope 1610C. Consequently, if the trigger event is asynchronous to the sampling clock, Trigger Out signal will only be activated after the subsequent rising edge of the sampling clock.
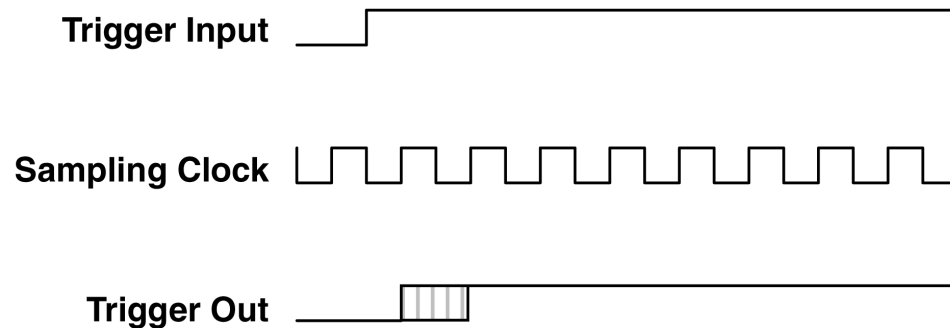
Figure 87: Trigger Out signal vs. sampling clock

If an External Clock is being used, Trigger Out signal will have a 2 external clock cycle uncertainty relative to trigger input.

Finally, note that there is no output short protection on this signal, so care should be taken in not interfacing it to any output, be it Ground or any other voltage.

CompuScope 1610C throughput & maximum PRF

A number of applications require the CompuScope 1610C to acquire data based on a rapidly occurring trigger signal. These high Pulse Repeat Frequency (PRF) applications include imaging, radar, ultrasound and lightning test.

Gage has performed extensive repetitive capture benchmarks in single record mode. In this mode, the signal is captured into on-board CompuScope memory and the captured data are transferred through the PCI bus using PCI bus mastering to PC RAM.

Please note that much higher PRFs will be achieved using CompuScope Multiple Record mode.

The following test results were obtained using a computer configured as follows:

- Pentium III, 850 MHz processor
- 256 MB RAM
- 20 GB disk drive
- Windows 98
- 33 MHz, 32 bit CompactPCI^{TM} bus
- All slots support bus mastering

A C application program optimized for fast repetitive capture in single record mode was used for throughput measurements. The CS1610C was operated using this application for many different capture depths and the results are plotted as points in the graph below. The PCI transfer rate was calculated from the linear portion of the curve at high depths.

PCI data transfer rate:	50 MB/s

PRF on CS1610C using C PRF application under Win 98
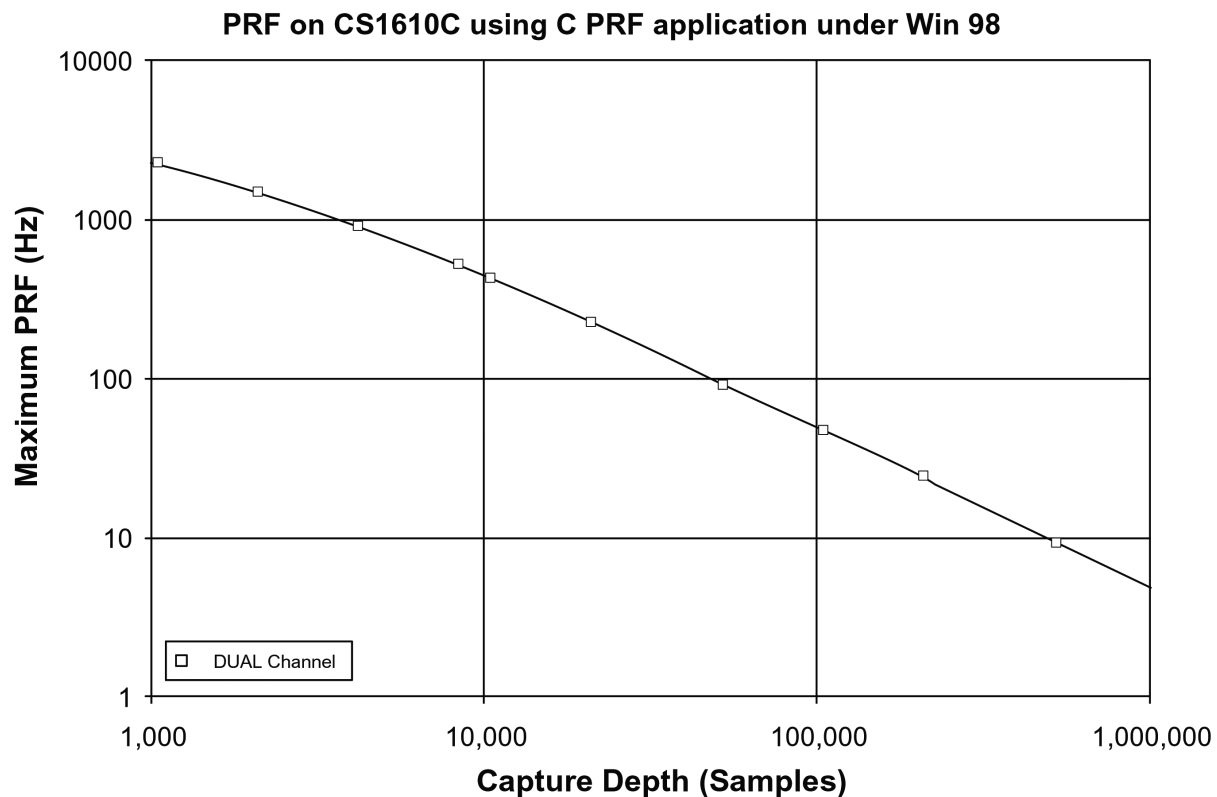
Figure 88: Maximum PRF vs. acquisition length

What you should receive with your CompuScope 3200C

If you order an independent CompuScope 3200C card, you should receive the following articles:

- One CompuScope 3200C card (of memory model type purchased)

2MB model
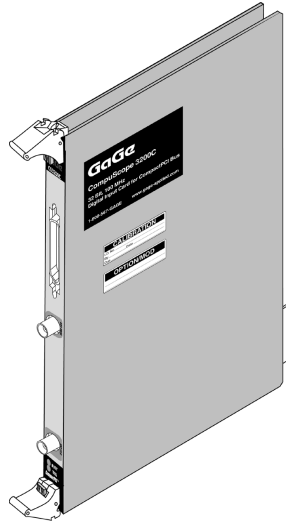
256MB or
2GB model

- One pleated foil cable
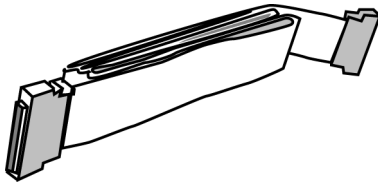
- Standard items included with each independent CompuScope 3200C card

Hardware Manual, including Driver Installation Guide
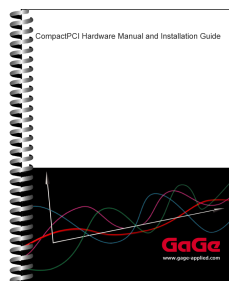
Note that you will receive only one copy of the Hardware Manual per order placed with Gage. Additional copies can be requested at order time.

The Hardware Manual is also available in PDF format on the Gage Software Disk or you can download card-specific manuals from Gage's Web site (www.gage-applied.com).

Gage Software Disk (with GageBit Software)

The Gage Software Disk, included on the inside-front cover of the Hardware Manual and Installation Guide, contains all of the software drivers you need to operate your Gage hardware. The CD also contains all of the installers for the application packages provided by Gage, including GageBit.

Note that some packages will only be available if you have purchased the software and have a key provided by Gage.

GageBit User's Guide
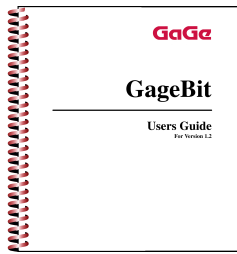
Note that you will receive only one copy of GageBit per order, irrespective of the number of cards you ordered. Additional copies can be requested at order time.

The GageBit User's Guide is also available in PDF format on the Gage Software Disk or you can download it from Gage's Web site.

Warranty card

- Optional items, if purchased

Buffer Board
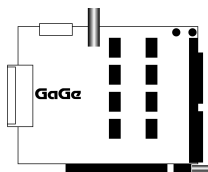
CS32x0: BNC Breakout Board
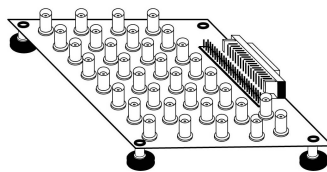
Software Development Kits (SDKs) & applicable manual(s)

Carefully inspect these articles before proceeding further. If you find any damage caused by transportation, please report it to the organization from which you purchased the CompuScope card.

CompuScope 3200C product introduction

The CompuScope 3200C is a CompactPCI bus based board-level product which allows the user to capture up to 32 bits of single-ended CMOS/TTL or differential ECL/PECL digital data into on-board memory of up to 2 Gigabytes at clock rates up to 100 MHz.

The CS3200C can also be configured, in software, to be 8, 16 or 32 bits wide, thereby allowing the user to maximize the use of acquisition memory for 8 or 16 bit inputs.

Multiple CompuScope 3200C cards can be used simultaneously to provide input of more than 32 bits. Consult the factory for Master/Slave synchronous timing modules to provide for word widths of up to 256 bits.

INPUT CIRCUITRY
The input stage of the CS3200C consists of 34 high-speed comparators: 32 for data and one each for clock and trigger. The use of high-speed comparators with fully programmable thresholds allows the use of virtually any logic level: 5V TTL/CMOS, 3.3V CMOS, 2.7 V CMOS, ECL, PECL or even custom logic levels.

Inputs need to be driven by a source capable of driving a 50 Ω load. This is necessary in order to maintain good signal integrity.

For CMOS or TTL signal sources not capable of driving 50 Ω loads, a special Buffer Board is available from Gage, which buffers the data with 50 Ω drivers. The input of the Buffer Board is a 68 pin IDC header for data, a BNC connector for Trigger and another BNC for Clock input. All input signals must be 0 to 3.3 V or 0 to 5V CMOS or TTL signals.

The output of the Buffer Board is a 68 pin MDR connector which connects to the CS3200C using a 6 foot long pleated foil cable, supplied with the CompuScope 3200C.

Differential ECL or PECL signals are, by definition, capable of driving a 50 Ω load and interface seamlessly with the CompuScope 3200C.

CONFIGURABLE INPUT
The output of the on-board comparators is fed into an on-board FPGA, which maximizes the use of on-board memory for data from 8, 16 or 32 bits of width.

The presence of this FPGA also makes it possible to build customized digital acquisition systems, including front-end data processing, for specific requirements. Contact the factory for such custom applications.

Customers must decide at the time of placing an order whether they require a differential ECL/PECL input or single-ended CMOS/TTL input CompuScope 3200C. This setting must be configured at the factory and cannot be modified in the field.

ON-BOARD MEMORY
The CompuScope 3200C card stores digital data in on-board acquisition memory, which is addressable through the CompactPCI bus under software control.

The on-board memory is configured as a circular buffer, so it is possible to store both pre- and post-trigger data. In other words, it is possible to wait indefinitely for a trigger event and then capture digital data from both before and after this event.

The number of data words that can be captured into on-board memory is a function of the size of the memory and input width. For example, a 2 MB model provides 2 million words of storage when the input is 8 bits wide. The same model provides 512 K samples of memory with 32 bit word width.

TRANSFERRING DATA TO PC MEMORY
The CompuScope 3200C is fully capable of acting as a bus master to DMA captured data into user buffers.

EXTERNAL CLOCK
The CompuScope 3200C allows the use of either internal or external clocks. External clock can be very useful in systems which require synchronous data capture. These applications include A/D Testing, Telecommunication, DSP Systems, Video, Ultrasonic Imaging, etc.

The external clock is carried on the 68 wire input connector. A high-speed comparator converts the input level of the clock to CMOS/TTL levels used by the on-board data latching and de-multiplexing circuitry.

The maximum clock frequency of the input clock is 100 MHz. The driving circuitry on the user's circuit must be capable of driving a 50 Ω load.

CLOCK EDGE SELECTION
The user is allowed to select either the rising or falling edge of the input clock to latch the data.

This flexibility allows the user to apply the CompuScope 3200C in situations in which one of the clock edges and input data do not satisfy the timing requirements. In such cases, using the opposite edge of the clock may resolve the timing conflict.

CLOCK AND DATA TIMING
If the customer operates the CompuScope 3200C with an external clock, it should be kept in mind that the maximum speed of the input clock is 100 MHz with a rise and fall time of 2.5 ns or less. The minimum clock frequency is zero, i.e. the clocks can be started and stopped at will, once the acquisition has started.

The setup and hold times of the data with respect to the active edge of the clock must satisfy the minimum requirements listed in the specifications.

CRYSTAL-BASED TIMEBASE
The CompuScope 3200C allows the use of both Internal or External clocking under software control.

When the internal clock is selected, the sampling clock is provided by a crystal-controlled oscillator, thereby providing very good short and long term timing accuracy.

When an external clock is used, the timing accuracy depends entirely on the quality of the external clock supplied by the user.

INPUT CONNECTOR
The data is input to the CompuScope 3200C over a 68 wire Pleated Foil cable. The input connector is a 68 pin MDR socket (P/N 3M 10268-55H3VC). The mating connector is a 3M 10168-6000EC. The mating connector hood is a 3M 10368-A230-00.

Each CompuScope 3200C card is supplied with a 6 foot *Pleated Foil* cable featuring the 3M 10168-6000EC connector.

TRIGGER
An External Trigger input is provided on the CompuScope 3200C. The configuration of this input is set at the factory as either differential ECL/PECL or single-ended CMOS/TTL.

It is possible to trigger either on the rising or falling edge of this trigger input.

TRIGGER OUTPUT
A Trigger Output signal (5 Volt TTL) is also provided by the CompuScope 3200C. This signal is synchronized to the internal clock which runs the de-multiplexed memory counters. As such, there can be a latency of as much as 8 clock cycles between a trigger input and a trigger output.

This Trigger Output can be used to synchronize an entire system to Gage's internal clock.

BNC BREAKOUT BOARD
One of the popular accessories for the CompuScope 3200C is a *BNC Breakout Board* which connects to the card using the pleated foil cable and allows the user to inject digital data, clock and trigger signals using BNC coaxial connectors.

CompuScope 3200C specifications

PLEASE CHECK THE GAGE WEBSITE FOR THE MOST UP-TO-DATE SPECIFICATIONS.

SYSTEM REQUIREMENTS

CompactPCI PICMG compliant system with the required number of free 6U slots; controller or PC with 128 MB RAM, 50 MB hard disk and SVGA video.

SIZE

6U CompactPCI
2MB Memory Model: Occupies 1 slot
Other memory versions: Occupies 2 slots

POWER

Typical:	26 Watts
Worst:	28.6 Watts

INPUT

Input Connector:	68 Pin MDR connector
No. of Data Lines:	32, 16 or 8, software selectable
Input Type:	Single Ended or Differential, factory set. Cannot be modified in the field
Input Levels:	
Single Ended:	CMOS (0 to 5 Volt), CMOS (0 to 3.3 Volt)
Differential:	ECL or PECL

CLOCK

Internal Clock Rate:	
MHz:	100, 50, 20, 10, 5, 2, 1
kHz:	500
External Clock:	Standard
External Clock Type:	Single Ended or Differential, set to the same type as data lines
External Clock Level:	Set to the same type as data lines. CMOS/TTL inputs are 3.3 V tolerant
Single Ended:	CMOS (0 to 5 Volt), CMOS (0 to 3.3 Volt), TTL (0 to 5 Volt) Software selectable
Differential:	ECL, PECL Software selectable
Max. Ext Clock Freq:	100 MHz
Min. Ext Clock Freq:	DC
Impedance:	50 Ω

TRIGGERING

Source:	Ext Trigger or Software
External Trigger:	Standard
Trigger Type:	Single Ended or Differential, set to the same type as data lines
Trigger Level:	Set to the same type as data lines. CMOS/TTL inputs are 3.3 V tolerant
Single Ended:	CMOS (0 to 5 Volt), CMOS (0 to 3.3 Volt), TTL (0 to 5 Volt) Software selectable
Differential:	ECL PECL Software selectable
Slope:	Positive or Negative
Post-Trigger Depth:	8 bits: 256 point minimum 128 point resolution
	16 bits: 128 point minimum 64 point resolution
	32 bits: 64 point minimum 32 point resolution

MEMORY MODE OPERATION

Data Storage:	In on-board memory
On-board Memory Size:	2MB 256MB 2GB (other memory sizes available upon request)
8 Bits Width:	Sample depth = card memory
16 Bits Width:	Sample depth = card memory ÷ 2
32 Bits Width:	Sample depth = card memory ÷ 4

MULTI-CARD SYSTEMS

Operating Mode:	Multiple/Independent (Master/Slave available upon request)

OPERATING SYSTEMS SUPPORTED

- Windows 98/ME/NT* CompuScope Driver version 3.60.30
     * Version 4, SP3 or higher
- Windows 2000**/XP   CompuScope Driver version 3.82.xx
     ** SP1 or higher

APPLICATION SOFTWARE

GageBit Application for Win 95/98/ME, Win NT/2000/XP

SOFTWARE DEVELOPMENT KITS (SDK)

- CompuScope SDK for C/C++
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for MATLAB
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for LabVIEW
  For Windows 98/ME/NT/2000/XP

- CompuScope SDK for LabWindows/CVI
  For Windows 98/ME/NT/2000/XP

OPTIONAL ACCESSORIES

Buffer Board
BNC Breakout Board

WARRANTY

One year parts and labor
All specifications subject to change without notice

CompuScope 3200C ordering information

Hardware and upgrades

Product	Order No.
CompuScope 3200C - 2M (CMOS or TTL)	732-161-001
CompuScope 3200C – 256M (CMOS or TTL)	732-161-005
CompuScope 3200C - 2G (CMOS or TTL)	732-161-007
CompuScope 3200C - 2M (Differential ECL/PECL)	732-161-021
CompuScope 3200C – 256M (Differential ECL/PECL)	732-161-025
CompuScope 3200C - 2G (Differential ECL/PECL)	732-161-027
CompuScope 3200C: Master/Slave Sets	Available upon request
CS3200C: Memory Upgrade Charge	732-181-004
CS3200C: Buffer Board	320-181-105
32X0: BNC Breakout Board	325-181-020

Software Development Kits (SDKs)

Product	Order No.
Gage SDK Pack on CD (No Hardcopy of Manuals included)	200-113-000
Gage SDK Pack on CD (Hardcopy of Manuals included)	200-113-002
CompuScope SDK for C/C++	200-200-101
CompuScope SDK for MATLAB	200-200-102
CompuScope SDK for LabVIEW	200-200-103
CompuScope SDK for LabWindows/CVI	200-300-100

CompuScope 3200C simplified block diagram

Figure 89: CompuScope 3200C simplified block diagram

CompuScope 3200C: identifying your CompuScope card(s)

You will find your CompuScope 3200C card type and version as shown in Figure 90. Figure 90 also shows the location of the Calibration label, which lists the Add-on and base board serial numbers. You should record these serial numbers for future reference on the technical support form found at the front of this guide. You may also see an "OPTION/MOD" label listing any upgrades or modifications which have been performed on your card.
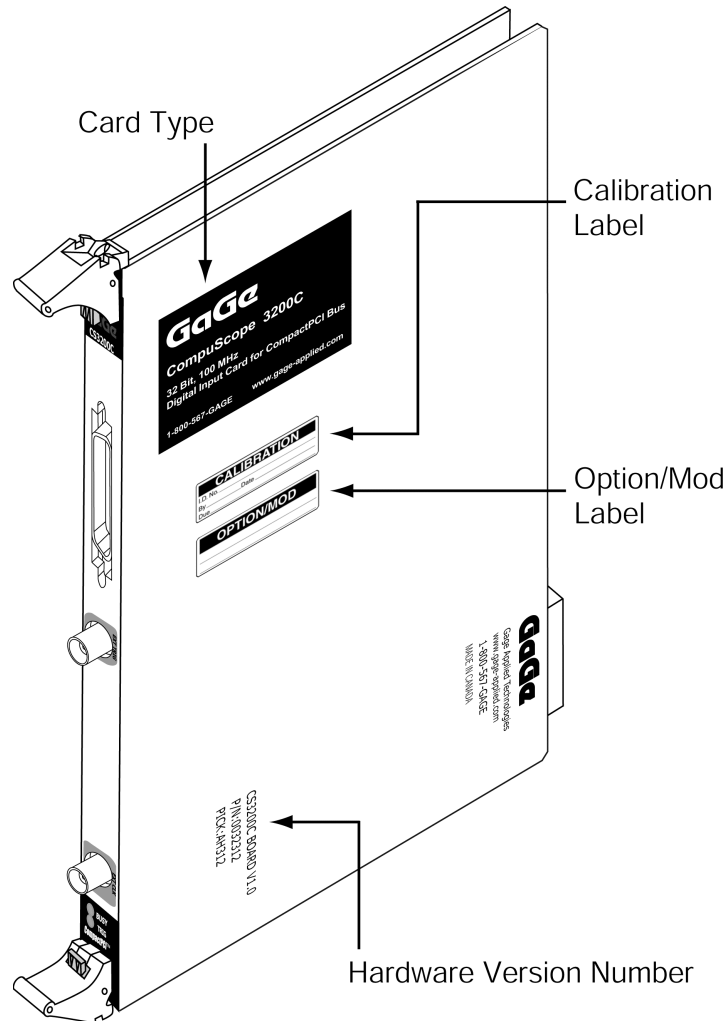
Figure 90: CS3200C labels and hardware version number

If you purchased a CompuScope 3200C card with 256M or 2G on-board acquisition memory, you should notice that the expanded memory card occupies a second slot. Such a 2-slot product is also referred to as an "Extreme Memory Card".

The exact amount of on-board acquisition memory is listed on the OPTION/MOD sticker.

Figure 91: CompuScope 3200C occupying 2 slots to accommodate extra memory capacity

CompuScope 3200C connectors and headers

The CompuScope 3200C accepts digital data using a connector designed specially for ultra-fast digital signal transmission.

A Trigger Out signal is also available on a BNC connector in order to synchronize the CS3200C to the rest of the test system. The connectors and headers on the CS3200C card are shown below:
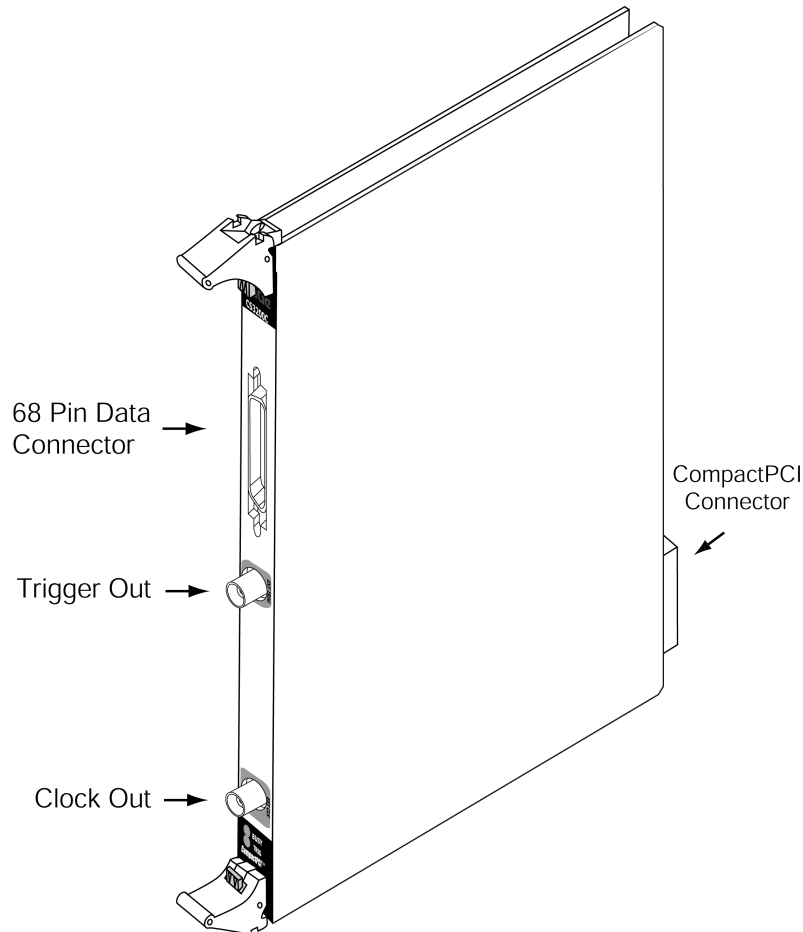
Figure 92: Connectors on CS3200C

- **Digital input MDR:** this connector is used to input up to 32 bits of single-ended or differential digital data lines, one clock input and one trigger input, all with 50 Ω characteristic impedance.

  This connector is designed to provide "equivalent to coax" performance by using copper conductors encapsulated in a specially formulated Teflon to provide the appropriate dielectric constant. This assembly is wrapped in a pleated copper foil, resulting in a 50 Ω transmission line impedance for each of the 68 conductors in the cable.

  For more information on the technology used in this connector, please visit www.mmm.com.

- **Trigger Out BNC:** this connector is used to output a 0 to 5 Volt, TTL signal which signifies that a trigger event has occurred on the CS3200C.

- **Clock Out BNC:** In some select cases, a user may want to drive the rest of the test system with the internal clock of the CS3200C. A 5 Volt CMOS clock signal capable of driving a 50 Ω load is available on the card as a standard feature for this purpose.

CompuScope 3200C triggering

Triggering allows the CompuScope 3200C to capture digital data just before or after an external event or software command. The CS3200C supports both pre- and post-trigger data capture.

The CompuScope 3200C allows the user to trigger the system on:

- External Trigger
- Software Trigger

The user can also specify whether to trigger on the rising or falling edge of the External Trigger signal.

CompuScope 3200C digital input

The CompuScope 3200C is available with two different input configurations:

- Single-Ended, TTL/CMOS Inputs

- Differential, ECL/PECL Inputs

Users must specify one or the other at the time of placing an order. The two configurations cannot be changed via software commands and require considerable changes to the input circuitry. As such, this change cannot be made in the field and must be done at the factory.

Pin layout on CS3200C connector – Single-ended, TTL/CMOS inputs

CS3200C connector pin layout (Single-ended, TTL/CMOS inputs)			
1	CLK	35	GND
2	D0	36	GND
3	D1	37	GND
4	D2	38	GND
5	D3	39	GND
6	D4	40	GND
7	D5	41	GND
8	D6	42	GND
9	D7	43	GND
10	D8	44	GND
11	D9	45	GND
12	D10	46	GND
13	D11	47	GND
14	D12	48	GND
15	D13	49	GND
16	D14	50	GND
17	D15	51	GND
18	D16	52	GND
19	D17	53	GND
20	D18	54	GND
21	D19	55	GND
22	D20	56	GND
23	D21	57	GND
24	D22	58	GND
25	D23	59	GND
26	D24	60	GND
27	D25	61	GND
28	D26	62	GND
29	D27	63	GND
30	D28	64	GND
31	D29	65	GND
32	D30	66	GND
33	D31	67	GND
34	TRIG IN	68	GND

Pin layout on CS3200C connector – Differential, ECL/PECL inputs

CS3200C connector pin layout (Differential, ECL/PECL inputs)			
1	CLK+	35	CLK-
2	D0+	36	D0-
3	D1+	37	D1-
4	D2+	38	D2-
5	D3+	39	D3-
6	D4+	40	D4-
7	D5+	41	D5-
8	D6+	42	D6-
9	D7+	43	D7-
10	D8+	44	D8-
11	D9+	45	D9-
12	D10+	46	D10-
13	D11+	47	D11-
14	D12+	48	D12-
15	D13+	49	D13-
16	D14+	50	D14-
17	D15+	51	D15-
18	D16+	52	D16-
19	D17+	53	D17-
20	D18+	54	D18-
21	D19+	55	D19-
22	D20+	56	D20-
23	D21+	57	D21-
24	D22+	58	D22-
25	D23+	59	D23-
26	D24+	60	D24-
27	D25+	61	D25-
28	D26+	62	D26-
29	D27+	63	D27-
30	D28+	64	D28-
31	D29+	65	D29-
32	D30+	66	D30-
33	D31+	67	D31-
34	TRIG IN+	68	TRIG IN-

Input comparators

The input stage for all inputs of the CS3200C is an EMI filter followed by a 50 Ω terminating resistor network wide bandwidth analog comparator.

For single-ended input models, one of the inputs to the comparator is the input signal and the other is a programmable voltage level generated by an on-board DAC (Digital to Analog Converter). This enables the input stage to handle different voltage level CMOS signals, e.g. 3.3 Volt, 5 Volt etc.

For differential input models, both inputs of the comparator are fed by the two differential signals corresponding to a particular input. For example, D0+ and D0- are fed into the inputs of the same comparator.

Front-end FPGA

At the heart of the CS3200C is a high-speed FPGA: all data lines, trigger and clock signals received from the outside world are injected into it; all data de-multiplexing is done inside it; all acquisition control state machines exist in it; all sampling clock selection circuitry resides in it; all triggering is done within it.

This design allows for tremendous flexibility in adapting the CS3200C for a number of customized applications that require not only fast digital data acquisition, but also some data manipulation. Contact the factory with your custom requirement.

This FPGA also allows the CS3200C to work in one of three input word widths of 32, 16 or 8 bits by de-multiplexing (DMUX) the data.

Gage products

For ordering information, see Gage's Product Catalog or visit our web site at www.gage-applied.com

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

Notes